From:	Sebrosky, Joseph
Sent:	Thursday, October 21, 2021 9:47 AM
To:	Afzali, Amir; Cyril Draffin; HOLTZMAN, Benjamin
Cc:	NICHOL, Marcus; TSCHILTZ, Michael; Shams, Mohamed; Segala, John; Christopher P. Chwasz; Jung, Ian; 'Tom King'; Oesterle, Eric; Uribe, Juan; Jim C. Kinsey Jr; Reckley, William; O'Banion (Watford), Margaret; Steven Nesbit; Chisholm, Brandon Michael; Chowdhury, Prosanta; Thomas Hicks; Bowman, Eric; Bowen, Jeremy; AUSTGEN, Kati
Subject:	Transmittal of Advanced Reactor Content of Application Project Revised Chapter 12, "Post-construction Inspection, Testing, and Analysis Program"
Attachments:	ARCAP ISG - Post-construction Inspection Testing and Analysis Program 10-18 version.docx

Amir Afzali
Southern Company Services
Licensing and Policy Director – Next Generation Reactors

Ben Holtzman
Program Advisor, New Reactors and Advanced Technology
Nuclear Energy Institute

Cyril Draffin
Senior Fellow, Advanced Nuclear
United States Nuclear Industry Council

Mr. Afzali, Mr. Holtzman, and Mr. Draffin,

The purpose of this email is to provide you with the attached Advanced Reactor Content of Application Project Revised Chapter 12, “Post-construction Inspection, Testing, and Analysis Program,” Draft White Paper Interim Staff Guidance (ISG). The staff has revised the previous draft white paper guidance for this Chapter (see: ADAMS Accession No. ML21049A277) that was discussed in a February 25, 2021 public meeting (see: https://www.nrc.gov/pmns/mtg?do=details&Code=20210148) to expand the scope of the guidance beyond guidance for the initial startup program. The attached revised draft white paper ISG is intended to provide guidance to the NRC staff regarding application content that would support making the appropriate finding under 10 CFR 50.57, “Issuance of operating license,” or under 10 CFR 52.97, “Issuance of combined licenses,” and 10 CFR 52.103, “Operation under a combined license.”

The attached document will be referenced in the NRC staff presentations during an upcoming advanced reactor stakeholder meeting tentatively scheduled for November 10, 2021. This email will be captured in ADAMS and the email will be made publicly available so that interested stakeholders will have access to the information prior to the meeting.

If you have questions regarding the attached documents please contact me.

Sincerely,

Joe Sebrosky
Senior Project Manager

Advanced Reactor Policy Branch
Office of Nuclear Reactor Regulation
301-415-1132

Hearing Identifier: NRR_DRMA
Email Number: 1388

Mail Envelope Properties (PH0PR09MB74366F990AA51A5E78503E74F8BF9)

Subject: Transmittal of Advanced Reactor Content of Application Project Revised Chapter 12, "Post-construction Inspection, Testing, and Analysis Program"
Sent Date: 10/21/2021 9:46:40 AM
Received Date: 10/21/2021 9:46:00 AM
From: Sebrosky, Joseph

Created By: Joseph.Sebrosky@nrc.gov

Recipients:
"NICHOL, Marcus" <mrn@nei.org>
Tracking Status: None
"TSCHILTZ, Michael" <mdt@nei.org>
Tracking Status: None
"Shams, Mohamed" <Mohamed.Shams@nrc.gov>
Tracking Status: None
"Segala, John" <John.Segala@nrc.gov>
Tracking Status: None
"Christopher P. Chwasz" <Christopher.Chwasz@inl.gov>
Tracking Status: None
"Jung, Ian" <Ian.Jung@nrc.gov>
Tracking Status: None
"'Tom King'" <thomasking2993@gmail.com>
Tracking Status: None
"Oesterle, Eric" <Eric.Oesterle@nrc.gov>
Tracking Status: None
"Uribe, Juan" <Juan.Uribe@nrc.gov>
Tracking Status: None
"Jim C. Kinsey Jr" <jim.kinsey@inl.gov>
Tracking Status: None
"Reckley, William" <William.Reckley@nrc.gov>
Tracking Status: None
"O'Banion (Watford), Margaret" <Margaret.O'Banion@nrc.gov>
Tracking Status: None
"Steven Nesbit" <steve.nesbit@lmnt-consulting.com>
Tracking Status: None
"Chisholm, Brandon Michael" <BMCHISHO@SOUTHERNCO.COM>
Tracking Status: None
"Chowdhury, Prosanta" <Prosanta.Chowdhury@nrc.gov>
Tracking Status: None
"Thomas Hicks" <hickste@earthlink.net>
Tracking Status: None
"Bowman, Eric" <Eric.Bowman@nrc.gov>
Tracking Status: None
"Bowen, Jeremy" <Jeremy.Bowen@nrc.gov>
Tracking Status: None
"AUSTGEN, Kati" <kra@nei.org>
Tracking Status: None
"Afzali, Amir" <AAFZALI@southernco.com>
Tracking Status: None

