PNNL-29769

FAST-1.0 Software Acceptance Testing Report

Developed Under NQA-1-2017

March 2020

Ken Geelhood
David Colameco
Travis Zipperer

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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Richland, Washington 99354

Project Summary and Document Characteristics

Project Name	FRAPCON and FRAPTRAN Fuel Performance Code Development and Assessment
Project No.	66419 Task 60-16-09
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Approvals

Role	Name	Signature	Date
Project Manager	Tara O’Neil	Tara K O'Neil Digitally signed by Tara K O'Neil Date: 2020.03.24 16:36:39 -07'00'	
Lead Software Developer	Ken Geelhood	Kenneth J (Ken) Geelhood Digitally signed by Kenneth J (Ken) Geelhood Date: 2020.03.23 19:00:47 -07'00'	
Code Custodian	David Colameco	David V Colameco Digitally signed by David V Colameco Date: 2020.03.23 17:06:02 -07'00'	

Revision History

Revision	Date	Comments
0	March 2020	Original Release

Introduction

The purpose of this document is to detail the software testing of FAST-1.0 through unit, integration, and assessment tests. More than 400 tests were designed to provide coverage of the requirements for FAST-1.0. These design requirements were developed in the U.S. Nuclear Regulatory Commission (NRC) Statement of Work (SOW) for NRC Agreement Number NRC-HQ-25-14-D-001 and are transcribed to this document as part of the Software Quality Assurance Plan (SQAP) for the FAST Code System, PNNL-28767. FAST 1.0 represents the merger of the FRAPCON and FRAPTRAN codes and as such FAST-1.0 performs steady state and transient fuel performance calculations described below.

FAST-1.0 calculates the steady state response of light-water reactor fuel rods during long-term burnup. The code calculates temperature, pressure, and deformation of a fuel rod as functions of time-dependent fuel rod power and coolant boundary conditions. The phenomena modeled by the code include: 1) heat conduction through fuel and cladding to the coolant; 2) cladding elastic and plastic deformation; 3) fuel-cladding mechanical interaction; 4) fission gas release from the fuel and rod internal pressure; and 5) cladding oxidation. FAST is used to perform independent calculations for regulatory evaluations of fuel performance under normal operation and anticipated operational occurrences (AOOs).

FAST-1.0 also calculates the transient performance of light-water reactor fuel rods during anticipated operational occurrences (AOOs). FAST-1.0 does not yet have full capabilities to model more rapid and severe transients that occur during hypothetical accidents such as loss of coolant accidents (LOCAs), anticipated transients without SCRAM (ATWS), and reactivity-initiated accidents (RIA). FAST calculates the temperature and deformation history of a fuel rod as a function of time-dependent fuel rod power and coolant boundary conditions. The phenomena modeled by FAST include: 1) heat conduction; 2) heat transfer from cladding to coolant; 3) elastic-plastic fuel and cladding deformation; 4) cladding oxidation; 5) fission gas release; and 6) fuel rod gas pressure.

FAST code assessment, development and maintenance drive a significant portion of the NRC fuel research activities and the tools are used in a substantial number of regulatory products. Given the centrality of the FAST code to the effectiveness of fuel research, it is critical to assess, develop and maintain this tool. The overall objectives are characterized by four main themes:

- Ensuring FAST maintains state-of-the-art features, material properties and fuel performance models.
- Making FAST easier to use and more reliable.
- Developing new capabilities required to perform more sophisticated analysis of in-reactor transient fuel response as well as analysis related to spent fuel storage.
- Supporting an active and engaged peer community through the FAST User Group.

Acronyms and Abbreviations

AOO	Anticipated Operational Occurrences
ASME	American Society of Mechanical Engineers
ATWS	Anticipated Transient Without Scram
CIP	Cabri International Project
CM	Configuration Management
CMMP	Configuration Management & Maintenance Plan
COR	Contracting Officer's Representative
CRUD	Chalk River Unidentified Deposit
DOE	United States Department of Energy
EBR-II	Experimental Breeder Reactor II
EOL	End of Life
FFTF	Fast Flux Test Facility
FGR	Fission Gas Release
FUMAC	Fuel Modeling in Accident Conditions
ID	Inner Diameter
IFBA	Integral Fuel Burnable Absorber
JAEA	Japan Atomic Energy Agency
LOCA	Loss of Coolant Accident
LWR	Light Water Reactor
MOX	Mixed Oxide
NRC	United States Nuclear Regulatory Commission
NSRR	Nuclear Safety Research Reactor
NQA-1	Nuclear Quality Assurance – 1
OD	Outer Diameter
PI	Principle Investigator
PM	Project Manager
PNNL	Pacific Northwest National Laboratory
POC	Point of Contact
QA	Quality Assurance
QAP	Quality Assurance Plan
RIA	Reactivity Initiated Accident
SCIP	Studsvik Cladding Integrity Program
SFR	Sodium Fast Reactor
SMR	Small Modular Reactor
SNAP	Symbolic Nuclear Analysis Program
SNL	Sandia National Laboratory

SOW	Statement of Work
SQA	Software Quality Assurance
SQAP	Software Quality Assurance Plan
V&V	Verification and Validation

Definitions

This Section provides definitions specific to the software project.

Assessment	A review, evaluation, inspection, test, check, surveillance, or audit to determine and document whether items, processes, systems, or services meet specified requirements and perform effectively. (NQA-1-2017)
Acceptance Testing	The process of exercising or evaluating a system or system component by manual or automated means to ensure that it satisfies the specific requirements and to identify differences between expected and actual results in the operating environment. (NQA-1-2017)
Configuration Item	A collection of hardware or software elements treated as unit for the purpose of configuration control. (NQA-1-2017)
Configuration Management (software)	The process of identifying and defining the configuration items in a system (i.e. software and hardware), controlling the release and change of those items throughout the system's life cycle, and recording and reporting the status of configuration items and change requests. (NQA-1-2017)
Baseline	A specification or product 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 control process. (NQA-1-2017)
Error	A condition deviating from an established baseline, including deviations from the current approved computer program and its baseline requirements. (NQA-1-2017)
Confluence	Confluence is an easy to use web-based tool that is utilized for electronically documenting software in a wiki format. Documents can also be controlled. It offers the ability to document, collaborate, and share.
Graded Approach	The process of ensuring that the level of analysis, documentation, and actions used to comply with a requirement is commensurate with: a) the relative importance to safety, safeguards, and security b) the magnitude of any hazard involved c) the life-cycle stage of a facility or item d) the programmatic mission of a facility e) the particular characteristics of a facility or item f) the relative importance of radiological and nonradiological hazards g) any other relevant factors (NQA-1-2017)
HDI	A web search engine that houses PNNL's Lab-level requirements and procedures and considerations for conducting work. The content is delivered via graphical workflows (step-by-step flowcharts with steps for each activity), through narrative work controls (listing of requirements and considerations for managing specific risks and hazards), or in forms or exhibits (linked documents that include greater detail).
Independent	(Independent Reviews or Independent Testing) Person sufficiently independent with respect to the material/product they are reviewing/testing; they did not perform the work they are reviewing or testing. Staff also possess enough subject matter expertise to adequately review/test/evaluate.
Operating Environment	A collection of software, firmware, and hardware elements that provide for the execution of computer programs. (NQA-1-2017)

