

### REACTOR VESSEL MATERIAL SURVEILLANCE PROGRAM

PROGRAM APPLICABILITY: 2504

#### 50054-01 INSPECTION OBJECTIVES

To verify by review of the applicant's reactor vessel (RV) surveillance capsule program as described in the combined operating license (COL) and as approved pursuant to 10 CFR 52 requirements that:

- a. Capsule brackets (CBs) are designed, fabricated, and installed as per the design document and operational program description.
- b. Capsules are designed, fabricated, and installed as per design documents and operational program description.
- c. Test specimens that are included in capsules conform to the surveillance capsule program.

#### 50054-02 INSPECTION REQUIREMENTS AND GUIDANCE

##### 02.01 General Inspection Guidance

This inspection procedure will be implemented prior to the approval of fuel loading. The design document containing a level of detail sufficient to implement this inspection procedure (IP) regarding the surveillance capsule program required by 10 CFR 50, Appendix H will be reviewed by the NRC headquarters staff. Upon approval of the surveillance capsule program, the associated inspections will be performed by the regional inspectors.

The RV surveillance capsule program inspection consists of three major areas: (1) CB design, (2) capsules design, and (3) test specimens.

The design of the CBs and the means of attachment shall (1) preclude structural material degradation of the attachment welds, (2) avoid interference with inservice inspection required by Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), and (3) ensure the integrity of the capsule during the service life of the reactor vessel.

The capsules are located typically at four azimuths at a common elevation in the core belt line region and may be attached to either the vessel wall, vessel cladding or the internals (e.g., the core barrel). A minimum capsule lead factor of 1 is used in determining the locations of the capsules. A lead factor is the ratio of the average neutron flux at the location of the specimens in a surveillance capsule to the average neutron flux at the

reactor pressure vessel inside surface at the peak fluence location. The sealed capsules are not attached directly to the vessel or internals but are in welded CBs. The capsules are mechanically retained by the CBs.

## 02.02 Specific Requirements

### a. Capsule Brackets

The CBs itself are not ASME Code-designed products. The CBs may be welded to the vessel wall, vessel cladding or internals. If the CBs are attached to the vessel wall or to the vessel cladding, construction and inservice inspection of the attachments and attachment welds must be performed according to the requirements for permanent structural attachments to reactor vessels specified in Sections III and XI of the ASME Code in accordance with 10 CFR Part 50, Appendix H, III.B.2 (10 CFR 50, App H).

1. Design Specification - Verify by review of design documents:
  - (a) that the CBs and attachment welds will not interfere with inservice inspection required by ASME Code Section XI by confirming that the design specification requires that at least 90 percent of the attachment weld is accessible for visual examination;
  - (b) that the design provides for a minimum capsule lead factor of 1 based on the locations specified for the capsules (in essence CBs);
  - (c) that the sealed capsules are not attached directly to the vessel, but are in welded CBs. Verify that the surveillance capsule holder locations specified are consistent with the facility's design basis and 10 CFR 50, Appendix H requirements. This will be done by NRC headquarters staff.
2. Fabrication - Verify by review of fabricated samples, design and material certification records:
  - (a) that the materials and as-built design of the bracket assembly conform with the requirements of the design specification;
  - (b) that welding records conform with the specified welding procedure, welder qualifications, and welding materials;
  - (c) that the fabrication of CBs and the attachment welds meet the requirements of the specification and or the ASME Code.

If the brackets are attached to the vessel wall or vessel cladding, verify that additional nondestructive examinations are to be performed on the vessel base metal, stainless steel cladding or weld buildup pads during vessel manufacture in accordance with the ASME Code Section III. Review nondestructive examination documentation records to verify the NDE procedures and personnel were qualified in accordance with the Code.

3. Capsule Installation - Verify by independent measurement or observation, or by review of as-built records:
  - (a) that the capsule bracket locations meets design drawings, specifically that the locations of the capsule brackets and capsule, typically at four azimuths at a common elevation in the core belt line region are correct;
  - (b) that at least 90 percent of each attachment weld is accessible for visual ISI examination;
  - (c) that the capsules have been loaded with neutron surveillance and vessel material samples as specified in the design specification.

b. Capsule Design, Fabrication and Installation

Specimens must be maintained in an inert environment within a corrosion-resistant capsule to prevent deterioration of the surface of the specimens during radiation exposure. Capsule design requires the verification of the following:

1. that capsule assembly conforms with the capsule program;
2. that the specimens are in an inert environment;
3. that the as-built capsules conform to the capsule design specifications (materials, welding etc.);
4. that approved welding procedures, welder qualifications, and welding materials were used.

c. Capsule Contents

The RV materials surveillance test specimens must meet the requirements of American Society for Testing and Materials (ASTM) Standard Practice E-185 and 10 CFR Part 50, Appendix H. The test specimens for the program are selected to represent materials used in the reactor beltline region. The specimens contained in the capsules typically include Charpy V-notch impact, tensile, and compact tension specimens from the limiting beltline region. Each capsule also contains Charpy V-notch impact specimens of weld heat-affected-zone (HAZ) metal as well as dosimeters and thermal monitors to measure the integrated neutron flux and temperature in the individual test capsules. The thermal history or heat treatment given these specimens is similar to the thermal history of the reactor vessel material with the exception that the post weld heat treatment received by the specimens has been simulated. Specifically, verify that capsules include material samples as described in the NRC-approved surveillance program.

Verify by review of design construction and installation records that the contents of the capsules include (see note):

1. Charpy V-notch impact, tensile, and compact tension from the limiting core region;
2. Charpy V-notch impact specimens of HAZ metal;
3. Neutron dosimeters and temperature monitors as required by ASTM E185.

Note: actual contents of the capsule will vary depending on the nuclear steam supply system (NSSS) vendors. Specimens inside the capsule are stored in an inert environment and are separated using separators.

#### 50054-03 RESOURCE ESTIMATE

This inspection procedure is estimated to take, on the average 16 to 32 hours for each unit prior to loading the fuel in the reactor vessel.

Depending on availability, resident staff members may assist the regional ISI inspectors.

#### 50054-04 REFERENCES

American Society for Testing and Materials (ASTM), ASTM E185, "Standard Recommended Practices for Surveillance Tests for Nuclear Reactor Vessels."

American Society for Testing and Materials (ASTM), ASTM E185-82, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels."

American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, NB 5000.

ASME Boiler and Pressure Vessel Code Section XI, IWB 2500.

U.S. Code of Federal Regulations, Title 10, Energy, Part 50, "Domestic Licensing of Production and Utilization Facilities."

U.S. Code of Federal Regulations, Title 10, Energy, Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements."

U.S. Code of Federal Regulations, Title 10, Energy, Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

END

ATTACHMENT:  
Revision History for IP 50054

ATTACHMENT 1

Revision History for IP 50054

Commitment Tracking Number	Issue Date	Description of Change	Training Required	Training Completion Date	Comment Resolution Accession Number
N/A	12/04/08 CN 08-034	Initial issue to support inspection of operation programs described in IMC 2504, Non-ITTAC Inspections  4 year review of CNs was performed and no commitments found.	No	N/A	ML062620142