Direct Testimony and Schedules
Allen L. Hiser, Jr.

BEFORE THE OFFICE OF ADMINISTRATIVE HEARINGS
FOR THE
MINNESOTA PUBLIC UTILITIES COMMISSION
STATE OF MINNESOTA

IN THE MATTER OF XCEL ENERGY'S PETITION FOR APPROVAL OF ITS 2023 ANNUAL FUEL FORECAST AND MONTHLY FUEL COST CHARGES	MPUC Docket No. E002/AA-22-179
	OAH Docket No. 21-2500-40336

DIRECT TESTIMONY OF

ALLEN L. HISER, JR.

On Behalf of

NORTHERN STATES POWER COMPANY

May 1, 2025

Exhibit___(ALH-1)

Cable Replacement and Subsequent License Renewal

Table of Contents

Schedules

I. INTRODUCTION AND QUALIFICATIONS

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Allen L. Hiser, Jr. My business address is 500 Townpark Lane, Kennesaw, Georgia 30144.

Q. BY WHOM ARE YOU EMPLOYED AND WHAT IS YOUR POSITION?

A. I am employed by Enercon as a Senior Principal Regulatory Services Engineer.

Q. FOR WHOM ARE YOU TESTIFYING?

A. I am testifying on behalf of Northern States Power Company – Minnesota, d/b/a Xcel Energy (Xcel Energy or the Company).

Q. PLEASE SUMMARIZE YOUR QUALIFICATIONS AND EXPERIENCE.

A. My qualifications and experience are set forth in my resume, attached as Exhibit___(ALH-1), Schedule 1. I have been employed by Enercon as a Senior Principal Regulatory Services Engineer since April 2024, supporting aging management, long-term operation (LTO), license renewal (LR), and time-limited aging analyses (TLAAs) for domestic and international organizations. Prior to joining Enercon, I worked for 34 years for the US Nuclear Regulatory Commission (NRC), which included 13 years as a Senior-Level Advisor for License Renewal Aging Management. In that position I was the NRC lead for aging management evaluations in the context of LR and subsequent LR (SLR). I earned a Ph.D. in Materials Science and Engineering from Johns Hopkins University.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. Xcel Energy engaged Enercon to review information related to an incident (Event) in October 2023 that caused inadvertent damage to direct current (DC) control cables at the Prairie Island Nuclear Generating Plant (PINGP). Specifically, the Company asked Enercon to opine on: (1) the appropriateness of the Company replacing the damaged cables following the Event, rather than attempting to repair them; (2) the likelihood that these cables would have been identified for replacement during the SLR operating period for PINGP had the Event not occurred; (3) the likelihood that, if not replaced following the Event or during SLR operating period, the cables would have failed, resulting in a forced outage at PINGP; (4) the Company's use of the outage time at PINGP following the Event to perform additional work that avoids future outage time; and (5) whether customers have benefitted from the past performance of PINGP. As part of this engagement, my work focused on issues (1), (2), and (3) and I prepared an Expert Report (Report) summarizing my conclusions. I attach that Report as Exhibit___(ALH-1), Schedule 2.

Q. HOW IS YOUR REPORT ORGANIZED?

A. I first provide background on PINGP, its plan to pursue SLR, the process for LR, NRC guidance for SLR, and the condition of the damaged cables. I then discuss LR and SLR guidance (including current PINGP LR program, Exhibit___(ALH-1), Schedule 3[1]) for instrumentation and control cables such as the DC control cables damaged during the Event. With all of this background, I then discuss SLR for PINGP Units 1 and 2 and the potential that

[1] *"Inaccessible Medium and Low Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Aging Management Program."* H65.2.21, Revision 4; Prairie Island Nuclear Generating Plant.

the DC control cables at issue would have either been identified for replacement during the SLR operating period or would have failed during plant operation, causing a forced outage.

Q. WHAT ARE THE PRINCIPAL CONCLUSIONS OF YOUR REPORT?

A. The principle conclusions discussed in my Report are: (1) Xcel Energy appropriately replaced (rather than attempting to repair) the DC control cables, to safeguard future plant operations and reliability to provide power to its customers; and (2) the DC control cables at issue would likely have been subject to replacement during the SLR operating period either in a planned shutdown due to degradation identified during testing and inspections (~20 percent likelihood) or following an unplanned dual unit outage after a spontaneous cable failure.

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes, it does.

ENERCON

Allen Hiser, Jr., Ph.D

Senior Principal Regulatory Services Engineer

Professional Years of Experience - 47

EDUCATION: Ph.D., Materials and Science Engineering, Johns Hopkins University, Baltimore, MD

MS, Mechanical Engineering, University of Maryland, College Park, MD

BS, Mechanical Engineering, University of Maryland, College Park, MD

PROFESSIONAL ASSOCIATIONS:

International Atomic Energy Agency (IAEA)

- Chairman of Steering Committee of International Generic Aging Lessons Learned (IGALL) Program, Phases 2 to 5 (2013-2021)
- IAEA IGALL Phase 1, Chairman of Working Group 1 Mechanical Components and member of the IGALL Clearing Group (2010-2013)
- Participant in seven pre-SALTO missions to (2x) Angra (Brazil), Laguna Verde (Mexico), Atucha (Argentina), Qinshan (China), Koeberg (South Africa), Mihama (Japan)
- Presenter at six long-term operation (LTO) workshops
- Presenter and session chairman at multiple Plant Life Management (PLiM) Symposia

NOTABLE SKILLS: NRC nuclear plant license renewal; materials engineering; irradiation embrittlement, fracture toughness, and fracture mechanics evaluations of reactor pressure vessel steels; fracture mechanics evaluation of nuclear power plant piping and other components; and corrosion issues for nuclear power plant components, which include stress corrosion cracking, irradiation-assisted stress corrosion cracking (IASCC), boric acid corrosion, flow-accelerated corrosion (FAC).

SUMMARY: Mr. Hiser is a Senior Principal Regulatory Services Engineer who supports aging management, long-term operations (LTO), license renewal (LR), and time-limited aging analysis (TLAAs) for domestic and international organizations. He previously worked for 34 years for the NRC, which included 13 years as a Senior-Level Advisor for LR Aging Management. Mr. Hiser was a reviewer for license renewal applications (LRAs), development of the General Aging Lessons Learned (GALL) and GALL-SLR (Subsequent License Renewal) reports, and development of NRC regulatory positions on LR. He developed and implemented a week-long workshop for foreign regulators on review principles for LR and aging management. Mr. Hiser has extensive interactions with the International Atomic Energy Agency (IAEA) LTO program. He also served as a member of the ASME Boiler and Pressure Vessel Code committees.

ENERCON PROFESSIONAL EXPERIENCE

Senior Principal Regulatory Services Engineer / Regulatory Services / Nuclear Services Group

Mr. Hiser supports ENERCON's regulatory services group in the areas of aging management, LTO, LR, and TLAAs for LRAs and SLRAs. 2023-present

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PREVIOUS PROFESSIONAL EXPERIENCE

U.S. NUCLEAR REGULATORY COMMISSION (NRC) 1990-2023

Senior Materials Engineer (Rehired Annuitant) (2022-2023)

- Knowledge management and knowledge transfer on license renewal and primary circuit component integrity
- Lead for consideration of risk information in license renewal

Senior-Level Advisor for License Renewal Aging Management (2009-retired 2021)

- Reviewer of license renewal applications, development of the GALL and GALL-SLR reports, and development of NRC regulatory positions on license renewal
- Developed and implemented a week-long workshop for foreign regulators on review principles for license renewal and aging management; staff from 13 regulatory bodies (and two licensees) have been participants in these workshops
- Extensive interactions with the IAEA long term operation (LTO) program (see previously for additional information)
- Member of ASME Boiler and Pressure Vessel Code committees

Chief of Steam Generator Integrity and Chemical Engineering Branch (2005-2009)

Supervised staff working as technical experts on issues related to integrity of key NPP components, including steam generators, piping and reactor vessel internals.

