

NWP SUM with NWP-A Single Page Export

1.0 Scope

The NWP Software User Manual (SUM) describes the functionality provided for NWP users to meet operational needs.

1.1 Identification

This document applies to the NextGen Weather Processor system developed under Federal Aviation Administration (FAA) Contract DTFAWA-15-D-00004 awarded on April 8, 2015.

1.2 System Overview

The Federal Aviation Administration (FAA) has, as part of its Next Generation Air Transportation System (NextGen) initiative, identified a need for more cohesive, accurate, timely, and improved weather information, and weather-related airspace usage constraint information. NextGen transforms the National Airspace System (NAS) into a flexible air transportation system and improves safety, efficiency, and capacity needs. Once implemented, the weather improvement properties of NextGen ultimately:

1. Replace and improve the functions of the legacy and prototype FAA weather systems and host new, advanced, aviation weather products.
2. Provide a common weather processing platform and infrastructure to improve, consolidate, and assimilate outputs from weather models and real-time sensor data to produce more accurate aviation weather products.

Today the legacy FAA weather processing systems (WARP, ITWS, and CIWS) and prototype system (CoSPA) operate autonomously as discrete systems:

1. Weather and Radar Processor (WARP) provides weather information to en-route air traffic controllers, supervisors, and traffic management coordinators.
2. Integrated Terminal Weather System (ITWS) provides 0-1 hour aviation weather information to terminal air traffic supervisors and controllers.
3. Corridor Integrated Weather System (CIWS) provides 0-2 hour aviation weather information.
4. Consolidated Storm Prediction for Aviation (CoSPA) is a prototype system which generates a 2-8 hour storm forecast.

These four systems have overlapping capabilities, yet their processes and algorithms vary; consequently, inconsistent results can be produced across these systems. These results are frequently disseminated to the same decision makers, complicating the formulation of weather-related air traffic control decisions. These decisions are often safety-critical, and they also have an immense impact on air traffic delays and cost.

The NextGen weather systems consist of Common Support Services - Weather (CSS-Wx) and the NextGen Weather Processor (NWP) System, where CSS-Wx focuses on providing weather information to support users and systems and the NWP System focuses on aviation weather processing and product generation. The FAA's updated weather architecture showing weather data sources, the weather product generation system (the NWP System), the distribution system (CSS-Wx), and various consuming systems is illustrated in Figure 1.

The NWP System includes an Aviation Weather Display (AWD). The AWD provides weather information, obtained via NAS Enterprise Messaging Services (NEMS), from the NWP product generation subsystems or other sources to NAS decision makers. The AWD replaces the

WARP briefing terminal and CIWS displays. The NWP System supports two types of AWD: Dedicated AWDs and displays of External AWD users. Dedicated AWDs provide the AWD user interface on hardware provided as part of the NWP System program, via the NWP AWD Services (NWP-A) over the FAA Telecommunications Infrastructure (FTI). Displays of External AWD users will provide the same interface, but through an External Web Server (EWS) to a web-browser on displays not provided as part of the program. Displays of External AWD users are outside of the NAS, and as such will access the EWS in the FAA Public Demilitarized Zone (DMZ).

For normal operations, the NWP System receives weather data from various weather sensors via CSS-Wx and generates aggregate weather products, airspace usage constraints, and weather hazard alerts to CSS-Wx for delivery to NAS consumers. In addition, the NWP-A receives weather data from NEMS for delivery to Dedicated AWD and External AWD users.

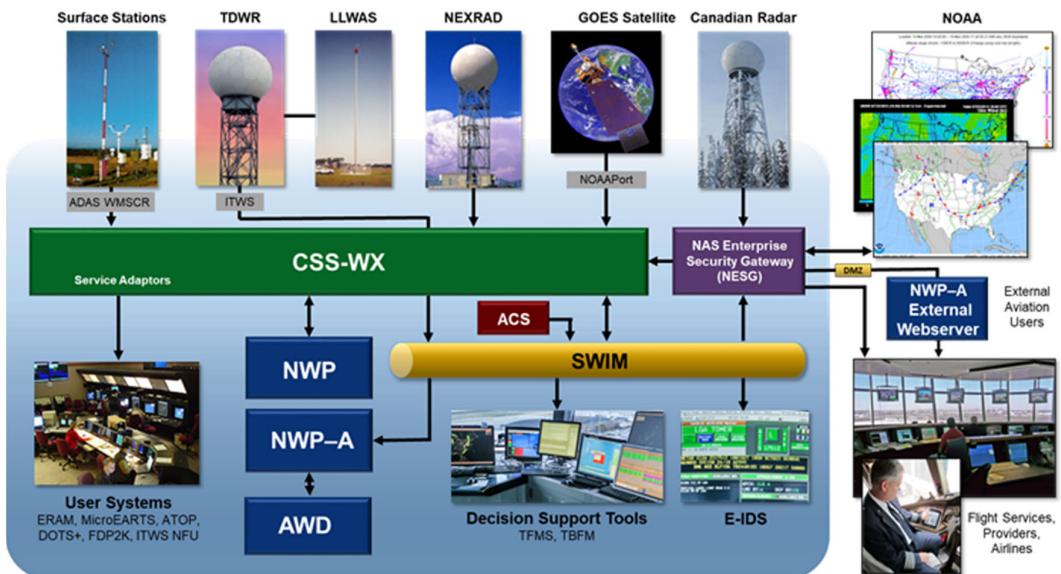


Figure 1. Top Level NextGen Context Diagram

The NWP System establishes the processing platform which subsumes the legacy functions of WARP and CIWS and the functions of the CoSPA prototype system. In addition to consolidating and replicating the weather functions provided by FAA legacy weather systems, NWP provides various improvements, such as 1-km radar precipitation, echo tops and trends mosaics at 25 sec update rate, flexible layers at 1-kft resolution selectable at each air traffic control facility, and 3-km deterministic forecasts of storms out to 8 hour lead times translated into time-evolving, height-dependent weather avoidance fields for use in aviation decision support tools.

The NWP System provides long-range weather analysis, forecast, and constraint products for the Contiguous United States, CANRAD coverage and Puerto Rico (CONUS+) coverage domain, which is the area encompassing the lower 48 states of the United States, all Canadian Radar (CANRAD) coverage, and Puerto Rico. It also provides long-range coverage of Alaska, Hawaii, and Guam. The product generation for long range products has been prototyped for the FAA by MIT Lincoln Laboratory (MIT LL), the National Center for Atmospheric Research (NCAR), and National Oceanic and Atmospheric Administration (NOAA) Earth System Research Laboratory (ESRL) Global Systems Division (GSD), and additionally includes Satellite Convection Analysis and Tracking (SATCAST), developed by the University of Alabama in Huntsville and the University of Wisconsin/Cooperative Institute for Meteorological Satellite

Studies (CIMSS) under funding from the National Aeronautics and Space Administration (NASA) Advanced Satellite Aviation weather Products (ASAP) program. NWP Domain products are generated at two redundant locations (Atlanta and Salt Lake City). The FAA Test Facility for the NWP System is planned to be at the William J. Hughes Technical Center (WJHTC).

The NWP System has five main high-level operating capabilities:

1. The Acquire Weather Data capability ingests radar weather data, satellite data, weather sensor location data, analysis product data, and data from numerical models and observational sensors. This data is ingested across multiple nodes within the NWP System.
2. The Generate Weather Products capability includes the translation of weather data from radars, pre-radar processing, generation of mosaic products, analysis products, forecast products, weather avoidance products, and forecast accuracy scoring, as well as product post-processing and packaging.
3. The Deliver Weather Information capability delivers weather products to the CSS-Wx System.
4. The Display Weather Products capability provides an AWD user interface to accept user inputs and provides domain weather products in windows, referred to as views, of one of the following types: graphical, textual, and static image.
5. The Support Operations capability provides a graphical user interface (GUI) for system monitoring, system control, and software/adaptation management functionality to support system operations. This capability also accommodates message exchange between the NWP System and the Remote Monitoring and Logging System (RMLS).

1.2.1 Subsystem Components

The following diagram illustrates the NWP System and the general information flow between the NWP System and external systems:

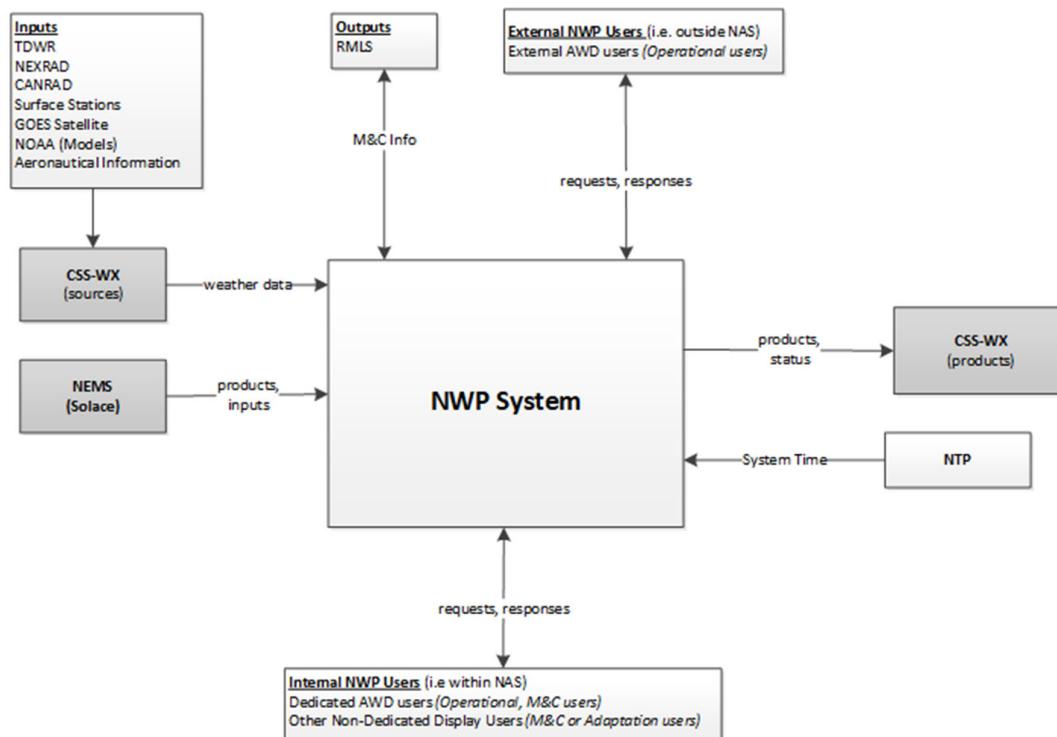


Figure 2. System Context Diagram

The NWP System is composed of the following CIs:

1. Virtualization and Operating System (VOS)
2. Universal Framework (UFRAME)
3. Product Generation (PG)
4. Visualization (VIZ)
5. System Management Services (SMS)

The AWD Data Service (ADS) is used by NWP-A to ingest Weather Products from NEMS.

Further information on each CI is provided in the Software Architecture section and in each respective Software Design Description (SDD).

The following figure illustrates the NWP System and the general information flow between the CIs of the NWP System and external systems:

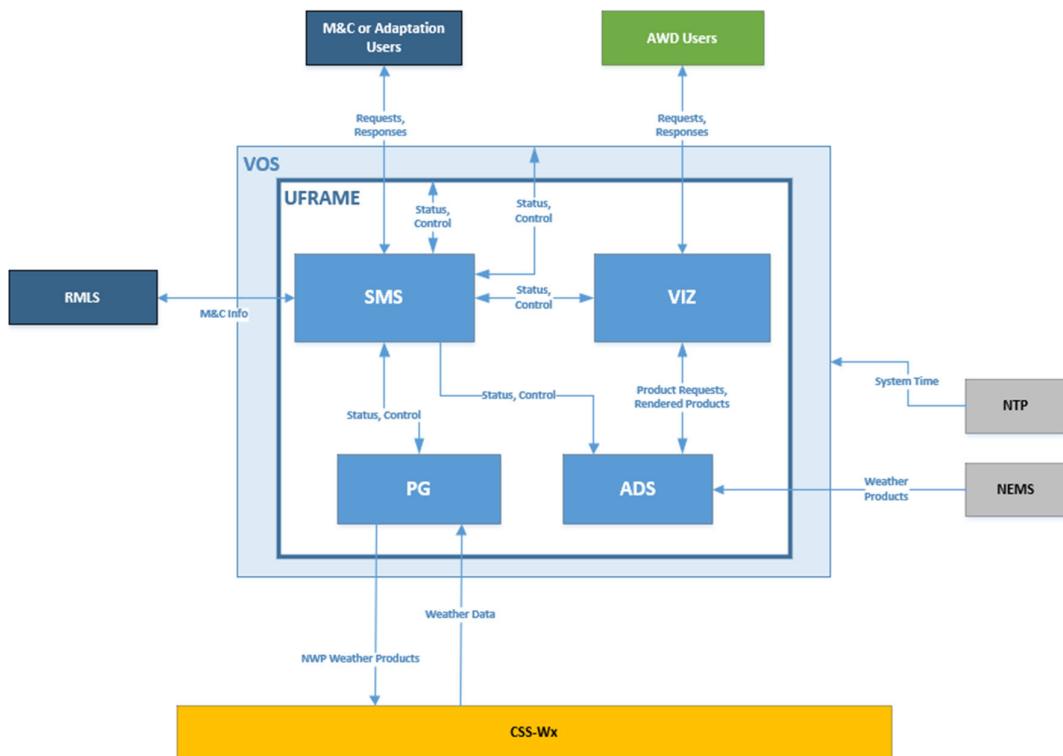


Figure 3. Software Components

Information flowing into and out of the NWP system passes through VOS and UFRAME to reach the PG, VIZ and SMS CIs.

1.2.2 Hardware Architecture

The NWP System uses a Commercial Off-The-Shelf (COTS) based, vendor agnostic hardware architecture. There are multiple distinct configurations of NWP System Hardware: NWP Domain Site, NWP-A Site, EWS Site. The Domain Site configuration contains a compute cluster consisting of multiple interconnected servers which form a High-Performance Computing (HPC) platform. The HPC is augmented with high performance interconnect and Direct Access Storage unit. External AWD users access the EWS from a web-browser on hardware not provided as part of the program. Displays of External AWD users are outside of the NAS and as such will access the EWS in the FAA Public DMZ.

The domain site installations are located in data centers in Atlanta (GEC) and Salt Lake City (UEC), with one acting as the active domain site and the other as a standby (these roles are determined by CSS-Wx). At each domain site, the NWP Local Area Network (LAN) equipment is connected to the local CSS-Wx node for ingesting weather products and publishing domain products. It is also connected to the FAA Telecommunications Infrastructure (FTI) Wide Area Network (WAN).

At the domain sites, rack mounted processing servers and storage are provided for Domain PG processing. These servers and storage arrays are connected to stacked 100 Gbps Ethernet switches. Both switches are connected to stacked 10 Gbps Utility switches, one of which is connected to the FTI edge router. Both of the 10 Gbps switches are also connected to the CSS-Wx node for high-speed product transfer between the systems.

The NWP-A site installations are located at the ARTCCs in Atlanta (ZTL), Salt Lake City (ZLC), Chicago (ZAU), Washington (ZDC), Cleveland (ZOB), and Minneapolis (ZMP). The servers at these installations will consist of at least three servers of the same configuration. These servers will provide cluster-wide services and maintenance connectivity. These servers and storage arrays are connected to stacked 100 Gbps Ethernet switches. Both switches are connected to stacked 10 Gbps Utility switches, one of which is connected to the FTI edge router.

The EWS will be deployed at the WJHTC, and installation will also consist of at least three servers. These servers are of the same configuration. These servers will provide cluster-wide services and maintenance connectivity. These servers and storage array are connected to stacked 100 Gbps Ethernet switches. Both switches are connected to stacked 10 Gbps Utility switches, one of which is connected to the NAS Enterprise Security Gateway (NESG) edge router and Public DMZ edge router.

Dedicated AWD subsystems are planned to be deployed at the SLC and ATL NAS Enterprise Management Centers (NEMC), and may be deployed at Terminal Radar Approach Control Facilities (TRACON)s, Air Traffic Control Tower (ATCT)s, Air Traffic Control System Command Center (ATSCC), Combined Center/Radar Approach Control (CERAP)s, and Air Route Traffic Control Center (ARTCC)s. The NWP local area network (LAN) at these sites is connected to the FTI WAN for access to NWP-A.

1.2.3 Software Architecture

A service-oriented architecture is used for the NWP applications to enhance interoperability and extensibility. Service-oriented interfaces are provided to encapsulate the implementation of application software components.

The software infrastructure predominantly leverages Free and Open-Source Software (FOSS) to minimize development cost and apply industry best practices for data center and web applications. This infrastructure provides the operating system, database, messaging middleware, service bus, software component deployment and life-cycle management, and web server implementations. The middleware provides the mechanism for messaging, web services, and application management.

The NWP software is partitioned into Computer Software Configuration Items (CSCIs). The operational CSCIs, along with the software components of which they are composed, are shown below:

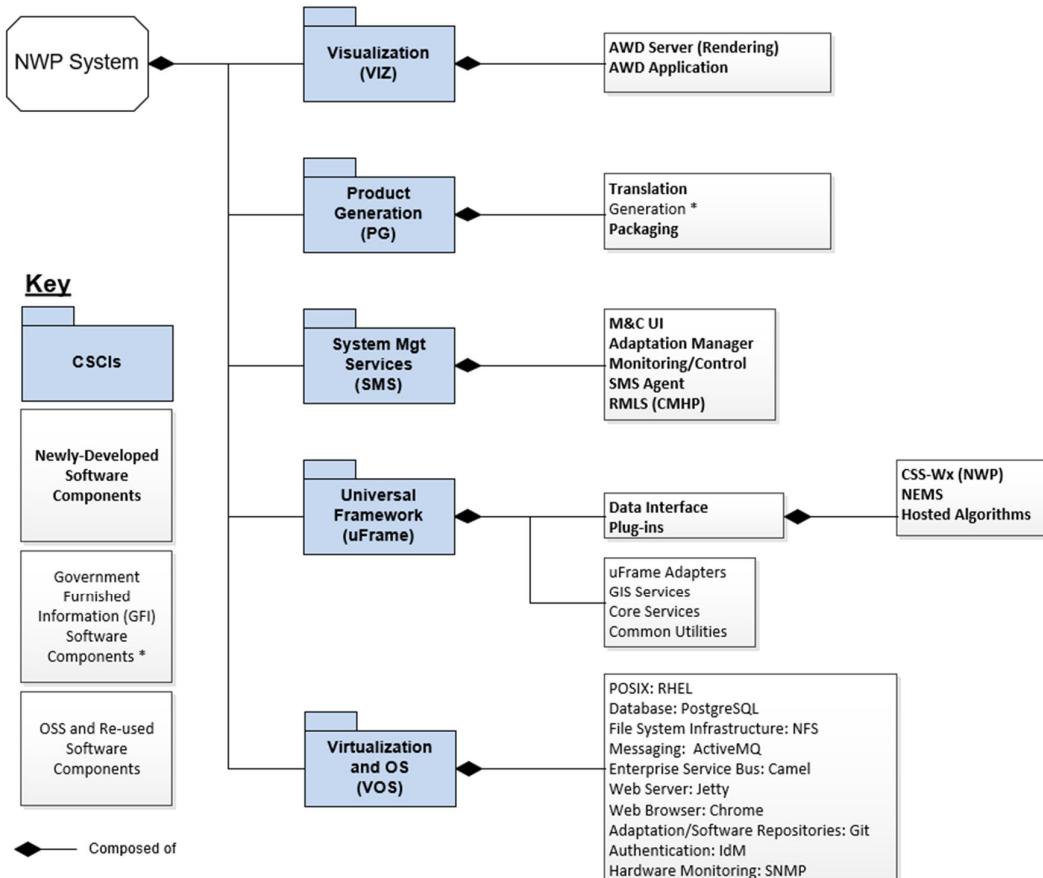


Figure 4. Systems Functionality Description

A Software Requirements Specification (SRS) defines the requirements for each developed CSCI enabling independent development and test of each. A Software Design Description (SDD) documents the software design for each CSCI enabling effective development, integration, and maintenance.

The CSCIs are layered as shown in Figure "Software Dependency Layers". Open layering is used; software items may depend on (i.e., use) the interfaces from any of the items below. This promotes reuse, extensibility, and testability while also isolating the impact of changes, enhancing maintainability.

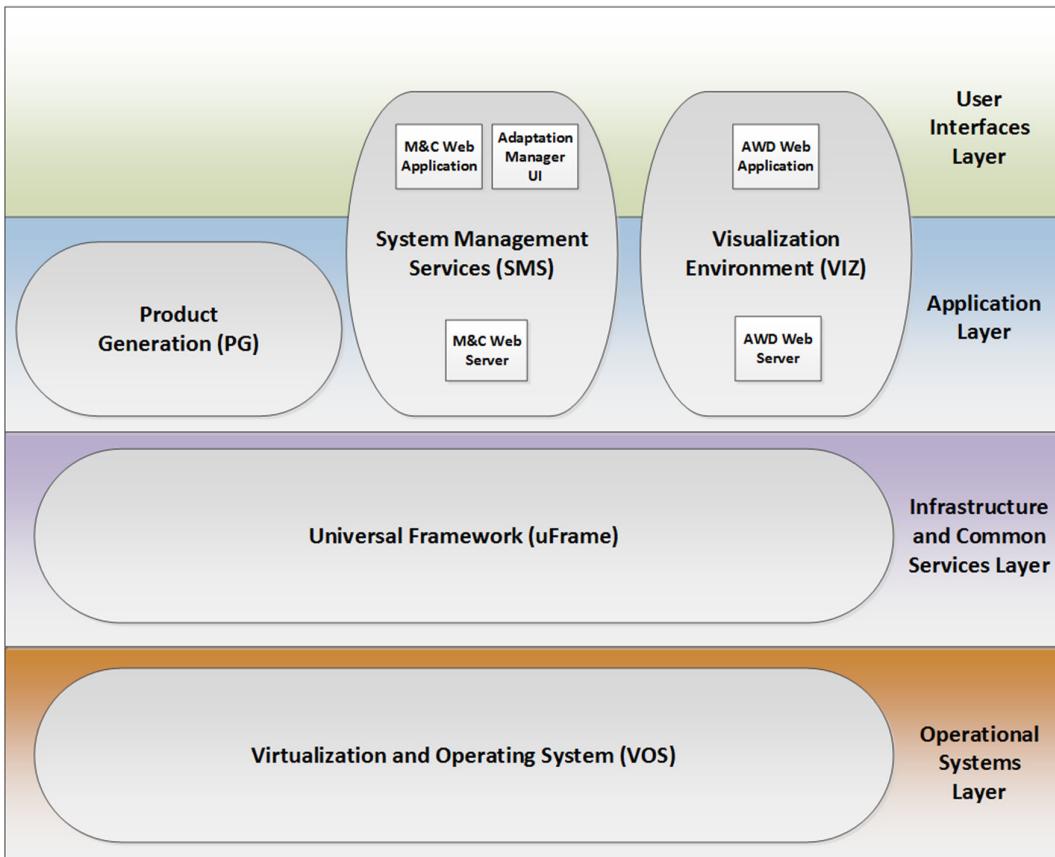


Figure 5. Software Dependency Layers

1.3 Document Overview

NOTE: This version of the Software User Manual depicts NWP Software with Terminal NWP capabilities disabled.

This SUM follows the specific content prescribed in the standard FAA STD-026A and the SUM Data Item Description (DID) DID-FAA-STD-026-17. Using the agile approach, the SUM presents the user interface capabilities available in the current software build. The SUM is updated and refined as needed during each software build.

The sections and appendixes are as follows:

1. Section 1 provides an overview of the NWP System and this SUM document.
2. Section 2 catalogs applicable documents referenced in the material.
3. Section 3 presents a software summary.
4. Section 4 describes access to the M&C and AWD software.
5. Section 5 provides a processing reference guide for NWP software.
6. Section 6 provides additional notes including an acronym list.

2.0 Referenced Documents

2.1 Government Documents

Table 1. Government Documents

Specifications:	
DTFAWA-15-D-00004	NWP Part I, Section C: Statement of Work
DTFAWA-15-D-00004	NWP Section E
DTFAWA-15-D-00004	NWP Section G
DTFAWA-15-D-00004	NWP Section H
DTFAWA-15-D-00004	NWP Section I
DTFAWA-15-D-00004	NWP Section J
DTFAWA-15-D-00004 Attachment J-01	NWP System Specification Document (SSD)
DTFAWA-15-D-00004 Attachment J-02	AWD System Specification Document (SSD)
DTFAWA-15-D-00004 Attachment J-04	NWP Contract Data Requirement List (CDRL)
DTFAWA-15-D-00004 Attachment J-06	ATC-396 NWP Product Description
DTFAWA-15-D-00004 Attachment J-07	NextGen Weather Systems Description Document
DTFAWA-15-D-00004 Attachment J-09	NWP Terminal Doppler Weather Radar (TDWR) Interface Requirements
DTFAWA-15-D-00004 Attachment J-19	NWP GFI Software and Reference Documents List
DTFAWA-15-D-00004 Attachment J-20	<i>NWP Airport Surveillance Radar - Model 9 (ASR-9) IRD</i>
DTFAWA-15-D-00004 Attachment J-21	<i>NWP ASR-11-IRD</i>
DTFAWA-15-D-00004 Attachment J-22	NWP to RMLS IRD
DTFAWA-15-D-00004 Attachment J-23	Web Service Requirements Document NWP Common Support Services - Weather (CSS-Wx) Web Feature Service (WFS)
DTFAWA-15-D-00004 Attachment J-24	NWP CSS-Wx Web Map Service (WMS) WSRD
DTFAWA-15-D-00004 Attachment J-25	NWP CSS-Wx Web Map Tile Service (WMTS) WSRD
DTFAWA-15-D-00004 Attachment J-27	ATC-392 NWP Domain Technology Description

DTFAWA-15-D-00004 Attachment J-30	CSS-Wx Hosted Algorithms, ATC-413
DTFAWA-15-D-00004 Attachment J-34	NWP Labor Categories
DTFAWA-15-D-00004 Attachment J-41	NWP-CSS-Wx IRD
DTFAWA-15-D-00004 Attachment J-46	NWP Government Owned Equipment List
DTFAWA-15-D-00004 Attachment J-47	NWP FAA Handbook-009-B, Common Message Handling Protocol (CMHP)
DTFAWA-15-D-00004 Attachment J-48	NWP CSS-Wx - Interface Control Document (ICD)
DTFAWA-15-D-00004 Attachment J-53	NWP FAA Orders Standards and Misc List
DID-FAA-026-09 (FAA-STD-026A)	Data Item Description for the Software Design Description (SDD)

2.2 Non Government Documents

Table 2. Non-Government Documents

Plans:	
A8538254	Software Development Plan (SDP)
Specifications:	
A11325597	System/Subsystem Specification (SSS)
A11325628	System/Subsystem Design Description (SSDD)
A11325841	Product Generation (PG) Software Requirements Specification (SRS)
A11325835	Visualization Environment (VIZ) Software Requirements Specification (SRS)
A11325811	System Management Services (SMS) Software Requirements Specification (SRS)
A11325830	Universal Framework (uFrame) Software Requirements Specification (SRS)
A11325769	Virtualization and Operating System (VOS) Software Requirements Specification (SRS)
Applicable Documents:	
B4101866	NWP Product Generation (PG) SDD
B4101867	NWP Visualization Environment (VIZ) SDD

B4101868	NWP Universal Framework (uFrame) SDD
B4101869	NWP System Management Services (SMS) SDD
B4101871	NWP Virtualization and Operating System (VOS) SDD

3.0 Software Summary

3.1 Software Application

There are three GUIs available: the M&C GUI, the Adaptation Manager GUI, and the AWD GUI.

The M&C GUI is a web-based user interface which allows users to monitor and control NWP system components. The user interface is available for each Domain, NWP-A, and the External Web Server. The user interface provides a consistent look and feel across the sites and is adapted to the actual components which make up each system.

The user interface provides the following high level capabilities:

1. A view of the local system status, from individual component state and mode to the overall roll-up state of the site.
2. Ability to set the mode of components and to control supported components.
3. Display of system events, performance monitoring, and statistics.

The Adaptation Manager GUI is a web based user interface which allows an adaptation user to manage NWP adaptation sets. The interface allows a user to view existing, create new, edit, and export adaptation sets. Edit options provided include direct edit of JSON files and a Quick Edit function for certain limited values. The interface also allows a user to compare adaptation sets in order to quickly see differences across versions. This is an offline interface; modifications made to adaptation sets via the Adaptation Manager GUI cannot be directly incorporated into the NWP system. The updated adaptation versions must be transferred from the Adaptation Manager to FTI network via removable media before installation on an NWP system.

The AWD GUI is also a web-based user interface which is accessed through a Dedicated AWD or through a standard web browser on a computer with access to the External Web Server. The interface allows view creation to display various weather products on a continental scale, and on a more local TRACON scale. The AWD GUI also offers a diagnostic playback capability (Section 3.4.4). The AWD GUI supports a wide range of graphical, text, and static image products, and provides functionality for a user to save a given configuration as a preference set which is accessible to the user from any AWD position.

Two (2) additional administrator tools are integrated into the system which provide user interfaces: IdM (Section 5.3.15) and Kibana (Section 5.3.17).

3.2 Software Inventory

The AWD and M&C GUIs are web-based user interfaces which are accessible via a Google Chrome web browser. No special software is required for use on a desktop computer. Section 5.3.11 Software Distribution and Installation provides detailed procedures for updating NWP software on Domain and NWP-A Systems via the M&C GUI.

3.3 Software Environment

The following resources are needed for a user to operate the software:

1. A workstation comparable in hardware capability to an NWP Dedicated AWD:
 - a. Minimum 4 GB memory recommended
 - b. Keyboard and mouse input devices
 - c. Color display with minimum 1920x1080 resolution

NOTE: If two color displays will be used for a dedicated AWD, plug the second monitor in and then reboot the workstation, in order for both monitors to be used correctly. If using two monitors they should be the same size and support the same resolution.

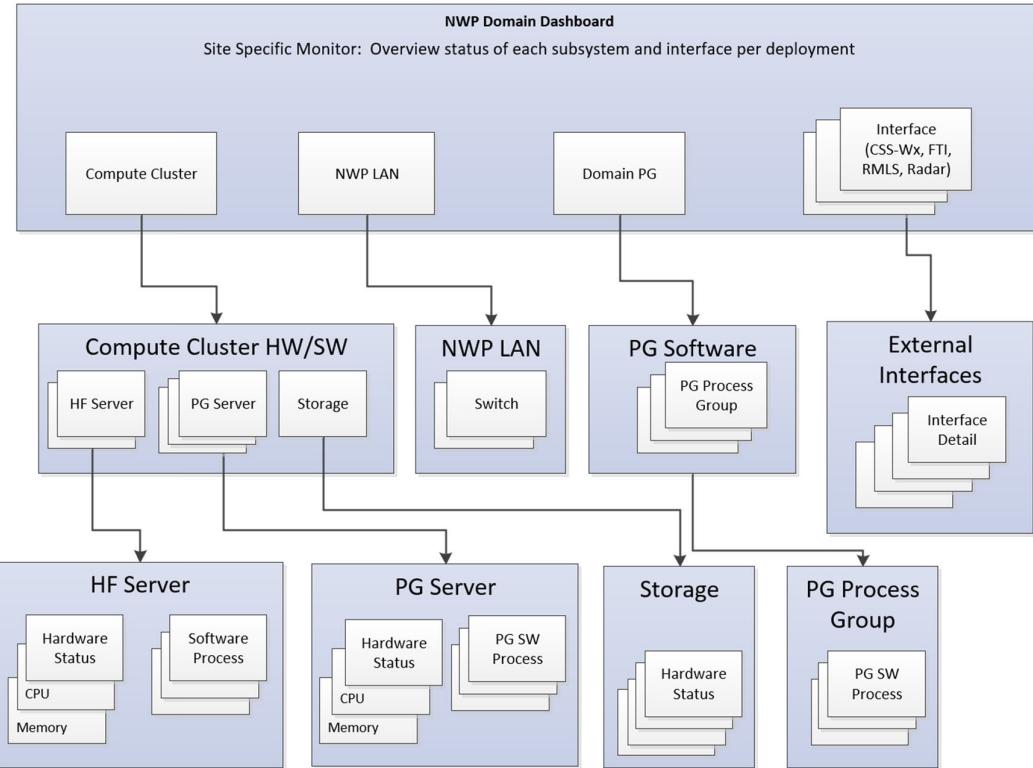
 - d. Speaker (for audible alarms on the M&C GUI)
2. The workstation must have access to the FTI network for AWD and M&C
3. Google Chrome web browser installed on the workstation
4. The Uniform Resource Locator (URL) address of the desired application
 - a. For Domain M&C:
 - (1) To navigate to the M&C Web Page, enter the following in the address bar:
 - (a) <https://<domain>-hf.<site-id>.nwp.nas.faa.gov:8180/sms-client>
Note: Replace <domain> and <site-id> above with either atl and gec for the Atlanta NEMC or slc and uec for the Salt Lake City NEMC. (Ex: <https://atl-hf.gec.nwp.nas.faa.gov>)
 - b. For NWP-A M&C
 - (1) To navigate to the M&C Web Page, enter the following in the address bar:
 - (a) https://<site_id>-mc.<site_id>.nwp.nas.faa.gov
Note: Replace <site_id> in both locations above with one of the following ARTCC designators:
 - 1 Atlanta ARTCC: ztl
 - 2 Chicago ARTCC: zau
 - 3 Cleveland ARTCC: zob
 - 4 Minneapolis ARTCC: zmp
 - 5 Salt Lake City ARTCC: zlc
 - 6 Washington ARTCC: zdc
 - c. For AWD
 - (1) To navigate to the AWD Web Page, enter the following in the address bar:
 - (a) https://<site_id>-awd.<site_id>.nwp.nas.faa.gov
Note: Replace <site_id> in both locations above with one of the ARTCC designators listed under the NWP-A M&C above.

3.4 Software Organization and Overview of Operation

Once launched, the M&C, Adaptation Manager, and AWD GUIs each execute as a single page application entirely within the web browser.

3.4.1 M&C Overview

The M&C display is organized in a hierarchical manner – the initial view shows top-level information for the entire system. The details for lower level components are viewed by navigating within the application. The M&C display's hierarchical nature for Domain is shown below:

**Figure 6. Domain M&C Software Hierarchy**

Monitor capabilities are inherent to the component hierarchy without any special user interaction. The colors red, yellow, and green are used to indicate the state of each component. Visual and audible alarms are used to alert the user to situations which may require attention. Control capabilities are accessible within the context of individual components, typically via right-click interactions. An Event Log provides detailed information to assist the user in understanding changes in status.

The M&C GUI information is organized via tabs containing subsystem and external interface information. The available tabs at the Domain site are as follows:

1. Subsystem tabs: Domain Compute Cluster, NWP LAN, Domain PG
2. Interface tabs: FTI, CSS-Wx, Radar, RMLS

An example view of an M&C GUI layout is shown below for the Compute Cluster tab view at a Domain site (specific views are described in Section 5):

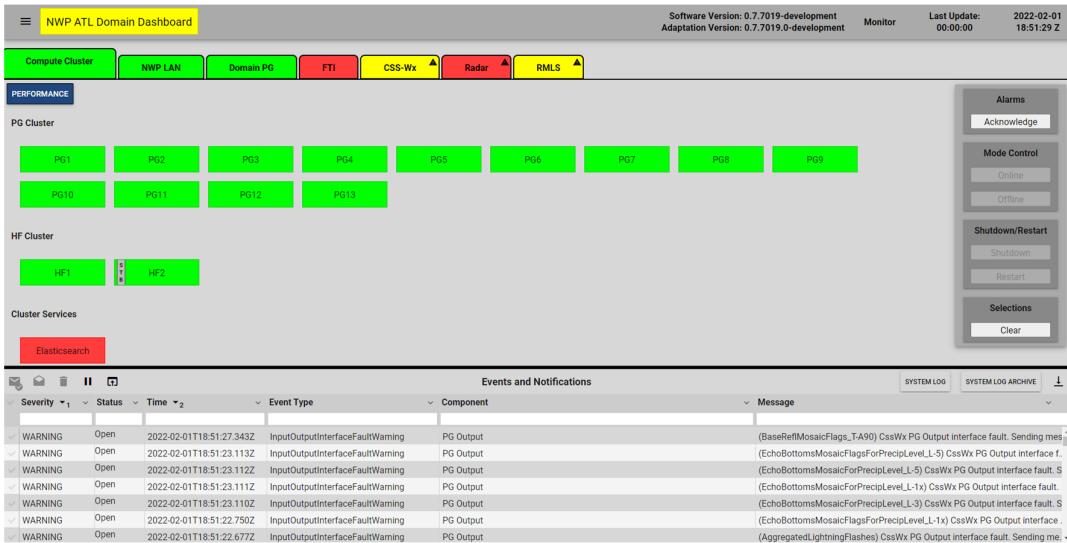
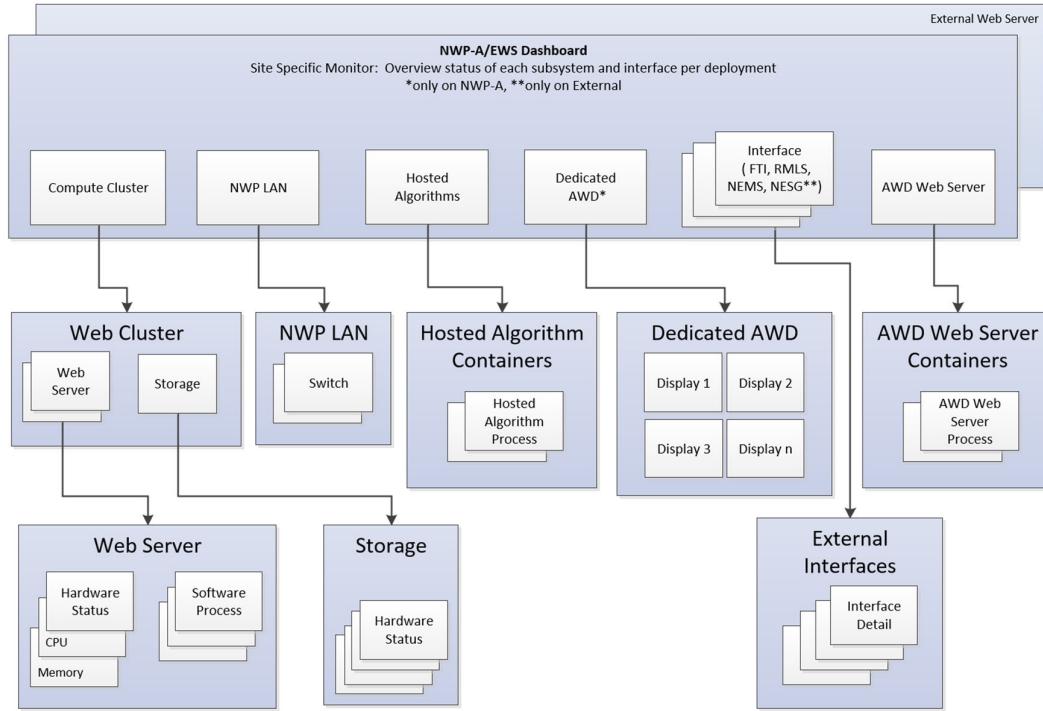


Figure 7. Domain M&C GUI Example

The information available on each tab is as follows:

1. Compute Cluster
 - a. Provides icons showing the state and mode of each server within the cluster
 - (1) Selecting an individual server icon provides specific hardware and software status
2. NWP LAN
 - a. Provides icons showing the state of each switch and router applicable to the site
3. Domain PG
 - a. Provides icons showing the state of PG software process groups and PG software processes

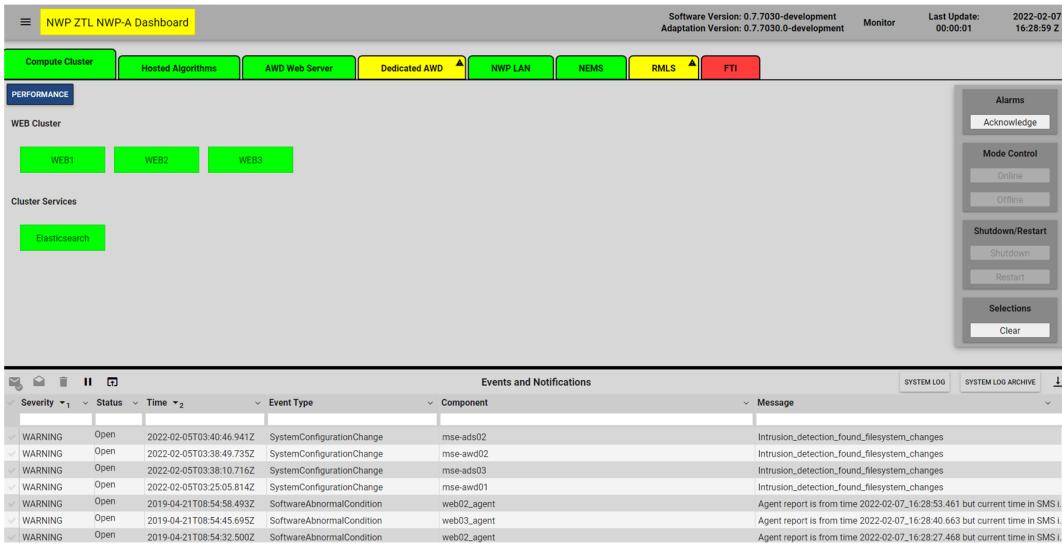
The M&C display at the NWP-A is also organized in a hierarchical manner similar to the Domain and is shown below:

**Figure 8. NWP-A/EWS M&C Software Hierarchy**

The M&C GUI information at NWP-A sites is also organized via tabs containing subsystem and external interface information. The available tabs are as follows:

1. Subsystem tabs: Compute Cluster, Hosted Algorithms, AWD Web Server, Dedicated AWD
2. Interface tabs: NWP LAN, NEMS, RMLS, FTI

An example view of the M&C GUI layout is shown below for the Compute Cluster tab view at an NWP-A site (specific views are described in Section 5):

**Figure 9. NWP-A M&C GUI Example**

The information available on each tab is as follows:

1. Compute Cluster
 - a. Provides icons showing the state and mode of each server within the cluster
 - (1) Selecting an individual server icon provides specific hardware and software status
2. Hosted Algorithms
 - a. Provides icons showing the state of each algorithm running on NWP-A servers
3. AWD Web Server
 - a. Provides icons showing the state of active containers running on the AWD Web Servers
4. Dedicated AWD
 - a. Provides icons showing the state of each Dedicated AWD associated with the NWP-A

The software used to update the display is event-driven; therefore, the user sees changes in system status displayed on the M&C GUI in a timely fashion. The software also reconnects when network interruptions are encountered. These features enhance the reliability of the information presented to the user.

The Event Log regularly removes old events from the M&C display to limit memory usage on the user's device. The timeliness of information displayed to the user can be affected by the bandwidth availability and latency of the network connection. Note, events cleared from the M&C display are retained and available to be accessed via the System Log button on the M&C. See Section 5.3.9.

Access to the M&C GUI does not require authentication for the Monitor role capabilities. The M&C GUI does require authentication with a user name and password in order to access Administrator role capabilities. A user may be assigned administrator role privileges on a per

site basis. User roles are assigned via Identity Manager (IdM). See Section 5.3.15. User roles and configured functionality per role are shown in the table below:

Table 3. M&C Capabilities and Required User Roles

M&C Capabilities		M&C User Roles	
M&C Capability Category	M&C Capability	Monitor	Administrator
View only	View M&C display View Event & Notifications Log		Default Capability for all user roles
Filter, Sort, and Export Event Logs	Export entries from Event Log Filter and Sort on Event Log		Default Capability for all user roles
Control Alarms	Enable & Disable Audible alarms Acknowledge Alarms		Default Capability for all user roles
Open/Close Events	Open or Close event from Events and Notifications log		Default Capability for all user roles
Clear Events & Notifications	Clear an event from Event Log	Inhibited	Available
Shutdown Component or Subsystem	Shutdown a software component or Domain PG Subsystem	Inhibited	Available
Restart a component or subsystem	Cold or Warm Restart a software component or a Domain PG Subsystem	Inhibited	Available
Transition a Component or subsystem to Offline Mode	Transition an applicable component (Domain HF or PG Server or NWP-A web server) to Offline Mode or Transition an applicable subsystem (Domain Compute Cluster, PG) to Offline mode	Inhibited	Available
Transition a Component Online	Transition an applicable component (Domain HF or PG Server or NWP-A web server) to Online Mode or Transition an applicable subsystem (Domain Compute Cluster, PG) to Online mode	Inhibited	Available
Perform Software updates	Update software version or restore a previous software version	Inhibited	Available

3.4.2 Adaptation Manager Overview

The Adaptation Manager allows a user to view, modify, and publish/archive sets of NWP adaptation. Adaptation data may be updated via file import, value entry into the UI (Quick Edit), or text edit of the JSON adaptation files. Once a set of adaptation data is updated for use in an NWP system, it is published and released to the adaptation repository where it is available for transfer to removable media. The adaptation set must then be transferred via removable media to the update server, where it is available for download and installation to NWP systems.

Upon launch of the Adaptation Manager UI, the user is prompted options as listed below. An option selection is made, along with a selection of the desired adaptation set(s).

1. Modify selected Adaptation version: Allows import of adaptation or direct edit of existing adaptation files. Also includes option to archive version such that it may no longer be modified.
2. Create new Adaptation version: Allows user to create a new adaptation set from an existing version of adaptation. New adaptation set version will be automatically incremented to the next available version number.
3. Compare two Adaptation versions: Allows user to view differences between two selected versions of adaptation.
4. View or Export archived Adaptation versions: Allows user to examine a read only view of the selected archived (previously published) adaptation version.

Once a selection is made, the user enters the Adaptation Manager main page. The main page provides directory and control options on the left panel:

Version	Last Saved	Version Info	Save History
<input type="checkbox"/> 0.7.7030.1-development	2022-02-06	new version	

Figure 10. Adaptation Manager Main Page

Right-clicking the adaptation directories in the Adaptation File Editor allows for operations such as creating a new directory or copying an existing directory. Right-clicking an adaptation file allows for options as shown in the example below:

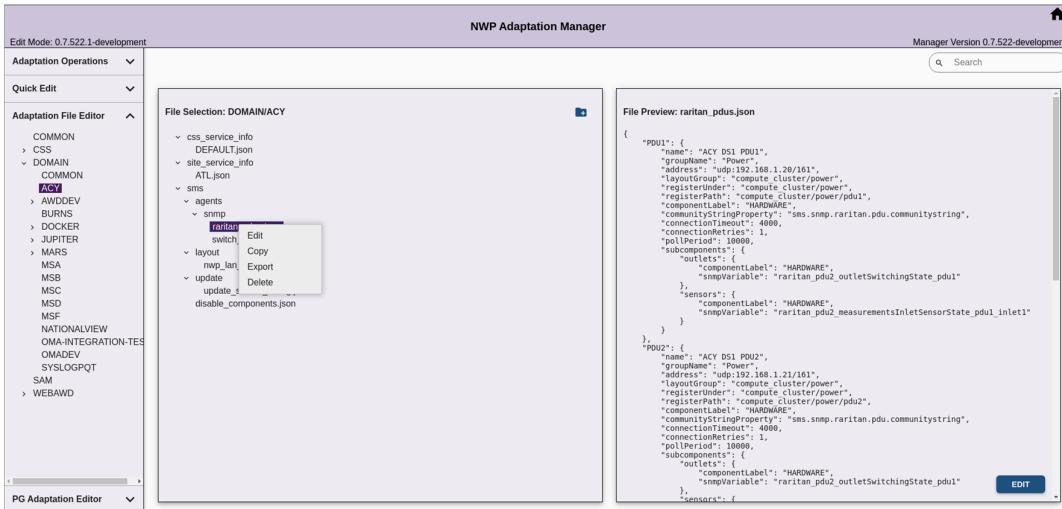


Figure 11. Adaptation File Editor Operations

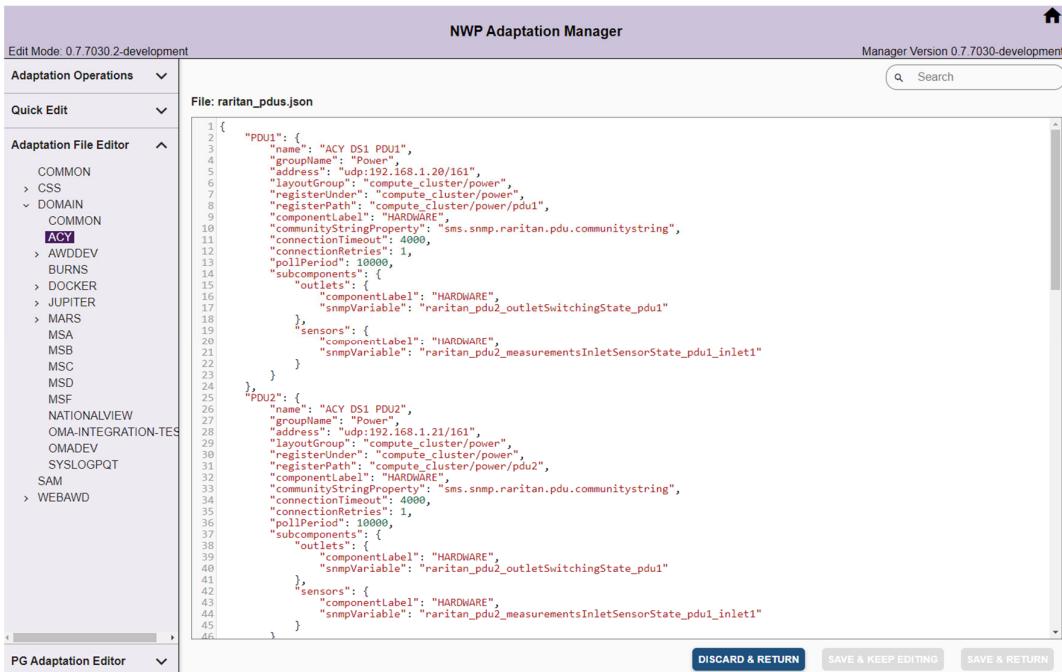


Figure 12. Adaptation File Editor Operations

3.4.3 AWD Overview

The AWD presents information using a customizable tile view structure. Upon initial access to the AWD, the user is presented with a blank screen. To display information, the user must first create a view using the hamburger menu icon at the top left of the screen.

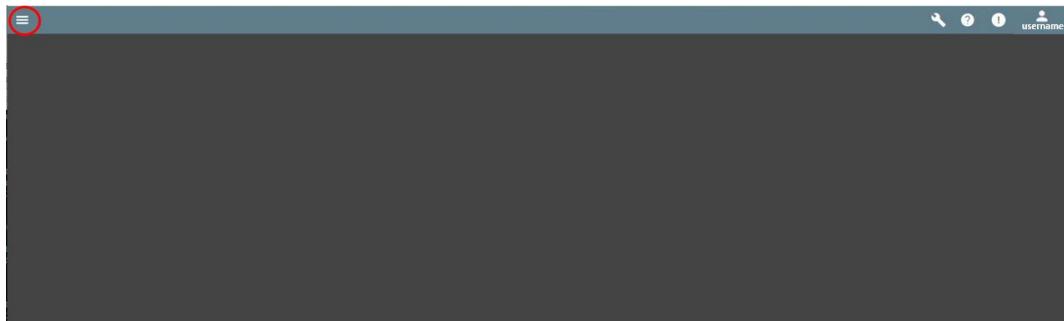


Figure 13. Blank AWD Screen

When the hamburger menu is expanded click **+Add New View** to add a view.

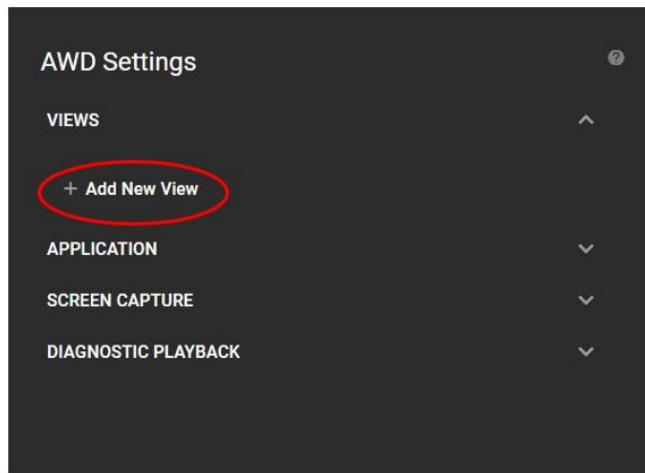


Figure 14. Hamburger Menu

Once a view is created, products can be displayed by opening the view settings as indicated by the gear icon circled in the figure below:

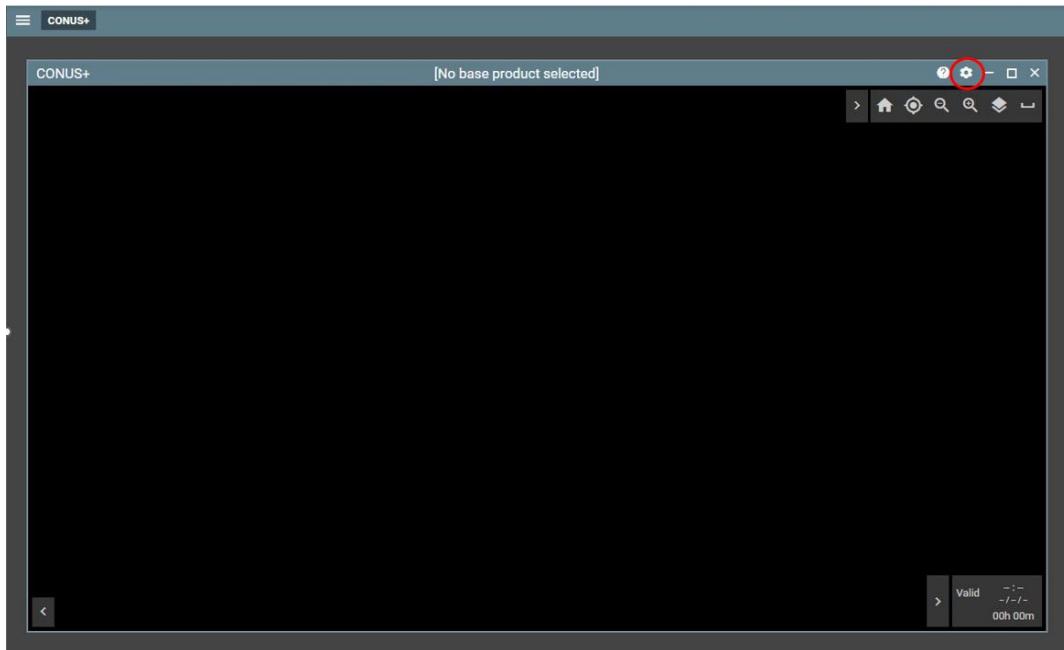


Figure 15. Product View

From the settings panel, a user can make a selection from a list of products supported for the given view type. The above image shows a CONUS+ Long Range view which supports the display of graphical products. A user is able to select graphical products, but not text products or static images which have their own views. The long range graphics view settings panel is shown below:

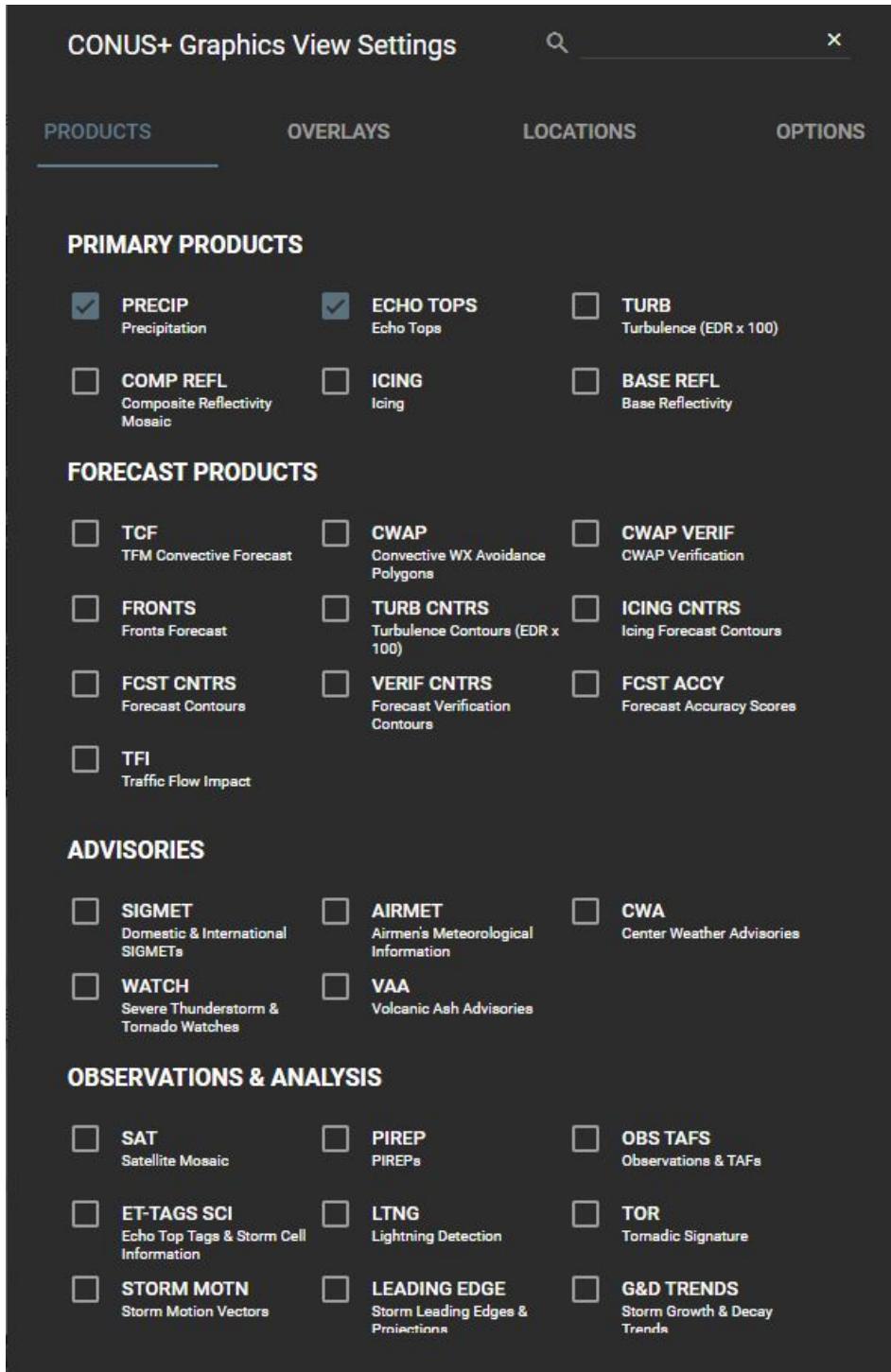


Figure 16. Long Range Graphics View Settings Panel

Once a product is selected for a view, it is shown on the product toolbar at the bottom left of the view. Below is a CONUS+ Long Range view with a product enabled:



Figure 17. CONUS+ Long Range View with Precip

Shown below, are the settings menus for the other available views along with a image of a product being enabled:

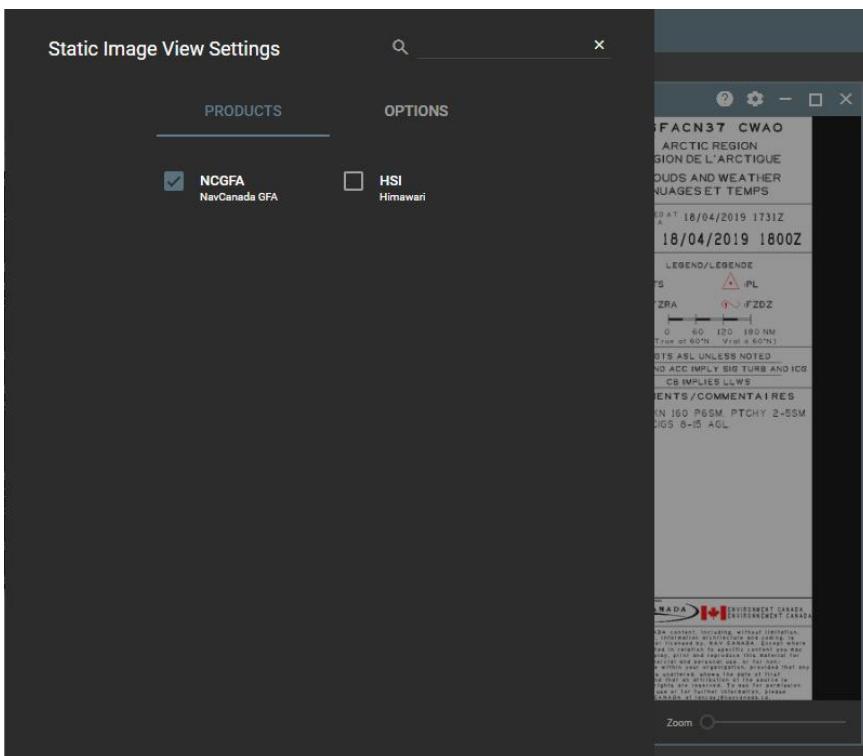


Figure 18. Static Image View Settings Menu

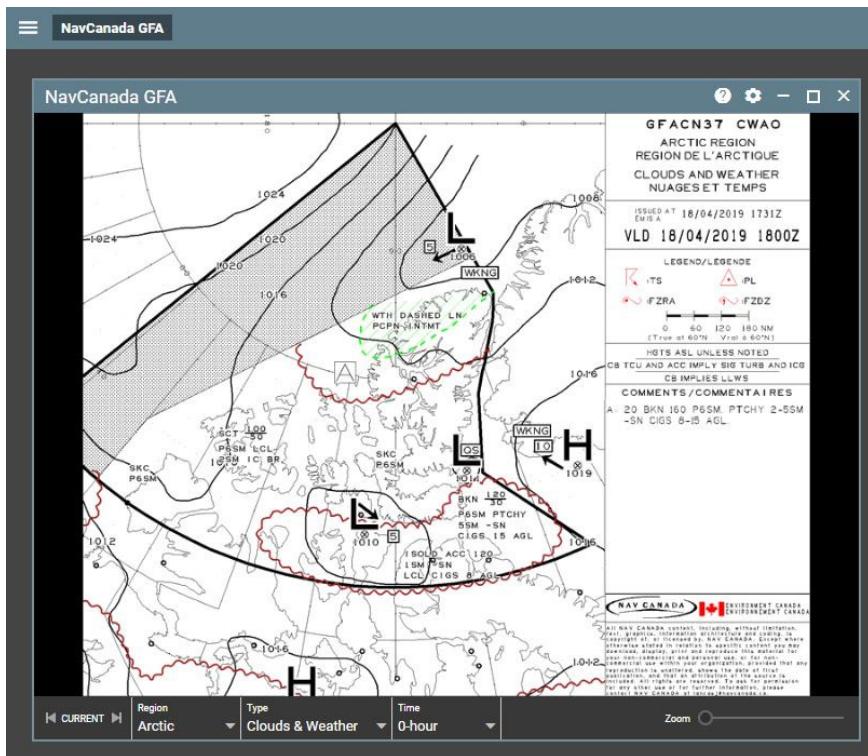


Figure 19. Static Image View

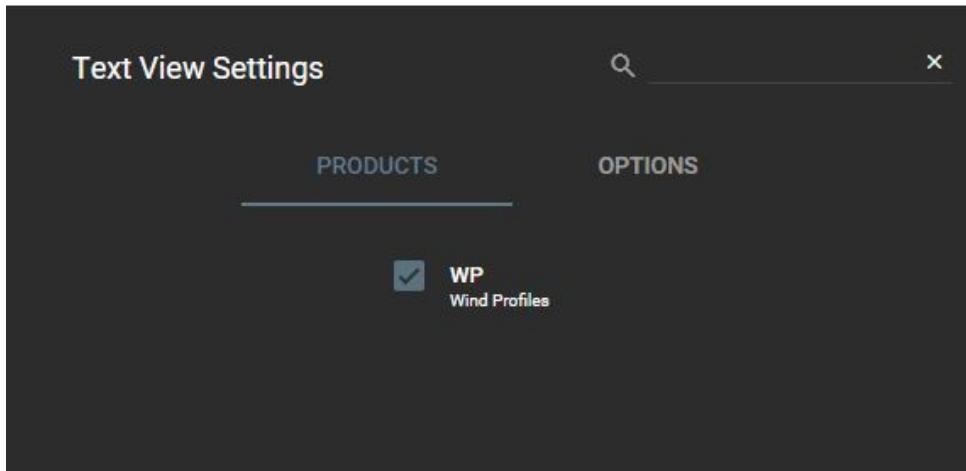


Figure 20. Text View Settings Menu

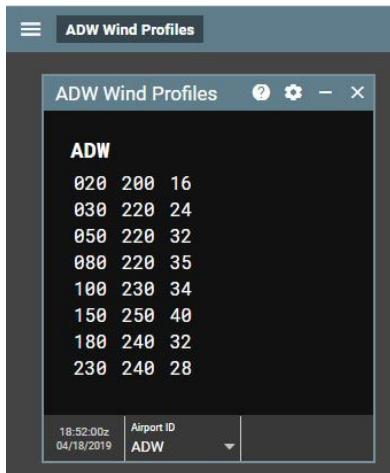


Figure 21. Text View

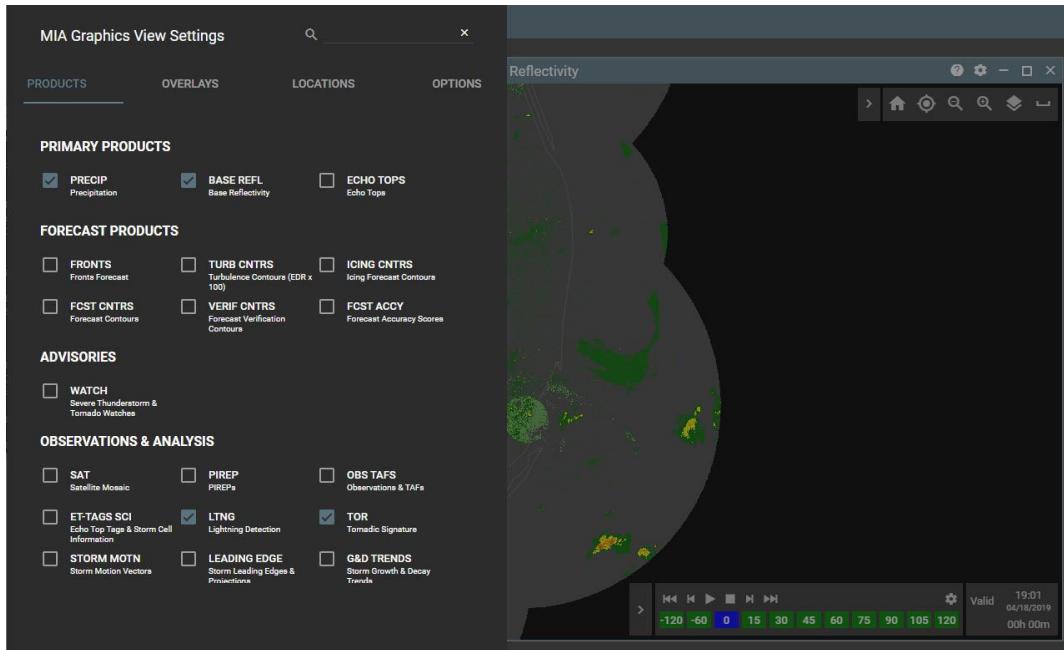
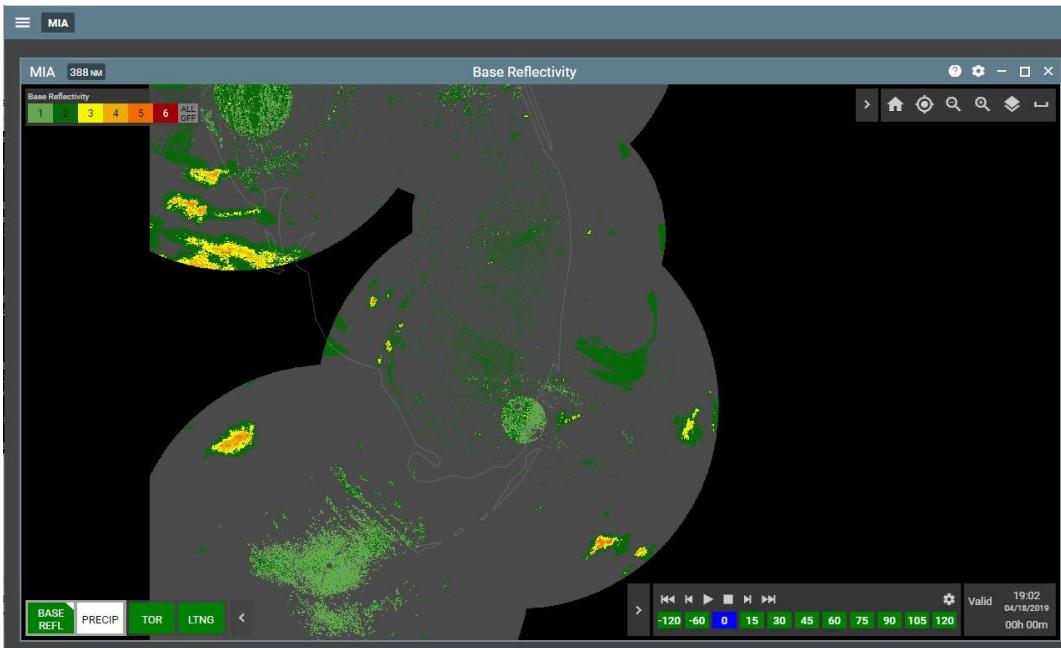


Figure 22. TRACON View Settings Menu

**Figure 23. MIA TRACON View**

The icons on the product toolbar change depending on product availability. The various icon states are listed in the table below:

Table 4. Product Availability States

Color	Meaning
Green	Visible and Available
White	Hidden and Available
Gray	Connected to product source; no product received and/or no data available
Red	Failure to connect to product source for given product

3.4.4 AWD Diagnostic Playback Archive

Diagnostic playback allows an AWD user to playback an archive of previously recorded NWP-A input data as if it were live. The use of diagnostic playback including how to start it, stop it, etc. is covered in the ATOM. This section describes how to setup the archives that are available for a user to select for playback.

When the user starts a diagnostic playback in the AWD they can choose from one of three different types of archives; NWP-A Input, Training, or Media. The NWP-A Input option will playback data directly from the live NWP-A input archive of data recently received by that NWP-A system. The last two are general categories that can be used to organize the archives.

The diagnostic playback archive group locations are configured in adaptation in `ads/replay/archive-groups.json`. The entries are in the following format:

```
1. {
  "training": {
```

```

    "displayName": "Training",
    "path": "training-archives"
  },
  "media": {
    "displayName": "Media",
    "path": "media-archives"
  }
}

```

The entry key must be unique. The entry value has two fields called displayName and path. The displayName field configures how the archive group will be named on the display. The path field is relative to /archive on the NWP-A. This adaptation could be edited to add an additional category as needed.

A new playback archive can be added to a group by placing a directory with the following structure under the archive group path. This structure matches the ADS input archive layout and can be populated by extracting an archive export from an NWP-A.

1. /archives/training-archives/training_scenario_alpha/
 - |- image
 - |- netcdf
 - |- xml

The playback archive will appear on the AWD as 'training_scenario_alpha' and the layout of the archive under that directory should match the layout of the /nwpshare/ads-input archive.

Section 5.2.4 describes how to create and download an archive export from either a domain or NWP-A M&C. Diagnostic playback archives can be created from NWP-A archive exports which contain all of the inputs received by that NWP-A during the specified period. The downloaded archive is a compressed tar file that can be transported to any NWP-A system via removable media. A user with sudo privileges can create a directory owned by the nwpapp user under one of the archive directories described above to extract the archive into. The name of that directory will be the name of the archive selection the user sees in the AWD (training_scenario_alpha in the above example). Archives extracted here will never be automatically cleaned up by purge and will remain there until they are manually removed.

To create the archive directory from the example above:

1. sudo -u nwpapp mkdir /archive/training-archives/training_scenario_alpha

To extract the archive file into the archive directory a command like the following should be used. The directory where the archive file being extracted is located (in the below example /mnt/usb) must be readable by the nwpapp user:

1. sudo -u nwpapp tar xf /mnt/usb/archive-export-20190418T140000-20190418T170000.tgz -C /archive/training-archives/training_scenario_alpha

Once the extraction is complete the directory should already be organized as shown above and the replay will immediately be available for AWD users.

3.5 States and Modes of Operation

This section explains the states and modes of operation for the NWP system and how the M&C GUI presents the relevant information to the user.

3.5.1 Component and Subsystem States

Each NWP Subsystem is assigned a state based on the states of its managed components. Each subsystem, component, and NWP interface is assigned a state (Further information about the component and subsystem states is available in section 5.2.1).

The element states supported are:

1. **Normal** (Green)
 - a. Signifies no errors
2. **Degraded** (Yellow)
 - a. Signifies non-critical errors are present
 - b. Visual and audible alarms are used to alert the user to this situation which may require attention
3. **Failed** (Red)
 - a. Signifies critical errors are present (may or may not be non-critical errors included as well)
 - b. Visual and audible alarms are used to alert the user to this situation which may require attention

This diagram illustrates the various state transitions:



Figure 24. M&C States and Transitions

3.5.2 Component and Subsystem Modes

The M&C Operator can control the mode of applicable NWP subsystems, and components. Supported modes are:

1. **Online**
 - a. Component is active, ingesting data, and providing operational products and services to consumers
2. **Offline**
 - a. Component is running, but is not disseminating products or performing its nominal operations
 - (1) This mode is manually commanded by M&C operators
 - (2) PG and HF servers will initialize in Offline mode after restart
 - (3) The system cannot automatically transition out of this mode, requires M&C operator action to transition mode
3. **Standby**
 - a. Component is running, but not disseminating products or performing its nominal operations
 - (1) Only the HF and PG servers are put into standby mode (automatically by the system)

- (2) The component is ready to take over for the redundant online component in case of failure
 - 1 Diagnostics and/or maintenance should not be run on a component in this mode
- (3) Transition from Standby to Online is automatic in a redundant component failure situation
- (4) May be ingesting data in preparation for a transition to Online

Additional information about modes:

- 1. Available mode values vary depending on the hardware or software component
 - a. Not all hardware and software components have a mode
- 2. The M&C operator has the capability to transition mode of the Domain Compute Cluster and Domain PG subsystems only. There is no mode control of NWP-A/External Web Server subsystems.
- 3. The M&C operator has the capability to transition a component or subsystem to certain modes
 - a. A user can transition a server (Domain, NWP-A, or ESW) between online and offline mode; the system will automatically command offline mode for a failed server
 - b. A server will remain in offline mode until M&C user command to Online
- 4. Some modes may be automatically transitioned by System Management Services (SMS)
 - a. The system determines if a component should be in standby mode (PG or HF server only)
 - b. Once the system determines that a standby component is needed, it will auto transition to online mode
 - c. It is only in standby mode if it is not needed for operations (and has been commanded to online mode by the user)

The following diagrams illustrate mode transitions in the NWP system:

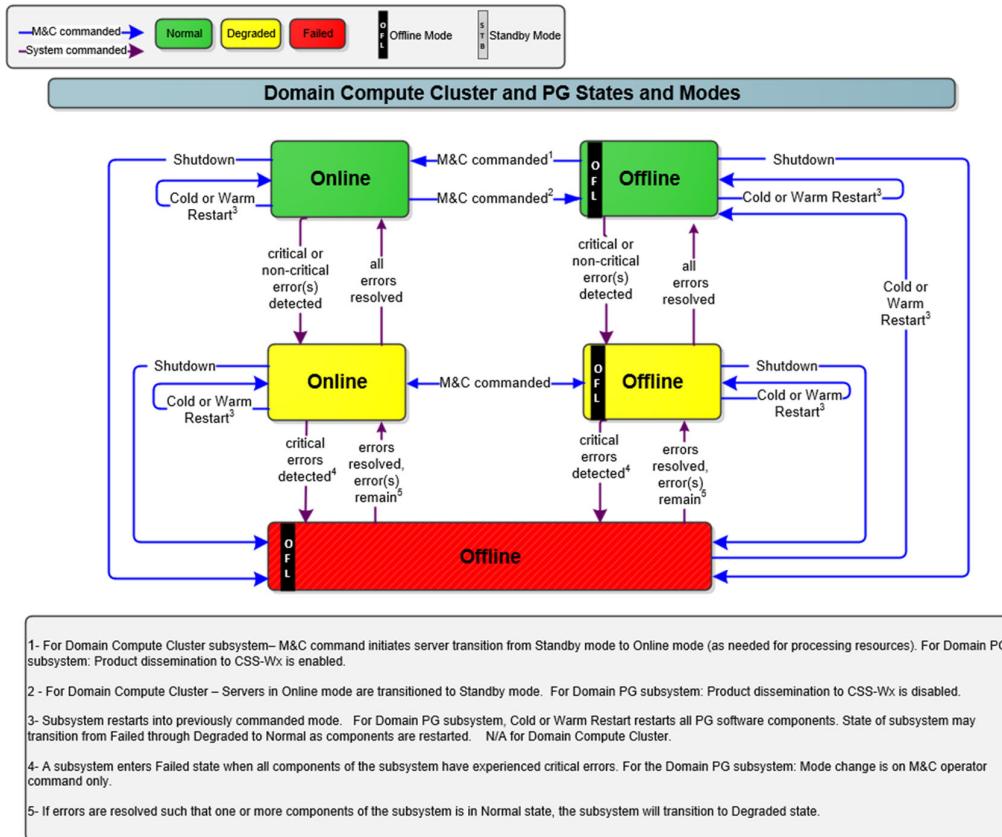


Figure 25. Domain Compute Cluster and PG States and Modes

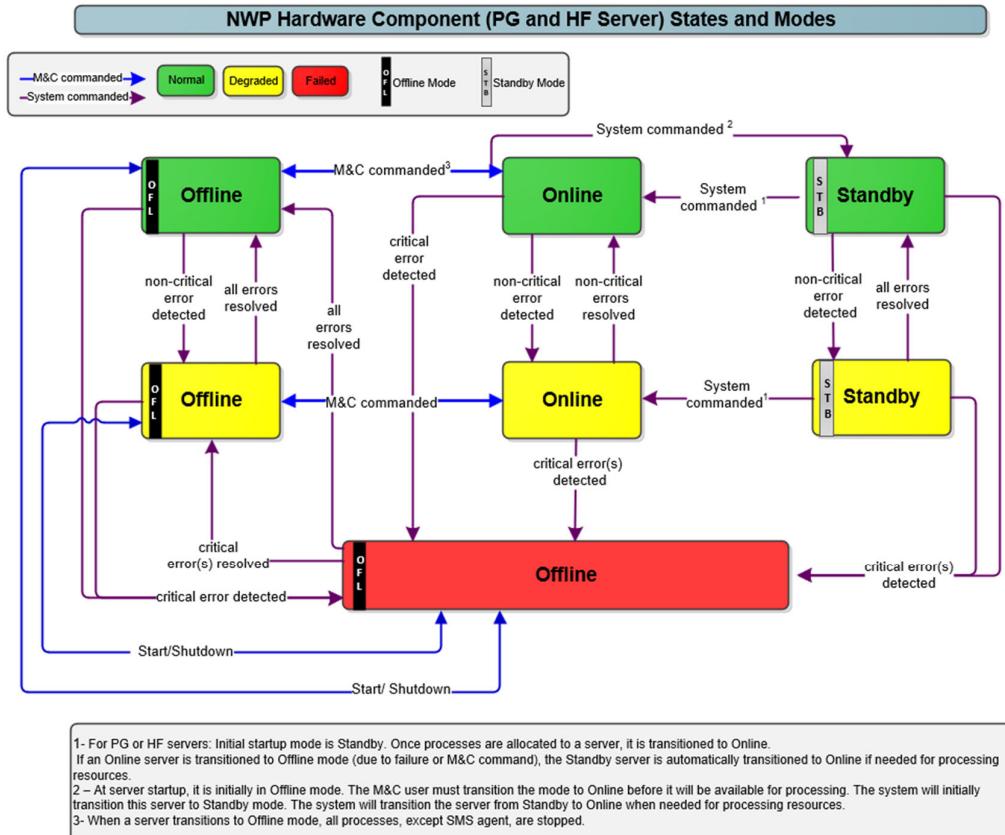


Figure 26. NWP Hardware Component States and Modes

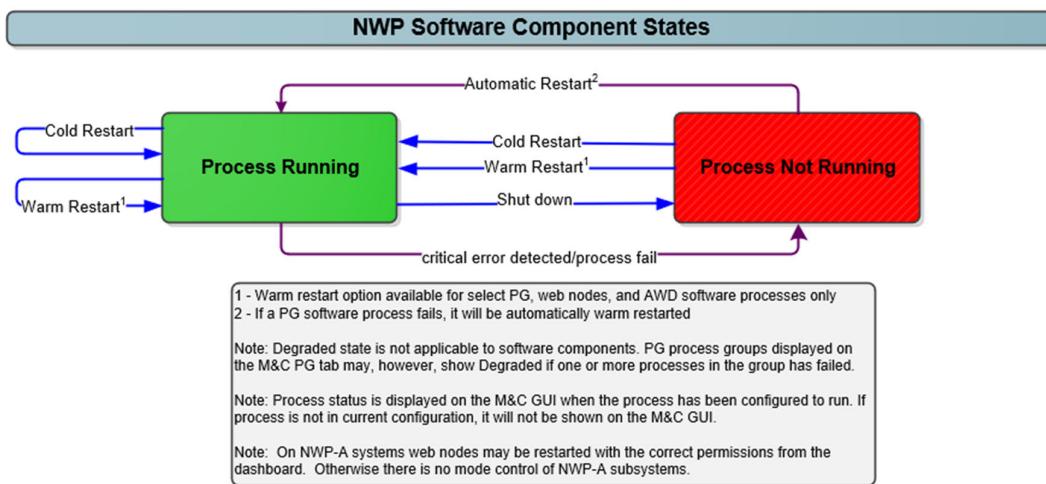


Figure 27. NWP Software Component States

3.5.3 AWD Operating States

The AWD GUI can only be in one of two states – available and unavailable. An AWD is available unless there is a graphical overlay indicating the AWD is unavailable, as shown below:

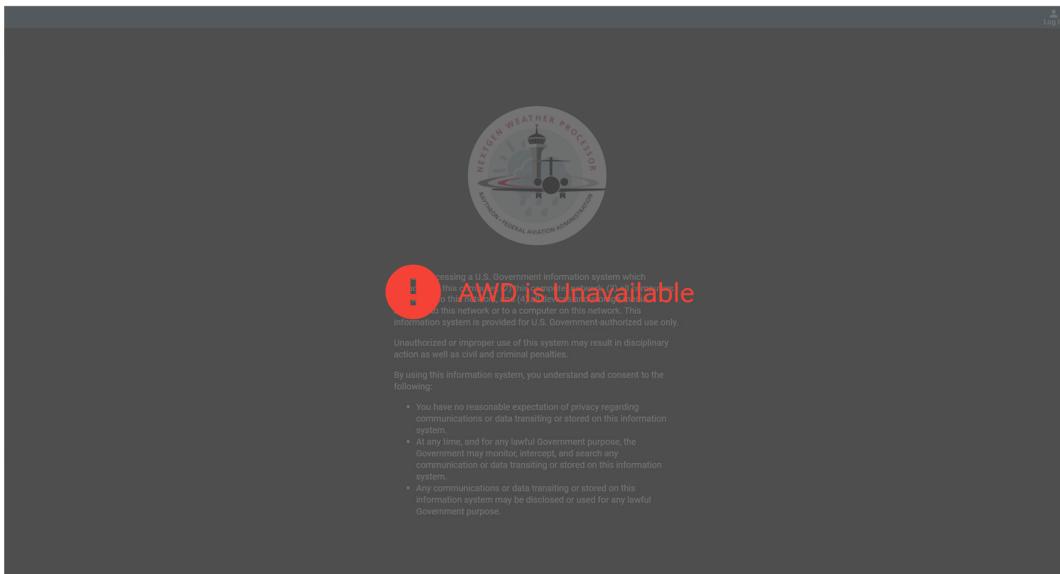


Figure 28. AWD Out of Service

3.6 Security and Privacy

The M&C and AWD GUIs present a disclaimer to the user at login which identifies usage restrictions and considerations as directed by the FAA. All M&C and AWD software is unclassified.

All NWP System software is developed in accordance with security requirements. The M&C and AWD are assessed for security vulnerabilities through a security certification and accreditation process. Access to physical workstation and related equipment is controlled by the site where the system is located. Access to M&C and AWD software is controlled by domain user accounts.

The Government's rights to software created by the NWP contractor are as specified in the contract. Contractor-developed software files are also export controlled. These files have a header containing applicable copyright, use rights, and export control information. The Government's rights to third-party software is specified in license documentation provided with each software product. The NWP contractor has reviewed third-party licenses to ensure the software is being used within the legal intent of the license. The contractor has also reviewed these products for security vulnerabilities.

3.7 Assistance and Problem Reporting

Contact the local NWP system administrator for assistance with issues and problem reporting. Section 5.3.9 Event Log has information about system events displayed to the user.

4.0 Access to the Software

This section has information to allow first-time and occasional users to gain access to and start using the AWD and M&C GUI.

4.1 First-time User of the Software

4.1.1 Equipment Familiarization

The procedures for preparing a user LRU to use the M&C GUI are LRU specific. The procedures for powering off a user LRU which is using the M&C GUI are also LRU specific. See the LRU manuals for power on, opening a web browser, closing a web browser, and power off procedures. The AWD GUI and M&C GUI run in a standard Google Chrome web browser.

The AWD and M&C GUI are designed to use standard user equipment input devices such as a keyboard and mouse. The appearance of the mouse cursor is determined by the theme applied to the user's desktop. The dimensions of the visual display can be adjusted by changing the size of the browser, and the M&C GUI can be resized to fit the browser dimensions. Unless specified otherwise, mouse click selections described in this document are left click operations.

4.1.2 Access Control

User accounts for the AWD and M&C GUI are managed as part of the NWP system administration. Contact the local system administrator for access. Section 5.3.15 provides information on NWP identity management functionality for system administrators.

The AWD and M&C GUI allow users to change passwords when necessary. When a password change is required, a dialog is presented to the user which requires the current password and the new password (entered twice for confirmation). The login screen presents the user with security and privacy disclaimer as directed by the FAA.

4.1.3 Installation and Setup

4.1.3.1 M&C Installation and Setup

The M&C GUI is a web-based user interface accessible via a Google Chrome web browser. No special software is required.

4.1.3.2 AWD Installation and Setup

The AWD GUI is also a web-based user interface accessible via a Google Chrome web browser. For website users to access the AWD, enter the AWD web server URL as described in Section 3.3 of this document. For a Dedicated AWD, the system must be installed and configured. Powering on the Dedicated AWD displays the AWD log in screen. If a Dedicated AWD is configured with a default user and default preference set, the Dedicated AWD starts with the default preference set applied (no log in screen). See Section 4.1.3.3 for steps required to configure a Dedicated AWD with a default user and default preference set.

4.1.3.3 Dedicated AWD Default User and Default Preference Set Setup

To configure a Dedicated AWD with the default user and default preference set, complete the following steps on an NWP-A ADS server:

(Note: the user account and associated preference set must already exist and the steps below should be completed on the NWP-A that the Dedicated AWD points to. For example, if the Dedicated AWD is configured to point to the ZTL NWP-A these steps must be completed on an ADS server at the ZTL NWP-A.)

1. Access the underlying operating system of the NWP-A ADS server, either via Secure Shell (SSH) or by physically being at the machine, connecting a KVM (Keyboard Video Mouse) to the ADS server, and accessing the console session via Ctrl+Alt+F1. See 4.2 for more information on initiating various sessions
2. As a system administrator, execute: `sudo -u nwpapp /opt/nwp/tools/default-user-tool/default-user-tool.sh set --target /nwpshare/awd/default-users.properties --fqdn <fully qualified domain name of the dedicated AWD workstation>`
3. Enter default username
4. Enter default user password (will prompt twice to verify)
5. Enter default preference set for user (Note: if preference set names are not known for the user, log into an AWD GUI to see all available preference sets for that user. Or log on to a Domain HF node and navigate to /prefshare/<username> to view them.)

Via the NWP-A ADS server, repeat steps 2-5 for any Dedicated AWD that needs a default user and default preference set, entering the fully qualified domain name of each target dedicated AWD in step 2.

4.2 Initiating a session

The sections below outline the specifics for starting an AWD and M&C GUI session. A user account must be granted the correct privileges to be allowed to login to the operating system, see Section 5.3.15.5.1.

A user might require access to the underlying operating system rather than one of the application GUIs. This is done either by accessing a given host through Secure Shell (SSH) or by physically being at a machine. Enter the Ctrl+Alt+F1 key combination on a keyboard connected to the machine to display Terminal 1 which is a console session for the operating system. The AWD GUI is accessed on Terminal 2 using the Ctrl+Alt+F2 key combination, and the M&C GUI is accessed on Terminal 3 using the Ctrl+Alt+F3 key combination.

4.2.1 Initiating an M&C Session

The following steps initiate an M&C GUI session and the figure below shows a typical M&C GUI login screen:

1. Perform one of the following steps to open a web browser:
 - a. If using a KVM Console, Press power button on KVM Console KVM1 to turn on console.
 - (1) log into the applicable server using administrator credentials, then click Applications → Internet → Google Chrome. Proceed to step 2.
 - b. If using an AWD workstation, press Ctrl + Alt + F3 to switch from the AWD display to the M&C display.
 - (1) By default the M&C session should be open to the M&C web page for the NWP-A system used by that AWD workstation.
2. If necessary navigate to the M&C Web Page for the desired NWP system. If the session is not already open, perform the following steps:
 - a. Enter the URL of the desired M&C GUI in the browser address bar.
 - (1) Each M&C GUI instance has a unique URL. See Section 3.3 for the correct URL for the desired instance.
 - b. Press <Enter>. The M&C Web Page displays.

3. Upon access, the user is presented with an M&C view in a Read-only, Monitor role. There is no login required for this role.
4. In order to login with Administrator privileges, select "Login" from the Main Menu icon that is located in the upper left corner as shown below.
 - a. Read the disclaimer and select the consent checkbox.
 - b. Enter user credentials.
 - c. Click the LOGIN button
 - d. If login fails, verify the user credentials were entered correctly.
 - e. On multiple failures (account locked after three (3) attempts), see an NWP system administrator for assistance with account credentials.
 - f. On successful login, the M&C GUI is ready to use.

NOTE: If the M&C web browser is open for an extended period of time without activity in an Administrator role, the GUI will automatically logout of the Administrator role into the Monitor role. For more details on the automatic logout process refer to the SUM Section 4.3.1.2.

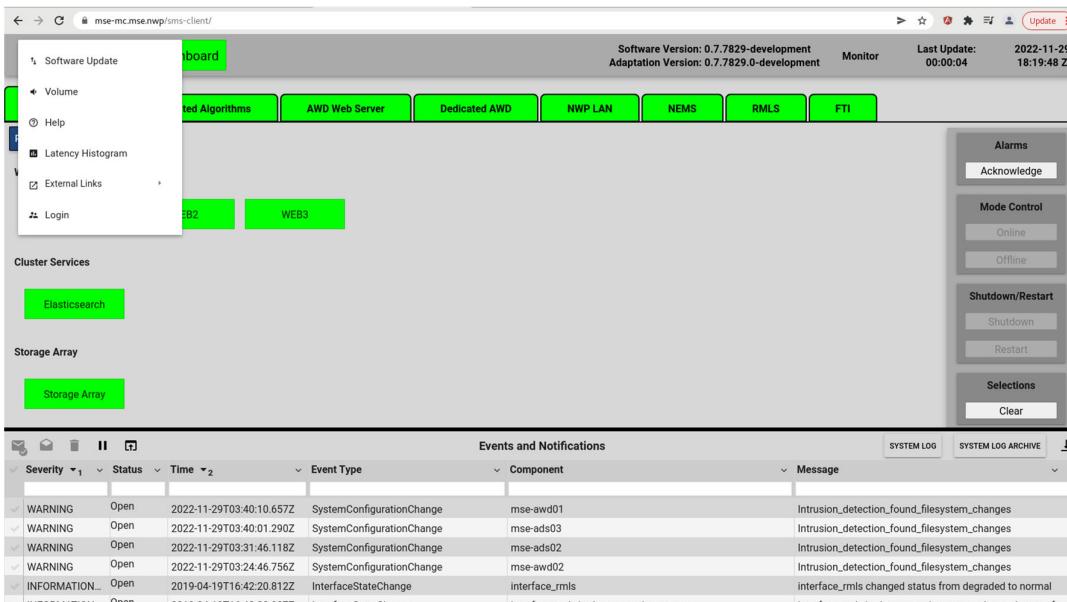


Figure 29. M&C Main Menu

****WARNING**WARNING**WARNING****

You are accessing a U.S. Government information system, which includes (1) this computer, (2) this computer network, (3) all computers connected to this network, and (4) all devices and storage media attached to this network or to a computer on this network. This information system is provided for U.S. Government-authorized use only.

Unauthorized or improper use of this system may result in disciplinary action, as well as civil and criminal penalties.

By using this information system, you understand and consent to the following:

- You have no reasonable expectation of privacy regarding communications or data transiting or stored on this information system.
- At any time, and for any lawful Government purpose, the Government may monitor, intercept, and search any communication or data transiting or stored on this information system.
- Any communications or data transiting or stored on this information system may be disclosed or used for any lawful Government purpose.

****WARNING**WARNING**WARNING****

I consent to these terms

Username *

Password *

LOGIN

Figure 30. M&C GUI Login Screen

When a user's M&C GUI password needs to be changed, there are additional steps to initiate a session. The password rules are presented to the user in red text:

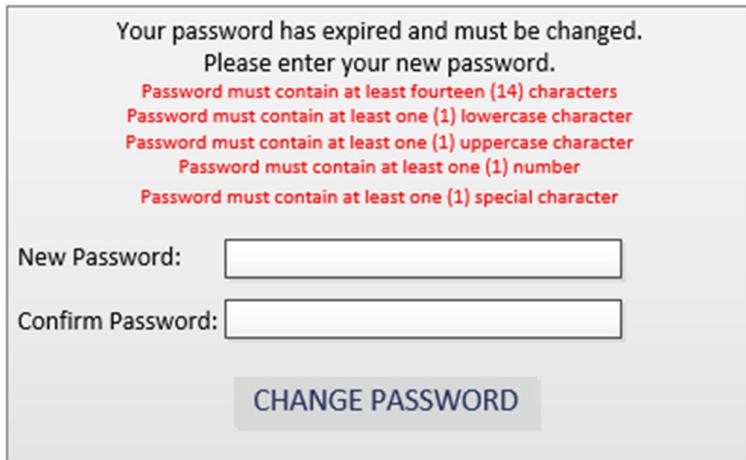


Figure 31. M&C GUI Password Expired

The M&C GUI password rules disappear as each is satisfied:

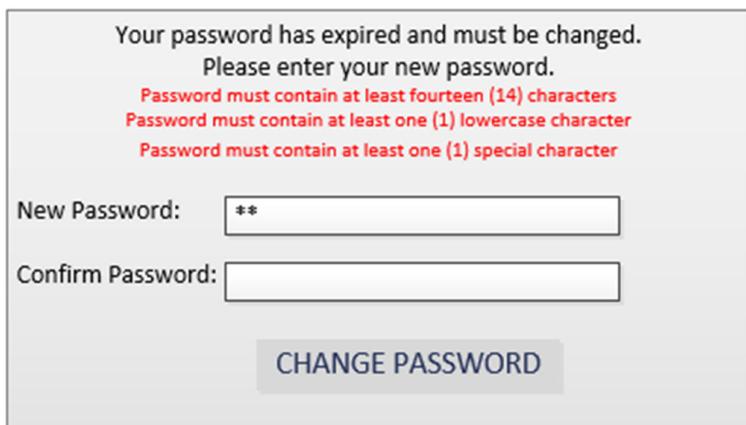


Figure 32. M&C GUI Password Rules Disappear

Once all M&C GUI password rules are satisfied the CHANGE PASSWORD button is active:



Figure 33. M&C GUI Password Rules Satisfied

If the new M&C GUI password has been used recently (see the table in Section 5.3.15.5.27 for a full list of password requirements), the system notifies the user:

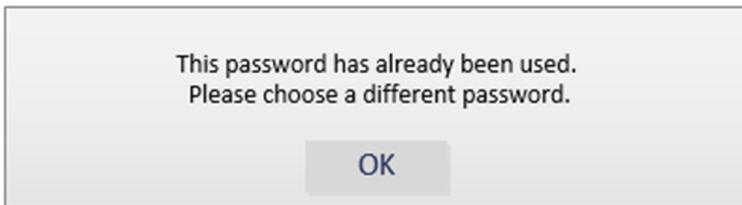


Figure 34. M&C GUI Password Change Failed

Once successful the system confirms the M&C GUI password changed:

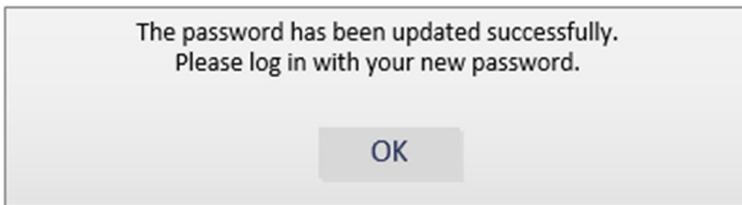


Figure 35. M&C GUI Password Change Success

4.2.2 Initiating an AWD Session

It is possible for a Dedicated AWD to have both an M&C GUI session and AWD GUI session active at once, however only one can be displayed on the screen at a time. The AWD GUI is always present on Terminal 2, which is accessed using the Ctrl+Alt+F2 key combination. If a default user is configured, a login is not necessary. If no default user is configured, or if there was a problem logging in with the default credentials, the user must manually log in. The following steps are a guide to accessing the Dedicated AWD GUI:

When presented with the AWD log in screen, read the usage disclaimer and then click the Log In button:

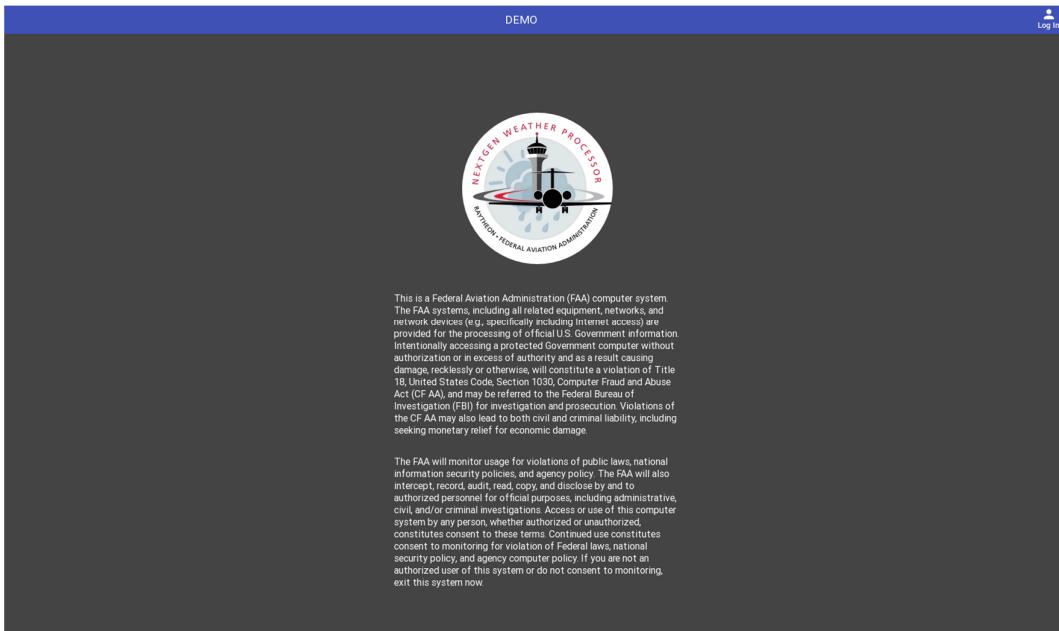


Figure 36. AWD Disclaimer

In the right sidebar, enter the user credentials and then click the LOG IN button:

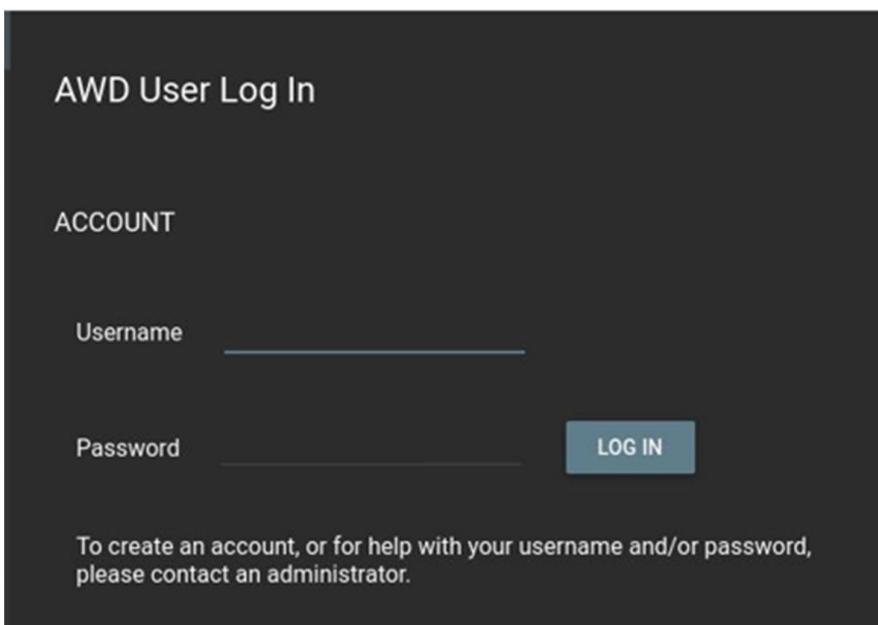


Figure 37. AWD Login Dialog

If successful, the default AWD GUI screen is displayed and available for use.

If the user credentials password is expired, the following password reset screen is displayed. Note the password rules vary depending on the policy set for the user. For information on the different password rules, see Section 5.3.15.5.27 Password Policies.

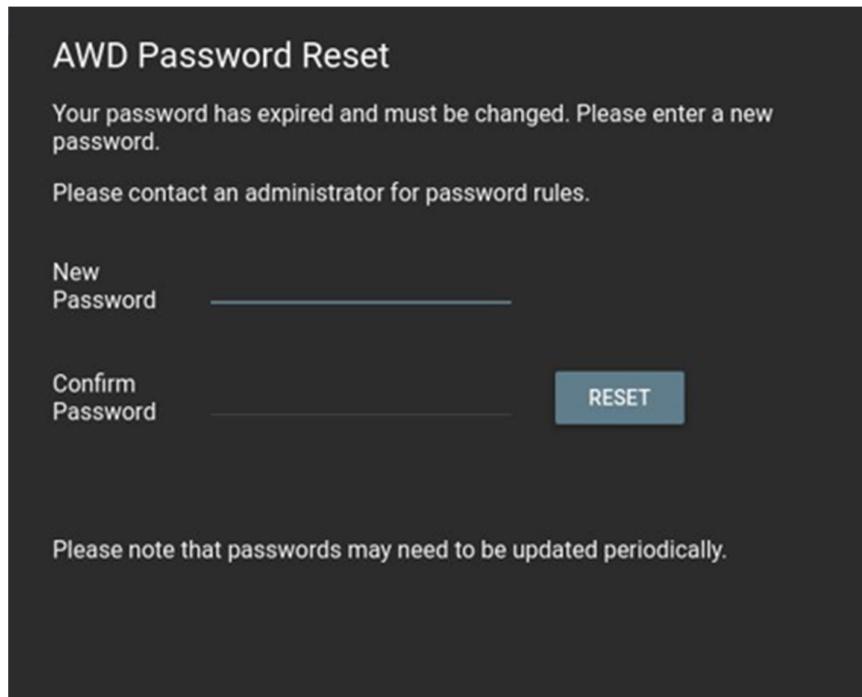


Figure 38. AWD Password Reset

Upon entering a new password which meets the provided criteria, the user is granted access without further prompts.

4.2.3 Log In/Switch User/Password Reset Error Messaging

The process of logging in, switching users, and resetting a password can all lead to error states. Below are the total set of error messages along with the causes that lead to them. These should appear, as appropriate, directly below the associated login/logout/switch Users dialog, in red.

Table 5. Logging In/Out, Switching Users, and Password Reset Errors

Error Message	Applicable Dialog	Cause
Wrong username and/or password. Please try again.	Log In Switch User	<p>The system does not recognize the username for reasons such as:</p> <ul style="list-style-type: none"> · User typed in Username wrong · User's temporary account expired · User's permanent account was manually deleted

Error Message	Applicable Dialog	Cause
		Or User's account is fine but they entered the wrong password
Unable to confirm user authentication. Please try again, or contact an administrator if this issue persists.	Log In Switch User	A User tries to log into a position not used before while the FTI link is down, and the locally stored cache does not recognize the User
You have exceeded the allowable number of failed attempts and your account is locked. Please contact an administrator.	Log In Switch User	The User has entered a wrong password for a valid account more than the number of times allowed within a certain time frame, as adapted
Your account has been disabled. Please contact an administrator.	Log In Switch User	A User's account has been disabled for any reason, such as (but not limited to) inactivity; a less severe administrator action than deleting the account altogether.
Your password does not meet the criteria. Please try again.	Password Reset	On the password reset dialog, the User tries to create an invalid password due to factors such as: <ul style="list-style-type: none">· Password does not meet minimum criteria· Password includes unallowable characters
Your password entries do not match. Please try again.	Password Reset	On the password reset dialog, the "enter" and "re-enter" passwords do not match
This password has already been used. Please choose a different password.	Password Reset	On the password reset dialog, the User has attempted to use a password that is the same as any that have already been used over the past 10 generations (or as configured)
Your requested action has timed out. Please try again later or contact an administrator.	Log In Switch User Password Reset	The action has taken longer than 10 seconds.
You are not authorized to access AWD. Please contact an administrator.	Log In Switch User	A valid User without AWD permissions (e.g., an M&C User not in the appropriate "AWD User Group") attempts to log into AWD.
This account has exceeded the allowable number of simultaneous sessions.	Log In Switch User	A valid user attempts to log in but the session manager identifies that too many sessions for that user exist. External AWD Only

4.3 Stopping and Suspending Work

4.3.1 M&C GUI

The M&C GUI functions as do most websites – the browser can be minimized to temporarily suspend use and the application will continue running. Audible alarms still occur when the browser is minimized. A pause button is available for the Event and Notifications Log to temporarily suspend message display.

4.3.1.1 Manually stopping the M&C GUI

In order to terminate the logged in M&C GUI user session, select the Main Menu icon in the upper left corner > Logout option and then click the CONFIRM button. The M&C will remain open in Monitor only role.

4.3.1.2 Automatic Administrator Role logout of the M&C GUI

The M&C screen will remain logged in to the Admin role as long as the user is interacting with the display (controlling subsystems or components, filtering on or exporting events, commanding software download or install, etc.). After a configured period of inactivity, i.e. configured elapsed time since the last command or action taken to interact with the GUI, a message will display warning the user that they will be automatically logged out of the session within the displayed time. Select ‘Logout Now’ to log out of the Administrator role and return to the Monitor only screen. Select ‘Continue’ to remain logged in to the current session and dismiss the warning.

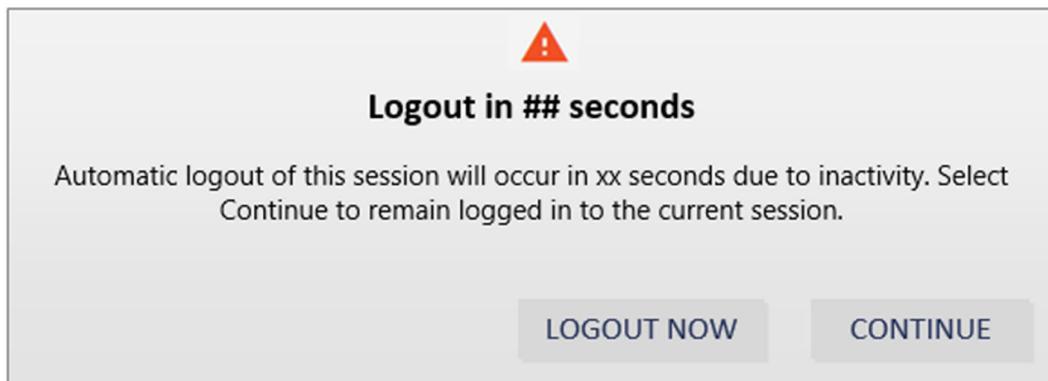


Figure 39. Automatic Administrator Role logout of M&C GUI

4.3.2 AWD GUI

A Dedicated AWD user is unable to exit the GUI (except by powering down the machine - performed by an NWP system administrator). However, the user can change by clicking the User icon and then clicking the SWITCH USER button:

AWD User Profile

ACCOUNT

Username awd_user

SWITCH USER

Figure 40. Switch User

Enter user credentials and then click the CONFIRM button:

AWD User Profile

ACCOUNT

Username |

Password

CONFIRM

To create an account, or for help with your username and/or password,
please contact an administrator.

Figure 41. CONFIRM Button

An AWD user can access the M&C GUI using the Ctrl+Alt+F3 key combination, however the GUI continues in the background until returning with the Ctrl+Alt+F2 key combination.

5.0 Processing Reference Guide

The M&C GUI provides the M&C user with monitor and control capabilities for configured NWP subsystems, components, and interfaces. This section provides detailed procedures for using the M&C GUI.

5.1 Capabilities

The M&C GUI is designed to provide an intuitive user experience. The following is a generalized image of the M&C Dashboard with blue numbering to denote different features:

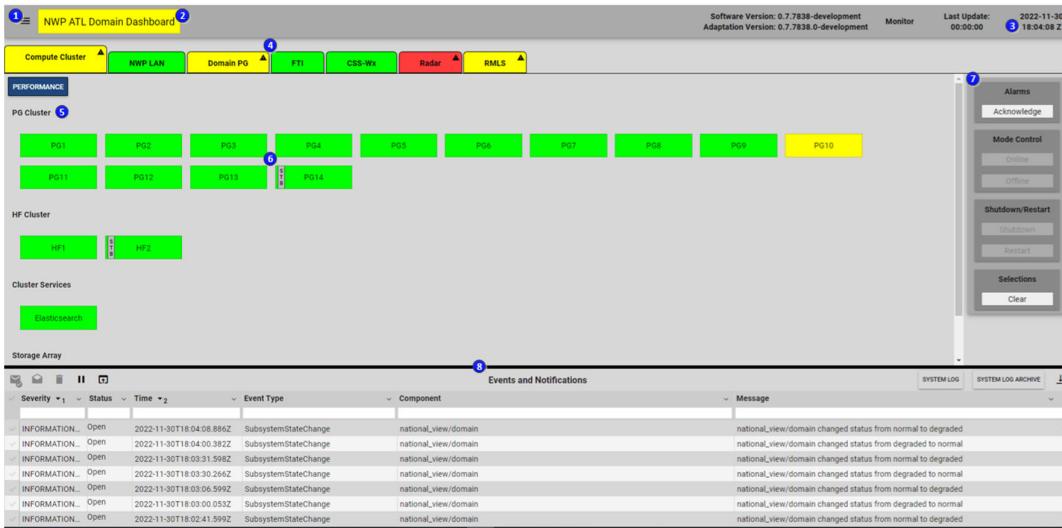


Figure 42. M&C GUI Overview with Numbering

The M&C title bar is common to all M&C displays. This title bar provides, from left to right:

1. main drop down menu
2. deployment title
3. currently installed software/adaptation version
4. username and role
5. time since the last update
6. browser date and time

Available options from the main drop down menu vary depending on the current user role and applicability to the particular deployment type. Options include Software Updates (with correct permissions), Volume, Help, Archive Export, External Links, and Logout:

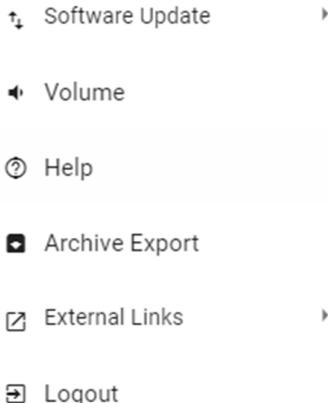


Figure 43. Main menu

Section 5.3.11 Software Distribution and Installation provides a description of the Software Update options that are available from the Main Menu pictured in Figure 37.

Selecting the Volume option from the Main Menu in Figure 37 opens a window from which the M&C user can control the volume of the audible tones using the click and drag method to move the slider control:

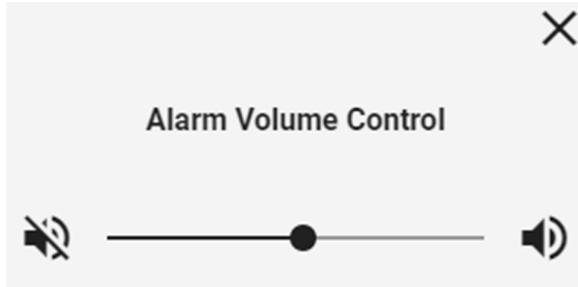


Figure 44. Volume Control for Browser Tab

Selecting the speaker icon on the left mutes the volume. Selecting the speaker icon on the right set the maximum volume. The workstation and browser volume must be enabled for M&C volume changes to take effect. These will be enabled by default when accessing the M&C from a Dedicated AWD.

Selecting Help from the Main Menu in Figure 37 opens a new browser tab in which the M&C Software User Manual (this document) is displayed.

Selecting Archive Export from the Main Menu in Figure 37 opens a pop-up window that allows a logged in user to create, delete, and download an archive.

Selecting External Links from the Main Menu in Figure 37 provides a sub-menu of all configured external links. Selecting a configured link opens the link in a new browser tab.

Selecting Logout from the Main Menu in Figure 37 opens a confirmation window to confirm the action:

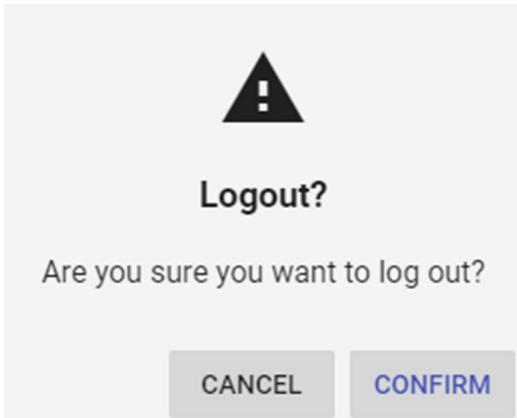


Figure 45. Confirmation of Logout

Selecting CANCEL closes the window and no action is taken. Selecting CONFIRM executes the request to exit the current session.

1. M&C GUI title is background colored to indicate the overall state of the subsystems logically grouped / associated with the site. A green background indicates Normal state with all configured subsystems and interfaces nominal. A yellow background indicates Degraded state with one or more configured subsystems or interfaces Degraded or Failed. A red background indicates Failed state with all configured subsystems and interfaces Failed.
2. The time since last update. The display updates every five (5) seconds at a minimum. If not updated in over ten (10) seconds, the timer changes to red indicating a problem with receipt of data at the display:

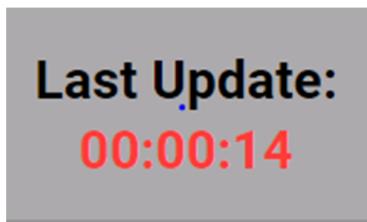


Figure 46. Last Update Timer Expired

3. A color coded tab is provided for each configured subsystem and interface relevant to the monitored system with a raised tab indicating the selection. The tabs displayed are dependent on the logical grouping associated with the installation. Selecting a tab displays icons for the components which comprise the subsystem. When the tab is selected, its selection is indicated by a raised tab.
4. A breadcrumb trail is provided if the M&C user navigates to display subsystem component details.

5. A colored icon is displayed for every component of the selected subsystem indicating the state and mode of each.
6. Buttons are provided for controlling selected components within the currently selected subsystem to include acknowledging alarms, transitioning modes, and shutdown/restart. The Clear button removes all icon selections on the current tab.
7. Displays the Events and Notifications relevant to the system deployment.

5.2 Conventions

A number of conventions are used in the M&C GUI to display the system status in an aesthetic manner.

5.2.1 State and Mode Indications

1. Green identifies components in Normal state.
2. Yellow identifies components in Degraded state.
3. Red identifies components in Failed state.
4. Blinking identifies components in an alarm state due to a non-critical or critical error.

The state and mode of each component or subsystem is shown in the following legend:

M&C Legend		
	NORMAL	DEGRADED
ONLINE		
OFFLINE		
STANDBY		

Figure 47. M&C GUI State and Mode Legend

Normal/Green indicates the component state is Normal and no errors have been detected.

Degraded/Yellow indicates the component has suffered a non-critical error.

Failed/Red indicates the component has suffered a critical error.

The component state automatically downgrades to Degraded or Failed upon detecting a non-critical or critical error and the icon blinks when a component has suffered a non-critical or critical error. The component state automatically transitions from Failed to Degraded when critical errors are resolved and a noncritical error remains. The component automatically transition from Failed to Normal when all errors are resolved.

An additional indicator is presented on a tab or component icon to represent mode. If no additional indicator is present, the subsystem or component is in the nominal Online mode. A black badge with OFL letters over the left portion indicates Offline mode. A gray badge with STB letters STB over the left portion indicates Standby mode. Currently, standby mode is only defined for PG and HF servers.

5.2.2 Logical Groupings and Overall State

A logical group is a grouping of subsystems associated with a Domain, NWP-A or External Web Server deployment. The subsystems within a logical group are determined by the system deployment or are configurable in Adaptation. Each subsystem can be associated with only one (1) logical group. The following legend describes the terminology and visual conventions used with logical groupings:

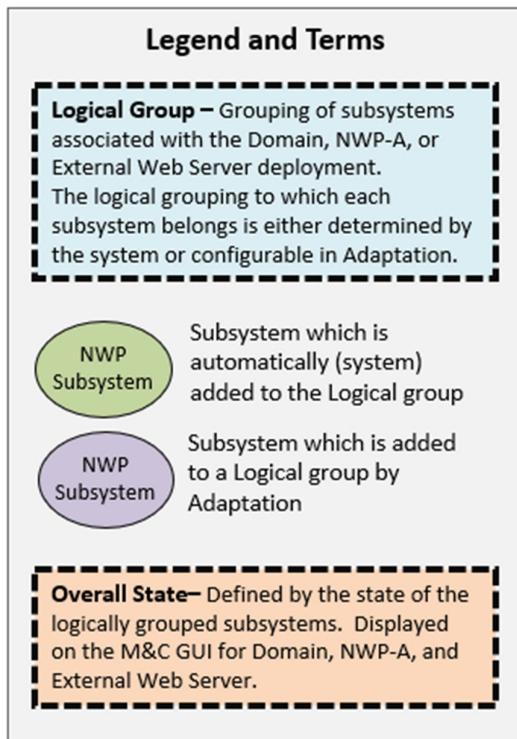
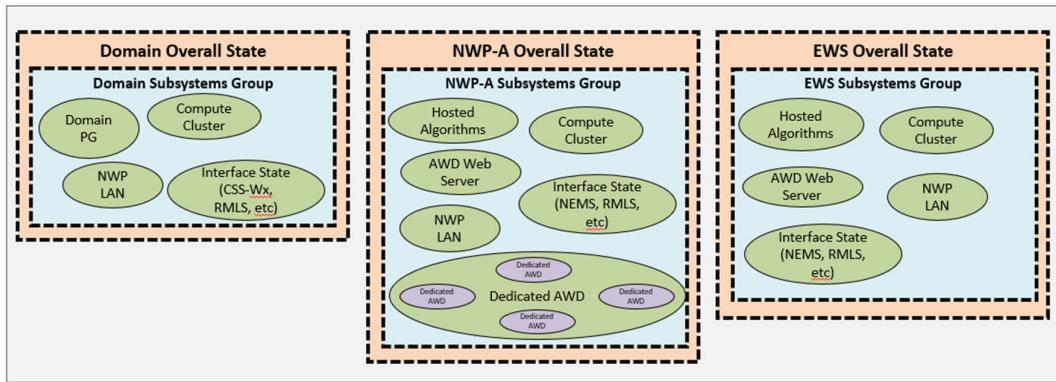


Figure 48. Logical Groupings Legend

The overall state displayed on the M&C GUI is derived from the states of the configured logically grouped subsystems. The grouped subsystems are dependent on installation type and specific sites. The following diagrams describe the groupings of subsystems and interfaces for each NWP site type: Domain, NWP-A and External Web Server:

**Figure 49. System Logical Groupings**

5.2.3 M&C Control Operations

Certain NWP subsystems, components, and interfaces can be controlled by an M&C user with an Administrator role, see table 3 in Section 3.4.1 for a breakdown of what is available to the Administrator Role versus the Monitor Role. The available control options are: transition to online mode, transition to offline mode, shutdown, restart, and reset. A reset is used for an interface connection, where a restart is a shutdown and start of a device. There are two restart options, a Cold restart and Warm restart, the Warm restart incorporates PG checkpoint data, where the Cold restart does not. The available options per M&C tab (subsystem or interface) and M&C component are summarized in the following tables (Y = control functionality provided, N = control option not available):

The following tabs have control capabilities available. No Mode or Shutdown/Restart capabilities are provided for the remainder of M&C tabs.

Table 6. Control Options available from M&C Tabs

M&C Tab	Online mode	Offline mode	Shutdown	Restart	Reset
Domain Compute Cluster	Y	Y	N	N	N
Domain PG	Y	Y	Y	Y	N

The software items that are marked as "control option not available" below cannot be shutdown from the M&C GUI and are not intended to be shutdown in operations.

Table 7. Control Options Available from Component Icons

M&C Icon	Icon Type	Online mode	Offline mode	Shutdown	Restart	Reset
Domain HF or PG server	HW	Y	Y	Y	Y	N
NWP-A Web Server	HW	Y	Y	Y	Y	N
Switch	HW	N	N	N	N	N
Power Distribution Units (PDUs)	HW	N	N	N	N	N
System Management Processes (SMS Agent, SMS Service, Service	SW	N	N	N	N	N

Database, SMS Database, Message Broker, NTP Sources)						
PG Data Service	SW	N	N	Y	Y	N
PG Process Group	SW	N	N	N	N	N
PG Algorithm Process	SW	N	N	Y	Y	N
PG Master Controller	SW	N	N	N	N	N
PG Local Controller	SW	N	N	N	N	N
Dedicated AWD	SW	N	N	N	N	N
AWD Web Server container	SW	N	N	N	Y	N
Hosted Algorithm container	SW	N	N	N	Y	N
FTI	Interface	N	N	N	N	N
CSS-Wx	Interface	N	N	N	N	N
RMLS	Interface	N	N	N	N	Y
NEXRAD (via Radar Tab)	Interface	Y	Y	N	N	N
CANRAD (via Radar Tab)	Interface	Y	Y	N	N	N
TDWR (via Radar Tab)	Interface	Y	Y	N	N	N
NEMS Connection	Interface	N	N	N	N	N
NESG	Interface	N	N	N	N	N

M&C components can be controlled either individually or via a group selection. To control a single component, the M&C user right-clicks the component and selects from the available menu options:

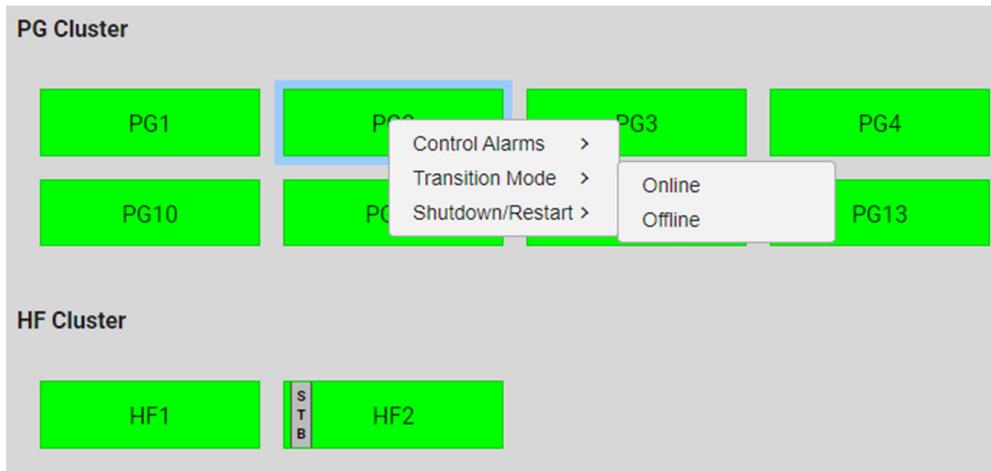
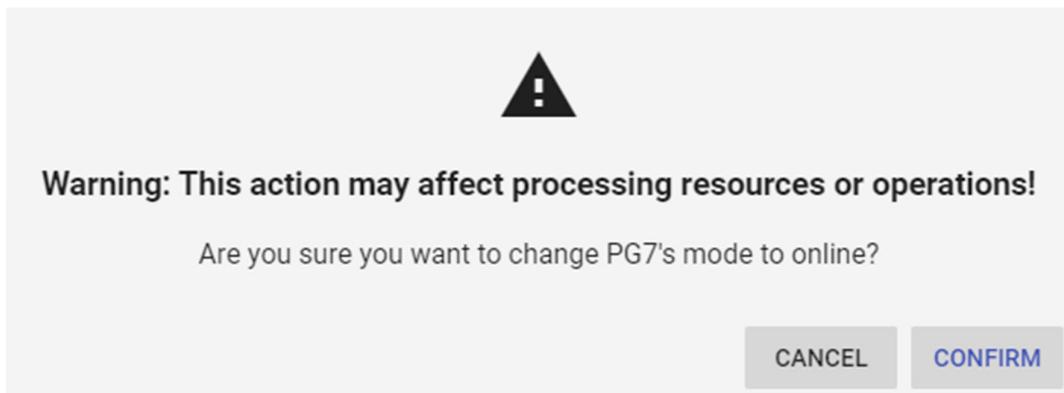


Figure 50. Control Functionality for Single Component

To control multiple components, use the Ctrl+left-click key combination to select target components and then select a control button on the right panel:

**Figure 51. Control Functionality for Multiple Components**

Selecting a control function opens a confirmation window to confirm the action:

**Figure 52. Control Action Confirmation Dialog**

Once an action is confirmed, a spin indicator may appear to alert the user the requested action is processing. If the action is processed and completed before the indicator is rendered (approximately less than 1 second), no indicator is shown. When the indicator does appear, it continues to spin as the requested action is in process. If the requested action does not complete in the configured time, an error message is displayed to alert the user the request has timed out. The timeout is configured separately per action.

The icons and components over which the spin indicator may be present are summarized in the following table:

Table 8. Spin Stop Table

M&C Component	M&C Action	Spin Stop
Domain Compute Cluster tab	Transition to Online or Offline mode	All configured servers have transitioned to the selected mode (Note: if a server is commanded to Offline mode, it will not automatically transition to Online. Not all servers may

		transition to Online; some may transition or stay in Standby mode, depending on system configurations)
Domain PG tab	Shutdown, Cold, or Warm restart	All PG algorithm processes have completed shutdown or all PG algorithm processes have been restarted
PG, HF, Web server	Restart	Hardware has been commanded to shutdown and has completed restart
PG, HF, Web server	Transition to Online or Offline mode	Hardware component has completed transition to Online or Offline mode
PG algorithm process	Restart	Process has completed shutdown and has been restarted
Other software process	Restart	Process has completed shutdown and has been restarted
NWP interface component	Reset	Interface connection has been terminated and completed reset

The following examples show the spin icon over a component icon, an M&C tab, and a System Event Log request:

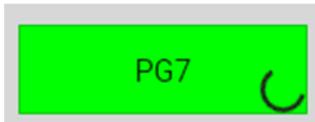


Figure 53. Spin Icon Over M&C Component



Figure 54. Spin Icon Over M&C Subsystem Tab

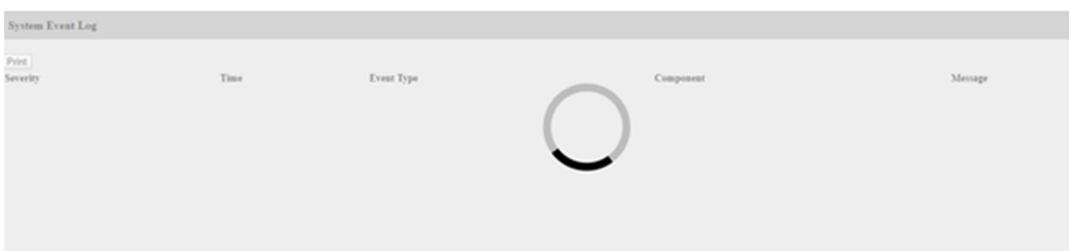


Figure 55. Spin Icon When Requesting System Events Log

When an action is not completed within the configured time, an error message is displayed to the M&C user:

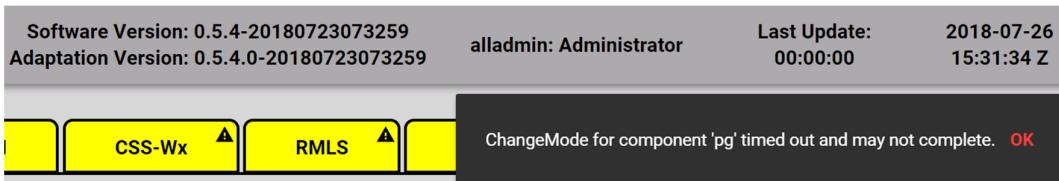


Figure 56. Process Timeout Error Message

5.2.4 Archive Export Manager

The M&C Archive Manager is accessed via the Archive Export option from the main menu of a Domain or NWP-A M&C. This dialog provides options for export of NWP input and product archives to removable media. Selecting 'Export Archive', provides the user with a dialog from which acquired input data and product data from selected times can be exported to removable media. An example of this dialog is shown below.

