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10 CFR 54

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October 3, 2003

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Dresden Nuclear Power Station, Units 2 and 3
Facility Operating License Nos. DPR–19 and DPR-25
NRC Docket No. 50-237 and 50-249

Quad Cities Nuclear Power Station, Units 1 and 2
Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: Additional Information for the Review of the License Renewal Applications for Quad Cities Nuclear Power Station, Units 1 and 2 and Dresden Nuclear Power Station, Units 2 and 3

References: (1) Letter from J. A. Benjamin (Exelon Generation Company, LLC) to U. S. NRC, "Application for Renewed Operating Licenses," dated January 3, 2003

(2) Letter from Tae Kim (USNRC) to John Skolds (Exelon Generation Company, LLC), "Request for Additional Information for the Review of the Dresden Nuclear Power Station, Units 2 and 3, and Quad Cities Nuclear Power Station, Unit 1 and 2, License Renewal Application," dated August 4, 2003

Exelon Generation Company, LLC (EGC) is submitting the additional information requested in Reference 2. This additional information provides further discussion of Section 2.4, "Scoping and Screening Results: Structures," Section 3.0, "Aging Management Review Results," Section 3.2, "Aging Management of Engineered Safety Features," Section 3.3, "Aging Management of Auxiliary Systems," Section 3.4, "Aging Management of Steam and Power Conversion System," Section 3.5, "Aging Management of Containments, Structures and Component Supports," Section 4.3, "Metal Fatigue of the Reactor Vessel, Internals, and Reactor Coolant Pressure Boundary Piping and Components," Section 4.6, "Fatigue of Primary Containment, Attached Piping, and Components,"

A097
A098

Section 4.7, "Other Plant-Specific TLAAs," and Appendix B, "Aging Management Programs" to support the NRC review of Reference 1.

Should you have any questions, please contact Al Fulvio at 610-765-5936.

I declare under penalty of perjury that the foregoing is true and correct.

Respectfully,

October 3, 2003
Executed on

Patrick R. Simpson
Manager – Licensing

Attachment: Response to Request for Additional Information

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station
NRC Senior Resident Inspector – Dresden Nuclear Power Station
Office of Nuclear Facility Safety – Illinois Department of Nuclear Safety

Attachment

Response to Request for Additional Information

DRESDEN AND QUAD CITIES
LICENSE RENEWAL APPLICATION
REQUEST FOR ADDITIONAL INFORMATION

Section 2.4 Scoping and Screening Results: Structures

RAI 2.4-1

LRA Table 2.2-2 also identifies structures that are not in scope of license renewal. These include:

Fuel oil pump house and oil storage tank foundation (Dresden)
Meteorological tower
Miscellaneous administrative buildings
Miscellaneous yard structures
Miscellaneous radwaste buildings
Miscellaneous river water structures
Miscellaneous Dresden Unit 1 structures (Dresden)
Miscellaneous transmission and distribution structures

Except for the meteorological tower and miscellaneous administrative buildings (provided there are no seismic II/I intended functions associated with these structures), the staff cannot evaluate whether these structures are correctly excluded from the license renewal scope. Additional descriptive information is needed for the remaining six (6) structures before a determination can be made. Therefore, the applicant is requested to:

Submit a more detailed description of these six (6) structures, define their function, and describe the technical bases for exclusion from the license renewal scope.

Verify that none of the eight (8) structures serve a seismic II/I intended function.

Response:

The eight (8) structures listed in RAI 2.4-1 are groups of non-safety related structures and major components that do not satisfy the requirements of 10 CFR 54.4(a). These structures provide structural support and anchorage for non-safety related equipment and equipment that is not required to support regulated events (ATWS, FP, EQ, and SBO). None of structures and major components in these structural groups serves a seismic II/I intended function. This was the technical basis for exclusion from the license renewal scope. With the exception of the meteorological towers, a description of remaining structural groups along with their functions is provided below.

Dresden - Fuel Oil Pump House and Oil Storage Tank Foundation

This structural group contains structures that support the non-safety related plant fuel supply subsystem for the plant heating steam boilers. A description of those structures and major components included within this structural group along with their functions are provided below.

1. Unit 2/3 Heating Boiler Fuel Oil Pump House – The pump house provides protection for personnel and heating oil transfer equipment from the outside environment.
2. Unit 2/3 Heating Boiler Fuel Oil Pump House Foundation - The foundation provides structural support for Heating Boiler fuel oil pump house (pumps and enclosure).
3. Unit 2/3 Fuel Oil Storage Tank – The storage tank contains the fuel oil used by the plant heating boilers to generate heat for the site.
4. Earthen Berm Surrounding the Unit 2/3 Fuel Oil Storage Tank – The berm is an earthen dike that surrounds the fuel oil storage tank preventing an environmental hazard in the event of a fuel oil spill. The berm provides a volume that can contain the entire contents of the tank.
5. Unit 2/3 Fuel Oil Storage Tank Foundation – The foundation provides structural support for the Fuel Oil Storage Tank

Dresden Station – Miscellaneous Administrative Buildings

This structural group covers a number of administrative, warehouse, and miscellaneous structures. Several of the structures provide protection for non-safety related equipment from the outside environment. A description of those structures and components included within this structural group are provided below.

1. Administration Building – This structure was the original administrative office area for site engineers and managers. The structure currently houses office space for radiation protection personnel.
2. Engineering & Construction Building – This structure provides office space for Design Engineering and construction personnel.
3. Storage Building - This structure contains the retired lake PH control system.
4. Units 1, 2, & 3, Environmental Monitor Huts - These structures protect cooling canal temperature chart recorders.
5. NRC Office Area – This area provides office space for the site NRC resident inspectors.
6. Units 2 & 3 Heating Boiler – This structure houses the site heating boilers that supply steam flow for plant and area heating during cold weather.
7. Microwave Tower & Building -These structures contain switchyard relay protection equipment.
8. Safety Valve Test Facility – This structure contains retired safety valve testing equipment.
9. Unit 3 Turbine Building RPA Access Control Building – This structure controls radiological access to the plant during refueling outages.
10. Site Sewage Ejector Station – This structure contains equipment that transfers sewage to the sewage treatment buildings for processing.
11. Sewage Treatment Buildings - A structure that houses equipment used to process wastes from the plant and properly disposes of them in accordance with EPA and NPDES requirements.
12. Mechanical & Electrical Maintenance Shops – This structure contains the offices space and work areas for mechanical and electrical maintenance personnel.
13. Administration Building Office Area – This structure provides office space for site personnel.
14. West Maintenance Warehouses – These structures provide storage space for

maintenance equipment.

15. Technical Support Center – This structure provides office space for site personnel during emergency operating drills and events.
16. Main Security Gate House - This structure provides controlled access for personnel and equipment to in the protected area of the plant site.
17. Security Diesel Generator Building – This structure houses the site security emergency diesel generators and supporting equipment.
18. Waste Water Treatment Building - This structure provides collection or treatment areas for non-radioactive and non-thermal flows (both process and non-process waste water) prior to discharging to the environment.
19. Main Warehouse – This structure provides storage of supplies and replacement parts for site maintenance.
20. Service Building – This structure contains the record retention center and provides office space and locker rooms for various site personnel.
21. Chemistry Building – This structure contains office space and laboratories for chemistry personnel.
22. Training Building Annex - This structure serves as a security in-process badging and training facility.
23. Training Building – This structure houses office space for training personnel as well as classrooms, workshops, and the control room simulator.
24. Warehouse Annex – This structure provides storage for maintenance supplies and equipment.
25. East Storage Buildings (2) These structures are used to store site equipment.
26. State of Illinois (IDNS) Sample Building – This structure contains site sampling equipment used by the Illinois Department of Nuclear Safety.
27. Hazardous Waste Storage Building – This structure is used as a storage area for hazardous wastes.
28. Waste Oil Drum Storage Building – This structure is used as a holding area for waste oils awaiting processing.
29. Equipment Storage Building(s) – These structures provide storage for various site equipment.

Quad Cities Station – Miscellaneous Administrative Buildings

This structural group covers a number of administrative, warehouse, and miscellaneous structures. Several of the structures provide protection for non-safety related equipment from the outside environment. A description of those structures and components included within this structural group along with their functions are provided below.

1. Construction/Training Office – This structure serves as a security in-process badging and training facility.
2. Office Building – This structure provides office space for site personnel.
3. Environs Monitoring Station (3) – These structures house equipment used to collect background radiation data.
4. Equipment Storage (2) – These structures are used to store equipment.
5. Fish Study Facility Building – This structure houses the site fish production facility (hatchery).
6. Gas Metering House – This structure houses gas metering equipment that supplies natural gas to the heating boilers.
7. Gate House - This structure provides controlled access for personnel and equipment to the protected area- of the plant site.

8. Visitor Center Tower – This structure is an observation deck that is no longer in use.
9. Heating Boiler Building – This structure supports the site heating facility that supplies steam flow for plant and area heating during cold weather and protects this equipment from the outside environment.
10. Radio Building – This structure contains equipment that provides a microwave communication link to the other end of the transmission lines.
11. Records Storage Building – This structure protects and stores plant records.
12. Service Building and Storeroom – This structure contains office spaces, locker rooms, maintenance shops and storage of spare parts and equipment for maintenance.
13. Sewage Treatment Plant – A structure that houses equipment used to process wastes from the plant and properly disposes of them in accordance with EPA and NPDES requirements.
14. Visitor Center – This structure is no longer used as a visitor center and now contains a fitness center for site employees.
15. Warehouse (3) - These structures house materials needed for plant maintenance and plant modifications
16. Waste Water Treatment Building – This structure provide collection or treatment areas for non-radioactive and non-thermal flows (both process and non-process waste water) prior to discharging to the environment.
17. Site Engineering Building - This structure houses Design Engineering personnel.
18. IDNS Building - This structure contains site sampling equipment used by the Illinois Department of Nuclear Safety.
19. Construction Buildings (2) – These structures provide housing to accommodate contract personnel and equipment.
20. New Weld Shop – This structure houses a welding facility.

Dresden Station - Miscellaneous Yard and Tank Structures

This structural group is a collection of miscellaneous non-safety related structures located throughout the site. Several of the structures provide protection for equipment from the outside environment and also provide a barrier to contain potentially environmentally hazardous materials. A description of those structures and components included within this structural group along with their functions are provided below.

1. Concentrated Acid Storage Tank Foundation - This foundation provides support for an acid storage tank located in the Unit 3 Turbine Building located near the service air compressor.
2. Liquid Hydrogen Storage Facility (including Oxygen Storage Tank Farm) - This facility (including foundations) provides support and protection for the hydrogen and oxygen storage tanks.
3. 2/3 Hydrogen Storage (Structures) - This structure provides support and protection for hydrogen storage
4. Various Fire Hydrant Huts - These structures provide protection for fire hydrants located outside of the plant and provide storage space for some fire protection equipment such as fire hoses.
5. Deep Well No. 1 - This well provides a source of ground water for general use.
6. 2/3 Main Condenser Bulk Chemical Storage Tanks Foundation, Chemical Pump Trailer, and Abandoned Hypochlorite Tank Foundation - This structure provides

support / protection for the storage tanks that contain chemicals used for water treatment of the main condensers.

