ONRAMP WIRELESS

TOTAL VIEW

OTV Supplement: Overhead Fault Circuit Indicator

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OTV Supplement: Overhead Fault Circuit Indicator

010-0098-00 Rev. C

March 4, 2015

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Revision History

Revision	Release Date	Change Description
A	September 13, 2013	Initial release supporting OTV 1.0.
B	January 15, 2014	■ Removed chapter on DNP3 integration as that information is now in a separate DNP3 manual. ■ Added new appendix that provides information about using CSV data exports.
C	March 4, 2015	Added a new appendix to provide details for the “v2b” WSO-11 variant.

1 Introduction

This document focuses on On-Ramp Wireless Total Reach network operation to support overhead Fault Circuit Indicator (FCI) monitoring with the SEL WSO-11 (Second Generation). It also provides On-Ramp Total View (OTV) administrators and operators with the following information:

- An overview of the overhead FCI operation.
- An overview of the overhead FCI (SEL WSO-11) application in OTV.

This is a supplemental document to be used in conjunction with the following publications which are available for OTV 1.0.

Table 1. Supplemental Documents

Document Title	Document Control Number
OTV Operator Guide	010-0040-00
EMS Operator Guide (1.4)	010-0045-00
EMS Operator Guide (2.1)	010-0107-00
DNP3 Concentrator Configuration Guide	010-0117-00

It is assumed that the user has a basic familiarity with On-Ramp Wireless Total Reach devices and network concepts. This document does not provide the following information:

- Gateway hardware or software installation
- OTV hardware or software installation
- Element Management System (EMS) hardware or software installation
- Physical installation of Node software or hardware.

2 FCI Overview

Schweitzer Engineering Laboratories® (SEL) is the industry leader that provides distribution line FCIs to aid in reducing the time it takes to detect a fault in the utility electric distribution system.

NOTE: This document is written for the Second Generation of the WSO-11. Appendix C discusses the differences between the First Generation (Version 1 or Rev A) and Second Generation (Version 2 or Rev B) of the WSO-11.

On-Ramp Wireless Total Reach radio technology is integrated into the SEL Wireless Sensor for Overhead Lines (WSO-11). This provides a centralized view for operators of a system of FCIs with real-time feedback from each device in the system.

Figure 1. WSO-11 Fault Circuit Indicator (FCI)

FCIs are battery-operated devices that operate for many years when they are directly installed on a distribution line. FCIs are installed system-wide on distribution circuits throughout a utility electric distribution grid. In a typical system, there may be thousands of FCIs geographically dispersed throughout the utility coverage area. There is typically one FCI per circuit phase, resulting in three FCIs per circuit location.

Each FCI detects and wirelessly reports the following types of information regarding the circuit phase on which it is installed:

- Permanent faults
- Historical permanent fault counts
- Momentary faults
- Historical momentary fault counts
- Historical load information
- Condition of the FCI battery

Each FCI is connected wirelessly to an Access Point (AP). APs are aggregated at a Gateway. The On-Ramp Wireless OTV application can log the FCI application data into an existing database for analytics using the On-Ramp Wireless Total Reach network. The OTV view generates a system-wide FCI application view of the state of FCIs and distribution circuits throughout the system. For a detailed view of the FCI device operation, see the SEL WSO-11 documentation.

2.1 FCI Operation

When the operator installs an FCI on a distribution line, the FCI uses its AutoRANGER® functionality to configure fault detection trip values based on the load detected in the distribution line. The FCI makes measurements of the load current and sets trip thresholds automatically. The FCIs have a minimum current threshold of >5A for proper operation.

After the FCI joins the On-Ramp Total Reach network and is configured using AutoRANGER, the FCI sends the following information to OTV. The operator can view this information on the OTV dashboard.

- In normal, non-faulted operation, each FCI sends a **Periodic Report** packet once a day or four times a day based on each devices deployed configuration. When a device is set up for once a day reporting, then each **Periodic Report** packet will contain hourly load information. When a device is set up for once every six hour reporting (four times/day), then each **Periodic Report** packet will contain 15 minute load information
- If an FCI detects a fault, a **Fault or LOC Report** packet is sent immediately to identify the type of fault detected.
- Upon clearing of a fault, a **Restoration Report** packet is sent immediately to show that the fault has been cleared.

The following table lists and describes the reported fields and values.

Table 2. Reported Fields and Values for OTV

Reported Field	Description
Fault Threshold (Amps)	Binary value corresponding to the current fault threshold setting of the device. The fault threshold is generated automatically as of the following fixed thresholds: ■ 50A ■ 100A ■ 200A ■ 400A ■ 600A ■ 800A ■ 1000A ■ 1200A For example, a LOAD[0] ≈30A results in a fault threshold = 100A. The fault threshold adjusts up or down based on the average load current. The average load current is sampled every 30 seconds

Reported Field	Description
Fault Magnitude (Amps)	Binary value that corresponds to the highest fault threshold exceeded during a fault event. The fault current is measured with a granularity equal to the automatically configured fault thresholds. This statistic reports the largest fault threshold that the current exceeded: ■ 50A ■ 100A ■ 200A ■ 400A ■ 600A ■ 800A ■ 1000A ■ 1200A For example, a fault of magnitude 900A is observed and followed by a sustained outage. The reported fault is the highest fault threshold exceeded → Reported Fault Current = 800A.
Battery Voltage (millivolts)	This field displays the measured battery voltage in millivolts.
Number of Momentary Faults Detected	Number of momentary fault events since last report. Momentary fault count represents the number over-current events with a loss-of-current detection prior to the momentary timeout (default 5 minutes) load current was restored. The number of momentary faults detected is incremented through the observation of a current that exceeds the automatically-configured fault threshold. The fault threshold is followed by a recloser operation (current detection being lost for ~75ms). This will not result in an outage five minutes after the detection of the fault current. For example, the unit is installed on Phase A and a single-phase fault occurs downstream on Phase A. A recloser activity clears the fault, and there is no sustained outage. A Momentary Fault (FLT) is recorded from the recloser activity (preceded by the fault current), but no sustained outage is detected.
Number of Momentary Load Pickups Detected	Number of load pickup events since last report. Momentary load pickup represents the number of times that the fault current threshold was exceeded, and a Loss of Current (LOC) was not detected within one second after the detection of the fault current. A momentary load pickup is incremented when the current exceeds the fault threshold, but the increase in the current is sustained. This does not result in recloser operation. The fault threshold is adjusted up by one or more thresholds at a time five minutes after the fault current was detected. For example, a lightly loaded line has a large customer load, such as a very large motor that switches on and off. When the motor turns on, the increase in load (or the short-term inrush current into the inductive load) exceeds the fault threshold. Five minutes later, the increased load causes the unit to adjust the fault threshold upward.
Number of Momentary Loss Of Current Events Detected	Number of momentary loss of current events since last report. The number of momentary loss of current events detected is generated by the observation of the loss of the current detection signal for a unit (defined as the current being lost for ~75ms). The current detection signal for the unit is restored two minutes after the loss of the signal was detected. For example, the unit is installed on Phase C and a single-phase fault occurs downstream on Phase A. The recloser activity clears the fault and there is no sustained outage. Due to the three-phase recloser operation, a momentary LOC is recorded due to the recloser activity.

Reported Field	Description
Number of Cumulative Lifetime Faults	Total lifetime permanent fault events recorded. The number of cumulative lifetime faults is incremented when an asynchronous fault event is generated. For example, a fault occurs downstream of the unit resulting in a sustained outage. A Fault (FLT) packet is sent asynchronously and the statistic is incremented by one.
Number of Cumulative Lifetime Loss Of Current Events	Total lifetime permanent loss of current events recorded. The number of cumulative lifetime loss of current events is incremented when an asynchronous LOC event is generated. For example, units downstream of a fault or an adjacent phase will register permanent loss of current when the protection operates.
Load (Amps)	Depending on device configuration Load (Amps) represents either Peak or Average current in the line (0-1310A). There are 24 entries of load information per **Periodic Report** packet. The 24 entries are evenly spaced measurement over the reporting period. So, for 24 hour (i.e. 1/day) reporting 24 hours/24 = 1 hour measurements. For 6 hour (i.e. 4/day) reporting 6 hours/24 = 6*60 minutes/24 = 15 minute measurements. If a device is configured for once /day (24 hour) reporting then each load entry represents the average over the hour or the peak over the hour for each of the 24 entries. If a device is configured for four/day (6 hour) reporting then each load entry represents the average over 15 minutes or the peak over 15 minutes for each of the 24 entries.

2.2 FCI Deployment

The WSO-11 FCI is designed to facilitate easy field deployment utilizing a standard utility “hot stick” as shown in Figure 2.

Figure 2. Service Technician in Bucket Lift with Hot Stick

A service technician using a bucket lift enables each device with a magnet as described in the SEL document *WSO-11 Installation Instructions (25-0283*). After enabling the device, the technician places the device on a line using a hot stick. Once the device has been enabled it will try to join the On-Ramp Total Reach network. Upon successfully joining the network the device will send a **Deployment Report** packet. Typically the WSO-11 will join the On-Ramp Total Reach network before it finishes arming. In this case, the device sends a deployment packet and OTV

will display the **Deployment Report** packet as shown below (**Mechanical Target Faulted, Unarmed**):

Then, after the device is armed, it sends a **Restoration Report** packet as shown below.

The **Restoration Report** packet denotes that the device is Armed and ready for fault detection.

NOTE: During deployment of WSO-11 devices the use of OTV to see the **Deployment/Restoration Report** packets is optional. The device is designed to allow a service technician to confirm that a device is properly deployed by viewing the transition of the mechanical target without the need to view the packet in OTV.