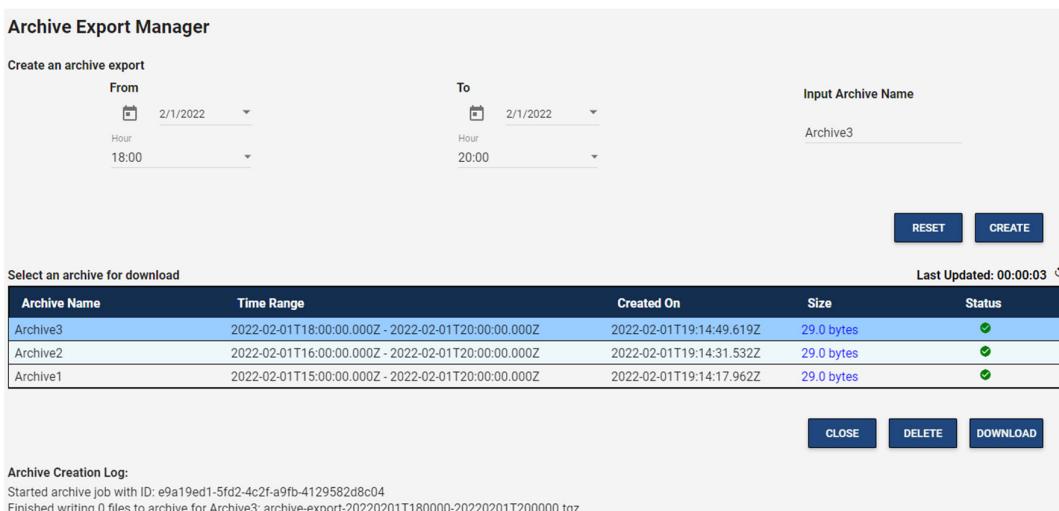


Figure 57. M&C Archive Export Manager

To export an archive to removable media, a user must first create an archive export. Select a time range and provide a name for the export file, in the 'Create an archive export' area (1) in the figure below. The archive export will collect all input data and product data over the selected time range. Acquired product data is archived and available for export to removable media for a configurable amount of time. Selecting the CREATE button (2), creates a compressed file on the file system which can then be downloaded for copy to removable media. An indication of the progress of the export file creation is provided under the 'Status' column (4). The total number of files for the selected time range is presented; if there is no data in the selected time range, the file count is zero (0). Additionally, creation status is provided in the Archive Creation Log at the bottom of the screen. This log is presented for the selected Archive only.

Once the file creation begins, it is displayed in the file listing (3). This listing automatically refreshes but can also be refreshed by the user via the refresh icon at (4). This window provides a listing of all of the archive exports which have been created on the file system and

are available for download to removable media. The name of the archive, specified time range, creation time, file size, and status are provided.

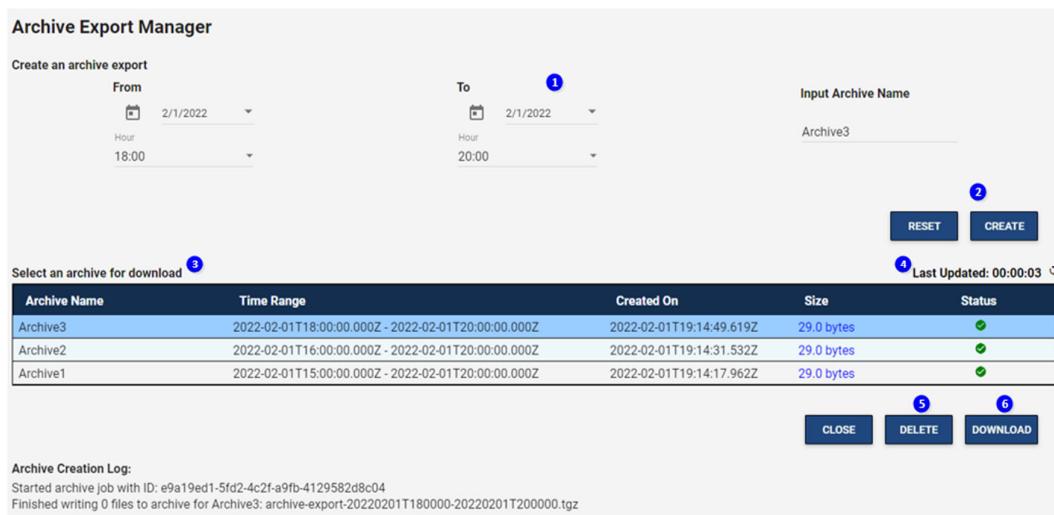


Figure 58. Annotated Archive Export Manager

Select an archive file for either deletion from the file system via 'DELETE' (5) or download for saving to a specified location via 'DOWNLOAD' (6). Selecting the 'DOWNLOAD' button opens a new browser provided 'Save' dialog window from which the user may navigate to the mounted removable media and save the selected file. Selecting the 'DELETE' button opens a confirmation window from which the user is prompted to confirm the action, as shown below. Upon confirmation, the archive tarball is deleted from the file system. Note: All archive data within the configured time limit remains on the file system; only the copy of data created for export is deleted.

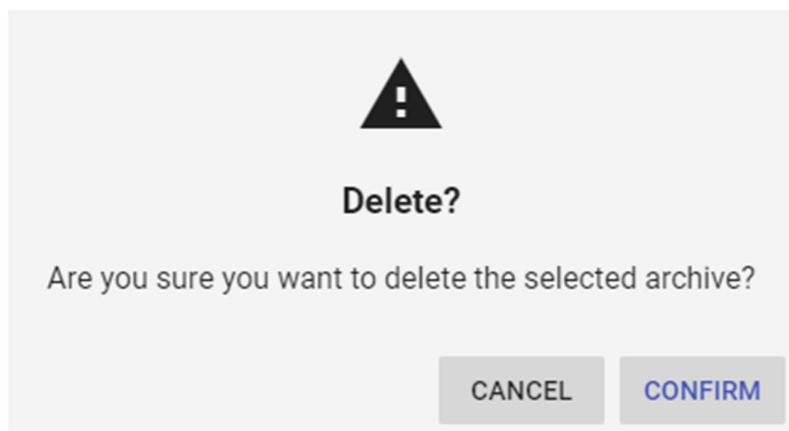


Figure 59. Archive Delete confirmation

5.2.5 Error Conditions

Error conditions are displayed via popups and/or are available in the Event log as applicable. Visual and audible alarms are used to alert the user to situations requiring attention.

5.3 Processing Procedures

The following paragraphs provide detailed information on use of the M&C GUI web application.

5.3.1 Monitor Subsystems

An M&C dashboard is provided for monitoring applicable subsystems and external interfaces. A separate tab is provided for each of the following for a Domain site:

1. NWP Subsystems
 - a. Domain Compute Cluster
 - b. NWP LAN
 - c. Domain PG
2. External Interfaces
 - a. FTI
 - b. CSS-Wx
 - c. Radar
 - d. RMLS

A separate tab is provided for each of the following subsystems and interfaces for an NWP-A or External Webserver site:

1. NWP Subsystems
 - a. Compute Cluster
 - b. AWD Web Server
 - c. Hosted Algorithms
 - d. Dedicated AWD (NWP-A Only)
 - e. NWP LAN
2. External Interfaces
 - a. NEMS
 - b. FTI
 - c. RMLS
 - d. NESG (External Web Server only)

An example of the NWP Domain Dashboard is shown below:

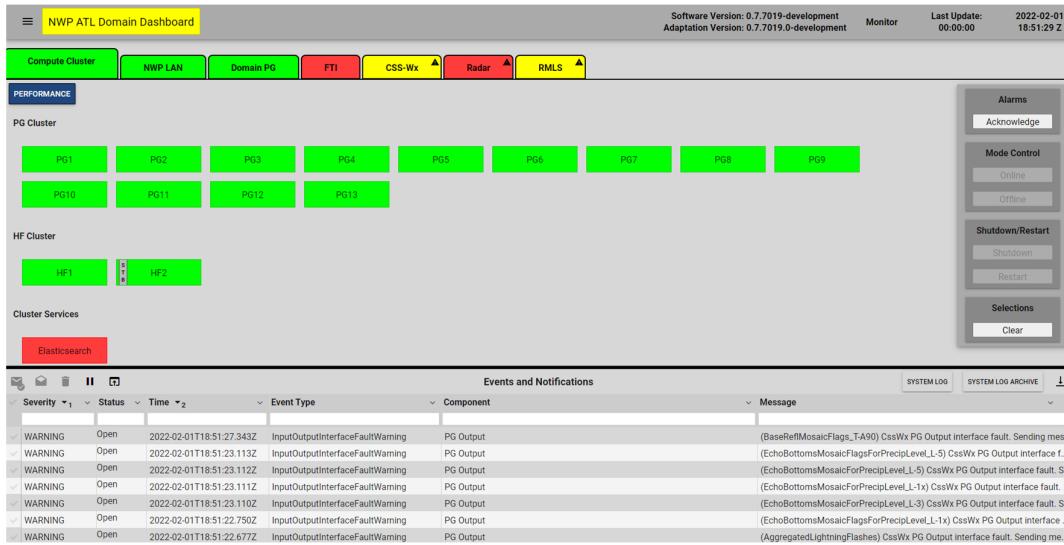


Figure 60. NWP Domain Dashboard

The subsystem and external interface statuses are provided via the colored tabs in the top row as shown below:



Figure 61. Domain Dashboard Subsystems and External Interfaces

When one or more components in a subsystem suffer a non-critical or critical failure which changes the component state to Degraded or Failed, respectively, the subsystem state changes to Degraded. The respective tab changes to yellow and a Warning icon appears on the tab to alert the user to a new failure. An audible alarm sounds for the affected component. If a failure occurs on a component or subsystem represented on a tab, other than the currently selected tab, an audible alarm still sounds. The M&C user clicks on the tab to display information about the affected subsystem or interface. The Warning icon remains on the tab until the failure on the component within the subsystem is acknowledged.

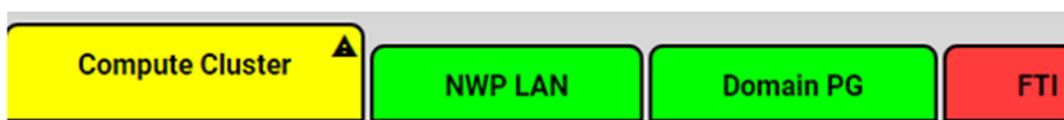


Figure 62. Tab Alert Icon

The subsystems and external interfaces shown on the Dashboard vary depending on installation applicability (see Section 3.4 for an overview of the NWP system hierarchy).

An example of the NWP-A Dashboard is shown below:



Figure 63. NWP-A Dashboard Subsystems and External Interfaces

An example of the External Webserver Dashboard is shown below:



Figure 64. External Webserver Dashboard Subsystems and External Interfaces

5.3.2 Monitor and Control Compute Cluster

A Compute Cluster tab is provided to monitor and control the subsystem and its components for each Domain M&C and NWP-A/External Web Server M&C. Because the components monitored differ between the Domain and NWP-A/External Web Server, these will be discussed separately in the following sections.

5.3.2.1 Domain Compute Cluster

The Domain Compute Cluster is comprised of the NWP servers deployed at a Domain site and the software which provides NWP infrastructure services. Selecting the Compute Cluster tab displays the components icons.

When the M&C user selects a subsystem or interface tab (1), additional component icons are displayed for status monitoring (2). The selected tab (Compute Cluster) is raised indicating it is the current tab and hardware component icons within the Domain Compute Cluster subsystem are displayed; an icon for each server in the PG Cluster and an icon for each server in the Hot Failover (HF) Cluster:

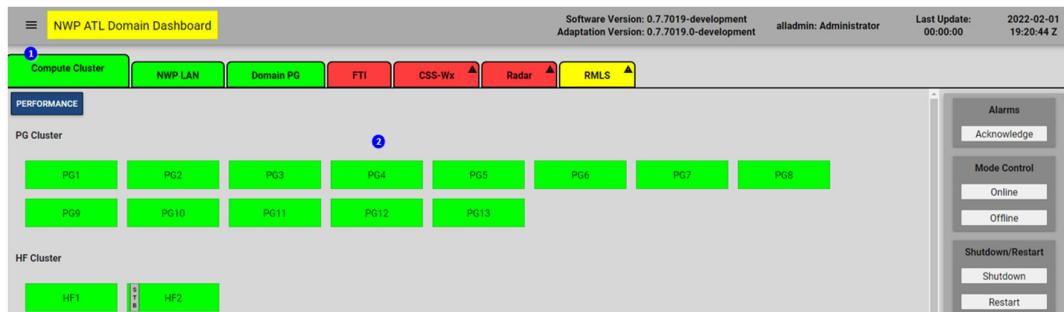


Figure 65. NWP Domain Dashboard

5.3.2.1.1 Control Compute Cluster

The Domain Compute Cluster can be transitioned between Online and Offline mode. At initial startup, the Compute Cluster is in Offline mode with all running and available servers are in Standby mode. A server which is not running is in Offline/Failed state. If a server is powered

on, but should not be used for processing, the M&C user must select the Offline mode for the individual server prior to proceeding with startup:

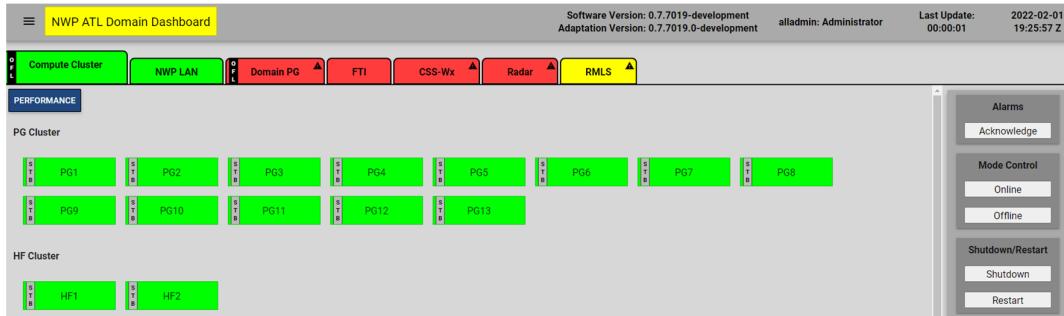


Figure 66. Compute Cluster Initial State

Once the M&C user determines the system is ready, the Compute Cluster is transitioned to Online via right-click menu options:

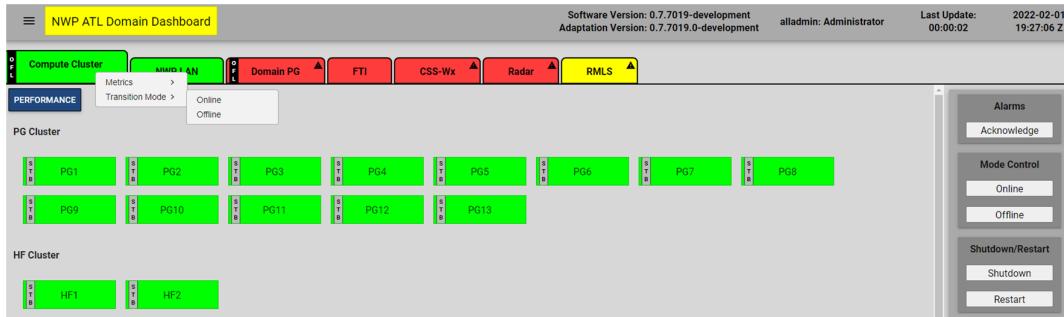


Figure 67. Compute Cluster Transition Mode

A confirmation dialog is presented to confirm the action:

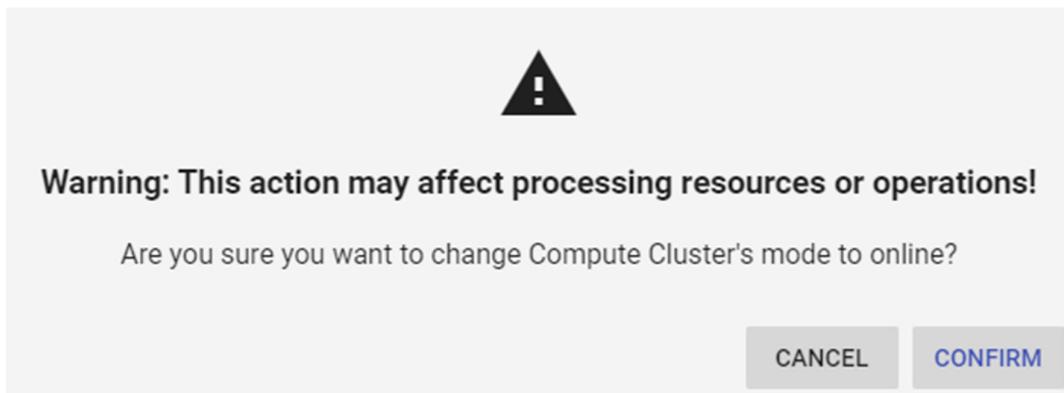
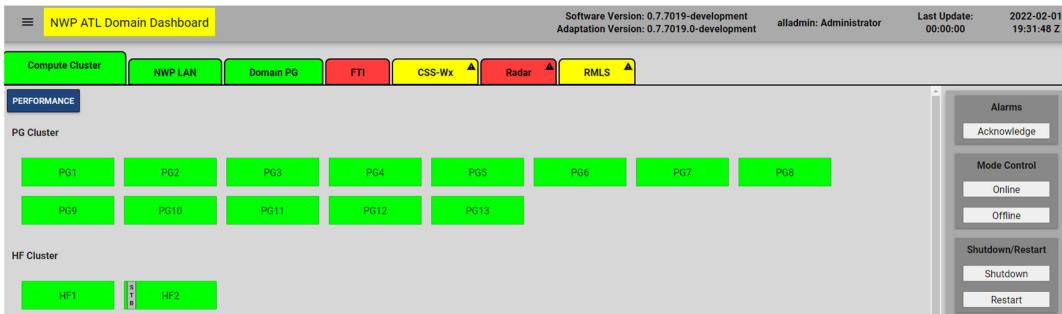


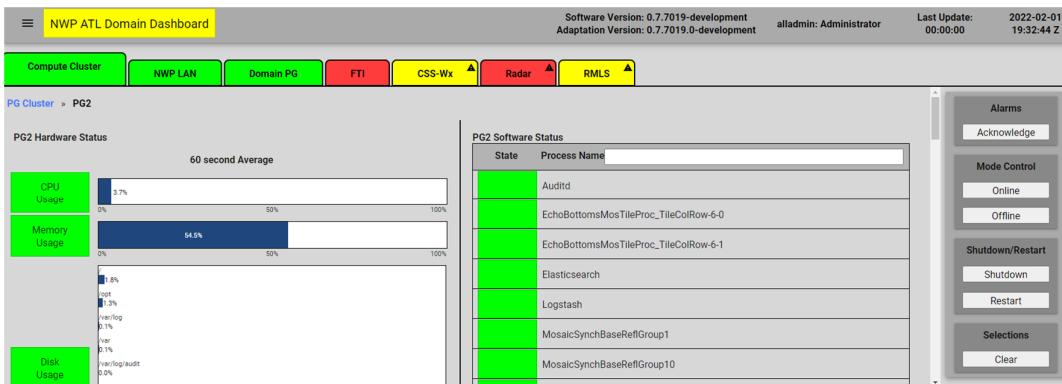
Figure 68. Compute Cluster Online Confirmation

If CANCEL is selected, the confirmation dialog closes and no action is taken: If the M&C user selects CONFIRM, the PG and HF servers automatically transition from Standby to Online mode as needed for processing and the Compute Cluster indicates Online/Normal state:

**Figure 69.** Compute Cluster in Online mode

5.3.2.1.2 Component Drill Down

For additional information on the particular component, the user can left-click a component icon for a more detailed drill down into the component which includes the hardware status and software process status for the server:

**Figure 70.** PG Server Component Display

The next image is the same PG2 server view with numbered references to describe the following details:

1. The Compute Cluster is 'Degraded' as indicated by the yellow tab. The subsystem itself has not failed, however, the PG2 Mount Points indicate a failure within the subsystem.
2. A breadcrumb trail displays indicating where in the display the user has navigated. The breadcrumb trail is selectable back to the main display.
3. Hardware Status displays components CPU Usage, Memory Usage, Disk Usage, configured Mount Points, and Network Interfaces on the left with additional information to the right of each icon (current percentage of CPU, Memory, and Disk usage and the state of each configured Mount Point and Network Interface). For more information, see Section 5.3.11 Monitor Performance.
4. Software Status lists individual software running on the particular server including the state and mode of each process. Processes are sorted by highest severity first (critical failures on top, degraded next, then normal) and can be searched and filtered using the field below "Process Name". If the list of processes is longer than can be displayed in the current view, a scroll bar opens to navigate through the list. For a PG server in Online mode, running processes include the PG Local Controller and assigned PG

processes each labelled with a descriptive name; shown generically as ‘PG Process x’ below:

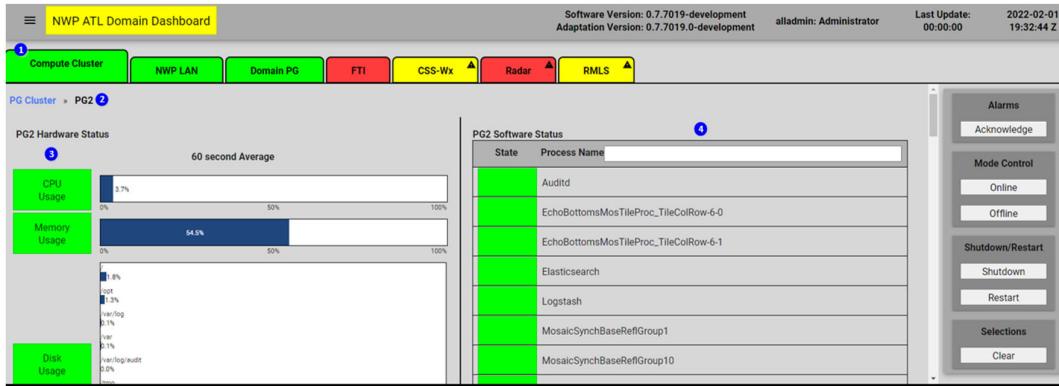


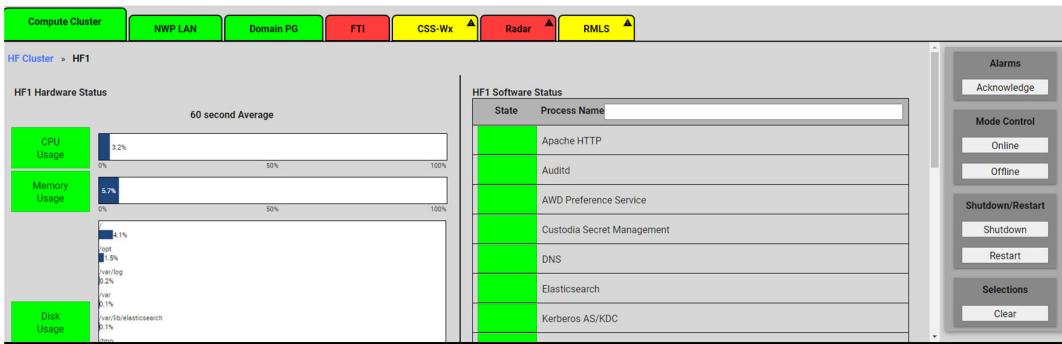
Figure 71 PG Server Component Display Detail

5.3.2.1.3 PG Server Software List

Table 9. PG Server Software List

Name	Description
Auditd	Security auditing process
Elasticsearch	Log storage and search engine
Logstash	Log collection process
NTP Sources	Availability and health of network time sources
PG Local Controller	Manages the individual product generation processes
SMS Agent	Collects statistics for the local machine and reports to the SMS Service
(Multiple product generation processes)	Many more product generation processes will be listed on the PG servers, allocated between the online PG servers in groups to balance load

Additional detail for an HF server can be similarly viewed. In the figure above, the M&C user selects Compute Cluster to navigate up a level and then selects either the HF1 or HF2 component. The Hardware Status for the server is provided on the left and Software Status on the right. Software include uFrame, SMS, PG Ingest, PG Master Controller, AWD Request, and NTP Sources.

**Figure 72. HF Server Component Display**

5.3.2.1.4 HF Server Software List

Table 10. HF Server Software List

Name	Description
Apache HTTP	HTTP interface for identity management software
Auditd	Security auditing process
AWD Preference Service	Server for storing AWD user preferences
Custodia Secret Management	Secure credentials storage
DNS	Domain Name Server process for the local network
Elasticsearch	Log storage and search engine
Kerberos AS/KDC	Part of the identity management suite of processes, user and machine authorization manager
Kerberos DB Admin	Part of the identity management suite of processes, kerberos administration process
LDAP Directory Server	Part of the identity management suite of processes, user roles and password storage server
Logstash	Log collection process
Message Broker	Inter-process message broker
NTP Sources	Availability and health of network time sources
OpenDNSSEC	Domain Name Server security management process
OTP Auth	Part of the identity management suite of processes, forwards user OTP validation requests
PG Data Service	Manages incoming and outgoing data between NWP and CSS-Wx
PG Master Controller	Manages the product generation processes
Service Database	Database for PG Data Service and AWD Preference Service

Name	Description
SMS Agent	Process monitoring this server's hardware and software
SMS Database	Database for system monitoring processes
SMS Service	Aggregates monitored states, orchestrates commands, and communicates state to M&C display
SSSD	Part of the identity management suite of processes, allows local usage of the centralized user permissions

5.3.2.1.5 Component Control

The Compute Cluster is comprised of servers and system management software processes which run on the servers. The M&C user with correct permissions can shutdown a server, restart a server, or change the mode of a server. The M&C user can take a server to Offline mode preventing software processes from running on the server or take a server to Online mode allowing processes to run on a server as needed. If the M&C user transitions a server to Online mode and sufficient processing resources are already available, the system automatically transition the server to Standby Mode. Additionally, the M&C user with correct permissions can control a software component by shutting it down or by performing a cold or warm restart. Individual software components do not have defined Online/Offline modes.

5.3.2.1.6 Server Restarts

An individual server can be commanded from the M&C display via a right-click of the server icon. To restart, the user selects the Shutdown/Restart > Restart option:



Figure 73. PG Server Shutdown/Restart Control

A confirmation dialog is presented to confirm the action. If RESTART is selected, a command to restart the server is sent. If CANCEL is selected, the confirmation dialog closes and no action is taken:

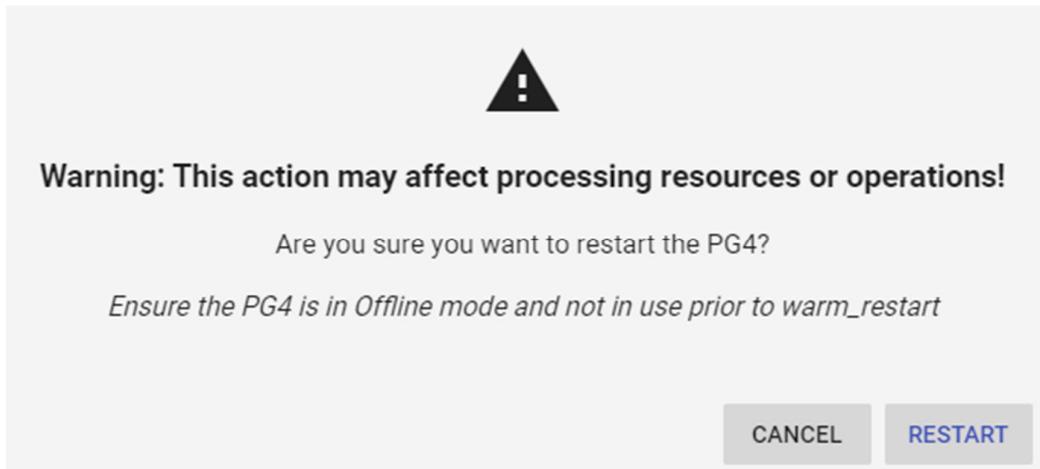


Figure 74. PG Restart Confirmation

5.3.2.1.7 Server Mode Control

The M&C user can change the mode of a server from the Compute Cluster main view and has two (2) options. First, right-click on the server icon to launch a drop down menu from which the Online or Offline mode is selected:

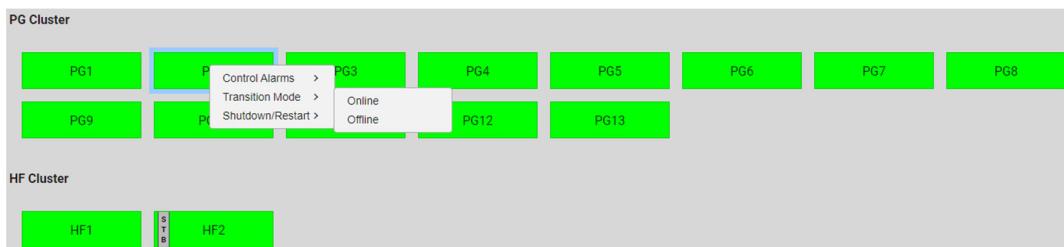


Figure 75. PG Server Mode Control

As before, a confirmation dialog is presented to confirm the action:

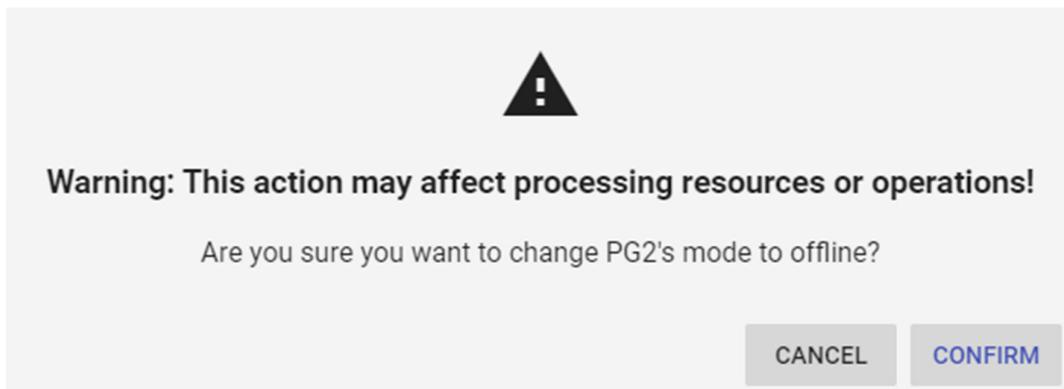


Figure 76. PG Offline Confirmation

Second, the M&C user can select multiple servers via the Ctrl+left-click key combination on each desired server icon and then left-click the Mode Control menu Online or Offline button:

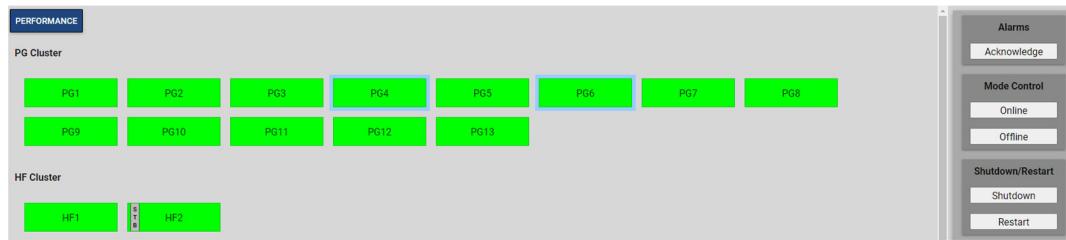


Figure 77. Multiple PG Server Mode Control

Once the option is selected, a confirmation dialog is presented for each selected server:

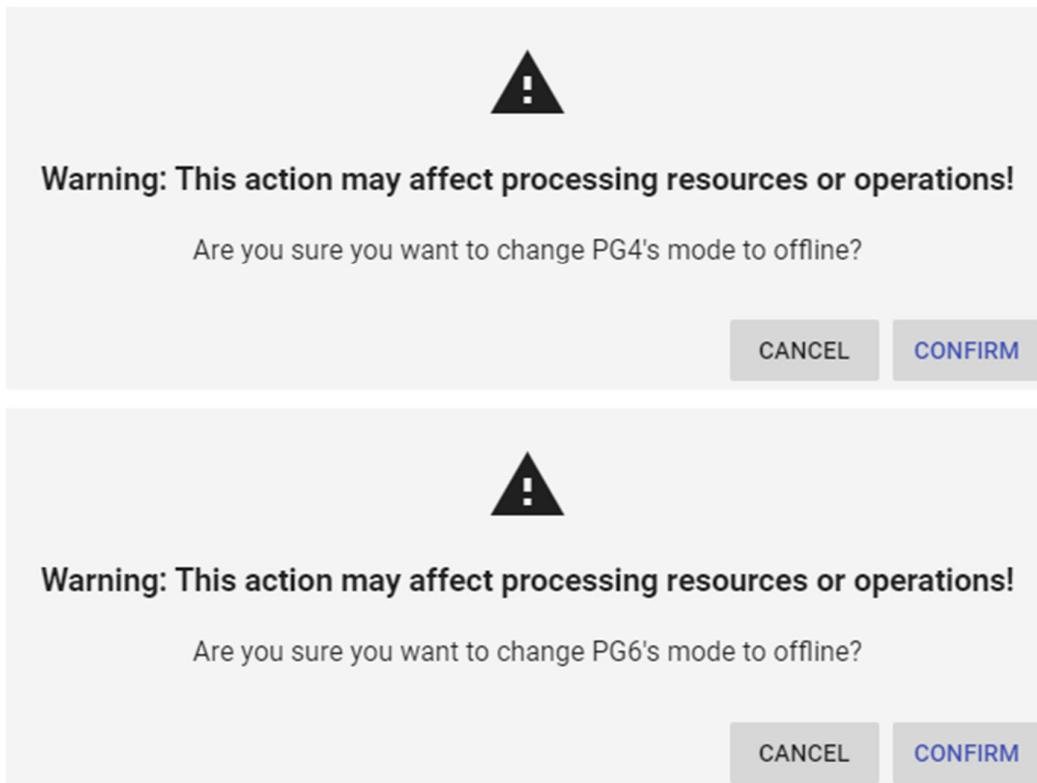


Figure 78. PG Multiple Confirmations

When a server successfully completes transition, to Offline mode for example, the 'OFL' badge is displayed on the server icon:

**Figure 79. PG3 and PG4 Servers in Offline Mode**

5.3.2.1.8 Software Process Control

Individual software processes may be shutdown, cold restarted, or warm restarted by an M&C user with the correct permissions. The cold restart and warm restart options are only available for certain software components as shown in the table below.

Table 11. Component Types

Component Type	Available Modes	M&C Shutdown/Restart Control	M&C GUI Location	Notes
System Management Process	N/A	N/A	Compute Cluster Tab -> HF server ->'Software Status' list	System Management processes: SMS Agent SMS Service Service Database SMS Database Message Broker
PG Data Service AWD Preference Service	N/A	Restart	Compute Cluster tab -> HF server -> Software list	Ingest and output process for PG data
PG Master Controller or PG Local Controller	N/A	N/A	Compute Cluster Tab -> PG or HF server ->'Software Status' list	PG master Controller and PG local controller are controlled via restarts of the PG subsystem
PG processes	N/A	Shutdown Cold Restart Warm Restart	Compute Cluster Tab -> PG or HF server -> 'Software Status' list AND Domain PG -> Drill down from	Cold Restart restarts the process without checkpoint data; Warm Restart restarts the process with checkpoint data if available

			PG process groups	
PG Software Process Group	N/A	N/A	Domain PG tab	Processes are organized into groups. Groups are displayed for summary status. No control options for presented groups

The M&C user has two (2) options for shutdown and restart of software components. First, right-click on the software icon to launch a drop down menu from which the Cold Restart or Warm Restart is selected:

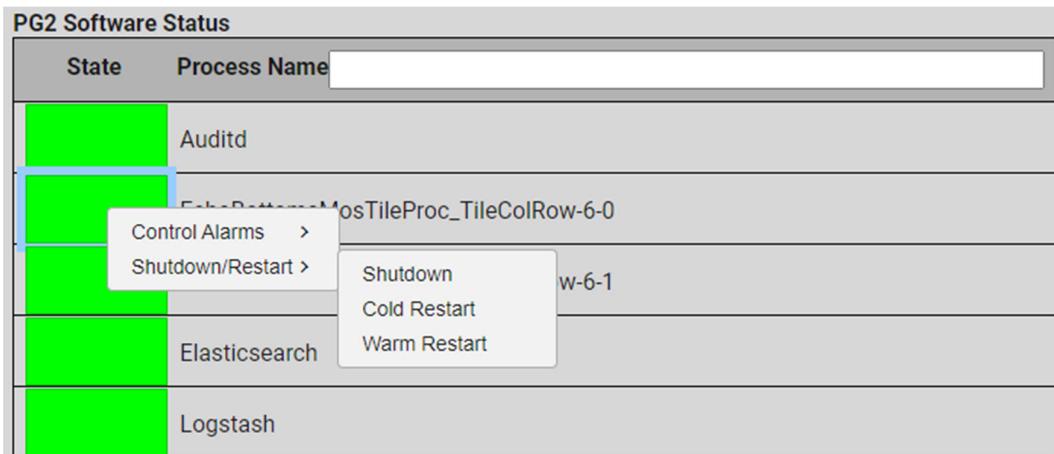


Figure 80. PG Software Process Shutdown/Restart Control

As before, a confirmation dialog is presented to confirm the action:

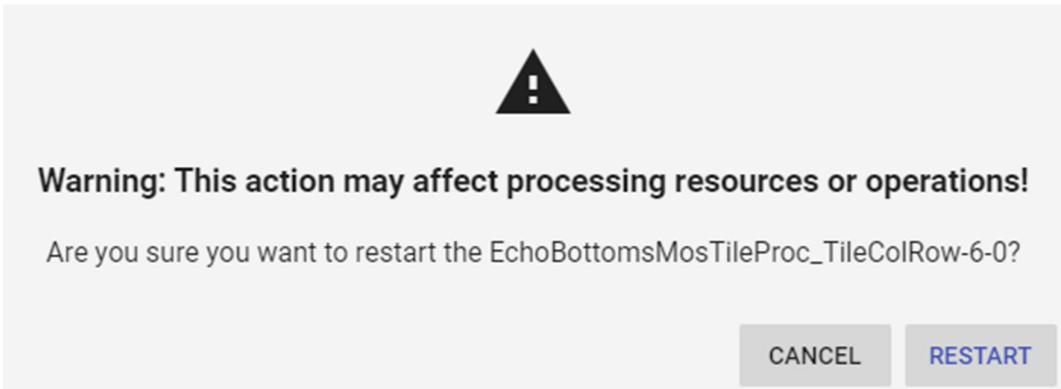


Figure 81. PG Software Restart Confirmation

Second, the M&C user can select multiple software processes via the Ctrl+left-click key combination on each desired software icon and then left-click the Mode Control menu Shutdown or Restart button:

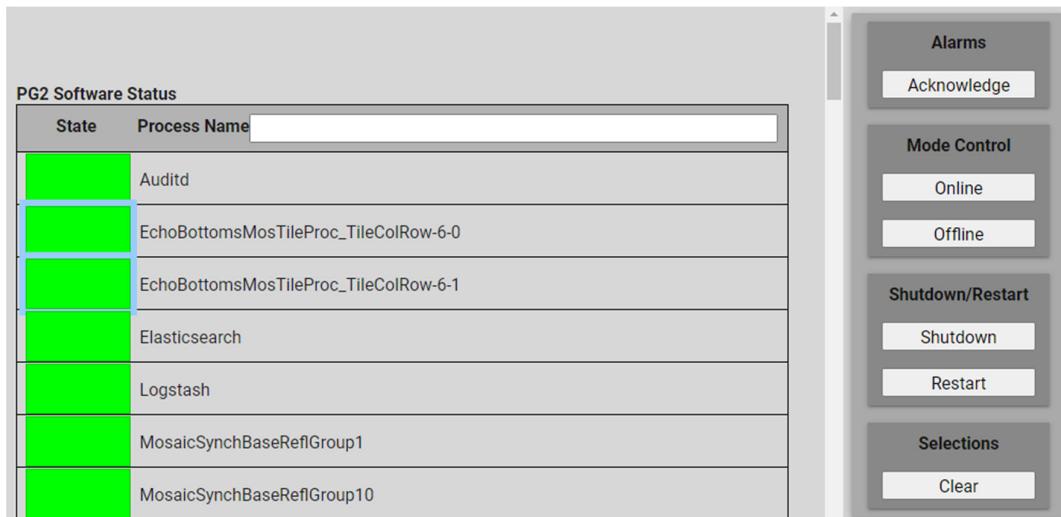


Figure 82. Multiple PG Software Process Selection

Once the option is selected, a confirmation dialog is presented for each selected software process:

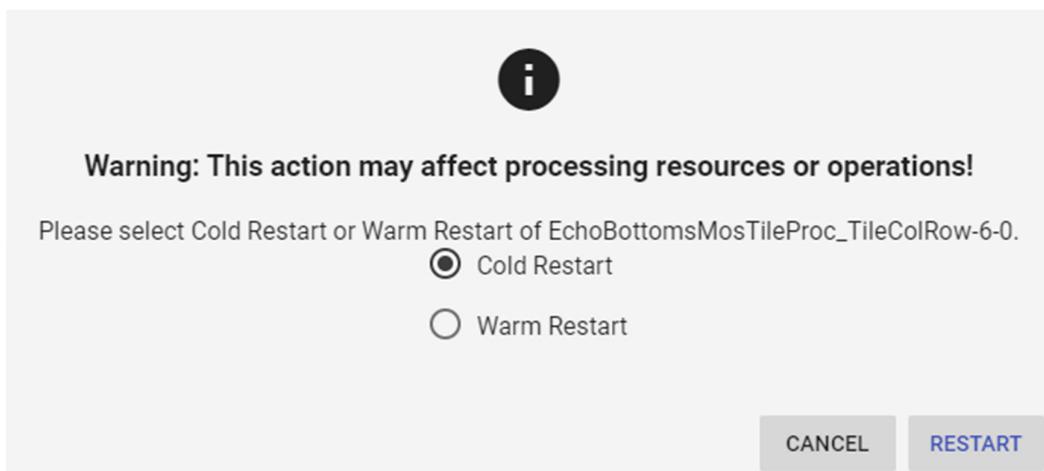
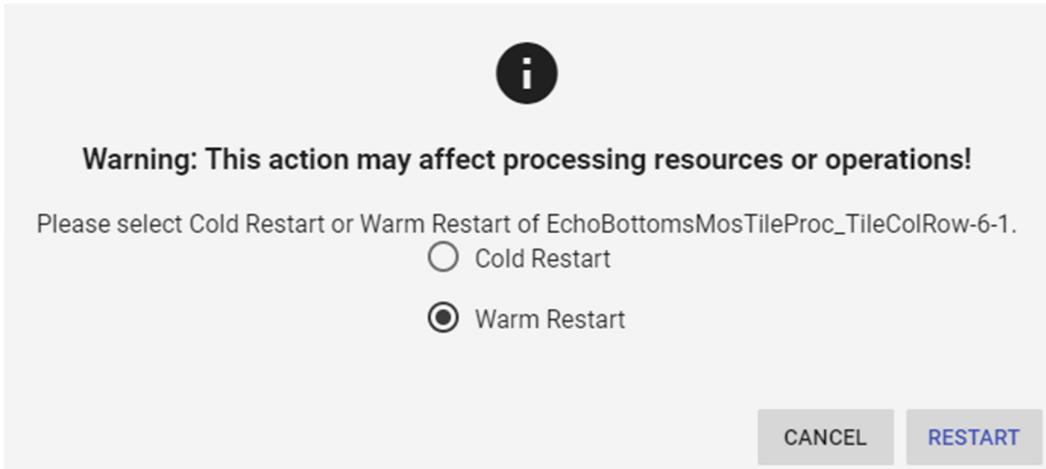


Figure 83. PG Software Cold Restart Confirmations

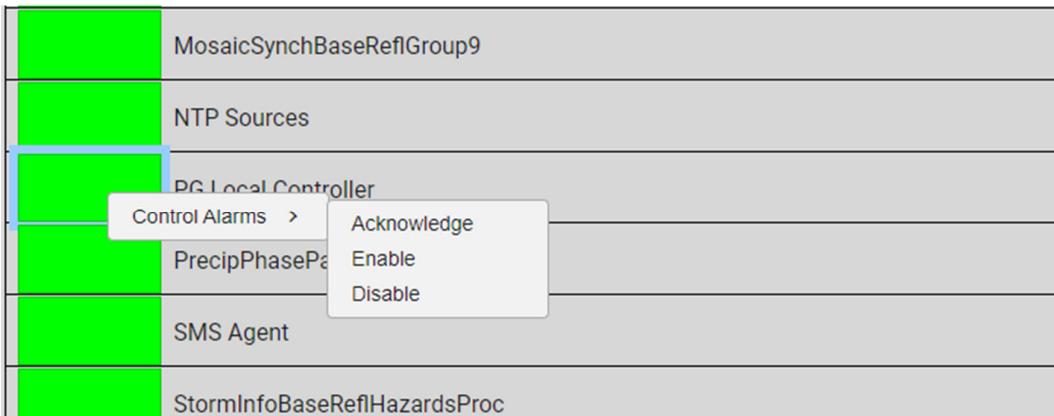
**Figure 84. PG Software Warm Restart Confirmation**

When a software process successfully shuts down, the icon indicates Failed state (blinking red) and is displayed at the top of the process list:

PG2 Software Status	
State	Process Name
Red	EchoBottomsMosTileProc_TileColRow-6-1
Green	Auditd
Green	EchoBottomsMosTileProc_TileColRow-6-0
Green	Elasticsearch
Green	Logstash
Green	MosaicSynchBaseRefGroup1
Green	MosaicSynchBaseRefGroup10

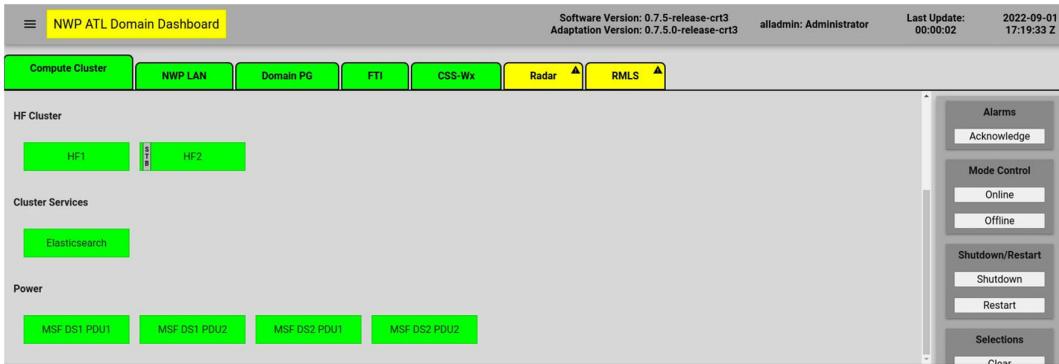
Figure 85. PG Software Process Shutdown

Some software processes have only status monitoring options; no control functions are available. For the PG Local Controller and PG Master Controller processes, only the Control Alarms option is applicable:

**Figure 86. PG Software Process Control Alarm Options**

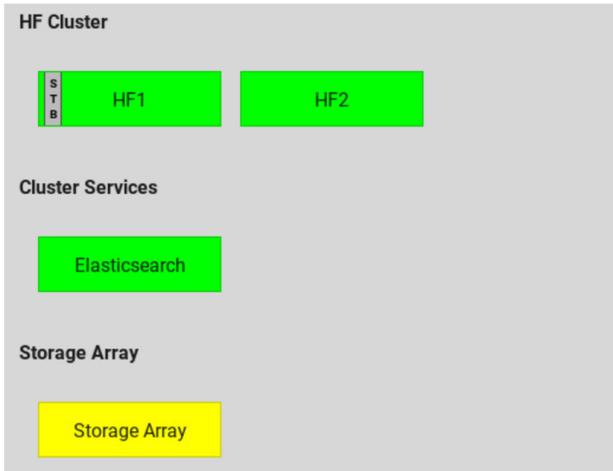
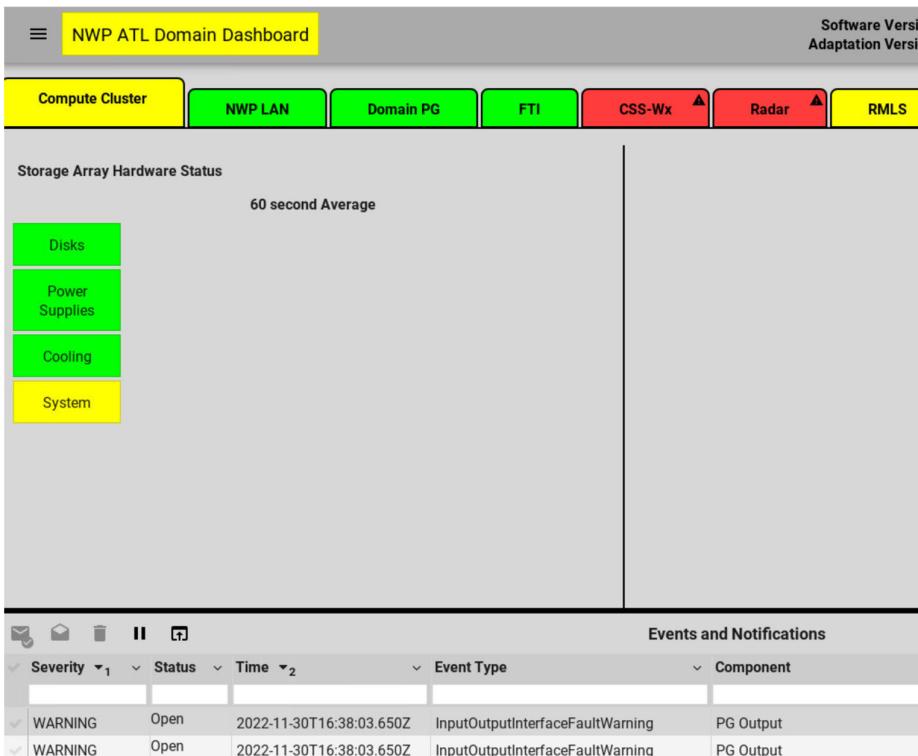
5.3.2.1.9 Hardware Monitoring

The Domain M&C GUI also offers some hardware monitoring under the Compute Cluster tab. Items that are included are the Cluster Services, and Power.

**Figure 87. Compute Cluster Hardware Monitoring**

5.3.2.1.10 Storage Array

To Domain M&C also displays the status of the storage array. The storage array can be selected to see the status of the cooling, power supplies, disks, and overall system health as reported by the storage array itself. In this example, the Storage Array is reporting as Degraded (yellow) due to the Overall System status of the array reporting Degraded.

**Figure 88. Compute Cluster Storage Array Monitoring****Figure 89. Compute Cluster Storage Array Monitoring Breakdown**

5.3.2.2 NWP-A Compute Cluster

A Compute Cluster tab is provided for the monitor and control of the NWP-A Compute Cluster subsystem and its components for each NWP-A and External Web Server M&C. The tabs provided for the NWP-A and External Web Server M&C are similar. The NWP-A includes tabs for Compute Cluster, Hosted Algorithms, AWD Web Server, Dedicated AWD, NWP LAN, NEMS, RMLS, and FTI as shown in the figure below. The EWS M&C contains all of these same tabs except for Dedicated AWD. Because of the similarity between the two M&C deployment types, both are described below as NWP-A:

The Compute Cluster is comprised of the NWP servers deployed at an NWP-A site and the software which provides NWP infrastructure services. Selection of the 'Compute Cluster' tab yields a display of components within the NWP-A Compute Cluster subsystem, as shown below. One icon is provided for each of the nodes comprising the Compute Cluster. The NWP-A is configured for three Web Servers, depicted as Web1 - Web3 on M&C, and also referred to as 'ADS Server' throughout this document.

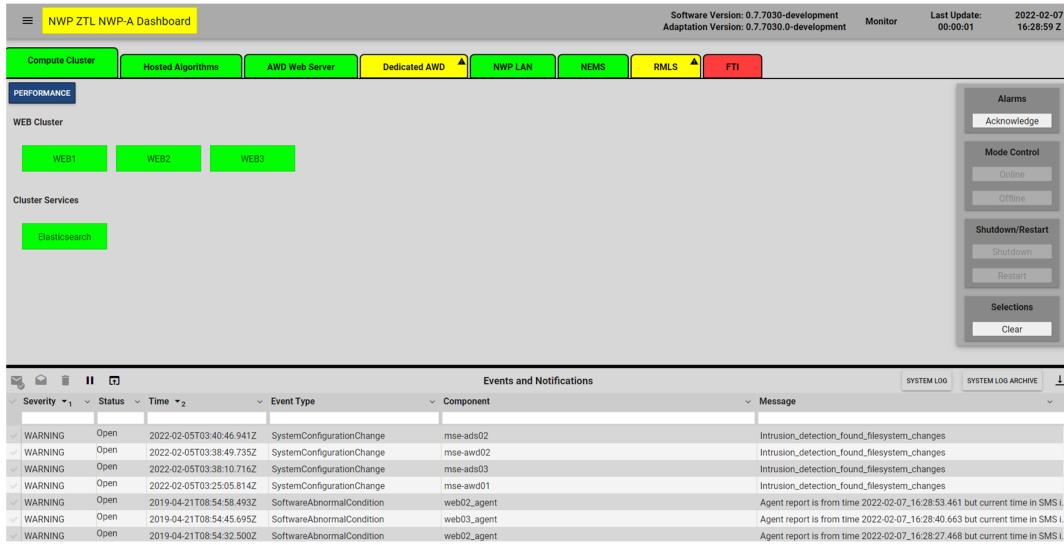


Figure 90. NWP-A Site Dashboard

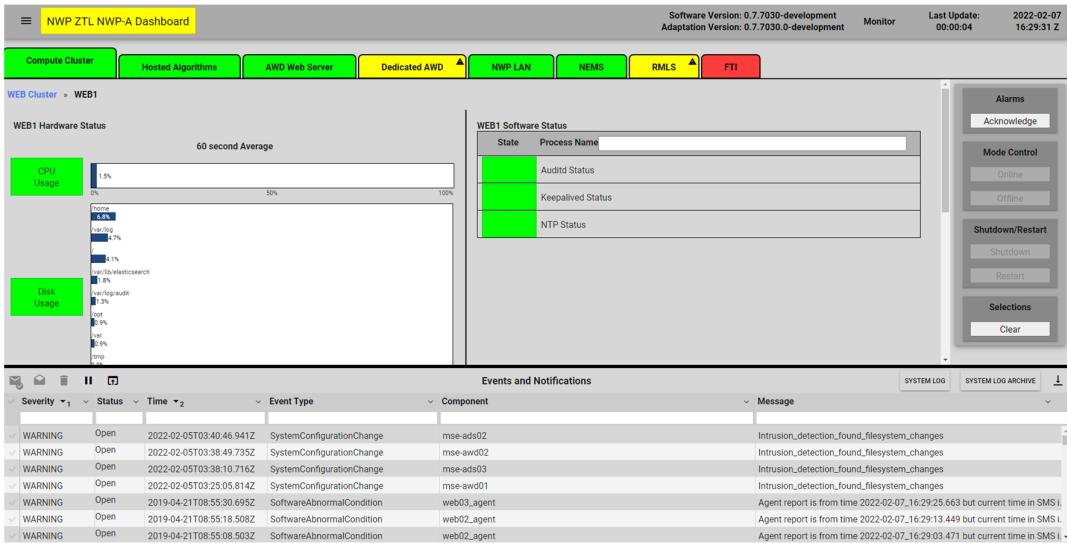
Each icon is color coded to indicate the roll up component state. Normal/green indicates all processes on the component are running, all hardware monitoring is normal, and no errors have been detected. Degraded/yellow indicates that one or more processes have failed on the component or there are one or more hardware issues present. The applicable icon will blink for an alert in the Degraded state and sound an alarm tone. Failed/red status indicates the component has suffered a critical error, is not running, or has shut down. The applicable icon will blink for an alarm in the failed state and sound an alarm tone. The component state will automatically downgrade to Degraded or Failed upon detection of a non-critical or critical error, respectively. The component state will automatically transition from Failed to Degraded when one or more errors have been resolved and an error remains. The component will automatically transition from Failed to Normal when all errors have been resolved.

5.3.2.2.1 Control NWP-A Compute Cluster:

M&C user mode control is not applicable to the NWP-A and External Web Server Compute Cluster subsystem. When the Web Server nodes are started, processes will automatically start. Once processes are started, the Compute Cluster automatically transitions to Online mode.

5.3.2.2.2 Component Drill Down:

Similar to the Domain Compute Cluster if the M&C user requires further information on a particular web node, the user may left click the node icon for a more detailed drill down in to the component. For example, selection of node Web1 will yield additional detail regarding the hardware of the particular node as shown below:

**Figure 91. Display of Node Web1 Detail**

The next image below provides numbered references to describe the following details for drill down of Web Server nodes.

1. The top left indicates which Web node is currently being examined. The Compute Cluster tab is selectable back to the main display.
2. This display shows detailed status of the server hardware. Icons are presented to indicate the state of CPU usage, memory usage, disk usage, configured mount points, network interfaces, disk state, power supply state, and fan state. Additional information is provided to the right of each icon: detailed state of each configured mount point and network interface, and current percentage of CPU, memory, and disk usages. On the right side of the screen the software status of the node is provided. The active processes running on the node as well as their status are listed for review.
3. This icon indicates the configured mount points for Web1 as well as the status of the points. If a mount point were to fail the icon would update to a yellow/Degraded state.

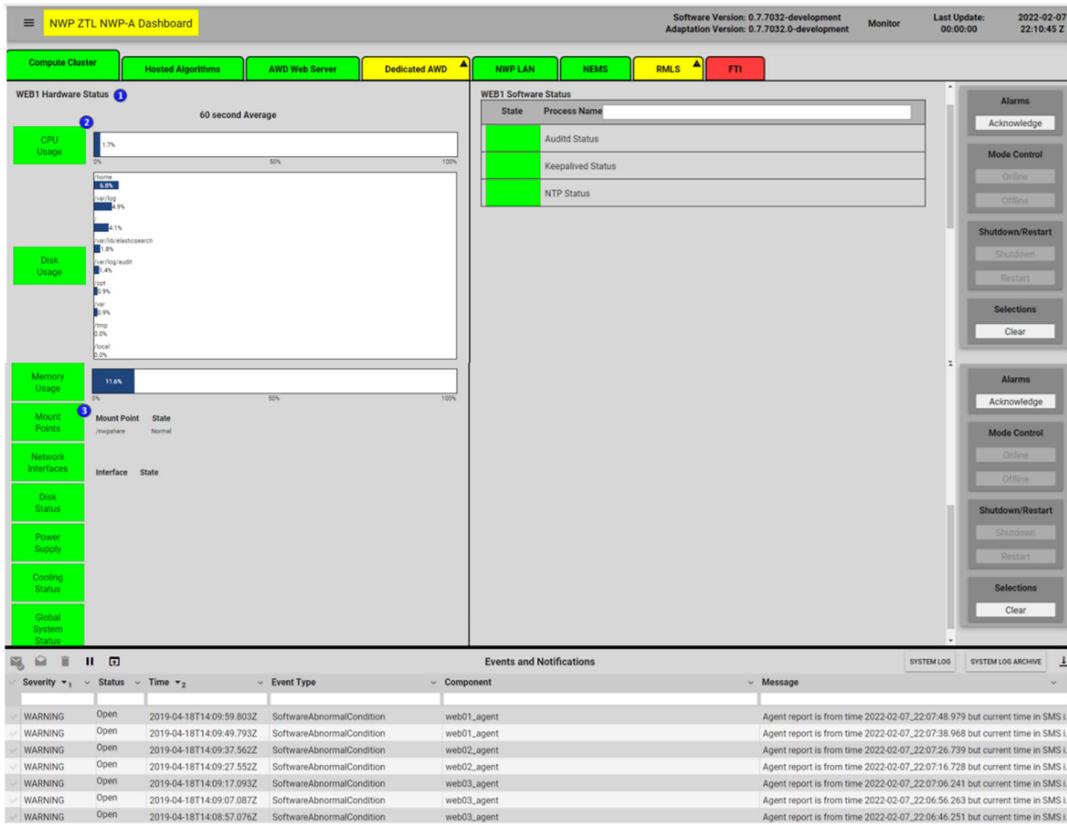
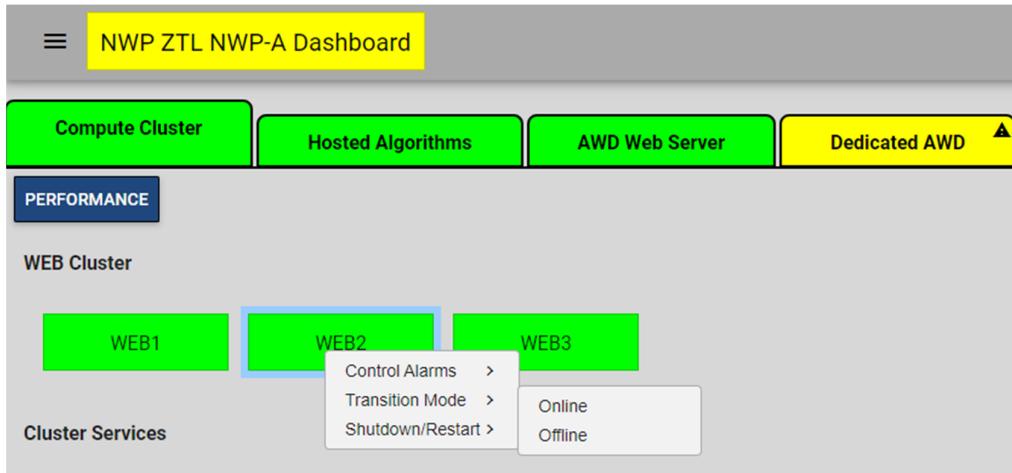


Figure 92. Detailed Display of Node Web1

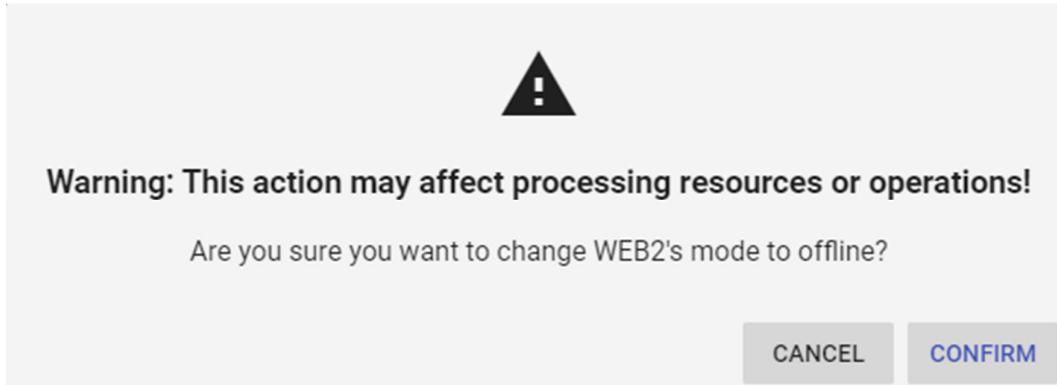
5.3.2.2.3 Web Node Control:

The M&C user, when in a role with the correct permissions, may shut down, restart, or change the mode of a node. The user may access the mode control via a right click on the node icon that is to be changed. Each node will begin in ‘Online’ mode and can be switched to ‘Offline’ mode for maintenance via right click as shown below. Once the M&C user transitions the mode to Offline, containers and their associated processes are automatically moved to other Online nodes. No new containers will appear on that node until it is switched back to Online.

A node can be commanded offline to stop the NWP-A pods running on that node in order to perform maintenance. When this occurs all pods currently running on that node will be evicted and scheduled to another node. It is best to only take nodes offline one at a time in order to not overutilize the remaining nodes. Doing so could affect system performance for end users.

**Figure 93. M&C User Selection of Web Node Mode**

When a new node mode is selected, the user will be prompted with a confirmation message as shown below, in this example Web2 would be transitioned to 'Offline':

**Figure 94. Node Mode Change Confirmation**

Alternatively, the M&C user may select multiple nodes for mode control via holding the <Ctrl> button and clicking on the icon for each desired node. Then, the 'Offline' or 'Online' button on the right of the screen is selected to transition the mode of multiple servers. In the figure below, nodes Web2 and Web3 have been selected. The Offline button is then selected with a left click. The user will then be presented with a confirmation dialog for each selected node, as shown above.

**Figure 95. Control Mode for Multiple Nodes**

Once the nodes have been successfully transitioned to Offline mode, an additional icon will be present over the node to indicate the changed mode, as shown below.

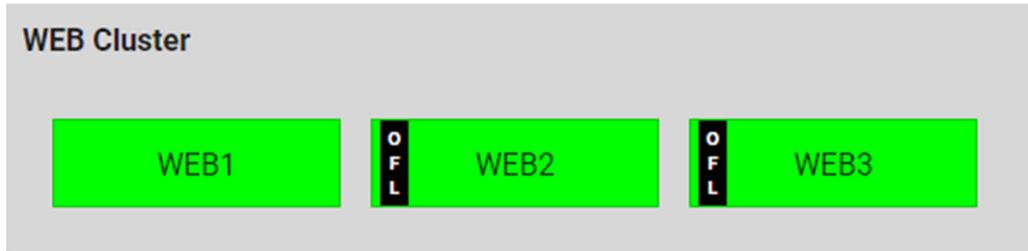


Figure 96. Web2 and Web3 Nodes in Offline Mode

It is not recommended to take all nodes offline at the same time, as that will make it impossible to command a node back online from M&C. In the event that this happens, you would need to uncordon one or more nodes via the command line of one of the servers. To do this:

Access the command line of any of the NWP-A servers for the affected system, either via Secure Shell (SSH) or, physically in person, with a KVM accessing the console of the server.

The following commands will need to be executed on the command line:

1. `kubectl get nodes`

For example, here is sample output of running this command:

NAME	STATUS	ROLES	AGE	VERSION
web01	Ready, SchedulingDisabled	controlplane, etcd, worker	40d	v1.23.7
web02	Ready, SchedulingDisabled	controlplane, etcd, worker	40d	v1.23.7
web03	Ready, SchedulingDisabled	controlplane, etcd, worker	40d	v1.23.7

Figure 97. kubectl get nodes All Cordonned Nodes Sample Output

The output of this command will list all the nodes in the cluster, as well as their statuses. Make a note of the name(s) of the node(s) under the NAME column which have a corresponding STATUS of "Ready,SchedulingDisabled"

In this example, the names of the cordoned nodes are web01, web02, and web03.

At least one of these nodes will need to be uncordoned, via the following command:

1. `kubectl uncordon <NODE NAME>`

For example, here is sample output of running this command on web02:

```
[nwp@mse-ads01 ~]$ kubectl uncordon web02
node/web02 uncordoned
```

Figure 98. Uncordoning node sample output

To verify the node was uncordoned, the `kubectl get nodes` command can be run again. Note the uncordoned node now has a status of "Ready"

For example, here is sample output of running this command after uncordoning web02:

```
[nwp@mse-ads01 ~]$ kubectl get nodes
NAME      STATUS            ROLES
web01    Ready, SchedulingDisabled   controlplane, etcd, worker
web02    Ready             controlplane, etcd, worker
web03    Ready, SchedulingDisabled   controlplane, etcd, worker
```

Figure 99. kubectl get nodes One Uncordoned Node Sample Output

Wait approximately five minutes for pods to start up on the uncordoned node, and the M&C will soon be available again.

5.3.2.2.4 Node Restarts:

Before shutdown or restart of a node it should be taken offline first.

When stopping the entire cluster nodes should be taken offline and shutdown one at a time, ending with the node that contains the uframe-sms process. To find the uframe-sms process select the "AWD Web Server" tab and in the filter box below the "Process Name" header enter "uframe-sms", note the web node identified in the last column. If the web node with the uframe-sms process is not shut down last the entire process will likely take longer since the uframe-sms process will need to be restarted on a different server before the next command can be sent.

An individual node may be commanded to restart from the M&C display. In order to restart a node, the user right clicks the icon for the desired node and selects 'Shutdown/Restart', as shown below. The user may then select either 'Shutdown' or 'Restart'.

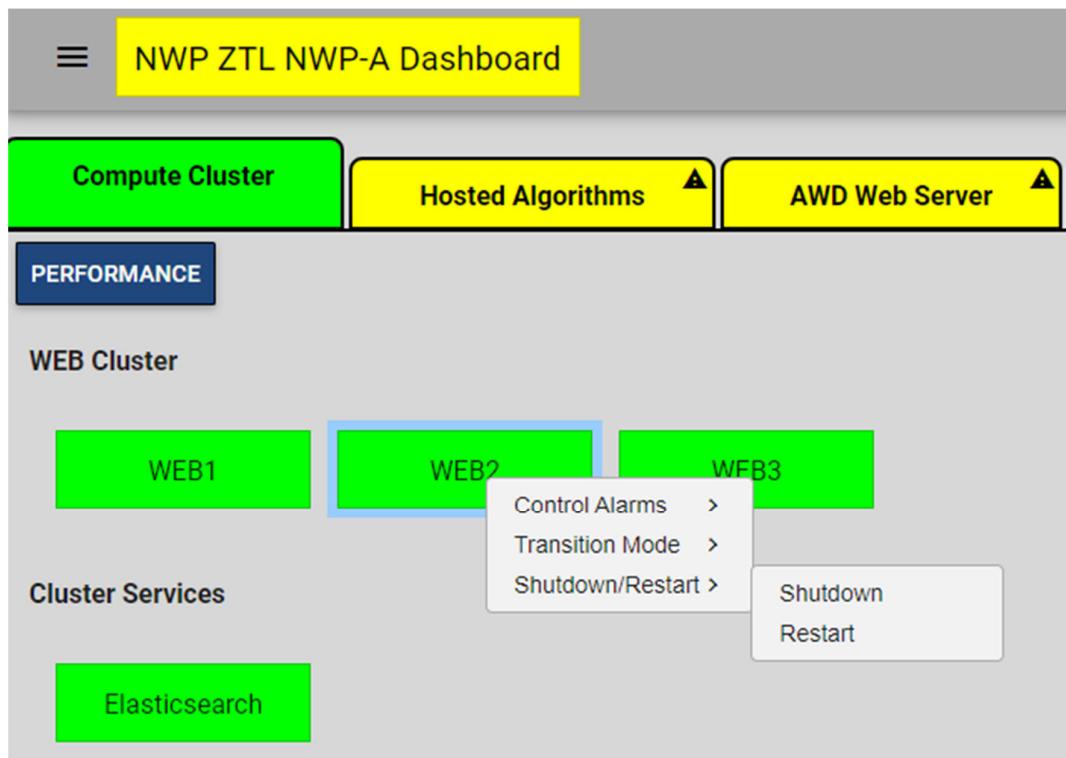
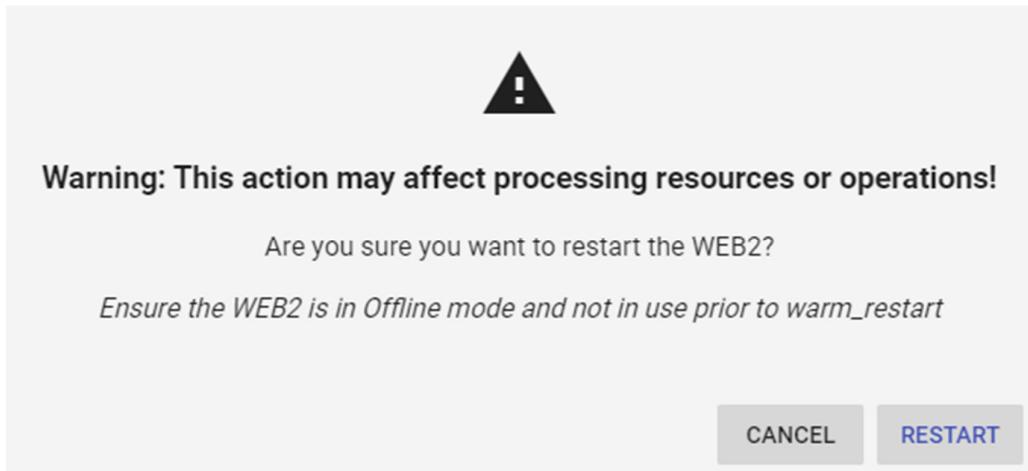


Figure 100. Node Shutdown/Restart Control

Upon selection of Shutdown or Restart, the user is prompted with a confirmation dialog, as shown below. If 'Restart' is selected, a command to restart the node will be sent. If 'Cancel' is selected, the popup will disappear and no further action will be taken.

**Figure 101. Node Shutdown/Restart Control****5.3.2.2.5 NWP-A Process Control**

Individual processes may be shutdown or restarted by an M&C user with the correct permissions.

Table 12. NWP-A Process Control

Component Type	Available Modes	M&C Shutdown/Restart Control	M&C GUI Location	Notes
System Management Process	N/A	Restart	Compute Cluster Tab -> Web server -> etc.	Allows controlling alarms, transitioning modes, and shutdown/restart of the web servers.
Hosted Algorithms	N/A	Restart	Hosted Algorithms tab	Algorithms are listed and can be restarted.
AWD Web Server	N/A	Restart	AWD Web Server tab	Processes are listed and can be shutdown or restarted.

5.3.2.2.6 NWP-A Storage Array

To NWP-A M&C also displays the status of the storage array. The storage array can be selected to see the status of the cooling, power supplies, disks, and overall system health as reported by the storage array itself.

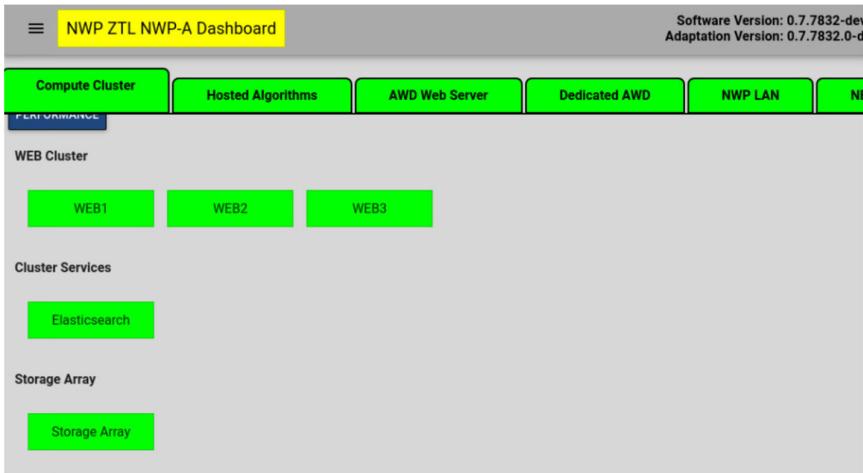


Figure 102. NWP-A Storage Array Monitoring

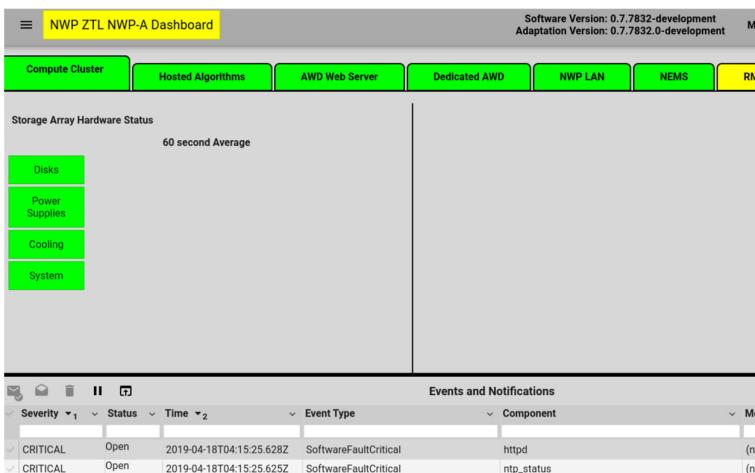


Figure 103. NWP-A Storage Array Monitoring Breakdown

5.3.3 Monitor LAN

The NWP LAN tab is provided to monitor the NWP Local Area Network (LAN) subsystem and its components applicable to an NWP Domain, NWP-A or External Web Server site. The NWP LAN tab displays the hardware components within the subsystem. An example of components on this tab is shown for the Domain. No M&C user control is available for NWP LAN components.

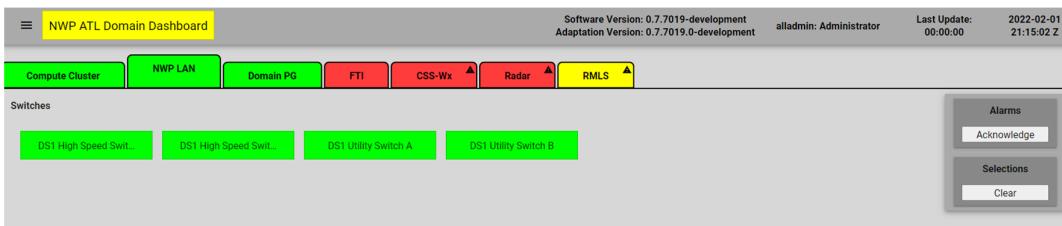


Figure 104. NWP Domain Dashboard LAN Subsystem and Components

5.3.4 Monitor and Control PG

A dashboard is provided for M&C user monitoring of all applicable subsystems, components, and external interfaces. A tab is provided for each monitored subsystem, including the PG subsystem. The PG subsystem is a virtual subsystem comprised of software components for processing of weather data. The status of those software components applicable to the particular monitored PG subsystem is available on the M&C GUI. Selection of the Domain PG tab produces additional icons for monitoring and control (if applicable) of components contained within the subsystem.

An excerpt of the NWP Domain Dashboard is provided below. When the M&C user left-clicks on the “Domain PG” tab as shown below, additional icons for subsystem component status monitoring appear in area below. The PG processes are categorized into groups specific to an area of coverage and listed under each area accordingly, as shown in the example below.

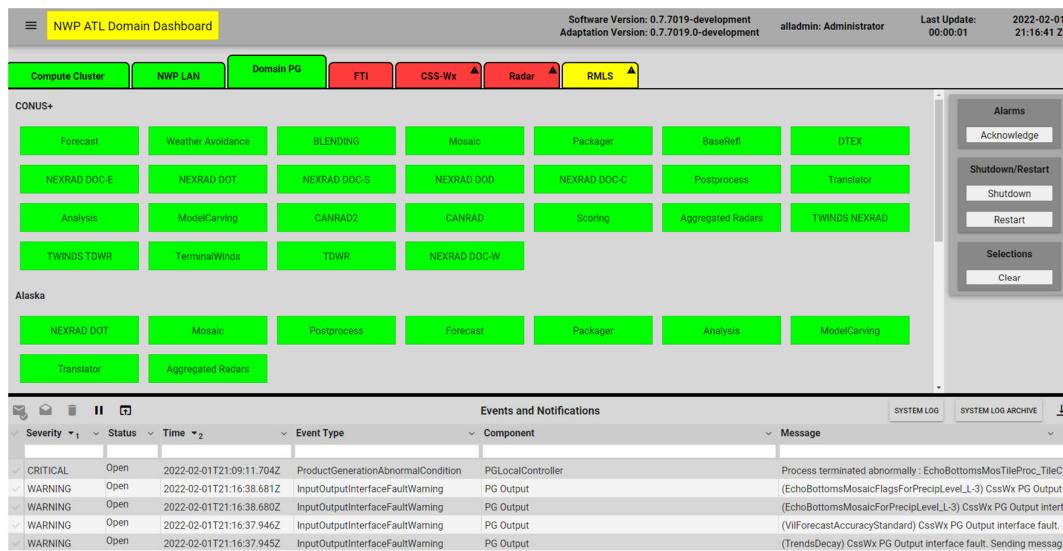
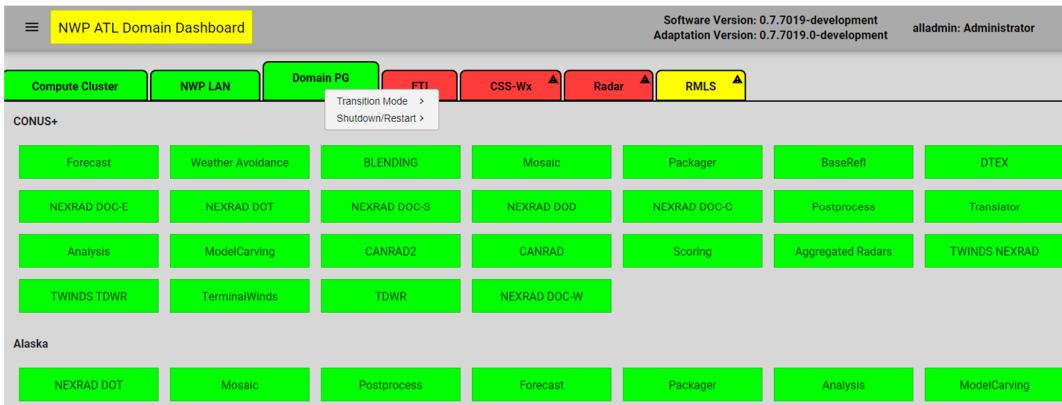


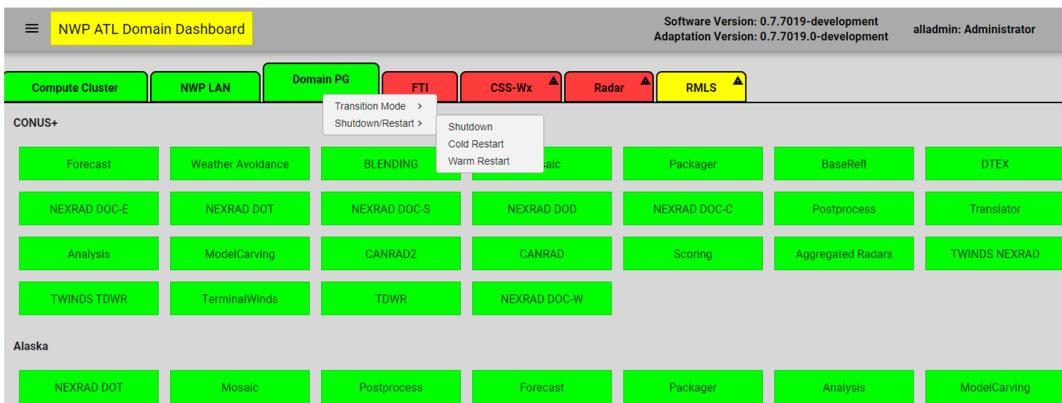
Figure 105. Domain PG Subsystem and Components

5.3.4.1 PG Subsystem Control

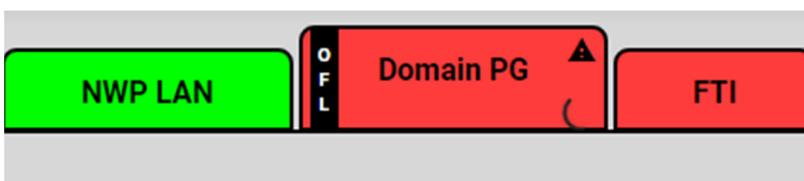
The Domain PG may be controlled via an M&C user. With the correct permissions, the M&C user may cold restart, warm restart, or shutdown the PG or the user may change the mode of the PG to online or offline. In order to shutdown or restart the PG or change the mode of the PG, the M&C user right-clicks on the ‘Domain PG’ tab and is presented with the drop down menu as shown below.

**Figure 106. PG Subsystem Control Options**

If the user selects Shutdown/Restart, they will be presented with the submenu options shown below.

**Figure 107. PG Subsystem Shutdown/Restart Options**

Selection of each option will launch a confirmation dialog to confirm the selection before action is taken. Upon selection of the action button, for example 'Shutdown', the PG subsystem will either be shutdown, or restarted, according to the user selection. The shutdown or restart transition in progress will be indicated via a spinner icon over the subsystem tab, as shown below. This spin indication will continue until the request has been completed. The spinner icon is present on any tab for which a command may be issued and any component icon for which a command may be issued.

**Figure 108. Process Spinner**

The M&C user can also change the mode of the PG subsystem between online and offline. When the PG subsystem is Offline, product dissemination to CSS-Wx is inhibited. When the PG subsystem is Online, product dissemination is enabled. PG Subsystem mode does not affect PG processing.

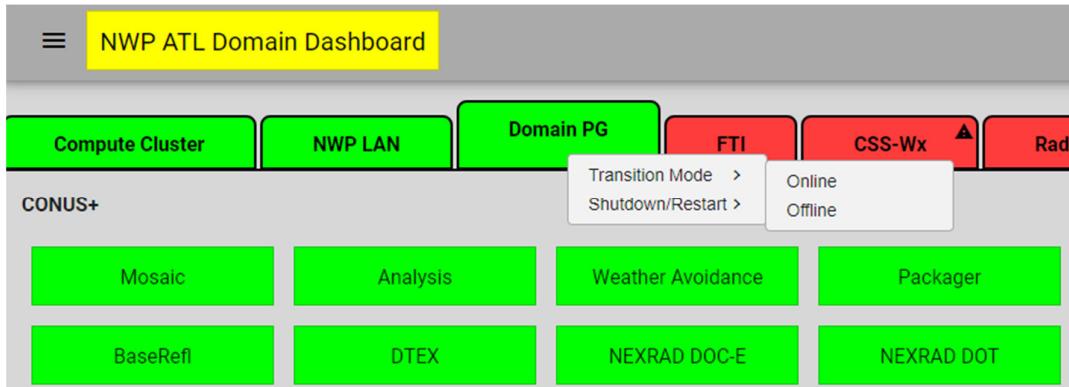


Figure 109. PG Subsystem Mode Change

5.3.4.2 PG Process Group Status

The PG tab contains icons which represent the collective status of a group of PG software components. In order to determine the number of processes in each state within a process group, the M&C user right-clicks the icon of a particular group. This launches a drop down menu with the option of displaying a color coded indication of the number of processes in the Failed, Degraded, and Normal state, as shown below.

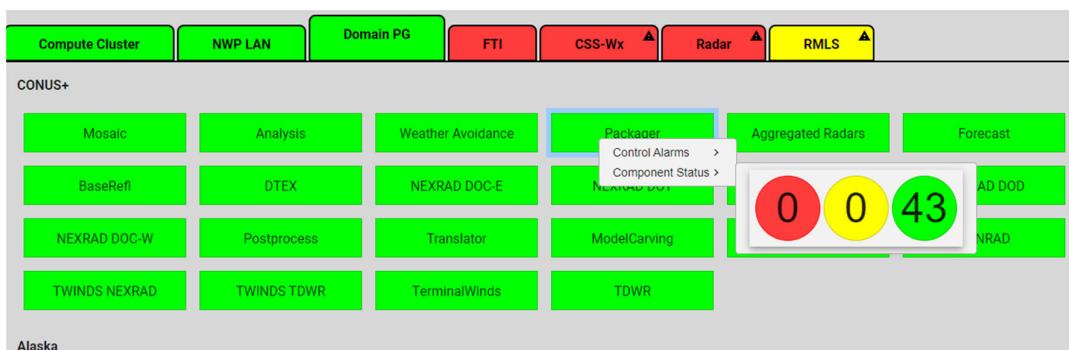


Figure 110. Process Group Component Status Summary

In order to see the individual state of each software process associated with a process group, the M&C user makes a single left-click on the icon for a process group. This click directs the user to a PG sub-tab which displays a listing of the processes configured in the process group, as shown below. Note each process running on a particular server will also be listed, with its status, on the Compute Cluster tab, via a left-click of the particular server on which the process is running.

Process Groups				
State	Process Name	Sub-Group	Short Name	Server
Green	BaseRefIMosaicTileAssembler	BaseRefI	BMA	pg01
Green	BaseRefIMosTileProc_TileColRow-0-0	BaseRefI	BMT_1	pg01
Green	BaseRefIMosTileProc_TileColRow-0-1	BaseRefI	BMT_4	pg01
Green	BaseRefIMosTileProc_TileColRow-1-0	BaseRefI	BMT_2	pg01
Green	BaseRefIMosTileProc_TileColRow-1-1	BaseRefI	BMT_5	pg01
Green	BaseRefIMosTileProc_TileColRow-2-0	BaseRefI	BMT_3	pg01
Green	BaseRefIMosTileProc_TileColRow-2-1	BaseRefI	BMT_6	pg01

Figure 111. Process Group List

The process view is shown again, below, with numbering and specific detail:

1. This listing shows the state of each process and is default sorted by state, with those in the Failed state at the top and Normal are at the bottom. Each process is listed by name with an indication of its state (Normal or Failed). Processes may be selected for shutdown and restart control by right-clicking the state icon for each process or utilizing buttons provided on the right of the M&C display.
2. The M&C user may search for a particular process by entering the name in the search bar shown here. This will filter the processes displayed according to the characters entered.
3. This column provides further classification of the software processes into subgroups and allows searching for specific subgroups.
4. This column provides a short name for each process subgroups and allows searching for specific short names.
5. An indication of the server on which the particular process is currently running subgroups and allows for searching for a specific server.
6. Scroll bar for scroll control and listing of additional processes.

Process Groups				
State	Process Name	Sub-Group	Short Name	Server
①	BaseRefIMosaicTileAssembler	BaseRefI	BMA	pg01
	BaseRefIMosTileProc_TileColRow-0-0	BaseRefI	BMT_1	pg01
	BaseRefIMosTileProc_TileColRow-0-1	BaseRefI	BMT_4	pg01
	BaseRefIMosTileProc_TileColRow-1-0	BaseRefI	BMT_2	pg01
	BaseRefIMosTileProc_TileColRow-1-1	BaseRefI	BMT_5	pg01
	BaseRefIMosTileProc_TileColRow-2-0	BaseRefI	BMT_3	pg01
	BaseRefIMosTileProc_TileColRow-2-1	BaseRefI	BMT_6	pg01

Figure 112. PG Subsystem Process List Details

5.3.4.3 PG Software Process Control

Individual software processes may be shutdown, cold restarted, or warm restarted by the M&C user, when in a role with the correct permissions. The M&C user has two options for shutdown and restart of software components: 1) Right-click on the colored icon associated with the software process to launch a drop down menu, from which shutdown or restart can be selected or 2) Ctrl+left-click multiple process lines in the listing and select shutdown or restart from the buttons on the right. The figure below shows an M&C user has left-clicked on an icon for a particular software process. This action launches a drop down menu from which the process may be shutdown or restarted.

The screenshot shows a software interface titled 'CONUS+ > Mosaic'. At the top, there is a navigation bar with tabs: 'Compute Cluster' (green), 'NWP LAN' (green), 'Domain PG' (green), 'FTI' (red), 'CSS-Wx' (red), 'Radar' (red), and 'RMLS' (yellow). Below the navigation bar is a 'Process Groups' section. A table lists five processes:

State	Process Name	Sub-Group	Short Name	Server
Green	BaseRefIMosaicTileAssembler	BaseRefI	BMA	pg01
Green	BaseRefIMosTileProc_TileColRow-0-0	BaseRefI	BMT_1	pg01
Green	BaseRefIMosTileProc_TileColRow-0-1	BaseRefI	BMT_4	pg01
Green	BaseRefIMosTileProc_TileColRow-1-0	BaseRefI	BMT_2	pg01
Green	BaseRefIMosTileProc_TileColRow-1-1	BaseRefI	BMT_5	pg01

A context menu is open over the third row ('BaseRefIMosTileProc_TileColRow-0-1'). The menu items are 'Control Alarms', 'Shutdown/Restart', and 'Warm Restart'. The 'Shutdown/Restart' item is highlighted with a blue selection bar.

Figure 113. PG Subsystem Individual Process Restart/Shutdown

Alternatively, an M&C user may shutdown or restart multiple processes. In the figure below, the M&C user has selected multiple processes with a Ctrl+left-click. The 'Shutdown' or 'Restart' buttons on the right may then be clicked to shutdown or restart the selected processes.

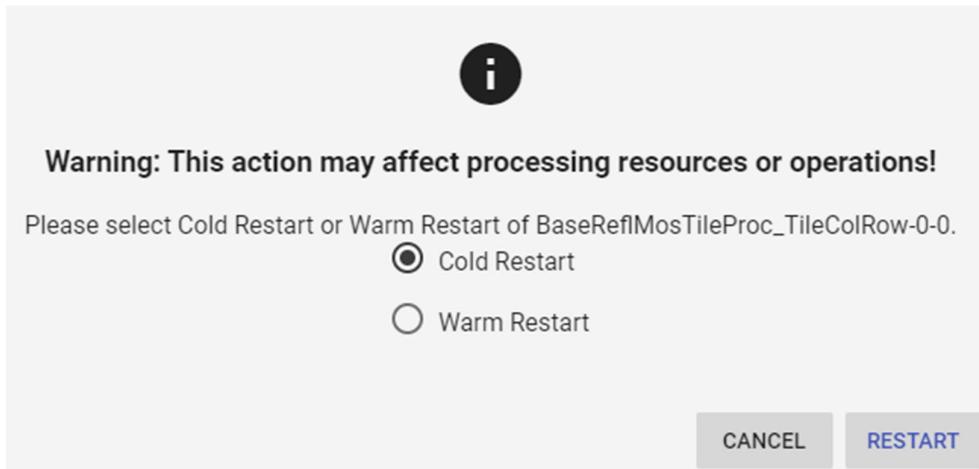
The screenshot shows a software interface titled 'CONUS+ > Mosaic'. At the top, there is a navigation bar with tabs: 'Compute Cluster' (green), 'NWP LAN' (green), 'Domain PG' (green), 'FTI' (red), 'CSS-Wx' (red), 'Radar' (red), and 'RMLS' (yellow). Below the navigation bar is a 'Process Groups' section. A table lists five processes, all of which have been selected (indicated by a blue selection bar on the left):

State	Process Name	Sub-Group	Short Name	Server
Green	BaseRefIMosaicTileAssembler	BaseRefI	BMA	pg01
Green	BaseRefIMosTileProc_TileColRow-0-0	BaseRefI	BMT_1	pg01
Green	BaseRefIMosTileProc_TileColRow-0-1	BaseRefI	BMT_4	pg01
Green	BaseRefIMosTileProc_TileColRow-1-0	BaseRefI	BMT_2	pg01
Green	BaseRefIMosTileProc_TileColRow-1-1	BaseRefI	BMT_5	pg01

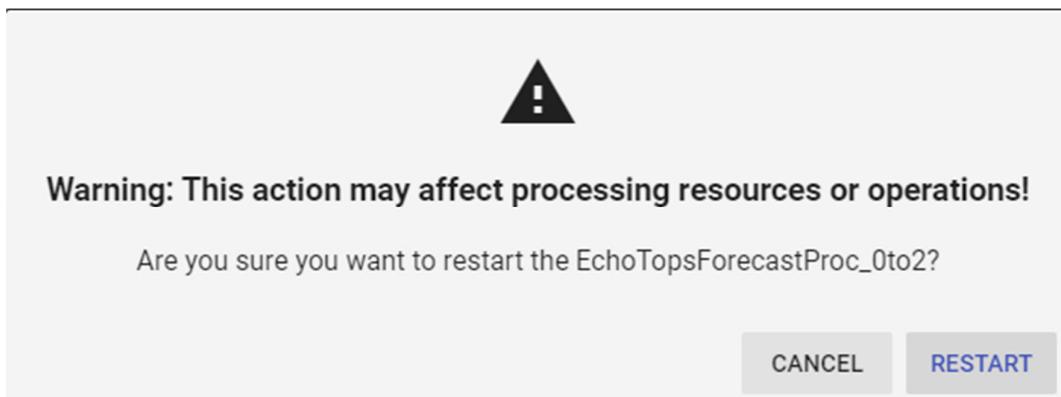
To the right of the table is a vertical toolbar with buttons for 'Alarms' (disabled), 'Acknowledge' (disabled), 'Shutdown/Restart' (disabled), 'Shutdown' (disabled), 'Restart' (highlighted with a blue selection bar), 'Selections' (disabled), and 'Clear' (disabled).

Figure 114. PG Subsystem Multiple Software Process Restart/Shutdown

When the 'Restart' button is selected, the user will be prompted with a selection for Cold Restart or Warm Restart for each of the selected processes sequentially:

**Figure 115. PG Process Cold Restart/Warm Restart**

The ‘Cold Restart’ radio button is selected by default. If the user wishes to warm restart the process, they may select the ‘Warm Restart’ radio button. Selection of ‘RESTART’ closes this window. A confirmation window will then display to confirm restart of the process for the selected radio button. Selection of ‘CANCEL’ cancels the request for the process.

**Figure 116. PG Process Cold Restart/Warm Restart Confirmation Window**

5.3.5 Monitor and Control NWP-A Subsystems

Each NWP-A site is comprised of the following subsystems: Compute Cluster, AWD Web Server, Dedicated AWD, and Hosted Algorithms. Each NWP-A site and the associated subsystems may be monitored from an M&C Display. The External Web Server consists of the Compute Cluster, AWD Web Server, and Hosted Algorithms subsystems.

5.3.5.1 Dedicated AWD Tab

The Dedicated AWD subsystem represents the Dedicated AWD clients associated with the NWP-A. M&C user selection of the Dedicated AWD tab yields a display of information regarding AWDs configured for the NWP-A site. All information presented on the Dedicated AWD tab is for monitoring purposes only. There is no M&C user control available from the Dedicated AWD tab.

An image of the NWP-A M&C with the Dedicated AWD tab selected is provided below. The Dedicated AWD tab is formatted to display status of each Dedicated AWD configured as part of the NWP-A deployment. Each AWD is represented by an icon, the color of which is used to depict the state of the AWD. The state of the icon represents the configuration status of the AWD connection only. Normal/green indicates that the AWD is configured correctly, online, and ready for updates. Degraded/yellow indicates the AWD is online with non-critical errors. Failed/red indicates that the AWD is not configured properly and is not prepared to accept updates.

By default the maximum number of AWDs configured as part of the NWP-A are displayed within the tab. The user may sort the AWDs via the 'Sort By' dropdown to the right of the connection status display. Sort by options include Alphanumeric, state (failed/degraded/normal), and mode (online, disconnected, and playback). The user may also search for specific AWDs with the 'Search' bar to the right of the sort options. Each AWD icon that matches the search entry will be displayed with a blue highlight around it.

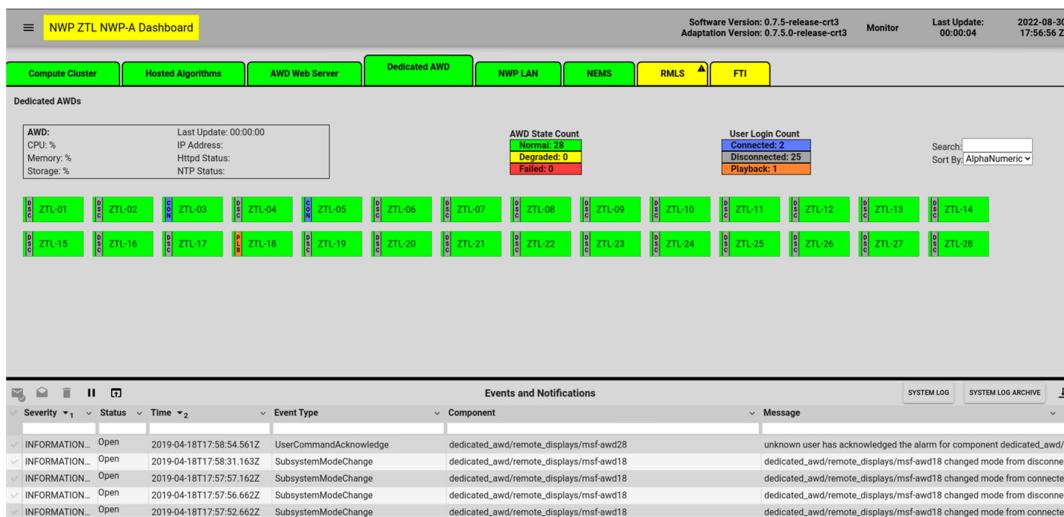


Figure 117. Dedicated AWD Subsystem and Components



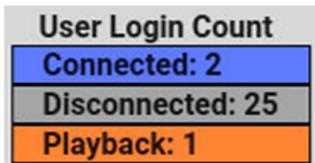
Figure 118. 'Disconnected' AWD



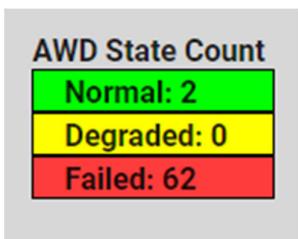
Figure 119. 'Connected' AWD

**Figure 120. 'Playback Mode' AWD**

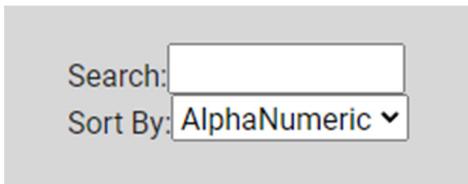
Mode badges are presented over the Dedicated AWD icon to indicate when an AWD is connected, disconnected, or in Playback mode. The 'Connected' mode indicates a user, either the default user or a specific user, is logged in to the AWD and is represented by a blue 'CON' banner on the left side of the AWD icon as shown above. The 'Disconnected' mode indicates that no user is logged into the AWD and is represented by a gray 'DSC' banner on the left side of the AWD icon as shown above. Playback mode is enabled by a user via the AWD Client, and in the M&C, represented by an orange 'PLB' banner on the left side of the AWD icon as shown above. The number of AWDs allowed to run playback mode simultaneously is limited to two per NWP-A system. If a user attempts to put more than two AWDs into playback mode it will display "Already at maximum replay clusters" and will not allow them to enter playback mode. The total number of AWDs in each mode is displayed above the AWD icon grid and is shown below.

**Figure 121. Total Number of AWDs in each Mode**

The number of AWDs in each state is also displayed above the AWD icon grid and is shown below.

**Figure 122. Total Number of AWDs in each State**

The AWD icon grid can also be sorted Alphanumerically, by Status, by Mode, or filtered by name in the Search bar and Sort dropdown menu shown below.

**Figure 123. AWD Search and Filtering Capabilities**

Hardware usage statistics are available for each configured AWD and displayed when a user hovers the mouse cursor over an AWD icon. The information is displayed above the AWD icon grid as shown below. The latest measured CPU, Storage utilization and Memory utilization statistics are presented along with the AWD IP address, Httpd Status, NTP Status of Normal/Degraded/Failed, and the last update of the Hardware stats.

ZTL-01	Last Update: 00:00:59
CPU: 11.41%	IP Address: 10.141.58.195
Memory: 18.54%	Httpd Status: Normal
Storage: 1.52%	NTP Status: Normal

Figure 124. Dedicated AWD Hardware Usage Statistics

5.3.5.2 AWD Web Server Tab

M&C user selection of the AWD Web Server tab yields a display of active containers running on the AWD Web Servers. A single software process runs within each container.

As shown below, the table contains an icon denoting the state of each process, the name of the process the container is running, and the web server node each container is running on. A search/filter capability is available within the column headers for Process Name and Server. Filtering occurs immediately as the user begins to type within the text field filtering out all process names or servers that does not include the entered text.

The state of AWD Web Servers are defined per container type and are displayed via icon on the left side of the table. Normal/green indicates that the container and associated process are connected and running properly. Yellow/degraded indicates that the container and associated process are running with a non-critical error. Failed/red indicates the process is not running or that a critical error has occurred in the container.

Controls available to the M&C User are displayed in a column on the right side of the display. An M&C user logged in with an Administrator role may perform a restart on an individual container. This may be accomplished by either a right click on the icon or by selecting the container within the table and selecting 'Restart' from the control panel.

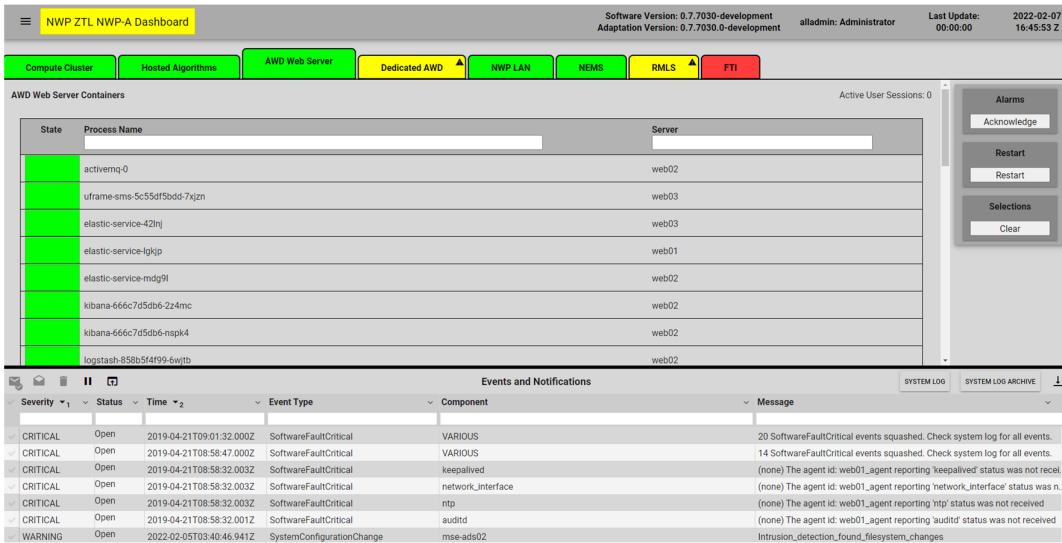


Figure 125. AWD Web Server Dashboard

On the External Web Server M&C GUI and the NWP-A M&C GUI, the number of active user sessions is displayed within the AWD Web Server tab, shown below with the Active User Sessions circled in red. The number represents the number of active web browser connections to the External Web Server.

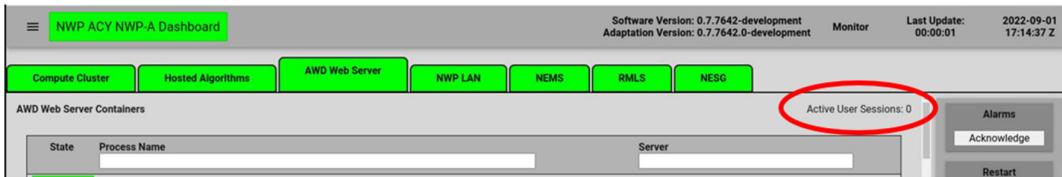


Figure 126. Active User Sessions

5.3.5.3 Hosted Algorithms Tab:

The Hosted Algorithms tab is provided for monitor and control of algorithms running on NWP-A servers. M&C user selection of the Hosted Algorithms tab yields a display of information regarding the algorithms running as part of the Hosted Algorithm components.

The Hosted Algorithms subsystem tab is shown below. This tab displays the state of currently running algorithms and the associated containers. Similar to the AWD Web Server, the table on the Hosted Algorithms dashboard provides the state of each container running within the subsystem in the 'State' column on the left. The name of the process that is running on each container is shown in the 'Process Name' column. The associated group of each process as well as the node that each container is running on are also shown in the table. Note, the header of the Process Name, Group, and Server column each contain a text search box that begins searching when the user begins typing. On the Hosted Algorithms dashboard the state of a container and the associated algorithm is displayed on the left side as seen in below. Normal/green indicates that the container and algorithm is running or producing data, starting up, or idle because no algorithm has been requested. Failed/red indicates the algorithm has stopped running due to critical errors. The Hosted Algorithms subsystem is limited to online only. There is no mode control of individual Hosted Algorithm containers. An M&C user logged in as Administrator role may perform a restart on an individual container either via right click of the icon or by selecting the icon for the appropriate container and selecting 'Restart' from the control panel on the right.

Hosted Algorithms has the same alarm acknowledge/disable capabilities as Dedicated AWD.

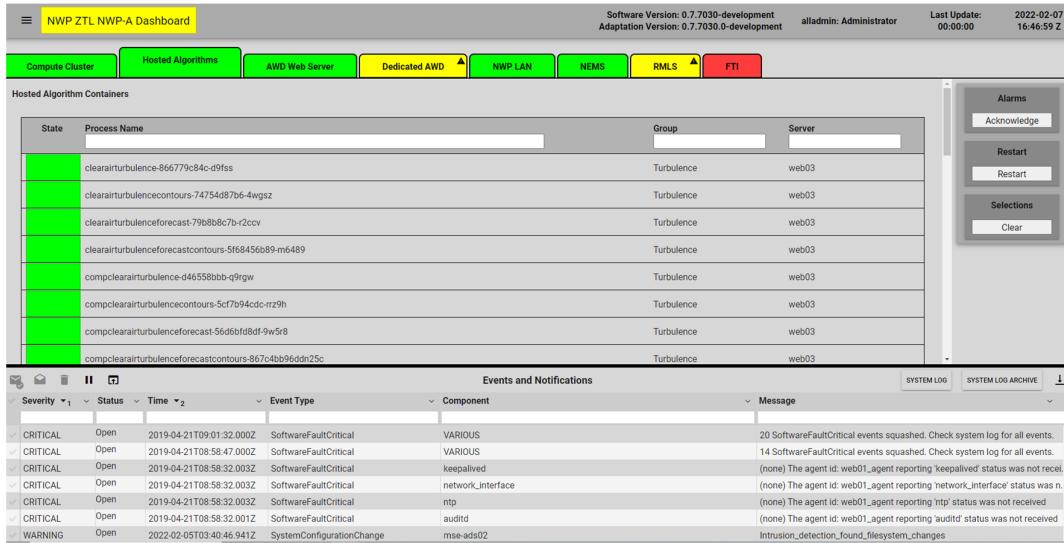


Figure 127. Hosted Algorithms Dashboard

5.3.5.4 Latency Histogram

From a NWP-A M&C screen, a histogram of AWD Input Display latency statistics may be viewed over a user defined period of time for a selected weather product. The AWD Input Display Product Latency represents the time from availability of a selected product until the time of display on an AWD. The histogram provides data for all AWDs connected to the NWP-A. Any user may display the latency histogram. The histogram is presented for the NWP-A represented by the M&C display; data represents latency values for data displayed on all Dedicated AWDs connected to the NWP-A site. Any user may click on the Hamburger Menu to launch a drop down menu to select the Latency Chart menu option. The user will be directed to a latency chart specific to the NWP-A site as shown below.

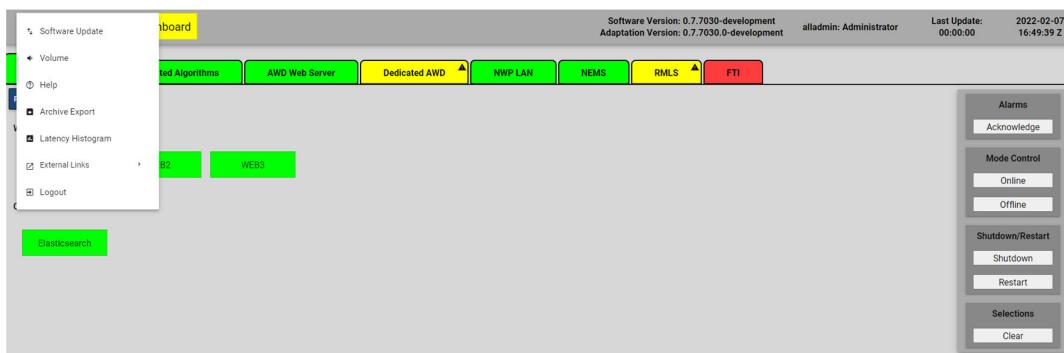
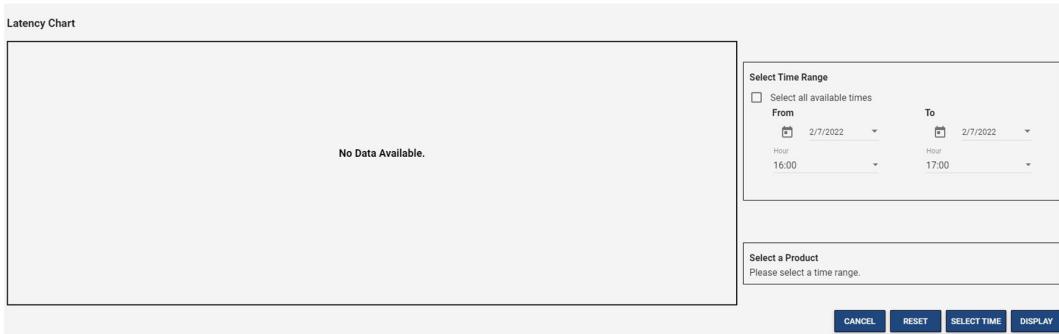


Figure 128. Selection of Latency View

Upon selection of the 'Latency Chart' option, the user will be directed to the Latency chart dialog, from which a latency histogram may be selected.

**Figure 129. NWP-A Latency Chart View**

1. The user must first select a time range over which to view the latency statistics. Latency statistics are available in one hour increments. The user may select a specific time range or check the box at the top to select all available hours (1).
2. Once a time range is selected, the user selects the 'SELECT TIME' button (2). A listing of available products over the selected time range will then display in the Select a Product dialog (4).
3. If a user wishes to reset the time range to default (current time – 1 hour), select the 'RESET' button (3).

**Figure 130. Latency Histogram: Time Selection**

4. Once the list of available products is populated, the user may select one product for viewing via the radio button next to the product name.



5.

Figure 131. Selection of Product for Latency Chart

6. Once a time range and product have been selected, select the ‘DISPLAY’ button to display the AWD Input Display Product Latency statistics for the selected product over the selected time range (5).
7. The selected product name is displayed at the top of the chart (6).
8. The AWD Display latency threshold for the selected product is displayed for reference (7).
9. The data is plotted as a histogram: each blue bar represents the number of AWD Input Display Product Latency events for each latency range which were created over the specified period of time. The latency events are counted in hourly bins. The exact number of events in each bin is displayed with text in black above the bar. For example, the second bin represents that there were 160 recorded latencies between the values of 1.0 and 1.5 seconds, between the hours of 16:00 and 17:00 (8).
10. Selection of the ‘CANCEL’ button will close the dialog (9).

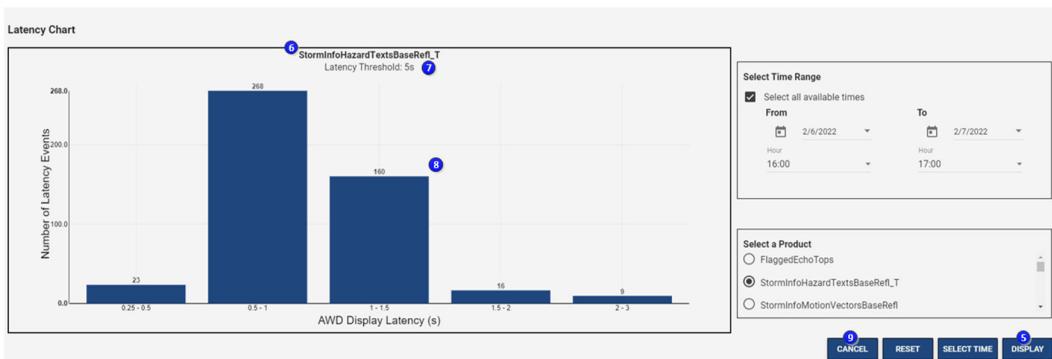


Figure 132. Selection of 'Display Histogram'

A final example histogram is shown below:

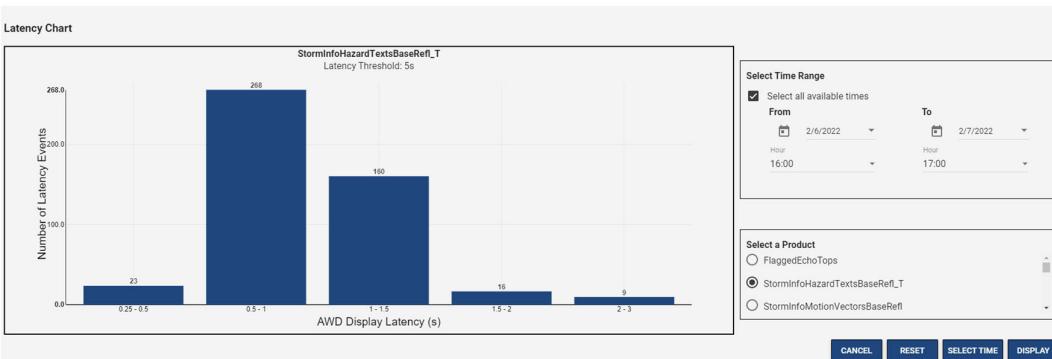


Figure 133. Example Display Latency Histogram

5.3.6 Transition Mode

Components which can be controlled by the M&C user via the M&C GUI are referred to as managed components. Each managed component’s status is defined by its state (Normal,

Degraded, and Failed) and its mode, if applicable. While subsystem and component state transitions are performed automatically by the system, certain mode transitions can be completed by the M&C user. The M&C user may transition a managed component to Online or Offline. Transitions to Standby mode are automatically performed by the system.

In order to transition a subsystem or component mode, the M&C user right clicks the icon for the desired component or right clicks the tab icon for the desired subsystem. A menu drop down is then available, from which the user can then select the desired mode.

Alternatively, multiple components may be transitioned simultaneously by using Ctrl+left-click to select multiple icons, then use of the Transition Mode buttons provided on the right of the Dashboard.

5.3.6.1 Transition Subsystem Mode

The M&C user may transition the mode of the Domain Compute Cluster or PG Subsystems. In order to transition the mode of a Domain Compute Cluster or PG subsystem, the M&C user selects the tab for the subsystem. An example of Domain PG is shown below:

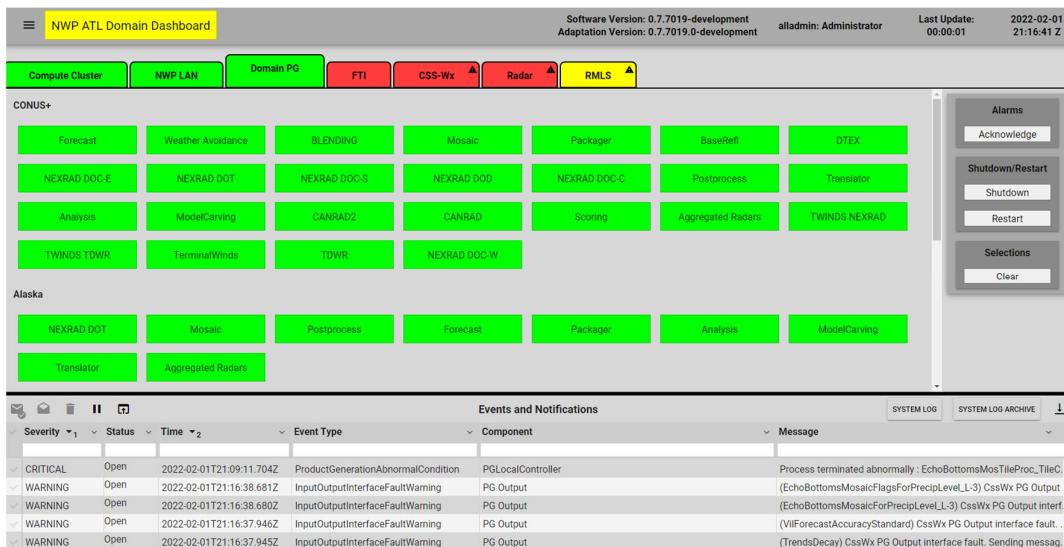
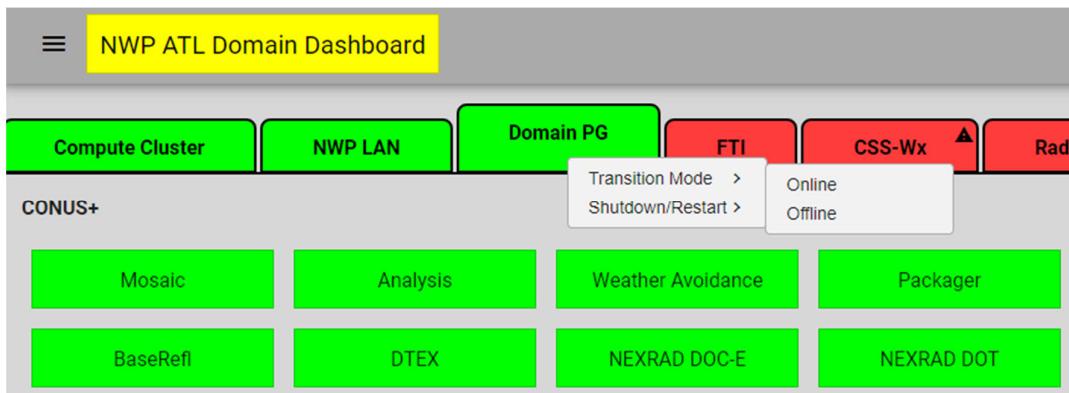
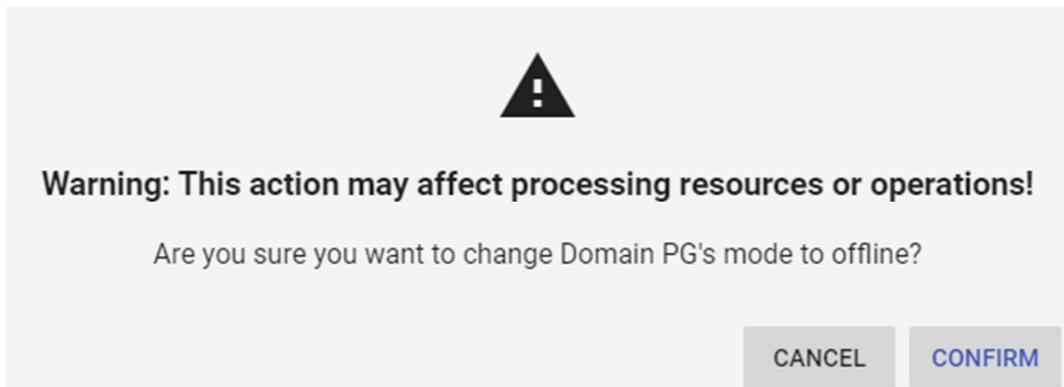


Figure 134. Domain PG Display

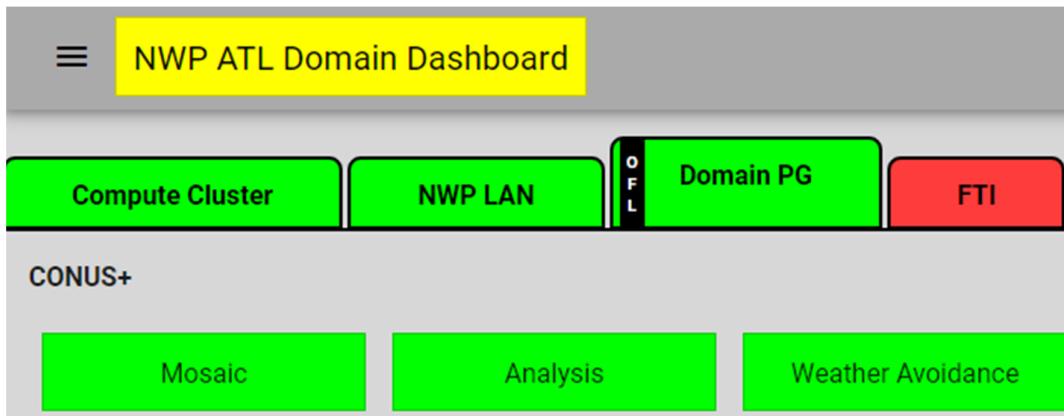
In order to transition the mode of the entire subsystem, the M&C user right-clicks on the Domain PG tab. This launches a drop down menu, from which Transition Mode > Online or Offline can be selected as shown below:

**Figure 135. Mode Transition from Tab**

A warning message/confirmation will then pop up to ensure the user wishes to perform the mode transition. An example confirmation is shown below:

**Figure 136. Mode Transition Confirmation Dialog**

The Offline mode for the entire subsystem will then be indicated via the 'OFL' banner on the tab as shown below:

**Figure 137. Subsystem Mode Offline**

5.3.6.2 Transition Component Mode

The M&C user may transition mode of certain NWP components. See section 5.3.2 for detailed operations and options for transition of PG and HF server mode.

5.3.7 Elasticsearch Maintenance

5.3.7.1 Overview

The NWP System uses Elasticsearch to efficiently search, index, and analyze log data. Elasticsearch is at the heart of the ELK (Elasticsearch, Logstash, Kibana) stack.

The data stored in Elasticsearch are distributed across shards. These shards are duplicated and provide redundant copies of data, so no data is lost in the case of a node failing. The NWP Elasticsearch cluster has been configured to wait 15 minutes after a node leaves the cluster before starting to rebalance the shards within the cluster. Keeping the Elasticsearch shards balanced is important to ensure that no data is lost in the event of an Elasticsearch node dying, but shard rebalancing is an expensive process. In the event of a momentary network interruption or brief system restart, it is ideal to delay the reallocation until the node becomes available again, as long as it is within a reasonable amount of time. However, in the event of a maintenance activity that is expected to take longer than 15 minutes, it is required to temporarily disable shard rerouting until the maintenance activity is complete.

The process of disabling shard rerouting and performing maintenance would have the following flow:

1. disable shard rerouting for the cluster
2. take down one Elasticsearch node for maintenance
3. bring the node back online and re-enable reallocation
4. wait for allocation to complete and the cluster status to be **Green** before repeating these steps for additional nodes

The following procedures detail how to disable and re-enable shard rerouting for a maintenance activity that will extend past this 15-minute window. Note that for the duration of the maintenance period during which a node has been removed from the Elasticsearch cluster, the cluster status will display as **Yellow**. Run the following curl commands with a user that has administrative Elasticsearch cluster privileges, as needed.

5.3.7.2 Disable Elasticsearch Shard Rerouting

1. Log into a server within the Elasticsearch cluster (for Domain log into any HF server, or for NWP-A log into any ADS server), as a user with site administrative privileges as needed (*this does not need to be the node that will be taken down for maintenance*).

2. Run the following command to disable rerouting of existing shards:

```
curl -u <admin-user> -X PUT "https://$(hostname -f):9200/_cluster/settings?pretty" -H 'Content-Type: application/json' -d'{ "transient": { "cluster.routing.allocation.enable": "new_primaries" } }' If prompted to enter a password, do so.
```

3. An acknowledgment message, such as the following, should be received and displayed showing the new setting:

```
{
  "acknowledged" : true,
  "persistent" : { },
  "transient" : {
    "cluster" : {
      "routing" : {
        "allocation" : {
          "enable" : "new_primaries"
        }
      }
    }
  }
}
```

Figure 138. Acknowledgement Message of Disabling Shard Rerouting

The Elasticsearch node can now be taken down for maintenance without the cluster attempting to rebalance its shards.

NOTE: it is important that shard rerouting, detailed in the following procedure, be re-enabled once maintenance is complete to ensure cluster stability and data protection.

5.3.7.3 Enable Elasticsearch Shard Rerouting

1. Log into a server in the Elasticsearch cluster as a user with site administrative privileges as needed.
 2. Run the following command to enable routing of all shards:
- ```
curl -u <admin-user> -X PUT "https://$(hostname -f):9200/_cluster/settings?pretty" -H 'Content-Type: application/json' -d'{ "transient": { "cluster.routing.allocation.enable" : "all" } }'
```
- If prompted to enter a password, do so.
3. An acknowledgement message, such as the following, should be received and displayed showing the new setting:

```
{
 "acknowledged" : true,
 "persistent" : { },
 "transient" : {
 "cluster" : {
 "routing" : {
 "allocation" : {
 "enable" : "all"
 }
 }
 }
 }
}
```

**Figure 139. Acknowledgement Message of Enabling Shard Rerouting**

Shard rebalancing can take some time; if additional nodes must be taken down for maintenance, wait for the Elasticsearch cluster status to be **Green** before repeating the steps to disable rerouting again.

Run the following command to view the cluster status:

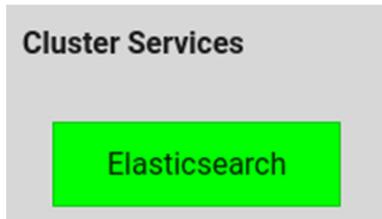
```
curl -u <admin-user> -X GET "https://$(hostname -f):9200/_cluster/health?pretty"
```

The following is example output of running the above curl command. Note the second line of the output indicates "status" : "green"

```
{
 "cluster_name" : "NWP-mse",
 "status" : "green",
 "timed_out" : false,
 "number_of_nodes" : 3,
 "number_of_data_nodes" : 3,
 "active_primary_shards" : 98,
 "active_shards" : 196,
 "relocating_shards" : 0,
 "initializing_shards" : 0,
 "unassigned_shards" : 0,
 "delayed_unassigned_shards" : 0,
 "number_of_pending_tasks" : 0,
 "number_of_in_flight_fetch" : 0,
 "task_max_waiting_in_queue_millis" : 0,
 "active_shards_percent_as_number" : 100.0
}
```

**Figure 140. Cluster Health Status Curl Output**

Alternatively, check the status of "Elasticsearch" on the M&C Compute Cluster page under "Cluster Services" to view the cluster status:



**Figure 141. M&C Green Elasticsearch Status**

If the maintenance period crosses over 00:00 UTC, a new index will be created. If this occurs, refer to the following procedure for manually reallocating a primary shard to ensure the cluster is properly load balanced.

#### 5.3.7.4 Manually Reallocate a Primary Shard

A new index will be created at 00:00 UTC, and its primary shards will be allocated to the available nodes in the cluster. By default, each node will contain one primary and one replica shard for every index. If a new index is created while a node has been taken down for maintenance, one node will end up hosting two primary shards for an index.

This procedure details how to identify a node with two primaries, and how to manually reroute one primary shard to a different node. Note that this should only be performed if a new index was created while a node was unavailable for maintenance and only once maintenance is complete and all nodes are back within the cluster.

1. Log into a server in the Elasticsearch cluster as a user with site administrative privileges as needed.

2. Identify the name of the index that was created while a node was absent from the cluster. The name will be of the format "nwpaudit-yyyy.mm.dd" with the date being the one that came after the time passed 00:00 UTC.
3. Run the following command to view the allocation status of all shards for that index:  
`curl -u <admin-user> -X GET "https://$(hostname -f):9200/_cat/shards/<index name>?pretty"`  
If prompted to enter a password, do so.  
After entering this command, a list of shards for that index will be displayed. The second column is the shard number, the third column indicates whether a shard is a primary shard or a replica shard, and the last column is the node the shard has been allocated to.
4. Identify the node that contains two primary shards for the index. Once identified, select one of the two primaries, and note down the shard number and what node it is currently on.
5. Identify the node that contains two replica shards for the index. Once identified, note down which node it is.
6. Run the following command, inserting the index name, shard number, original node, and destination node, to reallocate the primary shard to the node with two replica shards:

```

curl -u <user> -X POST "https://$(hostname -f):9200/_cluster/reroute?pretty" -H 'Content-Type: application/json' -d'
{
 "commands": [
 {
 "move": {
 "index": "<index name>", "shard": <shard number>,
 "from_node": "<original node>", "to_node": "<destination node>"
 }
 }
]
}
'
```

7. Run the following command (the same command that was run earlier in step 3), and verify that each node in the cluster now contains one primary and one replica shard for the index:

```
curl -u <admin-user> -X GET "https://$(hostname -f):9200/_cat/shards/<index name>?pretty"
```

If prompted to enter a password, do so.

### 5.3.8 Control M&C Alarms

A critical or non-critical error in a component, external interface, or subsystem is indicated on the M&C via a red or yellow flashing icon, respectively. Some errors may also sound audible alarms. Errors are indicated via icons as per the legend below.

