

MANUAL

FARM SRS Number (to be generated)

Revision 0

Printed February 16, 2022

FARM Software Requirements Specification

Haoyu Wang (ANL), Roberto Ponciroli (ANL), Andrea Alfonsi

Prepared by
Idaho National Laboratory
Idaho Falls, Idaho 83415

The Idaho National Laboratory is a multiprogram laboratory operated by
Battelle Energy Alliance for the United States Department of Energy
under DOE Idaho Operations Office. Contract DE-AC07-05ID14517.

Approved for unlimited release.



Issued by the Idaho National Laboratory, operated for the United States Department of Energy by Battelle Energy Alliance.

NOTICE: This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government, nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, make any warranty, express or implied, or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represent that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government, any agency thereof, or any of their contractors or subcontractors. The views and opinions expressed herein do not necessarily state or reflect those of the United States Government, any agency thereof, or any of their contractors.

Printed in the United States of America. This report has been reproduced directly from the best available copy.



FARM SRS Number (to be generated)
Revision 0
Printed February 16, 2022

FARM Software Requirements Specification

Haoyu Wang
Argonne National Laboratory
haoyuwang@anl.gov

Roberto Ponciroli
Argonne National Laboratory
rponciroli@anl.gov

Andrea Alfonsi
Idaho National Laboratory
andrea.alfonsi@inl.gov

Contents

1	Introduction	7
1.1	Dependencies and Limitations	7
2	References	8
3	Definitions and Acronyms	9
3.1	Definitions	9
3.2	Acronyms	9
4	System Requirements: FARM	11
4.1	Minimum Requirements	11
4.1.1	Minimum Requirements	11
4.1.1.1	CF-M-1	11
4.1.1.2	CF-M-2	11
4.1.1.3	CF-M-3	11
4.2	Functional Requirements	11
4.2.1	Framework and I/O	11
4.2.1.1	CF-F-1	11
4.2.1.2	CF-F-2	11
4.3	Usability Requirements	12
4.3.1	Supervisory Control	12
4.3.1.1	CF-SC-1	12
4.4	Performance Requirements	12
4.4.1	Infrastructure Support	12
4.4.1.1	CF-IS-1	12
4.5	System Operations	12
4.5.1	Human System Integration Requirements	12
4.5.2	Maintainability	12
4.6	Information Management	13
5	Verification	14

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** software 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 ENviroment

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.

Document Version Information