Software Design Verification	The process of determining if the product of the software design activity fulfills the software design requirements. (NQA-1-2017)
Software Engineering	(a) The application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software. (b) The study of approaches in (a) (NQA-1-2017)
Test Case	A set of test inputs, execution conditions, and expected results developed for a particular objective, such as to exercise a particular program path or to verify compliance with a specific requirement. (NQA-1-2017)
Test Plan (Procedure)	A document that describes the approach to be followed for testing a system or component. Typical contents identify items to be tested, tasks to be performed, and responsibilities for the testing activities. (NQA-1-2017)
Verification	Mathematical proof of the correctness of algorithms, by confirming that code subroutines and functions produce the expected numerical output.
Validation	The process of evaluating software to determine whether it satisfies specified requirements, by comparing code predictions to experimental data.
Unit test	Process or code developed to test the numeric accuracy and functionality of new or modified subroutines and functions.
Unit test suite	Set of unit tests created while developing and maintaining FAST.
Verification test suite	Set of input files that exercise all the code options, used to verify that code changes do not negatively impact code performance, and that results are as expected.
Validation test suite	Set of input files used to validate the codes' predictions against experimental measurements, to quantify the accuracy, bias, and uncertainty of code predictions.

Contents

Tables

1.0 Software Testing Requirements

FAST-1.0 was developed under NQA-1-2017 as defined in the Software Quality Assurance Plan (SQAP) for the FAST Code System, PNNL-28767. Software testing covers both acceptance testing to verify the software is generating expected and reasonable results, and installation verification testing that is performed on various operating systems which represent possible environments the FAST software could reside upon.

This section discusses the acceptance testing and installation verification testing for FAST-1.0.

1.1 Acceptance Testing Requirements

Acceptance testing is largest test suite consisting of 418 tests which provide adequate coverage of input options and models within the software to provide high confidence that FAST-1.0 is modeling fuel performance behavior as expected within the software's area of applicability. Acceptance testing is used to confirm that the code modifications and final code product is operating as expected. This is similar but separate from verification testing that is carried out by users to show that FAST-1.0 meets the modeling requirements of their organization in terms of code coverage relative to a specific product and range of material properties for the organization's fuel products being modeled.

1.1.1 Adequate Test Coverage

Acceptance testing performed for FAST-1.0 included 418 tests covering fuel types such as UO2, MOX, U3Si2, Gd2O3, and UPuZr; numerous clad types, mechanical deformation models, thermal models, axial fuel variations, coolants, corrosion model, spent fuel models and more listed in Sections 3.0 to 6.0.

1.1.2 Software Design Verification Testing

The 418 acceptance tests contained in this report (Sections 3.0 to 6.0) were designed to test the modeling of fuel performance scenarios required of FAST-1.0. The FAST-1.0 Software Design Requirements, PNNL-28868 cover the requirements outlined by the NRC in the SOW NRC-HQ-60-T-0009. Implementation of those requirements is outlined in the FAST-1.0 Software Design Verification Document, PNNL-29772.

1.1.3 Acceptance Tests for Installation Verification

Tests used for installation verification are outlined in Section 1.2

1.1.4 Tests Performed and Test Sequence

The acceptance tests are independent of each other and may be performed in parallel. Generally, they are performed in the order found in Section 3.0 to 6.0.

1.1.5 Ranges of Input Parameters Used

Acceptance tests model a wide range of conditions and tests which are outlined in Sections 3.0 to 6.0.

1.1.6 Key Output Values or Derived Values

The key output values for every acceptance test consist of the test completing without errors detected by FAST-1.0 or non-completion due to failed convergence, error condition, or code stop. Unit tests meet a predefined delta between an analytic solution and the solution of the respective code unit. Assessment tests are compared to experimental data and have been reported in FAST-1.0 Integral Assessment, PNNL-29727.

1.1.7 Acceptance Criteria

All tests must complete without errors detected by FAST-1.0 or non-completion due to failed convergence, error condition, or code stop. Unit tests must meet a predefined delta between an analytic solution and the solution of the respective code unit. Assessment tests are compared to experimental data and have been reported in PNNL-29727 with a discussion of the comparison of FAST-1.0 to measured results.

1.1.8 Observations of Unexpected or Unintended Results

FAST-1.0 was not observed to produce unexpected or unintended results. Unexpected or unintended results would have delayed the code release for investigation and remedy of the offending results.

1.1.9 Software Identifiers of the Compiled Software being Tested

The following software identifiers of the compiled codes on Linux and Windows in Table 1 are as follows:

Table 1 – FAST-1.0 Executable Identification

Executable	OS	Hash
FAST.exe	Windows 10	MD5 5b7ac46985d22069133326e3fe994126 SHA-1 f412f6490721c1259b0d5dd76969c9ac5db34feb
FAST	Linux	MD5 f450ffac9f581d39303d52f4318ffab0 SHA1 e46e1cac223c1f8d10f0a1a60cd8f257f0b8afd2

The following identifiers of the builds are included in Table 2 below:

Table 2 – FAST-1.0 Build File Listing Identification

File	Hash
FAST-1.0_Linux_Build_md5sum_listing	MD5 b9bdb877b71aedfa3f9f0c78255e3d5c SHA-1 7d5c02d07cb8571a11ff3f0339d3c3b3b0731fa6
FAST-1.0_Linux_Build_sha1sum_listing	MD5 e1edf23f359f5aade8038bf980056bfe SHA1 b62c0605fe27747d34f3d4e3eac3674850798795
FAST-1.0_Windows_Build_md5sum_listing	MD5 28269ddd3c01a48c4505150f2f7b9d67 SHA1 54db293217896457bded03d7c3f5e1108bdbe5b4
FAST-1.0_Windows_Build_sha1sum_listing	MD5 b64e3316ea81853e8ef72f28f88dc8cd SHA1 3bbcb96e9334e84fdcfe145e8ee9232e05de0745

1.1.10 Identification of System Software

Testing was performed on both Linux and Windows using Red Hat Enterprise Linux Workstation 7.7 and Windows 10 Enterprise Version 1803 respectively.