Devices ship from the factory with the mechanical target in the “Reset” (White) state and the Node powered off. When you apply the magnet to the device the mechanical target flips from “Reset” (White) to “Tripped” (Red) and powers on the Node. The mechanical target will stay in the “Tripped” (Red) state until the Node joins the On-Ramp Total Reach network **AND** the FCI completes arming. After both of these conditions are met, the mechanical target flips to “Reset” (White). If the device is unable to connect to the network **OR** is unable to detect load current above 5 A, the mechanical target stays “Tripped” (Red) indicating that the device is not armed.

Consequently, the field technician can use the mechanical target to verify a deployment prior to leaving the deployment site. If a WSO-11 was powered on with the magnet and its mechanical target goes through the sequence: “Reset” (White), “Tripped” (Red), “Reset” (White), then the technician knows that this device has both joined the network and successfully armed.

3 FCI Operation: Overhead FCI Application

This section details the OTV configuration and operation of SEL WSO-11 FCI.

3.1 Configuring the FCI Application

To initially set up the FCI application in OTV, the following items must be configured:

- Missed interval timeout
- Email alerts on alarm events

The FCI application supports **FCI Max Status Interval** in OTV, which is a configurable “missed interval timeout." The setting of this parameter defines the maximum amount of time (in minutes) between two successive updates for any FCI before OTV generates an alarm. This is an application-level alarm that alerts FCI operators when there are significant issues in the On-Ramp Total Reach network that would prevent automated FCI monitoring.

NOTE: This is a redundant On-Ramp Total Reach system alarm. Missed FCI intervals are noted in the EMS and OTV. The update rate of FCIs is low enough that the typical setting (2,940 minutes = 2 days + 60 minutes) results in an EMS alarm before an OTV alarm. In this example, EMS operators have two days to diagnose a Node missed interval alarm prior to notification to FCI operators. When using this configuration, this setting produces a scenario in which the EMS operators are the first responders to Node missed interval alarms.

3.1.1 FCI Missed Interval Timeout Settings

To configure the FCI Missed Interval Timeout parameter, complete the following steps:

1. Edit the config.properties file. This file is typically located in: /opt/onramp_apps/otv/instance_1/config.properties.
2. Edit the line: fci.status.interval.max.minutes=<timeout in minutes>. Where: “timeout in minutes” represents the time that elapses between successive intervals from any WSO-11 before OTV issues a **Timeout Exceeded** alarm.

3.1.2 FCI Email Alarm Configuration Settings

OTV supports an optional FCI email alarm alerting engine. The application enables an operator to monitor the OTV display instead of using the email alerting capabilities of the system. Depending on operating procedures, the operator can use the email system to supplement day-to-day operations of the FCI.

Use the following steps to configure the FCI email alarm configuration:

1. Log in to OTV with an admin account.

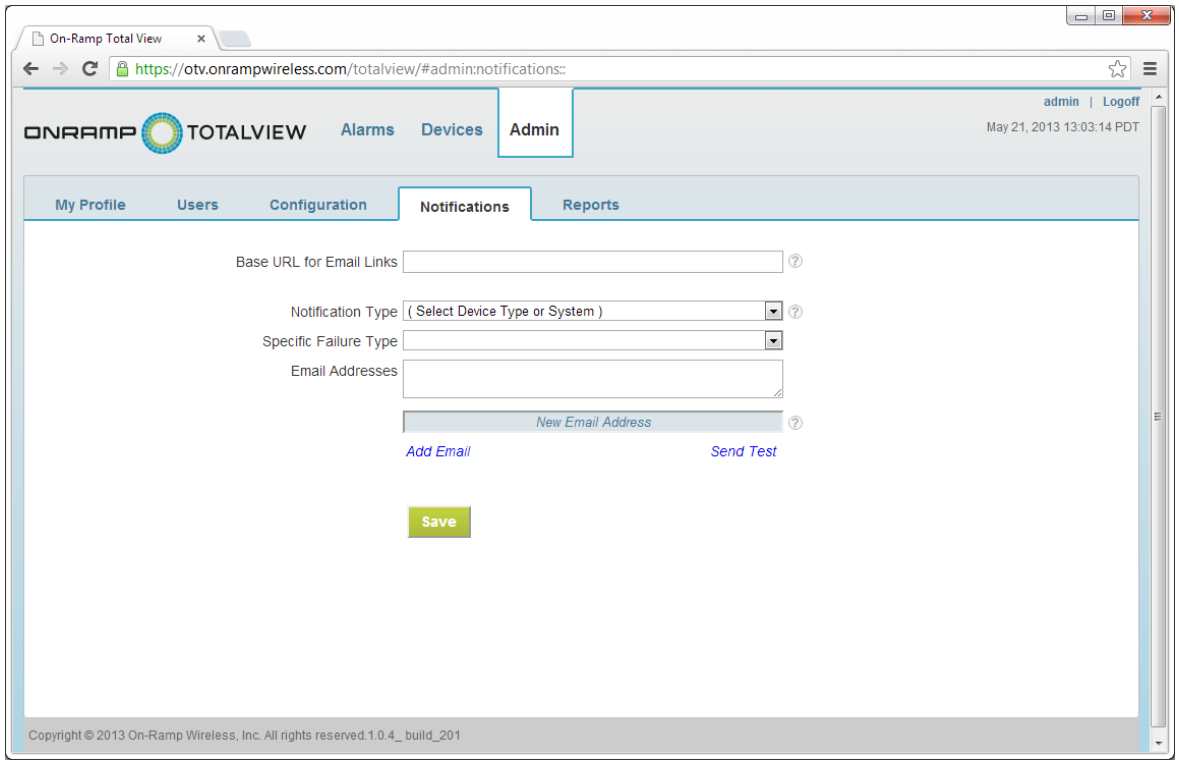
   NOTE: The Admin page enables configuration of all data applications, such as the RMU and FCI. In this section, only FCI settings are defined. Do not change settings not related to the configuration of the FCI.

2. From the login page, click the **Admin → Notifications** tabs.

   NOTE: Ensure that the OTV installer has preconfigured the SMTP/SMS settings in the OTV properties configuration file. This properties file is located in the following directory:

   `<otvserver>:/opt/onramp_apps/otv/instance_1/config.properties`

   For additional information, see the *OTV Software Installation Guide*.



3. For Notification Type, select FCI-O: WSO-11.
4. For Specific Failure Type, select a specific FCI alarm. There are nine FCI specific alarm classes shown below. Each FCI alarm can be configured for a different list of email addresses.
5. For Email Addresses field, add email addresses for individuals identified to receive automated email alerts from OTV when there are FCI alarms.
6. Click **Save**.
7. Repeat the steps above for each FCI alarm type.

Table 3. FCI Alarm Classes

FCI Alarm	Description
All failures for this device type	This alarm group generates an email for all FCI alarms, regardless of type.
Event Alarm	Signifies an alarm condition.
Fault	Generated when current is detected which exceeds the fault threshold for the required amount of time (delay trip time), and a subsequent outage is present at a time five minutes after the fault current was detected.

FCI Alarm	Description
Flash Error	Flash memory error was detected in firmware image.
Loss of current fault	This alarm group only generates an email when an FCI detects a permanent loss of current fault.
Low battery	This alarm group only generates an email when an FCI battery needs to be replaced.
Mechanical Target Faulted	Reports the state of the mechancial target in the FCI. If set, the target is in faulted (red) position. If clear, target is in reset (white) position.
RAM Error	Device operational error flag. This is a self-test check on the RAM of the controller and sets if memory errors are detected
Timeout Exceeded	This alarm group only generates an email for an FCI that has missed the interval period configured in Section 3.1.1.