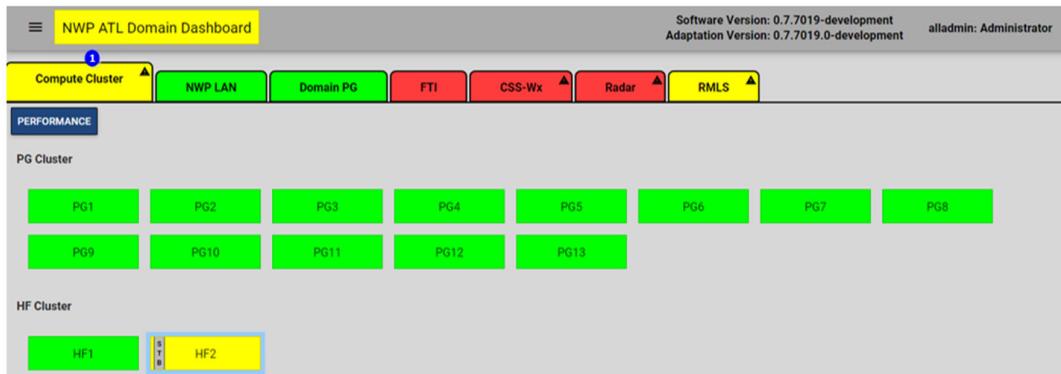
| M&C Legend |                                                                                                                                    |                                                                                                                                     |
|------------|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
|            | NORMAL                                                                                                                             | DEGRADED                                                                                                                            |
| ONLINE     | <span style="background-color: green; border: 1px solid black; padding: 2px;">&lt;component&gt;</span>                             | <span style="background-color: yellow; border: 1px solid black; padding: 2px;">&lt;component&gt;</span>                             |
| OFFLINE    | <span style="background-color: green; border: 1px solid black; padding: 2px; text-align: center;">O<br/>F<br/>L</span> <component> | <span style="background-color: yellow; border: 1px solid black; padding: 2px; text-align: center;">O<br/>F<br/>L</span> <component> |
| STANDBY    | <span style="background-color: green; border: 1px solid black; padding: 2px; text-align: center;">S<br/>T<br/>B</span> <component> | <span style="background-color: yellow; border: 1px solid black; padding: 2px; text-align: center;">S<br/>T<br/>B</span> <component> |
|            | FAILED                                                                                                                             |                                                                                                                                     |
|            |                                                                                                                                    | <span style="background-color: red; border: 1px solid black; padding: 2px;">&lt;component&gt;</span>                                |

**Figure 142. M&C GUI Mode and State Legend**

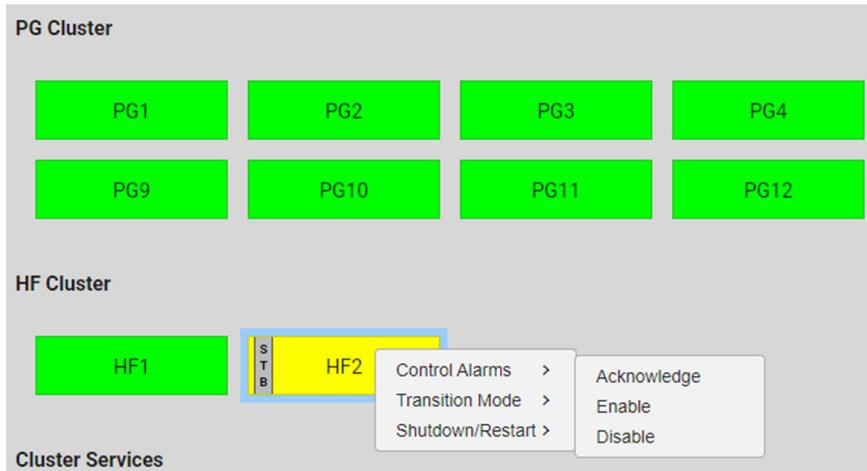
Upon a critical or non-critical error, the M&C user will be notified via an audible alarm and flashing red or yellow icon, respectively. In order to silence the audible alarm and cease the visual (blinking) indication, the M&C user will select ‘Acknowledge’ from a drop down menu specific to the component.

In order to enable or disable alarms on a single subsystem or component, the M&C user right-clicks the icon for the desired component. A menu drop down is then available, for which the user can then select the desired alarm functionality. The disable action inhibits audible alarms and inhibits the blinking action in case of an alarm. The icon will still turn red or yellow, if a critical or non-critical error is encountered, respectively.

An image of a Dashboard for a Domain site is provided as an example below. In this example, the HF2 server is degraded. Thus an audible alarm has sounded and the icon labelled ‘HF2’ is yellow. An icon (See (1) in the figure below) is also present on the Compute Cluster tab itself, indicating the presence of a new failure of a component within the subsystem. Because the HF2 server is a component of the Compute Cluster subsystem, the Compute Cluster subsystem’s state has transitioned to Degraded, as indicated by the yellow color of the Compute Cluster tab. Because a subsystem which is associated with the particular monitored NWP deployment is now degraded, the overall state is shown as Degraded/yellow, as shown by the yellow shading behind the “NWP ATL Domain Dashboard” below.

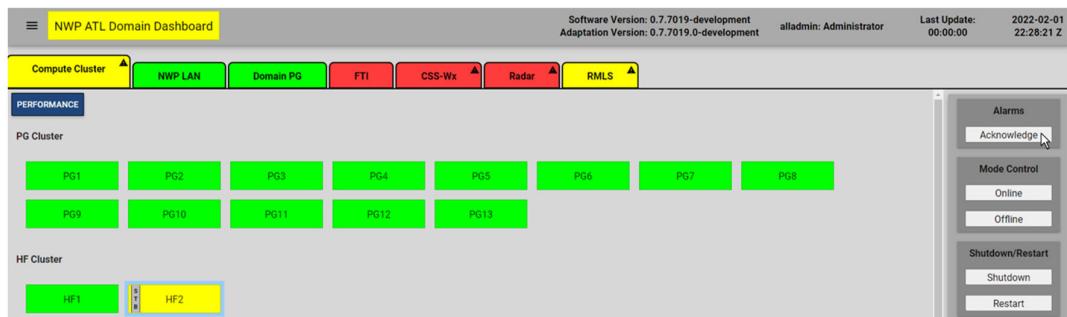
**Figure 143. Domain Dashboard with Failed Component and Unacknowledged Alarm**

In order to stop the sounding of the audible alarm and stop the flashing of the PG1 icon, the M&C user will right-click on the icon for the affected HF2 component. This will launch a drop down menu, from which ‘Control Alarms’, then ‘Acknowledge’ can be selected as shown below. This action will stop the sounding of the audible alarms for the selected component on the current tab. Any alarms for subsystems and/or components on other tabs of the M&C GUI will not be affected. Once all new alarms on the current tab have been acknowledged, the ‘!’ icon on the tab will disappear.

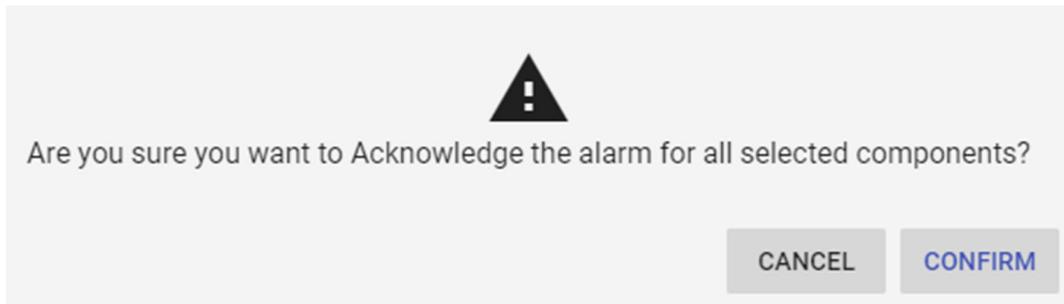


**Figure 144. Acknowledge a Degraded or Failed Alarm**

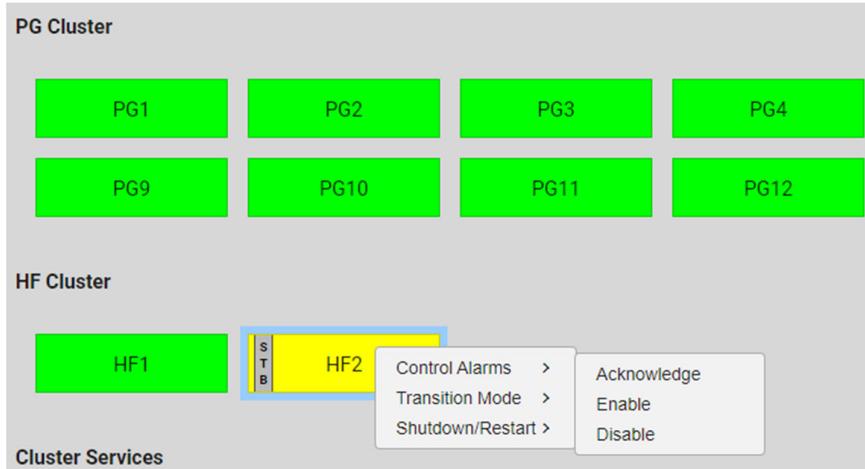
Alternatively, multiple components may be selected for acknowledgement. Ctrl+left-click each component to select each component to be acknowledged. Selection of the ‘Acknowledge’ button on the right control panel will result in a confirmation dialog to confirm acknowledgement of all selected components. Upon selection of ‘CONFIRM’, all selected components will be acknowledged and the selections will clear. If ‘CANCEL’ is selected, all selections will also clear.



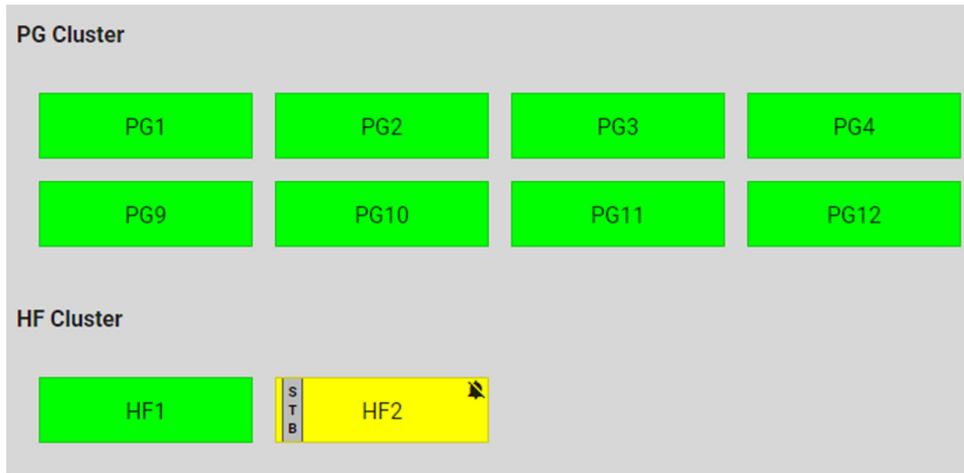
**Figure 145. Acknowledge Alarms for All Selected Components**

**Figure 146. Acknowledge Confirmation**

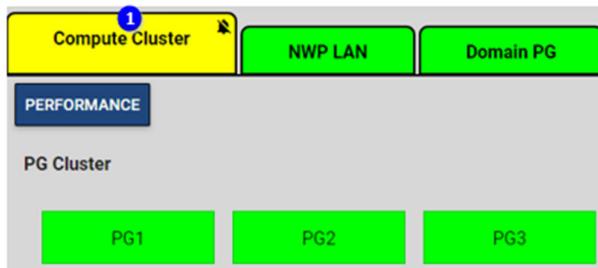
If the M&C user decides they do not need to hear further alarms for a component, they may disable the alarms by right-clicking on the applicable icon. A right-click will bring up a menu, from which alarms may be disabled.

**Figure 147. Disable a Component Alarm**

Once the Disable selection has been made, an icon will appear and remain present to indicate to the M&C user the alarms have been disabled. The disable action inhibits audible alarms and inhibits the blinking action in case of a failure. The icon will still turn red or yellow, if a critical or non-critical error is encountered, respectively. Note the bell icon over 'HF2'.

**Figure 148. Component with Disabled Alarm**

When any M&C component's alarm has been disabled, the user will be notified via an indicator on the tab containing the disabled component, as shown via (1) below. This icon will appear once one or more icon's alarm is disabled. It will disappear when no component alarms are disabled.

**Figure 149. Disable a Subsystem Alarm**

Even if alarms are disabled on a component or components within a tab, new alarms on components which are not disabled will still notify at the tab level via the triangle indicator noted above. If an alarm has been disabled for a component within a tab, and a new alarm on a separate component alerts, the tab will contain both indicators and will look as shown in the example below.

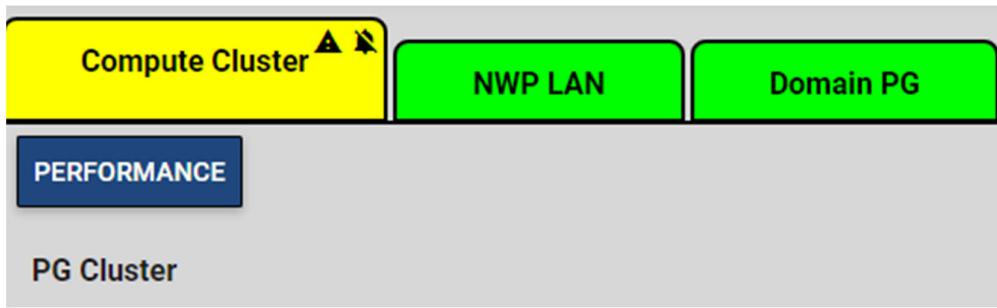


Figure 150. Subsystem with Disabled Alarm

### 5.3.9 Event Log

The M&C user monitors system events configured to be displayed on the M&C GUI via the Events and Notifications window located at the bottom of the GUI. The Events and Notifications window displays system generated events with severity, open/close status, date/time, event type, component, and message. System generated events can be configured to be displayed on either, or both, or neither the System Log and the M&C GUI. An event configured to display on the M&C GUI is also entered in the System Log and, after a system configured time, stored in the System Log Archive. The M&C user can also select to view events in the System Log or the System Log Archive.

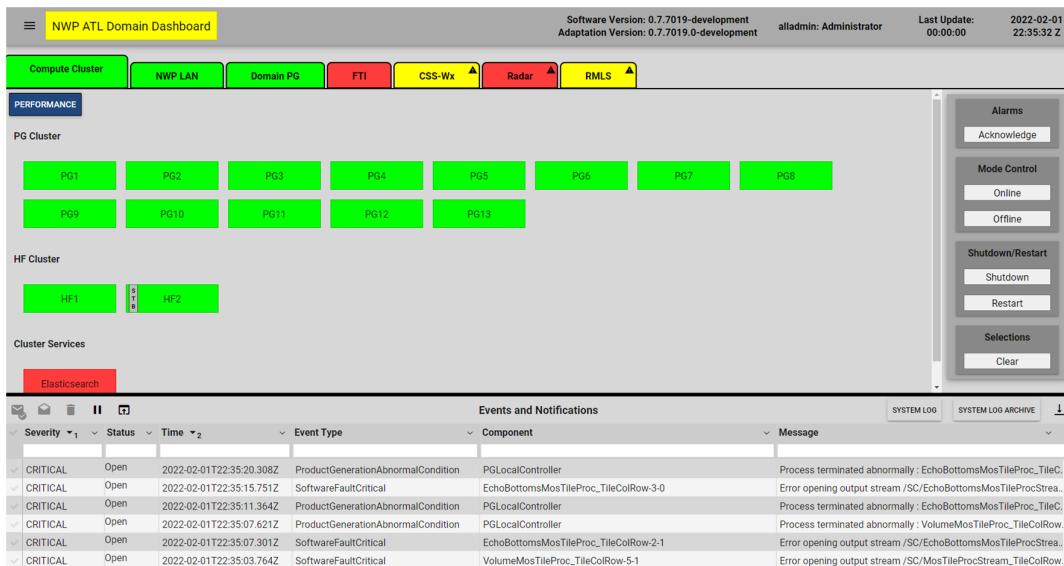


Figure 151. M&amp;C Event and Notifications Window

The M&C Events and Notifications window displays the events for each monitored subsystem in the common Events and Notifications window. For a listing of events, see Event Categories section at the end of this document. The event attributes displayed at the Events and Notifications pane are:

1. **Severity:** The event severity (CRITICAL, NONCRITICAL, WARNING, INFORMATION)
2. **Status:** The user commanded status of the event (Open/Closed) for tracking purposes
3. **Time:** The date and time of the event

4. **Event Type:** The event type (notification, failure, etc.)
5. **Component:** The NWP component which reported the event
6. **Message:** Detailed information provided for the event

Various options are available to the M&C user, some of which depend on roles and permissions. The various options are numbered in blue below:

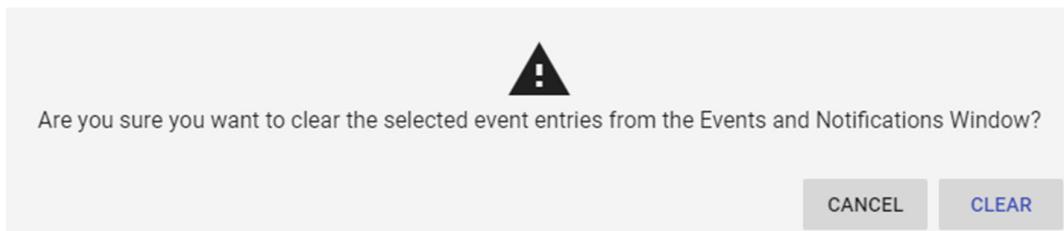
**Figure 152. Events and Notifications Window Details**

The buttons at the top left are provided for closing events, opening events, clearing the displayed events, pausing the event display, and exporting displayed events respectively.

1. **Close:** Selection of this icon changes the status of the selected event's status to 'Closed'. When an event is generated and configured to be displayed at the M&C Events and Notifications, its initial status is set to 'Open'. A user may 'Close' the event for tracking purposes via selection of this icon. An indication of which user performed the action and what time it was performed is provided upon hover over the Status field. In order to select events for closing, the user must first select the events desired for status change via the checkboxes as shown in the figure below. If all events displayed are desired to be closed, the user may select the top checkbox. Upon selection of the 'Close' icon, a confirmation dialog will pop up to confirm the action. Once the action is confirmed, the selected event status will change to 'Closed'. Note: any events which were previously closed will remain closed upon selection and confirmation of the 'Close' icon.
2. **Open:** Selection of this icon changes the selected events status to 'Open'. An event or events must first be selected as shown in the figure below. Upon selection of desired events and subsequent selection of the 'Open' icon, a confirmation dialog will appear to confirm the Open action. Upon confirmation, any events which were previously closed by an M&C user will change status to 'Open'. Any events which have been selected and are currently in 'Open' will remain in 'Open'.
3. **Clear:** Clears the selected events from the M&C window. This does not delete entries from the system event log. The user selects events using the check boxes in the far left column (to select or clear all events, left-click the top check box):

**Figure 153. Clear Selected Events**

The user left-clicks on the trashcan icon and is presented with a confirmation dialog to confirm the action. If CLEAR is selected, the selected events are cleared from the Events and Notifications window. If CANCEL is selected, the window closes and no further action is taken.



**Figure 154. Clear Events Confirmation Dialog**

4. **Pause:** Pauses the events as displayed in the window. When selected, the pause icon changes to a play icon and no additional events are displayed. The play button illuminates red in order to alert the user that no new events are currently being displayed. Events continue to be received and alerts/alarms sound even though the display is paused. Selecting the play icon allows the events display to resume; events which were received during the pause will be displayed.



**Figure 155. Event Window Icons When Paused**

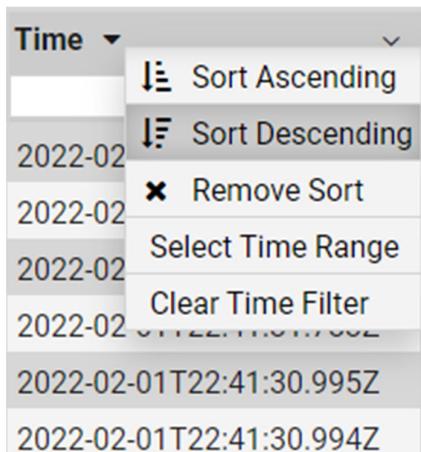
5. **Export:** Allows the list of currently displayed events (per M&C user filtering and/or clearing actions) to be extracted and displayed on a separate browser tab:

| Export      |        |                          |                                      |                                                 |                                                                                         |
|-------------|--------|--------------------------|--------------------------------------|-------------------------------------------------|-----------------------------------------------------------------------------------------|
| Severity    | Status | Time                     | Event Type                           | Component                                       | Message                                                                                 |
| CRITICAL    | Open   | 2022-09-08T11:56:40.971Z | InputOutputInterfaceFaultCritical    | VARIOUS                                         | 174 InputOutputInterfaceFaultCritical events squashed. Check system log for all events. |
| CRITICAL    | Open   | 2022-09-08T11:56:37.739Z | HardwareFaultCritical                | SwitchB                                         | Unable to retrieve status for snmp component powerSupply                                |
| CRITICAL    | Open   | 2022-09-08T11:56:37.739Z | HardwareFaultCritical                | FTISwitchB                                      | Unable to retrieve status for snmp component powerSupply                                |
| CRITICAL    | Open   | 2022-09-08T11:56:37.739Z | HardwareFaultCritical                | SwitchA                                         | Unable to retrieve status for snmp component powerSupply                                |
| CRITICAL    | Open   | 2022-09-08T11:56:37.739Z | HardwareFaultCritical                | FTISwitchA                                      | Unable to retrieve status for snmp component powerSupply                                |
| CRITICAL    | Open   | 2022-09-08T11:56:25.965Z | InputOutputInterfaceFaultCritical    | VARIOUS                                         | 216 InputOutputInterfaceFaultCritical events squashed. Check system log for all events. |
| CRITICAL    | Open   | 2022-09-08T11:56:19.732Z | HardwareFaultCritical                | FTISwitchB                                      | Unable to retrieve status for snmp component powerSupply                                |
| CRITICAL    | Open   | 2022-09-08T11:56:19.732Z | HardwareFaultCritical                | FTISwitchA                                      | Unable to retrieve status for snmp component powerSupply                                |
| CRITICAL    | Open   | 2022-09-08T11:56:19.732Z | HardwareFaultCritical                | SwitchB                                         | Unable to retrieve status for snmp component powerSupply                                |
| CRITICAL    | Open   | 2022-09-08T11:56:19.732Z | HardwareFaultCritical                | SwitchA                                         | Unable to retrieve status for snmp component powerSupply                                |
| CRITICAL    | Open   | 2022-09-08T11:56:11.116Z | InputOutputInterfaceFaultCritical    | VARIOUS                                         | 59 InputOutputInterfaceFaultCritical events squashed. Check system log for all events.  |
| CRITICAL    | Open   | 2022-09-08T11:56:01.800Z | InputOutputInterfaceFaultCritical    | RMLS                                            | RMLS failed to start                                                                    |
| CRITICAL    | Open   | 2022-09-08T11:56:01.800Z | InputOutputInterfaceFaultCritical    | RMLS                                            | RMLS failed to start                                                                    |
| NONCRITICAL | Open   | 2022-09-08T11:56:05.869Z | SoftwareFaultNonCritical             | compute_clusterhf_clusterhf01/software/postgres | Service Database is not replicating.                                                    |
| NONCRITICAL | Open   | 2022-09-08T11:56:01.863Z | InputOutputInterfaceFaultNonCritical | RMLS                                            | No RMLS connections and All clients started                                             |

**Figure 156. Events and Notifications Export**

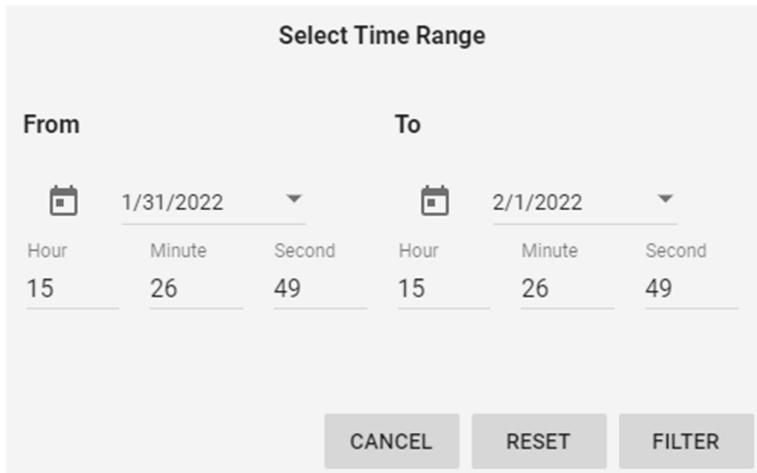
Events can be exported using the Export button.

6. This bar is used to expand the Events and Notifications pane.
7. The icon on the top-right is used to restore the Events and Notifications pane to its original size.
8. The scroll bar is provided to scroll events up or down.
9. The arrows next to each attribute allow for sorting and filtering of the displayed events. The Severity column can be filtered on any combination of the four severity levels: Critical, Non-Critical, Warning, or Informational. Additionally, the column lines can be dragged to resize.
10. The Status column provides the current Open/Closed status of the event. When events are configured to be displayed on the M&C Events and Notifications, they will be initially generated with an Open status. A user may change the status to Closed as described in Item 1 above. The user action is recorded and available for viewing when hovering over the Status column as shown in 10a. The user may filter on either open or closed events or sort by status.
11. The user can enter a specific time in the Time field. The user can also filter on a range of times using the arrow on the right side of the column:



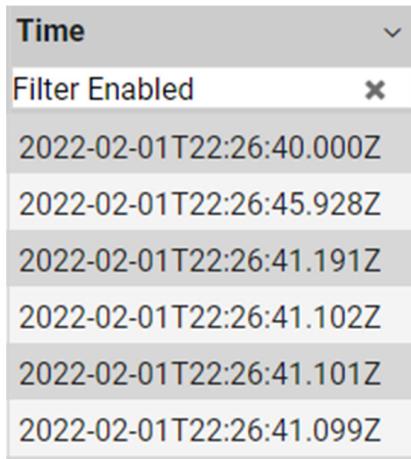
**Figure 157. Time Filter Selection**

Using the Select Time Range option opens a window in which the user selects a date and time range. Default time selections are: From - minus one (1) day; To - current date and time. The user can adjust the From or To timestamps using the entry fields. Selecting the RESET button returns the time display to the default values. Selecting the FILTER button closes the window and events within the selected time range are displayed. Selecting the CANCEL button closes the window and no filter is applied (a previously applied filter remains until specifically cleared or changed).



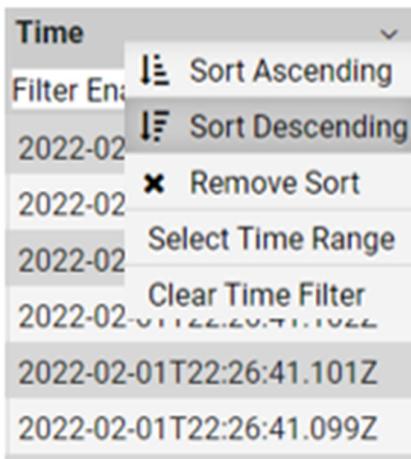
**Figure 158. Time Filter Window**

Once applied, the filter notification displays in the column window.



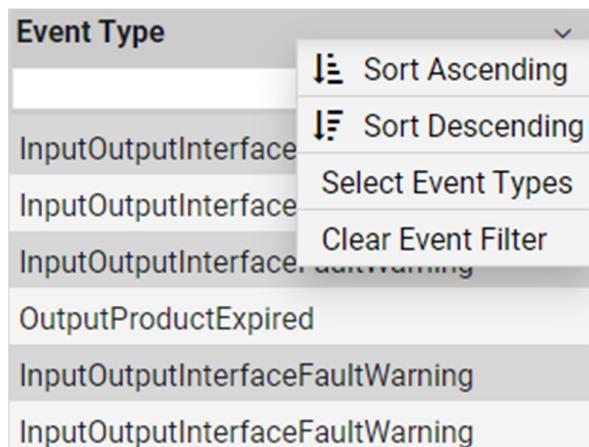
**Figure 159. Time Filter Enabled**

To remove the time filter, the user selects the Clear Time Filter option:

**Figure 160. Clear Time Filter**

The time filter is removed and all events (within system time settings and those not filtered by other filters) are displayed.

12. The user may type to filter on specific event type text or may select one or multiple event types using the Select Event Types option:

**Figure 161. Multiple Event Types Selection**

A window opens from which the user can select event types. One or more event types can be selected using the check marks next to each:

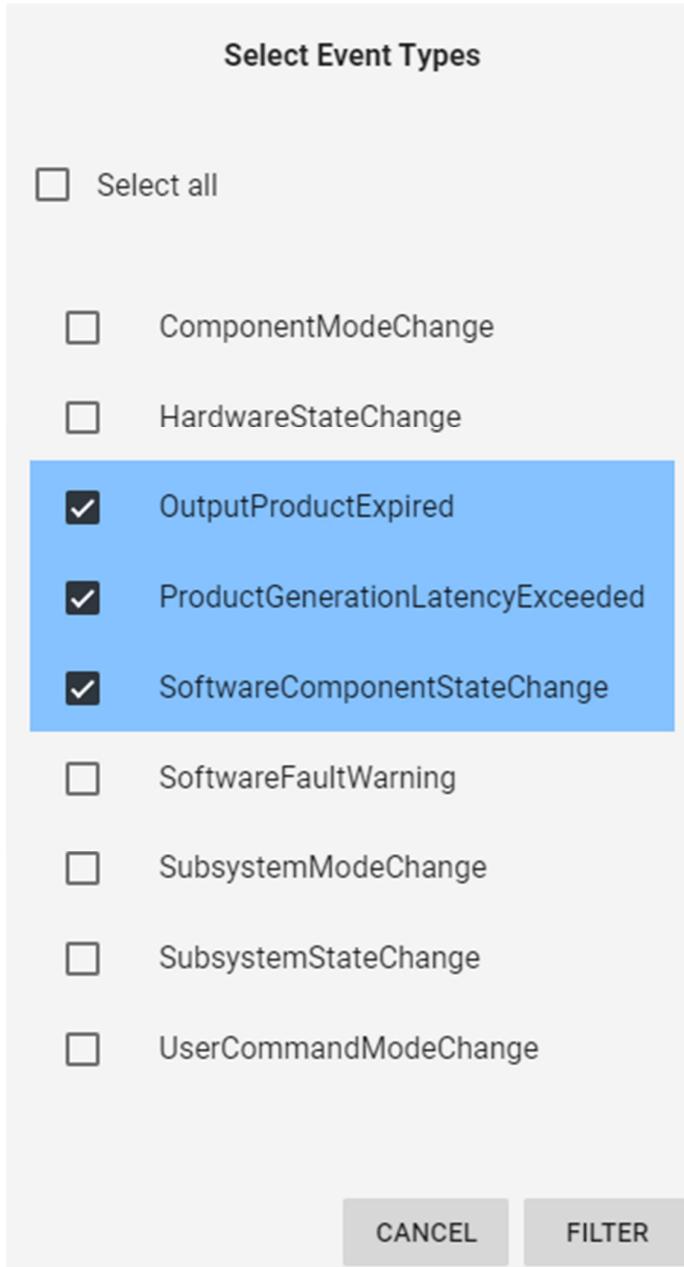
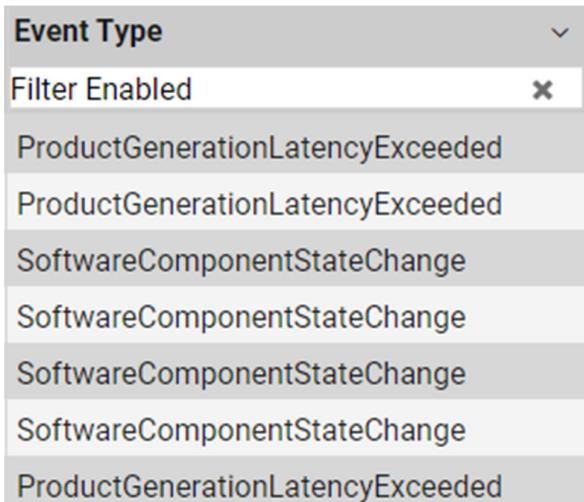
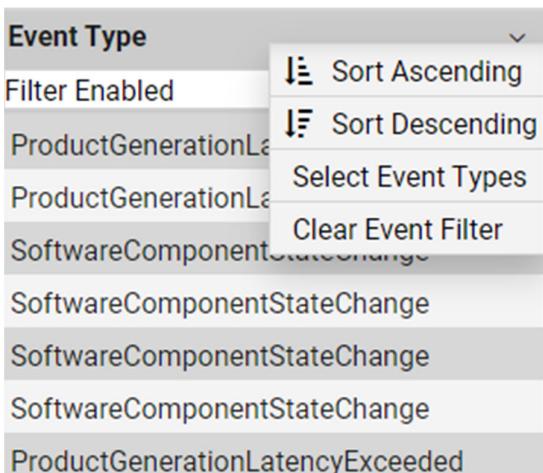


Figure 162. Event Type Filter

Selecting the CANCEL button closes the window and no filter is applied (a previously applied filter remains until specifically cleared or changed). Selecting the FILTER button closes the window, the filter notification displays in the column window, and only the specified event types are displayed:

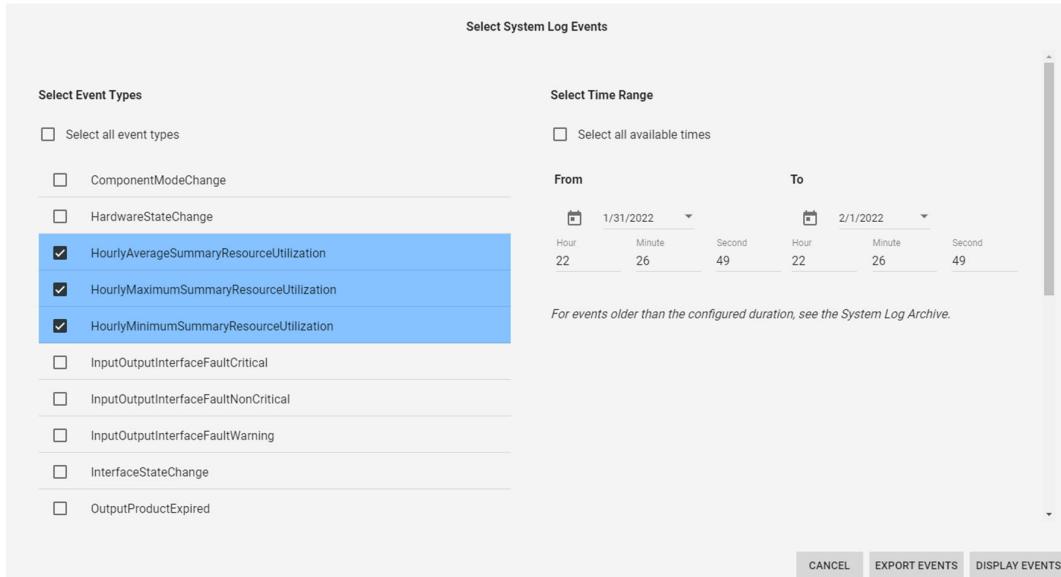
**Figure 163. Filter Enabled**

To remove the time filter, the user selects the Clear Event Filter option:

**Figure 164. Clear Event Filter**

13. The user may enter specific text into the Component or Message window to filter in each column.
14. If additional detail in the event Message is available, but not displayed in the currently sized window, a “...” will indicate additional text is available. Hover the mouse over the “...” to display the full message text.
15. Selecting the SYSTEM LOG button opens a window in which the user can specify event types and times to be displayed. The user can select one or multiple event types, or all event types using the 'Select all event types' option on the left. The user can select a specific time range using the filter or the entire time range using the 'Select all available times' option on the right. Note: Events may be configured to be displayed on either the M&C Events and Notifications log or the System Log, or both. Therefore there may be

additional events available in the System log that are not present in the Events and Notifications log.



**Figure 165. System Log filter**

The user may choose to EXPORT EVENTS or DISPLAY EVENTS. All event attributes are displayed or exported including event Severity, Status, Time, Event Type, Component, Message, and Status Info. For EXPORT EVENTS, the selected events are saved to a .csv file in the local Downloads folder:

For DISPLAY EVENTS, the System Event Log is displayed in a new browser tab:

| Event Query Results - Latest 5000 entries displayed. Additional events may be available via 'Export Events' |        |                          |                                         |                                 |                                                                                                                                                                                                  |                                   |
|-------------------------------------------------------------------------------------------------------------|--------|--------------------------|-----------------------------------------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| Severity                                                                                                    | Status | Time                     | Event Type                              | Component                       | Message                                                                                                                                                                                          | Status Info                       |
| INFORMATIONAL                                                                                               | open   | 2022-02-01T22:13:37.768Z | HourlyAverageSummaryResourceUtilization | compute_cluster/pg_cluster_pg13 | cpu:0.7% memory:54.3% disk:[local] 0.0% disk[home]:0.0% disk:[var]log:0.1% disk[opt]:1.9% disk:[var]0.1% disk[1]:2.1% disk[tmp]:0.0% disk:[var/lib/elasticsearch]:0.0% disk:[var]log[audit]:0.0% | Event created with current status |
| INFORMATIONAL                                                                                               | open   | 2022-02-01T22:13:37.768Z | HourlyAverageSummaryResourceUtilization | VARIOUS                         | 15 Hourly Average Summary Resource Utilization events squashed. Check system log for all events.                                                                                                 | Event created with current status |
| INFORMATIONAL                                                                                               | open   | 2022-02-01T22:13:37.768Z | HourlyAverageSummaryResourceUtilization | compute_cluster/pg_cluster_pg05 | cpu:2.2% memory:54.5% disk:[local] 0.0% disk[home]:0.0% disk:[var]log:0.1% disk[opt]:1.6% disk:[var]0.1% disk[1]:1.8% disk[tmp]:0.0% disk:[var/lib/elasticsearch]:0.0% disk:[var]log[audit]:0.0% | Event created with current status |
| INFORMATIONAL                                                                                               | open   | 2022-02-01T22:13:37.768Z | HourlyAverageSummaryResourceUtilization | compute_cluster/pg_cluster_pg10 | cpu:1.1% memory:57.8% disk:[local] 0.0% disk[home]:0.0% disk:[var]log:0.1% disk[opt]:1.6% disk:[var]0.1% disk[1]:1.8% disk[tmp]:0.0% disk:[var/lib/elasticsearch]:0.0% disk:[var]log[audit]:0.0% | Event created with current status |
| INFORMATIONAL                                                                                               | open   | 2022-02-01T22:13:37.768Z | HourlyMaximumSummaryResourceUtilization | compute_cluster/pg_cluster_pg02 | cpu:0.9% memory:56.5% disk:[local] 0.0% disk[home]:0.0% disk:[var]log:0.1% disk[opt]:1.9% disk:[var]0.2% disk[1]:1.8% disk[tmp]:0.0% disk:[var/lib/elasticsearch]:0.0% disk:[var]log[audit]:0.0% | Event created with current status |
| INFORMATIONAL                                                                                               | open   | 2022-02-01T22:13:37.768Z | HourlyMaximumSummaryResourceUtilization | compute_cluster/pg_cluster_pg13 | cpu:1.2% memory:54.3% disk:[local] 0.0% disk[home]:0.0% disk:[var]log:0.1% disk[opt]:1.9% disk:[var]0.1% disk[1]:2.1% disk[tmp]:0.0% disk:[var/lib/elasticsearch]:0.0% disk:[var]log[audit]:0.0% | Event created with current status |
| INFORMATIONAL                                                                                               | open   | 2022-02-01T22:13:37.768Z | HourlyMaximumSummaryResourceUtilization | VARIOUS                         | 15 Hourly Maximum Summary Resource Utilization events squashed. Check system log for all events.                                                                                                 | Event created with current status |

**Figure 166. Display System Log**

**16.** Selecting the SYSTEM LOG ARCHIVE button opens a window from which the user can select the desired archive file from the available list:

| System Log Archives |                                                 |
|---------------------|-------------------------------------------------|
| Date                | Filename                                        |
| 2022-02-03          | <a href="#"><u>sms-event-archive-0.csv</u></a>  |
| 2022-02-03          | <a href="#"><u>sms-event-archive-1.csv</u></a>  |
| 2022-02-03          | <a href="#"><u>sms-event-archive-2.csv</u></a>  |
| 2022-02-03          | <a href="#"><u>sms-event-archive-3.csv</u></a>  |
| 2022-02-03          | <a href="#"><u>sms-event-archive-4.csv</u></a>  |
| 2022-02-03          | <a href="#"><u>sms-event-archive-5.csv</u></a>  |
| 2022-02-03          | <a href="#"><u>sms-event-archive-6.csv</u></a>  |
| 2022-02-03          | <a href="#"><u>sms-event-archive-7.csv</u></a>  |
| 2022-02-03          | <a href="#"><u>sms-event-archive-8.csv</u></a>  |
| 2022-02-03          | <a href="#"><u>sms-event-archive-9.csv</u></a>  |
| 2022-02-03          | <a href="#"><u>sms-event-archive-10.csv</u></a> |

**Figure 167. Archive Log Selection**

Selecting the filename (left-click) displays the log in a new browser tab as a text output:

```
INFO:2022-02-03T18:00:10.511Z,SubsystemStateChange,national_view[domain_national_view:domain changed status from degraded to normal],open,Event created with current status
CRITICAL:2022-02-03T18:00:15.457Z,LogFileAuditCritical,log_directory[ds1_interconnect_x]/() Could not resolve the following addresses: udp:192.168.73.12/161 ,open,Event created with current status
CRITICAL:2022-02-03T18:00:15.457Z,LogFileAuditCritical,log_directory[advcnsgw_1_1gb_b/] Could not resolve the following addresses: udp:192.168.73.9/161 ,open,Event created with current status
INFORMATIONAL:2022-02-03T18:00:18.667Z,SubsystemStateChange,national_view[domain_national_view:domain changed status from normal to degraded],open,Event created with current status
INFORMATIONAL:2022-02-03T18:00:43.667Z,SubsystemStateChange,national_view[domain_national_view:domain changed status from normal to degraded],open,Event created with current status
INFORMATIONAL:2022-02-03T18:01:04.503Z,HourlyMinimumSummaryResourceUtilization,compute_cluster[pg_cluster/pg06,"cpu":0.2%
memory:3.6%
disk[/local]:4.0%
disk[/home]:0.0%
disk[/tmp/share]:0.8%
disk[/var/log]:0.3%
disk[/opt]:0.4%
disk[/var]:0.1%
disk[/]:4.0%
disk[/tmp]:0.0%
disk[/var/lib/elasticsearch]:0.0%
disk[/var/log/audit]:0.0%
",open,Event created with current status
INFORMATIONAL:2022-02-03T18:01:04.503Z,HourlyMinimumSummaryResourceUtilization,compute_cluster[pg_cluster/pg05,"cpu":0.2%
memory:3.7%
disk[/local]:4.0%
disk[/home]:0.0%
disk[/tmp/share]:0.8%
disk[/var/log]:0.3%
disk[/opt]:0.4%
disk[/var]:0.1%
disk[/]:4.0%
disk[/tmp]:0.0%
disk[/var/lib/elasticsearch]:0.0%
disk[/var/log/audit]:0.0%
```

**Figure 168. System Log Archive Display**

### 5.3.9.1 Event Categories:

The events and notifications displayed in the Events and Notifications window are classified into one of eight categories:

**Table 13. Event Categories**

| <b>Event Category</b>                     | <b>Applicable Component</b>                              | <b>Message</b>                                                                                              | <b>Applicable Severity</b>                  | <b>Category Definition</b>                                                                                                                                                                                                             |
|-------------------------------------------|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fault Notification                        | Hardware, Software, or Interface Component as applicable | Identification of Fault                                                                                     | Info<br>Warning<br>Non-Critical<br>Critical | Events indicate the event type, the affected component, the severity, and an indication of the fault that has occurred.<br><br>If severity is non-critical, or critical, there will also be an associated State or Mode Change" event. |
| User-settable Adaptation Parameter Change | software component                                       | Identification of the parameter that was changed.<br>List the original value and new value of the parameter | Info                                        | Information only events - no state change associated                                                                                                                                                                                   |
| Quality Assessment                        | software component                                       | Integrity Assessments indicate a pass or fail.<br>Decode Error only generated on Error.                     | Info<br>Warning                             | Integrity Assessments: Pass events are Info level severity<br><br>Failed Integrity checks and Decode Error are Warning level - no state change                                                                                         |
| Resource Utilization                      | hardware component                                       | Indication of resource utilization, message may contain multiple values                                     | Info                                        | Messaging indicates resource utilization values; storage utilization message indicates total capacity of storage, available capacity, and average utilization                                                                          |
| State or Mode Change                      | Hardware, Software, or Interface Component as applicable | Original state value and updated state value                                                                | Info                                        | The state change event is info level only. The events which drive a state change are non-critical or critical                                                                                                                          |
| Threshold Exceeded Notification           | Hardware, Software, or Interface Component as applicable | Indication of time or measurement that has exceeded configured thresholds                                   | Warning                                     | Warning level - no state change after single occurrence of event. Multiple occurrences may drive state change                                                                                                                          |

|                        |                                                          |                                             |      |                                                                                                                                                  |
|------------------------|----------------------------------------------------------|---------------------------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------|
|                        |                                                          |                                             |      | (for hardware components)                                                                                                                        |
| Timeliness Measurement | software component                                       | Latency or timeliness value as measured     | Info | Info level only. If these values are high such that a threshold is exceeded, a separate event is generated (see Threshold Exceeded Notification) |
| User Command           | Hardware, Software, or Interface Component as applicable | Username, time of command, action commanded | Info | M&C User has commanded an action from the display                                                                                                |

The following event types may be displayed, when configured, in the Events and Notifications window:

Each unique event is assigned a severity level: Info, Warning, Non-Critical, or Critical. Non-Critical events result in the affected component state of Degraded. Critical events result in the affected component state change of Failed. Info or Warning events do not cause a component state change.

**Table 14. Event Types**

| Event Category     | Event Type          | Severity    | Change state? | Event Details                                                                                                                                                                                                                     |
|--------------------|---------------------|-------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fault Notification | LRUFaultCritical    | Critical    | Yes – Failed  | An LRU fault with Critical severity. Specific event details will be available in the event message.<br><br>This is applicable to a specific hardware component which will be identified in the component field of the event data. |
| Fault Notification | LRUFaultNonCritical | NonCritical | Yes-Degraded  | An LRU fault with NonCritical severity. Specific event details will be available in the event message.<br><br>This is applicable to a specific                                                                                    |

|                    |                                      |              |              |                                                                                                                                                                                                                                                |
|--------------------|--------------------------------------|--------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                    |                                      |              |              | hardware component which will be identified in the component field of the event data.                                                                                                                                                          |
| Fault Notification | SoftwareFaultInfo                    | Info         | No           | <p>Informational level severity software fault (example, component was commanded to be shutdown).</p> <p>This is applicable to a specific software component which will be identified in the component field of the event data.</p>            |
| Fault Notification | SoftwareFaultCritical                | Critical     | Yes – Failed | <p>Critical level severity software fault (example, software process failed)</p> <p>This is applicable to a specific software component which will be identified in the component field of the event data.</p>                                 |
| Fault Notification | InputOutputInterfaceFaultWarning     | Warning      | No           | <p>An interface fault with Warning severity. Specific event details will be available in the event message.</p> <p>This is applicable to a specific interface component which will be identified in the component field of the event data.</p> |
| Fault Notification | InputOutputInterfaceFaultNonCritical | Non-Critical | Yes-Degraded | An interface fault with Non-Critical severity. Specific event details will                                                                                                                                                                     |

|                    |                                    |          |              |                                                                                                                                                                                                                                      |
|--------------------|------------------------------------|----------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                    |                                    |          |              | be available in the event message.<br>This is applicable to a specific interface component which will be identified in the component field of the event data.                                                                        |
| Fault Notification | InputOutputInterfaceFaultCritical  | Critical | Yes – Failed | An interface fault with Critical severity. Specific event details will be available in the event message.<br>This is applicable to a specific interface component which will be identified in the component field of the event data. |
| Fault Notification | DataRetentionAbnormalCondition     | Warning  | No           | A valid, but unexpected status associated with data retention has been detected.                                                                                                                                                     |
| Fault Notification | SoftwareAbnormalCondition          | Warning  | No           | A valid, but unexpected status associated with a specific software component has been detected.                                                                                                                                      |
| Fault Notification | DataRetrievalAbnormalCondition     | Warning  | No           | A valid, but unexpected status associated with data retrieval has been detected.                                                                                                                                                     |
| Fault Notification | ProductGenerationAbnormalCondition | Critical | No           | A valid, but unexpected status has been detected during product generation.                                                                                                                                                          |
| Fault Notification | SystemConfigurationChange          | Warning  | No           | Unauthorized changes to software and system configuration settings are detected                                                                                                                                                      |

|                                           |                             |         |    |                                                                                                                                                                                                                                                                                |
|-------------------------------------------|-----------------------------|---------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fault Notification                        | AuditProcessingFailure      | Info    | No | Audit processing failure has been detected                                                                                                                                                                                                                                     |
| Fault Notification                        | MalwareDetected             | Info    | No | An alert has been detected from the anti-virus software                                                                                                                                                                                                                        |
| Fault Notification                        | AdaptationVersionMismatch   | Warning | No | After an adaptation update, the adaptation version on one or more servers does not match.                                                                                                                                                                                      |
| Fault Notification                        | SoftwareVersionMismatch     | Warning | No | After a software update, the software version on one or more servers does not match.                                                                                                                                                                                           |
| User-settable Adaptation Parameter Change | AdaptationChange            | Info    | No | An adaptation parameter has been updated. The event message will indicate the specific parameter as well as the old and new value.                                                                                                                                             |
| Quality Assessment                        | InputProductIntegrityPassed | Info    | No | A product specific integrity assessment has been performed for the input product; the integrity assessment passed.                                                                                                                                                             |
| Quality Assessment                        | InputProductIntegrityFailed | Info    | No | A product specific integrity assessment has been performed for the input product; the integrity assessment failed. A failure of integrity indicates the file input file is zero size, the JMS payload is empty, or the payload is inconsistent with message metadata (the file |

|                      |                                         |              |    |                                                                                                                                                                                                                 |
|----------------------|-----------------------------------------|--------------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      |                                         |              |    | was improperly formatted).                                                                                                                                                                                      |
| Quality Assessment   | InputProductDecodeError                 | Non-Critical | No | An input product cannot be decoded or processed by PG.                                                                                                                                                          |
| Quality Assessment   | OutputProductIntegrityPassed            | Info         | No | A product specific integrity assessment has been performed for the output product; the integrity assessment passed.                                                                                             |
| Quality Assessment   | OutputProductIntegrityFailed            | Info         | No | A product specific integrity assessment has been performed for the output product; the integrity assessment failed. A failure of integrity indicates the file failed to be written or closed in CSS-Wx storage. |
| Quality Assessment   | AWDInputDisplayProductDecodeError       | Non-Critical | No | A WFS or WMS response cannot be decoded or processed.                                                                                                                                                           |
| Resource Utilization | HourlyAverageSummaryResourceUtilization | Info         | No | Event message contains the average value of resource utilization during the hour.                                                                                                                               |
| Resource Utilization | HourlyMinimumSummaryResourceUtilization | Info         | No | Event message contains the minimum value of each resource utilization event over the hour                                                                                                                       |
| Resource Utilization | HourlyMaximumSummaryResourceUtilization | Info         | No | Event message contains the maximum value of each resource utilization event during the hour.                                                                                                                    |

|                      |                      |      |    |                                                                                                                                                                                                                               |
|----------------------|----------------------|------|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| State or Mode Change | SubsystemStateChange | Info | No | An NWP subsystem (Compute Cluster, PG, or NWP LAN) has changed state. Available states are Normal, Degraded, and Failed.<br><br>The message will indicate the original and updated state.                                     |
| State or Mode Change | SubsystemModeChange  | Info | No | An NWP subsystem (PG) has changed mode. Available modes for subsystems are Online and Offline.<br><br>The message will indicate the original and updated mode.                                                                |
| State or Mode Change | ComponentModeChange  | Info | No | An NWP hardware, software, or interface component has changed mode. Available modes are: Online, Offline, and Standby. Not all modes apply to all components.<br><br>The message will indicate the original and updated mode. |
| State or Mode Change | HardwareStateChange  | Info | No | An NWP hardware component has changed state. Available states are Normal, Degraded, and Failed.<br><br>The message will indicate the specific component and the original and updated state.                                   |

|                                 |                                  |      |    |                                                                                                                                                                                                                       |
|---------------------------------|----------------------------------|------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| State or Mode Change            | SoftwareComponentStateChange     | Info | No | An NWP software component has changed state. Available states are Normal, Degraded, and Failed.<br><br>The message will indicate the specific component and the original and updated state.                           |
| State or Mode Change            | InterfaceStateChange             | Info | No | An NWP interface component has changed state. Available states are Normal, Degraded, and Failed.<br><br>The message will indicate the specific component and the original and updated state.                          |
| Threshold Exceeded Notification | OutputProductExpired             | Info | No | Message occurs when a product is ready at or after its expiration time. Message indicates a measurement of the time difference between when a particular product is ready for output and its product expiration time. |
| Threshold Exceeded Notification | InputProductExpired              | Info | No | Message indicates that a particular product was received by NWP at or after its expiration time.                                                                                                                      |
| Threshold Exceeded Notification | ProductGenerationLatencyExceeded | Info | No | Message indicates that the Product Generation Latency, the time between product generation start and delivery start to CSS-Wx, has exceeded latency thresholds defined                                                |

|                                 |                                        |              |                |                                                                                                                                    |
|---------------------------------|----------------------------------------|--------------|----------------|------------------------------------------------------------------------------------------------------------------------------------|
|                                 |                                        |              |                | for the particular product.                                                                                                        |
| Fault Notification              | ConfiguredAlertsTimeout                | Info         | No             | Event generated when the time since receipt of a Configured Alert by an AWD exceeds an adaptable time period.                      |
| Threshold Exceeded Notification | AWDInputDisplayProductExpired          | Info         | No             | Event generated when an AWD display product is received at or after its expiration time.                                           |
| Threshold Exceeded Notification | AWDInputDisplayProductLatencyExceeded  | Info         | No             | Event generated when a display product's latency exceeds adapted thresholds.                                                       |
| Threshold Exceeded Notification | CPUUtilizationExceedsLowerThreshold    | Non-Critical | Yes - Degraded | Event generated when the average CPU utilization percentage in a specified interval has exceeded adapted lower limit threshold.    |
| Threshold Exceeded Notification | CPUUtilizationExceedsUpperThreshold    | Critical     | Yes - Failed   | Event generated when the average CPU utilization percentage in a specified interval has exceeded adapted upper limit threshold.    |
| Threshold Exceeded Notification | MemoryUtilizationExceedsLowerThreshold | Non-Critical | Yes - Degraded | Event generated when the average memory utilization percentage in a specified interval has exceeded adapted lower limit threshold. |
| Threshold Exceeded Notification | MemoryUtilizationExceedsUpperThreshold | Critical     | Yes - Failed   | Event generated when the average memory utilization percentage in a specified interval has exceeded adapted upper limit threshold. |

|                                 |                                      |              |                |                                                                                                                                                            |
|---------------------------------|--------------------------------------|--------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Threshold Exceeded Notification | DiskUtilizationExceedsLowerThreshold | Non-Critical | Yes - Degraded | Event generated when the internal storage utilization percentage in a specified interval has exceeded adapted lower limit threshold.                       |
| Threshold Exceeded Notification | DiskUtilizationExceedsUpperThreshold | Critical     | Yes - Failed   | Event generated when the internal storage utilization percentage in a specified interval has exceeded adapted upper limit threshold.                       |
| Threshold Exceeded Notification | PerRadarProcessingLatencyExceeded    | Info         | No             | Event generated when the difference between the radar processing start and stop times exceeds 15 seconds.                                                  |
| Timeliness Measurement          | InputProductLatency                  | Info         | No             | Message indicates time difference between a product's Ingest time and its time of translation complete (time of internal availability).                    |
| Timeliness Measurement          | ProductGenerationLatency             | Info         | No             | Message indicates a measurement of the time difference between a product's generation start time and its time of delivery start to CSS-Wx.                 |
| Timeliness Measurement          | AWDInputDisplayProductLatency        | Info         | No             | Message indicates, for a particular AWD display product, a measurement of the time difference between the time of display product receipt and its display. |

|                        |                                  |              |                |                                                                                          |
|------------------------|----------------------------------|--------------|----------------|------------------------------------------------------------------------------------------|
| Timeliness Measurement | PerRadarProcessingLatency        | Info         | No             | Message indicates a time difference between radar processing start and stop times.       |
| User Command           | UserCommandModeChange            | Info         | No             | Message indicates the username, component, and the mode which was commanded to change.   |
| User Command           | UserCommandRestart               | Info         | No             | Message indicates the username and component which was commanded to restart.             |
| User Command           | UserCommandReset                 | Info         | No             | Message indicates the username and component which was commanded to reset.               |
| User Command           | UserCommandAcknowledge           | Info         | No             | Message indicates the username and component for which the alarm was acknowledged        |
| User Command           | UserCommandAlarmChange           | Info         | No             | Message indicates the username and component for which the alarm was enabled or disabled |
| Fault Notification     | HostedAlgorithmAbnormalCondition | Warning      | No             | Indicates an unexpected condition was reached in a hosted algorithm                      |
| Fault Notification     | SoftwareFaultWarning             | Warning      | No             | Event generated when a hosted algorithm encounters a runtime error.                      |
| Fault Notification     | SoftwareFaultNonCritical         | Non-Critical | Yes - Degraded | Database replication error detected, SNMP monitoring a software                          |

|                    |                           |              |                |                                                                 |
|--------------------|---------------------------|--------------|----------------|-----------------------------------------------------------------|
|                    |                           |              |                | component detects a degraded state                              |
| Fault Notification | HardwareFaultNonCritical  | Non-Critical | Yes - Degraded | SNMP monitoring a hardware component detects a degraded state   |
| Fault Notification | HardwareFaultCritical     | Critical     | Yes - Failed   | SNMP monitoring a hardware component detects a failure state    |
| Fault Notification | InterfaceFaultNonCritical | Non-Critical | Yes - Degraded | SNMP monitoring an interface component detects a degraded state |
| Fault Notification | InterfaceFaultCritical    | Critical     | Yes - Failed   | SNMP monitoring an interface component detects a failure state  |

### 5.3.10 Monitor Performance

The M&C operator may monitor performance of a single server or collection of servers. The M&C GUI provides the capability to view CPU, memory, and storage statistics.

#### 5.3.10.1 Single Server Performance Monitor

In order to monitor the performance of a single HF or PG server, the M&C user will, from the Compute Cluster tab, left-click on the icon of the desired server. In the example below, the M&C user has selected the PG4 server.

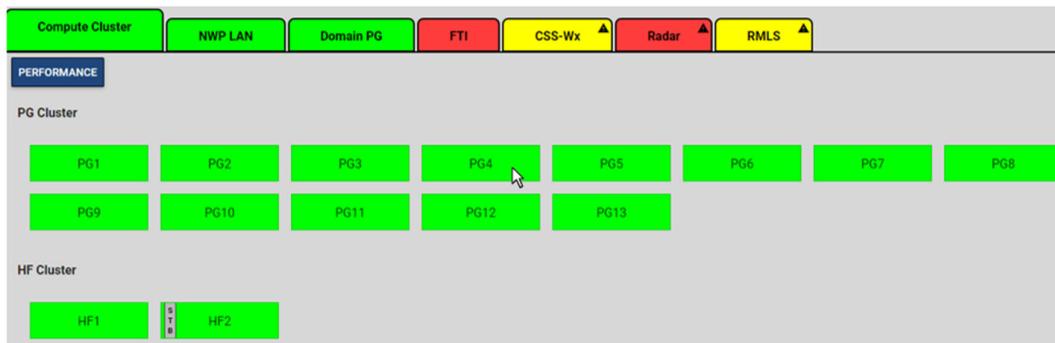


Figure 169. Select PG4 from the Compute Cluster Tab

This selection brings the user to a detailed view of the hardware and software status of the server as shown below:

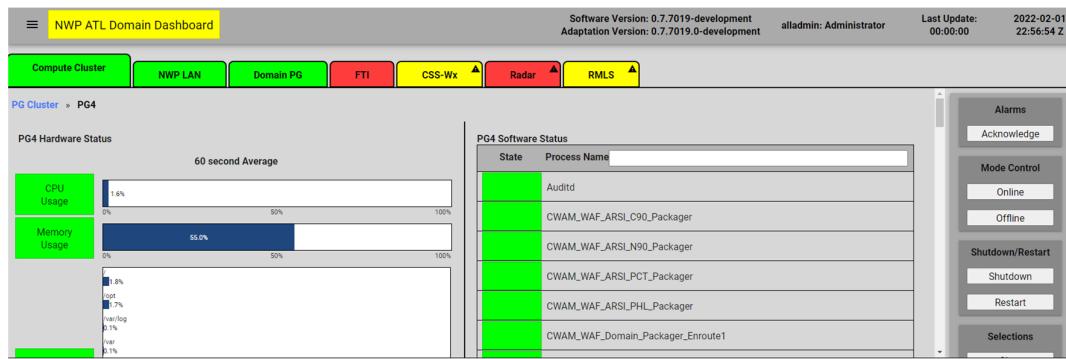


Figure 170. Server Detail View

The hardware performance information may be viewed on the left and is described by number in detail below:

**Figure 171. Server Performance Details**

1. This icon provides a colored indication of the state of the CPU usage. If the latest calculated average of CPU is within configured thresholds, the icon will indicate green/Normal. If the latest calculated CPU average usage exceeds lower configured threshold, the CPU icon will degrade from green/Normal to yellow/Degraded state. If the latest calculated CPU average exceeds the configured upper threshold, the CPU icon will change to the red/Failed state.
2. The blue bar to the right of the CPU icon provides an indication of CPU usage in percentage. The percentage displayed is the most recent calculated CPU average.

CPU averages are calculated at a system adaptable period, as noted by the title above the bar. This bar is updated each time a new CPU average is calculated.

3. This Memory icon and usage indications are presented in the same fashion as CPU (See 1-2 above).
4. The Disk usage icon indicates green/Normal if disk usage for all displayed disks is within user settable configured thresholds. If one or more disk usages exceed configured thresholds, this icon will indicate yellow/Degraded. Specific disks are listed to the right with a percentage bar to indicate current disk usage for each.
5. An indication of the remaining disk space for each disk is updated each time the average disk usage is updated. In order to see this indication, the user must hover over the applicable disk bar. An icon will appear with additional information for the particular disk as shown below:

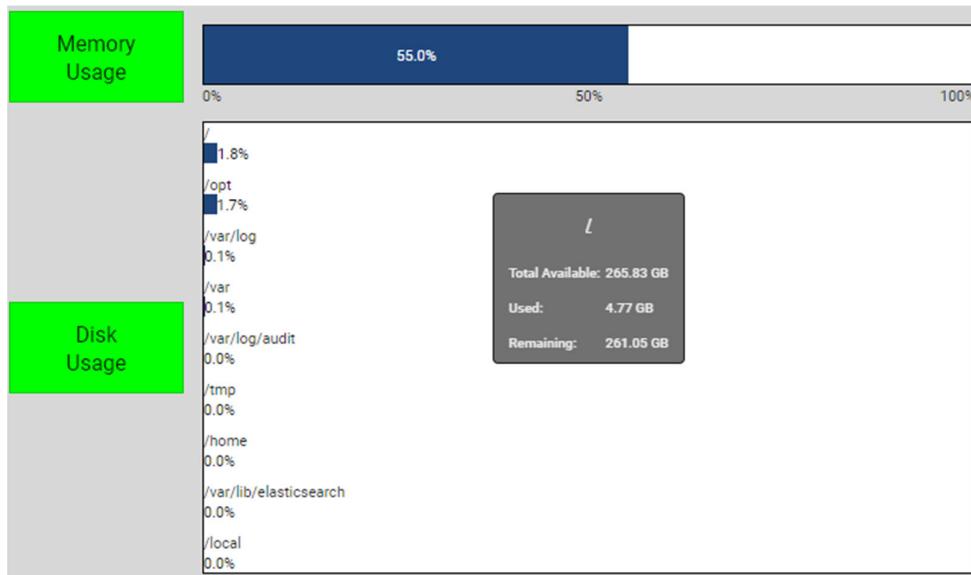


Figure 172. Hover Display for Total, Used, and Remaining Disk Space

6. This icon provides a colored indication of the overall status of the mount points. If all mount points connections are successful, this will be colored green/Normal state. If any mount point cannot be reached, it will be declared failed and this icon will indicate yellow/Degraded.
7. A listing of mount points with their current connection status is provided. Not all mount points may necessarily be shown, however, the top most utilized mount points will be shown.
8. This icon provides an indication of the status of the connections to the server. If all port connections are successful, the status is Normal. If a port connection is failed, the status will degrade to yellow/Degraded.
9. A listing of the specific ports configured for the server and the connection status of each port is provided.
10. The Global System Status icon provides a colored indication of the status of the server selected. The status of the Global System Status coincides with the status of the server indicated by the LCD on the front of the server itself.
11. This icon provides the status of the disk's hard drives beyond the disk usage as shown in 4 and 5.
12. The Cooling Status icon displays the status of the Server's cooling systems.

13. The Power Supply icon provides the status of the server's power supply.

**5.3.10.2 Compute Cluster Subsystem Performance Monitoring**  
An M&C user can monitor the performance of multiple servers within the Compute Cluster. In order to monitor the performance of multiple servers, the user will left-click the 'Performance' button as shown below:

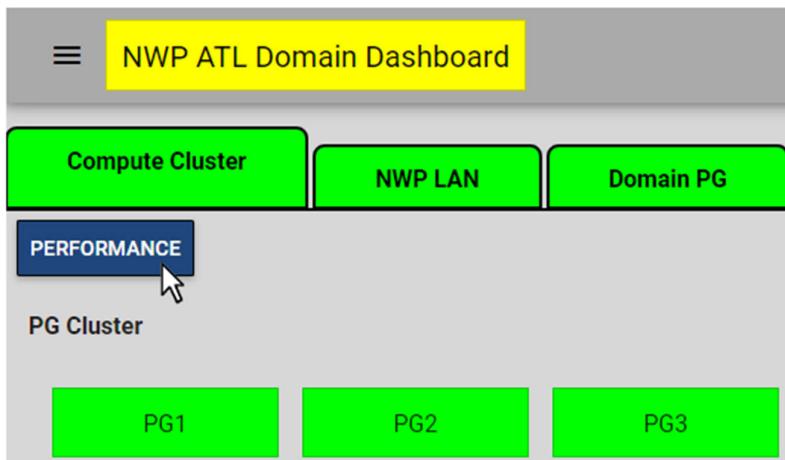
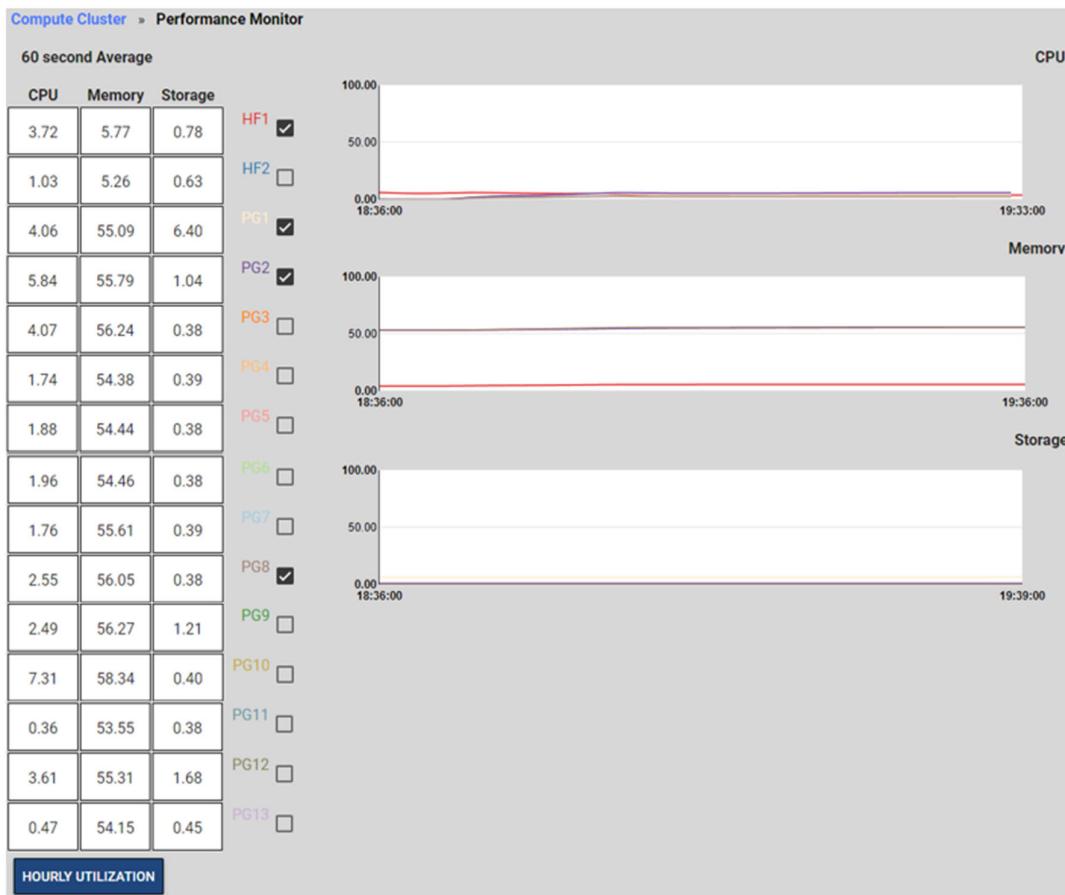
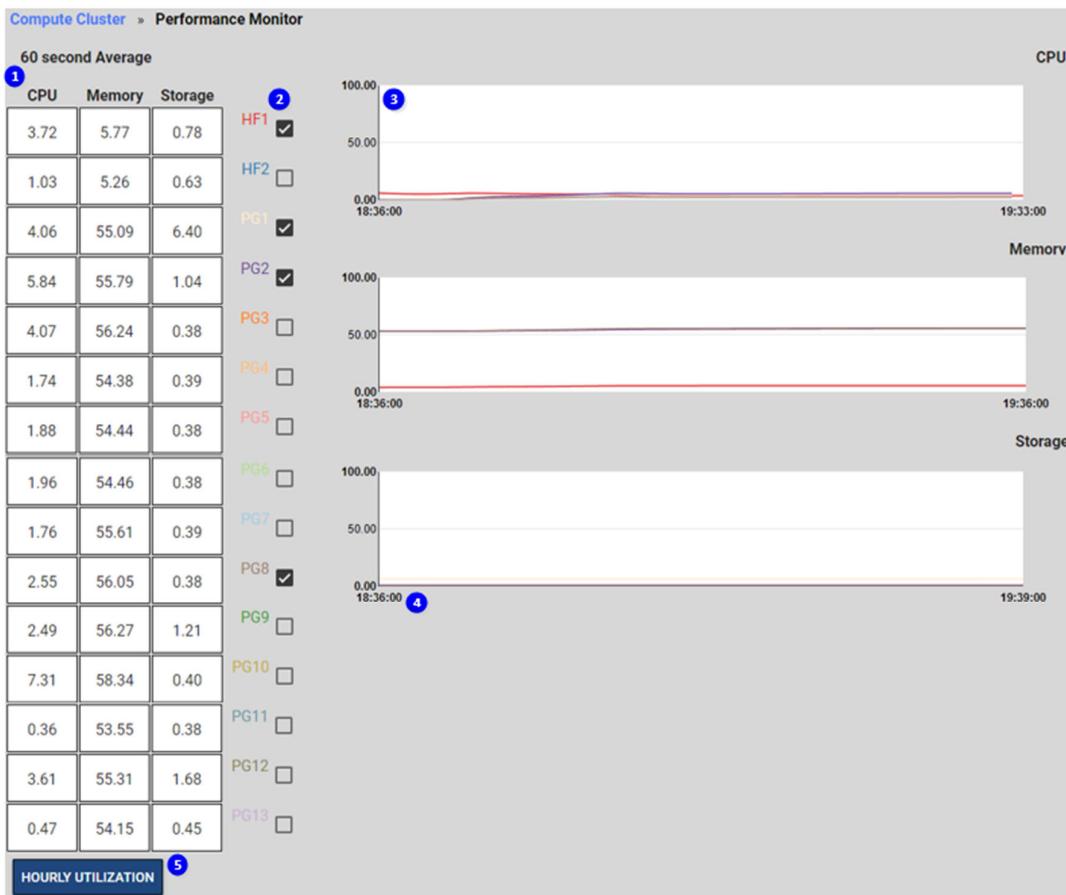


Figure 173. Compute Cluster Performance Monitor Selection

This action launches the performance monitoring window shown below:

**Figure 174. Compute Cluster Performance Monitor**

This screen provides the capability to monitor CPU, Memory, and Storage usage for selected servers. Statistics representing average CPU, Memory, and Storage are provided. The example below provides a numbered view. See description below for more detail.

**Figure 175. Performance Monitor Details**

1. Calculated averages for each server are provided. Averages are calculated over a system adaptable period and updated each time the average is calculated.
2. The M&C user selects the box for each server they wish to monitor on the graph by left-clicking on the box to the right of each labelled server. As boxes are checked, a color is assigned to the server.
3. The performance data is plotted with the color assigned for the server. The performance data averages are plotted from the time the server is selected for display of its graph until the most current calculated average. The graphs will be updated as additional averages are calculated. All performance data (CPU, Memory, and storage usage) are plotted as percentages.
4. Performance data are plotted by time. The latest time for plotting performance data is an adaptable value.
5. The user selects the 'Hourly Utilization' button to select and display a CSV report of each server's hourly CPU, Memory, and Storage statistics over an adaptable period of time.

On the NWP-A and External Web Server M&C GUIs, the same hardware metrics outlined above are displayed for a selected AWD Web Server. AWD Web Server software components and their status are provided under the AWD Web Server tab. In the example below, similar performance monitoring is shown for the NWP-A M&C Dashboard.

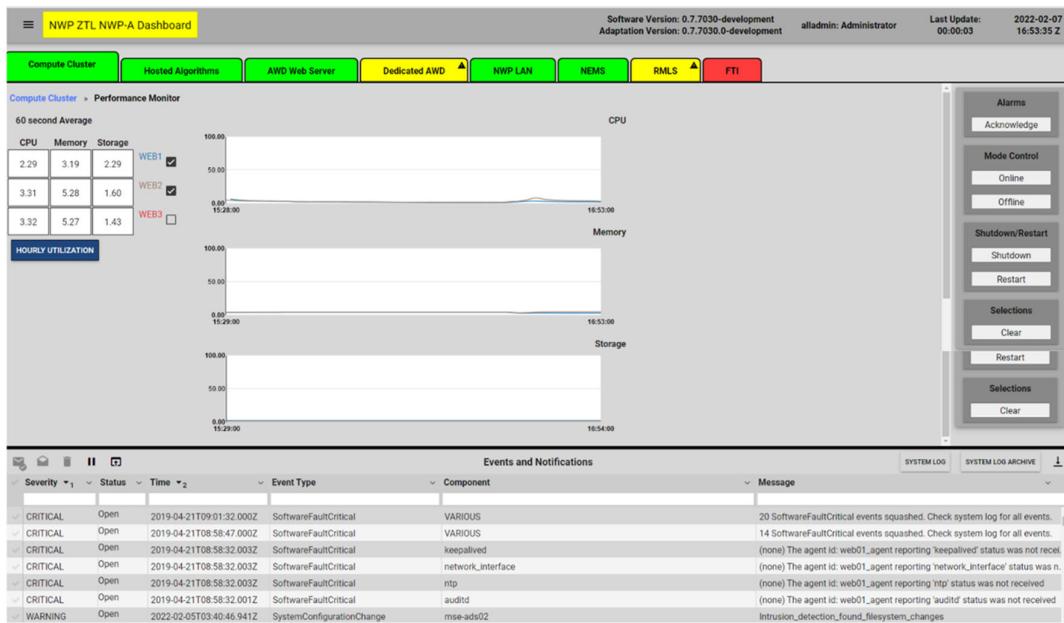


Figure 176. NWP-A Performance Monitor Details

### 5.3.11 Software Distribution and Installation

The M&C user may download, distribute, and install software and adaptation versions to a specified NWP deployment.

When a user commands **download** of a software and/or adaptation release, the system retrieves the selected release from the update server and stores it locally (for example, at the HF server on an NWP Domain). The **downloaded** software version is one which is available for installation on the local system, but is not currently running on the local system.

When a user commands to **install** a software and/or adaptation version, the currently running software and/or adaptation version is replaced with the selected version. Changes take effect after an automatic system restart. The **installed** version of software and adaptation is the version which is active and currently running on the local system.

The M&C user must be logged in with the administrator role for the particular site in order to have permissions to download and install software.

Before a software and/or adaptation update can be installed on a Domain NWP system, the M&C user must ensure the Compute Cluster subsystem is in Offline mode. Note: the PG and HF nodes can be in Standby or Offline mode.

#### 5.3.11.1 Domain Software/Adaptation Version Indication

The current software/adaptation version installed for the particular NWP instance (Domain) is presented on the top title bar of the respective GUI as shown below:

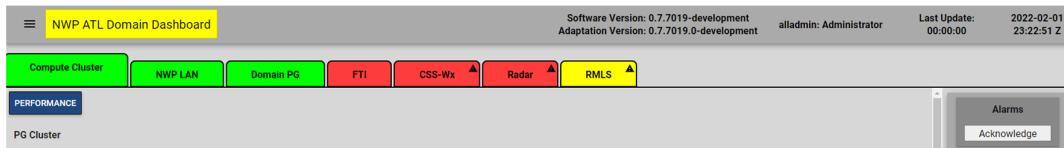


Figure 177. Currently Installed Software and Adaptation Version

### 5.3.11.2 Performing Domain Software and Adaptation Updates

In order to perform software and/or adaptation version updates, the M&C user selects the 'Software Update' option from the M&C GUI main menu. The M&C user must be logged in with the correct permissions in order to view the Software Update menu item and to launch the Software Update window.

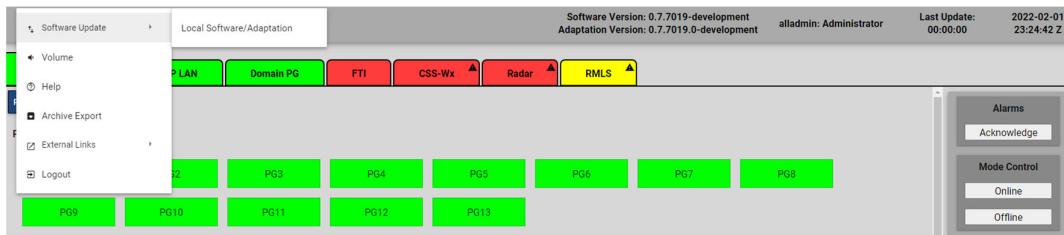


Figure 178. Domain M&amp;C Software Update Option

### 5.3.11.3 Download Domain Software Version

The 'Local Software/Adaptation' option is available for Domain, NWP-A, and External Web Server. When the 'Local Software/Adaptation' option is selected, a new window is presented which allows the user to select a software version and an adaptation version. The download and installation status are presented to the user as icons described in the following table:

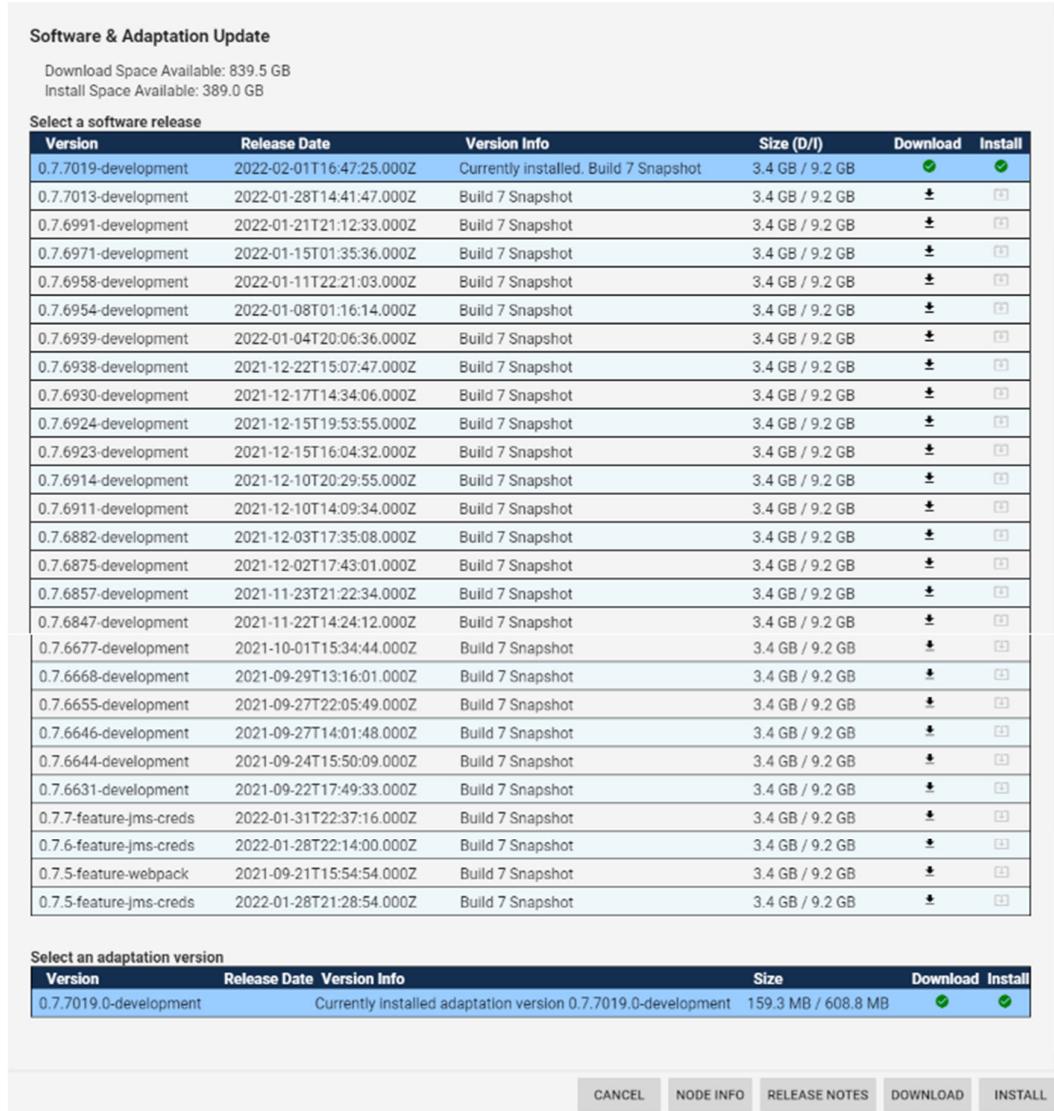
Table 15. Download/Installation Status Icons

| Icon | Description                                                                                                     |
|------|-----------------------------------------------------------------------------------------------------------------|
| ✓    | Version is successfully downloaded or installed                                                                 |
| ⬇    | Version is available for download from the update server                                                        |
| ⬇    | Version is not available for download from the update server (for reasons such as insufficient disk space)      |
| ⬇    | Version is available for installation to the local system                                                       |
| ⬇    | Version is not available for installation to the local system (must first be downloaded from the update server) |

If a version is not available for download from the update server, it is recommended that the user contact an administrator for further investigation.

The 'Software & Adaptation Update' window presents a list of all available software versions from the update server. For each available software release, the version number, release date, version info, and size are presented. Icons are provided next to each software version to

denote Download and Install status. The latest available software release is selected by default. The available adaptation versions associated with the selected software versions are presented in a table below the software versions. The latest available adaptation version is selected by default. If a different software version is selected, the list of available adaptation versions is updated to match the software version selection.



**Figure 179. Download/Install Local NWP Software Window**

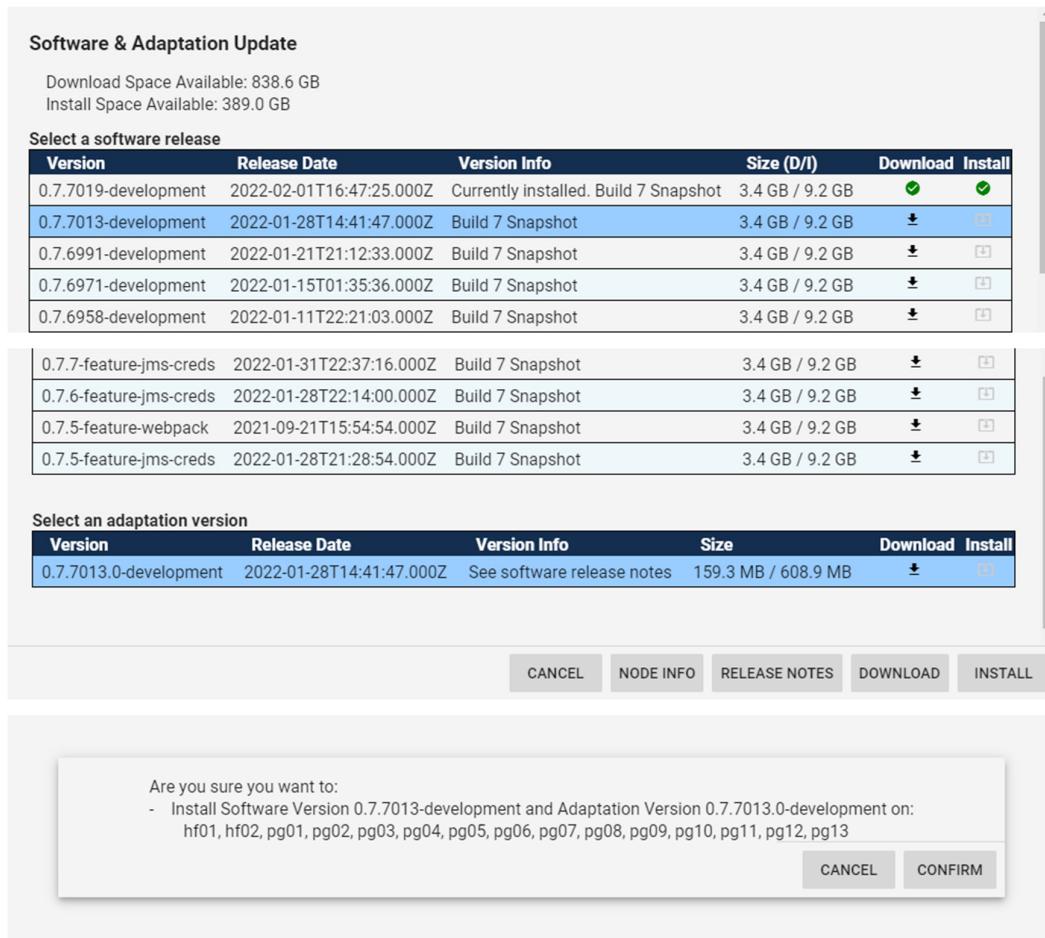
Depending on the current state of the selected software and adaptation version, different actions are available to the user. The following table summarizes the available commands, resulting user confirmation dialogs, and resulting system actions for different combinations of software and adaptation version states:

**Table 16. Download/Install Combinations and Confirmations**

| <b>Selected Software Version Status</b> | <b>Selected Adaptation Version Status</b> | <b>Available Commands</b> | <b>User Confirmation Dialog</b>                                                                                                                                        | <b>Resulting System Actions</b>                                                                                                  |
|-----------------------------------------|-------------------------------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Downloaded & Installed                  | Downloaded & Installed                    | None                      | N/A                                                                                                                                                                    | No action. Selections are already downloaded and installed to the system                                                         |
|                                         | Downloaded, Available for Install         | Install                   | Are you sure you want to install Adaptation version <selected>?                                                                                                        | Selection of Install will install the selected Adaptation version Only after user confirmation                                   |
|                                         | Available for Download                    | Download<br>Install       | Download:<br>'Are you sure you want to download Adaptation Version <selected>?'                                                                                        | Selection of Download will Download the selected adaptation version only after user confirmation                                 |
|                                         |                                           |                           | Install:<br>Adaptation Version <selected> has not yet been downloaded. Are you sure you want to download then install Adaptation version <selected>?'                  | Selection of Install will Download, then Install the selection adaptation version only after user confirmation                   |
|                                         | Not available for Download                | None                      | N/A                                                                                                                                                                    | No action allowed. Insufficient disk space to download update                                                                    |
| Downloaded, Available for Install       | Downloaded, Available for Install         | Install                   | Are you sure you want to install Software Version <selected> and Adaptation Version <selected>?                                                                        | Selection of Install will install both the selected software version and selected adaptation version after user confirmation     |
|                                         | Available for Download                    | Download<br>Install       | Download:<br>'Are you sure you want to download Adaptation Version <selected>?'                                                                                        | Selection of Download will Download the selected adaptation version only after user confirmation                                 |
|                                         |                                           |                           | Install:<br>Adaptation Version <selected> has not yet been downloaded.<br>Are you sure you want to download Adaptation version <selected> and install software version | Selection of Install will download the selected adaptation version, then install software and adaptation after user confirmation |

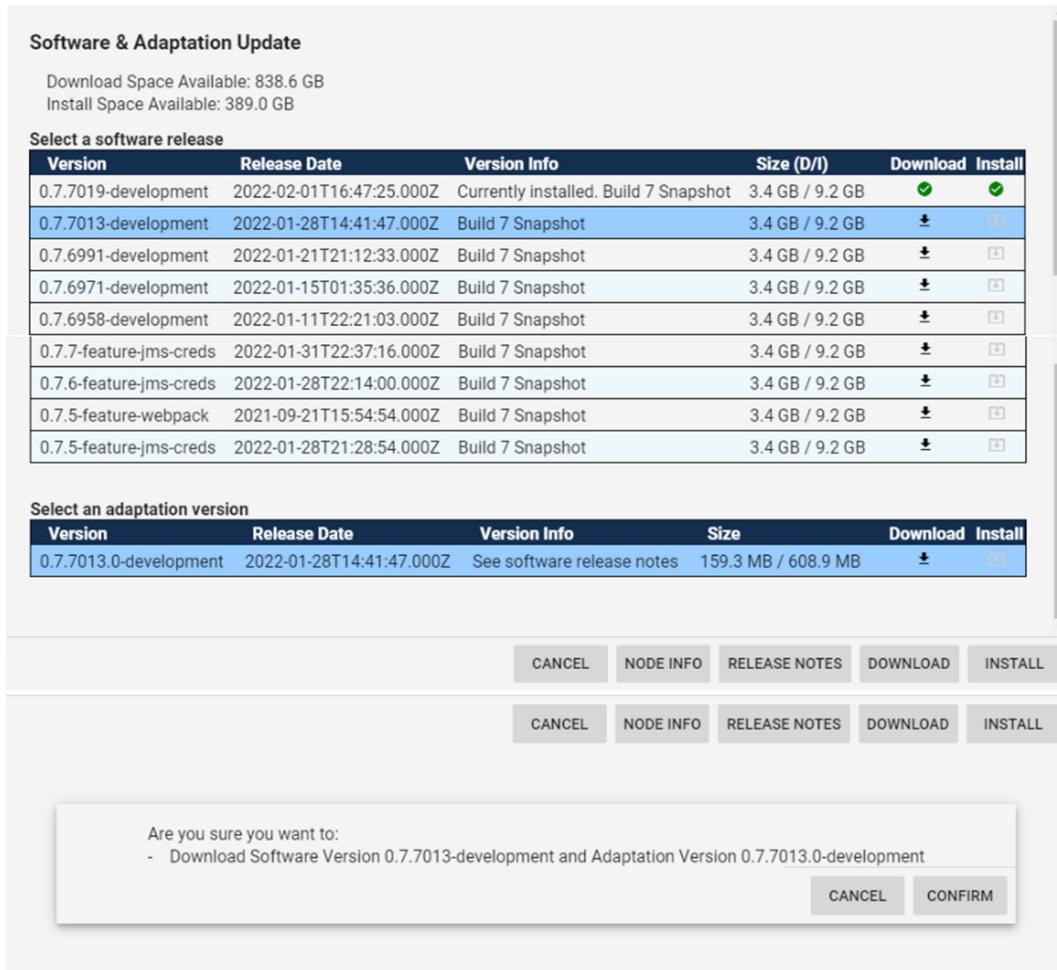
|                               |                               |          |                                                                                                                |                                                                                                                                 |
|-------------------------------|-------------------------------|----------|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
|                               |                               |          | <selected> and<br>Adaptation version<br><selected>?’                                                           |                                                                                                                                 |
|                               | Not available<br>for Download | None     | N/A                                                                                                            | No action allowed.<br>Software may not be<br>installed with the<br>selected adaptation<br>version.                              |
| Available for<br>Download     | Available for<br>Download     | Download | ‘Are you sure you want to<br>download Software<br>Version <selected> and<br>Adaptation Version<br><selected>?’ | Selection of Download<br>will Download the<br>selected software<br>version and adaptation<br>version after user<br>confirmation |
|                               | Not available<br>for Download | None     | N/a                                                                                                            | No action allowed.<br>Must select an<br>available Adaptation<br>version with the<br>software version for<br>download.           |
| Not Available<br>for Download | Any                           | None     | N/A                                                                                                            | No action allowed.<br>Must have sufficient<br>space to download<br>software version.                                            |

In the following example, Software Version 0.7.719 is the currently installed version on the system. Version 0.7.7013 is the selected version, so all adaptation versions available for Software Version 0.7.7013 are presented. Since Adaptation Version 0.7.7013.0 is selected, only the ‘CANCEL’ and ‘INSTALL’ buttons are enabled. The ‘DOWNLOAD’ button is disabled since both selections have already been successfully downloaded to the system. Upon selection of the ‘INSTALL’ button, the system provides the following confirmation:

**Figure 180. Adaptation Installation Confirmation**

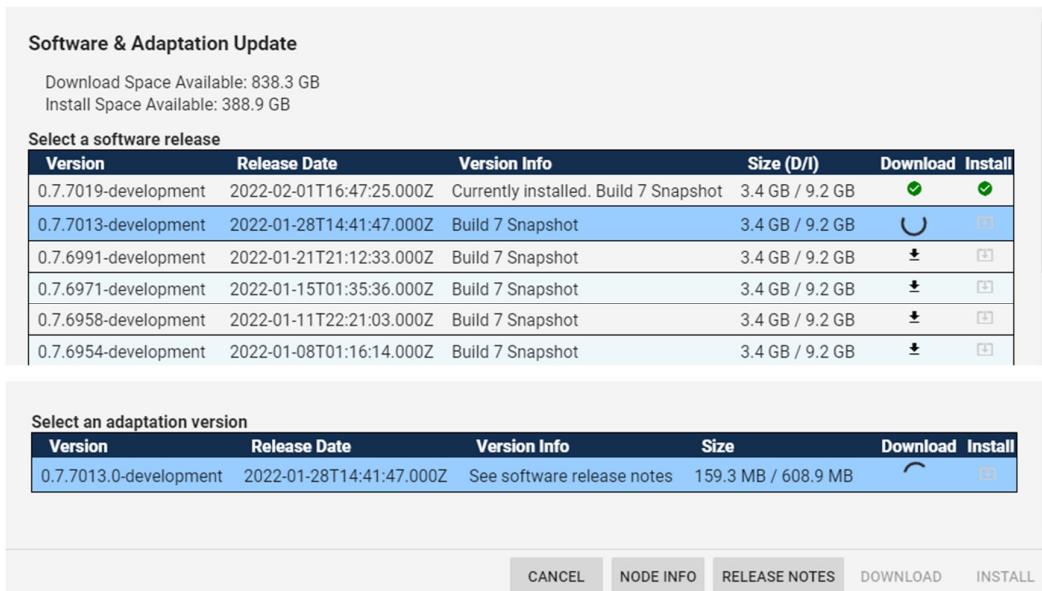
Upon selection of the 'CANCEL' button, the confirmation dialog closes, but the 'Software & Adaptation Update' window remains.

In the following example, the user has selected a new software version and new adaptation version. Because both versions are available for downloaded to the system, the 'DOWNLOAD' button is enabled. Upon selection of the 'DOWNLOAD' button, the user is prompted with the following confirmation:

**Figure 181. Software and Adaptation Download Confirmation**

Both the selected software release and adaptation version are downloaded from the update server to the local system. The download progress is noted with a spin indicator in the Download column:

**NOTE:** For downloads which require an extended period of time, opening a new browser window for a separate instance of the M&C is recommended so that this Software & Adaptation Update dialog can remain open for the duration of the download to provide proper status. To initiate a separate M&C session while downloading, open a new tab and follow the steps outlined in Section 4.2.1 Initiating an M&C session.

**Figure 182. Download Progress Indicator**

The system performs checksum validation as part of the download. If an error is encountered, the M&C user is alerted with an error message (see 'Download/Install local NWP software window') and the download does not continue. The 'DOWNLOAD' button is enabled only after acknowledgement of the error message and the user may elect to attempt the download again. If there is no error, upon selection of the 'DOWNLOAD' button the system deletes any previously failed download and attempts the download again in its entirety.

The system automatically retains up to two software versions by default. Once the retained number of versions is reached, the oldest version is automatically deleted from the system when a new version is downloaded. Note: the number of downloaded software versions retained can be temporarily adjusted but will revert back to the default of two after each software install. To temporarily change the number of retained software versions you must edit the properties file at `/opt/nwp/sms-uframe/edex/conf/resources/cmn-update.properties` and restart the SMS uFrame service on both HF nodes.

Once a download is complete, the version available for installation is denoted with the circle/checkmark icon and the 'INSTALL' button is enabled.

#### 5.3.11.4 Install Domain Software Version

A user may select any locally downloaded software version for installation. If the software version selected has previously been installed, the system will perform a rollback to that version upon selection and confirmation of the install. If the version has not been previously installed, a fresh install will be performed upon selection and confirmation of the install.

On a Domain system, it is possible to have more than one software and/or adaptation version installed across different nodes. Note: This condition is not expected except for non-nominal cases such as a powered off node. The software and adaptation version on each of the two HF nodes should always match for nominal operations. Selecting the 'RELEASE NOTES' button allows the user to view the release notes which were entered with the creation of the software and adaption.

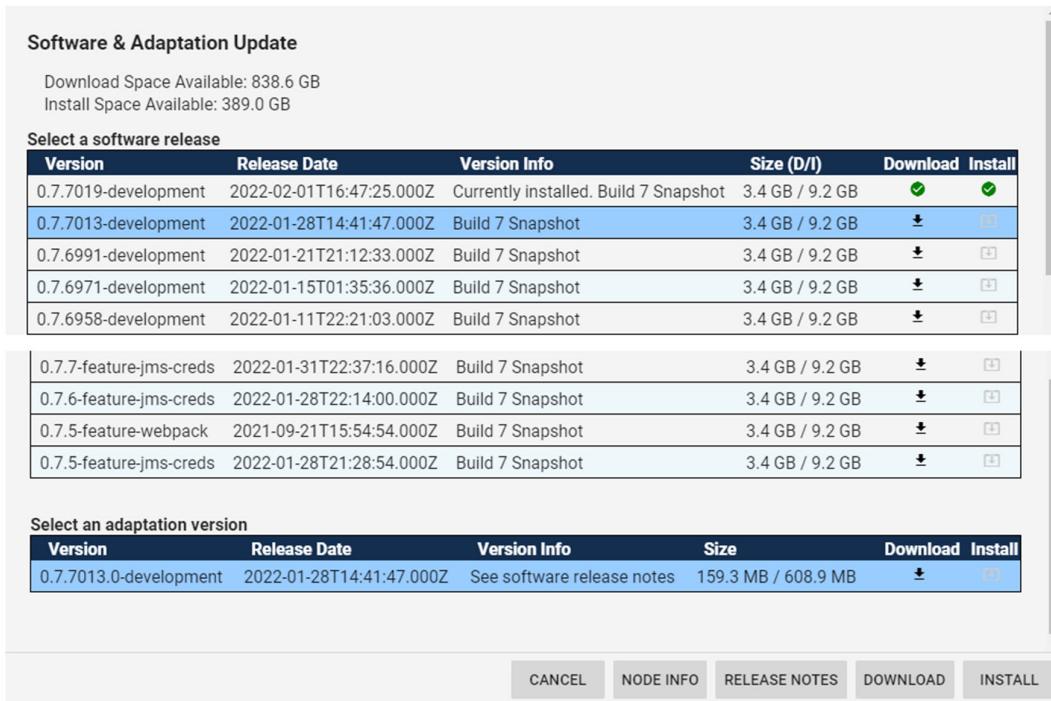
| <b>Release Notes</b> |                            | X |
|----------------------|----------------------------|---|
| <u>Software</u>      | <u>Adaptation</u>          |   |
| Build 7 Snapshot     | See software release notes |   |

**Figure 183. Release Notes Dialog**

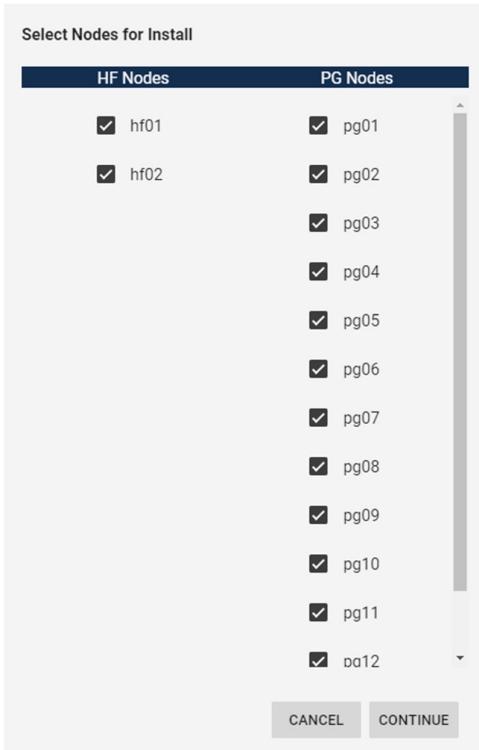
Additional information on the version or versions currently installed can be viewed by selecting the 'NODE INFO' button. The NODE INFO dialog is an informational dialog which presents a list of each node along with the currently installed software version and adaptation version on each node. The Adaptation Version archive notes, as entered by the user on the Adaptation Manager when the adaptation version was created and archived are also presented.

| <b>Version Information</b> |                         |                           | X |
|----------------------------|-------------------------|---------------------------|---|
| <b>Node</b>                | <b>Software Version</b> | <b>Adaptation Version</b> |   |
| hf01                       | 0.7.7019-development    | 0.7.7019.0-development    |   |
| hf02                       | 0.7.7019-development    | 0.7.7019.0-development    |   |
| pg01                       | 0.7.7019-development    | 0.7.7019.0-development    |   |
| pg02                       | 0.7.7019-development    | 0.7.7019.0-development    |   |
| pg03                       | 0.7.7019-development    | 0.7.7019.0-development    |   |
| pg04                       | 0.7.7019-development    | 0.7.7019.0-development    |   |
| pg05                       | 0.7.7019-development    | 0.7.7019.0-development    |   |
| pg06                       | 0.7.7019-development    | 0.7.7019.0-development    |   |
| pg07                       | 0.7.7019-development    | 0.7.7019.0-development    |   |
| pg08                       | 0.7.7019-development    | 0.7.7019.0-development    |   |
| pg09                       | 0.7.7019-development    | 0.7.7019.0-development    |   |
| pg10                       | 0.7.7019-development    | 0.7.7019.0-development    |   |
| pg11                       | 0.7.7019-development    | 0.7.7019.0-development    |   |
| pg12                       | 0.7.7019-development    | 0.7.7019.0-development    |   |
| pg13                       | 0.7.7019-development    | 0.7.7019.0-development    |   |

**Figure 184. Node Information Dialog**

**Figure 185. Version Selection for Install**

In the above Software & Adaptation Dialog, Version 0.7.7013 is selected for local installation along with the latest available Adaptation version, 0.7.7013-0-0. Upon selection of the 'INSTALL' button, the user is presented with a 'Select Nodes for Install' dialog:

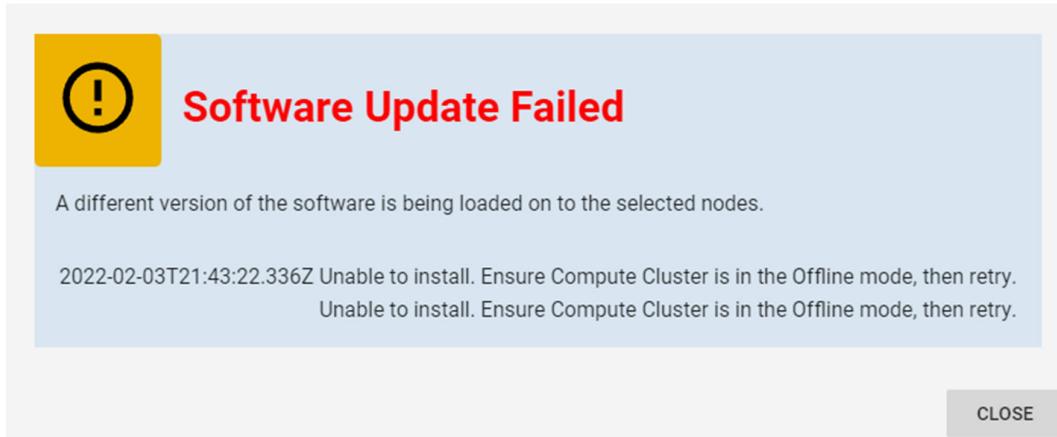
**Figure 186. Select Nodes for Install Dialog**

The 'Select Nodes for Install' dialog contains a list of all nodes on the system which will be updated during the install. By default, all nodes are selected as identified in the checkboxes beside each node. The user may de-select/select the nodes they wish to install to. Note: Both HF nodes should always be selected to ensure the HFs remain on the same version. The 'CANCEL' button will close the 'Select Nodes for Install' dialog and return the user back to the 'Software and Adaptation Update' window. Upon selection of 'CONTINUE', the user is prompted with a confirmation message:

**Figure 187. Install Confirmation Message**

Upon selection of 'CANCEL', the confirmation message disappears but the 'Software & Adaptation Update' window remains. Upon selection of 'CONFIRM', the system performs an automatic check of the checksum of each component of the installation package. If any of the checks are incorrect, the installation will not proceed.

The Domain NWP Compute Cluster subsystem must be in Offline mode in order to install a new software version. If it is not, the user will be prompted with an error message as shown below. Note: the PG and HF nodes can be in Standby or Offline mode. The user must close the Software & Adaptation Update window, transition the Compute Cluster to Offline mode, then relaunch the Software & Adaptation Update window to resume request of the install.



**Figure 188. Compute Cluster Online Failure Dialog**

The system runs an additional pre-check to ensure all nodes selected within the ‘Select Nodes for Install’ dialog can be reached. If a node or multiple nodes cannot be reached, an ‘Installation Failure’ dialog is presented as shown below. The Installation Failure dialog also pops up at any point throughout the installation process if a failure is encountered.

| Installation Failure |                              |         |
|----------------------|------------------------------|---------|
| Node                 | Status                       | Action  |
| hf01                 | TODO                         |         |
| hf02                 | TODO                         |         |
| pg01                 | TODO                         |         |
| pg02                 | TODO                         |         |
| pg03                 | SKIPPED                      | Skip ▾  |
| pg04                 | SKIPPED                      | Retry ▾ |
| pg05                 | TODO                         |         |
| pg06                 | FAILED - Agent not reachable | Skip ▾  |
| pg07                 | FAILED - Agent not reachable | Retry ▾ |
| pg08                 | TODO                         |         |
| pg09                 | TODO                         |         |
| pg10                 | TODO                         |         |
| pg11                 | TODO                         |         |
| pg12                 | TODO                         |         |
| pg13                 | TODO                         |         |

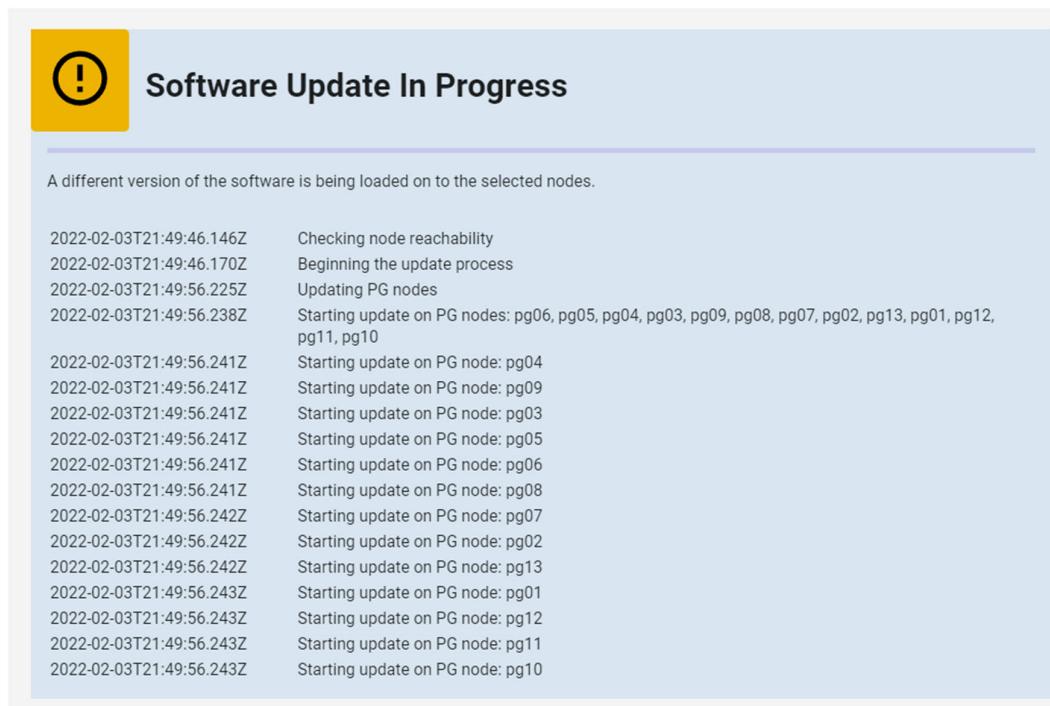
 

**Figure 189. Installation Failure Dialog**

The Installation Failure dialog displays a table listing each node on the system along with each node's installation status of TODO, SKIPPED, SUCCESS or FAILED. The Action column is only populated when a failure is encountered and provides a drop down selection of either 'Retry' or 'Skip'. Retry assumes the reason for failure has been resolved, and the user wishes to retry the installation. Skip is selected to proceed with the installation process without installing the

version on that particular node. The ‘ABORT’ button presents a confirmation message verifying the user wishes to halt the installation leaving the state on all nodes as is. Selection of the ‘CONTINUE’ button prompts the installation to proceed.

The Software & Adaptation Update window automatically closes and is replaced with a ‘Software Update In Progress’ window as shown below. The ‘Software Update In Progress’ window provides a summary of the installation progress per node. If the window is refreshed or closed, the installation will continue to run; the user will need to launch the login page to login after installation is completed.



**Figure 190. Software Update In Progress Window**

When the update has completed, as long as the browser window above has not been closed or refreshed, the page will automatically reload the M&C GUI back into the monitor role. Note: The M&C GUI will not automatically reload in cases where the hf node the user is running the software and/or adaptation update from is not selected for install. In these cases, a ‘CLOSE’ button will become available in the Software Update in Progress dialog once the install is complete.

#### 5.3.11.4.1 Error Conditions

If an error occurs during software installation, the failed nodes will automatically fallback to the current software version, and the user will get an error message for those nodes on the M&C screen. The table below lists the most common error conditions:

**Table 17. Domain Download and Installation Error Conditions**

| Error Condition                                        | Process  | System       | Notes                                                                                                                                                     |
|--------------------------------------------------------|----------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Software download already in progress                  | Download | Domain       | This occurs if another user issues a download request from a different M&C                                                                                |
| Communication error with update site                   | Download | Domain/NWP-A | This occurs when the Domain cannot communicate with the update server                                                                                     |
| Download software failed integrity check with checksum | Download | Domain       | This occurs when the checksum that is expected does not match what was downloaded                                                                         |
| Software download timed out                            | Download | Domain/NWP-A | This occurs if the download takes longer than 12 hours                                                                                                    |
| Compute Cluster online                                 | Install  | Domain       | This occurs if the Compute Cluster is in online mode when the install command is issued                                                                   |
| Node unreachable                                       | Install  | Domain       | This occurs if the pre-install check fails to any node in the Compute Cluster, the user will have the 'skip' or 'retry' the effected node(s) and continue |
| Failed to enter upgrade mode                           | Install  | Domain       | This occurs when the SMS hazelcast cluster is in a bad state and could not safely go into upgrade mode                                                    |
| Failed to stage adaptation on nwpshare                 | Install  | Domain       | This occurs when the adaptation cannot be extracted to the shared storage                                                                                 |
| Install failed on node                                 | Install  | Domain       | This occurs when services fail to start after an update and the software was reverted to the previous version on that node                                |
| Another command is already in progress                 | Download | NWP-A        | This occurs if another user is using the update service on a different M&C                                                                                |
| Incomplete software download                           | Download | NWP-A        | This occurs if not all the expected images are present after download                                                                                     |
| Installation failed                                    | Stage    | NWP-A        | This is a general error with helm charts or kubernetes configuration                                                                                      |
| Helm install timed out                                 | Stage    | NWP-A        | This occurs when the install and starting pods takes longer than 15 minutes                                                                               |
| Activating version failed                              | Activate | NWP-A        | This occurs when there is a problem switching the ingress routes to the new cluster                                                                       |
| Failed to uninstall previous version                   | Activate | NWP-A        | This occurs when the helm command to remove pods from the old version failed for an unknown reason, the new version is still active and unaffected        |

Detailed information for Domain download and installation failures can be found in the /opt/nwp/sms-uframe/edex/logs directory on the HF nodes and installation logs per node are located in /opt/nwp/version-archive/logs on each node.

Detailed information for NWP-A update failures can be found in the update-service pod in the /opt/nwp/nwp-update-service/logs directory.

### 5.3.11.5 NWP-A Software Update Service

The M&C user, in an administrator role, may perform actions required for installation of new software and adaptation versions on an NWP-A or External Web Server deployment. When a user commands **download** of a software and/or adaptation release, the system will retrieve the selected release from the update server and store the version locally. The **downloaded** software version is a software version which is available for installation on the local system, but is not currently running on the local system.

On an NWP-A or External Web Server, there are two phases of software installation: staging and activation. A staged version is ready for use but not yet commanded to be utilized. An activated version is the software version on which the NWP-A is running. When a user commands to **stage** a software and/or adaptation version, the currently active software and/or adaptation version remains the active version. Once the version is staged, both the active and staged versions run in parallel. The staged version is not yet operational until a user commands to activate it. The command to **activate** will perform a swap uninstalling the previously active version and activating the staged version. After the update is activated the AWDs will be forced to refresh after a reconnect, the Dedicated AWDs will auto-login if configured with a default user, however the EWS users will have to manually log in after the refresh.

Adaptation updates for NWP-A sites are treated in the same manner as software updates. For NWP-A deployments, the Compute Cluster remains online as the installation does not impact the active, operational software. A new cluster will be started for executing the update and after completion of the update the system will automatically switch over to the updated cluster.

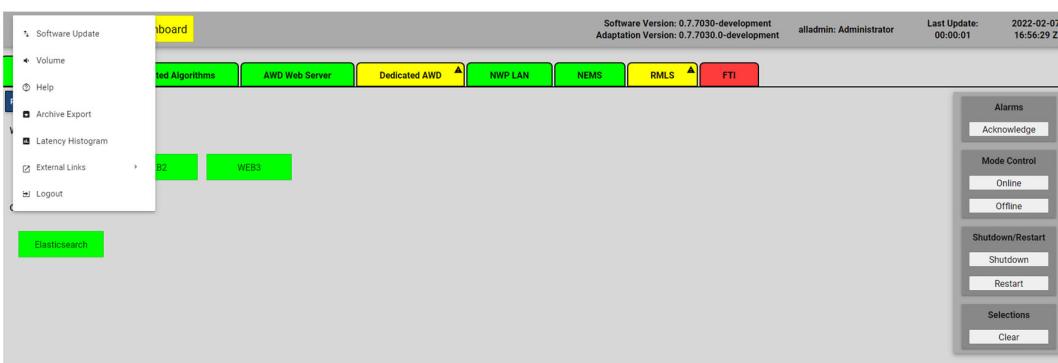
#### 5.3.11.5.1 Software Version Indication

The active software and adaptation version for the particular NWP instance (NWP-A or External Web Server) is presented on the top title bar of the respective GUI, as shown in the image below.



**Figure 191. Active Software and Adaptation Version Indication**

In order to perform software and/or adaptation version updates, the M&C user selects ‘Software Update’ from the main menu of the M&C GUI. The M&C user must be logged in with administrator role permissions in order to view the Software Update menu item and launch the NWP-A Software Update Service page.



**Figure 192. Software Update Options from M&C**

### 5.3.11.5.2 Local Software and Adaptation Version Updates

When the ‘Local Software/Adaptation’ option is selected, a new browser tab opens displaying the NWP-A Software Update Service page as seen in the figure below. This page allows the user to view status and select a software version and adaptation version. The download and installation status are presented to the user via icons, described in the table below:

**Table 18. Local Software/Adaptation Icons**

| Icon | Description                                                                                                |
|------|------------------------------------------------------------------------------------------------------------|
|      | Version is successfully downloaded or activated                                                            |
|      | Version is successfully staged                                                                             |
|      | Version is available for download from the update server                                                   |
|      | Version is not available for download from the update server (for reasons such as insufficient disk space) |
|      | Version is available to stage on the local system                                                          |
|      | Version is not available to stage on the local system (must first be downloaded from the update server)    |

The Software Update Service page presents a list of all available software versions from the update server. For each available software release, the version number, release date, size, and additional information about the release are presented. Icons are provided next to each software and adaptation version to denote download and activation (denoted as “Active”) status. Additionally, the ‘Version Info’ provides an indication of if the software version is the active version or has been previously active.

The active software release and adaptation version are selected by default as shown below. The available adaptation versions associated with the selected software version are presented in the table below the software versions table. If a different software version is selected, the list of available adaptation versions will update to match the software version selection.

The screenshot shows the NWP-A Software Update Service interface. At the top, it displays 'NWP-A Software Update Service'. Below this, there are two main sections: 'Software & Adaptation Update' and 'Select an adaptation version'. The 'Software & Adaptation Update' section contains a table with columns: Version, Release Date, Version Info, Size, Download, and Active. Several rows are listed, including versions 0.7.7033-development, 0.7.7032-development, 0.7.7031-development, 0.7.7030-development (which is highlighted in blue), and 0.7.7029-development. The 'Select an adaptation version' section has a similar table structure. At the bottom, there is a 'Software Update Log' section with a command history and buttons for 'RELEASE NOTES', 'DOWNLOAD', 'STAGE', and 'ACTIVATE'.

**Figure 193. NWP-A Software Update Service Page**

Depending on the current state of the selected software and adaptation version, different actions will be available for the user to command. General rules for software version installs are:

1. If a software version has been previously activated, a user may stage and activate that version again.
  - a. If the version has been removed from the update server, it will not be available for download. But, the version is retained on the local file system so it is available to stage and activate again.
2. If a software version is available on the update server and has not been previously downloaded, the user may download, stage and activate that version.
  - a. The version will need to be downloaded from the update server prior to staging
  - b. If download/staging of this new version causes more versions to exist on the local system than is allowed, an older version will need to be deleted
    - (1) If moving forward one version, the system will automatically delete an older, inactive version
    - (2) If installing an older version, the user will be prompted to select a version to delete prior to download/stage of the newly selected version

The table below summarizes the available commands, resulting user confirmation dialogs, and resulting system actions for different combinations of software and adaptation version states.

**Table 19. Update Version/Adaptation Commands**

| Selected Software Version Status | Selected Adaptation Version Status | Available Commands | User Confirmation Dialog | Resulting System Actions                                              |
|----------------------------------|------------------------------------|--------------------|--------------------------|-----------------------------------------------------------------------|
|                                  | Downloaded & Active                | None               | N/A                      | No action. Selections are already downloaded and active to the system |

|                                           |                                           |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                          |
|-------------------------------------------|-------------------------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Downloaded & Active                       | Downloaded, Staged, Available to Activate | Activate       | Are you sure you want to activate Adaptation version <selected>?                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Selection of Activate will promote the selected Adaptation version Only from Staged to Active after user confirmation                                                                                                    |
|                                           | Downloaded, Available to Stage            | Stage          | Are you sure you want to stage Adaptation version <selected>?                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Selection of Stage will install the selected version in parallel to the currently active version.                                                                                                                        |
|                                           | Available for Download                    | Download Stage | <p>Download:</p> <p>If download of the new adaptation version yields more versions than allowed on the system, the user will be prompted with a dialog from which to select version to be deleted.</p> <p>Confirmations:</p> <p>Select version(s) for delete. Are you sure you want to download Adaptation Version &lt;selected&gt;?</p> <p>Stage:</p> <p>Adaptation Version &lt;selected&gt; has not yet been downloaded. Are you sure you want to download then stage Adaptation version &lt;selected&gt;?</p> | <p>Selection of Download will Download the selected adaptation version only after user confirmation</p> <p>Selection of Stage will Download, then Stage the selected adaptation version only after user confirmation</p> |
|                                           | Not available for Download                | None           | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | No action allowed. Insufficient disk space to download update                                                                                                                                                            |
|                                           | Downloaded, Staged, Available to Activate | Activate       | Are you sure you want to activate Software Version <selected> and Adaptation Version <selected>?                                                                                                                                                                                                                                                                                                                                                                                                                 | Selection of Activate will promote both the selected software version and selected adaptation version from Staged to Active after user confirmation                                                                      |
| Downloaded, Staged, Available to Activate | Downloaded, Available to Stage            | Stage          | Are you sure you want to stage Adaptation Version <selected>?                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Selection of Stage will install the selected version in parallel to the currently active version.                                                                                                                        |
|                                           | Available for Download                    | Download Stage | <p>Download:</p> <p>'Are you sure you want to download Adaptation Version &lt;selected&gt;?'</p>                                                                                                                                                                                                                                                                                                                                                                                                                 | Selection of Download will Download the selected adaptation version only after user confirmation                                                                                                                         |

|                                |                                |          |                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                 |
|--------------------------------|--------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                |                                |          | <p>Stage:</p> <p>Adaptation Version &lt;selected&gt; has not yet been downloaded.</p> <p>Are you sure you want to download then stage Adaptation version &lt;selected&gt;?'</p>                                                                                                                                                              | <p>Selection of Stage will download then Stage the selected adaptation version after user confirmation</p>                                                                                                                      |
|                                | Not available for Download     | None     | N/A                                                                                                                                                                                                                                                                                                                                          | No action allowed. Software may not be installed with the selected adaptation version.                                                                                                                                          |
| Downloaded, Available to Stage | Downloaded, Available to Stage | Stage    | <p>Are you sure you want to stage Software Version &lt;selected&gt; and Adaptation Version &lt;selected&gt;?</p>                                                                                                                                                                                                                             | Selection of Stage will install the selected software and adaptation versions after user confirmation                                                                                                                           |
|                                | Available for Download         | Download | <p>If download of this version results in the number of versions on the system exceeding system defined thresholds, the user will be prompted to delete one or more existing versions.</p> <p>Confirmations:</p> <p>1) "Select version(s) to delete."</p> <p>2) 'Are you sure you want to download Adaptation Version &lt;selected&gt;?'</p> | Selection of Download will Download the selected adaptation version after user confirmation. If the user was prompted to delete a version, the selected version will also be deleted from the file system.                      |
|                                | Not available for Download     | None     | N/A                                                                                                                                                                                                                                                                                                                                          | No action allowed. Software may not be installed with the selected adaptation version.                                                                                                                                          |
| Available for Download         | Available for Download         | Download | <p>If download of this version results in the number of version on the system exceeding system defined thresholds, the user will be prompted to delete one or more existing versions.</p>                                                                                                                                                    | Selection of Download will Download the selected software version and adaptation version after user confirmation. If the user was prompted to delete a version, the selected version will also be deleted from the file system. |

|                            |                            |      |                                                                                                                                                              |                                                                                                                                                                                                         |
|----------------------------|----------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            |                            |      | Confirmations:<br>1) "Select version(s) to delete."<br>2) 'Are you sure you want to download Software Version <selected> and Adaptation Version <selected>?' |                                                                                                                                                                                                         |
|                            | Not available for Download | None | N/A                                                                                                                                                          | No action allowed. Must select an available Adaptation version with the software version for download.                                                                                                  |
| Not Available for Download | Any                        | None | N/A                                                                                                                                                          | No action allowed.<br>This could either be due to insufficient space to download software version, or because the version remains on the local file system but has been removed from the Update Server. |

### 5.3.11.5.3 Download Software & Adaptation Versions

In the example below, the user has selected a new software version and new adaptation version. Both versions are available for download to the system as identified by the icon in the Download column.

The screenshot shows the 'NWP-A Software Update Service' interface. At the top, it displays 'Software & Adaptation Update' and 'Download Space Available: -'. Below this, there are two tables: 'Select a software release' and 'Select an adaptation version'. The 'Software Release' table lists several software versions with their details and download status. The 'Adaptation Version' table lists one adaptation version. At the bottom, there is a 'Software Update Log' section showing install logs, a command history, and a state indicator of 'SUCCESS'. Buttons for 'RELEASE NOTES', 'DOWNLOAD', 'STAGE', and 'ACTIVATE' are also present.

| Version              | Release Date             | Version Info                                        | Size   | Download | Active |
|----------------------|--------------------------|-----------------------------------------------------|--------|----------|--------|
| 0.7.7032-development | 2022-02-07T15:55:17.000Z | Auto-generated software version info                | 5.4 GB | ▲        | □      |
| 0.7.7031-development | 2022-02-05T05:13:55.000Z | Auto-generated software version info                | 5.4 GB | ▲        | □      |
| 0.7.7030-development | 2022-02-04T16:52:49.000Z | Live version - Auto-generated software version info | 5.4 GB | ●        | ●      |
| 0.7.7029-development | 2022-02-04T14:32:18.000Z | Auto-generated software version info                | 5.4 GB | ▲        | □      |
| 0.7.7028-development | 2022-02-03T21:28:35.000Z | Auto-generated software version info                | 5.4 GB | ●        | □      |

| Version                | Release Date             | Version Info                           | Size     | Download | Active |
|------------------------|--------------------------|----------------------------------------|----------|----------|--------|
| 0.7.7032.0-development | 2022-02-07T15:55:17.000Z | Auto-generated adaptation version info | 481.5 MB | ▲        | □      |

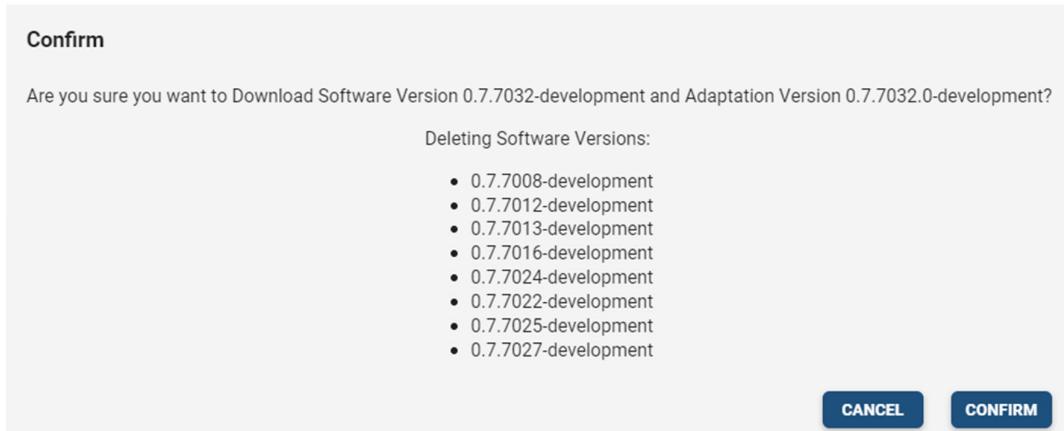
  

| Software Update Log                                                                                                  |  | Command: Start | State: SUCCESS |  |
|----------------------------------------------------------------------------------------------------------------------|--|----------------|----------------|--|
|                                                                                                                      |  |                |                |  |
| 2022-02-07T15:24:38.547Z: Installing version 0.7.7030-development/0.7.7030.0-development directly to live version... |  |                |                |  |
| 2022-02-07T15:29:19.090Z: Install completed successfully.                                                            |  |                |                |  |

Figure 194. Version Selection for Download

Upon selection of the 'DOWNLOAD' button, the user is prompted with either a confirmation dialog, as shown in the figure below, or a 'Select Version(s) to delete' dialog, depending on the current number of software/adaptation versions downloaded on the local system. If the number

of configured downloads on the system has been reached, the user will be prompted with the ‘Select Version(s) to delete’ dialog shown below in the second figure. To continue with the download, a version or multiple versions must be selected for deletion. The active software version will never be included in the list of Versions to delete.



**Figure 195. Software and Adaptation Download Confirmation Dialog**

| Select 8 Software Version(s) to delete |                          |                                      |
|----------------------------------------|--------------------------|--------------------------------------|
| Version                                | Release Date             | Version Info                         |
| 0.7.7028-development                   | 2022-02-03T21:28:35.000Z | Auto-generated software version info |
| 0.7.7027-development                   | 2022-02-03T19:09:51.000Z | Auto-generated software version info |
| 0.7.7025-development                   | 2022-02-02T23:58:42.000Z | Auto-generated software version info |
| 0.7.7024-development                   | 2022-02-02T18:01:08.000Z | Auto-generated software version info |
| 0.7.7022-development                   | 2022-02-01T22:20:49.000Z | Auto-generated software version info |
| 0.7.7016-development                   | 2022-02-01T01:40:42.000Z | Auto-generated software version info |
| 0.7.7013-development                   | 2022-01-28T18:57:12.000Z | Auto-generated software version info |
| 0.7.7012-development                   | 2022-01-28T01:41:16.000Z | Auto-generated software version info |
| 0.7.7008-development                   | 2022-01-27T17:49:11.000Z | Auto-generated software version info |

**Cancel**    **Continue**

**Figure 196. Select Version(s) to Delete Dialog**

Upon selection of ‘CONTINUE’, a confirmation message will be received. Upon selection of the ‘CONFIRM’ button, the selected software and adaptation versions are downloaded from the update server to the local system. The download in progress will be noted via the Software Update Log at the bottom of the window and with the State of the given Command in the bottom right as shown below.

The screenshot shows the 'Software & Adaptation Update' section of the service. It lists several software versions with their details and download status. Below this, there's a 'Select an adaptation version' section and a 'Software Update Log' at the bottom.

| Version              | Release Date             | Version Info                                        | Size   | Download | Active |
|----------------------|--------------------------|-----------------------------------------------------|--------|----------|--------|
| 0.7.7032-development | 2022-02-07T15:55:17.000Z | Auto-generated software version info                | 5.4 GB |          |        |
| 0.7.7031-development | 2022-02-05T05:13:55.000Z | Auto-generated software version info                | 5.4 GB |          |        |
| 0.7.7030-development | 2022-02-04T16:52:49.000Z | Live version - Auto-generated software version info | 5.4 GB |          |        |
| 0.7.7029-development | 2022-02-04T14:32:18.000Z | Auto-generated software version info                | 5.4 GB |          |        |
| 0.7.7028-development | 2022-02-03T21:28:35.000Z | Auto-generated software version info                | 5.4 GB |          |        |

| Version                | Release Date             | Version Info                           | Size     | Download | Active |
|------------------------|--------------------------|----------------------------------------|----------|----------|--------|
| 0.7.7032.0-development | 2022-02-07T15:55:17.000Z | Auto-generated adaptation version info | 481.5 MB |          |        |

| Software Update Log                                    |  | Command: Download | State: RUNNING |  |
|--------------------------------------------------------|--|-------------------|----------------|--|
|                                                        |  |                   |                |  |
|                                                        |  |                   |                |  |
| 2022-02-07T17:02:33.843Z: Validating input parameters. |  |                   |                |  |
| 2022-02-07T17:02:38.643Z: Starting software download   |  |                   |                |  |

**Figure 197. Indication of Download in Progress**

The system will perform a checksum validation as part of the download. If an error is encountered, the user will be alerted with an error message and the download will not continue. The user may select download again to attempt to re-download the version. Upon selection of the download button, the system will delete the previously failed download and attempt the download again in its entirety.