1.1.11 Computer Hardware Used

The following computer hardware was used for testing:

- Dell Precision Tower 7910 for Windows with Intel® Xeon® CPU E5-2609 v3 @1.90GHz (2 processors)
- Dell Precision Tower 7920 for Linux with Intel® Xeon® Gold 5120 CPU @2.20GHz (2 Processors)

1.1.12 Date of the Tests

The tests were conducted on March 15, 2020.

1.1.13 Tester or Person Transcribing Automated Test Results

David Colameco, FAST Code Custodian.

1.2 Installation Verification Tests

Installation verification tests are a smaller suite of six tests chosen by the FAST Principle Investigator to provide reasonable indications that the installation of FAST-1.0 was successful on the user's computer or server. Test cases will be provided in the software delivery to users along with a script to run the tests and perform differences with PNNL outputs. Expected differences will be presented and discussed in the FAST-1.0 User Installation and Verification Guide, PNNL-29775.

1.2.1 Test Coverage

Installation verification tests are intended to verify that the installation is producing the intended results. This is a smaller subset that covers fission gas release, oxide, strain, temperature and void cases which are part of the larger assessment testing suite of tests in this report.

1.2.2 Acceptance Tests

The following tests are used in the installation verification test suite are listed in Table 3 below.

Table 3 – FAST-1.0 Verification Suite Tests

File Name	Test Name	Comments
FGR_BWstudR1.in	FGR_BWstudR1	B&W Studsvik Rod 1 for predicted fission gas release.
Oxide_N05.in	Oxide_N05	N05 Case for predicted oxide thickness.
Strain_GE7.in	Strain_GE7	GE7 Case for permanent hoop strain following a power ramp.
Temperature_681-3.in	Temperature_681-3	IFA-681 Rod 3 for predicted fuel centerline temperature.
Temperature_ifa_432r3.in	Temperature_ifa_432r3	IFA-432 Rod 3 for predicted fuel centerline temperature.
Void_24i6.in	Void_24i6	24i6 case for predicted end of life rod void volume.

1.2.3 Acceptance Criteria

Installation verification tests should produce results consistent with the provided PNNL outputs with differences coming from machine names, date and time stamps, and minor rounding differences with examples provided in the FAST-1.0 User Installation and Verification Guide, PNNL-29775.

1.2.4 Observations of Unexpected or Unintended Results with Dispositioning

FAST-1.0 was not observed to produce unexpected or unintended results. Unexpected or unintended results would have delayed the code release for investigation and remedy of the offending results.

1.2.5 Software Identifiers of Compiled Software

The following software identifiers of the compiled codes on Linux and Windows are as follows:

Table 4 – FAST-1.0 Installation Verification Executable Identification

Executable	OS	Hash
FAST.exe	Windows 10	MD5 5b7ac46985d22069133326e3fe994126 SHA-1 f412f6490721c1259b0d5dd76969c9ac5db34feb
FAST	Linux	MD5 f450ffac9f581d39303d52f4318ffab0 SHA1 e46e1cac223c1f8d10f0a1a60cd8f257f0b8afd2

1.2.6 Identification of System Software

The following operating systems listed in Table 5 were used to perform installation tests and identify expected differences that users might encounter in their installation testing. The differences found were innocuous and involved a flat power profile case having identical fuel performance characteristics, but a different node listed as the peak. This has been seen before when comparing executables from different compilers.

Table 5 – FAST-1.0 Tested Operating Systems

Operating System	Version	Comments
Windows 10 Enterprise	1803	OS Build 17134.1304
Windows 10 Enterprise	1909	OS Build 18363.418
Windows Server 2016 Standard	1607	OS Build 14393.693
Windows Server 2019 Standard	1809	OS Build 17763.737
Debian Buster	10.0	Linux Kernel 4.19.0-6
Fedora	31.0	Linux Kernel 5.3.7-301
openSUSE Leap	15.1	Linux Kernel 4.12.14-lp152
Red Hat Enterprise Linux	8.1	Linux Kernel 4.18.0-147
Red Hat Enterprise Linux	7.7	Linux Kernel 3.10.0-1062
Ubuntu LTS	18.04.1	Linux Kernel 4.15.0-72

1.2.7 Computer Hardware Used

The following computer hardware was used for testing:

- Dell Precision Tower 7910 for all operating systems with Intel® Xeon® CPU E5-2609 v3 @1.90GHz (2 processors)

1.2.8 Date of Tests

The tests were conducted on March 15, 2020.

1.2.9 Tester or Person Transcribing Automated Test Results

David Colameco, FAST Code Custodian

1.3 Test Results

All 418 tests passed on Linux and Windows builds. The installation verification test suite is a subset of 6 tests from the larger 418 tests. Test result log files for each build are identified in Table 6:

Table 6 – FAST-1.0 Build Test Suite Log File

File	OS	Hash
LastTest.log	Windows	MD5 0ef3eabf495920094ab654da5ef45dbc SHA1 a61112b4a8288cdaff5ce7e44a606d6366700d97
LastTest.log	Linux	MD5 5584038495d8e4af43f23ecd5b228433 SHA-1 c7d7f46a3daa0c946ea0ca726e9178879de5728d

2.0 References

The following documents were utilized to develop and/or are referenced in this document:

- 10 CFR, Title 10 Code of Federal Regulations, United State Government, 2018.
- ASME NQA-1-2017, Quality Assurance Requirements for Nuclear Facility Applications, January 18, 2018.
- DOE G 414.1-4, Safety Software Guide for use with 10 CFR 830 Subpart A, Quality Assurance Requirements, and DOE O 414.1C, Quality Assurance, November 2010.
- NRC NUREG/BR-0167 Software Quality Assurance Program and Guidelines, February 1993.
- PNNL-28765, Configuration Management and Maintenance Plan for the FAST Code System, Revision 0, June 2019.
- PNNL-28766, Software Assessment Testing Plan for the FAST Code System, Revision 0, June 2019.
- PNNL-28767, Software Quality Assurance Plan for the FAST Code System, Revision 0, June 2019.
- PNNL-28868, FAST-1.0 Software Design Requirements Document, Revision 0, July 2019.
- PNNL-29727, FAST-1.0 Integral Assessment, Revision 0, March 2020.
- PNNL-29775, FAST-1.0 User Installation and Verification Guide, Revision 0, March 2020.
- Project Plan for the Enterprise-Wide Agreement (EPR 66421 and 66419), PNNL, February 2018.
- Statement of Work (SOW) FRAPCON and FRAPTRAN Fuel Performance Code Development and Assessment, NRC Task Order NRC-HQ-60-16-T-0009.

3.0 Analyzed Integration Tests

The analyzed integration tests are FAST input files that are run, and specific values are extracted from the output and compared to expected values. The primary purpose of these tests is to ensure that various input options are being correctly interpreted by the code. See the LastTest.log files listed in Table 6 for a complete listing of testing on Linux and Windows builds.

