INSPECTION PROCEDURE 71007

REACTOR VESSEL HEAD REPLACEMENT INSPECTION

PROGRAM APPLICABILITY: 2515

71007-01 INSPECTION OBJECTIVES

01.01 To verify that engineering evaluations and design changes associated with reactor vessel (RV) head replacement are completed in conformance with requirements in the facility license, the applicable codes and standards, licensing commitments, and the regulations.

01.02 To verify that the manufacture and fabrication of the RV head are completed in conformance with applicable codes and standards and design requirements. That all dimensions and related tolerances for the RV head including openings in it are in accordance with design drawings.

01.03 To verify that RV head removal and replacement activities maintain adequate nuclear and radiological safety.

01.04 To verify that the RV head post-installation test program is adequate, in conformance with requirements, and satisfactorily implemented.

71007-02 INSPECTION REQUIREMENTS

02.01 Inspection Scoping. Develop a site-specific inspection plan to select and review the safety-related activities associated with the major phases of the RV head replacement project (RVHRP).

a. A typical RVHRP involves four major phases: design and planning, RV head fabrication, RV head removal and replacement, and post-installation verification and testing. The RVHRP includes the provision of a temporary containment access opening. Refer to Appendix B of this procedure for additional guidance.

b. The inspector(s) should contact the NRR project manager to obtain any specific technical support from NRR.

c. During inspection preparation, review the processes for RVHRP and plans for identifying, tracking, and resolving problems related to RVHRP to ascertain that they are consistent with plant processes.

d. This procedure lists certain baseline inspection procedures mainly in Sections 02.02 and 03.02 to be used to perform parts of the inspection effort. The scope and depth of the inspection of these parts and the inspection hours credited to the baseline inspections should be in accordance with the guidance in this procedure. Inspection planning for the baseline inspections should take into account the extended schedule for the RVHRP and the prudent management of baseline inspection hours.

NOTE: Those requirements with an asterisk are the most significant ones that need to be performed and confirmed. The NRC inspector should as a minimum perform these requirements or verify the Authorized Nuclear Inspector has performed them.

02.02 Design and Planning Inspections. Conduct RV head design and planning inspections in accordance with the inspection plan by performing selective inspections, consistent with the safety significance and inspection resources, of the following areas:

a. Conduct RV head replacement engineering and technical support inspections in accordance with the inspection plan by performing selective inspections that will:

    1. Verify that selected design changes and modifications to systems, structures, and components (SSCs) described in the Final Safety Analysis Report (FSAR) for transporting the new and old RV heads in and out of the plant respectively are reviewed in accordance with 10 CFR 50.59. Use procedure IP 71111.02 as guidance.

    2. Review key design aspects and modifications for the replacement RV head and other modifications associated with RV head replacement utilizing IP 71111.17 and IP 7111.23 as guidance. Where applicable, include design reviews for the provision of a temporary containment opening.

b. Review the applicable engineering design, modification, and analysis associated with RV head lifting and rigging including: (1) crane and rigging equipment, (2) RV head component drop analysis, (3) safe load paths, and (4) lay-down areas. The inspection should focus on the impact of load handling activities on reactor core or spent fuel and its cooling and plant support systems for the reactor unit and common systems for the other operating unit(s) at the site.

c. Review radiation protection program controls, planning, and preparation in the following areas utilizing applicable portions of the baseline inspection procedures IP 71121.01 and 71121.02 as guidance:

    1. As Low As Reasonably Achievable (ALARA) planning.

    2. Dose estimates and dose tracking.

    3. Exposure controls including temporary shielding.

    4. Contamination controls.

    5. Radioactive material management.

6. Radiological work plans and controls.

7. Emergency contingencies.

8. Project staffing and training plans.

d. Review RVHRP activities in the following areas:

1. Security considerations associated with vital and protected area barriers that may be affected during replacement activities.

2. Where applicable at multi-unit sites, the controls and plans to minimize any adverse impact on the operating unit(s) and common systems.