Assistant Chief, Materials Engineering Branch, Office of Nuclear Regulatory Research (2003-2005)

Supervised staff working as technical experts on contracts related to integrity of key NPP components, including reactor pressure vessels, steam generators and piping.

Senior Materials Engineer, Materials and Chemical Engineering Branch, Office of Nuclear Reactor Regulation (2001-2003)

- Lead reviewer for CRDM nozzle cracking issues and Davis-Besse corrosion issue
- Witness in criminal cases related to Davis-Besse corrosion issue

Materials Engineer, Materials and Chemical Engineering Branch, Office of Nuclear Reactor Regulation (1994-2001)

Evaluated fracture mechanics and toughness issues related to nuclear power reactor safety.

Materials Engineer, Materials Engineering Branch, Office of Nuclear Regulatory Research (1990-1994)

Responsible for developing, initiating and implementing research contracts related to nuclear power plant operational safety, and independent assessment of critical nuclear power plant safety issues.

ENERCON

MATERIALS ENGINEERING ASSOCIATES, INC. 1981-1990

Mechanical Engineer

- Responsible for a wide range of experimental projects, including experimental and analytical assessments of neutron embrittlement effects on reactor pressure vessel steels, and fracture toughness of piping steels
- Developed more than 20 contracted formal reports for the Nuclear Regulatory Commission, the Electric Power Research Institute and other governmental and private organizations
- Member of ASME Boiler and Pressure Vessel Code committees and ASTM Subcommittee secretary

U.S. NAVAL RESEARCH LABORATORY 1977-1981

Student Trainee

- A part-time position during college undergraduate studies to develop engineering skills and implement testing related to the behavior of reactor pressure vessel (RPV) steels
- Testing of irradiated materials to assess fracture toughness (J-R curves), strength and impact (Charpy-V notch) properties

Brief Bio

Mr. Allen Hiser, PhD., is a Senior Principal Regulatory Services Engineer who supports aging management, long-term operations (LTO), license renewal (LR), and time-limited aging analysis (TLAAs) for domestic and international organizations. He previously worked for 34 years for the NRC, which included 13 years as a Senior-Level Advisor for LR Aging Management. Mr. Hiser was a reviewer for license renewal applications (LRAs), development of the General Aging Lessons Learned (GALL) and GALL-SLR (Subsequent License Renewal) reports, and development of NRC regulatory positions on LR. He developed and implemented a week-long workshop for foreign regulators on review principles for LR and aging management. Mr. Hiser has extensive interactions with the International Atomic Energy Agency (IAEA) LTO program. He also served as a member of the ASME Boiler and Pressure Vessel Code committees.

As a Senior Materials Engineer, Mr. Hiser has expertise in irradiation embrittlement, fracture toughness, and fracture mechanics evaluations of reactor pressure vessel steels; fracture mechanics evaluation of nuclear power plant piping and other components; and corrosion issues for nuclear power plant components, which include stress corrosion cracking, irradiation-assisted stress corrosion cracking (IASCC), boric acid corrosion, flow-accelerated corrosion (FAC). He earned a Ph.D. in Materials Science and Engineering from Johns Hopkins University.

Expert Report

of

Allen L. Hiser

ENERCON

May 1, 2025

Contents

Qualifications and Experience

Mr. Allen Hiser, PhD., has been employed by Enercon as a Senior Principal Regulatory Services Engineer since April 2024. He supports aging management, long-term operation (LTO), license renewal (LR), and time-limited aging analyses (TLAAs) for domestic and international organizations.

He previously worked for 34 years for the US Nuclear Regulatory Commission (NRC), which included 13 years as a Senior-Level Advisor for License Renewal Aging Management. In that position he was the NRC lead for aging management evaluations in the context of LR and subsequent LR (SLR). Mr. Hiser was a reviewer for license renewal applications (LRAs) and assisted in the development of the General Aging Lessons Learned (GALL) report, and he led the development of the GALL-SLR (Subsequent License Renewal) report and NRC regulatory positions on LR and SLR. He developed and implemented a week-long workshop for foreign regulators on review principles for LR and aging management.

Mr. Hiser has extensive interactions with the International Atomic Energy Agency (IAEA) LTO program, including serving as the chairman of the IAEA International Generic Aging Lessons Learned (IGALL) program for almost ten years. He also has supported the IAEA as a subject matter expert for Safety Aspects of Long Term Operation (SALTO) peer reviews at six international plants (China, Japan, South Africa, Mexico, Brazil, and Argentina), and as a trainer at more than ten workshops and training activities. He also served as a member of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code committees.

Mr. Hiser also has expertise in irradiation embrittlement, fracture toughness, and fracture mechanics evaluations of reactor pressure vessel steels; fracture mechanics evaluation of nuclear power plant piping and other components; and corrosion issues for nuclear power plant components, which include stress corrosion cracking, irradiation-assisted stress corrosion cracking (IASCC), boric acid corrosion, flow-accelerated corrosion (FAC). He earned a Ph.D. in Materials Science and Engineering from Johns Hopkins University.

Background

Nuclear power plants in the United States are licensed to operate for 40 years by the US NRC, and licenses may be renewed for an additional operating period of up to 20 years in accordance with Part 54 of Title 10 of the Code of Federal Regulations (CFR) (10 CFR 54, or Part 54), Requirements for Renewal of Operating Licenses for Nuclear Power Plants. Since there are no restrictions on the number of renewals in either Part 54 or the enabling legislation (Sections 103 or 104b of the Atomic Energy Act of 1954, as amended, and Title II of the Energy Reorganization Act of 1974), licenses may be renewed multiple times. For example, "subsequent license renewals" or SLRs are currently being issued by the NRC to enable licenses to be renewed for operation up to 80 years.

The operating license for Prairie Island Nuclear Generating Plant (PINGP), Unit 1, was issued August 9, 1973, and a renewed license (for operation to 60 years) was issued on June 27, 2011, with a license expiration date of August 9, 2033. Similarly, the operating license for PINGP, Unit 2, was issued on October 29, 1974, and a renewed license (for operation to 60 years) was issued on June 27, 2011, with a license expiration date of October 29, 2034.

By letter dated October 31, 2023, Xcel Energy notified the NRC of its plan to apply for the second renewed license for PINGP, in the fourth quarter of calendar year 2026. If approved by the NRC, PINGP, Unit 1, could operate for an additional 28 years (August 9, 2053), and Unit 2 for an additional 29 years (October 29, 2054).

Condition of the Damaged Control Cables

On October 19, 2023, horizontal direction boring at PINGP in support of a planned replacement of the 2RY power cable resulted in inadvertent damage to direct current (DC) control cables, which resulted in a trip of PINGP Unit 1 from 100 percent power. At the time, Unit 2 was in a scheduled refueling outage. Xcel Energy decided to replace the damaged DC control cables in lieu of repair.