7. 2/3 Underground Oil Separator & Miscellaneous Other Oil Separators and Pump (Ejector) Stations - These structures process drains before release to the environment. These structures include:

    2/3 Oil Separator & Pump Station
    345 KV Switchyard Oil Separator
    138 KV Switchyard Oil Separator
    Unit 1 Oil Separator
    Unit 1 Pump Station
    Unit 3 Ejector Station
    2/3 Ejector Station
    Unit 2 Ejector Station

Quad Cities Station - Miscellaneous Yard and Tank Structures

This structural group is a collection of miscellaneous non-safety related structures located throughout the site. Several of the structures provide protection for equipment from the outside environment and also provide a barrier to contain potentially environmentally hazardous materials. A description of those structures and components included within this structural group along with their functions are provided below.

1. Gas Bottle Storage Rack - This structure provides support and protection for stored gas bottles.
2. Hydrogen Storage – This structure provides support and protection for hydrogen storage tanks.
3. Make-up Demineralizer Feed Pump Building – This structure provides support and protection for the Make-up Demineralizer Pumps.
4. Microwave Tower – This structure provides support for microwave transmission equipment.
5. Motor Operated Gate - This structure provides security closure for access control.
6. Motorized Valve Box - This structure provides support and protection for spray canal valves.
7. Nitrogen Converter - This structure provides support for the nitrogen converter vaporizers.
8. Oil Separator – This structure processes drains before release to the environment.
9. Pump House (2) - These structures provide support and protection for well water equipment.
10. Sample House & Pump - This structure provides support and protection for circulating water sampling equipment.
11. Chemical Storage Tank Foundation (3) - These foundations provide support for chemical storage tanks and supporting equipment.
12. Well (5) – The wells provide source of ground water for general use.
13. Well Water Tank Foundation – This foundation provides support for the well water tank

Dresden Station Miscellaneous Radwaste Buildings

This structural group is a collection of miscellaneous non-safety related structures that provide structural support and anchorage of non-safety related equipment and systems and treated/processed radwaste materials. Several of these structures provide protection of personnel and non-safety related facilities, equipment and components from the outside environment and also provide radiation shielding. A description of those structures and components included within this structural group along with their functions are provided below.

1. Radwaste Upgrade (RUPs) Building – This structure was constructed as a fabrication building to support major modifications to the Radwaste System. It is currently for equipment storage.
2. Mixed Waste Storage Building – This structure provides storage of mixed wastes for future disposal.
3. Solid Radwaste Processing Building – This structure provides protection for personnel and non-safety related systems and components contained within the structure from the outside environment. The structure also provides structural support for radwaste solidification equipment.
4. Units 2 & 3 Offgas Filter Structure - This structure provides structural support of Off Gas System after-filter equipment and provides radiation shielding for plant personnel.
5. 2/3 Radwaste Floor Drain Sample Tanks (2) Foundation – These foundations provide structural support for the two floor drain sample tanks.
6. 2/3 Chimney Gas Sample House – This structure provides protection of non-safety related systems and components and plant personnel from the outside environment.
7. Max Recycle Radwaste Building – This structure provides structural support for radwaste collection and treatment equipment and for Unit 2/3 Chimney monitoring equipment. The structure also provides protection of personnel and non-safety related systems and components contained within the structure from the outside environment.
8. Units 2 & 3 Off-gas Filter Building – This structure provides structural support of Off Gas System equipment and piping and provides protection of personnel and non-safety related systems and components contained therein from the outside environment.
9. Units 2 & 3 Radwaste Building – This structure provides structural support for radwaste collection and treatment equipment, provides structural support of river discharge and service water system monitoring equipment, provides protection of personnel and non- safety related systems and components contained within from the outside environment, and provides support for equipment associated with fuel pool cooling and cleanup filters.
10. Radwaste Waste Sample Tanks (3) Foundation – These foundations provide structural support for the Radwaste Waste Sample Tanks
11. Radwaste Waste Surge Tank Foundation – This foundation provides structural foundation for the Radwaste Waste Surge Tank
12. Units 2 & 3 High Radiation Sample Buildings – These structures provide protection from outside environment for non-safety related systems & components and personnel, provides radiation shielding for plant personnel for post accident, and normal plant operation sampling.
13. Interim Radwaste Storage Facility (IRSF) – This structure provides safe storage of low level radwaste and provides radiation shielding for plant personnel.

Quad Cities Station Miscellaneous Radwaste Buildings

This structural group is a collection of miscellaneous non-safety related structures that provide structural support and anchorage of non-safety related equipment and systems and treated/processed radwaste materials. Several of these structures provide protection of personnel and non-safety related facilities, equipment and components from the outside environment and also provide radiation shielding. A description of those structures and components included within this structural group along with their functions are provided below.

1. Chemical Waste Sample Tank Foundation – This foundation provides support and anchorage for the chemical waste sample tank.
2. Floor Drain Sample Tank Foundation - This foundation provides support and anchorage for the floor drain sample tank.
3. Laundry Sample Tank Foundation - This foundation provides support and anchorage for the laundry sample tank.
4. Maximum Recycle Radwaste Building - This structure provides structural support for radwaste collection and treatment equipment.
5. Offgas Filter Building - This structure provides structural support of Off Gas System equipment and piping and provides protection of personnel and non-safety related systems and components contained therein from the outside environment.
6. Radwaste Solidification Building - This structure provides structural support for radwaste collection and treatment equipment.
7. Radwaste Building and Tank Farm Foundation - This foundation provides support and anchorage to the building and tank farm.
8. Stack Gas Monitoring Building – This structure provides support and anchorage of monitoring station equipment.
9. Waste Sample Tanks Foundation - This foundation provides support and anchorage for the waste sample tanks
10. HRSS Buildings (Unit 1 & 2) These structures provide protection from outside environment for non-safety related systems & components and personnel and provide radiation shielding for plant personnel for post accident and normal plant operation sampling.
11. Interim Radwaste Storage Facility (IRSF) - This structure provides safe storage of low-level radwaste and provides radiation shielding for plant personnel.
12. LTD (Laundry, Tool and Decontamination) Building – This structure provides storage for laundry, tools, and decontamination equipment.
13. River Discharge Tank Foundation (formerly "Waste Surge Tank") This structure provides support and anchorage for the river discharge tank.
14. Mausoleum – This structure provides radioactive material storage for equipment and components.
15. Dry Active Waste Building – This structure protects stored low level dry active waste from the outside environment.

Dresden Station Miscellaneous River Water Structures

This structural group is a collection of miscellaneous non-safety related structures related to the circulating water systems, cooling water canals, and reservoirs. These structures provide protection of personnel and non-safety related equipment from the outside environment and provide structural support for non-safety related equipment. A

description of those structures and components included within this structural group along with their functions are provided below.

1. Units 2 & 3 Circ Water Discharge Pipes - The circulating water discharge pipes provide the means of discharge/dispersion of heated circulating water into the Dresden cooling lake and/or the Illinois River. The circulating water discharge also provides the means of discharge, dispersion and dilution of low level liquid radwaste.
2. 2/3 Circ Water Flow Regulating Station - A structure with gates that distributes the water returning from the lake to the river (indirect open-cycle operation), to the intake flume to the crib house (closed cycle operation), or to a combination of both.
3. Unit 2 & 3 Lake Lift Station - The lift station provides protection for all non-safety-related systems and components contained within the structure from the outside environment. The lift station provides structural support for station cooling water system equipment. This equipment functions in controlling the flow of cooling water from the cooling lake through the intake and discharge canals. Additionally, the Lift Station maintains the hot canal and lake levels.
4. Circulating Water Cooling Towers (3) - The circulating water cooling towers provide supplemental cooling of the circulating water.
5. Goose Lake Pumping Station - The Goose Lake Pumping Station provides protection of pumps that control level in the adjacent retention pond.
6. Units 2 & 3 Cooling Lake, dikes and canals - The cooling lake provides cooling of the circulating water and service water prior to discharge into the Illinois River or return to the plant.

<u>Quad Cities Station Miscellaneous River Water Structures</u>

This structural group is a collection of miscellaneous non-safety related structures related to the circulating river water system. The circulating water system takes suction directly from the Mississippi River, discharges the flow through the condenser, and directs it back to the river. A description of those structures and components included within this structural group along with their functions are provided below.

1. Discharge Flume – The discharge flume controls direction of flow.
2. Discharge Flume Sample Pump (Structure) – The discharge flume sample pump structure houses and protects the non-safety related sample pump.
3. Dock – The dock provides access to river.
4. Floating Boom - The primary function of the floating boom is to prevent floating river debris from entering the intake flume and/or the circulating water pumps.
5. Intake Flume – The intake flume directs water to Crib House.
6. Lift Station - Lift Station structure provides protection for the non-safety related pumps and associated components that support the circulating water system from the outside environment. This facility is no longer in use.
7. Spray Canal – The spray canal was previously used to convey heated circulation water discharge for cooling. It is currently used in conjunction with the Fish Study Facility Building to produce walleye and hybrid striped bass fingerlings for stocking and release to the Mississippi River.
8. Spray Canal Blowdown Diffuser Pipe – The spray canal blowdown diffuser pipe provides measures for dispersion of circulating water. The spray canal blowdown

south diffuser pipe and the discharge bay function as the three site release points for liquid effluents.
9. Spray Canal Diversion Wall – The spray canal diversion wall provides flow direction control.
10. Wing Dam (6) - Wing dams provide river flow control. Wing Dam 31 is located between the intake and discharge canals and functions as a recirculation barrier that helps preclude released radioactive materials from being introduced back into the circulating water system. The top of this wing dam is about 2 feet below the river surface which creates some downstream water flow to prevent stagnant water areas from forming.

Dresden Station - Miscellaneous Dresden Unit 1 Structures

This structural group is a collection of miscellaneous non-safety related structures associated with Unit 1 at Dresden Station. Dresden Unit 1 shares the site and surrounding area with Units 2 and 3. Unit 1 has been placed in a safe storage condition until Units 2 and 3 are ready for decommissioning. None of these structures provide functional support for Units 2 and 3 and none of structures and major components in this structural group serves a seismic II/I intended function that could affect Units 2 and 3. A list of those structures included within this structural group is provided below.

1. Unit 1 Heating Boiler
2. Unit 1 Laundry Area
3. Unit 1 Turning Vane Storage Building
4. Unit 1 Core Spray Piping Building
5. Unit 1 Dry Cask Storage Pad
6. Unit 1 Fuel Handling Building
7. Unit 1 Off-gas Filter Building
8. Unit 1 Radwaste Building
9. Unit 1 Reactor Building
10. Unit 1 Turbine Building
11. Unit 1 HPCI Valve Building
12. Unit 1 Sphere Penetration Building
13. Unit 1 Chemical Decontamination Building
14. Unit 1 Chimney (Offgas)

Dresden Station - Miscellaneous Transmission and Distribution Structures

This structural group is a collection of miscellaneous non-safety related structures associated with the 138 KV and 345 KV switchyards. The purpose of the structures included in this group is to provide support and protection of the non-safety related components that are used for transmitting electrical power generated by the plant. A description of those structures and components included within this structural group along with their functions are provided below.

1. 345 KV Relay House – This structure provides support and protects all of the protective circuitry and supporting power for the buses and lines in the 345 KV switchyard from the outside environment.
2. 34 KV Relay House - This structure provides support and protects all of the protective circuitry and supporting power for the buses and lines in the 34 KV switchyard from the outside environment.