02.03 RV Head Fabrication Inspections at Vendor Facility

* a. Verify that material heat treatment which is used to enhance the mechanical properties of carbon, low alloy, and, high alloy chromium (Series 4XX) steels is conducted in accordance with approved vendor procedures or instructions.

b. Verify that procedures for obtaining test coupons from castings are consistent with paragraph NB 2226 of ASME Section III (Reference 5).

c. Verify that adequate heat treatment procedures are available to assure that applicable code and/or contract requirements are met for the following:

1. Furnace atmosphere.
2. Furnace temperature distribution, calibration of measuring and recording devices.
3. Thermocouple installation on parts to be (Numbers, locations, method of attachment).
4. Heating and cooling rates.
5. Quenching methods including quenching medium, maximum transfer time.
* 6. Record and documentation requirements.

d. Verify that personnel training, indoctrination and/or certification requirements have been established for heat treating, special processes, casting and forging, and for machining operations.

e. Observe heat treating operations in progress. Verify that approved procedures are available at work stations and that these procedures are followed. Specifically, review the control of process variables itemized in paragraph.

f. Verify that procedures have been established for controlling and implementing casting and forging operations with heat traceability throughout the manufacturing process.

g. Verify that the requirements exist for identifying what manufacturing functions are special processes and for qualifying the implementing procedures by determining if the processes are fully functional.

h. Verify that a system has been established and implemented for documentation of work performance (including required verification and testing) when special processes are used in manufacturing.

i. Examine the performance of selected special processes as required. Verify that qualified procedures are being followed and that the work is performed by personnel trained and certified in accordance with the manufacturers QA program requirements.

* j. Verify that the manufacturing or process control plan includes provisions for nondestructive examination in accordance with applicable code, material specification, and contract requirements.

k. Verify that provisions have been established for segregation of nonconforming materials and parts.

* l. Verify that welding operations to establish a layer of stainless steel on inside of RV head are done per specifications and design drawings.

* m. The inspectors will select a sample of dome to flange welds and CRDM flange-to-nozzles welds, and review the following:

1. Certified Mill Test Reports (CMTRs) of the dome, flange, weld rods, and CRDM nozzles.

2. CMTRs for the welding material for the RPV head cladding.

3. Cladding weld records, weld rod material control requisitions, traceability of weld rods, weld procedure qualification, welder qualifications, and non-conformance reports.

4. CRDM nozzle cladding welding inspection records, weld rod material control requisitions, traceability of weld rods, weld procedure qualification, welder qualifications, and non-conformance reports.

5. CRDM-to-nozzle welds records-welding and weld inspections, weld rod material control requisitions, traceability of weld rod, weld procedure qualification, welder qualifications, and non-conformance reports.

6. NDE procedures, NDE records of the welds, NDE personnel qualifications, certification of the NDE solvents that they did not contain deleterious substances such as mercury and corrosive chemicals.

* n. Verify that repair procedures have been established and that these procedures are consistent with applicable ASME Code, material specification, and contract requirements. Specifically, verify that:

1. Repair welding is conducted in accordance with procedures qualified to Section IX of the ASME Code (Reference 6).

2. All welders have been qualified in accordance with Section IX of the Code.

3. Records of the repair are maintained in accordance with applicable code and contract requirements.

* o. Verify that requirements have been established for the preparation of certified material test reports and that the records of all required examinations and tests are traceable by travelers to procedures and revisions to which they were performed.

* p. Verify the required documents, supplemental examinations, analyses, and ASME Code reconciliation to ensure the original ASME Code N-stamp documentation remains valid, and that the replacement head complies with appropriate NRC rues and industry requirements.

q. Inspect the RV head and verify proper identification and conformance to specification requirements within the limits of visual examination. Particular emphasis shall be given to surface condition and geometry such as body contour, weld ends, and fillets at intersection of pressure boundary surfaces. If applicable, verify that minimum wall thickness has been determined and meets equipment specification requirements.

* r. Verify that the Design Specification is reconciled or updated and a Design Report is prepared for the reconciliation of the replacement head. Both Design Specification and Report should be certified by professional engineers competent in ASME Code requirements.

* s. Verify that machining is carried out under a controlled system of operation (travelers, check lists) consistent with the manufacturers overall QA program.

* t. Verify that drawing/document control system is in use at the shop floor and is consistent with the manufacturers QA program. Verify that only the specified drawing and document revisions are available on the shop floor and are being used.

u. Verify that in-process changes at the shop floor level are being handled in accordance with established and approved procedures consistent with the manufacturers QA program.

* v. Verify that part identification and traceability is maintained throughout processing to the extent required by the manufacturers QA program and applicable contract requirements.

