

## **3.6 AGING MANAGEMENT OF ELECTRICAL AND INSTRUMENTATION AND CONTROLS**

### **Review Responsibilities**

**Primary** - Branch responsible for electrical engineering

**Secondary** - None

#### **3.6.1 Areas of Review**

This review plan section addresses the aging management review (AMR) of the electrical and instrumentation and controls (I&C). For a recent vintage plant, the information related to the Electrical and I&C is contained in Chapter 7, "Instrumentation and Controls," and Chapter 8, "Electric Power," of the plant's FSAR, consistent with the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG-0800) (Ref. 1). For older plants, the location of applicable information is plant-specific because their FSAR may have predated NUREG-0800. Typical electrical and I&C components that are subject to an AMR for license renewal are electrical cables and connections.

The staff has issued a GALL report addressing aging management for license renewal (Ref. 2). The GALL report documents the staff's basis for determining whether generic existing programs are adequate to manage aging without change, or generic existing programs should be augmented for license renewal. The GALL report may be referenced in a license renewal application, and should be treated in the same manner as an approved topical report.

Because a license renewal applicant may or may not be able to reference the GALL report as explained below, the following areas are reviewed:

##### **3.6.1.1 Management Programs Evaluated in the GALL Report that Are Relied on for License Renewal**

An applicant may reference the GALL report in a license renewal application to demonstrate that the applicant's programs at its facility correspond to those reviewed and approved in the report, and that no further staff review is required. If the material presented in the GALL report is applicable to the applicant's facility, the staff should find the applicant's reference to the report acceptable. In making this determination, the staff should consider whether the applicant has identified specific programs described and evaluated in the GALL report. The staff, however, should not repeat its review of the substance of the matters described in the report. Rather, the staff should ensure that the applicant verifies that the approvals set forth in the GALL report for generic programs apply to the applicant's programs.

##### **3.6.1.2 Further Evaluation of Aging Management as Recommended by the GALL Report**

The GALL report provides the basis for identifying those programs that warrant further evaluation during the staff review of a license renewal application. The staff review should focus on augmented programs for license renewal.

##### **3.6.1.3 Aging Management Evaluations that Are Different from or Not Addressed in the GALL Report**

The GALL report provides a generic staff evaluation of certain aging management programs. If an applicant does not rely on a particular program for license renewal, or if the applicant

indicates that the generic staff evaluation of the elements of a particular program does not apply to its plant, the staff should review each such aging management program to which the GALL report does not apply.

The GALL report provides a generic staff evaluation of certain components and aging effects. If an applicant has identified particular components subject to an AMR for its plant that are not addressed in the GALL report, or particular aging effects for a component that are not addressed in the GALL report, the staff should review the applicant's aging management programs applicable to these particular components and aging effects.

#### **3.6.1.4 FSAR Supplement**

The FSAR supplement summarizing the programs and activities for managing the effects of aging for the period of extended operation is reviewed.

### **3.6.2 Acceptance Criteria**

The acceptance criteria for the areas of review describe methods for determining whether the applicant has met the requirements of the NRC's regulations in 10 CFR 54.21.

#### **3.6.2.1 Aging Management Programs Evaluated in the GALL Report that Are Relied on for License Renewal**

Acceptable methods for managing aging of the electrical and I&C components are described and evaluated in Chapter VI of the GALL report (Ref. 2). In referencing this report, the applicant should indicate that the material presented in the GALL report is applicable to the specific plant involved, and provide the information necessary to adopt the finding of program acceptability as described and evaluated in the report. The applicant should also verify that the approvals set forth in the GALL report for generic programs apply to the applicant's programs. The applicant may reference appropriate programs as described and evaluated in the GALL report.

#### **3.6.2.2 Further Evaluation of Aging Management as Recommended by the GALL Report**

The GALL report indicates that further evaluation should be performed for:

##### **3.6.2.2.1 Electrical Equipment Subject to Environmental Qualification**

Environmental qualification is a TLAA as defined in 10 CFR 54.3. TLAA's are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The evaluation of this TLAA is addressed separately in Section 4.4 of this standard review plan.

##### **3.6.2.2.2 Quality Assurance for Aging Management of Nonsafety-Related Components**

Acceptance criteria are described in Branch Technical Position IQMB-1 (Appendix A.2 of this standard review plan).

##### **3.6.2.3 Aging Management Evaluations that Are Different from or Not Addressed in the GALL Report**

Acceptance criteria are described in Branch Technical Position RLSB-1 (Appendix A.1 of this standard review plan).