3. 138 KV Relay House - This structure provides support and protects all of the protective circuitry and supporting power for the buses and lines in the 138 KV switchyard from the outside environment.
4. 345 KV Switchyard Maintenance Building – This structure provides support and shelter for maintenance equipment and personnel working in the 345 KV Switchyard.
5. Transmission Towers - These structures provides support for transmission lines (those within the 138 KV & 345 KV switchyards). This population does not include all transmission towers. Those transmission towers necessary to provide offsite power restoration as defined by 10 CFR 50.63 (SBO) are included in the scope of license renewal and evaluated with the Station Blackout Building structure (See section 2.4.6 of the LRA).
6. 138 KV & 345 KV Switchyard Foundations - These foundations provide structural support for non-safety related components and structures associated with the electrical power distribution system. This population does not include all switchyard foundations. Those switchyard foundations providing necessary support for equipment and structures (e.g. breaker, end structures, and disconnect foundations) necessary to provide offsite power restoration as defined by 10 CFR 50.63 (SBO) are included in the scope of license renewal and evaluated with the Station Blackout Building structure (See section 2.4.6 of the LRA).

Quad Cities Station - Miscellaneous Transmission and Distribution Structures

This structural group is a collection of miscellaneous non-safety related structures associated with the 345 KV switchyard. The purpose of the structures included in this group is to provide support and protection of the non-safety related components that are used for transmitting electrical power generated by the plant. A description of those structures and components included within this structural group along with their functions are provided below.

1. Neutralizing Transformer (Retired) - This structure provides support /protection for the unused neutralizing Transformer.
2. Relay House - This structure provides support and protects all of the protective circuitry and supporting power for the buses and lines in the 345 kV switchyard from the outside environment.
3. Spare Main Transformer Storage (2) – These structures provide support for spare main transformers.
4. Switchgear House - This structure provides support and protection of reserve auxiliary power buses 1 and 2 along with various other non-safety related components from the outside environment.
5. Transformer Storage - This structure provides support for spare transformers.
6. Transmission Towers - These structures provide support for transmission lines within the 345 KV switchyard. This population does not include all transmission towers. Those transmission towers necessary to provide offsite power restoration as defined by 10 CFR 50.63 (SBO) are included in the scope of license renewal and evaluated with the Station Blackout Building structure (See section 2.4.6 of the LRA).

RAI 2.4-2

LRA Section 2.4.1 discusses the scoping and screening results for the Primary Containment. It is the staff's understanding that this section of the LRA addresses not only the primary containment (drywell, pressure suppression chamber, and the vent system connecting the two structures), but also all the structures inside the containment, all attachments to the containment, and the containment supports. LRA Table 2.4-1 identifies the primary containment component groups requiring aging management review, the associated component intended function(s), and the aging management review reference. Since LRA Table 2.4-1 combines many components under a single component group, the staff requests that the applicant identify which component group is intended to cover the specific components listed in (a) through (k) below, or identify the location in the LRA where these specific components are addressed. If these specific components are not considered to be within the scope of license renewal, please provide the technical bases for their exclusion. To assist in the review, the staff has noted figure numbers from either the Dresden or the Quad Cities UFSAR that identify specific components. However, the component list applies to all four units.

(a) Reactor Vessel to Biological Shield Stabilizers (D-UFSAR Figs. 3.9-1 and 2)

(b) Biological Shield to Containment Stabilizer (D-UFSAR Figs. 3.9-1 and 2 and QC-UFSAR Fig. 3.9-5 and 8)

(c) RPV Male Stabilizer Attached to Outside of Drywell Shell (QC-UFSAR Figs. 3.9-5 and 8)

(d) RPV Female Stabilizer and Anchor Rods (also referred to as Gib) embedded in Reactor Building concrete wall (D-UFSAR Fig. 3.9-1 and QC-UFSAR Figs. 3.9-8 and 9)

(e) Biological Shield Wall and Anchor Bolts (D-UFSAR Figs. 3.9-2 and 3 and QC-UFSAR Figs. 3.9-5 and 6))

(f) Reactor Vessel Support Skirt and Anchor bolts (D-UFSAR Figs. 3.9-2 and 3 and QC- UFSAR Figs. 3.9-5, 6 and 10)

(g) Reactor Vessel Support Ring Girder and Anchor Bolts (D-UFSAR Figs. 3.9-2 and 3 and QC-UFSAR Figs. 3.9-5, 6 and 10)

(h) Reactor Vessel Support Pedestal (D-UFSAR Figs. 3.9-2 and 3 and QC-UFSAR Figs. 3.9-5 and 6)

(i) Drywell internal 6x1-inch steel shear ring (QC-UFSAR Figs. 3.9-5 and 7)

(j) Drywell steel support skirt and anchor bolts (QC-UFSAR Figs. 3.9-5 and 7)

(k) The drywell head closure bolts and double gasket, tongue-and-groove seal arrangement (described in LRA Section 2.4.1)

Response

All of the components described below are included within the scope of license renewal. Items (a) though (k) below provide the LRA Table number and Component Group that address each specific component.

(a) Reactor Vessel to Biological Shield Stabilizers – Table 2.4-1, Primary Containment, Component Group Structural Steel

(b) Biological Shield to Containment Stabilizer – Table 2.4-1, Primary Containment, Component - Group Structural Steel

(c) RPV Male Stabilizer Attached to Outside of Drywell Shell – Table 2.4-1, Primary Containment, Component Group - Steel Embedments

(d) RPV Female Stabilizer and Anchor Rods (also referred to as Gib) embedded in Reactor Building concrete wall – Table 2.4-1, Primary Containment, Component Group - Steel Embedments

(e) Biological Shield Wall – Table 2.4-1, Primary Containment, Component Group - Concrete Walls (Structural Support and Shelter, Protection, Shielding)

Anchor bolts – Table 2.4-15, Component Supports, Component Group - Anchorage to Buildings, Including Bolted/Welded Connections (Structural Support)

(f) Reactor Vessel Support Skirt –Table 2.3.1-1, Reactor Vessel, Component Group - Support Skirts and Attachment Welds

Anchor bolts – Table 2.4-15, Component Supports, Component Group - Anchorage to Buildings, Including Bolted/Welded Connections (Structural Support)

(g) Reactor Vessel Support Ring Girder – Table 2.4-1, Primary Containment, Component Group - Support Members

Anchor bolts – Table 2.4-15, Component Supports, Component Group - Anchorage to Buildings, Including Bolted/Welded Connections (Structural Support)

(h) Reactor Vessel Support Pedestal – Table 2.4-1, Primary Containment, Component Group - Concrete Walls (Structural Support)

(i) Drywell internal 6x1-inch steel shear ring – Table 2.4-1, Primary Containment, Component Group - Steel Embedments

(j) Drywell steel support skirt – Table 2.4-1, Primary Containment, Component Group - Support Members

Anchor bolts – Table 2.4-15, Component Supports, Component Group - Anchorage to Buildings, Including Bolted/Welded Connections (Structural

Support)

(k) The drywell head closure bolts – Table 2.4-1, Primary Containment, Component Group - Drywell Heads

Double Gasket – Exelon procedure requires the gasket material to be replaced during reactor reassembly (at least once per refuel cycle). These gaskets are not long lived and therefore do not require aging management.

Tongue-and-groove Seal Arrangement – Table 2.4-1, Primary Containment, Component Groups - Drywell Heads and Drywells

RAI 2.4-3

Leakage through the refueling seals located at the top of the drywell potentially exposes the carbon steel drywell shell inner and outer surfaces to loss of material due to corrosion. This is a particular concern for the embedded portion of the drywell shell. Corrosion detected on the outer shell surface in the sand pocket region in a number of Mark I steel containments has been attributed to leakage past the drywell-to-reactor building refueling seal, coupled with clogging of the sand pocket drains. Leakage into the drywell, past the reactor vessel-to-drywell refueling seal, creates the potential for corrosion of the inaccessible portion of the inner surface of the drywell shell, embedded in the concrete floor.

From the information contained in the LRA, it is not clear to the staff (1) whether the refueling seals have been included in the license renewal scope, and (2) if included, how aging management is being addressed. Therefore, the applicant is requested to submit the following information:

(a) Verification that the refueling seals are included in the license renewal scope, or a detailed explanation for their exclusion.

(b) A detailed description of the plant-specific operating experience for the refueling seals in all four (4) units, including incidences of degradation, method of detection, root cause, corrective actions, and current inspection procedures.

(c) A detailed description of the scoping, screening, and aging management review for the refueling seals.

(d) The aging management program(s) credited to manage aging of the refueling seals.

Response

(a) The refueling seals are not within the scope of license renewal. Title 10, CFR 54, Section 54.4(a), sets forth the criteria that determine whether plant systems, structures, and components are within the scope of license renewal. The refueling seals do not satisfy any of the requirements set forth in 10 CFR 54.4(a).

The refueling seals are not safety related and they are not relied upon to remain

functional during design basis events to ensure (i) the integrity of the reactor coolant pressure boundary, (ii) the capability to shutdown the reactor and maintain it in a safe shutdown condition, or (iii) the capability to prevent or mitigate potential offsite exposures comparable to those referred to in 10 CFR 50.34(a)(1), 50.67(b)(2), or 100.11. Thus, the refueling seals are not brought into scope of license renewal by 10 CFR 54.4(a)(1).

Title 10 CFR 54.4(a)(2) sets forth the criterion that all non-safety related systems, structures and components whose failure could prevent satisfactory accomplishment of any of the safety related functions identified in 10 CFR 54.4(a)(1) are also within the scope of license renewal.

The drywell-to-reactor building refueling seal and the reactor pressure vessel (RPV)-to-drywell refueling seal, in conjunction with the refueling bulkhead, provides a watertight barrier to permit flooding above the RPV flange while preventing water from entering the drywell. Providing a watertight barrier to permit flooding above the RPV flange in support of refueling operations is not a safety related function.

- The NRC notified the nuclear industry of the potential for degradation of steel containments due to leakage past the drywell to reactor building refueling seals in IE Information Notice 86-99 and NRC Generic Letter 87-05. The Dresden and Quad Cities responses to these NRC communications are described in their respective UFSARs, Section 6.2.1.2.1.2 (Drywell Corrosion Potential). The UFSAR discussions include a commitment to monitor the sand pocket drain lines during refuel activities and if leakage is detected during refuel flood-up, an inspection to determine the source will take place and further corrective measures will be initiated. Dresden/Quad Cities LRA Section 4.7.2.2 (Degradation Rates of Inaccessible Exterior Drywell Plate Surfaces) describes the calculation that projected corrosion rates for the steel drywell plates in the sand pocket area and determined that the wall thickness was sufficient for the remainder of the 40-year license period, and determines it to be a TLAA. The TLAA disposition includes a commitment to confirm corrosion rate assumptions used in the calculations by UT inspection prior to the period of extended operation and to revise the corrosion calculation and validate that an acceptable wall thickness will remain to the end of the 60-year license operating period. These commitments support a conclusion that even if leakage past the drywell to reactor building refueling seal occurs, there will be no consequential failure of any of the safety related functions identified in 10 CFR 54.4(a)(1). Thus, the drywell to reactor building refueling seal is not brought into license renewal scope by 10 CFR 54.4(a)(2).