* w. Verify that the original ASME Code, Section III data packages for the replacement head are supplemented by documents included in the ASME Code Section XI (pre-service inspection) data packages.

x. Verify that in-process and final inspections are conducted in accordance with production plan requirements, that acceptance/rejection criteria have been established and personnel responsible for inspection have been identified.

y. Verify that provisions have been established to identify rejected items and removal of these items from the process flow.

z. Verify that procedures have been established for resolving nonconforming items and that these procedures are being implemented on the shop floor.

aa. Verify that procedures for repair and acceptance standards for rejected items have been established.

ab. Verify that gages and measuring devices on the shop floor which are used for determining acceptability of the product are under control of an established gage calibration system.

ac. Verify that adequate procedures are available and are being followed for protection of finish-machined surfaces and for prevention of damage to finished parts and components during handling and transfer.

ad. Verify that new and unique processes for metal removal such as electrical discharge machining (EDM) or chemical milling are evaluated and qualified before using them in production.

ae. Verify that use of cutting fluids is controlled and that precautions are taken to minimize contamination of austenitic stainless steels and high nickel alloys with halogen or sulfur-containing oils.

af. Verify that approved cleaning and degreasing procedures are available and are being followed.

ag. Observe selected machining operations. Verify that required tooling as well as cutting speed and feed rates are specified and followed.

ah. Examine representative sampling of finish-machined parts of RV head. Verify proper identification and conformance to specification and drawing requirements within limits of visual inspection. Verify that step changes in diameters of shafts and other section transitions are blended to specified radii and that the specified surface finish is achieved on critical areas such as sealing surfaces. If questionable, ask for measurement.

* ai. Examine selected manufacturing and inspection records of finished machined RV head and verify compliance with applicable documentation requirements.

02.04 RV Head Removal and Replacement Inspections. Conduct RV head removal and replacement inspections in accordance with the inspection plan by performing selective inspections, consistent with the safety significance and inspection resources, of the following areas:

a. Review activities associated with lifting and rigging including, preparations and procedures for rigging and heavy lifting including any required crane and rigging inspections, testing, equipment modifications, lay-down area preparations, and training.

b. Inspect major structural modifications, if any, that are performed to facilitate RV head replacement.

* c. Inspect the activities associated with containment access and, where applicable, restoration of temporary containment opening and containment leakage testing.

d. Inspect the following activities throughout the process as appropriate:

1. Establishment of operating conditions including defueling, RCS draindown, and system isolation and safety tagging/blocking.

2. Implementation of radiation protection controls.

3. Inspect controls for excluding foreign materials in the reactor vessel.

4. Installation, use, and removal of temporary services directly related to the activities identified in this procedure.

* e. Review radiological safety plans for temporary storage or disposal of the old RV head.

02.05 Post-installation Verification and Testing Inspections. Conduct RV head post-installation verification and testing inspections in accordance with the inspection plan. Perform selective inspections, consistent with the safety significance and inspection resources, of the following areas:

* a. Containment testing, as applicable.

b. The licensee's post-installation inspections and verifications program and its implementation.

* c. The conduct of RCS leakage testing and review the test results.

d. The procedures for equipment performance testing required to confirm the design and to establish baseline measurements and the conduct of testing.

* e. Preservice inspection of new welds.

71007-03 INSPECTION GUIDANCE

General Guidance

Comprehensive NRC inspection of RV replacement activities involves coordination of inspections to review engineering, safety assessment, welding, NDE, quality assurance, radiation protection, security, and testing.

The RV head replacement should be accomplished under 10 CFR 50.59. Licensees should begin interacting with the regions and NRR technical branches possibly two or more years before the scheduled replacement and prior to contracting a vendor for RV head fabrication. Any engineering reviews by NRR to support inspections should be coordinated through the NRR project manager.

All inspections of RV head replacement activities should be performed per this procedure

and integrated into the regional site-specific inspection plan.

The site-specific inspection plan should include the applicable inspection requirements outlined in Section 02. The emphasis on inspection activities should be based on the overall scope, the safety significance of the activities, the licensee's historical performance in that area, and industry experience. Additional emphasis may be considered for those activities that include new or different management controls or involve new techniques.

Additional guidance for specific inspections should be derived from inspection procedures relative to the area being examined. Those procedures include, but are not limited to, the procedures listed in Appendix A of this procedure..