Once the download is complete, the version will be denoted with a green circle/checkmark icon within the Download column and the Command State will show 'SUCCESS' and be highlighted green. The version availability icon within the Active column updates and is displayed in bold to inform the user the version is available for staging.

#### 5.3.11.5.4 Stage a Software Version

A user may select any locally downloaded software version to stage. If the software version selected has previously been installed, a switch back to that version can be commanded upon selection and confirmation to stage.

Selecting the 'RELEASE NOTES' button allows the user to view the release notes which were entered with the creation of the software and adaption. See figure below.

The dialog is titled 'Release Notes'. It contains two main sections: 'Software' and 'Adaptation'. The 'Software' section displays 'Auto-generated software version info' and the 'Adaptation' section displays 'Auto-generated adaptation version info'.

**Figure 198. Release Notes Dialog**

In the figure below, an example is provided where Version 0.7.032 is selected for local staging along with the latest available Adaptation version, 0.7.032. Upon selection of the 'STAGE' button, the user is prompted with a confirmation dialog similar to the Software and Adaptation Download Confirmation Dialog. Note only one version may be staged on the system.

The screenshot shows the 'NWP-A Software Update Service' interface. At the top, it says 'Software & Adaptation Update' and 'Select a software release'. Below this is a table with columns: Version, Release Date, Version Info, Size, Download, and Active. Several rows are listed, including versions 0.7.7032-development, 0.7.7031-development, 0.7.7030-development, 0.7.7029-development, and 0.7.7028-development. The row for 0.7.7032-development is highlighted with a blue background. Below the table, there's another section titled 'Select an adaptation version' with a similar table. The row for 0.7.7032.0-development is also highlighted. At the bottom, there are buttons for 'RELEASE NOTES', 'DOWNLOAD', 'STAGE' (which is highlighted in blue), and 'ACTIVATE'. The 'Software Update Log' section at the bottom shows command logs: 'Command: Download' and 'State: SUCCESS'. The log entries include: 2022-02-07T17:02:33.843Z: Validating input parameters., 2022-02-07T17:02:38.643Z: Starting software download., and 2022-02-07T17:11:07.102Z: Download completed successfully.

**Figure 199. Version Selection for Staging**

Selection of the 'CANCEL' button will dismiss the confirmation message. Upon selection of 'CONFIRM', all buttons will be disabled to prohibit conflicting commands. The system performs an automatic check of the checksum of each component of the installation package. If any of the checks are incorrect, staging of the version will not proceed.

Progress of the installation will be noted by the Command and State statuses at the bottom of the window. High level progress messages of the installation will also be provided within the Software Update Log window as shown below. If the Software Update Service window is refreshed or closed, the installation will continue to run. If the page is closed, the user will need to launch the page again via the M&C.

This screenshot is identical to Figure 199, showing the 'NWP-A Software Update Service' interface. The 'STAGE' button is now highlighted in blue. The 'Software Update Log' section at the bottom shows command logs: 'Command: Stage' and 'State: RUNNING'. The log entries are: 2022-02-07T17:14:23.162Z: Validating install parameters., 2022-02-07T17:14:23.162Z: Checking version conflicts., and 2022-02-07T17:14:25.811Z: Installing version 0.7.7032-development/0.7.7032.0-development as upgrade version...

**Figure 200. Version Stage in Progress**

When the installation is complete, the version is staged and will be denoted with an orange circle/checkmark icon within the Active column, as shown below. The staged version runs in parallel to the active version remaining inactive. Note the user may view the M&C Dashboard and AWD of the staged version by navigating to an awd-update and ads-update URL.

Upon completion of the install, the ‘STAGE’ button updates to ‘UNSTAGE’ and all buttons are enabled. In the event the user does not wish to promote the version to the operational version, selection of the UNSTAGE button uninstalls the version leaving the currently active version active.

The screenshot shows the 'Software & Adaptation Update' section of the NWP-A Software Update Service. It displays two tables: one for 'Software & Adaptation Update' and another for 'Select an adaptation version'. Both tables have columns for Version, Release Date, Version Info, Size, Download, and Active. The 'Active' column contains icons: a green circle for staged versions and an orange circle for active versions. In the 'Software & Adaptation Update' table, the first row (version 0.7.7032-development) has an orange circle in the Active column. In the 'Select an adaptation version' table, the first row (version 0.7.7032.0-development) also has an orange circle in the Active column. At the bottom right of the interface, there are four buttons: RELEASE NOTES, DOWNLOAD, UNSTAGE, and ACTIVATE. Below the tables is a 'Software Update Log' section with a list of log entries. The log entries show the process of validating install parameters, checking for conflicts, installing the version, attempting to forward routes, and finally completing the install successfully. The log also indicates the command was 'Stage' and the state was 'SUCCESS'.

**Figure 201. Indication of Successful Version Staging**

#### 5.3.11.5.5 Activate a Software Version

In order to promote a staged version to active, the user may command to switch the version by selection of the ‘ACTIVATE’ button. In the figure above, the staged Software version, 0.7.7032 is selected along with the staged Adaptation version, 0.7.7032. Upon selection of the ‘ACTIVATE’ button, the user is presented with a confirmation dialog similar to the confirmation dialog shown in Software and Adaptation Download Confirmation Dialog.

Similar to the download and stage confirmation dialogs, selection of the ‘CANCEL’ button dismisses the message. Upon selection of the ‘CONFIRM’ button, the system will perform a switch of the active version. In the example shown in the figure above, software version 0.7.7030 is the active version and software version 0.7.7032 is the staged version. The command to ‘ACTIVATE’ will switch the active version from 0.7.7.030 to 0.7.7032.

Progress of the activation is displayed with the Command and State statuses at the bottom of the window. High level progress messages are displayed in the Software Update Log similar to Version Stage in Progress. Successful activation of the version is denoted with a green circle/checkmark icon as shown below. Note the icon in the Active column for the previously active version updates to indicate the version is available to stage on the local system. The UNSTAGE button changes back to STAGE as the selected version is no longer staged.

The screenshot shows the NWP-A Software Update Service interface. At the top, it says "NWP-A Software Update Service". Below that, there's a section titled "Software & Adaptation Update" with a message about download space availability. A table lists several software versions with columns for Version, Release Date, Version Info, Size, Download (with icons), and Active. One row is highlighted in blue. Below this, another table shows adaptation versions with similar columns. At the bottom, there's a "Software Update Log" section with a command history and a status indicator "State: SUCCESS".

| Version              | Release Date             | Version Info                                        | Size   | Download | Active |
|----------------------|--------------------------|-----------------------------------------------------|--------|----------|--------|
| 0.7.7032-development | 2022-02-07T15:55:17.000Z | Live version - Auto-generated software version info | 5.4 GB |          |        |
| 0.7.7031-development | 2022-02-05T05:13:55.000Z | Auto-generated software version info                | 5.4 GB |          |        |
| 0.7.7030-development | 2022-02-04T16:52:49.000Z | Auto-generated software version info                | 5.4 GB |          |        |
| 0.7.7029-development | 2022-02-04T14:32:18.000Z | Auto-generated software version info                | 5.4 GB |          |        |
| 0.7.7028-development | 2022-02-03T21:28:35.000Z | Auto-generated software version info                | 5.4 GB |          |        |

| Version              | Release Date             | Version Info                                          | Size     | Download | Active |
|----------------------|--------------------------|-------------------------------------------------------|----------|----------|--------|
| 0.7.7032-development | 2022-02-07T15:55:17.000Z | Live version - Auto-generated adaptation version info | 481.5 MB |          |        |

| Software Update Log                                                       |  | Command: Activate | State: SUCCESS |
|---------------------------------------------------------------------------|--|-------------------|----------------|
|                                                                           |  |                   |                |
| 2022-02-07T17:25:58.524Z: Validating parameters                           |  |                   |                |
| 2022-02-07T17:25:59.742Z: Demoting current version to rollback version... |  |                   |                |
| 2022-02-07T17:26:02.439Z: Done demoting current version                   |  |                   |                |
| 2022-02-07T17:26:02.439Z: Promoting new version to live version...        |  |                   |                |
| 2022-02-07T17:26:05.600Z: Done activating new version                     |  |                   |                |

**Figure 202. Indication of Successful Version Staging**

### 5.3.11.5.6 Update Adaptation Version

A new Adaptation version may become available for the currently installed Software version. If the user opts to install the latest Adaptation version, then they will follow the same process as instructed for Software Version updates. The new version will be available for download from the update site as indicated by the icon in the Download column. The user will select the new version, download, stage and activate it using the same work flow documented above for Software updates.

## 5.3.12 NWP Application Software Initial Install

This procedure describes the installation of all the software necessary to make the NWP System operational. This procedure is only for the first installation of the system. After initial installation, the update server GUI can be used to update system software. All build artifacts referenced in this section should be obtained from Second Level Engineering.

The installation scripts require the ability to SSH from the execution host to the targets without using passwords. Before running a command, ensure you have a Kerberos ticket by running `kinit`. If at any point the installation scripting asks for a password, use CTRL-C to exit, `kinit` once again, and execute the script once more.

### 5.3.12.1 Domain PG Software Installation

Follow this section to install the software on the Domain PG HF.

**NOTE:** Pre-requisite - Update Site's repository has been populated with target build. See 5.3.22 Update Server Population

The artifacts required for Domain PG Installation are as follows.

**Table 20. NWP PG build artifacts**

| File                         | Bamboo Artifact Name |
|------------------------------|----------------------|
| deploy-scripts.tar.gz        | Deploy-scripts       |
| blendingWarmStartArchive.tgz | BlendingTar          |

First transfer the required artifacts to a user with sudo permissions home directory on HF01 via DVD, flash drive, or remote directory by executing the following steps:

From a user with sudo permissions, on HF01:

1. Ensure the user is in their home directory
2. Copy deploy-scripts to the home directory: `cp <path to>deploy-scripts.tar.gz ~`
3. Make a temporary directory in the user with sudo permissions home directory: `mkdir ~/deploy-scripts`
4. Un-tar the deploy scripts: `tar xzf deploy-scripts.tar.gz -C deploy-scripts/`
5. Remove the tar file: `rm deploy-scripts.tar.gz`
6. Copy blendingWarmStartArchive.tgz to /nwpshare: `sudo -u nwapp cp /<path to> /nwpshare/blendingWarmStartArchive.tgz`
7. Install the software: `cd deploy-scripts./scripts/install/string_install.py -c ./scripts/install/string_config/<String Config File for Domain>`  
**Note:** If any servers are offline, add `--skip-servers <csv_list>` where `csv_list` is a comma separated list of aliases from the string config representing the offline servers. To update servers that are skipped or are being replaced, the command `--only-servers <csv_list>` can be added to the installation scripts to specify which servers the commands should be executed on.
8. Delete the temporary directory:  
`cd ~`  
`rm -rf ~/deploy-scripts`
9. Navigate to the Domain M&C and log in as a domain administrator. Place all servers online, then set the Compute Cluster to online as described in section 5.3.2 Monitor and Control Compute Cluster.

### 5.3.12.2 NWP-A Kubernetes/Rancher Installation

Follow this section to install Kubernetes/Rancher on the NWP-A ADS. The following steps should only be executed if setting up for the first time or performing an ASL.

The artifacts required for Kubernetes/Rancher Installation are as follows:

**Table 21. NWP Rancher Build artifacts**

| File                     | Bamboo Artifact Name |
|--------------------------|----------------------|
| deploy-scripts.tar.gz    | Deploy-scripts       |
| rancher-<version>.tar.gz | rancher-charts       |
| rancher_<version>        | rancher-images       |

First transfer the required artifacts to a user with sudo permissions home directory on ADS01 via DVD, flash drive, or remote directory.

Add the Docker groups to the privileged user account that you are logged in with

1. `sudo usermod -a -G docker <user>`
2. `sudo usermod -a -G dockerroot <user>`

Sign out and sign back in for the group changes to take effect.

To verify the groups have been added, run `groups` and ensure that 'docker' and 'dockerroot' are both shown in the list.

From a user with sudo permissions on ADS01:

1. Make a temporary directory in the user with sudo permissions home directory  
: `mkdir ~/deploy-scripts`
2. Un-tar the deploy scripts `tar xzf deploy-scripts.tar.gz -C deploy-scripts/`
3. Remove the tar file: `rm deploy-scripts.tar.gz`
4. Change to the directory: `cd deploy-scripts`

Perform cluster setup. Carefully confirm the current environment settings are correct and enter "1" to begin. Enter the password to use for the Rancher admin account when prompted

1. `./scripts/install/nwpa_cluster_install -c`

If continuing on to install ELK skip to section 5.3.12.3, otherwise, delete the temporary directory:

1. `cd ~`
2. `rm -rf ~/deploy-scripts ~/rancher*`

### 5.3.12.3 NWP-A ELK Install

Follow this section to install Elasticsearch, Logstash, and Kibana (ELK) on the NWP-A ADS. The following steps should only be executed if setting up for the first time, performing an ASL or if ELK software has been updated.

The artifacts required for the ELK Installation are as follows:

**Table 22. NWP ELK Build artifacts**

| File                     | Bamboo Artifact Name |
|--------------------------|----------------------|
| deploy-scripts.tar.gz    | Deploy-scripts       |
| elk-docker-images.tar.gz | elk-docker-images    |

First transfer the required artifacts to a user with sudo permissions home directory on ADS01 via DVD, flash drive, or remote directory.

From a user with sudo permissions on ADS01:

1. Make a temporary directory in the user with sudo permissions home directory  
: `mkdir ~/deploy-scripts`
2. Un-tar the deploy scripts `tar xzf deploy-scripts.tar.gz -C deploy-scripts/`
3. Remove the tar file: `rm deploy-scripts.tar.gz`
4. Change to the directory: `cd deploy-scripts`

Load the ELK docker images into the local registry.

1. `python ./scripts/build_and_update/update_site_manager.py add_images --local-registry local-registry:5000 --image-file ../elk-docker-images.tar.gz --tag <ELK software version>`

Install ELK containers.

1. `cd rancher/charts`
2. `./helm_install.sh -c <Server YAML values file>.yaml -r <FQDN of Rancher Server> -v <ELK software version> -a <ELK adaptation version> -d local-registry:5000 -e -n`

Example:

1. `cd rancher/charts`
2. `./helm_install.sh -c acyztl_values.yaml -r acyztl-rancher.acy.nwp.nas.faa.gov -v <ELK software version> -a <ELK adaptation version> -d local-registry:5000 -e -n`

If continuing on to install NWP-A skip to section 5.3.12.4, otherwise, delete the temporary directory:

1. `cd ~`
2. `rm -rf ~/deploy-scripts`

#### 5.3.12.4 NWP-A Software Install

Follow this section to install the NWP-A software on the ADS.

**NOTE:** Pre-requisite - *Update Site's repository has been populated with target build. See [5.3.22 Update Server Population](#)*

The artifacts required for NWP-A Software Installation are as follows.

**Table 23. NWP-A Build artifacts**

| File                  | Bamboo Artifact Name |
|-----------------------|----------------------|
| deploy-scripts.tar.gz | Deploy-scripts       |

First transfer the required artifacts to a user with sudo permissions home directory on ADS01 via DVD, flash drive, or remote directory.

From a user with sudo permissions on ADS01:

1. Make a temporary directory in the user with sudo permissions home directory  
`:mkdir ~/deploy-scripts`
2. Un-tar the deploy scripts `tar xzf deploy-scripts.tar.gz -C deploy-scripts/`
3. Remove the tar file: `rm deploy-scripts.tar.gz`
4. Change to the directory: `cd deploy-scripts`

Install the NWP-A software. Carefully confirm the current environment settings are correct, and enter "1" to begin.

1. `cd ~`
2. `./deploy-scripts/scripts/install/nwpa_cluster_install -i -b <software version>:<adaptation version> -l <FQDN of Update Server>:443 -y <FQDN of Update Server> -o <Site ID>`

Example:

1. `cd ~`
2. `./deploy-scripts/scripts/install/nwpa_cluster_install -i -b <software version>:<adaptation version> -l acy-update01.acy.nwp.nas.faa.gov:443 -y acy-update01.acy.nwp.nas.faa.gov -o acyztl`

Delete the temporary directory: `rm -rf ~/deploy-scripts`

#### 5.3.12.5 Adaptation Manager Install

Follow this section to install the Adaptation Manager software. The artifacts required for Adaptation Manager Installation are as follows.

**NOTE:** Pre-requisite - *Update Site's repository has been populated with target build. See [5.3.22 Update Server Population](#)*

**Table 24. NWP Adaptation Manager Build artifacts**

| File                  | Bamboo Artifact Name | Notes |
|-----------------------|----------------------|-------|
| deploy-scripts.tar.gz | Deploy-scripts       |       |

First transfer the required artifacts to a user with sudo permissions home directory on Adaptation Manager server via DVD or flash drive. (*Note, the adaptation manager is not enrolled in IdM and therefore will not match the nwp user password from the other servers that are enrolled in IdM.*)

As a user with sudo permissions on adaptation manager:

1. Make a temporary directory in the user with sudo permissions home directory  
`mkdir ~/deploy-scripts`
2. Un-tar the deploy scripts `tar xzf deploy-scripts.tar.gz -C deploy-scripts/`
3. Change to the directory: `cd deploy-scripts`

Install the Adaptation Manager software.

1. `./scripts/install/string_install.py -c ./scripts/install/string_config/acy-adapt01-sam-config.json --version <software version> --adaptation-version <adaptation version>`

Delete the temporary directories:

1. `cd ~`
2. `rm -rf ~/deploy-scripts`

Navigate to the Adaptation Manager URL (i.e. `https://<FQDN of adapt server>:8280/manager`) and ensure it is available.

### 5.3.13 Monitor NWP Interfaces

The M&C GUI for a particular instance of NWP contains tabs for each of the applicable NWP Interfaces. These tabs display the monitored state and mode (if applicable) of the NWP Interfaces. A user in a ‘Monitor’ only role may view the state of interfaces. A user must be logged in with an ‘Admin’ role in order to reset interface connections.

Each type of NWP external interface is represented via a tab on the M&C display. The tab is color coded to represent the collective states of the interface connections for the respective interface type. Each individual interface connection is represented via an icon on the interface tab. Tabs are displayed only for interfaces associated with the given NWP deployment.

All icons representing the status of interface connections are color coded to describe the state of the connection. All icons have alarms which may be controlled via methods described in section 5.3.8.

The following table shows which interfaces are available to be configured at each type of M&C deployment. The numbers on the table denote the number of possible interface connections at the site. If an interface is not configured for a particular site, no interface status will be presented on the M&C GUI.

**Table 25. Interfaces by Deployment Type**

| NWP Interface (M&C Display Tab) | Domain M&C | NWP-A M&C |
|---------------------------------|------------|-----------|
| CSS-Wx                          | 1          |           |
| Radar                           | Multiple   |           |

|                           |                        |            |
|---------------------------|------------------------|------------|
| (received through CSS-Wx) |                        |            |
| <b>FTI</b>                | 1                      | 1          |
| <b>NTP</b>                | per server/workstation | per server |
| <b>RMLS</b>               | 1                      | 1          |
| <b>NEMS</b>               |                        | 1          |

An M&C user with Admin role may control certain interfaces. Control options per interface are described in the table below.

**Table 26. Interface Control Options**

| NWP Interface                          | Reset Control | Mode Control    |
|----------------------------------------|---------------|-----------------|
| <b>CSS-Wx</b>                          | No            | Through PG mode |
| <b>Radar</b> (received through CSS-Wx) | No            | Yes             |
| <b>FTI</b>                             | No            | No              |
| <b>NTP</b>                             | No            | No              |
| <b>RMLS</b>                            | Yes           | No              |

Examples of each type of interface follow in the subsections below.

#### 5.3.13.1 CSS-Wx

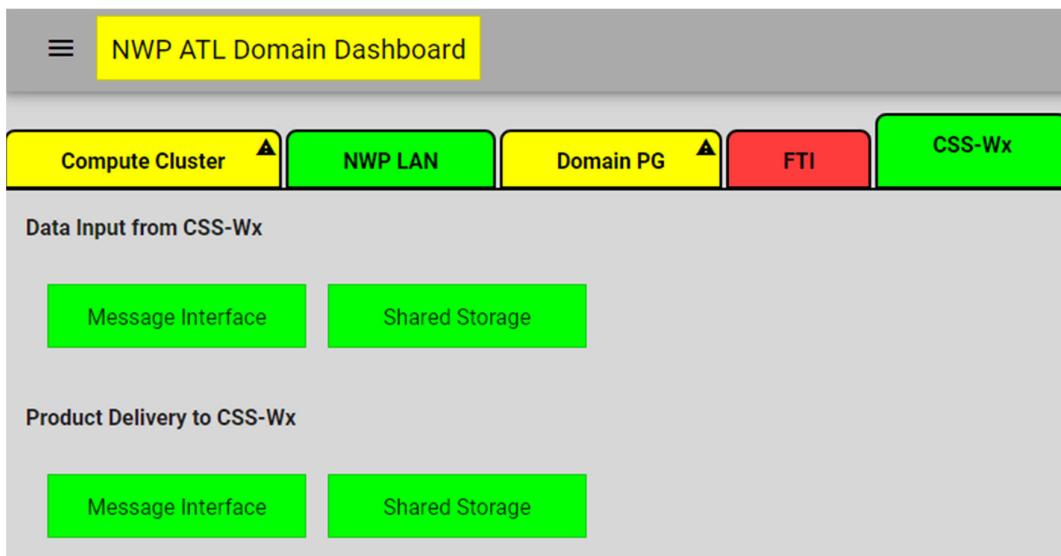
The CSS-Wx tab represents the state of the CSS-Wx connections at a Domain site. Each icon under the tab provides an indication of the state of the labelled functionality. At an NWP Domain, the state of each icon is determined per the reporting of both HF nodes when both are in Standby or Online mode. If both HF nodes report Normal, the state is normal. If one HF node reports Degraded or Failed, the state will be Degraded. The icon shows Failed only if both HF nodes report a failed state. If only one HF node is in Standby or online mode, the state is determined by that single node.

**Table 27. CSS-Wx Interface State Icons**

| Icon Category          | Icon Label        | Status Description                                                                                                                                                                                                                                                                                                                                                     | Site Applicability |
|------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Data Input from CSS-Wx | Message Interface | Status of receipt of product availability messages from CSS-Wx. <ul style="list-style-type: none"> <li>• Normal state is messages are received within a configured duration of time.</li> <li>• Degraded state if no messages are received within a configured duration of time.</li> <li>• Failed state if unable to deliver input product messages to PG.</li> </ul> | Domain             |
|                        | Shared Storage    | Status of CSS-Wx shared storage file for CSS-Wx input data.                                                                                                                                                                                                                                                                                                            | Domain             |

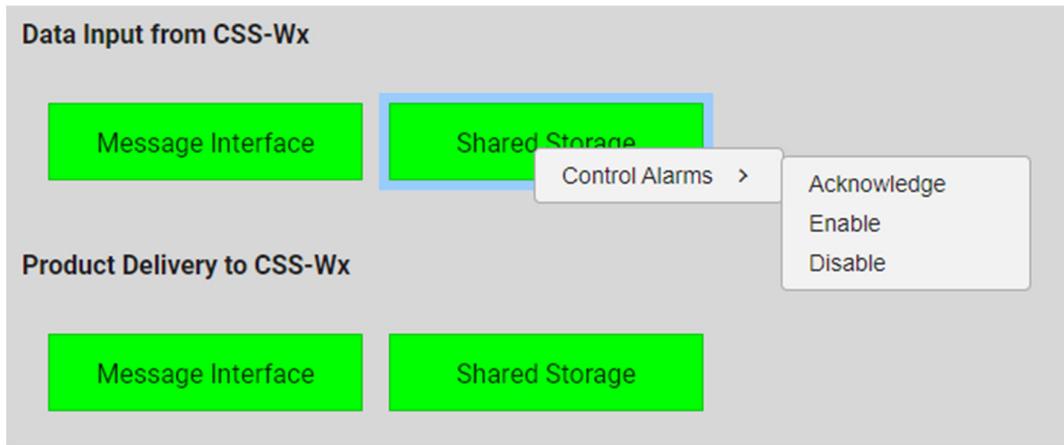
|                            |                   |                                                                                                                                                                                                                                                                                                                                                  |        |
|----------------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
|                            |                   | <ul style="list-style-type: none"> <li>Normal state when both HF1 and HF2 are able to read from the file path.</li> <li>Degraded state if either HF1 or HF2 are unable to read from file path.</li> <li>Failed state when both HF1 and HF2 are unable to read from file path.</li> </ul>                                                         |        |
| Product Delivery to CSS-Wx | Message Interface | Status of delivery of product availability messages to CSS-Wx. <ul style="list-style-type: none"> <li>Normal state if able to send product availability messages to CSS-Wx.</li> <li>Failed state if unable to send product availability messages to CSS-Wx</li> </ul>                                                                           | Domain |
|                            | Shared Storage    | Status of CSS-Wx shared storage file for NWP output data. <ul style="list-style-type: none"> <li>Normal state when both HF1 and HF2 are able to read from the file path.</li> <li>Degraded state if either HF1 or HF2 are unable to write to file path.</li> <li>Failed state when both HF1 and HF2 are unable to write to file path.</li> </ul> |        |

The icon layout for each type of NWP deployment is presented below.



**Figure 203. Domain NWP CSS-Wx Tab**

Each icon on the CSS-Wx tab, on any NWP deployment, has 'Control Alarm' functions only, example shown below. For additional information on control of component alarms, see section 5.3.8.

**Figure 204. CSS-Wx Alarm Control**

### 5.3.13.2 CSS-Wx Radar

The state of each NEXRAD, CANRAD, and TDWR radar received through CSS-Wx is presented on the Radar tab at a Domain M&C, as shown in the figure below. The radars are each presented in their own section: TDWR, NEXRAD, and CANRAD, respectively. The state of the radar is Normal when data is actively being received from CSS-Wx. The state is Failed when data has not been received in a configured duration of time.

Because of the number of radars, a scroll bar and search and summary controls are provided for each section. The summary, indicated by (1) below presents the total number of radars in the section in each state. Sort and search options are available for each type as shown by (2) through (4) below. Three options are provided for sorting: Alphanumeric, Status, and Mode. When sorted by 'Status', those radars with failed state are presented alphabetically first, followed by an alphabetical listing of the radars in Normal state. When sorted by 'Mode', those radars in Offline mode are displayed first, sorted alphabetically, regardless of state. The default sort is set to Status so any Failed radars are by shown at the top of the list. A user may type into the search box to find a specific radar. The radar will be highlighted with a blue highlight when found, as shown with KAMA below.

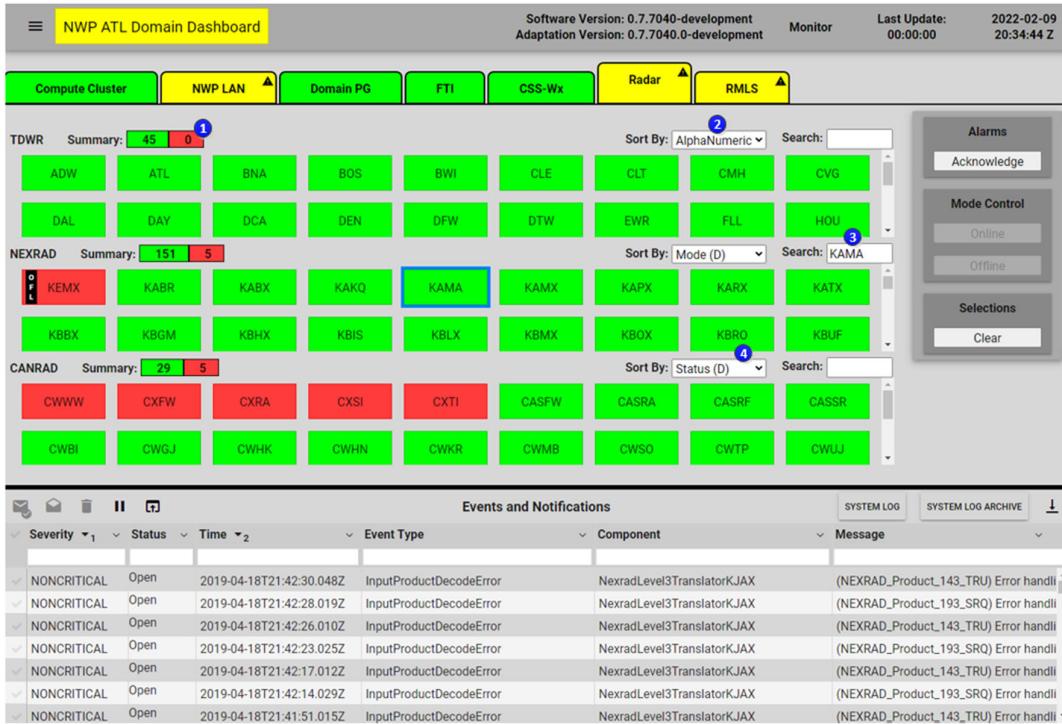


Figure 205. Radar Tab

The M&C operator, in an Admin role, may control which radar data is used in production of NWP products via control of the mode of each radar. When a radar icon is taken of Offline mode, the incoming radar data is not delivered to the PG, and is discarded by NWP. This data is not archived and thus acts as if it was never received. The Offline radar will be indicated as such via the black offline banner, as shown over KEMX below. When the radar icon is taken to Online mode, incoming radar data is accepted, routed to PG for use in creation of applicable products, and archived. The Online mode of the radar will be indicated as such with no banner over the icon, as shown with other radars such as KABR below.

Note the mode of the radars is solely controlled by the M&C operator. The M&C operator must take the radar to Offline when data is not desired for use and must return the radar to Online when data is desired. The state of the radar does not affect the mode. For example, if PHKI fails as shown in the figure below, and the operator does not want to receive PHKI data should the radar data resume, the operator should take the radar to Offline mode to ensure data is not used upon radar recovery (see KEMX).



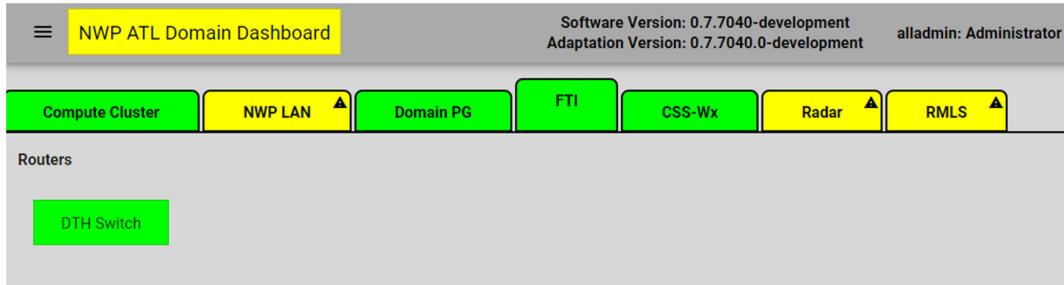
Figure 206. KEMX Radar in Offline Mode

In order to control the mode of the radar as described above and to acknowledge alarms in case of a failure, the following context menu options are available for each radar: Control

Alarms (Options: Acknowledge, Enable, Disable) and Transition Mode (Options: Online, Offline).

#### 5.3.13.3 FTI

Icons in the FTI tab represent the state of the switch(es) and the connections to the FTI. No reset control is available for these components, monitor of state only. The FTI tab is available on a Domain M&C display. Alarms for the switch icons under the FTI tab may be controlled as described in section 5.3.8 Control M&C Alarms.



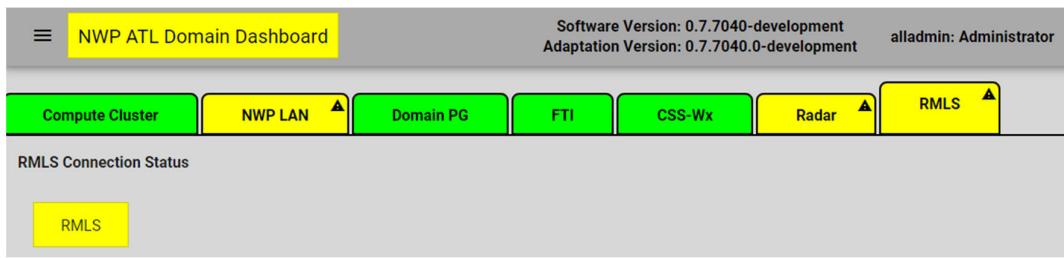
**Figure 207. FTI Tab**

#### 5.3.13.4 NTP

The NTP status is monitored per server. The status can be found via the Compute Cluster Tab, under the software listing for each server. Reference section 5.3.2, Monitor and Control NWP Compute Cluster, for an example of the status indication of the NTP client running on each server.

#### 5.3.13.5 RMLS

The state of the connection of RMLS to a Domain NWP or NWP-A, is represented with the RMLS tab, presented on any M&C. The RMLS interface may be reset if a user has Admin permissions. Right-click the icon for the connection to be reset and select 'Reset'. The user will be prompted with a confirmation dialog before the reset command is sent.



**Figure 208. RMLS Tab**

#### 5.3.13.6 NEMS

The NEMS tab is included with each NWP-A and External Web Server M&C. The interface displays the state of the connection of an NWP-A site to NEMS. The state of the NEMS connection is Normal (green) when the NWP-A site is connected to the messaging interface and messages are being processed without errors. The state is Degraded (yellow) when the messaging interface is connected but no messages are being processed or errors have

occurred. The state is Failed (red) if NWP-A is unable to establish a connection to NEMS. The NEMS M&C display with a Normal state is shown below

| Severity | Status | Time                     | Event Type                | Component   | Message                                                                   |
|----------|--------|--------------------------|---------------------------|-------------|---------------------------------------------------------------------------|
| WARNING  | Open   | 2019-04-21T09:56:07.152Z | SoftwareAbnormalCondition | web01_agent | Agent report is from time 2022-02-07_17:30:02.120 but current time in SMS |
| WARNING  | Open   | 2019-04-21T09:55:50.059Z | SoftwareAbnormalCondition | web01_agent | Agent report is from time 2022-02-07_17:29:51.26 but current time in SMS  |
| WARNING  | Open   | 2019-04-21T09:55:01.058Z | SoftwareAbnormalCondition | web01_agent | Agent report is from time 2022-02-07_17:29:36.26 but current time in SMS  |
| WARNING  | Open   | 2019-04-21T09:55:29.180Z | SoftwareAbnormalCondition | web02_agent | Agent report is from time 2022-02-07_17:29:24.148 but current time in SMS |
| WARNING  | Open   | 2019-04-21T09:55:19.752Z | SoftwareAbnormalCondition | web02_agent | Agent report is from time 2022-02-07_17:29:14.137 but current time in SMS |
| WARNING  | Open   | 2019-04-21T09:55:07.244Z | SoftwareAbnormalCondition | web03_agent | Agent report is from time 2022-02-07_17:29:02.212 but current time in SMS |
| WARNING  | Open   | 2019-04-21T09:54:57.241Z | SoftwareAbnormalCondition | web03_agent | Agent report is from time 2022-02-07_17:28:52.209 but current time in SMS |

**Figure 209. NEMS Tab for NWP-A M&C**

### 5.3.14 National View

Each Domain site will receive overall status information from the other Domain NWP, NWP-A, and External Webserver. This information will be consolidated into the National View Dashboard displayed in the M&C National View webpage hosted on the M&C webserver at each domain site. This architecture configuration allows authorized users to access the National View website from either Domain. While the National View is available from both Domain locations, the preferred National View URL should be for the active Domain.

1. The National View URL is formatted in this manner:
  - a. To navigate to the National View Web Page, enter the following in the address bar:
    - (1) [https://<site\\_id>-hf.<domain>.nwp.nas.faa.gov:8180/sms-client/nationalview.html](https://<site_id>-hf.<domain>.nwp.nas.faa.gov:8180/sms-client/nationalview.html)  
Note: Replace <site\_id> and <domain> above with either atl and gec for the Atlanta NEMC or slc and uec for the Salt Lake City NEMC. (Ex: <https://atl-hf.gec.nwp.nas.faa.gov>)

The M&C National View Dashboard provides the M&C user with a read-only view of the individual color-coded status icons showing the overall states of the domain sites, NWP-A, and External Webserver. The M&C National View Dashboard display is generally consistent with the overall M&C GUI structure detailed in section 5.0. From the National View Dashboard, the M&C user is able to view the overall status of the deployments, but they are not able to directly control any actions at a particular deployment, such as changing its current mode.

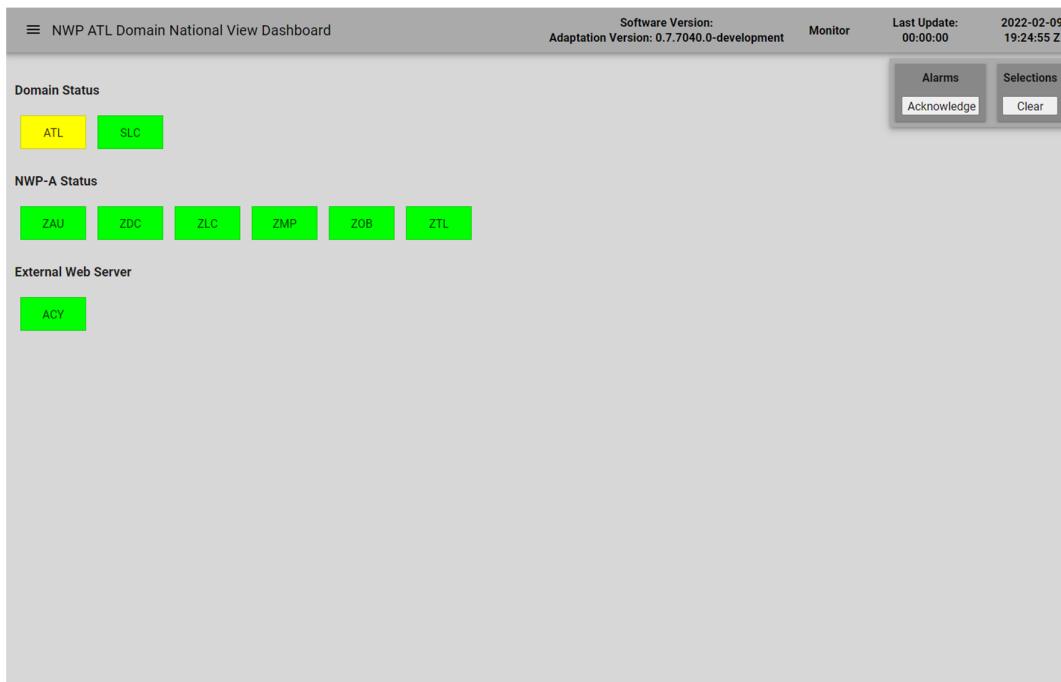
Although the M&C National View Dashboard does not include or display an Event and Notifications Log, it does provide audible or blinking alarms and alerts upon degradation of the current state to Degraded or Failed. Any M&C user accessing the National View may acknowledge an alarm or alert to stop the blinking and silence the audible alarm for their session in accordance with section 5.3.8 Control M&C Alarms. These acknowledgements will not affect the National View sessions of other M&C users. No alarms or alerts will occur if the state is upgraded. Because the M&C user does not have any control capabilities within the

National View, if additional information about the cause an alarm or alert is needed, the M&C user, assuming they have the necessary site-level permissions, will need to drill down to the specific deployment. This allows the user to view the deployment's Event and Notification Log, view the states of its subsystems or to exercise control actions on the deployment, within the limits of their assigned site-level permissions. The user initiates the drill down by clicking on the site's status icon.

In order to access the National View Dashboard, open a browser and go to the National View website address for either of the domains. The M&C National View Title Bar identifies the Domain hosting the National View website the user accessed. Each of the status icons displayed in the M&C National View is identified with the unique ID assigned to the particular deployment. Any changes to the deployment's overall state, either up or down between "Normal", "Degraded" or "Failed", of a Domain will cause the site's icon color to change to reflect the new state in the National View. The National View will provide audible or blinking alarms/alerts in accordance with section 5.3.8 upon degradation of the current state to Degraded or Failed. No alarms or alerts will occur if the state is upgraded.

The M&C National View Dashboard is shown below. The M&C National View Title Bar identifies the Domain hosting the National View website the user accessed. Refer to Section 5.0 for details related to the M&C GUI, state icon color codes, error criteria and to 5.3.8 Control M&C Alarms for details related to alarms and alerts.

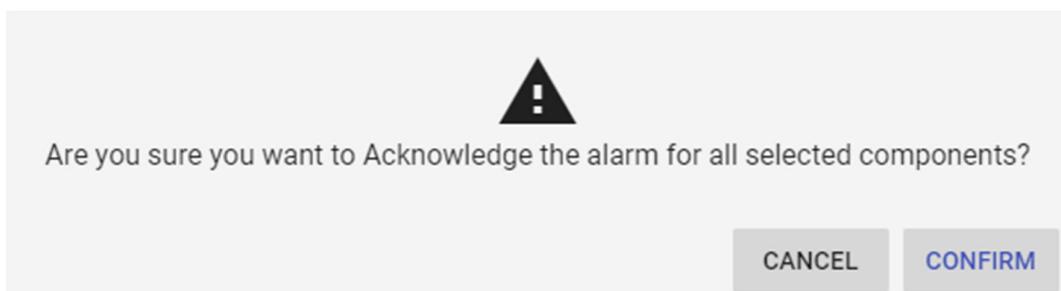
Each of the status icons displayed in the M&C National View is identified with the unique ID assigned to the particular deployment. Domain NWPs, NWP-A, and External Webservers are identified with three character sets as defined in J-07. Any changes to the deployment's overall state, either up or down between "Normal", "Degraded" or "Failed", of a Domain, NWP-A, or External Webserver will cause the site's icon color to change to reflect the new state in the National View. The National View will provide audible or blinking alarms/alerts in accordance with 5.3.8 Control M&C Alarms upon degradation of the current state to Degraded or Failed. No alarms or alerts will occur if the state is upgraded.



**Figure 210. M&C National View Dashboard**

The upper left portion of the display contains two icons, one per domain, that indicate the overall status of the Domain site. Each Domain's status icon, tagged with the three-character Domain ID, is color-coded to display the current state of the domain. The M&C National View does not provide any indication of which Domain is the primary or standby site. Similarly, a status icon is provided for each of the NWP-A sites and External Web Server. Each of these presents the overall state of the labelled site.

One or multiple National View icons may be selected for alarm acknowledgement. In order to select one or more components, <Ctrl> left click each icon desired for acknowledgement. Select 'Acknowledge'. Upon selection of the 'Acknowledge' button, a confirmation dialog will pop-up requesting confirmation of the Acknowledgement. Upon selection of 'CONFIRM', selected component alarms are acknowledged for all instances of the Domain site's National View. Upon selection of 'CANCEL', component alarms remain unacknowledged, but component selections are cleared. The 'Clear' button will also clear any component selections on the screen.



**Figure 211. Alarm Acknowledge Confirmation**

#### 5.3.14.1 Drill Down

Because the M&C National View Dashboard only provides a read-only view of the overall state for any site, if an M&C user desires more detailed information about a specific site, they can left click on the site's icon to initiate a drill down to the site.

### 5.3.15 Identity Management

#### 5.3.15.1 Overview

The NWP System uses Red Hat Identity Manager (IdM) to provide Lightweight Directory Access Protocol (LDAP) based centralized management of user accounts, roles, and credentials to support user authentication. IdM manages AWD user accounts, M&C user accounts, and System Administration operating system level user accounts - which includes System Administrators with privilege to login to IdM and perform user account and password management.

An IdM server instance is installed during the Automated System Loader (ASL) configuration phase of the HF server setup, together with an initial IdM System Administrator user account. The initial IdM System Administrator can then login to the IdM GUI to create additional System Administrator user accounts with IdM access and privileges to perform all or a subset of IdM functions.

To support redundancy, an instance of the IdM server resides on each Hot Failover (HF) server at each domain site - with the LDAP repository in each server instance is synchronized with the other instances using replication. The synchronization allows user authentication against any available server instance. Even if no server instance is accessible, user authentication is still

possible through the use of local credential caching of previous successful logins. For external (i.e., non-dedicated) access, the IdM server will reside on the proxy server.

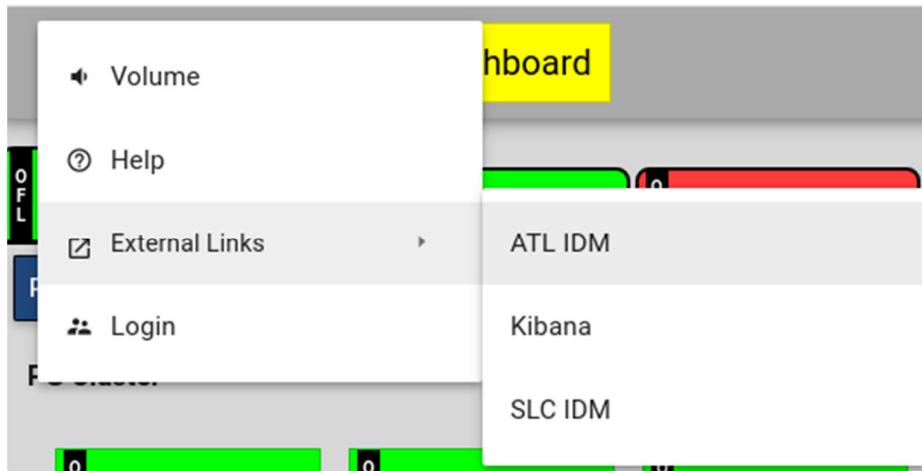
IdM is based on FreeIPA (Identity, Policy and Audit) and provides both a Web GUI and IPA Command Line (CLI) tools to perform account administration tasks. The Web GUI is hosted on each domain HF, and the GUI hosted on the preferred IdM server at each domain is accessible from any M&C.

### 5.3.15.2 Initiating an IdM Session

The IdM GUI can be reached directly by entering the IdM server URL into a web browser.

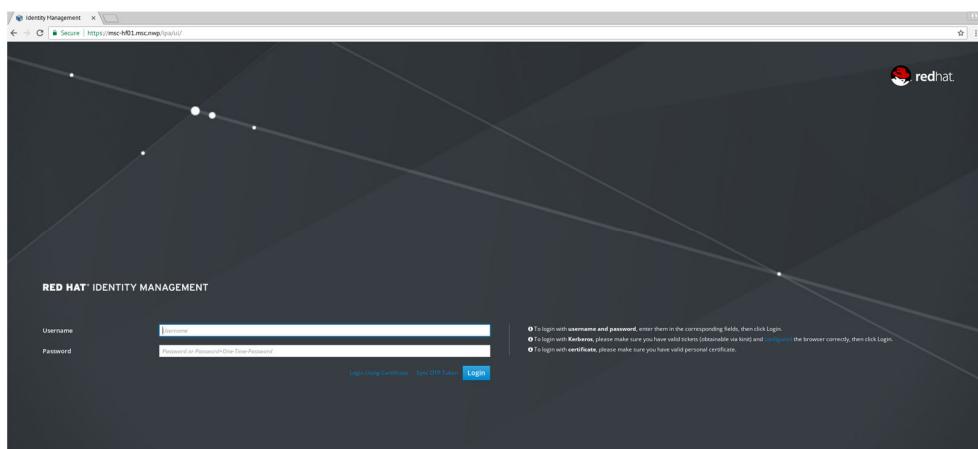
However, if a user does not know what the URL is, the following steps will also initiate an IdM GUI session:

1. Login to the Domain M&C.
2. Select the Main Menu icon in the upper-left corner, select the External Links option, and then select the Atlanta (ATL) IdM or Salt Lake City (SLC) IdM sub-option.



**Figure 212. Domain M&C External Links to IdM**

The IdM login screen for the preferred HF server at the selected domain site is then displayed.



**Figure 213. IdM Login**

3. Enter valid username and password credentials for the IdM System Administrator, and left-click the **Login** button. The message "Authenticating..." is displayed.
4. On successful authentication, by default, the Active users page variant of the Users page is displayed, under the **Identity** main menu option and **Users** sub-option. Note the "Administrator" user in the upper-right corner of the window, which is the initial IdM System Administration user.



**Figure 214. Default Active Users Page & Administrator Login**

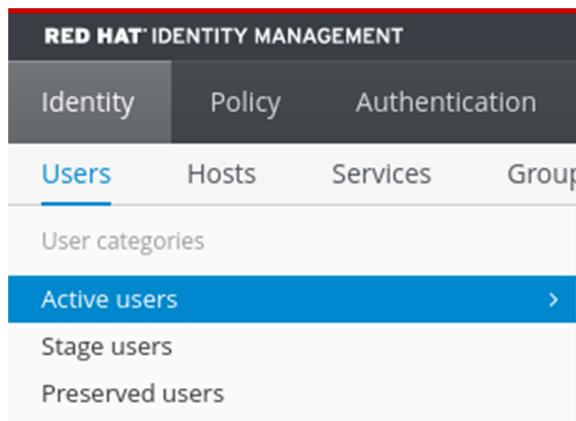
The Active users page list all users who are active and allowed to authenticate.

This screenshot is identical to Figure 214, showing the 'Active users' page of the Red Hat Identity Management interface. It displays a table of active users with their details like first name, last name, status, and email. The table shows 20 entries out of 32 total.

**Figure 215. Active Users Page**

Selection of the Preserved users category displays the Preserved users page that lists former active users who are manually deactivated and cannot authenticate but could be reactivated to the Active users list in the future.

Selection of the Stage users category displays the Stage users page that lists users in their initial state that are inactive because they are missing account properties that would allow them to be active.



**Figure 216. User Categories: Active Users, Stage Users, & Preserved Users**

Entries in each list can be filtered by entering a search keyword into the **Search** field, and only accounts with a User login containing the search keyword are displayed. For example, the above Active users list can be filtered to only show user logins containing "awd" in the list.

## Active users

|                          |                  |  |
|--------------------------|------------------|--|
| <input type="checkbox"/> | User login       |  |
| <input type="checkbox"/> | awd_user         |  |
| <input type="checkbox"/> | awd_website_user |  |
| <input type="checkbox"/> | awdadmin         |  |
| <input type="checkbox"/> | awdmonitor       |  |

Showing 1 to 4 of 4 entries.

**Figure 217. Using the Search Option**

The IdM features are organized as pages accessible by a set of hierarchical main menu and sub-menu options as follows:

**Table 28. IdM Menu / Sub-Menus**

| Menu             | Sub-Menus                                                                                                                                                                                 |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Identity         | <ul style="list-style-type: none"> <li>• Users</li> <li>• Hosts</li> <li>• Services</li> <li>• Groups</li> <li>• ID Views</li> <li>• Automember</li> </ul>                                |
| Policy           | <ul style="list-style-type: none"> <li>• Host-Based Access Control</li> <li>• Sudo</li> <li>• SELinux User Maps</li> <li>• Password Policies</li> <li>• Kerberos Ticket Policy</li> </ul> |
| Authentication   | <ul style="list-style-type: none"> <li>• OTP Tokens</li> <li>• RADIUS Servers</li> <li>• Certificate Identity Mapping Rules</li> </ul>                                                    |
| Network Services | <ul style="list-style-type: none"> <li>• Automount</li> <li>• DNS</li> </ul>                                                                                                              |

|                   |                                                                                                                                                                                                 |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>IPA Server</b> | <ul style="list-style-type: none"> <li>• Role-Based Access Control</li> <li>• ID Ranges</li> <li>• Realm Domains</li> <li>• Topology</li> <li>• API Browser</li> <li>• Configuration</li> </ul> |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Based on the privileges assigned to the specific IdM System Administrator, some of the menu/sub-menu options are not available (not visible rather than desensitized). Options listed in gray are not currently updated by an NWP IdM System Administrator.

### 5.3.15.3 Terminating an IdM Session

The following steps will terminate an IdM GUI session:

1. Left-click the option in the top right corner displaying the name of the logged in IdM System Administrator, in this case **Administrator**.
2. From the menu, left-click the **Logout** option.

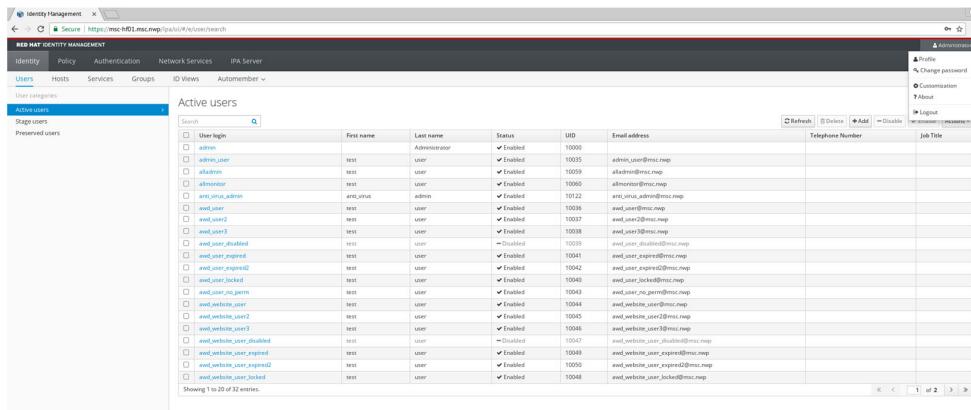
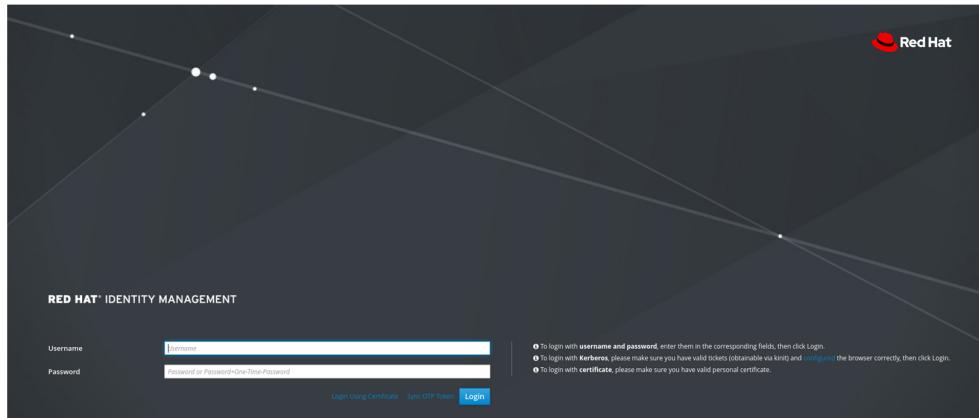


Figure 218. IdM Logout

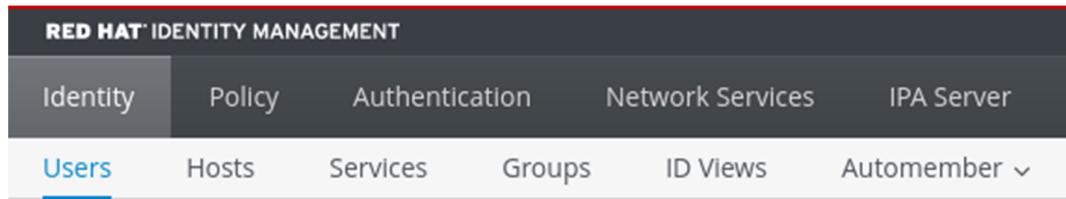
3. On successful logout, the login screen is re-displayed.



**Figure 219. Successful Logout - Return to Login Screen**

#### 5.3.15.4 Identity Menu

This section describes IdM features available via the Identity main menu option: Users, Hosts, Services, Groups, ID Views, and Automember.



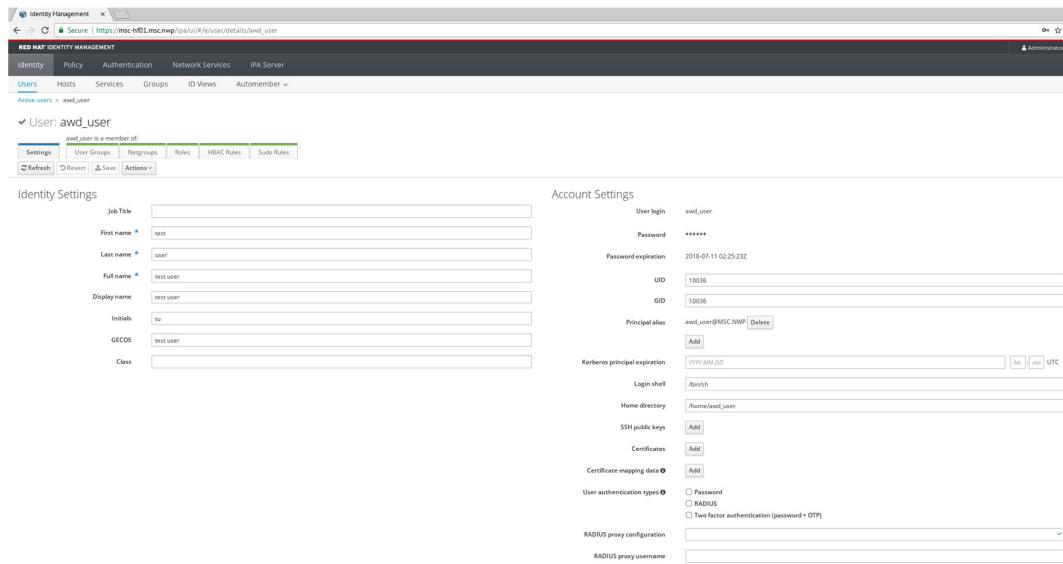
**Figure 220. Identity Menu**

The Services, ID Views, and Automember options are not currently updated by the IdM System Administrator and therefore are not described in this section.

##### 5.3.15.4.1 Users - Viewing and Modifying User Account Settings

The following steps will display the user account settings for an existing user:

1. If the Active users page is not already displayed, left-click the **Identity** option, and the **Users** sub-option.
2. Left-click a username in the **User login** column of the table.
3. The User page for the user that was selected is displayed on the Settings sub-page, containing both editable and read-only fields, with the **Save** button desensitized.



**Figure 221. User Page**

Examples of editable fields include the fields within the Identity Settings grouping and Employee Information grouping.

#### Identity Settings

|              |                     |
|--------------|---------------------|
| Job Title    | [empty input field] |
| First name * | test                |
| Last name *  | user                |
| Full name *  | test user           |
| Display name | test user           |
| Initials     | tu                  |
| GECOS        | test user           |
| Class        | [empty input field] |

**Figure 222. Identity Settings Grouping - Example of Editable Fields**

Examples of read-only fields are User login, Password (note the password value is obscured), Password expiration, and all fields in the Password Policy grouping.

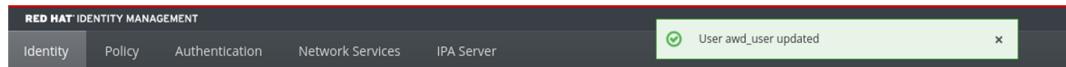
## Account Settings

|                     |                      |
|---------------------|----------------------|
| User login          | awd_user             |
| Password            | *****                |
| Password expiration | 2022-07-05 18:33:05Z |

**Figure 223. User Login, Password, and Password Expiration Fields - Examples of Read-Only Fields**

If an editable field is changed by typing in a text field, by selecting an **Add** button and adding an entry to a list, or selecting a radio, toggle, or checkbox button, the **Save** button is automatically sensitized.

A left-click on the **Save** button commits the update without confirmation, and the update is successful; the transient message "**User <user account name> updated**" is displayed at the top-center of the User settings page:



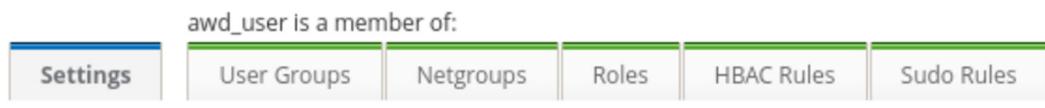
**Figure 224. User Updated Message**

If the update is unsuccessful, a failure message dialog is displayed that allows to retry the update.

### 5.3.15.4.2 Users - User Groups, Roles, Host Based Access Control (HBAC) Rules, Super User Do (Sudo) Rules

The User page defaults to the Settings sub-page. Next to the Settings button, there are a series of buttons that, on left-click, open the User Groups, Netgroups, Roles, HBAC rules, and Sudo Rules sub-pages, respectively.

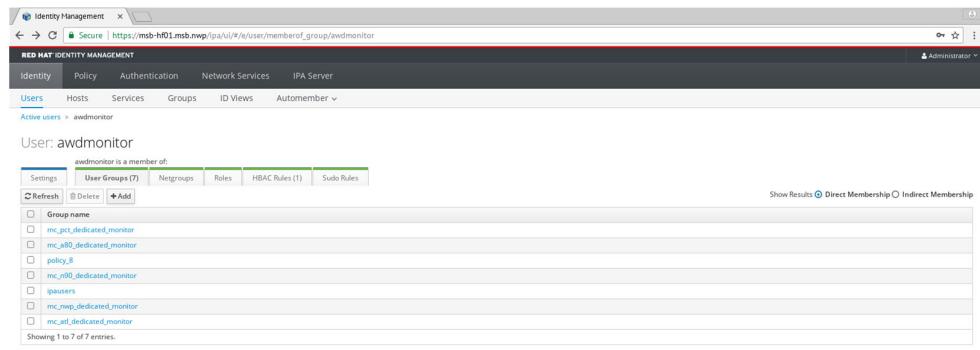
#### ✓ User: awd\_user



**Figure 225. User Sub-Pages**

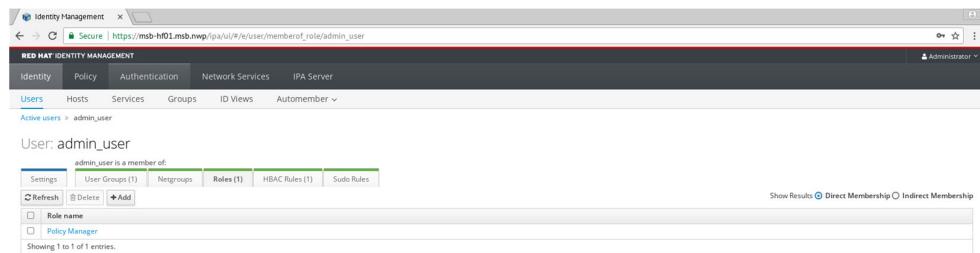
These sub-pages provide a mechanism to view and add/delete the following for a specific user:

1. User Groups - the groups a user belongs to defines the capability of the user at the application level and the password policy used during authentication. For example, the AWD and M&C GUI applications are able to retrieve the groups for a user, and parse the group name(s) to determine the function (i.e., AWD, M&C), site, role, and privileged operations associated with the user.



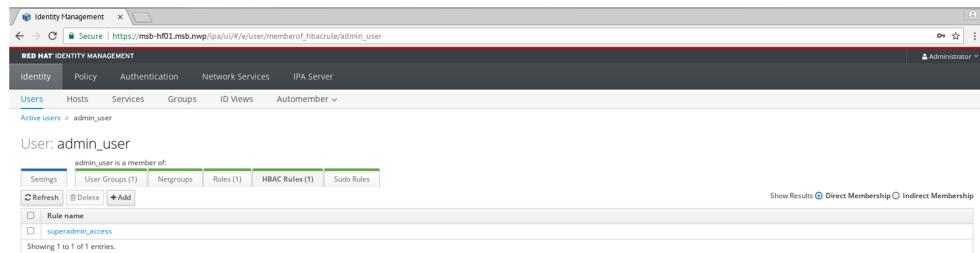
**Figure 226. User Groups**

2. **Netgroups** - not currently updated by the IdM system administrator and therefore not described.
3. **Roles** - the roles a user belongs to define the capability of the user at the Operating System (OS) or IdM level. For example, a role can be **Policy\_Manager**, **User\_Administrator**, or **Temporary\_Account**. Additional detail of Roles is provided in the IPA Server section.



**Figure 227. Roles**

4. **HBAC Rules** - the HBAC rules assigned to a user restrict to which physical hosts (machines) and by which services a user account can authenticate. Additional detail of HBAC Rules is provided in the Policy section.



**Figure 228. HBAC Rules**

5. **Sudo Rules** - the Sudo rules assigned to a user define which commands the user can execute, as if they were the root user. Additional detail of Sudo Rules is provided in the Policy section.

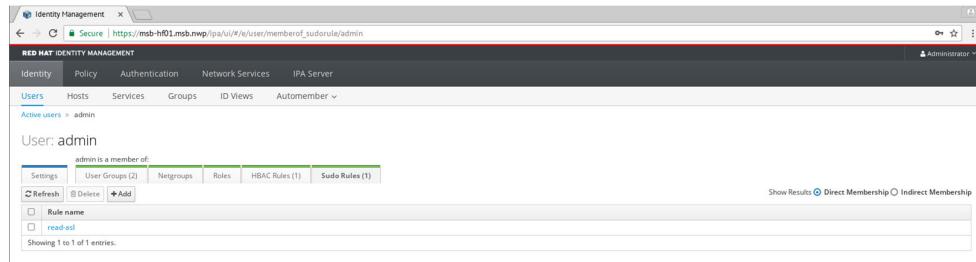


Figure 229. Sudo Rules

The group, role, HBAC rule, or Sudo rule must have already been created in order to be assigned to a user, and their creation is described in the Groups, Roles, HBAC, and Sudo sections, respectively.

To assign a user to one or more user groups:

- From the Users page, left-click the **User Groups** button. The user's User Groups sub-page is displayed. The group(s) the user belongs to is displayed. For example, awd\_user is a member of four groups, shown here after selecting the **User Groups** button.

The screenshot shows the 'User: awd\_user' page in the Red Hat Identity Management interface. The 'User Groups' tab is selected, showing four assigned groups: awd\_users, awd\_website\_users, ipusers, and limited\_products. The interface includes tabs for Settings, User Groups (4), Netgroups, Roles, HBAC Rules (1), and Sudo Rules. There are buttons for Refresh, Delete, and Add.

Figure 230. Example of a User's User Groups

- To add the user to additional user groups, left-click the **+Add** button. The User page is locked (desensitized), and the Add User into User Groups dialog is displayed. The dialog contains a list of user groups who are not currently assigned to the user.

The screenshot shows the 'Add User admin into User Groups' dialog in the Red Hat Identity Management interface. It lists available groups like editors, ipusers, policy\_13, etc., and prospective groups where a new group can be added. The dialog has buttons for Add and Cancel.

Figure 231. Users - Assign User Group(s) to User

3. Select user groups from the Available list, left-click ">" to copy to the prospective list, and left-click the **Add** button to add the user to the selected groups or the **Cancel** button to exit out of the dialog and not add the user to the selected groups. In both cases, the dialog is removed.

If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the User page.

If the add is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The User page is unlocked (sensitized) if the add is successful or cancelled.

To assign a user to one or more roles:

1. From the User page, left-click the **Roles** button. The user's Roles sub-page is displayed.

For example, user domainadmin has no assigned roles, as seen here:

**Figure 232. Example of a User's Roles Sub-Page**

2. To add the user to additional roles, left-click the **+Add** button. The User page is locked (desensitized), and the Add User into Roles dialog is displayed. The dialog contains a list of roles who are not currently assigned to the user.

**Figure 233 Users - Assign Role(s) to User**

3. Select roles from the available list, left-click ">" to copy to the prospective list, and left-click the **Add** button, or the **Cancel** button. In both cases, the dialog is removed.

If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the User page.

If the add is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The User page is unlocked (sensitized) if the add is successful or cancelled.

To assign a user to one or more HBAC rules:

- From the User page, left-click the **HBAC Rules** button. The user's HBAC Rules sub-page is displayed.

For example, user alladmin has two HBAC Rules:

User: alladmin

The screenshot shows a table with two entries under the 'Rule name' column: 'mrc\_user\_access' and 'superadmin\_access'. The table has a header row with 'Rule name' and a footer row indicating 'Showing 1 to 2 of 2 entries.'

**Figure 234. Example of a User's HBAC Rules Sub-Page**

- To add the user to additional HBAC Rules, left-click the **+Add** button. The User page is locked (desensitized), and the Add User into HBAC Rules dialog is displayed. The dialog contains a list of HBAC rules who are not currently assigned to the user.

The screenshot shows a modal dialog titled 'Add User admin into HBAC Rules'. It has two lists: 'Available' (containing 'allow\_all') and 'Prospective' (empty). At the bottom are 'Add' and 'Cancel' buttons.

**Figure 235. Users - Assign HBAC Rule(s) to User**

- Select roles from the available list, left-click ">" to copy to the prospective list, and left-click the **Add** button, or the **Cancel** button. In both cases, the dialog is removed.

If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the User page.

If the add is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The User page is unlocked (sensitized) if the add is successful or cancelled.

To assign a user to one or more Sudo Rules:

- From the User page, left-click the **Sudo Rules** button. The user's Sudo Rules sub-page is displayed.

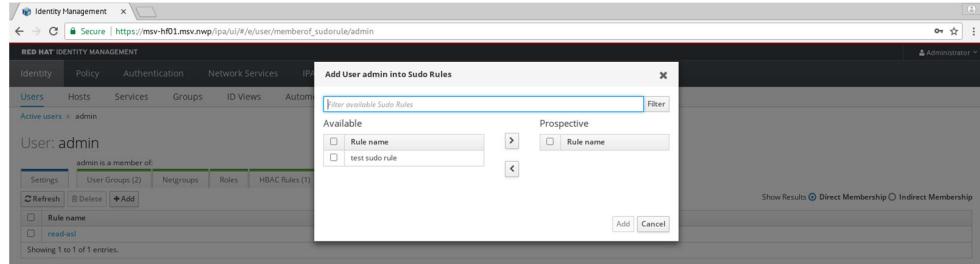
For example, user nwp has one Sudo Rule:

User: nwp

The screenshot shows a table with one entry under the 'Rule name' column: 'superuser'. The table has a header row with 'Rule name' and a footer row indicating 'Showing 1 to 1 of 1 entries.'

**Figure 236. Example of User's Sudo Rules Sub-Page**

2. To add the user to additional Sudo Rules, left-click the **+Add** button. The User page is locked (desensitized), and the Add User into Sudo Rules dialog is displayed. The dialog contains a list of Sudo rules that are not currently assigned to the user.



**Figure 237. Users - Assign Sudo Rule(s) to User**

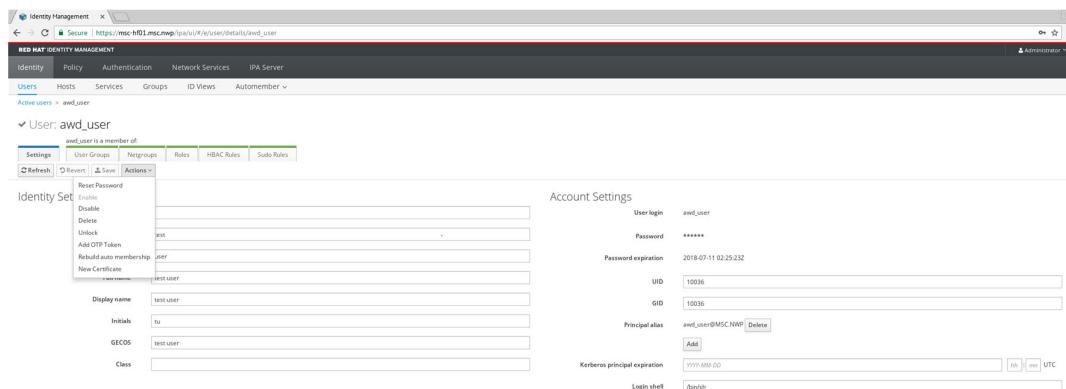
3. Select roles from the available list, left-click ">" to copy to the prospective list, and left-click the **Add** button, or the **Cancel** button. In both cases, the dialog is removed.

If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the User page.

If the add is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The User page is unlocked (sensitized) if the add is successful or cancelled.

#### 5.3.15.4.3 Users - Account Controls (Reset Password, Enable, Disable, Unlock, Delete)

From the User settings page, select the **Actions** option to see the account controls to reset the account password, enable/disable the account, unlock the account, and delete the account.



**Figure 238. Account Controls**

#### 5.3.15.4.4 Users - Reset (Change) Password

The following steps will reset the account password:

1. Left-click the **Actions** option.
2. From the menu, left-click the **Reset Password** option.

- The User Settings page is locked (grayed out and desensitized), and the Reset Password dialog is displayed.

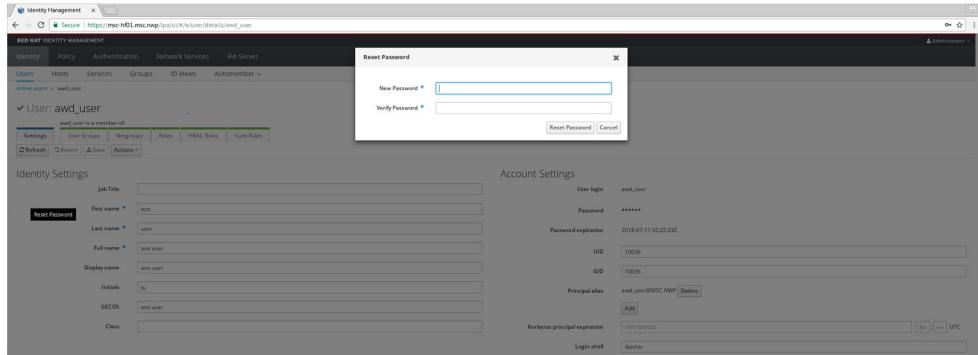


Figure 239. Password Reset Dialog

- In the dialog, enter the new password into both the New Password field and the Verify Password field. Both fields must match. While both fields are populated but not matching, the GUI displays "Passwords must match" in red.

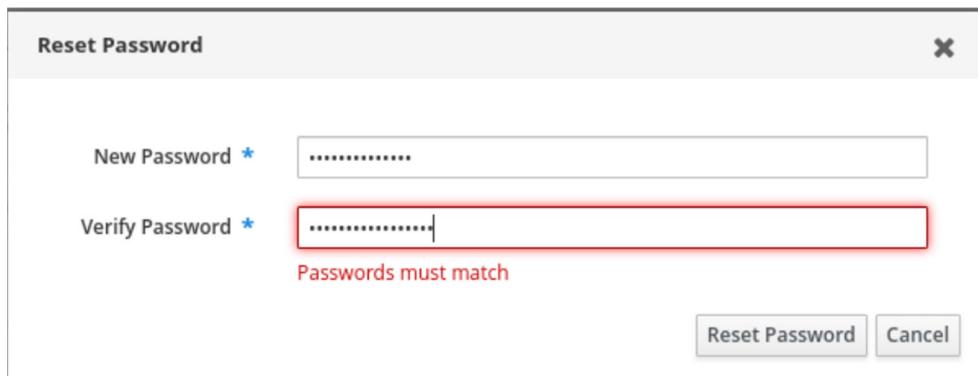


Figure 240. Mismatching Passwords Display

- Left-click the **Reset Password** button to commit the password reset, or the **Cancel** button to cancel the password reset. In both cases, the dialog is removed, unless **Reset Password** button is selected while the password fields are not populated or do not match.

If the password reset is committed, and the reset is successful, the transient message "**Password change complete**" is displayed at the top-center of the User settings page.

If the reset is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the reset. The User settings page is unlocked (sensitized) if the reset is successful or cancelled.

#### 5.3.15.4.5 Users - Enable/Disable Account

An account is automatically disabled after a configurable period of inactivity (i.e., time since last successful authentication). A user cannot successfully authenticate (i.e., login) to a disabled account. Disabling a user account deactivates the account and, therefore, disabled user accounts cannot be used to authenticate or use IdM services, such as Kerberos, or perform any tasks. Disabled user accounts still exist within IdM and all associated account information

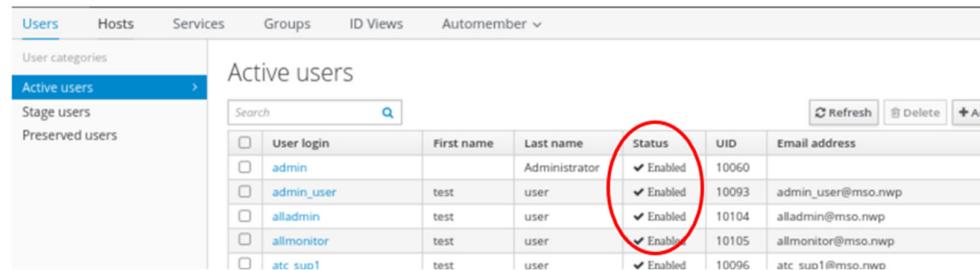
remains unchanged. Disabled user accounts remain in the active state and can be a member of user groups.

If attempting to disable the IdM default "admin" account, ensure that there is at least one alternative user with admin permissions. For more information on creating additional admin users, see 5.3.15.9.5 Adding a New User with Administrative Privileges (System Administrator).

A disabled account can only be enabled by an IDM administrator, either through the Web GUI or CLI.

The following steps will enable/disable a user account:

1. Left-click the **Actions** option.
2. From the menu, left-click the **Enable** (or **Disable**) option.  
Note that only one option, either Enable or Disable, is available, based on if the current account is in an enabled or disabled state, as shown in the Status column of the Active users page:



The screenshot shows the 'Active users' section of the Red Hat Identity Management interface. The table has columns for User login, First name, Last name, Status, UID, and Email address. The 'Status' column contains checkboxes. For the first four rows ('admin', 'admin\_user', 'alladmin', 'allmonitor'), the checkbox is checked and labeled 'Enabled'. For the last row ('atc\_suo1'), the checkbox is unchecked and labeled 'Enabled'. A red circle highlights the 'Enabled' checkbox in the fourth row ('alladmin').

| User login | First name | Last name     | Status                                      | UID   | Email address      |
|------------|------------|---------------|---------------------------------------------|-------|--------------------|
| admin      |            | Administrator | <input checked="" type="checkbox"/> Enabled | 10060 |                    |
| admin_user | test       | user          | <input checked="" type="checkbox"/> Enabled | 10093 | admin_user@mso.nwp |
| alladmin   | test       | user          | <input checked="" type="checkbox"/> Enabled | 10104 | alladmin@mso.nwp   |
| allmonitor | test       | user          | <input checked="" type="checkbox"/> Enabled | 10105 | allmonitor@mso.nwp |
| atc_suo1   | test       | user          | <input type="checkbox"/> Enabled            | 10096 | atc_suo1@mso.nwp   |

Figure 241. Active Users Page - Status Column

3. After left-clicking the **Enable** (or **Disable**) option, a Confirmation dialog is displayed, and the User settings page is locked (desensitized).

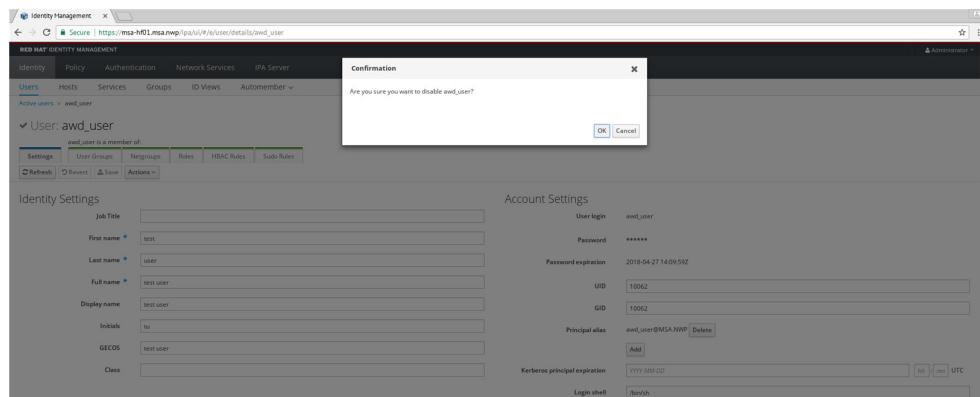


Figure 242. Disable Confirmation Dialog

4. Left-click the **OK** button to commit the enable/disable, or the **Cancel** button to cancel the enable/disable. In both cases, the dialog is removed.

If the enable/disable is successful, the transient message "**Disabled (Enabled) user account <user account name>**" is displayed at the top-center of the User settings page.

If the enable/disable is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the enable/disable. The User settings page is unlocked (sensitized) if the enable/disable is successful or cancelled.

The following steps will enable/disable one or more active user accounts from the Active users list on the Users page:

1. If the Active users page is not already displayed, left-click the **Identity** option, and the **Users** sub-option, and if necessary, select the **Active users** from the User categories menu.

| User login       | First name | Last name     | Status    | UID   | Email address            | Telephone Number | Job Title |
|------------------|------------|---------------|-----------|-------|--------------------------|------------------|-----------|
| admin            |            | Administrator | ✓ Enabled | 10060 |                          |                  |           |
| admin_user       | test       | user          | ✓ Enabled | 10093 | admin_user@mso.nwp       |                  |           |
| alladmin         | test       | user          | ✓ Enabled | 10104 | alladmin@mso.nwp         |                  |           |
| allmonitor       | test       | user          | ✓ Enabled | 10105 | allmonitor@mso.nwp       |                  |           |
| atc_sup1         | test       | user          | ✓ Enabled | 10096 | atc_sup1@mso.nwp         |                  |           |
| awd_user         | test       | user          | ✓ Enabled | 10094 | awd_user@mso.nwp         |                  |           |
| awd_website_user | test       | user          | ✓ Enabled | 10095 | awd_website_user@mso.nwp |                  |           |

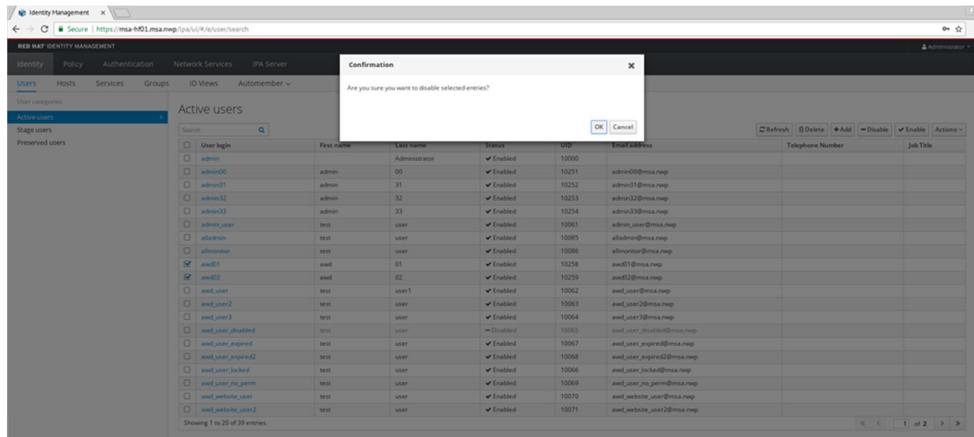
Figure 243. A Snippet of the Active Users Page

2. In the Active users list, left-click the checkboxes to the left of the User login column for each user account to be enabled/disabled, and left-click the Disable or Enable button at the top-right of the list:

| User login                                           | First name | Last name     | Status    | UID   | Email address            | Telephone Number | Job Title |
|------------------------------------------------------|------------|---------------|-----------|-------|--------------------------|------------------|-----------|
| admin                                                |            | Administrator | ✓ Enabled | 10060 |                          |                  |           |
| admin_user                                           | test       | user          | ✓ Enabled | 10093 | admin_user@mso.nwp       |                  |           |
| <input checked="" type="checkbox"/> alladmin         | test       | user          | ✓ Enabled | 10104 | alladmin@mso.nwp         |                  |           |
| <input checked="" type="checkbox"/> allmonitor       | test       | user          | ✓ Enabled | 10105 | allmonitor@mso.nwp       |                  |           |
| <input checked="" type="checkbox"/> atc_sup1         | test       | user          | ✓ Enabled | 10096 | atc_sup1@mso.nwp         |                  |           |
| <input checked="" type="checkbox"/> awd_user         | test       | user          | ✓ Enabled | 10094 | awd_user@mso.nwp         |                  |           |
| <input checked="" type="checkbox"/> awd_website_user | test       | user          | ✓ Enabled | 10095 | awd_website_user@mso.nwp |                  |           |

Figure 244. Selecting Multiple Users to Enable/Disable

3. The Users page is locked (desensitized), and the Confirmation dialog is displayed:



**Figure 245. Active Users Disable Confirmation Dialog**

4. Left-click the **OK** button to commit the enable/disable, or the **Cancel** button to cancel the enable/disable. In both cases, the dialog is removed.

If the enable/disable is successful, the transient message "**<count> items disabled (enabled)**" is displayed at the top-center of the Users page.

If the enable/disable is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the enable/disable. The Users page is unlocked (sensitized) if the enable/disable is successful or cancelled.

#### 5.3.15.4.6 Users - Unlock Account

An account is automatically locked after a configurable number of successive authentication failures within a configurable time period, as defined by the user account password policy. A user cannot successfully authenticate (i.e., login) to a locked account.

A locked account can only be unlocked by an IDM administrator, either through the Web GUI or CLI.

The following steps will unlock the user account:

1. Left-click the **Actions** option.
  2. From the menu, left-click the **Unlock** option. Note that the option is always available irrespective of the current account locked/unlocked state, and a non-locked user can still be successfully unlocked. The current lock state is not visible on any IdM page.
  3. The User settings page is locked (desensitized), and the Confirmation dialog is displayed.

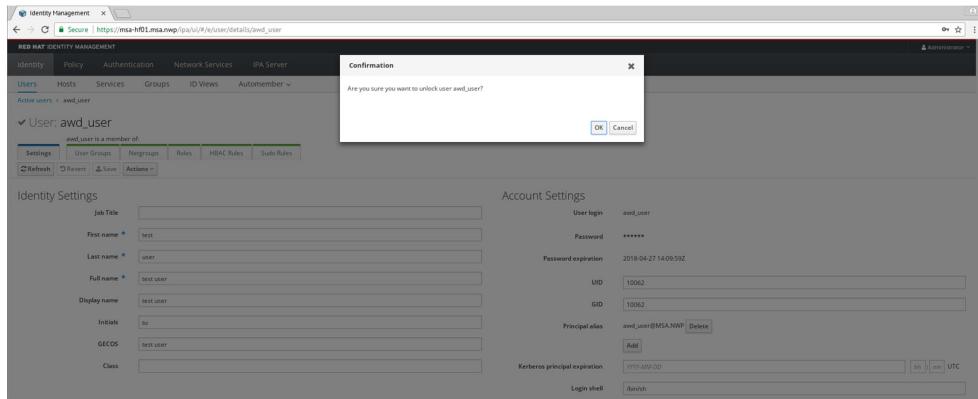


Figure 246. Unlock Confirmation Dialog

4. Left-click the **OK** button to commit the unlock, or the **Cancel** button to cancel the unlock. In both cases, the dialog is removed.

If the unlock is successful, the transient message "**Unlocked account <user account name>**" is displayed at the top-center of the User settings page.

If the unlock is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the unlock. The User settings page is unlocked (sensitized) if the unlock is successful or cancelled.

#### 5.3.15.4.7 Users - Delete Account

Deleting a user account permanently removes the user entry and all its information from IdM, including group memberships and passwords. Deleted user accounts cannot be restored. When you delete a user account, all the information associated with the account is lost permanently.

**WARNING:** Do not delete the admin user. The "admin" account is a pre-defined user required by IdM. Deleting the "admin" account causes problems with certain commands. If you want to define and use an alternative admin user, disable the pre-defined admin user after you grant admin permissions to at least one different user. For more information on disabling accounts, see 5.3.15.4.5 Users - Enable/Disable Account. For adding an alternative admin user, refer to 5.3.15.9.5 - Adding a New User with Administrative Privileges (System Administrator).

The following steps will delete the user account (or move the account from the Active users list to the (inactive) Preserved users list):

1. Left-click the **Actions** option.
2. From the menu, left-click the **Delete** option.
3. The User settings page is locked (desensitized), and the **Delete** dialog is displayed. Note: By default in the dialog, the **Delete Mode** option is set to **Delete**, meaning the user account will be permanently deleted. Selecting **Preserve** as the **Delete Mode** option will mean that, rather than being deleted, the account will be moved to the Preserved users list. The Preserved users list has former active users that cannot be used for authentication but can be re-activated at a later time through the **Restore** option from the Preserved users page.

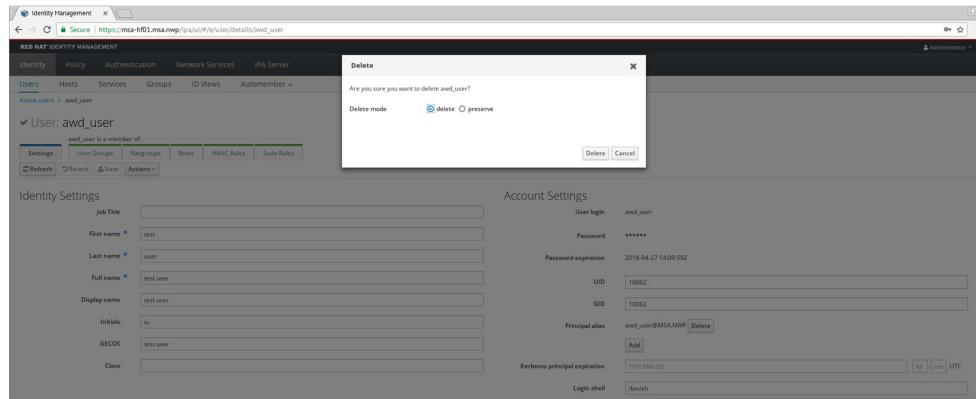


Figure 247. Delete Confirmation Dialog

4. Left-click the **Delete** button to commit the deletion/preserve, or the **Cancel** button to cancel the deletion/preserve. In both cases, the dialog is removed.

If the deletion/preserve is successful, the transient message "**Deleted user <user account name>**" is displayed at the top-center of the User page.

If the delete is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the delete. The User settings page is unlocked (sensitized) if the delete is successful or cancelled.

In the case of a successful preserve, the User settings page remains displayed; however, the deleted user is now listed in the Preserved users list, and removed from the Active users list.

In the case of a successful permanent deletion, the User settings page is removed (since the user no longer exists), and the Active users page is redisplayed.

The following steps will delete one or more user accounts from the Active users list on the Users page:

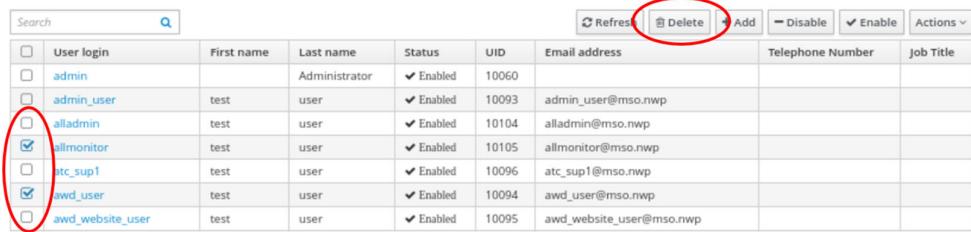
1. If the Active users page is not already displayed, left-click the **Identity** option, and the **Users** sub-option, and if necessary select the **Active users** from the User categories menu:

| User login       | First name | Last name     | Status  | UID   | Email address            | Telephone Number | Job Title |
|------------------|------------|---------------|---------|-------|--------------------------|------------------|-----------|
| admin            |            | Administrator | Enabled | 10060 |                          |                  |           |
| admin_user       | test       | user          | Enabled | 10093 | admin_user@mso.nwp       |                  |           |
| alladmin         | test       | user          | Enabled | 10104 | alladmin@mso.nwp         |                  |           |
| almonitor        | test       | user          | Enabled | 10105 | almonitor@mso.nwp        |                  |           |
| atc_sup1         | test       | user          | Enabled | 10096 | atc_sup1@mso.nwp         |                  |           |
| awd_user         | test       | user          | Enabled | 10094 | awd_user@mso.nwp         |                  |           |
| awd_website_user | test       | user          | Enabled | 10095 | awd_website_user@mso.nwp |                  |           |

Figure 248. A Snippet of the Active Users Page

2. In the Active users list, left-click the checkbox to the left of the User login column for each user account to be deleted, and left-click the Delete button at the top-right of the list.

## Active users



| User login       | First name | Last name     | Status  | UID   | Email address            | Telephone Number | Job Title |
|------------------|------------|---------------|---------|-------|--------------------------|------------------|-----------|
| admin            |            | Administrator | Enabled | 10060 |                          |                  |           |
| admin_user       | test       | user          | Enabled | 10093 | admin_user@mso.nwp       |                  |           |
| alladmin         | test       | user          | Enabled | 10104 | alladmin@mso.nwp         |                  |           |
| allmonitor       | test       | user          | Enabled | 10105 | allmonitor@mso.nwp       |                  |           |
| atc_sup1         | test       | user          | Enabled | 10096 | atc_sup1@mso.nwp         |                  |           |
| awd_user         | test       | user          | Enabled | 10094 | awd_user@mso.nwp         |                  |           |
| awd_website_user | test       | user          | Enabled | 10095 | awd_website_user@mso.nwp |                  |           |

Figure 249. Selecting Multiple Users for Deletion

## 3. The User's page is locked (desensitized), and the Confirmation dialog is displayed.

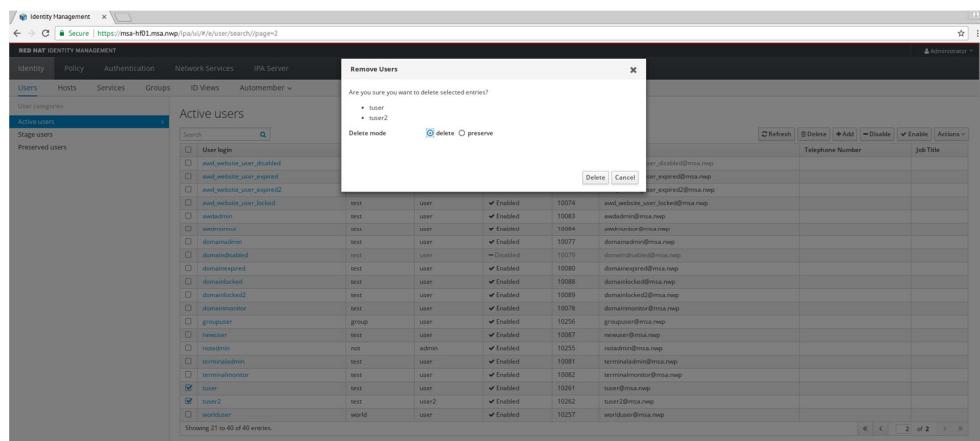


Figure 250. Active Users Delete Confirmation Dialog

4. Left-click the **OK** button to commit the delete, or the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items deleted**" is displayed at the top-center of the Users page.

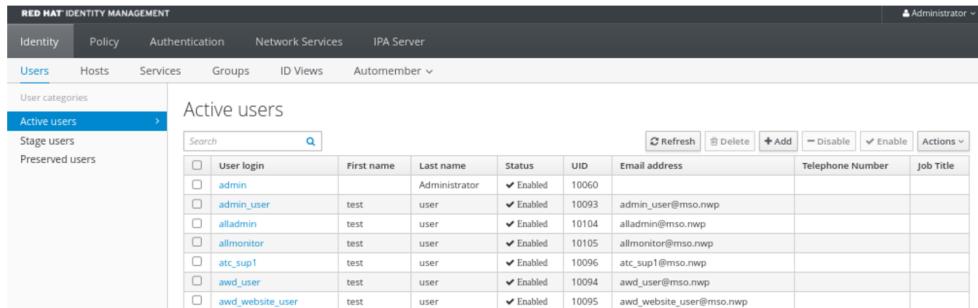
If the delete is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the delete. The Users page is unlocked (sensitized) if the delete is successful or cancelled.

Deletion of users in the Preserved and Staging users list uses the same mechanism.

## 5.3.15.4.8 Users - Add Account

The following steps will add a new user account to the Active users list on the Users page:

1. If the Active users page is not already displayed, left-click the **Identity** option, and the **Users** sub-option, and if necessary select the **Active users** from the User categories menu.

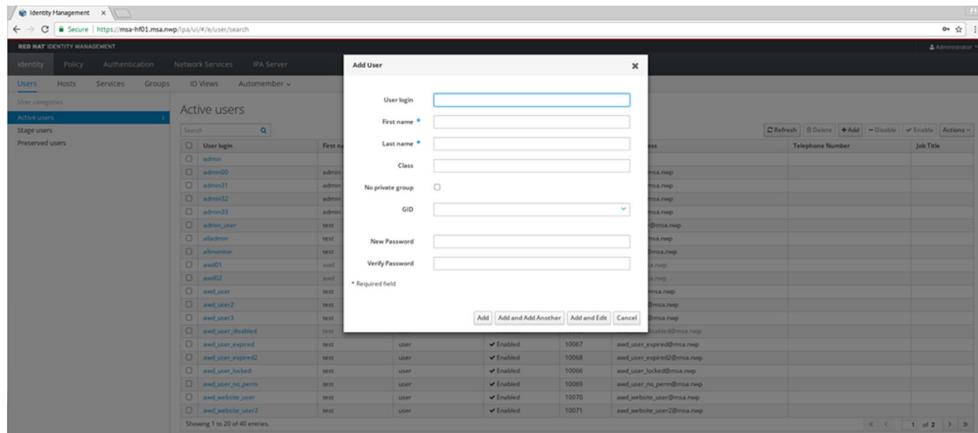


The screenshot shows the 'Active users' section of the Red Hat Identity Management interface. The table lists the following user information:

| User login       | First name | Last name     | Status  | UID   | Email address            | Telephone Number | Job Title |
|------------------|------------|---------------|---------|-------|--------------------------|------------------|-----------|
| admin            |            | Administrator | Enabled | 10060 |                          |                  |           |
| admin_user       | test       | user          | Enabled | 10093 | admin_user@mso.nwp       |                  |           |
| alladmin         | test       | user          | Enabled | 10104 | alladmin@mso.nwp         |                  |           |
| allmonitor       | test       | user          | Enabled | 10105 | allmonitor@mso.nwp       |                  |           |
| atc_sup1         | test       | user          | Enabled | 10096 | atc_sup1@mso.nwp         |                  |           |
| awd_user         | test       | user          | Enabled | 10094 | awd_user@mso.nwp         |                  |           |
| awd_website_user | test       | user          | Enabled | 10095 | awd_website_user@mso.nwp |                  |           |

Figure 251. A Snippet of the Active Users Page

2. Left-click the **Add** button at the top-right of the list. The Add User dialog is displayed.
3. Within the dialog, populate at least the mandatory fields, although it is also recommended to also complete the User login and New/Verify password fields. ( Note: Although no standard username format is enforced by iDM, for accounts associated with a Dedicated AWD, the preferred username format is SitelD and User initials, example: ZTLJB. )



The screenshot shows the 'Add User' dialog box. The fields filled in are:

- User login: **new\_user**
- First name: **Test**
- Last name: **User**
- New Password: **password123**
- Verify Password: **password123**

The dialog includes buttons for **Add**, **Add and Add Another**, **Add and Edit**, and **Cancel**.

Figure 252. Add User Dialog

4. To add the user account, left-click the **Add** button in the dialog if this is the only or last user account being created, or left-click **Add and Add Another** button to repeat the process to add further user accounts. To cancel adding the user account, left-click the **Cancel** button.

If the add is successful, the transient message "**user successfully created**" is displayed at the top-center of the Users page.

If the add is unsuccessful, for example in the case of a duplicate user, a failure message dialog is displayed which allows a retry or cancel. The Users page is unlocked (sensitized) if the add is successful or cancelled.

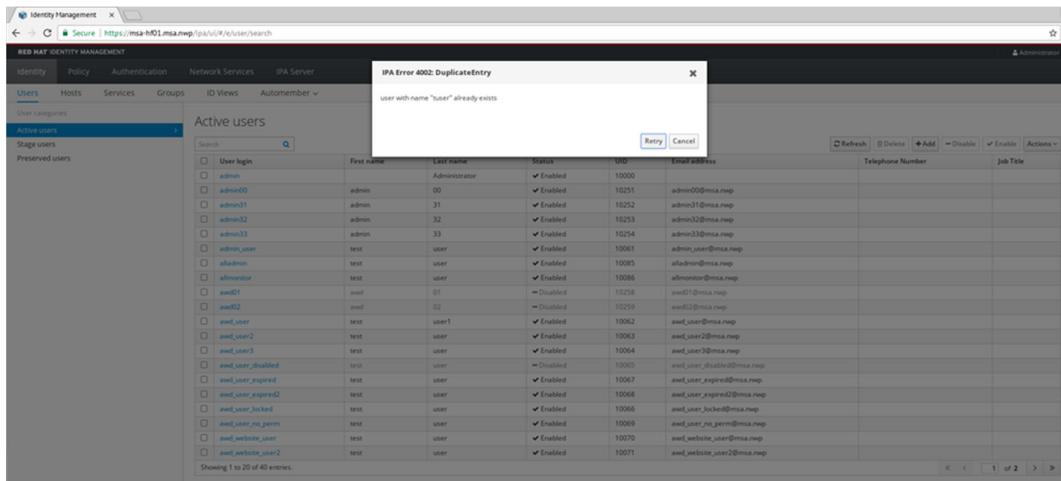


Figure 253. Duplicate Entry Failure Dialog

#### 5.3.15.4.9 Hosts

Hosts are used to define the physical machines and groups of physical machines (host groups) to which a user account can authenticate. Hosts are assigned to HBAC rules, and then HBAC rules are assigned to a user account.

To simplify the assignment of hosts to HBAC rules, hosts can be assigned to host groups, a logical group of hosts. The assignment of hosts to a host group is detailed in the Identity/Groups section.

The following steps will display the set of Hosts:

1. Left-click the **Identity** option and the **Hosts** sub-option.
2. The Hosts page is displayed containing the list of host names and their Enrolled status. Hosts must be enrolled to be used for authentication.

| Host name        | Description | Enrolled |
|------------------|-------------|----------|
| msv-hd1.msv.nwp  |             | True     |
| msv-hd2.msv.nwp  |             | True     |
| msv-hd3.msv.nwp  |             | True     |
| msv-hd32.msv.nwp |             | True     |
| msv-pg1.msv.nwp  |             | True     |
| msv-pg2.msv.nwp  |             | True     |
| msv-thd1.msv.nwp |             | True     |

Figure 254,. Hosts Page

#### 5.3.15.4.10 Hosts - Viewing Hosts

To view an existing Host, left-click the host in the Host name column of the table. The Host page lists details regarding the host. The IdM System Administrator should not need to edit any fields beyond what are configured when the host is created.

The screenshot shows the 'Hosts' tab selected in the Red Hat Identity Management interface. The host 'msu-hf01.msv.nwp' is displayed with its details. The 'Host Settings' section includes fields for Host name, Principal alias, Description, Class, Locality, Location, Platform, Operating system, SSH public keys, MAC address, Authentication indicators (otp, radius), Trusted for delegation, and Trusted to authenticate as user. The 'Assigned ID View' section lists 'Allowed to retrieve keytab' and 'Allowed to create keytab' roles. The 'Enrollment' section shows Kerberos Key Present, Host Provisioned, One-Time-Password, and Host Certificate sections.

**Figure 255. Host Page**

#### 5.3.15.4.11 Hosts - Add Host

Adding a new Host creates a new reference to a physical machine at which a user account will be able to authenticate. However, the host is not assigned to any HBAC rule.

The following steps will add a new Host:

1. From the Hosts page, left-click the **Add** button at the top-right of the list.
2. The Hosts page is locked (desensitized), and the Add Host dialog is displayed.

The screenshot shows the 'Add Host' dialog box. It requires entering a 'Host Name' (msu.msp) and a 'DNS Zone' (msu.msp). Other fields include 'Class' (empty), 'IP Address' (empty), 'Force' (unchecked), and 'Generate OTP' (unchecked). A note at the bottom states 'Required field'. At the bottom right are buttons for 'Add', 'Add and Add Another', 'Add and Edit', and 'Cancel'.

**Figure 256. Add Host**

3. Enter a host name (FQDN), and left-click the **Add** button to create the host, or the **Add and Add Another** to create another host, or the **Cancel** button to cancel the add. In all cases, the dialog is removed.

If the add is successful, the transient message "**Host successfully added**" is displayed at the top-center of the Hosts page.

If the add is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the add. The Hosts page is unlocked (sensitized) if the add is successful or cancelled.

#### 5.3.15.4.12 Hosts - Delete Host(s)

Deleting an existing Host permanently deletes the host and removes its reference from host groups and HBAC rules, and no user will be able to authenticate on that physical machine.

The following steps will delete a Host:

1. From the Hosts page, left-click the checkbox to the left of the Host name column for each Host to be deleted, and left-click the **Delete** button at the top-right of the list.
2. The Hosts page is locked (desensitized), and the Remove Hosts dialog is displayed.

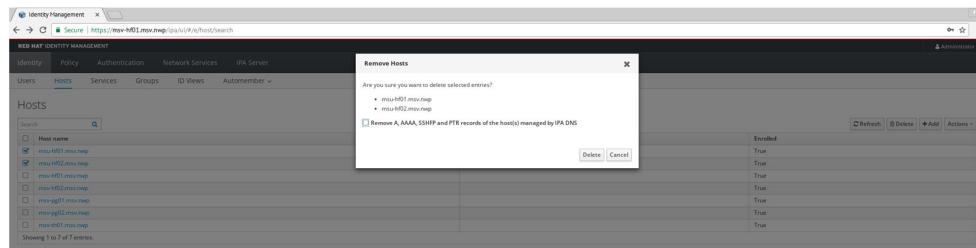


Figure 257 Delete Host(s)

3. If IdM is using an integrated Domain Name System (DNS), the dialog has a checkbox to optionally remove the server from the IPA DNS.
4. Left-click the **Delete** button to commit the delete, or the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items deleted**" displayed at the top-center of the Hosts page.

If the delete is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the delete. The Hosts page is unlocked (sensitized) if the delete is successful or cancelled.

#### 5.3.15.4.13 Groups

Groups are used to logically group sets of hosts (host groups) and sets of users (user groups). Host and user groups simplify the assignment of hosts and users to HBAC rules. In addition, the groups a user belongs to define the capability of the user at the application level and define the password policy used during authentication; this is further detailed in the Identity, Users section. User and host groups can be hierarchical (i.e., one or more user groups can be assigned to a parent user group, and one or more host groups can be assigned to a parent host group).

The following steps will display the set of User Groups sub-page:

1. Left-click the **Identity** option and the Groups sub-option.
2. The User Groups sub-page is displayed containing the list of user groups, their group ID, and description.

| Group name                     | GID   | Description                             |
|--------------------------------|-------|-----------------------------------------|
| admins                         | 10000 | Account administrators group            |
| awd_users                      | 10115 | AWD User Access                         |
| awd_users_level1_bos           | 10006 |                                         |
| awd_users_level1_gph           | 10008 |                                         |
| awd_users_level2_bos           | 10007 |                                         |
| awd_users_level2_gph           | 10009 |                                         |
| awd_website_users              | 10011 |                                         |
| editors                        | 10002 | Limited admins who can edit other users |
| ipusers                        |       | Default group for all users             |
| mc_all_dedicated_administrator | 10032 |                                         |
| mc_all_dedicated_monitor       | 10033 |                                         |
| mc_all_terminal_administrator  | 10030 |                                         |
| mc_all_terminal_monitor        | 10031 |                                         |
| mc_all_all_monitor             | 10034 |                                         |
| mc_all_dedicated_administrator | 10028 |                                         |
| mc_all_dedicated_monitor       | 10029 |                                         |
| mc_all_domain_admin            | 10120 |                                         |
| mc_all_domain_monitor          | 10121 |                                         |
| mc_all_national_admin          | 10116 |                                         |
| mc_all_national_monitor        | 10117 |                                         |

Figure 258. User Groups Sub-page

The groups page contains three categories: User Groups, Host Groups, and Netgroups. By default when displaying the Groups page, the User Groups sub-page is displayed. To display the Host Groups sub-page, select Host Groups from the Group categories menu at the left edge. To display the Netgroups sub-page, select Netgroups from the Group categories menu at the left edge. Netgroups are not currently used by the IdM System Administrator and are not further described.

| Host-group  | Description |
|-------------|-------------|
| all-servers |             |
| ip-servers  |             |
| msc-servers |             |

Figure 259. Hosts Groups Sub-page

#### 5.3.15.4.14 Groups - Viewing User Groups

To view an existing User Group, left-click the group in the Group name column of the table. The User Group page lists details regarding the group, defaulting to the Users sub-page that lists the users in the group.

| User login | UID   | Email address     | Telephone Number | Job Title |
|------------|-------|-------------------|------------------|-----------|
| almonitor  | 10060 | almonitor@msc.nwp |                  |           |

Figure 260 User Group Page

### 5.3.15.4.15 Groups - Add User Group

Adding a new User Group creates an empty group which is not currently associated with any user, HBAC rule, or Sudo rule.

The following steps add a new User Group:

1. From the Users Groups sub-page, left-click the **Add** button at the top-right of the list.
2. The Users Groups page is locked (desensitized), and the Add User Group dialog is displayed.

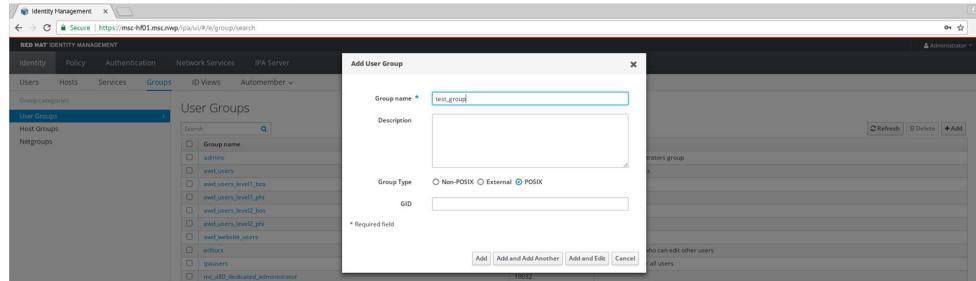


Figure 261. Add User Group

3. Enter a group name, and left-click the **Add** button to create the rule, or the **Add and Add Another** to create another group, or the **Cancel** button to cancel the add. In all cases, the dialog is removed.

If the add is successful, the transient message "**User successfully added**" displayed at the top-center of the User Groups page.

If the add is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the add. The User Groups page is unlocked (sensitized) if the add is successful or cancelled.

### 5.3.15.4.16 Groups - Delete User Group(s)

Deleting an existing User Group permanently deletes the user group and removes its reference from any users, HBAC rule, or Sudo rule to which the user group is assigned.

The following steps will delete a User Group:

1. From the Users Groups page, left-click the checkbox to the left of the Group name column for each user group to be deleted, and left-click the **Delete** button at the top-right of the list.
2. The User Groups page is locked (desensitized), and the Remove Users Groups dialog is displayed.

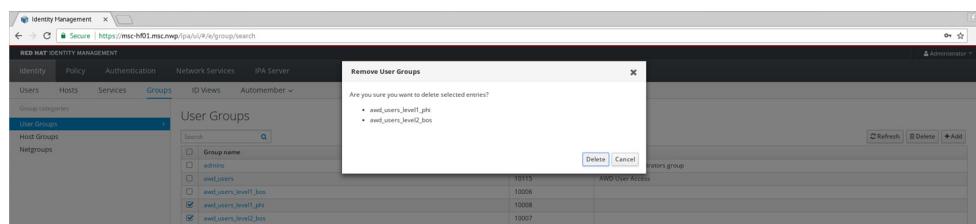


Figure 262. Delete User Group

3. Left-click the **Delete** button to commit the delete, or the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items deleted**" is displayed at the top-center of the User Groups page.

If the delete is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the delete. The User Groups page is unlocked (sensitized) if the delete is successful or cancelled.

#### 5.3.15.4.17 Groups - Assign User Group(s) To Users, HBAC Rules, Sudo Rules

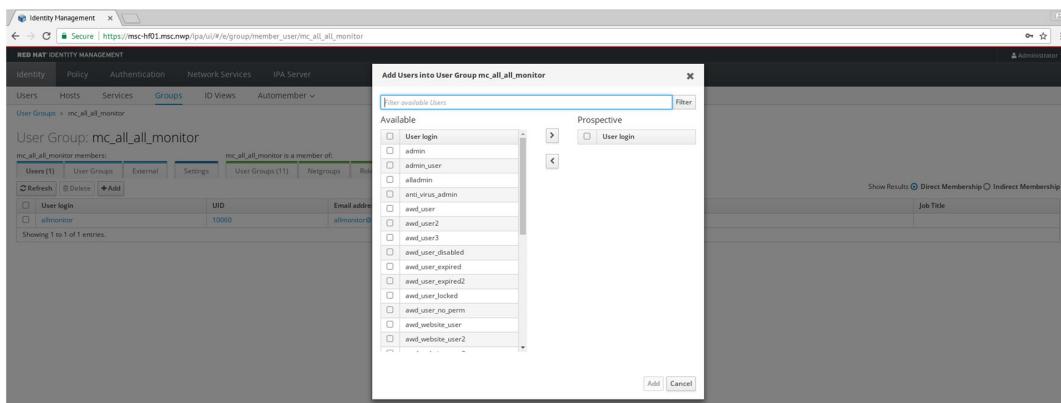
User groups are associated with users, HBAC rules, and Sudo rules.

The assignment of user groups to users can be achieved from the User Groups page or from the Groups button on the User page.

The assignment of user groups to HBAC rules can be achieved from the User Groups page or from the Groups button on the HBAC Rule page.

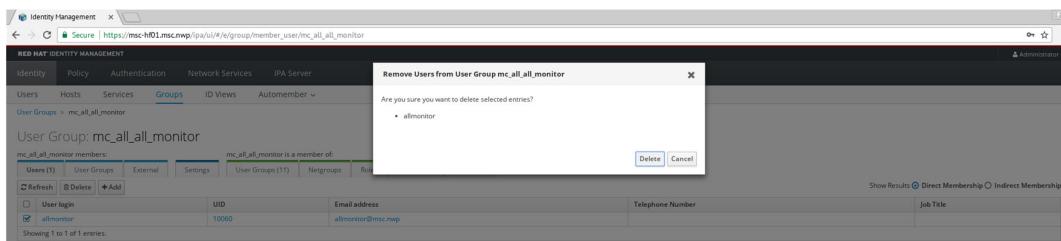
The assignment of user groups to Sudo rules can be achieved from the User Groups page or from the Groups button on the Sudo Rule page.

To add users into a user group, select the Users button from the User Groups page, left-click the **Add** button above the list of users in the user group, and select the set of users to add to the group from the Add Users into User Group dialog.



**Figure 263. Add Users to User Group**

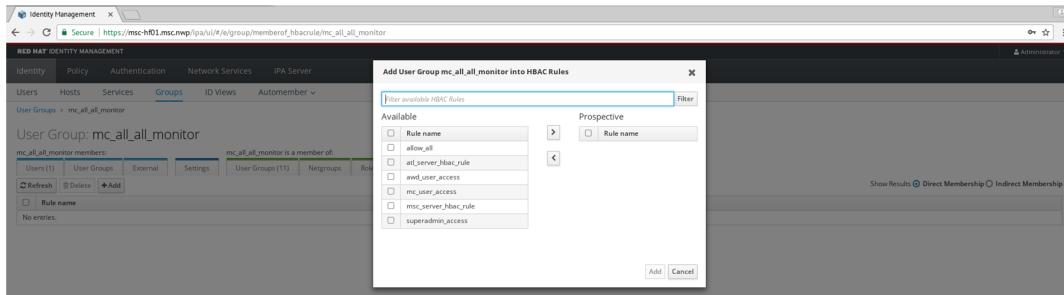
To delete users from a user group, select the Users button from the User Groups page, left-click the toggle button to the left of each user to be deleted, left-click the **Delete** button above the list of users in the user group, and confirm the deletion from the Remove Users from User Group dialog.



**Figure 264. Remove Users From User Group**

To add a user group into HBAC rules, select the HBAC Rules button from the User Group page, left-click the **Add** button above the list of HBAC Rules to which the user group is assigned, and

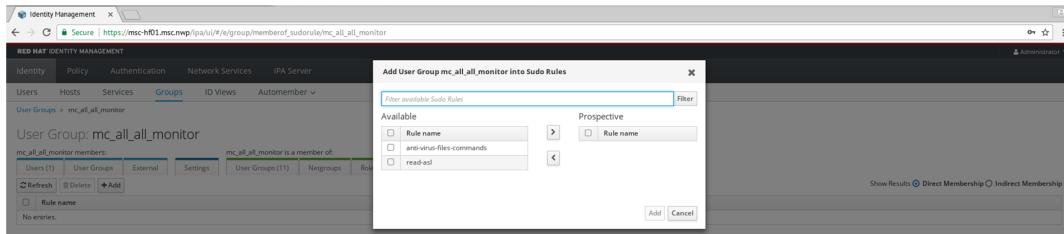
select the set of HBAC Rules to contain the User Group from the Add User Group into HBAC Rules dialog.



**Figure 265. Add User Group To HBAC Rules**

To delete a user group from HBAC Rules, select the HBAC Rules button from the User Group page, left-click the toggle button to the left of each rule name to be deleted, left-click the **Delete** button above the list of HBAC rules containing the user group, and confirm the deletion from the Remove HBAC Rule dialog.

To add a user group into Sudo rules, select the Sudo Rules button from the User Group page, left-click the **Add** button above the list of Sudo Rules to which the user group is assigned, and select the set of Sudo Rules to contain the User Group from the Add User Group into Sudo Rules dialog.



**Figure 266. Add User Group To Sudo Rules**

To delete a user group from Sudo Rules, select the Sudo Rules button from the User Group page, left-click the toggle button to the left of each rule name to be deleted, left-click the **Delete** button above the list of Sudo rules containing the user group, and confirm the deletion from the Remove Sudo Rule dialog.

#### 5.3.15.4.18 Groups - Viewing Host Groups

To view an existing Host Group, display the Host Groups sub-page, and left-click the group in the Host-group column of the table. The Host Group page lists details regarding the group, defaulting to the Hosts sub-page that lists the hosts in the group.



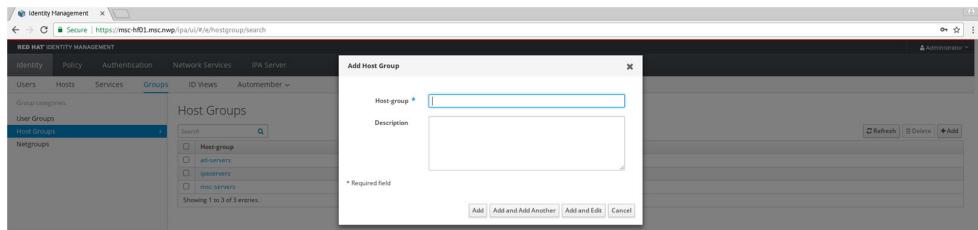
**Figure 267. Host Group Page**

#### 5.3.15.4.19 Groups - Add Host Group

Adding a new Host Group creates an empty group which is not currently associated with any host, HBAC rule, or Sudo rule.

The following steps add a new Host Group:

1. From the Host Groups sub-page, left-click the **Add** button at the top-right of the list.
2. The Host Groups page is locked (desensitized), and the Add Host Group dialog is displayed.



**Figure 268. Add Host Group**

3. Enter a group name, and left-click the **Add** button to create the rule, the **Add and Add Another** to add and then create another group, or the **Cancel** button to cancel the add. In all cases, the dialog is removed.

If the add is successful, the transient message "**Host successfully added**" is displayed at the top-center of the Host Groups page.

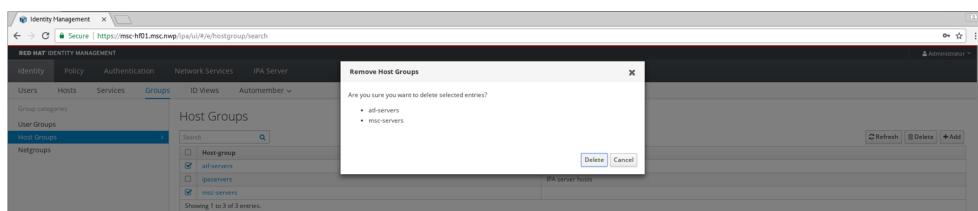
If the add is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the add. The Host Groups page is unlocked (sensitized) if the add is successful or cancelled.

#### 5.3.15.4.20 Groups - Delete Host Group(s)

Deleting an existing Host Group permanently deletes the host group and removes its reference from any hosts, HBAC rule, or Sudo rule to which the host group is assigned.

The following steps will delete a Host Group:

1. From the Host Groups page, left-click the checkbox to the left of the Group name column for each host group to be deleted, and left-click the **Delete** button at the top-right of the list.
2. The Host Groups page is locked (desensitized), and the Remove Host Groups dialog is displayed.



**Figure 269. Delete Host Groups**

3. Left-click the **Delete** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items deleted**" is displayed at the top-center of the Host Groups page.

If the delete is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the delete. The Host Groups page is unlocked (sensitized) if the delete is successful or cancelled.

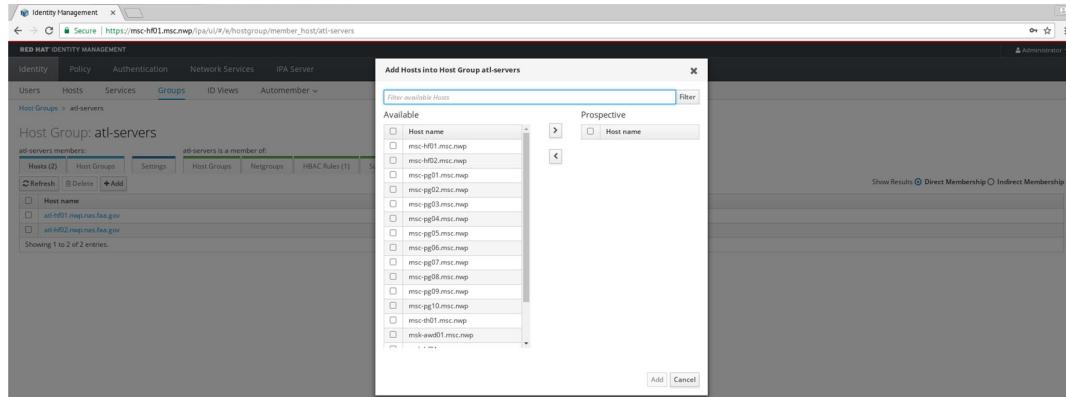
#### 5.3.15.4.21 Groups - Assign Host Group(s) To Hosts, HBAC Rules, Sudo Rules

Host groups are associated with hosts, HBAC rules, and Sudo rules. Hosts groups can also be associated with other host groups in a hierarchical structure.

The assignment of host groups to hosts is further described in the Identity/Hosts section, the assignment of host groups to HBAC rules is described in the Policy/HBAC section, and the assignment of host groups to Sudo rules is described in the Sudo rules section.

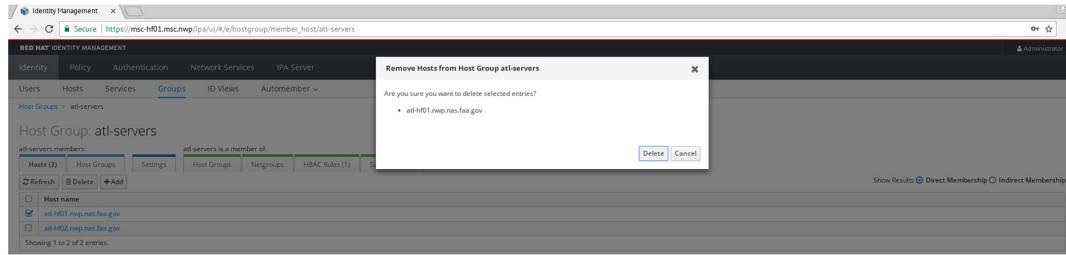
In addition to the assignment mechanism described in the Hosts, HBAC rules, and Sudo rules page, host groups can be assigned to each via the Host Group page.

To add hosts into a host group, select the Hosts button from the Host Group page, left-click the **Add** button above the list of hosts in the host group, and select the set of hosts to add to the group from the Add Users into Host Group dialog.



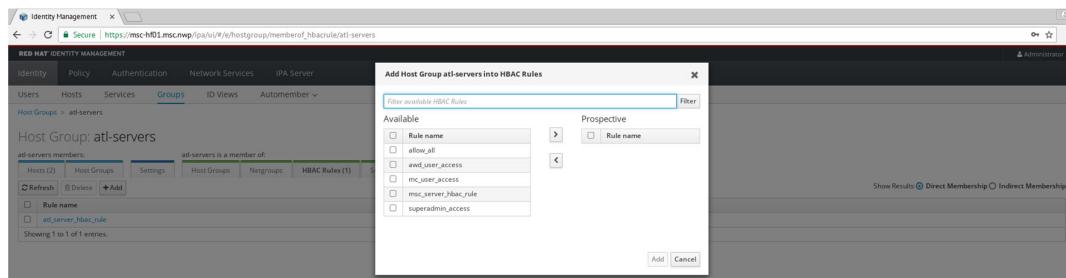
**Figure 270. Add Hosts To Host Group**

To delete hosts from a host group, select the Hosts button from the Host Group page, left-click the toggle button to the left of each host to be deleted, left-click the **Delete** button above the list of hosts in the host group, and confirm the deletion from the Remove Hosts from Host Group dialog.



**Figure 271. Remove Hosts From Host Group**

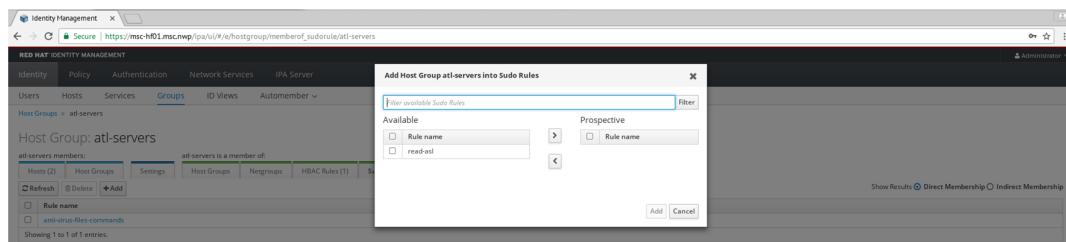
To add a host group into HBAC rules, select the HBAC Rules button from the Host Group page, left-click the **Add** button above the list of HBAC Rules to which the host group is assigned, and select the set of HBAC Rules to contain the Host Group from the Add Host Group into HBAC Rules dialog.



**Figure 272. Add Host Group To HBAC Rules**

To delete a host group from HBAC Rules, select the HBAC Rules button from the Host Group page, left-click the toggle button to the left of each rule name to be deleted, left-click the **Delete** button above the list of HBAC rules containing the Host Group, and confirm the deletion from the Remove HBAC Rule dialog.

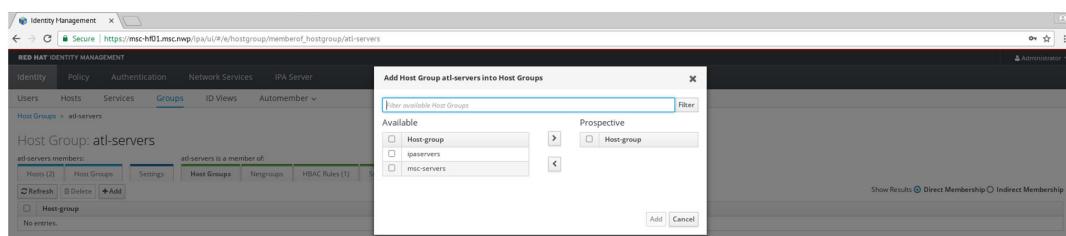
To add a host group into Sudo rules, select the Sudo Rules button from the Host Group page, left-click the **Add** button above the list of Sudo Rules to which the host group is assigned, and select the set of Sudo Rules to contain the Host Group from the Add Host Group into Sudo Rules dialog.



**Figure 273. Add Host Group To Sudo Rules**

To delete a host group from Sudo Rules, select the Sudo Rules button from the Host Group page, left-click the toggle button to the left of each rule name to be deleted, left-click the **Delete** button above the list of Sudo rules containing the Host group, and confirm the deletion from the Remove Sudo Rule dialog.

To add a host group into existing Host groups, select the Host Groups button from the Host Group page, left-click the **Add** button above the list of Host Groups to which the host group is assigned, and select the set of Host Groups to contain the Host Group from the Add Host Group into Host Groups dialog.



**Figure 274. Add Host Group To Host Group(s)**

To delete a host group from a Host Group, select the Host Group button from the Host Group page, left-click the toggle button to the left of each group name to be deleted, left-click the **Delete** button above the list of Host Groups containing the Host Group, and confirm the deletion from the Remove Host dialog.

#### 5.3.15.4.22 Using Groups to Control Access Permissions

NWP uses the group name to control access to the NWP applications. In order to access the AWD, the user must be a member of the `awd_users` group. M&C user access is controlled by site using a pattern of `mc_<site>_<system_type>_<role>`, where `<site>` is the three letter acronym of the site, `<system_type>` is domain or dedicated, and `<role>` is either administrator or monitor. For example, an administrator at the ATL Domain site would be a member of `mc_atl_domain_administrator`. See section 3.4.1 for more detail on the M&C role permissions.

#### 5.3.15.4.23 Groups relevant to NWP AWD application functionality

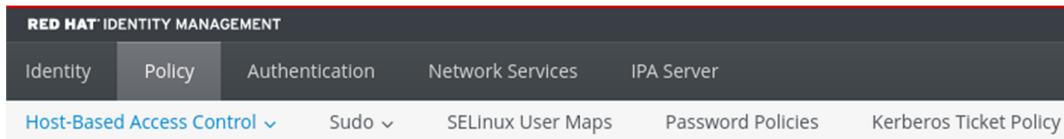
There is functionality on the AWDs that is only available to particular users which is controlled by the groups a user belongs to:

**Table 29. NWP AWD Groups**

| Group Name       | Functionality                                                 |
|------------------|---------------------------------------------------------------|
| limited_products | ability to display certain limited products (i.e., lightning) |

#### 5.3.15.5 Policy Menu

This section describes IdM features available via the Policy main menu option: Host-Based Access Control, Sudo, SELinux User Maps, Password Policies, and Kerberos Ticket Policy.



**Figure 275. Policy Menu**

The Security-Enhanced Linux (SELinux) User Maps and Kerberos Ticket Policy options are not currently used by NWP at this time and therefore are not described in this section.

#### 5.3.15.5.1 Host-Based Access Control (HBAC)

HBAC is used to restrict to which physical hosts (machines) and by which services a user account can authenticate. An HBAC Rule is used to define a set of hosts and services. One or more HBAC rules can be assigned to a user account. The hosts within a rule can be a discrete set of physical machines (Specified Hosts or Groups) or an "Any Host" override. The services within a rule can be a discrete set of one or more specified services and groups such as ssh, ftp, login, and su or an "Any Service" override.