"Cyril Draffin" <cyril.draffin@usnic.org>
Tracking Status: None
"HOLTZMAN, Benjamin" <bah@nei.org>
Tracking Status: None

Post Office: PH0PR09MB7436.namprd09.prod.outlook.com

Files	**Size**	**Date & Time**
MESSAGE	1905	10/21/2021 9:46:00 AM
ARCAP ISG - Post-construction Inspection Testing and Analysis Program 10-18 version.docx	174566	

Options
Priority: Normal
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:

This draft staff white paper has been prepared and is being released to support ongoing public discussions. The guidance found in this draft white paper uses an interim staff guidance (ISG) format. The staff is considering using the ISG format in the near future to provide guidance to facilitate the near-term review of advanced reactor applications.

This paper has not been subject to NRC management and legal reviews and approvals, and its contents are subject to change and should not be interpreted as official agency positions.

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

DANU [XX]-ISG-[YYYY-##]

Advanced Reactor Content of Application

Chapter 12 "Post-construction Inspection, Testing, and Analysis Program"

Interim Staff Guidance

October X, 2021

DANU [XX]-ISG-[YYYY-##]
Advanced Reactor Content of Application
Chapter 12 "Post-construction Inspection, Testing and Analysis Program"
Interim Staff Guidance

ADAMS Accession No.: MLxxxxxxxxx TAC: xxxxxx

OFFICE	QTE	[IRAB PM]	[NRR Technical Lead/Author]	[NRR Technical Lead Branch Chief]
NAME				
DATE				
OFFICE	[Other NRR Division Directors, as appropriate]	[Other NRC Division Directors, as appropriate]	[Regional Offices, as appropriate]	OGC
NAME				
DATE				
OFFICE	[PGCB LA]	[NRR Technical Lead Division Director]		
NAME				
DATE				

OFFICIAL RECORD COPY

INTERIM STAFF GUIDANCE

ADVANCED REACTOR CONTENT OF APPLICATION

CHAPTER 12 "POST-CONSTRUCTION INSPECTION, TESTING AND ANALYSIS PROGRAM"

DANU-ISG-YYYY-##

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC, or Commission) staff is providing this interim staff guidance (ISG) to facilitate the review of advanced reactor content of application guidance that is used to support reviews of non-light water reactors (non-LWRs), stationary micro reactors, and small modular LWRs submitting risk-informed applications for a construction permit (CP) or operating license (OL) under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities"; or for a combined license (COL), manufacturing license (ML), or design certification (DC) under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The guidance found in this ISG supports the development of the portion of an advanced reactor application associated with an applicant's "Post-construction Inspection, Testing and Analysis Program."

It is anticipated that this guidance will be updated to use for reviews of advanced nuclear reactor license and permit applications submitted under 10 CFR Part 53, "Licensing and Regulation of Advanced Nuclear Reactors," once the content of that regulation is developed.

BACKGROUND

This ISG is based on the advanced reactor content of application project (ARCAP), whose purpose is to develop technology-inclusive, risk-informed, and performance-based application guidance. The ARCAP is broader than, and encompasses, the industry-led technology-inclusive content of application project (TICAP). The guidance found in this ISG supplements the guidance found in Division of Advanced Reactors and Non-power Production and Utilization Facilities (DANU)-ISG-YYYY-##, "Advanced Reactor Content of Application Guidance," which provides a roadmap for developing all portions of an application. The guidance in this ISG is limited to the portion of an advanced reactor application associated with the development of risk-informed post-construction inspection, testing and analysis program for the nuclear reactor plant applicant.