Specific Guidance

03.01 Inspection Scoping

a. The licensee's design and planning phase may begin several years before replacement. Contracts for RV head fabrication have been issued three or more years before replacement. The licensee may install temporary or permanent modifications to transport the old and new RV heads through the plants well in advance of the selected outage. Significant design work and outage planning may be complete a year before the outage. The inspection should focus on RVHRP activities that verify proper restoration of pressure boundaries of the reactor coolant system (RCS), and containment systems, exclusion of foreign materials, and plant modifications that could affect plant risk during subsequent plant operation.

b. No guidance

c. No guidance

d. An early review of the licensee's RVHRP scope and schedule will provide advance opportunity to identify special inspection needs and plan the design and planning phase inspections. For the modifications installed prior to the outage, inspection before the outage is recommended. About a year before the selected outage, the licensee's outage scope and schedule should be detailed enough to develop the inspection plan for review of onsite work. Inspection planning has typically been performed by a region-based inspector with input from the resident inspector.

03.02 Design and Planning Inspections

a. The inspection plan should integrate the required design and planning inspections.

1. 10 CFR 50.59 evaluations and screening for such evaluations for selected modifications related to RVHRP should be reviewed using IP 71111.02 "Evaluation of Changes, Tests, or Experiments."

2. Inspection samples of permanent and temporary plant modifications for the RVHRP should be selected and reviewed as a part of the baseline inspection using IP 71111.17, "Permanent Plant Modifications," and IP 71111.23, "Temporary Plant Modifications."

The inspection should verify that (1) key RV head design aspects such as those listed below, and RV head modifications, and the designs of other related significant modifications are reviewed and approved in accordance with procedures and (2) replacement materials and components meet the appropriate design technical requirements. Those technical requirements include the applicable codes and standards, NRC requirements, and other commitments made by the licensee in the FSAR.

The inspection should review design attributes similar to those outlined in IP 71111.17.

The following list illustrates typical topics that may need to be reviewed:

- The general design for removal and reinstallation of the RV heads and related components.

- If needed, the design and analysis for the creation of a temporary containment opening for RV head replacement and its restoration - design reviews should be coordinated with the Mechanical and Civil Engineering Branch, NRR, via the Project Manager, to confirm the restored design margin - see Appendix B of this procedure for additional information.

- Adherence to and reconciliation of code requirements.

- Compliance with regulatory requirements including the incorporation of inservice inspection requirements of 10 CFR 50.55a (g).

b. Several heavy lifting evolutions are expected. While the radiological consequences of a heavy load drop are expected to be small with the core defueled, a dropped component could result in an unwarranted radioactive release and severe damage to equipment needed for reactor or radiological safety.

The licensee's plans and analysis for lifting and rigging of heavy loads are reviewed to verify that the safe load path analysis for component removal and reinstallation is technically sound. The inspection should focus on the impact of heavy load lifting operations on spent fuel and its cooling, support systems for the reactor, and common support systems for the other operating reactor unit(s) at the site.

The component drop analysis should be reviewed to verify, in general, that the potential offsite releases at the exclusion area boundary are within 10 CFR Part 100 limits and equipment to maintain safe shutdown will be unaffected.

Additional information on lifting heavy loads is available in Generic Letter 81-07, "Control of Heavy Loads," and NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants."

c. Specific guidance for radiation protection inspections is provided in IP 71121.01 and IP 71121.02.

The inspection should audit the licensee's outage radiation protection program and confirm that radiological concerns are factored into RVHRP planning. When applicable, review of radiological concerns associated with the establishment and restoration of a temporary containment opening should be included.

Training for the large RVHRP work force should be geared toward the specifics of RV head removal/replacement for both the radiation workers and radiation protection personnel. Review of planning for radioactive materials management should be considered due to the need for temporary storage of reusable equipment and the handling of the increased volumes of waste generated in a short time period. Efficient removal of materials from the work area improves housekeeping and reduces fire hazards. Emergency contingencies such as actions for a dropped component and the plans for closure of the containment (including temporary openings) in a high airborne condition should be reviewed.

d. Security boundaries may be affected during the RVHRP. The impact of the work on the boundaries and the licensee's contingency plans should be reviewed to verify conformance with the security plan.