3.1 Coolant Tests

The coolant tests are tests that exercise the different ways of specifying the coolant boundary conditions.

3.1.1 coolant_bc

This is an integration test for coolant_bc option for the user to supply the coolant temperature. This test supplies two different coolant temperatures and checks that these temperatures are correctly specified in the code.

Linux Test Result: Passed
Windows Test Result: Passed

3.1.2 FixedPCool

This is an integration test for option for the user to supply the coolant pressure. This test supplies a single coolant pressure at all axial nodes and checks that this pressure is correctly specified in the code.

Linux Test Result: Passed
Windows Test Result: Passed

3.1.3 FixedTCool

This is an integration test for option for the user to supply the coolant temperature. This test supplies different coolant temperatures at various axial nodes and checks that these temperatures are correctly specified in the code.

Linux Test Result: Passed
Windows Test Result: Passed

3.1.4 FixedTSurf

This is an integration test for option for the user to supply the fuel rod surface temperature. This test supplies different surface temperatures at various axial nodes and checks that these temperatures are correctly specified in the code.

Linux Test Result: Passed
Windows Test Result: Passed

3.1.5 FixedTPCool

This is an integration test for option for the user to supply the coolant temperature and pressure. This test supplies different coolant temperatures and pressures at various axial nodes and checks that these temperatures and pressures are correctly specified in the code.

Linux Test Result: Passed
Windows Test Result: Passed

4.0 Integration Tests

The integration tests are FAST input files that are run to exercise different code options to make sure that the use of these options does not cause a fatal error in FAST. Success of these tests is defined as completion of the code run without errors. See the LastTest.log files listed in Table 6 for a complete listing of testing on Linux and Windows builds.

4.1 Fuel Types

The fuel type tests consist of FAST input files that run various fuel types.

4.1.1 UO2

This test runs a typical Pressurized Water Reactor (PWR) case with UO_2 pellets to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.1.2 MOX-1

This test runs a typical PWR case with MOX pellets with the default thermal conductivity model to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.1.3 MOX-2

This test runs a typical PWR case with mixed oxide (MOX) pellets with the Halden conductivity model to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.1.4 U3Si2

This test runs a typical PWR case with U_3Si_2 pellets to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.1.5 Gd2O3

This test runs a typical PWR case with UO_2-Gd_2O_3 pellets to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.1.6 UPuZr

This test runs a typical Fast Reactor case with UPuZr fuel, HT9 cladding and Sodium Coolant to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.2 Clad Types

The clad type tests consist of FAST input files that run various clad types.

4.2.1 Zirc2

This test runs a typical Boiling Water Reactor (BWR) case with UO_2 pellets and Zircaloy-2 cladding to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.2.2 Zirc4

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.2.3 M5

This test runs a typical PWR case with UO_2 pellets and M5 cladding to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.2.4 ZIRLO

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.2.5 OptZIRLO

This test runs a typical PWR case with UO_2 pellets and Optimized ZIRLO cladding to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.2.6 E110

This test runs a typical PWR case with UO_2 pellets and E110 cladding to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.2.7 Zr1Nb

This test runs a typical PWR case with UO_2 pellets and Zr1Nb cladding to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.2.8 Kanthal_APMT

This test runs a typical BWR case with UO_2 pellets and Kanthal APMT (FeCrAl Variant) cladding to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.2.9 C35M

This test runs a typical BWR case with UO_2 pellets and C35M (FeCrAl Variant) cladding to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.2.10 C36M

This test runs a typical BWR case with UO_2 pellets and C36M APMT (FeCrAl Variant) cladding to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.2.11 SiC

This test runs a typical PWR case with UO_2 pellets and SiC cladding to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.2.12 HT9

This test runs a typical PWR case with UO_2 pellets and HT9 cladding to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.3 Mechanical Deformation

The mechanical deformation tests consist of FAST input files exercise the three different options for the mechanical solution.

4.3.1 FEA

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding using the cladding FEA package to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.3.2 FRACAS

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding using the default FRACAS-II mechanical package to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.3.3 FRACAS_CT

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding using the optional FRACAS-CT mechanical package to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.4 Thermal Models

The thermal model tests consist of FAST input files that exercise the transition between steady-state and transient heat transfer solutions.

4.4.1 SS_to_TR_to_SS_BOL

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding and alternating between the steady-stated, transient, and back to steady-state heat transfer correlations at beginning of life to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.4.2 SS_to_TR_to_SS_EOL

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding and alternating between the steady-stated, transient, and back to steady-state heat transfer correlations at end of life to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.4.3 SS_to_TR_to_SS_fixedTSurf

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding and alternating between the steady-stated, transient, and back to steady-state heat transfer correlations at beginning of life while holding the cladding surface temperature constant to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.5 Axial Fuel Variations

The axial fuel variation tests consist of FAST input files that exercise the user options to specify axial variations in various parameters.

4.5.1 AxialEnrch

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding using the option to specify different enrichment levels at various axial nodes to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.5.2 AxialVar_All

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding using the options to specify different enrichment levels, pellet central hole diameter, cladding outer diameter (OD), cladding thickness and gap thickness at various axial nodes with differing lengths to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.6 Coolant Options

The coolant option tests consist of FAST input files that run with various coolant types and heat transfer correlations.

4.6.1 Helium_Coolant

This test runs a typical case with UO_2 pellets and SiC cladding using helium coolant to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.6.2 Sodium_Coolant

This test runs a typical case with UO_2 pellets and Zircaloy-2 cladding using sodium coolant to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.6.3 Chen_HTC

This test runs a typical BWR case with UO_2 pellets and Zircaloy-2 cladding using the option to force the Chen heat transfer correlation to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.6.4 ConstantInlet

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding using the option to set constant coolant inlet conditions to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.6.5 Dittus_Boelter_HTC

This test runs a typical BWR case with UO_2 pellets and Zircaloy-2 cladding using the option to force the Dittus Boelter heat transfer correlation to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.6.6 JensLottes_HTC

This test runs a typical BWR case with UO_2 pellets and Zircaloy-2 cladding using the option to force the Jens Lottes heat transfer correlation to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.6.7 NoFlow

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding using the option to specify no flow resulting in no axial coolant heatup to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.6.8 PWR_Inlet_Conditions

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding under normal PWR coolant conditions and high power to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.6.9 Thom_HTC

This test runs a typical BWR case with UO_2 pellets and Zircaloy-2 cladding using the option to force the Thom heat transfer correlation to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.6.10 TimeDependentInlet

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding using the option to specify time-varying coolant inlet conditions to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.7 Corrosion Options

The corrosion option test consists of a FAST input files that runs with various corrosion uncertainty parameters.

