June 8, 2000

MEMORANDUM TO: Docket Files

FROM: Sam Lee, Sr. Materials Engineer
Technical Section
License Renewal and Standardization Branch
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

SUBJECT: NUCLEAR ENERGY INSTITUTE (NEI) DRAFT COMMENTS ON "GENERIC AGING LESSONS LEARNED (GALL) REPORT"-AGING MANAGEMENT PROGRAMS

By a May 30, 2000, electronic mail, Mr. Douglas Walters of NEI provided the enclosed industry draft comments on the draft GALL report. NEI is proposing a new chapter in the GALL report to address aging management programs and activities. NEI is continuing to develop this chapter and will provide the staff with a final version shortly.

Project No. 690

Enclosure: As stated

cc: PUBLIC

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CHAPTER XI

EXISTING AGING MANAGEMENT PROGRAMS (AMP) AND ACTIVITIES

Existing Aging Management Programs (AMP) and Activities

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A.1

Aging Management Program for Electrical Cables and Connections Exposed to an Adverse Localized Environment Caused by Heat or Radiation

Description

In most areas within a nuclear power plant, the actual ambient environments are less severe than the design environments. However, in a limited number of localized areas, the actual environments may be more severe than the design environments. Conductor insulation materials used in cables and connections may degrade more rapidly than expected in these adverse localized environments. The purpose of this aging management program is to provide reasonable assurance that the intended functions of electrical cables and connections exposed to adverse localized environments caused by heat or radiation will be maintained consistent with the current licensing basis through the period of extended operation.

As stated in NUREG/CR-5643, "*The major concern with cables, is the performance of aged cable when it is exposed to accident conditions.*" The statement of considerations for the final license renewal rule (60FR22477) states, "*The major concern is that failures of deteriorated cable systems (cables, connections, and penetrations) might be induced during accident conditions.*" The electrical cables and connections covered by this aging management program, being non-EQ, are either not exposed to harsh accident conditions or are not required to remain functional during or following an accident to which they are exposed. Although the electrical cables and connections included in this program are important to overall plant safety, their capability to perform their intended functions during or following a design basis event is not a major concern.

EVALUATION AND TECHNICAL BASIS

1) ***Scope:*** The inspection program includes accessible electrical cables and connections within the scope of license renewal that are installed in adverse localized environments caused by heat or radiation in the presence of oxygen. An adverse localized environment is a condition in a limited plant area that is significantly more severe than the specified service condition for the electrical cable or connection.
2) ***Preventive Actions:*** No actions are taken as part of this program to prevent or mitigate aging degradation.
3) ***Parameters Monitored/Inspected:*** Accessible electrical cables and connections installed in adverse localized environments are visually inspected for cable and connection jacket surface anomalies such as embrittlement, discoloration, cracking or surface contamination.
4) ***Detection of Aging Effects:*** Cable and connection jacket surface anomalies are precursor indications of conductor insulation aging degradation from heat or radiation in the presence of oxygen. Accessible electrical cables and connections installed in adverse localized environments are visually inspected at least once every 10 years, which is an adequate period to preclude failures of the conductor insulation.
5) ***Monitoring and Trending:*** No actions are taken as part of this program to trend inspection results.
6) ***Acceptance Criteria:*** No unacceptable, visual indications of cable and connection jacket surface anomalies, which suggest that conductor insulation degradation exists, as determined by engineering evaluation. An unacceptable indication is defined as a noted condition or situation that, if left unmanaged, could lead to a loss of the intended function.
7)
8) ***Corrective Actions & Confirmatory Process:*** Further investigation is performed on electrical cables and connections when the acceptance criteria are not met in order to ensure that the intended functions will be maintained consistent with the current licensing basis. Corrective actions may include, but are not limited to, testing, shielding or otherwise changing the environment, relocation or replacement of the affected cable or connection. Specific corrective actions are implemented in accordance with the station's corrective action program. When an unacceptable condition or situation is identified, a determination is made as to whether the same condition or situation is applicable to other accessible or inaccessible cables or connections. Confirmatory actions, as needed, are implemented as part of the station's corrective action program.
9) ***Administrative Controls:*** The implementation of this program is controlled by plant procedures.

10) ***Operating Experience:*** Operating experience has shown that adverse localized environments caused by heat or radiation for electrical cables and connections may exist next to or above (within three feet of) steam generators, pressurizers, or hot process pipes such as feedwater lines.

References

NUREG-1723, *Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Station, Units 1, 2 and 3*, February 2000

NUREG/CR-5643, *Insights Gained From Aging Research*, March 1992

IEEE Std. P1205, *IEEE Guide for Assessing, Monitoring and Mitigating Aging Effects on Class 1E Equipment Used in Nuclear Power Generating Stations.*

SAND96-0344, *Aging Management Guideline for Commercial Nuclear Power Plants - Electrical Cable and Terminations*, September 1996, prepared by Sandia National Laboratories for the U.S. Department of Energy.

A.2

Aging Management Program for Electrical Cables Used in Instrumentation Circuits that are Sensitive to Reduction in Conductor Insulation Resistance (IR) Exposed to an Adverse Localized Environment Caused by Heat or Radiation

DESCRIPTION

In most areas within a nuclear power plant, the actual ambient environments are less severe than the design environments. However, in a limited number of localized areas, the actual environments may be significantly more severe than the design environments. Conductor insulation materials used in electrical cables may degrade more rapidly than expected in these adverse localized environments. Exposure of electrical cables to adverse localized environments caused by heat or radiation can result in reduced insulation resistance (IR). Reduced IR causes an increase in leakage currents between conductors, and from individual conductors to ground. A reduction in IR can be a concern for circuits with sensitive, low-level signals such as radiation monitoring and nuclear instrumentation since it may contribute to inaccuracies in the instrument loop. When an instrumentation loop is found to be out of calibration during routine preventative maintenance, trouble shooting is preformed which includes the instrumentation cable. The purpose of this aging management program is to provide reasonable assurance that the intended functions of electrical cables used in circuits with sensitive, low-level signals exposed to adverse localized environments caused by heat or radiation will be maintained consistent with the current licensing basis through the period of extended operation.

As stated in NUREG/CR-5643, "*The major concern with cables, is the performance of aged cable when it is exposed to accident conditions.*" The statement of considerations for the final license renewal rule (60FR22477) states, "*The major concern is that failures of deteriorated cable systems (cables, connections, and penetrations) might be induced during accident conditions.*" The electrical cables covered by this aging management program, being non-EQ, are either not exposed to harsh accident conditions or are not required to remain functional during or following an accident to which they are exposed. Although the electrical cables and connections included in this program are important to overall plant safety, their capability to perform their intended functions during or following a design basis event is not a major concern.