During excavation to support the DC control cable replacement, crews also identified additional degradation to other control cables in the same trench that were not affected by the 2RY cable replacement incident. These additional degraded control cables were also replaced.

The original DC control cables were buried in direct contact with the soil, as was typical practice in the early 1970s, and not in an underground cable bus duct or conduit. All of the replacement cables were installed in polyvinyl chloride (PVC) conduit to limit environmental interactions.

The condition of the damaged DC control cables was described as follows:

> Upon investigating the event, the Company discovered that the damaged control cables were aging (about 50 years old) and at risk of additional water intrusion as evident by green discoloration of the copper conductor and jacket embrittlement.

Portions of the damaged DC control cables were sent to the Electric Power Research Institute (EPRI) for testing and assessment.[1] In addition, a sample of backfill from the area of the damaged cables was provided to EPRI.

EPRI has indicated that 11 percent of the cable samples provided were damaged due to heat and 9 percent had cracked or breached jackets. Examination of the cable ends identified that several of the cable portions sent to EPRI displayed a blue-colored copper oxide at the cut surfaces and across some of the adjacent fill material. EPRI has stated that this coloring indicates exposure of the copper conductor to moisture, most likely from breaches in the cable jacket and chlorine present in the polymer. The release of chlorine could occur through pyrolysis of the insulation were it to reach a high enough temperature. Since no other sources of chlorine were present, EPRI has stated that this would indicate that the control cable was overheated.

[1] It is my understanding that EPRI is in the final stages of its engagement and will issue a final report regarding its findings and conclusions in the near-term.

The backfill sample provided to EPRI was observed to be comprised in large part of fine sand of a similar particle size, with a low moisture content, suggesting that thermal resistivity was higher than planned for buried cables. EPRI has further indicated that the high thermal resistivity could lead to cable overheating and hardening of the cable jacket, which could cause cracks to form that would allow moisture intrusion.

EPRI summarizes that the control cable samples provided by PINGP had been subjected to:

- moisture (observed corrosion of the conductor)
- overheating (copper oxide on the conductor and hardened jackets)
- locations where jackets had been cracked

And EPRI concludes that given these three findings, plus the likely high thermal resistance of the backfill (evidenced by inspection), replacement of this cable when excavation damage occurred—rather than simply repairing the cable—represented best industry practice.

Based on the observations of the condition of the damaged DC control cables and the other DC control cables in the same trench, and the results from EPRI's examination of the control cables from PINGP, the decision to replace the DC control cables in lieu of repair was a prudent measure that will ensure future reliability of the control cables.

<u>License Renewal and Subsequent License Renewal</u>

The NRC process and requirements for License Renewal and SLR are the same. However, the NRC guidance for LR and SLR differ, and both the LR and SLR guidance are relevant since PINGP has already gone through the LR process, received NRC approval, and will be going through SLR in the near future. Therefore, I provide background on the LR process and both the LR and the SLR guidance, before addressing the likelihood that the cables damaged during the Event would have been identified for replacement during the SLR operating period.

As described in greater detail below, the NRC guidance for LR does not identify any specific aging management that is needed for the subject DC control cables. In contrast, the NRC guidance for SLR does identify specific aging management for them.

Process for License Renewal

The main elements of the license renewal requirements in Part 54 include submittal of an application,[2] review of the application by the NRC and, if found to be acceptable in accordance with 10 CFR 54.29 (§ 54.29), issuance of the renewed license. The application contains technical information (§ 54.21), technical specification changes or additions (§ 54.22), and environmental information (§ 54.23).

The discussion below focuses on the requirements for the technical information identified in Part 54, specifically the integrated plant assessment (IPA) required by § 54.21(a).

The IPA has three essential purposes:

1. For the systems, structures, and components (SSCs) that are within the scope of license renewal (scoping criteria are provided by § 54.4(a)), to identify the structures and components (SCs) subject to an aging management review, for those SCs that meet these criteria:
    a. Perform an intended function(s) within the scope of § 54.4
    b. Perform the intended function "without moving parts or without a change in configuration or properties" (§ 54.21(a)(1)(i))
    c. Not subject to replacement based on a qualified life or specified time period (§ 54.21(a)(1)(ii))
2. To describe and justify the methods used in item 1 above.
3. To demonstrate that the effects of aging for each SSC identified in item 1 above will be adequately managed so that their intended function(s) will be maintained consistent with the plant current licensing basis for the period of extended operation.

Item 1 describes the "scoping and screening" of "passive and long-lived" SCs that are subject to aging management review (AMR). The criteria of § 54.21(a)(1)(i) [Item 1b] identifies the in-scope SCs that are "passive" and the criteria of § 54.21(a)(1)(ii) [Item 1c] identifies the in-scope SCs that are "long-lived"; SCs meeting both of these criteria are subject to AMR.

Although not explicitly described or defined in Part 54, AMR is implemented to identify the applicable aging effect(s) that can prevent the SC from performing its intended function(s).

[2] An application for license renewal for operation to 60 years is referred to as a license renewal application (LRA), and an application for SLR is referred to as an SLRA.

The aging effects are identified principally by considering the material and the environment for the SC, and the SC itself. Based on the SC and the aging effect(s), an appropriate aging management program (AMP) (or possibly programs) is identified to manage the aging effects(s). In accordance with § 54.29(a)(1), the NRC must make a finding, in part, that there is "reasonable assurance" that the effects of aging on the functionality of in-scope SCs will be managed during the period of extended operation.

NRC Guidance for Subsequent License Renewal

To facilitate an efficient and predictable process for license renewal, the NRC has developed two main guidance documents. The GALL Report provides generic assessments for AMR of SCs that are typically subject to AMR, including identification of materials of construction, environments, and aging effects that require management. The GALL Report also identifies acceptable AMPs, although plant-specific alternatives may be proposed. The NRC initially developed the GALL Report in 2001 for plant operation to 60 years and subsequently in 2017 issued a version of the GALL Report for plant operation to 80 years, the GALL-SLR Report (NUREG-2191). The latter built upon the contents of the last revision of the GALL Report (NUREG-1801, Revision 2) by considering aging management needs for 80 years of operation.

Although AMPs are not specifically identified in Part 54, AMPs are used as a convenient way to communicate the important elements of plant activities to manage the effects of aging for the subject SCs that are required to be age managed, which is identified in the regulations. The overall goal of AMPs is to ensure timely identification of adverse conditions which do not meet acceptance criteria and thus require corrective actions, such as reanalysis, repair, or replacement of the subject SCs before loss of intended function(s).

The initial GALL AMPs (published 2001) relied on lessons learned from plant operating experience, research results, reviewed LRAs, and expert opinion. For plant-specific use of a GALL or GALL-SLR AMP, the plant's operating experience and operating conditions are used to ensure that the AMP is adequate for the plant, as addressed in the abstract of the GALL-SLR Report:

> If an applicant credits an AMP in the GALL-SLR Report, it is incumbent on the applicant to ensure that the conditions and operating experience (OE) at the plant are bounded by the conditions and OE for which the GALL-SLR Report program was evaluated. If these bounding conditions are not met, it is incumbent on the applicant to address any additional aging effects and augment the AMPs for SLR.

Plant AMPs are intended to be "living programs" and "should be informed, and enhanced, when necessary, based on the plant's ongoing review of both plant-specific and industry operating experience"[3]. This "living program" aspect of AMPs is reflected in the "Operating Experience" element of GALL-SLR AMPs, which identifies:

> The program is informed and enhanced, when necessary, through the systematic and ongoing review of both plant-specific and industry OE including research and development such that the effectiveness of the AMP is evaluated consistent with the discussion in Appendix B of the GALL-SLR Report.

