APPENDIX K

LICENSE RENEWAL UPDATED SAFETY ANALYSIS REPORT SUPPLEMENT

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APPENDIX K - LICENSE RENEWAL UPDATED SAFETY ANALYSIS REPORT SUPPLEMENT

1.0 INTRODUCTION

This appendix provides the Updated Safety Analysis Report (USAR) Supplement as required by 10 CFR 54.21(d) for the Cooper Nuclear Station (CNS) License Renewal Application (LRA). Appendix B of the CNS LRA provides descriptions of the programs and activities that manage the effects of aging for the period of extended operation. Section 4 of the LRA documents the evaluations of time-limited aging analyses for the period of extended operation. Appendix B and Section 4 have been used to prepare the summary program and activity descriptions for the CNS USAR Supplement information in this appendix.

The information presented in this section has been incorporated into the USAR following issuance of the renewed operating license. Upon inclusion of the USAR Supplement in the CNS USAR, future changes to the descriptions of the programs and activities are made in accordance with 10 CFR 50.59.

The following information documents aging management programs and activities credited in the Cooper Nuclear Station (CNS) license renewal review [Section K-2.1] and time-limited aging analyses [Section K-2.2] evaluated for the period of extended operation.

2.0 AGING MANAGEMENT PROGRAMS AND ACTIVITIES

The CNS license renewal application (Reference 1) and information in subsequent related correspondence provided sufficient basis for the NRC to make the findings required by 10 CFR 54.29 (Final Safety Evaluation Report) (Reference 2). As required by 10 CFR 54.21(d), this USAR supplement contains a summary description of the programs and activities for managing the effects of aging [Section K-2.1] and a description of the evaluation of time-limited aging analyses for the period of extended operation [Section K-2.2]. The period of extended operation is the 20 years after the expiration date of the original operating license.

2.1 Aging Management Programs

The integrated plant assessment for license renewal identified aging management programs necessary to provide reasonable assurance that components within the scope of license renewal will continue to perform their intended functions consistent with the current licensing basis (CLB) for the period of extended operation. This section describes the aging management programs and activities required during the period of extended operation. All aging management programs will be implemented prior to entering the period of extended operation.

CNS quality assurance (QA) procedures, review and approval processes, and administrative controls are implemented in accordance with the requirements of 10 CFR 50, Appendix B. The CNS Quality Assurance Program applies to safety-related structures and components. Corrective actions and administrative (document) control for both safety-related and nonsafety-related structures and components are accomplished per the existing CNS Corrective Action Program and Document Control Program and are applicable to all aging management programs and activities that will be required during the period of extended operation. The confirmation process is part of the Corrective Action Program and includes reviews to assure adequacy of proposed actions, tracking and reporting of open corrective actions, and review of corrective action effectiveness. Any follow-up inspection required by the confirmation process is documented in accordance with the Corrective Action Program. The corrective action, confirmation process, and administrative controls of the CNS (10 CFR Part 50, Appendix B) Quality Assurance Program are applicable to all aging management programs and activities required during the period of extended operation.

2.1.1 Aboveground Steel Tanks Program

The Aboveground Steel Tanks Program is a new program that manages loss of material from external surfaces of outdoor, aboveground carbon steel tanks by periodic visual inspection of external surfaces and thickness measurement of locations that are inaccessible for external visual inspection.

This new program was implemented consistent with the corresponding program described in NUREG-1801, Section XI.M29, Aboveground Steel Tanks, prior to the period of extended operation. Thickness measurements will be performed at least once during the first ten years of the period of extended operation and periodically thereafter. The results of the initial inspection will be used to determine the frequency of subsequent inspections.

2.1.2 Bolting Integrity Program

The Bolting Integrity Program is an existing program that relies on recommendations for a comprehensive bolting integrity program, as delineated in NUREG-1339, industry recommendations, and Electric Power Research Institute (EPRI) NP-5769, with the exceptions noted in NUREG-1339 for safety-related bolting. The program relies on industry recommendations for comprehensive bolting maintenance, as delineated in EPRI TR-104213 for pressure retaining bolting and structural bolting.

The program applies to bolting and torquing practices of safety- and nonsafety-related bolting for pressure retaining components, NSSS component supports, and structural joints. The program addresses all bolting regardless of size except reactor head closure studs, which are addressed by the Reactor Head Closure Studs Program [Section K-2.1.32]. The program includes periodic inspection of closure bolting for signs of leakage that may be due to crack initiation, loss of preload, or loss of material due to corrosion. The program also includes preventive measures to preclude or minimize loss of preload and cracking.

The Bolting Integrity Program was enhanced as follows.

- Included guidance from EPRI NP-5769 and EPRI TR-104213 for material selection and testing, bolting preload control, ISI, plant operation and maintenance, and evaluation of the structural integrity of bolted joints.
- Clarified that actual yield strength is used in selecting materials for low susceptibility to stress corrosion cracking, that the use of lubricants containing MoS_2 is prohibited for bolting at CNS, and that proper gasket compression will be visually verified following assembly.
- Included guidance from EPRI NP-5769 and EPRI TR-104213 for replacement of non-Class 1 bolting and disposition of degraded structural bolting.

Enhancements were implemented prior to the period of extended operation.

2.1.3 Buried Piping and Tanks Inspection Program

The Buried Piping and Tanks Inspection Program is a new program that includes (a) preventive measures to mitigate corrosion and (b) inspections to manage the effects of corrosion on the pressure-retaining capability of buried carbon steel, and gray cast iron components. Preventive measures are in accordance with standard industry practice for maintaining external coatings and wrappings. Buried components are inspected on a periodic basis, as well as when excavated during maintenance. If trending within the corrective action program identifies susceptible locations, the areas with a history of corrosion problems are evaluated for the need for additional inspection, alternate coating, or replacement.

The Buried Piping and Tanks Inspection Program included a risk assessment of in-scope buried piping and tanks that included consideration of the impacts of buried piping or tank leakage and of conditions affecting the risk for corrosion. The piping segments and tanks were classified as having a high, medium or low impact of leakage based on items such as the safety class, the hazard posed by fluid contained in the piping, and the impact of leakage on plant operation. The corrosion risk was determined through consideration of items such as piping or tank material, soil resistivity, drainage, the presence of cathodic protection, and the type of coating.

Prior to the PEO, inspections were performed for buried piping and tanks in six systems. These systems were diesel generator fuel oil (DGFO), standby gas treatment, high pressure coolant injection (HPCI), service water (SW), condensate makeup (CM), and plant drains. Planned or opportunistic direct visual inspections of excavated piping were performed for DGFO, standby gas treatment, plant drains, SW, and CM systems. NPPD used a non-visual examination method for the emergency condensate storage tank supply to HPCI piping due to its lack of ready access for excavation. The total linear feet of piping inspected using all of the methods discussed above was required to be a minimum of 2% of all high-risk in-scope buried piping. However, the risk assessment did not classify any in-scope buried piping as being high-risk. Notwithstanding, the amount of piping inspected in each of the above systems exceeded 2% of the in-scope buried piping for each system.

During the PEO, examinations of in-scope buried piping and tanks will be performed at a frequency of at least once every 10 years. Examinations will consist of visual inspections as well as non-destructive examination (e.g. ultrasonic and guided wave) to perform an overall assessment of the condition of buried piping and tanks. The examinations will include visual inspection of at least eight feet of excavated piping on at least three high-risk in-scope systems, and will examine a minimum of 2% of the total linear feet of high-risk in-scope buried piping during each 10-year period.

The cathodic protection system is maintained and annually tested in accordance with NACE standards RP0285-2002 and SP0169-2007 with a minimum system availability of 90%. If 90% availability is not maintained, the condition is entered into the corrective action program to evaluate the impact and effect corrective actions.

This new program was implemented consistent with the corresponding program described in NUREG-1801, Section XI.M34, Buried Piping and Tanks Inspection, prior to the period of extended operation.

2.1.4 BWR CRD Return Line Nozzle Program

The BWR Control Rod Drive (CRD) Return Line Nozzle Program is an existing program. Under this program, CNS has cut and capped the CRD return line nozzle to mitigate fatigue cracking and continues Inservice Inspection (ISI) examinations using ASME Section XI to monitor the effects of crack initiation and growth on the intended function of the control rod drive return line nozzle. ISI examinations include ultrasonic inspection of the nozzle inside radius section and nozzle-to-vessel weld. CNS also conducts UT examinations of the CRD return line nozzle-to-cap weld in accordance with the guidelines of staff-approved boiling water reactor vessel and internals project (BWRVIP) document BWRVIP-75-A as part of the BWR Stress Corrosion Cracking Program [Section K-2.1.7].

2.1.5 BWR Feedwater Nozzle Program

The BWR Feedwater Nozzle Program is an existing program. Under this program, CNS has removed feedwater nozzle cladding and installed a double piston ring, triple thermal sleeve sparger to mitigate cracking. This program implements enhanced inservice inspection (ISI) of the feedwater nozzles in accordance with the requirements of ASME Section XI, Subsection IWB and the recommendation of General Electric (GE) NE 523-A71-0594-A and BWROG-TP-14-012 to detect cracking.

2.1.6 BWR Penetrations Program

The BWR Penetrations Program is an existing program that includes (a) inspection and flaw evaluation in conformance with the guidelines of staff-approved boiling water reactor vessel and internals project (BWRVIP) documents BWRVIP-27-A and BWRVIP-49-A and (b) monitoring and control of reactor coolant water chemistry in accordance with the guidelines of BWRVIP-190 Revision 1, to ensure the long-term integrity of vessel penetrations and nozzles.

2.1.7 BWR Stress Corrosion Cracking Program

The BWR Stress Corrosion Cracking Program is an existing program that includes (a) preventive measures to mitigate intergranular stress corrosion cracking (IGSCC), and (b) inspection and flaw evaluation to monitor IGSCC and its effects on reactor coolant pressure boundary components made of stainless steel, CASS, or nickel alloy.

CNS has taken actions to prevent IGSCC and will continue to use materials resistant to IGSCC for component replacements and repairs following the recommendations delineated in NUREG-0313, Generic Letter 88-01, Generic Letter 88-01 Supplement 1, and the staff-approved BWRVIP-75-A report. Inspection of piping identified in NRC Generic Letter 88-01 to detect and size cracks is performed in accordance with the staff positions on schedule, method, personnel qualification, and sample expansion included in the generic letter and the staff-approved BWRVIP-75-A report.

2.1.8 BWR Vessel ID Attachment Welds Program

The BWR Vessel ID Attachment Welds Program is an existing program that includes (a) inspection and flaw evaluation in accordance with the guidelines of staff-approved boiling water reactor vessel and internals project (BWRVIP) BWRVIP-48-A and (b) monitoring and control of reactor coolant water chemistry in accordance with the guidelines of BWRVIP-190 Revision 1, (EPRI Report 3002002623) to ensure the long-term integrity and safe operation of reactor vessel inside diameter (ID) attachment welds and support pads.

2.1.9 BWR Vessel Internals Program

The BWR Vessel Internals Program is an existing program that includes (a) inspection, flaw evaluation, and repair in conformance with the applicable, staff-approved BWR reactor vessel and internals project (BWRVIP) documents and (b) monitoring and control of reactor coolant water chemistry in accordance with the guidelines of BWRVIP-190 Revision 1, to ensure the long-term integrity of vessel internal components. In addition, the BWR Vessel Internals Program includes inspection of the steam dryer in accordance with BWRVIP-139 guidance.

During the course of NRC review of the LRA, NPPD committed to provide a core plate rim bolt analysis that demonstrated their adequacy considering the potential loss of pre-load through the PEO (Commitment NLS2009100-1). The NRC review is documented in a Staff Evaluation dated July 25, 2014. The following inspection plan is credited, as committed to by NPPD:

- Until the NRC endorses the revised inspection guidance of BWRVIP-25, NPPD will perform VT-3 inspections on the top side of a 50% sample of the Core Plate Hold Down Bolts every other refueling outage (Commitment NLS2013092-01).

The BWR Vessel Internals Program has been enhanced as follows.

- Includes actions to replace the plugs in the core plate bypass holes based on their qualified life.

Enhancements have been implemented prior to the period of extended operation.