EVALUATION AND TECHNICAL BASIS

1) ***Scope of Program:*** This program includes electrical cables used in circuits with sensitive, low-level signals such as radiation monitoring and nuclear instrumentation that are within the scope of license renewal.
2) ***Preventive Actions:*** No actions are taken as part of this program to prevent or mitigate aging degradation.
3) ***Parameters Monitored/Inspected:*** The parameters monitored are specific to the instrumentation loop being calibrated as documented in the preventive maintenance procedure. ***(4) Detection or Aging Effects:*** Calibration provides sufficient indication of the need for corrective actions by monitoring key parameters and providing trending data based on acceptance criteria related to instrumentation loop performance. The normal calibration frequency provides reasonable assurance that severe aging degradation will be detected prior to loss of the cable intended function.
4)
5) ***Monitoring and Trending:*** No actions are taken as part of this program to trend the test results.
6) ***Acceptance Criteria:*** Calibration readings within the loop specific acceptance criteria as set out in the preventive maintenance procedure.
7)
8) ***Corrective Actions & Confirmatory Process:*** Corrective actions such as recalibration and circuit trouble-shooting are implemented when an instrument loop is found to be out of calibration. Specific corrective actions are implemented in accordance with the station's corrective action program. Confirmatory actions, as needed, are implemented as part of the station's corrective action program.
9) ***Administrative Controls:*** The implementation of this program is controlled by plant procedures.

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10) *Operating Experience:* Operating experience has shown that a significant number of cable failures are identified through routine calibration testing.

References

NUREG-1705, *Safety Evaluation Report Related to the License Renewal of Calvert Cliffs Nuclear Power Plant, Units 1 and 2*, December 1999

NUREG/CR-5643, *Insights Gained From Aging Research*, March 1992

IEEE Std. P1205, *IEEE Guide for Assessing, Monitoring and Mitigating Aging Effects on Class 1E Equipment Used in Nuclear Power Generating Stations.*

SAND96-0344, *Aging Management Guideline for Commercial Nuclear Power Plants - Electrical Cable and Terminations*, September 1996, prepared by Sandia National Laboratories for the U.S. Department of Energy.

A.3

Aging Management Program for Inaccessible Medium-Voltage Cables Exposed to an Adverse Localized Environment Caused by Moisture and Voltage Stress

DESCRIPTION

Most electrical cables in nuclear power plants are located in dry environments. However, some cables may be exposed to condensation and wetting in inaccessible locations such as conduits, cable trenches, cable troughs, duct banks, underground vaults, or direct buried installations. When an energized cable is exposed to but not designed for these conditions, water treeing or a decrease in the dielectric strength of the conductor insulation can occur, which can lead to electrical failure. The purpose of this aging management program is to provide reasonable assurance that the intended functions of inaccessible medium-voltage cables exposed to adverse localized environments caused by moisture and voltage exposure will be maintained consistent with the current licensing basis through the period of extended operation.

EVALUATION AND TECHNICAL BASIS

1) ***Scope of Program:*** The program includes inaccessible (e.g., in conduit or direct buried) medium-voltage cables within the scope of license renewal that are exposed to significant moisture and significant voltage. Significant moisture is defined as periodic exposures to moisture that last more than a few days (e.g., cable in standing water). Periodic exposures to moisture that last less than a few days (i.e., normal rain and drain) are not significant. Significant voltage exposure is defined as being subjected to system voltage for more than twenty-five percent of the time. The moisture and voltage exposures described as significant in these definitions are not significant for medium-voltage cables that are designed for these conditions (e.g., continuous wetting and continuous energization is not significant for submarine cables).
2) ***Preventive Actions:*** No actions are taken as part of this program to prevent or mitigate aging degradation.
3) ***Parameters Monitored/Inspected:*** In-scope, medium-voltage cables exposed to significant moisture and significant voltage are tested to provide an indication of the condition of the conductor insulation. The specific type of test performed will be determined prior to each test.
4) ***Detection of Aging Effects:*** In-scope, medium-voltage cables exposed to significant moisture and significant voltage are tested at least once every 10 years, which is an adequate period to preclude failures of the conductor insulation.
5) ***Monitoring and Trending:*** No actions are taken as part of this program to trend the test results.
6) ***Acceptance Criteria:*** The acceptance criteria for each test is defined by the specific type of test performed and the specific cable tested.
7)
8) ***Corrective Actions & Confirmatory Process:*** Further investigation is performed when the test acceptance criteria are not met in order to ensure that the intended functions of the electrical cables and connections will be maintained consistent with the current licensing basis. Specific corrective actions are implemented in accordance with the station's corrective action program. When an unacceptable condition or situation is identified, a determination is made as to whether the same condition or situation is applicable to other inaccessible, in-scope, medium-voltage cables. Confirmatory actions, as needed, are implemented as part of the station's corrective action program.
9) ***Administrative Control:*** The implementation of this program is controlled by plant procedures.
10) ***Operating Experience:*** Operating experience has shown that XLPE or high molecular weight polyethlene (HMWPE) insulation materials are most susceptible to water tree formation. The formation and growth of water trees varies directly with operating voltage. Treeing is much less prevalent in 4kV cables than those operated at 13 or 33kV.

References

NUREG-1723, *Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Station, Units 1, 2 and 3*, February 2000

NUREG/CR-5643, *Insights Gained From Aging Research*, March 1992

IEEE Std. P1205, *IEEE Guide for Assessing, Monitoring and Mitigating Aging Effects on Class 1E Equipment Used in Nuclear Power Generating Stations.*

SAND96-0344, *Aging Management Guideline for Commercial Nuclear Power Plants - Electrical Cable and Terminations*, September 1996, prepared by Sandia National Laboratories for the U.S. Department of Energy.

A.4

Borated Water Leakage Surveillance Program For Electrical Components

DESCRIPTION

Ingress of borated water into electrical connectors, if not found and corrected, can lead to corrosion and connector failure. NRC Generic Letter (GL) 88-05 "*Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants*," March 17, 1988 mandates that PWR licensees monitor the condition of the reactor coolant pressure boundary for occurrences of borated water leakage. Refer to the *Generic Letter 88-05 Program* for specific information. This program is an augmentation of the *Generic Letter 88-05 Program* and has the purpose of preventing or eliminating aging effects related to corrosion of electrical connector contact surfaces caused by intrusion of borated water.

1) ***Scope of Program:*** This program includes electrical connectors located in proximity to borated water systems; inside or outside containment.
2) ***Preventive Actions:*** Visual inspections are performed of electrical connector and enclosure external surfaces for evidence of borated water leakage such as discoloration or accumulated boric acid residue. Boric acid residue is removed and a determination is made as to the possible intrusion of borated water into the electrical connector or enclosure.
3) ***Parameters Monitored/Inspected:*** Once any boric acid residue is removed from the external surfaces, the external areas where connector parts have mating surfaces or are sealed are inspected for evidence of borated water intrusion.
4) ***Detection of Aging Effects:*** Inspections are performed each refueling outage. Operating experience supports this frequency as adequate for preventing loss of component intended function.
5) ***Monitoring and Trending:*** No actions are taken as part of this program to trend the inspection results.
6) ***Acceptance Criteria:*** No corrective action is necessary if borated water from leaks is determined not to have intruded into electrical connectors and enclosures.
7)
8) ***Corrective Action & Confirmatory Process:*** Corrective actions are implemented upon a determination of the possible intrusion of borated water into an electrical connector or enclosure. Corrective actions may include, but are not limited to, removing contaminants or corrosion from electrical connector contact surfaces, testing, and sealing the electrical connector or enclosure to prevent future water intrusion. Specific corrective actions are implemented in accordance with the station's corrective action program. Confirmatory actions, as needed, are implemented as part of the station's corrective action program.
9) ***Administrative Controls:*** The implementation of this program is controlled by plant procedures.
10) ***Operating Experience:*** Based on industry wide and plant specific operating experience, augmenting the GL 88-05 program as described in this program for electrical connectors is adequate to detect and prevent aging effects caused by borated water leakage before there is a loss of component intended function.