#### **3.6.2.4 FSAR Supplement**

The summary description of the programs and activities for managing the effects of aging for the period of extended operation in the FSAR supplement should be appropriate such that later changes can be controlled by 10 CFR 50.59. The description should contain information associated with the bases for determining that aging effects are managed during the period of extended operation.

#### **3.6.3 Review Procedures**

For each area of review, the following review procedures are to be followed:

##### **3.6.3.1 Aging Management Programs Evaluated in the GALL Report that Are Relied on for License Renewal**

The applicant may reference the GALL report in its license renewal application, as appropriate. The staff should not repeat its review of the substance of the matters described in the report. If the applicant has provided the information necessary to adopt the finding of program acceptability as described and evaluated in the GALL report, the staff should find the applicant's reference to the report in a license renewal application acceptable. In making this determination, the reviewer verifies that the applicant has provided a brief description of the system, components, materials, and environment. The reviewer also verifies that the applicant has stated that the applicable aging effects and industry and plant-specific operating experience have been reviewed by the applicant and are evaluated in the GALL report. The reviewer verifies that the applicant has identified those aging effects for the Electrical and I&C System components that are contained in the report as applicable to its plant. In addition, the reviewer verifies that the applicant has stated that the plant programs covered by the applicant's reference contain the same program elements that the staff evaluated and relied upon in approving the corresponding generic program in the GALL report.

The reviewer should verify that the applicant has stated that certain of its aging management programs contain the same program elements as the corresponding generic program described in the GALL report, and upon which the staff relied in its evaluation. The reviewer should also verify that the applicant has stated that the GALL report is applicable to its plant with respect to these programs. The reviewer verifies that the applicant has identified the appropriate programs as described and evaluated in the GALL report. Programs evaluated in the report regarding the Electrical and I&C System components are summarized in Table 3.6-1 of this review plan section. No further staff evaluation is necessary if so recommended in the GALL report.

##### **3.6.3.2 Further Evaluation of Aging Management as Recommended by the GALL Report**

###### **3.6.3.2.1 Electrical Equipment Subject to Environmental Qualification**

Environmental qualification is a TLAA as defined in 10 CFR 54.3. TLAA's are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The staff reviews the evaluation of this TLAA separately following the guidance in Section 4.4 of this standard review plan.

###### **3.6.3.2.2 Quality Assurance for Aging Management of Nonsafety-Related Components**

The applicant's aging management programs for license renewal should contain the elements of corrective actions, the confirmation process, and administrative controls. Safety-related

components are covered by 10 CFR Part 50, Appendix B, which is adequate to address these program elements. However, Appendix B does not apply to non safety-related components that are subject to an AMR for license renewal. Nevertheless, the applicant has the option to expand the scope of its 10 CFR Part 50, Appendix B program to include these components and address these program elements. If the applicant chooses this option, the reviewer verifies that the applicant has documented such a commitment in the FSAR supplement. If the applicant chooses alternative means, the branch responsible for quality assurance should be requested to review the applicant's proposal on a case-by-case basis.

### **3.6.3.3 Aging Management Evaluations that Are Different from or Not Addressed in the GALL Report**

Review procedures are described in Branch Technical Position RLSB-1 (Appendix A.1 of this standard review plan).

### **3.6.3.4 FSAR Supplement**

The reviewer verifies that the applicant has provided information, equivalent to that in Table 3.6-2, in the FSAR supplement for aging management of the Electrical and I&C System for license renewal. The reviewer also verifies that the applicant has provided information, equivalent to that in Table 3.6-2, in the FSAR supplement for Subsection 3.6.3.3, "Aging Management Evaluations that Are Different from or Not Addressed in the GALL Report."

The staff expects to impose a license condition on any renewed license to require the applicant to update its FSAR to include this FSAR supplement at the next update required pursuant to 10 CFR 50.71(e)(4). As part of the license condition, until the FSAR update is complete, the applicant may make changes to the programs described in its FSAR supplement without prior NRC approval, provided that the applicant evaluates each such change pursuant to the criteria set forth in 10 CFR 50.59.

As noted in Table 3.6-2, an applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.

### **3.6.4 Evaluation Findings**

The reviewer verifies that the applicant has provided information sufficient to satisfy the provisions of this review plan section, and the staff's evaluation supports conclusions of the following type, to be included in the staff's safety evaluation report:

The staff concludes that the applicant has demonstrated that the aging effects associated with the Electrical and I&C System will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the current licensing basis during the period of extended operation. The staff also concludes that the FSAR supplement contains an appropriate summary description of the programs and activities for managing the effects of aging for the Electrical and I&C System, as reflected in the license conditions.

### **3.6.5 Implementation**

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the method described herein will be used by the staff in its evaluation of conformance with NRC regulations.