The following steps will display the set of HBAC Rules:

1. If the HBAC Rules page is not already displayed, either left-click the **Policy** option, and the HBAC Rules page is displayed by default, or alternatively, if another **Policy** page is

displayed, left-click the **Host-Based Access Control** sub-option, and left-click **HBAC Rules** in the pulldown menu.

2. The HBAC Rules page is displayed containing the list of rules, and their Enabled/Disabled status.

| Rule name          | Status   | Description                                                           |
|--------------------|----------|-----------------------------------------------------------------------|
| allow_all          | Disabled | Allow all users to access any host from any host                      |
| allow_systemd-user | Enabled  | Allow pam_systemd to run user@service to create a system user session |
| avd_user_access    | Enabled  |                                                                       |
| mc_user_access     | Enabled  |                                                                       |
| superadmin_access  | Enabled  |                                                                       |

**Figure 276. HBAC Rules Page**

From the Host-Based Access Control sub-option, in addition to displaying the HBAC Rules, the HBAC Services and HBAC Service Groups can be displayed. Service Groups are simply a logical grouping of services to simplify the assignment of services to HBAC rules

| Service name       | Description                                                           |
|--------------------|-----------------------------------------------------------------------|
| allow_all          | Allow all users to access any host from any host                      |
| allow_systemd-user | Allow pam_systemd to run user@service to create a system user session |
| avd_user_access    |                                                                       |
| mc_user_access     |                                                                       |
| superadmin_access  |                                                                       |

**Figure 277. HBAC Menu**

| Service name | Description         |
|--------------|---------------------|
| crond        | crond               |
| ftp          | ftp                 |
| gdm          | gdm                 |
| gdm-password | gdm-password        |
| gssftp       | gssftp              |
| kdm          | kdm                 |
| login        | login               |
| nwo-auth-ac  |                     |
| proftpd      | proftpd             |
| pure-ftpd    | pure-ftpd           |
| sshd         | sshd                |
| su           | su                  |
| sudo         | su with login shell |
| sudo-i       | sudo                |
| vsftpd       | vsftpd              |

**Figure 278. HBAC Services**

### 5.3.15.5.2 HBAC - Viewing HBAC Rules

To view an existing HBAC rule, left-click the username in the **Users** column of the table. The HBAC Rule page lists which users the rule applies to, the set of hosts/host groups, and the set of services/service groups.

In the example HBAC Rule page for mc\_user\_access below, the mc\_user\_access HBAC rule is used by a set of M&C users, who have access from any host, but only using the nwp\_auth\_ac service.

This nwp\_auth\_ac service is the authentication service used by the M&C GUI application. This would mean that the set of M&C users would have access at any host but only from the M&C GUI (i.e., no access from the operating system via a service such as ssh).

The screenshot shows the Red Hat Identity Management interface for managing Host Based Access Control (HBAC) rules. The URL is https://msb-hf01.nwp.spa.us/4.8/hbacrule/details/mc\_user\_access. The page title is 'HBAC Rule: mc\_user\_access'. The 'General' section shows the rule name 'mc\_user\_access' and an empty description field. The 'Who' section lists 'Specified Users and Groups' with several users selected, including 'domainadmin', 'domainmonitor', 'domaindisabled', 'domainexpired', 'terminaladmin', 'terminalmonitor', 'awdadmin', 'awdmonitor', 'alladmin', and 'allmonitor'. The 'Accessing' section lists 'Specified Hosts and Groups' with 'Hosts' selected. The 'Via Service' section lists 'Specified Services and Groups' with 'nwp-auth-ac' selected. Navigation tabs include 'Identity', 'Policy', 'Authentication', 'Network Services', and 'IPA Server'. A top navigation bar includes 'Host Based Access Control', 'Sudo', 'SELinux User Maps', 'Password Policies', and 'Kerberos Ticket Policy'.

**Figure 279. HBAC Rule Page**

#### 5.3.15.5.3 HBAC - Add HBAC Rule

Adding a new HBAC rule creates a new empty rule with no defined hosts or services and are not assigned to any users.

The following steps will add a new HBAC rule:

1. From the HBAC Rules page, left-click the **Add** button at the top-right of the list.
2. The HBAC Rules page is locked (desensitized), and the Add HBAC Rule dialog is displayed.

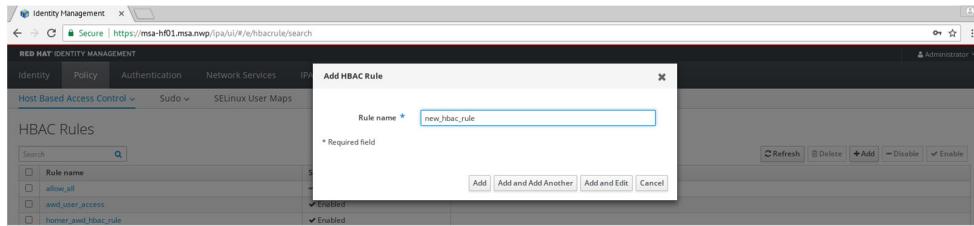


Figure 280. Add HBAC Rule

3. Enter a rule name, and left-click the **Add** button to create the rule, the **Add and Add Another** to add and create another rule, or the **Cancel** button to cancel the add. In all cases, the dialog is removed.

If the add is successful, the transient message "**HBAC Rule successfully added**" is displayed at the top-center of the HBAC Rules page.

If the add is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the add. The HBAC Rules page is unlocked (sensitized) if the add is successful or cancelled.

#### 5.3.15.5.4 HBAC - Delete HBAC Rule(s)

Deleting an existing HBAC rule permanently deletes the rule, and the rule is no longer used for authentication by any users previously assigned the rule.

The following steps will delete an HBAC rule:

1. From the HBAC Rules page, left-click the checkbox to the left of the Rule name column for each HBAC Rule to be deleted, and left-click the **Delete** button at the top-right of the list.
2. The HBAC Rules page is locked (desensitized), and the Remove HBAC Rules dialog is displayed.

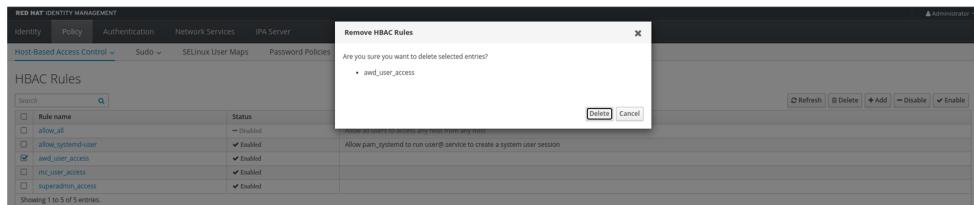


Figure 281. Delete HBAC Rule(s)

3. Left-click the **Delete** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items deleted**" is displayed at the top-center of the HBAC Rules page.

If the delete is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the delete. The HBAC Rules page is unlocked (sensitized) if the delete is successful or cancelled.

An HBAC rule can also be deleted from the **Actions** option at the top-left of the HBAC Rule page for the rule.

### 5.3.15.5.5 HBAC - Enable/Disable HBAC Rule(s)

Enabling an HBAC rule simply defines that the rule is active, and when assigned to a user, will be utilized when authenticating the user. Disabling an HBAC rule does not remove the rule from a user; however the rule will not be utilized when authenticating the user.

The following steps will disable/enable an HBAC rule:

- From the HBAC Rules page, left-click the checkbox to the left of the Rule name column for each HBAC Rule to be enabled/disabled, and left-click the **Enable/Disable** button at the top-right of the list.
- The HBAC Rules page is locked (desensitized), and the Confirmation dialog is displayed.

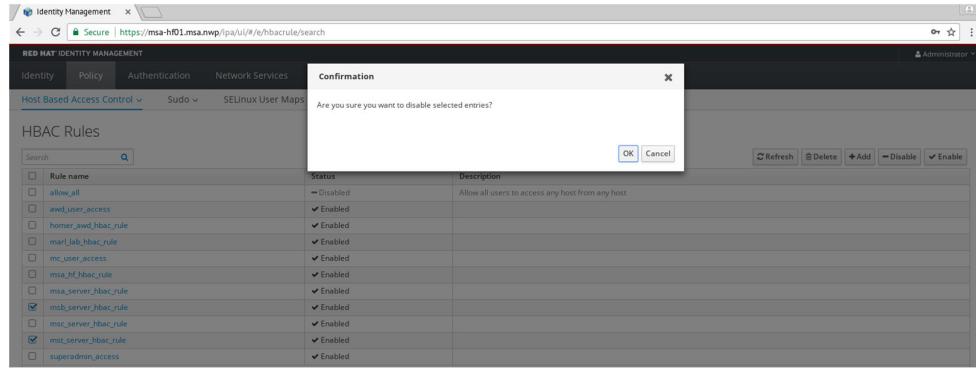


Figure 282. Disable HBAC Rule(s)

- Left-click the **OK** button to commit the enable/disable, or left-click the **Cancel** button to cancel the enable/disable. In both cases, the dialog is removed.

If the enable/disable is successful, the transient message "<count> items disabled(enabled)" is displayed at the top-center of the HBAC Rules page.

If the enable/disable is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the enable/disable. The HBAC Rules page is unlocked (sensitized) if the enable/disable is successful or cancelled.

An HBAC rule can also be enabled/disabled from the **Actions** option at the top-left of the HBAC Rule page for the rule.

### 5.3.15.5.6 HBAC - Assign User(s) to HBAC Rule(s)

An HBAC rule is initially created without being assigned to any user, and the rule can then be assigned to one or more users.

A user is initially created without an HBAC rule, and the user can then be assigned one or more rules. In order to authenticate, a user must have at least one HBAC rule, containing at least one host and one service via which login is allowed.

The following steps will add an HBAC rule to one or more users from the HBAC Rule page:

- From the HBAC Rule page, in the Who list, left-click the **Specified Users and Groups** radio button (if not selected), and left-click the **Add** button at the top-right of the user or user groups list.
- The HBAC Rule page is locked (desensitized), and the User select dialog is displayed. The dialog contains a list of active users or user groups who are not currently assigned to the HBAC rule.

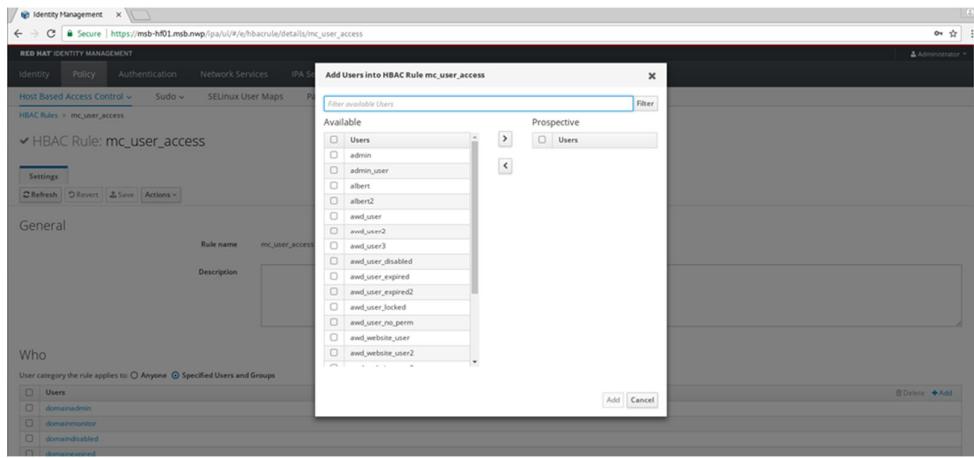


Figure 283. Add User(s) To HBAC Rule

3. Select users from the available list, left-click ">" to copy to the prospective list, and left-click the **Add** button to add or the **Cancel** button to cancel the add. In both cases, the dialog is removed.

If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the HBAC Rule page.

If the add is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The HBAC Rule page is unlocked (sensitized) if the add is successful or cancelled.

Alternatively, if the HBAC Rule should be assigned to all users rather than a specified list, in the Who list, left-click the **Anyone** radio button, and then left-click the **Save** button at the top-right of the page.

The following steps will add one or more HBAC rules to one user from the User HBAC Rules page:

1. From the Active Users page, left-click the username in the **User login** column of the table. The User settings page is displayed.
2. Left-click the **HBAC Rules** membership button. The User HBAC rules page is displayed, containing a list of all HBAC Rules assigned to the user.
3. Left-click the **Add** button at the top-left of the list.
4. The User HBAC Rules page is locked (desensitized), and the HBAC Rules select dialog is displayed. The dialog contains a list of rules who are not currently assigned to the user.

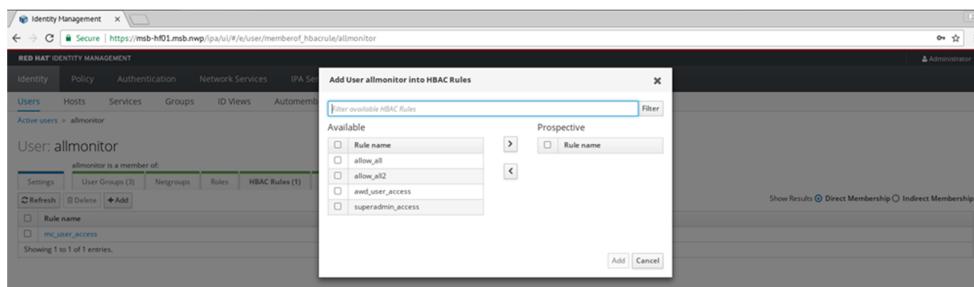


Figure 284. Add HBAC Rule(s) To User

5. Select one or more rules from the available list, left-click ">" to copy to the prospective list, and left-click the **Add** button to add or the **Cancel** button to cancel the add. In both cases, the dialog is removed.

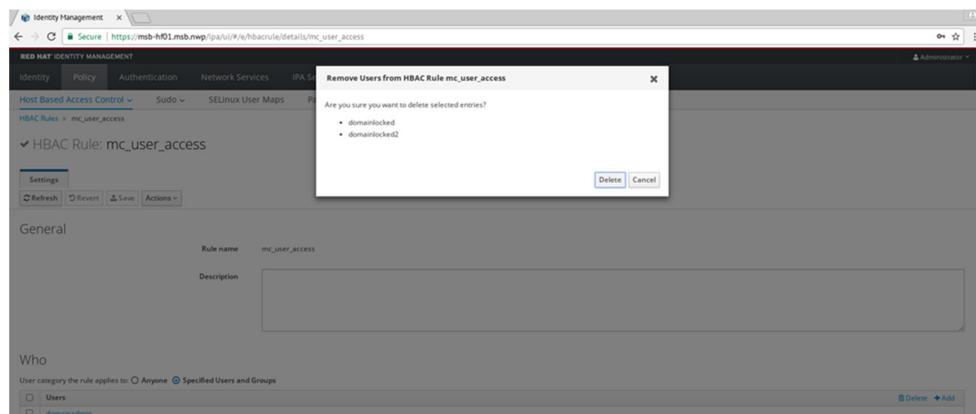
If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the User HBAC Rules page.

If the add is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The User HBAC Rules page is unlocked (sensitized) if the add is successful or cancelled.

#### 5.3.15.5.7 HBAC - Remove User(s) From HBAC Rule(s)

The following steps will remove an HBAC rule for a one or more users:

1. From the HBAC Rule page, in the Who list, left-click the checkbox to the left of the Users column for each user account to be removed from the HBAC rule, and left-click the Delete button at the top-right of the list.
2. The HBAC Rule page is locked (desensitized), and the Remove Users dialog is displayed.



**Figure 285. Remove User(s) From HBAC Rule**

3. Left-click the **OK** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

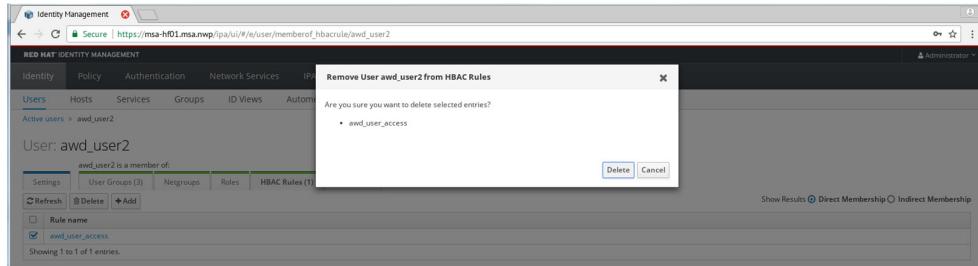
If the delete is successful, the transient message "**<count> items removed**" is displayed at the top-center of the HBAC Rule page.

If the delete is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The HBAC Rule page is unlocked (sensitized) if the delete is successful or cancelled.

The following steps will remove one or more HBAC rules for a specific user from the User HBAC Rules page:

1. From the Active Users page, left-click the username in the **User login** column of the table. The User settings page is displayed.
2. Left-click the **HBAC Rules** membership button. The User HBAC rules page is displayed, containing a list of all HBAC Rules assigned to the user.
3. In the Rules list, left-click the checkbox to the left of the Rule Name column for each HBAC Rule to be deleted for the user, and left-click the Delete button at the top-left of the list.

- The User HBAC rules page is locked (desensitized), and the Remove User dialog is displayed.



**Figure 286. Remove HBAC Rule(s) From User**

- Left-click the **OK** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items removed**" is displayed at the top-center of the User HBAC rules page.

If the delete is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The User HBAC rules page is unlocked (sensitized) if the delete is successful or cancelled.

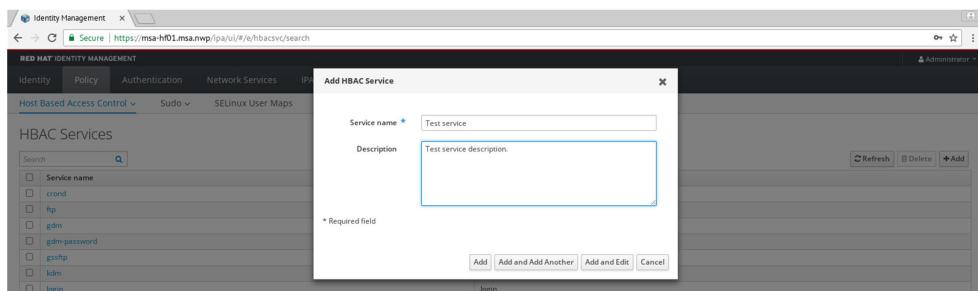
#### 5.3.15.5.8 HBAC - Add HBAC Service

An HBAC rule is initially created without being assigned to any service, and the rule can then be assigned to one or more services. A number of low-level operating system services are pre-defined, and the IDM administrator can create new services. The pre-defined services are: crond, ftp, gdm, gdm-password, gssftp, kdm, login, proftpd, pure-ftpd, sshd, su, su-i, sudo, sudo-i, and vsftpd. The AWD and M&C GUI application users authenticate using the Pluggable Authentication Module (PAM) nwp-auth-ac module, and therefore, need to authenticate via an nwp-auth-ac service. This service must be manually added to IdM during account setup and assigned to all AWD and M&C users.

The HBAC Services page is accessed from the **Policy** option and **Host-Based Access Control** sub-option.

The following steps will add a service from the HBAC Services page:

- From the HBAC Services page, left-click the **Add** button at the top-right of the services list.
- The HBAC Services page is locked (desensitized), and the Add HBAC Service dialog is displayed.



**Figure 287. Add HBAC Service**

3. Enter a service name and description, and left-click the **Add** button to create the rule, the **Add and Add Another** to add and create another service, or the **Cancel** button to cancel the add. In all cases, the dialog is removed.

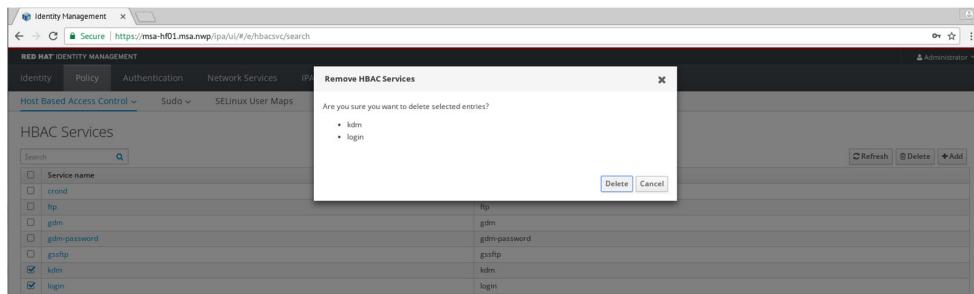
If the add is successful, the transient message "**HBAC Service successfully added**" is displayed at the top-center of the HBAC Services page.

If the add is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the add. The HBAC Services page is unlocked (sensitized) if the add is successful or cancelled.

#### 5.3.15.5.9 HBAC - Delete HBAC Service(s)

The following steps will delete a service or services from the HBAC Services page:

1. From the HBAC Services page, left-click the checkbox to the left of the Service name column for each HBAC Service to be deleted, and left-click the **Delete** button at the top-right of the list.
2. The HBAC Services page is locked (desensitized), and the Remove HBAC Services dialog is displayed.



**Figure 288. Delete HBAC Service(s)**

3. Left-click the **OK** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items deleted**" is displayed at the top-center of the HBAC Services page.

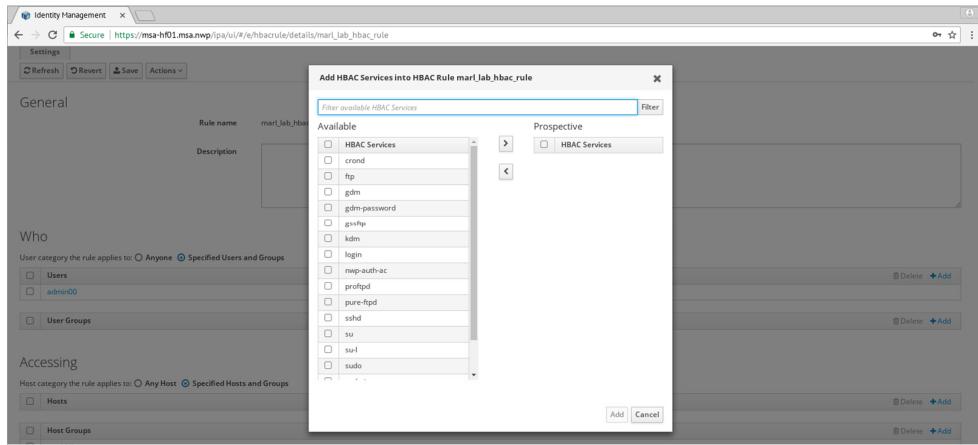
If the delete is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the delete. The HBAC Services page is unlocked (sensitized) if the delete is successful or cancelled.

#### 5.3.15.5.10 HBAC - Assign Service(s) to HBAC Rule

New services are initially created without an HBAC rule via the HBAC Services page, and the service can then be assigned to one or more rules. In order to authenticate, a user must have at least one HBAC rule, containing at least one host and one service via which login is allowed. When creating a new service, only a service name and description is required.

The following steps will add one or more services to an HBAC rule from the HBAC Rule page:

1. From the HBAC Rule page, in the Who list, left-click the **Specified Services and Groups** radio button (if not selected), and left-click the **Add** button at the top-right of the services and service groups list.
2. The HBAC Rule page is locked (desensitized), and the Service select dialog is displayed. The dialog contains a list of services or service groups who are not currently assigned to the HBAC rule.



**Figure 289 Add Service(s) To HBAC Rule**

3. Select services from the available list, left-click ">" to copy to the prospective list, and left-click the **Add** button, or left-click the **Cancel** button to cancel the add. In both cases, the dialog is removed.

If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the HBAC Rule page.

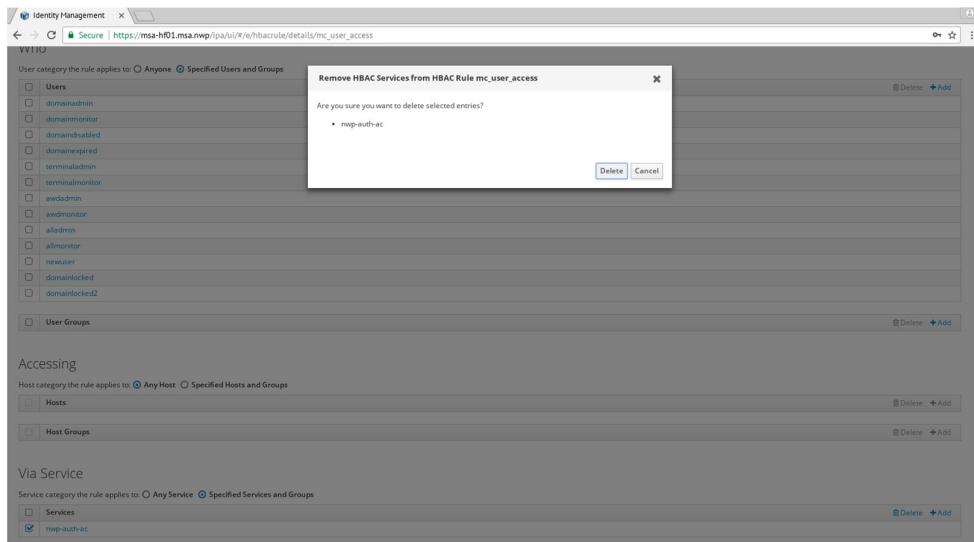
If the add is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The HBAC Rule page is unlocked (sensitized) if the add is successful or cancelled.

Alternatively, if the HBAC Rule should authenticate via any service rather than a specified list, in the Via Service list, left-click the **Any Service** radio button, and the left-click the **Save** button at the top-right of the page.

#### 5.3.15.5.11 HBAC - Remove Services(s) From HBAC Rule

The following steps will remove one or more services from an HBAC rule:

1. From the HBAC Rule page, in the Via Service list, left-click the checkbox to the left of the Services or Service Groups column for the service(s) to be removed from the HBAC rule, and left-click the Delete button at the top-right of the list.
2. The HBAC Rule page is locked (desensitized), and the Remove HBAC Services dialog is displayed.

**Figure 290. Remove Service(s) From HBAC Rule**

3. Left-click the **OK** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items removed**" is displayed at the top-center of the HBAC Rule page.

If the delete is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The HBAC Rule page is unlocked (sensitized) if the delete is successful or cancelled.

#### **5.3.15.5.12 HBAC - Assign Hosts/Host Groups to HBAC Rule**

An HBAC rule is initially created without being assigned to any hosts, and the rule can then be assigned to one or more hosts.

Host and host groups are initially created without an HBAC rule via the Hosts page (from the **Identity** option and **Hosts** sub-option), and the hosts can then be assigned to one or more rules. In order to authenticate, a user must have at least one HBAC rule, containing at least one host and one service via which login is allowed.

The following steps will add one or more hosts to an HBAC rule from the HBAC Rule page:

1. From the HBAC Rule page, in the Accessing list, left-click the **Specified Hosts and Groups** radio button (if not selected), and left-click the **Add** button at the top-right of the hosts and host groups list.
2. The HBAC Rule page is locked (desensitized), and the Hosts/Host Groups select dialog is displayed. The dialog contains a list of hosts and host groups who are not currently assigned to the HBAC rule.

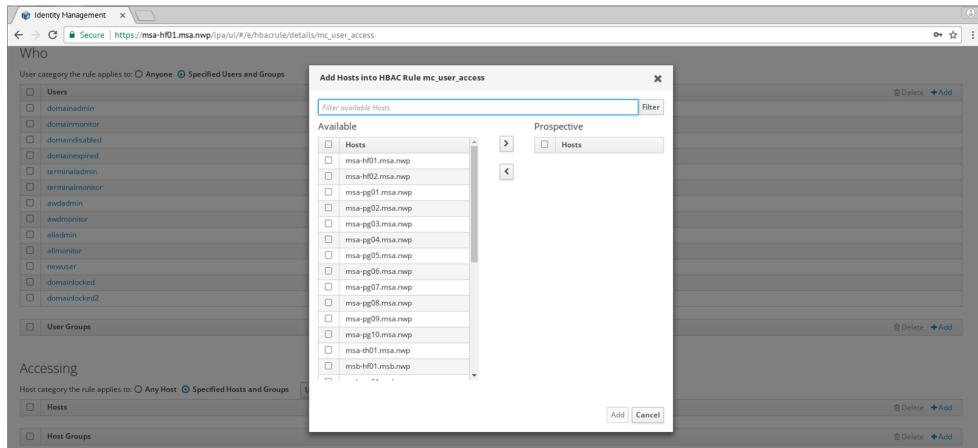


Figure 291. Add Host(s) To HBAC Rule

3. Select hosts from the available list, left-click ">" to copy to the prospective list, and left-click the **Add** button to add, or left-click the **Cancel** button to cancel the add. In both cases, the dialog is removed.

If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the HBAC Rule page.

If the add is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The HBAC Rule page is unlocked (sensitized) if the add is successful or cancelled.

Alternatively, if the HBAC Rule should authenticate via any host rather than a specified list, in the Accessing list, left-click the **Any Host** radio button, and then left-click the **Save** button at the top-right of the page.

#### 5.3.15.5.13 HBAC - Remove Hosts/Host Groups From HBAC Rule

The following steps will remove one or more hosts from an HBAC rule:

1. From the HBAC Rule page, in the Accessing list, left-click the checkbox to the left of the Hosts or Host Groups column for the service(s) to be removed from the HBAC rule, and left-click the **Delete** button at the top-right of the list.
2. The HBAC Rule page is locked (desensitized), and the Remove Hosts/Host Groups dialog is displayed.

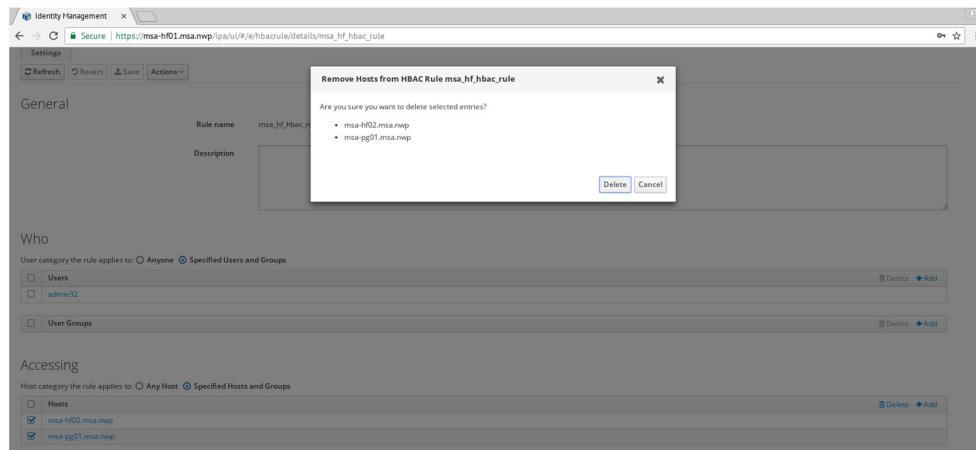


Figure 292. Remove Host(s)/Host Group(s) From HBAC Rule

3. Left-click the **OK** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items removed**" is displayed at the top-center of the HBAC Rule page.

If the delete is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The HBAC Rule page is unlocked (sensitized) if the delete is successful or cancelled.

#### 5.3.15.5.14 Sudo (Super User Do)

Sudo is used to provide a user account with the capability to perform root privileged commands. A Sudo Rule is used to define a set of hosts and commands, and then one or more Sudo rules can be assigned to a user account. The hosts within a rule can be a discrete set of physical machines (Specified Hosts or Groups) or an "Any Host" override. The commands within a rule can be a discrete set of one or more commands to allow file access and execute permission or an "Any Command" override.

The following steps will display the set of Sudo Rules:

1. Left-click the **Policy** option and the **Sudo** sub-option, and left-click **Sudo Rules** in the pulldown menu.

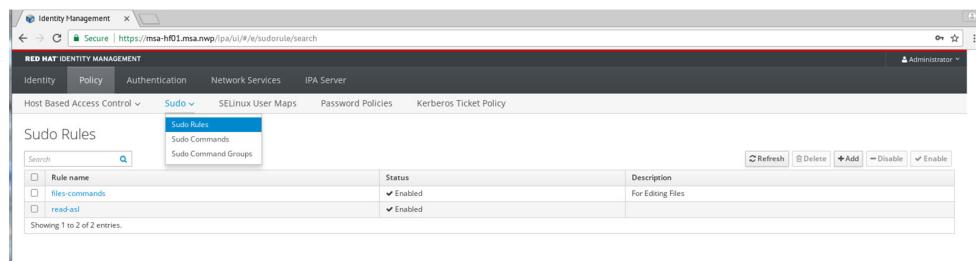


Figure 293. Sudo Menu and Rules Page

2. The Sudo Rules page is displayed containing the list of rules, and their Enabled/Disabled status.

From the Sudo sub-option, in addition to displaying the Sudo Rules, the Sudo Commands and Sudo Command Groups can be displayed. Command Groups are simply a logical grouping of commands to simplify the assignment of commands to Sudo rules.

|                                                  | Description            |
|--------------------------------------------------|------------------------|
| <input checked="" type="checkbox"/> Sudo Command |                        |
| <input type="checkbox"/> /bin/cat /etc/hosts.env |                        |
| <input type="checkbox"/> /usr/bin/vim /etc/hosts | For Editing Conf Files |

Figure 294. Sudo Commands

If an IdM sudo rule has been created not using the GUI, the following command must be run for each sudo rule "`ipa sudorule-add-option SUDORULE-NAME use_pty`" in order to comply with Center for Internet Security (CIS) requirements.

#### 5.3.15.5.15 Sudo - Viewing Sudo Rules

To view an existing Sudo rule, left-click the rule name in the Rule name column of the table. The Sudo Rule page lists which users the rule applies to, the set of hosts/host groups, and the set of allow and deny commands/command groups.

In the example Sudo Rule page for file-commands below, the file-commands rule is used by user admin31, who has access from any hosts on string msa but only has privilege in running the vim /etc/hosts command.

**NOTE:** In order to comply with security requirements, all sudo rules must have "use\_pty" added to them. This can be added by using the "+ Add" button and entering "use\_pty" in the dialog box, followed by clicking "Add".

| User category the rule applies to: | Anyone                | Specified Users and Groups |
|------------------------------------|-----------------------|----------------------------|
| <input checked="" type="radio"/>   | <input type="radio"/> |                            |

| Users                                       | External |
|---------------------------------------------|----------|
| <input checked="" type="checkbox"/> admin31 |          |

Figure 295. Sudo Rule Page

The screenshot shows the Sudo Rule Page with several sections:

- User Groups:** Contains a table with rows for "User Groups" and "Host Groups".
- Access this host:** A section for "Host category rule applies to" with options for "Any Host" and "Specified Hosts and Groups". It lists "Hosts" and "External".
- Host Groups:** Contains a table with rows for "Host Groups" and "msa-servers".
- Run Commands:** A section for "Command category rule applies to" with options for "Any Command" and "Specified Commands and Groups". It lists "Allow" and "Deny" sections.
- Allow:** Contains tables for "Sudo Allow Commands" (with rows for "Sudo Allow Commands" and "User/bin/vim /etc/hosts") and "Sudo Allow Command Groups" (with a single row).
- Deny:** Contains tables for "Sudo Deny Commands" and "Sudo Deny Command Groups" (both with a single row).
- As Whom:** A section for "RunAs User category rule applies to" with options for "Anyone" and "Specified Users and Groups". It lists "RunAs Users" and "Groups of RunAs Users".
- RunAs Groups:** A section for "RunAs Group category rule applies to" with options for "Any Group" and "Specified Groups". It lists "RunAs Groups".

Figure 296. Sudo Rule Page cont.

### 5.3.15.5.16 Sudo - Add Sudo Rule

Adding a new Sudo rule creates a new empty rule with no defined hosts or command and is not assigned to any users.

The following steps will add a new Sudo rule:

- From the Sudo Rules page, left-click the **Add** button at the top-right of the list.
- The Sudo Rules page is locked (desensitized), and the Add Sudo Rule dialog is displayed.

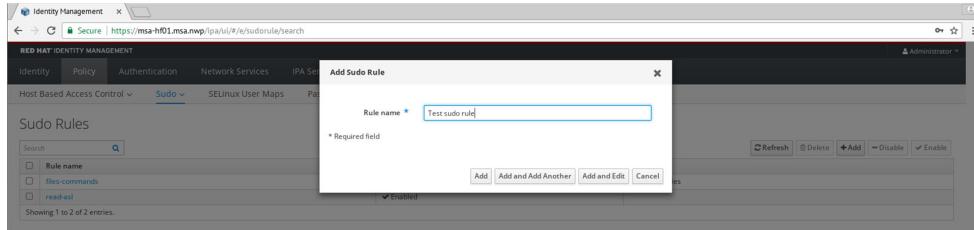


Figure 297. Add Sudo Rule

- Enter a rule name, and left-click the **Add** button to create the rule, the **Add and Add Another** to add and create another rule, or the **Cancel** button to cancel the add. In both cases, the dialog is removed.

If the add is successful, the transient message "**Sudo Rule successfully added**" is displayed at the top-center of the Sudo Rules page.

If the add is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The Sudo Rules page is unlocked (sensitized) if the add is successful or cancelled.

### 5.3.15.5.17 Sudo - Delete Sudo Rule(s)

Deleting an existing Sudo rule permanently deletes the rule, and the rule is no longer used for authentication by any users previously assigned the rule.

The following steps will delete a Sudo rule:

1. From the Sudo Rules page, left-click the checkbox to the left of the Rule name column for each Sudo Rule to be deleted, and left-click the **Delete** button at the top-right of the list.
2. The Sudo Rules page is locked (desensitized), and the Remove Sudo Rules dialog is displayed.

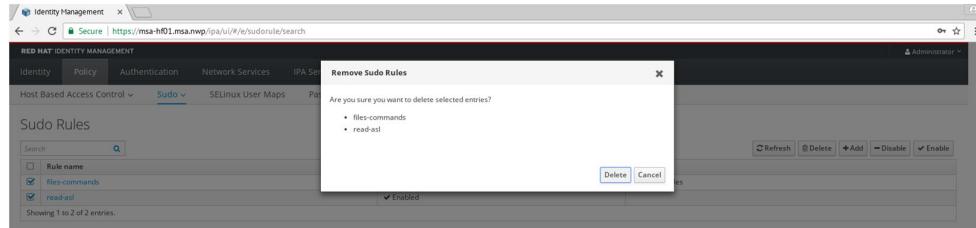


Figure 298. Delete Sudo Rule(s)

3. Left-click the **Delete** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items deleted**" displayed at the top-center of the Sudo Rules page.

If the delete is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The Sudo Rules page is unlocked (sensitized) if the delete is successful or cancelled.

A Sudo rule can also be deleted from the **Actions** option at the top-left of the Sudo Rule page for the rule.

### 5.3.15.5.18 Sudo - Enable/Disable Sudo Rule(s)

Enabling a Sudo rule simply defines that the rule is active, and when assigned to a user, it will be utilized when the user attempts to utilize the privileged command. Disabling a Sudo rule does not remove the rule from a user; however, the rule will not be used when attempting the privileged command.

The following steps will disable/enable a Sudo rule:

1. From the Sudo Rules page, left-click the checkbox to the left of the Rule name column for each Sudo Rule to be enabled/disabled, and left-click the **Enable/Disable** button at the top-right of the list.
2. The Sudo Rules page is locked (desensitized), and the Confirmation dialog is displayed.

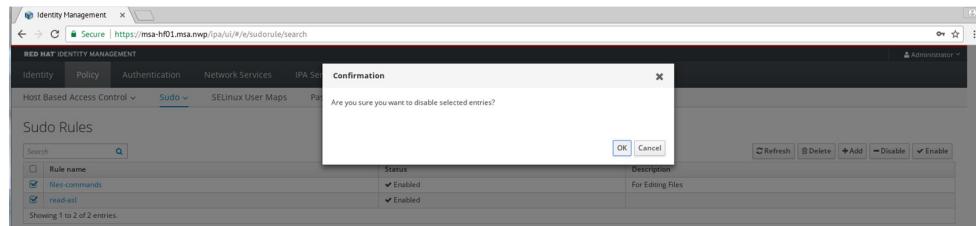


Figure 299 Disable Sudo Rule(s)

3. Left-click the **OK** button to commit the enable/disable, or left-click the **Cancel** button to cancel the enable/disable. In both cases, the dialog is removed.

If the enable/disable is successful, the transient message "**<count> items disabled(enabled)**" is displayed at the top-center of the Sudo Rules page.

If the enable/disable is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The Sudo Rules page is unlocked (sensitized) if the enable/disable is successful or cancelled.

A Sudo rule can also be enabled/disabled from the **Actions** option at the top-left of the Sudo Rule page for the rule.

#### 5.3.15.5.19 Sudo - Assign User(s) to Sudo Rule(s)

A Sudo rule is initially created without being assigned to any user, and the rule can then be assigned to one or more users.

A user is initially created without a Sudo rule, and the user can then be assigned one or more rules.

The following steps will add a Sudo rule to one or more users from the Sudo Rule page:

1. From the Sudo Rule page, in the Who list, left-click the **Specified Users and Groups** radio button (if not selected), and left-click the **Add** button at the top-right of the user or user groups list.
2. The Sudo Rule page is locked (desensitized), and the User select dialog is displayed. The dialog contains a list of active users or user groups who are not currently assigned to the Sudo rule.

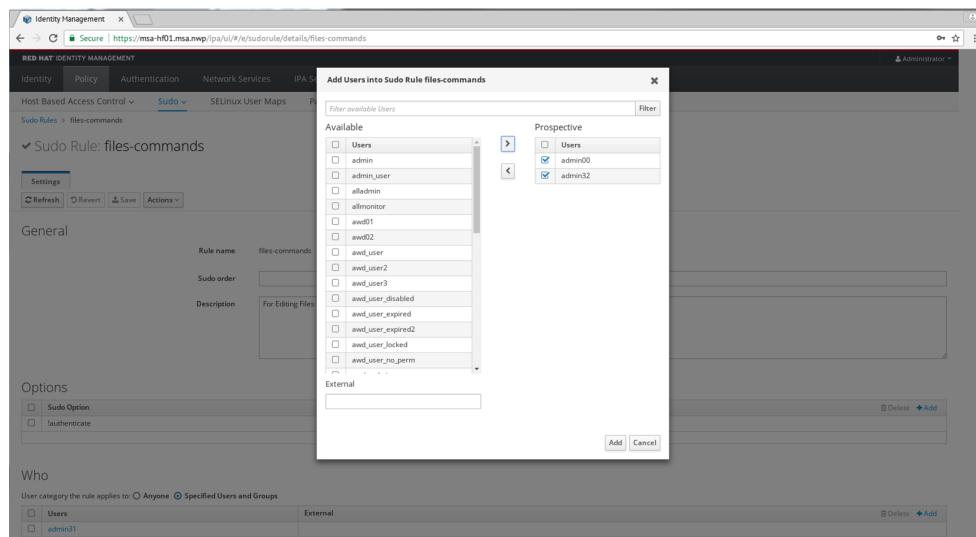


Figure 300. Add User(s) To Sudo Rule

3. Select users from the available list, left-click ">" to copy to the prospective list, and left-click the **Add** button to add, or left-click the **Cancel** button to cancel the add. In both cases, the dialog is removed.

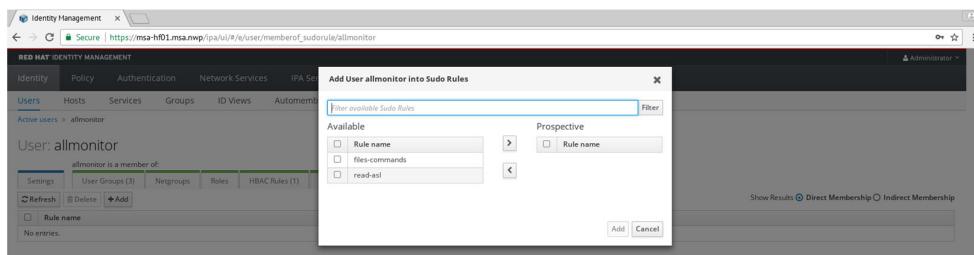
If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the Sudo Rule page.

If the add is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The Sudo Rule page is unlocked (sensitized) if the add is successful or cancelled.

Alternatively, if the Sudo Rule should be assigned to all users rather than a specified list, in the Who list, left-click the **Anyone** radio button, and the left-click the **Save** button at the top-right of the page.

The following steps will add one or more Sudo rule to one user from the User Sudo Rules page:

1. From the Active Users page, left-click the username in the **User login** column of the table. The User settings page is displayed.
2. Left-click the **Sudo Rules** membership button. The User Sudo rules page is displayed, containing a list of all Sudo Rules assigned to the user.
3. Left-click the **Add** button at the top-left of the list.
4. The User Sudo Rules page is locked (desensitized), and the Sudo Rules select dialog is displayed. The dialog contains a list of rules who are not currently assigned to the user.



**Figure 301. Add Sudo Rule(s) To User**

5. Select rule from the available list, left-click ">" to copy to the prospective list, and left-click the **Add** button to add, or left-click the **Cancel** button to cancel the add. In both cases, the dialog is removed.

If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the User Sudo Rules page.

If the add is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The User Sudo Rules page is unlocked (sensitized) if the add is successful or cancelled.

#### 5.3.15.5.20 Sudo - Remove User(s) From Sudo Rule(s)

The following steps will remove a Sudo rule for one or more users:

1. From the Sudo Rule page, in the Who list, left-click the checkbox to the left of the Users column for each user account to be removed from the Sudo rule, and left-click the Delete button at the top-right of the list.
2. The Sudo Rule page is locked (desensitized), and the Remove Users dialog is displayed.

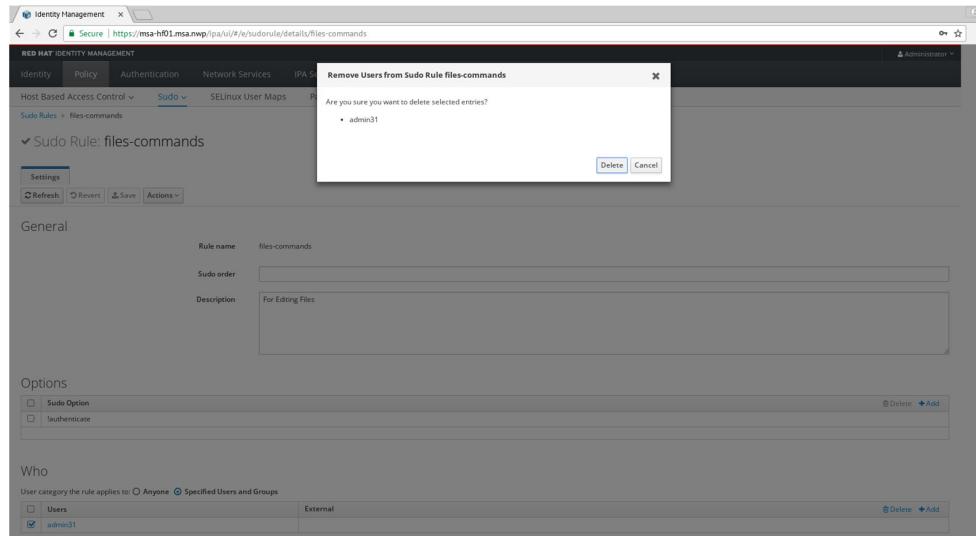


Figure 302. Remove User(s) From Sudo Rule

3. Left-click the **OK** button to commit the delete, or the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items removed**" is displayed at the top-center of the Sudo Rule page.

If the delete is unsuccessful, a failure message dialog is displayed which allows a retry or cancel the delete. The Sudo Rule page is unlocked (sensitized) if the delete is successful or cancelled.

The following steps will remove one or more Sudo rule for a specific user from the User Sudo Rules page:

1. From the Active Users page, left-click the username in the **User login** column of the table. The User settings page is displayed.
2. Left-click the **Sudo Rules** membership button. The User Sudo rules page is displayed, containing a list of all Sudo Rules assigned to the user.
3. In the Rules list, left-click the checkbox to the left of the Rule Name column for each Sudo Rule is to be deleted for the user, and left-click the Delete button at the top-left of the list.
4. The User Sudo rules page is locked (desensitized), and the Remove User dialog is displayed.

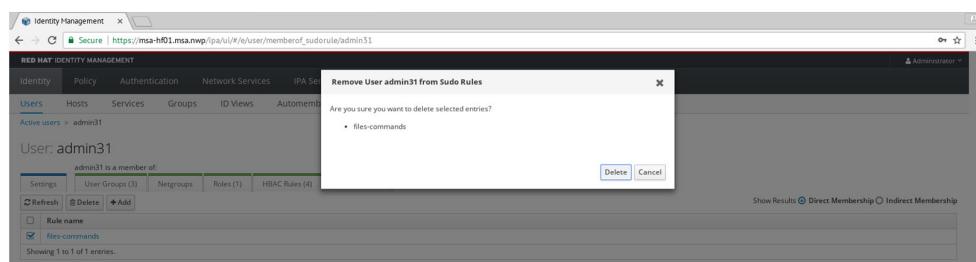


Figure 303. Remove Sudo Rule(s) From User

5. Left-click the **OK** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items removed**" is displayed at the top-center of the User Sudo rules page.

If the delete is unsuccessful, a failure message dialog is displayed which allows a retry or cancel the delete. The User Sudo rules page is unlocked (sensitized) if the delete is successful or cancelled.

#### 5.3.15.5.21 Sudo - Add Sudo Command

A Sudo rule is initially created without being assigned to any command, and the rule can then be assigned to one or more commands. When creating a new command, only a Sudo command name and description is required.

The Sudo Commands page is accessed from the **Policy** option and **Sudo** sub-option.

The following steps will add a command from the Sudo Commands page:

1. From the Sudo Commands page, left-click the **Add** button at the top-right of the commands list.
2. The Sudo Commands page is locked (desensitized), and the Add Sudo Command dialog is displayed.

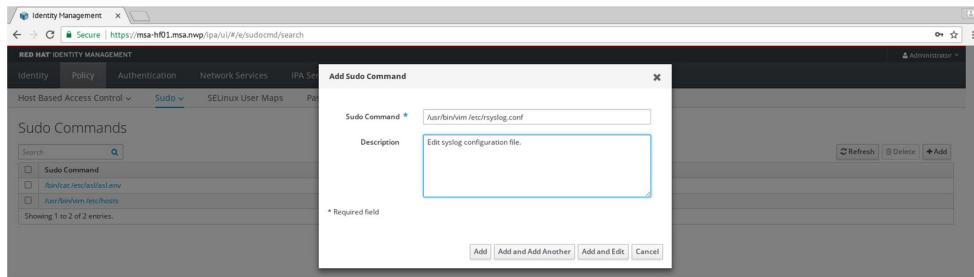


Figure 304. Add Sudo Command

3. Enter a command name and description, and left-click the **Add** button to create the rule, or the **Add and Add Another** to add and create another command, or the **Cancel** button to cancel the add. In all cases, the dialog is removed.

If the add is successful, the transient message "**Sudo Command successfully added**" is displayed at the top-center of the Sudo Commands page.

If the add is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The Sudo Commands page is unlocked (sensitized) if the add is successful or cancelled.

#### 5.3.15.5.22 Sudo - Delete Sudo Command(s)

The following steps will delete a command or commands from the Sudo Commands page:

1. From the Sudo Commands page, left-click the checkbox to the left of the Sudo Command name for each Sudo Command to be deleted, and left-click the **Delete** button at the top-right of the list.
2. The Sudo Commands page is locked (desensitized), and the Remove Sudo Commands dialog is displayed.

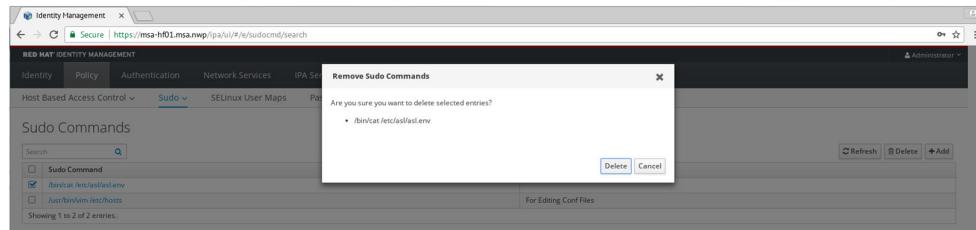


Figure 305. Delete Sudo Command(s)

3. Left-click the **OK** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items deleted**" is displayed at the top-center of the Sudo Commands page.

If the delete is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The Sudo Commands page is unlocked (sensitized) if the delete is successful or cancelled.

#### 5.3.15.5.23 Assign Allow Command(s) to Sudo Rule

New commands are initially created without a Sudo rule via the Sudo Commands page, and the command can then be assigned to one or more rules.

The following steps will add one or more allow commands to a Sudo rule from the Sudo Rule page:

1. From the Sudo Rule page, in the Run Commands list, left-click the **Specified Commands and Groups** radio button (if not selected), and left-click the **Add** button at the top-right of the Commands and Command groups list.
2. The Sudo Rule page is locked (desensitized), and the Add Allow Sudo Commands select dialog is displayed. The dialog contains a list of commands or command groups who are not currently assigned to the Sudo rule.

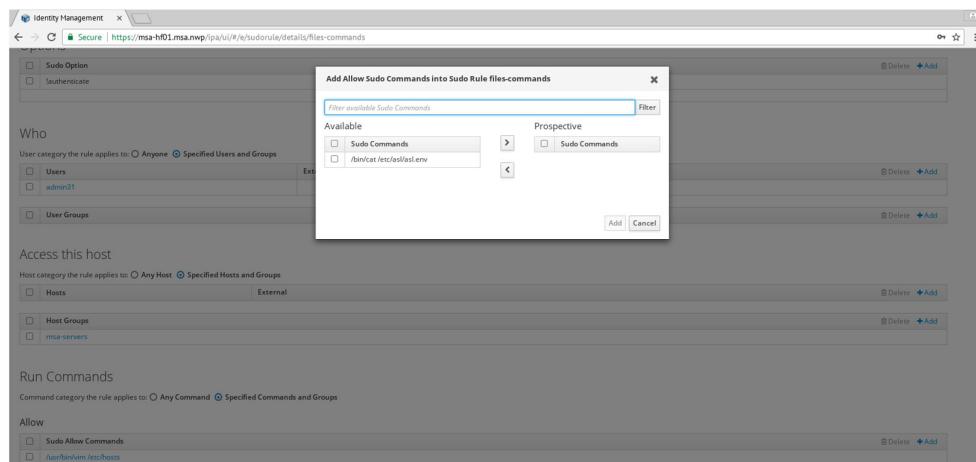


Figure 306. Add Allow Commands(s) To Sudo Rule

3. Select Commands from the available list, left-click ">" to copy to the prospective list, and left-click the **Add** button to add, or left-click the **Cancel** button to cancel the add. In both cases, the dialog is removed.

If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the Sudo Rule page.

If the add is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The Sudo Rule page is unlocked (sensitized) if the add is successful or cancelled.

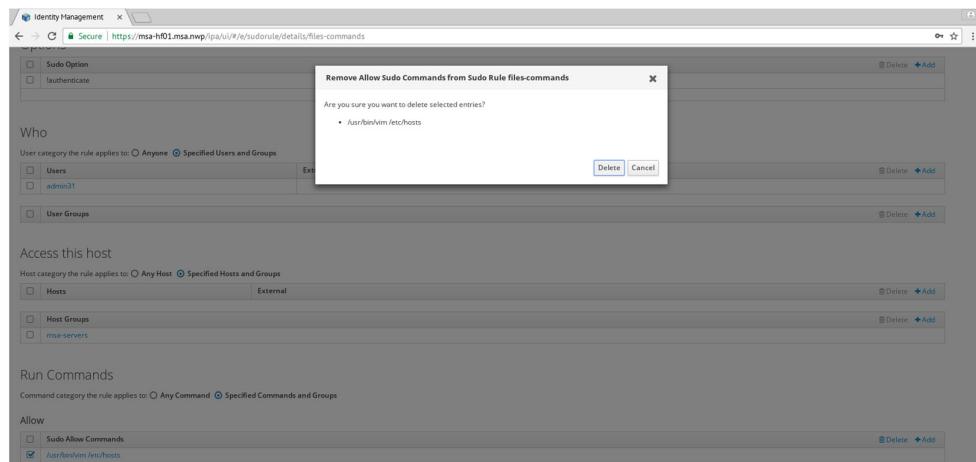
Alternatively, if the Sudo Rule should allow any command rather than a specified list, in the Via Command list, left-click the **Any Command** radio button, and the left-click the **Save** button at the top-right of the page.

In addition to adding Allow Commands, it is possible to add more general Allow Commands and then add more specific Deny Commands, that restrict the scope of the allow commands.

#### 5.3.15.5.24 Sudo - Remove Allow Commands(s) From Sudo Rule

The following steps will remove one or more allow commands from a Sudo rule:

1. From the Sudo Rule page, in the Run Commands list, left-click the checkbox to the left of the Commands or Command Groups column for the command(s) to be removed from the Sudo rule, and left-click the Delete button at the top-right of the list.
2. The Sudo Rule page is locked (desensitized), and the Remove Sudo Commands dialog is displayed.



**Figure 307. Remove Allow Command(s) From Sudo Rule**

3. Left-click the **OK** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items removed**" is displayed at the top-center of the Sudo Rule page.

If the delete is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The Sudo Rule page is unlocked (sensitized) if the delete is successful or cancelled.

The mechanism for deleting Deny Commands is identical to that used for deleting Allow Commands.

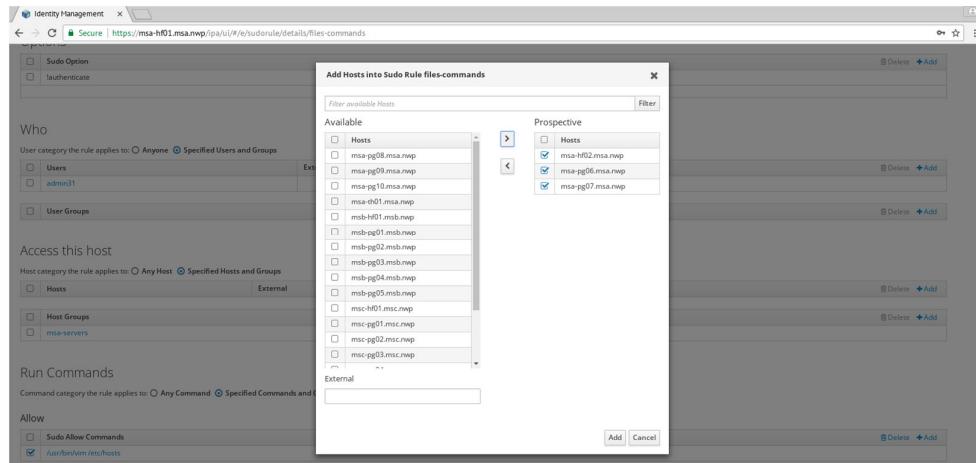
#### 5.3.15.5.25 Sudo - Assign Hosts/Host Groups to Sudo Rule

A Sudo rule is initially created without being assigned to any hosts, and the rule can then be assigned to one or more hosts.

Host and host groups are initially created without a Sudo rule via the Hosts page (from the **Identity** option and **Hosts** sub-option), and the hosts can then be assigned to one or more rules.

The following steps will add one or more hosts to a Sudo rule from the Sudo Rule page:

1. From the Sudo Rule page, in the Accessing list, left-click the **Specified Hosts and Groups** radio button (if not selected), and left-click the **Add** button at the top-right of the hosts and host groups list.
2. The Sudo Rule page is locked (desensitized), and the Hosts/Host Groups select dialog is displayed. The dialog contains a list of hosts and host groups who are not currently assigned to the Sudo rule.



**Figure 308. Add Host(s) To Sudo Rule**

3. Select hosts from the available list, left-click ">" to copy to the prospective list, and left-click the **Add** button to add, or left-click the **Cancel** button to cancel the add. In both cases, the dialog is removed.

If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the Sudo Rule page.

If the add is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The Sudo Rule page is unlocked (sensitized) if the add is successful or cancelled.

Alternatively, if the Sudo Rule should authenticate via any host rather than a specified list, in the Via Command list, left-click the **Any Host** radio button, and the left-click the **Save** button at the top-right of the page.

#### 5.3.15.5.26 Sudo - Remove Hosts/Host Groups From Sudo Rule

The following steps will remove one or more hosts from a Sudo rule:

1. From the Sudo Rule page, in the Access this host list, left-click the checkbox to the left of the Hosts or Host Groups column for the command(s) to be removed from the Sudo rule, and left-click the **Delete** button at the top-right of the list.
2. The Sudo Rule page is locked (desensitized), and the Remove Hosts/Host Groups dialog is displayed.

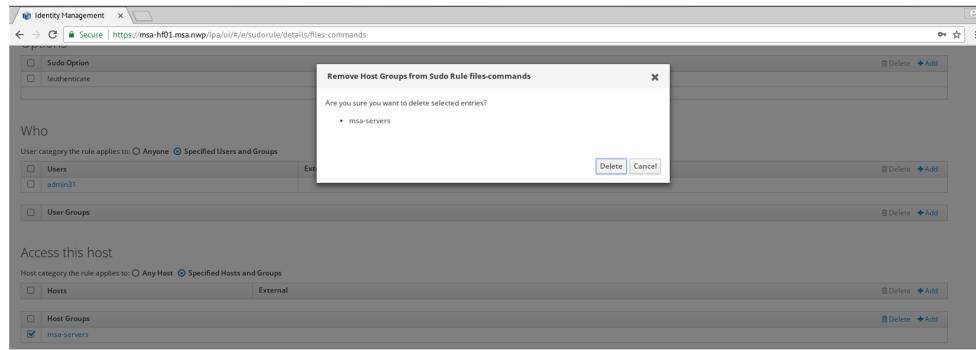


Figure 309. Remove Host(s)/Host Group(s) From Sudo Rule

3. Left-click the **OK** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items removed**" is displayed at the top-center of the Sudo Rule page.

If the delete is unsuccessful, a failure message dialog is displayed which allows a retry or cancel. The Sudo Rule page is unlocked (sensitized) if the delete is successful or cancelled.

#### 5.3.15.5.27 Password Policies

A password policy is a set of rules that a password must adhere to in order to meet security standards. All users must have a password so that the user can authenticate and the password policy defines the attributes that the password must meet.

During the IDM server installation, a default `global_policy` password policy is created that is used by all user accounts. In addition, the Automated System Loader (ASL) creates additional password policies: `policy_noexpiration` and `policy_shortpassword`. The `policy_noexpiration` policy is intended to be used by default accounts that cannot have the password expire. The `policy_shortpassword` policy has less strict complexity and length requirements, and it similarly does not expire.

The policy attributes are:

Table 30. Policy Attributes

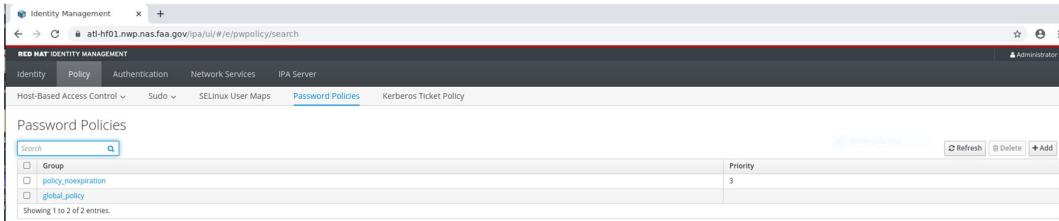
| Attribute                 | Description                                                                                                                    | Global Policy | <code>policy_noexpiration</code> | <code>policy_shortpassword</code> |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------------|-----------------------------------|
| <code>max_lifetime</code> | The maximum time in days that a password is valid until it needs to be changed. Setting to 0 means the password never expires. | 90 days       | 0                                | 0                                 |
| <code>min_lifetime</code> | The minimum time in hours between subsequent changes to a password. Leaving this setting blank means it is not in effect.      | blank         | blank                            | blank                             |

| Attribute              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Global Policy | policy_noexpiration | policy_shortpassword |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------|----------------------|
| history size           | The number of previous password stories. A user cannot re-use a password that is in the history.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 24            | 24                  | 24                   |
| character classes      | <p>The minimum number of different character classes a password must contain.</p> <p>A character class is:</p> <ul style="list-style-type: none"> <li>• an upper case character</li> <li>• a lower case character</li> <li>• a digit</li> <li>• a special character</li> <li>• an international character</li> </ul> <p>Since character class does not specifically enforce that a password must contain at least one upper case, one lower case, one digit, and one special character, that capability is achieved at the Pluggable Authentication Module (PAM) authentication level in the pwquality module.</p> | 4             | 4                   | 0                    |
| min length             | The minimum number of characters in a password. Setting to 0 means no minimum length.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 14            | 14                  | 4                    |
| max failures           | The maximum number of successive failed login attempts before IdM locks the user account.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3             | 3                   | 3                    |
| failure reset interval | The time in seconds following a failed login before IdM resets the current successive failed login attempt count. This is related to max failures, so that in order to lock an account, the max failures must occur, with the time                                                                                                                                                                                                                                                                                                                                                                                 | 300 seconds   | 300 seconds         | 300 seconds          |

| Attribute        | Description                                                                                                                                                                                              | Global Policy    | policy_noexpiration | policy_shortpassword |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------|----------------------|
|                  | between each individual failure being less than the failure reset interval.                                                                                                                              |                  |                     |                      |
| lockout duration | The time in seconds that an account remains locked following the account being locked for successive failed login attempts. When the lockout duration is reached, the account is automatically unlocked. | 31536000 seconds | 31536000 seconds    | 31536000 seconds     |
| priority         | The numeric priority of a policy. If a user is assigned multiple password policies, the policy attributes of the lowest priority policy are applied.                                                     | Not Applicable   | 3                   | 5                    |

The following steps will display the set of Password Policies:

1. Left-click the **Policy** option, and left-click the **Password Policies** sub-option.
2. The Password Policies page is displayed containing the list of policies and their priority.

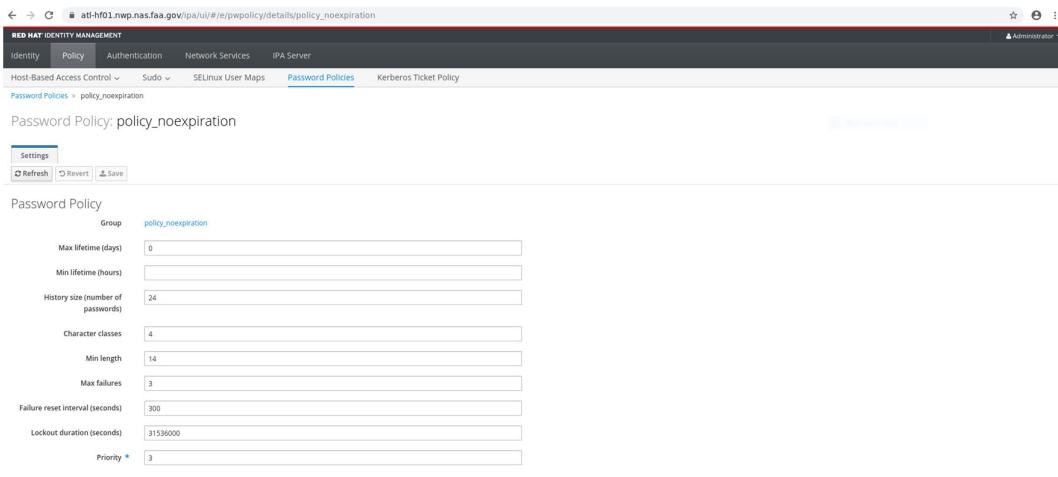


**Figure 310. Password Policies Page**

### 5.3.15.5.28 Password Policies - Viewing and Modifying Password Policy Settings

The following steps will display the settings of an existing password policy:

1. If the Password Policies page is not already displayed, left-click the **Policy** option and the **Password Policies** sub-option.
2. Left-click the policy group name in the Group column of the table.
3. The Password Policy page is displayed on the settings sub-page, containing both editable and read-only fields, with the **Save** button desensitized.

**Figure 311. Password Policy page**

If an editable field is changed by typing in a text field, the **Save** button is automatically sensitized.

A left-click on the **Save** button commits the update without confirmation, and the update is successful, the transient message "**Password policy <policy group name> updated**" is displayed at the top, center of the Password Policies page.

If the update is unsuccessful, a failure message dialog is displayed that allows to retry the update.

The following behaviors should be noted:

1. On a password policy change, the new policy attributes setting do not apply to existing passwords, only new/reset passwords.
2. When resetting a password (i.e., providing a temporary password) via the IdM GUI, the password policy is not applied. The policy is only applied for application and operating system authentication.

#### **5.3.15.5.29 Password Policies - Add Password Policy**

A password policy is not directly assigned to a user. First, a user group is created (reference the Identity section for more information), and then when creating a new password policy, the password policy is associated with the user group. Then, the user group is assigned to the user, and therefore indirectly, the password policy is assigned to the user.

Adding a new Password policy creates a policy with all values blank.

The following steps will add a new Password policy:

1. From the Password Policies page, left-click the **Add** button at the top-right of the list.
2. The Password Policies page is locked (desensitized), and the Add Password Policy dialog is displayed.

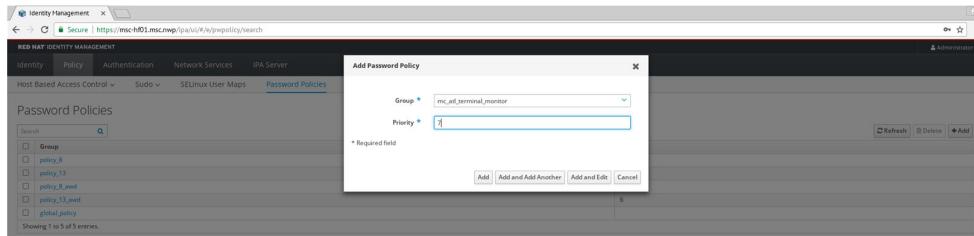


Figure 312. Add Password Policy

3. Select an existing group from the Group pulldown menu and enter a priority, and left-click the **Add** button to create the policy, the **Add and Add Another** to add and create another policy, or the **Cancel** button to cancel the add. In all cases, the dialog is removed.

If the add is successful, the transient message "**Password Policy successfully added**" is displayed at the top-center of the Password Policies page.

If the add is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the add. The Password Policies page is unlocked (sensitized) if the add is successful or cancelled.

#### 5.3.15.5.30 Password Policy - Delete Password Policy/Policies

Deleting an existing Password policy permanently deletes the policy, and the policy is no longer associated to any group. If this means that a user no longer has a password policy (via a group), then the user authenticates using the global password policy.

The following steps will delete a Password policy:

1. From the Password Policies page, left-click the checkbox to the left of the Group column for each policy to be deleted, and left-click the **Delete** button at the top-right of the list.
2. The Password Policies page is locked (desensitized), and the Remove Password Policies dialog is displayed.

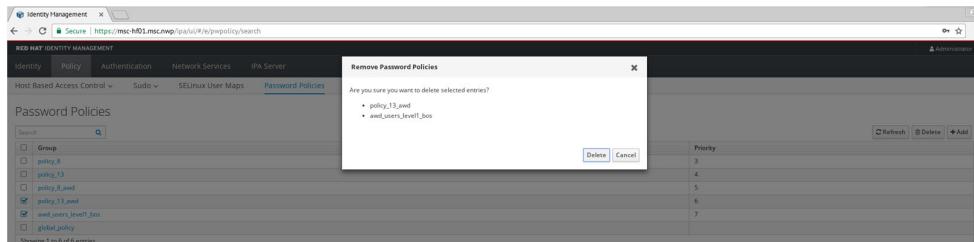


Figure 313. Delete Password Policy/Policies

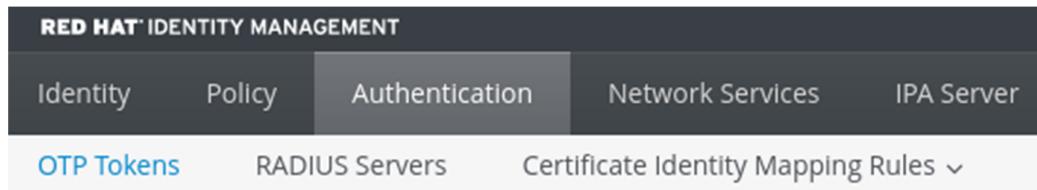
3. Left-click the **Delete** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items deleted**" is displayed at the top-center of the Password Policies page.

If the delete is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the delete. The Password Policies page is unlocked (sensitized) if the delete is successful or cancelled.

### 5.3.15.6 Authentication Menu

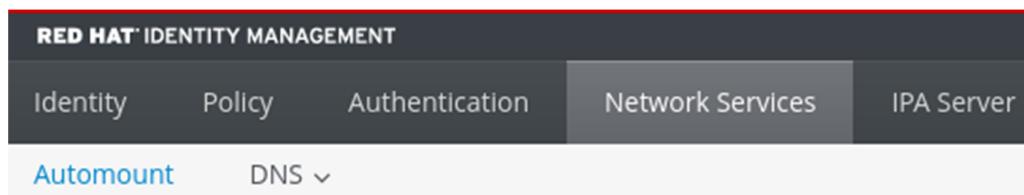
The IdM features and options available via the Authentication main menu are not used by NWP at this time. The unused options include: Certificates, OTP Tokens, RADIUS Servers, and Certificate Identity Mapping Rules.



**Figure 314. Authentication Menu**

### 5.3.15.7 Network Services Menu

This section is a placeholder to describe the IdM features available via the Network Services main menu option: Automount and DNS.

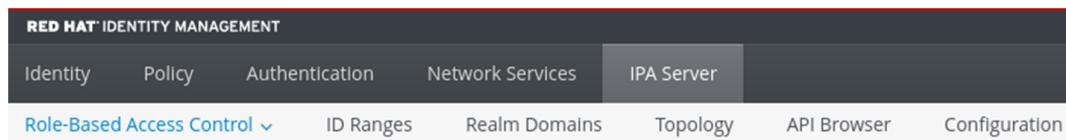


**Figure 315. Network Services Menu**

The options are not currently updated by the IdM System Administrator and therefore are not described in this section.

### 5.3.15.8 IPA Server Menu

This section describes IdM features available via the IPA Server main menu option: Role-Based Access Control, ID Ranges, Realm Domains, Topology, API Browser, and Configuration.



**Figure 316. IPA Server Menu**

The ID Ranges, Realm Domains, and API Browser options are not currently updated by the IdM System Administrator and therefore are not described in this section.

### 5.3.15.8.1 Role-Based Access Control (RBAC)

RBAC is used to provide IdM System Administrator users with permissions to manage users within IdM.

A permission is the lowest level control and defines the individual IdM operations that can be performed such as adding, deleting, or modifying a user account. A privilege is a logical grouping of one or more permissions such as all password policy permissions. A role is a logical grouping of one or more privileges and is assigned to an IdM user, so that user can perform the actions defined in the privilege(s) of the role.

After installation of IdM, a default set of roles, privileges, and permissions are available. Included within this default set are 2 NWP specific privileges and 1 NWP specific role:

1. **Temporary Account** role - this role has no privileges or permissions. It should be assigned to any user account that is considered "temporary" and will be automatically deleted after a configurable **Autoexpiration Time** number of days.
2. **Autoexpiration Time** privilege - this privilege should be assigned to any role who is allowed to edit the temporary account deletion time.
3. **Autodisable Time** privilege - this privilege should be assigned to any role who is allowed to edit the unused account disable time.

The following steps will display the set of Roles:

1. If the Roles page is not already displayed, either left-click the **IPA Server** option, and the Roles page is displayed by default; alternatively, if another **IPA Server** page is displayed, left-click the **Role Based Access Control** sub-option and left-click **Roles** in the pulldown menu.
2. The Roles page is displayed containing the list of roles, and their descriptions.

| Role Name              | Description                                    |
|------------------------|------------------------------------------------|
| IT Security Specialist | IT Security Specialist                         |
| IT Specialist          | IT Specialist                                  |
| Policy Manager         | An admin who can manage the password policies. |
| Security Architect     | Security Architect                             |
| Temporary Account      | Flags an account as temporary.                 |
| User Administrator     | Responsible for creating Users and Groups      |
| helpdesk               | Helpdesk                                       |

**Figure 317. Roles Page**

| Role Name              | Description                                    |
|------------------------|------------------------------------------------|
| IT Security Specialist | IT Security Specialist                         |
| IT Specialist          | IT Specialist                                  |
| Policy Manager         | An admin who can manage the password policies. |
| Security Architect     | Security Architect                             |
| Temporary Account      | Flags an account as temporary.                 |
| User Administrator     | Responsible for creating Users and Groups      |
| helpdesk               | Helpdesk                                       |

**Figure 318. RBAC Menu**

From the Role-Based Access Control sub-option, in addition to displaying the Roles, the Privileges and Permissions can be displayed.

The screenshot shows the 'Privileges' page in the Red Hat Identity Management web interface. The URL is <https://msv-h01.msv.nwpipa.u/#/privilege/search>. The page has a search bar at the top left and a toolbar with refresh, delete, and add buttons at the top right. The main content area displays a table of privileges with columns for 'Privilege name' and 'Description'. The table lists 35 entries, with the first few rows shown below:

| Privilege name                              | Description                                      |
|---------------------------------------------|--------------------------------------------------|
| ADTrust Agents                              | System accounts able to access trust information |
| Autodiscover Time                           | 180                                              |
| Autonegotiate Time                          | 30                                               |
| Automember Readers                          | Read Automember definitions                      |
| Automember Task Administrator               | Automember Task Administrator                    |
| Automount Administrators                    | Automount Administrators                         |
| CA Administrator                            | CA Administrator                                 |
| Certificate Administrators                  | Certificate Administrators                       |
| Certificate Identity Mapping Administrators | Certificate Identity Mapping Administrators      |
| DNS Administrators                          | DNS Administrators                               |
| DNS Servers                                 | DNS Servers                                      |
| Dnszone Administrator                       | Dnszone Administration                           |
| Group Administrators                        | Group Administrators                             |
| HBAC Administrator                          | HBAC Administrator                               |
| Host Administrators                         | Host Administrators                              |
| Host Enrollment                             | Host Enrollment                                  |
| Host Group Administrators                   | Host Group Administrators                        |
| IPA Masters Readers                         | Read list of IPA masters                         |
| Kerberos Ticket Policy Readers              | Read global and per-user Kerberos ticket policy  |
| Modify Group membership                     | Modify Group membership                          |

At the bottom of the table, it says 'Showing 1 to 20 of 35 entries.'

**Figure 319. Privileges**

The screenshot shows the 'Permissions' page in the Red Hat Identity Management web interface. The URL is <https://msv-h01.msv.nwpipa.u/#/permission/search>. The page has a search bar at the top left and a toolbar with refresh, delete, and add buttons at the top right. The main content area displays a table of permissions with a single column for 'Permission name'. The table lists 45 entries, with the first few rows shown below:

| Permission name                              |
|----------------------------------------------|
| Add Automount Rebuild Membership Task        |
| Add Configuration Sub-Entries                |
| Add Replication Agreements                   |
| Certificate Remove Hold                      |
| Get Certificates status from the CA          |
| Modify DNA Range                             |
| Modify PassSync Managers Configuration       |
| Modify Replication Agreements                |
| Read DNA Range                               |
| Read LDBM Databases Configuration            |
| Read PassSync Managers Configuration         |
| Read Replication Agreements                  |
| Remove Replication Agreements                |
| Request Certificate                          |
| Request Certificate Ignoring CA ACLs         |
| Request Certificates from a different host   |
| Renew Certificates from the CA               |
| Revoke Certificate                           |
| System: Add Automount Keys                   |
| System: Add Automount Locations              |
| System: Add Automount Maps                   |
| System: Add CA                               |
| System: Add CA ACL                           |
| System: Add CA Certificate For Renewal       |
| System: Add Certificate Store Entry          |
| System: Add Cermac Rules                     |
| System: Add DNS Entries                      |
| System: Add Group Password Policy            |
| System: Add Group Password Policy comprehend |
| System: Add Groups                           |
| System: Add HBAC Rule                        |
| System: Add HBAC Service Groups              |
| System: Add HBAC Services                    |
| System: Add Hostgroups                       |
| System: Add Hosts                            |

**Figure 320. Permissions**

### 5.3.15.8.2 RBAC - Viewing Roles, Privileges, Permissions

To view an existing role, left-click the role in the Role name column of the table. By default, the Role page lists which users the role applies to and provides access to list the privileges associated with the role.

The screenshot shows the 'Role-Based Access Control' section under 'Roles'. A sub-page for 'Policy Manager' is displayed. The 'Privileges' tab is selected. A table lists 'Policy Manager members' with one entry: 'User login' (admin). Buttons for Refresh, Delete, and Add are visible.

**Figure 321. Role Page - Users Sub-page**

To view the privileges associated with the role, left-click the **Privileges** button.

The screenshot shows the 'Role-Based Access Control' section under 'Roles'. A sub-page for 'Policy Manager' is displayed. The 'Privileges' tab is selected. A table lists 'Policy Manager members' with two entries: 'Privilege name' and 'Password Policy Administrator'. Buttons for Refresh, Delete, and Add are visible.

**Figure 322. Role Page - Privileges Sub-page**

To view the permissions associated with the privilege, left-click the Privilege name from the privileges list.

The screenshot shows the 'Role-Based Access Control' section under 'Privileges'. A sub-page for 'Password Policy Administrator' is displayed. The 'Permissions' tab is selected. A table lists 'Permissions' with eight entries. Buttons for Refresh, Delete, and Add are visible.

**Figure 323. Privilege Page**

### 5.3.15.8.3 RBAC - Add Role

Adding a new role creates a new role that is not assigned to any users and has no privileges.

The following steps will add a new Role:

1. From the Roles page, left-click the **Add** button at the top-right of the list.
2. The Roles page is locked (desensitized), and the Add Role dialog is displayed.

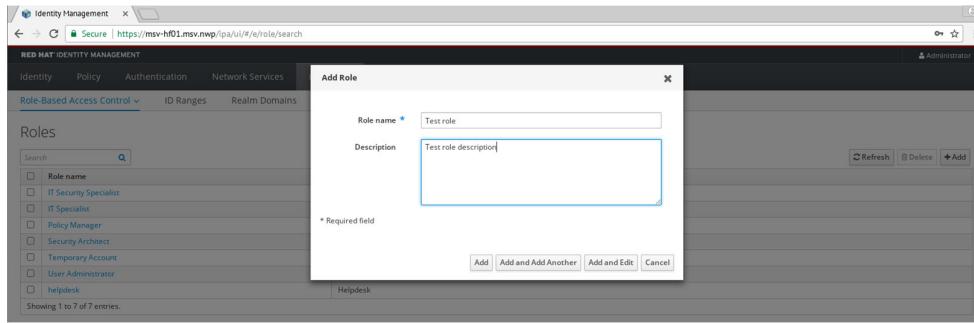


Figure 324. Add Role

3. Enter a role name, and left-click the **Add** button to create the role, the **Add and Add Another** to add the current role and create another role, or the **Cancel** button to cancel the add. In all cases, the dialog is removed.

If the add is successful, the transient message "**Role successfully added**" is displayed at the top-center of the Roles page.

If the add is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the add. The Roles page is unlocked (sensitized) if the add is successful or cancelled.

#### 5.3.15.8.4 RBAC - Delete Role(s)

Deleting an existing role permanently deletes the role, and any users assigned the role no longer have the privileges associated with the role.

The following steps will delete a role:

1. From the Roles page, left-click the checkbox to the left of the Role name column for each Role to be deleted, and left-click the **Delete** button at the top-right of the list.
2. The Roles page is locked (desensitized), and the Remove Roles dialog is displayed.

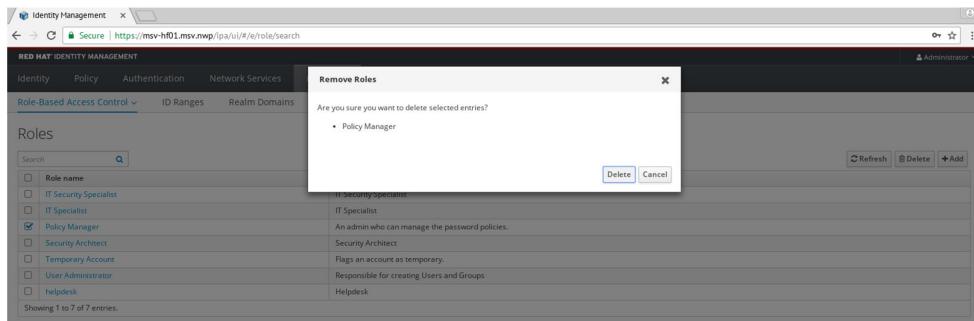


Figure 325. Delete Role(s)

3. Left-click the **Delete** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items deleted**" is displayed at the top-center of the Roles page.

If the delete is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the delete. The Roles page is unlocked (sensitized) if the delete is successful or cancelled.

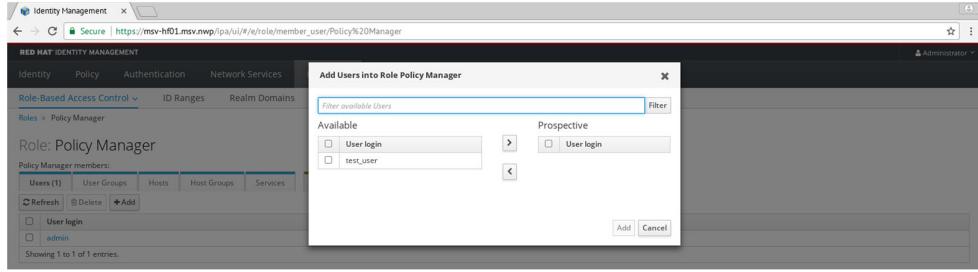
### 5.3.15.8.5 RBAC - Assign User(s) to Role(s)

A role is initially created without being assigned to any user, and the role can then be assigned to one or more users.

A user is initially created without a Role, and the user can then be assigned one or more roles.

The following steps will add one or more users to a Role from the Role page:

1. From the Role page, left-click the **Add** button at the top-right of the users list.
2. The Role page is locked (desensitized), and the Add Users dialog is displayed. The dialog contains a list of active users or user groups who are not currently assigned to the role.



**Figure 326. Add User(s) To Role**

3. Select users from the available list, left-click ">" to copy to the prospective list, and left-click the **Add** button to add, or left-click the **Cancel** button to cancel the add. In both cases, the dialog is removed.

If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the Role page.

If the add is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the add. The Role page is unlocked (sensitized) if the add is successful or cancelled.

The following steps will add one or more roles to one user from the User Roles page:

1. From the Active Users page, left-click the username in the **User login** column of the table. The User settings page is displayed.
2. Left-click the **Roles** membership button. The User Roles page is displayed, containing a list of all Roles assigned to the user.
3. Left-click the **Add** button at the top-left of the list.
4. The User Roles page is locked (desensitized), and the Add User select dialog is displayed. The dialog contains a list of roles who are not currently assigned to the user.

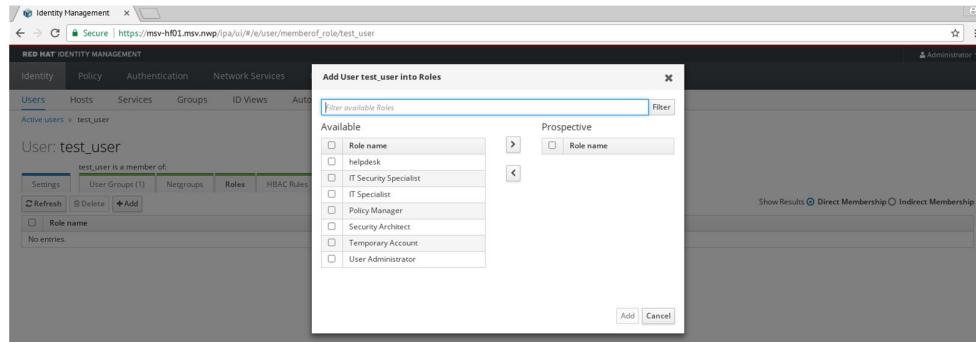


Figure 327. Add Role(s) To User

- Select rule from the available list, left-click ">" to copy to the prospective list, and left-click the **Add** button to add, or left-click the **Cancel** button to cancel the add. In both cases, the dialog is removed.

If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the User Roles page.

If the add is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the add. The User Roles page is unlocked (sensitized) if the add is successful or cancelled.

### 5.3.15.8.6 HBAC - Remove User(s) From Roles(s)

The following steps will remove a Role for one or more users:

- From the Role page, left-click the checkbox to the left of the User login column for each user account to be removed from the role, and left-click the **Delete** button at the top-right of the list.
- The Role page is locked (desensitized), and the Remove Users dialog is displayed.

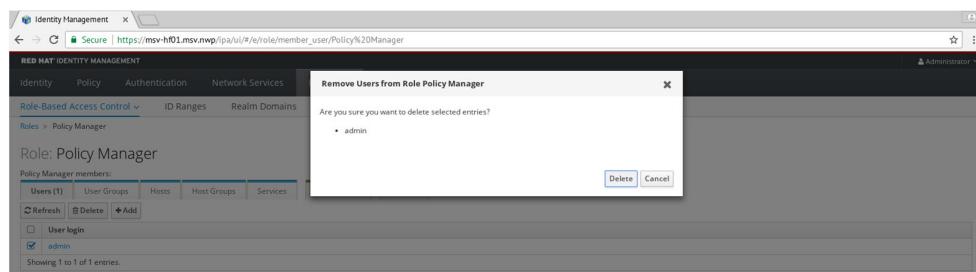


Figure 328 Remove User(s) From Role

- Left-click the **OK** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items removed**" is displayed at the top-center of the Role page.

If the delete is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the delete. The Role page is unlocked (sensitized) if the delete is successful, or cancelled.

The following steps will remove one or more role for a specific user from the User Roles page:

1. From the Active Users page, left-click the username in the **User login** column of the table. The User settings page is displayed.
2. Left-click the **Roles** membership button. The User Roles page is displayed, containing a list of all Roles assigned to the user.
3. In the Roles list, left-click the checkbox to the left of the Role name column for each role to be deleted for the user, and left-click the Delete button at the top-left of the list.
4. The User Roles page is locked (desensitized), and the Remove User dialog is displayed.

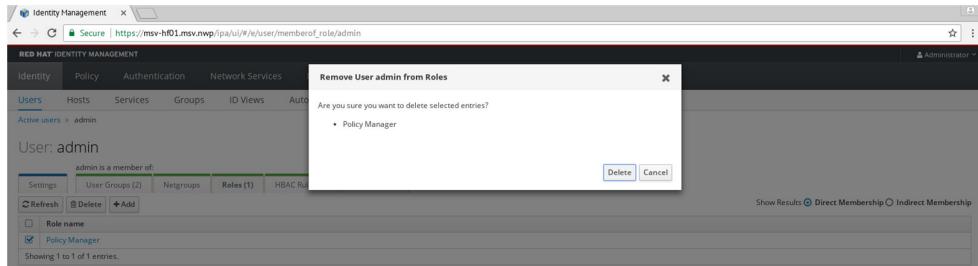


Figure 329. Remove Role(s) From User

5. Left-click the **OK** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items removed**" is displayed at the top-center of the User Roles page.

If the delete is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the delete. The User Roles page is unlocked (sensitized) if the delete is successful or cancelled.

#### 5.3.15.8.7 RBAC - Add Privilege

A privilege is initially created without being assigned to any role, and the privilege can then be assigned to one or more roles and indirectly to users.

The Privileges page is accessed from the **IPA Server** option and **Privileges** sub-option.

The following steps will add a privilege from the Privileges page:

1. From the Privileges page, left-click the **Add** button at the top-right of the privilege list.
2. The Privileges page is locked (desensitized), and the Add Privilege dialog is displayed.

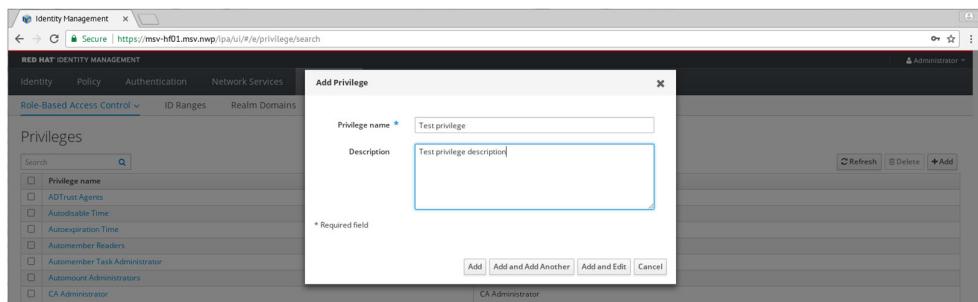


Figure 330. Add Privilege

3. Enter a privilege name and description, and left-click the **Add** button to create the privilege, the **Add and Add Another** to create the privilege and then create another privilege, or the **Cancel** button to cancel the add. In all cases, the dialog is removed.

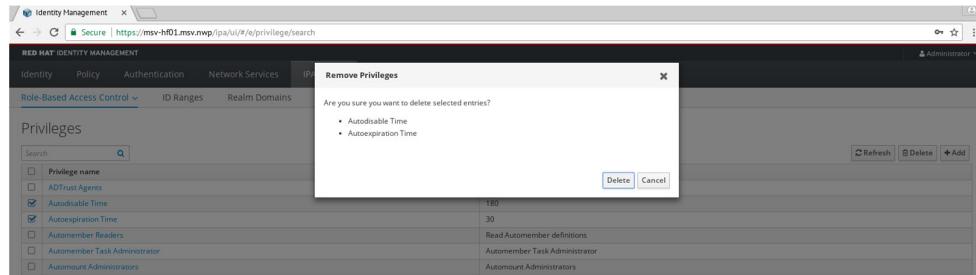
If the add is successful, the transient message "**Privilege successfully added**" is displayed at the top-center of the Privileges page.

If the add is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the add. The Privileges page is unlocked (sensitized) if the add is successful or cancelled.

#### 5.3.15.8.8 RBAC - Delete Privilege(s)

The following steps will delete a privilege or privileges from the Privileges page:

1. From the Privileges page, left-click the checkbox to the left of the Privilege name column for each Privilege to be deleted, and left-click the **Delete** button at the top-right of the list.
2. The Privileges page is locked (desensitized), and the Remove Privileges dialog is displayed.



**Figure 331. Delete Privilege(s)**

3. Left-click the **OK** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

If the delete is successful, the transient message "**<count> items deleted**" displayed at the top-center of the Privileges page.

If the delete is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the delete. The Privileges page is unlocked (sensitized) if the delete is successful or cancelled.

#### 5.3.15.8.9 RBAC - Assign Privilege(s) to Role

New privileges are initially created without a role via the Privileges page, and the privilege can then be assigned to one or more roles.

The following steps will add one or more privileges to a role from the Role page:

1. From the Role page, left-click the **Privileges** button, and left-click the **Add** button at the top-right of the privileges list.
2. The Role page is locked (desensitized), and the Add Role into privileges dialog is displayed. The dialog contains a list of privileges who are not currently assigned to the role.

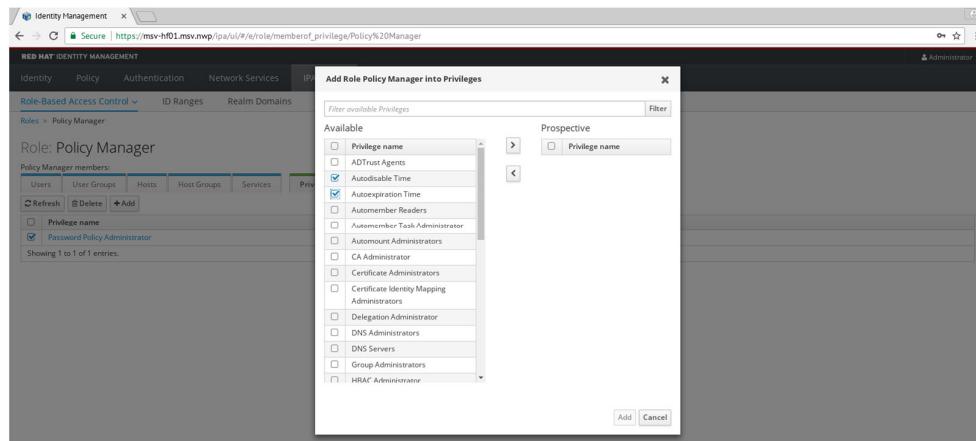


Figure 332. Add Privilege(s) To Role

3. Select privileges from the available list, left-click ">" to copy to the prospective list, and left-click the **Add** button to add, or left-click the **Cancel** button to cancel the add. In both cases, the dialog is removed.

If the add is successful, the transient message "**<count> items added**" is displayed at the top-center of the Role page.

If the add is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the add. The Role page is unlocked (sensitized) if the add is successful or cancelled.

#### 5.3.15.8.10 RBAC - Remove Privileges(s) From Role

The following steps will remove one or more privileges from a role:

1. From the Role page, left-click the **Privileges** button, left-click the checkbox to the left of the Privilege name column for the privilege(s) to be removed from the role, and left-click the **Delete** button at the top-right of the list.
2. The Role page is locked (desensitized), and the Remove Role from Privileges dialog is displayed.

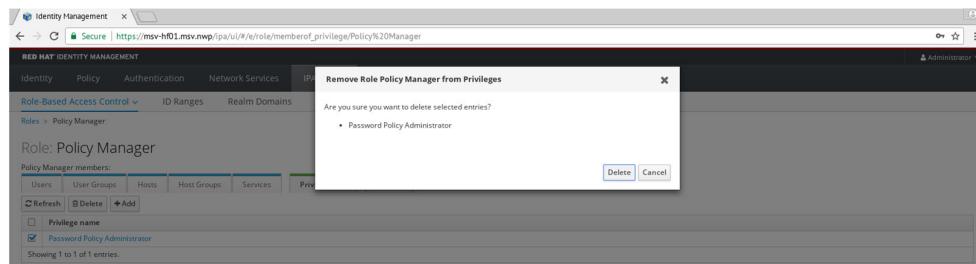


Figure 333. Remove Privilege(s) From Role

3. Left-click the **OK** button to commit the delete, or left-click the **Cancel** button to cancel the delete. In both cases, the dialog is removed.

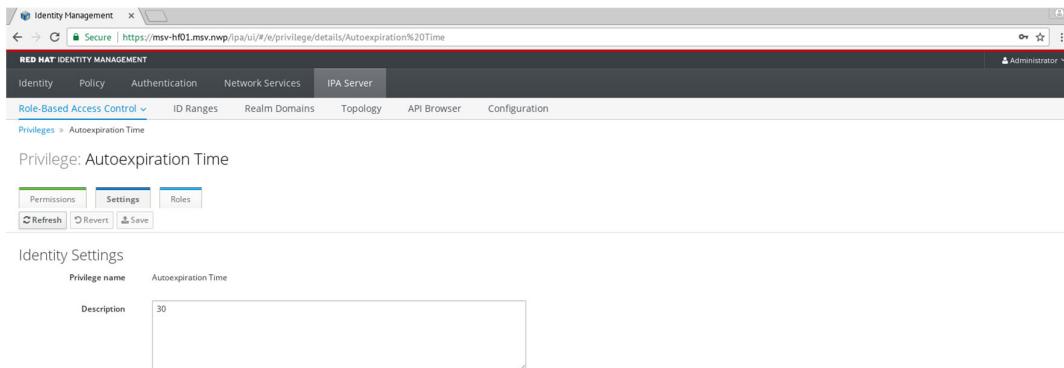
If the delete is successful, the transient message "**<count> items removed**" is displayed at the top-center of the Role page.

If the delete is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the delete. The Role page is unlocked (sensitized) if the delete is successful or cancelled.

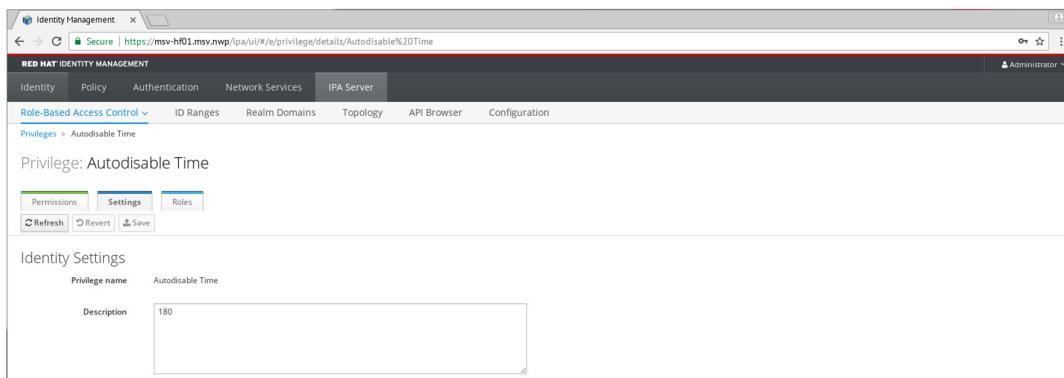
### 5.3.15.8.11 RBAC - Edit Privilege Settings

The two NWP specific privileges, Autoexpiration Time and Autodisable time, are used to set the temporary account deletion time and unused account disable time, respectively. The values of these two settings can be modified by editing the description field of the privilege identity:

1. From the Privileges page, left-click the Autoexpiration Time (or Autodisable Time) entry in Privilege name column.
2. From the Privilege page, left-click the Settings button.
3. In the Description field, entry the new value (range 1...30 for expiration, 30...180 for disable), and left-click the **Save** button. This value is then used by the system on the next daily check for temporary or unused accounts.



**Figure 334. Autoexpiration Time**



**Figure 335. Autodisable Time**

### 5.3.15.8.12 RBAC - Add/Delete Permissions

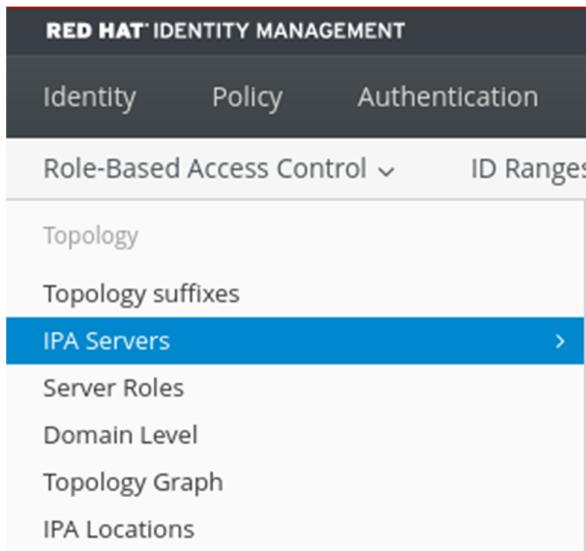
Although the capability exists from the permissions page to add to or delete from the default set of IdM permissions, this capability is not currently used and is therefore not further described.

### 5.3.15.8.13 RBAC - Assign Permission(s) to Privilege

The default set of IdM privileges are already pre-configured with a set of permissions and settings, and although the capability exists from the privilege page to add or delete permissions, this capability is not currently used and is therefore not further described.

### 5.3.15.8.14 Topology

The Topology sub-pages—Topology suffixes, IPA Servers, Server Roles, Domain Level, Topology Graph, and IPA Locations—display information regarding the cluster of IPA servers that provide user authentication services for NWP.



**Figure 336. Topology Sub-Pages**

Most of the pages display information that is configured as part of the IdM server installation within the Automated System Loader (ASL), and the information is viewable, rather than editable.

The following steps will display the topology page/current sub-page:

1. If the Topology page is not already displayed, left-click the **IPA Server** option, and the **Topology** sub-option.
2. The Topology page is displayed and shows the Topology sub-page menu and the last displayed Topology sub-page.

The screenshot shows the 'Topology' page with the 'IPA Servers' sub-page selected. The top navigation bar includes Identity, Policy, Authentication, Network Services, IPA Server, and Configuration. Below the navigation is a secondary bar with Role-Based Access Control, ID Ranges, Realm Domains, Topology (which is underlined to indicate it's active), API Browser, and Configuration. The main content area displays a table of IPA servers. The table has columns for Server name, Min domain level, Max domain level, and Managed suffixes. Three entries are listed: msv-hf01.msv.nwp, msv-hf01.msv.nwp, and msv-hf02.msv.nwp. All three have a min domain level of 0, max domain level of 1, and managed suffixes of 'domain, ca'. A note at the bottom says 'Showing 1 to 3 of 3 entries.'

**Figure 337. Topology Page/IPA Servers Sub-Page**

During setup of the domain servers, the replication topology will need to be edited.

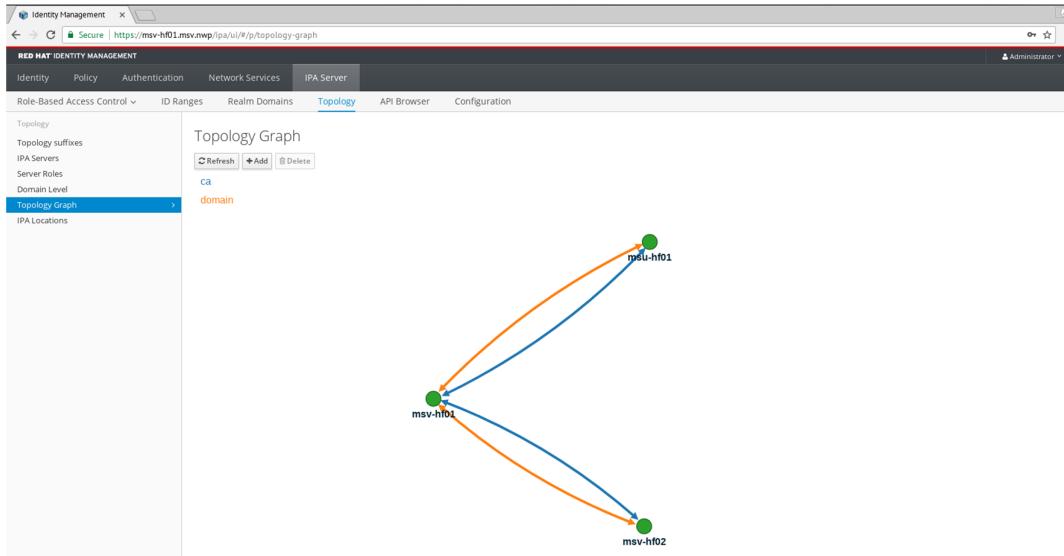
The Topology Graph page shows the relationships between the servers in the IdM domain. For NWP, this shows the IdM Domain and Certificate Authority (CA) replication agreements between the 4 Hot Failover (HF) servers - 2 at each NWP Domain - where each HF hosts an instance of the IdM server. Since NWP uses master-master replication to ensure consistency

and redundancy across all server instances, each server has a replication agreement with the other 3 servers.

#### 5.3.15.8.15 Topology- Viewing and Modifying The Topology Graph

To display the topology graph, if the Configuration page is not already displayed, left-click the **IPA Server** option, the **Topology** sub-option, and the **Topology Graph** sub-page from the list of sub-pages.

The example below shows an example IdM domain (blue line) and CA (orange line) replication policy between 3 IdM servers. In the case of NWP, the topology needs to be configured to replicate every domain HF with every other domain HF.

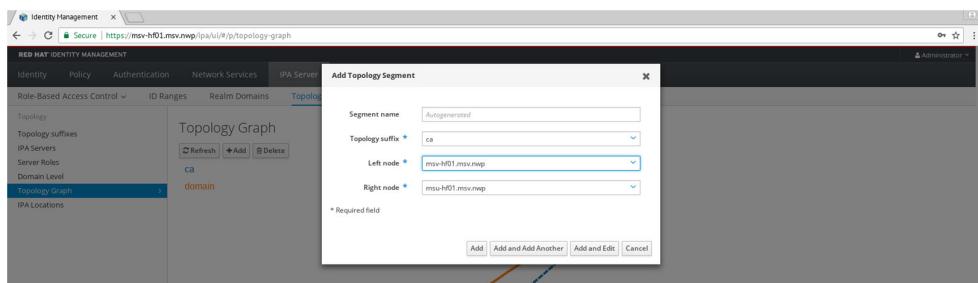


**Figure 338. Topology Graph**

There are 2 methods to edit the topology graph to add a replication line between 2 servers.

The first method to add a replication line is via a dialog:

1. Left-click the **Add** button.
2. The Topology Graph page is locked (greyed), and the Add Topology Segment dialog is displayed.



**Figure 339. Add Replication Agreement**

3. In the dialog, enter the name, and select the servers and replication kind from the pulldown lists, and left-click the **Add** button to create the agreement, the **Add and Add Another** to create the agreement and then create another agreement, or the **Cancel** button to cancel the add. In all cases, the dialog is removed.

If the add is successful, the topology graph is updated.

If the add is unsuccessful, a failure message dialog is displayed that allows to retry or cancel the add. The Topology Graph page is unlocked (sensitized) if the add is successful or cancelled.

The second method to add a replication line is graphical:

1. Dwell over the first server icon. The icon highlights and displays a "domain+" option and a "+ca" option.



**Figure 340. Dwelling Mouse Over Server Icon Example**

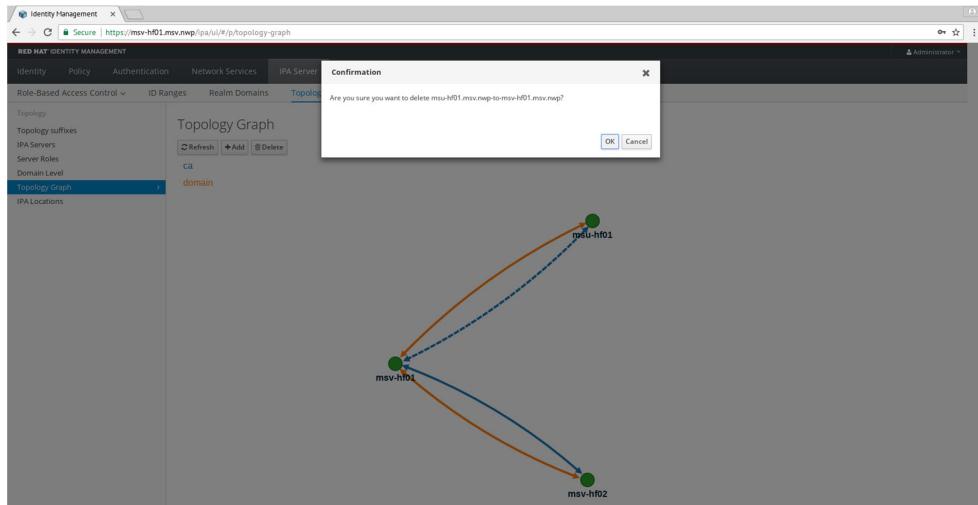
2. Left-click the option for the replication kind. A line is drawn from the server icon and follows the mouse.
3. Left-click the second server icon.

If the add is successful, the topology graph is updated with a replication line drawn from the first server to the second server. This is a unidirectional replication and would typically have to be repeated in the opposite direction.

If the add is unsuccessful, a failure message dialog is displayed.

To edit the topology graph to delete a replication line between 2 servers is a graphical process:

1. Left-click the replication line. The line style changes to dashed.
2. Left-click the **Delete** button.
3. The Topology Graph page is locked (greyed), and the deletion confirmation dialog is displayed. Left-click **OK** to confirm the deletion, or left-click **Cancel** to cancel the deletion. In both cases, the dialog is closed.



**Figure 341. Delete Replication Agreement**

If the delete is successful, the topology graph is updated with a replication line removed between the first server to the second server.

If the delete is unsuccessful, a failure message dialog is displayed.

#### 5.3.15.8.16 Configuration

The Configuration page allows the IdM System Administrator to change a set of configuration settings for the IPA Server.

#### 5.3.15.8.17 Configuration - Viewing and Modifying Configuration Settings

The following steps will display the configuration settings:

1. If the Configuration page is not already displayed, left-click the **IPA Server** option and the **Configuration** sub-option.
2. The Configuration page is displayed containing editable fields for Search, User, Group, SELinux, and Service options, with the **Save** button desensitized.

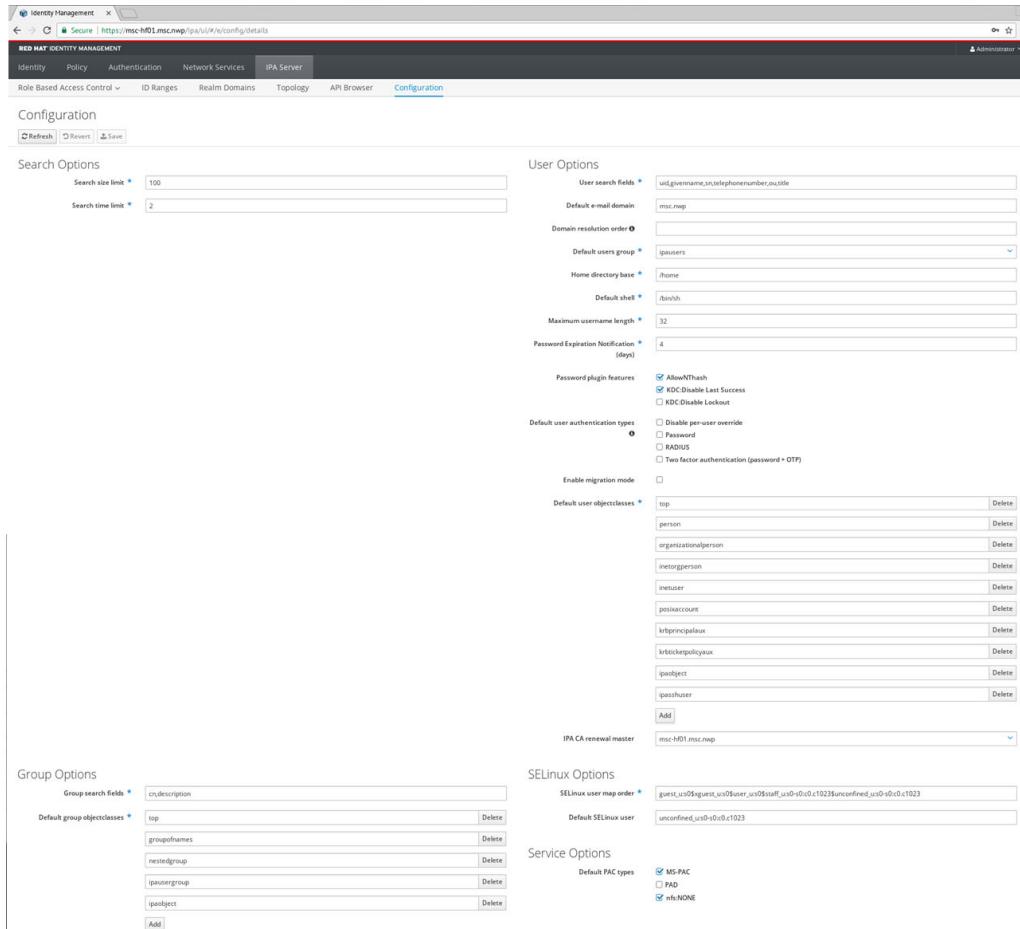


Figure 342. Configuration Page

If an editable field is changed by typing in a text field, selecting an **Add** button and adding an entry to a list, selecting a **Delete** button and removing an entry from a list, or selecting a radio button or toggle button, the **Save** button is automatically sensitized.

A left-click on the **Save** button commits the update without confirmation, and the update is successful; the transient message "**Configuration updated**" is displayed at the top-center of the Configuration page.

If the update is unsuccessful, a failure message dialog is displayed that allows to retry the update.

### 5.3.15.9 Example Workflow of Common IdM Tasks

The following example workflow walks through common functions that may be performed by an IdM administrator:

1. Accessing IdM
2. Adding New Users
  - a. Adding a New AWD User
  - b. Adding a New User With Admin Access to an M&C

- c. Adding a New User with Administrative Privileges (System Administrator)
- 3. Resetting a Password
- 4. Deleting a User
- 5. Adding a Host
- 6. Logging Out of IdM

#### 5.3.15.9.1 Accessing IdM

IdM can be accessed either directly via the IdM server URL or through the External Links menu found in the M&C. For more information, see 5.3.15.2 Initiating An IdM Session.

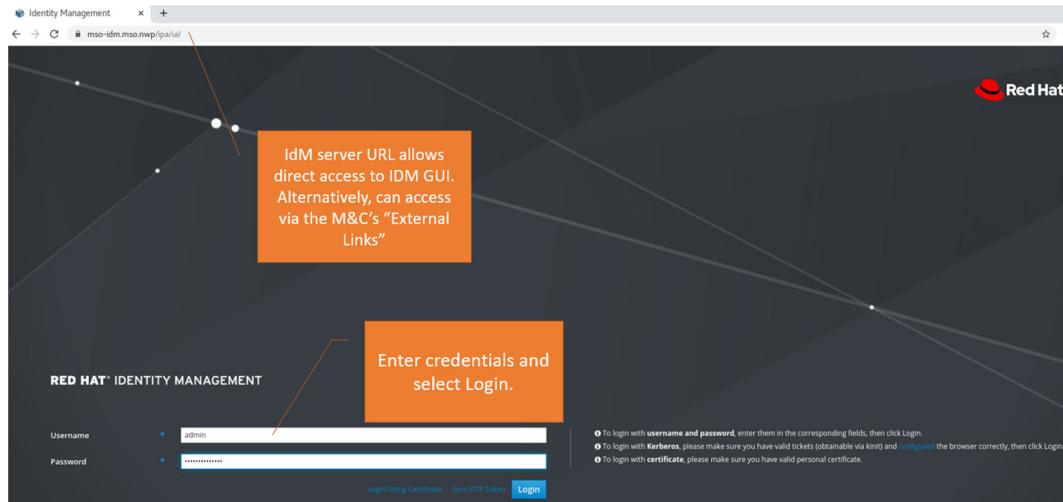


Figure 343. IdM Login Page

#### 5.3.15.9.2 Adding New Users

An IdM administrator can add new users to the system. The user groups, roles, Host-Based Access Control (HBAC) rules, Sudo rules, and other user customizations can be modified after the user is created.

For further information on users in IdM, see 5.3.15.4.1 Users.



Figure 344. +Add Button to Add User

The screenshot shows the 'Add User' form with several input fields and validation messages:

- User login:** A text input field containing "test\_user". An orange callout box to its right says "Account username goes here".
- First name \***: A text input field containing "test". An orange callout box to its right says "First/last name fields are required".
- Last name \***: A text input field containing "user". An orange callout box to its right says "First/last name fields are required".
- No private group:** A checkbox.
- GID:** A dropdown menu.
- New Password:** A text input field containing "....". An orange callout box to its right says "Temporary password entered here".
- Verify Password:** A text input field containing "....". This field is highlighted with a blue border.

\* Required field

Buttons at the bottom: Add, Add and Add Another, Add and Edit, Cancel

**Figure 345. Adding a User - Fields**

Select **Add** to create a new user and be brought back to the Active Users homepage.

Select **Add and Edit** to be brought directly to the newly created user's profile and settings.

For further information on adding a new user, see 5.3.15.4.1 Users - Adding a New User Account.

#### 5.3.15.9.3 Adding a New AWD User

In order to access the AWD, the newly created user must be a member of the awd\_users group and have the awd\_user\_access HBAC rule.

In order to add the user to the awd\_users group, do the following:

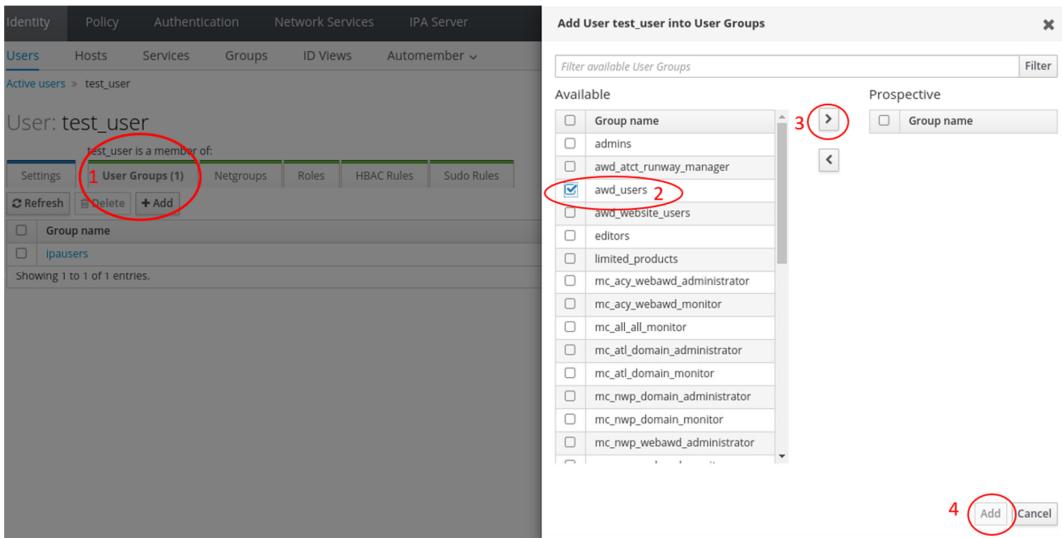


Figure 346. Adding User to "awd\_users" Group

Navigate to the user's profile.

1. Select the **User Groups** tab.
2. Select the **awd\_users** group from the available list.
3. Select **>** to add the selected group to the prospective list.
4. Select **Add** to finalize the addition of the user to the group.

Additional user groups can be added as needed (e.g., **awd\_website\_users** to give the user permission to log on from an external AWD, **limited\_products** to allow the user to display a limited product like lightning, etc.), but the minimum to access an AWD is the **awd\_users** group.

For more information on adding users to user groups, see 5.3.15.4.1 Users: Assigning User Groups.

In order to add the user to the **awd\_user\_access** HBAC rule, do the following:

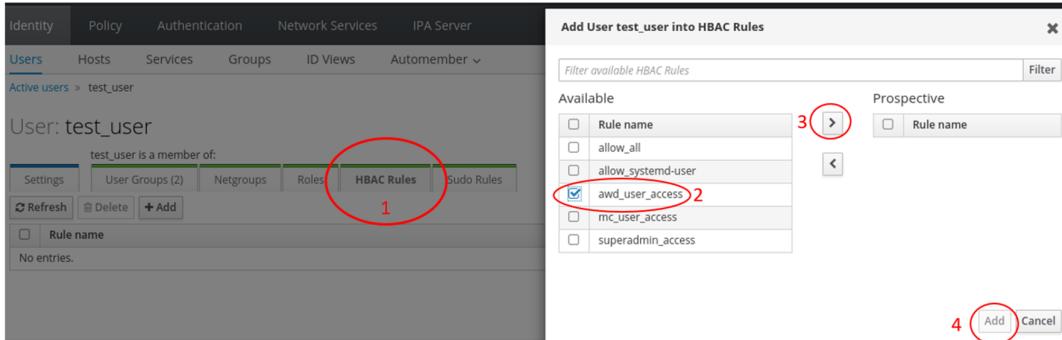
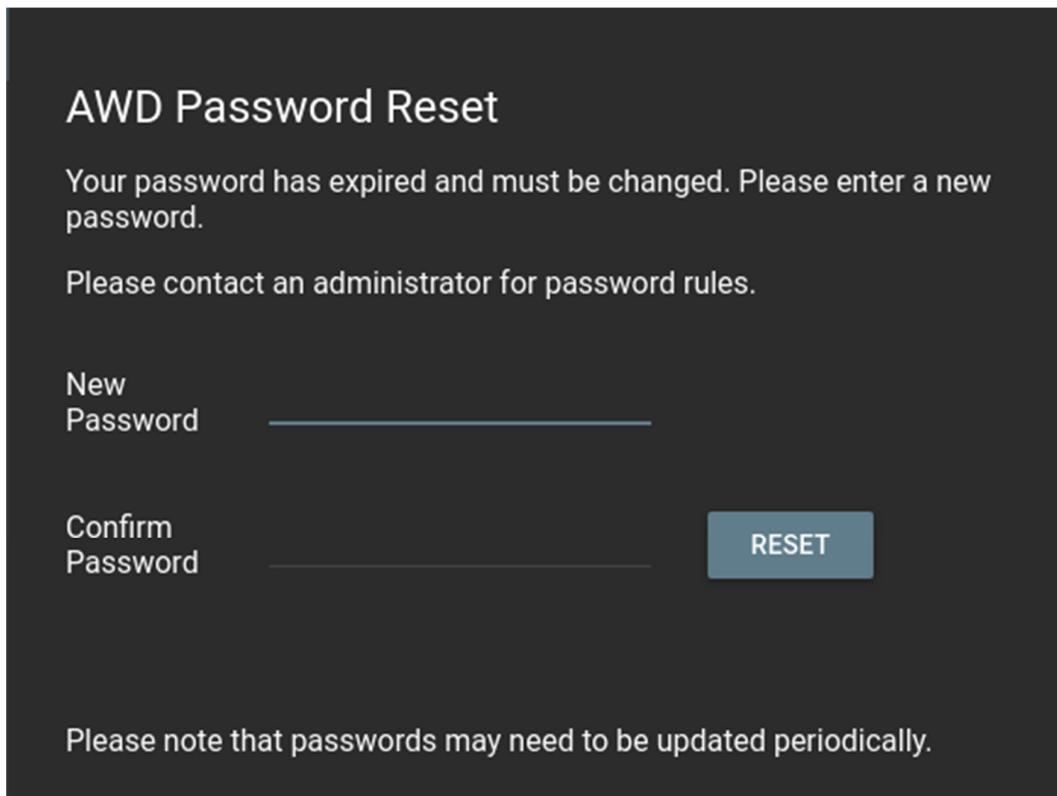


Figure 347. Adding User to "awd\_user\_access" HBAC Rule

1. Select the **HBAC Rules** tab.
2. Select the **awd\_user\_access** rule from the available list.
3. Select **>** to add the selected rule to the prospective list.
4. Select **Add** to finalize the addition of the user to the rule.

For more information on adding users to HBAC rules, see 5.3.15.4.1 Users: Assigning User HBAC Rules.

When the newly created user attempts to login with the username and password that was set above, they will be prompted to reset the password by the AWD:



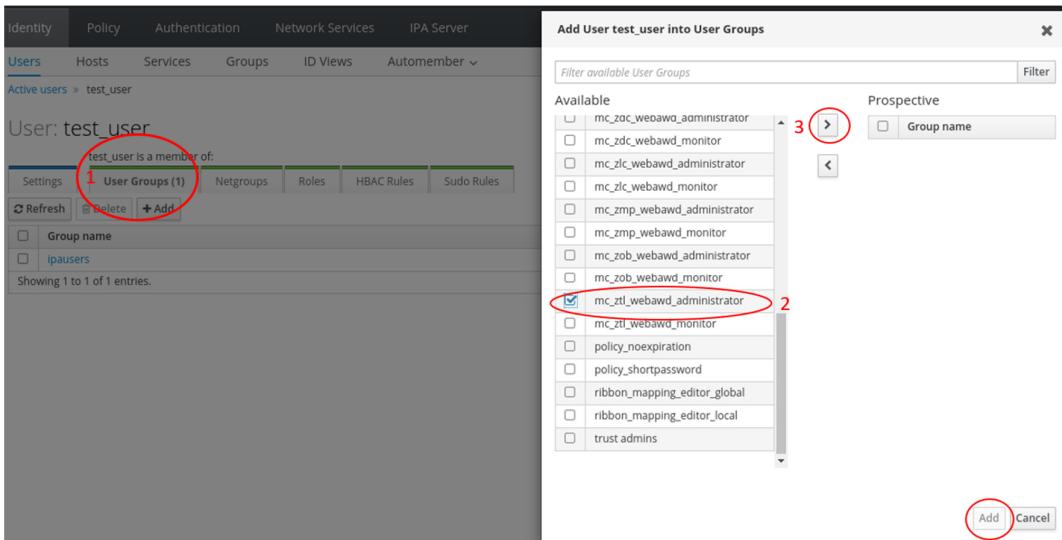
**Figure 348. AWD Password Reset Menu**

Note that the new password must be in line with all password guidelines. After setting a new password, the user can freely access the AWD.

#### **5.3.15.9.4 Adding a New User With Admin Access to an M&C**

In order to access the M&C as an administrator for a specific site, the newly created user must be a member of the corresponding mc\_[site]\_[domain/webawd]\_administrator group and have the mc\_user\_access HBAC rule.

In this example, newly created test\_user needs to be made an administrator for the ZTL site M&C. test\_user must be added to the correct group, which is mc\_ztl\_webawd\_administrator in this case:



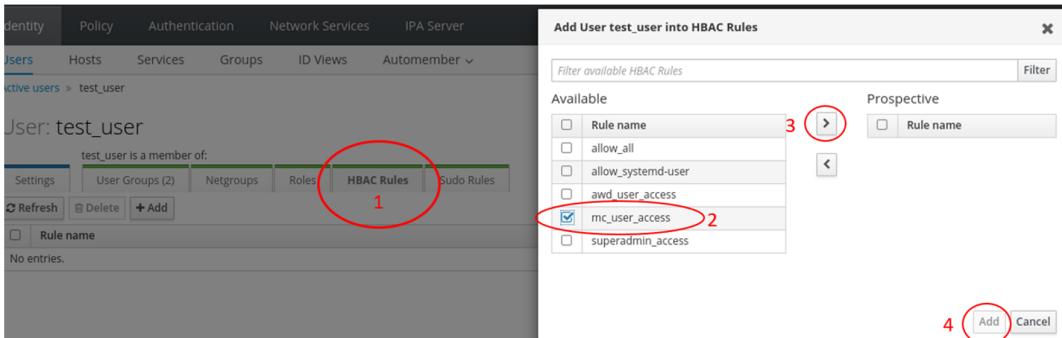
**Figure 349. Adding User to "mc\_[site]\_[domain/webawd]\_administrator" Group**

1. Navigate to the user's profile.
2. Select the **User Groups** tab.
3. Select the **mc\_[site]\_webawd\_administrator** group from the available list.
4. Select **>** to add the selected group to the prospective list.
5. Select **Add** to finalize the addition of the user to the group.

Additional user groups can be added as needed by selecting multiple groups, such as if making an account an administrator for more than one site.

For more information on adding users to user groups, see 5.3.15.4.1 Users: Assigning User Groups.

In order to add the user to the mc\_user\_access HBAC rule, do the following:

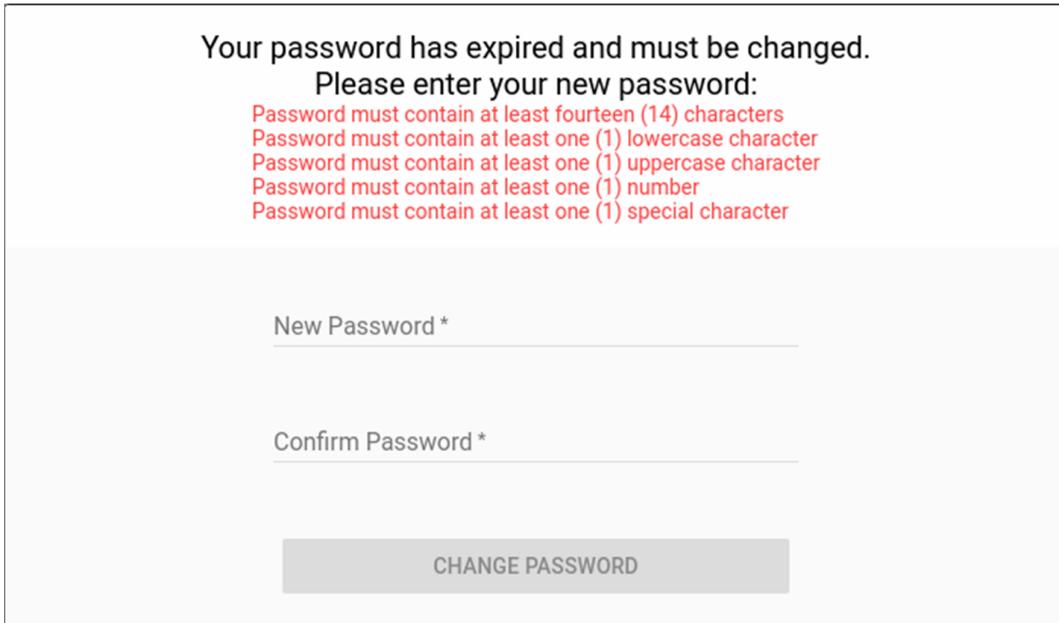


**Figure 350. Adding User to "mc\_user\_access" HBAC Rule**

1. Select the **HBAC Rules** tab.
2. Select the **mc\_user\_access** rule from the available list.
3. Select **>** to add the selected rule to the prospective list.
4. Select **Add** to finalize the addition of the user to the rule.