4.7.1 M5_corr_h2_uncertainties

This test runs a typical BWR case with UO_2 pellets and M5 cladding using the option to specify model uncertainties on the corrosion and hydrogen pickup models to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.8 Spent Fuel

The spent fuel tests consist of FAST input files that perform various spent fuel analyses using the options for spent fuel built into FAST.

4.8.1 NP1DATING

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding followed by an end of life DATING calculation using the option for Helium decay to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.8.2 NP2DATING

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding followed by an end of life DATING calculation using the option for nitrogen decay to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.8.3 NP3DATING

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding followed by an end of life DATING calculation using the option for user input temperature to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.8.4 NP4DATING

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding followed by an end of life DATING calculation using the option for user input temperature and stress to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.8.5 P1

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding followed by an end of life DATING calculation using the option for Helium decay and specified cladding surface temperatures to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.8.6 P2

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding followed by an end of life DATING calculation using the option for nitrogen decay and specified cladding surface temperatures to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.8.7 P3

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding followed by an end of life DATING calculation using the option for user input temperature and specified cladding surface temperatures to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.8.8 P4

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding followed by an end of life DATING calculation using the option for input temperature and stress and specified cladding surface temperatures to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.8.9 SF_addgmles_addswell

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding followed by an end of life spent fuel storage calculation using the option for long term swelling and helium production to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.9 Developer Options

The developer tests consist of FAST input files that exercise various developer options.

4.9.1 modheat-BWR

This test runs a typical BWR case with UO_2 pellets and Zircaloy-4 cladding using the developer default value of moderator heating fraction to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.9.2 modheat-HBWR

This test runs a typical HBWR case with UO_2 pellets and Zircaloy-4 cladding using the developer default value of moderator heating fraction to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.9.3 modheat-PWR

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding using the developer default value of moderator heating fraction to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.9.4 modheat-user

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding using a user specified value of moderator heating fraction to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.9.5 calcoxide_off

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding using the develop option to turn off the calculation of cladding oxidation to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.10 FGR Models

The Fission Gas Release (FGR) models tests consist of FAST input files that exercise the various fission gas release models.

4.10.1 ANS54_1982

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding using the ANS 5.4 (1982) fission gas release model to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.10.2 Massih

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding using the Massih fission gas release model to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.10.3 FRAPFGR

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding using the FRAPFGR fission gas release model to ensure that the case runs to completion.

Linux Test Result: Passed

Windows Test Result: Passed

4.10.4 ANS54_2011

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding using the ANS 5.4 (2011) fission gas release model to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.10.5 BWR_9x9_Gap_Bounding_S1r2

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding using the Massih fission gas release model and an aggressive power history to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.10.6 Generic_PWR_Kr85_SPH2

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding using the Massih fission gas release model and an aggressive power history to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.10.7 PWR_14x14_Gap_Bounding

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding using the ANS 5.4 (2011) fission gas release model and an aggressive power history to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.10.8 IFBA_1val

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with an IFBA coating applied uniformly to all axial nodes to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.10.9 IFBA_AllConstantVals

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with an IFBA coating applied with a constant values thickness on each axial node to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.10.10 IFBA_UO2_AxialVariations

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with an IFBA coating applied with a different value thickness on each axial node to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.10.11 IFBA_MOX_AxialVariations

This test runs a typical PWR case with MOX pellets and ZIRLO cladding with an IFBA coating applied with a different value thickness on each axial node to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.10.12 NoIFBA

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with no IFBA coating to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.11 FRAPCON Cases

The FRAPCON case test consists of a FRAPCON input files that is run using FAST to demonstrate compatibility.

4.11.1 24i6

This test runs one of the FRAPCON fission gas release assessment cases to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.12 Gases

The gases tests consist of FAST input files that run with various fill gas compositions.

4.12.1 50N250Air

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with initial fill gas of 50% nitrogen and 50% air to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.12.2 Air

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with initial fill gas of 100% air to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.12.3 AllGases

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with initial fill gas mixture of all the available gasses to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.12.4 Argon

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with initial fill gas of 100% argon to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.12.5 FissionGas

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with initial fill gas of 100% fission gas to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.12.6 Helium

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with initial fill gas of 100% helium to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.12.7 Nitrogen

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with initial fill gas of 100% nitrogen to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.12.8 Steam

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with initial fill gas of 100% steam to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.13 Problem Time

The problem time tests consist of FAST input files that exercise the various ways to input time.

4.13.1 Days

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with time specified in days to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.13.2 Hours

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with time specified in hours to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.13.3 Seconds

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with time specified in seconds to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.13.4 MWd_mtU

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with time specified as burnup in MWd/MTU to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.14 Refabrication

The refabrication tests consist of FAST input files that exercise the user options to fuel that is refabricated.

4.14.1 Refabrication

This test runs a typical BWR case with UO_2 pellets and Zircaloy-2 cladding using the refabrication option to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.14.2 Refabrication_plenum

This test runs a typical BWR case with UO_2 pellets and Zircaloy-2 cladding using the refabrication option with a new upper plenum, lower plenum, and external plenum to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.15 PARCS_p2f

The PARCS_p2f tests consist of FAST input files that read PARCS files for various input parameters.

4.15.1 016_rod_01

This test runs a sample input case that uses information from an external PARCS file to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.15.2 485_rod_05

This test runs a sample input case that uses information from an external PARCS file to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.15.3 598_rod_13

This test runs a sample input case that uses information from an external PARCS file to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.16 Radial Power Profile

The radial power profile tests consist of FAST input files that run various options for fuel radial power profile.

4.16.1 RadialPowProf_userdef

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with the option for the user to specify the radial power profile to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.16.2 RadialPowProf_tubrnp1993

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with the option to use the code default of TUBRNP (1993) radial power profile model to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.17 Namelist Check

The Namelist check test consists of a FAST input file that specifies a value for every possible input variable.

4.17.1 FAST_Input_all_namelists

This test runs a sample input case that uses every available input variable to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.18 Decay Heating

The Decay heating test consists of a FAST input file that exercises the decay heat model.

4.18.1 decay

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with the option to use the built-in decay heat model to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.19 FAST-to-FAST Restart

The FAST-to-FAST Restart test consists of a FAST input file that creates a FAST restart file.

4.19.1 base

This test runs a typical PWR case with UO_2 pellets and ZIRLO cladding with the option to produce a FAST-to-FAST restart file to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.20 Geometry

The geometry tests consist of FAST input files that run various options for fuel and cladding geometry.