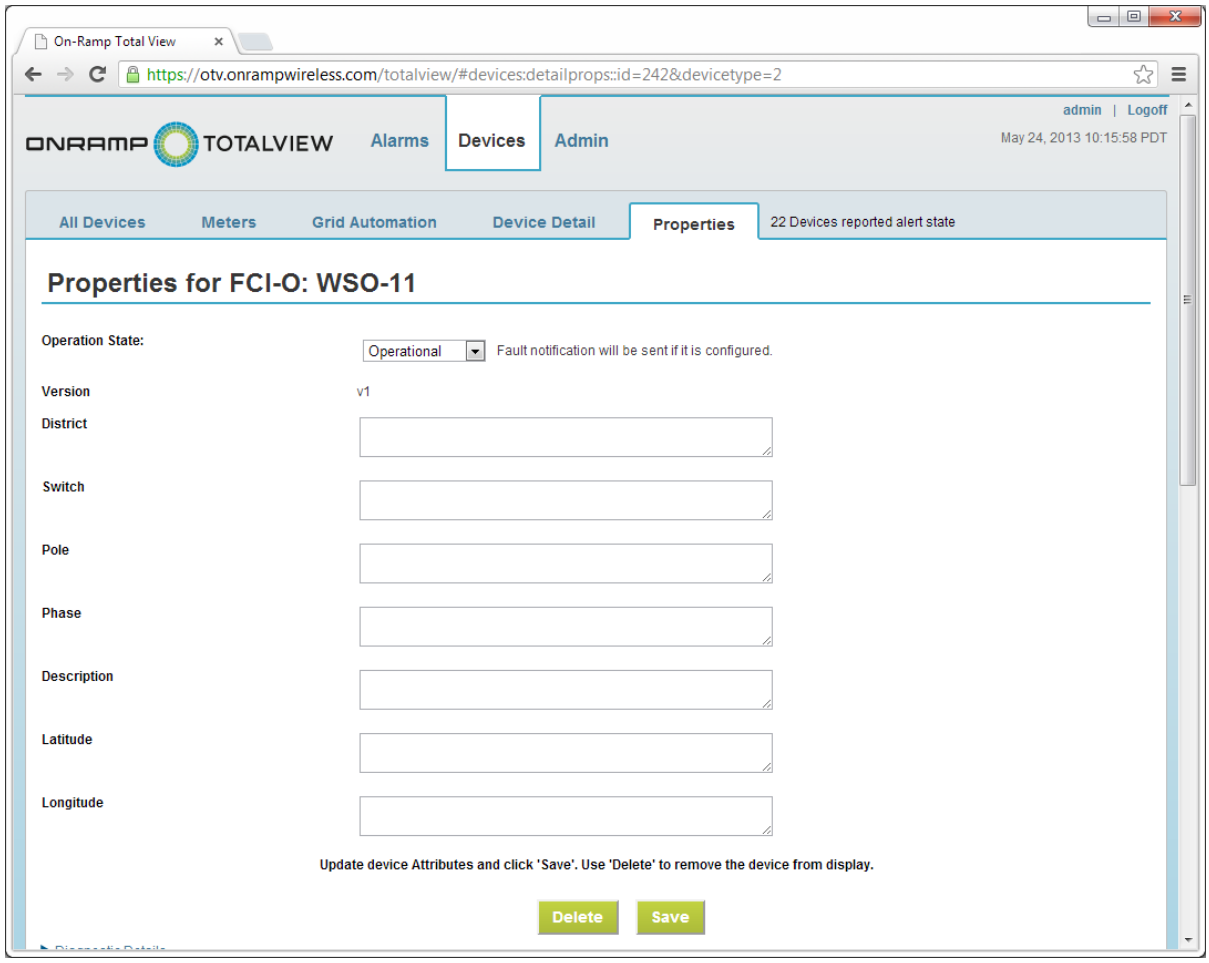
3.2 Deploying an FCI

Adding a remote FCI to the On-Ramp Total Reach system is a multi-step process that may span several days in a geographically diverse network.

3.2.1 Creating a Work Order

The following steps summarize how a work order is created:

1. A work order requests that several devices are ready to be scheduled for deployment.
2. The work order maps specific On-Ramp Wireless radio Mac Addresses for each FCI to be installed to a physical location.
3. The work order proceeds to the EMS operator.
4. The EMS operator adds the Mac Addresses to the EMS and then validates that security keys are in place as described in the *EMS Operator Guide*.
5. After the Mac Addresses are added to the EMS, the physical installation of each device can then take place. There can be a span of several days between adding the device to the EMS and the physical installation of the device in the field.
6. The field technicians install and verify each FCI operation in the field as described in the SEL document *WSO-11 Installation Instructions (25-0283)*. To close the work order, the installer must validate that the Mac Addresses are installed at each location and note each installation on the work order.
7. The work order is routed back to the EMS operator.
8. The EMS operator moves the device from **Maintenance Mode**, as described in the *EMS Operator Guide*.
9. The work order is then routed back to the OTV operator.
10. For each deployed FCI, the OTV operator updates the **District, Switch, Pole, Phase, Latitude,** and **Longitude** device attributes moves the device from **Maintenance** Mode to **Operational** Mode.



11. The work order is complete.

3.2.2 Completing a Work Order

To complete the work order, the OTV operator must have a list of the installed Mac Addresses and locations. Use the following steps to update the device attributes and complete the work order:

1. Log into OTV with an admin or operator account.

   NOTE: The login account must have permissions to use the correct application data. For example, if FCIs are being processed, the admin or operator account must have FCI data privileges.

2. Click the **Devices** tab from the log in window.

   NOTE: The **Devices** tab displays a listing of all devices controlled by OTV. If the login account is limited to a specific application view, such as FCI or FAA lights, only those device types are displayed. If the login account has access to all types of data, both types of devices display. If the list is long, the operator can sort the columns by field to quickly identify newly-added devices.

For example, if FCIs are added, the operator can use the following sorting steps to quickly move the newly-added devices to the top of the listing view:

a. Select FCI-O: WSO-11 from the Device Type drop-down list.

b. Click the **District** column. Depending on the previous settings, you can click on this column heading twice.

c. A list of Mac Addresses and blank columns displays for the physical installation fields to be entered.

3. Select a Mac Address to be processed from the sorted list.
4. Click the **Properties** link.
5. Enter **District, Switch, Pole, Phase, Latitude,** and **Longitude** data in the associated text field.
6. Click **Save**.
7. Repeat above steps for each node to update.

NOTE: The information entered should be in a consistent format. As the network expands, this will aid in searching for devices in an alarm or listing view.

The following table lists and describes other device attribute fields.

Table 4. FCI Device Attribute Descriptions

Physical Information	Description
District	Customer-specific nomenclature.
Switch	Customer-specific nomenclature.
Pole	Customer-specific nomenclature.
Phase	Customer-specific nomenclature.
Latitude	This field is only used when the On-Ramp Wireless geospatial mapping feature is licensed. If not using this system, leave this field blank. For additional information, contact an On-Ramp Wireless Customer Support representative.
Longitude	This field is only used when the On-Ramp Wireless geospatial mapping feature has been licensed. If not using this system, leave this field blank. For additional information, contact an On-Ramp Wireless Customer Support representative.

8. If utilizing the optional OTV DNP3 adapter to communicate with the WSO-11, the controlling entity (e.g., SCADA master controller application) must be configured to support WSO-11 DNP3 devices. This can be done in one of two ways:

- ❒ Manual entry of the WSO-11 DNP3 data points to meaningful descriptors.
- ❒ Automatic entry of the WSO-11 DNP3 data points by having the DNP3 master application “ingest” the WSO-11 DNP3 Device Profile .xml file.

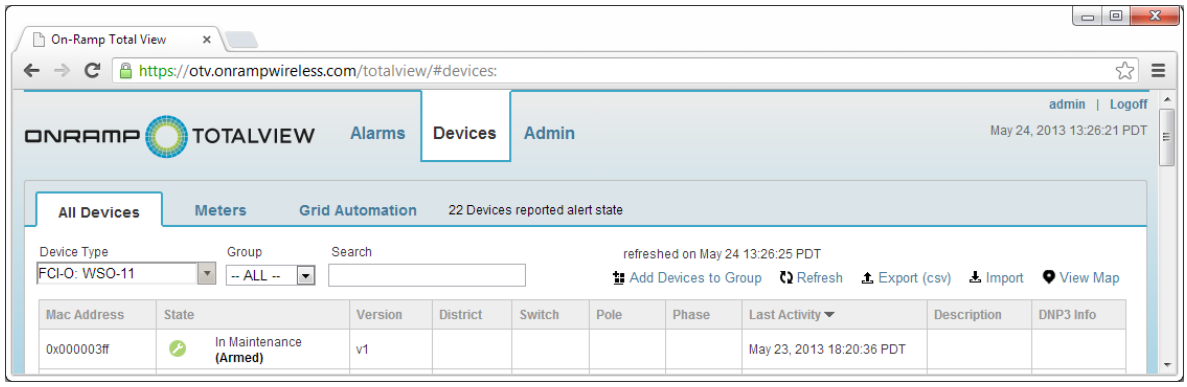
For additional information related to DNP3, refer to the *DNP3 Concentrator Configuration Guide (010-0117-00)*.

3.3 Maintenance Mode

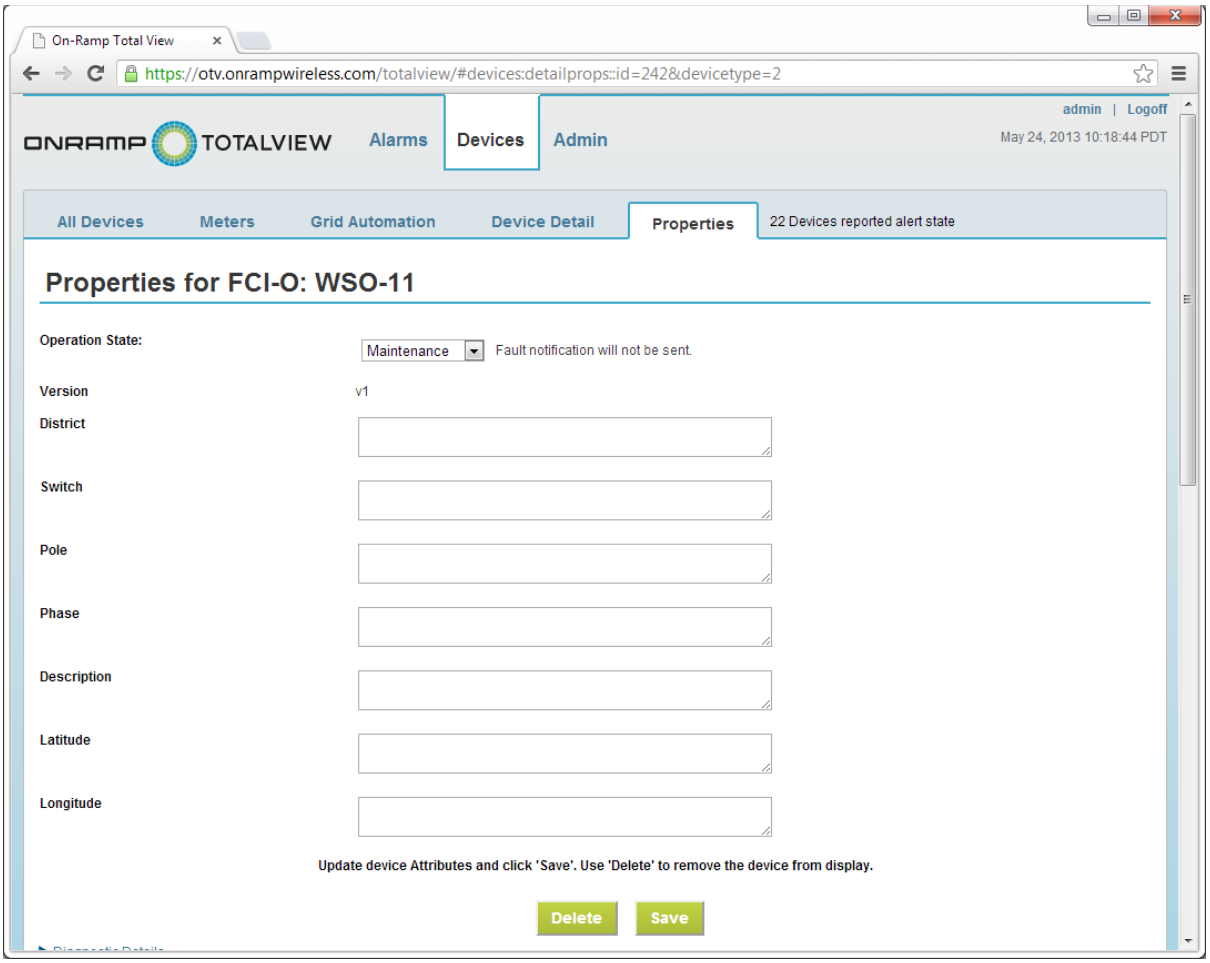
When a device is in Maintenance Mode, it can sometimes trigger alarms for devices that are not in operation (Operational Mode). The OTV Maintenance Mode offers a simple way to filter FCI email alarms for a device either during deployment or when an end device is undergoing physical maintenance

During either of these times, an end device can be in the maintenance state for a long period of time and cause unnecessary alarms. You can optionally disable alarms for devices that are known to be in maintenance mode.