- Potential leakage of water past the RPV to drywell refueling seal can occur only when the reactor is in a cold shutdown condition with the reactor cavity flooded to support refueling operations. Leakage past the RPV-to-drywell seal would result in cold (<150°F), demineralized water entering the drywell. Leakage of cold, demineralized water into the drywell cannot result in failure of any safety-related equipment because 1) there is no equipment inside the drywell whose safety-related function is credited in support of refueling operations, 2) the drywell contains a drainage system and sumps to collect and monitor unidentified leakage inside the drywell, and 3) the frequent

personnel entry into the drywell that occurs during most refueling outages would result in any substantial leakage past the RPV to drywell refueling seal being noticed and corrective actions being taken. These considerations support a conclusion that even if leakage past the RPV-to-drywell refueling seal occurs, there will be no consequential failure of any of the safety related functions identified in 10 CFR 54.4(a)(1). Thus, the RPV-to-drywell refueling seal is not brought into license renewal scope by 10 CFR 54.4(a)(2).

The refueling seals are not relied upon in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for fire protection, environmental qualification, pressurized thermal shock (N/A for BWRs), anticipated transients without scram, or station blackout. Thus, the refueling seals are not brought into license renewal scope by 10 CFR 54.4(a)(3).

(b) The refueling seals are not within the scope of license renewal. As such, evaluation of their operating experience is not included within the scope of the license renewal application.

(c) The refueling seals are not within the scope of license renewal. A detailed explanation of the scoping considerations is provided in response to question 1), above. The refueling seals are passive components that are not within the scope of license renewal. As such, they have not been included within the scope of aging management review.

(d) The refueling seals are not within the scope of license renewal. As such, the refueling seals are not within the scope of an aging management program.

<u>RAI 2.4-4</u>

LRA Table 2.4-2 presents a comprehensive list of component groups. However, for certain components, the staff requires further explanation to complete its evaluation. The applicant is requested to submit the following information:

(a) A description of "Neutron-Absorbing Sheets," and an explanation why it is included as a structural component when the aging management results are documented in LRA 3.3 - Auxiliary Systems.

(b) A description of "Secondary Containment Boot Seals."

(c) Verification that "Storage Racks" refers to spent fuel racks, and an explanation why it is included as a structural component when the aging management results are documented in LRA 3.3 - Auxiliary Systems.

Response:

a) The spent fuel pool racks contain neutron absorbing sheets that maintain a k_{eff} no greater than .95 when all of the spent fuel is in place. These neutron adsorbing sheets are made of boral at Dresden and boraflex at Quad Cities

and are evaluated in Sections VII.A2.1-b and VII.A1.1-a of NUREG 1801, Generic Aging Lessons Learned Report, Volume 2. Exelon assigned an aging management reference for these components to Table 3.3.1, Aging Management Programs Evaluated in NUREG-1801 That Are Relied Upon for License Renewal for the Auxiliary Systems, because NUREG 1801 directs licensees to this same reference. Table 3.3.1 of the Dresden and Quad Cities License Renewal Application is a recreation of all BWR related line items found in Table 3 of NUREG 1801, Volume 1. NUREG 1801 line items VII.A2.1-b and VII.A1.1-a are assigned to Table 3 of NUREG 1801, Volume 1. Exelon assigned these structural components to aging management references for auxiliary systems only because it is an expectation of NUREG 1801.

b) The Reactor Building serves as the secondary containment whose primary purpose is to minimize the ground level release of airborne radioactive materials and to provide for a controlled, elevated release of the building atmosphere under accident conditions. To achieve this function, the Reactor Building is designed to maintain an internal negative pressure ≥ ¼ inch H_2O under neutral wind conditions. Reactor Building pipe penetrations are sealed as necessary to minimize air in leakage and maintain the negative internal pressure. These pipe penetration seals are called "Secondary Containment Boot Seals". Boot seals are fabricated with a silicone rubber material that allows pipe movement while providing a seal between the pipe and the Reactor Building.

c) "Storage Racks" refer to "Spent Fuel Storage Racks" and are consistent with the components evaluated in Section VII.A2.1-c of NUREG 1801, Volume 2. At Dresden and Quad Cities, Spent Fuel Storage Racks are treated as structures, rather than part of an auxiliary system. Therefore, they were included in Section 2.4 of the LRA, the scoping and screening results for structures. The NUREG 1801 line item for Spent Fuel Storage Racks (VII.A2.1-c) is assigned to Table 3 of NUREG 1801, Volume 1 for Auxiliary Systems. Exelon credited the aging management programs in NUREG 1801 for spent fuel storage racks. Therefore the aging management reference for the spent fuel racks listed in section 2.4 for structures cross-references an aging management program in the NUREG 1801 section for auxiliary systems.

RAI 2.4-5

Based on information provided in LRA Section 2.4.6, the exact scope of structural components included in this section is not clear to the staff. Also, clarification is needed for several "Components" listed in Table 2.4-6.

In order to complete the screening review for the station blackout building and yard structures, the staff requests the applicant to submit the following information:

(a) LRA Table 2.4-6 lists the following components requiring an aging management review: "Bus Duct Covers," "Bus Duct Supports," "Dead End Structures," and "Transmission Towers." These appear to be the yard structures. Verify that the staff's interpretation is correct, or describe more completely the yard structures

included in the scope of this section.

(b) The staff has assumed that the foundations for the bus duct supports, dead end structures, and transmission towers, and also for the transformers and circuit breakers are included with the SBO building foundation under the LRA Table 2.4-6 component group "Foundations." Verify that the staff's interpretation is correct, or describe more completely the foundations included in the scope of this section.

(c) The component "steel piles (Dresden only)" is also listed in LRA Table 2.4-6. LRA Section 2.4.6 provides no description of the steel piles. Describe the steel piles at Dresden and define intended function(s). Also explain why the "Aging Management Ref" for the steel piles is 3.3.2.207. LRA Section 3.3 covers Auxiliary Systems.

Response:

Exelon has reviewed LRA Section 2.4.6, Table 2.4-6, and provides the following clarifications:

a) Components Groups "Bus Duct Covers", "Bus Duct Supports", "Dead End Structures", and "Transmission Towers" are yard structures that require aging management review. Initially, these were not included within the scope of license renewal and were included in Miscellaneous Yard Structures discussed in the response to RAI 2.4-1. The Station Blackout offsite power feeds were not initially included in scope. However, these specific component groups were later added to the scope of License Renewal to comply with interim staff guidance concerning scoping of offsite power systems necessary to support the Station Blackout Rule (10 CFR 50.63). As such, they were evaluated with the Station Blackout Building in section 2.4.6 of the LRA. These component groups are not included in "Miscellaneous Yard Structures" shown on Table 2.2-1, which is a grouping of yard structures that do not satisfy the requirements of 10 CFR 54(a).

b) Table 2.4-6, Component Groups Requiring Aging Management Review – Station Blackout Building, contains two foundation groups. The foundation group with the "Non-S/R Structural Support" component function includes the foundations for the bus duct supports, dead end structures, and breaker foundations serving the Reserve Auxiliary Transformers and Transmission Towers. The foundation group with the "Structural Support" component function includes the Station Blackout Building foundations.

c) The component group "steel piles (Dresden only)" listed in LRA Table 2.4-6 are associated with a transmission tower that carries power transmission cables from the switch yard to Reserve Auxiliary Transformer 22 located outside of the Turbine Building. The concrete foundation for this transmission tower is supported by seven steel "H" piles resting on bedrock. The steel piles provide structural support for the transmission tower and associated concrete foundation. Aging Management Reference 3.3.2.207 accurately evaluates the aging of these steel piles. However, the aging management reference for these steel piles was inadvertently included in LRA Table 3.3-2 and should have been included in LRA Table 3.5-2.

Table 2.4-6 line item for Steel Piles (Dresden only) should have read as follows:

Component Groups	Component Intended Function	Aging Management Ref
Steel Piles (Dresden only)	Non-S/R Structural Support	3.5.2.17

Table 3.5-2 should have included a new line item that is identical to 3.3.2.207, as follows:

Ref No	Component Group	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Discussion
3.5.2.17	Steel Piles	Carbon Steel	Soil and groundwater	None	None	NUREG-1801 does not address carbon steel piles in a soil and ground water environment. The intended function of steel piles driven in undisturbed soils is not affected by corrosion.

<u>RAI 2.4-6</u>

LRA Table 2.4-10 presents the list of structural components applicable to the miscellaneous foundations. The applicant's description of the miscellaneous foundations does not explain the component "Caulking/Sealants (Dresden)." It is not clear to the staff what the application would be for foundations. The applicant is requested to submit a detailed description of this component and its intended function.

Response

The Component Group, "Caulking/Sealants (Dresden Only)", is a rubber sealant (type-A) used to seal the Contaminated Condensate Storage Tank between the foundation and tank bottom. The sealant prevents moisture from entering the area between the concrete foundation and the tank bottom, preventing exposure of embedded anchor bolts to moisture.

<u>RAI 2.4-7</u>

UFSAR Section 9.2.5 describes the ultimate heat sink for both stations. A summary of

these descriptions is contained in LRA Section 2.3.3.22 "Ultimate Heat Sink." The staff reviewed this information in depth, in order to ensure that all structures and structural components, including earthen embankments, that are necessary to guarantee the ultimate heat sink, have been identified to be within the scope of license renewal and subject to an aging management review. To complete its review of LRA Section 2.4.11, the staff requires a number of clarifications concerning the ultimate heat sink at both stations.

Quad Cities: LRA Section 2.4.11 Crib House states that at Quad Cities, the crib house includes the suction lines for the RHR service water system. It also states that for license renewal purposes the Quad Cities discharge flume weir wall that forms one of the boundaries of the UHS is included as part of the crib house. To complete the review the staff requests the following information:

(a) Clarify why the suction lines for the QC Diesel Generator Cooling Water Pumps are not included in the discussion since they are described in LRA Section 2.3.3.22 as taking suction from the crib house.

(b) Explain why the following components related to the Quad Cities crib house are not included in the aging management review, or identify the component group in LRA Table 2.4-11 that includes them (for reference, some of the items are identified in Figure 2.4-2 of the QC UFSAR):

- Intake flume/canal (define all boundaries that form the basin)
- Log Boom
- Crib House wire mesh screens, if applicable
- Crib House stop logs, if applicable
- Crib house dewatering valves and trash rake refuse pit, if applicable
- Discharge structure, including rolling gates
- 16 ft diameter discharge piping
- 96" Ice Melting Line, including gate
- 14" Circulating Water Pipe
- Discharge flume/canal (define all boundaries that form the basin)
- Weir gate in the discharge canal

Dresden: LRA Section 2.4.11 Crib House states that at Dresden, the crib house includes the diesel generator cooling pumps and the suction piping for the containment cooling service water system pumps. It also states that the crib house contains stop logs that can be used to isolate the compartment and raise its water level where the containment cooling service water system pump and the diesel fire pump take their suction. To complete the review the staff requests the following information:

(c) Confirm that for Dresden the cooling lake and associated "hot" and "cold" canals, described in Dresden Station UFSAR Section 2.4, are not part of the ultimate heat sink and do not serve an intended function for license renewal. If they do, submit the aging management review, including the credited aging management program(s).