03.03 RV Head Fabrication Inspections at Vendor Facility

a. No guidance

b. The code paragraph references given in Section II of this procedure are based on the 1974 edition of the ASME Code. It is recognized that other code editions may apply to in-process, work being reviewed under this procedure. It is also recognized that special heat treatment requirements may be contained in the equipment specifications or procurement documents for the parts of materials under review. The inspector is responsible for determining the applicable construction standards and developing specific evaluation criteria for such situations.

c. No guidance

d. No guidance

e. No guidance

* f. Heat traceability is required since it is the most practical method for assuring material identification.

g. For the purposes of this procedure, special processes can be defined as metallurgical, chemical, mechanical or other processes which may produce significant changes in the properties or characteristics of the product and where assurance of satisfactory results is largely dependent on the use of qualified procedures, personnel and equipment. In most applications of special processes the assurance of quality can not be obtained by direct inspection of the in-process activity or final product.

h. No guidance

i. Criterion IX of Appendix B includes welding, heat treating and nondestructive testing as special processes. Examples of special processes are the following:

1. Chemical cleaning
2. Etching, pickling or passivating
3. Vapor degreasing
4. Electroplating
5. Anodizing
6. Painting, coating, or surface conditioning
7. Shot-peening
8. Sand or shot blasting
9. Special metal removal techniques (Example: Elox, EDM)

j. The processes reviewed under this procedure should be controlled to same extent as are all activities of component manufacturers (holders of N-stamp symbols and certificates of authorization. Close adherence to established processing variables such as maximum and minimum forging temperature limits for specific material grades, uniform temperature distribution during soaking treatments, metal pouring temperature, etc., are important in achieving the desired mechanical properties, material homogeneity and soundness. Exceeding established process parameters can cause material defects which will not be remedied during subsequent operations and which may be difficult to detect by mechanical and nondestructive testing.

* k. The inspector is expected to perform a thorough review of applicable material or equipment specifications, procurement documents, and the manufacturers process qualification data to form additional bases for his evaluation.

l. No guidance

m. No guidance

n. No guidance

o. No guidance

* p. The ASME Code does not specifically address control of machining operations or establish special requirements in his area. It is intended, however, that the manufacturer performing machining operate under a controlled fabrication system which complies with the requirements of NA 4000. Non-code machine shops should operate under a system which meets the requirements of 10 CFR 50 Appendix B for their particular scope of activities.

q. No guidance

r. No guidance

s. No guidance

t. No guidance

u. No guidance

v. No guidance

w. No guidance

x. No guidance

y. The recommended areas of inspection can be expanded to include the requirements from other inspection procedures.

z. No guidance

aa. No guidance

ab. No guidance

ac. No guidance

ad. It is emphasized that poor machining practices can have a significant effect on performance and life expectancy of parts and components. Abusive machining such as the use of excessive feed rates or improper or dull tooling for example can significantly degrade surface integrity and cause accelerated fatigue failure or stress corrosion attack.

ae. Similarly, inadequate radii or sharp corners can cause high stress concentrations resulting iii premature failures.

af. The inspector is expected to perform a review of applicable material and equipment specifications, procurement documents and the manufacturers process qualification data, as applicable to form additional bases for his evaluation.

03.04 RV Head Removal and Replacement Inspections

a. Some cutting, machining, and welding activities may be performed during the RV replacement outages. Several procedures are listed in Appendix A to this procedure that contain useful guidance for welding inspections.

Training and qualifications of licensee and contract quality control/assurance inspectors, and NDE examiners are reviewed to verify personnel meet site and code qualification requirements and are prepared for the site specific tasks. In the past, mockups have been used for qualifying welding procedures and training and qualifying welders, machinists, and NDE inspectors.

For the selected welds review weld procedures and welder qualification records, confirm that the Code required essential and supplemental essential welding variables for the welding processes used were met, and verify that preservice NDE requirements were completed. Also, review the non-conformance reports for each major steam generator replacement weld to confirm that welding deficiencies were dispositioned in accordance with Code requirements.

b. No specific guidance.

c. The inspection should verify that modifications to walls and other structures and removal and restoration of component supports are documented.

d. A temporary containment opening may need to be established to allow for the movement of RV components. The inspections should verify that the procedures and methods used to enlarge and restore the containment access ensure that the design assumptions and requirements are satisfied and that the containment is restored to at least its required strength and integrity criteria. Post restoration testing should demonstrate that the containment has been properly restored. See Appendix B of this procedure for additional information.

e. Implementation of controls for personnel access to radiologically controlled work areas, surveillance of work activities, and procedure adherence should be verified. Reviews should be made of the implementation of ALARA, radiological exposure, contamination, and airborne contamination controls planned for cutting, welding, and other activities including contaminated interference removal. Also, implementation of any special controls for contaminated tools and waste should be reviewed. Where applicable, controls for shielding installations should consider the effects of additional weight loads on equipment.