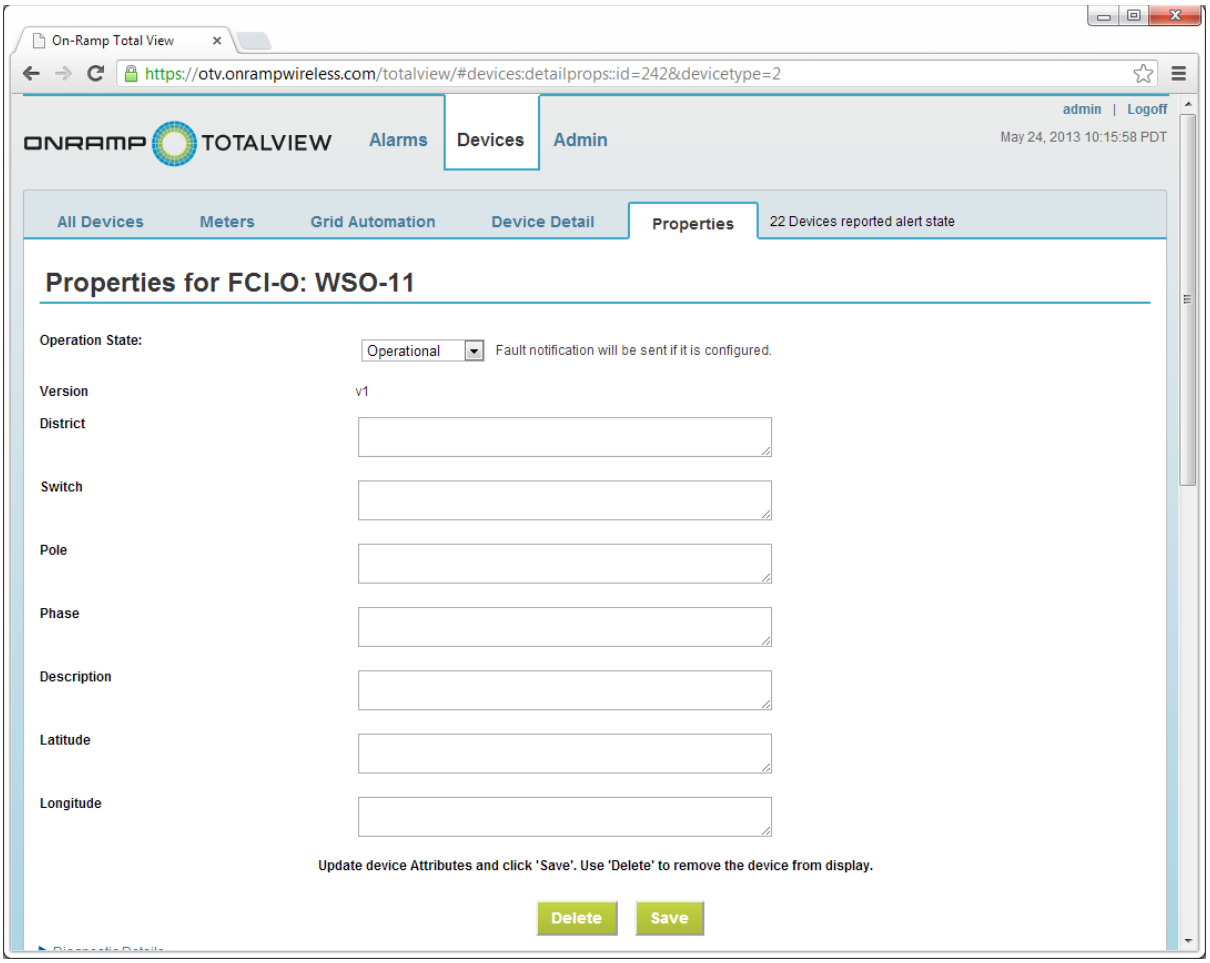
To aid deployment, FCIs are assumed to be in **Maintenance Mode** when they first join the system. When a device is in **Maintenance Mode,** it does not generate email alerts based on device alarms. In addition, the state of the device in the device or alarm list includes a wrench symbol in the *state* icon, as shown in the following example:



The device properties page shows the current mode, as shown below.



When the device is out of maintenance mode and ready for automated monitoring, the user can modify the mode in the **Device Properties** page from **Maintenance** to **Operational**.



After clicking the **Save** button, the device alarm email notification is enabled.

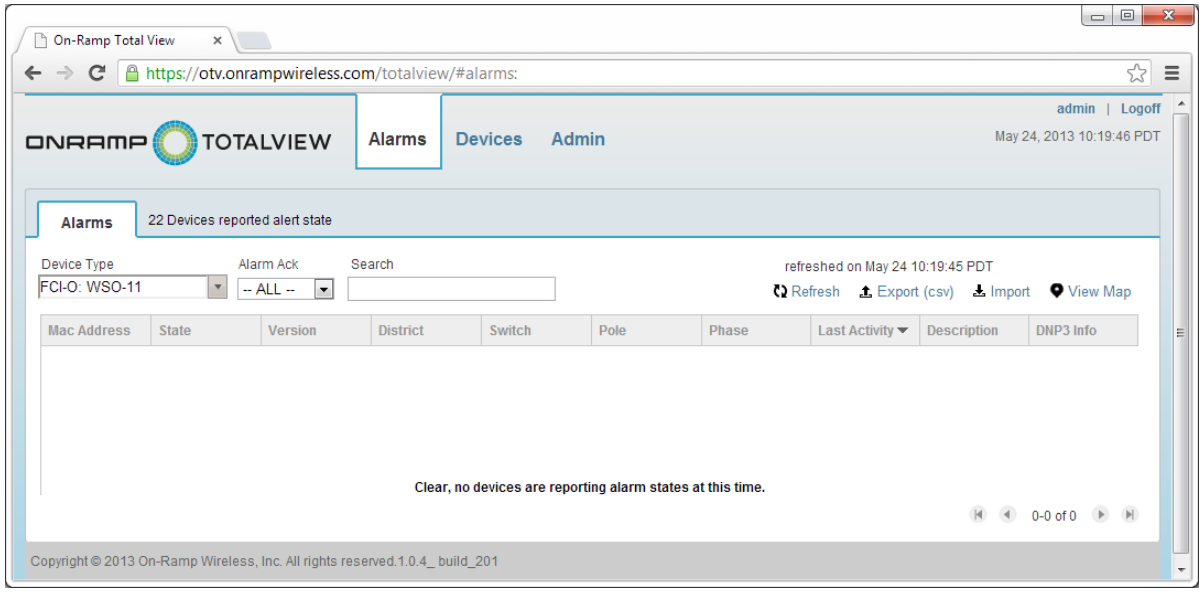
NOTE: The Alarms and Devices screens do not immediately display entries without the wrench icon. After **Operational Mode** is initiated, OTV begins to display operational entries without the wrench, as the new data is received. The update rate is dependent on the device settings. For devices that operate with once daily update intervals, the new data may not display without **Maintenance Mode** indicators for up to 24 hours.

3.4 FCI Daily Operation

For day-to-day operation of the FCI application, an operator should be continuously logged in to OTV. FCI operators can optionally enable OTV email alerts to help facilitate day-to-day operations. Each FCI operator must have an operator account with FCI data viewing capabilities enabled and be logged in to OTV for application operation.

Typically, the operator is logged in and leaves the OTV view on the login page, with the default setting on the **Alarms** tab. The **Alarms** tab screen displays a network-wide summary of all FCI devices with active alarms. In a normally operating system, there are no alarms. In the following

example, the display is on the **Alarms** tab with the following setting: **Clear, no devices are reporting alarm states at this time**.



Information displays on the screen above when an FCI generates an alarm.

NOTE: If there are multiple alarms from a single device, only the most recent alarm is highlighted.

Each FCI can generate an alarm for the following conditions:

- **Fault**
  Generated when a current is detected that exceeds the fault threshold for the required amount of time (delay trip time) and a subsequent outage is present five minutes after the fault current was detected. A fault displays on the Alarm screen as a red circle, as shown below. As shown below, the **Fault Report** packet additionally shows the state of the Mechanical target that is physically showing in the field. Additionally, it shows the state of the device; in this case the device is “Unarmed” as it is in a Faulted condition. Unarmed means that it is not triggered to catch a fault as is expected in this case.

- **Loss of Current (LOC)**
  Generated when a current detection signal is lost and it remains lost for two minutes after detection. When the two minute delay expires, the loss of current signal is still detected. An LOC displays on the Alarm screen as a yellow circle, as shown below. As shown below, the **Loss of Current Report** packet additionally shows the state of the device; in this case the device is “Unarmed” as it is in a Faulted condition. Unarmed means that it is not triggered to catch a fault as is expected in this case.