The second guidance document for SLR is the Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants, or SRP-SLR (NUREG-2192). The SRP-SLR provides guidance for NRC review of the SLRA, including scoping and screening, and AMR.

One provision of the NRC guidance is that applicants may combine similar SCs into commodity groups. SCs can be combined into commodity groups based on characteristics such as similar function, similar design, similar materials of construction, and similar environments. One commonly used commodity group is for cables that have similar function, design, insulation material, and operating environment. In such a case, the aging effects that require management should be common and thus similar aging management practices should be applicable to all members of the commodity group. The use of commodity groups simplifies the management of their members, since they define populations of what are expected to be identically performing SCs.

<u>LR Guidance for Instrumentation & Control Cables</u>

The renewed license for PINGP to permit plant operation from 40 to 60 years used the GALL report relevant to license renewal (GALL Report Rev. 1 (NUREG-1801, Rev. 1)) as a basis. This report provides no guidance for aging management of inaccessible instrumentation and control cables during the license renewal operating period from 40 to 60 years. This is likely due to the emphasis on control cables with higher voltage levels, which are covered by Chapter XI.E2, "Chapter XI.E2, "Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits," and inaccessible power cables with much higher voltages, which are covered by Chapter XI.E3, "Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental

[3] License Renewal Interim Staff Guidance LR–ISG–2011–05: Ongoing Review of Operating Experience, US Nuclear Regulatory Commission, March 16, 2012.

Qualification Requirements". For the latter GALL Report AMP, medium-voltage cables are defined as those operating from 2 kilovolt (kV) to 35 kV. The replaced 2RX and 2RY power cables operate at 34.5 kV, thus within the scope of the program, whereas the damaged DC control cables operate at 600 volts.

The PINGP license renewal program for power cables (Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program), is described in Prairie Island H Procedure No. H65.2.21[4] (Schedule 3) as managing "the effects of aging resulting from the wetting or submergence of inaccessible low and medium voltage power cables (operating at greater than or equal to 400 V) within the scope of license renewal." In fact, the scope of the PINGP AMP expands the voltage range for the GALL Report AMP but includes only power cables and not DC control cables, consistent with the GALL Report AMP. Thus, the PINGP AMP for license renewal was found to be acceptable by the NRC, and the direct buried DC control cables are not included in the scope of aging management for license renewal at PINGP. This is the current licensing basis for PINGP in the license renewal period.

SLR Guidance for Instrumentation & Control Cables

For SLR, in-scope inaccessible instrumentation and control cables that are installed in duct bank, buried conduit or direct buried are addressed by GALL-SLR AMR Item VI.A.LP-35b, as illustrated in the GALL-SLR Report extract below. This item describes the SC as "Electrical conductor insulation for inaccessible instrumentation and control cables (e.g., installed in duct bank, buried conduit or direct buried)." The various applicable materials for these cables are listed, with an environment of "Adverse localized environment caused by significant moisture." In the case of the DC control cables at PINGP that are direct buried in soil, the adverse environment would be caused by moisture causing aging of the insulation of the cables. Finally, the aging effect and aging mechanism is "Reduced electrical insulation resistance or degraded dielectric strength due to significant moisture."

[4] *"Inaccessible Medium and Low Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Aging Management Program."* H65.2.21, Revision 4; Prairie Island Nuclear Generating Plant.

VI Table A	ELECTRICAL COMPONENTS Equipment Not Subject to 10 CFR 50.49 Environmental Qualification Requirements							
New, Modified, Deleted, Edited Item	Item	SRP Item (Table, ID)	Structure and/or Component	Material	Environment	Aging Effect/Mechanism	Aging Management Program (AMP)/TLAA	Further Evaluation
M	VI.A.LP-35b	3.6-1, 010	Electrical conductor insulation for inaccessible instrumentation and control cables (e.g., installed in duct bank, buried conduit or direct buried)	Various organic polymers such as EPR, SR, EPDM, XLPE, butyl rubber, and combined thermoplastic jacket/insulation shield	Adverse localized environment caused by significant moisture	Reduced electrical insulation resistance or degraded dielectric strength due to significant moisture	AMP XI.E3B, "Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements"	No

EPRI indicated on the as-found degradation of the PINGP control cables that this may be a multi-step process, starting with overheating of the cable causing hardening of the cable jackets. The hardening would then lead to cracking of the cable jacket, permitting moisture intrusion.

The applicable AMP identified in the GALL-SLR report as being acceptable for this AMR item is GALL-SLR XI.E3B, Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements. This AMP uses condition monitoring, including testing and visual inspection of in-scope cables, to manage the aging of the cables within its scope and provide reasonable assurance that the cables will remain functional throughout the operating period of the extended license.

Provisions of this AMP (and the respective AMP element) include:

- Additional tests and periodic visual inspections are determined by the test/inspection results and industry and plant-specific aging degradation OE with the applicable cable electrical insulation. (Scope of Program)
- For this AMP, instrumentation cables are cables carrying either analog or digital signals such as coaxial cable, or cable comprised of twisted 16 or 18 American wire gauge (AWG) conductor shielded pairs rated 300 V with an overall shield. Examples of control cables included in this AMP are multi-conductor 600 V 12 or 14 AWG cables used to monitor or initiate control functions through indication, switches, limit switches, relays, contacts, etc. (Scope of Program)
- Inaccessible and underground instrumentation and control cables within the scope of SLR are periodically visually inspected to assess age degradation of the electrical insulation. (Parameters Monitored or Inspected)
- Visual inspection of inaccessible and underground instrumentation and control cables also includes a determination as to whether other adverse environments exist. Cables subjected to these adverse environments are also evaluated for

significant aging degradation of the cable insulation system. (Parameters Monitored or Inspected)

- For inaccessible instrumentation and control cables exposed to significant moisture, visual inspection frequency is adjusted based on inspection and test results as well as plant-specific and industry OE. For inaccessible and underground instrumentation and control cables exposed to significant moisture where testing is required, a one-time test is performed. Visual inspection occurs at least once every 6 years and may be coordinated with the periodic inspection for water accumulation. (Detection of Aging Effects)
- The cable testing portion of the AMP utilizes sampling. The following factors are considered in the development of the electrical insulation sample: temperature, voltage, cable type, and construction including the electrical insulation composition. A sample of 20 percent with a maximum sample [size] of 25 constitutes a representative cable sample size. (Detection of Aging Effects)
- An unacceptable indication is defined as a noted condition or situation that, if left unmanaged, could potentially lead to a loss of intended function. (Acceptance Criteria)
- Results that do not meet the acceptance criteria are addressed in the applicant's corrective action program under those specific portions of the quality assurance (QA) program that are used to meet Criterion XVI, "Corrective Action," of Part 50 of Title 10 of the Code of Federal Regulations (10 CFR 50), Appendix B. (Corrective Actions)

For sampling programs like GALL-SLR XI.E3B, Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements, corrective actions would include remediation of the identified conditions (i.e., such as reanalysis, repair, or replacement of the subject SCs before loss of intended function(s)) and consideration of sample expansion to potentially include testing and inspection of additional SCs in the scope of the AMP.

<u>SLR for PINGP Units 1 and 2</u>

As noted previously, Xcel Energy has notified the NRC of its plan to submit an application for the second renewed license for the PINGP, in the fourth quarter of calendar year 2026.