   If a temporary containment opening is established, the method of disposal of any concrete debris may be considered. While much of this material is not expected to be contaminated, consideration should be given to any activation materials including hard to detect isotopes such as H-3 and Fe-55.

   Review licensee's evaluations of adverse impact of temporary services (electrical power, structural supports, and systems) on plant equipment and systems important safety.

f. If the retired RV head is stored on site, the storage facility should be reviewed to verify that access is properly controlled and dose rates at the perimeter are below applicable limits. For additional information, refer to Generic Letter 81-38, "Storage of Low-Level Radioactive Wastes at Power Reactor Sites."

03.05 Post-installation Verification and Testing Inspections. The inspection should review the licensee's post-installation verification and testing program to verify that modifications are completed in accordance with the design; that drawings, procedures, and training have been updated as appropriate; that post-installation walkdowns and inspections are performed to ensure equipment is restored and temporary services are removed; that equipment cleanliness has been verified; that pre-service inspection of welds to establish baseline data are performed; and that deficiencies are properly dispositioned. Verify that changes in performance of the RV head and in its associated parameters, such as flow rates, pressures, and temperatures are appropriately included in design documents and plant procedures. In addition to reviewing the licensee's program to verify restoration, the inspector may perform independent walkdowns to confirm equipment restoration.

If a temporary containment opening was established for RV replacement, refer to Appendix B of this procedure for additional guidance on testing following restoration.

Direct inspection of portions of the primary and secondary leakage tests and visual examinations and review of the test results should be performed. The inspection should verify that testing satisfies ASME Code and applicable regulatory requirements, that testing was conducted according to the procedure, and that results were satisfactory or properly resolved.

Section 02.04 of Inspection Procedure 93803 contains additional inspection guidance for testing inspections.

71007-04 INSPECTION RESOURCES

The required number of direct inspection hours per RVHRP plant will vary significantly based on a number of factors such as licensee experience, contractor experience, and the variable complexities of the given RV replacement. The scope and depth of the inspections should be sufficient to provide the desired level of assurance that the licensee adequately performs activities important to safety and that the relevant codes, standards, requirements, and commitments are met. The total resources required for RVHRP inspection using IP 71007 is estimated to be 350 direct inspection hours. It is expected that portions of the inspections in this procedure can be credited towards satisfying baseline inspections, such as IPs 71121.01, 71121.02, 71111.02, 71111.17, and 71111.23. Approximately 140 hours at a single unit station and 110 hours per unit at a multi-unit site are expected to be credited towards baseline inspections. Inspection of the establishment/restoration of a temporary containment opening will require additional inspection effort.

71007-05 REFERENCES

Generic Letter 81-07, "Control of Heavy Loads" (Microfiche locations 7964/024, 7900/310, and 90191/292)

NUREG-0612 "Control of Heavy Loads at Nuclear Power Plants" (Microfiche location 6411/280)

Generic Letter 81-38, "Storage of Low-Level Radioactive Wastes at Power Reactor Sites" (Microfiche location 10848-343)

Regulatory Guide 1.136, Revision 2, "Materials, Construction, and Testing of Concrete Containments" (Microfiche location 09162-003)

ASME Boiler & Pressure Vessel Code, Section III, xxxx Addition up to & including xxxx Addenda.

ASME Boiler & Pressure Vessel Code, Section XI, xxxx Addition up to & including xxxx Addenda.

END

Appendices:

A. Applicable Inspection Procedures
B. Temporary Containment Opening Review Guidance

APPENDIX A

APPLICABLE INSPECTION PROCEDURES

Inspection Procedure No.	Inspection Procedure Title
71111.02	Evaluation of Changes, Tests, or Experiments
71111.17	Permanent Plant Modifications
71111.23	Temporary Plant Modifications
71121.01	Access Control to Radiologically Significant Areas
71121.02	ALARA Planning and Controls
55050	Nuclear Welding General Inspection Procedure
55100	Structural Welding General Inspection Procedure
57050	Nondestructive Examination Procedure Visual Examination Procedure Review/Work Observation/Record Review
57060	Nondestructive Examination Procedure Liquid Penetrant Examination Procedure Review/Work Observation/Record Review
57070	Nondestructive Examination Procedure Magnetic Particle Examination Procedure Review/Work Observation/Record Review
57080	Nondestructive Examination Procedure Ultrasonic Examination Procedure Review/Work Observation/Record Review
57090	Nondestructive Examination Procedure Radiographic Examination Procedure Review/Work Observation/Record Review
70370	Testing Piping Support and Restraint Systems
81064	Compensatory Measures
	Containment Inspections**
70307	Containment Integrated Leak Rate Test - Procedure Review
70313	Containment Integrated Leak Rate Test
70323	Containment Leak Rate Test Results Evaluation