- **Low Battery Flag**
  This flag is set when it is time to replace the FCI battery (0 - Normal, 1 - Low Battery Warning Flag).

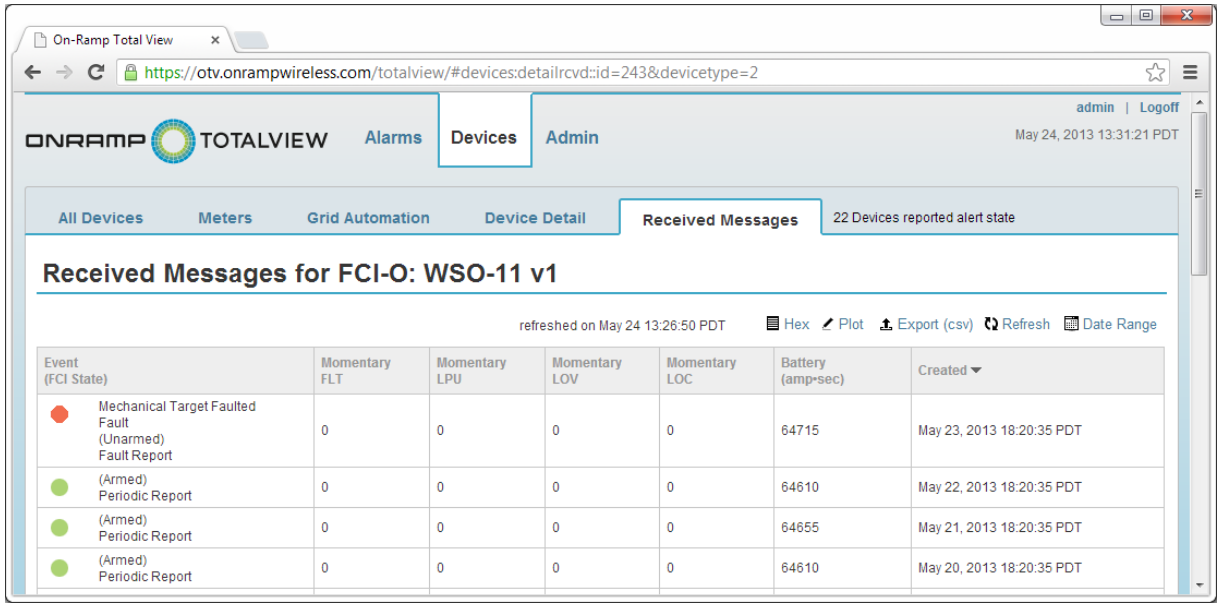
3.5 Viewing FCI Details

Operators can view in-depth details about an FCI, regardless of the current state of the FCI. When an FCI displays on the screen, the operator can click on the device to view more information regarding the current state. From the Alarm display or the Devices display, click on a device to view its detailed history. The detailed history for the device provides important information to help diagnose an FCI alarm. When an alarm is received, the operator can view the detailed history to find the cause of the alarm or see if there is a history for the device that explains the behavior.

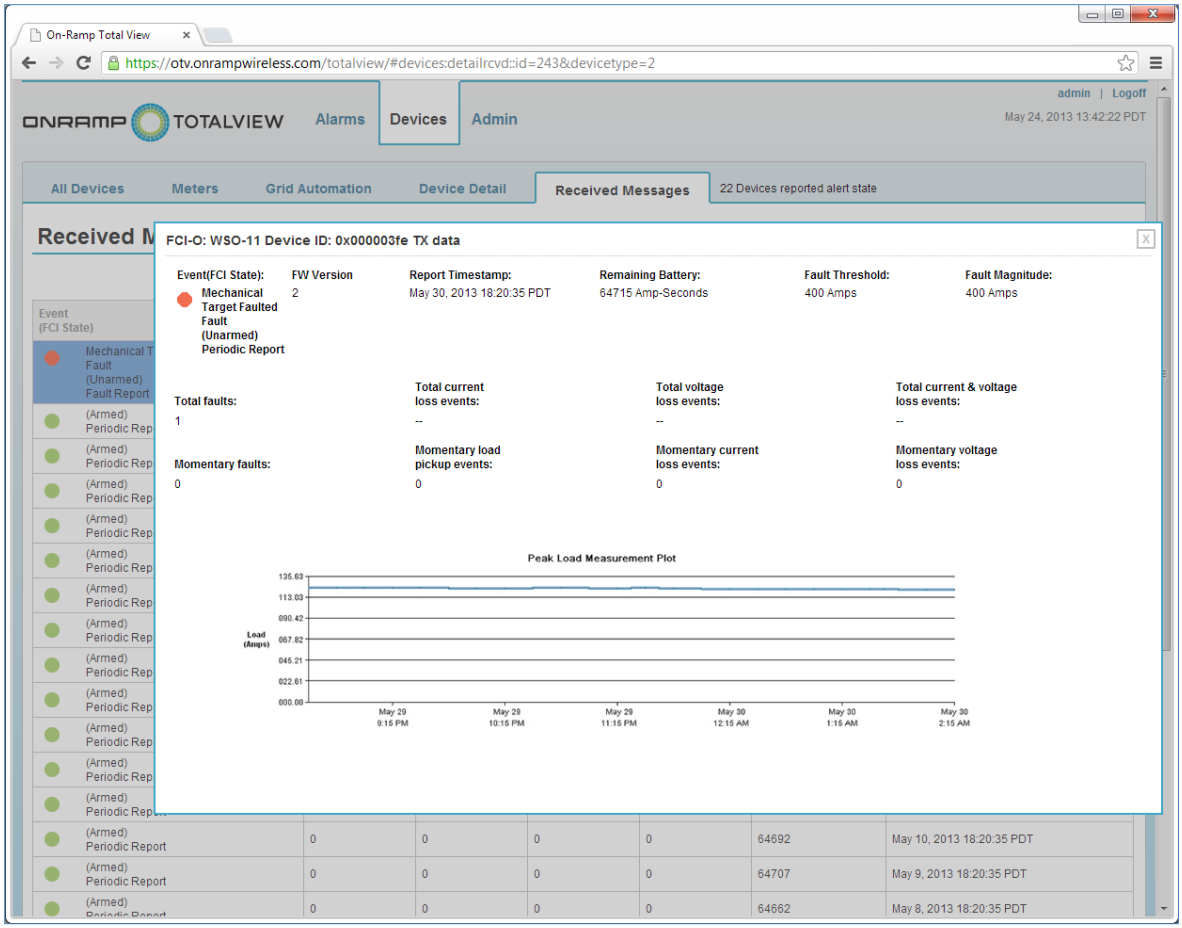
For example, the most typical type of alarm is the **Fault Exception** alarm. A Fault Exception alarm signals that the unit has detected a high current condition in a particular phase of a circuit, resulting in a Fault alarm.

When the **Fault Exception** alarm is detected, the operator can select the device from the display that shows the device history, as shown below.

NOTE: This display is an example used to demonstrate the types of data available to an operator on a daily basis when they use the On-Ramp Total Reach network to monitor FCIs. An additional description of debugging techniques outside of this example is beyond the scope of this document.

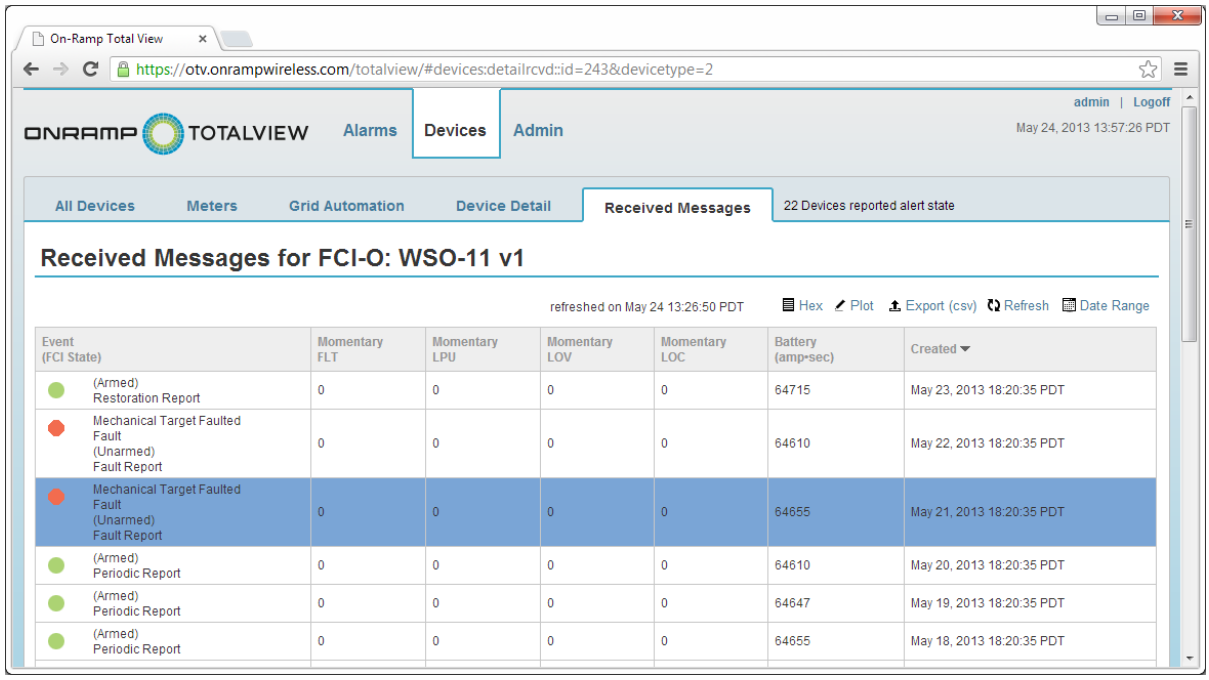


The detailed history describes that the device is operating normally. The operator can also scroll through the historical information for the device to see if there are any other fault indications of interest. The operator can click a specific fault indication for a device to view deeper level of detail regarding the fault, as shown below.



