

# MANUAL

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## FARM Software Requirements Specification and Traceability Matrix

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# 1 Introduction

The **FARM** plug-in is a generalized module for supervised control within RAVEN.

The plug-in is aimed to compute the admissible actuator range for a system control, which is important to avoid operational constraints violation.

This document is aimed to report and explain the **FARM** plug-in software requirements. In addition, it reports the traceability matrix between software requirements and requirement tests (tests that testify the software is compliant with respect its own requirements).

## 1.1 Dependencies and Limitations

The plug-in should be designed with the fewest possible constraints. Ideally the plug-in (in conjunction with RAVEN) should run on a wide variety of evolving hardware, so it should follow well-adopted standards and guidelines. The software should run on any POSIX compliant system (including Windows POSIX emulators such as MinGW).

In order to be functional, **FARM** depends on the following software/libraries.

- RAVEN (<https://raven.inl.gov>) and all its dependencies (listed in “RAVEN Software Design Description” - SDD-513)

## 2 References

- ASME NQA 1 2008 with the NQA-1a-2009 addenda, “Quality Assurance Requirements for Nuclear Facility Applications,” First Edition, August 31, 2009.
- ISO/IEC/IEEE 24765:2010(E), “Systems and software engineering Vocabulary,” First Edition, December 15, 2010.
- LWP 13620, “Managing Information Technology Assets”
- SDD-513, “ RAVEN Software Design Description ”
- PLN-5552, “ RAVEN and RAVEN Plug-ins Software Quality Assurance and Maintenance and Operations Plan ”



## 3 Definitions and Acronyms

### 3.1 Definitions

- **Baseline.** A specification or product (e.g., project plan, maintenance and operations [M&O] plan, requirements, or design) that has been formally reviewed and agreed upon, that thereafter serves as the basis for use and further development, and that can be changed only by using an approved change control process. [ASME NQA-1-2008 with the NQA-1a-2009 addenda edited]
- **Validation.** Confirmation, through the provision of objective evidence (e.g., acceptance test), that the requirements for a specific intended use or application have been fulfilled. [ISO/IEC/IEEE 24765:2010(E) edited]
- **Verification.**
  - The process of evaluating a system or component to determine whether the products of a given development phase satisfy the conditions imposed at the start of that phase.
  - Formal proof of program correctness (e.g., requirements, design, implementation reviews, system tests). [ISO/IEC/IEEE 24765:2010(E) edited]

### 3.2 Acronyms

**ANL** Argonne National Laboratory

**API** Application Programming Interfaces

**ASME** American Society of Mechanical Engineers

**CG** Command Governor

**DOE** Department of Energy

**HDF5** Hierarchical Data Format (5)

**LWRS** Light Water Reactor Sustainability

**NEAMS** Nuclear Energy Advanced Modeling and Simulation

**NHES** Nuclear-Renewable Hybrid Energy Systems

**IES** Integrated Energy Systems

**INL** Idaho National Laboratory

**IT** Information Technology

**MOAS** Maximal Output Admissible Set

**NQA** Nuclear Quality Assurance

**O&M** Operation and Maintenance

**POSIX** Portable Operating System Interface

**PP** Post-Processor

**QA** Quality Assurance

**RAVEN** Risk Analysis and Virtual ENvironment

**RG** Reference Governor

**ROM** Reduced Order Model

**SDD** System Design Description

**XML** eXtensible Markup Language

## **4 System Requirements: FARM**

### **4.1 Minimum Requirements**

#### **4.1.1 Minimum Requirements**

##### **4.1.1.1 CF-M-1**

Computer: Any POSIX (and POSIX-like) system

##### **4.1.1.2 CF-M-2**

RAM: 2 GB per core execution (depending on the type of analysis and data generated)

##### **4.1.1.3 CF-M-3**

Language: Python 3.x

### **4.2 Functional Requirements**

#### **4.2.1 Framework and I/O**

##### **4.2.1.1 CF-F-1**

The FARM plug-in shall allow user to provide parameterized state-space matrices XML file as input.