References

NUREG-1723, *Safety Evaluation Report Related to the License Renewal of Oconee Nuclear Station, Units 1, 2 and 3*, February 2000

NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants," March 17, 1988.

A.5

10CFR50.55a/ASME Section XI, Subsection IWE

DESCRIPTION

10CFR50.55a imposes the examination requirements of ASME B&PV Code Section XI on reinforced and prestressed concrete containments. Examination requirements of ASME Class MC pressure retaining components, metallic shell/liners of Class CC containments, integral attachments, seals and gaskets, pressure retaining bolting, and surface areas including welds are covered in Subsection IWE. Therefore, ASME Code Section XI, Subsection IWE (1992 Edition with 1992 Addenda or later versions including authorized Relief Requests), along with additional requirements specified in 10CFR50.55a(b)(2), constitute an existing mandated program which should be referenced by the applicant's containment inservice inspection program for managing aging of steel containments and liners of concrete containments for license renewal.

EVALUATION AND TECHNICAL BASIS

Per NUREG-1611, an application for License Renewal should reference ASME Code Section XI, Subsection IWE and associated modifications/additions specified in 10CFR50.55a for managing aging of containment steel elements.

Evaluation of 10CFR50.55a/IWE against the ten (10) attributes for an acceptable aging management program is presented below. An applicant should ensure that its implementation of 10CFR50.55a/IWE for containment steel elements is consistent with this evaluation.

1) ***Scope of Program:*** Subsection IWE-1000 specifies the components within the scope of IWE (1992 edition with 1992 Addenda or later versions) for steel containments and liners of concrete containments. The components within the scope of IWE are Class MC pressure retaining components (steel containments) and their integral attachments; metallic shell and penetration liners of Class CC containments and their integral attachments; containment seals and gaskets; containment pressure retaining bolting; and surface areas, including welds and base metal. The concrete portions of containment are in accordance with IWL. IWE exempts from examination (1) components that are outside the boundaries of the containment as defined in the Design Specifications; (2) embedded or inaccessible portions of containment components that met the requirements of the original Construction Code; (3) components that become embedded or inaccessible as a result of vessel repair or replacement if IWE-1232 and IWE-5220 are met; and (4) piping, pumps, and valves that are part of the containment system, or which penetrate or are attached to the containment vessel (governed by IWB or IWC). (10CFR 50.55a(b)(2)ix) specifies additional requirements, one of which covers inaccessible areas. It states that the licensee shall evaluate the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of or result in degradation to such inaccessible areas.
2) ***Preventive Action:*** No preventive actions are specified; IWE is a monitoring program.
3) ***Parameters Monitored or Inspected:*** Table IWE-2500-1 specifies six categories for examination. Table 2500-1 references the applicable section in 3500, which identifies the aging effects, which are evaluated.

Category	Parts Examined	Examination Method
E-A	Containment Surface	General Visual, Visual VT-3
E-B *	Pressure Retaining Welds	Visual VT-1
E-C	Containment Surfaces Requiring Augmented Examination	Visual VT-1, Volumetric
E-D	Seals, Gaskets, and Moisture Barriers	Visual VT-3
E-F *	Pressure Retaining Dissimilar Metal Welds	Surface

E-G	Pressure Retaining Bolting	Visual VT-1, Bolt torque or tension test
E-P	All Pressure Retaining Components (Pressure boundary, penetration bellows, airlocks, seals and gaskets)	10 CFR 50, Appendix J (Containment Leak Rate Testing)

These two categories are optional per 10 CFR 50.55a(b)(2)(ix)(C).
** The applicable examination method (where multiple methods are listed) depends on the particular subcategory within each category.

4) ***Detection of Aging Effects:*** The frequency and scope of examinations are sufficient to ensure the aging effects are detected before they compromise the design basis requirements. Under IWE, inservice examinations and pressure tests must be performed in accordance with one of two Inspection Programs A or B on a specified schedule. Under Inspection Program A there are four inspection intervals (at 3, 10, 23, and 40 years) for which a 100% of the required examinations must be completed. Within each interval there are various inspection periods for which a certain percentage of the examinations must be performed to reach 100% at the end of that interval. In addition, a general visual examination is performed once each inspection period. After 40 years of operation, any future examinations must be performed in accordance with the Inspection Program B. Under Inspection Program B there is an initial interval of 12 years and successive intervals of 10 years each, during which 100% of the required examinations must be completed. Regarding the extent of examination, all accessible surfaces receive a visual examination. Selected areas, such as containment surfaces requiring augmented examination (E-C) require volumetric examination.
5) ***Monitoring and Trending:*** With the exception of inaccessible areas, all surfaces are monitored by virtue of the examination requirements on a scheduled basis as described above. When component examination results require evaluation of flaws, areas of degradation, or repairs and the component is found to be acceptable for continued service, the areas containing such flaws, degradation or repairs shall be reexamined during the next inspection in accordance with Examination Category E-C (containment surfaces requiring augmented examination). When these reexaminations reveal that the flaws, areas of degradation, or repairs remain essentially unchanged for three consecutive inspection periods, these areas no longer require augmented examination in accordance with Examination Category E-C. Except as permitted by 10 CFR 50.55a(b)(2)(ix)(D), IWE requires that examinations performed during any one inspection that reveal flaws or areas of degradation exceeding the acceptance standards shall be extended to include an additional number of examinations within the same category approximately equal to the initial number of examinations. Also, except as permitted by 10 CFR 50.55a(b)(2)(ix)(D), when additional flaws or areas of degradation that exceed the acceptance standards are revealed, all of the remaining examinations within the same category must be performed to the extent specified in Table IWE 2500-1 for the inspection interval.
6) ***Acceptance Criteria:*** Table IWE-3410-1 presents criteria to evaluate the acceptability of the containment components for service following the preservice examination and each inservice examination. This table specifies the acceptance standard for each Examination Category (E-A, E-B, E-C, etc.). Most of the acceptance standards rely upon visual examinations, an engineering evaluation or require corrective action . For some examinations such as Augmented Examinations, numerical values are specified for the acceptance standards.. For containment steel shell or liner, material loss exceeding 10% of the nominal containment wall thickness, or material loss that is projected to exceed 10% of the nominal containment wall thickness prior to the next examination, shall be documented. Such areas shall be accepted by engineering evaluation or corrected by repair or replacement in accordance with IWE-3122.
7) ***Corrective Actions:*** IWE states that components whose examination results indicate flaws or areas of degradation that do not meet the acceptance standards listed in Table-3410-1 can be considered acceptable if an engineering evaluation indicates that the flaw or area of degradation is nonstructural in nature or has no effect on the structural integrity of the containment. Components that do not meet the acceptance standards are required to satisfy additional examination requirements and the flaw or area of degradation must be removed by mechanical methods or the component repaired. For repair of components within the scope of IWE, IWE-4000 and IWE-3124 state that repairs and reexaminations shall comply with the requirements of IWA-4000. IWA-4000 provides rules and requirements for the repair of pressure retaining components including metal containments and metallic liners of concrete containments.