(d) Explain why the following components related to the Dresden crib house are not included in the aging management review, or identify the component group in LRA Table 2.4-11 that includes them (for reference, some of the items are identified in Figure 2.4-1 of the Dresden UFSAR):

- Intake flume/canal (define all boundaries that form the basin)
- Floating Boom protecting intake canal
- Crib House wire mesh screens
- Crib House stop logs
- Crib house dewatering valves and trash rake refuse pit
- Discharge Outfall Structure, including rolling gates
- 14.0 ft Diameter Circulating Water Pipe from Power Plant
- 8.0 ft Diameter Ice Melt Recirculating Pipe, including ice melt gate (or deicing valve)
- Circulating water pipe, similar to 14" circulating water pipe shown on Figure 2.4-2 of the QC UFSAR, if applicable
- Discharge flume/canal (define all boundaries that form the basin)
- Flow-regulating Station

Response:

<u>Quad Cities</u>

(a) The suction lines in the Quad Cities Crib House are associated with RHR service water system. The Diesel Generator Cooling Water Pumps take suction off of the RHR service water line (see boundary diagrams LR-QDC-M-37, location E-3 and E-8 and LR-QDC-M-79, location F-4.) These branch connections are physically located in the Turbine Building, in the RHR service water pump vaults. The difference between LRA Sections 2.4.11 and 2.3.3.22 is that LRA Section 2.4.11 discusses the equipment contained in the structure and LRA Section 2.3.3.22 discusses the functions served by maintaining the UHS.

(b) The following provides the additional requested information for each of the Quad Cities components listed above:

- Intake flume/canal (define all boundaries that form the basin) - The intake flume boundaries includes the topographic basin from the high point (at approximately 565' elevation) on the river bottom between the crib house and the main river channel on the west side and extending to the crib house on the east side. This basin is rock and earthen bottom. LRA Table 2.4-11, Component Group Concrete Walls, addresses the crib house walls.

- Log Boom - The log boom is a floating structure that functions as a barrier to floating debris during normal operations. However, it does not perform any function to retain water in the event of a loss of lock and dam 14 (the design basis event bringing the UHS in scope). Therefore, the log boom does not fall within the scope of License Renewal and does not require aging management.

- Crib House wire mesh screens (if applicable) – Quad Cites has Wire Mesh Screens filtering the RHR Service Water intake. These wire mesh screens do not perform a function in maintaining the UHS and therefore are not in the scope of License Renewal and do not require aging management.

- Crib House stop logs (if applicable) – The stop logs are installed to perform maintenance in crib house bays (intake and discharge bays). At Quad Cities, they do not perform any function relative to maintaining the UHS. As such, they are not in the scope of License Renewal and do not require aging management.

- Crib house dewatering valves and trash rake refuse pit, (if applicable) – The dewatering valves are used to drain circulating water piping and bays. Station procedures require the unit to be in cold shut down prior to draining these areas, therefore the UHS would not be required. Additionally, these valves are not required to perform pressure boundary functions for the UHS. As such, the dewatering valves are not in the scope of License Renewal and do not require aging management. Quad Cities does not have a Trash Rake Refuse Pit.

- Discharge structure, including rolling gates – At Quad Cities, the discharge structure shown on UFSAR Figure 2.4-2 is attached to and managed as part of the crib house. The crib house walls are addressed in LRA Table 2.4-11 under Component Group - Concrete Walls. The rolling gates shown on this same figure are installed for maintenance of the circulating water system only. They are open during normal operations and are not required to support any UHS function. Therefore, they are not within the scope of License Renewal and do not require aging management.

- 16 ft diameter discharge piping –This component falls within the scope of License Renewal and is evaluated in LRA Table 2.3.3-22 under Component Group - Piping and Fittings.

- 96" Ice Melting Line, including gate – The Ice Melting Line falls within the scope of License Renewal and is evaluated in LRA Table 2.3.3-22 under Component Group - Piping and Fittings. The gate is the Ice Melt Valve which also falls within the scope of License Renewal and is evaluated in LRA Table 2.3.3-22 under Component Group – Valves. Note that LRA Table 2.3.3-22, Component - Group Valves, should have been revised to delete "(Dresden Only)" as shown below.

- 14" Circulating Water Pipe – The 14" Circulating Water Pipe shown on UFSAR Figure 2.4-2 is the service water return line from the RHR Service Water system and the Diesel Generator Cooling Water system. This non-safety related piping, located outside of the turbine building, is not required to support any intended function and does not fall within the scope of License Renewal. As such, it does not require aging management.

- Discharge flume/canal (define all boundaries that form the basin) The discharge flume falls within the scope of License Renewal. Those portions within the scope of License Renewal begin at the crib house (LRA Table 2.4-11, Component Group - Concrete Walls) and extend to the discharge canal weir (LRA Table 2.4-11, Component Group - Concrete Canal Weirs).

- Weir gate in the discharge canal – The weir gate falls within the scope of License Renewal and is evaluated in LRA Table 2.4-11 under Component Group - Concrete Canal Weirs.

Dresden

(c) Dresden cooling lake and the associated hot and cold canals are not credited with water supply in the event the normal heat sink (the river) is unavailable. Therefore, the cooling lake and the associated hot and cold canals do not require aging management.

(d) The following provides additional requested information for each of the Dresden components listed above:

- Intake flume/canal (define all boundaries that form the basin) – The intake canal falls within the scope of License Renewal. The intake flume starts at the Kankakee River intake canal interface with the canal bottom high point at elevation 495'-0" and runs to the crib house. LRA Table 2.3.3-22 should have added "Earthen Structures" to address the canal, as shown below. LRA Table 2.4-11, Component Groups - Concrete Slabs and Concrete Walls, addresses the crib house.

- Floating Boom protecting intake canal – The floating boom is a floating structure that functions as a barrier to floating debris during normal operations. However, it does not perform any function in retaining water in the event the normal heat sink (the river) is unavailable. Therefore, the log boom does not fall within the scope of License Renewal and does not require aging management.

- Crib House wire mesh screens – In the event the normal heat sink becomes unavailable, the Crib House Wire Mesh Screens are removed to allow the installation of the stop logs. These screens therefore provide no function in maintaining the UHS and are not in the scope of License Renewal and do not require aging management.

- Crib House stop logs – The stop logs are needed to support the UHS should have been added to LRA Tables 2.3.3-22 and 3.3-2 as shown below.

- Crib house dewatering valves and trash rake refuse pit – LRA Table 2.3.3-22, Component Group Valves, addresses the dewatering valves. The trash rake refuse pit is part of the crib house structure. LRA Table 2.4-11, Component Groups Concrete Slabs and Concrete Walls, address the crib house.

- Discharge Outfall Structure, including rolling gates – Portions of the Outfall Structure fall within the scope of the Rule and perform a structural pressure barrier function for the UHS. The Outfall Structure should have been added to LRA Table 2.3.3-22, under Component Group - Concrete Slabs and Concrete Walls, as shown below. The rolling gates are available for performing maintenance on the Discharge Outfall Structure bays, are normally open, and are not required to perform any function associated with the UHS. As such they are not within the scope of License Renewal and do not require aging management.

- 14.0 ft Diameter Circulating Water Pipe from Power Plant – The circulating water pumps are secured in the event the normal heat sink (the river) is unavailable. Therefore this piping is not relied upon for the UHS and does not require aging management.

- 8.0 ft Diameter Ice Melt Recirculating Pipe, including ice melt gate (or deicing valve) – LRA Table 2.3.3-22, Component Group Piping and Fittings

- Circulating water pipe, similar to 14" circulating water pipe shown on Figure 2.4-2 of the QC UFSAR (if applicable) – This piping is not applicable to Dresden. At Quad Cities the Circulating Water discharges at the crib house, at Dresden it discharges at the Discharge Structure.

- Discharge flume/canal (define all boundaries that form the basin) – The discharge canal falls within the scope of License Renewal. The discharge flume starts at the Discharge Outfall Structure and runs to the discharge canal interface with the Illinois River at Elevation 498'-0". LRA Table 2.3.3-22 should have added "Earthen Structures" to address the canal. "Concrete Walls" and "Concrete Slabs" should have also been added to LRA Table 2.3.3-22 to address the Discharge Outfall Structure, as shown below.

Flow-regulating Station – Failure of the Flow-regulating Station would not affect plant safety or the ability to accomplish safe shutdown in either configuration (open or closed cycle). Therefore, the Flow-regulating Station was considered out of scope and does not require aging management.

Note: Systems do not usually contain structures. Structures usually line up with structures between Chapter 2 and Chapter 3, but there are some exceptions. In this unusual circumstance where the Ultimate Heat Sink system does contain structural components, the aging management reference provided in the system portion of Chapter 2 is to the structural portion of Chapter 3 of the LRA, when applicable.

Table 2.3.3-22 Component Groups Requiring Aging Management Review – Ultimate Heat Sink

Component Group	Component Intended Function	Aging Management Ref
Concrete Slabs (Dresden only)	Structural Pressure Barrier	3.5.1.22
Concrete Walls (Dresden only)	Structural Pressure Barrier	3.5.1.22
Earthen Structures (Dresden only)	Structural Pressure Barrier	3.5.1.22

Stop Logs (Dresden only)	Structural Pressure Barrier	3.3.2.304
Valves	Pressure Boundary	3.3.2.278, 3.3.2.300

Table 3.3-2 Aging management review results for the auxiliary systems that are not addressed in NUREG-1801 (Continued)

Ref No	Component Group	Material	Environment	Aging Effect	Aging Management Program	Discussion
3.3.2.304	Stop Logs	Aluminum	Air, moisture, and humidity <100° C (<212°F)	None	None	NUREG-1801 does not address aluminum stop logs. Aluminum is reactive, but develops an oxide film that protects it from further corrosion. No viable aging effects exist in the indoor environment for aluminum stop logs.

Table 3.5-1 Aging management programs evaluated in NUREG-1801 that are relied on for license renewal for containments, structures and component supports (Continued)

Ref No	Component	Components Evaluated	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.5.1.22	Group 6: all accessible/ inaccessible concrete, steel, and earthen components	NUREG-1801 Components Concrete Curbs Concrete Slabs Concrete Stairs Concrete Walls Foundations Metal Siding Misc. Steel Precast Concrete Panels Steel Embedments Steel Panels and Cabinets Steel Plates Steel Sump Screens Structural Steel Evaluated with NUREG-1801 Components Concrete Canal Weirs Earthen Canal Walls	All types of aging effects, including loss of material due to abrasion, cavitation, and corrosion	Inspection of Water-Control Structures (B.1.31) or FERC/ US Army Corps of Engineers dam inspections and maintenance	No	Consistent with NUREG-1801, with exception. The exceptions to structural aging effect for concrete due to settlement are described in Section 3.5.1.2.1. The exceptions to structural aging effect due to freeze-thaw are described in Section 3.5.1.2.2. The exceptions to structural aging effect due to leaching of calcium hydroxide are described in Section 3.5.1.2.3. The exceptions to structural aging effect due to reaction with aggregates are described in Section 3.5.1.2.4. The exceptions to structural aging effect due to abrasion and cavitation are described in Section 3.5.1.2.5. The exceptions to structural aging effects due to corrosion of embedded steel are described in Section 3.5.1.2.6. The exceptions to structural aging effects due to aggressive chemical attack are described in Section 3.5.1.2.7.

<u>RAI 2.4-8</u>

Based on the information provided in LRA Section 2.4.12, it is not clear to the staff that "fire barrier" is the only intended function for the walls and ceilings of the Dresden Unit 1 crib house. The applicant is requested to submit the following information:

(a) How would collapse of the building walls and ceiling effect the availability of the diesel-driven fire pump?