During scoping for the development of the PINGP SLRA, the DC control cables at issue will likely be combined into one commodity group to facilitate their treatment for aging management. If the AMP described in GALL-SLR XI.E3B is used without change for the aging management of this commodity group and does not require enhancement to address this plant-specific OE for these types of cables, then a sample of 20 percent of the commodity group (with a maximum sample size of 25 cables) would be subject to testing and inspection.

For AMPs based on sampling of the in-scope SCs like GALL-SLR XI.E3B, the specific cables to be tested and/or inspected would be based on several factors. The factors considered when selecting cables for the sample would include the environmental and operational characteristics of the cables (e.g., exposed to soil or air, moisture content, cable age, average time the cable is energized, etc.). These factors and their influence on causing or accelerating age-related degradation of the cables are intended to identify the cables that are the most susceptible to aging effects throughout the period of extended operation of the plant.

An estimate from PINGP is that more than 100 cables at PINGP may be in the scope of aging management for SLR and potentially placed in the same commodity group as the DC control cables at issue. If the actual number of cables in the commodity group exceeds 125 after SLR scoping, then the sampling of cables with a maximum of 25 samples is potentially much lower than 20 percent of the total population of cables for PINGP for SLR. This maximum number of samples could increase as a result of corrective actions identifying the need for sample expansion due to adverse indications from completed testing and inspection.

Projecting how the DC control cables would be handled in the PINGP SLR aging management process cannot be determined with certainty but can be informed by knowledgeable engineering judgement based on the attributes of the AMP. Because the knowledge of the condition and the environment of the DC control cables has been greatly expanded due to the activities following the October 19, 2023, event, an assessment of the likely treatment of the DC control cables in the SLRA and possible future behavior of the cables to meet their intended function(s) will be bifurcated to consider (a) only the information available prior to October 19, 2023, and (b) the current knowledge base (as of April 15, 2025) from the observations and evaluations on the condition of the DC cables following the October 19, 2023, event, including the completed cable replacement.

Case a – only knowledge prior to October 19, 2023

For this case, the DC control cables will be divided into two groups. Group 1 is the DC control cables that were damaged in 2023 and the other degraded control cables found in the trench, all of which have been replaced, and Group 2 is the remaining DC control cables, the actual condition of which has not been determined. Note that for this Case, the DC control cables damaged in 2023 are not damaged and have not been replaced, but they are degraded, as identified by EPRI. Note that only cables within the scope of aging management review as described in § 54.21(a)(1) would be considered in Group 1 and Group 2.

From discussions with the PINGP Cable Program owner, there have been no observations of significant water issues that would have triggered additional inspections, testing, or other corrective actions out of a concern for an adverse impact on the aging of the DC control cables and would indicate the potential for an adverse localized environment for these cables. This includes no observations of water in manholes nor ponding in the areas with buried DC control cables, and no information on the degraded condition of the DC control cables. Thus, there would be no basis to bias the sampling to either include or exclude the Group 1 DC control cables from selection for testing and inspection.

Case a(1): If the Group 1 DC control cables were included among the sample population that were subject to testing and inspection (e.g., likely less than 20 percent probability for a random sample), then any existing aging degradation would be identified with a high reliability. At this point, the plant would have definitive information on the condition of the Group 1 DC control cables and would be expected to take appropriate corrective actions. With a reasonable expectation that testing and inspection would identify the now-known highly degraded condition of the Group 1 DC control cables and the other control cables in the same vicinity, the correction actions would likely include replacement of the Group 1 DC control cables similar to the actions taken by PINGP following the event in 2023, but this replacement would likely occur in a planned dual unit outage.

Case a(2): If the Group 1 DC control cables were not included among the sample population that were subject to testing and inspection (e.g., likely greater than 80 percent probability with a random sample), then the results from testing and inspection of the likely less than 20 percent sample (and any possible sample expansion) would be used within the AMP to identify any testing or inspection activities that would be necessary for the unsampled Group 1 DC control cables.

Case a(2)(a): For this subcase, the Group 2 DC control cables subjected to testing and inspection (and any potential sample expansion) would not indicate the need for testing and inspection of the Group 1 cables. With the Group 1 cables then not subject to testing and inspection, the indications of significant aging effects on the damaged DC control cables by EPRI would indicate a high likelihood that the Group 1 DC control cables would spontaneously fail to perform their intended functions during the projected 80-year operating period. This would result in plant alarms, spurious operation of equipment, and potentially tripping one or both units. A likely corrective action for this case would be replacement of the control cables with both units in an unplanned outage, similar to the replacement following the event in 2023 which only had one unit trip (the other unit was in a planned refueling outage).

Case a(2)(b): For this subcase, the Group 2 control cables subject to testing and inspection, due to original sampling or potential sample expansion, would indicate the need for testing and inspection of the Group 1 cables, and any existing aging degradation in the Group 1 cables would be identified with a high reliability. This case would proceed along the same path as Case a(1), and the correction actions would likely include replacement of the affected DC control cables similar to the actions taken by PINGP following the event in 2023, but this replacement would likely occur in a planned dual unit outage.

Case b – the current knowledge base (as of April 15, 2025)

The two key pieces of information that are available as of April 15 are (1) aging degradation is occurring in the DC control cables, and (2) the subject DC control cables have been replaced and should have an extremely high reliability through the projected 80-year operating period.

The observations and conclusions from the observed aging degradation of the DC control cables would be considered within the SLR AMP as plant-specific operating experience for selection of samples to be tested and inspected within the AMP. This information should permit the AMP to identify a cable sampling approach that would be more likely to identify additional degraded cables, if there are any, and to provide an overall enhanced reliability of the cables addressed by the AMP beyond that available with only the knowledge before October 19, 2023, as described in Case a.

Because the DC control cables damaged in the 2023 event, along with the other control cables in the same trench, have been replaced and placed within PVC conduits to further protect them from environmental conditions, this population of replaced DC control cables should have a very high reliability through the projected 80-year operating period, with loss of intended function(s) from these cables at the lowest likelihood.

Observations on PINGP AMP Implementation Effectiveness

One indication of the effectiveness of AMP implementation at PINGP is the process that was used to monitor and plan for replacement of the 2RY Transformer Cable, Cable 2RYCS1. This cable is in the scope of the existing PINGP Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program, which is described in Procedure H65.2.21 as managing "the effects of aging resulting from the wetting or submergence of inaccessible low and medium voltage power cables (operating at greater than or equal to 400 V) within the scope of license renewal." The program includes testing of cables at least every six years.

After identifying a trend of declining test results, the frequency of testing of power cable 2RYCS1 was increased. Ultimately, a decision was made to replace this cable when the test results indicated that cable replacement should be scheduled. Along with replacement of the 2RYCS1 power cable, the replacement work included replacement of the similar 2RXCS1 power cable.

The test schedule implementation for the 2RYCS1 power cable was effective in identifying the need to replace the power cable, and a decision to replace the similar 2RXCS1 power cable, indicating effective implementation of the PINGP Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program in identifying the need for corrective action to the power cables included in the AMP.

Conclusions

1. Appropriateness of replacing rather than repairing the DC cables.

The damaged DC control cables were found by EPRI to be highly degraded, with cracking and corrosion of the cables indicating that failure was likely to occur within the intended SLR operating period, which would end in 2054 for Unit 2. The condition of the cables was a main driver in the decision to replace the control cables, as identified in 22-0179 DOC-035 Supplement 1 PUBLIC (provided as Exhibit___(NJD-1), Schedule 2), and this condition was confirmed by EPRI.