8) ***Confirmation Process:*** When areas of degradation are identified, an evaluation is required to determine if repair or replacement is necessary. If the evaluation determines that repair or replacement is necessary, IWE requires confirmation to ensure that appropriate corrective actions have been completed and are effective. IWE states that repairs and reexaminations shall comply with the requirements of IWA-4000. Reexaminations are required to be conducted in accordance with the requirements of IWA-2000 and the recorded results must demonstrate that the repair meets the acceptance standards set forth in Table IWE-3410-1. (Additional confirmation of leak tightness is achieved through the pressure tests required by 10 CFR 50, Appendix J.)
9) ***Administrative Controls:*** An approved site QA Program would be applicable to IWE. IWA-1400 provides requirements for Owner's Responsibility. This includes responsibility for preparation of plans, schedules, and inservice inspection summary reports, and submittal of these plans and reports to the enforcement and regulatory authorities having jurisdiction at the plant site. Owner is also responsible for the preparation of written examination instructions and procedures, verification of qualification level of personnel who perform the examinations, and documentation of a Quality Assurance Program. IWA-6000 specifically covers the requirements for the preparation, submittal, and retention of records and reports.
10) ***Operating Experience:*** ASME Section XI, Subsection IWE was specifically developed to identify aging degradation of containment steel components. Since ASME Section XI, Subsection IWE was only recently adopted by 10CFR50.55a, long term experience in managing aging of containment components needs to be established. Examinations performed in accordance with Appendix J to 10 CFR Part 50 (which is similar to the visual inspections of IWE) have provided operating experience which supports the reasonableness and effectiveness of IWE. The license renewal applicant should provide plant-specific operating experience related to inservice inspection of containment and occurrences of degradation.

A.6

10CFR50.55a/ASME Section XI, Subsection IWL

DESCRIPTION

10CFR50.55a imposes the examination requirements of ASME B&PV Code Section XI on reinforced and prestressed concrete containments. Examination requirements of ASME Class CC concrete components are covered in Subsection IWL. Therefore, ASME Code Section XI, Subsection IWL (1992 Edition with 1992 Addenda or later versions), including authorized Relief Requests along with additional requirements specified in 10CFR50.55a(b)(2), constitute an existing mandated program which should be referenced by the applicant's containment inservice inspection program for managing aging of concrete containments for license renewal.

EVALUATION AND TECHNICAL BASIS

Per NUREG-1611, an application for license renewal should reference ASME Code Section XI, Subsection IWL and associated modifications/additions specified in 10CFR50.55a for managing aging of containment concrete elements and prestressing systems.

Evaluation of 10CFR50.55a/IWL against the ten (10) attributes for acceptable aging management program is presented below. An applicant should ensure that its implementation of 10CFR50.55a/IWL for containment concrete elements and prestressing systems is consistent with this evaluation.

1) ***Scope of Program***: Subsection IWL-1000 specifies the components within the scope of IWL (1992 edition with 1992 Addenda or later versions]) for concrete containments. The components within the scope of IWL are reinforced concrete and unbonded post-tensioning systems of Class CC containments, as defined by CC-1000. Steel metallic liners are governed by IWE. IWL exempts from examination portions of the concrete containment that are inaccessible (e.g. concrete covered by liner, foundation material, or backfill, or are obstructed by adjacent structures or other components). 10 CFR 50.55a(b)(2)(viii) specifies additional requirements, one of which covers inaccessible areas. It states that the licensee shall evaluate the acceptability of inaccessible areas when conditions exist in accessible areas that could indicate the presence of or result in degradation to such inaccessible areas.
2) ***Preventive Action***: No preventive actions are specified; IWL is a monitoring program.
3) ***Parameters Monitored or Inspected***: Table IWL-2500-1 specifies two categories for examination of concrete surfaces. Category L-A for all concrete surfaces and Category L-B for concrete surfaces surrounding tendon anchorages. Both of these categories rely upon visual examination methods. Visual examination would identify loss of material and cracking of concrete components. Table IWL-2500-1 specifies Category L-B for test and examination requirements for unbonded post tensioning systems.
4) ***Detection of Aging Effects***: The frequency and scope of examination are sufficient to ensure that aging effects are detected before the design basis requirements would be compromised. The frequency of inspection is specified in IWL-2400. Concrete inspections are performed in accordance with Examination Category L-A. Under IWL, inservice inspections for concrete and unbonded post-tensioning systems are required at 1, 3, and 5 years following the structural integrity test. Thereafter, inspections are performed at 5 year intervals. The required minimum number of each tendon type selected for inspection varies from 2 to 4 percent. Regarding the extent, all concrete surfaces receive a visual VT-3C examination. Selected areas, such as those that indicate suspect conditions and areas surrounding tendon anchorages receive a more rigorous VT-1 or VT-1C examination. In the case of tendons, only a sample of the tendons of each tendon type requires examination at each inspection. The tendons to be examined during an inspection are selected on a random basis. Table IWL-2521-1 specifies the number of tendons to be selected for each type (e.g. hoop, vertical, dome, helical, and inverted U) for each inspection period. Prestressing forces in sample tendons are measured. In addition, one sample tendon of each type is removed for examination and testing.
5) ***Monitoring and Trending***: With the exception of inaccessible areas, all concrete surfaces are monitored by virtue of the examination requirements on a regular basis as described above. In

addition to the random sampling used for tendon examination, one tendon of each type is selected from the first year inspection sample and designated as a common tendon. Each common tendon is then examined during each inspection. This provides monitoring and trending information over the life of the plant. 10 CFR 50.55a and IWL also require that prestressing forces in all inspection sample tendons be measured by lift-off tests and compared to acceptance standards based on the predicted force for that type of tendon over its life.

6) ***Acceptance Criteria***: IWL-3000 provides acceptance criteria for concrete containments. For concrete surfaces, the acceptance criteria rely on the determination of the Responsible Engineer whether there is any evidence of damage or degradation sufficient to warrant further evaluation or repair. Although the acceptance criteria are qualitative, guidance is provided in IWL-2510, which references ACI 201.1R-92 for identification of concrete degradation. In addition, IWL-2320 requires the Responsible Engineer to be a registered professional engineer experienced in evaluating the inservice condition of structural concrete and knowledgeable of the design and construction codes and other criteria used in design and construction of concrete containments. Alternate acceptance criteria based on ACI 349.3R is also acceptable. The acceptance standards for the unbonded post-tensioning system is quantitative in nature. For the post-tensioning system, quantitative acceptance criteria are given for tendon force, tendon wire or strand samples, and corrosion protection medium.

7) ***Corrective Actions***: IWL specifies that items with examination results which do not meet the acceptance standards shall be evaluated to IWL-3300 "Evaluation." Items which do not meet the acceptance standards are to be evaluated by the Owner. The Owner is responsible for preparation of an Engineering Evaluation Report. The report should include an evaluation whether the concrete containment is acceptable without repair of the item and if repair is required, the extent, method, and completion date for the repair or replacement. Also included in the report is the cause of the condition and the extent, nature, and frequency of additional examinations. IWL also provides repair procedures to follow in Article IWL-4000. This includes requirements for the concrete repair, repair of reinforcing steel, repair of the post-tensioning system, and examination of the repaired area.

8) ***Confirmation Process***: When areas of degradation are identified, an evaluation is performed to determine if repair or replacement is necessary. As part of this evaluation, IWL-3300 requires the Engineering Evaluation Report include the extent, nature, and frequency of additional examinations.