(b) Are the walls and ceiling inspected as part of Maintenance Rule structures monitoring, and is this program credited to manage aging of the walls and ceiling for license renewal?

Response:

Exelon has reviewed LRA Section 2.4.12 and provides the following clarifications:

(a) While the Unit 1 Crib House walls and ceiling have been evaluated as fire barriers, they were not evaluated for the secondary effect they could have on the diesel-driven fire pump if they were to collapse. Such an evaluation would be performed if the structure contained safety related components. However, the Unit 1 Crib House is not a safety related structure and there are no safety related components contained within the building. Since the walls and ceiling do not perform a safety related function and there are no safety related components that can be affected by the collapse of the walls or ceiling, the criteria stated in 10 CFR 54.4(a)(2) are not applicable to this situation. For these reasons, structural support is not an intended function of the walls and ceiling. This position is supported by NUREG-1800, Standard Review Plan for Review of license Renewal Applications for Nuclear Power Plants. Table 2.1-2 of NUREG-1800 states:

"An applicant need not consider hypothetical failures or second, third, or fourth level support systems. For example, if a non-safety related diesel generator is only relied upon to remain functional to demonstrate compliance with the NRC's SBO regulations, an applicant may not need to consider (1) an alternate/backup cooling water system, (2) the diesel generator non-seismically qualified building walls, or (3) an overhead segment of non-seismically qualified piping (in a Seismic II/I configuration)."

The Unit 1 Crib House is not "explicitly credited" in the Dresden current licensing basis documents for Fire Protection. In addition, the Unit 1 diesel-driven fire pump provides a backup supply of river water to the fire protection system. It is not the primary system credited for maintaining fire protection system pressure.

(b) The Unit 1 Crib House structure is included within the scope of the Maintenance Rule Structural Monitoring program. While the walls and ceiling are inspected per the Structural Monitoring Program criteria, this activity is not credited for License Renewal for the reasons stated in (a) above.

<u>RAI 2.4-9</u>

Based on information provided in LRA Section 2.4.14, the staff cannot identify which "LRA Aging Management Ref No" is applicable to each of the crane/rail systems included in the scope of LRA 2.4.14. Also, it is unclear to the staff why cranes and hoists have been split into two (2) groups, covered under different sections of LRA Section 2.0, and why all references to aging management results point to LRA Section 3.3 - Auxiliary Systems.

The applicant is requested to clarify the treatment of cranes and hoists in the scoping and screening, and in the aging management review. Please submit the following information:

(a) A list of all cranes/hoists/rails and associated components in the scope of license renewal.

(b) A list of all cranes/hoists/rails and associated components excluded from the license renewal scope, and the technical bases for their exclusion.

(c) A list of all cranes/hoists/rails and associated components requiring an aging management review (i.e., passive, long-lived).

(d) A list of all cranes/hoists/rails and associated components requiring aging management and/or TLAA, and the specific aging management program(s) and TLAAs credited to manage aging.

Response:

With the exception of cranes and hoists associated with the refueling system, most cranes are integral parts of structures for which they provide service. For this reason, Exelon separated overhead lifting systems into two separate groups. Those cranes and hoists associated with the refueling system are evaluated in LRA Section 2.3.3.1, Refueling Equipment. All other cranes and hoists were evaluated in LRA Section 2.4.14, Cranes and Hoists. Only overhead lifting systems associated with refuel handling are evaluated in NUREG 1801 (Section VII.B.1-a). Components from this section of the NUREG are evaluated for aging management under Auxiliary Systems (see Table 3 in NUREG 1801 Volume 1). In order to maintain consistency with NUREG 1801, Exelon decided to evaluate the aging for all overhead lifting systems (refueling and non-refueling) in LRA Section 3.3, Aging Management of Auxiliary System.

a) Crane subsystems are installed throughout various buildings at Dresden and Quad Cities. A list of crane subsystems included within the scope of License Renewal is provided below for each site. Each crane subsystem includes rails, structural girders required for support of the crane loads, and the crane mechanism. The crane mechanism includes drive tires/wheels, bolts, nuts, rivets, load blocks, suspension housing, hand chain wheels, chain attachments, clevis, yokes, suspension bolts, shafts, gears, bearings, pins, rollers, locks and clamping devices, hook retaining nuts, hook retaining collars/pins, retaining member welds, load sprockets, drums, sheaves, mechanical brake mechanisms, and hooks.

   In addition to crane subsystems, a number of monorail tracks have been installed over various locations throughout each site to facilitate maintenance. Portable hoists are installed on these monorails when maintenance is required or equipment requires movement. Those instances below for which the description does not include a crane or hoist only refer to monorails.

   <u>Dresden Reactor Building – In Scope</u>
   - Unit 2 Reactor Building (613' Elevation) Hatch Jib Crane
   - Unit 3 Reactor Building (613' Elevation) Hatch Jib Crane
   - Reactor Building (Elevation 613') New Fuel Storage Vault Jib Crane
   - Reactor Service Platform Jib Crane
   - Unit 2 Reactor Building (545' Elevation) Hatch Jib Crane
   - Reactor Building Overhead Crane

Dresden Turbine Building - In Scope

- Unit 3 Diesel Generator Room Monorails (2)
- Diesel Generator Room Monorail Crane
- Unit 2 Turbine Building Overhead Crane
- Unit 2 Diesel Generator Room Monorails (2)
- Unit 3 Turbine Building Overhead Crane

Dresden Primary Containment – In Scope

- Unit 2 Drywell Equipment Hatch Monorails
- Unit 2 Drywell CRD Pit Jib Monorails
- Unit 2 Drywell Ground Floor Continuous Monorails
- Unit 2 Drywell 2nd Floor Jib Monorails
- Unit 3 Drywell Equipment Hatch Monorails
- Unit 3 Drywell CRD Pit Jib Monorails
- Unit 3 Drywell Ground Floor Continuous Monorails
- Unit 3 Drywell 2nd Floor Jibs Monorails

Dresden Miscellaneous Buildings – In Scope

- 2/3 Diesel Generator Room Monorails (3)
- Unit 2 HPCI Room Trolley Chain Hoist
- Unit 3 HPCI Room Trolley Chain Hoist
- 2/3 Cribhouse Service Water Pump Electric Hoist (a single monorail that is used to move and position the stop logs for set up of the ultimate heat sink)
- Circ water pump monorails and trolleys (4) (these non-safety related monorails pass over the safety related Unit 2 and Unit 3 diesel generator cooling water pumps)

Quad Cities Reactor Building – In Scope

- Unit 1 CRD Repair Floor Jib
- Unit 2 CRD Repair Floor Jib
- New Fuel Inspection Stand Jib
- Unit 1 and 2 Reactor Service Platform Jib
- Unit 1 and 2 Reactor Building Overhead Crane
- Unit 1 Reactor Building (Elevation 666') Jib crane (does not exist on Unit 2)

Quad Cities Turbine Building – In Scope

- Unit 1 Turbine Building Overhead Crane
- Unit 2 Turbine Building Overhead Crane
- Unit 1 Emergency Diesel Generator Room Monorails
- Unit 2 Emergency Diesel Generator Room Monorails
- Unit 1 HPCI Monorail Hoist
- Unit 2 HPCI Monorail Hoist
- RHR Service Water Pump Monorails (8)

Quad Cities Primary Containment – In Scope

- Unit 1 Drywell First Level Monorail

- Unit 2 Drywell First Level Monorail
- Unit 1 Drywell 2nd Floor Jibs for SRV work
- Unit 2 Drywell 2nd Floor Jibs for SRV work

Quad Cities Miscellaneous Buildings – In Scope

- Unit 1/2 (Common) Emergency Diesel Generator Room Monorails

b) The following list contains all cranes, hoists, and rails at each site that have been excluded from the scope of License Renewal. The list only applies to cranes, hoists and rails that are located within structures that have been included within the scope of License Renewal. Cranes, hoists, and monorails physically located in structures that are not within the scope of License Renewal are not listed below. Out-of-scope structures do not include safety related equipment. As such, any crane, hoist or monorail located within the structure could not affect safety related equipment. For this reason they were excluded from the scope of License Renewal along with the associated structure. The cranes, hoists, or monorails listed below are not safety related, are not required for any safety related system to perform any intended function, and are not capable of moving any load over or spatially interact with safety related equipment. For these reasons, they were excluded from the scope of License Renewal.

Dresden Reactor Building – Out of Scope

- Unit 2 Reactor Building (517' Elevation) Material Interlock Underhung Jib Crane
- Unit 3 Reactor Building (517' Elevation) Material Interlock Underhung Jib Crane
- Unit 2 Reactor Building (589' Elevation–RWCU Filter Demin blocks) Monorails (1)
- Unit 3 Reactor Building (589' Elevation-RWCU Filter Demin blocks) Monorails (1)
- Unit 2 Reactor Building (545' Elevation – north of RBCCW HX) Monorails (1)
- Unit 3 Reactor Building (570 Elevation – north of main hatch) Monorails (1)
- Unit 3 Reactor Building (517' Elevation – East & West) Monorails (2)

Dresden Turbine Building – Out of Scope

- Control Rod Drive Overhaul Shop Crane Underhung
- Control Rod Drive Overhaul Shop Jib Crane
- Unit 2 Turbine Building Trackway (Elevation 538') Elevator Air Hoist Crane Monorail
- Unit 3 Turbine Building Trackway (Elevation 538') Elevator Air Hoist Crane Monorail
- Control Rod Drive Flush Tank Jib Crane
- Unit 3 Safety Valve Test Boiler Jib Crane
- Unit 3 Safety Valve Test Boiler Crane Monorail
- Unit 2 Turbine Building Trackway Rollup Door Hoist Mechanism
- Unit 3 Turbine Building Trackway Rollup Door Hoist Mechanism

- All condensate / booster pump monorails (16)
- All control rod drive hydraulic pump monorails (4)
- Reactor Recirculation Motor Generator Set Monorails (4)
- All stator cooling water heat exchanger monorails (2)
- Reactor feedwater pump monorails (2)
- Instrument air compressor monorails (3)
- Feedwater regulating valve station monorails (5)
- Turbine Building floor / equipment drain sump pump monorails & jib
- Turbine Building freight elevator monorail (549' elevation)
- Main Condenser pull/pit monorail (1)
- Low pressure heater monorails (12)
- Low pressure heater bay area monorails (4)
- South Turbine Building 2/3 MG Sets Rollomatic Filters Underhung Crane

Dresden Miscellaneous Buildings – Out of Scope

- 2/3 Cribhouse Refuse Basket Underhung Crane
- Station Blackout Building monorails (4)
- Service water pump monorails and trolleys (5)
- Service water strainer monorail and trolley (1)
- 2/3 Cribhouse East/West Monorail Electric Hoist/Trolley

Quad Cities Reactor Building – Out of Scope

- Unit 1 Reactor Building (Elevation 666') Monorail Hoist
- Unit 2 Reactor Building (Elevation 666') Monorail Hoist
- CRD Repair Area Monorail Hoist
- CRD Repair Room Monorail