2.1.10 Containment Inservice Inspection - CISI Program

The CISI Program is an existing program that manages loss of material and cracking for the primary containment Class MC pressure retaining components and their integral attachments including the associated bolted connections. The program uses the ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWE for ASME Class MC components (see Appendix J).

Visual inspections per ASME Section XI, Subsection IWE monitor loss of material of the steel containment shells and their integral attachments; containment hatches and airlocks; moisture barriers; and pressure-retaining bolting by inspecting surfaces for evidence of flaking, blistering, peeling, discoloration, and other signs of distress.

The Containment Inservice Inspection Program was enhanced as follows.

- Provided guidance for surfaces requiring augmented examination to require accessible areas to be examined using a visual examination method and surface areas not accessible on the side requiring augmented examination to be examined using an ultrasonic thickness measurement method in accordance with IWE-2500 (b).
- Provided guidance to document material loss in a local area exceeding ten percent of the nominal containment wall thickness or material loss in a local area projected to exceed ten percent of the nominal containment wall thickness before the next examination in accordance with IWE-3522 for volumetric inspections.

Enhancements were implemented prior to the period of extended operation.

2.1.11 Containment Leak Rate Program

The Containment Leak Rate Program is an existing program. As described in 10 CFR Part 50, Appendix J, containment leak rate tests are required to assure that (a) leakage through reactor containment and systems and components penetrating containment shall not exceed allowable values specified in technical specifications or associated bases and (b) periodic surveillance of reactor containment penetrations and isolation valves is performed so that proper maintenance and repairs are made during the service life of containment, and systems and components penetrating containment. The program utilizes 10 CFR 50 Appendix J, Option B, and the guidance in NRC Regulatory Guide 1.163 and NEI 94-01.

2.1.12 Diesel Fuel Monitoring Program

The Diesel Fuel Monitoring Program is an existing program that entails sampling to ensure that adequate diesel fuel quality is maintained to prevent loss of material in fuel systems. Exposure to fuel oil contaminants such as water and microbiological organisms is minimized by periodic sampling and analysis, draining and cleaning of tanks, and verifying the quality of new fuel oil before its introduction into the storage tanks.

Sampling and analysis activities are in accordance with technical specifications for fuel oil purity and the guidelines of ASTM Standards ASTM D4057 and D975.

The One-Time Inspection Program [Section K-2.1.29] describes inspections planned to verify that the Diesel Fuel Monitoring Program has been effective at managing aging effects.

The Diesel Fuel Monitoring Program was enhanced as follows.

- Used ASTM Standard D4057 for sampling of the diesel fire pump fuel oil storage tank.
- Included periodic visual inspections and cleaning of the diesel fuel oil day tanks, the diesel fuel oil storage tanks, and the diesel fire pump fuel oil storage tank.
- Included periodic multilevel sampling of the diesel fuel oil day tanks and representative low point sampling of the diesel fire pump fuel oil storage tank. This included periodic visual inspections as well as ultrasonic bottom surface thickness measurement of the diesel fuel oil day tanks, the diesel fuel oil storage tanks, and the diesel fire pump fuel oil storage tank.
- Provided the acceptance criterion of $\leq$ 10 mg/l for the determination of particulates in the diesel fire pump fuel oil storage tank.
- Specified acceptance criterion for UT thickness measurements of the bottom surfaces of the diesel fuel oil day tanks, the diesel fuel oil storage tanks, and the diesel fire pump fuel oil storage tank. The acceptance criteria for UT measurement of tank bottom thickness for the referenced diesel fuel tanks was based on component as-built information adjusted for corrosion allowance. If measurements were to show less than the minimum nominal thickness less corrosion allowance, engineering would evaluate the measured thickness for acceptability under the corrective action program. Evaluation would include consideration of potential future corrosion to ensure that future inspections are scheduled before wall thickness becomes unacceptable.

Enhancements were implemented prior to the period of extended operation.

2.1.13 Environmental Qualification (EQ) of Electric Components Program

The Environmental Qualification (EQ) of Electric Components Program is an existing program that manages the effects of thermal, radiation, and cyclic aging through the use of aging evaluations based on 10 CFR 50.49(f) qualification methods. As required by 10 CFR 50.49, EQ components are refurbished, replaced, or their qualification is extended prior to reaching the aging limits established in the evaluation. Reanalysis of an aging evaluation addresses attributes of analytical methods; data collection and reduction methods; underlying assumptions; and acceptance criteria and corrective actions. Some aging evaluations for EQ components are time-limited aging analyses (TLAAs) for license renewal.

2.1.14 External Surfaces Monitoring Program

The External Surfaces Monitoring Program is an existing program that inspects external surfaces of components subject to aging management review. The program is also credited with managing loss of material from internal surfaces for situations in which internal and external material and environment combinations are the same such that external surface condition is representative of internal surface condition. This program does not manage aging effects on structures.

Surfaces that are inaccessible during plant operations are inspected during refueling outages. Surfaces that are insulated are inspected when the external surface is exposed (i.e., during maintenance). Surfaces are inspected at frequencies to assure the effects of aging are managed such that applicable components will perform their intended function during the period of extended operation.

The External Surfaces Monitoring Program was enhanced as follows.

- Clarified that periodic inspections of systems in scope and subject to aging management review for license renewal in accordance with 10 CFR 54.4 (a)(1) and (a)(3) will be performed. Inspections shall include areas surrounding the subject systems to identify hazards to those systems. Inspections of nearby systems that could impact the subject systems will include SSCs that are in scope and subject to aging management review for license renewal in accordance with 10 CFR 54.4 (a)(2).

This enhancement was implemented prior to the period of extended operation.

2.1.15 Fatigue Monitoring Program

The Fatigue Monitoring Program is an existing program that tracks the number of critical thermal and pressure transients for selected reactor coolant system components, in order not to exceed design limits on fatigue usage. The program ensures the validity of analyses that explicitly assumed a fixed number of thermal and pressure transients by assuring that the actual effective number of transients does not exceed the assumed limit.

This program also addresses the effects of the coolant environment on component fatigue life by assessing the impact of the reactor coolant environment on a sample of critical components for the plant.

The Fatigue Monitoring Program has been enhanced as follows.

- Consideration of the effect of the reactor water environment has been accomplished for the reactor vessel shell and lower head, feedwater nozzles, core spray nozzles and RHR pipe transition, as described below. In addition, NPPD reviewed design basis ASME Class 1 component fatigue evaluations to determine whether the CNS locations that have been evaluated for the effects of the reactor coolant environment on fatigue included the limiting component within the reactor coolant pressure boundary. If a more limiting component was identified, NPPD similarly determined the effects of the reactor coolant environment on its fatigue usage in accordance with the following.

  (1) Update the fatigue usage calculations using refined fatigue analyses to determine valid CUFs less than 1.0 when accounting for the effects of reactor water environment. This includes applying the appropriate F_{en} factors to valid CUFs determined using an NRC-approved version of the ASME code or NRC-approved alternative (e.g., NRC-approved code case). NPPD will use NUREG/CR-6909 when determining the effects of the reactor coolant environment on the fatigue life of Alloy 600 or other nickel alloy components.

  (2) Repair or replace the affected locations before exceeding an environmentally adjusted CUF of 1.0.

- The CNS Fatigue Monitoring Program has been enhanced to require the recording of each transient associated with the actuation of a safety/relief valve (SRV) associated with Torus Fatigue.

Enhancements were implemented at least two years prior to entering the period of extended operation.

2.1.16 Fire Protection Program

The Fire Protection Program is an existing program that includes a fire barrier inspection and a diesel-driven fire pump inspection. The fire barrier inspection requires periodic visual inspection of fire barrier penetration seals, fire dampers, fire stops, fire wraps, fire barrier walls, ceilings, and floors, and periodic visual inspection and functional tests of fire rated doors to ensure that their operability is maintained. The diesel-driven fire pump inspection requires that the pump and its driver be periodically tested and inspected to ensure that diesel engine fuel supply lines can perform their intended functions.

The Fire Protection Program also includes periodic inspection and testing of the CO_2 and Halon fire suppression systems.

The Fire Protection Program was enhanced as follows.

- Explicitly stated that the diesel fire pump engine sub-systems (including the fuel supply line) shall be observed while the engine is running. Acceptance criteria were revised to verify that the diesel engine does not exhibit signs of degradation while running, such as excessive fuel oil, lube oil, coolant, or exhaust gas leakage.

- Specified that diesel fire pump engine carbon steel exhaust components are inspected for evidence of corrosion or cracking at least once every five years.

- Required visual inspections of fire damper framing to check for signs of degradation.

- Required visual inspections of the Halon and CO_2 fire suppression systems at least once every six months, where radiologically accessible at power, to check for signs of degradation in a manner suitable for trending. Those sections of the CO_2 system that are in radiation areas when at power are inspected every 24 months under shutdown conditions.

- Included visual inspections of concrete flood curbs, manways, hatches, and hatch covers on a 24-month basis to check for signs of degradation.

Enhancements were implemented prior to the period of extended operation.

2.1.17 Fire Water System Program

The Fire Water System Program is an existing program that applies to water-based fire protection systems that consist of sprinklers, nozzles, fittings, valves, hydrants, hose stations, standpipes, and aboveground and underground piping and components that are tested in accordance with applicable National Fire Protection Association (NFPA) codes and standards. Such testing assures functionality of systems. To determine if significant corrosion has occurred in water-based fire protection systems, periodic flushing, system performance testing and inspections are conducted. Also, many of these systems are normally maintained at required operating pressure and monitored such that leakage resulting in loss of system pressure is immediately detected and corrective actions initiated.

In addition, wall thickness evaluations of fire protection piping are periodically performed on system components using non-intrusive techniques (e.g., volumetric testing) to identify evidence of loss of material due to corrosion.

A sample of sprinkler heads will be tested or replaced using the guidance of NFPA-25 (2002 edition), Section 5.3.1.1.1. NFPA-25 states, "Where sprinklers have been in place for 50 years, they shall be replaced or representative samples from one or more sample areas shall be submitted to a recognized testing laboratory for field service testing." This sampling will be repeated every ten years after initial field service testing per the guidance of NFPA-25.

The Fire Water System Program was enhanced as follows.

- Included inspection of hose reels for corrosion. Acceptance criteria was enhanced to verify no unacceptable corrosion.

- Included visual inspection of spray and sprinkler system internals for evidence of corrosion. Acceptance criteria was enhanced to verify no unacceptable corrosion.

- Wall thickness evaluations of fire protection piping are to be performed on system components using non-intrusive techniques (e.g., volumetric testing) to identify evidence of loss of material due to corrosion. These inspections were performed before the end of the current operating term and will be performed at intervals thereafter during the period of extended operation. Results of the initial evaluations were used to establish an every cycle inspection interval to ensure aging effects are identified prior to loss of intended function.

- A sample of sprinkler heads required for 10 CFR 50.48 are to be tested or replaced using guidance of NFPA-25 (2002 edition), Section 5.3.1.1.1, before the end of the 50-year sprinkler head service life and at 10-year intervals thereafter during the extended period of operation.

Enhancements were implemented prior to the period of extended operation.

2.1.18 Flow-Accelerated Corrosion Program

The Flow-Accelerated Corrosion (FAC) Program is an existing program that applies to safety-related and nonsafety-related carbon steel components and gray cast iron in systems containing high-energy fluids carrying two-phase or single-phase high-energy fluid per the criteria given in EPRI NSAC-202L.

The program, based on EPRI recommendations in NSAC-202L for an effective flow-accelerated corrosion program, predicts, detects, and monitors FAC in plant piping and other pressure retaining components. This program includes (a) an evaluation to determine critical locations, (b) initial operational inspections to determine the extent of thinning at these locations, and (c) follow-up inspections to confirm predictions, or repair or replace components as necessary. The aging effect of loss of material managed by the Flow-Accelerated Corrosion Program is equivalent to the aging effect of wall thinning as defined in NUREG-1801 Volume 2 Table IX.E.

The FAC Program was enhanced as follows.

- Updated the System Susceptibility Analysis for the Flow-Accelerated Corrosion Program to reflect the lessons learned and new technology that became available after the publication of NSAC-202L Revision 1.

- Program guidance documents were revised to stipulate requirements for training and qualification of non-CNS personnel involved in implementing the FAC program.