9) ***Administrative Controls***: An approved site QA Program would be applicable to IWL. IWA-1400 provides requirements for Owner's Responsibility. This includes responsibility for preparation of plans, schedules, and inservice inspection summary reports, and submittal of these plans and reports to the enforcement and regulatory authorities having jurisdiction at the plant site. Owner is also responsible for the preparation of written examination instructions and procedures, verification of qualification level of personnel who perform the examinations, and documentation of a Quality Assurance Program. IWA-6000 specifically covers the requirements for the preparation, submittal, and retention of records and reports.

10) ***Operating Experience***: ASME Section XI, Subsection IWL was specifically developed to manage aging degradation of containment concrete components. Since ASME Section XI, Subsection IWL was only recently adopted by 10CFR50.55a, long term experience w/IWL needs to be established. The license renewal applicant should provide plant-specific operating experience related to inservice inspection of containment and occurrences of degradation. The IWL inspections are comparable to the concrete inspections performed in accordance with 10 CFR 50 Appendix J. NUREG-1540 states that inspections mandated by Appendix J to 10 CFR Part 50, though basically visual, have been reasonably effective in identifying containment problems to date. Therefore, previous Appendix J inspections provide additional verification that a visual inspection of containment concrete is effective.

A.7

10CFR50, Appendix J

DESCRIPTION

Currently there are two options, Option A and Option B, either of which meet the requirements of the containment LRT program. Under Option A, all of the testing must be performed on a periodic interval. Option B is a performance-based approach, which eliminates the prescriptive requirements that are marginal to safety. Some of the differences between these options are discussed below and more detailed information for Option B is provided in NRC Regulatory Guide 1.163 and NEI 94-01, Rev. 0

EVALUATION AND TECHNICAL BASIS

1) ***Scope of Program:*** The scope of the containment LRT program must include all pressure retaining passive components. Two types of tests shall be implemented. Type A tests are performed to measure leakage rates through all potential leakage paths including containment welds, valves, fittings, and components, which penetrate containment. Type B tests are performed to measure local leakage rates across each pressure containing or leakage limiting boundary for containment penetrations. Type A and Type B tests defined in 10 CFR 50, Appendix J are acceptable methods for performing these leak rate tests. Leakage testing for isolation valves (normally performed under Type C tests), if not included under this program, should be included under leakage rate test programs for systems containing the isolation valves.
2) ***Preventive Actions:*** Since the containment LRT program is a monitoring program, no preventive actions are needed.
3) ***Parameters Monitored:*** The parameters to be monitored are leakage rates through containment liner/welds, penetrations, fittings, and other access openings.
4) ***Detection of Aging Effects:*** A containment LRT program is effective in detecting degradation which compromises the containment pressure boundary, including seals and gaskets. While the calculation of leakage rates demonstrates the leak-tightness and structural integrity of the containment, it does not by itself provide information, which would indicate that aging degradation has initiated, or that the capacity of the containment may have been reduced for other types of loads such as seismic. This would be achieved with the additional implementation of an acceptable containment inservice inspection program as described earlier.
5) ***Monitoring and Trending:*** Since the LRT program must be repeated throughout the operating license period, the entire pressure boundary is being monitored over time. The frequency of these tests depends on which option (A or B) is selected. With Option A, testing is performed on a regular fixed time interval as defined in 10 CFR 50, Appendix J. In the case of Option B, the period for testing may be extended based on acceptable performance of meeting leakage limits on prior tests. Additional details for implementing Option B are provided in NRC R.G. 1.163 and NEI 94-01, Rev.0.
6) ***Acceptance Criteria:*** Acceptance criteria for leakage rates are defined in the plant technical specifications. Acceptance criteria are acceptable if they meet the requirements in 10 CFR 50, Appendix J.
7) ***Corrective Actions:*** When leakage rates do not meet the acceptance criteria, corrective actions are taken in accordance with 10 CFR 50, Appendix J and NEI 94-01. If results are not acceptable, then an evaluation is required to identify the cause of the unacceptable performance and appropriate corrective actions must be taken.
8) ***Confirmation Process:*** When corrective actions are implemented to repair the condition causing the excessive leakage, confirmation by additional leak rate testing is required to confirm that the deficiency has been corrected.
9) ***Administrative Controls:*** Results of the LRT program must be documented as described in 10 CFR 50, Appendix J to demonstrate that the acceptance criteria for leakage have been satisfied. The records are required to be available for inspection at the plant site. Test results that exceed the performance criteria must be assessed under 10 CFR 50.72 and 10 CFR 50.73. The quality assurance for corrective actions, confirmation process, and administrative control shall be in accordance with the plant's Quality Assurance Program.

10) ***Operating Experience:*** The plant-specific operating experience should be reviewed to ensure that the containment LRT program is effective in preventing unacceptable leakage through the containment pressure boundary. The requirements for Option B of 10 CFR 50, Appendix J should ensure that the test frequency is based on plant-specific operating experience.

A.8

Inservice Inspection Program For Class 1, 2 and 3 Components

DESCRIPTION

Inservice Inspection (ISI) in conformance with ASME Section XI (edition specified in 10CFR50.55a) for all Class 1, 2 and 3 pressure retaining components; as amended by CLB.
See existing GALL for specific ASME XI examination category.

EVALUATION AND TECHNICAL BASIS

1) **Scope of Program:** The inservice inspection program manages the cracking of pressure retaining boundary of Class 1, 2 and 3 components. The AMA utilizes systematic inspections, and corrective actions to ensure that pressure boundary integrity is maintained.
2) **Preventive Actions:** ASME Section XI provides a method of detection; no preventative actions are provided.
3) **Parameters Monitored or Inspected:** The inservice inspection program detects and sizes cracks and detects leakage by ISI. Examination and inspection requirements are specified in Tables IWB-2500-1, IWC-2500-1, or IWD-2500-1
4) **Detection of Aging Effects:** Degradation of the pressure boundary due to cracks cannot occur without crack initiation and growth; the extent and schedule of ISI assure detection of cracks before loss of intended function. Degradation of the pressure boundary due to corrosion will result in leakage through the pressure boundary; the extent and schedule of ISI assure detection of leakage before loss of intended function.
5) **Monitoring and Trending:** The inspection schedule of IWB-2400, IWC-2400 or IWD-2400 should provide for timely detection of cracks and/or leaks.
6) **Acceptance Criteria:** Any relevant conditions detected are evaluated in accordance with IWB-3000, IWC-3000 or IWD-3000.
7) **Corrective Actions:** Repair is in conformance with IWA-4000.
8)
9) **Confirmation Process and Administrative Controls:** Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of Appendix B to 10 CFR Part 50 and will continue to be adequate for the period of extended operation.
10) **Operating Experience:** ISI provides assurance of detection of cracks and/or pitting for examined components.

A.9

Closed Cooling Water Chemistry Aging Management Activities

DESCRIPTION

The closed cooling water chemistry program minimizes corrosion by maintaining corrosion inhibitors based on the guidelines of EPRI TR-107396 for closed cooling water systems.