In the example above, the operator sees that, over the past 24 hours of operation, the line experienced a peak load of approximately 122 amps. The trip threshold was set for 400 amps, and it experienced a 400 amp permanent fault. This FCI also experienced a total of one faults in its lifetime.

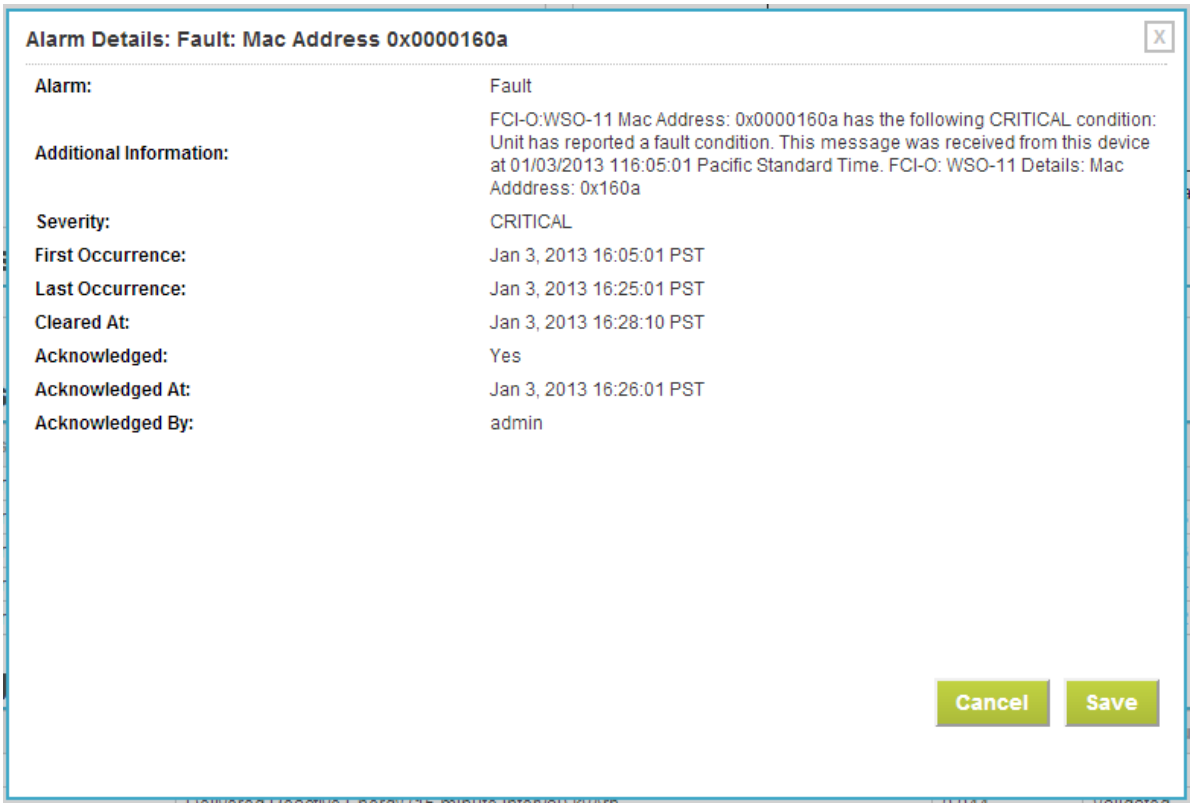
NOTE: The OTV operator does not have to clear or acknowledge any FCI alarms. The system is designed so that all OTV application alarms are self-clearing when the faulting event is cleared in the system. As faults are cleared the device will send a **Restoration Report** packet as shown below. In this instance the faulted device was configured for a 6 hour reporting interval (15 minute load intervals). The Fault was detected at 9:23 AM and it was cleared at 12:29 PM of the same day. The second **Fault Report** packet happened because the fault took ~3 hours to repair. The outage time was long enough that it happened to cross one of the normally scheduled 6 hour reporting intervals at which point the device continued to report its current state (Fault). This second **Fault Report** does not indicate a second fault on the same circuit, but is a continuation of the first event. Faults are not cleared until the device sends a **Restoration Report** as shown.



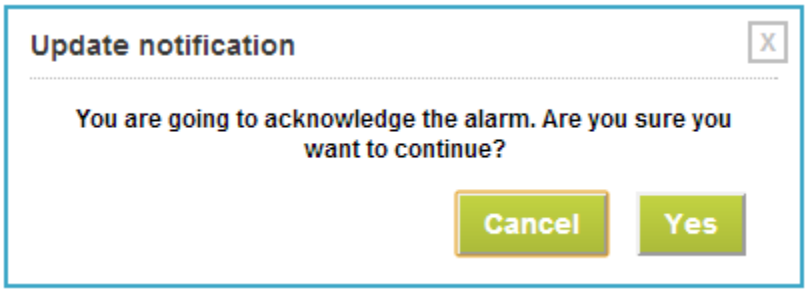
3.5.1 Alarm Acknowledgment

Alarms sent by devices to OTV may be acknowledged (Acked) or not (Not Acked). If they are not acknowledged, the alarm will continue to trigger email alerts until it is acknowledged. Proceed as follows to acknowledge an alarm:

1. Click the Alarms or Devices tab.
2. Click the alarm or data row for the specific alarm to acknowledge. The alarm or node detail screen will appear.
3. Click the Alarms tab. This will display the table of alarms that have been sent.
4. Click the row of the desired alarm to acknowledge. This displays the Alarm Details screen, shown below:



5. Click the Acknowledged drop-down menu and select Yes. A confirmation window will appear as shown:

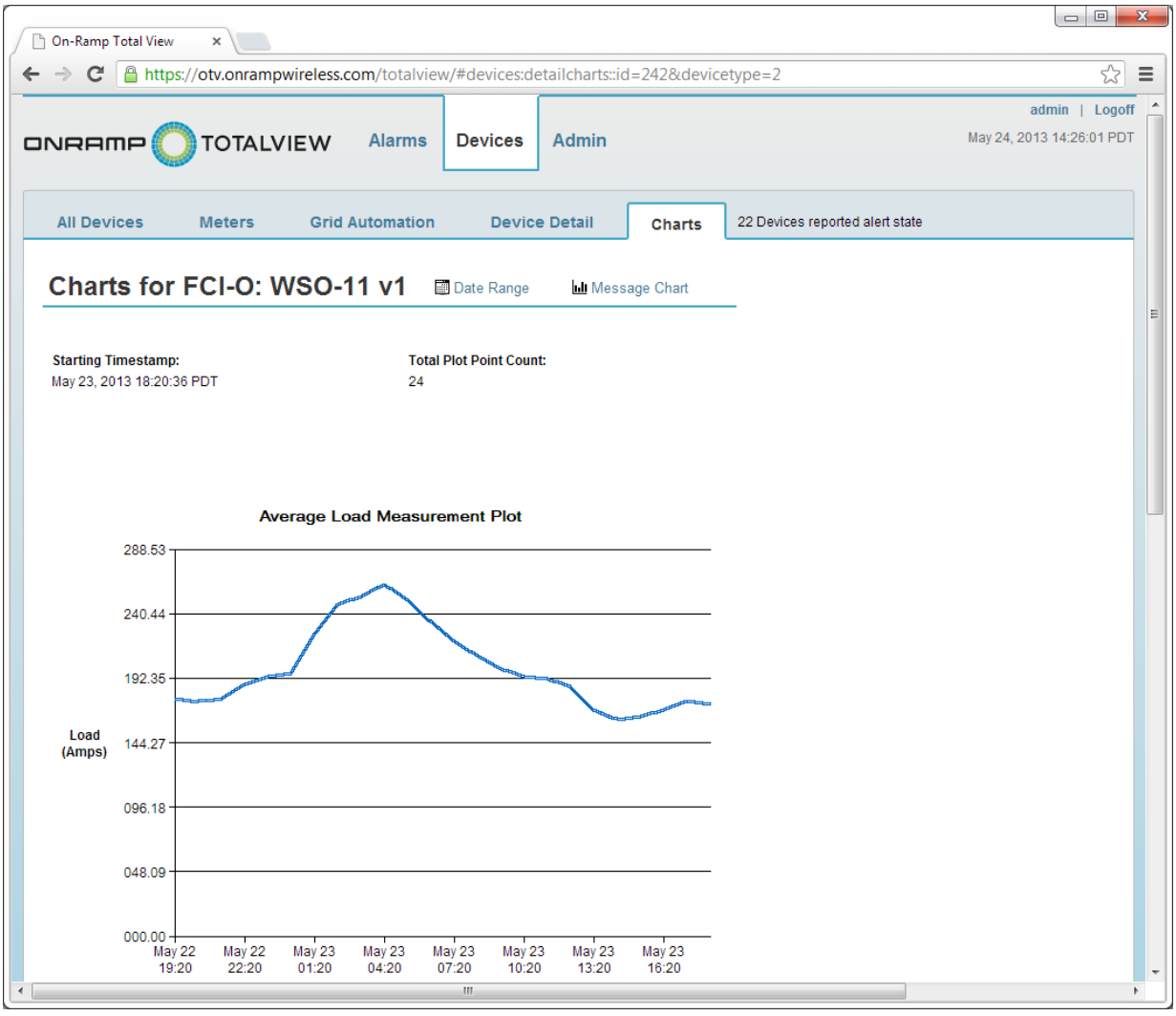


6. Click Yes to confirm that you want to acknowledge the alarm.
7. Click Save. The alarm will now show as an acknowledged alarm.