These enhancements were implemented prior to the period of extended operation.

2.1.19 <u>Inservice Inspection – ISI Program</u>

The Inservice Inspection – ISI Program is an existing program that encompasses ASME Section XI Subsection IWB, IWC, IWD, and IWF requirements (see Appendix J).

This program manages loss of material, cracking, and reduction of fracture toughness to assure that the pressure boundary functions of the reactor pressure vessel and reactor coolant system pressure boundary are maintained through the period of extended operation.

Regulation 10 CFR 50.55a imposes inservice inspection (ISI) requirements of ASME Code, Section XI, for Class 1, 2, and 3 pressure-retaining components, their integral attachments, and supports (Class 1, 2, 3, and MC) in light-water cooled power plants. Inspection, repair, and replacement of these components are covered in Subsections IWB, IWC, IWD, and IWF respectively. The program includes periodic visual, surface, and volumetric examination and leakage tests of Class 1, 2, and 3 pressure-retaining components, their integral attachments and supports.

2.1.20 <u>Inservice Inspection – IWF Program</u>

The Inservice Inspection – IWF Program is contained in the Inservice Inspection (ISI) program that manages loss of material for ASME Class 1, 2, 3 and MC components supports, associated bolting and base plates (see Appendix J).

The program conducts visual inspections of components supports for evidence of corrosion, deformation, misalignment, improper clearances, improper spring settings, damage to close tolerance machined or sliding surfaces, and missing, detached, or loosened support items that may compromise support function or load capacity.

The Inservice Inspection – IWF Program was enhanced as follows.

- Clarified that Class MC piping and component supports are included in the program.
- Clarified that the successive inspection requirements of IWF-2420 and the additional examination requirements of IWF-2430 are applied.

Enhancements were implemented prior to the period of extended operation.

2.1.21 Masonry Wall Program

The Masonry Wall Program is an existing program that manages aging effects so that the evaluation basis established for each masonry wall within the scope of license renewal remains valid through the period of extended operation.

The program includes visual inspection of all masonry walls identified as performing intended functions in accordance with 10 CFR 54.4. Included components are 10 CFR 50.48-required masonry walls, radiation shielding masonry walls, and masonry walls with the potential to affect safety-related components. Structural steel components of masonry walls are managed by the Structures Monitoring Program [Section K-2.1.36].

Masonry walls are visually examined at a frequency selected to ensure there is no loss of intended function between inspections.

The Masonry Wall Program was enhanced as follows.

- Clarified that the control house – 161 kV switchyard is included in the program.
- Clarified that structures with conditions classified as "acceptable with deficiencies" or "unacceptable" shall be entered into the corrective action program.

Enhancements were implemented prior to the period of extended operation.

2.1.22 Metal-Enclosed Bus Inspection Program

The Metal Enclosed Bus Inspection Program is a new program that inspects the following non-segregated phase bus.

- non-segregated bus between the emergency station service transformer and 4.16 kV switchgear buses (1F and 1G).
- non-segregated bus between the start-up station service transformer X-winding and 4.16 kV switchgear buses (1A and 1B).

Inspections of the metal enclosed bus (MEB) include the bus and bus connections, the bus enclosure assemblies, and the bus insulation and insulators. A sample of the accessible bolted connections will be inspected for loose connections. The bus enclosure assemblies will be inspected for loss of material and elastomer degradation. This program will be used instead of the Structures Monitoring Program for external surfaces of the bus enclosure assemblies. The bus insulation or insulators will be inspected for degradation leading to reduced insulation resistance (IR). These inspections will include visual inspections, as well as quantitative measurements, such as thermography or connection resistance measurements, as required.

This program was implemented prior to the period of extended operation. This new program was implemented consistent with the corresponding program described in NUREG-1801, Section XI.E4, Metal-Enclosed Bus, prior to the period of extended operation. Inspection of a sample of accessible bolted connections, MEB internal surfaces, bus insulation, and internal bus supports was completed prior to the period of extended operation, and will be completed at least once every 10 years thereafter. In addition to activities described in NUREG-1801, Section XI.E4, the program includes inspection of the bus enclosure assemblies. Inspection of the bus enclosure assemblies was completed prior to the period of extended operation, and will be completed at least once every 10 years thereafter.

2.1.23 Neutron Absorber Monitoring Program

The Neutron Absorber Monitoring Program is an existing program that manages loss of material of Boral neutron absorption panels in the spent fuel racks. The program relies on representative coupon samples mounted in surveillance assemblies located in the spent fuel pool to monitor performance of the absorber material without disrupting the integrity of the storage system.

Surveillance assemblies are removed from the spent fuel pool on a prescribed schedule and physical and chemical properties are measured. From this data, the stability and integrity of Boral in the storage cells are assessed. To verify there is no loss of neutron absorbing capacity of the Boral material, NPPD has supplemented the Neutron Absorber Monitoring Program to include neutron attenuation testing of representative sample coupons. Acceptance criteria is that measured or analyzed neutron-absorber capacity required to ensure the 5% subcriticality margin for the spent fuel pool is maintained assuming neutron absorber degradation is the only mechanism. Results not meeting the acceptance criteria are entered into the CNS Corrective Action Program for disposition. One test was performed prior to the period of extended operation (PEO), with another confirmatory test performed within the first ten years of the PEO.

2.1.24 Non-EQ Bolted Cable Connections Program

The Non-EQ Bolted Cable Connections Program is a new program which provides a one-time inspection, on a sampling basis, to confirm the absence of age-related degradation of bolted cable connections due to thermal cycling, ohmic heating, electrical transients, vibration, chemical contamination, corrosion, and oxidation. Connections associated with cables within the scope of license renewal were considered for this program. The factors considered for sample selection were application (medium and low voltage, defined as < 35 kV), circuit loading (high loading), and location (high temperature, high humidity, vibration, etc.). The technical basis for the sample selections was documented. If an unacceptable condition or situation is identified in the selected sample, the corrective action program was used to evaluate the condition and determine appropriate corrective action.

This program was implemented prior to the period of extended operation.

2.1.25 Non-EQ Inaccessible Medium-Voltage Cable Program

The Non-EQ Inaccessible Medium-Voltage Cable Program is a new program that inspects in-scope inaccessible low-voltage and medium-voltage power cables.

The Non-EQ Inaccessible Medium-Voltage Cable Program entails periodic inspections for water collection in cable manholes and periodic testing of cables. In-scope medium-voltage cables (cables with operating voltage from 2 kV to 35 kV) exposed to significant moisture are tested at least once every ten years to provide an indication of the condition of the conductor insulation. Significant moisture is defined as periodic exposures to moisture that last more than a few days (e.g., cable in standing water). Periodic exposures to moisture that lasts less than a few days (i.e., normal rain and drain) are not significant.

Inspections for water accumulation in manholes containing in-scope inaccessible low-voltage and medium voltage power cables are performed at least once every two years. Condition-based inspections of Manhole 6A (which is not dewatered by a sump pump) are performed based on high water level annunciation.

In-scope inaccessible low-voltage power cables (cables with operating voltage from 480 V to 2 kV) that are subject to aging management review are included in this program. The in-scope inaccessible low-voltage power cables were tested for degradation of the cable insulation prior to the period of extended operation and will be tested at least once every 10 years thereafter. A proven, commercially available test was used (and is being used) for detecting deterioration due to wetting of the insulation system for all in-scope inaccessible low-voltage power cables (480 V to 2 kV).

This program was implemented prior to the period of extended operation. This new program was implemented consistent with the corresponding program described in NUREG-1801 Section XI.E3, Inaccessible Medium-Voltage Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements.

2.1.26 Non-EQ Instrumentation Circuits Test Review Program

The Non-EQ Instrumentation Circuits Test Review Program is a new program that inspects the applicable cables in the following systems or sub-systems.

- neutron monitoring system intermediate range monitors
- neutron monitoring system local power range monitors

- neutron monitoring system average power range monitors
- reactor building ventilation exhaust radiation monitors
- main steam line radiation monitors

The Non-EQ Instrumentation Circuits Test Review Program assures the intended functions of sensitive, high-voltage, low-signal cables exposed to adverse localized equipment environments caused by heat, radiation and moisture (i.e., neutron flux monitoring instrumentation, reactor building ventilation exhaust radiation monitoring, and main steam line radiation monitoring) can be maintained consistent with the current licensing basis through the period of extended operation. Most sensitive instrumentation circuit cables and connections are included in 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. The review of calibration results will be performed once every ten years, with the first review having occurred before the period of extended operation.

For sensitive instrumentation circuit cables that are disconnected during instrument calibrations, testing using a proven method for detecting deterioration for the insulation system (such as insulation resistance tests or time domain reflectometry) will occur at least once every ten years, with the first test having occurred before the period of extended operation. This program considers the technical information and guidance provided by the industry.

This program was implemented prior to the period of extended operation. This new program was implemented consistent with the corresponding program described in NUREG-1801 Section XI.E2, Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits.

2.1.27 Non-EQ Insulated Cables and Connections Program

The Non-EQ Insulated Cables and Connections Program is a new program that assures the intended functions of insulated cables and connections exposed to adverse localized environments caused by heat, radiation and moisture can be maintained consistent with the current licensing basis through the period of extended operation. An adverse localized environment is significantly more severe than the specified service condition for the insulated cable or connection.

A representative sample of accessible insulated cables and connections within the scope of license renewal will be visually inspected for cable and connection jacket surface anomalies such as embrittlement, discoloration, cracking or surface contamination. The program sample consists of all accessible cables and connections in localized adverse environments.

This program was implemented prior to the period of extended operation. This new program was implemented consistent with the corresponding program described in NUREG-1801 Section XI.E1, Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements to visually inspect accessible cables in an adverse localized environment at least once every 10 years, with the first inspection prior to the period of extended operation.

2.1.28 Oil Analysis Program

The Oil Analysis Program is an existing program that maintains oil systems free of contaminants (primarily water and particulates) thereby preserving an environment that is not conducive to loss of material, cracking, or fouling. Activities include sampling and analysis of lubricating oil for detrimental contaminants, water, and particulates.

Sampling frequencies are based on vendor recommendations, accessibility during plant operation, equipment importance to plant operation, and previous test results.

The One-Time Inspection Program [Section K-2.1.29] utilizes inspections or non-destructive evaluations of representative samples to verify that the Oil Analysis Program has been effective at managing aging effects.

The Oil Analysis Program was enhanced as follows.

- Included viscosity and neutralization number of oil samples from components that did not have regular oil changes, along with analytical ferrography and elemental analysis for the identification of wear particles.
- Included screening for particulate and water content for oil replaced periodically.
- Formalized preliminary oil screening for water and particulates and laboratory analyses, including defined acceptance criteria for all components included in the scope of the program. The program specified corrective actions in the event acceptance criteria are not met.

Enhancements were implemented prior to the period of extended operation.

2.1.29 One-Time Inspection Program

The One-Time Inspection Program is a new program that included measures to verify effectiveness of an aging management program (AMP) and confirm the insignificance of an aging effect. For structures and components that rely on an AMP, this program verified effectiveness of the AMP by confirming that unacceptable degradation was not occurring and the intended function of a component will be maintained during the period of extended operation. One-time inspections addressed concerns for potentially long incubation periods for certain aging effects on structures and components. There were cases where either (a) an aging effect is not expected to occur but there is insufficient data to completely rule it out, or (b) an aging effect is expected to progress very slowly. For these cases, there was confirmation that either (a) the aging effect is indeed not occurring, or (b) the aging effect is occurring very slowly as not to affect the component or structure intended function. A one-time inspection of the subject component or structure is appropriate for this verification. The inspections were nondestructive examinations (including visual, ultrasonic, or surface techniques). The inspections were performed within the ten years prior to the period of extended operation.

The elements of the One-Time Inspection Program included (a) determination of the sample size based on an assessment of materials of fabrication, environment, plausible aging effects, and operating experience; (b) identification of the inspection locations in the system or component based on the aging effect; (c) determination of the examination technique, including acceptance criteria that would be effective in managing the aging effect for which the component is examined; and (d) evaluation of the need for follow-up examinations to monitor the progression of any aging degradation.