##### **4.2.1.2 CF-F-2**

The FARM plug-in shall allow user to provide un-parameterized state-space matrices XML file as input.

## **4.3 Usability Requirements**

### **4.3.1 Supervisory Control**

#### **4.3.1.1 CF-SC-1**

The FARM plug-in shall support for user-defined instructions for adjusting the actuator value and provide admissible actuator range without violating any operational constraints.

## **4.4 Performance Requirements**

### **4.4.1 Infrastructure Support**

#### **4.4.1.1 CF-IS-1**

The FARM plug-in shall be able to be executed in parallel via RAVEN.

## **4.5 System Operations**

### **4.5.1 Human System Integration Requirements**

The command line interface shall support the ability to toggle any supported coloring schemes on or off pursuant to section 508 of the Rehabilitation Act of 1973.

#### **4.5.2 Maintainability**

- The latest working version (defined as the version that passes all tests in the current regression test suite) shall be available at all times through the repository host provider.
- Flaws identified in the system shall be reported and tracked in a ticket or issue based system. The technical lead or any COB member will determine the severity and priority of all reported issues. The technical lead will assign resources at his or her discretion to resolve identified issues.
- The software maintainers will entertain all proposed changes to the system in a timely manner (within two business days).

- The FARM plug-in in its entirety will be made publicly available under the Apache version 2.0 license.

## **4.6 Information Management**

The FARM plug-in in its entirety will be made publicly available on an appropriate repository hosting site (e.g. GitHub). Backups and security services will be provided by the hosting service.

## **5 Verification**

The regression test suite shall employ several verification tests using comparison against analytic solutions (when possible) and convergence rate analysis.

## 6 FARM:SYSTEM REQUIREMENTS

### 6.1 Requirements Traceability Matrix

This section contains all of the requirements, requirements' description, and requirement test cases. The requirement tests are automatically tested for each CR (Change Request) by the CIS (Continuous Integration System).

#### 6.1.1 Minimum Requirements

Requirment ID	Requirment Descrip-tion	Test(s)
CF-M-1	Computer: Any POSIX (and POSIX-like) system	1)"RAVEN User Manual", INL/EXT-15-34123 2)Continous Integration System
CF-M-2	RAM: 2 GB per core execution (depending on the type of analysis and data genarated)	1)"RAVEN User Manual", INL/EXT-15-34123 2)Continous Integration System
CF-M-3	Language: Python 3.x	1)"RAVEN User Manual", INL/EXT-15-34123 2)Continous Integration System

Minimum Requirements

#### 6.1.2 Functional Requirements

Requirment ID	Requirment Descrip-tion	Test(s)
CF-F-1	The FARM plug-in shall allow user to provide parameterized state-space matrices XML file as input.	1)D:_fork_RefGov_para_xmlABC.xml
CF-F-2	The FARM plug-in shall allow user to provide un-parameterized state-space matrices XML file as input.	1)D:_fork_RefGov_unpara_xmlABC.xml

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Framework and I/O

### 6.1.3 Usability Requirements

Requirment ID	Requirment Descrip- tion	Test(s)
CF-SC-1	The FARM plug-in shall support for user-defined instructions for adjusting the actuator value and provide admissible actuator range without violating any operational constraints.	1)D:_fork_RefGov_para_xmlABC.xml 2)D:_fork_RefGov_unpara_xmlABC.xml

Supervisory Control

### 6.1.4 Performance Requirements

Requirment ID	Requirment Descrip- tion	Test(s)
CF-IS-1	The FARM plug-in shall be able to be executed in parallel via RAVEN.	1)D:_fork_RefGov_para_xmlABC.xml 2)D:_fork_RefGov_unpara_xmlABC.xml

Infrastructure Support