Repair of the damaged cables would have faced significant challenges if it had in fact been feasible from an operation perspective. The extensive degradation of the damaged DC control cables identified upon excavation of the cable trench, along with the degradation of the other control cables in the trench, mean that finding locations in the original cables that would have an adequate condition to provide a tie-in for the repair would have been difficult, if possible. The uncertainties in performing the repair due to these challenges is large, and implementing repairs may have incurred additional down time if the repairs were attempted but ultimately found to be infeasible due to the poor condition of the cables, and instead cable replacement was necessary.

The testing of the cables is a lengthy time item that is necessary to ensure correct equipment operation. The necessary time for testing of the cables, whether repaired or replaced, would be the same. However, there would be a greater likelihood of issues identified by the testing for the repair caused by the poor condition of the original cables. And with a repair likely requiring replacement in the future, another round of testing would have been required upon replacement.

With a repair, any remnants of the original cables that would still be used in service would continue to be exposed to a degrading environment (e.g., moisture and overheating that accelerated the aging effects) which would have made the future need for additional repairs or ultimately replacement almost certain.

Thus, repair of the damaged cables would not have been a permanent solution, and the repaired areas (splices, etc.) would have created additional locations for degradation and potential cable failure. These additional locations would have required additional testing and inspections to ensure their continued acceptable condition. Finally, any repair of the degraded cables would likely have left a vulnerable section from the original cable or the repair area that would have an elevated risk of failure during operation of both units, potentially causing a trip of both units.

Replacement of the DC control cables significantly reduces the need for future monitoring and testing of the cables, due to their short environmental exposure over the remaining intended ~30-year service period, if SLR is approved. In addition, the placement of the new cables in PVC conduit will significantly reduce the environmental stressors on the cables and greatly reduce the future degradation of the cables.

Based on the above discussion, replacement of the DC control cables was the appropriate step for Xcel Energy to take to safeguard future plant operations and reliability to provide power to its customers.

2. SLR Process Scenario.

The following discussion is predicated on the degradation of the DC control cables not being identified prior to entry to SLR, and the state of knowledge on the condition of the cables and their degradation progression limited to that known before October 19, 2023.

The DC control cables would almost certainly have been in the scope of SLR as a part of a commodity group. The GALL-SLR AMP that would have been used for the cables, GALL-SLR XI.E3B, Electrical Insulation for Inaccessible Instrument and Control Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements, implements testing and inspection on a sampling basis, which would likely have resulted in a less than 20 percent chance of these control cables having testing and inspection. Since there would be no information to indicate a higher sensitivity to degradation of the subject DC control cables over the rest of the commodity group, there is likely more than an 80 percent chance that no testing or inspections would have been required for them based on initial sampling by the AMP. There is an unquantifiable chance that the subject DC control cables would be a part of sample expansion based on the results from the initial sampling of cables, since it is unknown if the condition of the sampled cables would have warranted sample expansion.

If the cables were selected for testing and inspection during the SLR operating period, it is likely that the degradation would be identified, and the cables would be identified for replacement. However, as indicated above, the likeliness that this chain of events would have occurred is probably less than 20 percent, plus an unquantifiable chance that the subject DC control cables would be a part of sample expansion.

If the cables were not subject to testing and inspection (likely greater than an 80 percent probability minus an unquantifiable chance that the subject DC control cables would be a part of sample expansion), then the risk that they would spontaneously fail at some point when both units are operating and producing power for Xcel Energy's customers is significant (based on refueling schedule timing). This would result in plant alarms, spurious operation of equipment, and potentially tripping one or both units. A likely corrective action for this case would be replacement of the control cables as occurred following the event in 2023, but now with both units in an unplanned outage.

In summary, the DC control cables at issue would likely have been subject to replacement during the SLR operating period, either in a planned shutdown due to degradation identified during testing and inspections (~20 percent likelihood) or following an unplanned dual unit outage after a spontaneous cable failure.

Acronym List

AMP	Aging management program
AMR	Aging management review
ASME	American Society of Mechanical Engineers
AWG	American wire gauge
CFR	Code of Federal Regulations
DC	Direct current
EPRI	Electric Power Research Institute
FAC	Flow-accelerated corrosion
GALL	Generic Aging Lessons Learned
GALL-SLR	Generic Aging Lessons Learned for Subsequent License Renewal
IAEA	International Atomic Energy Agency
IASCC	irradiation-assisted stress corrosion cracking
IGALL	International Generic Aging Lessons Learned
IPA	integrated plant assessment
kV	kilovolts
LR	License renewal
LRA	License renewal application
LTO	Long-term operation
NRC	(U.S.) Nuclear Regulatory Commission
OE	Operating experience
PINGP	Prairie Island Nuclear Generating Plant
PVC	Polyvinyl chloride
QA	Quality assurance
SALTO	Safety Aspects of Long Term Operation
SLR	Subsequent or second license renewal
SLRA	Subsequent or second license renewal application
SCs	Structures and components
SSCs	Systems, structures, and components
TLAA	Time-limited aging analyses

H	INACCESSIBLE MEDIUM AND LOW VOLTAGE CABLES NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS AGING MANAGEMENT PROGRAM	NUMBER: H65.2.21
		REV: 4
		Page 1 of 14

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H	INACCESSIBLE MEDIUM AND LOW VOLTAGE CABLES NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS AGING MANAGEMENT PROGRAM	NUMBER: H65.2.21
		REV: 4
		Page 2 of 14

TABLE OF CONTENTS

LIST OF TABLES

1.0 PURPOSE

1.1 To identify and describe the Inaccessible Medium and Low Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Aging Management Program and associated activities credited for managing specific aging effects.

1.2 This procedure specifies the implementing documents for and describes the implementation of the ten elements of an aging management program described in the USAR.

2.0 APPLICABILITY

2.1 This instruction applies to renewed license activities required by an aging management program (AMP) which is part of the current licensing basis under the renewed operating licenses. Prairie Island received renewed operating licenses on June 27, 2011.

3.0 PROGRAM DESCRIPTION

3.1 LRA Appendix B Summary Description

3.1.1 The Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program manages the effects of aging resulting from the wetting or submergence of inaccessible low and medium voltage power cables (operating at greater than or equal to 400V) within the scope of license renewal.

3.1.2 The program manages the effects of aging through the performance of periodic testing of inaccessible low and medium voltage power cables within the scope of license renewal and exposed to significant moisture.

A. Significant moisture is defined as periodic exposures to moisture that last more than a few days (e.g., cable wetting or submergence in water).

B. Inaccessible cables at PINGP are located in underground ducts or direct buried, and as such have the potential to be exposed to significant moisture, therefore, inaccessible low and medium voltage power cables within the scope of this program are subject to testing.

C. The program will test the inaccessible low and medium voltage power cables within the scope of license renewal and exposed to significant moisture to provide an indication of the condition of the conductor insulation.

D. The testing performed will be a proven test for detecting deterioration of the insulation system due to wetting or submergence.

E. Testing of the inaccessible low and medium voltage power cables within the scope of license renewal and exposed to significant moisture is performed at least once every six years.

F. The first tests for License Renewal are to be completed before the period of extended operation.

3.1.3 The program also includes actions to limit the exposure of in-scope inaccessible low and medium voltage power cable to long term significant moisture through periodic manhole and pull box inspections for water accumulation, and draining of water, as needed.