A one-time inspection activity was used to verify the effectiveness of the Diesel Fuel Monitoring Program by confirming that unacceptable loss of material was not occurring on components within systems managed by the Diesel Fuel Monitoring Program [Section K-2.1.12].

A one-time inspection activity was used to verify the effectiveness of the Oil Analysis Program by confirming that unacceptable cracking, loss of material, and fouling was not occurring on components within systems managed by the Oil Analysis Program [Section K-2.1.28].

A one-time inspection activity was used to verify the effectiveness of the three water chemistry control programs by confirming that unacceptable cracking, loss of material, and fouling was not occurring on components within systems managed by water chemistry control programs [Sections K-2.1.38, K-2.1.39, and K-2.1.40].

One-time inspection activities on the following were used to confirm that loss of material and cracking, as applicable, were not occurring or were so insignificant that an aging management program was not warranted.

- internal surfaces of stainless steel components in the standby gas treatment system containing raw water (drain water)

- internal surfaces of stainless steel tubing in the circulating water system containing raw water (river water) internal surfaces of stainless steel tubing and components in the off gas system containing raw water (drain water)

- internal surfaces of stainless steel components in the radwaste system containing raw water (drain water)

- internal surfaces of stainless steel tubing and components in the service air system exposed to condensation

The program provided for increasing inspection sample size and locations in the event that aging effects were detected. Unacceptable inspection findings were evaluated in accordance with the corrective action process to determine the need for subsequent (including periodic) inspections and for monitoring and trending the results.

For specific system components where significant aging effects were not expected, one-time inspection activities were used to confirm that loss of material and cracking, as applicable, were not occurring or were so insignificant that an aging management program was not warranted. When evidence of an aging effect was revealed by a one-time inspection, routine evaluation of the inspection results identified appropriate corrective actions.

This new program was implemented consistent with the corresponding program described in NUREG-1801, Revision 1, Section XI.M32, One-Time Inspection, except that "Surface Condition" (from NUREG-1801, Revision 2, Section XI.M32, "Examples of Parameters Monitored or Inspected and Aging Effect for Specific Structure of Component" table) is included as a Parameter Monitored for "Loss of Material" and "Cracking."

2.1.30 One-Time Inspection – Small-Bore Piping Program

The One-Time Inspection – Small-Bore Piping Program is a new program applicable to small-bore American Society of Mechanical Engineers (ASME) Code Class 1 piping less than 4 inches nominal pipe size (NPS 4"), which includes pipe, fittings, and branch connections. The ASME Code does not require volumetric examination of Class 1 small-bore piping. The CNS One-Time Inspection of ASME Code Class 1 Small-Bore Piping Program will manage cracking through the use of volumetric examinations.

The program included a sample selected based on susceptibility, inspectability, dose considerations, operating experience, and limiting locations of the total population of ASME Code Class 1 small-bore piping locations.

If evidence of an aging effect was revealed by a one-time inspection, evaluation of the inspection results would have identified appropriate corrective actions.

The inspection was performed within the ten years prior to the period of extended operation. This new program was implemented consistent with the corresponding program described in NUREG-1801, Section XI.M35, One-Time Inspection of ASME Code Class 1 Small-Bore Piping.

Based on operating experience identified during the review of the License Renewal Application, NPPD committed to additional examinations. During the period of extended operation, periodic volumetric examinations of Class 1 socket weld connections will be performed. Three Class 1 socket welds will receive volumetric examination during each 10 year ISI interval. The examination method will be a volumetric examination of the base metal ½" beyond the toe of the socket fillet weld which allows for the use of qualified ultrasonic examination techniques as close as possible to the fillet weld. The volumetric examinations will be performed by certified examiners following guidelines set forth in ASME Section V, Article 4 consistent with the guidelines for examination volume of ½" beyond the toe of the weld as established in MRP-146, "Materials Reliability Program: Management of Thermal Fatigue in Normally Stagnant Non-Isolable Reactor Coolant System Branch Lines."

2.1.31 Periodic Surveillance and Preventive Maintenance Program

The Periodic Surveillance and Preventive Maintenance Program is an existing program that includes periodic inspections and tests that manage aging effects not managed by other aging management programs, including loss of material, cracking, change in material properties, loss of material due to wear, and fouling. In addition to specific activities in the plant's preventive maintenance program and surveillance program, the Periodic Surveillance and Preventive Maintenance Program includes enhancements to add new activities. The preventive maintenance and surveillance testing activities are generally implemented through repetitive tasks or routine monitoring of plant operations. While primarily used for managing the effects of aging on internal surfaces, the program is also credited with managing loss of material from external surfaces for situations in which external and internal material and environment combinations are the same such that internal surface condition is representative of external surface condition.

Surveillance testing and periodic inspections using visual or other non-destructive examination techniques verify that the following components are capable of performing their intended function.

- reactor building monorails, railroad airlock doors, reactor building crane, rails and girders, and refueling bridge equipment assembly
- reactor building elastomer seals for railroad airlock doors
- SLC system accumulator shells
- HPCI system turbine lube oil heat exchanger tubes
- ADS piping and T-quenchers in waterline region of the suppression chamber
- RCIC system vacuum pump discharge piping, piping elements, and components
- RCIC system turbine lube oil heat exchanger tubes
- SGT system components
- SGT system fan inlet flexible connections
- SGT plant stack internal surface
- plant drain system components
- DG system exhaust gas components
- DG system intercooler tubes and fins
- DG system service air components
- HVAC system flexible duct connections

- HVAC system portable blower fan housings and flexible trunks kept in storage that may be used for ventilation
- HVAC system fan coil unit tubes, fins and drip pan
- PC system equipment and floor drain components
- HPCI system piping and components related to suppression chamber level instrumentation
- ADS piping and valve body components exposed to indoor air
- DG system air intake components
- DGDO fuel oil tank vent piping and flame arrestors
- FP halon/CO_2 piping and components
- FP nozzles and piping in dry pipe suppression subsystem and air intake duct on the diesel engine-driven fire pump
- FP system plastic tubing and valve body components
- piping, piping components, and piping elements in the circulating water system, nonradioactive floor drain system, heating and ventilation system, off gas system, potable water system, primary containment system, radiation monitoring – ventilation system, radwaste system, diesel generator starting air system, reactor equipment cooling system, turbine equipment cooling system, and service air system
- service air primary containment penetration X-21
- nitrogen system vaporizer tank and vaporizer coil

The Periodic Surveillance and Preventive Maintenance Program was enhanced as follows.

- Enhanced as necessary to assure that the effects of aging will be managed such that applicable components will continue to perform their intended functions consistent with the current licensing basis through the period of extended operation.
- For each activity that refers to a representative sample, a representative sample will be selected for each unique material and environment combination. The sample size will be 20% of the population (defined as components having the same material, environment, and aging effect combination) or a maximum of 25 components.

Enhancements were implemented prior to the period of extended operation.

2.1.32 Reactor Head Closure Studs Program

The Reactor Head Closure Studs Program is an existing program that is included in the Inservice Inspection (ISI) Program in conformance with the requirements of ASME Section XI, Subsection IWB, Category B-G-1 and preventive measures (e.g., rust inhibitors, stable lubricants, appropriate materials) to mitigate cracking and loss of material of reactor head closure studs, nuts, washers, and bushings (see Appendix J).

2.1.33 Reactor Vessel Surveillance Program

The Reactor Vessel Surveillance Program is an existing program that manages reduction in fracture toughness of reactor vessel beltline materials to assure that the pressure boundary function of the reactor pressure vessel is maintained through the period of extended operation.

CNS has received NRC approval to use the BWR vessel and internals project (BWRVIP) Integrated Surveillance Program (ISP). The Reactor Vessel Surveillance Program monitors changes in the fracture toughness properties of ferritic materials in the reactor pressure vessel (RPV) beltline region. As BWRVIP-ISP capsule test reports become available for RPV materials representative of CNS, the actual shift in the reference temperature for nil-ductility transition of the vessel material may be updated. In accordance with 10 CFR 50 Appendices G and H, CNS reviews relevant test reports to assure compliance with fracture toughness requirements and P-T limits.

BWRVIP-116, "BWR Vessel and Internals Project Integrated Surveillance Program (ISP) Implementation for License Renewal," describes the design and implementation of the ISP during the period of extended operation. BWRVIP-116 identifies additional capsules of the Supplemental Surveillance Program (SSP), their withdrawal schedule, and contingencies to ensure that the requirements of 10 CFR 50 Appendix H are met through the period of extended operation. BWRVIP-116 has been incorporated into BWRVIP-86, Rev. 1-A, “Updated BWR Integrated Surveillance Program (ISP) Implementation Plan,” and is superseded.

The Reactor Vessel Surveillance Program was enhanced as follows.

- If the CNS license renewal capsule is removed from the reactor vessel without the intent to test it, the capsule will be stored in a manner which maintains it in a condition which would permit its future use, including during the period of extended operation, if necessary.

- Ensure that the additional requirements specified in the final NRC safety evaluation for BWRVIP-116 will be addressed before the period of extended operation.

These enhancements were implemented prior to the period of extended operation.

2.1.34 Selective Leaching Program

The Selective Leaching Program is a new program that ensured the integrity of components made of cast iron, bronze, brass, and other alloys exposed to condensation, raw water, steam, treated water, and soil (groundwater) that may lead to selective leaching. The program included a one-time visual inspection, hardness measurement (where feasible based on form and configuration), destructive testing, or other industry accepted mechanical inspection techniques of selected components that may be susceptible to selective leaching to determine whether loss of material due to selective leaching is occurring, and whether the process will affect the ability of the components to perform their intended function through the period of extended operation.

This new program was implemented consistent with the corresponding program described in NUREG-1801, Revision 1, Section XI.M33, Selective Leaching of Materials (except for destructive testing was in accordance with NUREG-1801, Revision 2), prior to the period of extended operation. As a result of the testing results, ongoing inspections for selective leaching will continue during the PEO.

2.1.35 Service Water Integrity Program

The Service Water Integrity Program is an existing program that relies on implementation of the recommendations of GL 89-13 to ensure that the effects of aging on the service water (SW) system will be managed through the period of extended operation. The program includes component inspections for cracking, erosion, corrosion, wear, and blockage and performance monitoring to verify the heat transfer capability of the safety-related heat exchangers cooled by SW. Periodic cleaning and flushing of redundant or infrequently used loops are the methods used to control or prevent fouling within the heat exchangers and loss of material in SW components.

2.1.36 Structures Monitoring Program

The Structures Monitoring Program is an existing program that performs inspections in accordance with 10 CFR 50.65 (Maintenance Rule) as addressed in Regulatory Guide 1.160 and NUMARC 93-01. Periodic inspections are used to monitor the condition of structures and structural commodities to ensure there is no loss of intended function.

Since protective coatings are not relied upon to manage the effects of aging for structures included in the Structures Monitoring Program, the program does not directly address protective coating monitoring and maintenance. However, observation of the condition of the paint or coating is an effective method for identifying the absence of degradation of the underlying material. Therefore, monitoring of the condition of coatings on SSCs within the scope of the Structures Monitoring Program is implicitly included within that program.

The Structures Monitoring Program was enhanced as follows.

- Clarified that the following structures are included in the program.
  - biological shield wall
  - blowout panels (including east end of steam tunnel)
  - control room ceiling support system
  - crane rails and girders
  - CRD shootout steel
  - diesel fuel tank hatch cover

- diesel fuel tank retaining wall and slab
- drywell fill slab
- drywell shell protection panels and jet deflectors
- drywell stabilizer supports
- exterior walls
- foundations (buildings)
- guide wall
- manholes and duct banks
- monorails
- new fuel storage vault
- office building (or administration building)
- oil tank bunker crushed rock fill
- pump baffle plates
- reactor building loop seal drain caps
- reactor building railroad airlock doors
- reactor building sump structure
- reactor cavity floor and walls
- reactor cavity liner
- reactor pedestal
- sacrificial shield wall (steel portion)
- sacrificial shield wall lateral supports
- shield plugs
- spent fuel pool floor and walls
- steam tunnel
- sumps and sump liners
- transformer yard and switchyard support structures and foundations
- transmission towers (galvanized), wooden utility towers, wooden utility poles, and foundations
- traveling screen casing and associated framing

• Clarified that, in addition to structural steel and concrete, the following commodities are inspected for each structure as applicable.