### **3.6.6 References**

1. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, July 1981.
2. NUREG-1801, "Generic Aging Lessons Learned (GALL)," U.S. Nuclear Regulatory Commission, April 2001.

**Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL Report**

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended
BWR/PWR	Electrical equipment subject to 10 CFR 50.49 environmental qualification (EQ) requirements	Degradation due to various aging mechanisms	Environmental qualification of electric components	Yes, TLA (see Subsection 3.6.2.2.1)
BWR/PWR	Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure caused by thermal/thermooxidative degradation of organics; radiolysis and photolysis (ultraviolet [UV] sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	Aging management program for electrical cables and connections not subject to 10 CFR 50.49 EQ requirements	No
BWR/PWR	Electrical cables used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements that are sensitive to reduction in conductor insulation resistance (IR)	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced IR; electrical failure caused by thermal/thermooxidative degradation of organics; radiation-induced oxidation; moisture intrusion	Aging management program for electrical cables used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements	No
BWR/PWR	Inaccessible medium-voltage (2 kV to 15 kV) cables (e.g., installed in conduit or direct buried) not subject to 10 CFR 50.49 EQ requirements	Formation of water trees, localized damage leading to electrical failure (breakdown of insulation); water trees caused by moisture intrusion	Aging management program for inaccessible medium-voltage cables not subject to 10 CFR 50.49 EQ requirements	No

**Table 3.6-1. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL Report (continued)**

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended
PWR	Electrical connectors not subject to 10 CFR 50.49 EQ requirements that are exposed to borated water leakage	Corrosion of connector contact surfaces caused by intrusion of borated water	Boric acid corrosion	No

**Table 3.6-2. FSAR Supplement for Aging Management of Electrical and Instrumentation and Control System**

Program	Description of Program	Implementation Schedule*
<p>Aging management program for non-environmentally qualified electrical cables and connections exposed to an adverse localized environment caused by heat, radiation, or moisture.</p>	<p>Accessible electrical cables and connections installed in adverse localized environments are visually inspected at least once every 10 years for cable and connection jacket surface anomalies, such as embrittlement, discoloration, cracking, swelling, or surface contamination, which are precursor indications of conductor insulation aging degradation from heat, radiation or moisture. 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.</p>	<p>First inspection for license renewal should be completed before the period of extended operation</p>
<p>Aging management program for non-environmentally qualified electrical cables used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance, and are exposed to an adverse localized environment caused by heat, radiation, or moisture.</p>	<p>Electrical cables used in circuits with sensitive, low-level signals, such as radiation monitoring and nuclear instrumentation, are tested as part of the instrumentation loop calibration at the normal calibration frequency, which provides sufficient indication of the need for corrective actions based on acceptance criteria related to instrumentation loop performance.</p>	<p>First tests for license renewal should be completed before the period of extended operation</p>
<p>Aging management program for non-environmentally qualified inaccessible medium-voltage cables exposed to an adverse localized environment caused by moisture and voltage exposure</p>	<p>In-scope, medium-voltage cables exposed to significant moisture and significant voltage are tested at least once every 10 years to provide an indication of the condition of the conductor insulation. The specific type of test must be based on technology that is state-of-the-art at the time the test is performed, and must be approved by the NRC staff. Significant moisture is defined as periodic exposures that last more than a few days (e.g., cable in standing water). Periodic exposures that last less than a few days (e.g., normal rain and drain) are not significant. Significant voltage exposure is defined as being subjected to system voltage for more than 25% 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 are not significant for submarine cables).</p>	<p>First tests for license renewal should be completed before the period of extended operation</p>

**Table 3.6-2. FSAR Supplement for Aging Management of  
Electrical and Instrumentation and Control System (continued)**

<b>Program</b>	<b>Description of Program</b>	<b>Implementation Schedule*</b>
Boric acid corrosion.	The program consists of (1) visual inspection of external surfaces that are potentially exposed to boric acid water leakage, (2) timely discovery of leak path and removal of the boric acid residues, (3) assessment of the damage, and (4) follow-up inspection for adequacy. This program is implemented in response to GL 88-05.	Existing program
Quality assurance	The 10 CFR Part 50, Appendix B program provides for corrective actions, the confirmation process, and administrative controls for aging management programs for license renewal. The scope of this existing program will be expanded to include non safety-related structures and components that are subject to an AMR for license renewal.	Program should be implemented before the period of extended operation
<p>* An applicant need not incorporate the implementation schedule into its FSAR. However, the reviewer should verify that the applicant has identified and committed in the license renewal application to any future aging management activities to be completed before the period of extended operation. The staff expects to impose a license condition on any renewed license to ensure that the applicant will complete these activities no later than the committed date.</p>		

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