4.20.1 CentralHoleBottom

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding with pellets with a central hole in the bottom portion of the rod to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.20.2 CentralHoldFull

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding with pellets with a central hole in all the pellets to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.20.3 CentralHoleTop

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding with pellets with a central hole in the top portion of the rod to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.20.4 Cylinder

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding with solid pellets to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.20.5 ID_Coating

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding with an ID cladding coating to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.20.6 OD_Coating

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding with an OD cladding coating to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.20.7 ID_OD_Coating

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding with an ID and OD cladding coating to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.20.8 Upper_plenum

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding with an upper plenum to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.20.9 Lower_plenum

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding with a lower plenum to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.20.10 Upper_Lower_plenum

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding with an upper and lower plenum to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.20.11 External_Upper_plenum

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding with an external plenum to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.20.12 External_Upper_Lower_plenum

This test runs a typical PWR case with UO_2 pellets and Zircaloy-4 cladding with an upper, lower, and external plenum to ensure that the case runs to completion.

Linux Test Result: Passed
Windows Test Result: Passed

4.21 VTK

The VTK test consists of a FAST input file that creates a VTK plot output file.

4.21.1 Vtk

This test runs a typical PWR case with UO_2 pellets and Zircaloy-2 cladding that will produce a VTK output plot file.

Linux Test Result: Passed
Windows Test Result: Passed

5.0 Unit Tests

The unit tests are small Fortran programs that feed a subroutine or subset of subroutines with input data to produce a specific value. A hand calculation was been performed and the output from the FAST subroutine was compared to the hand calculation. See the LastTest.log files listed in Table 6 for a complete listing of testing on Linux and Windows builds.

5.1 Coolant Unit Tests

The coolant unit tests provide the various heat transfer or critical heat flux models in FAST with specific input data and compare the produced heat transfer coefficient or critical heat flux value to the value that was determined by an alternate calculation.

5.1.1 Thom_unit

The Thom_unit test exercises the Thom heat transfer correlation and compares the output to a known value.

Linux Test Result: Passed
Windows Test Result: Passed

5.1.2 Chen_unit

The Chen_unit test exercises the Chen heat transfer correlation and compares the output to a known value.

Linux Test Result: Passed
Windows Test Result: Passed

5.1.3 Jens_Lottes

The Jens_Lottes test exercises the Jens Lottes heat transfer correlation and compares the output to a known value.

Linux Test Result: Passed
Windows Test Result: Passed

5.1.4 Sodium_HTC_unit

The Sodium_HTC_unit test exercises the sodium heat transfer correlation and compares the output to a known value.

Linux Test Result: Passed
Windows Test Result: Passed

5.1.5 Helium_HTC_unit

The Helium_HTC_unit test exercises the helium heat transfer correlation and compares the output to a known value.

Linux Test Result: Passed
Windows Test Result: Passed

5.1.6 Mod_Tong_Young_unit

The Mod_Tong_Young_unit test exercises the modified Tong-Young heat transfer correlation and compares the output to a known value.

Linux Test Result: Passed
Windows Test Result: Passed

5.1.7 Greoneveld_unit

The Greoneveld_unit test exercises the Greoneveld heat transfer correlation and compares the output to a known value.

Linux Test Result: Passed
Windows Test Result: Passed

5.1.8 Bjornard_Griffith_unit

The Bjornard_Griffith_unit test exercises the Bjornard-Griffith heat transfer correlation and compares the output to a known value.

Linux Test Result: Passed
Windows Test Result: Passed

5.1.9 EPRI_CHF_unit

The EPRI_CHF_unit test exercises the EPRI critical heat flux correlation and compares the output to a known value.

Linux Test Result: Passed
Windows Test Result: Passed

6.0 Assessment Tests

Assessment tests are FAST input files that describe an in-reactor test that has been performed and is described in the literature. Relevant output from each test is compared to measured data and to a previous code prediction. In the case of FAST-1.0, the previous code predictions were made with FRAPCON-4.0.

Comparisons of FAST predictions to measured data are used to assess the overall uncertainty and potential bias in the code predictions of specific parameters. Comparisons of FAST predictions to previous code predictions are analyzed by the code developers to ensure that any differences can be accounted for by changes that have been made in the code.

Assessment of the code is made in five key areas; fission gas release, cladding oxide thickness, cladding permanent hoop strain, fuel centerline temperature, and rod void volume. See the LastTest.log files listed in Table 6 for a complete listing of testing on Linux and Windows builds.

6.1 FGR Tests

The FGR tests assess the ability of FAST to predict fission gas release. Cases include steady-state cases, and power ramp cases. Fuel types include UO_2, MOX, and UO_2-Gd_2O_3.

6.1.1 FGR_24i6

This test runs the 24i6 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.2 FGR_28i6

This test runs the 28i6 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.3 FGR_30i8

This test runs the 30i8 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.4 FGR_36i8

This test runs the 36i8 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.5 FGR_111i5

This test runs the 111i5 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.6 FGR_332

This test runs the 332 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.7 FGR_429-DH

This test runs the IFA-429 rod DH case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.8 FGR_4110-ae2

This test runs the 4110-AE2 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.9 FGR_4110-be2

This test runs the 4110-BE2 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.10 FGR_15309

This test runs the 15309 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.11 FGR_AN1

This test runs the AN1 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.12 FGR_AN8

This test runs the AN8 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.13 FGR_ANO-2_TSQ002

This test runs the TSQ002 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.14 FGR_apt2_2

This test runs the APT 2-2 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.15 FGR_apt3_3

This test runs the APT 3-3 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.16 FGR_apt3_10

This test runs the APT 3-10 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.17 FGR_apt4_4

This test runs the APT 4-4 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.18 FGR_apt4_5

This test runs the APT 4-5 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.19 FGR_apt4_6

This test runs the APT 4-6 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.20 FGR_apt4_12

This test runs the APT 4-12 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.21 FGR_bnfl-de

This test runs the BNFL rod DE case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.22 FGR_bnfl-dh

This test runs the BNFL rod DH case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.23 FGR_BWstudR1

This test runs the B&W Studsvik Rod 1 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.24 FGR_BWstudR3

This test runs the B&W Studsvik Rod 3 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.25 FGR_cbp

This test runs the CBP case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.26 FGR_cbr

This test runs the CBR case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.27 FGR_cby

This test runs the CBY case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.28 FGR_d200

This test runs the D200 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.29 FGR_d226

This test runs the D226 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.30 FGR_E09-inner

This test runs the E09 inner ring case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.31 FGR_E09-intermediate

This test runs the E09 intermediate ring case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.32 FGR_E09-outer

This test runs the E09 outer ring case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.33 FGR_epl-4

This test runs the EPL-4 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.34 FGR_fumex6f

This test runs the FUMEX 6F case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.35 FGR_fumex6s

This test runs the FUMEX 6S case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.36 FGR_GAIN-301