** May only be applicable when the containment access has been enlarged.

END

APPENDIX B

TEMPORARY CONTAINMENT OPENING REVIEW GUIDANCE

A. OBJECTIVE

This appendix provides additional guidance for inspection of activities associated with establishing a temporary containment opening in the containment shell for Reactor Vessel (RV) head replacement and its subsequent restoration.

B. BACKGROUND

To replace the RV head in containments that have small equipment hatches, some licensees have chosen to replace the RV head in one piece through a temporary transfer opening cut through the containment instead of disassembling the RV and transporting its sections and components through the equipment hatch. On the basis of time and radiological considerations, this approach has generally been preferable. After completion of the RV head replacement, the opening is closed, the containment structure is restored to its original configuration and integrity, and structural integrity testing is performed. Cutting the temporary opening and closing it, may be carried out without NRC's approval under the provisions of 10 CFR 50.59, provided the process does involve licensee amendment. However, since this process involves construction activities for the most important safety-related structure in a nuclear power plant, quality assurance and quality control practices should be strictly followed, and the restoration of the containment should be inspected by NRC.

C. GUIDANCE

GENERAL

This appendix is intended to augment the existing inspection guidance in this procedure to identify regulatory concerns and licensee activities associated with cutting and closing a temporary containment opening. Some of the discussion below may overlap previous guidance and is only provided for clarity.

NRC inspection emphasis should be on verification that the containment is restored to its original integrity after closure of the temporary opening. Because actions related to cutting and restoring a temporary opening in a prestressed concrete containment encompass issues concerning reinforced concrete and steel containments, issues related to prestressed concrete containments are used as the basis for this appendix. Therefore, some items discussed below may not apply to all containment designs.

Construction as used herein is an all-inclusive term that covers materials, design, fabrication, installation, examination, and testing. The licensee should prepare specifications covering all aspects of the construction of the temporary opening as discussed in the following sections.

REGULATORY CONCERNS

In a prestressed concrete containment, the components that are cut and replaced include

concrete, reinforcing bars, tendon sheathing, and the steel liner. The tendons, together with the grease in the sheathings that pass through the opening area, are removed before the opening is cut. The tendons may be reused in the restoration. The concerns are as follows:

1. The steel liner plate may be torch-cut and reused. During reinstallation, the gap around the liner plate for welding may not be as uniform as it would be for new plates. The uniformity of the gap is dependant upon how skillfully the plate was initially torch-cut. The strength of the replacement welds may not be the same as the uncut plate, but it should be very similar to the strength of the weld joints in the original structure.

2. The creep and shrinkage of the concrete used to close the opening, which is usually high for newly poured concrete, could result in higher compressive strain in the concrete adjacent to the repaired opening as a result of prestressing and may cause liner buckling.

3. The creep and relaxation of reused tendons could cause the loss of prestress as a result of tensioning and detensioning.

4. The leak tightness of the tendon sheathing may be compromised as a result of withdrawing and re-inserting the tendons, resulting in grease leakage. This leakage may reduce the strength of the concrete and leave the tendon unprotected.

5. The location of reinforcing bar splices at one section without staggering may compromise the strength of the containment. The use of sister splice samples for testing instead of production splices may not reflect the true quality of the production splices.

6. After closing the opening, the containment is to be subjected to a structural integrity test (SIT). The test pressure is usually 1.15 times the design pressure. This test may result in wider cracks in the concrete shell, which may allow migration of moisture to steel components embedded therein, resulting in potential corrosion.

DESIGN REVIEWS

Design reviews, if implemented, should be coordinated with the Mechanical and Civil Engineering Branch, NRR, via the Project Manager, to confirm the restored design margin.

Codes and Standards

Acceptable options for industry codes and standards to be used for the design, construction, and restoration of the containment access are as follows:

1. The codes and standards described in the final safety analysis report (FSAR), consistent with current regulations, as the basis of the facility operating license are to be utilized.