- anchor bolts
- anchorage/embedments
- base plates
- battery racks
- beams, columns, floor slabs, and walls (below grade)
- cable trays and supports
- component and piping supports
- conduits and conduit supports
- electrical and instrument panels and enclosures
- equipment pads and foundations
- flood curbs
- flood, pressure and specialty doors
- flood retention materials (spare parts)
- HVAC duct supports
- instrument line supports
- instrument racks, frames, and tubing trays
- manways, hatches, manhole covers, and hatch covers

- missile shields
- penetration sealant (flood, radiation)
- penetration sleeves and sealant (mechanical/ electrical not penetrating PC boundary)
- pipe whip restraints
- seals and gaskets (doors, manways and hatches)
- stairs and handrails, platforms, grating, decking, and ladders
- support pedestals
- vents and louvers

- Inspect inaccessible concrete areas that are submerged or below grade which may become exposed due to excavation, construction or other activities. CNS will also inspect inaccessible concrete areas when observed conditions in accessible areas exposed to the same environment indicate that significant concrete degradation is occurring.

- Inspect elastomers (seals, gaskets, and roof elastomers) to identify cracking and change in material properties.

- Perform an engineering evaluation of groundwater samples to assess aggressiveness of groundwater to concrete on a periodic basis (at least once every five years). CNS will obtain samples from a well that is representative of the groundwater surrounding below-grade site structures. Samples will be monitored for sulfates, pH and chlorides.

- Perform visual structural examinations of wood to identify loss of material and change in material properties.

- Perform visual structural monitoring of the oil tank bunker crushed rock fill to identify loss of form.

- Clarified that structures with conditions classified as "acceptable with deficiencies" or "unacceptable" shall be entered into the corrective action program.

- Enhanced the Structures Monitoring Program procedure to: a) include more detailed guidance on acceptance criteria (using ACI documents ACI 201.1R-92, and ACI 349.3R-96) to preclude potential inconsistent application of inspection criteria, and b) provide more detailed guidance on trending.

Enhancements were implemented prior to the period of extended operation.

2.1.37 Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel Program

The Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program is a new program that assures reduction of fracture toughness due to thermal aging and reduction of fracture toughness due to radiation embrittlement will not result in loss of intended function. This program evaluates CASS components in the reactor vessel internals and requires non-destructive examinations as appropriate.

This program supplements reactor vessel internals inspections required by the BWR Vessel Internals Program [Section K-2.1.9] and the Inservice Inspection – ISI Program [Section K-2.1.19] to manage the effects of loss of fracture toughness due to thermal aging and neutron embrittlement of cast austenitic stainless steel (CASS) components.

This aging management program includes:

(a) identification of susceptible components determined to be limiting from the standpoint of thermal aging susceptibility (i.e., ferrite and molybdenum contents, casting process, and operating temperature) accounting for the synergistic effects of thermal aging and neutron irradiation embrittlement (neutron fluence), and

(b) for each "potentially susceptible" component, aging management is accomplished through either a supplemental examination of the affected component during the period of extended operation, or a component-specific evaluation to determine its susceptibility to reduction of fracture toughness.

This new program basis is documented in the CNS BWR Vessel Internals Program and has been implemented consistent with the corresponding program described in NUREG-1801, Section XI.M13, Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program, prior to the period of extended operation. With implementation of the program, it was determined that under the criteria established by the above section of NUREG-1801, CNS had no susceptible vessel internals components that require further aging management under this program.

2.1.38 Water Chemistry Control – Auxiliary Systems Program

The Water Chemistry Control – Auxiliary Systems Program is an existing program that manages loss of material and cracking for components exposed to treated water and steam.

Program activities include sampling and analysis of water in auxiliary condensate drain system components, auxiliary steam system components, and heating and ventilation system components to minimize component exposure to aggressive environments.

The One-Time Inspection Program [Section K-2.1.29] utilizes inspections or non-destructive evaluations of representative samples to verify that the Water Chemistry Control – Auxiliary Systems Program has been effective at managing aging effects.

2.1.39 Water Chemistry Control – BWR Program

The Water Chemistry Control – BWR Program is an existing program that manages aging effects caused by corrosion and cracking mechanisms. The program relies on monitoring and control of water chemistry based on EPRI Report 3002002623 (BWRVIP-190 Revision 1). BWRVIP-190 Revision 1 has guidelines for primary water, condensate and feedwater, and control rod drive (CRD) mechanism cooling water. EPRI guidelines in BWRVIP-190 Revision 1 also include recommendations for controlling water chemistry in the torus/pressure suppression chamber, condensate storage tank, demineralized water storage tanks, and spent fuel pool.

The Water Chemistry Control – BWR Program optimizes the primary water chemistry to minimize the potential for loss of material and cracking. This is accomplished by limiting the levels of contaminants in the reactor coolant system that could cause loss of material and cracking. Additionally, CNS has instituted hydrogen water chemistry and noble metal chemical addition to limit the potential for IGSCC through the reduction of dissolved oxygen in the treated water.

The One-Time Inspection Program [Section K-2.1.29] utilizes inspections or non-destructive evaluations of representative samples to verify that the Water Chemistry Control – BWR Program has been effective at managing aging effects.

2.1.40 Water Chemistry Control – Closed Cooling Water Program

The Water Chemistry Control – Closed Cooling Water Program is an existing program that includes preventive measures that manage loss of material, cracking, and fouling for components in closed cooling water systems: diesel generator jacket water (DGJW) system, reactor equipment cooling (REC) system, and turbine equipment cooling (TEC) system. These chemistry activities provide for monitoring and controlling closed cooling water chemistry using CNS procedures and processes based on EPRI guidance for closed cooling water chemistry.

The One-Time Inspection Program [Section K-2.1.29] utilizes inspections or non-destructive evaluations of representative samples to verify that the Water Chemistry Control – Closed Cooling Water Program has been effective at managing aging effects.

2.2 Evaluation of Time-Limited Aging Analyses

In accordance with 10 CFR 54.21(c), an application for a renewed license requires an evaluation of time-limited aging analyses for the period of extended operation. The following time-limited aging analyses have been identified and evaluated to meet this requirement.

2.2.1 Reactor Vessel Neutron Embrittlement

The reactor vessel neutron embrittlement time-limited aging analyses, including consideration for the measurement uncertainty recapture (MUR) power uprate for cycle 25 and beyond, either have been projected to the end of the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii) or will be managed for the period of extended operation in accordance with 10 CFR 54.24(c)(1)(iii) as summarized below.

Based on the plant operating history and assuming 100 percent capacity factor through the period of extended operation, CNS will not surpass 50 EFPY. However, 54 EFPY (90 percent capacity factor times 60 years) is conservatively used as the end of the period of extended operation to evaluate reactor vessel neutron embrittlement time-limited aging analyses.

2.2.1.1 Reactor Vessel Fluence

Calculated fluence is based on a time-limited assumption defined by the operating term. Therefore, analyses that evaluate reactor vessel neutron embrittlement based on calculated fluence are time-limited aging analyses.

The high energy (> 1 MeV) neutron fluence for the welds and shells of the reactor pressure vessel beltline region was determined using the Radiation Analysis Modeling Application (RAMA) fluence method which adheres to the guidance prescribed in Regulatory Guide 1.190.

2.2.1.2 Adjusted Reference Temperature

The change in reference temperature of nil-ductility transition (ΔRT_{NDT}) and adjusted reference temperature (ART) values were projected to 54 EFPY using the methods described in Regulatory Guide 1.99 Revision 2. Credible surveillance data and the integrated surveillance program (ISP) were used to determine chemistry factors and best-estimate chemistry values for the lower intermediate shell plates. All projected values for ART are below the 200°F suggested in Section 3 of Regulatory Guide 1.99 as an acceptable value of ART for the end of the period of extended operation.

The time-limited aging analysis for adjusted reference temperature has been projected to the end of the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

2.2.1.3 Pressure-Temperature Limits

Appendix G of 10 CFR 50 requires that the reactor vessel remain within established pressure-temperature (P-T) limits during boltup, hydro-test, pressure tests, normal operation, and anticipated operational occurrences. These limits are calculated using materials and fluence data, including data obtained through the Reactor Vessel Surveillance Program.

The P-T limit curves will continue to be updated, as required by Appendix G of 10 CFR Part 50, assuring that limits remain valid through the period of extended operation.

The aging effects associated with the reactor vessel pressure-temperature limits will be managed for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

2.2.1.4 Upper-Shelf Energy

The predictions for percent drop in Charpy upper shelf energy (C_vUSE) values were projected to 54 EFPY using projected beltline fluence values, chemistry and surveillance data, and un-irradiated C_vUSE information in accordance with Regulatory Guide 1.99. All projected C_vUSE values for 54 EFPY remain above the 50 ft-lb minimum acceptable value specified in Appendix G of 10 CFR 50.

The time-limited aging analyses for upper shelf energy have been projected to the end of the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

2.2.1.5 Reactor Vessel Circumferential Weld Inspection Relief

Relief from reactor vessel circumferential weld examination requirements during the fourth ten-year ISI interval for CNS was requested in 2007 for the fourth Inservice Inspection (ISI) Interval. The relief request is based on BWRVIP-05 and the associated NRC safety evaluation report (SER), and its supplement (References 4 and 5). The relief request was updated and resubmitted to the NRC for approval at the beginning of the 5th ISI interval and was authorized for the CNS renewed operating license which ends on January 18, 2034 (see Appendix J).

The CNS reactor pressure vessel circumferential weld parameters at 54 EFPY will remain within the NRC's (64 EFPY) bounding CE parameters from the BWRVIP-05 SER. The fact that the values projected to the end of the period of extended operation are less than the 64 EFPY value provided by the NRC leads to the conclusion that the CNS RPV conditional failure probability is less than the conditional failure probability of the NRC analysis. As such, the conditional probability of failure for circumferential welds remains below that determined during the NRC's final safety evaluation of BWRVIP-05.

2.2.1.5.1 Axial Welds

A basic assumption in calculating the failure probability of the circumferential welds is the failure probability of the axial welds.

The CNS reactor vessel limiting axial weld parameters were compared to those used in the NRC analysis in BWRVIP-05 (Reference 4). The projected 54 EFPY CNS mean ART for axial welds is less than the value shown in the NRC SER for BWRVIP-74 (Reference 6).

The time-limited aging analysis for reactor vessel circumferential weld inspection relief has been projected to the end of the period of extended operation in accordance with 10 CFR 54.21(c)(1)(ii).

2.2.2 Metal Fatigue

2.2.2.1 Class 1 Metal Fatigue

Fatigue evaluations were performed in the design of the CNS Class 1 components in accordance with their design requirements. ASME Section III fatigue evaluations are contained in analyses and stress reports, and because they may be based on a number of transient cycles assumed for a 40-year operating term, these evaluations are considered time-limited aging analyses.

Design cyclic loadings and thermal conditions for the Class 1 components are defined by the applicable design specifications for each component. The original design specifications provided a set of transients that were used in the design of the components and are included as part of each component analysis or stress report.

The Fatigue Monitoring Program tracks and evaluates the cycles and requires corrective actions if limits are approached. The Fatigue Monitoring Program ensures that the numbers of transient cycles experienced by the plant remain within the analyzed numbers of cycles, and hence the component CUFs remain below the code allowable value of 1.0.

2.2.2.1.1 Reactor Vessel

The design code for the reactor vessel is specified in Section IV-2.5.1 of the USAR. Fatigue evaluations for the reactor vessel were performed as part of the vessel design. The fatigue analyses of the reactor vessel are considered time-limited aging analyses because they are based on numbers of design cycles expected to occur in 40 years of operation.

The actual numbers of transient cycles remain within analyzed values used for reactor vessel fatigue analyses. CNS will monitor these transient cycles using the Fatigue Monitoring Program and assure that action is taken if any of the actual cycles approach their analyzed numbers. As such, the Fatigue Monitoring Program will manage the effects of aging due to fatigue on the reactor vessel in accordance with 10 CFR 54.21(c)(1)(iii).

2.2.2.1.2 Reactor Vessel Feedwater Nozzle

As discussed in USAR Section IV-2.5.1.1, the feedwater nozzles were modified in 1980 to remove stainless steel cladding in order to reduce thermal stresses and crack initiation.