This test runs the GAIN Rod 301 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.37 FGR_GAIN-302

This test runs the GAIN Rod 302 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.38 FGR_GAIN-701

This test runs the GAIN Rod 701 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.39 FGR_GAIN-702

This test runs the GAIN Rod 702 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.40 FGR_ge2notc

This test runs the GE2 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.41 FGR_ge4notc

This test runs the GE4 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.42 FGR_ge6notc

This test runs the GE6 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.43 FGR_ge7

This test runs the GE7 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.44 FGR_GraveRodN06

This test runs the Gravelines Rod N06 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.45 FGR_GraveRodN12

This test runs the Gravelines Rod N12 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.46 FGR_ifa597~3notc

This test runs the IFA-597 rod 3 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.47 FGR_ifa-597-4-5-6-7R10

This test runs the IFA-597-4-5-6-7 Rod 10 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.48 FGR_ifa-597-4-5-6-7R11

This test runs the IFA-597-4-5-6-7 Rod 11 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.49 FGR_ifa606notcP2

This test runs the IFA-606 Phase 2 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.50 FGR_ifa629-1notc

This test runs the IFA-629-1 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.51 FGR_IFA-629-3R5

This test runs the IFA-629-3 Rod 5 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.52 FGR_IFA-629-3R6

This test runs the IFA-629-3 Rod 6 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.53 FGR_ifa633moxr6fgrbigplen

This test runs the IFA-663 Rod 6 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.54 FGR_ifa-651-1r1

This test runs the IFA-651-1 Rod 1 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.55 FGR_ifa-651-1r3

This test runs the IFA-651-1 Rod 3 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.56 FGR_ifa-651-1r6

This test runs the IFA-651-1 Rod 6 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.57 FGR_irrmp16

This test runs the Inter-ramp Rod 16 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.58 FGR_irrmp18

This test runs the Inter-ramp Rod 18 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.59 FGR_lff

This test runs the LFF case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.60 FGR_M2-2C

This test runs the M2-2C case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.61 FGR_M308-2

This test runs the M308-2 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.62 FGR_M501-HR1

This test runs the M501 HR1 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.63 FGR_M501-HR2

This test runs the M501 HR2 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.64 FGR_M501-HR3

This test runs the M501 HR3 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.65 FGR_M501-HR4

This test runs the M501 HR4 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.66 FGR_M501-MR1

This test runs the M501 MR1 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.67 FGR_M501-MR2

This test runs the M501 MR2 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.68 FGR_M501-MR3

This test runs the M501 MR3 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.69 FGR_M501-MR4

This test runs the M501 MR4 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.70 FGR_M504-H8

This test runs the M504-H8 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.71 FGR_M504-I2

This test runs the M504-I2 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.72 FGR_M504-K9

This test runs the M504-K9 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.73 FGR_M504-M9

This test runs the M504-M9 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.74 FGR_PA29-4

This test runs the PA29-4 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.75 FGR_pk6-2

This test runs the PK6-2 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.76 FGR_pk6-3

This test runs the PK6-3 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.77 FGR_pk6-s

This test runs the PK6-S case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.78 FGR_regate

This test runs the REGATE case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.79 FGR_riso-f7-3

This test runs the RISO F7-3 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.80 FGR_riso-f9-3

This test runs the RISO F9-3 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.1.81 FGR_riso-f14-6

This test runs the RISO F14-6 case to compare predicted fission gas release to measured fission gas release.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.2 Oxide Tests

The oxide tests assess the ability of FAST to predict cladding oxide thickness. Cladding types include Zircaloy-2, Zircaloy-4, M5, and ZIRLO.

6.2.1 Oxide_15309

This test runs the 15309 case to compare predicted cladding oxide thickness to measured cladding oxide thickness.

Linux Test Result: Passed by completing.

Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.2.2 Oxide_A06

This test runs the A06 case to compare predicted cladding oxide thickness to measured cladding oxide thickness.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.2.3 Oxide_A12

This test runs the A12 case to compare predicted cladding oxide thickness to measured cladding oxide thickness.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.2.4 Oxide_gea1

This test runs the GE A1 case to compare predicted cladding oxide thickness to measured cladding oxide thickness.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.2.5 Oxide_h836-6

This test runs the H8/36-6 case to compare predicted cladding oxide thickness to measured cladding oxide thickness.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.2.6 Oxide_N05

This test runs the N05 case to compare predicted cladding oxide thickness to measured cladding oxide thickness.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.2.7 Oxide_TSQ002

This test runs the TSQ002 case to compare predicted cladding oxide thickness to measured cladding oxide thickness.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3 Strain Tests

The strain tests assess the ability of FAST to predict cladding permanent hoop strain following a power ramp. The fuel for strain tests is UO_2. The cladding types for these tests include Zircaloy-2, Zircaloy-4, ZIRLO, and M5.

6.3.1 Strain_AN1

This test runs the AN1 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.2 Strain_AN8

This test runs the AN8 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.3 Strain_BWstudR1

This test runs the B&W Studsvik Rod 1 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.4 Strain_BWstudR3

This test runs the B&W Studsvik Rod 3 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.5 Strain_GE2

This test runs the GE2 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.6 Strain_GE4

This test runs the GE4 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.7 Strain_GE6

This test runs the GE6 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.8 Strain_GE7

This test runs the GE7 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.9 Strain_IRRMP-16

This test runs the inter-ramp rod 16 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.10 Strain_IRRMP-18

This test runs the inter-ramp Rod 18 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.11 Strain_KKL-1m

This test runs the KKL-1 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.12 Strain_KKL-2

This test runs the KKL-2 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.13 Strain_KKL-3

This test runs the KKL-3 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.14 Strain_KKL-4

This test runs the KKL-4 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.15 Strain_M5-H1m

This test runs the M5-H1 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.16 Strain_M5-H2m

This test runs the M5-H2 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.17 Strain_O2m

This test runs the O2 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.18 Strain_PK1-1

This test runs the PK1-1 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.19 Strain_PK1-3

This test runs the PK1-3 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.20 Strain_PK2-1

This test runs the PK2-1 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.21 Strain_PK2-3

This test runs the PK2-3 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.22 Strain_PK2-S

This test runs the PK2-S case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.23 Strain_PK4-1

This test runs the PK4-1 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.24 Strain_PK4-2

This test runs the PK4-2 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.25 Strain_PK6-1

This test runs the PK6-1 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.26 Strain_PK6-2

This test runs the PK6-2 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.27 Strain_Z-2m

This test runs the Z-2 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.28 Strain_Z-3m

This test runs the Z-3 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.3.29 Strain_Z-4m

This test runs the Z-4 case to compare predicted cladding permanent hoop strain to measured cladding permanent hoop strain following a power ramp.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4 Temperature Tests

The temperature tests assess the ability of FAST to predict fuel centerline temperature. Fuel types include UO_2, MOX, and UO_2-Gd_2O_3. Assessments are made at beginning of life during the first ramp to power, and throughout life.