3.5.2 Multi-day Plotting

Data sent from nodes to the APs may be plotted on a graph to show trends and response activity over a period of time. This can be useful to fine tune the device/AP network for optimal performance. Proceed as follows:

1. Select the row of the desired device in the Alarms or Devices screens.
2. The Device detail screen will appear. By default all data rows for the past 24 hours are plotted on the top right of the screen. To plot a single device ID data plot, click the desired row in the Received Messages section. A detail screen will appear showing the single plot.
3. To change the date range for the plot, click on the Charts link on the top right of the page.
4. Click the Date Range link. Select your range and the plot on the page will update.
5. Use your cursor to mouse across the graph to display key data points.

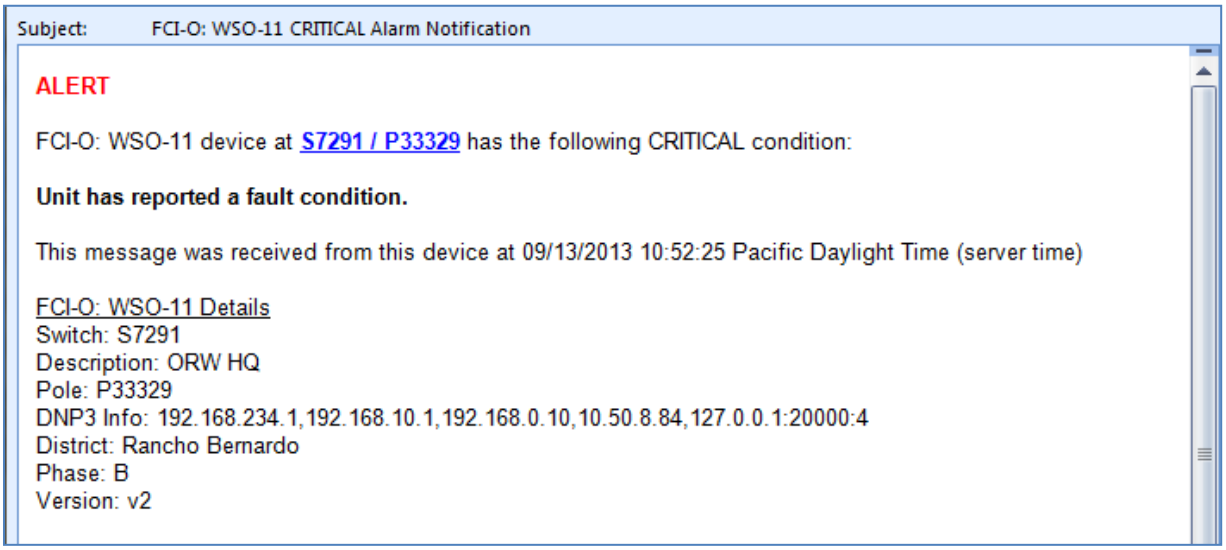


4 Email Alert Examples

The following example shows an email alert generated by the OTV system. Each email identifies the following information:

- Location Information, as entered into OTV for that device
- Short description of the fault condition
- Time stamp for the message
- Other details specific to the FCI being monitored

These example messages highlight two examples of fault conditions on an FCI-O WSO-11.



Subject: FCI-O: WSO-11 CRITICAL Alarm Notification

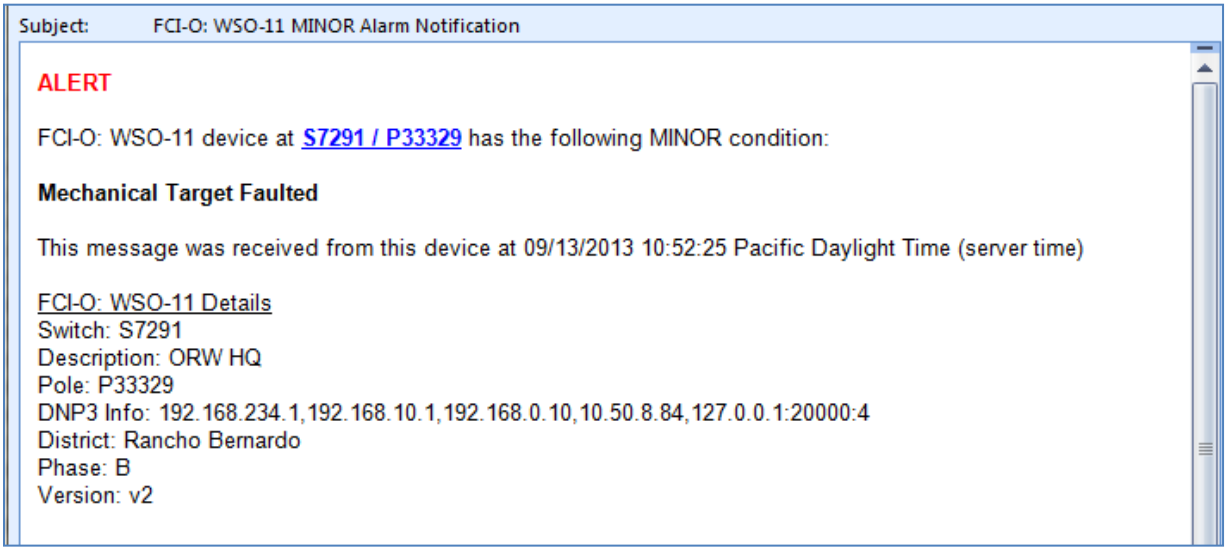
ALERT

FCI-O: WSO-11 device at S7291 / P33329 has the following CRITICAL condition:

Unit has reported a fault condition.

This message was received from this device at 09/13/2013 10:52:25 Pacific Daylight Time (server time)

FCI-O: WSO-11 Details
Switch: S7291
Description: ORW HQ
Pole: P33329
DNP3 Info: 192.168.234.1,192.168.10.1,192.168.0.10,10.50.8.84,127.0.0.1:20000:4
District: Rancho Bernardo
Phase: B
Version: v2



Subject: FCI-O: WSO-11 MINOR Alarm Notification

ALERT

FCI-O: WSO-11 device at S7291 / P33329 has the following MINOR condition:

Mechanical Target Faulted

This message was received from this device at 09/13/2013 10:52:25 Pacific Daylight Time (server time)

FCI-O: WSO-11 Details
Switch: S7291
Description: ORW HQ
Pole: P33329
DNP3 Info: 192.168.234.1,192.168.10.1,192.168.0.10,10.50.8.84,127.0.0.1:20000:4
District: Rancho Bernardo
Phase: B
Version: v2

Appendix A FCI Configuration File Sample

The following text is an example of the parameters specific to the FCI application that are added to the OTV configuration file.

```
####
# FCI config props, should be added to cima's config.properties
####

app_adapter.2.classpath=<CIMA_HOME>/dm/fci-adapter
app_adapter.2.spring_app_ctx_file_names=fciAdapterContext.xml

# amount of time for timeout trigger process
fci.status.interval.max.minutes=1440
```

Appendix B OTV Column Renaming and Column Insertion

Inserting New Column

To insert a new attribute requires two statements. The first statement pushes the 'Last Activity' column up by one slot. The second statement puts the new attribute into the vacated slot in which 'Last Activity' occupied.

```
Update USER_DATA_TYPE2UI_META set node_list_col_position = 7 where
user_data_type_id=2 and node_list_col_name=' Last Activity';

INSERT into USER_DATA_TYPE2UI_META
(user_data_type_id,node_list_col_name,node_list_col_render_class,node_list_col_
truncatable,node_list_col_position,node_list_col_width,
node_list_col_sort_name, node_editable_attrib, node_xml_publish_attrib,
node_email_publish_attrib) VALUES
('2','NewAttribNameHere','NewAttribTitleHere','com.onrampwireless.gateway.clien
t.module.main.view.NodeListingPagingTable.NodeAttribsTextColumnDefinition',0,6,
10,'new_attrib_name',1,2,2);
```

To Change the Name of Existing Meta Attribute Column

```
update USER_DATA_TYPE2UI_META set node_list_col_title = 'New Switch Name' where
user_data_type_id = 2 and node_list_col_name = 'Switch';
```

Appendix C WSO-11 v1 vs. WSO-11 v2

SEL has manufactured two hardware versions of the WSO-11. Version 1 is obsolete and no longer available while Version 2 is the current production model. Although Version 1 is no longer available, it can still be in service in existing networks. This section will highlight the fundamental differences between Version 1 and Version 2.

NOTE: The terms "Rev A," "Generation 1," and "v1" are synonymous with "Version 1" of the WSO-11. Similar nomenclature applies to "Version 2" of the WSO-11.

All Version 2 devices with a software version higher than Version 3.5 are considered "v2b," which supports momentary event reporting and true event timestamps. "v2b" is an SEL firmware change (not a hardware change) and therefore did not justify "Version 3" or "Rev C" designation. However, since OTV must support additional reports with a software version higher than Version 3.5, it is reported in OTV as a "v2b" device. More information regarding the "v2b" device can be found in Appendix D.

Usage Models and Supported Reports

- Both versions support a periodic reporting structure. Both support the 24-hour periodic reporting structure but only Version 2 supports the 6-hour periodic reporting.
- Version 2 supports a restoration report when a fault clears. Version 1 does not have a restoration report and relies on normally scheduled periodic reports to clear the reported fault state.
- Version 2 supports deployment reports when first joining the Total Reach network. Version 1 indirectly does this by sending an asynchronous periodic report; it does not have a dedicated deployment report.
- Version 2 supports either peak or average current load measurements by configuration. Version 1 only supports average current load measurements.
- Version 2 supports either 1-hour current load measurements or 15-minute current load measurements. This is intricately tied with either 24-hour periodic reports or 6-hour periodic reports. Version 1 only supports 1-hour current load measurement intervals in 24-hour periodic reporting intervals.
- Battery Status. Version 2 reports in units of [mV], Version 1 reports in units of [amp*sec].
- Version 1 DNP3 interface is not supported. For additional information related to DNP3, refer to the *DNP3 Concentrator Configuration Guide (010-0117-00)*.