The 10 CFR Part 53 regulation is under development, and as such, the guidance found in this document is subject to change based on the outcome of that rulemaking. As the 10 CFR Part 53 requirements are developed, this ISG guidance will be supplemented, as necessary, to provide guidance for developing the post-construction inspection, testing and analysis program to reflect any differences in requirements between 10 CFR Part 50/52 and Part 53. The goal of the 10 CFR Part 53 rulemaking effort is to develop the regulatory infrastructure to support the licensing of advanced nuclear reactors. The term ''advanced nuclear reactor,'' for purposes of this rulemaking, means "a nuclear fission or fusion reactor with significant improvements compared to commercial nuclear reactors operating on or under construction as of January 14, 2019. The Part 53 rulemaking would revise the NRC's regulations by adding a risk-informed,

technology-inclusive regulatory framework for advanced nuclear reactors, in response to a growing interest in possible licensing and deployment of advanced nuclear reactors and the related requirements of the Nuclear Energy Innovation and Modernization Act (NEIMA; Public Law 115-439), as amended by the Energy Act of 2020. Key documents related to the Part 53 rulemaking, including preliminary proposed rule language and stakeholder comments, can be found at Regulations.gov under Docket ID NRC-2019-0062.

RATIONALE

Note – this section will be updated with additional stakeholder interactions – expected during the monthly ARCAP meetings.

APPLICABILITY

This ISG is applicable to non-light-water reactors (non-LWRs), stationary micro reactors and small modular LWRs submitting applications for a CP or OL under 10 CFR Part 50 or for a DC, a COL, or a ML under 10 CFR Part 52. Once the content of 10 CFR Part 53 is developed and this ISG is updated where necessary, this guidance will also apply to applicants for a reactor CP, OL, COL, DC, and ML under 10 CFR Part 53.[1]

GUIDANCE

Post-construction inspection, testing, and analysis are addressed, in part, in the regulatory requirements for applicants to provide a description of their quality assurance programs, as required by 10 CFR 50, Appendix B. These quality assurance requirements are also included in 10 CFR 50.34(a)(7) for CP applicants and in 10 CFR 50.34(b)(6) for OL applicants. In addition, similar requirements associated with quality assurance are contained in 10 CFR 52.79(a)(25). Some advanced reactor applicants for which the requirements of 10 CFR 50.43 apply will find similar requirements contained in 10 CFR 50.43(e)(1). More specific requirements associated with inspections, tests, analyses, and acceptance criteria (ITAAC) for Part 52 applicants are discussed below. Requirements to describe preoperational testing and initial operations in OL and COL applications are described in 50.34(b)(6)(iii) and 52.79(a)(28), respectively.

The need for the staff (and the Commission) to make a finding that the as-built facility has been constructed and will be operated in conformance with the approved design and license is embodied and codified in both 10 CFR Part 50 and Part 52 regulations. 10 CFR 50.57, "Issuance of operating license," paragraph(a) states:

> *Pursuant to § 50.56, an operating license may be issued by the Commission, up to the full term authorized by § 50.51, upon finding that:*
>
> *(1) Construction of the facility has been substantially completed, in conformity with the construction permit and the application as amended, the provisions of the Act, and the rules and regulations of the Commission; and*
> *(2) The facility will operate in conformity with the application as amended, the provisions of the Act, and the rules and regulations of the Commission.*

[1] This document does not provide guidance regarding the testing requirements prior to receipt of byproduct, source, or special nuclear material under 10 CFR Parts 30, 40, and 70. A CP applicant may address these testing requirements with its CP application (in accordance with 10 CFR 50.31) or separately from the CP application.

10 CFR 52.97, “Issuance of combined licenses,” states:

> (a)(1) After conducting a hearing in accordance with § 52.85 and receiving the report submitted by the ACRS, the Commission may issue a combined license if the Commission finds that:
>
> > (iii) There is reasonable assurance that the facility will be constructed and will operate in conformity with the license, the provisions of the Act, and the Commission's regulations.

Also, 10 CFR 52.103, “Operation under a combined license,” paragraph (g) states:

> *The licensee shall not operate the facility until the Commission makes a finding that the [ITAAC] acceptance criteria in the combined license are met.*

This ISG is intended to provide guidance to the NRC staff regarding application content that would support making the above findings under these regulations. The ISG consists of guidance related to post-construction inspection, preoperational testing (i.e., tests conducted following construction and construction-related testing, but prior to initial fuel load), analysis verification and initial startup testing (i.e., tests conducted during and after initial fuel load, up to and including initial power ascension). The primary objective of the post-construction inspection, testing and analysis program (PITAP) is to demonstrate, to the extent possible, that the safety-related (SR), safety-significant structures, systems and components (SSCs) were constructed and will operate in accordance with the design and as described in the safety analysis report. Additional objectives of the PITAP include:

- Providing reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the plant is built and will operate in accordance with the safety analysis, the associated provisions of the Atomic Energy Act, and the applicable NRC regulations,
- Providing reasonable assurance that the facility exhibits the performance and associated safety margins that are described in the design,
- Satisfying any license conditions associated with the PITAP,
- Obtaining as-built data to validate the analytical assumptions, limits, and/or models,
- Familiarizing the plant’s operating and technical staff with operation of the facility, and
- Verifying the adequacy of the plant operating and emergency procedures.