6.4.1 Temperature_515-A1

This test runs the IFA-515-A1 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.2 Temperature_515-A2

This test runs the IFA-515-A2 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.3 Temperature_515-B1

This test runs the IFA-515-B1 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.4 Temperature_515-B2

This test runs the IFA-515-B2 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.5 Temperature_558r6

This test runs the IFA-558 rod 6 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.6 Temperature_633r1

This test runs the IFA-633 rod 1 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.7 Temperature_633r3

This test runs the IFA-633 rod 3 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.8 Temperature_633r5

This test runs the IFA-633 rod 5 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.9 Temperature_636-2

This test runs the IFA-636 rod 2 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.10 Temperature_636-4

This test runs the IFA-636 rod 4 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.11 Temperature_677.1r2

This test runs the IFA-677.1 rod 2 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.12 Temperature_677.1r3

This test runs the IFA-677.1 rod 3 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.13 Temperature_677.1r4

This test runs the IFA-677.1 rod 4 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.14 Temperature_677.1r6

This test runs the IFA-677.1 rod 6 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.15 Temperature_681-1

This test runs the IFA-681 rod 1 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.16 Temperature_681-1BOL

This test runs the IFA-681 rod 1 beginning of life case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.17 Temperature_681-2

This test runs the IFA-681 rod 2 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.18 Temperature_681-3

This test runs the IFA-681 rod 3 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.19 Temperature_681-4

This test runs the IFA-681 rod 4 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.20 Temperature_681-5

This test runs the IFA-681 rod 5 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.21 Temperature_681-6

This test runs the IFA-681 rod 6 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.22 Temperature_ifa-432r1

This test runs the IFA-432 rod 1 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.23 Temperature_ifa-432r1BOLlower

This test runs the IFA-432 rod 1 beginning of life lower thermocouple case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.24 Temperature_ifa-432r1BOLupper

This test runs the IFA-432 rod 1 beginning of life upper thermocouple case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.25 Temperature_ifa-432r2BOLlower

This test runs the IFA-432 rod 2 beginning of life lower thermocouple case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.26 Temperature_ifa-432r3

This test runs the IFA-432 rod 3 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.27 Temperature_ifa-432r3BOLlower

This test runs the IFA-432 rod 3 beginning of life lower thermocouple case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.28 Temperature_ifa-432r3BOLupper

This test runs the IFA-432 rod 3 beginning of life upper thermocouple case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.29 Temperature_ifa-513r1

This test runs the IFA-513 rod 1 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.30 Temperature_ifa-513r1BOLlower

This test runs the IFA-513 rod 1 beginning of life lower thermocouple case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.31 Temperature_ifa-513r1BOLupper

This test runs the IFA-513 rod 1 beginning of life upper thermocouple case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.32 Temperature_ifa-513r6

This test runs the IFA-513 rod 6 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.33 Temperature_ifa-513r6BOLlower

This test runs the IFA-513 rod 6 beginning of life lower thermocouple case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.34 Temperature_ifa-513r6BOLupper

This test runs the IFA-513 rod 6 beginning of life upper thermocouple case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.35 Temperature_ifa-562r18

This test runs the IFA-562 rod 18 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.36 Temperature_IFA-597-4-5-6-7R10tc

This test runs the IFA-597-4-5-6-7 rod 10 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.37 Temperature_IFA-597-4-5-6-7R11

This test runs the IFA-597-4-5-6-7 rod 11 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.38 Temperature_ifa-597r8

This test runs the IFA-597 rod 8 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.39 Temperature_ifa-651-1r1tc

This test runs the IFA-651 rod 1 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.40 Temperature_ifa-651-1r3tc

This test runs the IFA-651 rod 3 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.41 Temperature_ifa-651-1r6tc

This test runs the IFA-651 rod 6 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.42 Temperature_IFA-677-2

This test runs the IFA-677 rod 2 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.43 Temperature_ifa606tcP2

This test runs the IFA-606 phase 2 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.44 Temperature_ifa610-2extend

This test runs the IFA-610-2 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.45 Temperature_ifa610-4extend

This test runs the IFA-610-4 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.46 Temperature_ifa629-1r1tcextend

This test runs the IFA-629-1 rod 1 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.47 Temperature_ifa629-1r2tcextend

This test runs the IFA-629-1 rod 2 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.48 Temperature_ifa629-3r5ext

This test runs the IFA-629-3 rod 5 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.49 Temperature_ifa629-3r5PvM

This test runs the IFA-629-3 rod 5 case to compare predicted fuel centerline temperature to measured fuel centerline temperature. This case is to generate the data for the predicted vs. measured plot.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.50 Temperature_ifa629-3r6ext

This test runs the IFA-629-3 rod 6 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.51 Temperature_ifa629-3r6PvM

This test runs the IFA-629-3 rod 6 case to compare predicted fuel centerline temperature to measured fuel centerline temperature. This case is to generate the data for the predicted vs. measured plot.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.52 Temperature_ifa633moxr6fgrbigplenTC

This test runs the IFA-633 rod 6 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.53 Temperature_ifa648r1extend

This test runs the IFA-648 rod 1 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.4.54 Temperature_ifa648r2tcextend

This test runs the IFA-648 rod 2 case to compare predicted fuel centerline temperature to measured fuel centerline temperature.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.5 Void Volume Tests

The Void Volume tests assess the ability of FAST to predict void volume at end of life. Cases include rods irradiated to various burnup levels.

6.5.1 Void_07-R2D5

This test runs the 07-R2D5 case to compare predicted end of life rod void volume to measured end of life rod void volume.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.5.2 Void_111i5

This test runs the 111i5 case to compare predicted end of life rod void volume to measured end of life rod void volume.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.5.3 Void_15309

This test runs the 15309 case to compare predicted end of life rod void volume to measured end of life rod void volume.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.5.4 Void_24i6

This test runs the 24i6 case to compare predicted end of life rod void volume to measured end of life rod void volume.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.5.5 Void_36i8

This test runs the 36i8 case to compare predicted end of life rod void volume to measured end of life rod void volume.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.5.6 Void_ANO-2_TSQ002Void

This test runs the ANO-2 TSQ002 case to compare predicted end of life rod void volume to measured end of life rod void volume.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

6.5.7 Void_R3_2AH3_D15

This test runs the Ringhals 3 2AH3 D15 case to compare predicted end of life rod void volume to measured end of life rod void volume.

Linux Test Result: Passed by completing.
Windows Test Result: Passed by completing with an analysis of results in PNNL-29727.

PNNL-29769

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