Quad Cities Turbine Building – Out of Scope

- Unit 1 Condensate Pit Jib
- Unit 2 Condensate Pit Jib
- Unit 1 Condensate Demineralizer Monorail
- Unit 2 Condensate Demineralizer Monorail
- Unit 1 Turbine Building Trackway Crane
- Unit 2 Turbine Building Trackway Crane
- Radwaste Truck Bay Crane
- Max Recycle Crane
- Radwaste Basement Jib
- Radwaste Shield Door Hoists (#94-#96)
- "C" Warehouse Overhead Cranes (East & West)
- Unit 1CRD pump Monorail
- Unit 2 CRD pump Monorail
- Reactor Recirc MG Set Monorails (4)
- Instrument Air Compressor Monorails (2)
- Unit 1 Battery Room Area Monorail
- Unit 2 Battery Room Area Monorail
- Unit 2 Reactor Feed Pump Vent Fan area Monorail (does not exist on Unit 1)
- Generator Lifting Beam (on Turbine Deck)

- 10 Ton Lifting Beam with Hoist (on Turbine Deck)
- Trolley Monorail (on Turbine Deck)
- Unit 1 Off Gas Filter Room Area Monorail
- Unit 2 Off Gas Filter Room Area Monorail
- Unit 1 TBCCW Heat Exchanger Area Trolley with Underhung Hoist
- Unit 1 Outside the West end of the Heater Bay Ground Floor Monorail (2)
- Unit 2 TBCCW Heat Exchanger Area Monorail Trolley with Underhung Hoist
- Unit 1 (Elevation 595') Outside the West end of the Heater Bay Ground Floor Monorail (2)
- Unit 2 (Elevation 595') Outside the West end of the Heater Bay Ground Floor Monorail (2)
- Unit 1 (Elevation 611') Outside the West end of the Heater Bay Second Floor Monorail (7)
- Unit 2 (Elevation 611') Outside the West end of the Heater Bay Second Floor Monorail (7)
- Unit 1 Reactor Feed Pump Exhaust Fan Area Monorail (does not exist on Unit 2)
- Unit 1 (Elevation 668') Floor Elevation Monorail
- Unit 2 (Elevation 648') Floor Elevation Monorail

<u>Quad Cities Miscellaneous Buildings – Out of Scope</u>

- Unit 1 Station Blackout Diesel Room Monorail
- Unit 2 Station Blackout Diesel Room Monorail
- Crib House Monorail for circulating water pumps
- Fish Basket Jib
- Trash Rake Crane

c) All cranes, hoists, and monorails within the scope of License Renewal require aging management review are listed in the response to (a) above. While the type of components comprising crane subsystems can vary, the following cranes component types require aging management:

   a. Load carrying flanges
   b. Support structures
   c. Bolts, nuts, or rivets
   d. Load blocks
   e. Suspension housings
   f. Hand chain wheels
   g. Chain attachments
   h. Clevis
   i. Yokes
   j. Suspension Bolts
   k. Shafts
   l. Gears
   m. Bearings
   n. Pins
   o. Rollers
   p. Lock and Clamping Devices
   q. Hook Retaining Nuts

r. Hook Retaining Collars/Pins
s. Retaining Member Welds
t. Load Sprockets
u. Drums
v. Sheaves
w. Hydraulic Subsystems
x. Cable
y. Cable Clamps
z. Brakes
aa. Bridge/Beam Structures

d) All cranes, hoists, and monorails within the scope of License Renewal (listed in the response to (a) above) require aging management review. Aging for these cranes, hoists, and monorails will be managed under Aging Management Program B.1.15, Overhead Heavy Load and Light Load Handling Systems. The reactor building overhead cranes at Dresden and Quad Cities were designed to meet or exceed the design fatigue loading requirements of the Crane Manufacturers Association of America (CMAA) Specification 70, Class A1. The evaluation of expected cycles over the life of each plant is the basis of a safety determination and is therefore a TLAA. Section 4.7.1, Reactor Building Crane Load Cycles, provides the disposition for this TLAA.

RAI 2.4-10

Based on information provided in LRA Section 2.4.15, it is not clear to the staff that all component supports within the scope of license renewal are included in the component supports commodity group. Also, clarification is needed for several "Components" listed in Table 2.4-15.

In order to complete the screening review for component supports, the staff requests the applicant to submit the following information:

(a) Clarify if the ASME Class 1 supports in this commodity group include the reactor vessel support skirt /support ring and reactor vessel upper lateral stabilizer support. If not, where are these supports addressed in the LRA? If not managed by ASME Section XI, Subsection IWF, submit the technical basis for crediting an alternate aging management program.

(b) Clarify if the ASME Class MC supports in this commodity group include the drywell lower ring support and the drywell upper lateral support. If not managed by ASME Section XI, Subsection IWF, submit the aging management review for the drywell supports, including the technical basis for this exception.

(c) Since LRA Section 2.4.15 is not referenced anywhere in LRA Sections 2.3 or 2.4, verify that all supports associated with "Components" listed in LRA Sections 2.3 and 2.4.1 through 2.4.14 are included in the component supports commodity group. If not, identify the supports not included and submit the aging management review, including credited aging management programs.

(d) Verify that the "Anchorage to Buildings Including Bolted/Welded Connections"

component in LRA Table 2.4-15 includes anchors directly into concrete.

Response:

(a) The ASME Class 1 supports discussed in Section 2.4-15 of the LRA do not include the reactor vessel support skirt. The reactor vessel support skirt was evaluated in LRA Section 2.3.1.1, "Reactor Vessel". The reactor vessel support skirt was included in LRA Table 2.3.1-1 under the Component Group "Support Skirts and Attachment Welds." This is in alignment with NUREG 1801, which assigns "Support Skirt and Attachment Welds" to Section IV.A1, "Reactor Vessel (Boiling Water Reactor)." The aging management of the support skirts and attachment welds has been analyzed as a TLAA and is discussed in LRA Section 4.3.1, Reactor Vessel Fatigue Analysis. Specifically, the reactor vessel support skirt will be managed for fatigue under aging management program, B.1.34, Metal Fatigue of the Reactor Coolant Pressure Boundary.

The reactor vessel support ring girder and upper lateral stabilizer supports were analyzed in LRA Section 2.4.15, "Component Supports Commodity Group" as part of the "Support Members (Includes Spring Hangers)" Component Group. The upper lateral stabilizer supports are managed by Aging Management Program B.1.27, "ASME Section XI, Subsection IWF". The reactor vessel support ring girder is not an ASME Section XI, Subsection IWF component. The reactor vessel support ring girder is managed under Aging Management Program B.1.30, Structures Monitoring Program.

(b) The drywell lower ring support and the drywell upper lateral support are included in the ASME Class MC supports discussed in LRA Section 2.4.15, Component Supports Commodity Group. The drywell lower ring support and the drywell upper lateral support will be managed under Aging Management Program B.1.27, ASME Section XI, Subsection IWF.

(c) LRA Section 2.4.15, "Component Supports Commodity Group," includes all supports associated with the "Components" listed in LRA Sections 2.3 and 2.4.1 through 2.4.14, with two exceptions:

Table 2.3.1-1 of LRA Section 2.3.1.1, "Reactor Vessel," includes supports for the reactor vessel and reactor vessel internals. The aging management of the support skirts and attachment welds has been analyzed as a TLAA and is discussed in LRA Section 4.3.1, Reactor Vessel Fatigue Analysis. Specifically, the reactor vessel support skirt will be managed for fatigue under aging management program, B.1.34, Metal Fatigue of the Reactor Coolant Pressure Boundary.

Table 2.3.1-2 of LRA Section 2.3.1.2, "Internals," includes components internal to the reactor vessel that provide support for other internal components. Aging Management Programs B.1.2, Water Chemistry, and B.1.9, BWR Vessel Internals, manage the aging of these internal components. Jet pump assemblies and orificed fuel support pieces are managed under Aging Management Program B.1.10, Thermal Aging and Neutron Irradiation Embrittlement of Cast Austenitic Stainless Steel (CASS). In addition to these Aging Management Programs, several Component Groups found in LRA Table 2.3.1-2 with a structural support function have been analyzed as a TLAA and

are discussed in LRA Section 4.2, Neutron Embrittlement of the Reactor Vessel and Internals.

For all other component supports included in LRA Section 2.4.15 (other than the two exceptions discussed), the following Aging Management Programs apply:

- B.1.27, "ASME Section XI, Subsection IWF," will manage ASME Class 1, 2, and 3 component supports.
- B.1.27, "ASME Section XI, Subsection IWF," will manage ASME Class MC component supports during the period of extended operation, as stated in (b) above.
- B.1.2, "Water Chemistry," and AMP B.1.23, "One-Time Inspection," will manage component supports exposed to a torus water environment.
- B.1.30, "Structures Monitoring Program," will manage component supports other than in the above categories.

(d) The Component Group, Anchorage to Buildings Including Bolted/Welded Connections, found in LRA Table 2.4-15 includes anchors directly into concrete. The concrete surrounding the anchors is addressed with the corresponding structures as identified in LRA Section 2.4.

<u>RAI 2.4-11</u>

Based on information provided in LRA Section 2.4-16, the staff cannot identify the insulation and insulation jacketing included in the license renewal scope nor the specific subset that is included in this commodity group. It is also unclear whether insulation and jacketing on the reactor coolant system has been included.

In LRA Table 2.4-16, the aging management references are to LRA Sections 3.2 (Engineered Safety Features), 3.3 (Auxiliary Systems), and 3.4 (Steam and Power Conversion Systems). However, in LRA Section 2.3 (Scoping and Screening Results: Mechanical), insulation is not discussed and there are no references to LRA Section 2.4.16.

In order to complete the screening review for insulation and insulation jacketing, the staff requests the applicant to submit the following information:

(a) Specifically identify the mechanical systems or portions of systems that have insulation and/or insulation jacketing within the license renewal scope, and their location in the plant.

(b) Specifically identify the structures and structural components that have insulation and/or insulation jacketing within the license renewal scope, and their location in the plant.

(c) Specifically identify any insulation and/or insulation jacketing within the license renewal scope, but not included in the insulation commodity group; submit the aging management review for this insulation and/or insulation jacketing.

(d) List all insulation and insulation jacketing materials included in the insulation commodity group and the results of the aging management review for each.

(e) For insulation and insulation jacketing materials not requiring aging management, submit the technical basis for this conclusion, including plant-specific operating experience.

(f) For insulation and insulation jacketing materials requiring aging management, identify the aging management program(s) credited to manage aging.

Response:

(a) The methodology used for scoping and screening of mechanical system insulation is described in LRA Section 2.1.6, Additional Considerations Incorporated into the Methodology, Treatment of Piping and Equipment Insulation During Scoping and Screening.

Scoping and screening identified the following systems to have insulation and/or insulation jacketing within the license renewal scope.