The applicant’s plans for the PITAP are required by 10 CFR 50.34(b)(6)(iii) for plants applying for an OL under 10 CFR Part 50 and 10 CFR 52.79(a)(28) for plants applying for a COL under 10 CFR 52.79. Furthermore, 10 CFR 50, Appendix B specifies that inspection and verification activities must be performed to ensure that SSCs are installed in accordance with design documents and that analytical calculations were correctly performed and align with design requirements. If the application is for a CP, the PITAP description can be limited to the Phase 1 inspection, testing, and analysis verification that would be required by 10 CFR 50, Appendix B, along with a description of the scope, objectives and programmatic controls associated with the test program.

For plants applying for a COL via 10 CFR 52.79, but referencing a DC under 10 CFR 52.47 or a design with a ML under 10 CFR 52.157, the PITAP may include the ITAAC associated with the DC or ML (see 10 CFR 52.47(b)(1) and 10 CFR 52.158(a), respectively), or the ITAAC may be

included in a separate document. For COL applicants, the Commission will identify within the COL the inspections, tests, analyses and acceptance criteria per 10 CFR 52.97(b).

Specifically, 10 CFR 52.47(b)(1) requires that a DC application contain:

> *The proposed inspections, tests, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations*.

For MLs, much of the post-construction inspection and testing may be performed at the manufacturer's facility and not at the final site. Regarding MLs, 10 CFR 52.158(a) states, in part, the following:

> *The application must contain:*
> (*a)(1) Inspections, tests, analyses, and acceptance criteria (ITAAC). The proposed inspections, tests, and analyses that the licensee who will be operating the reactor shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met:*
> *(i) The reactor has been manufactured in conformity with the manufacturing license; the provisions of the Act, and the Commission's rules and regulations; and*
> *(ii) The manufactured reactor will be operated in conformity with the approved design and any license authorizing operation of the manufactured reactor.*
> *(2) If the application references a standard design certification, the ITAAC contained in the certified design must apply to those portions of the facility design which are covered by the design certification.*

In addition to the application content guidance in this ISG, the staff may use guidance for the review of PITAP (and ITAAC) content regarding inspection, testing, analysis verification, and acceptance criteria in NUREG-0800, "Standard Review Plan," (SRP) Section 14.3, "Inspections, Tests, Analysis, and Acceptance Criteria." Although the guidance in SRP 14.3 is applicable to light water reactors (LWRs), it may contain insights that are useful for non-LWR application reviews. SRP 14.3 guidance in Appendix C, "Detailed Review Guidance" may only be applicable if the features described are considered within the scope of SR or safety-significant systems covered by this ISG. In addition, the SRP 14.3 guidance pertaining to verification of compliance with general design criteria should instead focus on verification of compliance with the applicants proposed principal design criteria. An applicant may use discretion when developing the format for inspection, test, and analysis verification content as the format guidance in SRP 14.3 is not considered mandatory. It should be noted that the scope of ITAAC is limited to the pre-operational phase prior to initial fuel loading. Guidance regarding PITAP (and ITAAC) for Emergency Planning and Physical Security Hardware is not addressed in this ISG; but guidance for these topics is contained in SRP Sections 14.3.10 and 14.3.12, respectively.

The reviewer should review the completeness of the PITAP information provided with respect to the license, permit, or certification being requested and the guidance provided below. The staff should note that inspection and verification activities performed under an applicant's quality assurance program do not need to be described separately in the PITAP application description.

Rather, the applicant may roadmap documentation of these activities to the quality assurance program elements to facilitate staff review.