EVALUATION AND TECHNICAL BASIS

1) ***Scope of Program:*** This AMA relies on preventive measures to preclude loss of material due to general, crevice, and pitting corrosion. The preventive measures are accomplished through periodic monitoring and controlling of corrosion inhibitor concentrations within specified limits to preclude the onset and propagation of loss of material.
2) ***Preventive Actions:*** Maintaining system corrosion inhibitor concentrations within specified limits to preclude loss of material due to general, crevice, and pitting corrosion.
3) ***Parameters Monitored:*** Depending on the corrosion inhibitor used, corrosion inhibitor concentrations monitored and maintained per the guidance outlined in the EPRI water chemistry guidelines for closed cooling water systems to preclude loss of material due to general, crevice, and pitting corrosion.
4) ***Detection of Aging Effects:*** The Chemistry Program precludes aging and requires no detection of aging effects.
5) ***Monitoring and Trending:*** Corrosion inhibitor concentrations are monitored and trended on a system specific periodic basis per the guidance outlined in the EPRI water chemistry guidelines for closed cooling water systems.
6) ***Acceptance Criteria:*** Corrosion inhibitor concentrations are maintained within the system specific limits specified in the EPRI water chemistry guidelines for closed cooling water systems.
7) ***Corrective Actions:*** Corrosion inhibitor concentrations outside the allowable limits must be returned to the acceptable range within the time periods specified in the EPRI water chemistry guidelines for closed cooling water systems. Specific corrective actions to return out-of-specification corrosion inhibitor concentrations to acceptable levels are site specific.
8) ***Confirmation Process:*** Following corrective actions, additional samples are taken and analyzed to verify that the corrective actions were effective in returning corrosion inhibitor concentrations to acceptable ranges.
9) ***Administrative Controls:*** The Chemistry Program is controlled by a company, department, or station directive or program manual and is implemented by controlled plant procedures.
10) ***Operating Experience:*** No instances of loss of material failures due to inadequate closed cooling water system chemistry have been reported. This operating experience demonstrates that the use of corrosion inhibitors in closed cooling water systems that are monitored and maintained by the Chemistry Program is effective in precluding loss of material due to general, crevice, and pitting corrosion.

A.10

Flow Accelerated Corrosion Program

DESCRIPTION

Implementation of EPRI guidelines of NSAC-202L-R2 for effective erosion/corrosion program

EVALUATION AND TECHNICAL BASIS

1) ***Scope of Program:*** The flow accelerated corrosion program predicts, detects, monitors, and mitigates Flow Accelerated Corrosion (FAC) in plant piping. The program is described in the EPRI guidelines of NSAC-202L-R2. The program includes the following activities: (a) conduct appropriate analysis and limited baseline inspection, (b) determine the extent of thinning and repair/ replace components as appropriate, and (c) perform follow-up inspections to confirm or quantify and take longer term corrective actions if necessary.
2) ***Preventive Actions:*** The rate of FAC is affected by piping material, geometry and hydrodynamic conditions, and operating conditions such as temperature, pH, steam quality, operating hours, and dissolved oxygen content.
3) ***Parameters Monitored/Inspected:*** The program monitors the effects of FAC on the intended function of piping by measuring wall thickness by nondestructive examination and by performing analytical evaluations. The inspection program delineated in NSAC-202L stipulates ultrasonic or radiographic testing of susceptible locations based on operating conditions. For each location outside the acceptance guidelines, the inspection sample is expanded based on engineering judgment. Analytical models such as those incorporated into the CHECWORKS Code are used to predict FAC in piping systems based on specific plant data including material and hydrodynamic and operating conditions.
4) ***Detection of Aging Effects:*** Inspection schedule of the EPRI guidelines provides for timely detection of leakage. Aging degradation of piping and fittings occurs by wall thinning; extent and schedule of inspection assure detection of wall thinning before the loss of intended function of the piping.
5) ***Monitoring and Trending:*** Inspections and analytical evaluations are performed per the EPRI guidelines. Remaining life is recalculated after each inspection, and the next scheduled inspection is determined based on this. If degradation is detected such that the wall thickness is less than the minimum allowed wall thickness, additional examinations are performed in adjacent areas to bound the thinning.
6) ***Acceptance Criteria:*** Inspection results are used to calculate number of refueling or operating cycles remaining before the component reaches design Code minimum allowable wall thickness. If calculations indicate that an area will reach design Code minimum, the component must be repaired, replaced, or reevaluated.
7) ***Corrective Actions:*** Prior to service, reevaluate, repair or replace degraded areas as required. Follow-up inspections are performed to confirm or quantify thinning and take longer-term corrective actions such as adjustment of operating parameters, or selection of materials resistant to FAC.
8)
9) ***Confirmation Process and Administrative Controls:*** Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with requirements of Appendix B to CFR Part 50 and will continue to be adequate for the period of license renewal.
10) ***Operating Experience:*** Wall-thinning problems in single-phase systems have occurred in feedwater and condensate systems (NRC Bulletin No. 87-01, IN 81-28, 92-35, 95-11), and in two-phase piping in extraction steam lines (IN 89-53, 97-84) and moisture separation reheater and feedwater heater drains (IN 89-53, 91-18, 93-21, 97-84). This AMA was originally outlined in NUREG-1344 and implemented through GL 89-08. The program has evolved through industry experience and is now described in NSAC-202L. Application of this AMA has resulted in the replacement of piping identified as being subject to FAC before this degradation has challenged the pressure boundary integrity. This AMA has provided effective means of ensuring the structural integrity of high-energy carbon steel systems. NRC has audited programs based on the EPRI methodology at several plants and has determined that these activities can provide a good prediction of the onset of FAC so that timely corrective actions can be undertaken.

A.11

Fire Water System Aging Management Activities

DESCRIPTION

Water b'ased fire protection system piping and components are tested in accordance with applicable NFPA commitments. NFPA testing assures functionality of the systems and assures adequate flows. In addition, selected portions of the system are inspected to address concerns of GL 98-13, including evidence of corrosion, erosion and biofouling. Also, system is normally maintained at required operating pressure and is monitored such that loss of system pressure is immediately detected and corrective actions initiated.

EVALUATION AND TECHNICAL BASIS

1) ***Scope of Program:*** This AMA focuses on managing loss of material due to corrosion of the carbon steel and cast iron components exposed to raw water.
2) ***Preventive Actions:*** System testing is performed to assure adequate pressures and flowrates. Internal inspections are performed on system components when disassembled to identify evidence of loss of material due to corrosion. Repair and replacement actions are initiated as necessary.
3) ***Parameters Monitored/Inspected:*** Loss of material due to corrosion could reduce wall thickness and result in system leakage. The parameters monitored are system ability to maintain adequate flow and pressure and internal system corrosion conditions.
4) ***Detection of Aging Effects:*** Continuous system pressure monitoring, periodic system flow testing, and internal inspections is an effective method to assure that the system intended function is maintained.
5) ***Monitoring and Trending:*** System pressure is monitored continuously. Results of system performance testing are monitored and trended as required by NFPA commitments. Degradation identified by internal inspections are evaluated and corrective actions taken as required.
6) ***Acceptance Criteria:*** Ability of system to maintain required pressure and visual assessment in internal system conditions.
7)
8)
9) ***Corrective Actions, Confirmation Process, and Administrative Controls:*** Site corrective actions program, QA procedures, site review and approval process, and administrative controls are implemented in accordance with plant requirements and will continue to be adequate for license renewal.
10) ***Operating Experience:*** Water based fire protection systems designed, inspected, tested and maintained in accordance with NFPA standards have demonstrated reliable performance.