For more information on adding users to HBAC rules, see 5.3.15.4.1 Users: Assigning User HBAC Rules.

When the newly created user attempts to login with the username and password that was set above, they will be prompted to reset the password by the M&C:



**Figure 351. M&C Password Reset Menu**

Note that the new password must be in line with all password guidelines. After setting a new password, the user can freely access the M&C for allowed sites.

#### **5.3.15.9.5 Adding a New User with Administrative Privileges (System Administrator)**

The following section pertains to creating a system administrator user (i.e., a user with administrative privileges) on IdM. A new administrator user can only be created by another administrator, such as the default "admin" user. Administrative users should be added to the "admins" and "trust admins" IdM default groups, and they should also have the "superadmin\_access" HBAC rule. If the administrative user credentials will be used during ASL (e.g., if IdM's default admin account is disabled), the "read\_asl" Sudo rule must be enabled. If the administrative user will be used on the system beyond IdM web access, the "superuser" Sudo rule should be enabled.

The "admins" and "trust admins" user groups are created by default in IdM. Members of the "admins" group are users with administrative privileges; by default, the IdM account "admin" is initially the only member of this group. Members of the "trust admins" group are users with privileges to manage Active Directory trusts.

In order to add the user to the "admins" and "trust admins" groups, do the following:

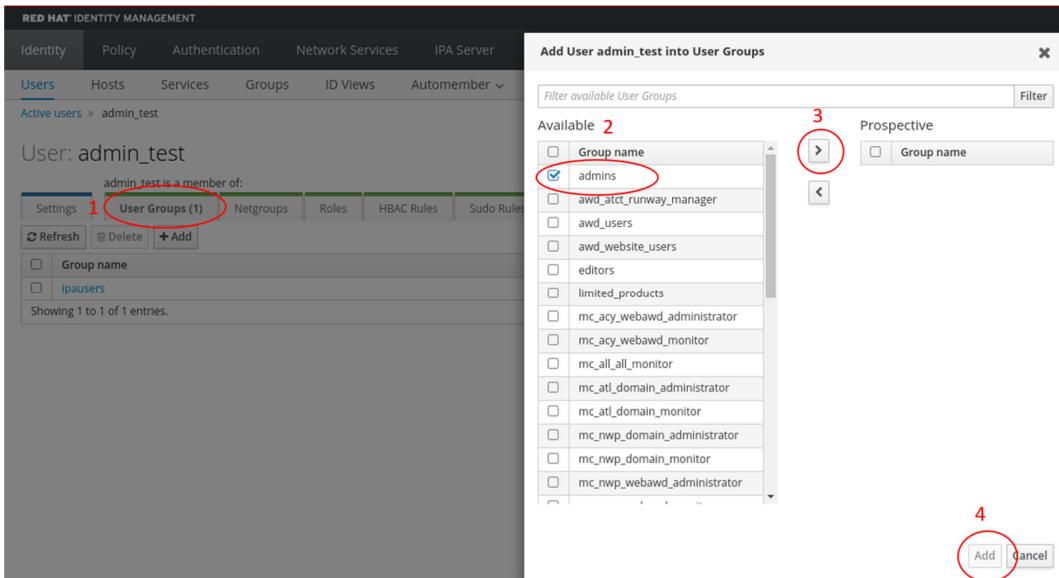


Figure 352. Adding user to "admins" and "trust admins" user groups

Navigate to the user's profile.

1. Select the **User Groups** tab.
2. Select the **admins** and **trust admins** group names from the available list.
3. Select **>** to add the selected groups to the prospective list.
4. Select **Add** to finalize the addition of the user to the groups.

For more information on adding users to user groups, see 5.3.15.4.13 Groups.

In order to be given administrator privileges with SSH access, the newly created user must be given the `superadmin_access` rule.

In order to add the user to the `superadmin_access` HBAC rule, do the following:

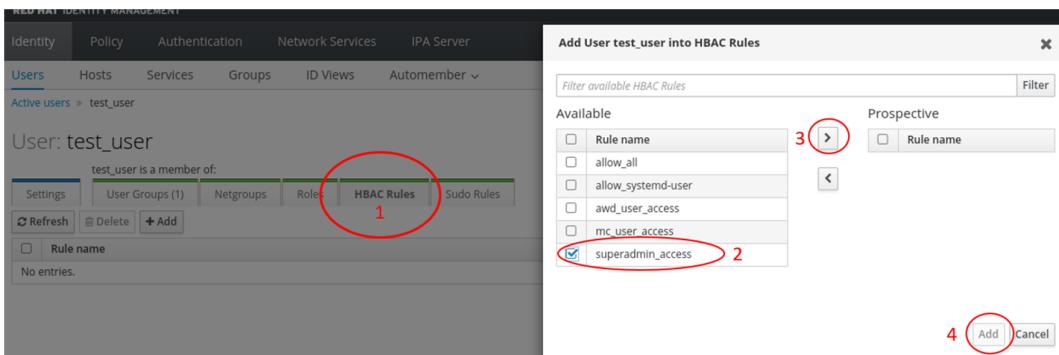


Figure 353. Adding User to "superadmin\_user\_access" HBAC Rule

Navigate to the user's profile.

1. Select the **HBAC Rules** tab.
2. Select the **superadmin\_user\_access** rule from the available list.
3. Select **>** to add the selected rule to the prospective list.
4. Select **Add** to finalize the addition of the user to the rule.

For more information on adding users to HBAC rules, see 5.3.15.4.1 Users: Assigning User HBAC Rules.

In order to add the user to the superuser sudo rule, do the following:

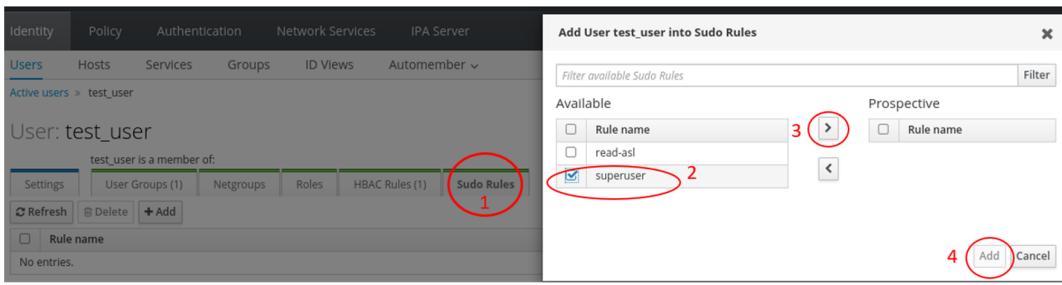


Figure 354. Adding User to "superuser" Sudo Rule

1. Select the **Sudo Rules** tab.
2. Select the **superuser** rule from the available list.
3. Select **>** to add the selected rule to the prospective list.
4. Select **Add** to finalize the addition of the user to the rule.

In order to add the user to the `read_asl` sudo rule, do the following:

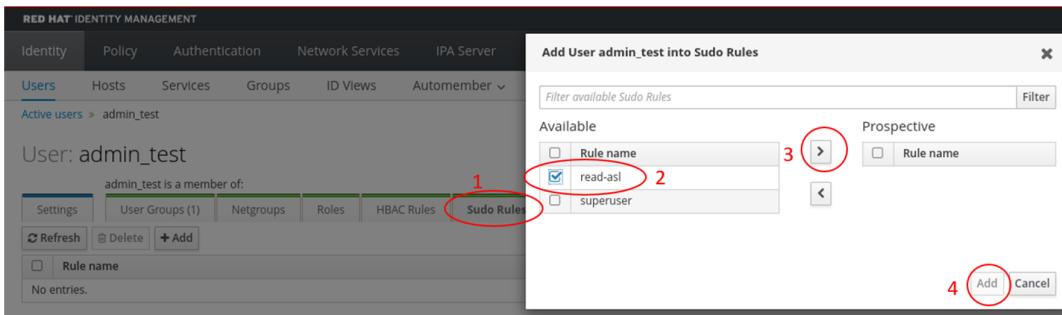


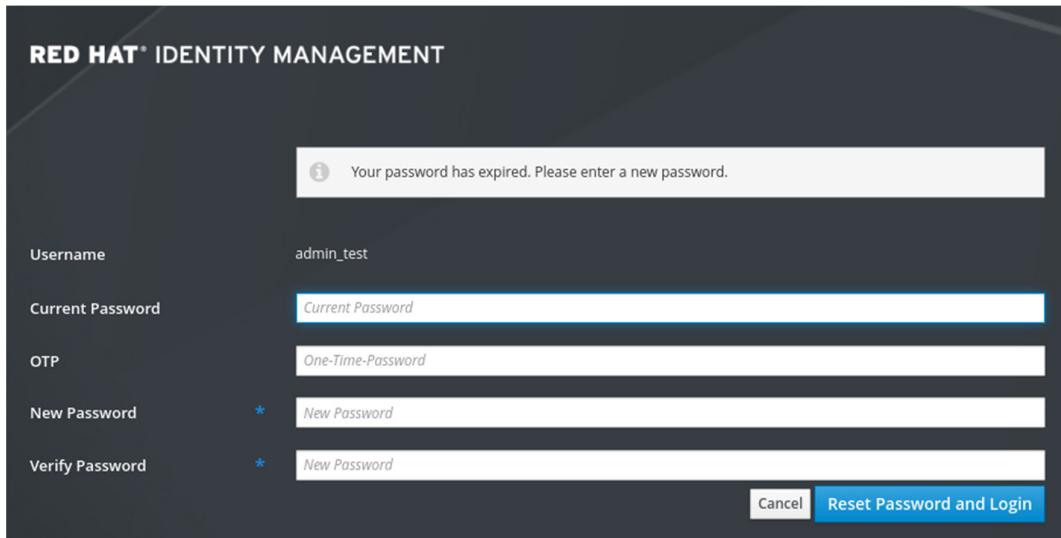
Figure 355. Adding User to "read\_asl" Sudo rule

1. Select the **Sudo Rules** tab.
2. Select the **read\_asl** rule from the available list.
3. Select **>** to add the selected rule to the prospective list.
4. Select **Add** to finalize the addition of the user to the rule.

For more information on adding users to sudo rules, see 5.3.15.4.1 Users: Assigning User Sudo Rules.

**NOTE:** In order to comply with security requirements, the options "`!authenticate`" and "`use_pty`" must be listed within the superuser sudo rule's Options when the rule is set up.

When the newly created admin user attempts to log into IdM or SSH in for the first time, the newly created user will need to set a new password:

**Figure 356. IdM New User Login Password Reset**

```
[nwp@nwpdevhost15 ~]$ ssh -X test_user@mso-awd01
WARNING**WARNING**WARNING
```

You are accessing a U.S. Government information system which includes (1) this computer, (2) this computer network, (3) all computers connected to this network, and (4) all devices and storage media attached to this network or to a computer on this network. This information system is provided for U.S. Government-authorized use only.

Unauthorized or improper use of this system may result in disciplinary action as well as civil and criminal penalties.

By using this information system, you understand and consent to the following:

- \* You have no reasonable expectation of privacy regarding communications or data transiting or stored on this information system.
- \* At any time, and for any lawful Government purpose, the Government may monitor, intercept, and search any communication or data transiting or stored on this information system.
- \* Any communications or data transiting or stored on this information system may be disclosed or used for any lawful Government purpose.

WARNING\*\*WARNING\*\*WARNING

Password:

Password expired. Change your password now.

Current Password:

New password:

**Figure 357. SSH Password Reset Dialog**

Note that the new password must be in line with all password guidelines. After setting a new password, the user can freely log in.

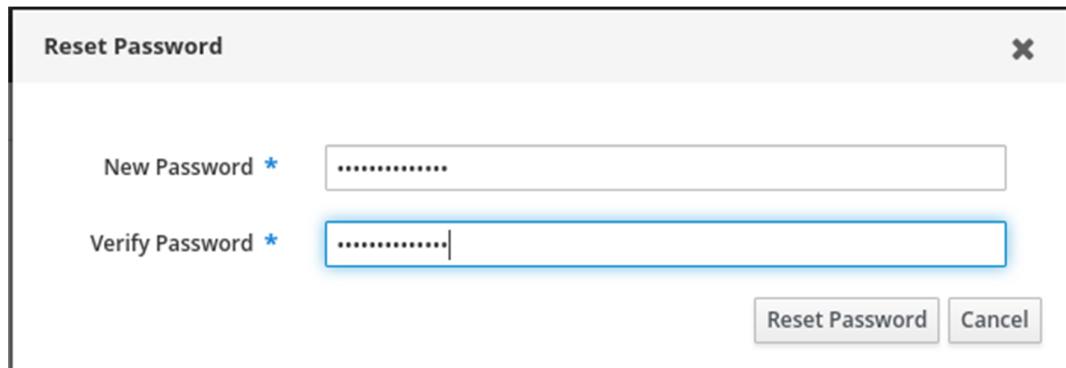
### 5.3.15.9.6 Resetting a Password

To reset a user's password, from the user's profile page, select **Actions > Reset Password**.

The screenshot shows the 'Users' tab selected in the top navigation bar. Below it, 'Active users' and 'test\_user' are listed. Under 'test\_user', there is a sub-section titled 'Identity Set'. A dropdown menu labeled 'Actions' is open, and the 'Reset Password' option is circled in red.

**Figure 358. Resetting Password for a User**

Then, enter the new password in the resulting dialog, and select **Reset Password** to confirm the change.

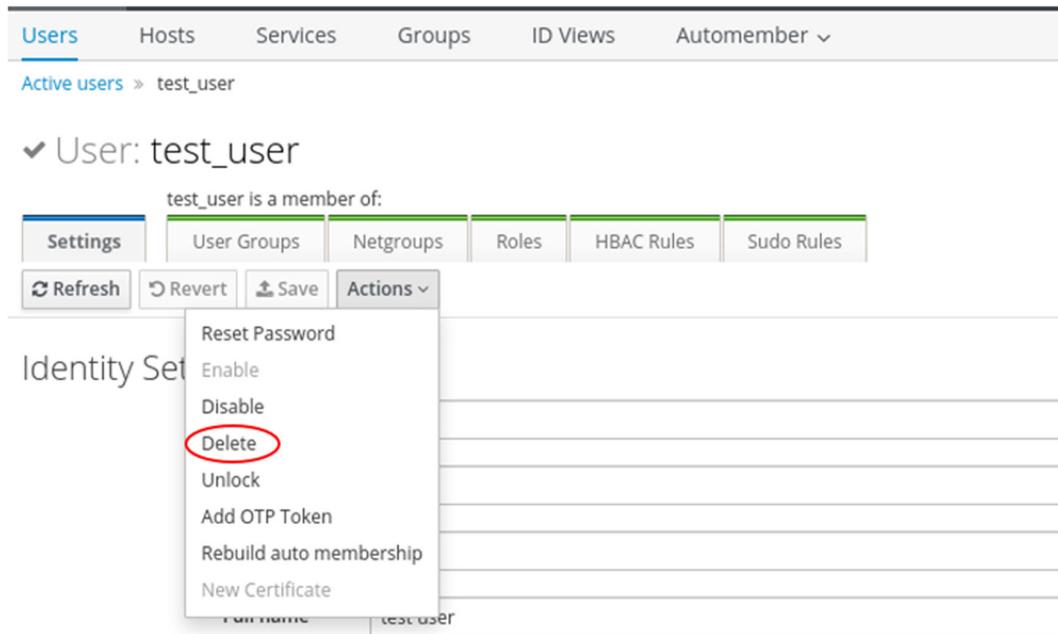


**Figure 359. Reset Password Dialog**

Note that resetting a password via IdM immediately expires the password, and when the user with the reset password attempts to login, the user will be prompted to update the password on their end.

### 5.3.15.9.7 Deleting a User

To permanently delete a user, from the user's profile page, select **Actions > Delete**.



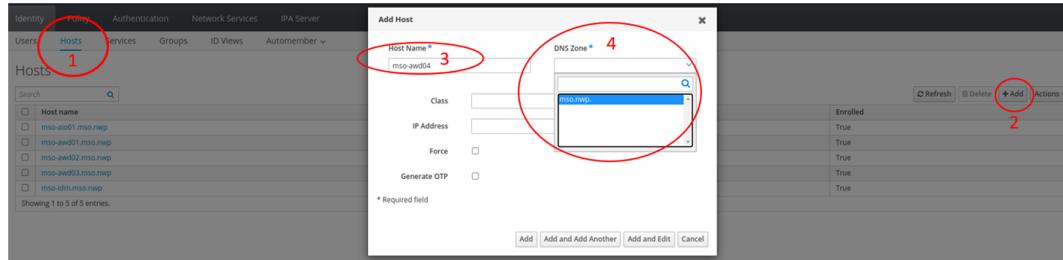
**Figure 360. Permanently Deleting a User**

Then, confirm in the popup dialog. The page will reload on the Active Users homepage, where the deleted account will no longer be listed.

For more information on deleting a user account, see 5.3.15.4.1 Users: Deleting an Account.

#### 5.3.15.9.8 Adding a Host

In order to add a new host, do the following:



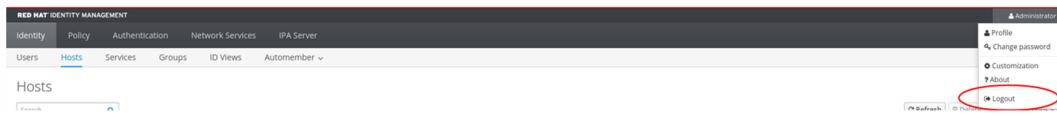
**Figure 361. Adding a Host**

1. Select the **Hosts** tab.
2. Select the **+Add** button.
3. Enter the host name that is being added.
4. Select the DNS Zone of the host name.
5. Select **Add** to create a new host and be brought back to the Hosts homepage.
6. Select **Add and Edit** to be brought directly to the newly created host's profile and settings.

For further information on adding a new host, see 5.3.15.4.9 Hosts - Adding a Host.

#### 5.3.15.9.9 Logging Out of IdM

When finished using IdM, log out by doing the following:



**Figure 362. Logging Out of IdM**

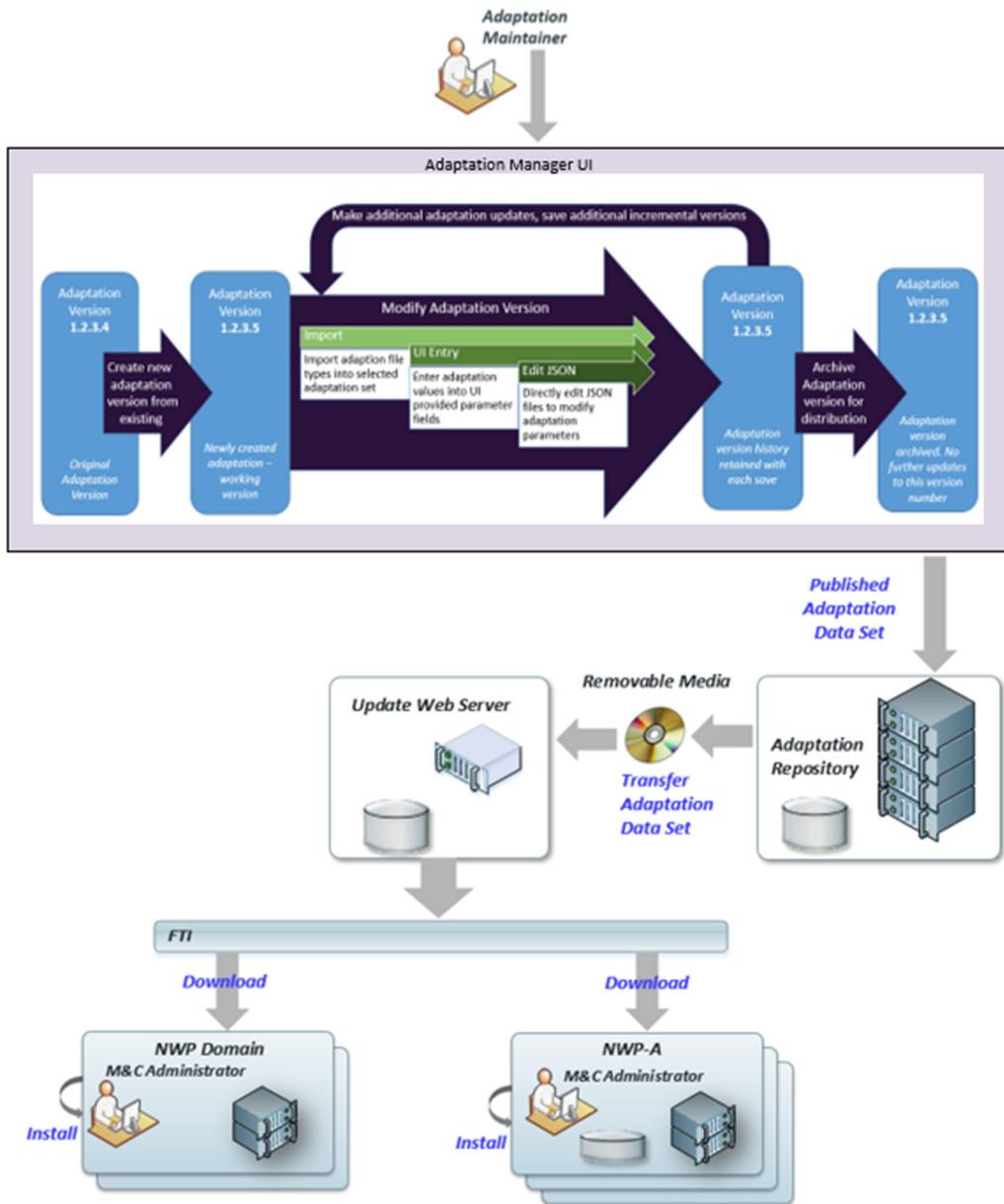
Select the IdM administrator user in the upper right hand, and then select **Logout**.

For further information on terminating an IdM session, see 5.3.15.3 Terminating An IdM Session.

The initial installation of the IdM will include user groups, sudo rules, and HBAC rules necessary for the setup of the IdM system. The group names that pertain to specific sites will be provided. The superuser sudo rule will be provided so that the administrator responsible for the setup of the IdM may install the system.

### 5.3.16 Adaptation Management

The Adaptation Manager UI is available offline only. A user may view, modify, publish, and archive sets of NWP adaptation via the Adaptation Manager UI. Adaptation data may be updated via file import (ex. for the 56 day AeroDB update), value entry into the UI, or text edit of the JSON adaptation files. Once a set of adaptation data is updated for use in an NWP system, it is published and released to the adaptation repository where it is available for transfer to removable media. The adaptation set must then be transferred via removable media to the update server, where it is available for download and installation to NWP systems. See section 5.3.11 Software Distribution and Installation for details of software and adaptation distribution and installation. See figure below for a description of the entire adaptation set update and distribution workflow.



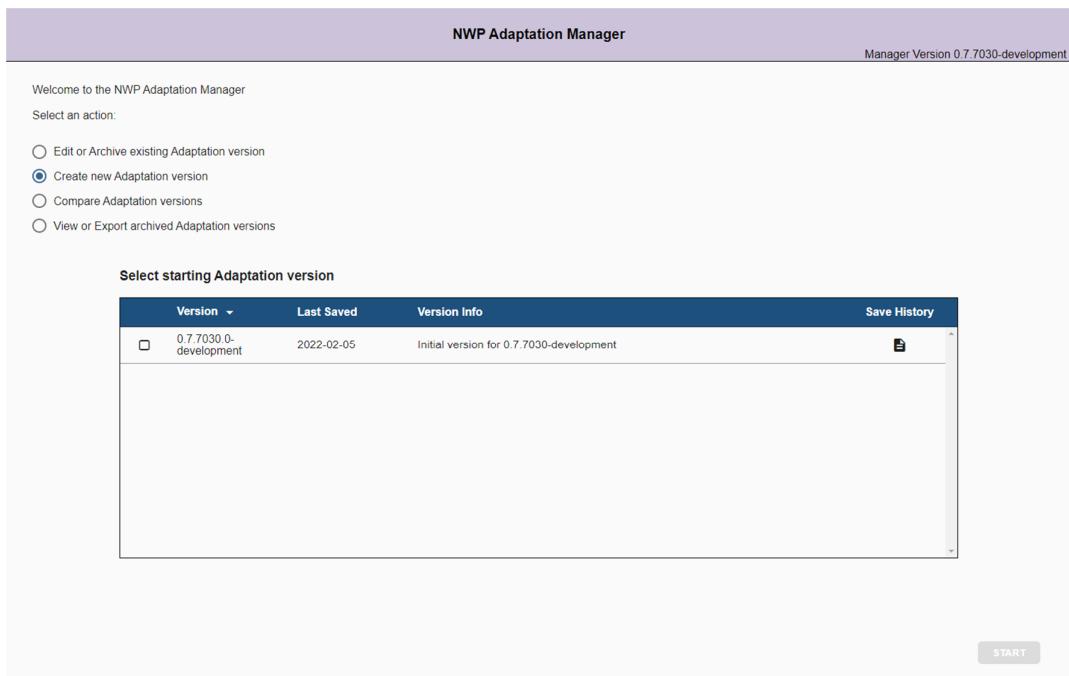
**Figure 363. Adaptation Set Update and Distribution Workflow**

Upon launch of the Adaptation Manager UI, the user is prompted with several options as listed below. The following sections describe each option in detail.

1. Edit or Archive existing Adaptation version
  - a. Select this option to modify adaptation values on an existing editable (not yet archived) version of adaptation. Adaptation values may be modified via import of data files, update of values in UI provided fields, or direct edit of JSON adaptation files. The selected adaptation set may also be archived and can no longer be modified.
2. Create new Adaptation version (default selection)

- a. Select this option to create a new adaptation set from an existing version of adaptation. Select an existing version from which to start. The new adaptation set version will be incremented and descriptive information about the new set may be entered.
- 3. Compare Adaptation versions
  - a. Select this option to view differences between two selected versions of adaptation.
- 4. View or Export archived Adaptation versions
  - a. Select this option for a read only view of the selected archived (previously published) adaptation version.

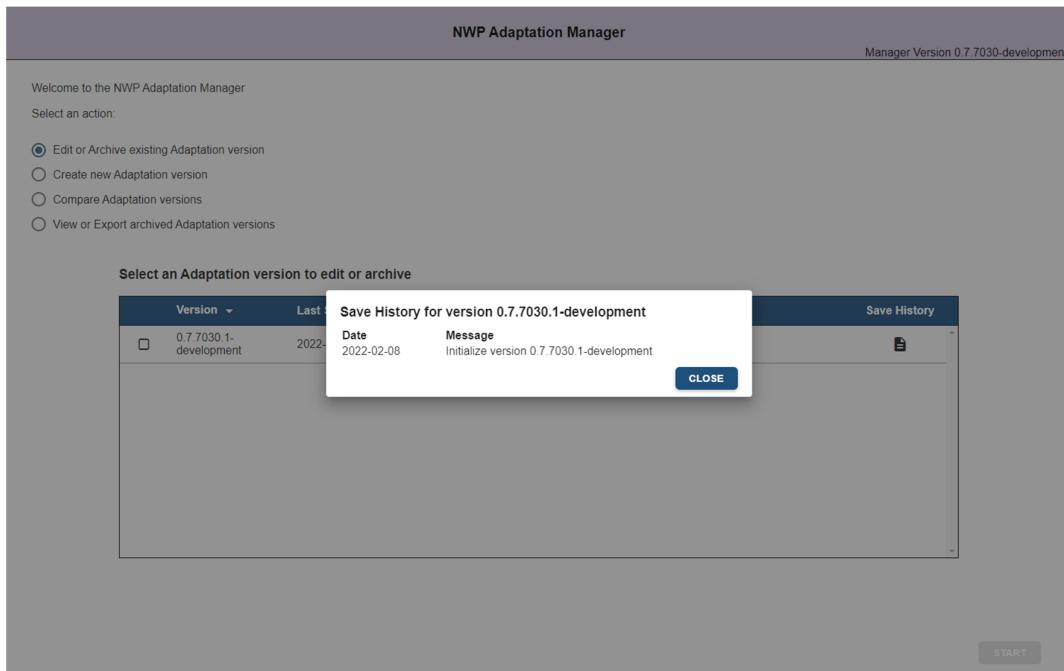
The Adaptation Manager UI runs on the Adaptation Management workstation. Once a user has accessed the Adaptation Management workstation, they may launch the Adaptation Manager via a web browser. Upon launching the Adaptation Manager web page, the user is presented with four options as shown in the figure below. The default selection when only the baseline adaptation version has been created is 'Create new Adaptation version'. The default selection when more than one adaptation version is available is 'Edit or Archive existing Adaptation set'. Once the desired selection is made, the user is presented with a listing of available adaptation versions for which to perform the selected operation. Once the desired version selection is made, the 'Start' button is enabled and may be selected in order to begin the selected operation.



**Figure 364. Adaptation Manager Home Screen**

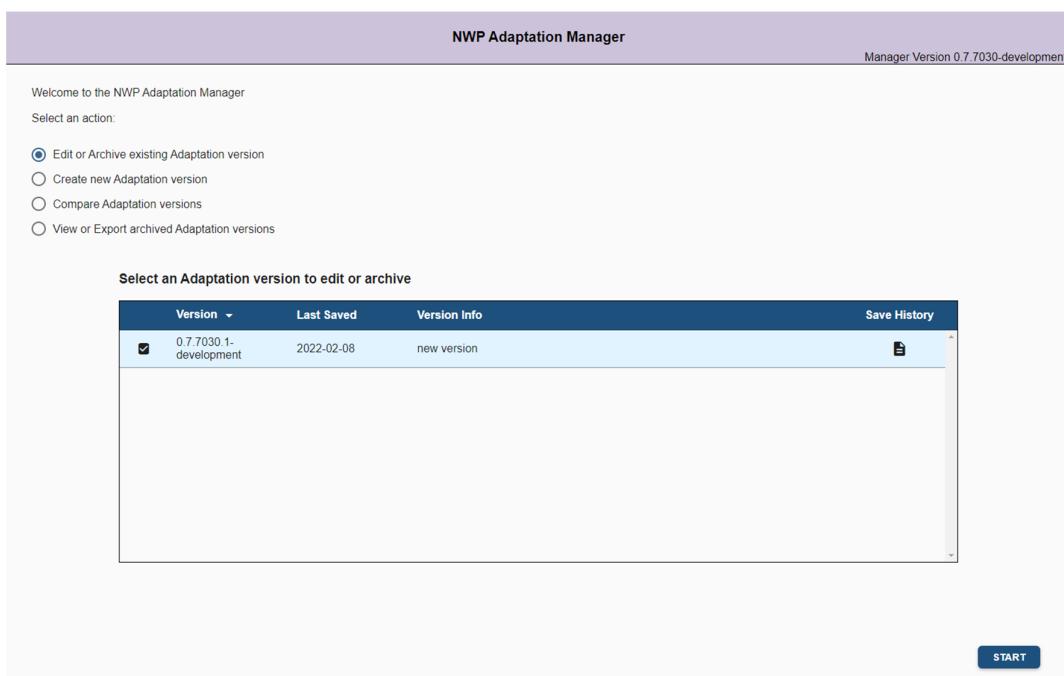
#### 5.3.16.1 Edit or Archive existing Adaptation version

Upon selection of 'Edit or Archive existing Adaptation version', a listing of adaptation versions available for modification and publication is presented. Each version is listed with a version number, the date of the last save of the existing version, version information as entered at the time of version creation, and commit messages as created by the system each time the version is updated. The change history may be viewed via clicking on the icon as shown below.



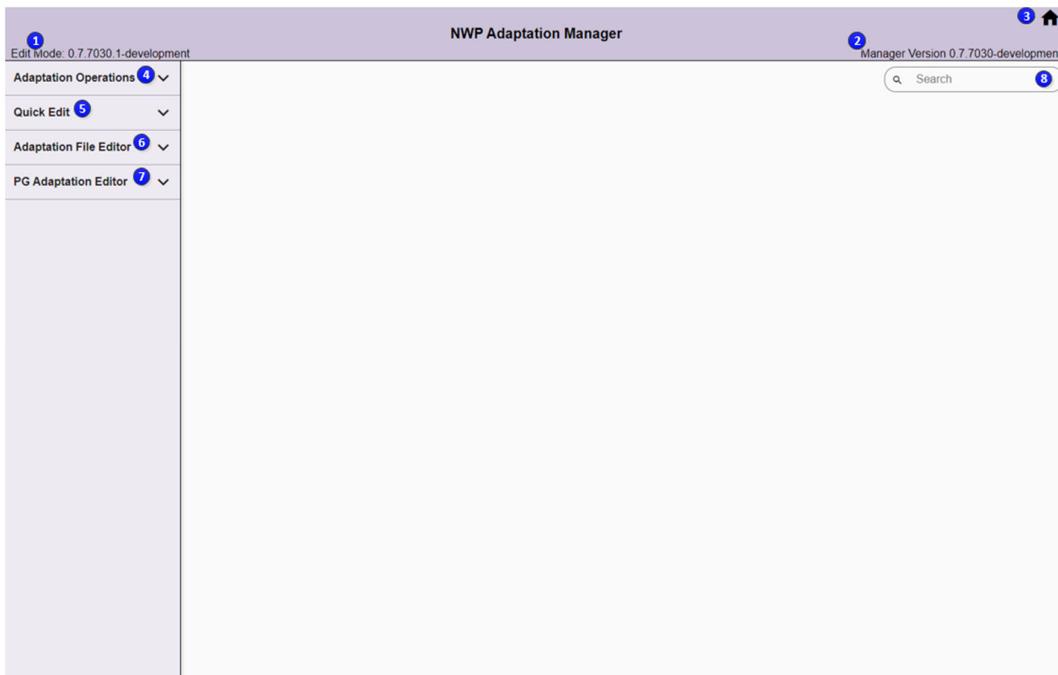
**Figure 365. Pop-up Listing of Save History**

Upon selection of the desired adaptation version, the 'Start' button is enabled and the user is directed to the 'modify and publish adaptation' page for the selected version.



**Figure 366. Select Version for Modification**

When the Adaptation Manager is accessed to update a selected adaptation version, the Adaptation Manager enters edit mode. Adaptation set information and options for edit are presented as shown below.



**Figure 367. Modify Adaptation Data**

The figure above is labeled with numbers to describe each overall area:

1. The title bar indicates the mode of operation dependent on the initial selection into Adaptation Manager as well as the subject adaptation version. In this case, the user has selected to modify an adaptation version and so is in Edit Mode.
2. The version of the Adaptation Manager itself is continuously presented on the bottom right of the title bar.
3. Select the home icon to exit out of the currently selected mode and return to the main home screen as presented in the figure below.
4. The main menu bar on the right presents the various options available. Selection of the down arrow near the label expands each section to present options available. Adaptation Operation options include:
  - a. Import AIMM: This page will allow a user to import AIMM data (AeroDB dataset) into the selected adaptation version
  - b. Archive Adaptation Set: Archive the current adaptation version and no further updates may be made
5. The Quick Edit section allows update of adaptation directly on the screen. Input adaptation values will be updated in the applicable adaptation files after save.
6. The Adaptation File Editor presents the listing and organization of the NWP Adaptation files. Selection of a file from this tree will allow for edit of the adaptation parameters in the file within the adaptation manager. Note: Only those adaptation files which contain system-settable or user-settable adaptation will be able to be modified in the Adaptation

Manager. Design parameter updates must be coordinated through NWP software updates.

7. The PG Adaptation Editor presents the listing and organization of the NWP Adaptation files used by the PG. Selection of a file from this tree will allow for edit of the adaptation parameters in the file within the adaptation manager.
8. Entering a term in the search window searches all adaptation files and provides a highlight on the locations in which the searched term was found.

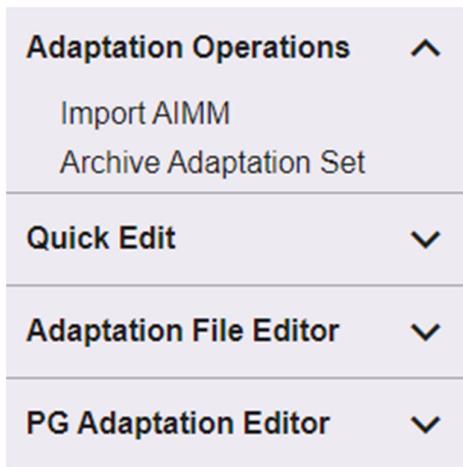


Figure 368. Adaptation Operations Options

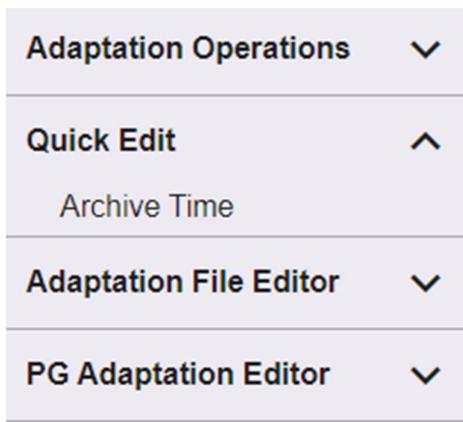
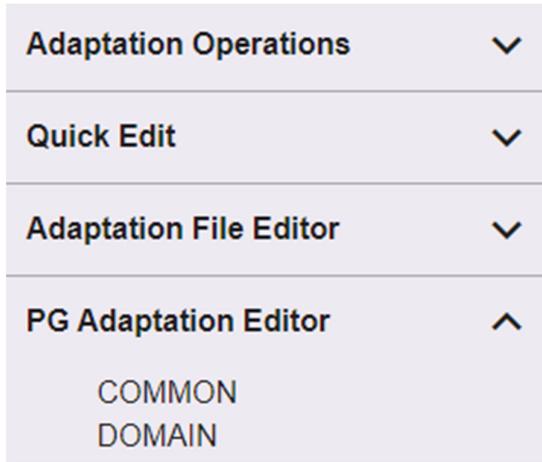


Figure 369. Quick Edit Options



**Figure 370. Adaptation File Editor - Adaptation Tree**



**Figure 371 . PG File Editor – Adaptation Tree**

#### 5.3.16.1.1 Adaptation Operations

Selection of any of the options in this category presents new options on the main area of the adaptation screen.

##### 5.3.16.1.1.1 Import Values

Adaptation files may be imported to the Adaptation Manager via selection of the 'Import' context menu item on a specific adaptation folder. The 'Import file' option is available in Edit Mode only, i.e. when the 'Edit selected Adaptation Set' option is selected. See Section Adaptation Folder Operations for more information on importing files directly to a selected folder. The 56 day AeroDB update, referred to as 'AIMM data' in the Adaptation Manager, may be imported into the Adaptation Manager via the Adaptation Operations/Import AIMM option. Upon selection of this option from Adaptation Operations, a file selection screen is presented. The user may select the AIMM data file using the 'BROWSE' button. Upon selection of 'BROWSE', the browser's files section dialog will be presented. Select a file within the dialog. Once a selection has been made, the 'IMPORT' button is enabled. Select 'IMPORT' to import the AIMM data into the selected Adaptation version. AIMM data will then be imported into the working adaptation version. The progress of the import is displayed via a progress bar at the bottom of the screen as shown in the figure below. Upon successful completion of the import and translation process, the progress will display as 100% complete. The AIMM data will be incorporated into the Adaptation tree and can be viewed upon selection of appropriate files under the Adaptation File Editor.

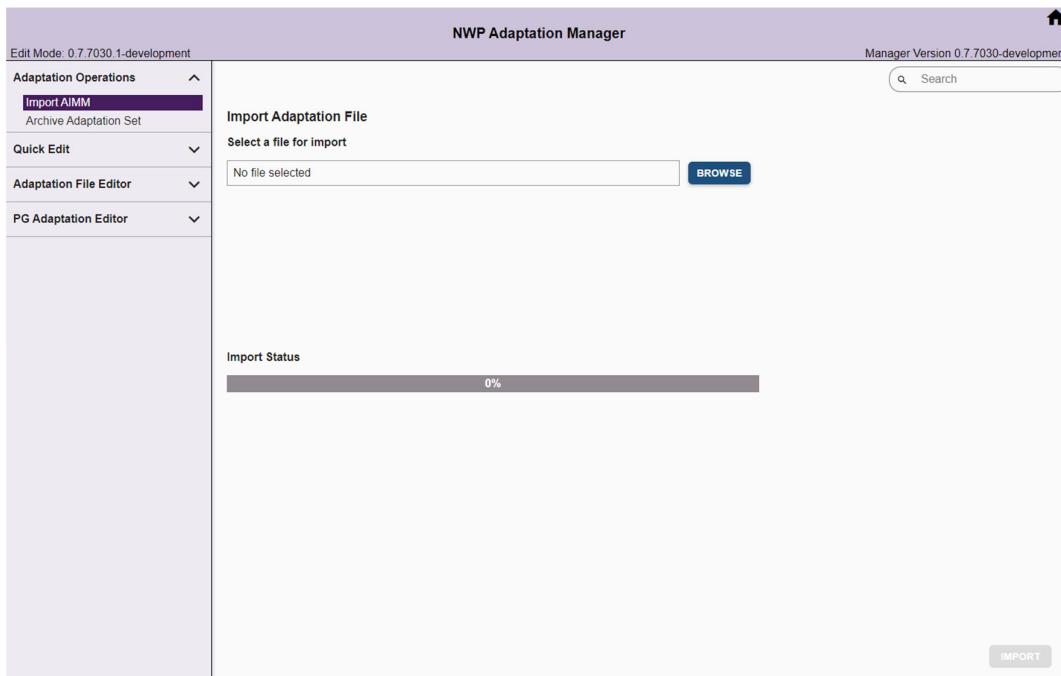


Figure 372. Import AIMM

In case of any errors during the import of the database, the errors will be displayed under the Import Progress section of the display. The 'IMPORT' button will be re-enabled to allow the user to attempt to import again.

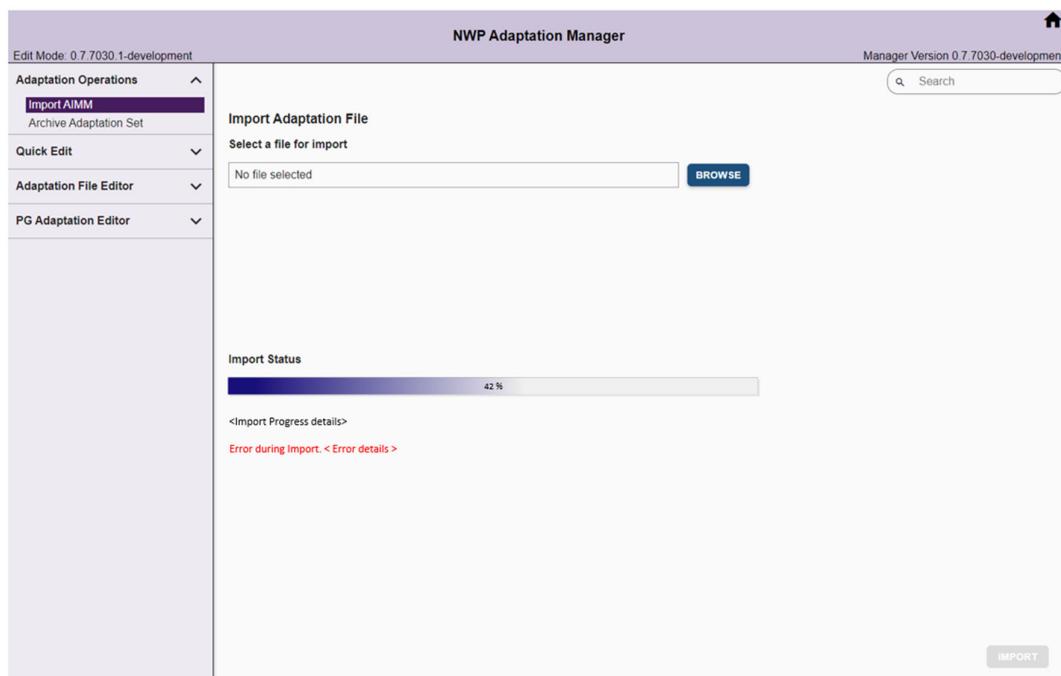


Figure 373. AIMM Import Status Messaging

### 5.3.16.1.1.2 Archive Adaptation Set

The 'Archive Adaptation Set' option is available in Edit Mode only, i.e. when the 'Edit selected Adaptation Set' or 'Create New Adaptation Set' option is selected. Select the Archive Adaptation Set option to archive the current adaptation set. This action saves the adaptation set and the particular revision may no longer be modified. The version will be archived to the Adaptation Manger workstation local storage.

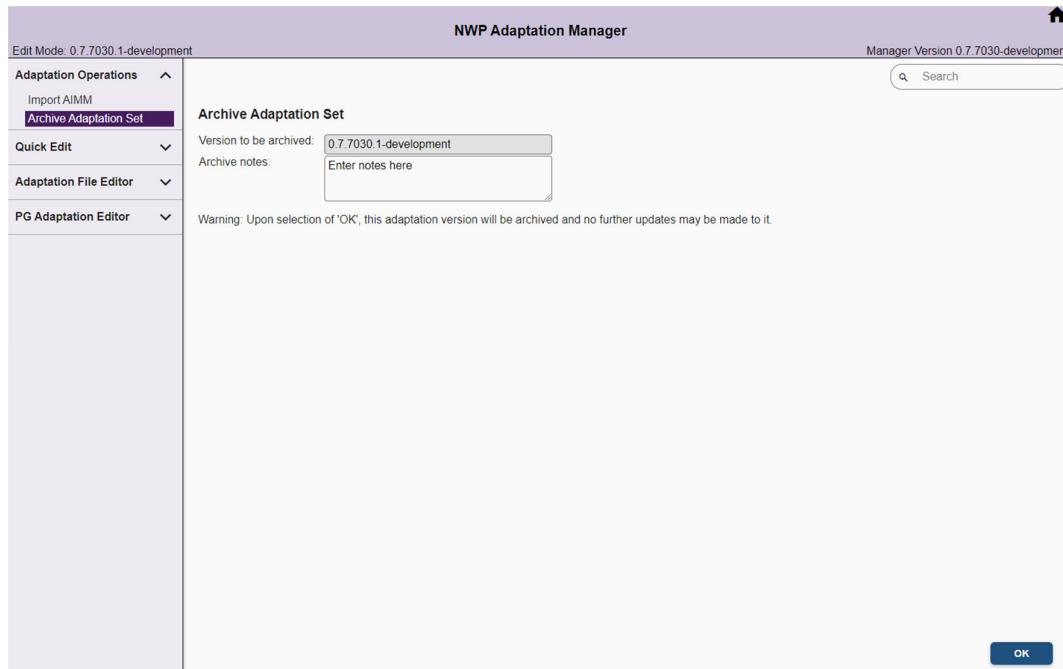
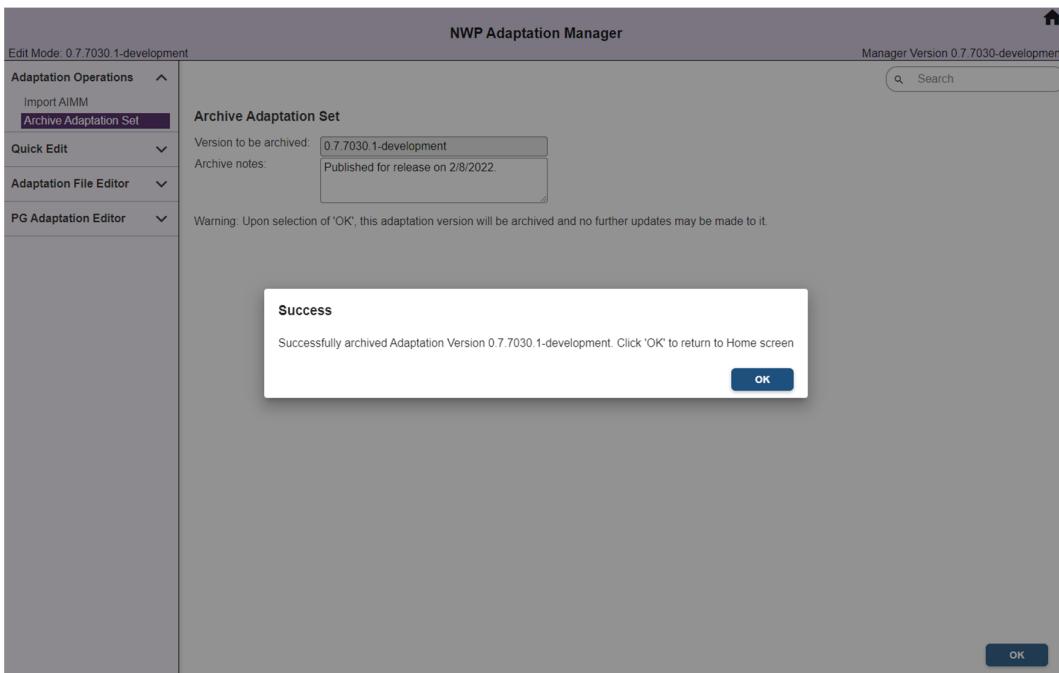


Figure 374. Publish Adaptation Set

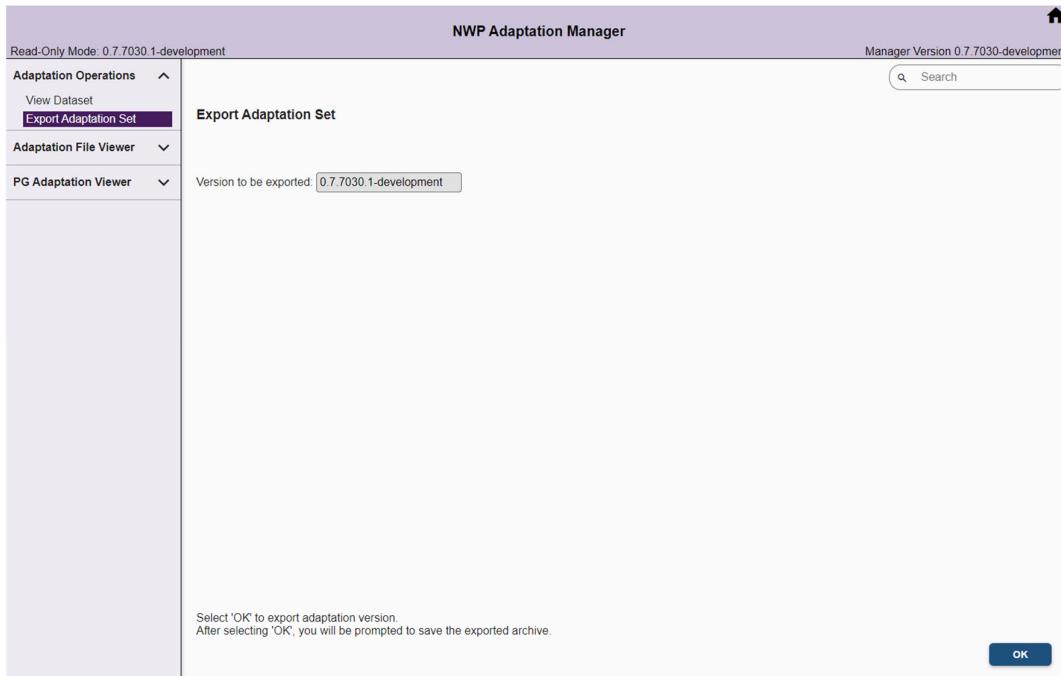
Once final archive notes are entered, the 'OK' button is enabled a user may archive the adaptation version. Upon completion, the user is notified via a popup. Selection of OK returns the user to the main adaptation menu since no further updates may be made.



**Figure 375. Publish Adaptation Confirmation**

#### 5.3.16.1.1.3 Export Adaptation Set

An adaptation version must be archived before it may be exported. Therefore, the 'Export Adaptation Set' option is available in Read Only Mode only, i.e. when the 'View or Export archived Adaptation versions' is selected from the home screen. Select the 'Export Adaptation Set' option to export the current adaptation set to a selected location. Select 'OK' to start the archive. Depending on the web browser settings, the adaptation version will either be saved to the configured default location or a popup will launch requesting input of the desired location to save the export. Configure browser settings to enable the popup in order to select the desired location for the export, either on the Adaptation Manager workstation or on configured removable media. Once transferred to removable media, the adaptation version may be added to the Update server and is available for download from M&C.

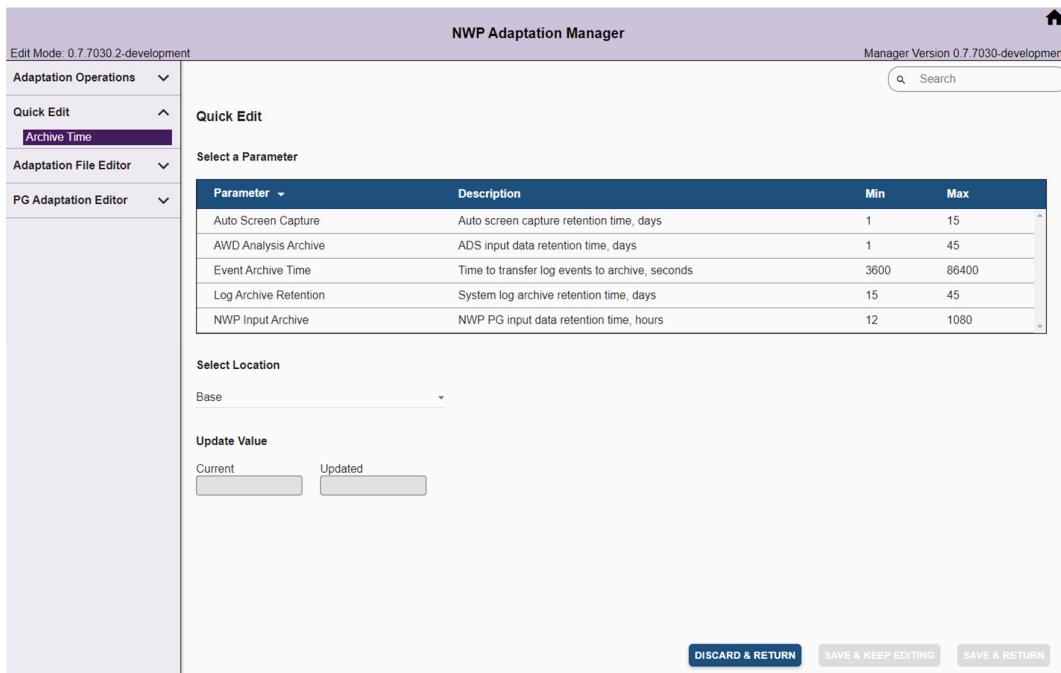
**Figure 376. Export Adaptation**

### 5.3.16.1.2 Quick Edit

Quick Edit is available in Adaptation Manager ‘Edit Mode’ only. Selection of any of the options in this category presents new options on the main area of the adaptation screen for update of selected adaptation parameters.

#### 5.3.16.1.2.1 Archive Time

The parameters available for edit are listed at the top of the page and include value minimum and maximums when applicable. Select the desired parameter for edit, then select the location of the specific adaptation parameter to be modified. Many parameters will be kept within the Common directory in order to apply to all sites. If the indented change is to be affected for only one site, select only the applicable site (the adaptation file will already need to be copied to the site).

**Figure 377. Quick Edit Limited Parameters**

Once a parameter and site are selected, the user may view the current value, then update to the new desired value. If the entered value is outside of defined limits, the box will highlight red as shown below.

This screenshot shows the same 'NWP Adaptation Manager' interface as Figure 377, but with a different parameter selected. The 'Event Archive Time' row in the table has a red border around its entire row, indicating that the entered value is outside the defined limits. The 'Current' value is '15' and the 'Updated' value is '25'. The rest of the interface is identical to Figure 377.

| Parameter             | Description                                     | Min  | Max   |
|-----------------------|-------------------------------------------------|------|-------|
| Auto Screen Capture   | Auto screen capture retention time, days        | 1    | 15    |
| AWD Analysis Archive  | ADS input data retention time, days             | 1    | 45    |
| Event Archive Time    | Time to transfer log events to archive, seconds | 3600 | 86400 |
| Log Archive Retention | System log archive retention time, days         | 15   | 45    |
| NWP Input Archive     | NWP PG input data retention time, hours         | 12   | 1080  |

**Figure 378. Entered Value is Outside Defined Limits**

The ‘Save & Return’ and ‘Save & Keep Editing’ buttons are enabled once a valid new value is input. The data must be saved before navigating away from this page in order to retain the changes.

| Parameter             | Description                                     | Min  | Max   |
|-----------------------|-------------------------------------------------|------|-------|
| Auto Screen Capture   | Auto screen capture retention time, days        | 1    | 15    |
| AWD Analysis Archive  | ADS input data retention time, days             | 1    | 45    |
| Event Archive Time    | Time to transfer log events to archive, seconds | 3600 | 86400 |
| Log Archive Retention | System log archive retention time, days         | 15   | 45    |
| NWP Input Archive     | NWP PG input data retention time, hours         | 12   | 1080  |

**Figure 379. Modify System Performance Adaptation**

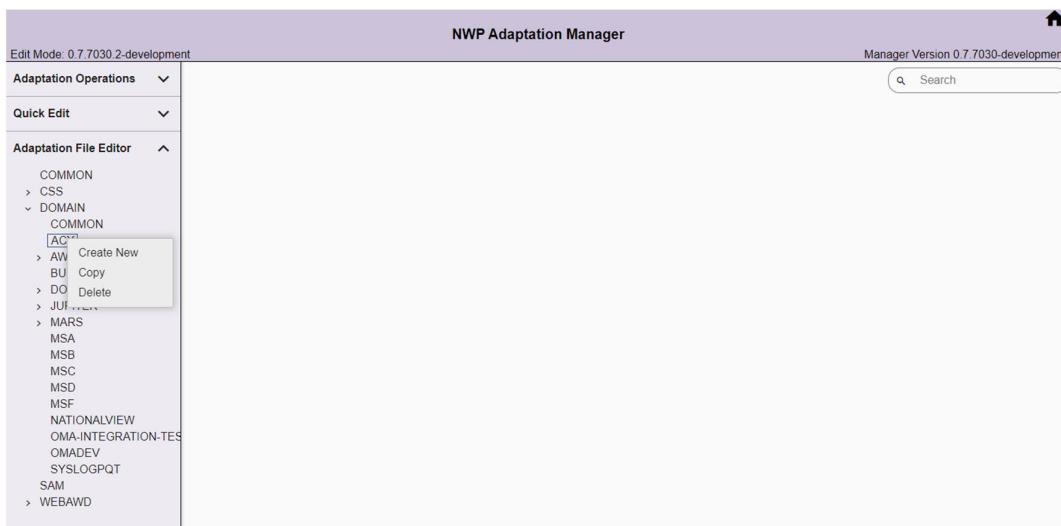
There is one option for Quick Edit: ‘Archive Time’. The available parameters, their descriptions and required limits are shown below. The NWP Input Archive time describes the time that NWP input products are retained at an NWP Domain site. Setting this value at the Base level of Adaptation sets the value for Domain sites. The value may also be set uniquely for each Domain by setting for the desired location.

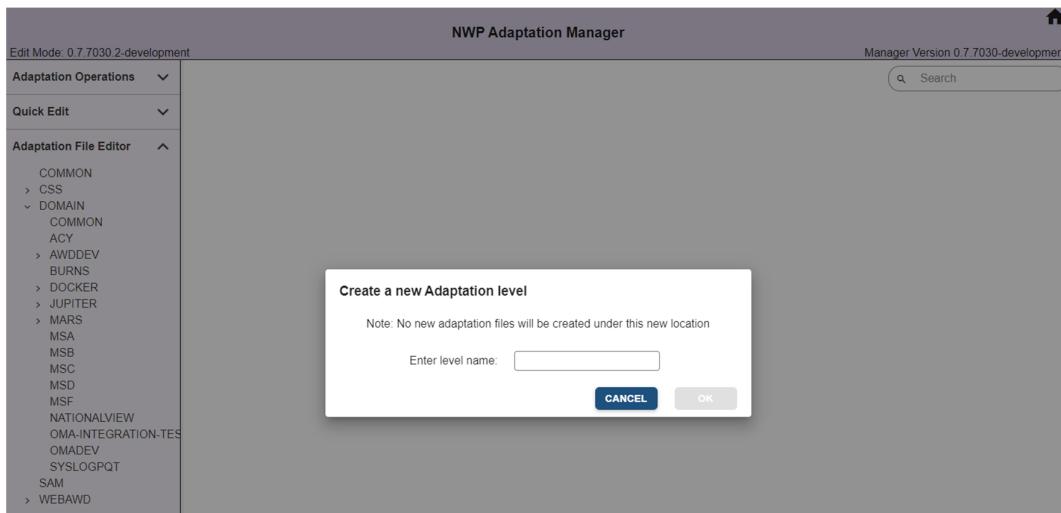
#### 5.3.16.1.3 Adaptation Site Operations

NWP Adaptation is organized in a tree as presented in the left pane under ‘Adaptation File Editor’. This tree contains a listing of all configured NWP sites. For the purposes of this discussion, each Domain will be referred to as an NWP ‘site’. Selection of any of the sites listed presents a new window containing a listing of the adaptation files associated with the site. Adaptation parameters common to all NWP sites are stored in files under the Common structure. Site specific adaptation files are located under the Adaptation level for each particular site. Any adaptation values stored in files under a particular site override the corresponding adaptation files located in the Common area.

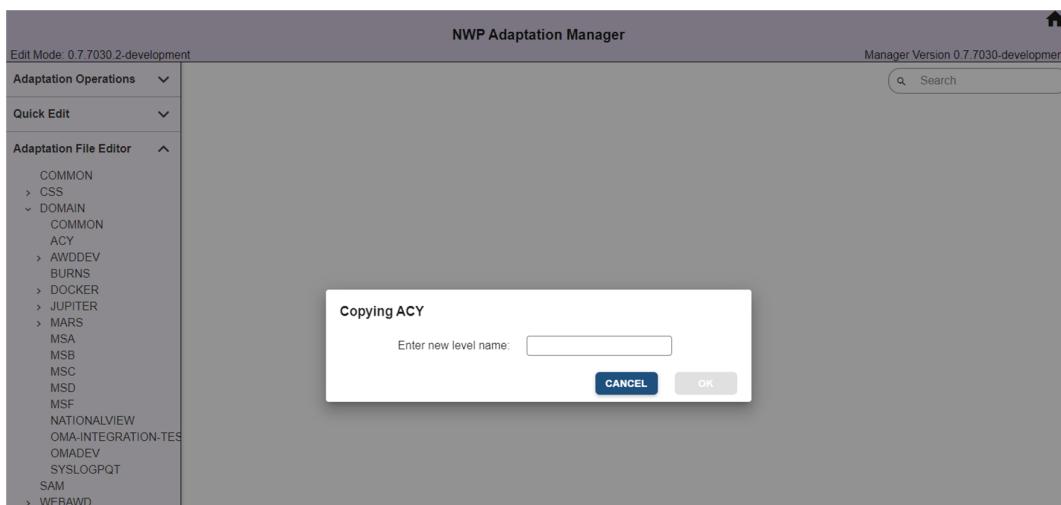
**Figure 380. Adaptation File Editor - Site Options**

Adaptation sites may be edited via right-click of a selected adaptation site. Right-click invokes a context menu with options to Create New, Copy, or Delete a site. When 'Create New' is selected, a popup will prompt the user to enter a new site name. The directory will be created but no adaptation files will be created under the directory. Therefore the new site will inherit all adaptation from the main/common directory but no site specific adaptation. See section Copy Adaptation File for adding specific adaptation files to the newly created site.

**Figure 381. Adaptation Site Right-Click Menu**

**Figure 382. Create New Adaptation Site**

Similarly, a new adaptation site may be created via Copy of an existing adaptation site. When 'Copy' is selected, the user will again be prompted to enter the new site name. This time, any adaptation files specific to the selected site will be copied into the newly created site.

**Figure 383. Copy Existing Adaptation Site**

Finally, an adaptation site may be deleted. Selection of 'Delete' deletes the site and any adaptation files contained directly under the site.

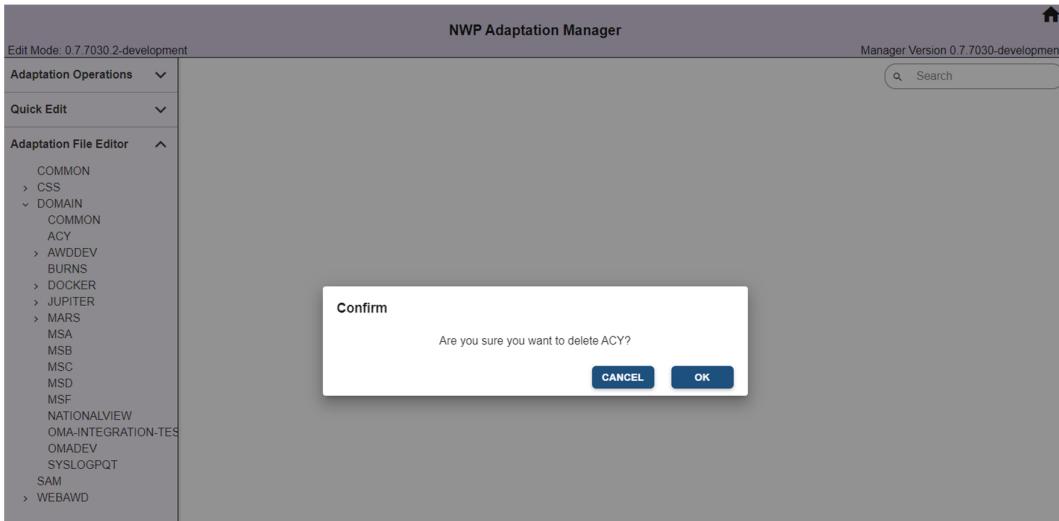


Figure 384. Delete Selected Adaptation Site

#### 5.3.16.1.3.1 Adaptation File Operations

JSON adaptation files may be directly edited via the Adaptation Manager by left-click to select a desired adaptation site. Upon selection of the site, a new window is launched which provides a directory of all adaptation files under the selected site as shown below.

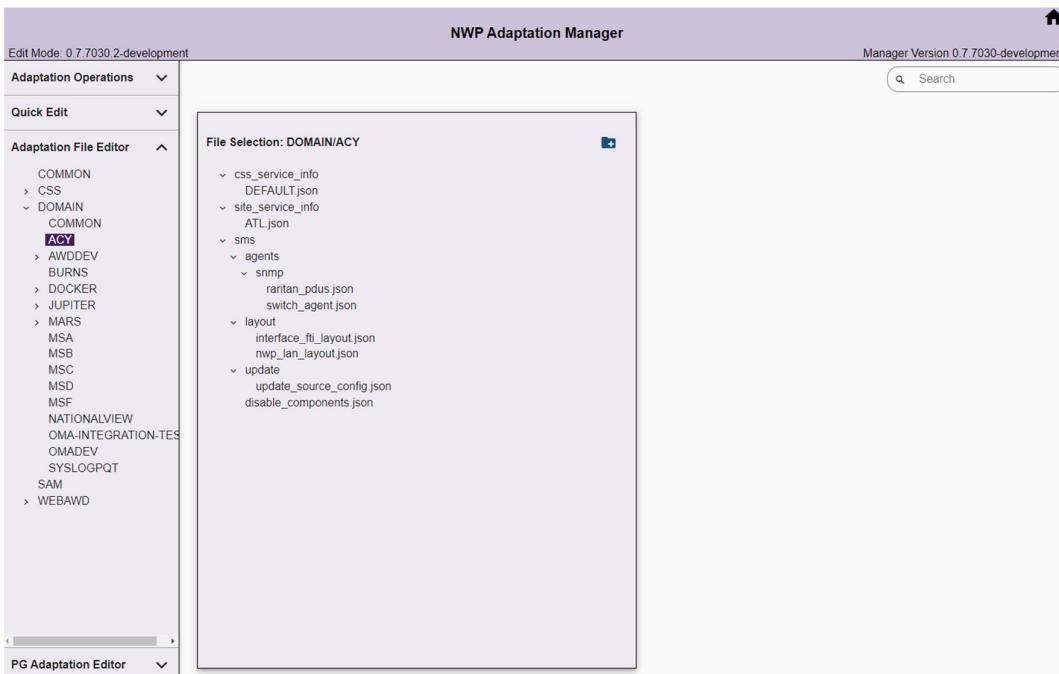


Figure 385. Site Specific Adaptation File Listing

Upon left-click on any of the files in the list, a new window is launched which displays a preview of the selected file.

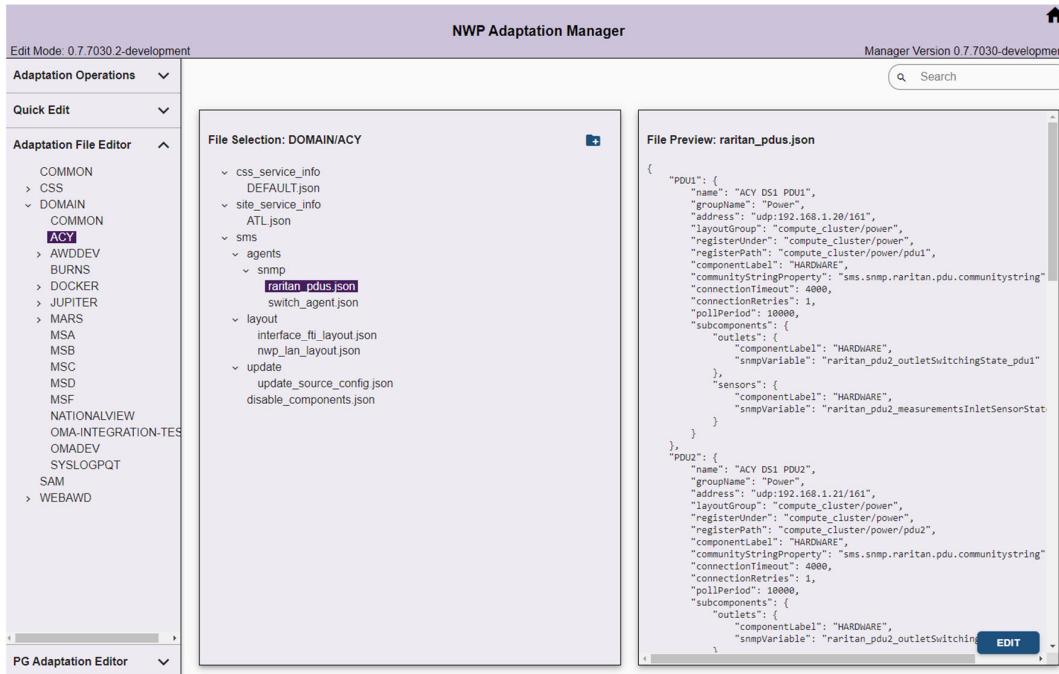


Figure 386. Adaptation File Preview

The selected adaptation file may be edited in one of two ways: either select the 'EDIT' button on the lower right of the Preview pane, or right-click the desired adaptation file from the File Selection listing, and select 'Edit' as shown below.

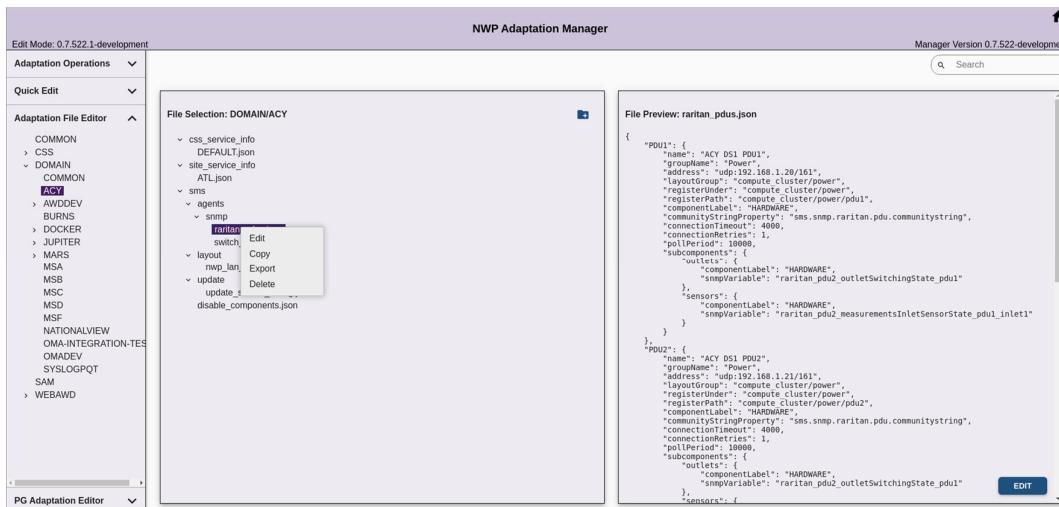
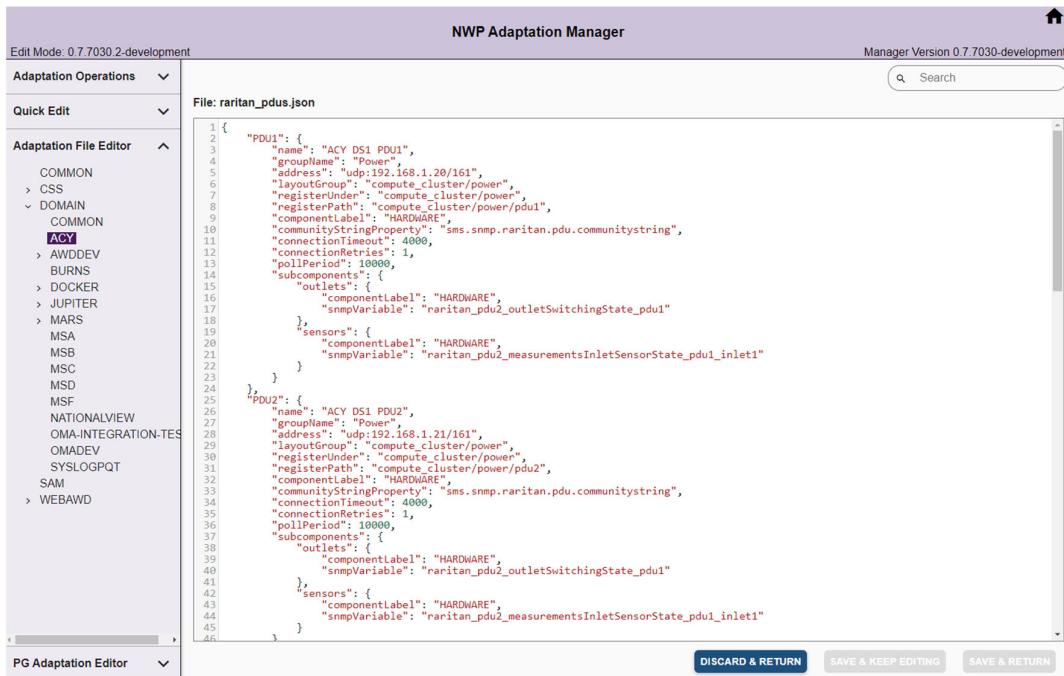


Figure 387. Initiate Edit of Selected Adaptation File

Upon selection of 'Edit', the user is presented with an edit display specific to the selected adaptation file as shown below. From here, text edits of the adaptation file may be made. Options after edits are made are 'Discard & Return', 'Save & Keep Editing', and 'Save &

Return'. When 'Discard & Return' is selected, no changes will be saved and the file will be reverted to its original text. The user will be reverted back to the Preview of the file as shown in Figure above. When 'Save & Keep Editing' is selected, the changes will be saved and user will remain on the Edit screen as shown in the figure below. When 'Save & Return' is selected, the changes will be saved, then user will be reverted back to the Preview of the file as shown above.



**Figure 388. Edit Adaptation File**

#### 5.3.16.1.3.2 Copy Adaptation file

An adaptation file may be copied from one adaptation site directory into another via the right-click context menu on the selected adaptation file. Upon selection of 'Copy', the user is prompted with a Copy Adaptation file dialog. The user must select a directory location to copy the file as shown below.

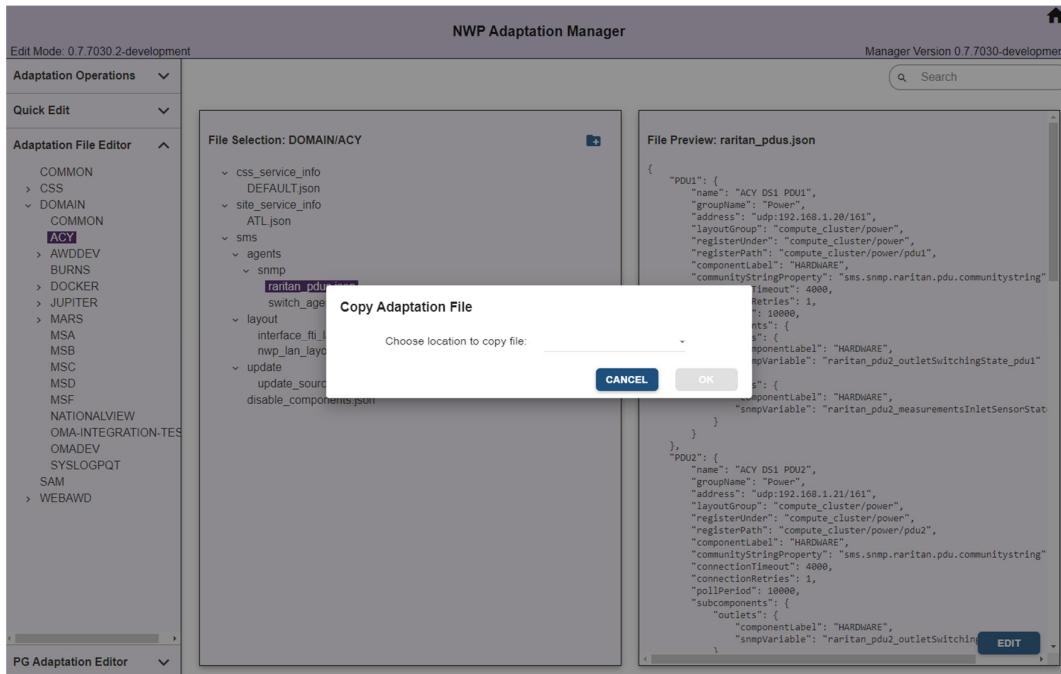


Figure 389. Copy Adaptation File

The user may then begin typing to search the drop down list of available site locations for copy. Upon selection of a location, select 'OK' to copy the file to the selected location.

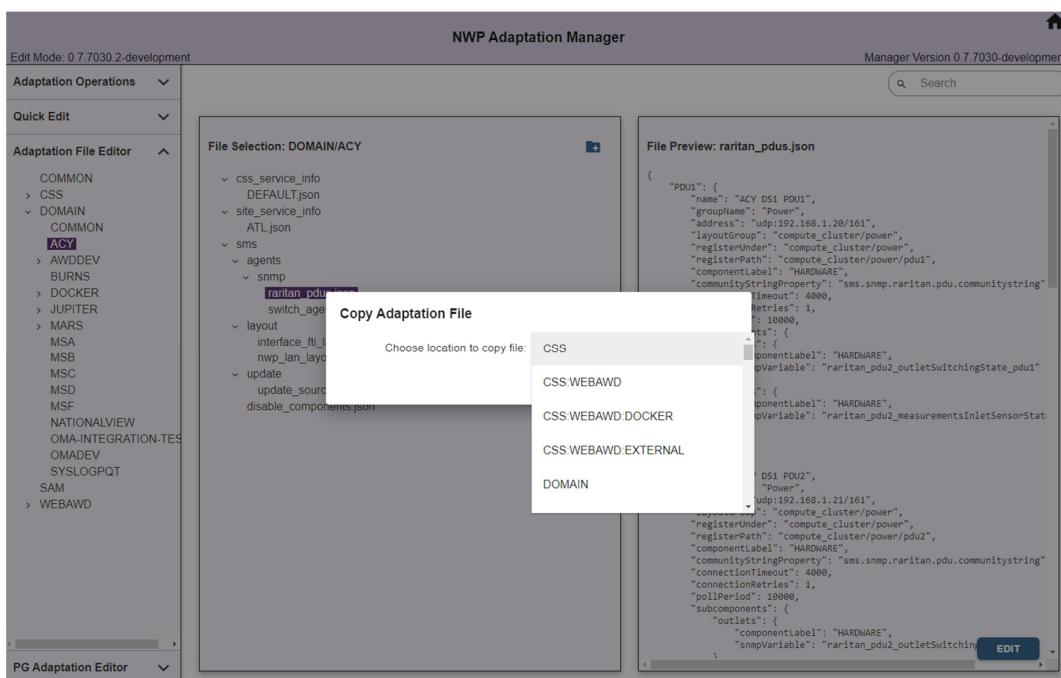
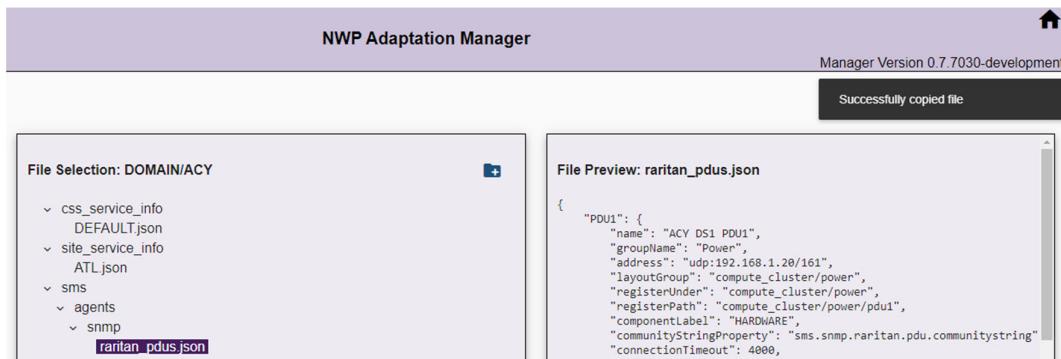


Figure 390. Site Location Selection for File Copy

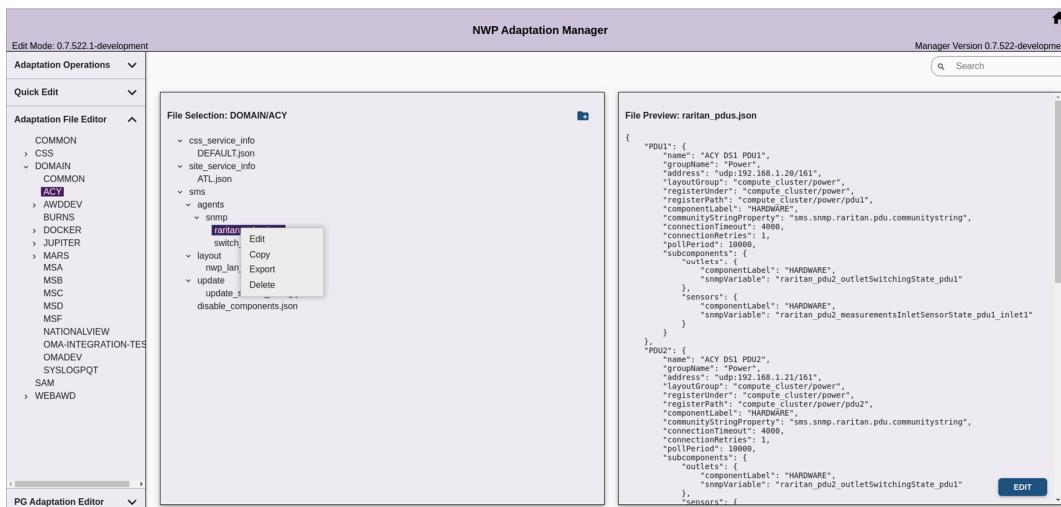
The user will be notified upon successful copy of the selected adaptation file. Select the desired site location to launch the adaptation file listing and preview the newly copied file.



**Figure 391. Successfully Copied Adaptation File**

#### 5.3.16.1.3.3 Export Adaptation File

An individual adaptation file may be exported from the Adaptation Manger. Left-click the adaptation file within the file selection tree and select 'Export'. This action will launch the browser's 'Save As' dialog, from which the file may be copied from the Adaptation Manager to a configured location on the Adaptation Manager workstation or configured removable media.



**Figure 392. Export Adaptation File**

#### 5.3.16.1.3.4 Adaptation Folder Operations

Select operations may be performed on adaptation file folders. Available operations include Create New folder, and import of files. In order to create a new folder, right-click the folder under which the new folder is desired. Select 'Create New'. A new directory will be created under the selected. In order to import a file into a specific adaptation folder, right-click the folder under which the new adaptation file is to be placed. Select 'Import'. Upon selection of 'Import File', a browser dialog will launch, from which the location of the file desired for import may be made. Upon selection of 'Open', the file will be imported into the selected directory.

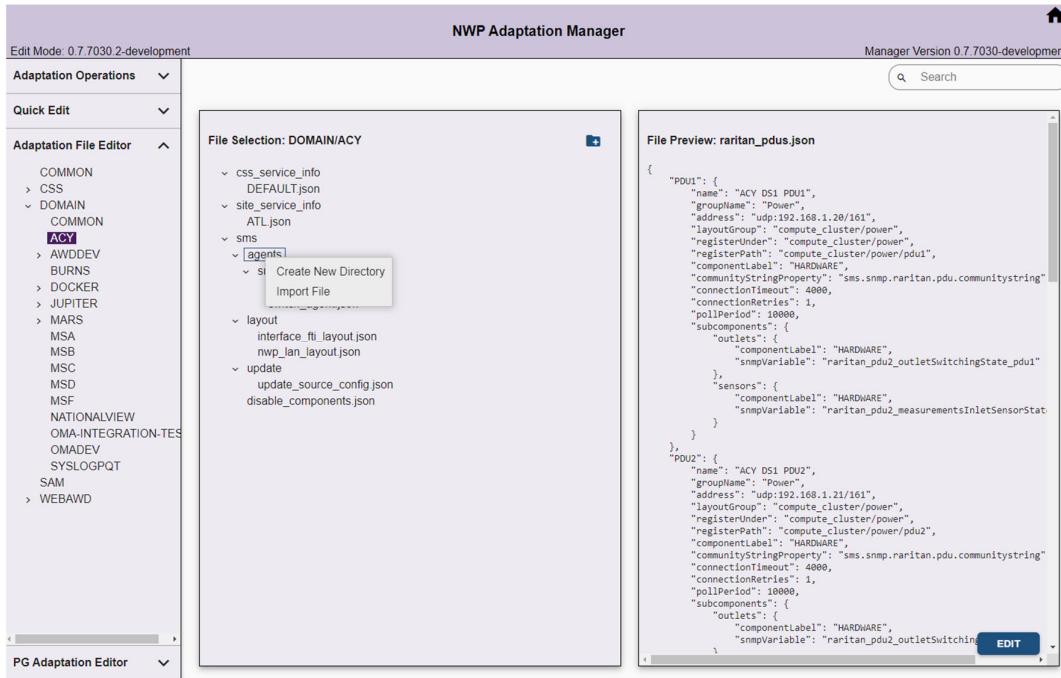
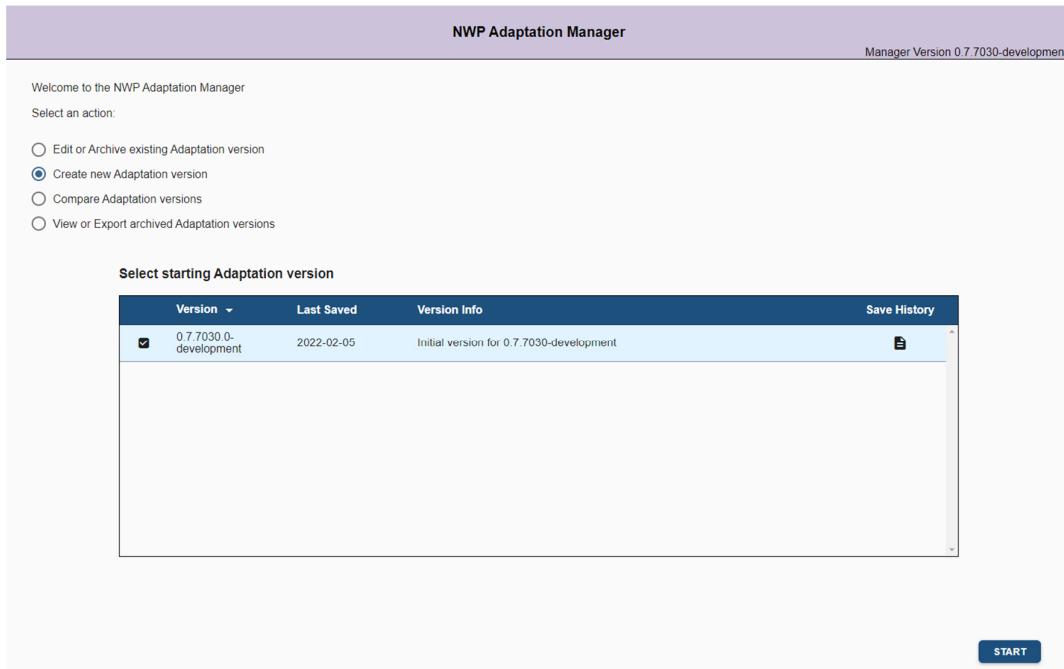


Figure 393. Adaptation Directory Operations - File Import

### 5.3.16.2 Create New Adaptation Version

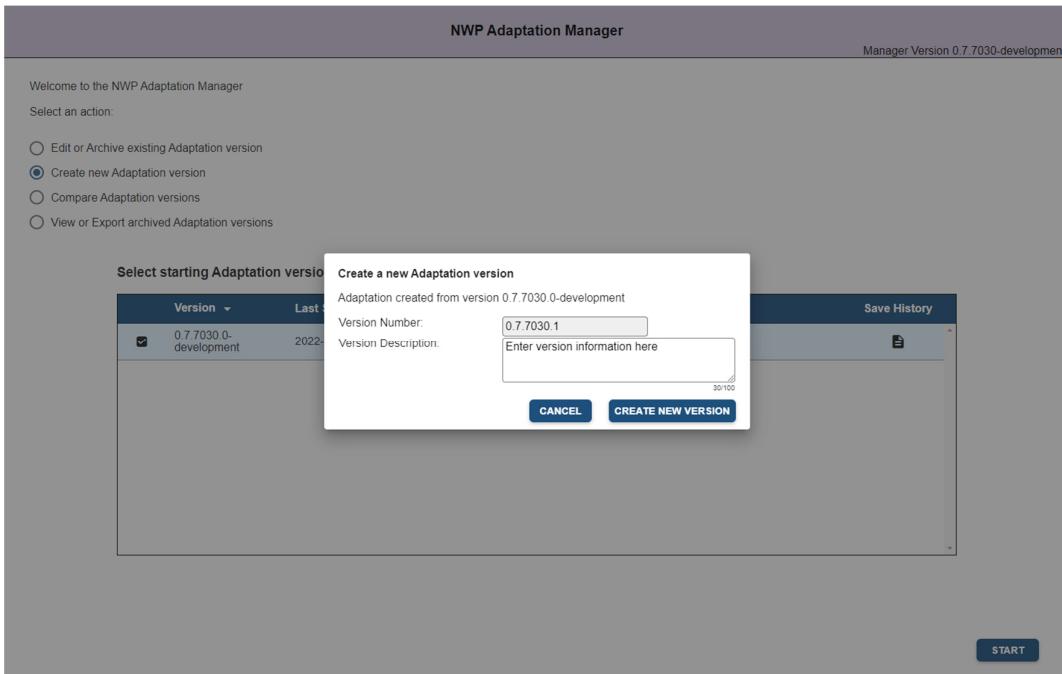
Upon selection of 'Create new Adaptation version', a listing of adaptation versions available for which a new version may be created is presented. Each version is listed with a version number, the date of the last save of the existing version, and version information as entered at the time of version creation. Upon selection of the desired adaptation version, the 'Start' button is enabled and the user is directed to a version creation page.



**Figure 394. Create New Adaptation Version**

#### 5.3.16.2.1 Version Creation Dialog

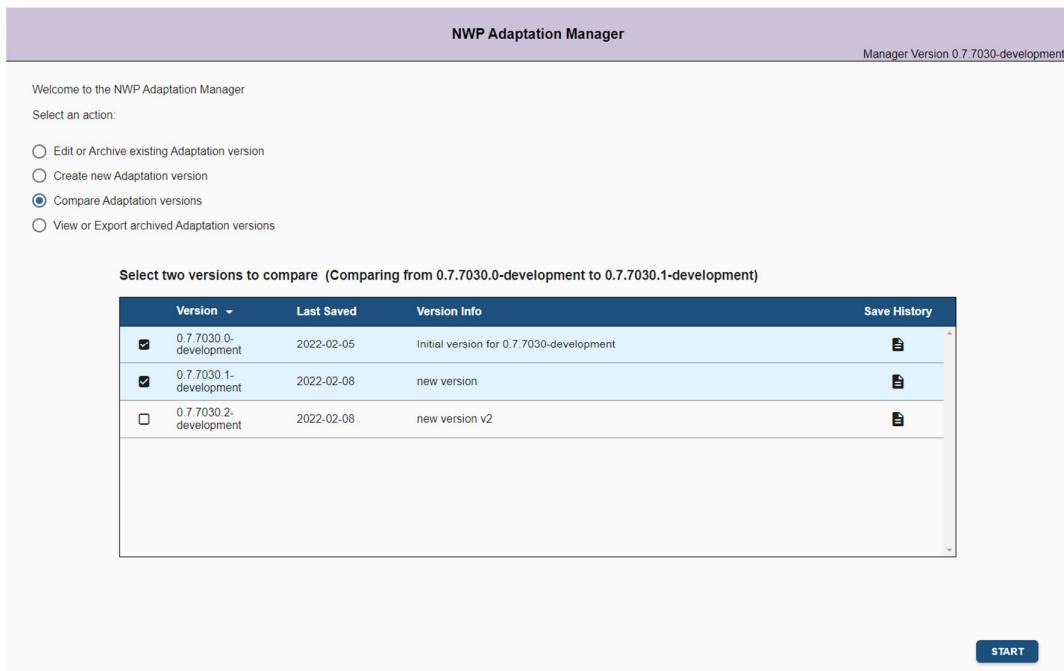
Upon selection of 'Create new Adaptation version from selected', a user will be prompted with a dialog to enter information about the newly created version. The version number will be automatically incremented by the system based on the version selected. The user may enter details about the version.



**Figure 395. Create New Version Dialog**

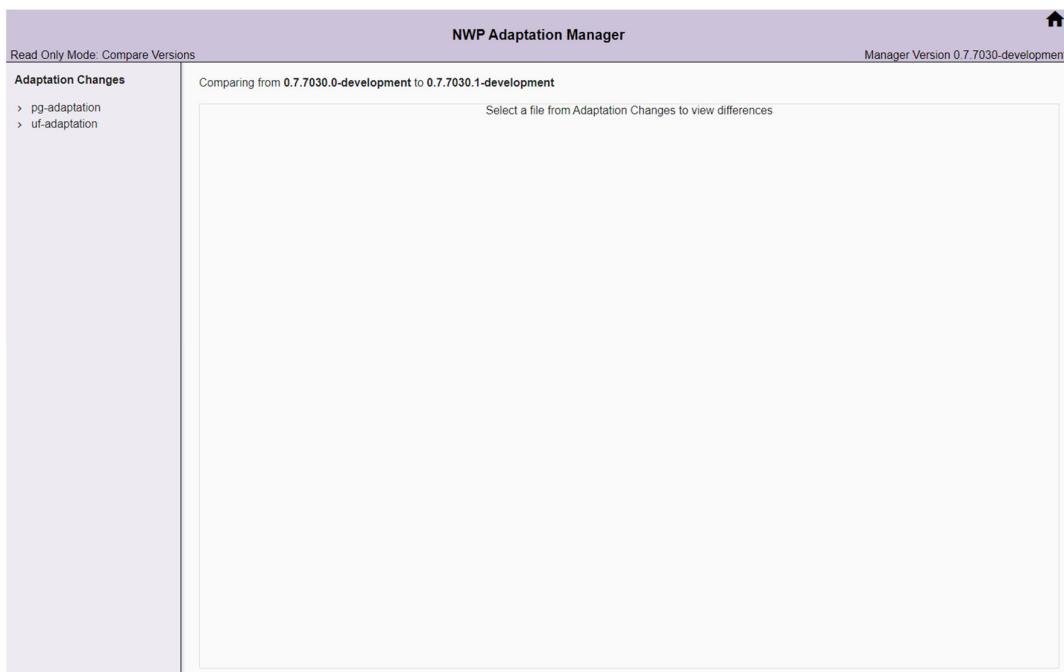
### 5.3.16.3 Compare Adaptation Versions

Upon selection of 'Compare Adaptation Versions', a listing of adaptation versions available for comparison is presented. Adaptation versions which are available for edit or which have been archived are presented in the list. Each version is listed with a version number, the date of the last save of the existing version, and version information as entered at the time of version creation. The user must select two versions for comparison. Only two versions may be selected. Once two versions are selected, the 'Start' button is enabled. Selection of this button directs the user to a new screen for comparison of the two selected versions.

**Figure 396. Compare Adaptation Versions**

### 5.3.16.3.1 Compare Adaptation Versions

Once the comparison screen is entered, the top title bar indicates the user is now in read only mode. A listing of all files which contain changes between the two selected versions is presented in the left 'Adaptation Changes' pane.

**Figure 397. Compare Adaptation Versions - File Selection**

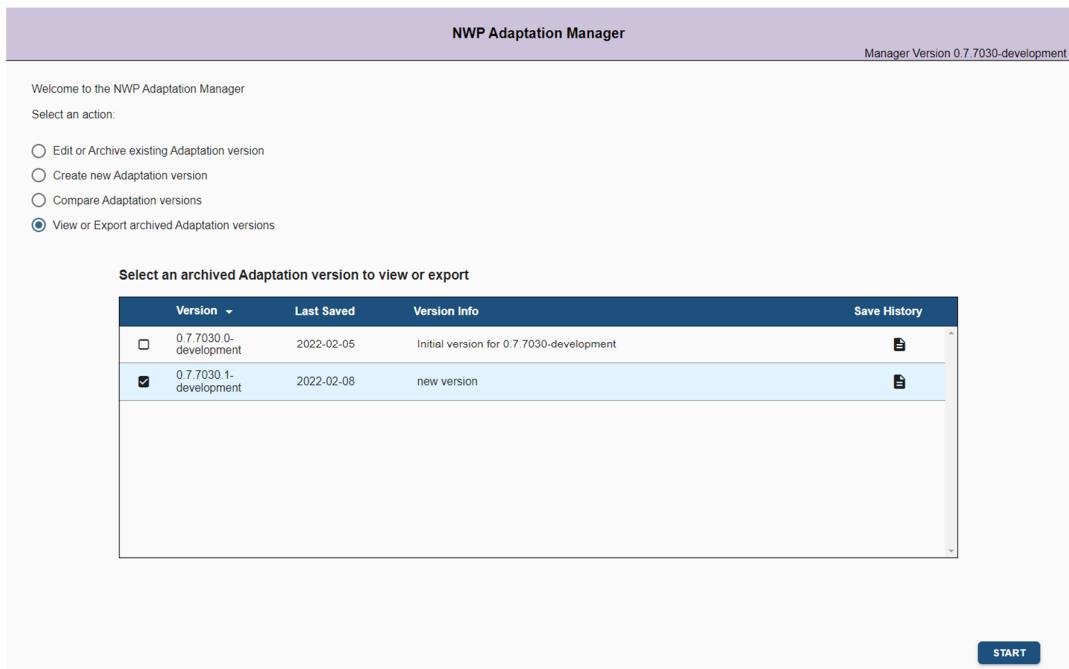
Upon selection of a site from the Adaptation Changes tree, all of the adaptation files under the site which have differences between the two selected versions will be available to view. Selection of one of those files displays a read only view of the differences between Version 1 and Version 2.



**Figure 398. Compare Versions - File Selection**

#### 5.3.16.4 View or Export archived Adaptation versions

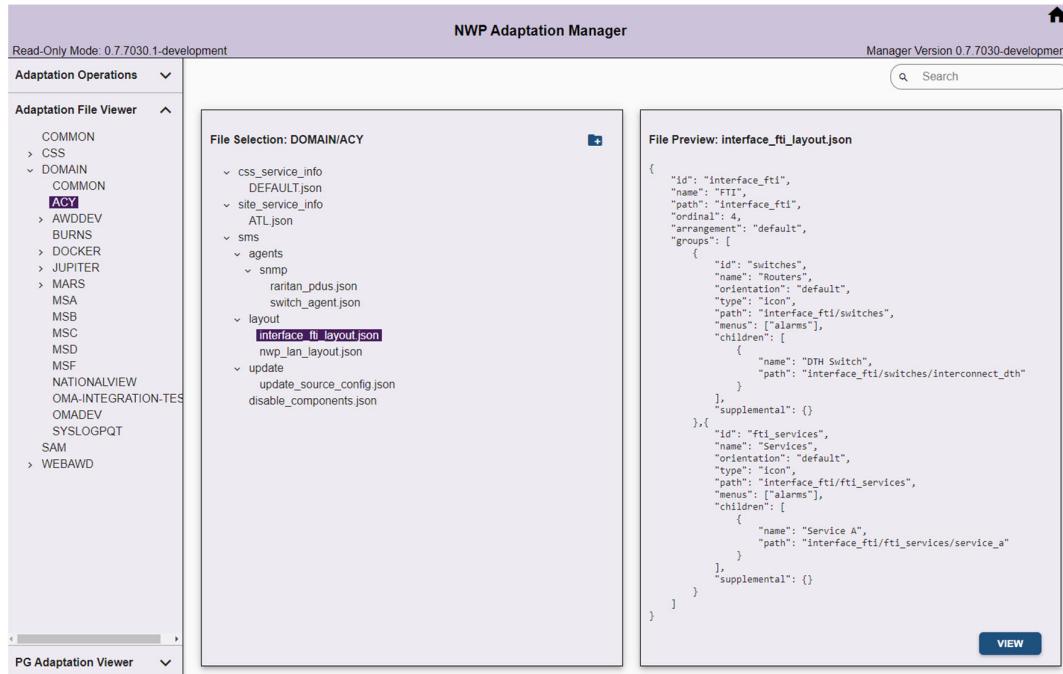
Upon selection of 'View or Export archived Adaptation versions', a listing of previously published and archived adaptation versions is presented. Each version is listed with a version number, the date of the last save of the existing version, and version information as entered at the time of version creation. The user may select only one version for a detailed view of parameters in read only mode. Once a version selection is made, the 'Start' button is enabled. Selection of this button directs the user to a read only screen for viewing specific adaptation parameters.



**Figure 399. View Archived Adaptation Versions**

#### 5.3.16.4.1 View Archived Adaptation

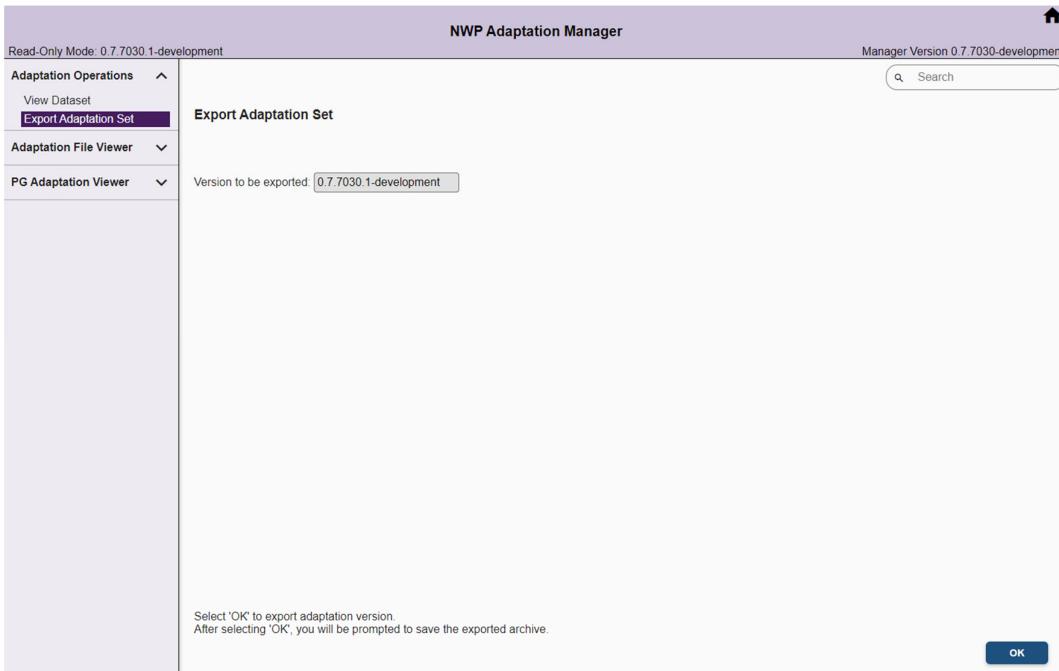
The Read Only screen for viewing an archived adaptation set presents the adaptation tree for the archived adaptation set. The Search and Export Adaptation Set Adaptation Operations are also enabled. The user must select a file for viewing either from the Adaptation File viewer or the PG Adaptation viewer. Once a file is selected, its contents are presented in a read only window, as shown in the figure below.



**Figure 400. View Archived Adaptation Set**

#### 5.3.16.4.2 Export Archived Adaptation Set

The entire Archived Adaptation Set can be exported by selecting Export Adaptation Set under Adaptation Operations. On the Export Adaptation Set screen the Version to be exported is visible. The user must select the OK button to export. This action will launch the browser's 'Save As' dialog, from which the tar file may be copied from the Adaptation Manager to a selected location on the Adaptation Manager workstation or removable media.

**Figure 401. Export Archived Adaptation Set**

#### 5.3.16.4.3 View Dataset

Datasets imported to an Archived Adaptation set are available for review by selecting View Dataset under Adaptation Operations. The Dataset Name, Terminal, Start Time, End Time, and Creation Time are all displayed.

| Dataset Name                           | Terminal | Sim Start Time | Sim End Time | Creation Time |
|----------------------------------------|----------|----------------|--------------|---------------|
| No datasets imported for this version. |          |                |              |               |

**Figure 402. View Dataset Tab**

#### 5.3.16.4.4 Adding exported adaptation to update server

Once the exported adaptation update package is exported to a removable drive and copied to the update server filesystem it can be added to the update site by using scripts bundled in the same "tar" file.

The file should be copied to an empty folder on the update server and uncompressed by using "tar xf 0.7.1.tar" ( replace the tar file name with the specific filename actually downloaded ).

Once unpacked, use the following command, as a system administrator, to add to the update site, but insert the actual version being added: "sudo python update\_site\_manager.py add\_adaptation --merge-from . --local-registry localhost:5000 --versions-to-keep 10 --adaptation-version {adaptation version downloaded} --force-update /var/www/html/nwp-update-repository"

#### 5.3.16.4.5 Adding a full build to the update server

Similarly to adding only the adaptation version above; once a new software build package is copied to the update server the same `update_site_manager.py` script can be used to upload the version using different arguments.

As a system administrator, use: "sudo python `update_site_manager.py update_site --image-file docker-images.tar.gz --merge-from . --local-registry localhost:5000 --versions-to-keep 10 /var/www/html/nwp-update-repository"`

### 5.3.17 Audit Analysis - Kibana

#### 5.3.17.1 Overview

The NWP system uses Kibana to provide a visualization tool for review and analysis of audit data. It is installed and configured automatically during ASL.

Kibana is a Commercial Off-The-Shelf (COTS)/Free and Open-Source Software (FOSS) product that has been integrated with NWP without modification.

This section serves as an introduction; more detailed instructions (for the current Kibana version) can be found at:

1. <https://www.elastic.co/guide/en/kibana/index.html>
2. <https://www.elastic.co/guide/en/elasticsearch/reference/index.html>

Kibana can be accessed directly by entering the URL into a web browser. It can also be accessed through the hamburger menu on the M&C. Initial access to Kibana requires a user name and password, controlled through the same IdM database as the rest of the NWP system, with access being granted to site admins and NWP-wide admins. Security is provided at the Elasticsearch level by the ReadonlyREST Elasticsearch plugin. This plugin maintains its own credentials cache for 24 hours in case of a loss of IdM connectivity. Changes to a user's credentials in IdM can take up to 24 hours to propagate.

#### 5.3.17.2 Access/The Management Tab

Each NWP site gets its own instance of Kibana containing the audit logs of all nodes at the local site. Instances at other sites can be accessed remotely by using the URL of the remote installation or by drilling down through the M&C National View.

On first access, Kibana requires minimal configuration in order to know what stored information to make queries against. When prompted to define the index pattern, if using NWP-A use the following:

1. **nwpaudit\***
2. **nwpcontainers\***
3. **nwplogback\***

If using an NWP Domain system, only the **nwpaudit\*** index needs to be defined.

When prompted for the Timestamp Filter field name, select @timestamp from the dropdown. If need be, these settings can be modified from the Management tab after the initial setup. Once configured, Kibana makes available for analysis all audit data via tabs to the left of the screen.

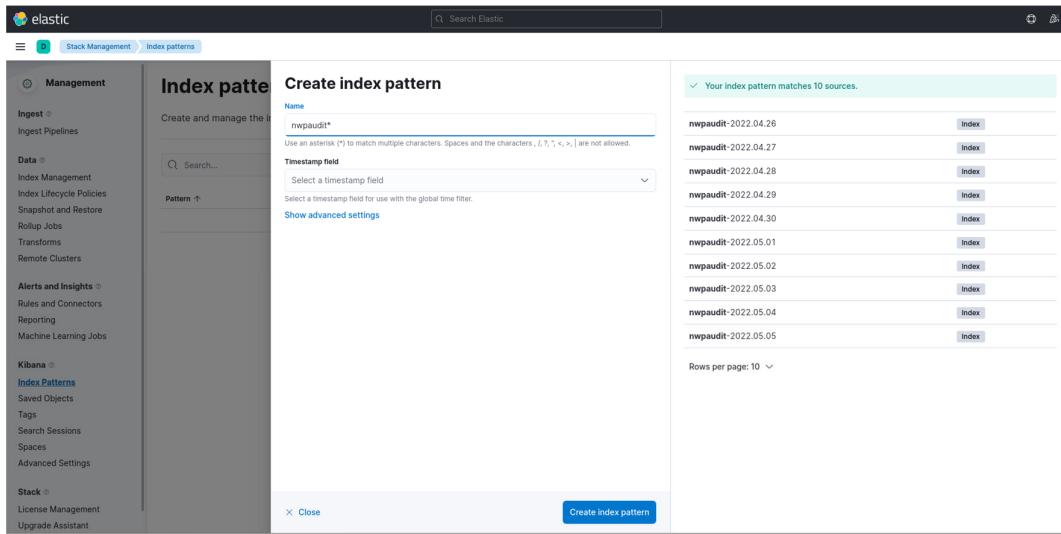


Figure 403. Management Tab - Define Pattern Index

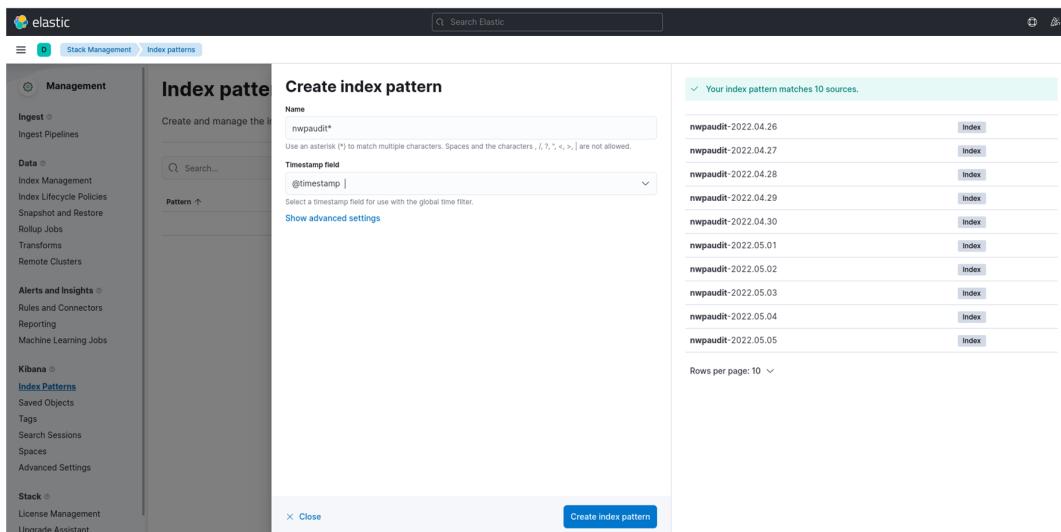
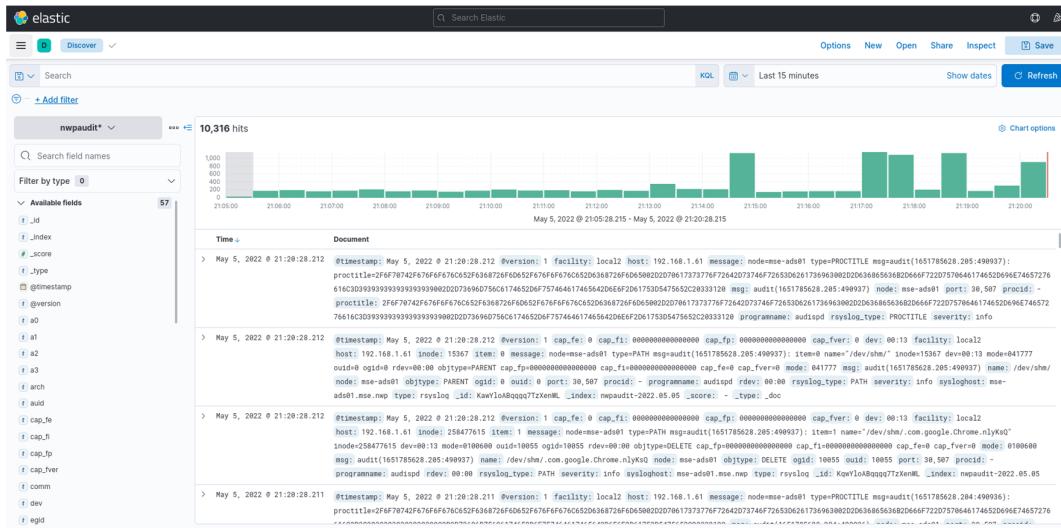


Figure 404. Management Tab - Configure Settings

### 5.3.17.3 The Discover Tab - Searching Logs

The Discover Tab is used to conduct searches of the Audit logs to find events of interest. By default, this view displays the audit logs of the site and a bar graph indicating event frequency for the last 15 minutes.

NWP Software User Manual with NWP-A – Single Page Export - Redlined



**Figure 405. Discover Tab - Searching Logs**

The time period to display logs for can be selected via the calendar button on the left of the display. This will bring up a callout where the time period can be set at the top right of the callout (commonly and recently used ranges are also displayed), and an auto refresh period can be set with the control on the bottom (default to not auto refresh).

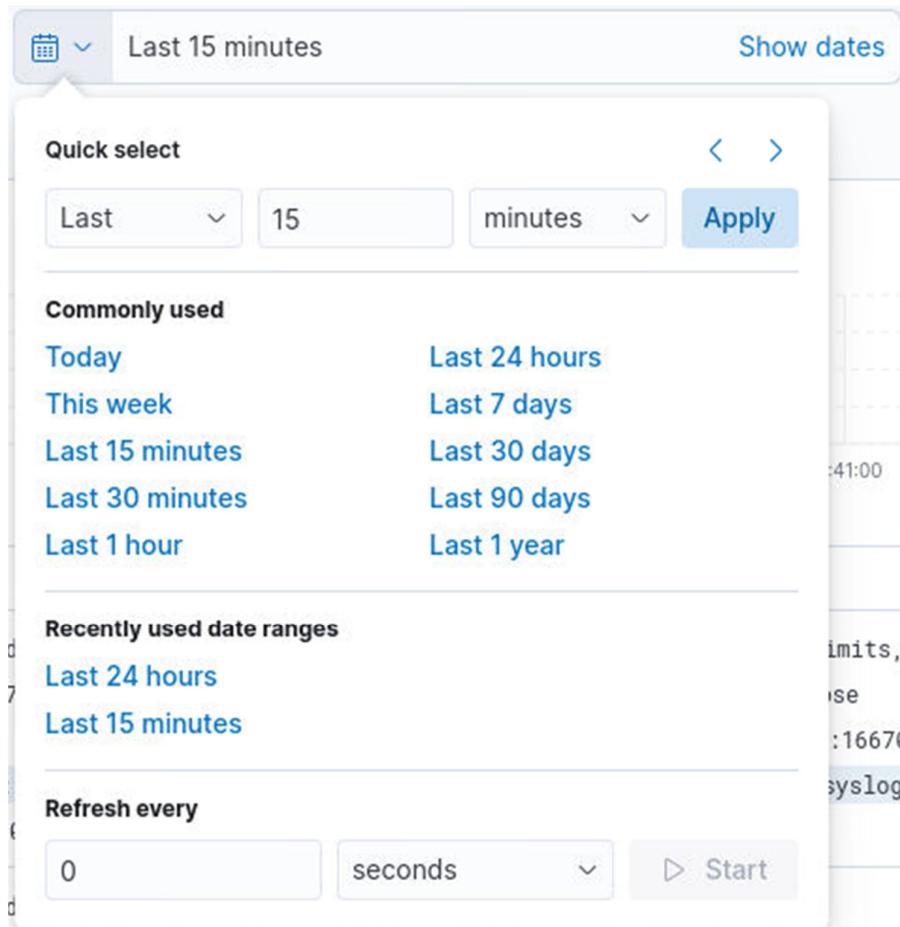


Figure 406. Time Period Control

By default, all audit fields are displayed. The fields can be filtered to only those of interest by hovering over the field of interest and clicking + (Add field as column).

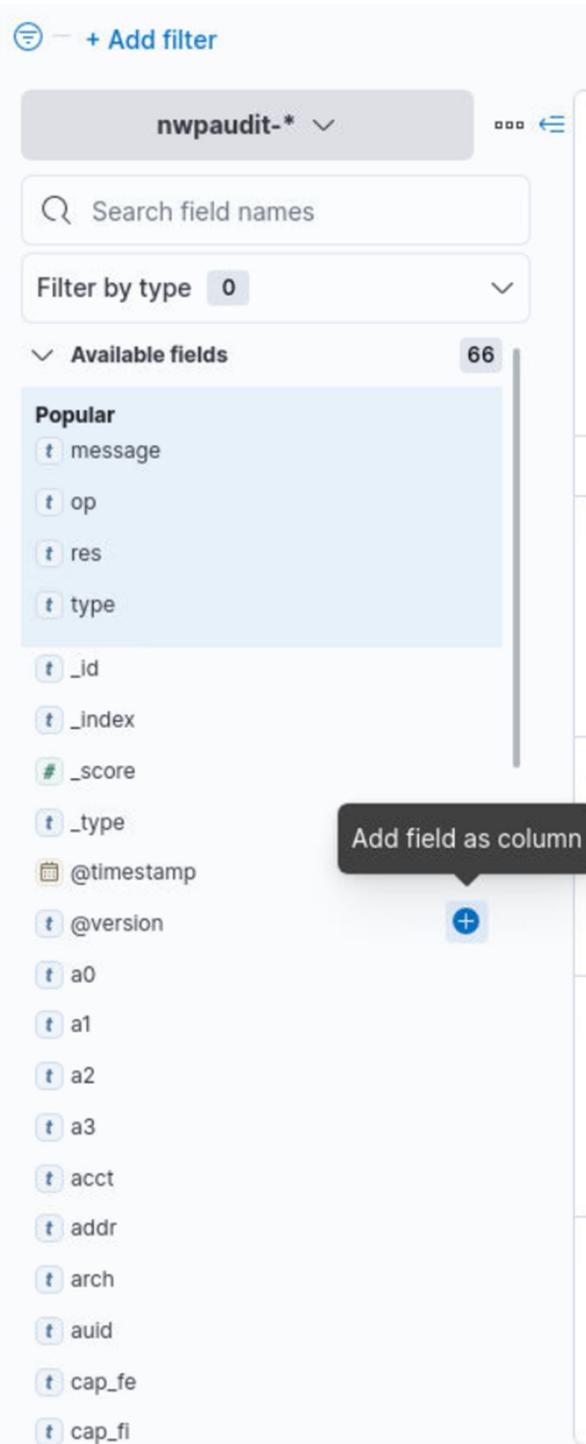
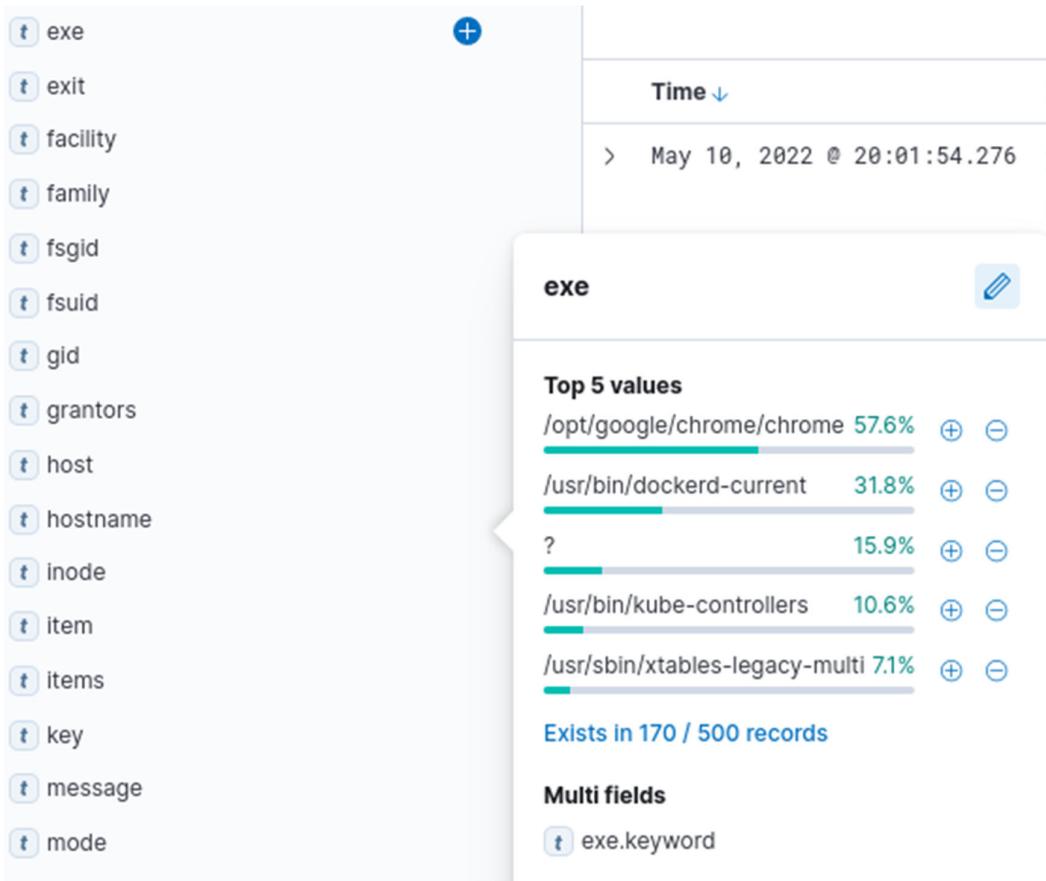


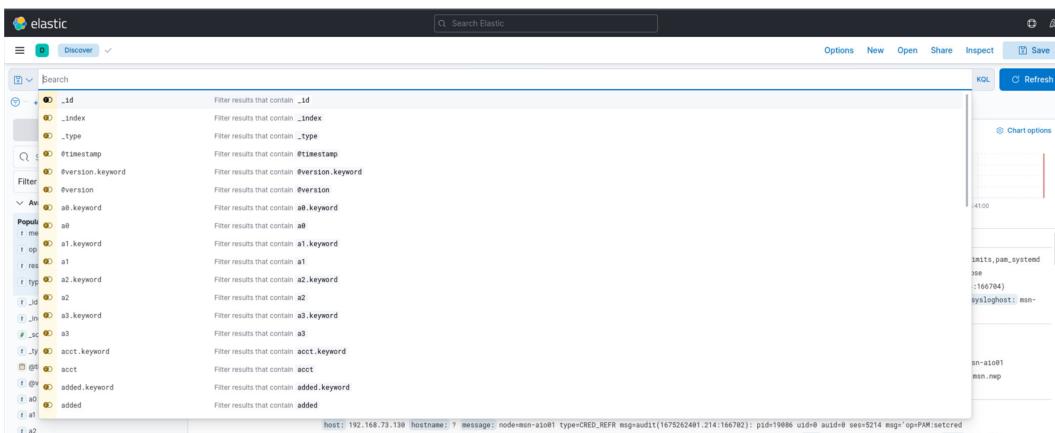
Figure 407. Field Filter

Multiple fields can be selected. Clicking on a field in this same bar will show the top five values of that field and how often each value occurs.



**Figure 408. Example of Top 5 Values Display**

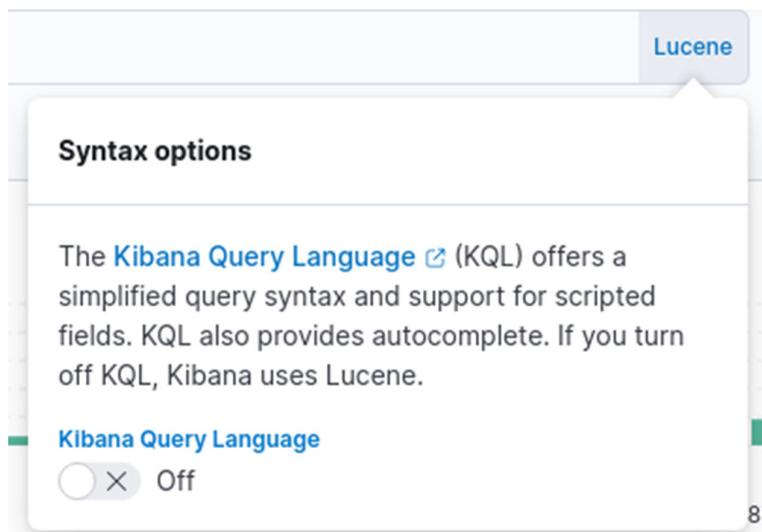
The search bar at the top allows for a ranked search to be conducted of the audit data free form using either Kibana Query Language (KQL), by default, or the Lucene query syntax. The search bar offers auto complete and suggested searches.



**Figure 409. Search Bar**

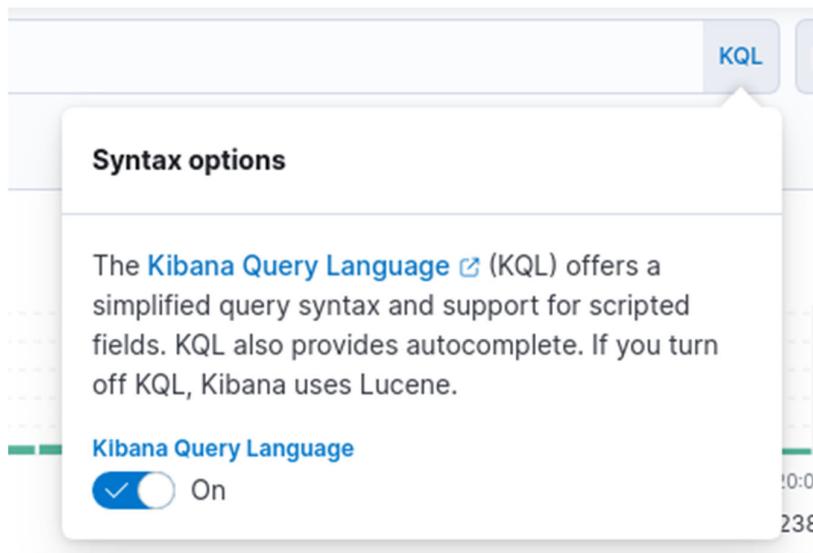
The text at the right of the search bar, KQL in this example image, indicates which language/syntax the search is conducted in.

In order to change the search from KQL to Lucene, select KQL, and toggle Kibana Query Language off. Notice that the text at the right of the search bar reads "Lucene" once KQL is toggled off.



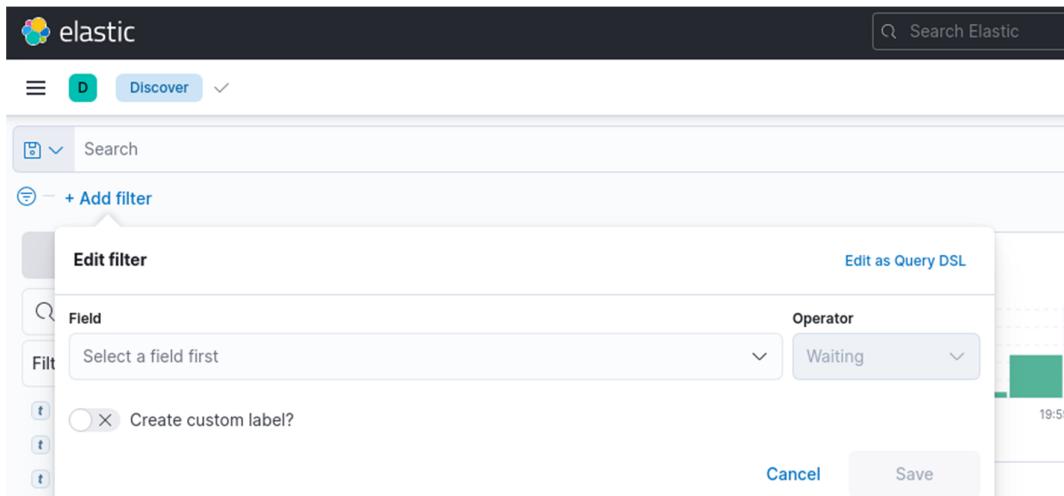
**Figure 410. KQL Toggled Off**

Likewise, toggle Kibana Query Language on to switch from Lucene to KQL. Notice that the text at the right of the search bar reads "KQL" once KQL is toggled on.