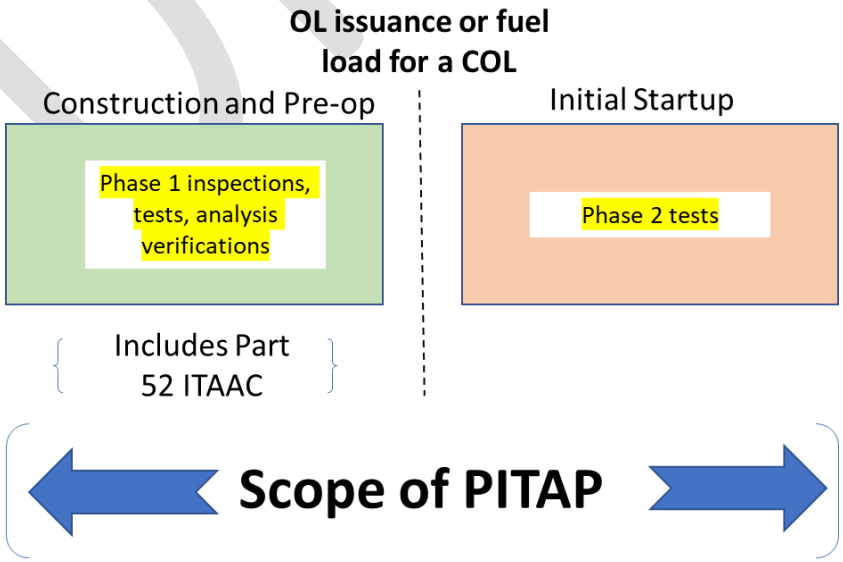
The PITAP is generally divided into two phases: Phase 1 - the preoperational phase (prior to initial fuel loading), and; Phase 2 - initial startup testing (initial fuel loading and initial power ascension). Note that the staff should ensure that all tests identified in the Phase 1 program can be performed prior to loading fuel.

If the application is for a CP, the PITAP description can be limited to the Phase 1 inspection, testing, and analysis verification along with a description of the scope, objectives and programmatic controls associated with the test program. For OL, DC, COL, and ML applications, the application should include a description of the Phase 1 inspection, test and analysis verification programs and Phase 2 test programs along with a description of the scope, objectives and programmatic controls associated with the test programs. The detailed description of the PITAP can be included in the final safety analysis report (FSAR) or in a separate document referenced in the FSAR. Where the activities are addressed by the quality assurance program, an applicant may provide a roadmap from elements in that program to the PITAP elements in lieu of duplicating information.

For each PITAP area described below, the NRC staff should ensure that the application contains acceptance criteria for each inspection, test, and analysis verification, and that those criteria are consistent with the facility's licensing basis. In general, the acceptance criteria should be objective and unambiguous. In some cases, the acceptance criteria may be more general because the detailed supporting information in the safety analysis does not lend itself to concise verification. For example, the acceptance criteria for the design integrity (i.e., functional arrangement) of piping and structures may be that a report "exists" that concludes the design commitments are met. Numeric performance values verifying SSC performance should be included in PITAP acceptance criteria, where applicable.

The NRC staff should ensure that assumptions and insights from key safety and integrated plant safety analyses are adequately verified through inspection, testing or analysis verification.

The figure below illustrates the scope of the PITAP.



A. Phase 1 - Preoperational Inspection, Testing, and Analysis Verification

1. Inspection

Inspect or Inspection mean visual observations, physical examinations, or reviews of records based on visual observation or physical examination that compare the SSC condition to one or more design features described in the safety analysis or other licensing basis document. Examples include walkdowns, configuration checks, measurements of dimensions, or non-destructive examinations. As-built means the physical properties of the SSC following the completion of its installation or construction activities at its final location at the plant site. In cases where it is technically justifiable, determination of physical properties of the as-built SSC may be based on measurements, inspections, or tests that occur prior to installation (e.g., at a ML facility), provided that subsequent fabrication, handling, installation, and testing do not alter the properties.

The NRC staff should verify that the PITAP (or referenced elements of the quality assurance program) includes a post-construction (preoperational) inspection program that addresses verification of the following:

a. Basic configuration and key design features for SR and safety-significant SSCs. This activity includes inspection of the functional arrangement of the as-built safety-significant SSCs described in the safety analysis report.
b. Electrical separation for SR and safety-significant SSCs where required.
c. Materials of construction for SR and safety-significant SSCs per approved design codes and standards (e.g. ASME Code Section III, Section VIII, etc.) .
d. Fabrication, installation, and inspection of SR and safety-significant piping and other components per approved design codes and standards (e.g. ASME Code Section III, Section VIII, etc.).
e. Design reports for the as-built ASME Code Section III piping per approved design codes and standards (e.g. ASME Code Section III, Section VIII, etc.).
f. Completion of design reconciliation for as-built SR and safety-significant components per approved design condes and standards.
g. Accessibility for inservice inspection and inservice testing, where necessary.

2. Testing

Testing means the actuation or operation, or establishment of specified conditions, to evaluate the performance or integrity of as-built SSCs, unless explicitly stated otherwise. Some of these testing activities will involve measurements and/or testing that can only be conducted at the vendor or manufacturer site due to the configuration of equipment or modules or the nature of the test (e.g., measurements of reactor vessel internals). For these specific items where access to the component for inspection or test is impractical after installation in the plant, the test completion documentation (e.g., test or inspection record) will be generated at the vendor site and provided to the licensee. Onsite activities for these testing activities will likely be limited to receipt and placement of the component/module in its final location.