A.12

Fuel Oil Chemistry Program

DESCRIPTION

The plant chemistry program maintains fuel oil quality through monitoring and controlling of fuel oil impurities using the guidance of ASTM Standards D975, D1796, D2276, and D2709. If excessive water, biologica l activity, or particulates are found corrective actions are taken. Additionally, new fuel oil deliveries are treated with a biocide and analyzed for water content to avoid contamination of existing fuel oil stock.

EVALUATION AND TECHNICAL BASIS

1) ***Scope of Program:*** This program relies on preventive measures to preclude loss of material due to general, crevice, microbiologically influenced, and pitting corrosion and cracking due to stress corrosion cracking. The preventive measures are accomplished through periodic monitoring and controlling of water or the addition of biocides to preclude the onset and propagation of loss of material and/or cracking.
2) ***Preventive Actions:*** Maintaining fuel oil quality by minimizing water concentrations to preclude loss of material due to general, crevice, and pitting corrosion and cracking due to stress corrosion cracking. Maintaining fuel oil quality by minimizing biological activity through the use of biocides.
3) ***Parameters Monitored:*** Water and biological activity or particulate contamination concentrations are monitored using the methods outlined in ASTM D1796, D2276, D2709 or another industry acceptable method to preclude loss of material due to corrosion and cracking.
4) ***Detection of Aging Effects:*** The Chemistry Program controls fuel oil contaminant concentrations to maintain fuel oil quality to the standard outlined in ASTM D975 that precludes aging and requires no detection of aging effects.
5) ***Monitoring and Trending:*** Water and biological activity or particulate contamination concentrations are monitored and trended on a periodic basis as outlined in plant documents.
6) ***Acceptance Criteria:*** Water and biological activity or particulate contamination concentrations are maintained below the limits specified in ASTM D975 for the grade of fuel oil used.
7) ***Corrective Actions:*** Water and biological activity or particulate contamination concentrations in excess of allowable limits must be returned to the acceptable range within the time periods specified by plant documents. Specific corrective actions to return out-of-specification contaminant levels to acceptable levels are site specific.
8) ***Confirmation Process:*** Following corrective actions, additional samples are taken and analyzed to verify that the corrective actions were effective in returning contaminant concentrations to acceptable ranges.
9) ***Administrative Controls:*** The Chemistry Program is controlled by a company, department, or station directive or program manual and is implemented by controlled plant procedures.
10) ***Operating Experience:*** No instances of fuel oil system components failures attributed to contamination were identified. This good operating experience demonstrates that the Chemistry Program for fuel oil systems in controlling contaminant concentrations is an effective aging management program for loss of material and cracking.

A.13

Boric Acid Corrosion Aging Management Program

DESCRIPTION

Implementation of NRC Generic Letter 88-05

EVALUATION AND TECHNICAL BASIS

1) ***Scope of Program:*** This AMA encompasses leakage from mechanical closures in the RCS and other safety-related borated water systems. The Program utilizes systematic inspections, leakage evaluations, and corrective actions to ensure that boric acid corrosion does not lead to degradation of the leakage source or adjacent structures or components which could cause loss of the SC intended function.
2) ***Preventive Actions:*** The removal of concentrated boric acid and elimination of boric acid leakage mitigates corrosion by minimizing the exposure of the susceptible material to the corrosive element.
3) ***Parameters Monitored or Inspected:*** Boric acid residue, borated water leakage, and degradation of coatings are directly related to the degradation of components. The AMA monitors the effects of boric acid corrosion and/or aggressive chemical attack on the intended function of the component by detection of coolant leakage by implementing the requirements delineated in GL 88-05 including guidelines for locating small leaks, conducting examinations, and performing engineering evaluations.
4) ***Detection of Aging Effects:*** Degradation of the component due to boric acid corrosion or aggressive chemical attack cannot occur without leakage of coolant containing boric acid. Conditions leading to boric acid corrosion such as crystal buildup and evidence of moisture are readily detectable by visual inspections. Insulation need be removed from areas only when leakage is observed or suspected, or when a leakage path must be exposed for additional inspection. Inspection criteria are included in the plant-specific procedures.
5) ***Monitoring and Trending:*** Information obtained from the performance of inspections and evaluations under this activity can be added to the previously existing data. This information is available for review for trending purposes. However, there are no monitoring or trending activities required by GL 88-05, and none are necessary to manage this Aging Effect/Mechanism.
6) ***Acceptance Criteria:*** All identified cases of boric acid leakage and/or crystal buildup are evaluated.
7) ***Corrective Actions:*** GL 88-05 requires that corrective actions to prevent recurrences of degradation caused by boric acid leakage be included in the program implementation. These corrective actions include any modifications to be introduced in the present design or operating procedures of the plant that (a) reduce the probability of primary coolant leaks at the locations where they may cause corrosion damage and (b) entail the use of suitable corrosion resistant materials or the application of protective coatings/claddings.
8)
9) ***Confirmation Process and Administrative Controls:*** Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of Appendix B to 10 CFR Part 50 and will continue to be adequate for the period of extended operation.
10) ***Operating Experience:*** Inspection points should be added as deemed necessary based on operating experience. The responsible personnel should review industry-operating experience to explore methods aimed at reducing boric acid related corrosion. The inspection measures required by GL 88-05 are deemed adequate for managing boric acid corrosion by NUREG-1705.

A.14

Generic letter 89-13 Program

DESCRIPTION

In response to GL 89-13, the industry implemented surveillance and control program to manage flow blockage problems in open-cycle service water systems due to biofouling, silt, mud, and corrosion products. The AMA program generally includes (1) water sampling to determine biological species. (2) inspections of piping and components for biofouling, damaged coatings and degraded material condition, (3) removal of biofouling and corrosion products, (4) and monitoring of heat exchanger performance for all safety-related heat exchangers cooled by open-cycle service water.

EVALUATION AND TECHNICAL BASIS

1) ***Scope of Program***: This AMA requires the implementation of an on-going program of surveillance and control techniques to significantly reduce the incidence of flow blockage caused by biofouling, corrosion, erosion, protective coating failures, and silting problems in systems and components supplied with open cycle cooling water (service water system). This program addresses the aging effects of material loss and fouling due to macro-organisms and various corrosion mechanisms.
2) ***Preventive Actions***: This AMA requires a condition and performance monitoring program, and may include control/preventive measures such as chemical treatment or flushing of infrequently used systems.
3) ***Parameters Monitored or Inspected***: Cleanliness and material integrity of piping, components, heat exchangers and their internal lining/coating (when applicable), that are part of the service water system or that are cooled by service water are periodically inspected, monitored, and/or tested to ensure adequate flow and heat transfer capabilities.
4) ***Detection of Aging Effects***: This AMA includes inspections for biofouling, damaged coatings, and degraded material condition. Visual inspections are typically performed; however, nondestructive testing is also an effective method to measure surface condition and the extent of wall thinning associated with the service water system piping and components, when determined necessary.
5) ***Monitoring and Trending***: Inspection scope, method (e.g. visual, NDE) and testing frequencies are in accordance with the utility commitments under GL 89-13. Inspections and/or nondestructive testing will determine the extent of biofouling, the condition of the surface coating, the magnitude of localized pitting, and the amount of MIC, if applicable. Additionally, monitoring of system parameters (e.g., flow, and differential pressure) is effective in providing an indication of flow blockage. Heat transfer testing results are documented in the plant test procedures and are reviewed by the appropriate group.
6) ***Acceptance Criteria***: Biofouling is considered undesirable, and is removed, or reduced, as part of the inspection process. Guidelines should be provided as part of the plant's inspection procedures, to list the expectations for acceptable surface condition. Wall thinning measurements require minimum determination of wall thickness values. Depending on the extent of degradation, a plant problem/condition report may be initiated in accordance with the site corrective action process.
7) ***Corrective Actions***: Evaluations are performed for test or inspection results that are deemed to be in excess of established acceptance criteria. If inadequate heat transfer exists to satisfy safety analysis requirements, a problem/condition report is initiated to document the concern in accordance with plant administrative procedures. The corrective action ensures that the conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined, and an action plan is developed to preclude repetition.
8)
9) ***Confirmation Process and Administrative Controls***: Site QA procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of Appendix B to 10 CFR Part 50 and will continue to be adequate for the period of extended operation.