Appendix D WSO-11 v2b

Firmware Version 3.5 or greater builds upon the v2 device with the changes indicated in this appendix.

D.1 Support for Momentary Events

Support for momentary events includes:

- Momentary Fault Report
- Momentary Loss of Current Report
- Disturbance Fault Report
- Load Pickup Event Report

These messages fall under the category of momentary event reporting and were previously available only as count values reported in a WSO-11 periodic report, typically reported every 24 hours. Unlike the permanent reports (such as Permanent Faults and Permanent Loss of Currents) which rely on a restoration report to indicate a restoration of service, momentary events do not have a matching restoration of service report.

The benefit of having momentary messages is that it allows for real time identification of momentary events. These momentary reports are not enabled by default because there can be an impact on overall battery life. Contact an SEL representative to discuss the tradeoffs and to enable one or more of these momentary event reports.

D.2 Real Event Time Stamps

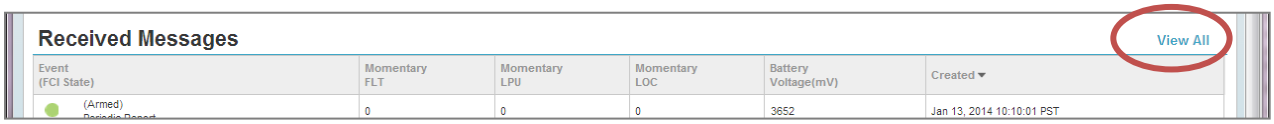
A significant improvement of the v2b device is that time stamping of all events is referenced relative to when the event actually occurred (computed internally in the WSO-11). In older v2 devices, the time stamping of all events is marked when the Total Reach Head End receives the report. Because of the variation of the time it takes to transmit a report or if there is a prolonged communications network outage, the time stamp of reports can be misleading.

D.3 Mechanical Target Indicator

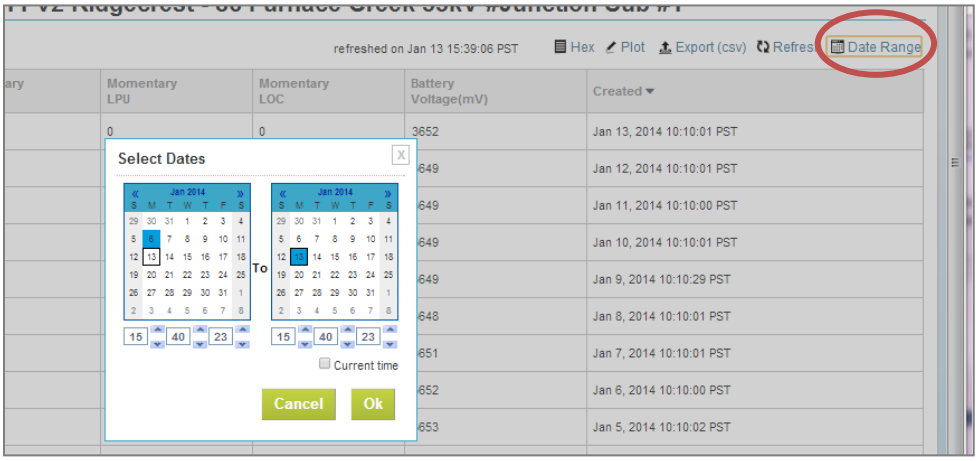
The mechanical target on the WSO-11 now follows both permanent faults and momentary faults (if momentary fault reporting is enabled). Clearing of the mechanical target caused by a fault occurs when current is restored and a customer-defined reset timer has expired. The customer-defined reset timer is disabled by default and is intended to be used with the enablement of momentary fault reporting. Contact an SEL representative for more information. Note that the mechanical flag state is reported to OTV every 24 hours only, so for momentary fault events (which lack restoration reports), OTV may continue to display the mechanical flag state as asserted until the next periodic report is received.

Appendix E Using CSV Data Exports

1. WSO-11 data may be exported as a comma delimited (CSV) file for each device. To do this, go to the "Received Messages" "View All" screen.



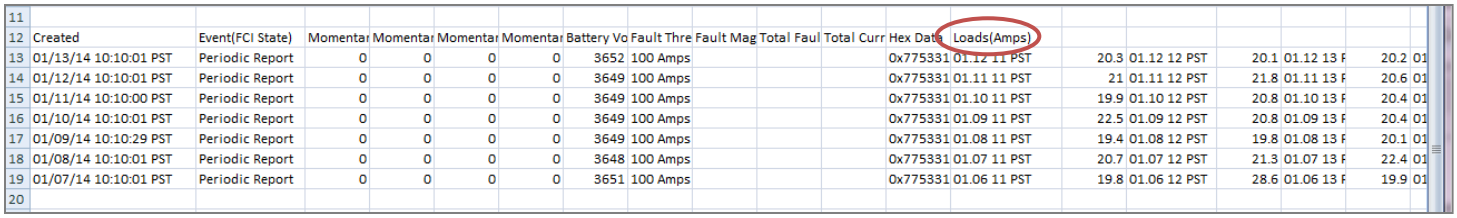
2. Select the desired date range using the date range option.



3. Click on export:

The csv export file is downloaded using the browsers file download capability. The csv file has the meta data populated for that device. This should be straightforward to interpret. Each received block of data shall be available in rows below some column headings. The event column lists the type of data that is shown. Most data will be Periodic Reports, which includes 24 readings of the load on the circuit. Only fault reports show the Fault Magnitude, Total Faults, and Total Current Loss Events count.

4. Depending on the update interval of the WSO-11, the data will be either 1 hour apart or 15 minutes apart. Make note of the configuration of your system before attempting to interpret the data in this csv file. See the following figure.



11																				
12	Created	Event(FCI State)	Momentar	Momentar	Momentar	Momentar	Battery Vo	Fault Thre	Fault Mag	Total Faul	Total Curr	Hex Data	Loads(Amps)							
13	01/13/14 10:10:01 PST	Periodic Report	0	0	0	0	3652	100 Amps				0x775331	01.12 11 PST	20.3	01.12 12 PST	20.1	01.12 13 F	20.2	01	
14	01/12/14 10:10:01 PST	Periodic Report	0	0	0	0	3649	100 Amps				0x775331	01.11 11 PST	21	01.11 12 PST	21.8	01.11 13 F	20.6	01	
15	01/11/14 10:10:00 PST	Periodic Report	0	0	0	0	3649	100 Amps				0x775331	01.10 11 PST	19.9	01.10 12 PST	20.8	01.10 13 F	20.4	01	
16	01/10/14 10:10:01 PST	Periodic Report	0	0	0	0	3649	100 Amps				0x775331	01.09 11 PST	22.5	01.09 12 PST	20.8	01.09 13 F	20.4	01	
17	01/09/14 10:10:29 PST	Periodic Report	0	0	0	0	3649	100 Amps				0x775331	01.08 11 PST	19.4	01.08 12 PST	19.8	01.08 13 F	20.1	01	
18	01/08/14 10:10:01 PST	Periodic Report	0	0	0	0	3648	100 Amps				0x775331	01.07 11 PST	20.7	01.07 12 PST	21.3	01.07 13 F	22.4	01	
19	01/07/14 10:10:01 PST	Periodic Report	0	0	0	0	3651	100 Amps				0x775331	01.06 11 PST	19.8	01.06 12 PST	28.6	01.06 13 F	19.9	01	
20																				

Each of the 24 readings is shown in two columns, starting with the column heading “Loads(Amps).” See the following table. Each reading has a shortened date/time stamp followed by a column that contains the load itself measured in units of Amps. The timestamps are shown in increasing time.

Loads(Amps)						
01.12 11 PST	20.3	01.12 12 PST	20.1	01.12 13 PST	20.2	01.12 14 PST
01.11 11 PST	21	01.11 12 PST	21.8	01.11 13 PST	20.6	01.11 14 PST
01.10 11 PST	19.9	01.10 12 PST	20.8	01.10 13 PST	20.4	01.10 14 PST
01.09 11 PST	22.5	01.09 12 PST	20.8	01.09 13 PST	20.4	01.09 14 PST

So, in the example shown above, the data is reported every day at 10:10 PST. The time stamp field is formatted this way:

MM.DD HH TIMEZONE

Therefore, 01.12.12 PST means January 12 at 12:10 PST because this timestamp is derived from the scheduled update interval of 10:10 PST. Please note all times are displayed in 24 hour time. Microsoft Excel formulas may be used to reformat the abbreviated timestamp into a more typical Microsoft Excel timestamp.

Appendix F Abbreviations and Terms

Abbreviation/Term	Definition
AutoRANGER	A function of the FCI that configures fault detection trip values based on the load detected in the distribution line.
AP	Access Point (TRN AP-1000). The On-Ramp Total Reach network component geographically deployed over a territory.
CSV	Comma Separated Values
DNP3	Distributed Network Protocol
OTV	On-Ramp Total View. The network component that passes data from the Gateway to the associated upstream databases.
EMS	Element Management System. The network component that provides a concise view of the On-Ramp Total Reach network for controls and alarms.
FCI	Fault Circuit Indicator. The Schweitzer Engineering Laboratories® (SEL) designed end device that remotely monitors distribution lines for voltage and/or current faults.
LOC	Loss of Current
Node	The wireless module developed by On-Ramp Wireless that integrates with OEM sensors and communicates sensor data to an Access Point.
On-Ramp Total Reach	The On-Ramp Wireless' proprietary wireless communication network and technology.
ORW	On-Ramp Wireless
RMU	Remote Monitoring Unit. The end device that monitors Federal Aviation Administration (FAA) obstruction lights.
UI	User Interface
WSO-11	Also referred to as SEL WSO-11. Schweitzer Engineering Laboratories® (SEL) Wireless Sensor for Overhead Lines used as a Fault Circuit Indicator (FCI)