In certain situations, a type test may be performed. A type test means a test on one or more sample components of the same type and manufacturer to qualify other components of that same type and manufacturer. A type test is not necessarily a test of the as-built SSCs. Testing includes functional and hydrostatic tests for the systems. The NRC staff should

verify that the PITAP includes a post-construction (preoperational) testing program for SR and safety-significant SSCs that addresses the following, as applicable:

a. Reactivity Control Functions:
    i. Reactivity control system performance
b. Heat Removal Functions:
    i. Pressure boundary integrity
    ii. Normal heat removal and control system performance
    iii. Residual heat removal system integrity and performance
c. Containment of Radioactive Material:
    i. Functional containment performance
    ii. Radiation and criticality monitoring system performance
    iii. Radioactive waste processing, handling, and storage system performance
d. Testing required by consensus design codes and standards applied in the design (e.g., ASME, IEEE) for items such as pumps, valves, dynamic restraints, electrical equipment, as applicable.
e. Flow induced system vibration and thermal expansion tests.
f. Electrical system performance for normal and emergency power.
g. Equipment identified as necessary for defense-in-depth.
h. Instrumentation and control systems relied upon in the safety analysis to perform SR or safety-significant functions.
i. Fuel handling and storage system performance.
j. Support system performance for SR and safety-significant equipment (e.g., cooling).

3. Analysis

Analysis means a calculation, mathematical computation, or engineering or technical evaluation. Engineering or technical evaluations could include, but are not limited to, comparisons with operating experience or design of similar SSCs. These analyses may include flooding analyses, over-pressure protection, containment analyses, core cooling analyses, fire protection, transient analyses, anticipated transient without scram analyses, steam generator tube rupture analyses, radiological analyses, or other key analyses as may be included in the safety basis documents. The NRC staff should verify that the PITAP (or referenced quality assurance program element) includes a description of where important analysis of SR and safety-significant SSCs should be verified including areas such as:

a. Thermal and hydraulic analysis important to the performance of required safety functions.
b. Seismic analysis
    i. Verification that the seismic Category I equipment can withstand seismic design basis loads without loss of safety function.
    ii. Verification that the as-built seismic Category I equipment, including anchorages, is seismically bounded by the tested or analyzed conditions.
c. Verification that equipment required to be qualified for a harsh environment can withstand the environmental conditions that would exist before, during, and following a design basis event without loss of safety function for the time required to perform the safety function.
d. Critical assumptions from transient and accident analysis including barrier performance and effluent release calculations.

e. For instrumentation and control (I&C) SSCs, analytical limits associated with each key variable, the ranges (normal, abnormal, and accident conditions), and the rates of change for these variables to be accommodated until proper completion of the protective action is ensured.

B. Phase 2 - Initial Startup Testing

1. Testing

The NRC staff should verify that the PITAP includes a post-construction (initial startup) testing program for SR and safety-significant SSCs that addresses the following, as applicable:

a. Initial fuel loading and reactor physics tests:
   i. Initial criticality
   ii. Shutdown margin
   iii. Reactivity control system performance
   iv. Shutdown time
   v. Manual scram function
   vi. Neutron monitoring instrumentation operation and calibration
b. Low power testing:
   i. Reactivity control system worth
   ii. Neutron monitoring instrumentation operation and calibration
   iii. Neutron flux distribution
   iv. Neutron and gamma radiation surveys
   v. Operability of alarms and low power protective features
   vi. Reactivity control system performance
   vii. Shutdown time
c. Power ascension testing:
   i. Reactivity coefficients and power to flow characteristics
   ii. Neutron flux and power distribution
   iii. Reactivity control system influence on power distribution and core design limits
   iv. Reactivity control system performance
   v. Shutdown time
   vi. Reactor coolant system performance
   vii. Flow induced vibration monitoring
   viii. Neutron and gamma radiation surveys
   ix. Neutron monitoring instrumentation and calibration
   x. Operability of alarms and full power protective features
   xi. Plant response to various anticipated operational occurrences (AOOs) (e.g., turbine trip, loss of normal power)
d. Performance of residual heat removal system.
e. Performance of liquid and gaseous waste systems.
f. Performance of first-of-a-kind, inherent or passive safety features.
g. Flow induced vibration and thermal expansion within design limits.

