INSPECTION PROCEDURE 79502

PLANT SYSTEMS AFFECTING PLANT WATER CHEMISTRY

PROGRAM APPLICABILITY: 2513, 2515

SALP: Radiological Controls

79502-01 INSPECTION OBJECTIVE

The objective of this procedure is to verify that the installation and operation of the components of the plant's primary, secondary, and auxiliary water systems provide conditions that ensure long-term integrity of the reactor coolant pressure boundary.

79502-02 INSPECTION REQUIREMENTS

02.01 Audits and Appraisals. Review the results of audits and appraisals performed by or for the licensee since the last inspection and the adequacy of the licensee's commitments and corrective actions.

02.02 Primary and Secondary Water Systems. Compare the "as-built" primary and secondary water systems with the most recently updated Final Safety Analysis Report (FSAR). Assess unreviewed, post-operational modifications in design and materials as to the effect of these changes on the ingress of chemical impurities and the control of corrosion.

02.03 Auxiliary Water Systems. Review the installation and operation of water cleanup systems (condensate and reactor water cleanup in both BWRs and PWRs as well as steam generator blowdown in PWRs) to verify that each system (a) is capable of meeting its designed capacity, (b) is producing water of the required purity, and (c) contains adequate instrumentation to monitor the effectiveness of the system.

02.04 Demineralizers. Review and evaluate the licensee's policy and procedures for replacing or regenerating spent cation and anion demineralizer resins. Assess the potential that the demineralizer effluent (i.e., reactor coolant or feedwater) may become contaminated by impurities in bulk chemicals, by ion break-through, or by demineralizer regenerant chemicals.

79502-03 INSPECTION GUIDANCE

General Guidance. This inspection procedure complements IE Inspection Procedure 79501, "LWR Water Chemistry Control and Chemical Analysis," which covers the water chemistry control program and chemical analysis.

Applicable sections of the FSAR (especially Section 5.4.8, "Reactor Water Cleanup System"; Section 9.2, "Water Systems"; Section 10.3.5, "Water Chemistry"; Section 10.4.6, "Condensate Cleanup System"; and Section 10.4.8, "Steam Generator Blowdown System") should be reviewed before proceeding with the inspection. The inspector also should review the FSAR drawings of subsystems in the primary and secondary water systems so as to become aware of potential paths of impurity in-leakage or cross contamination.

The inspector should become knowledgeable of the operating history of the plant (through interviews of cognizant personnel and review of pertinent records) to the extent that he is aware of any significant off-normal chemical behavior or any evidence of degradation of the reactor coolant pressure boundary (with special emphasis on the steam generator and turbine) that has been attributed to corrosion. This background information will facilitate the inspector's assessment of the adequacy of the plant's condensate/feedwater cleanup systems and the effectiveness of the water chemistry program (covered by Inspection Procedure 79501) in preventing the types of degradation of plant components (e.g., fuel elements, BWR recirculation lines, steam generator tubes and support plates, and turbine blades and disks) that have been observed in BWRs and PWRs.

Specific Guidance

03.01 Audits and Appraisals

a. Review reports of required audits since the last inspection. Look particularly for those audits that probe for programmatic weakness and assess the quality of the program. Focus upon licensee followup actions for identified deficiencies. Are corrective actions timely and technically acceptable?

   Requirements for reviews and audits normally are contained in the Technical Specifications. Audit teams should include someone with experience or training commensurate with the scope, complexity or special nature of the activities audited (Regulatory Guide 1.146 and ANSI/ASME N45.2.23-1978, Section 2.2.).

b. Review reports of other audits, appraisals, assessments, evaluations, etc., that may provide information on program quality.

03.02 Primary and Secondary Water Systems. In-leakage of circulating cooling water and air into the condenser hotwell is considered to be the principal source of impurities in BWR reactor coolant water and in PWR secondary coolant water. The inspector should have general knowledge of the chemical quality of the circulating cooling water and should be aware of any potential incompatibility between this water and the condenser tubing that might cause loss of tubing integrity (e.g., through chemical or biological reactions or through scouring by abrasive particles).

