MANUAL

SPC-3171
Revision 0
Printed May 27, 2022

FORCE Software Requirements Specification and Traceability Matrix

Konor Frick, Paul Talbot

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.

SPC-3171
Revision 0
Printed May 27, 2022

FORCE Software Requirements Specification and Traceability Matrix

Konor Frick, Paul Talbot

Contents

1 Introduction 7
1.1 Other Design Documentation 7
1.2 Dependencies and Limitations 7
2 References 9
3 Definitions and Acronyms 10
3.1 Definitions 10
3.2 Acronyms 10
3.3 System Operations 11
3.3.1 Human System Integration Requirements 11
3.3.2 Maintainability 11
3.3.3 Human System Integration Requirements 12
3.4 Information Management 12
4 Verification 13
5 FORCE:SYSTEM REQUIREMENTS 14
5.1 Requirements Traceability Matrix 14
5.1.1 Minimum Requirements 14

1 Introduction

The Framework for Optimization of ResourCes and Economics is a collection of software tools,models, and datasets acquired and developed under the Integrated Energy Systems (IES) program to enable analysis of technical and economic viability of myriad IES configurations. FORCE is the consolidating interface and data repository for all the IES toolsets ranging from macrotechnoeconomic analysis to transient process modeling and experimental validation for integrated energy systems. This document is aimed to report and explain the HYBRID 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 Other Design Documentation

Also available within the repository is the FORCE User manual within the "docs" folder. This user manual gives a detailed explanation of the installation process, system dependencies alongside links upon which where to find them, and an explanation of the use cases within the repository.

1.2 Dependencies and Limitations

The software should be designed with the fewest possible constraints. The only primary constraint is:

1. Python 3 – `https://docs.conda.io/en/latest/miniconda.html`

However, enhanced capabilities will require the installation of the aforementioned plugins (HYBRID, HERON, RAVEN, TEAL) which have the dependencies shown below.

RAVEN

1. Visual Studio Community Edition – Link Available on the raven github
2. Raven specific python library set. – Available through the install process.

HERON, TEAL

1. Risk Analysis and Virtual ENviroment (RAVEN) – `https://raven.inl.gov/SitePages/Software%20Infrastructure.aspx`

HYBRID

1. Commercial Modelica platform Dymola – https://www.3ds.com/products-services/catia/products/dymola/latest-release/

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”

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

API Application Programming Interfaces

ANL Argonne National Laboratory

ARMA Auto-Regressive Moving Average

DOE Department of Energy

FMI Functional Mock-up Interface

FMU Functional Mock-up Unit

HERON Heuristic Energy Resource Optimization Network

IES Integrated Energy Systems

INL Idaho National Laboratory

NHES Nuclear-Renewable Hybrid Energy Systems

IT Information Technology

ORNL Oak Ridge National Laboratory

M&O Maintenance and Operations

NQA Nuclear Quality Assurance

POSIX Portable Operating System Interface

QA Quality Assurance

RAVEN Risk Analysis and Virtual ENviroment

SDD System Design Description

TEAL Tool for Economic Analysis

TRANSFORM Transient Simulation Framework of Reconfigurable Modules

XML eXtensible Markup Language

3.3 System Operations

3.3.1 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.

3.3.2 Maintainability

- The latest working version (defined as the version that passes all tests in the current regression test suite) shall be publicly 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 FORCE framework in its entirety is made publicly available under the Apache version 2.0 license.

3.3.3 Human System Integration Requirements

The regression test suite will cover at least 80% of all models at all times. The results of the regression tests will be stored in the Continuous Integration System.

3.4 Information Management

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

4 Verification

The regression test suite shall employ several verification tests of the correct mechanical executions of the models and workflows reported in this repository.

5 FORCE:SYSTEM REQUIREMENTS

5.1 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).

5.1.1 Minimum Requirements

Requirment ID	**Requirment Description**	**Test(s)**
R-M-1	Dymola 2020x or higher	1)K. Frick, A. Alfonsi, C. Rabiti, "HYBRID User Manual", INL/MIS-20-60624
R-M-2	Visual Studio 2017 or higher with associated 64-bit Intel Compiler	1)K. Frick, A. Alfonsi, C. Rabiti, "HYBRID User Manual", INL/MIS-20-60624
R-M-3	Python 3 or higher to be able to execute RAVEN-based workflows	1)K. Frick, A. Alfonsi, C. Rabiti, "HYBRID User Manual", INL/MIS-20-60624

Minimum Requirements

INL
Idaho National Laboratory