C. General Guidelines

The PITAP should be planned and conducted in an orderly fashion. Accordingly, the NRC staff should ensure that the description of the PITAP in the application addresses the following programmatic items related to the development and conduct of the PITAP:

1. The PITAP objectives, including the objectives of each phase of the program.
2. The scope of each phase of the PITAP.
3. The organization and responsibilities for conduct and control of the inspection and testing program.
4. A general schedule and sequence for conducting the inspections and tests, including established hold points.
5. The extent to which the test program will use plant operating, emergency and surveillance procedures and technical specifications.
6. The plan for interfacing PITAP activities with other ongoing activities so as to coordinate and avoid interferences.
7. The prerequisites which must be in place prior to conducting each inspection and test, including implementation of the technical specifications (Phase 2 tests only).
8. The information to be measured during each inspection and test.
9. The description for each inspection, test, and analysis verification should include the acceptance criteria that define the performance, physical condition or analysis results that must be demonstrated to confirm the design characteristics and features perform consistent with the design.
10. Where modifications have been made to SSCs, re-inspection and retesting should be conducted, as necessary.
11. The conditions which would cause the test to be terminated prematurely.
12. The review process and documentation to be applied for each inspection and test, including verification that any retesting has been satisfactorily completed.
13. The review process and bases for concluding the PITAP inspection, test, analysis verification results support safe operation of the plant.
14. Requirements for validation of analytical codes that may be applicable to the test.

Once completion of pre-operational inspection, test, or analysis verification and the supporting design information demonstrates that a system has been properly constructed, it then becomes the function of other programs such as the quality assurance program and configuration management program to ensure that the system is not modified and remains in accordance with the approved design through license issuance.

D. Guidelines for Testing

In addition, the NRC staff should ensure that the application includes a general description for each test, or group of similar tests (i.e., test abstract), to be conducted. The focus of the test descriptions should be on providing the bases for the tests and test conditions selected, instrumentation to be used, and a description of how the tests will confirm the performance of the SSCs. The PITAP development should also take into consideration PITAP experience at other similar facilities and include measures to avoid problems they have had.

Although guidance provided in RG 1.68, *Initial Test Programs For Water-Cooled Nuclear Power Plants*, is specific to water-cooled reactors, applicants may use this RG to gain insights that could inform the development of initial test programs for advanced reactors.

In general, each test should directly, or indirectly through analysis, confirm SSC performance over the full range of operating conditions (normal operation, AOOs, design basis events (DBEs), design basis accidents (DBAs) and beyond design basis event (BDBE) conditions) over the plant lifetime. In addition, the performance of other SSCs containing radioactive material (e.g., spent fuel storage) should be confirmed in the PITAP. Risk insights from the plant's

probabilistic risk assessment (PRA) and safety analysis should be used to identify the specific systems and components, test objectives, test conditions and test parameters selected so as to test the risk-significant equipment and conditions. Thus, a graded approach to testing can be applied provided the test program provides reasonable assurance the SR and safety-significant SSCs will perform satisfactorily. In addition, the test program should be sequenced and structured so that plant safety is never entirely dependent upon untested SSCs or temporary plant equipment.

The test program should ensure that tests are not initiated until there is verification that all applicable prerequisites for the test have been completed or are in place. The test sequence should be established to ensure that testing is completed, and operability confirmed on systems and equipment needed to support future testing.

Approved test procedures should be in a form suitable for review by regulatory inspectors at least 60 days prior to their intended use or at least 60 days prior to fuel loading for fuel loading and startup test procedures. Applicants/licensees should provide timely notification to the NRC of changes in approved test procedures that have been made available for NRC review.

E. General Responsibilities

The NRC staff should ensure that the application describes the responsibilities and guidelines for conduct of the PITAP. In general, the applicant is responsible for all aspects of the PITAP, although other parties (e.g., vendors) may conduct some of the testing. The applicant's responsibilities include:

1. Defining the qualifications of the personnel managing, conducting, and reviewing the inspection, test, and analysis verification program results.
2. Using contractor or vendor personnel, as appropriate.
3. Providing training as necessary to ensure that personnel are ready to perform their functions.
4. Developing the testing objectives, schedule, sequence, prerequisites, procedures safety precautions and acceptance criteria.
5. Managing, controlling, and approving key aspects (e.g., prerequisites, procedures) of the test program.
6. Establishing a plant review committee to review, evaluate, and disposition the inspection, test, and analysis verification results.
7. Coordination with other elements of the plant organization (e.g., engineering, design, operations), as necessary, in planning, conducting, and reviewing inspection, test, and analysis verification results.
8. Preparation, approval, and retention of test reports.
9. The tests should be conducted using detailed procedures approved by managers in the applicant's startup test program organization.
10. The personnel conducting the tests (including contractors, vendors, or others) having the appropriate training, experience and education determined necessary by management.