The inspector should also be aware that contamination of reactor coolant and feedwater can, and has, occurred through flow paths other than from the condenser hotwell (see Section 03.05, "Prevalent Concerns"). In PWRs, the in-leakage of primary water to the secondary side of the steam generator represents a source of contamination of the secondary water as well as an indication that either the secondary water chemistry or some other factor has failed to prevent degradation of the reactor coolant pressure boundary.

03.03 Auxiliary Water Systems and Demineralizers. The criteria for both an acceptable condensate cleanup system and a water chemistry program (covered by Inspection Procedure 79501) that are adequate to monitor and maintain the required water purity are based on Regulatory Guide 1.56 for BWRs and on the NRC Standard Review Plan, Section 5.4.2.1, "Branch Technical Position MTEB 5-3" for PWRs. PWR Secondary Water Chemistry Guidelines have been developed by the Steam Generator Owners Group (SGOG) and the Electric Power Research Institute (EPRI). A committee of utility industry personnel has developed similar guidelines for BWR water chemistry.

After it has been verified that the licensee has met the commitments in the FSAR to design and operate an effective water cleanup system (covered by this inspection procedure) and to develop a water chemistry control program for monitoring both the effectiveness of the cleanup systems and the quality of the reactor water and feedwater systems (covered by Inspection Procedure 79501), the major emphasis of subsequent inspections should be placed on verifying the implementation of the chemistry program (covered by IP 79501). This action will not only establish if the licensee is taking correct steps to maintain the required quality of reactor coolant and feedwater but will also provide baseline data for the inspector's assessment of subsequent off-normal chemistry transients or later evidence of degradation of water lines, steam generator tubes or turbine blades and disks.

03.04 See Section 03.03, above.

03.05 Prevalent Concerns. The operational history of nuclear power plants provides evidence of actual or potential failures of the reactor coolant pressure boundary by cracking or pitting of reactor coolant lines and steam generator tubes in PWRs. Other evidence of metal attack has been observed as degradation of fuel elements, tubesheets and tube support plates in steam generators, and blades and disks of low-pressure turbines. A contributing cause of some of these problems has been the formation of locally corrosive environments as the result of ingress of impurities during shutdown or operation of the plant. Examples of known paths of ingress are as follows:

a. exposure to air during plant outages

b. failure of condenser tubes as the result of chemical or biological attack or mechanical degradation

c. leakage of air through both condensate pump seals and turbine gland seals

d. improper operation of condensate polishers or leaching of regenerative chemicals from demineralizer beds

e. erosion or corrosion of copper from feedwater heaters, condenser tubes, and moisture separator reheaters

f. contamination of the source of auxiliary feedwater (especially by air)

g. leakage through heat exchangers or auxiliary system water

h. contamination of reactor or condensate makeup water

Some PWR plants control the quality of the secondary water only by means of steam generator blowdown; i.e., these plants do not have condensate polishers. Such plants must place greater emphasis on the integrity of the condenser, hotwell, and condensate pumps and on the exclusion of impurities during outages, as well as on surveillance for impurities in the condensate and feedwater.

However, the installation of condensate polishers has not guaranteed the absence of cracking, corrosion or other forms of metallurgical degradation in piping, steam generators, or turbines. Consequently, licensees must closely monitor the operation and regeneration of condensate polishers and employ the most sensitive analytical methods available to achieve and maintain water purity as high as possible.

79502-04 REFERENCES

(Note: For a more extensive bibliography on plant water chemistry, see Inspection Procedure 79501.)

Final Safety Analysis Report Chapters 5, 9, and 10.

NUREG-0800, Standard Review Plan, Section 10.4.6, "Condensate Cleanup Systems."

___, Section 5.4.2.1, "Steam Generator Materials".

___, Section 10.4.8, "Steam Generator Blowdown System."

Regulatory Guide 1.56, "Maintenance of Water Purity in Boiling Water Reactors."

EPRI NP-2704-SR (Special Report), "PWR Secondary Water Chemistry Guidelines," October 1982.

BWR Owner's Group Water Chemistry Guidelines Committee, "BWR Water Chemistry Guidelines," April 1, 1984.

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