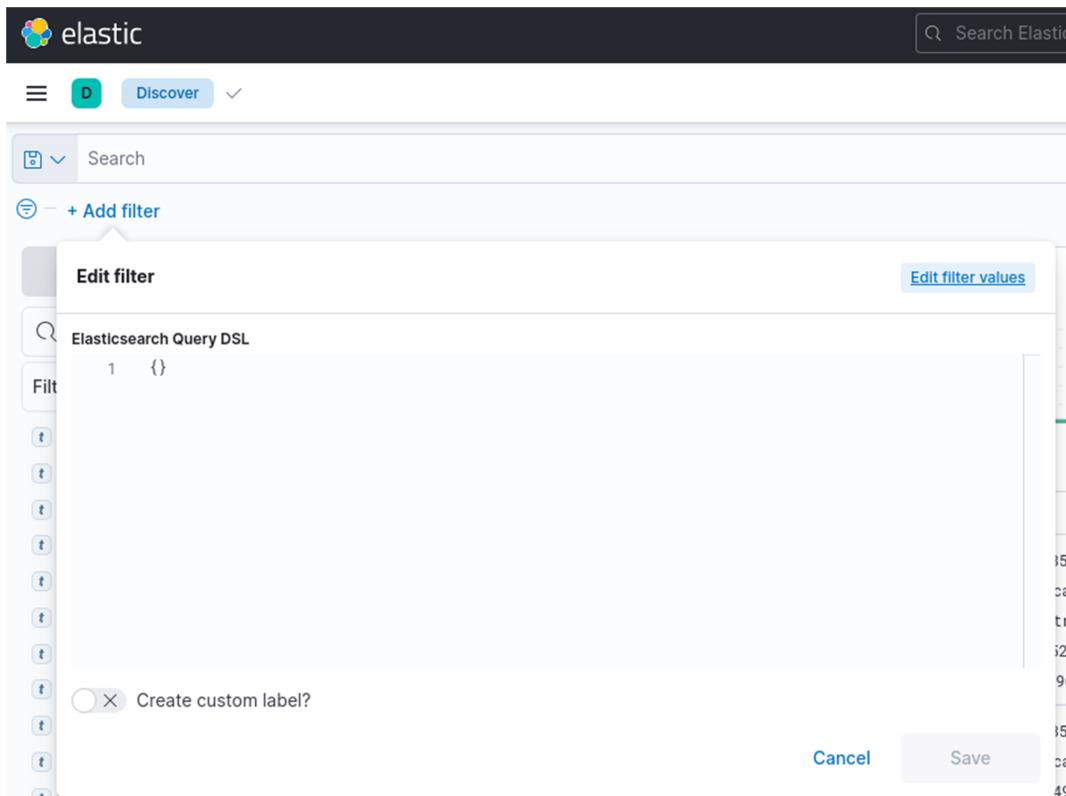


**Figure 411. KQL Toggled On**

The filter bar just below the search bar allows for a strict search of values. Filters are composed either through pick menus, which is the default, or through free form Query Domain Specific Language (DSL).

**Figure 412. Filter Bar - Pick Menus**

To switch the filter to the free form Query DSL, select the text in the right side of the filter that says "Edit as Query DSL," and the filter will swap to show the following:

**Figure 413. Filter Bar - Free Form Query DSL**

Use filters to search based on absolute values, and queries to conduct a search based on relevance.

Controls at the top of the page allow for saving the current search, opening a previous search, starting a new search, and displaying a URL for the current search.



Figure 414. Search Control

#### 5.3.17.4 The Visualize Tab - Visual Interpretation of Searches of Interest

The Visualize Tab (via the Visualize Library option) allows for analysis of audit data graphically, using charts, graphs, tables, and gauges. Source data can be from a new search or from a search saved in the Discover Tab.

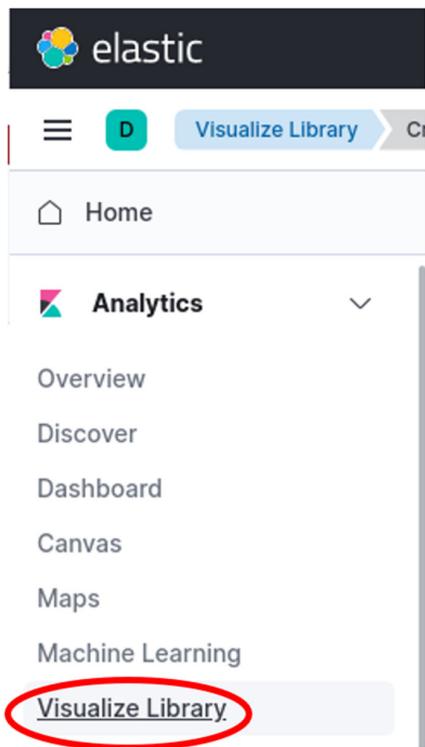
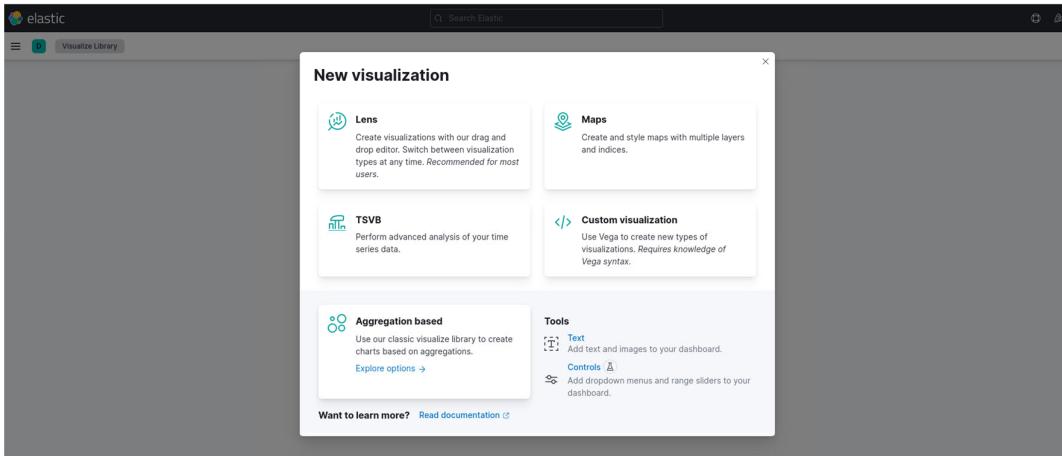
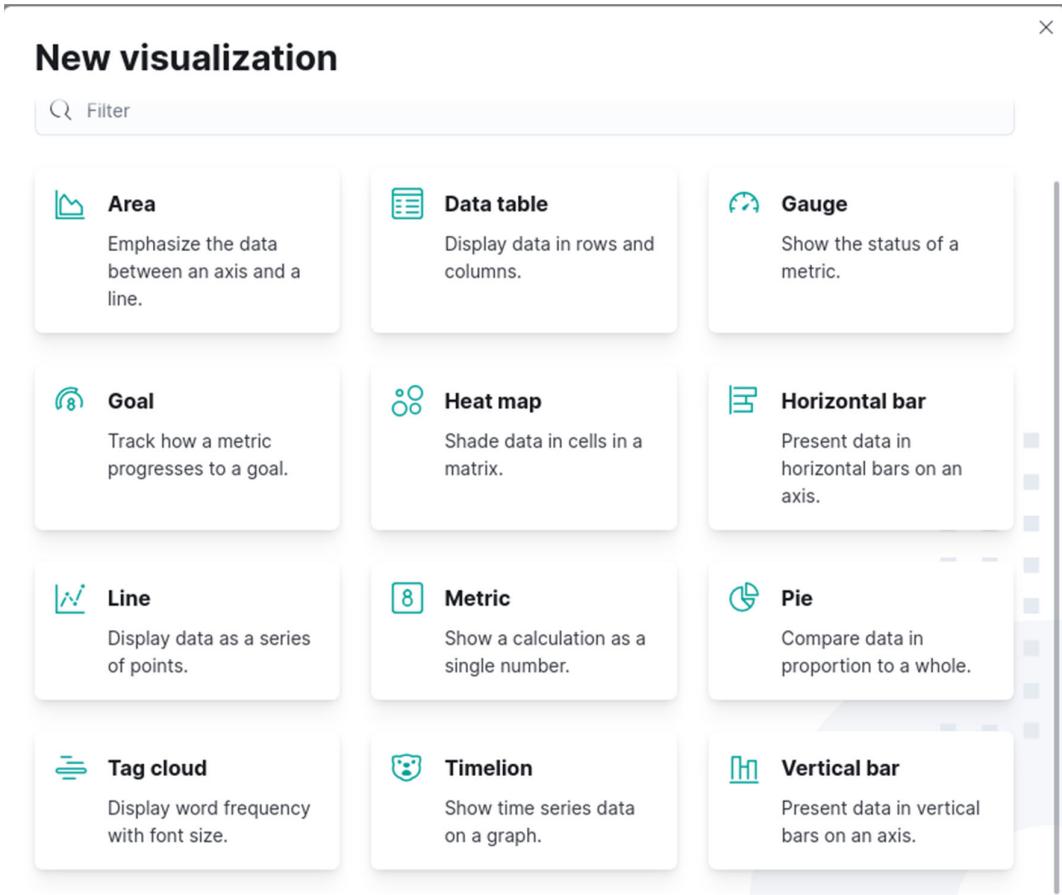


Figure 415. Accessing the Visualize Tab/Library



**Figure 416. Visualize Tab - New Visualization Options**

There are multiple ways to use the Visualization tab. The "Lens" option allows for visualization with a drag and drop editor. The "Aggregation based" option displays a library of visualization options and allows the user to easily create charts based on aggregations.



**Figure 417. Aggregation Based Visualization Options**

From there, different visualizations can be selected for display, such as a pie chart:

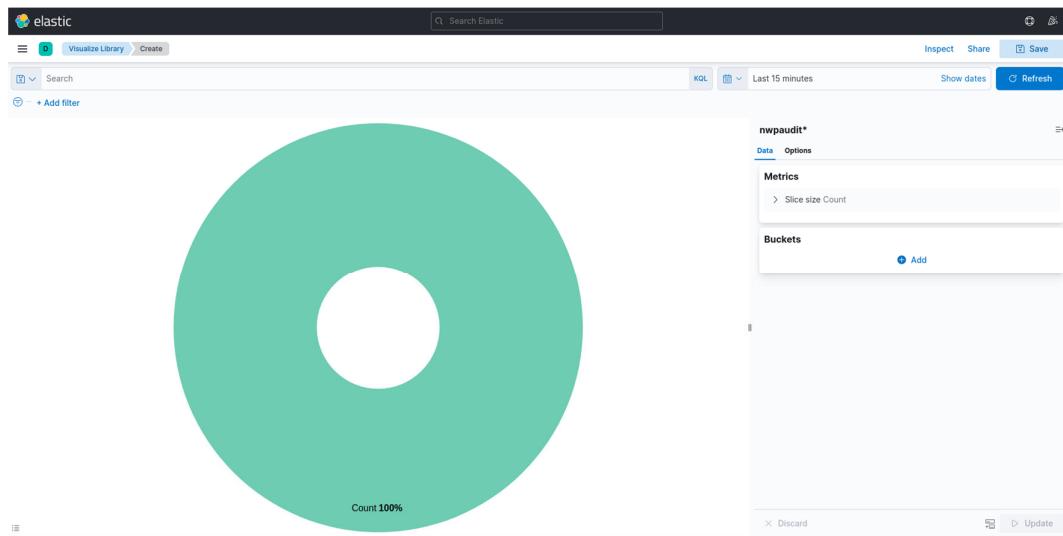


Figure 418. Visualize Pie Chart

#### 5.3.17.5 The Dashboard Tab - Monitoring/Reporting of Multiple Visualizations

The Dashboard Tab allows for the composition of multiple visualizations, allowing multiple audit events of interest to be monitored/reported at once.

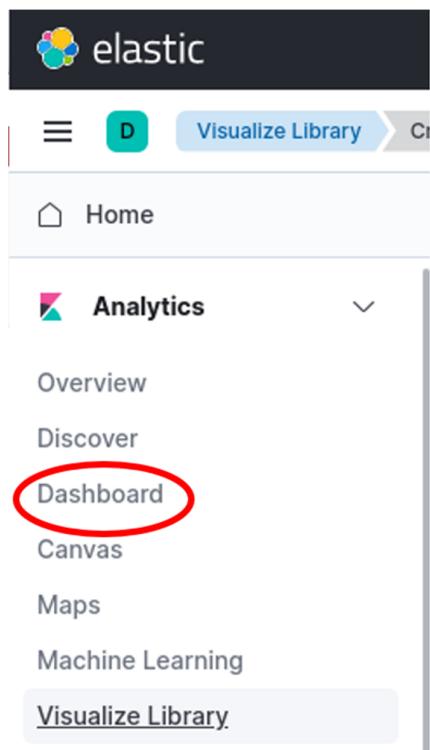
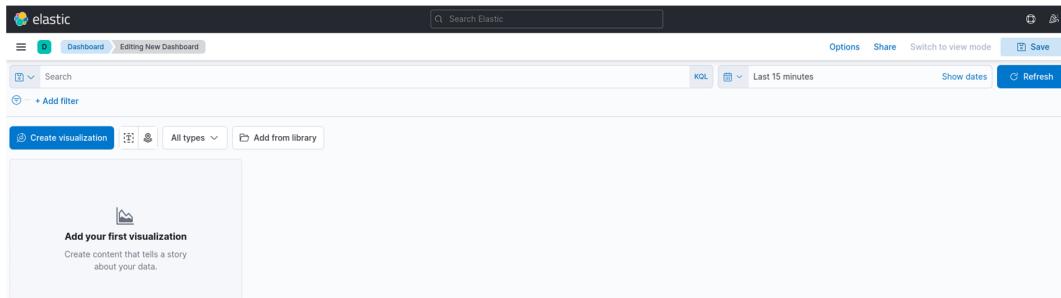
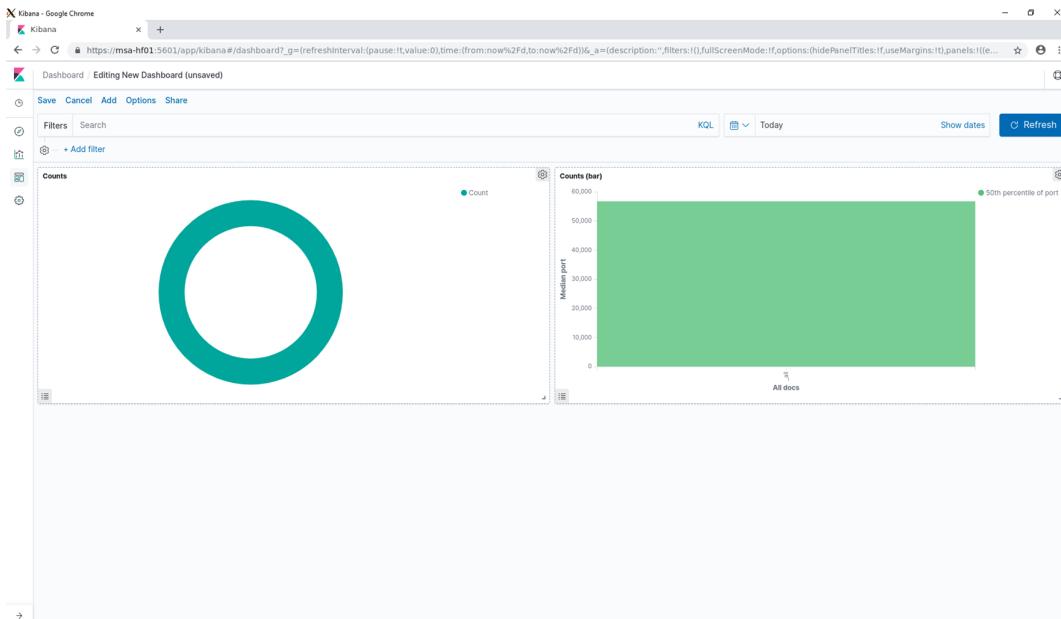


Figure 419. Accessing the Dashboard Tab



**Figure 420. Empty Dashboard With No Visualizations**



**Figure 421. Dashboard Tab With Visualizations**

### 5.3.17.6 Exporting Audit Data

In order to export audit data, first generate a query or filter in the Discover tab to find the data of interest (searched for 'login' below)

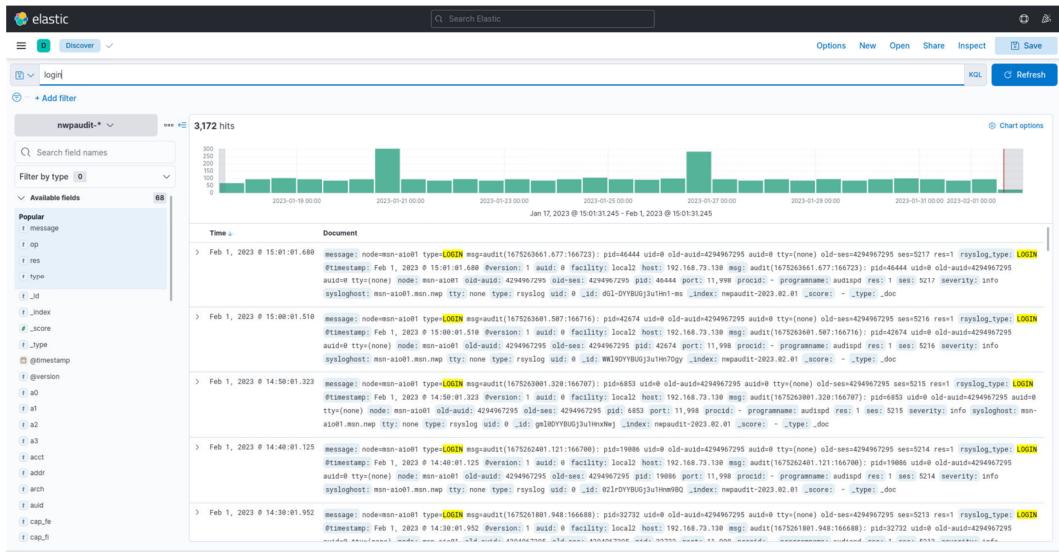


Figure 422. Example Query

Now that a query has been generated, it can be exported from the "Share" option in the upper right corner

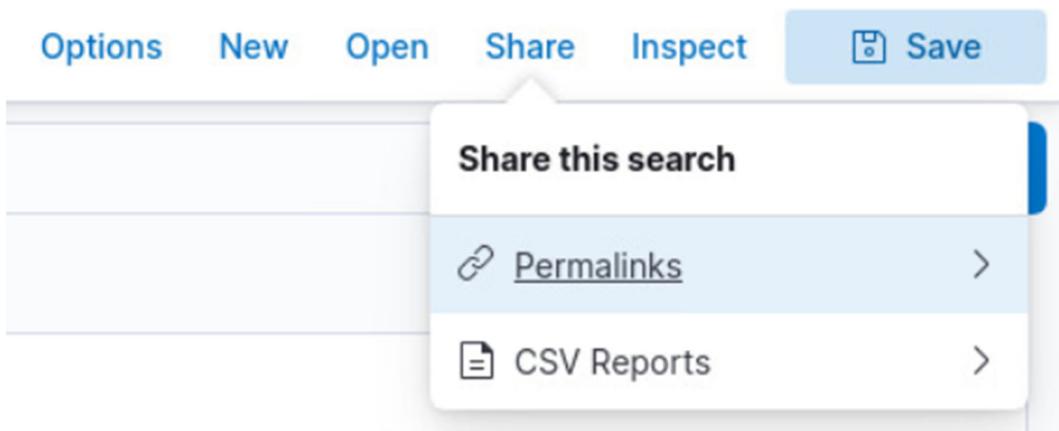


Figure 423. Share this search

Select the "CSV Reports" option and select "Generate CSV":

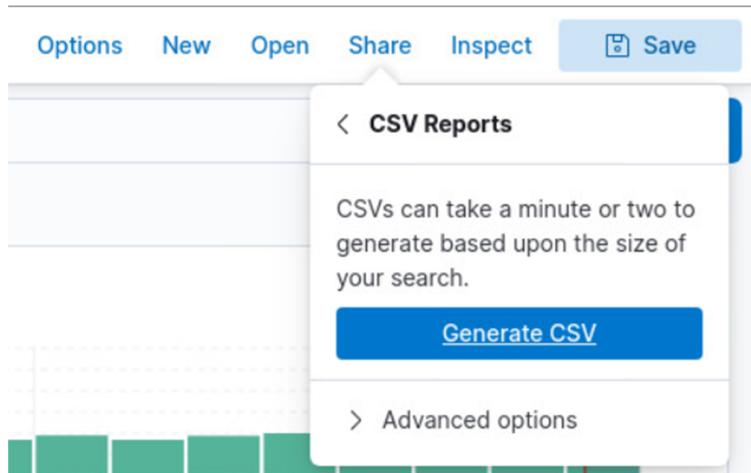


Figure 424. Generate CSV Report

This will trigger the system to generate your report in the background. The finished reports can be found by selecting Stack Management under the Management tab then selecting Reporting under Alerts and Insights:

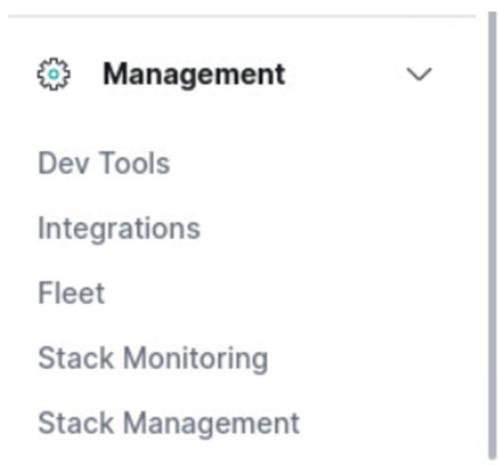


Figure 425. Retrieving the Report

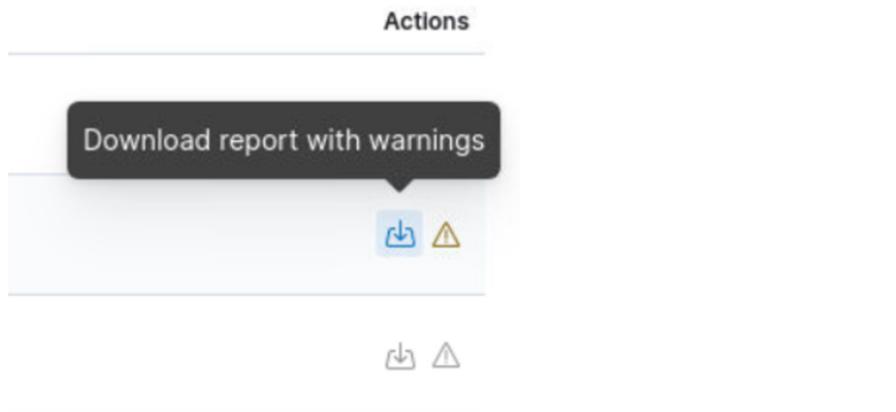


The Reporting tab will show all of the export reports

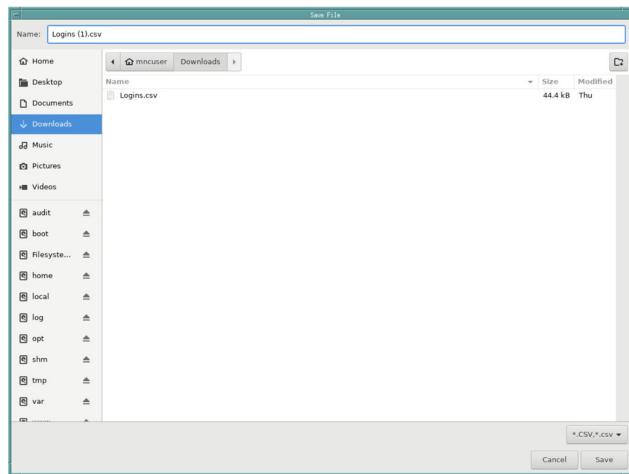
| Report             | Created at            | Status                                                                | Actions                              |
|--------------------|-----------------------|-----------------------------------------------------------------------|--------------------------------------|
| Login15Days search | 2023-02-01 @ 03:08 PM | Failed at 2023-02-01 @ 03:08 PM<br>See report info for error details. | <span style="color: red;">✗</span>   |
| Logins search      | 2023-01-26 @ 04:12 PM | Completed at 2023-01-26 @ 04:13 PM<br>See report info for warnings.   | <span style="color: green;">✓</span> |
| Logins search      | 2023-01-26 @ 03:48 PM | Completed at 2023-01-26 @ 03:48 PM<br>See report info for warnings.   | <span style="color: green;">✓</span> |

**Figure 426. Display of Generated Reports**

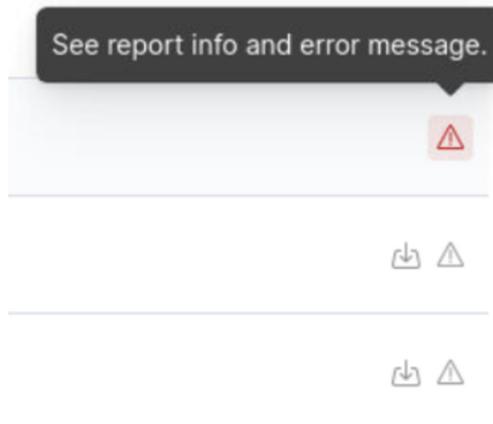
If the report was successfully generated you can click the download button to download it and the user will be prompted to choose a location to download.



**Figure 427. Download Report**



If there were errors in the query these can be seen by clicking the exclamation point button which will cause a pane to pop out from the right containing the errors or warnings generated



**Figure 428. Report Errors or Warnings**

**Report info**

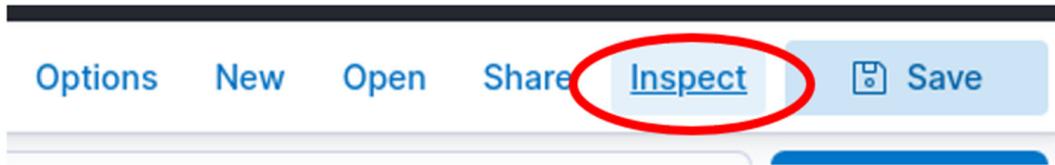
2023-02-01 08:03:08 PM

|               |                                                |
|---------------|------------------------------------------------|
| Time zone     | Africa/Abidjan                                 |
| Started at    | 2023-02-01T15:08:30.985Z                       |
| Completed at  | 2023-02-01T15:08:36.716Z                       |
| Processed by  | msn-elk (0fd701c9-4e95-4a03-a0b0-721efc944545) |
| Content type  | n/a                                            |
| Size in bytes | n/a                                            |
| Attempts      | 3                                              |
| Max attempts  | 3                                              |
| Timeout       | 120000                                         |
| Export type   | csv_searchsource                               |

Error Error: Max attempts (3) reached for job Idlszjed000o7ebfb0ghgjs9. Failed with: <html>\r\n<head> <title>413 Request Entity Too Large</title> </head>\r\n<body>\r\n<center>413 Request Entity Too Large</h1> </center>\r\n<br> <center>nginx</center>\r\n</body></html>

#### 5.3.17.7 Alternative Export Method

Kibana sources all its information through the Elasticsearch REST endpoint. It also will show you how it got the information you're asking for, letting you make your own requests as well. To do this first select the "Inspect" option towards the top right of the page

**Figure 429. Inspect Option**

A pane will pop out from the right side of the screen:

The Inspector pane displays the following information:

- Request:** Documents
- Statistics:**
  - Hits: 500
  - Index pattern: nwpaudit\*
  - Index pattern ID: bdfd38c0-d09b-11ec-b7d3-6f57b7a006e2
  - Query time: 370ms
  - Request timestamp: 2022-05-10T20:32:16.862Z

**Figure 430. Inspector Pane Pop Out**

Select "Request", and JSON will be displayed for the request:

```

{
 "track_total_hits": false,
 "sort": [
 {
 "timestamp": {
 "order": "desc",
 "unmapped_type": "boolean"
 }
 }
],
 "fields": [
 {
 "field": "*",
 "include_unmapped": true
 },
 {
 "field": "timestamp",
 "format": "strict_date_optional_time"
 }
],
 "size": 500,
 "version": true,
 "script_fields": {},
 "stored_fields": []
}

```

**Figure 431. Request Pane of Inspector**

From there, copy the query from the Request pane:

```

"query": {
 "bool": {
 "must": [
 {
 "query_string": {
 "query": "nwpaudit*"
 }
 }
]
 }
}

```

```

 "query": "rsyslog_type:user_logout",
 "analyze_wildcard": true
 }
},
{
 "range": {
 "@timestamp": {
 "format": "strict_date_optional_time",
 "gte": "2019-08-15T22:32:37.726Z",
 "lte": "2019-08-15T22:47:37.726Z"
 }
 }
},
],
"filter": [],
"should": [],
"must_not": []
}
}
}

```

Open a terminal and enter the following command, replacing <admin\_user> with the administrator's user name, <password> with the administrator's password, <fqdn> with the fully qualified domain name of the local node, <num\_results> with the number of top matched results to show, up to 10000, and <query> with the query string:

```
curl -u <admin_user>:<password> -H'Content-Type: application/json' https://<fqdn>:9200/nwpaudit-*/_search?pretty -d '{ "size": <num_results>, <query> }'
```

For example:

```
curl -u domainadmin:secret -H'Content-Type: application/json' https://atl-hf01.gec.nas.faa.gov:9200/nwpaudit-*/_search?pretty -d '{ "size": 300, "query": { "bool": { "must": [{ "query_string": { "query": "rsyslog_type:user_logout", "analyze_wildcard": true } }, { "range": { "@timestamp": { "format": "strict_date_optional_time", "gte": "2019-08-15T22:32:37.726Z", "lte": "2019-08-15T22:47:37.726Z" } }] }, "filter": [], "should": [], "must_not": [] } }
```

The above will write the report to the terminal session. When happy with the output, use a redirect (i.e., append "> filename" to the above command) to write the report to a file.

#### 5.3.17.8 Background - NWP Audit Dataflow

NWP sources its audit data from the Linux Audit daemon and the httpd log (for user events from IdM). These logs are processed by rsyslog for distribution to the NCMS and to a local instance of Logstash. Logstash is used to filter the incoming information and break apart messages into fields of interest for later searches. Logstash then sends this information to a local instance of Elasticsearch, an engine for storing and searching information. Elasticsearch stores the information in a database broken into pieces called "shards," and in the NWP configuration, one primary shard is kept on each node for load sharing purposes, and one backup shard is kept on each NWP node for providing data redundancy and failure resilience. The backup shard kept on each node represents a different piece of the database than the primary, so that in the loss of one or even a few nodes, the system is able to utilize the backup shards to take the place of the lost primaries. Elasticsearch provides an API for searching the documents stored in this database, and Kibana accesses this API, providing a GUI from which the audit data can be analyzed.

#### 5.3.18 Automated System Loader (ASL)

The Automated System Loader is a collection of various utilities and custom tailored scripts resulting in a complete, repeatable, and configurable installation framework. This installation framework installs the Red Hat Enterprise Linux (RHEL) Edition Operating System and additional COTS and Open Source Software packages, together with software, hardware and network configuration files. For example, ASL installs Identity Manager (IdM) for user authentication, Kibana for audit log visualization, Chrome for AWD and M&C display, and Network File System (NFS) for networked file storage. At the completion of the ASL phase, the system is ready for the installation of the NWP application software.

On operating system login to a server or AWD workstation, the message of the day displays information regarding the most recent ASL installation, including the ASL version (or image) name entered at the ASL build phase, the Linux kernel version, and time of last installation. This information is also available by listing the content of file /etc/motd on a node.

```
#####
This system was automatically installed by a set of
ASL Scripts.
#
Name: mso-awd01
Date: Wed Apr 27 14:44:31 UTC 2022
#
Project: NWP
Site: mso
O/S Rel: Linux 3.10.0-1160.49.1.el7.x86_64
ASL Version: 20220427_RL_rpms
#
Any system changes, not reconciled into the ASL
Scripts, will be *LOST* in the event that the Operating
System needs to be reloaded.
#
#####
```

**Figure 432. Message Of The Day**

Similarly to the NWP application software, ASL is configuration management (CM) controlled within a Git repository. On operating system login to a server or AWD workstation, additional version information is kept in /etc/asl/asl\_build\_info, which contains the ASL version, Git branch, Git tag, and any commits that deviate from the tag.

```
ASL Build Information File

Git Build Information:
Branch: development Tag: 20180508

Date and Time Stamp:
20180508_1406

Build Identification:
20180508
```

**Figure 433. Build Information**

The ASL version (or image) is built on an ASL server and can then be deployed to a Domain site, NWP-A site, EWS site, or Adaptation Manager node from media to each node individually. Site ASL deployment is always from media, and the remainder of this section primarily describes the ASL process starting with the installation from existing media; however, the ASL build process and ASL media creation (sections 5.3.18.1-2) are briefly described for context and completeness.

### **5.3.18.1 IdM and Hosts Backup**

Follow this section to create backups of IdM user accounts and hosts. This is not required to do pre-ASL but can be followed if additional user accounts have been created and need to be carried over to the system post-ASL or for conducting regular backups.

From the primary HF,

1. Log in as user with sudo permissions.

2. Execute the command: `sudo ipa-backup`
3. Copy the backup directory (`ipa-full-<YYYY-MM-DD-HH-MM-SS>`, ex. `ipa-full-20230428143148`) from `/var/lib/ipa/backup/` to removable media to preserve it.
4. Copy the `/etc/hosts` file to removable media to preserve it.
  - a. Make note of the original permissions and owner (via `ls -l`) on this file for future reference.

*Note: if needed, refer to section 5.3.21 on how to mount and unmount encrypted removable media.*

### 5.3.18.2 ASL Build

To create a new ASL image from the Git repository:

1. Login to the ASL build engine as a development user; this may be the same as the central ASL server.
2. `cd <repository base directory>/builds`
3. To create a build for network install, execute `./build_custom -v <unique ASL version ID prefix> -i <ASL image>` to run the build script for the selected image.
  - a. When the build is complete, the image will be in `/local/asl/<ASL image>`.
4. To create a build for media install, execute `./build_custom -v <unique ASL version ID prefix> <ASL image> [...subsequent ASL image]` to run the build script for the selected ISO image(s). Media installs consist of two parts: an operating system image, which contains a server-level image, and a custom image containing the ASL post-install scripts and other supplemental software loaded during the post-install process.
  - a. When the build(s) is/are complete, the ISO image(s) will be in `/local/asl/builds`.

### 5.3.18.3 Creating ASL Media

To create ASL on media from a newly created or existing ASL build:

1. Login to the ASL build engine as the root user.
2. `cd /local/asl/builds`
3. If the ASL server cannot write media, execute `scp <ASL image>.iso <destination user>@<destination equipment>:to copy each ISO image over the network to the home directory of the destination user on the destination equipment that can burn media. On the equipment that can burn media, execute wodim dev=/dev/cdrom -eject -v -data <ASL image>.iso to write the ISO image to the media. 2 DVDs are created, one each for ISO: ASL Server OS Disk and ASL String Disk.`

### 5.3.18.4 Media ASL

The mechanism to perform an ASL install from removable media is dependent on the hardware (R740 for Domain HF and Domain/NWP-A Test Harness, R640 for Domain PG and NWP-A ADS or EWS, & T3420 for Dedicated AWD, Workstations, Update Manager, and Adaptation Manager). In addition, there are post-ASL tasks to configure the Domain HFs as replicated Red Hat Identity Manager (IdM) servers and to configure the network file storage for a site.

#### 5.3.18.4.1 Domain HF (R740) and PG (R640)

*When running Domain ASLs, ASL should be run first and IdM configured on HF01; then ASL may proceed on HF02 and all of the PG machines.*

1. Power on the machine.
2. When power up is complete, DELL EMC will be displayed over a blue background. When the screen transitions to a black terminal with options displayed, press F2 for system setup.
3. Select device settings. Select Integrated RAID Controller option. Scroll down to the *Actions* header, and select the *Configure* option.
4. Select *Clear Configuration*. Check the *Confirm* box and select *Yes*. Select *Okay* to confirm the action has completed successfully.
5. Select *Create Virtual Disk*. From the drop down menu for *Select RAID Level*, select *RAID6*. Confirm that *Unconfigured Capacity* is selected. Select *Select Physical Disks*.
6. Ensure *Media Type* has *HDD* selected, *Interface Type* has *Both* selected, and *Logical Sector Size* has *Both* selected. Scroll down; under *Choose Unconfigured Physical Disk*, select *Check All*. Select *Apply Changes*, and select *OK*.
7. Scroll down to the *Default Initialization* option and select *Fast*. Select *Create Virtual Disk*. Check the *Confirm* box and select *Yes*. Select *OK* to confirm. Select *Back*, then *Back*, then *Finish*, and *Finish*.
8. Select *System Bios*. When the menu appears, select *Boot Settings*. Ensure that *Boot Mode* is set to *UEFI*. Click exit in the top right corner.
  - a. If changes were applied, select *Yes* to save changes, and select *OK* to confirm. Select *Finish* and select *Yes* to confirm.
9. The machine will reboot. On startup, press F2 for system setup. Select *System Bios*. When the menu appears, select *Boot Settings*, then select *BIOS Boot Settings*.
10. Verify the sequence reads *Embedded SATA Port Optical Drive L: EFI DVD/CDROM 1*, then *Integrated RAID Controller 1: Red Hat Enterprise Linux*, then *PXE Device 1: Integrated NIC 1 Port 1 Partition 1*.
  - a. If not, select *Boot Sequence* and use +/- to move the sequence to the correct order. Select *Exit*.
  - b. If changes were applied, select *Yes* to save changes, select *OK* to confirm.
  - c. Select *Finish* and select *Yes* to confirm. The machine will reboot.
11. Wait for the machine to reboot and begin loading BIOS again. While the machine looks for a place to boot from, insert the ASL Server OS Disk. Press F11, select *One Shot Boot Menu*, and select to boot from the DVD drive. **Note:** Inserting the DVD before the reboot takes place corrupts the inserted DVD and should not be done for any reason.
12. When prompted for a password, enter the ASL password.
13. Enter the name of the machine being ASL'd. Enter the number corresponding to site being ASL'd. This could be Domain, Workstations/AWD or NWP-A.
14. If there is a need to modify an environment variable (e.g., *IDM\_CLIENT\_PASSWORD*) prior to ASL:
  - a. When prompted, enter 'C' to indicate that a variable needs to be changed.
  - b. Enter the variable name (e.g., "IDM\_CLIENT\_PASSWORD") when prompted for the variable name.
  - c. Enter the variable value (e.g., the *admin password*) when prompted.
15. When prompted, enter 'X' to indicate that variable settings are completed and confirm that ASL should be started.
16. Wait for the system to eject the disk and prompt for the insertion of the ASL String Disk.

- 17.** Insert the ASL String Disk. Wait for the disk to spin up, press enter. If prompted with "ERROR: Failed to mount disc," wait longer and press enter again to retry. Wait for the disk to load.
- 18.** When disk has completed loading, the disk will eject.

Post ASL install, Identity Manager is configured for each HF, as the root user, as follows:

- 1.** If no domain HF has been previously set up across NWP, it is necessary on the first HF to run `/usr/local/bin/configure_idm_server -i`. This script configures the initial IdM domain for use, including setup of the default administration account.
- 2.** If an IdM backup was created pre-ASL and should be restored (see 5.3.18.1 for more information):
  - a.** Load the IdM backup (`ipa-full-<YYYY-MM-DD-HH-MM-SS>`) directory via removable media onto the primary HF. Make note of the path to backup for the next step.
  - b.** Execute the following commands to restore the backup:
 

```
ipa-restore </path-to-backup>
/usr/local/bin/remove_replica_server --server <FQDN of
secondary HF>
Note: if the admin password has been changed, instead of the above command,
run /usr/local/bin/remove_replica_server --server <FQDN of
secondary HF> --admin-password and enter the new admin password when
prompted.
kinit admin <admin password>
ipa host-mod --sshpubkey= --updatedns <FQDN of primary HF>
cd /etc/ssh
KEY1=`cat ssh_host_ecdsa_key.pub`; KEY2=`cat
ssh_host_ed25519_key.pub`; KEY3=`cat ssh_host_rsa_key.pub`;
ipa host-mod --sshpubkey="$KEY1" --sshpubkey="$KEY2" --
sshpubkey="$KEY3" --updatedns <FQDN of primary HF>
```
  - c.** Copy in the previously archived hosts file to `/etc/hosts`, and ensure the permissions and owner match that of the original.
- 3.** Otherwise, if at least one domain HF has already been set up, run `/usr/local/bin/configure_idm_server`. This script will replicate the existing IdM database onto the newly-imaged server.

Post ASL install, on HF01 and HF02:

- 1.** Enter the following command to observe that sp01:/nwpshare (the storage array) is mounted on `/nwpshare`: `df -h`
  - a.** Note: Confirm the storage array's ownership is set to `nwpapp:nwpapp`.
- 2.** Check that `/var/nfs` has been mounted. If not, mount it: `sudo mount /var/nfs`

#### 5.3.18.4.2 NWP-A ADS and EWS (R640)

Since NWP-A ADS and EWS servers are R640 servers, the ASL mechanism is identical to the Domain PG, as detailed in 5.3.18.4.1.

#### 5.3.18.4.3 Dedicated AWD, Workstations, Adaptation Manager, and Update Manager (T3420)

- 1.** Power on the machine.
- 2.** As the machine boots, repeatedly press F12 until the boot options are displayed.

3. There will be lists of boot options, including LEGACY BOOT, UEFI BOOT and OTHER OPTIONS. If LEGACY BOOT is available continue to step 6. If LEGACY BOOT is not available, select *Change Boot Mode Settings*.
4. Select *Legacy Boot Mode*. Answer Yes to proceed. Select *Apply The Changes*. The machine will reboot.
5. Select *BIOS Setup*, select the *Boot Sequence* menu.
6. Under *Boot List Option*, select *Legacy*, if not already selected.
7. Boot Sequence options should appear. Ensure each option is checked.
8. If changes were made, select the *Apply* button. Select *Okay* to confirm.
9. Select *Exit*. The machine should begin to reboot.
10. As the machine boots, repeatedly press F12 until the boot options are displayed.
11. Insert the OS Server disk.
12. Under *Legacy Boot*, select *CD/DVD/CD-RW Drive* to begin the ASL.
13. When prompted for a password, enter the ASL password.
14. Enter the name of the machine being ASL'd. Enter the number corresponding to the site being ASL'd for the NWP-A/AWD.
15. Wait for the system to eject the disk and prompt for the insertion of the ASL String Disk.
16. Insert the ASL String Disk. Wait for the disk to spin up, and press enter. If prompted "ERROR: Failed to mount disc," wait longer, and press enter again to retry.
17. Wait for the disk to load. When disk has completed loading, the disk will eject.

#### 3.18.4.4 Reindex Elasticsearch

Post ASL, the initial Elasticsearch index may need to be reindexed in order to use the correct template.

**Note:** Commands with <user> will need administrative Elasticsearch cluster privileges as needed.

On HF01, enter the following command to view the settings of the first index, where <nwpaudit-yyyy.mm.dd> will be replaced with nwpaudit-<ASL date>: curl -u <user> https://\$(hostname -f):9200/<nwpaudit-yyyy.mm.dd>/\_settings?pretty

**NOTE:** If Elasticsearch responds with error messages indicating *readonlyrest failed to start*, *restart elasticsearch.service on HF01*, and try the curl command again.

If the outputted settings contains the elements within /etc/logstash/templates/rsyslog-template.json (except for index\_patterns and order), then the initial index is correct, and the remaining steps in this procedure can be skipped. If the settings differ, continue the procedure to reconfigure the first index.

On HF01:

1. Stop logstash on all nodes:
  - a. For HFs, enter the command: `for x in {01..02}; do echo "hf$x"; ssh -o loglevel=error hf$x "sudo systemctl stop logstash.service"; done`
  - b. For PGs, enter the command: `for x in {01..14}; do echo "pg$x"; ssh -o loglevel=error pg$x "sudo systemctl stop logstash.service"; done`
2. Enter the following command to ensure all data has been written to the cluster (command will fail if data is still being indexed, so run the command multiple times until successful)

```
curl -u <user> -X POST "https://$(hostname -f):9200/_flush?pretty"
```

3. Note the document count of the initial index.

```
curl -u <user> -X GET https://$(hostname -f):9200/<nwpaudit-yyyy.mm.dd>/_count?pretty
```

4. Create a temporary reindex for the initial data.

```
curl -u <user> -X POST "https://$(hostname -f):9200/_reindex?pretty" -H 'Content-Type: application/json' -d'
{
 "source": {
 "index": "nwpaudit-yyyy.mm.dd"
 },
 "dest": {
 "index": "tempreindex"
 }
}'
```

#### Code Block 1 Temporary Reindex

5. Confirm that the temporary index contains the same document count as the initial index.

```
curl -u <user> -X GET https://$(hostname -f):9200/tempreindex/_count?pretty
```

6. Delete the initial index.

```
curl -u <user> -X DELETE https://$(hostname -f):9200/<nwpaudit-yyyy.mm.dd>?pretty
```

7. Reindex the temporary index back into <nwpaudit-yyyy.mm.dd> with the correct template:

```
curl -u <user> -X POST "https://$(hostname -f):9200/_reindex?pretty" -H 'Content-Type: application/json' -d'
{
 "source": {
 "index": "tempreindex"
 },
 "dest": {
 "index": "nwpaudit-yyyy.mm.dd"
 }
}'
```

#### Code Block 2 Reindex Temporary Index

8. Confirm that the new index contains the same document count as the temporary index.

```
curl -u <user> -X GET https://$(hostname -f):9200/<nwpaudit-yyyy.mm.dd>/_count?pretty
```

9. Confirm that the new template uses settings within /etc/logstash/templates/rsyslog-template.json (except for index\_patterns and order):

```
curl -u <user> https://$(hostname -f):9200/<nwpaudit-yyyy.mm.dd>/_settings?pretty
```

10. Delete the temporary index.

```
curl -u <user> -X DELETE https://$(hostname -f):9200/tempreindex?pretty
```

11. Start logstash on all nodes:

- a. For HFs, enter the command: `for x in {01..02}; do echo "hf$x"; ssh -o loglevel=error hf$x "sudo systemctl start logstash.service"; done`
- b. For PGs, enter the command: `for x in {01..14}; do echo "pg$x"; ssh -o loglevel=error pg$x "sudo systemctl start logstash.service"; done`

### 5.3.19 Reserved

### 5.3.20 COTS/FOSS/OS and Chrome Updates

The NWP System implements updates to COTS/FOSS/OS and Google Chrome through the use of rpm packages, where available. Though most machines will be updated through the Update Server, the PG nodes and the Adaptation Manager will not have direct access to the Update Server. As a result, the Adaptation Manager will need to get its updates via a USB drive, and the PG nodes will need to get their updates from the Domain HFs. It is expected that the end user will obtain the necessary packages and metadata for the packages that will be updated. The packages and metadata should be placed onto a USB drive.

**NOTE:** Whenever `aide_scan.sh -u` is run, the AIDE database will be reinitialized. To check for file changes before re-initializing the database, follow the optional steps. However, checking for file changes may take a significant amount of time.

**NOTE:** If a user with administrative privileges (i.e., system administrator) is unavailable, the root account may be used.

#### 5.3.20.1 Syncing the Repositories for Red Hat Enterprise Linux

The NWP machines use the Red Hat server repositories. A valid RHEL server license is needed to sync the server packages. `Reposync` can be used to pull the packages to a local location. To pull a repository and move it to a thumb drive, follow the steps below:

1. Login to an internet-connected RHEL machine with a valid RHEL subscription (an internet connection is required to retrieve the latest changes from Red Hat).
2. Run the following reposync commands, as a system administrator, to retrieve the latest changes from Red Hat and place the repositories in `/tmp`:
  - a. **For RHEL 7:**

```
sudo reposync --gpgcheck -l --repoid=rhel-7-server-rpms --
download-metadata --download_path=/tmp --newest-only
sudo reposync --gpgcheck -l --repoid=rhel-7-server-optional-
rpms --download-metadata --download_path=/tmp --newest-only
sudo reposync --gpgcheck -l --repoid=rhel-7-server-extras-
rpms --download-metadata --download_path=/tmp --newest-only
```
  - b. **For RHEL 9:**

```
sudo reposync --gpgcheck --repoid=rhel-9-for-x86_64-
appstream-rpms --download-metadata --download_path=/tmp --
newest-only
sudo reposync --gpgcheck --repoid=rhel-9-for-
x86_64-baseos-rpms --download-metadata --download_path=/tmp -
newest-only
sudo reposync --gpgcheck --repoid=rhel-9-for-
x86_64-highavailability-rpms --download-metadata --download-
path=/tmp --newest-only
sudo reposync --gpgcheck --
repoid=rhel-9-for-x86_64-supplementary-rpms --download-
metadata --download_path=/tmp --newest-only
```

3. Mount the USB drive onto the machine that contains the repositories.
4. Move the repositories onto the USB drive:
  - a. **For RHEL 7:**  
`mv /tmp/rhel-7-server-rpms /tmp/rhel-7-server-optional-rpms  
 /tmp/rhel-7-server-extras-rpms <mounted location of thumb  
 drive>`
  - b. **For RHEL 9:**  
`mv /tmp/rhel-9-for-x86_64-appstream-rpms /tmp/rhel-  
 9-for-x86_64-baseos-rpms /rhel-9-for-x86_64-highavailability-  
 rpms /tmp/rhel-9-for-x86_64-supplementary-rpms <mounted  
 location of thumb drive>`
5. Unmount the USB drive.
6. Exit out of the internet-connected RHEL machine with a valid RHEL subscription.

### 5.3.20.2 Syncing the Repository for Google Chrome

This update repository is used for updating Google Chrome. RPMs can be dropped in here to be made available for updates.

1. Login to an internet-connected RHEL machine (an internet connection is required to retrieve the latest changes for Google Chrome).
2. Run reposync, as a system administrator, to get the latest changes for Google Chrome and place the directory in /tmp:  
`sudo reposync --gpgcheck -l --repoid=google-chrome --download-  
 metadata --download_path=/tmp --newest-only`
3. Mount the USB drive onto the machine that contains the repository.
4. Move the repository onto the USB drive:  
`mv /tmp/google-chrome <mounted location of thumb drive>`
5. Unmount the USB drive.
6. Exit out of the internet-connected RHEL machine.

### 5.3.20.3 Preparing RPMs for the COTS/FOSS Update Repository

The COTS/FOSS update repository is used for updating any software that is not Google Chrome or provided by RHEL. RPMs can be placed in this repository and made available for updates. Examples of these RPM packages include the following:

1. RPMs built internally by NWP such as the SMS Agent, Postgres, and ActiveMQ
2. Elasticsearch, Logstash, and Kibana (ELK) packages for the NWP domain
3. Other COTS/FOSS packages such as those from the Extra Packages for Enterprise Linux (EPEL) repo that were installed initially by ASL and may need to be updated in the future

A complete list of RPMs, the process for building internal packages and how to acquire updates to rpms originally installed by ASL are provided in Software Engineering Environment (SEE) documentation. The creation of these update packages will be handled by Second Level Engineering. The steps below can be executed on a SEE developer workstation to prepare the packages to be moved to the operation NWP update server for distribution to NWP systems.

1. Login to a RHEL machine.
2. Create a directory in /tmp to consolidate RPMs:  
`mkdir -p /tmp/software-updates/`
3. Copy all necessary RPMs to the temporary directory:  
`cp <path to RPM> /tmp/software-updates`
4. Mount the USB drive onto the machine that contains the repository.

5. Move the repository onto the USB drive:  
`mv /tmp/software-updates <mounted location of thumb drive>`
6. Unmount the USB drive.
7. Exit out of the RHEL machine.

#### 5.3.20.4 Creating the RHEL Repository at the Update Server

To create an update repository for the Update Server, follow these instructions for moving the packages and metadata to /var/www/html/rhel-update-repository, creating the new repo data, and rebuilding the AIDE database.

It is optional to check for AIDE database inconsistencies before updating the repositories. All of the following steps are mandatory:

1. Use the command `lsblk` to see the current drives, to later compare in step 5 after the USB drive is inserted.
2. Insert the USB drive, containing packages and metadata, into the Update Server.
3. Log into the Update Server as a user with administrative privileges, as needed.
4. If the directory `/media/stick` does not exist, create it:  
`sudo mkdir -p /media/stick`
5. Mount the USB drive; `lsblk` can be run to find drive, then run:  
`sudo mount <drive> /media/stick`
6. Copy the packages and metadata to /var/www/rhel-update-repository:  
`sudo cp -r /media/stick/rhel-7-server-* /var/www/html/rhel-update-repository`
7. Delete the old repodata directories if they exists.  
`sudo rm -r /var/www/html/rhel-update-repository/rhel-7-server-*/*repodata`
8. Create the new repo data by running the following commands:  
`sudo createrepo /var/www/html/rhel-update-repository/rhel-7-server-rpms`  
`sudo createrepo /var/www/html/rhel-update-repository/rhel-7-server-optional-rpms`  
`sudo createrepo /var/www/html/rhel-update-repository/rhel-7-server-extras-rpms`
9. After using the `createrepo` commands, change the directories created in the above step to have root apache ownership (`chown root:apache`) and 755 permissions (`chmod 755`).
10. Unmount the USB drive:  
`sudo umount /media/stick`
11. Re-initialize the AIDE database:  
`sudo /usr/local/bin/aide_scan.sh -u`

#### 5.3.20.5 Creating the Chrome Repository at the Update Server

To create an update repository for the Update Server, follow these instructions for moving the packages and metadata to /var/www/html/chrome-update-repository, creating the new repo data and rebuilding the AIDE database.

It is optional to check for AIDE database inconsistencies before updating the repositories. All of the following steps are mandatory:

1. Use the command `lsblk` to see the current drives, to later compare in step 5 after the USB drive is inserted.
2. Insert the USB drive, containing packages and metadata, into the Update Server.
3. Log into the Update Server as a user with administrative privileges, as needed.

4. If the directory /media/stick does not exist, create it:  
`sudo mkdir -p /media/stick`
5. Mount the USB drive; `lsblk` can be run to find drive, then run:  
`sudo mount <drive> /media/stick`
6. Copy the packages and metadata to /var/www/html/chrome-update-repository:  
`sudo rsync -rlpogtv /media/stick/google-chrome /var/www/html/chrome-update-repository/`
7. Delete the old repodata directory if it exists:  
`sudo rm -r /var/www/html/chrome-update-repository/google-chrome/repo-data`
8. Create the new repodata:  
`sudo createrepo /var/www/html/chrome-update-repository/google-chrome/`
9. Unmount the USB drive:  
`sudo umount /media/stick`
10. Re-initialize the AIDE database:  
`sudo /usr/local/bin/aide_scan.sh -u`

#### 5.3.20.6 Creating the General COTS/FOSS Update Repository at the Update Server

To create an update repository for the Update Server, follow these instructions for moving the packages and metadata to /var/www/html/software-update-repository, creating the new repodata, and rebuilding the AIDE database.

It is optional to check for AIDE database inconsistencies before updating the repositories. All of the following steps are mandatory:

1. Use the command `lsblk` to see the current drives, to later compare in step 5 after the USB drive is inserted.
2. Insert the USB drive, containing packages and metadata, into the Update Server.
3. Log into the Update Server as a user with administrative privileges, as needed.
4. If the directory /media/stick does not exist, create it:  
`sudo mkdir -p /media/stick`
5. Mount the USB drive; `lsblk` can be run to find drive, then run:  
`sudo mount <drive> /media/stick`
6. Copy the packages and metadata to /var/www/html/software-update-repository:  
`sudo rsync -rlpogtv /media/stick/software-updates/* /var/www/html/software-update-repository/software-update-rpms/`
7. Delete the old repodata directory if it exists:  
`sudo rm -r /var/www/html/software-update-repository/software-update-rpms/repo-data`
8. Create the new repodata:  
`sudo createrepo /var/www/html/software-update-repository/software-update-rpms/`
9. Unmount the USB drive:  
`umount /media/stick`
10. Re-initialize the AIDE database:  
`sudo /usr/local/bin/aide_scan.sh -u`

#### 5.3.20.7 Updating the Update Server

Updating the Update Server can only be done once the update repository has been created on the Update Server. To update the Update Server, update the repositories and re-initialize the AIDE database.

The following steps are optional:

1. Log into the Update Server as a user with administrative privileges.
2. Run a scan for AIDE database inconsistencies:  
`sudo /usr/local/bin/aide_scan.sh`
3. Check for AIDE database inconsistencies:
  - a. `sudo vim /var/log/aide/aide.log`
  - b. Analyze the log, and take appropriate action if any issues are found.

The following steps are mandatory:

1. Log into the Update Server as a user with administrative privileges, as needed.
2. Make the metadata in the yum repo usable:  
`sudo yum makecache`
3. Install the available updates:  
`sudo yum update`
4. Re-initialize the AIDE database:  
`sudo /usr/local/bin/aide_scan.sh -u`

#### 5.3.20.8 Updating the Adaptation Manager

The USB drive containing the software patches will be needed to update the Adaptation Manager.

The following steps are optional:

1. Log into the Adaptation Manager as a user with administrative privileges.
2. Run a scan for AIDE database inconsistencies:  
`sudo /usr/local/bin/aide_scan.sh`
3. Check for AIDE database inconsistencies:
  - a. `sudo vim /var/log/aide/aide.log`
  - b. Analyze the log, and take appropriate action if any issues are found.

The following steps are mandatory:

1. Plug the USB drive, containing packages and metadata, into the Adaptation Manager.
2. Log into the Adaptation Manager as a user with administrative privileges, as needed.
3. If the directory `/media/stick` does not exist, create it:  
`sudo mkdir -p /media/stick`
4. Mount the USB drive:  
`sudo mount <drive> /media/stick`
5. Delete the old repodata directory if it exists:  
`sudo rm -r /media/stick/rhel-7-server-rpms/repodata`
6. Create the following new repodata:  
`sudo createrepo /var/www/html/rhel-update-repository/rhel-7-server-rpms`  
`sudo createrepo /var/www/html/rhel-update-repository/rhel-7-server-optional-rpms`  
`sudo createrepo /var/www/html/rhel-update-repository/rhel-7-server-extras-rpms`
7. Make the metadata in the yum repo usable:  
`sudo yum makecache`
8. Install the available updates:  
`sudo yum update`
9. Unmount the USB drive:  
`sudo umount /media/stick`

**10. Re-initialize the AIDE database:**

```
sudo /usr/local/bin/aide_scan.sh -u
```

**5.3.20.9 Updating the NWP-A and AWD Nodes**

Updating NWP-A and Dedicated AWDs can only be done once the update repository has been created on the Update Server. The process for updating the NWP-A & AWD is the same process used for updating the Update Server:

The following steps are optional:

- 1.** Log into the AWD as a user with administrative privileges.
- 2.** Run a scan for AIDE database inconsistencies:  
`sudo /usr/local/bin/aide_scan.sh`
- 3.** Check for AIDE database inconsistencies:
  - a.** `sudo vim /var/log/aide/aide.log`
  - b.** Analyze the log, and take appropriate action if any issues are found.

The following steps are mandatory:

- 1.** Login to the AWD as a user with administrative privileges, as needed.
- 2.** Make the metadata in the yum repo usable:  
`sudo yum makecache`
- 3.** Install the available updates:  
`sudo yum update`
- 4.** Re-initialize the AIDE database:  
`sudo /usr/local/bin/aide_scan.sh -u`

**5.3.20.10 Updating NWP-A ELK**

The artifacts deploy-scripts.tar.gz and elk-docker-images.tar.gz will be required to update ELK. These artifacts can be obtained from the development team.

It is optional to check for AIDE database inconsistencies before updating NWP-A ELK.

The following steps are optional:

- 1.** Log into an NWP-A ADS server as a user with administrative privileges.
- 2.** Run a scan for AIDE database inconsistencies:  
`sudo /usr/local/bin/aide_scan.sh`
- 3.** Check for AIDE database inconsistencies:
  - a.** `sudo vim /var/log/aide/aide.log`
  - b.** Analyze the log, and take appropriate action if any issues are found.

The following steps are mandatory:

- 1.** Log into an NWP-A ADS server as a user with administrative privileges.
- 2.** Transfer deploy-scripts.tar.gz and elk-docker-images.tar.gz to a directory on the NWP-A ADS server.
- 3.** Create a deploy-scripts directory, and untar deploy-scripts.tar.gz into it:  
`mkdir deploy-scripts`  
`tar xzf deploy-scripts.tar.gz -C deploy-scripts/`  
`rm deploy-scripts.tar.gz`  
`cd deploy-scripts`
- 4.** If this is not the first time you are installing NWP-A ELK (skip this step otherwise), you must first uninstall the prior installation:  
`./helm_uninstall.sh -r <Rancher URL> -e`

5. Load the ELK Docker images into the local registry:

```
python ./scripts/build_and_update/update_site_manager.py
add_images --local-registry local-registry:5000 --image-file
../elk-docker-images.tar.gz --tag <ELK software version>
```

6. Install the ELK containers:

```
cd rancher/charts
./helm_install.sh -c <sitename>_values.yaml -r <Rancher URL> -v
<ELK software version> -a <ELK adaptation version> -d local-
registry:5000 -e -n
```

7. Re-initialize the AIDE database:

```
sudo /usr/local/bin/aide_scan.sh -u
```

#### 5.3.20.11 Creating the Repository at the HF Nodes

Creating the repository at the HF nodes can only be done once the update repository has been created on the Update Server. To update the HF nodes, run the `pull-patch-updates` command.

It is optional to check for AIDE database inconsistencies before updating the repositories.

The following steps are optional (for all HF nodes):

1. Log into the HF node as a user with administrative privileges.

2. Run a scan for AIDE database inconsistencies.

```
sudo /usr/local/bin/aide_scan.sh
```

3. Check for AIDE database inconsistencies:

- a. `sudo vim /var/log/aide/aide.log`

- b. Analyze the log, and take appropriate action if any issues are found.

The following steps are mandatory:

1. Login to the HF node as a user with administrative privileges, as needed.

2. As a sudoer, run the `pull-patch-updates` command:

```
/usr/local/bin/pull-patch-updates
```

**note: this command contains sudo commands within it. it should not be run with sudo but must be run by a sudoer.**

#### 5.3.20.12 Updating the Domain HF Nodes and PGs

Updating a Domain HF can only be done once the update repository has been created on the Domain HF nodes. To update the Domain HF nodes, run the `updatePgAndHfRpms` command.

It is optional to check for AIDE database inconsistencies before updating the repositories.

The following steps are optional (for all Domain nodes):

1. Log into the Domain node as a user with administrative privileges.

2. Run a scan for AIDE database inconsistencies:

```
sudo /usr/local/bin/aide_scan.sh
```

3. Check for AIDE database inconsistencies:

- a. `sudo vim /var/log/aide/aide.log`

- b. Analyze the log, and take appropriate action if any issues are found.

The following steps are mandatory:

1. Login to the domain HF as a user with administrative privileges, as needed.

2. Run the `updatePgAndHfRpms` command:

```
/usr/local/bin/updatePgAndHfRpms
```

## 5.3.21 Use of Encrypted Media

### 5.3.21.1 Overview

In accordance with FAA security policy, NWP supports the use of encrypted USB drives for transferring data. This section covers creating an encrypted USB drive, mounting an encrypted USB drive, and unmounting an encrypted USB drive.

### 5.3.21.2 Creating an encrypted USB Drive

1. Get an unencrypted generic USB drive.
2. Ensure physical and remote access can be attained at the server or workstation.
3. Log in to an NWP server or workstation as an admin user. If a user with administrative privileges is unavailable, the root account may be used.
4. Get the current state of drives with command `lsblk`. Make note of current drives for comparison after USB drive is inserted.
5. Insert the USB drive.
6. Find the newly created device by running `lsblk`. The device will probably be named `sdb1`. Use this as <device name> in the following steps.

**WARNING:** The following command, creating a LUKS container, will erase the target drive; care must be exercised. Executing the command against the wrong device can render the system inoperable.

7. Create a LUKS container by using the following command `sudo cryptsetup luksFormat /dev/<device name>`
  - a. Follow the instructions on the screen after running the command. Enter the new password for the device, as needed. It must be at least thirteen characters. It must also contain at least one upper case letter, one lower case letter, and one non-alphanumeric character (e.g., "!", "@", "#", "\$", "%", "^").
8. Check that the new device is correctly formatted by running `sudo cryptsetup luksDump /dev/<device name>`
  - a. If the device has been successfully formatted, the LUKS header will be present.
9. Open the device, and map it by running `sudo cryptsetup luksOpen /dev/<device name> stick1`
10. Ensure the device is mapped (i.e., there is a mapping for `stick1`) by running `ls -lt /dev/mapper`  
**WARNING:** The following command, wiping the encrypted device, will erase the target drive; care must be exercised. Executing the command against the wrong device can render the system inoperable.
11. Wipe the newly encrypted device by running `sudo dd if=/dev/zero of=/dev/mapper/stick1 status=progress`
  - a. **NOTE:** This process will take time based on the size of the device; the larger the device, the longer this process will take.
12. Create a file system on the encrypted device by running `sudo mkfs.ext4 /dev/mapper/stick1`
13. Create the stick directory by running `sudo mkdir /media/stick`
14. Mount the USB on the stick directory by running `sudo mount /dev/mapper/stick1 /media/stick`
15. Verify that the encrypted file system is present by running `ls -alt /media/stick`

- a. The user should see a directory named `lost+found`.

- 16.** Unmount the device by running `sudo umount /media/stick`
- 17.** Close the LUKS device by running `sudo cryptsetup luksClose stick1`
- 18.** Physically remove the USB drive.

#### 5.3.21.3 Mounting an encrypted USB Drive

1. Log in to an NWP server or workstation as a user with administrative privileges. If a user with administrative privileges is unavailable, the root account may be used.
2. Get the current state of drives with command `lsblk`. Make note of current drives for comparison after USB drive is inserted.
3. Insert the USB drive.
4. Find the device by running `lsblk`. The device will probably be named `sdb1`. Use this as <device name> in the following steps.
5. Open the LUKS device:  
`sudo cryptsetup luksOpen /dev/<device name> stick1`  
Enter the password for the encrypted device when prompted.
6. Create the mount directory if it doesn't already exist:  
`sudo mkdir -p /media/stick`
7. Mount the volume:  
`sudo mount /dev/mapper/stick1 /media/stick`

#### 5.3.21.4 Unmounting an encrypted USB Drive

1. Close all files that may be open from the USB drive.
2. Log in to an NWP server or workstation as a user with administrative privileges. If a user with administrative privileges is unavailable, the root account may be used.
3. Unmount the volume:  
`sudo umount /media/stick`
4. Remove the mount directory:  
`sudo rmdir /media/stick`
5. Close the LUKS device:  
`sudo cryptsetup luksClose stick1`
6. Physically remove the USB drive.

### 5.3.22 Update Server Population

Follow this procedure to copy and load the necessary software artifacts to the update server to enable further installation of the NWP Application.

The artifacts required for NWP Installation are as follows. These artifacts can be obtained from Second Level Engineering.

**Table 31. NWP SW artifacts**

| File                            | Bamboo Artifact Name        | Notes |
|---------------------------------|-----------------------------|-------|
| <code>update_site.tar.gz</code> | <code>updatesite-Tar</code> |       |

| File                  | Bamboo Artifact Name | Notes                                                                                                                                                                                  |
|-----------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| dted-repository.tar   | dted-repository      | Does not change often. Only needed if new DTED was imported.<br>Can be confirmed by comparing the hashed subdirectory within the tar file via <code>tar tvf dted-repository.tar</code> |
| docker-images.tar.gz  | nwp-docker-images    |                                                                                                                                                                                        |
| deploy-scripts.tar.gz | Deploy-scripts       |                                                                                                                                                                                        |

First from a Privileged Account, transfer the required artifacts to the account's home directory on the Update Server via flash drive (See 5.3.21 Use of Encrypted Media for instructions).:

1. Make a temporary directory in the account's home directory : `mkdir ~/deploytmp`
2. Copy the required artifacts into the temp directory. If installing from media: `cp /media/stick/nwp/nwp-release/{deploy-scripts.tar.gz,update_site.tar.gz,docker-images.tar.gz,dted-repository.tar} ~/deploytmp`

If Docker has not been previously set up on the update server, add the docker and dockerroot groups to the current user as follows:

1. `sudo usermod -a -G docker <user>`
2. `sudo usermod -a -G dockerroot <user>`

Sign out and sign back in for the group changes to take effect. (To verify the groups have been added, run `groups` and ensure that 'docker' and 'dockerroot' are both shown in the list.)

Extract the artifacts to the temp directory and then remove them as follows:

1. Change to the temp directory: `cd ~/deploytmp`
2. Un-tar the deploy scripts: `tar xzf deploy-scripts.tar.gz`
3. Un-tar the Update Site SW: `tar xzf update_site.tar.gz`
4. Un-tar DTED (if necessary): `tar xf dted-repository.tar`
5. Remove the deploy scripts tar file: `rm deploy-scripts.tar.gz`
6. Remove the Update Site tar file: `rm update_site.tar.gz`
7. Remove the DTED tar file (if necessary): `rm dted-repository.tar`

Populate the update site with the software version.

**NOTE:** The `nwpa_cluster_install` script will populate the update site with the new software version for all system types including Domain, NWP-A, and Adapatation Manager.

1. `./scripts/install/nwpa_cluster_install -u -s ${HOME}/deploytmp/docker-images.tar.gz -w ${HOME}/deploytmp/nwp-update-repository -b <software version>:<adaptation version> -l <FQDN of update server>:443 -y <FQDN of update server> -d ${HOME}/deploytmp`

If there is an older version on the update site that needs to be preserved, add '`-K <software version>`' to the `nwpa_cluster_install` command to keep the version on the update site. If there are multiple versions that need to be kept, the `<software version>` argument can be a comma separated list without spaces.

1. Carefully confirm that the current environment settings displayed by the script are correct; if so, enter "1" to start loading the software (Note: <software

version>:<adaptation version> is of the format 0.7.7861-<git branch>:0.7.7861.0-<git branch>)

To check that the software was loaded correctly to the update repository, navigate to the Update Server index.json URL (<https://nwpupdate.acy.nwp.nas.faa.gov/nwp-update-repository/index.json>). A JSON page displays the listing of the available builds with the corresponding adaptation, dted, and files. Verify the intended software version (and DTED if updated) is listed.

Delete the temporary directory: `rm -rf ~/deploytmp`

### 5.3.23 Certificate Expiration and Replacement

Note: all of the certificates used contain embedded Online Certificate Status Protocol (OCSP) information.

#### 5.3.23.1 Prerequisites

SSL certificates are managed by RPMs built internally by NWP. The RPMs are separated by SSL class as follows:

1. ssl-certs-devel for locally issued development certificates
2. ssl-certs-pilot for certificates issued by the FAA NAS TEST Root CA
3. ssl-certs-production for certificates that are issued for production NWP sites

It is expected that the files distributed by the RPM are signed with a root-ca already known by IdM. Perform all of the following operations from an account with sudo privileges. The <domain> prefix refers to the site ID of the current site, for example atl or slc.

When certificates need to be replaced, follow section 5.3.20.3 Preparing RPMs for the COTS/FOSS Update Repository and section 5.3.20.6 Creating the General COTS/FOSS Update Repository at the Update Server to load the new SSL certs RPM onto the update server. Then, follow the relevant section in 5.3.20 COTS/FOSS/OS and Google Chrome Updates for each node that certificates are being replaced on. Note that the `yum update` command in these procedures will install any patches that are available in the update repository. This command can be replaced with `yum update ssl-certs-<class>` to isolate the ssl-certs RPM for patching.

#### 5.3.23.2 Replacing Certificates in IDM

In the event that a root CA requires an update due to expiration or any other reason (change in certificate authority, compromised root CA, etc.), follow the Root CA update steps below. If only the certificate requires updating, refer to the Install/Update new certificates section below.

##### 5.3.23.2.1 Root CA updates, on each HF:

1. `cd /opt/nwp/vos-tools/ssl`
  2. `sudo ipa-cacert-manage install cert-chain.cer`
  3. `kinit admin`
  4. if existing certificates have expired, stop chrony (`systemctl stop chronyd`) and set system time to before expiration (`date "<day month year>"`)
  5. `sudo ipa-certupdate`
  6. set back to current date (`ntpdate <ntp server>`) and restart chrony (`systemctl start chronyd`)
  7. for every NWP node in the system that is enrolled as an IdM client, run `ipa-certupdate`. If existing certificates have expired, run '`date "<day month year>"`; `kinit admin`; `ipa-certupdate`; `ntpdate <ntp server>`'
- NOTE:** step 7 must be done on every NWP node before proceeding to IdM certificate installation

**5.3.23.2.2 Install/Update new certificates into IdM on each HF:**

1. ALL CLIENTS MUST RUN IPA-CERTUPDATE BEFORE THIS SECTION CAN BE EXECUTED
2. `cd /opt/nwp/vos-tools/ssl/cert-tools/request_files/<domain>`
3. `sudo ipa-server-certinstall --http --dirsrv ${HOSTNAME}.p12`
4. `sudo ipactl restart`

**5.3.23.3 Replacing Certificates in uFrame**

In the event that a root CA requires an update due to expiration or any other reason (change in certificate authority, compromised root CA, etc...), follow the appropriate Root CA update section below. If the root CA does not need updating skip to section 5.3.23.3.3.

**5.3.23.3.1 Root CA updates, on every node:**

1. `cd /etc/pki/ca-trust/source/anchors`
2. change the name of all files to not conflict with the new certificates (such as adding the issuing year to the file name), maintaining the .crt extension.
3. `sudo cp /opt/nwp/vos-tools/ssl/*.crt .`
4. `sudo update-ca-trust enable`
5. `sudo update-ca-trust extract`
6. verify the new certificates are trusted by the system  
`openssl verify /opt/nwp/vos-tools/ssl/root-ca.crt`

**5.3.23.3.2 Root CA updates, on Every HF, AWD, TH, ADS, PG and Adaptation Manager:**

1. `cd /opt/nwp`
2. `sudo cp /opt/nwp/vos-tools/ssl/truststore.jks .`
3. `sudo chmod 600 truststore.jks`
4. `sudo chown nwpapp:nwpapp truststore.jks`

**5.3.23.3.3 Update keystore.jks on each HF, AWD, TH, Adaptation Manager, ADS, PG:**

1. `cd /opt/nwp/`
2. `sudo cp /opt/nwp/vos-tools/ssl/keystores/<domain>/${HOSTNAME}/keystore.jks .`
3. `sudo chmod 600 keystore.jks`
4. `sudo chown nwpapp:nwpapp keystore.jks`
5. Restart services based on current node
  - a. HF
    - (1) Log into the M&C and transition the Compute Cluster offline
    - (2) `sudo systemctl stop sms-agent.service`
    - (3) `sudo systemctl stop request-sms.service`
    - (4) `sudo systemctl restart activemq.service`
    - (5) `sudo systemctl start request-sms.service`
    - (6) `sudo systemctl start sms-agent.service`
    - (7) repeat steps ii-vi for HF02
    - (8) Transition the Compute Cluster back online
  - b. AWD

- (1) sudo systemctl restart sms-agent.service
- c. TH
  - (1) sudo systemctl restart request-css.service
  - (2) sudo systemctl restart activemq.service
- d. Adaptation Manager
  - (1) sudo systemctl restart request-sam.service
  - (2) sudo systemctl restart activemq.service
- e. No services need to be restarted on ADS or PG nodes following this step

#### **5.3.23.3.4 Update the Network Security Services (NSS) database on the TH and Update Server:**

1. cd /etc/httpd/alias
2. sudo rm -rf \*.db
3. sudo /usr/bin/certutil -N -d /etc/httpd/alias -f /etc/httpd/alias/pwdfile.txt
4. sudo /usr/bin/certutil -A -i /opt/nwp/vos-tools/ssl/cert-tools/request\_files/<domain>/\${HOSTNAME}.crt -d /etc/httpd/alias -n Server-Cert -t "u,u,u" -f /etc/httpd/alias/pwdfile.txt
5. sudo pk12util -i /opt/nwp/vos-tools/ssl/cert-tools/request\_files/<domain>/\${HOSTNAME}.p12 -d /etc/httpd/alias -W <certificate authentication password> -k /etc/httpd/alias/pwdfile.txt
6. sudo chmod 640 \*.db
7. sudo chown root:apache \*.db
8. sudo systemctl restart httpd.service

#### **5.3.23.4 Replacing Certificates in the ELK Stack**

##### **5.3.23.4.1 Replacing ELK Certificates on Domain**

On each system in the Elasticsearch cluster:

1. sudo cp /opt/nwp/vos-tools/ssl keystores/<domain>/\${HOSTNAME}/keystore.jks /etc/elasticsearch/
  - a. 'y' if prompted to confirm overwriting the existing keystore
2. If the system is an HF (running Kibana):
  - a. sudo systemctl stop logstash.service kibana.service
  - b. sudo systemctl restart elasticsearch.service
  - c. sudo systemctl start logstash.service kibana.service
3. If the system is not an HF (not running Kibana):
  - a. sudo systemctl stop logstash.service
  - b. sudo systemctl restart elasticsearch.service
  - c. sudo systemctl start logstash.service

##### **5.3.23.4.2 Replacing ELK Certificates on NWP-A and EWS**

On each ADS node:

1. 

```
sudo cp /opt/nwp/vos-tools/ssl keystores/<site_id>/${HOSTNAME}/keystore.jks /etc/elasticsearch/
```

  - a. `'y'` if prompted to confirm overwriting the existing keystore
2. Perform a rolling restart of ELK resources:
  - a. Elasticsearch:
    - (1) `kubectl -n nwp-elk rollout restart daemonset elastic-service`
    - (2) `kubectl -n nwp-elk rollout status ds elastic-service`
  - b. Logstash:
    - (1) `kubectl -n nwp-elk rollout restart deployment logstash`
    - (2) `kubectl -n nwp-elk rollout status deployment logstash`
  - c. Kibana:
    - (1) `kubectl -n nwp-elk rollout restart deployment kibana`
    - (2) `kubectl -n nwp-elk rollout status deployment kibana`

### 5.3.23.5 Replacing Certificates on the EWS Proxy Server

On the EWS Proxy Server, after certificates have been distributed using the series of commands outlined in section 5.3.23.1, signal Nginx to reload:

1. `sudo nginx -s reload`

### 5.3.23.6 Docker Client Certificates

On EWS ADS nodes:

1. `sudo rm -rf /etc/docker/certs.d/<remote registry>/`
2. `sudo cp /opt/nwp/vos-tools/ssl/cert-tools/request_files/<site_id>/${HOSTNAME}.crt /etc/docker/certs.d/<remote registry>/client.cert`
3. `sudo cp /opt/nwp/vos-tools/ssl/cert-tools/request_files/<site_id>/${HOSTNAME}.key /etc/docker/certs.d/<remote registry>/client.key`
4. `sudo cp /opt/nwp/vos-tools/ssl/issuer.crt /etc/docker/certs.d/<remote registry>/ca.crt`

### 5.3.23.7 Kubernetes secrets - NWP-A / EWS

In the event that a root CA requires an update due to expiration or any other reason (change in certificate authority, compromised root CA, etc...), follow the Root CA update steps below on any ADS node:

1. Update TLS secret for CA
  - a. `kubectl -n cattle-system create secret generic tls-ca --from-file=cacerts.pem=/opt/nwp/vos-tools/ssl/certchain.cer --save-config --dry-run=client -o yaml | kubectl apply -f -`
2. Perform a rolling restart of NWP-A resources:
  - a. Note down the namespace for the current software version:
    - i. `kubectl get namespaces`
  - b. Restart uframe-sms
    - i. `kubectl -n <namespace> rollout restart deployment uframe-sms`

- ii. `kubectl -n <namespace> rollout status deployment uframe-sms`
- c. Restart uframe-awd**
  - i. `kubectl -n <namespace> rollout restart deployment uframe-sms`
  - ii. `kubectl -n <namespace> rollout status deployment uframe-sms`
- d. Restart update-service**
  - i. `kubectl -n nwp-update rollout restart deployment update-service`
  - ii. `kubectl -n nwp-update rollout status deployment update-service`

### 5.3.23.8 Update NWP-A Application Certificates for Ingress

On any ADS node:

1. `kubectl -n cattle-system create secret tls tls-rancher-ingress --cert=/opt/nwp/vos-tools/ssl/cert-tools/request_files/<site_id>/<site_id>-awd.crt --key=/opt/nwp/vos-tools/ssl/cert-tools/request_files/<site_id>/<site_id>-awd.key --save-config --dry-run=client -o yaml | kubectl apply -f -`
2. `kubectl -n ingress-nginx create secret tls ingress-default-cert --cert=/opt/nwp/vos-tools/ssl/cert-tools/request_files/<site_id>/<site_id>-awd.crt --key=/opt/nwp/vos-tools/ssl/cert-tools/request_files/<site_id>/<site_id>-awd.key --save-config --dry-run=client -o yaml | kubectl apply -f -`
3. `kubectl -n ingress-nginx rollout restart daemonset nginx-ingress-controller`
4. `kubectl -n ingress-nginx rollout status daemonset nginx-ingress-controller`
5. `kubectl -n cattle-system rollout restart deployment rancher`
6. `kubectl -n cattle-system rollout status deployment rancher`

## 5.4 Related processing

NWP system component states are continuously updated by monitoring performed on the servers. As changes are detected, the M&C GUI is updated to allow the user to maintain situational awareness. The display updates are automatic and do not require any action by the user.

Users can view the log section at the bottom of the M&C GUI for any processing updates. Changes are detected automatically and does not require user action to display. The user can view the log for any situational awareness

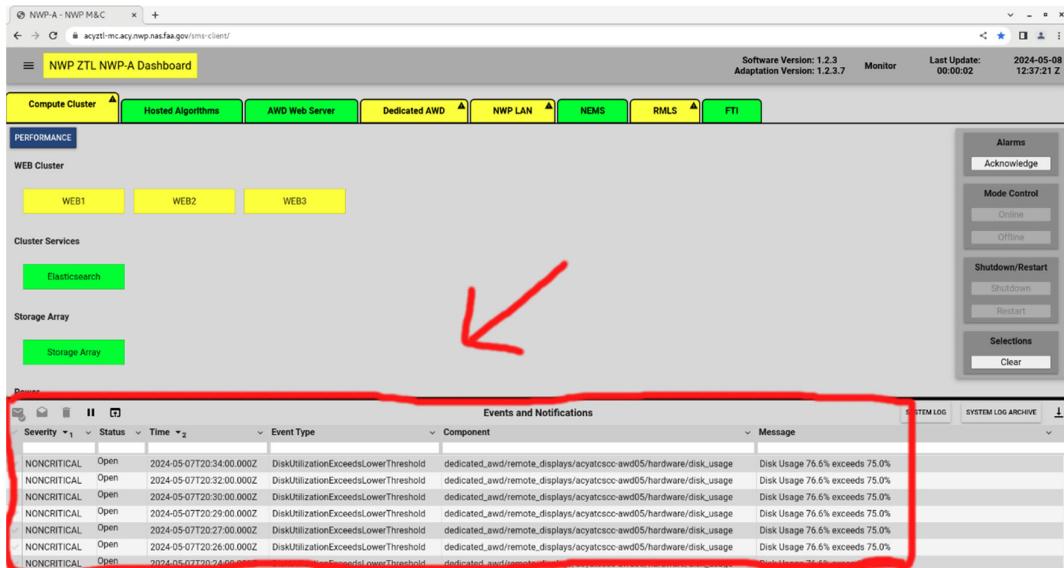


Figure 434. M&amp;C GUI Log

Additionally, there are hardware and software related processes the M&C user can view from the Compute Cluster tab for NWP Domain. Select from PG 1-14/HF 1 or 2, then observe the Software and Hardware status column

Below you will find the status of Hardware or Software related processes

1. From the Domain M&C/NWP-A M&C, click the hamburger icon on the top left corner
2. Click on Login
3. Enter credentials
4. Click Login
5. From the M&C dashboard, click on the **Compute Cluster** tab
6. Click on PG/HF Cluster (NWP Domain)/Web node (NWP-A)

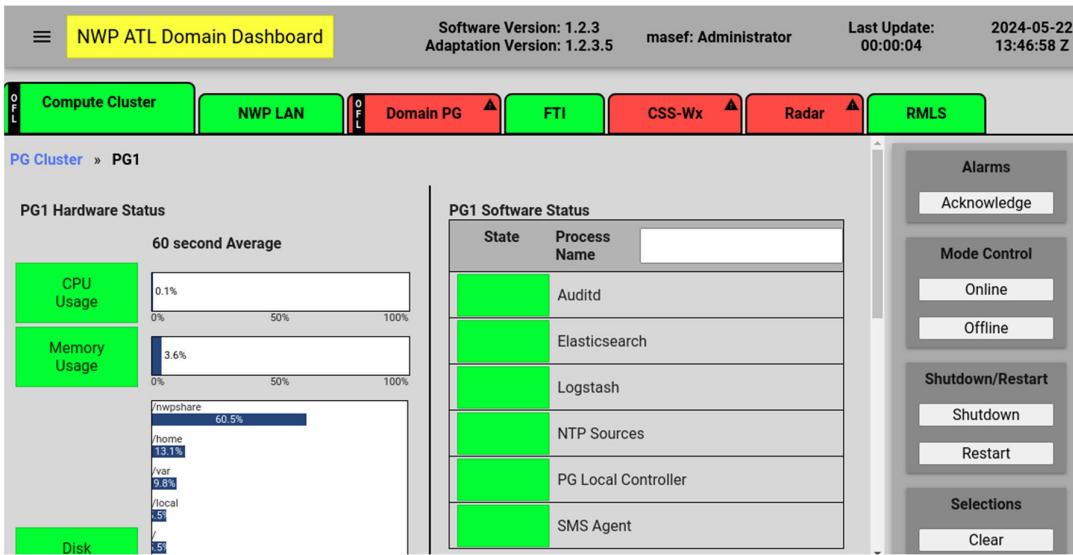


Figure 435. NWP Domain M&amp;C, Compute Cluster, PG Processes

The same can be viewed for NWP-A M&C. Go to the Compute Cluster tab, and select the Web Cluster node. Here you can view the Hardware and Software related processes associated with that node

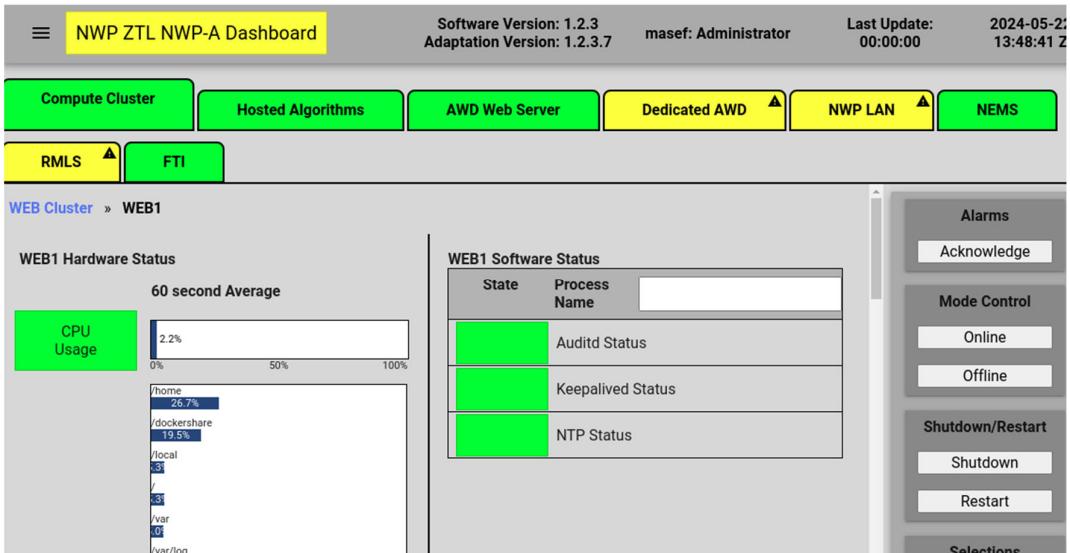


Figure 436. NWP-A M&amp;C, Compute Cluster, Web node processes

## 5.5 Data Backup

Detailed logs of NWP system state and mode changes are stored and retained on the servers. The M&C GUI is capable of creating archives of input data, however the M&C GUI user does not have any responsibility for creating or retaining this backup data. The user has the capability to export a soft copy of the Event Log data when desired.

Users export log data from the M&C GUI. Users can enter parameters and specify time and date of log data they want to display and get a list of viewing of the selected parameters. The users can then export the data.

1. From the Domain M&C/NWP-A M&C, click the hamburger icon on the top left corner
2. Click on Login
3. Enter credentials
4. Click Login
5. From the M&C Dashboard, click on the System Log button

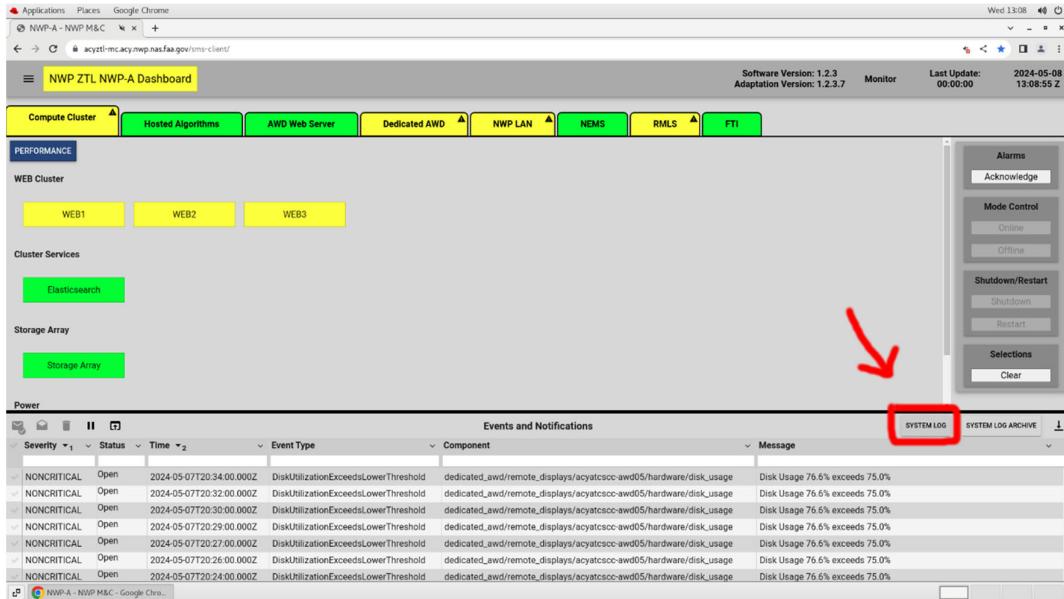


Figure 437. NWP-A M&amp;C GUI System Log button

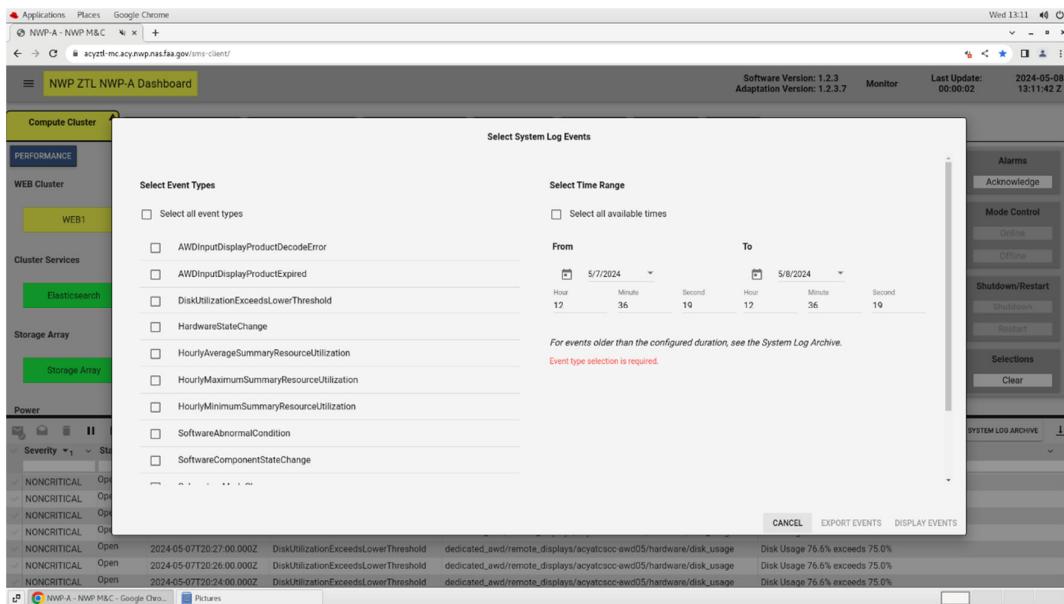


Figure 438. NWP-A System Log filtering

## 5.6 Recovery from Errors, Malfunctions, and Emergencies

If the M&C GUI, or AWD web browser loses network connectivity, the display stops updating. The web application automatically re-connects when network connectivity is restored without user interaction.

Procedures for handling alarms in the M&C GUI are in Section 5.3.8 Control M&C Alarms above. Procedures for stopping/starting systems and subsystems refer to Section 5.2.3 M&C Control Operations.

A great example for this would be disconnecting the ethernet cable from the workstation. When the ethernet cable is disconnected, observe the M&C GUI Update timer is highlighted red to signify loss of connection.



Figure 439. M&C GUI Title Bar

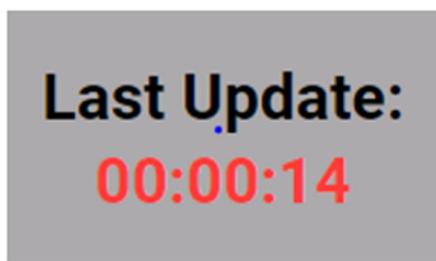


Figure 440. Last Update timeout elapse

Additionally, observe the AWD display with primary products selected, observe the time at the bottom right of the window stopped updating to let users know that the data stopped coming in

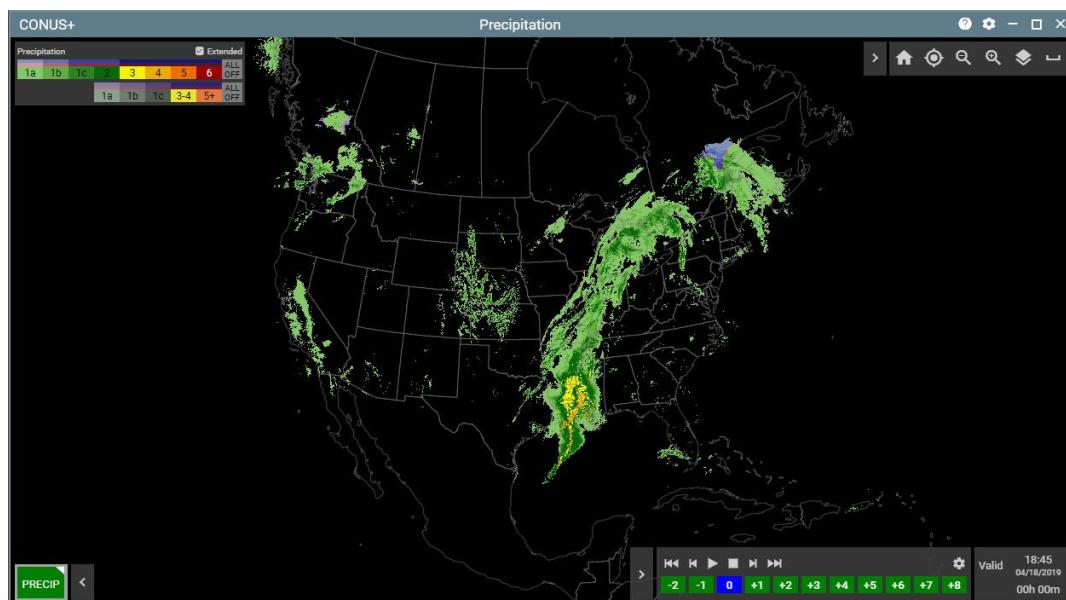
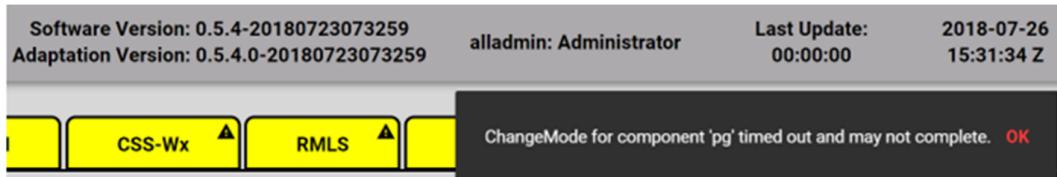


Figure 441. AWD Time

## 5.7 Messages

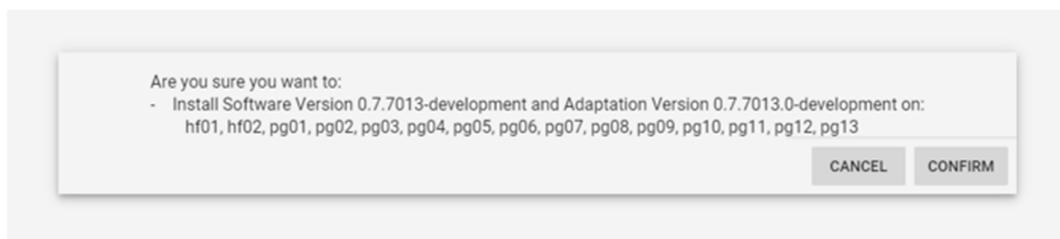
Error messages which occur while performing user functions are presented in dialog boxes. These messages should be acknowledged by the user, and any required action has detailed instructions included in the message.



**Figure 442. PG Timeout error message**

Users are presented with a dialog box to confirm their actions. A great example is when the user is performing Software Updates for NWP Domain/NWP-A.

A dialog box is presented to user to confirm their action when downloading a new software and adaptation version. Same dialog box is also presented when installing the software and adaptation version.



**Figure 443. Software & Adaptation version installation confirmation message**

## 5.8 Quick-Reference Guide

This section provides a summary of some commonly used functionality of the M&C display and where to find additional information:

**Table 32. Quick Reference Table**

| Functionality                      | Section Reference                                                                         |
|------------------------------------|-------------------------------------------------------------------------------------------|
| Monitor National View Status       | National View: Section 5.3.14                                                             |
| Monitor Compute Cluster Subsystems | Domain Compute Cluster: Section 5.3.2.1<br>NWP-A and EWS Compute Cluster: Section 5.3.2.2 |
| Acknowledge Alarms                 | Control M&C Alarms: Section 5.3.8                                                         |

## 6.0 Notes

### Acronyms

**Table 33. Acronyms**

| Acronym | Definition                                        |
|---------|---------------------------------------------------|
| ABC     | ASCII Binary Container                            |
| ACID    | atomic, consistent, isolated, durable             |
| ADS     | AWD Data Service                                  |
| AES     | Advanced Encryption Standard                      |
| AIDE    | Advanced Intrusion Detection Environment          |
| AIMM    | Aeronautical Information Management Modernization |
| AIREP   | Aircraft Report                                   |
| AO      | Authorizing Official                              |
| AOI     | Area of Interest                                  |
| AP      | Anomalous Propagation                             |
| API     | Application Program Interface                     |
| ARENA   | Areas Noted for Attention                         |
| ARSI    | Arrival Route Status and Impact                   |
| ARTCC   | Air Route Traffic Control Center                  |
| ASAP    | Advanced Satellite Aviation weather Products      |
| ASL     | Automated System Loader                           |
| ASR     | Airport Surveillance Radar                        |
| ATCSCC  | Air Traffic Control System Command Center         |
| ATCT    | Airport Traffic Control Towers                    |
| ATIS    | Automatic Terminal Information Service            |
| ATOM    | Air Traffic Operator's Manual                     |
| AWD     | Aviation Weather Display                          |
| AWIPS   | Advanced Weather Interactive Processing System    |
| BLM     | Bureau of Land Management                         |
| BSD     | Berkeley Software License                         |
| CANRAD  | Canadian Radar                                    |
| CCFP    | Collaborative Convective Forecast Product         |

| <b>Acronym</b> | <b>Definition</b>                                                |
|----------------|------------------------------------------------------------------|
| CDO            | Climate Data Operator                                            |
| CDR            | Coded Departure Routes                                           |
| CDRL           | Contract Data Requirements List                                  |
| CI             | Configuration Item                                               |
| CIFS           | Common Internet File System                                      |
| CIMSS          | Cooperative Institute for Meteorological Satellite Studies       |
| CIP            | Current Icing Potential                                          |
| CIWS           | Corridor Integrated Weather System                               |
| CM             | Configuration Management                                         |
| CMHP           | Common Message Handling Protocol                                 |
| CMMI           | Capability Maturity Model Integration                            |
| CMS            | Content Management System                                        |
| CONUS          | Continental United States (lower 48 states of the United States) |
| CONUS+         | CONUS, CANRAD coverage and Puerto Rico                           |
| CONVOL         | Conventional Volume                                              |
| CoSPA          | Consolidated Storm Prediction for Aviation                       |
| COTS           | Commercial Off-The-Shelf                                         |
| CPU            | Central Processing Unit                                          |
| CR             | Composite Reflectivity                                           |
| CRP            | Compressed Radial Packets                                        |
| CSCI           | Computer Software Configuration Item                             |
| CSS            | Cascading Style Sheet                                            |
| CSS-Wx         | Common Support Services - Weather                                |
| CWAF           | Convective Weather Avoidance Field                               |
| CWSU           | Center Weather Service Unit                                      |
| CXF            | Color Exchange Format                                            |
| DAC            | Discretionary Access Control                                     |
| DAG            | Directed Acyclic Graph                                           |
| DAO            | Data Access Object                                               |
| DHC            | Digital Hydrometeor Classification                               |
| DID            | Data Item Description                                            |
| DMZ            | Demilitarized Zone                                               |
| DOM            | Domain Object Model                                              |

| <b>Acronym</b> | <b>Definition</b>                           |
|----------------|---------------------------------------------|
| DOPVOL         | Doppler Volume Scan                         |
| DOS            | Denial Of Service                           |
| DQE            | Data Quality Editing                        |
| DSL            | Domain Specific Language                    |
| DTED           | Digital Terrain Elevation Data              |
| EAR            | Export Administration Regulations           |
| EDEX           | Enterprise Data Exchange                    |
| ELK            | Elasticsearch, Logstash and Kibana          |
| EP             | End Point                                   |
| EPL            | Eclipse Public License                      |
| ESB            | Enterprise Service Bus                      |
| ESRI           | Environmental Systems Research Institute    |
| ESRL           | Earth System Research Laboratory            |
| ETI            | Estimated Time to Impact                    |
| EWS            | External Web Server                         |
| FAA            | Federal Aviation Administration             |
| FAF            | Flags and Filters                           |
| FCA            | Flow Constrained Areas                      |
| FEA            | Flow Evaluation Areas                       |
| FIP            | Forecast Icing Potential                    |
| FIPS           | Federal Information Processing Standards    |
| FISMA          | Federal Information Security Management Act |
| FOSS           | Free and Open Source Software               |
| FTI            | FAA Telecommunications Infrastructure       |
| FSF            | Free Software Foundation                    |
| FTM            | Free Text Message                           |
| FQDN           | Fully Qualified Domain Name                 |
| GCOS           | Global Climate Observing System             |
| GDM            | GNOME Desktop Manager                       |
| GFE            | Government-Furnished Equipment              |
| GFI            | Government-Furnished Information            |
| GFS            | Global Forecast System                      |
| GINI           | GOES NOAAPORT Interface                     |

| <b>Acronym</b> | <b>Definition</b>                                             |
|----------------|---------------------------------------------------------------|
| GIS            | Geographic Information System                                 |
| GML            | Geography Markup Language                                     |
| GPL            | General Public License                                        |
| GSD            | Global Systems Division                                       |
| GSM            | General Status Message                                        |
| GTK            | GIMP Tool Kit                                                 |
| GUI            | Graphical User Interface                                      |
| HBAC           | Host Based Access Control                                     |
| HDF            | Hierarchical Data Format                                      |
| HF             | Hot Failover                                                  |
| HI             | Hail Index                                                    |
| HMAC           | Hash-based Message Authentication Code                        |
| HPC            | High Performance Computing                                    |
| HRRR           | High-Resolution Rapid Refresh                                 |
| HTML           | HyperText Markup Language                                     |
| HTTP           | Hypertext Transfer Protocol                                   |
| HTTPS          | Hypertext Transfer Protocol - Secure socket Layers encryption |
| IAW            | In Accordance With                                            |
| ICAO           | International Civil Aviation Organization                     |
| ICD            | Interface Control Document                                    |
| IEEE           | Institute of Electrical and Electronics Engineers             |
| IHL            | Icing Hazard Levels                                           |
| ILS            | Instrument Landing System                                     |
| IMDG           | In Memory Data Grid                                           |
| IoT            | Internet of Things                                            |
| IP             | Internet Protocol                                             |
| IPC            | Inter-Process Communication                                   |
| IRD            | Interface Requirements Document                               |
| IRS            | Interface Requirements Specification                          |
| ISO            | International Organization for Standardization                |
| ITAR           | International Traffic in Arms Regulations                     |
| ITWS           | Integrated Terminal Weather System                            |
| JAAS           | Java Authentication and Authorization Service                 |

| <b>Acronym</b> | <b>Definition</b>                             |
|----------------|-----------------------------------------------|
| JAXB           | Java Architecture for XML Binding             |
| JAX-RS         | Java API for RESTful Web Services             |
| JBIGI          | Java Business Integration                     |
| JCL            | Jakarta Commons Logging                       |
| JCSMP          | Java Content Subscription Management Protocol |
| JDBC           | Java Database Connectivity                    |
| JDK            | Java Development Kit                          |
| JMS            | Java Message Service                          |
| JMX            | Java Management Extensions                    |
| JNA            | Java Native Access                            |
| JNDI           | Java Naming and Directory Interface           |
| JNI            | Java Native Interface                         |
| JPA            | Java Persistence API                          |
| JPEG           | Joint Photographic Experts Group              |
| JSON           | JavaScript Object Notation                    |
| JSP            | JavaServer Page                               |
| JTS            | Java Topology Suite                           |
| JVM            | Java virtual machine                          |
| KML            | Keyhole Markup Language                       |
| KVM            | Kernel-based Virtual Machine                  |
| LAMP           | Localized Aviation MOS Program                |
| LAN            | Local Area Network                            |
| LDAP           | Lightweight Directory Access Protocol         |
| LGPL           | GNU Lesser General Public License             |
| LL             | Lincoln Laboratory                            |
| LLWAS          | Low Level Wind shear Alert System             |
| LRU            | Line Replaceable Unit                         |
| LSO            | VLAPS Surface Observation                     |
| LUKS           | Linux Unified Key Setup                       |
| M&C            | Monitoring and Control                        |
| MD             | Mesocyclone Detection                         |
| METAR          | Meteorological Aviation Report                |
| MIT            | Massachusetts Institute of Technology         |

| Acronym | Definition                                                       |
|---------|------------------------------------------------------------------|
| MIT LL  | MIT Lincoln Laboratory                                           |
| MOA     | Military Operations Areas                                        |
| MTBF    | Mean Time Between Failures                                       |
| MTSAT   | Multi-functional Transport Satellite                             |
| MVC     | Model–view–controller                                            |
| MVCC    | Multiversion Concurrency Control                                 |
| MVVM    | Model–view–viewmodel                                             |
| NAM     | North American Mesoscale                                         |
| NAS     | National Airspace System                                         |
| NASA    | National Aeronautics and Space Administration                    |
| NAVAID  | Navigational Aids                                                |
| NAWX    | North American Regional Weather                                  |
| NCAR    | National Center for Atmospheric Research                         |
| NCTS    | NWP Certification Test System                                    |
| NDB     | Non-Directional Beacons                                          |
| NEDIS   | National Environmental Satellite, Data, and Information Services |
| NEMC    | NAS Enterprise Management Center                                 |
| NEMS    | National Airspace System Enterprise Messaging Service            |
| NetCDF  | Network Common Data Form                                         |
| NextGen | Next Generation Air Transportation System                        |
| NFS     | Network File System                                              |
| NIST    | National Institute of Standards and Technology                   |
| NOAA    | National Oceanic and Atmospheric Administration                  |
| NSS     | Network Security Services                                        |
| NTP     | Network Time Protocol                                            |
| NV      | National View                                                    |
| NWP     | NextGen Weather Processor                                        |
| NWP-A   | NWP AWD Services                                                 |
| ODE     | Ordinary Differential Equation                                   |
| NWS     | National Weather Service                                         |
| OCSP    | Online Certificate Status Protocol                               |
| ODE     | Ordinary Differential Equation                                   |
| OGC     | Open Geospatial Consortium                                       |

| <b>Acronym</b> | <b>Definition</b>                            |
|----------------|----------------------------------------------|
| ORDBMS         | object-relational database management system |
| ORM            | Object-relational mapping                    |
| OS             | Operating System                             |
| OSGi           | Open Service Gateway initiative              |
| OSS            | Open Source Software                         |
| PAM            | Pluggable Authentication Module              |
| PaaS           | Platform as a service                        |
| PDB            | Product Definition Block                     |
| PDD            | Product Description Document                 |
| PG             | Product Generator / Product Generation       |
| PIREP          | Pilot Report                                 |
| PNG            | Portable Network Graphics                    |
| POA&M          | Plans of Action and Milestones               |
| POES           | Polar Operational Environmental Satellites   |
| POJO           | Plain Old Java Object                        |
| POSIX          | Portable Operating System Interface          |
| PQT            | Preliminary Qualification Test               |
| PRF            | Pulse Repetition Frequency                   |
| QT             | Cute                                         |
| RAP            | Rapid Refresh                                |
| RAPT           | Route Availability Planning Tool             |
| RBAC           | Role Based Access Control                    |
| RBDT           | Ribbon Display Terminals                     |
| RCP            | Rich Client Platform                         |
| RHEL           | Red Hat Enterprise Linux                     |
| RMLS           | Remote Monitoring and Logging System         |
| RNAV           | Area Navigation                              |
| RR             | Request Response                             |
| SAI            | Simple Asynchronous Interface                |
| SATCAST        | SATellite Convection AnalySis and Tracking   |
| SCI            | Software Configuration Item                  |
| SDD            | Software Design Description                  |
| SDP            | Software Development Plan                    |

| Acronym | Definition                              |
|---------|-----------------------------------------|
| SDV     | Super-Res Digital Velocity              |
| SE      | Symbology Encoding                      |
| SEE     | Software Engineering Environment        |
| SEDA    | staged event-driven architecture        |
| SID     | Standard Instrument Departures          |
| SLD     | Styled Layer Descriptor                 |
| SLD     | Super cooled Large Droplets             |
| SLF4J   | Simple Logging Facade for Java          |
| SMS     | System Management Services              |
| SNMP    | Simple Network Management Protocol      |
| SOA     | service-oriented architecture           |
| SOAP    | Simple Object Access Protocol           |
| SOW     | Statement of Work                       |
| SPA     | Single Page Web Applications            |
| SQL     | Structured Query Language               |
| SREF    | Short-Range Ensemble Forecast           |
| SRQ     | Super-Res Digital Reflectivity with DQA |
| SRS     | Software Requirements Specification     |
| SRS     | Spatial Reference System                |
| SSDD    | System/Subsystem Design Description     |
| SSH     | Secure Shell                            |
| SSS     | System/Subsystem Specification          |
| SSSD    | System Security Services Daemon         |
| STAR    | Standard Terminal Arrival Routes        |
| STAX    | Streaming API for XML                   |
| SUA     | Special Use Airspace                    |
| SUI     | Sensitive Unclassified Information      |
| SUM     | Software User Manual                    |
| SW      | Software                                |
| SWF     | Small Web Format                        |
| SWIM    | System Wide Information Management      |
| TAF     | Terminal Aerodrome Forecast             |
| TBD     | To Be Determined                        |

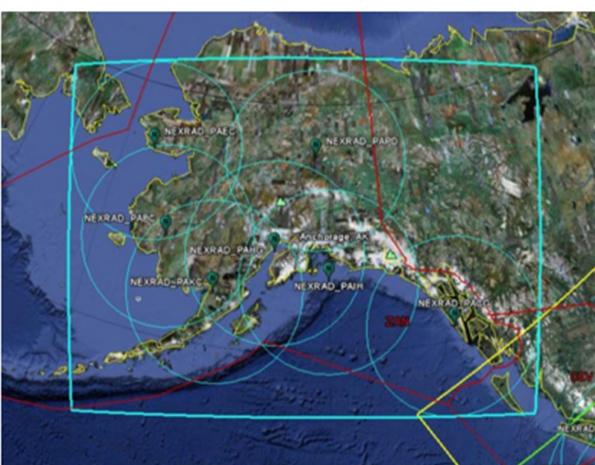
| <b>Acronym</b> | <b>Definition</b>                               |
|----------------|-------------------------------------------------|
| TCP            | Transmission Control Protocol                   |
| TCP/IP         | Transmission Control Protocol/Internet Protocol |
| TDD            | Technology Description Document                 |
| TDWR           | Terminal Doppler Weather Radar                  |
| TLS            | Transponder Landing System                      |
| TRACON         | Terminal Radar Approach Control                 |
| TRP            | TRACON Reference Point                          |
| TRU            | Tornado Rapid Update                            |
| TSTM           | Thunderstorm Probability                        |
| UA             | Upper Air                                       |
| UCC            | Unified Code Count                              |
| uFrame         | Universal Framework                             |
| UGRD           | U-Component of Wind                             |
| UI             | User Interface                                  |
| URI            | Uniform Resource Identifier                     |
| URL            | Uniform Resource Locator                        |
| UTC            | Coordinated Universal Time                      |
| UUA            | Urgent                                          |
| VDSM           | Virtual Desktop and Server Manager              |
| VGRD           | V-Component of Wind                             |
| VHF            | Very High Frequency                             |
| VIL            | Vertically Integrated Liquid                    |
| VIZ            | Visualization Framework                         |
| VLAPS          | Variational Local Area Prediction System        |
| VM             | Virtual Machine                                 |
| VOR            | Omni-directional Range                          |
| VORTAC         | VOR Tactical Air Navigation System              |
| VOS            | Virtualization and Operating System             |
| W3C            | World Wide Web Consortium                       |
| WAF            | Weather Avoidance Fields                        |
| WAFS           | World Area Forecast System                      |
| WAN            | Wide Area Network                               |
| WARP           | Weather and Radar Processor                     |

| Acronym | Definition                         |
|---------|------------------------------------|
| WATRS   | West Atlantic Route System         |
| WFS     | Web Feature Service                |
| WJHTC   | William J. Hughes Technical Center |
| WKT     | Well-known Text                    |
| WMO     | World Meteorological Organization  |
| WMS     | Web Mapping Service                |
| WMPS    | Web Map Tile Service               |
| WPC     | Weather Prediction Center          |
| WSDD    | Web Service Description Document   |
| WSRD    | Web Service Requirements Document  |
| WXXM    | Weather Exchange Model             |
| XML     | Extensible Markup Language         |

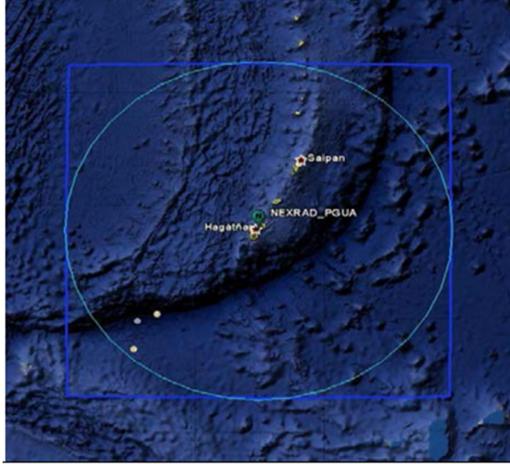
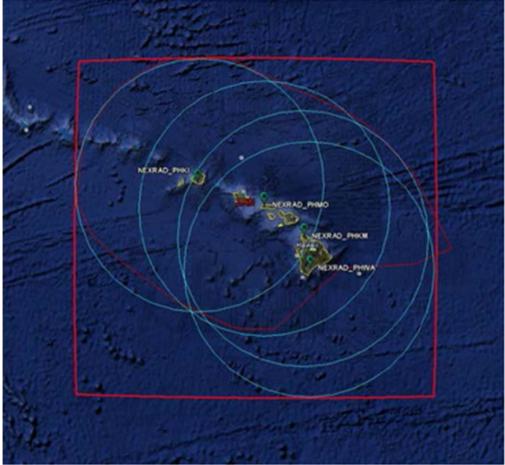
## Glossary

**Table 34. Glossary**

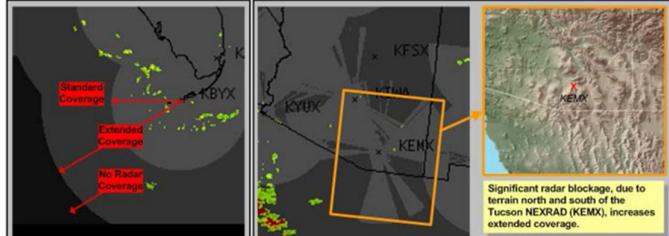
| Term                     | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Accuracy                 | For observations, the acceptable variation from the true value or standard. For forecasts, the acceptable variation from the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Acquired Products        | Data that arrive at each AWD for display, including data from CSS-Wx <i>and backup TDWR and LLWAS sources</i> . Acquired products can consist of rendered images, features and overlays or feature data used to update alerts.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Acquired Product Archive | The archive of all Acquired Products that arrive at online, dedicated AWDs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Active Window            | An active window allows the user to interact with the products in the graphics window and assess the status of the products via the Product Status Buttons.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Adaptation Data          | Parameters that can change NWP subsystem behavior or that modify the configuration of NWP hardware resources without changing NWP software. There are two types of adaptation data: System-Settable Adaptation Data and User-Settable Adaptation Data.<br><br>System-Settable Adaptation Data: Adaptation data that can be modified only by a user with adaptation maintenance privileges. The subsystem using the system settable adaptation can be in Online or Offline mode when the update is deployed, though the change only has effect upon a subsystem restart.<br><br>User-Settable Adaptation Data: Adaptation data that can be changed by a user without adaptation maintenance privileges (e.g. M&C user or AWD user) and that has immediate effect to system behavior (no subsystem restart required). |

|                                          |                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                          | Default values for user-settable adaptation data are defined by users with adaptation maintenance privileges.                                                                                                                                                                                                           |
| Adaptation Manager                       | An adaptation management capability used by a user with adaptation maintenance privileges to create, update or delete versioned sets of adaptation data.                                                                                                                                                                |
| AIMM                                     | The organization that provides AeroDB. The 56-day AeroDB updates are referred to as 'AIMM' data in the Adaptation Manager.                                                                                                                                                                                              |
| Air Route Traffic Control Center (ARTCC) | One of twenty facilities providing enroute air traffic control services for a defined airspace volume within the continental US.                                                                                                                                                                                        |
| Alaska Domain                            | The grid that includes all Alaskan radar coverage is shown as the light-blue line. The map projection and domain boundary are defined in Section 1 of ATC-392.<br>                                                                   |
| Alert                                    | Products containing notifications of operationally significant weather events in the vicinity of air terminals                                                                                                                                                                                                          |
| Analysis                                 | A method of verification that consists of comparing hardware or software design with known scientific and technical principles, procedures, and practices to estimate the capability of the proposed design to meet the mission and system requirements.                                                                |
| Archive                                  | To retain specified information for a system-adaptable period of time. The AWD handles two types of archives:<br>Screen Capture Archive and Acquired Product Archive.                                                                                                                                                   |
| Aviation Weather Display                 | Any display currently providing an NWP user interface, including AWD user interfaces, adaptation maintainer user interfaces, monitoring and control user interfaces and security control interfaces. The display need not be NWP provided hardware to be considered an AWD                                              |
| AWD Web Server                           | Subsystem which provides AWD services for Dedicated AWDs via NWP-A and for External AWDs via the EWS.                                                                                                                                                                                                                   |
| Component                                | An element of an NWP subsystem for which monitoring and control services are provided. Consists of three major types: Hardware components, including Line Replaceable Units (LRUs), software components and interface components (which allow the monitoring and control of logical or physical links to other systems) |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CONUS+ Domain            | An augmentation of the CONUS grid (shown in green) that extends north/east to include all Canadian radar coverage and south/east to include Puerto Rico (yellow outline). The map projections and domain boundaries are defined in Section 1 of ATC-392.                                                                                                                                                                                                                                                               |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| CSS-Wx System            | An enterprise service dissemination of common weather observations and forecasts to enable collaborative and dynamic NAS decision making.                                                                                                                                                                                                                                                                                                                                                                              |
| Dynamic Projection       | A map orientation such that longitude in the center of the display is oriented vertically.                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Element                  | An NWP subsystem or an NWP component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| External AWD             | A virtual instance of the AWD consisting of software which presents products obtained via the EWS to users external to the NAS.                                                                                                                                                                                                                                                                                                                                                                                        |
| External Users           | Users that are outside the FAA NAS Enterprise Security Gateway (NESG).                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| External Web Server      | Instance of NWP-A which provides data to users outside of the NAS                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Forecast ( <i>noun</i> ) | A statement of expected meteorological conditions for a specified time or period, and for a specified area or portion of airspace.                                                                                                                                                                                                                                                                                                                                                                                     |
| Graphic Map Interface    | A user interface capability for viewing additional information about a current display location, available either by selecting or hovering-over a location.                                                                                                                                                                                                                                                                                                                                                            |
| Graphics View            | <p>A generic type of movable, expandable window which shows weather information. The weather information is made up of primary and secondary products. The Graphics View windows also display overlays such as state boundaries, ARTCC boundaries and other aeronautical information. Graphics View windows allow the user to select which products and overlays to display and how they should be drawn.</p> <p>There are three types of Graphics View windows: TRACON View, Long Range View and Configured View.</p> |
| Gridded Products         | Rectangular arrays whose elements contain a product value coinciding with uniformly spaced observations or computed results on a 2-D surface. Gridded products map to earth's surface through a map projection, for example, Lambert Conformal or Lambert Azimuthal Equal-Area.                                                                                                                                                                                                                                        |
| Guam Domain              | The grid that includes all Guam radar coverage is shown as the blue line. The map projection and domain boundary are defined in Section 1 of ATC-392.                                                                                                                                                                                                                                                                                                                                                                  |

|                      |                                                                                                                                                                                                                                                                                                                            |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      |                                                                                                                                                                                                                                           |
| GUI                  | A graphical user interface that includes features such as windows, panels, text, menus, buttons, etc.                                                                                                                                                                                                                      |
| Hawaii Domain        | The grid that includes all Hawaiian radar coverage is shown as the red line. The map projection and domain boundary are defined in Section 1 of ATC-392.<br>                                                                             |
| Hosted Algorithm     | An algorithm that converts products into data suitable for a rendering algorithm to generate image layers or graphical features required by a display. Hosted Algorithms are described in Project Report ATC-413. Algorithms are executed at the NWP-A to create products for display at Dedicated AWDs and External AWDs. |
| Internal System Time | A representation of current time, available to any system component, that is synchronized with the FAA Telecommunications Infrastructure's (FTI) Operational Internet Protocol (IP) Network Time Protocol (NTP) Service. The internal system time drift is maintained within 10 milliseconds from the FTI NTP time source. |
| Internal Users       | Users running on the FAA Telecommunications Infrastructure (FTI) network.                                                                                                                                                                                                                                                  |
| Long Range View      | A movable, expandable window which contains weather data for one (1) of five (5) NWP domains: CONUS+, Alaska, Hawaii, Guam, or the Northern Hemisphere.                                                                                                                                                                    |

|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Low Level Windshear Alert System (LLWAS) | A wind shear detection system that measures wind speed and direction at remote sensor station sites situated around the airport terminal. The LLWAS-NE (Network Expansion) and LLWAS-RS (Relocation and Sustainment) model generate runway specific microburst and wind shear alert messages <i>that are available to the AWD as backup data.</i>                                                                                                                                                                                                                                                                                                                                                                        |
| Mode                                     | Indicates whether the component is able to provide products and services. See section 3.5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Monitor                                  | Continually observe a feature of interest detected by the system or designated to provide output.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Mosaic                                   | Combined data from multiple similar systems or sensors into one (1) product to give a regional or national view of a feature such as reflectivity, echo tops, weather avoidance field, or satellite imagery.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| National Airspace System (NAS)           | A complex collection of facilities, systems, equipment, procedures, and airports operated by thousands of people to provide a safe and efficient flying environment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Non-Dedicated Display                    | A display other than a Dedicated AWD (i.e. not provided as part of the NWP System), hosting a web-browser and being used to access either the NWP AWD user interface, M&C user interface or adaptation manager interface.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Non-Gridded Products                     | Observations or computed results associated with singular or sparsely distributed sets of geospatial locations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| NWP-A                                    | NWP-AWD Services which includes AWD Data Service (ADS) capability for execution of Hosted Algorithms, and AWD server side software. Provides data to users within the National Airspace System (NAS) over FTI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| NWP Domains                              | Geospatial regions for which NWP generates products. NWP generates weather products for five different domains: CONUS+, Alaska, Hawaii, Guam, and the Northern Hemisphere.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| NWP System                               | Describes the entire collection of hardware and software provided under the NWP contract. Includes Domain product generator, AWD Web servers, Dedicated AWDs and NWP LANs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Primary Product                          | A product which can be displayed alone, or combined with other products for display. Primary products cannot be displayed in combination with other primary products.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Radar Coverage                           | The radar coverage quality is reflected in the coverage pattern, as shown in the picture below. The height of the radar beam above the ground increases with increasing distance from the radar. At about 230 km distant, the radar beam is sufficiently high that the intensity of the weather may be underestimated. Standard radar coverage is within 230 km of the radar and is indicated by lighter gray in the coverage pattern. Extended coverage is beyond 230 km of the radar. Additionally, beam blockage in mountainous terrain may result in degraded coverage. Extended and degraded (impaired) coverage areas are shown in darker gray. Finally, no radar coverage is indicated by the darkest gray color. |



|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reference Time                  | A current product's time stamp, also known as Time Zero (0).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Render, Rendering               | The process of generating an image from data by means of computer programs. Along with the data, information such as geometry, viewport and other display representation characteristics should be available in order to produce an image.                                                                                                                                                                                                                                                                                                          |
| Runway Status                   | <i>The operational status of a runway (active, inactive, or closed).</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Score Region                    | The polygon around a “home” location within which forecast accuracy and forecast confidence scores are calculated.                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Screen Capture Archive          | The archive of screen captures that are collected routinely from operational dedicated AWDs whenever the screen contents changes.                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Secondary Product               | A product which can be displayed with a primary product. More than one (1) secondary product can be displayed with a single primary product. System Adaptation defines permissible product combinations of primary products with secondary products. Secondary products can be displayed graphically and/or alphanumerically, depending on the product. Secondary products align their products to the primary product they are being displayed with using the System Adaptation loop alignment category that is assigned to the secondary product. |
| State                           | Indicates the health of the managed component. See section 3.5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Static Image View               | A movable, expandable window which contains a static image of a weather product.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Styled Layer Descriptor (SLD)   | An XML schema, specified by the OGC for describing the appearance of map layers. An SLD is capable of describing the rendering of vector and raster data. SLDs are typically used to instruct a Web Map Service how to render a specific layer.                                                                                                                                                                                                                                                                                                     |
| Subsystem                       | A major element of the NWP system consisting of one of the following types: Compute Cluster, Domain Product Generator, Hosted Algorithms, Dedicated AWD, AWD Web Server, Adaptation Manger and NWP LAN. All subsystems, except the Adaptation Manager which is an off-line subsystem, are subject to NWP monitoring and control.                                                                                                                                                                                                                    |
| Subsystem or component Restart  | Shutdown of a subsystem or component followed by restart of the subsystem/component, initialization of all functions, and execution of any startup diagnostics. Restarts may be warm (checkpoint data is used) or cold (no use of checkpoint data).                                                                                                                                                                                                                                                                                                 |
| System-Settable Adaptation Data | See Adaptation Data.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| TDWR View                       | <p><i>A backup view defined for the AWD, including the following content:</i></p> <ul style="list-style-type: none"> <li>· <i>TDWR Microburst Product</i></li> <li>· <i>TDWR High Resolution Precipitation</i></li> <li>· <i>TDWR Low Resolution Precipitation</i></li> <li>· <i>TDWR Gust Front Product</i></li> <li>· <i>TDWR Alerts</i></li> </ul>                                                                                                                                                                                               |

|                                           |                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Terminal Area                             | A region that includes the airport and TRACON areas and for some airports is over 100 NMI from center field. <i>NWP terminal technology is described in ATC-415.</i>                                                                                                                                                                            |
| Text View                                 | A movable window which contains formatted weather text product data.                                                                                                                                                                                                                                                                            |
| TRACON Product Display Modes              | A set of TRACON AWD configurations to support back-up operations. The dedicated AWDs will be physically connected to TDWR and LLWAS sensors, and will have the ability to receive backup products for the TRACON. The TRACON product display modes include “CSS-Wx System,” “TDWR Backup,” and “LLWAS Backup.”                                  |
| TRACON View                               | A movable, expandable window which contains weather data for one (1) of 34 TRACONS. TRACON View windows are rotated about the TRACON Reference Point (TRP) to be aligned with magnetic north and are range-limited to the specific TRACON area or a bounding box. The rotation and range limits may be specified by system-settable adaptation. |
| Transition Mode                           | Determines whether the AWD transition between TRACON product display modes will be “automatic” or “manual.”                                                                                                                                                                                                                                     |
| Preference Set                            | Display configuration parameters and settings to set-up a user’s default display and windows environment.                                                                                                                                                                                                                                       |
| User-Settable Adaptation Data             | See Adaptation Data.                                                                                                                                                                                                                                                                                                                            |
| View                                      | A common framework that defines how windows are displayed. The contents of the windows are dependent on the type of View that is being displayed. The user can display and manipulate any combination of View windows.                                                                                                                          |
| Web Feature Service (WFS)                 | An OGC standard protocol that provides an interface allowing requests for geographical features across the Web using platform-independent calls.                                                                                                                                                                                                |
| Web Map Service (WMS)                     | An OGC standard protocol for serving geo-referenced map images over the Internet that are generated by a map server using data from a GIS database.                                                                                                                                                                                             |
| Windows Configuration Data                | System-generated data that describe, in computer display terms, details of how the windows are drawn and what windows contain.                                                                                                                                                                                                                  |
| World Wide Web Consortium (W3C) standards | W3C standards, developed by the international community, define the main set of standards for the World Wide Web. The AWD user interfaces will conform to the HTML, XML, CSS, DOM and Java Script API standards recommended by the W3C. Standards can be found online at <a href="http://www.w3.org/TR/">http://www.w3.org/TR/</a> .            |

## 7.0 Product Generation Processes Appendix

The following is an example list of processes and the corresponding PG server each process was run on as mentioned in Table 9 -PG Server Software List. The list of processes is an example of primary algorithmic processes that may be running on the PG servers at a given time, and include the co-located processes used to integrate 3rd party algorithms (eg. Blending, SATCAST, VLAPS) used within the Domain.