A. The Manhole and pull box inspection frequency will be based on actual plant experience with water accumulation.

1. However, the inspection frequency will be at least once every five years.
2. The first inspection for License Renewal will be completed before the period of extended operation.
3. Manhole and pull box inspections are also performed following a flooding event where the river level reaches an elevation where water intrusion might be expected to occur.

3.1.4 This program considers the technical guidance provided in NUREG/CR-5643, IEEE Std. P1205, SAND9B-OSat.4, and EPRI TR-109619.

3.2 LRA Appendix B Conclusion

3.2.1 The Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program is a new program that implements periodic tests on inaccessible non-EQ low and medium voltage power cables within the scope of License Renewal and exposed to wetting or submergence,

3.2.2 Implementation of the Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program provides reasonable assurance that aging effects will be managed such that electrical cables within the scope of this program will continue to perform their intended function(s) during the period of extended operation.

3.2.3 This program will be implemented prior to the period of extended operation.

3.3 NRC Commitments

3.3.1 LR Commitment #17: An Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program will be implemented. Program features will be as described in LRA Section B2.1.21.

A. Significant details of commitment #17 from SER NUREG-1960, Supplement #1 are the following:

1. The Inaccessible Medium Voltage Cables Subject to 10 CFR 50.49 Environmental Qualification Requirements Program is expanded to include 400V to 2kV inaccessible low voltage power cables.

2. The exposure to significant voltage (system voltage for more than 25 percent of the time) criterion applied to inaccessible medium voltage cables (2kV to 35kV) is deleted.

3. Significant moisture is defined as periodic exposures to moisture that last more than a few days (e.g., cable wetting or submergence in water).

4. The Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program is expanded to include the inspection of pull boxes with conduit ends containing in-scope inaccessible low and medium voltage power cables for accumulation of water and draining of water, if necessary.

5. Manhole and pull box inspection frequencies will be based on actual plant-specific OE with water accumulation, but the inspection frequency will be at least once every 5 years (Revised by USAR change 604000000561).

6. The Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program is expanded to include event-driven inspections (e.g., manhole and pull box inspections following a flooding event where river level reaches an elevation where water intrusion might be expected to occur).

7. The cable test frequency is revised to at least once every 6 years.

8. The initial pull box inspections conducted prior to the period of extended operation will provide baseline information to be used to establish the frequency of future inspections. Additional event-based pull box inspections are to be considered should initial and subsequent inspection indicate water intrusion may be occurring as a result of external events such as heavy rain.

4.0 PROGRAM ELEMENTS

4.1 Scope of Program

4.1.1 Cables and connections included within the scope of the Inaccessible Medium Voltage Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements Program (Inaccessible Medium Voltage Cables Program) include all non-EQ medium voltage cables and connections in scope of License Renewal and identified in PINGP Aging Management Report LR-AMR-339, “Electrical Commodities” as meeting all the requirements that promote the adverse localized environment of reduced insulation resistance from water treeing:

- Insulation contains a manufacturer’s flaw (conservatively assumed present)
- Voltage Stress at 2 kV levels through 35 kV
- Moist/Wet environment greater than a few days at a time (underground installation)

4.1.2 The scope of the program also includes inaccessible low voltage (400 V to 2kV) power cables that are subject to aging management review and are exposed to significant moisture. Significant moisture is defined as periodic exposures to moisture that last more than a few days (e.g., cable wetting or submergence in water).

4.1.3 Inaccessible cables at PINGP are located in underground ducts or direct buried, and as such have the potential to be exposed to significant moisture, therefore, inaccessible low and medium voltage power cables within the scope of this program are subject to testing.

4.1.4 The Inaccessible Medium Voltage Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements Program manages the aging effect of reduced insulation resistance from the adverse localized environment (moisture) of low and medium voltage power cable and connection insulations by detecting degradation of insulation resistance through periodically testing using a specific test (such as insulation resistance tests, time domain reflectometry tests, or other tests effective in determining cable insulation condition) that would provide an indication of the condition of the conductor insulation.

A. The cables will be tested at least once every six years. The first tests for license renewal are to be completed before the period of extended operation.

4.1.5 The manhole between the switchyard and the Cooling Tower (CT) Buses will also be inspected for water accumulation.

A. The program includes periodic inspections of the manhole for the accumulation of water over the medium-voltage cables.

B. The inspections will be performed based on actual plant experience with water accumulation in the manhole.

C. However, the inspection frequency will be at least once every five years.

D. The first inspection for license renewal is to be completed before the period of extended operation. Additionally, manhole inspections will also be performed following a flooding event where the river level reaches an elevation where water intrusion might be expected to occur.

4.1.6 The scope of the program also includes the inspection of pull boxes with conduit ends associated with inaccessible low and medium voltage power cables that are subject to aging management review, for the accumulation of water, and draining of water, if necessary.

A. The configuration of the in-scope pull boxes and associated conduit will be evaluated, and pull boxes where water would be expected to accumulate, will be inspected.

B. The pull box inspection frequency will be based on actual plant experience with water accumulation; however, the inspection frequency will be at least once every five years.

C. Additionally, pull box inspections will also be performed following a flooding event where the river level reaches an elevation where water intrusion might be expected to occur.

4.1.7 The Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program manages the aging effects of the reduction of insulation resistance by periodic testing of inaccessible non-EQ low and medium voltage power cables that are subject to aging management review and exposed to significant moisture.

A. The inaccessible medium voltage cables identified in PINGP Aging Management Report LR-AMR-339 “Electrical Commodities” as meeting all the conditions required that could promote the formation of water trees in the insulation and supporting License Renewal loads require aging management by this program.

B. The Inaccessible Medium Voltage Cables Not Subject To 10 CFR 50.49 Environmental Qualification Requirements Program does not rely upon any other program to detect the reduction of insulation resistance in the non-EQ inaccessible low and medium voltage power cables.

4.1.8 This PINGP AMP manages aging effects due to the aging mechanisms shown in Table 1 for the components in the systems and/or structures listed above. Program implementing documents are listed in Table 2.

4.2 Preventive Actions

4.2.1 The periodic testing program provides an indication of the condition of the conductor insulation.

4.2.2 The program also includes actions to limit the exposure of inaccessible low and medium voltage power cables that are subject to aging management review, to long term significant moisture through periodic manhole and pull box inspections for water accumulation and draining of water, as needed.

4.3 Parameters Monitored/Inspected

4.3.1 The periodic testing program provides an indication of the condition of the conductor insulation.

4.3.2 The program also includes actions to limit the exposure of inaccessible low and medium voltage power cables that are subject to aging management review, to long term significant moisture through periodic manhole and pull box inspections for water accumulation and draining of water, as needed.

4.3.3 Manhole and pull box inspections will also be performed following a flooding event where the river level reaches an elevation where water intrusion might be expected to occur.

4.3.4 The type of test performed will be a proven test for detecting deterioration of insulation due to wetting, such as power factor, partial discharge, or other state-of-the-art test.

4.4 Detection of Aging Effects

4.4.1 All low and medium-voltage insulated power cables that are subject to aging management review and subject to long periods of high moisture conditions are tested (such as insulation resistance tests, time domain reflectometry tests, or other tests effective in determining cable insulation condition), at least once every six years to provide an indication of the condition of the cable insulation and the ability of the cable to perform its intended function.

A. This is an adequate period to preclude failures of the conductor insulation since experience has shown that aging degradation is a slow process.