In 2007, Cooper submitted a Technical Specification change request (Reference 3) that included a re-evaluation of the feedwater nozzle fatigue including MUR. The projected CUF for the nozzle/shell junction, including system cycling and rapid cycling, slightly exceeds 1.0.

The feedwater rapid cycling is analyzed based on years of operation, and the number of analyzed years (40) will be exceeded during the period of extended operation. Consequently, the feedwater nozzle CUF cannot be successfully projected for the period of extended operation. The feedwater nozzle is one of the locations identified by NUREG-6260 for assessment of the effects of the reactor water environment on fatigue. See Section K-2.2.2.3 for a discussion of the environmentally assisted fatigue analysis of the feedwater nozzles and how CNS will manage the aging effect due to fatigue on the feedwater nozzles. CNS will continue to manage fatigue due to rapid cycling using the BWR Feedwater Nozzle Program. As such, the effects of fatigue on the feedwater nozzles will be managed for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

2.2.2.1.3 Reactor Vessel Internals

The CNS reactor pressure vessel internals are not Class 1 pressure boundary components. As such, no plant specific fatigue analysis of the entire reactor vessel internals was performed. Fatigue analyses of specific internals piece parts have been performed over the years; however, the only time-limited aging analyses associated with fatigue of the reactor vessel internals at CNS are the core plate plugs addressed below in Section K-2.2.5. A qualitative review of the internals was performed for the MUR power uprate, and it was concluded that the governing stresses for all RPV internal components in the MUR condition remain bounded by the existing values. The shroud support and brackets welded to the vessel are considered part of the vessel and had CUFs calculated in the vessel stress report.

2.2.2.1.4 Class 1 Piping

Original piping was designed in accordance with B31.1, "Power Piping." Other Class IS piping is designed to meet the supplementary requirements included in Section A-3.1 of the USAR.

Repairs, replacements and modifications are generally performed in accordance with the original code requirements. As permitted by ASME Section XI, later editions of the code or ASME III have been used for some modifications at CNS. To the extent practical, portions of the Class IN piping and nozzle safe ends subject to intergranular stress corrosion cracking (IGSCC) have been replaced with resistant material. The design code for the replaced piping is ASME Section III, 1983 Edition per Section A-3.1 of the USAR.

In the B31.1 code, fatigue is addressed by using stress range reduction factors to reduce stress allowable. Components with less than 7000 equivalent full temperature cycles are limited to the calculated stress allowable without reduction per B31.1. Components that exceed 7000 equivalent full temperature cycles have allowable stresses reduced through the application of stress range reduction factors. Since the reactor coolant pressure boundary will not exceed 7000 full temperature cycles in 60 years of operation, the existing stress analyses remain valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

To the extent practical, portions of the reactor water cleanup (RWCU) and the reactor pressure vessel drain line piping subject to IGSCC have been replaced with IGSCC-resistant material. The design code for the replaced piping is B31.1, as discussed in Section A-3.1 of the USAR.

Specific to the ASME Section III piping, a review of CNS fatigue analyses found CUFs calculated for reactor recirculation (RR), residual heat removal (RHR), RWCU, main steam (MS), core spray (CS), reactor feedwater (RF), and reactor pressure vessel level sensing lines.

For the ASME Section III piping, CNS will monitor the cycles actually incurred compared to the cycles analyzed using the Fatigue Monitoring Program and assure that action is taken if any of the actual cycles approach their analyzed numbers. As such, the Fatigue Monitoring Program will manage the effects of aging due to fatigue on the ASME Section III piping in accordance with 10 CFR 54.21(c)(1)(iii).

2.2.2.2 Non-Class 1 Metal Fatigue

The design of ASME III Code Class 2 and 3 piping systems incorporates the Code stress reduction factor for determining acceptability of piping design with respect to thermal stresses. In general, 7000 thermal cycles are assumed, allowing a stress reduction factor of 1.0 in the stress analyses. CNS evaluated the validity of this assumption for 60 years of plant operation. The results of this evaluation indicate that the 7000 thermal cycle assumption will not be exceeded for 60 years of operation. Therefore, the pipe stress calculations remain valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

Non-Class 1 components, other than piping system components, required fatigue analyses only if they were built to ASME Section III, NC-3200 or ASME Section VIII, Division 2. CNS has no non-Class 1 components built to these codes and therefore has no associated time-limited aging analyses for components other than piping system components.

2.2.2.3 Effects of Reactor Water Environment on Fatigue Life

NUREG/CR-6260 (Reference 9) addresses the application of environmental factors to fatigue analyses (CUFs) and in Section 5.7

identifies the locations most sensitive to environmental effects for CNS vintage General Electric plants. These locations are relevant to CNS.

(1) Reactor vessel shell and lower head

(2) Reactor vessel feedwater nozzle

(3) Reactor recirculation piping (including inlet and outlet nozzles)

(4) Core spray line reactor vessel nozzles and associated Class 1 piping

(5) Residual heat removal return line Class 1 piping

(6) Feedwater line Class 1 piping

CNS evaluated these six locations using environmentally assisted fatigue correction factors (F_{en}).

Based on the current fatigue analysis, none of the projected CUF values of the above listed locations are expected to exceed 1.0 at the end of the period of extended operation when environmental effects are considered. Due to the factor of safety included in the ASME code, a CUF of greater than 1.0 does not indicate that fatigue cracking is expected. However, there is a higher potential for fatigue cracking during the period of extended operation at locations that may exceed CUFs of 1.0.

The effects of environmentally assisted fatigue (EAF) will be managed by the Fatigue Monitoring Program for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

2.2.3 Environmental Qualification of Electrical Components

The CNS Environmental Qualification (EQ) of Electric Components Program implements the requirements of 10 CFR 50.49 (as further defined by the Division of Operating Reactors Guidelines, NUREG-0588, and Reg. Guide 1.89). The program requires action before individual components exceed their qualified life. In accordance with 10 CFR 54.21(c)(1)(iii), implementation of the EQ Program provides reasonable assurance that the effects of aging on components associated with EQ time-limited aging analyses will be adequately managed such that the intended functions can be maintained for the period of extended operation.

2.2.4 Fatigue of Primary Containment, Attached Piping, and Components

Analyses of the CNS containment are included in the Plant Unique Analysis Report (PUAR) (Reference 7) and the generic Mark 1 containment report, MPR-751 (Reference 8).

The CUF for the torus shell was determined to be 0.51 at the butt weld between the torus shell plates of unequal thickness at the torus equator. However, the initial analysis was redone in 1997, including the limiting ASME Code fatigue reduction factor of 5 for the entire shell. This new analysis yielded a CUF of 0.947. Rather than projecting this analysis, CNS will manage the aging effects due to fatigue of the torus shell using cycle-based fatigue monitoring. Thus the Fatigue Monitoring Program will manage the aging effects due to fatigue on the torus shell for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

The fatigue analysis of the S/RV discharge line piping is bounded by MPR-751, the GE Mark 1 containment program (Reference 8). MPR-751 was prepared to bound all BWR plants which utilize the Mark I containment design. The analysis concluded that for all plants and piping systems considered, in all cases the fatigue usage factors for an assumed 40-year plant life was less than 0.5. In a worst-case scenario, extending plant life by an additional 20 years would produce usage factors below 0.75. Since this is less than 1.0, the fatigue criteria are satisfied.

For torus attached piping (internal and external to the torus), the results of the generic GE Mark I containment program (based on 40 years of operation) were that the torus attached piping would have cumulative usage factors of less than 0.5. In particular, the locations reported for CNS were all less than 0.3. Conservatively multiplying the CUFs by 1.5 demonstrates that for 60 years of operation, the torus attached piping for CNS would have CUFs below 0.75.

Therefore, the analysis for the S/RV discharge piping and other attached piping has been projected to the end of the period of extended operation in accordance with 10 CFR 50.21(c)(ii).

For Type 1 torus piping penetration assemblies, including expansion joint bellows, the cycle life is specified to be a minimum of 7000 cycles over a period of 40 years. The 7000 thermal cycle assumption is valid and bounding for 60 years of operation. Therefore, the torus piping penetration stress calculations remain valid for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(i).

2.2.5 Core Plate Plugs

The 88 core plate bypass holes were plugged in the mid-1970s to eliminate in core instrument vibration that was causing damage to fuel channels. A stress analysis was performed on the plug considering normal operating conditions, pressure and thermal transients, and installation/removal operations. The results show acceptable stress levels in all plug components during normal operation and transients.

The analysis of the fatigue life of these plugs is a time-limited aging analysis. The evaluation concluded that the predicted core plate plug life for both spring relaxation and for stress (fatigue) cracking was 32 EFPY and that the cumulative usage factor (CUF) at 32 EFPY is approximately 0.94, based on plotted data. The slope of the curve in this evaluation is such that it appears the CUF would exceed 1.0 prior to 54 EFPY. Cracking due to fatigue of the core plate plugs will be managed by the BWR Vessel Internals Program, with enhancement to include management of plugs in the core plate bypass holes, for the period of extended operation in accordance with 10 CFR 54.21(c)(1)(iii).

2.3 Newly-Identified Structures, Systems, and Components

In accordance with 10 CFR 54.37(b), after the renewed license is issued, the FSAR update required by 10 CFR 50.71(e) must include any systems, structures, and components (SSC) newly identified that would have been subject to an aging management review or evaluation of time-limited aging analyses (TLAA) in accordance with 10 CFR 54.21. Regulatory Issue Summary

(RIS) 2007-16, Revision 1[10], provides an acceptable basis for complying with the 10 CFR 54.37(b) regulation.

2.3.1 Newly-Identified SSCs Requiring Aging Management

In the context of 10 CFR 54.37(b), newly identified SSCs that should be included in the next FSAR update required by 10 CFR 50.71(e) are those SSCs that meet one of the two following conditions:

(1) There is a change to the current licensing basis (CLB) that meets the following criteria:

- The change impacts SSCs that were not in scope for license renewal when the NRC approved the license renewal application.
- The SSCs would have been in the scope of license renewal based on the CLB change if 10 CFR 54.4(a) were applied to the SSCs.

(2) SSCs were installed in the plant at the time of the license renewal review that, in accordance with the CLB at the time, should have been included in the scope of license renewal per 10 CFR 54.4(a) but were not identified as in scope until after issuance of the renewed license.

Reviews are performed utilizing the guidance of RIS 2007-16, Rev. 1, to determine if the above criteria are met, resulting in newly-identified SSCs that require Aging Management. Table K-2-1 identifies SSCs which meet the criteria for inclusion into the USAR pursuant to 10 CFR 54.37(b).

2.3.2 Newly-Identified SSCs Requiring TLAA Evaluation {S}

Reviews are performed of newly-identified SSCs requiring evaluation of TLAAs. As defined in 10 CFR 54.3, TLAAs meet the following six criteria:

(1) Involve systems, structures, and components (SSCs) within the scope of license renewal, in accordance with 10 CFR 54.4(a);

(2) Consider the effects of aging;

(3) Involve time-limited assumptions defined by the current operating term (40 years);

(4) Were determined to be relevant by the licensee in making a safety determination;

(5) Involve conclusions or provide the basis for conclusions, related to the capability of the system, structure, and component to perform its intended functions, as delineated in 10 CFR 54.4(b); and

(6) Are contained or incorporated by reference in the CLB.