**Table 35. PG Processes**

| <b>PG Server:</b> | <b>Process:</b>                       |
|-------------------|---------------------------------------|
| pg01              | AmdarTranslatorProc                   |
| pg01              | BaseReflMosaicPackager_Alaska         |
| pg01              | BaseReflMosaicPackager_Guam           |
| pg01              | BaseReflMosaicPackager_Hawaii         |
| pg01              | BaseReflMosaicTileAssembler           |
| pg01              | BaseReflMosaicTileAssembler_Alaska    |
| pg01              | BaseReflMosaicTileAssembler_Guam      |
| pg01              | BaseReflMosaicTileAssembler_Hawaii    |
| pg01              | BaseReflMosTileProc_Alaska            |
| pg01              | BaseReflMosTileProc_Guam              |
| pg01              | BaseReflMosTileProc_Hawaii            |
| pg01              | BaseReflMosTileProc_TileColRow-0-0    |
| pg01              | BaseReflMosTileProc_TileColRow-0-1    |
| pg01              | BaseReflMosTileProc_TileColRow-1-0    |
| pg01              | BaseReflMosTileProc_TileColRow-1-1    |
| pg01              | BaseReflMosTileProc_TileColRow-2-0    |
| pg01              | BaseReflMosTileProc_TileColRow-2-1    |
| pg01              | CompReflLayersProc                    |
| pg01              | CWAP_Proc_EnrouteMed_0to2H            |
| pg01              | CWAP_Proc_EnrouteMed_T0               |
| pg01              | CWAPPackagerProc                      |
| pg01              | EchoBottomsMosaicTileAssembler2       |
| pg01              | EchoBottomsMosTileProc_TileColRow-0-1 |
| pg01              | EchoBottomsMosTileProc_TileColRow-1-1 |
| pg01              | EchoBottomsMosTileProc_TileColRow-2-1 |
| pg01              | EchoBottomsMosTileProc_TileColRow-3-1 |
| pg01              | FcaFeatureExtractionProc_Extrap       |
| pg01              | FcaFeatureExtractionProc_HRRR         |
| pg01              | FcaFeatureExtractionProc_LAMP         |
| pg01              | FcaFeatureExtractionProc_SREF         |
| pg01              | ForecastAccuracyPackager              |
| pg01              | ForecastConfidencePackager            |

| <b>PG Server:</b> | <b>Process:</b>                        |
|-------------------|----------------------------------------|
| pg01              | ForecastConfidenceProc                 |
| pg01              | FrontsForecastPackager                 |
| pg01              | GoesSatelliteTranslatorProc_Alaska     |
| pg01              | GoesSatelliteTranslatorProc_East       |
| pg01              | GoesSatelliteTranslatorProc_PuertoRico |
| pg01              | GoesSatelliteTranslatorProc_West       |
| pg01              | LightningPackagerProc                  |
| pg01              | LightningPackagerProc_Alaska           |
| pg01              | LightningTranslatorProc                |
| pg01              | OneMinuteObservationTranslatorProc     |
| pg01              | PreSatelliteProc                       |
| pg01              | PreSatelliteProc_Alaska                |
| pg01              | PreSatelliteProc_Hawaii                |
| pg01              | SatelliteMosaicPackager                |
| pg01              | SatelliteMosaicPackager_Alaska         |
| pg01              | SatelliteMosaicPackager_Hawaii         |
| pg01              | SatelliteMosaicProc                    |
| pg01              | SatelliteMosaicProc_Alaska             |
| pg01              | SatelliteMosaicProc_Hawaii             |
| pg01              | SatelliteRemapperProc_Alaska           |
| pg01              | SatelliteRemapperProc_GOES-E           |
| pg01              | SatelliteRemapperProc_GOES-W           |
| pg01              | SatelliteRemapperProc_Hawaii           |
| pg01              | SrefTranslatorProc                     |
| pg01              | TornadoPackagerProc                    |
| pg01              | TornadoPackagerProc_Alaska             |
| pg01              | TornadoPackagerProc_Guam               |
| pg01              | TornadoPackagerProc_Hawaii             |
| pg01              | VolumeMosTileProc_TileColRow-1-0       |
| pg01              | VolumeMosTileProc_TileColRow-2-2       |
| pg01              | WeatherBulletinTranslatorProc          |
| pg02              | EchoBottomsMosTileProc_TileColRow-6-0  |
| pg02              | EchoBottomsMosTileProc_TileColRow-6-1  |

| <b>PG Server:</b> | <b>Process:</b>                     |
|-------------------|-------------------------------------|
| pg02              | MosaicSynchBaseReflGroup1           |
| pg02              | MosaicSynchBaseReflGroup10          |
| pg02              | MosaicSynchBaseReflGroup11          |
| pg02              | MosaicSynchBaseReflGroup12          |
| pg02              | MosaicSynchBaseReflGroup13          |
| pg02              | MosaicSynchBaseReflGroup14          |
| pg02              | MosaicSynchBaseReflGroup2           |
| pg02              | MosaicSynchBaseReflGroup3           |
| pg02              | MosaicSynchBaseReflGroup4           |
| pg02              | MosaicSynchBaseReflGroup5           |
| pg02              | MosaicSynchBaseReflGroup6           |
| pg02              | MosaicSynchBaseReflGroup7           |
| pg02              | MosaicSynchBaseReflGroup8           |
| pg02              | MosaicSynchBaseReflGroup9           |
| pg02              | PrecipPhasePackager                 |
| pg02              | StormInfoBaseReflHazardsProc        |
| pg02              | StormInfoBaseReflHazardsProc_Alaska |
| pg02              | StormInfoBaseReflHazardsProc_Guam   |
| pg02              | StormInfoBaseReflHazardsProc_Hawaii |
| pg02              | StormInfoBaseReflMotionProc         |
| pg02              | StormInfoBaseReflMotionProc_Alaska  |
| pg02              | StormInfoBaseReflMotionProc_Guam    |
| pg02              | StormInfoBaseReflMotionProc_Hawaii  |
| pg02              | StormInfoCompReflPackager           |
| pg02              | StormInfoCompReflProc               |
| pg02              | StormInfoCompReflProc_Alaska        |
| pg02              | StormInfoCompReflProc_Guam          |
| pg02              | StormInfoCompReflProc_Hawaii        |
| pg02              | StormInfoPackager_Alaska            |
| pg02              | StormInfoPackager_Guam              |
| pg02              | StormInfoPackager_Hawaii            |
| pg02              | StormInfoVilPackager                |
| pg02              | StormInfoVilProc                    |

| <b>PG Server:</b> | <b>Process:</b>                       |
|-------------------|---------------------------------------|
| pg02              | StormInfoVilProc_Alaska               |
| pg02              | StormInfoVilProc_Guam                 |
| pg02              | StormInfoVilProc_Hawaii               |
| pg02              | VolumeMosaicPackager_Alaska           |
| pg02              | VolumeMosaicPackager_Guam             |
| pg02              | VolumeMosaicPackager_Hawaii           |
| pg02              | VolumeMosaicPackager1                 |
| pg02              | VolumeMosaicPackager2                 |
| pg02              | VolumeMosaicPackager3                 |
| pg02              | VolumeMosaicTileAssembler_Alaska      |
| pg02              | VolumeMosaicTileAssembler_Guam        |
| pg02              | VolumeMosaicTileAssembler_Hawaii      |
| pg02              | VolumeMosaicTileAssembler1            |
| pg02              | VolumeMosTileProc_Alaska              |
| pg02              | VolumeMosTileProc_Guam                |
| pg02              | VolumeMosTileProc_Hawaii              |
| pg02              | VolumeMosTileProc_TileColRow-0-1      |
| pg02              | VolumeMosTileProc_TileColRow-2-0      |
| pg02              | VolumeMosTileProc_TileColRow-3-2      |
| pg02              | VolumeMosTileProc_TileColRow-5-0      |
| pg02              | VolumeMosTileProc_TileColRow-6-0      |
| pg02              | VolumeMosTileProc_TileColRow-7-0      |
| pg03              | CellInterpVecsProc                    |
| pg03              | CellInterpVecsProc_Alaska             |
| pg03              | CellInterpVecsProc_Guam               |
| pg03              | CellInterpVecsProc_Hawaii             |
| pg03              | CWAP_Proc_Low_Fcst4                   |
| pg03              | EchoBottomsMosaicPackager1            |
| pg03              | EchoBottomsMosaicPackager2            |
| pg03              | EchoBottomsMosaicTileAssembler_Alaska |
| pg03              | EchoBottomsMosaicTileAssembler_Guam   |
| pg03              | EchoBottomsMosaicTileAssembler_Hawaii |
| pg03              | EchoBottomsMosaicTileAssembler1       |

| <b>PG Server:</b> | <b>Process:</b>                       |
|-------------------|---------------------------------------|
| pg03              | EchoBottomsMosTileProc_Alaska         |
| pg03              | EchoBottomsMosTileProc_Guam           |
| pg03              | EchoBottomsMosTileProc_Hawaii         |
| pg03              | EchoBottomsMosTileProc_TileColRow-0-0 |
| pg03              | EchoBottomsMosTileProc_TileColRow-1-0 |
| pg03              | EchoBottomsMosTileProc_TileColRow-2-0 |
| pg03              | EchoTopsForecastProc_2to8             |
| pg03              | EnvelopeInterpVecsProc                |
| pg03              | EnvelopeInterpVecsProc_Alaska         |
| pg03              | EnvelopeInterpVecsProc_Guam           |
| pg03              | EnvelopeInterpVecsProc_Hawaii         |
| pg03              | GfsTranslatorProc_Guam                |
| pg03              | LightningAggregation                  |
| pg03              | LightningAggregation_Alaska           |
| pg03              | LightningFeatureProc                  |
| pg03              | ModelCarvingProc                      |
| pg03              | ModelStormMotionProc                  |
| pg03              | ModelStormMotionProc_Alaska           |
| pg03              | ModelStormMotionProc_Guam             |
| pg03              | ModelStormMotionProc_Hawaii           |
| pg03              | PostMosaicTrackProc                   |
| pg03              | PostMosaicTrendsProc                  |
| pg03              | RapTranslatorProc                     |
| pg03              | RapTranslatorProc_Alaska              |
| pg03              | RapTranslatorProc_Hawaii              |
| pg03              | Send25SecTimeSignal                   |
| pg03              | Send300SecTimeSignal                  |
| pg03              | Send30SecTimeSignal                   |
| pg03              | SynopticInterpVecsProc                |
| pg03              | TornadoAggregationProc                |
| pg03              | TornadoAggregationProc_Alaska         |
| pg03              | TornadoAggregationProc_Guam           |
| pg03              | TornadoAggregationProc_Hawaii         |

| <b>PG Server:</b> | <b>Process:</b>                   |
|-------------------|-----------------------------------|
| pg04              | CWAM_WAF_ARSI_C90_Packager        |
| pg04              | CWAM_WAF_ARSI_N90_Packager        |
| pg04              | CWAM_WAF_ARSI_PCT_Packager        |
| pg04              | CWAM_WAF_ARSI_PHL_Packager        |
| pg04              | CWAM_WAF_Domain_Packager_Enroute1 |
| pg04              | CWAM_WAF_Domain_Packager_Enroute2 |
| pg04              | CWAM_WAF_Domain_Packager_Mosaic   |
| pg04              | CWAM_WAF_Forecast_C90_Enroute     |
| pg04              | CWAM_WAF_Forecast_C90_Low         |
| pg04              | CWAM_WAF_Forecast_N90_Enroute     |
| pg04              | CWAM_WAF_Forecast_N90_Low         |
| pg04              | CWAM_WAF_Forecast_PCT_Enroute     |
| pg04              | CWAM_WAF_Forecast_PCT_Low         |
| pg04              | CWAM_WAF_Forecast_PHL_Enroute     |
| pg04              | CWAM_WAF_Forecast_PHL_Low         |
| pg04              | CWAM_WAF_Merge_Forecast_ARSI      |
| pg04              | CWAM_WAF_Merge_Forecast_RAPT      |
| pg04              | CWAM_WAF_Merge_T-Zero_ARSI        |
| pg04              | CWAM_WAF_Merge_T-Zero_RAPT        |
| pg04              | CWAM_WAF_RAPT_C90_Packager        |
| pg04              | CWAM_WAF_RAPT_N90_Packager        |
| pg04              | CWAM_WAF_RAPT_PCT_Packager        |
| pg04              | CWAM_WAF_RAPT_PHL_Packager        |
| pg04              | CWAM_WAF_T-Zero_C90_Enroute       |
| pg04              | CWAM_WAF_T-Zero_C90_Low           |
| pg04              | CWAM_WAF_T-Zero_Domain_Enroute    |
| pg04              | CWAM_WAF_T-Zero_N90_Enroute       |
| pg04              | CWAM_WAF_T-Zero_N90_Low           |
| pg04              | CWAM_WAF_T-Zero_PCT_Enroute       |
| pg04              | CWAM_WAF_T-Zero_PCT_Low           |
| pg04              | CWAM_WAF_T-Zero_PHL_Enroute       |
| pg04              | CWAM_WAF_T-Zero_PHL_Low           |
| pg04              | CWAP_Proc_EnrouteHigh_0to2H       |

| <b>PG Server:</b> | <b>Process:</b>                       |
|-------------------|---------------------------------------|
| pg04              | CWAP_Proc_EnrouteHigh_T0              |
| pg04              | CWAP_Proc_High_2to8H                  |
| pg04              | EchoBottomsMosTileProc_TileColRow-7-0 |
| pg04              | EchoBottomsMosTileProc_TileColRow-7-1 |
| pg04              | GridDividerAlaska                     |
| pg04              | GridDividerGroup1                     |
| pg04              | GridDividerGroup10                    |
| pg04              | GridDividerGroup11                    |
| pg04              | GridDividerGroup12                    |
| pg04              | GridDividerGroup13                    |
| pg04              | GridDividerGroup14                    |
| pg04              | GridDividerGroup2                     |
| pg04              | GridDividerGroup3                     |
| pg04              | GridDividerGroup4                     |
| pg04              | GridDividerGroup5                     |
| pg04              | GridDividerGroup6                     |
| pg04              | GridDividerGroup7                     |
| pg04              | GridDividerGroup8                     |
| pg04              | GridDividerGroup9                     |
| pg04              | GridDividerHawaii                     |
| pg04              | MosaicSynchVolumeGroup1               |
| pg04              | MosaicSynchVolumeGroup10              |
| pg04              | MosaicSynchVolumeGroup11              |
| pg04              | MosaicSynchVolumeGroup12              |
| pg04              | MosaicSynchVolumeGroup13              |
| pg04              | MosaicSynchVolumeGroup14              |
| pg04              | MosaicSynchVolumeGroup2               |
| pg04              | MosaicSynchVolumeGroup3               |
| pg04              | MosaicSynchVolumeGroup4               |
| pg04              | MosaicSynchVolumeGroup5               |
| pg04              | MosaicSynchVolumeGroup6               |
| pg04              | MosaicSynchVolumeGroup7               |
| pg04              | MosaicSynchVolumeGroup8               |

| <b>PG Server:</b> | <b>Process:</b>                       |
|-------------------|---------------------------------------|
| pg04              | MosaicSynchVolumeGroup9               |
| pg04              | VolumeMosaicTileAssembler2            |
| pg04              | WeatherTypeProc                       |
| pg05              | CWAM_WAF_Domain_Packager_Forecast_Low |
| pg05              | CWAM_WAF_T-Zero_Low_Altitude_Enroute  |
| pg05              | CWAP_Proc_EnrouteLow_2to8H            |
| pg05              | EchoBottomsMosTileProc_TileColRow-4-1 |
| pg05              | GridDqeBaseRefNexradKAKQ              |
| pg05              | GridDqeBaseRefNexradKAPX              |
| pg05              | GridDqeBaseRefNexradKATX              |
| pg05              | GridDqeBaseRefNexradKBGM              |
| pg05              | GridDqeBaseRefNexradKBMX              |
| pg05              | GridDqeBaseRefNexradKBUF              |
| pg05              | GridDqeBaseRefNexradKCBW              |
| pg05              | GridDqeBaseRefNexradKCLE              |
| pg05              | GridDqeBaseRefNexradKCXX              |
| pg05              | GridDqeBaseRefNexradKDDC              |
| pg05              | GridDqeBaseRefNexradKDIX              |
| pg05              | GridDqeBaseRefNexradKDTX              |
| pg05              | GridDqeBaseRefNexradKEAX              |
| pg05              | GridDqeBaseRefNexradKEOX              |
| pg05              | GridDqeBaseRefNexradKEVX              |
| pg05              | GridDqeBaseRefNexradKFCX              |
| pg05              | GridDqeBaseRefNexradKFFC              |
| pg05              | GridDqeBaseRefNexradKFTG              |
| pg05              | GridDqeBaseRefNexradKGJX              |
| pg05              | GridDqeBaseRefNexradKGRK              |
| pg05              | GridDqeBaseRefNexradKGWX              |
| pg05              | GridDqeBaseRefNexradKHNX              |
| pg05              | GridDqeBaseRefNexradKICT              |
| pg05              | GridDqeBaseRefNexradKILX              |
| pg05              | GridDqeBaseRefNexradKIWA              |
| pg05              | GridDqeBaseRefNexradKJGX              |

| <b>PG Server:</b> | <b>Process:</b>          |
|-------------------|--------------------------|
| pg05              | GridDqeBaseRefNexradKLCH |
| pg05              | GridDqeBaseRefNexradKLOT |
| pg05              | GridDqeBaseRefNexradKLTX |
| pg05              | GridDqeBaseRefNexradKLZK |
| pg05              | GridDqeBaseRefNexradKMBX |
| pg05              | GridDqeBaseRefNexradKMHX |
| pg05              | GridDqeBaseRefNexradKMOB |
| pg05              | GridDqeBaseRefNexradKMTX |
| pg05              | GridDqeBaseRefNexradKNKX |
| pg05              | GridDqeBaseRefNexradKOHX |
| pg05              | GridDqeBaseRefNexradKPBZ |
| pg05              | GridDqeBaseRefNexradKPDT |
| pg05              | GridDqeBaseRefNexradKRAX |
| pg05              | GridDqeBaseRefNexradKRLX |
| pg05              | GridDqeBaseRefNexradKSGF |
| pg05              | GridDqeBaseRefNexradKSOX |
| pg05              | GridDqeBaseRefNexradKTFX |
| pg05              | GridDqeBaseRefNexradKTLH |
| pg05              | GridDqeBaseRefNexradKTYX |
| pg05              | GridDqeBaseRefNexradKVAX |
| pg05              | GridDqeBaseRefNexradKVTX |
| pg05              | GridDqeBaseRefNexradPABC |
| pg05              | GridDqeBaseRefNexradPAHG |
| pg05              | GridDqeBaseRefNexradPAPD |
| pg05              | GridDqeBaseRefNexradPHKM |
| pg05              | GridDqeBaseRefNexradTJUA |
| pg05              | GridDqeVolumeNexradKAKQ  |
| pg05              | GridDqeVolumeNexradKAPX  |
| pg05              | GridDqeVolumeNexradKATX  |
| pg05              | GridDqeVolumeNexradKBGM  |
| pg05              | GridDqeVolumeNexradKBMX  |
| pg05              | GridDqeVolumeNexradKBUF  |
| pg05              | GridDqeVolumeNexradKCBW  |

| <b>PG Server:</b> | <b>Process:</b>         |
|-------------------|-------------------------|
| pg05              | GridDqeVolumeNexradKCLE |
| pg05              | GridDqeVolumeNexradKCXX |
| pg05              | GridDqeVolumeNexradKDDC |
| pg05              | GridDqeVolumeNexradKDIX |
| pg05              | GridDqeVolumeNexradKDTX |
| pg05              | GridDqeVolumeNexradKEAX |
| pg05              | GridDqeVolumeNexradKEOX |
| pg05              | GridDqeVolumeNexradKEVX |
| pg05              | GridDqeVolumeNexradKFCX |
| pg05              | GridDqeVolumeNexradKFFC |
| pg05              | GridDqeVolumeNexradKFTG |
| pg05              | GridDqeVolumeNexradKGJX |
| pg05              | GridDqeVolumeNexradKGRK |
| pg05              | GridDqeVolumeNexradKGWX |
| pg05              | GridDqeVolumeNexradKHNX |
| pg05              | GridDqeVolumeNexradKICT |
| pg05              | GridDqeVolumeNexradKILX |
| pg05              | GridDqeVolumeNexradKIWA |
| pg05              | GridDqeVolumeNexradKJGX |
| pg05              | GridDqeVolumeNexradKLCH |
| pg05              | GridDqeVolumeNexradKLOT |
| pg05              | GridDqeVolumeNexradKLTX |
| pg05              | GridDqeVolumeNexradKLZK |
| pg05              | GridDqeVolumeNexradKMBX |
| pg05              | GridDqeVolumeNexradKMHX |
| pg05              | GridDqeVolumeNexradKMOB |
| pg05              | GridDqeVolumeNexradKMTX |
| pg05              | GridDqeVolumeNexradKNKX |
| pg05              | GridDqeVolumeNexradKOHX |
| pg05              | GridDqeVolumeNexradKPBZ |
| pg05              | GridDqeVolumeNexradKPDT |
| pg05              | GridDqeVolumeNexradKRAX |
| pg05              | GridDqeVolumeNexradKRLX |

| <b>PG Server:</b> | <b>Process:</b>            |
|-------------------|----------------------------|
| pg05              | GridDqeVolumeNexradKSGF    |
| pg05              | GridDqeVolumeNexradKSOX    |
| pg05              | GridDqeVolumeNexradKTFX    |
| pg05              | GridDqeVolumeNexradKTLH    |
| pg05              | GridDqeVolumeNexradKTYX    |
| pg05              | GridDqeVolumeNexradKVAX    |
| pg05              | GridDqeVolumeNexradKVTX    |
| pg05              | GridDqeVolumeNexradPABC    |
| pg05              | GridDqeVolumeNexradPAHG    |
| pg05              | GridDqeVolumeNexradPAPD    |
| pg05              | GridDqeVolumeNexradPHKM    |
| pg05              | GridDqeVolumeNexradTJUA    |
| pg05              | GridSlicerProc_BaseRefl    |
| pg05              | NexradLevel3TranslatorKAKQ |
| pg05              | NexradLevel3TranslatorKAPX |
| pg05              | NexradLevel3TranslatorKATX |
| pg05              | NexradLevel3TranslatorKBGM |
| pg05              | NexradLevel3TranslatorKBMX |
| pg05              | NexradLevel3TranslatorKBUF |
| pg05              | NexradLevel3TranslatorKCBW |
| pg05              | NexradLevel3TranslatorKCLE |
| pg05              | NexradLevel3TranslatorKCXX |
| pg05              | NexradLevel3TranslatorKDCC |
| pg05              | NexradLevel3TranslatorKDIX |
| pg05              | NexradLevel3TranslatorKDTX |
| pg05              | NexradLevel3TranslatorKEAX |
| pg05              | NexradLevel3TranslatorKEOX |
| pg05              | NexradLevel3TranslatorKEVX |
| pg05              | NexradLevel3TranslatorKFCX |
| pg05              | NexradLevel3TranslatorKFFC |
| pg05              | NexradLevel3TranslatorKFTG |
| pg05              | NexradLevel3TranslatorKGJX |
| pg05              | NexradLevel3TranslatorKGRK |

| <b>PG Server:</b> | <b>Process:</b>                              |
|-------------------|----------------------------------------------|
| pg05              | NexradLevel3TranslatorKGWX                   |
| pg05              | NexradLevel3TranslatorKHNX                   |
| pg05              | NexradLevel3TranslatorKICT                   |
| pg05              | NexradLevel3TranslatorKILX                   |
| pg05              | NexradLevel3TranslatorKIWA                   |
| pg05              | NexradLevel3TranslatorKJGX                   |
| pg05              | NexradLevel3TranslatorKLCH                   |
| pg05              | NexradLevel3TranslatorKLOT                   |
| pg05              | NexradLevel3TranslatorKLTX                   |
| pg05              | NexradLevel3TranslatorKLZK                   |
| pg05              | NexradLevel3TranslatorKMBX                   |
| pg05              | NexradLevel3TranslatorKMHX                   |
| pg05              | NexradLevel3TranslatorKMOB                   |
| pg05              | NexradLevel3TranslatorKMTX                   |
| pg05              | NexradLevel3TranslatorKNKX                   |
| pg05              | NexradLevel3TranslatorKOHX                   |
| pg05              | NexradLevel3TranslatorKPBZ                   |
| pg05              | NexradLevel3TranslatorKPDT                   |
| pg05              | NexradLevel3TranslatorKRAX                   |
| pg05              | NexradLevel3TranslatorKRLX                   |
| pg05              | NexradLevel3TranslatorKSGF                   |
| pg05              | NexradLevel3TranslatorKSOX                   |
| pg05              | NexradLevel3TranslatorKTFX                   |
| pg05              | NexradLevel3TranslatorKTLH                   |
| pg05              | NexradLevel3TranslatorKTYX                   |
| pg05              | NexradLevel3TranslatorKVAX                   |
| pg05              | NexradLevel3TranslatorKVTX                   |
| pg05              | NexradLevel3TranslatorPABC                   |
| pg05              | NexradLevel3TranslatorPAHG                   |
| pg05              | NexradLevel3TranslatorPAPD                   |
| pg05              | NexradLevel3TranslatorPHKM                   |
| pg05              | NexradLevel3TranslatorTJUA                   |
| pg05              | NonGridSlicerProc_StormInfo_BaseRefl_Hazards |

| <b>PG Server:</b> | <b>Process:</b>                             |
|-------------------|---------------------------------------------|
| pg05              | NonGridSlicerProc_StormInfo_BaseRefl_Motion |
| pg05              | RadarStatusPackager                         |
| pg05              | SlicedBaseReflPackager                      |
| pg05              | SlicedStormInfoBaseReflPackager             |
| pg05              | TiltDqeNexradKAKQ                           |
| pg05              | TiltDqeNexradKAPX                           |
| pg05              | TiltDqeNexradKATX                           |
| pg05              | TiltDqeNexradKBGM                           |
| pg05              | TiltDqeNexradKBMX                           |
| pg05              | TiltDqeNexradKBUF                           |
| pg05              | TiltDqeNexradKCBW                           |
| pg05              | TiltDqeNexradKCLE                           |
| pg05              | TiltDqeNexradKCXX                           |
| pg05              | TiltDqeNexradKDDC                           |
| pg05              | TiltDqeNexradKDIX                           |
| pg05              | TiltDqeNexradKDTX                           |
| pg05              | TiltDqeNexradKEAX                           |
| pg05              | TiltDqeNexradKEOX                           |
| pg05              | TiltDqeNexradKEVX                           |
| pg05              | TiltDqeNexradKFCX                           |
| pg05              | TiltDqeNexradKFFC                           |
| pg05              | TiltDqeNexradKFTG                           |
| pg05              | TiltDqeNexradKGJX                           |
| pg05              | TiltDqeNexradKGRK                           |
| pg05              | TiltDqeNexradKGWX                           |
| pg05              | TiltDqeNexradKHNX                           |
| pg05              | TiltDqeNexradKICT                           |
| pg05              | TiltDqeNexradKILX                           |
| pg05              | TiltDqeNexradKIWA                           |
| pg05              | TiltDqeNexradKJGX                           |
| pg05              | TiltDqeNexradKLCH                           |
| pg05              | TiltDqeNexradKLOT                           |
| pg05              | TiltDqeNexradKLTX                           |

| <b>PG Server:</b> | <b>Process:</b>         |
|-------------------|-------------------------|
| pg05              | TiltDqeNexradKLZK       |
| pg05              | TiltDqeNexradKMBX       |
| pg05              | TiltDqeNexradKMHX       |
| pg05              | TiltDqeNexradKMOB       |
| pg05              | TiltDqeNexradKMTX       |
| pg05              | TiltDqeNexradKNKX       |
| pg05              | TiltDqeNexradKOHX       |
| pg05              | TiltDqeNexradKPBZ       |
| pg05              | TiltDqeNexradKPDT       |
| pg05              | TiltDqeNexradKRAX       |
| pg05              | TiltDqeNexradKRLX       |
| pg05              | TiltDqeNexradKSGF       |
| pg05              | TiltDqeNexradKSOX       |
| pg05              | TiltDqeNexradKTFX       |
| pg05              | TiltDqeNexradKTLH       |
| pg05              | TiltDqeNexradKTYX       |
| pg05              | TiltDqeNexradKVAX       |
| pg05              | TiltDqeNexradKVTX       |
| pg05              | TiltDqeNexradPABC       |
| pg05              | TiltDqeNexradPAHG       |
| pg05              | TiltDqeNexradPAPD       |
| pg05              | TiltDqeNexradPHKM       |
| pg05              | TiltDqeNexradTJUA       |
| pg05              | TrackAndTrendNexradKAKQ |
| pg05              | TrackAndTrendNexradKAPX |
| pg05              | TrackAndTrendNexradKATX |
| pg05              | TrackAndTrendNexradKBGM |
| pg05              | TrackAndTrendNexradKBMX |
| pg05              | TrackAndTrendNexradKBUF |
| pg05              | TrackAndTrendNexradKCBW |
| pg05              | TrackAndTrendNexradKCLE |
| pg05              | TrackAndTrendNexradKCXX |
| pg05              | TrackAndTrendNexradKDDC |

| <b>PG Server:</b> | <b>Process:</b>         |
|-------------------|-------------------------|
| pg05              | TrackAndTrendNexradKDIX |
| pg05              | TrackAndTrendNexradKDTX |
| pg05              | TrackAndTrendNexradKEAX |
| pg05              | TrackAndTrendNexradKEOX |
| pg05              | TrackAndTrendNexradKEVX |
| pg05              | TrackAndTrendNexradKFCX |
| pg05              | TrackAndTrendNexradKFFC |
| pg05              | TrackAndTrendNexradKFTG |
| pg05              | TrackAndTrendNexradKGJX |
| pg05              | TrackAndTrendNexradKGRK |
| pg05              | TrackAndTrendNexradKGWX |
| pg05              | TrackAndTrendNexradKHNX |
| pg05              | TrackAndTrendNexradKICT |
| pg05              | TrackAndTrendNexradKILX |
| pg05              | TrackAndTrendNexradKIWA |
| pg05              | TrackAndTrendNexradKJGX |
| pg05              | TrackAndTrendNexradKLCH |
| pg05              | TrackAndTrendNexradKLOT |
| pg05              | TrackAndTrendNexradKLTX |
| pg05              | TrackAndTrendNexradKLZK |
| pg05              | TrackAndTrendNexradKMBX |
| pg05              | TrackAndTrendNexradKMHX |
| pg05              | TrackAndTrendNexradKMOB |
| pg05              | TrackAndTrendNexradKMTX |
| pg05              | TrackAndTrendNexradKNKX |
| pg05              | TrackAndTrendNexradKOHX |
| pg05              | TrackAndTrendNexradKPBZ |
| pg05              | TrackAndTrendNexradKPDT |
| pg05              | TrackAndTrendNexradKRAX |
| pg05              | TrackAndTrendNexradKRLX |
| pg05              | TrackAndTrendNexradKSGF |
| pg05              | TrackAndTrendNexradKSOX |
| pg05              | TrackAndTrendNexradKTFX |

| <b>PG Server:</b> | <b>Process:</b>                  |
|-------------------|----------------------------------|
| pg05              | TrackAndTrendNexradKTLH          |
| pg05              | TrackAndTrendNexradKTYX          |
| pg05              | TrackAndTrendNexradKVAX          |
| pg05              | TrackAndTrendNexradKVTX          |
| pg05              | TrackAndTrendNexradPABC          |
| pg05              | TrackAndTrendNexradPAHG          |
| pg05              | TrackAndTrendNexradPAPD          |
| pg05              | TrackAndTrendNexradPHKM          |
| pg05              | TrackAndTrendNexradTJUA          |
| pg05              | VolumeMosTileProc_TileColRow-4-3 |
| pg05              | VolumeMosTileProc_TileColRow-5-3 |
| pg05              | VolumeProductGeneratorNexradKAKQ |
| pg05              | VolumeProductGeneratorNexradKAPX |
| pg05              | VolumeProductGeneratorNexradKATX |
| pg05              | VolumeProductGeneratorNexradKBGM |
| pg05              | VolumeProductGeneratorNexradKBMX |
| pg05              | VolumeProductGeneratorNexradKBUF |
| pg05              | VolumeProductGeneratorNexradKCBW |
| pg05              | VolumeProductGeneratorNexradKCLE |
| pg05              | VolumeProductGeneratorNexradKCXX |
| pg05              | VolumeProductGeneratorNexradKDDC |
| pg05              | VolumeProductGeneratorNexradKDIX |
| pg05              | VolumeProductGeneratorNexradKDTX |
| pg05              | VolumeProductGeneratorNexradKEAX |
| pg05              | VolumeProductGeneratorNexradKEOX |
| pg05              | VolumeProductGeneratorNexradKEVX |
| pg05              | VolumeProductGeneratorNexradKFCX |
| pg05              | VolumeProductGeneratorNexradKFFC |
| pg05              | VolumeProductGeneratorNexradKFTG |
| pg05              | VolumeProductGeneratorNexradKGJX |
| pg05              | VolumeProductGeneratorNexradKGRK |
| pg05              | VolumeProductGeneratorNexradKGWX |
| pg05              | VolumeProductGeneratorNexradKHNX |

| <b>PG Server:</b> | <b>Process:</b>                  |
|-------------------|----------------------------------|
| pg05              | VolumeProductGeneratorNexradKICT |
| pg05              | VolumeProductGeneratorNexradKILX |
| pg05              | VolumeProductGeneratorNexradKIWA |
| pg05              | VolumeProductGeneratorNexradKJGX |
| pg05              | VolumeProductGeneratorNexradKLCH |
| pg05              | VolumeProductGeneratorNexradKLOT |
| pg05              | VolumeProductGeneratorNexradKLTX |
| pg05              | VolumeProductGeneratorNexradKLZK |
| pg05              | VolumeProductGeneratorNexradKMBX |
| pg05              | VolumeProductGeneratorNexradKMHX |
| pg05              | VolumeProductGeneratorNexradKMOB |
| pg05              | VolumeProductGeneratorNexradKMTX |
| pg05              | VolumeProductGeneratorNexradKNKX |
| pg05              | VolumeProductGeneratorNexradKOHX |
| pg05              | VolumeProductGeneratorNexradKPBZ |
| pg05              | VolumeProductGeneratorNexradKPDT |
| pg05              | VolumeProductGeneratorNexradKRAX |
| pg05              | VolumeProductGeneratorNexradKRLX |
| pg05              | VolumeProductGeneratorNexradKSGF |
| pg05              | VolumeProductGeneratorNexradKSOX |
| pg05              | VolumeProductGeneratorNexradKTFX |
| pg05              | VolumeProductGeneratorNexradKTLH |
| pg05              | VolumeProductGeneratorNexradKTYX |
| pg05              | VolumeProductGeneratorNexradKVAX |
| pg05              | VolumeProductGeneratorNexradKVTX |
| pg05              | VolumeProductGeneratorNexradPABC |
| pg05              | VolumeProductGeneratorNexradPAHG |
| pg05              | VolumeProductGeneratorNexradPAPD |
| pg05              | VolumeProductGeneratorNexradPHKM |
| pg05              | VolumeProductGeneratorNexradTJUA |
| pg06              | CompReflLayersPackager1          |
| pg06              | CompReflLayersPackager2          |
| pg06              | CompReflLayersPackager3          |

| <b>PG Server:</b> | <b>Process:</b>            |
|-------------------|----------------------------|
| pg06              | CompReflLayersProc_Alaska  |
| pg06              | CompReflLayersProc_Guam    |
| pg06              | CompReflLayersProc_Hawaii  |
| pg06              | CWAP_Proc_EnrouteMed_2to8H |
| pg06              | GridDqeBaseReflNexradKABX  |
| pg06              | GridDqeBaseReflNexradKAMX  |
| pg06              | GridDqeBaseReflNexradKBBX  |
| pg06              | GridDqeBaseReflNexradKBIS  |
| pg06              | GridDqeBaseReflNexradKBLX  |
| pg06              | GridDqeBaseReflNexradKBRO  |
| pg06              | GridDqeBaseReflNexradKCAE  |
| pg06              | GridDqeBaseReflNexradKCCX  |
| pg06              | GridDqeBaseReflNexradKCRP  |
| pg06              | GridDqeBaseReflNexradKDAX  |
| pg06              | GridDqeBaseReflNexradKDGX  |
| pg06              | GridDqeBaseReflNexradKDOX  |
| pg06              | GridDqeBaseReflNexradKDYX  |
| pg06              | GridDqeBaseReflNexradKENX  |
| pg06              | GridDqeBaseReflNexradKESX  |
| pg06              | GridDqeBaseReflNexradKEYX  |
| pg06              | GridDqeBaseReflNexradKFDX  |
| pg06              | GridDqeBaseReflNexradKFSX  |
| pg06              | GridDqeBaseReflNexradKGGW  |
| pg06              | GridDqeBaseReflNexradKGRB  |
| pg06              | GridDqeBaseReflNexradKGSP  |
| pg06              | GridDqeBaseReflNexradKHGX  |
| pg06              | GridDqeBaseReflNexradKHTX  |
| pg06              | GridDqeBaseReflNexradKILN  |
| pg06              | GridDqeBaseReflNexradKINX  |
| pg06              | GridDqeBaseReflNexradKJAX  |
| pg06              | GridDqeBaseReflNexradKLBB  |
| pg06              | GridDqeBaseReflNexradKLGX  |
| pg06              | GridDqeBaseReflNexradKLNX  |

| <b>PG Server:</b> | <b>Process:</b>          |
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| pg06              | GridDqeBaseRefNexradKLSX |
| pg06              | GridDqeBaseRefNexradKLWX |
| pg06              | GridDqeBaseRefNexradKMAX |
| pg06              | GridDqeBaseRefNexradKMLB |
| pg06              | GridDqeBaseRefNexradKMPX |
| pg06              | GridDqeBaseRefNexradKMRX |
| pg06              | GridDqeBaseRefNexradKMVX |
| pg06              | GridDqeBaseRefNexradKMXX |
| pg06              | GridDqeBaseRefNexradKOAX |
| pg06              | GridDqeBaseRefNexradKPAH |
| pg06              | GridDqeBaseRefNexradKPUX |
| pg06              | GridDqeBaseRefNexradKRIW |
| pg06              | GridDqeBaseRefNexradKSFX |
| pg06              | GridDqeBaseRefNexradKSJT |
| pg06              | GridDqeBaseRefNexradKTBW |
| pg06              | GridDqeBaseRefNexradKTWX |
| pg06              | GridDqeBaseRefNexradKUEX |
| pg06              | GridDqeBaseRefNexradKVNX |
| pg06              | GridDqeBaseRefNexradKYUX |
| pg06              | GridDqeBaseRefNexradPAEC |
| pg06              | GridDqeBaseRefNexradPAKC |
| pg06              | GridDqeBaseRefNexradPHKI |
| pg06              | GridDqeBaseRefNexradPHWA |
| pg06              | GridDqeVolumeNexradKABX  |
| pg06              | GridDqeVolumeNexradKAMX  |
| pg06              | GridDqeVolumeNexradKBBX  |
| pg06              | GridDqeVolumeNexradKBIS  |
| pg06              | GridDqeVolumeNexradKBLX  |
| pg06              | GridDqeVolumeNexradKBRO  |
| pg06              | GridDqeVolumeNexradKCAE  |
| pg06              | GridDqeVolumeNexradKCCX  |
| pg06              | GridDqeVolumeNexradKCRP  |
| pg06              | GridDqeVolumeNexradKDAX  |

| <b>PG Server:</b> | <b>Process:</b>         |
|-------------------|-------------------------|
| pg06              | GridDqeVolumeNexradKDGX |
| pg06              | GridDqeVolumeNexradKDOX |
| pg06              | GridDqeVolumeNexradKDYX |
| pg06              | GridDqeVolumeNexradKENX |
| pg06              | GridDqeVolumeNexradKESX |
| pg06              | GridDqeVolumeNexradKEYX |
| pg06              | GridDqeVolumeNexradKFDX |
| pg06              | GridDqeVolumeNexradKFSX |
| pg06              | GridDqeVolumeNexradKGGW |
| pg06              | GridDqeVolumeNexradKGRB |
| pg06              | GridDqeVolumeNexradKGSP |
| pg06              | GridDqeVolumeNexradKHGX |
| pg06              | GridDqeVolumeNexradKHTX |
| pg06              | GridDqeVolumeNexradKILN |
| pg06              | GridDqeVolumeNexradKINX |
| pg06              | GridDqeVolumeNexradKJAX |
| pg06              | GridDqeVolumeNexradKLBB |
| pg06              | GridDqeVolumeNexradKLGX |
| pg06              | GridDqeVolumeNexradKLNX |
| pg06              | GridDqeVolumeNexradKLSX |
| pg06              | GridDqeVolumeNexradKLWX |
| pg06              | GridDqeVolumeNexradKMAX |
| pg06              | GridDqeVolumeNexradKMLB |
| pg06              | GridDqeVolumeNexradKMPX |
| pg06              | GridDqeVolumeNexradKMRX |
| pg06              | GridDqeVolumeNexradKMVX |
| pg06              | GridDqeVolumeNexradKMXX |
| pg06              | GridDqeVolumeNexradKOAX |
| pg06              | GridDqeVolumeNexradKPAH |
| pg06              | GridDqeVolumeNexradKPUX |
| pg06              | GridDqeVolumeNexradKRIW |
| pg06              | GridDqeVolumeNexradKSFX |
| pg06              | GridDqeVolumeNexradKSJT |

| <b>PG Server:</b> | <b>Process:</b>            |
|-------------------|----------------------------|
| pg06              | GridDqeVolumeNexradKTBW    |
| pg06              | GridDqeVolumeNexradKTXW    |
| pg06              | GridDqeVolumeNexradKUEX    |
| pg06              | GridDqeVolumeNexradKVNX    |
| pg06              | GridDqeVolumeNexradKYUX    |
| pg06              | GridDqeVolumeNexradPAEC    |
| pg06              | GridDqeVolumeNexradPAKC    |
| pg06              | GridDqeVolumeNexradPHKI    |
| pg06              | GridDqeVolumeNexradPHWA    |
| pg06              | NexradLevel3TranslatorKABX |
| pg06              | NexradLevel3TranslatorKAMX |
| pg06              | NexradLevel3TranslatorKBBX |
| pg06              | NexradLevel3TranslatorKBIS |
| pg06              | NexradLevel3TranslatorKBLX |
| pg06              | NexradLevel3TranslatorKBRO |
| pg06              | NexradLevel3TranslatorKCAE |
| pg06              | NexradLevel3TranslatorKCCX |
| pg06              | NexradLevel3TranslatorKCRP |
| pg06              | NexradLevel3TranslatorKDAX |
| pg06              | NexradLevel3TranslatorKDGX |
| pg06              | NexradLevel3TranslatorKDOX |
| pg06              | NexradLevel3TranslatorKDYX |
| pg06              | NexradLevel3TranslatorKENX |
| pg06              | NexradLevel3TranslatorKESX |
| pg06              | NexradLevel3TranslatorKEYX |
| pg06              | NexradLevel3TranslatorKFDX |
| pg06              | NexradLevel3TranslatorKFSX |
| pg06              | NexradLevel3TranslatorKGGW |
| pg06              | NexradLevel3TranslatorKGRC |
| pg06              | NexradLevel3TranslatorKGSP |
| pg06              | NexradLevel3TranslatorKHGX |
| pg06              | NexradLevel3TranslatorKHTX |
| pg06              | NexradLevel3TranslatorKILN |

| <b>PG Server:</b> | <b>Process:</b>            |
|-------------------|----------------------------|
| pg06              | NexradLevel3TranslatorKINX |
| pg06              | NexradLevel3TranslatorKJAX |
| pg06              | NexradLevel3TranslatorKLBB |
| pg06              | NexradLevel3TranslatorKLGX |
| pg06              | NexradLevel3TranslatorKLNX |
| pg06              | NexradLevel3TranslatorKLSX |
| pg06              | NexradLevel3TranslatorKLWX |
| pg06              | NexradLevel3TranslatorKMAX |
| pg06              | NexradLevel3TranslatorKMLB |
| pg06              | NexradLevel3TranslatorKMPX |
| pg06              | NexradLevel3TranslatorKMRX |
| pg06              | NexradLevel3TranslatorKMVX |
| pg06              | NexradLevel3TranslatorKMXX |
| pg06              | NexradLevel3TranslatorKOAX |
| pg06              | NexradLevel3TranslatorKPAH |
| pg06              | NexradLevel3TranslatorKPUX |
| pg06              | NexradLevel3TranslatorKRIW |
| pg06              | NexradLevel3TranslatorKSFX |
| pg06              | NexradLevel3TranslatorKSJT |
| pg06              | NexradLevel3TranslatorKTBW |
| pg06              | NexradLevel3TranslatorKTWX |
| pg06              | NexradLevel3TranslatorKUEX |
| pg06              | NexradLevel3TranslatorKVNX |
| pg06              | NexradLevel3TranslatorKYUX |
| pg06              | NexradLevel3TranslatorPAEC |
| pg06              | NexradLevel3TranslatorPAKC |
| pg06              | NexradLevel3TranslatorPHKI |
| pg06              | NexradLevel3TranslatorPHWA |
| pg06              | TiltDqeNexradKABX          |
| pg06              | TiltDqeNexradKAMX          |
| pg06              | TiltDqeNexradKBBX          |
| pg06              | TiltDqeNexradKBIS          |
| pg06              | TiltDqeNexradKBLX          |

| <b>PG Server:</b> | <b>Process:</b>   |
|-------------------|-------------------|
| pg06              | TiltDqeNexradKBRO |
| pg06              | TiltDqeNexradKCAE |
| pg06              | TiltDqeNexradKCCX |
| pg06              | TiltDqeNexradKCRP |
| pg06              | TiltDqeNexradKDAX |
| pg06              | TiltDqeNexradKDGX |
| pg06              | TiltDqeNexradKDOX |
| pg06              | TiltDqeNexradKDYX |
| pg06              | TiltDqeNexradKENX |
| pg06              | TiltDqeNexradKESX |
| pg06              | TiltDqeNexradKEYX |
| pg06              | TiltDqeNexradKFDX |
| pg06              | TiltDqeNexradKFSX |
| pg06              | TiltDqeNexradKGW  |
| pg06              | TiltDqeNexradKGRB |
| pg06              | TiltDqeNexradKGSP |
| pg06              | TiltDqeNexradKHGX |
| pg06              | TiltDqeNexradKHTX |
| pg06              | TiltDqeNexradKILN |
| pg06              | TiltDqeNexradKINX |
| pg06              | TiltDqeNexradKJAX |
| pg06              | TiltDqeNexradKLBB |
| pg06              | TiltDqeNexradKLGX |
| pg06              | TiltDqeNexradKLNX |
| pg06              | TiltDqeNexradKLSX |
| pg06              | TiltDqeNexradKLWX |
| pg06              | TiltDqeNexradKMAX |
| pg06              | TiltDqeNexradKMLB |
| pg06              | TiltDqeNexradKMPX |
| pg06              | TiltDqeNexradKMRX |
| pg06              | TiltDqeNexradKMVX |
| pg06              | TiltDqeNexradKMXX |
| pg06              | TiltDqeNexradKOAX |

| <b>PG Server:</b> | <b>Process:</b>         |
|-------------------|-------------------------|
| pg06              | TiltDqeNexradKPAH       |
| pg06              | TiltDqeNexradKPUX       |
| pg06              | TiltDqeNexradKRIW       |
| pg06              | TiltDqeNexradKSFX       |
| pg06              | TiltDqeNexradKSJT       |
| pg06              | TiltDqeNexradKTBW       |
| pg06              | TiltDqeNexradKTXW       |
| pg06              | TiltDqeNexradKUEX       |
| pg06              | TiltDqeNexradKVNX       |
| pg06              | TiltDqeNexradKYUX       |
| pg06              | TiltDqeNexradPAEC       |
| pg06              | TiltDqeNexradPAKC       |
| pg06              | TiltDqeNexradPHKI       |
| pg06              | TiltDqeNexradPHWA       |
| pg06              | TrackAndTrendNexradKABX |
| pg06              | TrackAndTrendNexradKAMX |
| pg06              | TrackAndTrendNexradKBBX |
| pg06              | TrackAndTrendNexradKBIS |
| pg06              | TrackAndTrendNexradKBLX |
| pg06              | TrackAndTrendNexradKBRO |
| pg06              | TrackAndTrendNexradKCAE |
| pg06              | TrackAndTrendNexradKCCX |
| pg06              | TrackAndTrendNexradKCRP |
| pg06              | TrackAndTrendNexradKDAX |
| pg06              | TrackAndTrendNexradKDGX |
| pg06              | TrackAndTrendNexradKDOX |
| pg06              | TrackAndTrendNexradKDYX |
| pg06              | TrackAndTrendNexradKENX |
| pg06              | TrackAndTrendNexradKESX |
| pg06              | TrackAndTrendNexradKEYX |
| pg06              | TrackAndTrendNexradKFDX |
| pg06              | TrackAndTrendNexradKFSX |
| pg06              | TrackAndTrendNexradKGW  |

| <b>PG Server:</b> | <b>Process:</b>         |
|-------------------|-------------------------|
| pg06              | TrackAndTrendNexradKGRB |
| pg06              | TrackAndTrendNexradKGSP |
| pg06              | TrackAndTrendNexradKHGX |
| pg06              | TrackAndTrendNexradKHTX |
| pg06              | TrackAndTrendNexradKILN |
| pg06              | TrackAndTrendNexradKINX |
| pg06              | TrackAndTrendNexradKJAX |
| pg06              | TrackAndTrendNexradKLBB |
| pg06              | TrackAndTrendNexradKLGX |
| pg06              | TrackAndTrendNexradKLNX |
| pg06              | TrackAndTrendNexradKLSX |
| pg06              | TrackAndTrendNexradKLWX |
| pg06              | TrackAndTrendNexradKMAX |
| pg06              | TrackAndTrendNexradKMLB |
| pg06              | TrackAndTrendNexradKMPX |
| pg06              | TrackAndTrendNexradKMRX |
| pg06              | TrackAndTrendNexradKMVX |
| pg06              | TrackAndTrendNexradKMXX |
| pg06              | TrackAndTrendNexradKOAX |
| pg06              | TrackAndTrendNexradKPAH |
| pg06              | TrackAndTrendNexradKPUX |
| pg06              | TrackAndTrendNexradKRIW |
| pg06              | TrackAndTrendNexradKSFX |
| pg06              | TrackAndTrendNexradKSJT |
| pg06              | TrackAndTrendNexradKTBW |
| pg06              | TrackAndTrendNexradKTWX |
| pg06              | TrackAndTrendNexradKUEX |
| pg06              | TrackAndTrendNexradKVNX |
| pg06              | TrackAndTrendNexradKYUX |
| pg06              | TrackAndTrendNexradPAEC |
| pg06              | TrackAndTrendNexradPAKC |
| pg06              | TrackAndTrendNexradPHKI |
| pg06              | TrackAndTrendNexradPHWA |

| <b>PG Server:</b> | <b>Process:</b>                   |
|-------------------|-----------------------------------|
| pg06              | VolumeMosTileProc_TileColRow-3-0  |
| pg06              | VolumeMosTileProc_TileColRow-4-2  |
| pg06              | VolumeMosTileProc_TileColRow-6-3  |
| pg06              | VolumeMosTileProc_TileColRow-7-3  |
| pg06              | VolumeProductGeneratorNexradKABX  |
| pg06              | VolumeProductGeneratorNexradKAMX  |
| pg06              | VolumeProductGeneratorNexradKB BX |
| pg06              | VolumeProductGeneratorNexradKBIS  |
| pg06              | VolumeProductGeneratorNexradKBLX  |
| pg06              | VolumeProductGeneratorNexradKBRO  |
| pg06              | VolumeProductGeneratorNexradKCAE  |
| pg06              | VolumeProductGeneratorNexradKCCX  |
| pg06              | VolumeProductGeneratorNexradKCRP  |
| pg06              | VolumeProductGeneratorNexradKDAX  |
| pg06              | VolumeProductGeneratorNexradKDGX  |
| pg06              | VolumeProductGeneratorNexradKDOX  |
| pg06              | VolumeProductGeneratorNexradKDYX  |
| pg06              | VolumeProductGeneratorNexradKENX  |
| pg06              | VolumeProductGeneratorNexradKESX  |
| pg06              | VolumeProductGeneratorNexradKEYX  |
| pg06              | VolumeProductGeneratorNexradKFDX  |
| pg06              | VolumeProductGeneratorNexradKFSX  |
| pg06              | VolumeProductGeneratorNexradKG GW |
| pg06              | VolumeProductGeneratorNexradKG RB |
| pg06              | VolumeProductGeneratorNexradKG SP |
| pg06              | VolumeProductGeneratorNexradKH GX |
| pg06              | VolumeProductGeneratorNexradKHTX  |
| pg06              | VolumeProductGeneratorNexradKILN  |
| pg06              | VolumeProductGeneratorNexradKINX  |
| pg06              | VolumeProductGeneratorNexradKJ AX |
| pg06              | VolumeProductGeneratorNexradKL BB |
| pg06              | VolumeProductGeneratorNexradKL GX |
| pg06              | VolumeProductGeneratorNexradKL NX |

| <b>PG Server:</b> | <b>Process:</b>                  |
|-------------------|----------------------------------|
| pg06              | VolumeProductGeneratorNexradKLSX |
| pg06              | VolumeProductGeneratorNexradKLWX |
| pg06              | VolumeProductGeneratorNexradKMAX |
| pg06              | VolumeProductGeneratorNexradKMLB |
| pg06              | VolumeProductGeneratorNexradKMPX |
| pg06              | VolumeProductGeneratorNexradKMRX |
| pg06              | VolumeProductGeneratorNexradKMVX |
| pg06              | VolumeProductGeneratorNexradKMXX |
| pg06              | VolumeProductGeneratorNexradKOAX |
| pg06              | VolumeProductGeneratorNexradKPAH |
| pg06              | VolumeProductGeneratorNexradKPUX |
| pg06              | VolumeProductGeneratorNexradKRIW |
| pg06              | VolumeProductGeneratorNexradKSFX |
| pg06              | VolumeProductGeneratorNexradKSJT |
| pg06              | VolumeProductGeneratorNexradKTBW |
| pg06              | VolumeProductGeneratorNexradKTXW |
| pg06              | VolumeProductGeneratorNexradKUEX |
| pg06              | VolumeProductGeneratorNexradKVNX |
| pg06              | VolumeProductGeneratorNexradKYUX |
| pg06              | VolumeProductGeneratorNexradPAEC |
| pg06              | VolumeProductGeneratorNexradPAKC |
| pg06              | VolumeProductGeneratorNexradPHKI |
| pg06              | VolumeProductGeneratorNexradPHWA |
| pg07              | ContourForecastGenPackager       |
| pg07              | ContourGenEchoTopsForecastProc   |
| pg07              | ContourGenMosaicProc             |
| pg07              | ContourGenMosaicProc_Alaska      |
| pg07              | ContourGenMosaicProc_Guam        |
| pg07              | ContourGenMosaicProc_Hawaii      |
| pg07              | ContourGenPackager               |
| pg07              | ContourGenPackager_Alaska        |
| pg07              | ContourGenPackager_Guam          |
| pg07              | ContourGenPackager_Hawaii        |

| <b>PG Server:</b> | <b>Process:</b>                 |
|-------------------|---------------------------------|
| pg07              | ContourGenStdVilForecast        |
| pg07              | ContourGenTrendProc             |
| pg07              | ContourGenTrendProc_Alaska      |
| pg07              | ContourGenTrendProc_Guam        |
| pg07              | ContourGenTrendProc_Hawaii      |
| pg07              | ContourGenWeakVilForecast       |
| pg07              | ContourTrendsGenPackager        |
| pg07              | ContourTrendsGenPackager_Alaska |
| pg07              | ContourTrendsGenPackager_Guam   |
| pg07              | ContourTrendsGenPackager_Hawaii |
| pg07              | CWAP_Proc_Low_Fcst2             |
| pg07              | GridDqeBaseRefNexradKABR        |
| pg07              | GridDqeBaseRefNexradKAMA        |
| pg07              | GridDqeBaseRefNexradKARX        |
| pg07              | GridDqeBaseRefNexradKBHX        |
| pg07              | GridDqeBaseRefNexradKBOX        |
| pg07              | GridDqeBaseRefNexradKBYX        |
| pg07              | GridDqeBaseRefNexradKCBX        |
| pg07              | GridDqeBaseRefNexradKCLX        |
| pg07              | GridDqeBaseRefNexradKCYS        |
| pg07              | GridDqeBaseRefNexradKDFX        |
| pg07              | GridDqeBaseRefNexradKDLH        |
| pg07              | GridDqeBaseRefNexradKDMX        |
| pg07              | GridDqeBaseRefNexradKDVN        |
| pg07              | GridDqeBaseRefNexradKEMX        |
| pg07              | GridDqeBaseRefNexradKEPZ        |
| pg07              | GridDqeBaseRefNexradKEWX        |
| pg07              | GridDqeBaseRefNexradKFDR        |
| pg07              | GridDqeBaseRefNexradKFSD        |
| pg07              | GridDqeBaseRefNexradKFWS        |
| pg07              | GridDqeBaseRefNexradKGLD        |
| pg07              | GridDqeBaseRefNexradKGRR        |
| pg07              | GridDqeBaseRefNexradKGYX        |

| <b>PG Server:</b> | <b>Process:</b>          |
|-------------------|--------------------------|
| pg07              | GridDqeBaseRefNexradKHDX |
| pg07              | GridDqeBaseRefNexradKHPX |
| pg07              | GridDqeBaseRefNexradKICX |
| pg07              | GridDqeBaseRefNexradKIND |
| pg07              | GridDqeBaseRefNexradKIWX |
| pg07              | GridDqeBaseRefNexradKJKL |
| pg07              | GridDqeBaseRefNexradKLIX |
| pg07              | GridDqeBaseRefNexradKLRX |
| pg07              | GridDqeBaseRefNexradKLVX |
| pg07              | GridDqeBaseRefNexradKMAF |
| pg07              | GridDqeBaseRefNexradKMKX |
| pg07              | GridDqeBaseRefNexradKMQT |
| pg07              | GridDqeBaseRefNexradKMSX |
| pg07              | GridDqeBaseRefNexradKMUX |
| pg07              | GridDqeBaseRefNexradKNQA |
| pg07              | GridDqeBaseRefNexradKOKX |
| pg07              | GridDqeBaseRefNexradKOTX |
| pg07              | GridDqeBaseRefNexradKPOE |
| pg07              | GridDqeBaseRefNexradKRGX |
| pg07              | GridDqeBaseRefNexradKRTX |
| pg07              | GridDqeBaseRefNexradKSHV |
| pg07              | GridDqeBaseRefNexradKSRX |
| pg07              | GridDqeBaseRefNexradKTLX |
| pg07              | GridDqeBaseRefNexradKUDX |
| pg07              | GridDqeBaseRefNexradKVBX |
| pg07              | GridDqeBaseRefNexradKWWX |
| pg07              | GridDqeBaseRefNexradPACG |
| pg07              | GridDqeBaseRefNexradPAIH |
| pg07              | GridDqeBaseRefNexradPGUA |
| pg07              | GridDqeBaseRefNexradPHMO |
| pg07              | GridDqeVolumeNexradKABR  |
| pg07              | GridDqeVolumeNexradKAMA  |
| pg07              | GridDqeVolumeNexradKARX  |

| <b>PG Server:</b> | <b>Process:</b>         |
|-------------------|-------------------------|
| pg07              | GridDqeVolumeNexradKBHX |
| pg07              | GridDqeVolumeNexradKBOX |
| pg07              | GridDqeVolumeNexradKBYX |
| pg07              | GridDqeVolumeNexradKCBX |
| pg07              | GridDqeVolumeNexradKCLX |
| pg07              | GridDqeVolumeNexradKCYS |
| pg07              | GridDqeVolumeNexradKDFX |
| pg07              | GridDqeVolumeNexradKDLH |
| pg07              | GridDqeVolumeNexradKDMX |
| pg07              | GridDqeVolumeNexradKDVN |
| pg07              | GridDqeVolumeNexradKEMX |
| pg07              | GridDqeVolumeNexradKEPZ |
| pg07              | GridDqeVolumeNexradKEWX |
| pg07              | GridDqeVolumeNexradKFDR |
| pg07              | GridDqeVolumeNexradKFSD |
| pg07              | GridDqeVolumeNexradKFWS |
| pg07              | GridDqeVolumeNexradKGLD |
| pg07              | GridDqeVolumeNexradKGRR |
| pg07              | GridDqeVolumeNexradKGYX |
| pg07              | GridDqeVolumeNexradKHDX |
| pg07              | GridDqeVolumeNexradKHPX |
| pg07              | GridDqeVolumeNexradKICX |
| pg07              | GridDqeVolumeNexradKIND |
| pg07              | GridDqeVolumeNexradKIWX |
| pg07              | GridDqeVolumeNexradKJKL |
| pg07              | GridDqeVolumeNexradKLIX |
| pg07              | GridDqeVolumeNexradKLRX |
| pg07              | GridDqeVolumeNexradKLVX |
| pg07              | GridDqeVolumeNexradKMAF |
| pg07              | GridDqeVolumeNexradKMKX |
| pg07              | GridDqeVolumeNexradKMQT |
| pg07              | GridDqeVolumeNexradKMSX |
| pg07              | GridDqeVolumeNexradKMU  |

| <b>PG Server:</b> | <b>Process:</b>            |
|-------------------|----------------------------|
| pg07              | GridDqeVolumeNexradKNQA    |
| pg07              | GridDqeVolumeNexradKOKX    |
| pg07              | GridDqeVolumeNexradKOTX    |
| pg07              | GridDqeVolumeNexradKPOE    |
| pg07              | GridDqeVolumeNexradKRGX    |
| pg07              | GridDqeVolumeNexradKRTX    |
| pg07              | GridDqeVolumeNexradKSHV    |
| pg07              | GridDqeVolumeNexradKSRX    |
| pg07              | GridDqeVolumeNexradKTLX    |
| pg07              | GridDqeVolumeNexradKUDX    |
| pg07              | GridDqeVolumeNexradKVBX    |
| pg07              | GridDqeVolumeNexradKWWX    |
| pg07              | GridDqeVolumeNexradPACG    |
| pg07              | GridDqeVolumeNexradPAIH    |
| pg07              | GridDqeVolumeNexradPGUA    |
| pg07              | GridDqeVolumeNexradPHMO    |
| pg07              | HazardMosaicProc           |
| pg07              | HazardMosaicProc_Alaska    |
| pg07              | HazardMosaicProc_Guam      |
| pg07              | HazardMosaicProc_Hawaii    |
| pg07              | NexradLevel3TranslatorKABR |
| pg07              | NexradLevel3TranslatorKAMA |
| pg07              | NexradLevel3TranslatorKARX |
| pg07              | NexradLevel3TranslatorKBHX |
| pg07              | NexradLevel3TranslatorKBOX |
| pg07              | NexradLevel3TranslatorKBYX |
| pg07              | NexradLevel3TranslatorKCBX |
| pg07              | NexradLevel3TranslatorKCLX |
| pg07              | NexradLevel3TranslatorKCYS |
| pg07              | NexradLevel3TranslatorKDFX |
| pg07              | NexradLevel3TranslatorKDLH |
| pg07              | NexradLevel3TranslatorKDMX |
| pg07              | NexradLevel3TranslatorKDVN |

| <b>PG Server:</b> | <b>Process:</b>            |
|-------------------|----------------------------|
| pg07              | NexradLevel3TranslatorKEMX |
| pg07              | NexradLevel3TranslatorKEPZ |
| pg07              | NexradLevel3TranslatorKEWX |
| pg07              | NexradLevel3TranslatorKFDR |
| pg07              | NexradLevel3TranslatorKFSD |
| pg07              | NexradLevel3TranslatorKFWS |
| pg07              | NexradLevel3TranslatorKGLD |
| pg07              | NexradLevel3TranslatorKGRR |
| pg07              | NexradLevel3TranslatorKGYX |
| pg07              | NexradLevel3TranslatorKHDX |
| pg07              | NexradLevel3TranslatorKHPX |
| pg07              | NexradLevel3TranslatorKICX |
| pg07              | NexradLevel3TranslatorKIND |
| pg07              | NexradLevel3TranslatorKIWX |
| pg07              | NexradLevel3TranslatorKJKL |
| pg07              | NexradLevel3TranslatorKLIX |
| pg07              | NexradLevel3TranslatorKLRX |
| pg07              | NexradLevel3TranslatorKLVX |
| pg07              | NexradLevel3TranslatorKMAF |
| pg07              | NexradLevel3TranslatorKMKX |
| pg07              | NexradLevel3TranslatorKMQT |
| pg07              | NexradLevel3TranslatorKMSX |
| pg07              | NexradLevel3TranslatorKMUX |
| pg07              | NexradLevel3TranslatorKNQA |
| pg07              | NexradLevel3TranslatorKOKX |
| pg07              | NexradLevel3TranslatorKOTX |
| pg07              | NexradLevel3TranslatorKPOE |
| pg07              | NexradLevel3TranslatorKRGX |
| pg07              | NexradLevel3TranslatorKRTX |
| pg07              | NexradLevel3TranslatorKSHV |
| pg07              | NexradLevel3TranslatorKSRX |
| pg07              | NexradLevel3TranslatorKTLX |
| pg07              | NexradLevel3TranslatorKUDX |

| <b>PG Server:</b> | <b>Process:</b>            |
|-------------------|----------------------------|
| pg07              | NexradLevel3TranslatorKVBX |
| pg07              | NexradLevel3TranslatorKWWX |
| pg07              | NexradLevel3TranslatorPACG |
| pg07              | NexradLevel3TranslatorPAIH |
| pg07              | NexradLevel3TranslatorPGUA |
| pg07              | NexradLevel3TranslatorPHMO |
| pg07              | PrecipPhasePackager_Alaska |
| pg07              | PrecipPhaseProc_Alaska     |
| pg07              | TiltDqeNexradKABR          |
| pg07              | TiltDqeNexradKAMA          |
| pg07              | TiltDqeNexradKARX          |
| pg07              | TiltDqeNexradKBHX          |
| pg07              | TiltDqeNexradKBOX          |
| pg07              | TiltDqeNexradKBYX          |
| pg07              | TiltDqeNexradKCBX          |
| pg07              | TiltDqeNexradKCLX          |
| pg07              | TiltDqeNexradKCYS          |
| pg07              | TiltDqeNexradKDFX          |
| pg07              | TiltDqeNexradKDLH          |
| pg07              | TiltDqeNexradKDMX          |
| pg07              | TiltDqeNexradKDVN          |
| pg07              | TiltDqeNexradKEMX          |
| pg07              | TiltDqeNexradKEPZ          |
| pg07              | TiltDqeNexradKEWX          |
| pg07              | TiltDqeNexradKFDR          |
| pg07              | TiltDqeNexradKFSD          |
| pg07              | TiltDqeNexradKFWS          |
| pg07              | TiltDqeNexradKGLD          |
| pg07              | TiltDqeNexradKGRR          |
| pg07              | TiltDqeNexradKGYX          |
| pg07              | TiltDqeNexradKHDX          |
| pg07              | TiltDqeNexradKHPX          |
| pg07              | TiltDqeNexradKICX          |

| <b>PG Server:</b> | <b>Process:</b>         |
|-------------------|-------------------------|
| pg07              | TiltDqeNexradKIND       |
| pg07              | TiltDqeNexradKIWX       |
| pg07              | TiltDqeNexradKJKL       |
| pg07              | TiltDqeNexradKLIX       |
| pg07              | TiltDqeNexradKLRX       |
| pg07              | TiltDqeNexradKLVX       |
| pg07              | TiltDqeNexradKMAF       |
| pg07              | TiltDqeNexradKMKX       |
| pg07              | TiltDqeNexradKMQT       |
| pg07              | TiltDqeNexradKMSX       |
| pg07              | TiltDqeNexradKMUX       |
| pg07              | TiltDqeNexradKNQA       |
| pg07              | TiltDqeNexradKOKX       |
| pg07              | TiltDqeNexradKOTX       |
| pg07              | TiltDqeNexradKPOE       |
| pg07              | TiltDqeNexradKRGX       |
| pg07              | TiltDqeNexradKRTX       |
| pg07              | TiltDqeNexradKSHV       |
| pg07              | TiltDqeNexradKSRX       |
| pg07              | TiltDqeNexradKTLX       |
| pg07              | TiltDqeNexradKUDX       |
| pg07              | TiltDqeNexradKVBX       |
| pg07              | TiltDqeNexradKWWX       |
| pg07              | TiltDqeNexradPACG       |
| pg07              | TiltDqeNexradPAIH       |
| pg07              | TiltDqeNexradPGUA       |
| pg07              | TiltDqeNexradPHMO       |
| pg07              | TrackAndTrendNexradKABR |
| pg07              | TrackAndTrendNexradKAMA |
| pg07              | TrackAndTrendNexradKARX |
| pg07              | TrackAndTrendNexradKBHX |
| pg07              | TrackAndTrendNexradKBOX |
| pg07              | TrackAndTrendNexradKBYX |

| <b>PG Server:</b> | <b>Process:</b>         |
|-------------------|-------------------------|
| pg07              | TrackAndTrendNexradKCBX |
| pg07              | TrackAndTrendNexradKCLX |
| pg07              | TrackAndTrendNexradKCYS |
| pg07              | TrackAndTrendNexradKDFX |
| pg07              | TrackAndTrendNexradKDLH |
| pg07              | TrackAndTrendNexradKDMX |
| pg07              | TrackAndTrendNexradKDVN |
| pg07              | TrackAndTrendNexradKEMX |
| pg07              | TrackAndTrendNexradKEPZ |
| pg07              | TrackAndTrendNexradKEWX |
| pg07              | TrackAndTrendNexradKFDR |
| pg07              | TrackAndTrendNexradKFSD |
| pg07              | TrackAndTrendNexradKFWS |
| pg07              | TrackAndTrendNexradKGLD |
| pg07              | TrackAndTrendNexradKGRR |
| pg07              | TrackAndTrendNexradKGYX |
| pg07              | TrackAndTrendNexradKHDX |
| pg07              | TrackAndTrendNexradKHPX |
| pg07              | TrackAndTrendNexradKICX |
| pg07              | TrackAndTrendNexradKIND |
| pg07              | TrackAndTrendNexradKIWX |
| pg07              | TrackAndTrendNexradKJKL |
| pg07              | TrackAndTrendNexradKLIX |
| pg07              | TrackAndTrendNexradKLRX |
| pg07              | TrackAndTrendNexradKLVX |
| pg07              | TrackAndTrendNexradKMAF |
| pg07              | TrackAndTrendNexradKMKX |
| pg07              | TrackAndTrendNexradKMQT |
| pg07              | TrackAndTrendNexradKMSX |
| pg07              | TrackAndTrendNexradKMUX |
| pg07              | TrackAndTrendNexradKNQA |
| pg07              | TrackAndTrendNexradKOKX |
| pg07              | TrackAndTrendNexradKOTX |

| <b>PG Server:</b> | <b>Process:</b>                  |
|-------------------|----------------------------------|
| pg07              | TrackAndTrendNexradKPOE          |
| pg07              | TrackAndTrendNexradKRGX          |
| pg07              | TrackAndTrendNexradKRTX          |
| pg07              | TrackAndTrendNexradKSHV          |
| pg07              | TrackAndTrendNexradKSRX          |
| pg07              | TrackAndTrendNexradKTLX          |
| pg07              | TrackAndTrendNexradKUDX          |
| pg07              | TrackAndTrendNexradKVBX          |
| pg07              | TrackAndTrendNexradKWWX          |
| pg07              | TrackAndTrendNexradPACG          |
| pg07              | TrackAndTrendNexradPAIH          |
| pg07              | TrackAndTrendNexradPGUA          |
| pg07              | TrackAndTrendNexradPHMO          |
| pg07              | VolumeMosTileProc_TileColRow-1-1 |
| pg07              | VolumeMosTileProc_TileColRow-2-1 |
| pg07              | VolumeMosTileProc_TileColRow-3-1 |
| pg07              | VolumeMosTileProc_TileColRow-4-1 |
| pg07              | VolumeProductGeneratorNexradKABR |
| pg07              | VolumeProductGeneratorNexradKAMA |
| pg07              | VolumeProductGeneratorNexradKARX |
| pg07              | VolumeProductGeneratorNexradKBHX |
| pg07              | VolumeProductGeneratorNexradKBOX |
| pg07              | VolumeProductGeneratorNexradKBYX |
| pg07              | VolumeProductGeneratorNexradKCBX |
| pg07              | VolumeProductGeneratorNexradKCLX |
| pg07              | VolumeProductGeneratorNexradKCYS |
| pg07              | VolumeProductGeneratorNexradKDFX |
| pg07              | VolumeProductGeneratorNexradKDLH |
| pg07              | VolumeProductGeneratorNexradKDMX |
| pg07              | VolumeProductGeneratorNexradKDVN |
| pg07              | VolumeProductGeneratorNexradKEMX |
| pg07              | VolumeProductGeneratorNexradKEPZ |
| pg07              | VolumeProductGeneratorNexradKEWX |

| <b>PG Server:</b> | <b>Process:</b>                  |
|-------------------|----------------------------------|
| pg07              | VolumeProductGeneratorNexradKFDR |
| pg07              | VolumeProductGeneratorNexradKFSD |
| pg07              | VolumeProductGeneratorNexradKFWS |
| pg07              | VolumeProductGeneratorNexradKGLD |
| pg07              | VolumeProductGeneratorNexradKGRR |
| pg07              | VolumeProductGeneratorNexradKGYX |
| pg07              | VolumeProductGeneratorNexradKHDX |
| pg07              | VolumeProductGeneratorNexradKHPX |
| pg07              | VolumeProductGeneratorNexradKICX |
| pg07              | VolumeProductGeneratorNexradKIND |
| pg07              | VolumeProductGeneratorNexradKIWX |
| pg07              | VolumeProductGeneratorNexradKJKL |
| pg07              | VolumeProductGeneratorNexradKLIX |
| pg07              | VolumeProductGeneratorNexradKLRX |
| pg07              | VolumeProductGeneratorNexradKLVX |
| pg07              | VolumeProductGeneratorNexradKMAF |
| pg07              | VolumeProductGeneratorNexradKMKX |
| pg07              | VolumeProductGeneratorNexradKMQT |
| pg07              | VolumeProductGeneratorNexradKMSX |
| pg07              | VolumeProductGeneratorNexradKMUX |
| pg07              | VolumeProductGeneratorNexradKNQA |
| pg07              | VolumeProductGeneratorNexradKOKX |
| pg07              | VolumeProductGeneratorNexradKOTX |
| pg07              | VolumeProductGeneratorNexradKPOE |
| pg07              | VolumeProductGeneratorNexradKRGX |
| pg07              | VolumeProductGeneratorNexradKRTX |
| pg07              | VolumeProductGeneratorNexradKSHV |
| pg07              | VolumeProductGeneratorNexradKSRX |
| pg07              | VolumeProductGeneratorNexradKTLX |
| pg07              | VolumeProductGeneratorNexradKUDX |
| pg07              | VolumeProductGeneratorNexradKVBX |
| pg07              | VolumeProductGeneratorNexradKVWX |
| pg07              | VolumeProductGeneratorNexradPACG |

| <b>PG Server:</b> | <b>Process:</b>                  |
|-------------------|----------------------------------|
| pg07              | VolumeProductGeneratorNexradPAIH |
| pg07              | VolumeProductGeneratorNexradPGUA |
| pg07              | VolumeProductGeneratorNexradPHMO |
| pg08              | BoundarySuppressorProc           |
| pg08              | CanradOdimTranslatorCASAG        |
| pg08              | CanradOdimTranslatorCASBE        |
| pg08              | CanradOdimTranslatorCASBI        |
| pg08              | CanradOdimTranslatorCASBV        |
| pg08              | CanradOdimTranslatorCASCL        |
| pg08              | CanradOdimTranslatorCASCM        |
| pg08              | CanradOdimTranslatorCASCV        |
| pg08              | CanradOdimTranslatorCASDR        |
| pg08              | CanradOdimTranslatorCASET        |
| pg08              | CanradOdimTranslatorCASFT        |
| pg08              | CanradOdimTranslatorCASFW        |
| pg08              | CanradOdimTranslatorCASGO        |
| pg08              | CanradOdimTranslatorCASHR        |
| pg08              | CanradOdimTranslatorCASKR        |
| pg08              | CanradOdimTranslatorCASLA        |
| pg08              | CanradOdimTranslatorCASMB        |
| pg08              | CanradOdimTranslatorCASMR        |
| pg08              | CanradOdimTranslatorCASRA        |
| pg08              | CanradOdimTranslatorCASRF        |
| pg08              | CanradOdimTranslatorCASSF        |
| pg08              | CanradOdimTranslatorCASSM        |
| pg08              | CanradOdimTranslatorCASSR        |
| pg08              | CanradOdimTranslatorCASSU        |
| pg08              | CanradOdimTranslatorCASVD        |
| pg08              | CanradOdimTranslatorCASWL        |
| pg08              | CanRadSigmetTranslatorCWMB       |
| pg08              | CanRadSigmetTranslatorCXME       |
| pg08              | CanRadSigmetTranslatorCXNI       |
| pg08              | CanRadSigmetTranslatorCXPG       |

| <b>PG Server:</b> | <b>Process:</b>              |
|-------------------|------------------------------|
| pg08              | CanRadSigmetTranslatorCXSS   |
| pg08              | CWAP_Proc_Low_Fcst3          |
| pg08              | EarthRelToProjRelProc        |
| pg08              | EarthRelToProjRelProc_Alaska |
| pg08              | EarthRelToProjRelProc_Guam   |
| pg08              | EarthRelToProjRelProc_Hawaii |
| pg08              | EchoTopsFeatureProc          |
| pg08              | EnvStabilityProc             |
| pg08              | ForecastSynchEchoTops        |
| pg08              | ForecastSynchVil             |
| pg08              | GridDqeBaseRefICanradCASAG   |
| pg08              | GridDqeBaseRefICanradCASBE   |
| pg08              | GridDqeBaseRefICanradCASBI   |
| pg08              | GridDqeBaseRefICanradCASBV   |
| pg08              | GridDqeBaseRefICanradCASCL   |
| pg08              | GridDqeBaseRefICanradCASCM   |
| pg08              | GridDqeBaseRefICanradCASCV   |
| pg08              | GridDqeBaseRefICanradCASDR   |
| pg08              | GridDqeBaseRefICanradCASET   |
| pg08              | GridDqeBaseRefICanradCASFT   |
| pg08              | GridDqeBaseRefICanradCASFW   |
| pg08              | GridDqeBaseRefICanradCASGO   |
| pg08              | GridDqeBaseRefICanradCASHR   |
| pg08              | GridDqeBaseRefICanradCASKR   |
| pg08              | GridDqeBaseRefICanradCASLA   |
| pg08              | GridDqeBaseRefICanradCASMB   |
| pg08              | GridDqeBaseRefICanradCASMR   |
| pg08              | GridDqeBaseRefICanradCASRA   |
| pg08              | GridDqeBaseRefICanradCASRF   |
| pg08              | GridDqeBaseRefICanradCASSF   |
| pg08              | GridDqeBaseRefICanradCASSM   |
| pg08              | GridDqeBaseRefICanradCASSR   |
| pg08              | GridDqeBaseRefICanradCASSU   |

| <b>PG Server:</b> | <b>Process:</b>            |
|-------------------|----------------------------|
| pg08              | GridDqeBaseRefICanradCASVD |
| pg08              | GridDqeBaseRefICanradCASWL |
| pg08              | GridDqeBaseRefICanradCWMB  |
| pg08              | GridDqeBaseRefICanradCXME  |
| pg08              | GridDqeBaseRefICanradCXNI  |
| pg08              | GridDqeBaseRefICanradCXPG  |
| pg08              | GridDqeBaseRefICanradCXSS  |
| pg08              | GridDqeVolumeCanradCASAG   |
| pg08              | GridDqeVolumeCanradCASBE   |
| pg08              | GridDqeVolumeCanradCASBI   |
| pg08              | GridDqeVolumeCanradCASBV   |
| pg08              | GridDqeVolumeCanradCASCL   |
| pg08              | GridDqeVolumeCanradCASCM   |
| pg08              | GridDqeVolumeCanradCASCV   |
| pg08              | GridDqeVolumeCanradCASDR   |
| pg08              | GridDqeVolumeCanradCASET   |
| pg08              | GridDqeVolumeCanradCASFT   |
| pg08              | GridDqeVolumeCanradCASFW   |
| pg08              | GridDqeVolumeCanradCASGO   |
| pg08              | GridDqeVolumeCanradCASHR   |
| pg08              | GridDqeVolumeCanradCASKR   |
| pg08              | GridDqeVolumeCanradCASLA   |
| pg08              | GridDqeVolumeCanradCASMB   |
| pg08              | GridDqeVolumeCanradCASMR   |
| pg08              | GridDqeVolumeCanradCASRA   |
| pg08              | GridDqeVolumeCanradCASRF   |
| pg08              | GridDqeVolumeCanradCASSF   |
| pg08              | GridDqeVolumeCanradCASSM   |
| pg08              | GridDqeVolumeCanradCASSR   |
| pg08              | GridDqeVolumeCanradCASSU   |
| pg08              | GridDqeVolumeCanradCASVD   |
| pg08              | GridDqeVolumeCanradCASWL   |
| pg08              | GridDqeVolumeCanradCWMB    |

| <b>PG Server:</b> | <b>Process:</b>                          |
|-------------------|------------------------------------------|
| pg08              | GridDqeVolumeCanradCXME                  |
| pg08              | GridDqeVolumeCanradCXNI                  |
| pg08              | GridDqeVolumeCanradCXPG                  |
| pg08              | GridDqeVolumeCanradCXSS                  |
| pg08              | IsothermalHeightProc                     |
| pg08              | LampTranslatorProc                       |
| pg08              | SatcastGfsTranslatorProc                 |
| pg08              | SatcastProductGeneratorProc_GoesE        |
| pg08              | SatcastSatelliteTranslatorProc_GoesE_1km |
| pg08              | SatcastSatelliteTranslatorProc_GoesE_4km |
| pg08              | SatcastServerProc_GoesE                  |
| pg08              | SatelliteFeatureProc                     |
| pg08              | Send60SecTimeSignal                      |
| pg08              | StormForecastProc                        |
| pg08              | SurfaceObsTranslatorProc                 |
| pg08              | TiltDqeCanradCASAG                       |
| pg08              | TiltDqeCanradCASBE                       |
| pg08              | TiltDqeCanradCASBI                       |
| pg08              | TiltDqeCanradCASBV                       |
| pg08              | TiltDqeCanradCASCL                       |
| pg08              | TiltDqeCanradCASCM                       |
| pg08              | TiltDqeCanradCASCV                       |
| pg08              | TiltDqeCanradCASDR                       |
| pg08              | TiltDqeCanradCASET                       |
| pg08              | TiltDqeCanradCASFT                       |
| pg08              | TiltDqeCanradCASFW                       |
| pg08              | TiltDqeCanradCASGO                       |
| pg08              | TiltDqeCanradCASHR                       |
| pg08              | TiltDqeCanradCASKR                       |
| pg08              | TiltDqeCanradCASLA                       |
| pg08              | TiltDqeCanradCASMB                       |
| pg08              | TiltDqeCanradCASMR                       |
| pg08              | TiltDqeCanradCASRA                       |

| <b>PG Server:</b> | <b>Process:</b>          |
|-------------------|--------------------------|
| pg08              | TiltDqeCanradCASRF       |
| pg08              | TiltDqeCanradCASSF       |
| pg08              | TiltDqeCanradCASSM       |
| pg08              | TiltDqeCanradCASSR       |
| pg08              | TiltDqeCanradCASSU       |
| pg08              | TiltDqeCanradCASVD       |
| pg08              | TiltDqeCanradCASWL       |
| pg08              | TiltDqeCanradCWMB        |
| pg08              | TiltDqeCanradCXME        |
| pg08              | TiltDqeCanradCXNI        |
| pg08              | TiltDqeCanradCXPG        |
| pg08              | TiltDqeCanradCXSS        |
| pg08              | TrackAndTrendCanradCASAG |
| pg08              | TrackAndTrendCanradCASBE |
| pg08              | TrackAndTrendCanradCASBI |
| pg08              | TrackAndTrendCanradCASBV |
| pg08              | TrackAndTrendCanradCASCL |
| pg08              | TrackAndTrendCanradCASCM |
| pg08              | TrackAndTrendCanradCASCV |
| pg08              | TrackAndTrendCanradCASDR |
| pg08              | TrackAndTrendCanradCASET |
| pg08              | TrackAndTrendCanradCASFT |
| pg08              | TrackAndTrendCanradCASFW |
| pg08              | TrackAndTrendCanradCASGO |
| pg08              | TrackAndTrendCanradCASHR |
| pg08              | TrackAndTrendCanradCASKR |
| pg08              | TrackAndTrendCanradCASLA |
| pg08              | TrackAndTrendCanradCASMB |
| pg08              | TrackAndTrendCanradCASMR |
| pg08              | TrackAndTrendCanradCASRA |
| pg08              | TrackAndTrendCanradCASRF |
| pg08              | TrackAndTrendCanradCASSF |
| pg08              | TrackAndTrendCanradCASSM |

| <b>PG Server:</b> | <b>Process:</b>                   |
|-------------------|-----------------------------------|
| pg08              | TrackAndTrendCanradCASSR          |
| pg08              | TrackAndTrendCanradCASSU          |
| pg08              | TrackAndTrendCanradCASVD          |
| pg08              | TrackAndTrendCanradCASWL          |
| pg08              | TrackAndTrendCanradCWMB           |
| pg08              | TrackAndTrendCanradCXME           |
| pg08              | TrackAndTrendCanradCXNI           |
| pg08              | TrackAndTrendCanradCXPG           |
| pg08              | TrackAndTrendCanradCXSS           |
| pg08              | VlapsConverterProc                |
| pg08              | VlapsConverterProc_Alaska         |
| pg08              | VlapsConverterProc_Hawaii         |
| pg08              | VlapsProc                         |
| pg08              | VlapsProc_Alaska                  |
| pg08              | VlapsProc_Hawaii                  |
| pg08              | VlapsTranslatorProc               |
| pg08              | VlapsTranslatorProc_Alaska        |
| pg08              | VlapsTranslatorProc_Hawaii        |
| pg08              | VolumeMosaicTileAssembler3        |
| pg08              | VolumeMosTileProc_TileColRow-0-3  |
| pg08              | VolumeMosTileProc_TileColRow-1-3  |
| pg08              | VolumeMosTileProc_TileColRow-2-3  |
| pg08              | VolumeMosTileProc_TileColRow-3-3  |
| pg08              | VolumeMosTileProc_TileColRow-4-0  |
| pg08              | VolumeMosTileProc_TileColRow-5-2  |
| pg08              | VolumeProductGeneratorCanradCASAG |
| pg08              | VolumeProductGeneratorCanradCASBE |
| pg08              | VolumeProductGeneratorCanradCASBI |
| pg08              | VolumeProductGeneratorCanradCASBV |
| pg08              | VolumeProductGeneratorCanradCASCL |
| pg08              | VolumeProductGeneratorCanradCASCM |
| pg08              | VolumeProductGeneratorCanradCASCV |
| pg08              | VolumeProductGeneratorCanradCASDR |

| <b>PG Server:</b> | <b>Process:</b>                       |
|-------------------|---------------------------------------|
| pg08              | VolumeProductGeneratorCanradCASET     |
| pg08              | VolumeProductGeneratorCanradCASFT     |
| pg08              | VolumeProductGeneratorCanradCASFW     |
| pg08              | VolumeProductGeneratorCanradCASGO     |
| pg08              | VolumeProductGeneratorCanradCASHR     |
| pg08              | VolumeProductGeneratorCanradCASKR     |
| pg08              | VolumeProductGeneratorCanradCASLA     |
| pg08              | VolumeProductGeneratorCanradCASMB     |
| pg08              | VolumeProductGeneratorCanradCASMR     |
| pg08              | VolumeProductGeneratorCanradCASRA     |
| pg08              | VolumeProductGeneratorCanradCASRF     |
| pg08              | VolumeProductGeneratorCanradCASSF     |
| pg08              | VolumeProductGeneratorCanradCASSM     |
| pg08              | VolumeProductGeneratorCanradCASSR     |
| pg08              | VolumeProductGeneratorCanradCASSU     |
| pg08              | VolumeProductGeneratorCanradCASVD     |
| pg08              | VolumeProductGeneratorCanradCASWL     |
| pg08              | VolumeProductGeneratorCanradCWMB      |
| pg08              | VolumeProductGeneratorCanradCXME      |
| pg08              | VolumeProductGeneratorCanradCXNI      |
| pg08              | VolumeProductGeneratorCanradCXPG      |
| pg08              | VolumeProductGeneratorCanradCXSS      |
| pg09              | CWAP_Proc_Low_Fcst5                   |
| pg09              | CWAP_Proc_Low_T0                      |
| pg09              | EchoBottomsMosTileProc_TileColRow-5-0 |
| pg09              | EchoBottomsMosTileProc_TileColRow-5-1 |
| pg09              | ForecastVerificationProc_EchoTops0to2 |
| pg09              | ForecastVerificationProc_Vil0to2      |
| pg09              | FrontsForecastProc                    |
| pg09              | GridDqeBaseReflTdwrADW                |
| pg09              | GridDqeBaseReflTdwrATL                |
| pg09              | GridDqeBaseReflTdwrBNA                |
| pg09              | GridDqeBaseReflTdwrBOS                |

| <b>PG Server:</b> | <b>Process:</b>        |
|-------------------|------------------------|
| pg09              | GridDqeBaseRefITdwrBWI |
| pg09              | GridDqeBaseRefITdwrCLE |
| pg09              | GridDqeBaseRefITdwrCLT |
| pg09              | GridDqeBaseRefITdwrCMH |
| pg09              | GridDqeBaseRefITdwrCVG |
| pg09              | GridDqeBaseRefITdwrDAL |
| pg09              | GridDqeBaseRefITdwrDAY |
| pg09              | GridDqeBaseRefITdwrDCA |
| pg09              | GridDqeBaseRefITdwrDEN |
| pg09              | GridDqeBaseRefITdwrDFW |
| pg09              | GridDqeBaseRefITdwrDTW |
| pg09              | GridDqeBaseRefITdwrEWR |
| pg09              | GridDqeBaseRefITdwrFLL |
| pg09              | GridDqeBaseRefITdwrHOU |
| pg09              | GridDqeBaseRefITdwrIAD |
| pg09              | GridDqeBaseRefITdwrIAH |
| pg09              | GridDqeBaseRefITdwrICT |
| pg09              | GridDqeBaseRefITdwrIND |
| pg09              | GridDqeBaseRefITdwrJFK |
| pg09              | GridDqeBaseRefITdwrLAS |
| pg09              | GridDqeBaseRefITdwrMCI |
| pg09              | GridDqeBaseRefITdwrMCO |
| pg09              | GridDqeBaseRefITdwrMDW |
| pg09              | GridDqeBaseRefITdwrMEM |
| pg09              | GridDqeBaseRefITdwrMIA |
| pg09              | GridDqeBaseRefITdwrMKE |
| pg09              | GridDqeBaseRefITdwrMSP |
| pg09              | GridDqeBaseRefITdwrMSY |
| pg09              | GridDqeBaseRefITdwrOKC |
| pg09              | GridDqeBaseRefITdwrORD |
| pg09              | GridDqeBaseRefITdwrPBI |
| pg09              | GridDqeBaseRefITdwrPHL |
| pg09              | GridDqeBaseRefITdwrPHX |

| <b>PG Server:</b> | <b>Process:</b>        |
|-------------------|------------------------|
| pg09              | GridDqeBaseRefITdwrPIT |
| pg09              | GridDqeBaseRefITdwrRDU |
| pg09              | GridDqeBaseRefITdwrSDF |
| pg09              | GridDqeBaseRefITdwrSJU |
| pg09              | GridDqeBaseRefITdwrSLC |
| pg09              | GridDqeBaseRefITdwrSTL |
| pg09              | GridDqeBaseRefITdwrTPA |
| pg09              | GridDqeBaseRefITdwrTUL |
| pg09              | GridDqeVolumeTdwrADW   |
| pg09              | GridDqeVolumeTdwrATL   |
| pg09              | GridDqeVolumeTdwrBNA   |
| pg09              | GridDqeVolumeTdwrBOS   |
| pg09              | GridDqeVolumeTdwrBWI   |
| pg09              | GridDqeVolumeTdwrCLE   |
| pg09              | GridDqeVolumeTdwrCLT   |
| pg09              | GridDqeVolumeTdwrCMH   |
| pg09              | GridDqeVolumeTdwrCVG   |
| pg09              | GridDqeVolumeTdwrDAL   |
| pg09              | GridDqeVolumeTdwrDAY   |
| pg09              | GridDqeVolumeTdwrDCA   |
| pg09              | GridDqeVolumeTdwrDEN   |
| pg09              | GridDqeVolumeTdwrDFW   |
| pg09              | GridDqeVolumeTdwrDTW   |
| pg09              | GridDqeVolumeTdwrEWR   |
| pg09              | GridDqeVolumeTdwrFLL   |
| pg09              | GridDqeVolumeTdwrHOU   |
| pg09              | GridDqeVolumeTdwrIAD   |
| pg09              | GridDqeVolumeTdwrIAH   |
| pg09              | GridDqeVolumeTdwrICT   |
| pg09              | GridDqeVolumeTdwrIND   |
| pg09              | GridDqeVolumeTdwrJFK   |
| pg09              | GridDqeVolumeTdwrLAS   |
| pg09              | GridDqeVolumeTdwrMCI   |

| <b>PG Server:</b> | <b>Process:</b>               |
|-------------------|-------------------------------|
| pg09              | GridDqeVolumeTdwrMCO          |
| pg09              | GridDqeVolumeTdwrMDW          |
| pg09              | GridDqeVolumeTdwrMEM          |
| pg09              | GridDqeVolumeTdwrMIA          |
| pg09              | GridDqeVolumeTdwrMKE          |
| pg09              | GridDqeVolumeTdwrMSP          |
| pg09              | GridDqeVolumeTdwrMSY          |
| pg09              | GridDqeVolumeTdwrOKC          |
| pg09              | GridDqeVolumeTdwrORD          |
| pg09              | GridDqeVolumeTdwrPBI          |
| pg09              | GridDqeVolumeTdwrPHL          |
| pg09              | GridDqeVolumeTdwrPHX          |
| pg09              | GridDqeVolumeTdwrPIT          |
| pg09              | GridDqeVolumeTdwrRDU          |
| pg09              | GridDqeVolumeTdwrSDF          |
| pg09              | GridDqeVolumeTdwrSJU          |
| pg09              | GridDqeVolumeTdwrSLC          |
| pg09              | GridDqeVolumeTdwrSTL          |
| pg09              | GridDqeVolumeTdwrTPA          |
| pg09              | GridDqeVolumeTdwrTUL          |
| pg09              | SurfaceObsGridderProc         |
| pg09              | SurfaceObsGridderProc_Alaska  |
| pg09              | TdwrRadialPacketTranslatorADW |
| pg09              | TdwrRadialPacketTranslatorATL |
| pg09              | TdwrRadialPacketTranslatorBNA |
| pg09              | TdwrRadialPacketTranslatorBOS |
| pg09              | TdwrRadialPacketTranslatorBWI |
| pg09              | TdwrRadialPacketTranslatorCLE |
| pg09              | TdwrRadialPacketTranslatorCLT |
| pg09              | TdwrRadialPacketTranslatorCMH |
| pg09              | TdwrRadialPacketTranslatorCVG |
| pg09              | TdwrRadialPacketTranslatorDAL |
| pg09              | TdwrRadialPacketTranslatorDAY |

| <b>PG Server:</b> | <b>Process:</b>               |
|-------------------|-------------------------------|
| pg09              | TdwrRadialPacketTranslatorDCA |
| pg09              | TdwrRadialPacketTranslatorDEN |
| pg09              | TdwrRadialPacketTranslatorDFW |
| pg09              | TdwrRadialPacketTranslatorDTW |
| pg09              | TdwrRadialPacketTranslatorEWR |
| pg09              | TdwrRadialPacketTranslatorFLL |
| pg09              | TdwrRadialPacketTranslatorHOU |
| pg09              | TdwrRadialPacketTranslatorIAD |
| pg09              | TdwrRadialPacketTranslatorIAH |
| pg09              | TdwrRadialPacketTranslatorICT |
| pg09              | TdwrRadialPacketTranslatorIND |
| pg09              | TdwrRadialPacketTranslatorJFK |
| pg09              | TdwrRadialPacketTranslatorLAS |
| pg09              | TdwrRadialPacketTranslatorMCI |
| pg09              | TdwrRadialPacketTranslatorMCO |
| pg09              | TdwrRadialPacketTranslatorMDW |
| pg09              | TdwrRadialPacketTranslatorMEM |
| pg09              | TdwrRadialPacketTranslatorMIA |
| pg09              | TdwrRadialPacketTranslatorMKE |
| pg09              | TdwrRadialPacketTranslatorMSP |
| pg09              | TdwrRadialPacketTranslatorMSY |
| pg09              | TdwrRadialPacketTranslatorOKC |
| pg09              | TdwrRadialPacketTranslatorORD |
| pg09              | TdwrRadialPacketTranslatorPBI |
| pg09              | TdwrRadialPacketTranslatorPHL |
| pg09              | TdwrRadialPacketTranslatorPHX |
| pg09              | TdwrRadialPacketTranslatorPIT |
| pg09              | TdwrRadialPacketTranslatorRDU |
| pg09              | TdwrRadialPacketTranslatorSDF |
| pg09              | TdwrRadialPacketTranslatorSJU |
| pg09              | TdwrRadialPacketTranslatorSLC |
| pg09              | TdwrRadialPacketTranslatorSTL |
| pg09              | TdwrRadialPacketTranslatorTPA |

| <b>PG Server:</b> | <b>Process:</b>               |
|-------------------|-------------------------------|
| pg09              | TdwrRadialPacketTranslatorTUL |
| pg09              | TiltDqeTdwrADW                |
| pg09              | TiltDqeTdwrATL                |
| pg09              | TiltDqeTdwrBNA                |
| pg09              | TiltDqeTdwrBOS                |
| pg09              | TiltDqeTdwrBWI                |
| pg09              | TiltDqeTdwrCLE                |
| pg09              | TiltDqeTdwrCLT                |
| pg09              | TiltDqeTdwrCMH                |
| pg09              | TiltDqeTdwrCVG                |
| pg09              | TiltDqeTdwrDAL                |
| pg09              | TiltDqeTdwrDAY                |
| pg09              | TiltDqeTdwrDCA                |
| pg09              | TiltDqeTdwrDEN                |
| pg09              | TiltDqeTdwrDFW                |
| pg09              | TiltDqeTdwrDTW                |
| pg09              | TiltDqeTdwrEWR                |
| pg09              | TiltDqeTdwrFLL                |
| pg09              | TiltDqeTdwrHOU                |
| pg09              | TiltDqeTdwrIAD                |
| pg09              | TiltDqeTdwrIAH                |
| pg09              | TiltDqeTdwrICT                |
| pg09              | TiltDqeTdwrIND                |
| pg09              | TiltDqeTdwrJFK                |
| pg09              | TiltDqeTdwrLAS                |
| pg09              | TiltDqeTdwrMCI                |
| pg09              | TiltDqeTdwrMCO                |
| pg09              | TiltDqeTdwrMDW                |
| pg09              | TiltDqeTdwrMEM                |
| pg09              | TiltDqeTdwrMIA                |
| pg09              | TiltDqeTdwrMKE                |
| pg09              | TiltDqeTdwrMSP                |
| pg09              | TiltDqeTdwrMSY                |

| <b>PG Server:</b> | <b>Process:</b>      |
|-------------------|----------------------|
| pg09              | TiltDqeTdwrOKC       |
| pg09              | TiltDqeTdwrORD       |
| pg09              | TiltDqeTdwrPBI       |
| pg09              | TiltDqeTdwrPHL       |
| pg09              | TiltDqeTdwrPHX       |
| pg09              | TiltDqeTdwrPIT       |
| pg09              | TiltDqeTdwrRDU       |
| pg09              | TiltDqeTdwrSDF       |
| pg09              | TiltDqeTdwrSJU       |
| pg09              | TiltDqeTdwrSLC       |
| pg09              | TiltDqeTdwrSTL       |
| pg09              | TiltDqeTdwrTPA       |
| pg09              | TiltDqeTdwrTUL       |
| pg09              | TrackAndTrendTdwrADW |
| pg09              | TrackAndTrendTdwrATL |
| pg09              | TrackAndTrendTdwrBNA |
| pg09              | TrackAndTrendTdwrBOS |
| pg09              | TrackAndTrendTdwrBWI |
| pg09              | TrackAndTrendTdwrCLE |
| pg09              | TrackAndTrendTdwrCLT |
| pg09              | TrackAndTrendTdwrCMH |
| pg09              | TrackAndTrendTdwrCVG |
| pg09              | TrackAndTrendTdwrDAL |
| pg09              | TrackAndTrendTdwrDAY |
| pg09              | TrackAndTrendTdwrDCA |
| pg09              | TrackAndTrendTdwrDEN |
| pg09              | TrackAndTrendTdwrDFW |
| pg09              | TrackAndTrendTdwrDTW |
| pg09              | TrackAndTrendTdwrEWR |
| pg09              | TrackAndTrendTdwrFLL |
| pg09              | TrackAndTrendTdwrHOU |
| pg09              | TrackAndTrendTdwrIAD |
| pg09              | TrackAndTrendTdwrIAH |

| <b>PG Server:</b> | <b>Process:</b>                  |
|-------------------|----------------------------------|
| pg09              | TrackAndTrendTdwrICT             |
| pg09              | TrackAndTrendTdwrIND             |
| pg09              | TrackAndTrendTdwrJFK             |
| pg09              | TrackAndTrendTdwrLAS             |
| pg09              | TrackAndTrendTdwrMCI             |
| pg09              | TrackAndTrendTdwrMCO             |
| pg09              | TrackAndTrendTdwrMDW             |
| pg09              | TrackAndTrendTdwrMEM             |
| pg09              | TrackAndTrendTdwrMIA             |
| pg09              | TrackAndTrendTdwrMKE             |
| pg09              | TrackAndTrendTdwrMSP             |
| pg09              | TrackAndTrendTdwrMSY             |
| pg09              | TrackAndTrendTdwrOKC             |
| pg09              | TrackAndTrendTdwrORD             |
| pg09              | TrackAndTrendTdwrPBI             |
| pg09              | TrackAndTrendTdwrPHL             |
| pg09              | TrackAndTrendTdwrPHX             |
| pg09              | TrackAndTrendTdwrPIT             |
| pg09              | TrackAndTrendTdwrRDU             |
| pg09              | TrackAndTrendTdwrSDF             |
| pg09              | TrackAndTrendTdwrSJU             |
| pg09              | TrackAndTrendTdwrSLC             |
| pg09              | TrackAndTrendTdwrSTL             |
| pg09              | TrackAndTrendTdwrTPA             |
| pg09              | TrackAndTrendTdwrTUL             |
| pg09              | VolumeMosTileProc_TileColRow-0-2 |
| pg09              | VolumeMosTileProc_TileColRow-1-2 |
| pg09              | VolumeMosTileProc_TileColRow-5-1 |
| pg09              | VolumeMosTileProc_TileColRow-6-1 |
| pg09              | VolumeMosTileProc_TileColRow-6-2 |
| pg09              | VolumeProductGeneratorTdwrADW    |
| pg09              | VolumeProductGeneratorTdwrATL    |
| pg09              | VolumeProductGeneratorTdwrBNA    |

| <b>PG Server:</b> | <b>Process:</b>               |
|-------------------|-------------------------------|
| pg09              | VolumeProductGeneratorTdwrBOS |
| pg09              | VolumeProductGeneratorTdwrBWI |
| pg09              | VolumeProductGeneratorTdwrCLE |
| pg09              | VolumeProductGeneratorTdwrCLT |
| pg09              | VolumeProductGeneratorTdwrCMH |
| pg09              | VolumeProductGeneratorTdwrCVG |
| pg09              | VolumeProductGeneratorTdwrDAL |
| pg09              | VolumeProductGeneratorTdwrDAY |
| pg09              | VolumeProductGeneratorTdwrDCA |
| pg09              | VolumeProductGeneratorTdwrDEN |
| pg09              | VolumeProductGeneratorTdwrDFW |
| pg09              | VolumeProductGeneratorTdwrDTW |
| pg09              | VolumeProductGeneratorTdwrEWR |
| pg09              | VolumeProductGeneratorTdwrFLL |
| pg09              | VolumeProductGeneratorTdwrHOU |
| pg09              | VolumeProductGeneratorTdwrIAD |
| pg09              | VolumeProductGeneratorTdwrIAH |
| pg09              | VolumeProductGeneratorTdwrICT |
| pg09              | VolumeProductGeneratorTdwrIND |
| pg09              | VolumeProductGeneratorTdwrJFK |
| pg09              | VolumeProductGeneratorTdwrLAS |
| pg09              | VolumeProductGeneratorTdwrMCI |
| pg09              | VolumeProductGeneratorTdwrMCO |
| pg09              | VolumeProductGeneratorTdwrMDW |
| pg09              | VolumeProductGeneratorTdwrMEM |
| pg09              | VolumeProductGeneratorTdwrMIA |
| pg09              | VolumeProductGeneratorTdwrMKE |
| pg09              | VolumeProductGeneratorTdwrMSP |
| pg09              | VolumeProductGeneratorTdwrMSY |
| pg09              | VolumeProductGeneratorTdwrOKC |
| pg09              | VolumeProductGeneratorTdwrORD |
| pg09              | VolumeProductGeneratorTdwrPBI |
| pg09              | VolumeProductGeneratorTdwrPHL |

| <b>PG Server:</b> | <b>Process:</b>                        |
|-------------------|----------------------------------------|
| pg09              | VolumeProductGeneratorTdwrPHX          |
| pg09              | VolumeProductGeneratorTdwrPIT          |
| pg09              | VolumeProductGeneratorTdwrRDU          |
| pg09              | VolumeProductGeneratorTdwrSDF          |
| pg09              | VolumeProductGeneratorTdwrSJu          |
| pg09              | VolumeProductGeneratorTdwrSLC          |
| pg09              | VolumeProductGeneratorTdwrSTL          |
| pg09              | VolumeProductGeneratorTdwrTPA          |
| pg09              | VolumeProductGeneratorTdwrTUL          |
| pg10              | BlendingInputAdapter                   |
| pg10              | BlendingOutputAdapter                  |
| pg10              | BlendingSystem                         |
| pg10              | CIFlagsBlendingPackager                |
| pg10              | ConvInitFlagsAdvectionProc_0to2        |
| pg10              | ConvInitFlagsAdvectionProc_2to4        |
| pg10              | CWAM_WAF_Forecast_CalHrrr_Enroute      |
| pg10              | CWAM_WAF_Forecast_Low_Altitude_Enroute |
| pg10              | CWAP_Proc_EnrouteHigh_2to8H            |
| pg10              | EchoTopsBlendingPackager               |
| pg10              | FilterForecastProc_EchoTops            |
| pg10              | FilterForecastProc_Vil                 |
| pg10              | HrrrTranslatorProc                     |
| pg10              | MsaMasterProc_0to2                     |
| pg10              | MsaSlaveProc-1_0to2                    |
| pg10              | MsaSlaveProc-2_0to2                    |
| pg10              | MsaSlaveProc-3_0to2                    |
| pg10              | MsaSlaveProc-4_0to2                    |
| pg10              | MsaSlaveProc-5_0to2                    |
| pg10              | MsaSlaveProc-6_0to2                    |
| pg10              | MsaSlaveProc-7_0to2                    |
| pg10              | MsaSlaveProc-8_0to2                    |
| pg10              | ProbForecastBlendingPackager           |
| pg10              | ProbForecastProc_HRRR                  |

| <b>PG Server:</b> | <b>Process:</b>                              |
|-------------------|----------------------------------------------|
| pg10              | VilBlendingPackager                          |
| pg11              | CWAM_WAF_Forecast_Domain_Enroute             |
| pg11              | CWAM_WAF_T-Zero_Domain_Low                   |
| pg11              | CWAP_Proc_EnrouteLow_0to2H                   |
| pg11              | CWAP_Proc_EnrouteLow_T0                      |
| pg11              | EchoTopsForecastProc_0to2                    |
| pg12              | CWAM_WAF_Domain_Packager_Enroute3            |
| pg12              | CWAM_WAF_Domain_Packager_Enroute4            |
| pg12              | CWAM_WAF_Domain_Packager_Forecast_High       |
| pg12              | CWAM_WAF_Forecast_Domain_High                |
| pg12              | CWAM_WAF_T-Zero_Domain_High                  |
| pg12              | CWAP_Proc_High_0to2H                         |
| pg12              | CWAP_Proc_High_T0                            |
| pg12              | CWAP_Proc_Low_Fcst1                          |
| pg12              | EchoBottomsMosTileProc_TileColRow-3-0        |
| pg12              | EchoBottomsMosTileProc_TileColRow-4-0        |
| pg12              | EchoTopsForecastPackager                     |
| pg12              | MsaMasterProc_2to8                           |
| pg12              | MsaSlaveProc-1_2to8                          |
| pg12              | MsaSlaveProc-2_2to8                          |
| pg12              | MsaSlaveProc-3_2to8                          |
| pg12              | MsaSlaveProc-4_2to8                          |
| pg12              | PrecipPhaseProc                              |
| pg12              | VilForecastPackager                          |
| pg13              | AutoAircraftReportQualityControlProc         |
| pg13              | CWAM_WAF_Forecast_Domain_Low                 |
| pg13              | GridSlicerProc_TerminalWinds_ModelPressure   |
| pg13              | NonGridSlicerProc_TerminalWinds_AutoAircraft |
| pg13              | NonGridSlicerProc_TerminalWinds_OMO          |
| pg13              | Send15MinsTimeSignal                         |
| pg13              | TerminalWindProfilePackager                  |
| pg13              | TerminalWindsCoarseAnalysisA80               |
| pg13              | TerminalWindsCoarseAnalysisA90               |

| <b>PG Server:</b> | <b>Process:</b>                |
|-------------------|--------------------------------|
| pg13              | TerminalWindsCoarseAnalysisBNA |
| pg13              | TerminalWindsCoarseAnalysisC90 |
| pg13              | TerminalWindsCoarseAnalysisCAE |
| pg13              | TerminalWindsCoarseAnalysisCLE |
| pg13              | TerminalWindsCoarseAnalysisCLT |
| pg13              | TerminalWindsCoarseAnalysisCMH |
| pg13              | TerminalWindsCoarseAnalysisCOS |
| pg13              | TerminalWindsCoarseAnalysisCVG |
| pg13              | TerminalWindsCoarseAnalysisD01 |
| pg13              | TerminalWindsCoarseAnalysisD10 |
| pg13              | TerminalWindsCoarseAnalysisD21 |
| pg13              | TerminalWindsCoarseAnalysisDAY |
| pg13              | TerminalWindsCoarseAnalysisF11 |
| pg13              | TerminalWindsCoarseAnalysisFSM |
| pg13              | TerminalWindsCoarseAnalysisI90 |
| pg13              | TerminalWindsCoarseAnalysisICT |
| pg13              | TerminalWindsCoarseAnalysisIND |
| pg13              | TerminalWindsCoarseAnalysisJAN |
| pg13              | TerminalWindsCoarseAnalysisL30 |
| pg13              | TerminalWindsCoarseAnalysisLFT |
| pg13              | TerminalWindsCoarseAnalysisLIT |
| pg13              | TerminalWindsCoarseAnalysisM03 |
| pg13              | TerminalWindsCoarseAnalysisM98 |
| pg13              | TerminalWindsCoarseAnalysisMCI |
| pg13              | TerminalWindsCoarseAnalysisMIA |
| pg13              | TerminalWindsCoarseAnalysisMSY |
| pg13              | TerminalWindsCoarseAnalysisN90 |
| pg13              | TerminalWindsCoarseAnalysisNCT |
| pg13              | TerminalWindsCoarseAnalysisOKC |
| pg13              | TerminalWindsCoarseAnalysisP50 |
| pg13              | TerminalWindsCoarseAnalysisPCT |
| pg13              | TerminalWindsCoarseAnalysisPHL |
| pg13              | TerminalWindsCoarseAnalysisPIT |

| <b>PG Server:</b> | <b>Process:</b>                |
|-------------------|--------------------------------|
| pg13              | TerminalWindsCoarseAnalysisRDU |
| pg13              | TerminalWindsCoarseAnalysisRNO |
| pg13              | TerminalWindsCoarseAnalysisRSW |
| pg13              | TerminalWindsCoarseAnalysisS56 |
| pg13              | TerminalWindsCoarseAnalysisSDF |
| pg13              | TerminalWindsCoarseAnalysisSGF |
| pg13              | TerminalWindsCoarseAnalysisSTT |
| pg13              | TerminalWindsCoarseAnalysisT75 |
| pg13              | TerminalWindsCoarseAnalysisTUL |
| pg13              | TerminalWindsCoarseAnalysisZSU |
| pg13              | TerminalWindsFineAnalysisA80   |
| pg13              | TerminalWindsFineAnalysisA90   |
| pg13              | TerminalWindsFineAnalysisBNA   |
| pg13              | TerminalWindsFineAnalysisC90   |
| pg13              | TerminalWindsFineAnalysisCAE   |
| pg13              | TerminalWindsFineAnalysisCLE   |
| pg13              | TerminalWindsFineAnalysisCLT   |
| pg13              | TerminalWindsFineAnalysisCMH   |
| pg13              | TerminalWindsFineAnalysisCOS   |
| pg13              | TerminalWindsFineAnalysisCVG   |
| pg13              | TerminalWindsFineAnalysisD01   |
| pg13              | TerminalWindsFineAnalysisD10   |
| pg13              | TerminalWindsFineAnalysisD21   |
| pg13              | TerminalWindsFineAnalysisDAY   |
| pg13              | TerminalWindsFineAnalysisF11   |
| pg13              | TerminalWindsFineAnalysisFSM   |
| pg13              | TerminalWindsFineAnalysisI90   |
| pg13              | TerminalWindsFineAnalysisICT   |
| pg13              | TerminalWindsFineAnalysisIND   |
| pg13              | TerminalWindsFineAnalysisJAN   |
| pg13              | TerminalWindsFineAnalysisL30   |
| pg13              | TerminalWindsFineAnalysisLFT   |
| pg13              | TerminalWindsFineAnalysisLIT   |

| <b>PG Server:</b> | <b>Process:</b>              |
|-------------------|------------------------------|
| pg13              | TerminalWindsFineAnalysisM03 |
| pg13              | TerminalWindsFineAnalysisM98 |
| pg13              | TerminalWindsFineAnalysisMCI |
| pg13              | TerminalWindsFineAnalysisMIA |
| pg13              | TerminalWindsFineAnalysisMSY |
| pg13              | TerminalWindsFineAnalysisN90 |
| pg13              | TerminalWindsFineAnalysisNCT |
| pg13              | TerminalWindsFineAnalysisOKC |
| pg13              | TerminalWindsFineAnalysisP50 |
| pg13              | TerminalWindsFineAnalysisPCT |
| pg13              | TerminalWindsFineAnalysisPHL |
| pg13              | TerminalWindsFineAnalysisPIT |
| pg13              | TerminalWindsFineAnalysisRDU |
| pg13              | TerminalWindsFineAnalysisRNO |
| pg13              | TerminalWindsFineAnalysisRSW |
| pg13              | TerminalWindsFineAnalysisS56 |
| pg13              | TerminalWindsFineAnalysisSDF |
| pg13              | TerminalWindsFineAnalysisSGF |
| pg13              | TerminalWindsFineAnalysisSTT |
| pg13              | TerminalWindsFineAnalysisT75 |
| pg13              | TerminalWindsFineAnalysisTUL |
| pg13              | TerminalWindsFineAnalysisZSU |
| pg13              | TerminalWindsProfileProcA80  |
| pg13              | TerminalWindsProfileProcA90  |
| pg13              | TerminalWindsProfileProcBNA  |
| pg13              | TerminalWindsProfileProcC90  |
| pg13              | TerminalWindsProfileProcCAE  |
| pg13              | TerminalWindsProfileProcCLE  |
| pg13              | TerminalWindsProfileProcCLT  |
| pg13              | TerminalWindsProfileProcCMH  |
| pg13              | TerminalWindsProfileProcCOS  |
| pg13              | TerminalWindsProfileProcCVG  |
| pg13              | TerminalWindsProfileProcD01  |

| <b>PG Server:</b> | <b>Process:</b>             |
|-------------------|-----------------------------|
| pg13              | TerminalWindsProfileProcD10 |
| pg13              | TerminalWindsProfileProcD21 |
| pg13              | TerminalWindsProfileProcDAY |
| pg13              | TerminalWindsProfileProcF11 |
| pg13              | TerminalWindsProfileProcFSM |
| pg13              | TerminalWindsProfileProcI90 |
| pg13              | TerminalWindsProfileProcICT |
| pg13              | TerminalWindsProfileProcIND |
| pg13              | TerminalWindsProfileProcJAN |
| pg13              | TerminalWindsProfileProcL30 |
| pg13              | TerminalWindsProfileProcLFT |
| pg13              | TerminalWindsProfileProcLIT |
| pg13              | TerminalWindsProfileProcM03 |
| pg13              | TerminalWindsProfileProcM98 |
| pg13              | TerminalWindsProfileProcMCI |
| pg13              | TerminalWindsProfileProcMIA |
| pg13              | TerminalWindsProfileProcMSY |
| pg13              | TerminalWindsProfileProcN90 |
| pg13              | TerminalWindsProfileProcNCT |
| pg13              | TerminalWindsProfileProcOKC |
| pg13              | TerminalWindsProfileProcP50 |
| pg13              | TerminalWindsProfileProcPCT |
| pg13              | TerminalWindsProfileProcPHL |
| pg13              | TerminalWindsProfileProcPIT |
| pg13              | TerminalWindsProfileProcRDU |
| pg13              | TerminalWindsProfileProcRNO |
| pg13              | TerminalWindsProfileProcRSW |
| pg13              | TerminalWindsProfileProcS56 |
| pg13              | TerminalWindsProfileProcSDF |
| pg13              | TerminalWindsProfileProcSGF |
| pg13              | TerminalWindsProfileProcSTT |
| pg13              | TerminalWindsProfileProcT75 |
| pg13              | TerminalWindsProfileProcTUL |

| <b>PG Server:</b> | <b>Process:</b>                  |
|-------------------|----------------------------------|
| pg13              | TerminalWindsProfileProcZSU      |
| pg13              | TerminalWindsResamplerNexradKAMX |
| pg13              | TerminalWindsResamplerNexradKAPX |
| pg13              | TerminalWindsResamplerNexradKBOX |
| pg13              | TerminalWindsResamplerNexradKCAE |
| pg13              | TerminalWindsResamplerNexradKCCX |
| pg13              | TerminalWindsResamplerNexradKCLE |
| pg13              | TerminalWindsResamplerNexradKDAX |
| pg13              | TerminalWindsResamplerNexradKDGX |
| pg13              | TerminalWindsResamplerNexradKDIX |
| pg13              | TerminalWindsResamplerNexradKDOX |
| pg13              | TerminalWindsResamplerNexradKDTX |
| pg13              | TerminalWindsResamplerNexradKEAX |
| pg13              | TerminalWindsResamplerNexradKESX |
| pg13              | TerminalWindsResamplerNexradKFCX |
| pg13              | TerminalWindsResamplerNexradKFFC |
| pg13              | TerminalWindsResamplerNexradKFSX |
| pg13              | TerminalWindsResamplerNexradKFTG |
| pg13              | TerminalWindsResamplerNexradKFWS |
| pg13              | TerminalWindsResamplerNexradKGRR |
| pg13              | TerminalWindsResamplerNexradKGSP |
| pg13              | TerminalWindsResamplerNexradKHGX |
| pg13              | TerminalWindsResamplerNexradKICT |
| pg13              | TerminalWindsResamplerNexradKILN |
| pg13              | TerminalWindsResamplerNexradKIND |
| pg13              | TerminalWindsResamplerNexradKINX |
| pg13              | TerminalWindsResamplerNexradKIWA |
| pg13              | TerminalWindsResamplerNexradKIWX |
| pg13              | TerminalWindsResamplerNexradKLCH |
| pg13              | TerminalWindsResamplerNexradKLIX |
| pg13              | TerminalWindsResamplerNexradKLOT |
| pg13              | TerminalWindsResamplerNexradKLSX |
| pg13              | TerminalWindsResamplerNexradKLVX |

| <b>PG Server:</b> | <b>Process:</b>                  |
|-------------------|----------------------------------|
| pg13              | TerminalWindsResamplerNexradKLWX |
| pg13              | TerminalWindsResamplerNexradKLZK |
| pg13              | TerminalWindsResamplerNexradKMKX |
| pg13              | TerminalWindsResamplerNexradKMLB |
| pg13              | TerminalWindsResamplerNexradKMPX |
| pg13              | TerminalWindsResamplerNexradKMTX |
| pg13              | TerminalWindsResamplerNexradKMUX |
| pg13              | TerminalWindsResamplerNexradKNQA |
| pg13              | TerminalWindsResamplerNexradKOHX |
| pg13              | TerminalWindsResamplerNexradKOKX |
| pg13              | TerminalWindsResamplerNexradKPBZ |
| pg13              | TerminalWindsResamplerNexradKPUX |
| pg13              | TerminalWindsResamplerNexradKRAX |
| pg13              | TerminalWindsResamplerNexradKRGX |
| pg13              | TerminalWindsResamplerNexradKSGF |
| pg13              | TerminalWindsResamplerNexradKSRX |
| pg13              | TerminalWindsResamplerNexradKTBW |
| pg13              | TerminalWindsResamplerNexradKTLX |
| pg13              | TerminalWindsResamplerNexradKTWX |
| pg13              | TerminalWindsResamplerNexradTJUA |
| pg13              | TerminalWindsResamplerTdwrADW    |
| pg13              | TerminalWindsResamplerTdwrATL    |
| pg13              | TerminalWindsResamplerTdwrBNA    |
| pg13              | TerminalWindsResamplerTdwrBOS    |
| pg13              | TerminalWindsResamplerTdwrBWI    |
| pg13              | TerminalWindsResamplerTdwrCLE    |
| pg13              | TerminalWindsResamplerTdwrCLT    |
| pg13              | TerminalWindsResamplerTdwrCMH    |
| pg13              | TerminalWindsResamplerTdwrCVG    |
| pg13              | TerminalWindsResamplerTdwrDAL    |
| pg13              | TerminalWindsResamplerTdwrDAY    |
| pg13              | TerminalWindsResamplerTdwrDCA    |
| pg13              | TerminalWindsResamplerTdwrDEN    |

| <b>PG Server:</b> | <b>Process:</b>                |
|-------------------|--------------------------------|
| pg13              | TerminalWindsResamplerTdwrDFW  |
| pg13              | TerminalWindsResamplerTdwrDTW  |
| pg13              | TerminalWindsResamplerTdwrEWR  |
| pg13              | TerminalWindsResamplerTdwrFLL  |
| pg13              | TerminalWindsResamplerTdwrHOU  |
| pg13              | TerminalWindsResamplerTdwrIAD  |
| pg13              | TerminalWindsResamplerTdwrIAH  |
| pg13              | TerminalWindsResamplerTdwrICT  |
| pg13              | TerminalWindsResamplerTdwrIND  |
| pg13              | TerminalWindsResamplerTdwrJFK  |
| pg13              | TerminalWindsResamplerTdwrLAS  |
| pg13              | TerminalWindsResamplerTdwrMCI  |
| pg13              | TerminalWindsResamplerTdwrMCO  |
| pg13              | TerminalWindsResamplerTdwrMDW  |
| pg13              | TerminalWindsResamplerTdwrMEM  |
| pg13              | TerminalWindsResamplerTdwrMIA  |
| pg13              | TerminalWindsResamplerTdwrMKE  |
| pg13              | TerminalWindsResamplerTdwrMSP  |
| pg13              | TerminalWindsResamplerTdwrMSY  |
| pg13              | TerminalWindsResamplerTdwrOKC  |
| pg13              | TerminalWindsResamplerTdwrORD  |
| pg13              | TerminalWindsResamplerTdwrPBI  |
| pg13              | TerminalWindsResamplerTdwrPHL  |
| pg13              | TerminalWindsResamplerTdwrPHX  |
| pg13              | TerminalWindsResamplerTdwrPIT  |
| pg13              | TerminalWindsResamplerTdwrRDU  |
| pg13              | TerminalWindsResamplerTdwrSDF  |
| pg13              | TerminalWindsResamplerTdwrSJU  |
| pg13              | TerminalWindsResamplerTdwrSLC  |
| pg13              | TerminalWindsResamplerTdwrSTL  |
| pg13              | TerminalWindsResamplerTdwrTPA  |
| pg13              | TerminalWindsResamplerTdwrTUL  |
| pg13              | TerminalWindsWindfieldPackager |

| <b>PG Server:</b> | <b>Process:</b>                |
|-------------------|--------------------------------|
| pg13              | TiltDqeTerminalWindsNexradKAMX |
| pg13              | TiltDqeTerminalWindsNexradKAPX |
| pg13              | TiltDqeTerminalWindsNexradKBOX |
| pg13              | TiltDqeTerminalWindsNexradKCAE |
| pg13              | TiltDqeTerminalWindsNexradKCCX |
| pg13              | TiltDqeTerminalWindsNexradKCLE |
| pg13              | TiltDqeTerminalWindsNexradKDAX |
| pg13              | TiltDqeTerminalWindsNexradKDGX |
| pg13              | TiltDqeTerminalWindsNexradKDIX |
| pg13              | TiltDqeTerminalWindsNexradKDOX |
| pg13              | TiltDqeTerminalWindsNexradKDTX |
| pg13              | TiltDqeTerminalWindsNexradKEAX |
| pg13              | TiltDqeTerminalWindsNexradKESX |
| pg13              | TiltDqeTerminalWindsNexradKFCX |
| pg13              | TiltDqeTerminalWindsNexradKFFC |
| pg13              | TiltDqeTerminalWindsNexradKFSX |
| pg13              | TiltDqeTerminalWindsNexradKFTG |
| pg13              | TiltDqeTerminalWindsNexradKFWS |
| pg13              | TiltDqeTerminalWindsNexradKGRR |
| pg13              | TiltDqeTerminalWindsNexradKGSP |
| pg13              | TiltDqeTerminalWindsNexradKHGX |
| pg13              | TiltDqeTerminalWindsNexradKICT |
| pg13              | TiltDqeTerminalWindsNexradKILN |
| pg13              | TiltDqeTerminalWindsNexradKIND |
| pg13              | TiltDqeTerminalWindsNexradKINX |
| pg13              | TiltDqeTerminalWindsNexradKIWA |
| pg13              | TiltDqeTerminalWindsNexradKIWX |
| pg13              | TiltDqeTerminalWindsNexradKLCH |
| pg13              | TiltDqeTerminalWindsNexradKLIX |
| pg13              | TiltDqeTerminalWindsNexradKLOT |
| pg13              | TiltDqeTerminalWindsNexradKLSX |
| pg13              | TiltDqeTerminalWindsNexradKLVX |
| pg13              | TiltDqeTerminalWindsNexradKLWX |

| <b>PG Server:</b> | <b>Process:</b>                |
|-------------------|--------------------------------|
| pg13              | TiltDqeTerminalWindsNexradKLZK |
| pg13              | TiltDqeTerminalWindsNexradKMZX |
| pg13              | TiltDqeTerminalWindsNexradKMLB |
| pg13              | TiltDqeTerminalWindsNexradKMPX |
| pg13              | TiltDqeTerminalWindsNexradKMTX |
| pg13              | TiltDqeTerminalWindsNexradKMUX |
| pg13              | TiltDqeTerminalWindsNexradKNQA |
| pg13              | TiltDqeTerminalWindsNexradKOHX |
| pg13              | TiltDqeTerminalWindsNexradKOKX |
| pg13              | TiltDqeTerminalWindsNexradKPBZ |
| pg13              | TiltDqeTerminalWindsNexradKPUX |
| pg13              | TiltDqeTerminalWindsNexradKRAX |
| pg13              | TiltDqeTerminalWindsNexradKRGX |
| pg13              | TiltDqeTerminalWindsNexradKSGF |
| pg13              | TiltDqeTerminalWindsNexradKSRX |
| pg13              | TiltDqeTerminalWindsNexradKTBW |
| pg13              | TiltDqeTerminalWindsNexradKTLX |
| pg13              | TiltDqeTerminalWindsNexradKTWX |
| pg13              | TiltDqeTerminalWindsNexradTJUA |
| pg13              | TiltDqeTerminalWindsTdwrADW    |
| pg13              | TiltDqeTerminalWindsTdwrATL    |
| pg13              | TiltDqeTerminalWindsTdwrBNA    |
| pg13              | TiltDqeTerminalWindsTdwrBOS    |
| pg13              | TiltDqeTerminalWindsTdwrBWI    |
| pg13              | TiltDqeTerminalWindsTdwrCLE    |
| pg13              | TiltDqeTerminalWindsTdwrCLT    |
| pg13              | TiltDqeTerminalWindsTdwrCMH    |
| pg13              | TiltDqeTerminalWindsTdwrCVG    |
| pg13              | TiltDqeTerminalWindsTdwrDAL    |
| pg13              | TiltDqeTerminalWindsTdwrDAY    |
| pg13              | TiltDqeTerminalWindsTdwrDCA    |
| pg13              | TiltDqeTerminalWindsTdwrDEN    |
| pg13              | TiltDqeTerminalWindsTdwrDFW    |

| <b>PG Server:</b> | <b>Process:</b>             |
|-------------------|-----------------------------|
| pg13              | TiltDqeTerminalWindsTdwrDTW |
| pg13              | TiltDqeTerminalWindsTdwrEWR |
| pg13              | TiltDqeTerminalWindsTdwrFLL |
| pg13              | TiltDqeTerminalWindsTdwrHOU |
| pg13              | TiltDqeTerminalWindsTdwrIAD |
| pg13              | TiltDqeTerminalWindsTdwrIAH |
| pg13              | TiltDqeTerminalWindsTdwrICT |
| pg13              | TiltDqeTerminalWindsTdwrIND |
| pg13              | TiltDqeTerminalWindsTdwrJFK |
| pg13              | TiltDqeTerminalWindsTdwrLAS |
| pg13              | TiltDqeTerminalWindsTdwrMCI |
| pg13              | TiltDqeTerminalWindsTdwrMCO |
| pg13              | TiltDqeTerminalWindsTdwrMDW |
| pg13              | TiltDqeTerminalWindsTdwrMEM |
| pg13              | TiltDqeTerminalWindsTdwrMIA |
| pg13              | TiltDqeTerminalWindsTdwrMKE |
| pg13              | TiltDqeTerminalWindsTdwrMSP |
| pg13              | TiltDqeTerminalWindsTdwrMSY |
| pg13              | TiltDqeTerminalWindsTdwrOKC |
| pg13              | TiltDqeTerminalWindsTdwrORD |
| pg13              | TiltDqeTerminalWindsTdwrPBI |
| pg13              | TiltDqeTerminalWindsTdwrPHL |
| pg13              | TiltDqeTerminalWindsTdwrPHX |
| pg13              | TiltDqeTerminalWindsTdwrPIT |
| pg13              | TiltDqeTerminalWindsTdwrRDU |
| pg13              | TiltDqeTerminalWindsTdwrSDF |
| pg13              | TiltDqeTerminalWindsTdwrSJU |
| pg13              | TiltDqeTerminalWindsTdwrSLC |
| pg13              | TiltDqeTerminalWindsTdwrSTL |
| pg13              | TiltDqeTerminalWindsTdwrTPA |
| pg13              | TiltDqeTerminalWindsTdwrTUL |