F. Acceptance Criteria

In reviewing the application, the NRC staff needs to have reasonable assurance that the requirements to conduct an PITAP, as stated in 10 CFR 50.34(b)(6)(iii), 10 CFR 52.47(b)(1), and 10 CFR 52.79(a)(28) are met for the design and technology under review. This

determination should be based on whether the information provided in the application is sufficient to conclude:

1. The Phase 1 inspection, testing, and analysis verification program (including elements of the quality assurance program as applicable) includes all SR and safety-significant SSCs that can reasonably be verified at the preoperational stage.
2. Acceptance criteria are provided for each inspection, test, and analysis verification and they are consistent with the safety analysis and technical specifications.
3. The Phase 2 test program includes all SR and safety-significant SSCs that were not tested in Phase 1.
4. The applicant's responsibilities are clearly described.
5. The description in the application covers all of the overarching items listed previously for developing the PITAP, or deviations are justified.
6. Risk insights have been used to select the most important parameters to be inspected and measured.
7. First-of-a-kind SSCs and inherent/passive safety features are identified and included in the inspection, test, and analysis verification program.
8. Applications for a COL, DC, or ML include the ITAAC either as a standalone document or as part of the PITAP.
9. The parameters to be measured in the test program are sufficient to determine, directly or through analysis, the SSC performs as designed.
10. Information sufficient to validate the analytical assumptions, limits, and models will be collected.
11. The applicant's process for reviewing inspection, testing, and analysis verification results and determining the acceptability of the results or requiring a modification and re-inspection/re-test/re-verification, are clearly described and reasonable.

With positive answers to the above items, it can be concluded that the performance of each SR and safety-significant feature of the design has been demonstrated and sufficient data exists to assess the analytical tools used in the safety analysis. Thus, there is reasonable assurance that the PITAP is in compliance with the applicable regulations for a CP, OL, COL, DC, or ML.

IMPLEMENTATION

The NRC staff will use the information discussed in this ISG in performing safety evaluations of license applications submitted under 10 CFR 50 or 52 (or later for 53).

[Identify how the information will facilitate staff review of license amendments, license renewal applications, etc.]

BACKFITTING AND ISSUE FINALITY DISCUSSION

[OGC provides this discussion, but the staff can propose text for OGC consideration].

Example: The NRC staff issuance of this ISG is not considered backfitting as defined in 10 CFR 50.109(a)(1), nor is it deemed to be in conflict with any of the issue finality provisions in 10 CFR Part 52.

CONGRESSIONAL REVIEW ACT

[OGC provides this discussion to support issuance of the final ISG. However, the staff can propose text for OGC consideration].

Example: This ISG is a rule as defined in the Congressional Review Act (5 U.S.C. §§ 801-808). However, the Office of Management and Budget has not found it to be a major rule as defined in the Congressional Review Act.

FINAL RESOLUTION

By [insert date], this information will be transitioned into [identify the appropriate regulatory process (Standard Review Plan (SRP), Regulatory Guide (RG))]. Following the transition of this guidance to the [SRP, RG], this ISG will be closed.

APPENDIX

A. Resolution of Public Comments

APPENDIX A

Resolution of Public Comments

A notice of opportunity for public comment on this Interim Staff Guidance (ISG) was published in the *Federal Register* (*insert FR Citation #)* on [date] for a 30-60 day comment period. [Insert number of commenters] provided comments which were considered before issuance of this ISG in final form.

Comments on this ISG are available electronically at the NRC's electronic Reading Room at http://www.nrc.gov/reading-rm/adams.html. From this page, the public can gain entry into ADAMS, which provides text and image files of NRC's public documents. Comments were received from the following individuals or groups:

Letter No.	ADAMS No.	Commenter Affiliation	Commenter Name	Abbreviation
1				
2				
3				
4				
5				

The comments and the staff responses are provided below.

Comment 1: [Each comment summary must clearly identify the entity that submitted the comment and the comment itself].

NRC Response: Comment responses should begin with a direct statement of the NRC staff's position on a comment, e.g., "the NRC staff agrees with the comment" or the "NRC staff disagrees with the comment".

- If the NRC staff agrees, explain why and provide a clear statement as to how the relevant language was revised or supplemented to address the comment. Include the following language at the end of the comment response: "The final ISG was changed by <*describe the change; if necessary by quoting the newly revised language*>."
- If the NRC disagrees with a comment and no change was made to the generic communication, then explain why and provide the following language at the end of the comment response: "No change was made to the final ISG as a result of this comment."

APPENDIX B

References