10) ***Operating Experience***: The industry has extensive experience with identifying and resolving flow blockages and degradation of the open-cycle service water system. Procedures have been developed and implemented to address biofouling; inspection activities; and heat transfer testing. Numerous piping repairs have been made, and design changes have been implemented to replace degraded

portions of the system. With the ongoing use of the inspection and testing activities, the open-cycle cooling water system (service water system) operability has been maintained.

A.15

Primary Water Chemistry Program

DESCRIPTION

The primary water chemistry program minimizes impurities by monitoring and maintaining the water chemistry conditions based on guidelines of EPRI TR-105714 and EPRI TR-103515 for primary water chemistry.

Evaluation and technical basis

1) ***Scope Of Program***: This program relies on preventive measures to preclude loss of material due to general, crevice, and pitting corrosion and cracking due to stress corrosion cracking. The preventive measures are accomplished through periodic monitoring and controlling of know detrimental contaminants such as chlorides, fluorides (pwrs only), dissolved oxygen, and sulfate concentrations below the levels known to result in the onset and propagation of loss of material and/or cracking.
2) ***Preventive Actions***: Maintaining system chemistry to minimize contaminant concentrations to preclude loss of material due to general, crevice, and pitting corrosion and cracking due to stress corrosion cracking.
3) ***Parameters Monitored***: Environmental contaminates such as chlorides, fluorides (pwrs only), sulfates, and dissolved oxygen/hydrogen peroxide are directly or indirectly (electrochemical corrosion potential [ecp] for o_2 and h_2o_2) monitored to preclude loss of material due to corrosion and cracking. water quality is maintained per the guidance outlined in the EPRI water chemistry guidelines for primary water systems.
4) ***Detection Of Aging Effects***: The chemistry program precludes aging and requires no detection of aging effects.
5) ***Monitoring And Trending***: Contaminants such as chlorides, fluorides (pwrs only), sulfates, and dissolved oxygen/hydrogen peroxide concentrations are monitored and trended on a system specific periodic based upon the guidance outlined in the EPRI water chemistry guidelines for primary water systems.
6) ***Acceptance Criteria***: Contaminants such as chlorides, fluorides (pwrs only), sulfates, and dissolved oxygen/hydrogen peroxide concentrations are maintained below the system specific limits based on the limits specified in the epri water chemistry guidelines for primary water systems.
7) ***Corrective Actions***: Contaminants such as chlorides, fluorides (pwrs only), sulfates, and dissolved oxygen/hydrogen peroxide concentrations in excess of allowable limits must be returned to the acceptable range within the time periods specified in the EPRI water chemistry guidelines for primary water systems. Specific corrective actions to return out-of-specification contaminant levels to acceptable levels are site specific.
8) ***Confirmation Process***: Following corrective actions, additional samples are taken and analyzed to verify that the corrective actions were effective in returning contaminants such as chlorides, fluorides (pwrs only), sulfates, and dissolved oxygen/hydrogen peroxide concentrations to acceptable ranges.
9) ***Administrative Controls***: The chemistry program is controlled by a company, department, or station directive or program manual and is implemented by controlled plant procedures.
10) ***Operating Experience***: No incidents of loss of material attributed to an inadequate chemistry program for primary water have been reported. Several instances of cracking have been reported that were attributed to improper construction, fatigue, or the accidental introduction of contaminants. this good operating experience demonstrates that the chemistry program for primary water systems is effective in maintaining an environment that precludes loss of material and cracking.

A.16

Secondary Water Chemistry Program

DESCRIPTION

The secondary water chemistry program minimizes impurities by monitoring and maintaining the water chemistry conditions based on guidelines of EPRI TR-102134-R4 for secondary water chemistry.

EVALUATION AND TECHNICAL BASIS

1) ***Scope of Program:*** The secondary water chemistry program relies on preventive measures to preclude loss of material due to general, crevice, and pitting corrosion and cracking due to stress corrosion cracking. The preventive measures are accomplished through periodic monitoring and controlling of known detrimental contaminants such as chlorides, fluorides, dissolved oxygen, and sulfate concentrations below the levels known to result in the onset and propagation of loss of material and/or cracking.
2) ***Preventive Actions:*** Maintaining system chemistry to minimize contaminant concentrations to preclude loss of material due to general, crevice, and pitting corrosion and cracking due to stress corrosion cracking.
3) ***Parameters Monitored:*** Contaminants such as chlorides, fluorides, sulfates, and dissolved oxygen are directly monitored to preclude loss of material due to corrosion and cracking. Water quality is maintained based on the guidance outlined in the EPRI water chemistry guidelines for secondary water systems.
4) ***Detection of Aging Effects:*** The Chemistry Program precludes aging and requires no detection of aging effects.
5) ***Monitoring and Trending:*** Contaminants such as chlorides, fluorides, sulfates, and dissolved oxygen concentrations are monitored and trended on a system specific periodic basis per the guidance outlined in the EPRI water chemistry guidelines for secondary water systems.
6) ***Acceptance Criteria:*** Contaminants such as chlorides, fluorides, sulfates, and dissolved oxygen concentrations are maintained below the system specific limits basted on the limits specified in the EPRI water chemistry guidelines for secondary water systems.
7) ***Corrective Actions:*** Contaminants such as chlorides, fluorides, sulfates, and dissolved oxygen concentrations in excess of allowable limits must be returned to the acceptable range within the time periods based on the EPRI water chemistry guidelines for secondary water systems. Specific corrective actions to return out-of-specification contaminant levels to acceptable levels are site specific.
8) ***Confirmation Process:*** Following corrective actions, additional samples are taken and analyzed to verify that the corrective actions were effective in returning contaminant concentrations to acceptable ranges.
9) ***Administrative Controls:*** The Chemistry Program is controlled by a company, department, or station directive or program manual and is implemented by controlled plant procedures.
10) ***Operating Experience:*** A search of industry operating experience did not reveal any corrosion related problems in systems whose environments are controlled by the Chemistry Program that is based on the EPRI guidelines for secondary water chemistry. This good operating experience demonstrates that the Chemistry Program for secondary water systems is effective in maintaining an environment that precludes loss of material and cracking.