During the course of review of the CNS LRA, the NRC questioned the implementation of the BWRVIP-25 inspection requirements. NPPD asserted that the aging effect due to irradiation induced stress relaxation on core plate hold down bolts is managed by performing an analysis which showed that the preload clamping condition of the core plate hold down bolts is not critical to seismic integrity. The NRC requested that NPPD perform a TLAA related to irradiation induced stress relaxation of the core plate hold down bolts and submit this analysis to the staff for review and approval prior to entering into the period of extended operation. NPPD submitted a complete proprietary report, "Cooper Nuclear Station Core Plate Bolt Stress Report," by letter dated January 16, 2012, as supplemented by letters dated July 3, 2013, October 1, 2013, and May 19, 2014. In a Staff Evaluation dated July 25, 2014, the NRC concluded that there is reasonable assurance that the CNS core plate bolts are structurally acceptable for 60-year plant life. This was based on the determination that the core plate bolts satisfy the ASME Code criteria for the applicable loads and load combinations, and that the methodology and assumptions utilized in the stress analysis were reasonable and consistent with BWRVIP-25.}

TABLE K-2-1

NEWLY-IDENTIFIED SSCs REQUIRING AGING MANAGEMENT

Structure/ System	Component Type	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	Notes
TG Lube Oil	Valve Body	Aluminum	Lube Oil (internal)	Loss of material	Oil Analysis	Reference: Condition Report CR-CNS-2012-00744
TG EH Fluid	Valve Body	Aluminum	Lube Oil (internal)	Loss of material	Oil Analysis	Reference: Condition Report CR-CNS-2012-00744
Control Bldg	Flood curb	Carbon steel	Air – indoor uncontrolled	Loss of Materal	Structures Monitoring	Flood barrier per NEDC 11-084

3.0 REFERENCES FOR APPENDIX K

1. NPPD Letter NLS2008071 to USNRC, "License Renewal Application, Cooper Nuclear Station Docket 50-298, DPR-46," September 24, 2008.

2. NRC letter to NPPD, "Safety Evaluation Report Related to the License Renewal of Cooper Nuclear Station," September 1, 2010.

3. NPPD Letter NLS2007069 to USNRC, "License Amendment Request to Revise Technical Specifications - Appendix K Measurement Uncertainty Recapture Power Uprate, Cooper Nuclear Station Docket 50-298, DPR-46," November 19, 2007.

4. Strosnider, J. (NRC) to C. Terry (BWRVIP Chairman), "Final Safety Evaluation of the BWR Vessel and Internals Project BWRVIP-05 Report (TAC NO. 92925)," letter dated July 28, 1998.

5. Strosnider, J. (NRC) to C. Terry (BWRVIP Chairman), "Supplement to Final Safety Evaluation of the BWR Vessel and Internals Project BWRVIP-05 Report (TAC NO. MA3395)," letter dated March 7, 2000.

6. Wagoner, V., and T. Mulford (NRC) to All BWRVIP Committee Members, "Acceptance for Referencing of BWRVIP-74 in License Renewal Applications," letter dated October 31, 2001.

7. Nebraska Public Power District, Cooper Nuclear Station, Plant Unique Analysis Report, Mark I Containment Program, revised February 26, 2007.

8. Technical Report MPR-751, Mark I Containment Program Augmented Class 2/3 Fatigue Evaluation Method and Results for Typical Torus Attached and SRV Piping Systems, November 1982.

9. NUREG/CR-6260, Application of NUREG/CR-5999 Interim Fatigue Curves to Selected Nuclear Power Plant Components, February 1995.

10. Regulatory Issue Summary 2007-16, Revision 1, “Implementation of the Requirements of 10 CFR 54.37(b) for Holders of Renewed Licenses,” April 28, 2010.

4.0 LICENSE RENEWAL COMMITMENTS

A preliminary list of commitments made in the License Renewal Application for Cooper Nuclear Station was provided in the letter transmitting the LRA to the NRC. The commitments reflected the contents of the LRA as submitted but were considered preliminary in that the specific wording of some commitments was subject to change, and additional commitments could be made, during the NRC review of the LRA. Any other actions discussed in the LRA should be considered intended or planned actions. These other actions were included for informational purposes but are not considered regulatory commitments.

The final commitments as submitted by NPPD, and accepted by NRC, were confirmed in the NRC's Safety Evaluation Report (SER) for the renewed operating licenses. These final commitments, as confirmed in the SER, became effective upon NRC issuance of the renewed operating license. A consolidated listing of the commitments made by NPPD, as revised, for License Renewal is provided in Table K-4-1.

TABLE K-4-1

CONSOLIDATED LIST OF LICENSE RENEWAL COMMITMENTS

Commitment Number	Commitment	Committed Date
NLS2008071-01 (Rev. 1)	Implement the aboveground Steel Tanks Program. [LRA Section B.1.1] The thickness measurements will be performed at least once during the first ten years of the period of extended operation and periodically thereafter. The results of the initial inspection will be used to determine the frequency of subsequent inspections. [RAI B.1.1-1]	January 18, 2014
NLS2008071-02	Enhance the Bolting Integrity Program to include guidance from EPRI NP-5769 and EPRI TR-104213 for material selection and testing, bolting preload control, ISI, plant operation and maintenance, and evaluation of the structural integrity of bolted joints. Enhance the program to clarify that actual yield strength is used in selecting materials for low susceptibility to SCC, to clarify the prohibition on use of lubricants containing MoS_2 for bolting at CNS, and to specify that proper gasket compression will be visually verified following assembly. Enhance the program to include guidance from EPRI NP-5769 and EPRI TR-104213 for replacement of non-Class 1 bolting and disposition of degraded structural bolting. [LRA Section B.1.2]	January 18, 2014
NLS2008071-03	Implement the Buried Piping and Tanks Inspection Program. [LRA Section B.1.3]	January 18, 2014
NLS2008071-04	Enhance the BWR Vessel Internals Program to include actions to replace the plugs in the core plate bypass holes based on their qualified life. [LRA Section B.1.9]	January 18, 2014
NLS2008071-05 (Rev. 1)	Enhance the Containment Inservice Inspection Program to add examination of required accessible areas using a visual examination method and surface areas not accessible on the side requiring augmented examination to be examined using an ultrasonic thickness measurement method in accordance with IWE-2500(b). Enhance the program to document material loss in a local area exceeding 10% of the nominal containment wall thickness or material loss in a local area projected to exceed 10% of the nominal containment wall thickness before the next examination in	January 18, 2014

Commitment Number	Commitment	Committed Date
	accordance with IWE-3522 for volumetric inspections. [LRA Section B.1.10] To ensure the [drywell sand cushion drain] lines are obstruction free, a vacuum test of all eight sand bed drain lines will be performed prior to the period of extended operation (PEO). [RAI B.1.10-1]	
NLS2008071-06 (Rev. 2)	Enhance the Diesel Fuel Monitoring Program to include the use of ASTM Standard D4057 for sampling of the diesel fire pump fuel oil storage tank. Enhance the Diesel Fuel Monitoring Program to include periodic visual inspections and cleaning of the diesel fuel oil day tanks, the diesel fuel oil storage tanks, and the diesel fire pump fuel oil storage tank. Enhance the program to include periodic multilevel sampling of the diesel fuel oil day tanks and representative low point sampling of the diesel fire pump fuel oil storage tank and to include periodic visual inspections as well as ultrasonic bottom surface thickness measurement of the diesel fuel oil day tanks, the diesel fuel oil storage tanks, and the diesel fire pump fuel oil storage tank. Enhance the program to provide the acceptance criterion of ≤ 10 mg/l for the determination of particulates in the diesel fire pump fuel oil storage tank. Enhance the program to specify acceptance criterion for UT thickness measurements of the bottom surfaces of the diesel fuel oil day tanks, the diesel fuel oil storage tanks, and the diesel fire pump fuel oil storage tank. [LRA Section B.1.12] The acceptance criteria for UT measurement of tank bottom thickness for the referenced diesel fuel tanks will be based on component as-built information adjusted for corrosion allowance. If measurements show less than the minimum nominal thickness less corrosion allowance, engineering will evaluate the measured thickness for acceptability under the corrective action program. Evaluation will include consideration of potential future corrosion to ensure that future inspections are scheduled before wall thickness becomes unacceptable. [RAI B.1.12-1]	January 18, 2014

Commitment Number	Commitment	Committed Date
NLS2008071-07	Enhance the External Surfaces Monitoring Program to clarify that periodic inspections of systems in scope and subject to aging management review for license renewal in accordance with 10 CFR 54.4(a)(1) and (a)(3) will be performed. Inspections shall include areas surrounding the subject systems to identify hazards to those systems. Inspections of nearby systems that could impact the subject systems will include SSCs that are in scope and subject to aging management review for license renewal in accordance with 10 CFR 54.4(a)(2). [LRA Section B.1.14]	January 18, 2014
NLS2008071-08 (Rev. 3)	Consideration of the effect of the reactor water environment will be accomplished through implementation of one or more of the following options for the reactor vessel shell and lower head, feedwater nozzles, core spray nozzles and RHR pipe transition. In addition, NPPD will review design basis ASME Class 1 component fatigue evaluations to determine whether the CNS locations that have been evaluated for the effects of the reactor coolant environment on fatigue include the limiting component within the reactor coolant pressure boundary. If a more limiting component is identified, NPPD will determine the effects of the reactor coolant environment on its fatigue usage in accordance with the following. (1) Update the fatigue usage calculations using refined fatigue analyses to determine valid CUFs less than 1.0 when accounting for the effects of reactor water environment. This includes applying the appropriate F_{en} factors to valid CUFs determined using an NRC-approved version of the ASME code or NRC-approved alternative (e.g., NRC-approved code case). NPPD will use NUREG/CR-6909 when determining the effects of the reactor coolant environment on the fatigue life of Alloy 600 or other nickel alloy components. (2) Repair or replace the affected locations before exceeding a CUF of 1.0. The CNS Fatigue Monitoring Program will be enhanced to require the recording of each transient associated with the actuation of a safety/relief valve (SRV).	January 18, 2014
NLS2008071-09 (Rev. 2)	Enhance the Fire Protection Program to explicitly state that the diesel fire pump	January 18, 2014

Commitment Number	Commitment	Committed Date
	engine subsystems (including the fuel supply line) shall be observed while the engine is running. Acceptance criteria will be revised to verify that the diesel engine does not exhibit signs of degradation while running, such as excessive fuel oil, lube oil, or exhaust gas leakage. Enhance the program to specify that diesel fire pump engine carbon steel exhaust components are inspected for evidence of corrosion or cracking at least once every five years. Enhance the program to require visual inspections of fire damper framing to check for signs of degradation. Enhance the program to require visual inspections of the Halon and CO_2 fire suppression systems at least once every six months, where radiologically accessible at power, to check for signs of degradation in a manner suitable for trending. Those sections of the CO_2 system that are in radiation areas when at power are inspected every 24 months under shutdown conditions. Enhance the program to require visual inspection of concrete flood curbs, manways, hatches, and hatch covers on a 24-month basis to check for signs of degradation. [LRA B.1.16]	
NLS2008071-10	Enhance the Fire Water System Program to include inspection of hose reels for corrosion. Acceptance criteria will be enhanced to verify no unacceptable corrosion. Enhance the program to include visual inspection of spray and sprinkler system internals for evidence of corrosion. Acceptance criteria will be enhanced to verify no unacceptable corrosion. Enhance the program to provide wall thickness evaluations of fire protection piping on system components using non-intrusive techniques (e.g., volumetric testing) to identify evidence of loss of material due to corrosion. These inspections will be performed before the end of the	January 18, 2014

Commitment Number	Commitment	Committed Date
	current operating term and at intervals thereafter during the period of extended operation. Results of the initial evaluations will be used to determine the appropriate inspection interval to ensure aging effects are identified prior to loss of intended function. Enhance the program to add that a sample of sprinkler heads required for 10 CFR 50.48 will be tested or replaced using guidance of NFPA-25 (2002 edition), Section 5.3.1.1.1, before the end of the 50-year sprinkler head service life and at 10-year intervals thereafter during the period of extended operation. [LRA Section B.1.17]	
NLS2008071-11 (Rev. 1)	Enhance the Flow Accelerated Corrosion Program to update the System Susceptibility Analysis for this program to reflect the lessons learned and new technology that became available after the publication of NSAC-202L Revision 1. [LRA Section B.1.18] Program guidance documents will be revised to stipulate requirements for training and qualification of non-CNS personnel involved in implementing the FAC program. [RAI B.1.18-3]	January 18, 2014
NLS2008071-12	Enhance the Inservice Inspection – IWF Program to include Class MC piping and component supports. Enhance the program to clarify that the successive inspection requirements of IWF-2420 and the additional examination requirements of IWF-2430 will be applied. [LRA Section B.1.20]	January 18, 2014
NLS2008071-13	Enhance the Masonry Wall Program to clarify that the control house – 161 kV switchyard is included in the program. Enhance the program to clarify that structures with conditions classified as “acceptable with deficiencies” or “unacceptable” shall be entered into the Corrective Action Program. [LRA Section B.1.21]	January 18, 2014
NLS2008071-14	Implement the Metal-Enclosed Bus Inspection Program. [LRA Section B.1.22]	January 18, 2014
NLS2008071-15	Implement the Non-EQ Bolted Cable Connections Program. [LRA Section B.1.24]	January 18, 2014
NLS2008071-16 (Rev. 3)	Implement the Non-EQ Inaccessible Medium-Voltage Cable Program. [LRA Section B.1.25]	January 18, 2014