4.4.2 Periodic inspections (periodicity will be based on inspection results) of manholes and pull boxes, for water accumulation and draining of water, as needed, will be conducted to minimize the catalyst of prolonged moisture conditions that promotes degradation of the cable insulation.

A. However, the inspection frequency will be at least once every five years.

B. The first cable insulation tests and manhole/pull box inspections for License Renewal are to be completed prior to the period of extended operation.

C. If an unacceptable condition or situation is identified, a determination would be made as to whether the same condition or situation is applicable to other inaccessible low and medium-voltage power cables that are subject to aging management review.

4.4.3 Manhole and pull box inspections will also be performed following a flooding event where the river level reaches an elevation where water intrusion might be expected to occur.

4.5 Monitoring and Trending

4.5.1 Trending actions are not included as part of this program because the ability to trend inspection or test results is limited and dependant on the specific type of test selected. If opportunities of trending become available, trending will be used as a performance tool.

4.6 Acceptance Criteria

4.6.1 The acceptance criteria for each test is defined by the specific type of test performed and the specific cable tested.

4.6.2 Periodic and event based manhole and pull box inspections (and drainage), for the accumulation of water around low and medium-voltage power cables, **SHALL** minimize time periods the cables and connections are exposed to water.

4.7 Corrective Actions

4.7.1 An assessment is performed when the test acceptance criteria are not met in order to ensure that the intended functions of the insulated cables and connections used in low and medium-voltage circuits can be maintained consistent with the current licensing basis.

4.7.2 The assessment **SHALL** include the significance of the test results, the operability of the component, the reportability of the event, the extent of the concern, the potential cause for not meeting the test criteria, the corrective actions required, and the likelihood of recurrence.

A. 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 low and medium-voltage cables that are subject to aging management review and whether additional testing or an increased testing frequency should be considered.

B. If unacceptable water levels are encountered during the manhole and pull box inspections, corrective actions (such as pumping down the water levels below the routed cables) **SHALL** be initiated.

C. Event based inspections would also be considered should the initial or subsequent inspections indicate that water intrusion may be occurring as the result of external events such as heavy rain.

4.7.3 Repair and replacement actions are initiated as necessary and corrective actions are taken to prevent recurrence. See LR-TR-519, Element 7, Corrective Actions, for further discussion of this element.

4.7.4 For those structures or components identified as within the scope of license renewal and subject to an AMR, the requirements of 10 CFR Part 50, Appendix B program address the corrective actions, confirmation process, and administrative controls for aging management during the period of extended operation.

4.8 Confirmation Process

4.8.1 Corrective action effectiveness is part of the PINGP Corrective Action Program.

4.8.2 See LR-TR-519, Element 8, Confirmation Process, for further discussion of this element.

4.9 Administrative Controls

4.9.1 See LR-TR-519, Element 9, Administrative Controls, for the discussion of this element.

4.10 Operating Experience

4.10.1 The primary source of industry OE includes INPO documents, NRC communications, and Westinghouse documents, as applicable. The primary source of plant-specific OE includes Corrective Action Program issues, NRC Inspection Reports, Program Examination Results, Program Assessments and Evaluations, and INPO Evaluations, as applicable.

4.10.2 Appropriate guidance is contained in FP-PA-ARP-01 to ensure age-related degradation of structures and components is evaluated and considered for re-evaluation, repair, or replacement.

4.10.3 Ongoing review of both internal and external OE in accordance with H65 ensures operating experience will continue to be adequately addressed and incorporated into the Aging Management Program or activity and that potential age-related degradation will be adequately maintained during the period of extended operation.

5.0 REFERENCES

5.1 Program References

5.1.1 USAR Appendix L.2.21

5.2 Records

5.2.1 LR-TR-519, Aging Management Program Elements 7, 8, and 9

5.2.2 LR-TR-511, Operating Experience Data Collection Report

5.2.3 LR-AMP-432, Inaccessible Medium Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Program

5.2.4 LRA Section B2.1.21

5.2.5 NUREG-1960, Section 3.0.3.1.12, NUREG-1960 Supplement 1, Section 3.0.3.1.12

5.2.6 L-PI-10-109, Enclosure 1, Pages 9 and 10

5.2.7 AR 01162919 - LR Commitment 17 - Implement XI.E3 Program

5.2.8 LR-AMR-339, Electrical Commodities

Table 1 Managed Aging Effects

Item/Material	Environments (Stressors)	Aging Effect	Aging Mechanism(s)
Inaccessible Medium Voltage Cables and Connections (Insulation), underground, buried	Moisture and Voltage Stress	Reduced insulation resistance (formation of water trees) and electrical failure	Reduced insulation resistance caused by formation of water trees could lead to electrical failure

Table 2 Implementing Documents

Document Number	Title
AB-4	Flood
FP-PE-CBL-01	Cable Condition Monitoring Program
PE 4825	Testing of Cables Rated Greater Than 600 Volts
PE 4826	Testing of Cables Rated Less Than 600 Volts
MSIP 3000	Motor Megger
MSIP 3033	Off-Line Motor Testing Using the PDMA Motor Tester

Table 3 Implementing Maintenance Plans

Maintenance Plan	Title
10006669	OFFLINE TEST-MTR 211D(21 D5 DSL RM FAN)
10017005	OFFLINE TEST-MTR 221D(22 D6 DSL RM FAN)
10017022	OFF LINE TEST - 121 SCRNWSH PMP MTR
10017036	MANHOLE 13.8KV INSP
10008412	TEST CABLE 24505-1(CT12 TO 4KV BUS 25)
10014258	TEST CBLS 26413-1&2(CT12 TO 4KV BUS 26)
10011115	121 MDCLP OFF-LINE PDMA TEST
10014314	TEST CABLE 221C-4 (UNDRGRD TO MCC 1AB2)
10014548	TEST CTSUB-1 CABLES PER PE 4825
10014549	TEST CTSUB-2 CABLES PER PE 4825
10013785	TEST 2RXCS1 CABLES PER PE 4825
10013786	TEST 2RYCS1 CABLES PER PE 4825
10009048	TEST UNDERGROUND MV CABLE 15407-4
10014619	TEST CABLE 13408-2(11 CL PMP CABLE)
10014627	TEST CABLE 16408-2(BUS 16 FDR CABLE)
10014633	TEST CABLE 23404-2(21 CL P CABLE)
10009987	INSP PB 1181 FOR WTR INTRUSION
10009988	INSP PB 1180 FOR WTR INTRUSION
10015133	INSP JB 1045 FOR WTR INTRUSION
10009989	INSP JB 1046 FOR WTR INTRUSION
10015134	INSP JB 1051 FOR WTR INTRUSION
10015135	INSP JB 2046 FOR WTR INTRUSION
10015136	INSP PB 2181 FOR WTR INTRUSION
10015137	INSP PB 2177 FOR WTR INTRUSION
10015138	INSP PB 2045 FOR WTR INTRUSION
10009990	INSP JB 2051 FOR WTR INTRUSION
10015201	TEST CBL 1AB2-20(MCC 1AB2 TO CL HDR)
10010164	TEST CABLE 185-2 (BKR 185 TO 121 MDFP)
10014042	TEST CABLE 1AB1-20, MCC 1AB1 TO MV32031
10010165	TEST CABLE 111C-5 (FDR TO MCC 1AB1)
10015531	BUS CT1 TO CT11/XFMR CABLE TESTING
10015532	BUS CT2 TO CT12/XFMR CABLE TESTING