Or, and preferably:

2. To the extent practical, the latest American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME code) edition and addenda. Practical adjustments can be made in the use of the updated ASME code provisions to accommodate the limitations of design and construction. The quality and overall margins required in the original design are to be maintained and should be included in decisions on the extent to which adjustments are made for using the updated ASME code provisions. If the licensee chooses this option, review of its acceptability should be coordinated with the Mechanical and Civil Engineering Branch, NRR, via the Project Manager.

Analysis

The licensee should perform structural analyses for the containment, which considers the effect of the opening for the applicable loads and load combinations resulting from the containment opening.

Stress analyses of the containment structure are to be performed considering both the presence of the temporary opening and conditions after its repair. This analysis should incorporate the properties of the materials of the replacement components, which may affect the behavior of the containment structure locally and globally. The analyses should demonstrate that the code allowable limits have not been exceeded in both cases. The loads and loading combinations for the post opening closure case of containment should be the same as those specified in the FSAR or the applicable Standard Review Plan (SRP) sections. Also, consideration should be given to the conditions arising from the existence of the temporary opening, ranging from initial cutting to closing including potential construction loads. For the temporary opening of containment, no P_a load will apply in the analysis.

Design Changes

The materials and replacement components used to restore the containment should be the same as those originally used and documented in the FSAR except that the concrete used to close the opening can be adjusted to reduce the creep and shrinkage. If different materials or components are used, they should satisfy the applicable design criteria and requirements and provide an equivalent overall safety margin as provided in the originally licensed design.

TEMPORARY OPENING INSPECTIONS

On the basis of the regulatory concerns previously described, the areas of inspection interest can be summarized as follows:

1. Welding of the steel liner or shell, since the torch cut may result in irregular edges. The welding process, use of proper materials, the skill and training of the welder, and post installation examination and testing should be considered. The replacement welds may not be the same strength as the original uncut liner, but it should provide a joint strength equivalent to the strength of the weld joints in the original structure.

2. Proper concrete mix design and qualification and proper placement techniques should ensure that concrete in the repair area exhibits low creep and shrinkage. The certification of the concrete mix design, should ensure that the design mix is

similar to that used in original construction, and that the mix is controlled to reduce creep and shrinkage. Sufficient testing should have been done prior to placement to ensure that design strength is attainable. Also, the certification of materials used in the concrete containment, such as aggregate, cement, water, and admixtures are of interest.

Witnessing the initial concrete placement is important to verify that the concrete is being handled and tested properly. In cases where the interior form for the concrete containment is the liner plate, additional stiffeners may be needed to prevent buckling.

3. The tensioning force of the tendons, which may be reused, should be tensioned to a level of preload which would not cause more creep and relaxation. The prestressing sequence should also be carefully implemented to ensure its conformance with the original design basis.

4. The control of grease filling should be such that the tendons are adequately covered and there is no leakage from the sheathing that can be observed on the surface of the containment.

5. The rebar splicing around the opening and the use of the sister splices for quality control testing should be in conformance with the applicable design requirements. Checks on the proper certification of the rebar and splice materials and worker qualifications may also be included.

6. Witnessing of the structural integrity test (SIT) and the integrated leak rate test (ILRT) of the containment.

Fabrication, Installation, Examination, and Testing

Fabrication, installation, examination, and testing with appropriate instrumentation are to be performed in accordance with the applicable ASME Code as stated above under "Codes and Standards" or the stipulations in the FSAR. The behavior of the repaired containment structure locally and globally as obtained from the SIT and the ILRT is to be assessed.

Generally, the facility technical specifications require periodic examinations of the containment integrity including inspections of the tendons. It is not expected that those examinations will be altered by the restoration of the temporary containment access. Of concern however is the potential for degradation of the containment structural integrity or leak tightness that could result from the restoration. For example, tendon degradation could occur due to moisture intrusion via a pathway created in a damaged or inadequately restored tendon duct. An assessment should be of the licensee's measures and/or planned actions (e.g., analysis, testing, examination) to verify that containment integrity is maintained following the restoration. Assistance in performing this assessment should be coordinated with the Mechanical and Civil Engineering Branch, NRR, via the Project Manager.

Inspection and Quality Assurance

Quality assurance and independent (third-party) inspection requirements for cutting and closing the temporary opening are applicable. Verification of these activities should be performed.

Training and Qualification

The training and qualifications of craft and quality assurance personnel may be reviewed as there have been past problems with the use of inexperienced personnel.

END