Commitment Number	Commitment	Committed Date
	Inspections for water accumulation in manholes containing in-scope inaccessible low-voltage and medium-voltage power cables will be performed at least once every two years. In-scope inaccessible low-voltage power cables (cables with operating voltage from 480 V to 2 kV) that are subject to aging management review are included in this program. The in-scope inaccessible low-voltage power cables will be tested for degradation of the cable insulation prior to the period of extended operation and at least once every 10 years thereafter. A proven, commercially available test will be used for detecting deterioration due to wetting of the insulation system for all in-scope inaccessible low-voltage power cables (480 V to 2 kV). [RAI B.1.25-2, Rev. 0] Condition-based inspections of [the manhole not dewatered by a sump pump] will be performed based on high water level annunciation.	
NLS2008071-17	Implement the Non-EQ Instrumentation Circuits Test Review Program. [LRA Section B.1.26]	January 18, 2014
NLS2008071-18	Implement the Non-EQ Insulated Cables and Connections Program. [LRA Section B.1.27]	January 18, 2014
NLS2008071-19 (Rev. 1)	Enhance the Oil Analysis Program to include viscosity and neutralization number of oil samples from components that do not have regular oil changes, along with analytical ferrography and elemental analysis for the identification of wear particles. Enhance the program to include screening for particulate and water content for oil replaced periodically. Enhance the program to formalize preliminary oil screening for water and particulates and laboratory analyses, including defined acceptance criteria for all components included in the scope of the program. The program will specify corrective actions in the event acceptance criteria are not met. [LRA Section B.1.28]	January 18, 2014

Commitment Number	Commitment	Committed Date
NLS2008071-20 Revision 3	Implement the One-time Inspection Program. [LRA Section B.1.29, except that: a) "surface condition" (from NUREG-1801 Revision 2 Section XI.M32 "Examples of Parameters Monitored or Inspected and Aging Effect for Specific Structure or Component" table) is included as a parameter monitored for loss of material and cracking, b) the CASS main steam line and reactor recirculation flow elements do not require inspection to confirm that reduction of fracture toughness is not occurring], and c) a representative sample size will be 20% of the population (defined as components having the same material, environment, and aging effect combination), or a maximum of 25 components.]	January 18, 2014
NLS2008071-21	Implement the One-time Inspection-Small-Bore Piping Program. [LRA Section B.1.30]	January 18, 2014
NLS2008071-22 (Rev. 1)	Enhance the Periodic Surveillance and Preventive Maintenance Program to include the activities described in the table provided in the program description of LRA Section B.1.31. For each activity that refers to a representative sample, a representative sample will be selected for each unique material and environment combination. The sample size will be 20% of the population (defined as components having the same material, environment, and aging effect combination) or a maximum of 25 components. [LRA Section B.1.31]	January 18, 2014
NLS2008071-23 (Rev. 1)	Enhance the Reactor Vessel Surveillance Program to add that if the CNS license renewal capsule is removed from the reactor vessel without the intent to test it, the capsule will be stored in a manner which maintains it in a condition which would permit its future use, including during the period of extended operation, if necessary. Enhance the program to ensure that the additional requirements that are specified in the final NRC safety evaluation for BWRVIP-116 will be addressed before the period of extended operation. [LRA Section B.1.33]	January 18, 2014

Commitment Number	Commitment	Committed Date
NLS2008071-24 (Rev. 1)	Implement the Selective Leaching Program. [LRA Section B.1.34], with the following exceptions: 1) a representative sample size is 20% of the population (defined as components having the same material/ environment combination) or a maximum of 25 components, and 2)destructive testing is an acceptable inspection technique.	January 18, 2014
NLS2008071-25 (and Supplement 1) Rev. 2	Revise procedures to ensure the structures described in the LRA Section B.1.36 table are included in the program, except that "Service Water Pipe Slab" is deleted. Revise procedures to ensure the commodities described in the LRA Section B.1.36 table are inspected, as applicable, except that "blowout panels (including east end of steam tunnel)" and "exterior walls" will be treated as structures enhancements. Enhance the Structures Monitoring Program to add guidance to inspect inaccessible concrete areas that are submerged or below grade which may become exposed due to excavation, construction or other activities. CNS will also inspect inaccessible concrete areas when observed conditions in accessible areas exposed to the same environment indicate that significant concrete degradation is occurring. Enhance the Structures Monitoring Program to perform inspections of elastomers (seals, gaskets, and roof elastomers) to identify cracking and change in material properties. Enhance the Structure Monitoring Program to perform an engineering evaluation of groundwater samples to assess aggressiveness of groundwater to concrete on a periodic basis (at least once every five years). CNS will obtain samples from a well that is representative of the groundwater surrounding below-grade site structures. Samples will be monitored for sulfates, pH and chlorides. Enhance the Structures Monitoring Program to add guidance to perform visual structural examinations of wood to identify loss of material and change in material properties. Enhance the Structures Monitoring Program to add guidance to perform visual structural monitoring of the oil tank bunker crushed rock fill to identify loss of form.	January 18, 2014

Commitment Number	Commitment	Committed Date
	Enhance the Structures Monitoring Program to clarify that structures with conditions classified as "acceptable with deficiencies" or "unacceptable" shall be entered into the Corrective Action Program. [LRA Section B.1.36] Supplement 1: NPPD will enhance the Structures Monitoring Program procedure to: a) include more detailed guidance on acceptance criteria (using ACI documents ACI 201.1R-92, and ACI 349.3R-96) to preclude potential inconsistent application of inspection criteria, and b) provide more detailed guidance on trending.	
NLS2008071-26	Implement the Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS) Program. [LRA Section B.1.37]	January 18, 2014
NLS2009100-1 (Rev. 1)	NPPD will submit (or otherwise make available for NRC review and approval) a complete proprietary version of an analysis of the core plate rim bolts that demonstrates their adequacy considering potential loss of pre-load through the period of extended operation. This will be provided at least two years prior to the period of extended operation. NPPD expects to satisfy this commitment using the generic analysis being developed by the BWRVIP, provided that it is applicable to CNS.	January 18, 2012
NLS2009100-2	NPPD will confirm that there are no niobium-bearing CASS materials used for vessel internal components, or provide a flaw evaluation methodology for niobium-bearing CASS internal components for staff review and approval. This will be provided at least two years prior to the period of extended operation. NPPD expects to implement this commitment by a generic analysis sponsored by the BWRVIP in collaboration with EPRI.	January 18, 2012
NLS2009100-3 (Rev. 1)	NPPD will confirm there are no CASS materials with greater than 25% ferrite or provide a flaw evaluation methodology for CASS internal components with greater than 25% ferrite for staff review and approval. NPPD expects to implement this commitment by a generic analysis sponsored by the BWRVIP in collaboration with EPRI.	January 18, 2019

Commitment Number	Commitment	Committed Date
NLS2010019-01	NPPD will implement the plant modifications designed to correct the main steam line support discrepancies noted in RAI B.1.20-1 prior to the period of extended operation.	January 18, 2014
NLS2010019-02	To verify there is no loss of neutron absorbing capacity of the Boral material, NPPD will supplement the Neutron Absorber Monitoring Program to include neutron attenuation testing of representative sample coupons. Acceptance criteria will be that measured or analyzed neutron-absorber capacity required to ensure the 5% subcriticality margin for the spent fuel pool is maintained assuming neutron absorber degradation is the only mechanism. Results not meeting the acceptance criteria will be entered into the CNS Corrective Action Program for disposition. One test will be performed prior to the period of extended operation (PEO), with another confirmatory test performed within the first 10 years of the PEO.	January 18, 2014
NLS2010044-01	During the period of extended operation, NPPD will perform periodic volumetric examinations of Class 1 socket weld connections. Three Class 1 socket welds will receive volumetric examination during each 10 year ISI interval. The examination method will be a volumetric examination of the base metal ½" beyond the toe of the socket fillet weld which allows for the use of qualified ultrasonic examination techniques as close as possible to the fillet weld. The volumetric examinations will be performed by certified examiners following guidelines set forth in ASME Section V, Article 4 consistent with the guidelines for examination volume of ½" beyond the toe of the weld as established in MRP-146, "Materials Reliability Program: Management of Thermal Fatigue in Normally Stagnant Non-Isolable Reactor Coolant System Branch Lines."	January 18, 2014
NLS2010050-02	NPPD will remove sludge and visually inspect the wetted portion of the torus every other refueling outage from RE29 (2016) until the end of the period of extended operation. In addition, CNS will perform ultrasonic examinations of test evaluation areas every outage as a supplement to the visual inspections performed every other outage.	January 18, 2034

Commitment Number	Commitment	Committed Date
NLS2010050-03	NPPD will complete an analysis following each torus inspection, including the results of the supplemental ultrasonic examinations performed every outage on test evaluation areas, that demonstrates that the projected pitting of the torus up to the next inspection interval will not result in reduction of torus wall thickness below minimum acceptable values.	January 18, 2034
NLS2010050-04 (Rev. 1)	The Buried Piping and Tanks Inspection Program will include a risk assessment of in-scope buried piping and tanks that includes consideration of the impacts of buried piping or tank leakage and of conditions affecting the risk for corrosion. The piping segments and tanks will be classified as having a high, medium or low impact of leakage based on items such as the safety class, the hazard posed by fluid contained in the piping, and the impact of leakage on plant operation. The corrosion risk will be determined through consideration of items such as piping or tank material, soil resistivity, drainage, the presence of cathodic protection, and the type of coating. During the period of extended operation (PEO), examinations of in-scope buried piping and tanks will be performed at a frequency of at least once every 10 years. Examinations of buried piping and tanks during the PEO will consist of visual inspections as well as non-destructive examination (e.g. ultrasonic and guided wave) to perform an overall assessment of the condition of buried piping and tanks. The examinations will include visual inspection of a least eight feet of excavated piping on at least three high-risk in-scope systems, and will examine a minimum of 2% of the total linear feet of high-risk in-scope buried piping during each 10-year period.	January 18, 2014
NLS2010050-05 (Rev. 1)	Prior to the PEO, NPPD will inspect buried piping and tanks in six systems. These systems are diesel generator fuel oil (DGFO), standby gas treatment, high pressure coolant injection (HPCI), service water (SW), condensate makeup (CM), and plant drains. Direct or opportunistic visual inspections of excavated piping will be performed for DGFO, standby gas treatment, plant drains, SW, and CM systems. NPPD will use a non-visual examination method for the emergency condensate storage tank supply to HPCI piping due to its lack of ready access for excavation. In addition, non-visual examination methods may be employed for	January 18, 2014

Commitment Number	Commitment	Committed Date
	buried piping in other systems where the piping configuration allows for effective assessment via such methods. The total linear feet of piping inspected using all of the methods discussed above will be a minimum of 2% of all high-risk in-scope buried piping.	
NLS2010050-06	Irrespective of risk ranking, NPPD will inspect at least one segment of buried piping in each of three in-scope systems, service water, fire protection, and condensate makeup.	January 18, 2014
NLS2010062-01	NPPD will upgrade the site cathodic protection system prior to the period of extended operation for in-scope piping and buried tanks.	January 18, 2014
NLS2010062-02	The Buried Piping and Tanks Inspection Program will be revised to ensure that during the PEO the cathodic protection system will be maintained and annually tested in accordance with NACE standards RP0285-2002 and SP0169-2007 with a minimum system availability of 90%. If 90% availability is not maintained, the condition will be entered into the corrective action program to evaluate the impact and effect corrective action.	January 18, 2014
NLS2013100-01	NPPD will confirm that the reactor recirculation and main steamline flow restrictor CASS materials are either: a) not greater than 25% ferrite, or b) will perform a flaw tolerance evaluation, or c) will perform a qualified visual or volumetric examination.	January 18, 2019