System	Location	System	Location
Reactor vessel	Inside Containment	Feedwater system	Inside and Outside Containment
Reactor recirculation system	Inside Containment	Main Condenser	Outside Containment
Head spray system (Dresden only)	Inside Containment	Condensate and condensate booster system	Outside Containment
Reactor vessel head vent system	Inside Containment	Feedwater heater drains and valves	Outside Containment
Nuclear boiler instrumentation system	Inside Containment	Reactor building closed cooling water	Inside (Quad Cities only) and Outside Containment
Shutdown cooling system (Dresden only)	Inside and Outside Containment	Service water system	Outside Containment
Standby liquid control system	Outside Containment	Diesel generator service water system	Outside Containment
Reactor water cleanup system	Inside and Outside Containment	HVAC- main control room	Outside Containment
Isolation condenser (Dresden only)	Inside and Outside Containment	SBO building HVAC	Outside Containment
Reactor core isolation cooling system (Quad Cities only)	Inside and Outside Containment	HVAC- radwaste building	Outside Containment
Core spray system	Inside Containment	Plant heating steam	Outside Containment

Low pressure coolant injection system (Dresden only)	Inside and Outside Containment	HVAC – auxiliary electric room and computer room	Outside Containment
Residual heat removal system (Quad Cities only)	Inside and Outside Containment	HVAC – high radiation sampling system	Outside Containment
Containment cooling service water system (Dresden only)	Outside Containment	Emergency diesel generators and auxiliaries	Outside Containment
Residual heat removal service water system (Quad Cities only)	Outside Containment	SBO diesel generator and auxiliaries	Outside Containment
High pressure coolant injection system	Inside and Outside Containment	Drywell nitrogen inerting	Outside Containment
Main steam system	Inside and Outside Containment	Nitrogen containment atmosphere dilution system	Outside Containment
Extraction steam system	Outside Containment		

(b) Scoping and screening identified the following buildings or structures as having insulation (fire wrapping/fire proofing) within the scope of license renewal:

- Reactor Buildings (Section 2.4.2)
- Main Control Room and Auxiliary Electric Equipment Room (Section 2.4.3)
- Turbine Buildings (Section 2.4.4)
- Diesel Generator Buildings (Section 2.4.5)
- Station Blackout Buildings (Section 2.4.6)

(c) For mechanical systems, all insulation and insulation jacketing within the license renewal scope are included in the Insulation Component Group (Section 2.4.16). For buildings and structures, the fire wrapping or fire proofing are included as line items in the LRA Section 2.4 component tables for the buildings listed above. The Aging Management Reference in the Section 2.4 component tables points to the aging management review results.

(d) The requested information for mechanical systems is contained in the LRA at the following points:

- Section 3.2, Table 3.2-2, Aging Management References 3.2.2.44, 3.2.2.45, 3.2.2.46, 3.2.2.47 and 3.2.2.48
- Section 3.3, Table 3.3-2, Aging Management References 3.3.2.122 and 3.3.2.123
- Section 3.4, Table 3.4-2, Aging Management References 3.4.2.22 and 3.4.2.23

The requested information for structures is contained in LRA Section 3.3, Table 3.3-2, Aging Management References 3.3.2.62 and 3.3.2.63.

(e) The line items listed in response to Item (d) include identification of insulation

and/or insulation jacketing materials that do not exhibit aging effects and that do not require aging management. This information is included in the columns headed "Aging Effect/Mechanism" and "Aging Management Program" associated with each line item identified. The "Discussion" column for each line item where there are no aging effects provides a technical basis for this conclusion.

The aging management review that evaluated insulation and insulation jacketing included a search of problem identification forms and work orders to identify documented insulation failures at Dresden or Quad Cities. This search identified a total of fifteen (15) documented insulation failures. Of these fifteen failures, three failures were attributed to age-related degradation, seven failures were attributed to causes unrelated to aging (e.g., damage by personnel), and five were attributed to indeterminate causes.

(f) The requested information for mechanical systems is contained in the LRA at the following points:

- Section 3.2, Table 3.2-2, Aging Management References 3.2.2.44, 3.2.2.45, 3.2.2.46, 3.2.2.47 and 3.2.2.48
- Section 3.3, Table 3.3-2, Aging Management References 3.3.2.122 and 3.3.2.123
- Section 3.4, Table 3.4-2, Aging Management References 3.4.2.22 and 3.4.2.23

The requested information for structures is contained in the LRA at the following points:

- Section 3.3, Table 3.3-2, Aging Management References 3.3.2.62 and 3.3.2.63

Section 3.0 Aging Management Review Results

RAI 3.0-1

The following RAI is applicable to various subsections of LRA Section 3.0.

Numerous tables included in the application list the component material and environment to which the component is exposed. However, the applicant did not provide a description of these environments (both internal and external) in the LRA. It should be noted that the aging effect depends on the component material as well as the plant specific environment characteristic. A description of the specific information, such as dry gas, moist air, warm moist air, air, moisture and humidity <100EC, indoor and outdoor environment, outdoor ambient condition, raw water, treated water, soil and groundwater, leaking fluid, refrigerant and sheltered, should be defined in terms of ranges of temperature, humidity, pressure, compositions, etc. This environmental information is necessary for the staff to perform its AMR of structures and components in the LRA. Provide a description of the environments included in the LRA.

Response:

The Dresden and Quad Cities License Renewal Application (LRA) generally used the environments established in NUREG 1801, Generic Aging Lessons Learned (GALL) Report. In those cases where site-specific environments were different than that specified in NUREG 1801, the site-specific environment was used. The table below identifies all environments listed in LRA Tables 3.1-2, 3.2-2, 3.3-2, 3.4-2, 3.5-2, and 3.6-2 and provides either a definition of the site-specific environment or a reference to the applicable NUREG 1801 environment. The below environments are presented in alphabetical order.

NUREG 1801 was used to identify environments whenever possible. For example, if NUREG 1801 listed an environment with carbon steel components and Dresden or Quad Cities also had stainless steel in that same system, the NUREG 1801 environment was applied to the stainless steel. When the environment at Dresden or Quad Cities did not match the NUREG 1801 description, the NUREG 1801 environment was modified to capture the site-specific conditions (e.g. glycol was added to clarify certain applications of demineralized water). When no clear NUREG 1801 environment link could be made, the site-specific conditions were identified as the environment and a definition developed.

Environment	Environment Definition or Reference
<90° C (<194°F) Treated Water	Same as NUREG-1801, Reference: VIII.E.5-a, and VIII.E.5-b
25-288°C (77-550°F) Demineralized Water	Same as NUREG-1801, Reference: V.D2.1-a, V.D2.1-b, V.D2.1-c, V.D2.1-d, V.D2.2-a, V.D2.3-a, V.D2.3-b, and V.D2.3-c
288°C (550°F) Reactor Coolant Water	Same as NUREG-1801 Reference: IV.A1.2-e, IV.C1.1-i, IV.C1.2-a, IV.C1.2-b, IV.C1.2-c, IV.C1.3-a, IV.C1.3-c, IV.C1.3-b, and IV.C1.3-d
288°C (550°F) Steam	Same as NUREG-1801, Reference: IV.A1.1-a, IV.A1.1-b, IV.A1.2-a, IV.A1.3-a, IV.C1.1-a, IV.C1.1-b VIII.B2.1-b, VIII.B2.1-a, VIII.B2.1-c, VIII.B2.2-b, and VIII.B2.2-a
Air	Same as NUREG-1801, Reference: V.D2.5-b, and V.D2.5-a
Air and Steam up to 320°C (608°F)	Same as NUREG-1801, Reference: V.D2.1-f
Air and Steam up to 320°C (608°F) (Primarily Air)	Similar to NUREG-1801, Reference: V.D2.1-f, but a qualifier was added to this NUREG 1801 environment to distinguish between air and steam environment.
Air and Steam up to 320°C (608°F) (Primarily Steam)	Similar to NUREG-1801, Reference: V.D2.1-f, but a qualifier was added to this NUREG 1801 environment to distinguish between air and steam environment.
Air, Moisture, and Humidity < 100°C (212°F)	Same as NUREG-1801, Reference: V.E.1-b, VII.I.1-b, and VIII.H.1-b
Air, Moisture, and Humidity Where Surface Temp > 100°C (212°F)	Similar to NUREG-1801, Reference: V.E.1-b, VII.I.1-b, and VIII.H.1-b, but components that have a surface temperature > 212°F are not considered susceptible to external surface aging degradation.
Air, Moisture, Humidity, and Leaking Fluid	Same as NUREG-1801, Reference: V.E.2-b, V.E.2-a, VII.I.2-a, VII.I.2-b VIII.H.2-a, and VIII.H.2-b

Environment	Environment Definition or Reference
Air with Metal Temperature up to 288°C (550°F)	Same as NUREG-1801, Reference:IV.C1.2-d, IV.C1.2-e, IV.C1.2-f, IV.C1.3-e, IV.C1.3-f, IV.C1.3-g Note that this environment was not part of the original License Renewal Application, nor was contained in the original response provided to RAI 3.0-1, submitted to the NRC on 6/11/03. It was added as part of the response to RAI 3.1-22.
Ambient Environment Inside Building	Same as NUREG-1801, Reference: III.A1.3-a, III.A2.3-a, III.A3.3-a, and III.A5.3-a
Ambient Temperature Air	Same as NUREG-1801, Reference: IV.A1.7-a
Chemically Treated Demineralized Water < 90°C (194°F) (TTA-Nitrite based chemical treatment)	The Emergency Diesel Generator Jacket Water, Reactor Building Closed Cooling Water, and Turbine Building Closed Cooling Water systems utilize the same closed cooling water chemistry. A Nitrite-Tolytriazole mixture (nitrite inhibitor based CCW) is used with a pH control agent for corrosion and microbiological control. The coolant mixture is normally in a saturated aerated condition at low pressures and temperatures. Exelon procedures maintain the chemical makeup of the nitrite inhibitor based closed cooling water in accordance with EPRI TR-107396 "Closed Cooling Water Chemistry Guidelines".
Chemically Treated Demineralized Water <90°C (194°F)	Same as NUREG-1801, Reference: VII.H2.1-a
Chemically Treated Demineralized Water <90°C (194°F) (Glycol based chemical treatment)	The Station Blackout Diesel Generator Jacket Water systems utilize ethylene glycol based cooling water chemistry. The corrosion inhibitor objectives for glycol coolants differ considerably from those for pure water corrosion inhibitors. The coolant mixture is normally in a saturated aerated condition at low pressures and temperatures. Demineralized water that is maintained within chemistry guidelines is used for initial mixing of the glycol-based coolant. Exelon Corporate procedures maintain the chemical makeup of the glycol based closed cooling water in accordance with EPRI TR-107396 "Closed Cooling Water Chemistry Guidelines".
Chemically Treated Oxygenated Water	Same as NUREG-1801, Reference: VII.A4.1-a, VII.A4.2-a, VII.A4.2-b, VII.A4.3-a, VII.A4.3-b, and VII.A4.5-b,
Condensate	Condensate is water that has been filtered and demineralized, contains no added corrosion inhibitors, and low conductivity and impurities. Condensate has not been deaerated or deoxygenated.
Containment Nitrogen	The drywell is made inert with nitrogen to render the primary containment atmosphere non-flammable by maintaining the oxygen content below 4% by volume during normal operation. The drywell has an average

Environment	Environment Definition or Reference
	temperature of 135°F during normal operations. The relative humidity in the drywell ranges between 20% and 90%.
Demineralized Water - Stator Liquid Cooling	This demineralized water is maintained within the limits of conductivity $\leq$ 0.5μS/cm and dissolved oxygen 2-8 ppm and goal of silica <20 ppb and copper <20 ppb.
Diesel Fuel Oil	Same as NUREG-1801, Reference: VII.H2.5-a
Dry Gas	Industrial gas, containing little or no moisture, such as carbon dioxide, Freon, Halon, hydrogen, oxygen, and nitrogen. These gases are considered inert with respect to corrosion potential because they have no significant moisture content.
Encased in Concrete	The high alkalinity of concrete (pH > 12.5) provides an environment that protects embedded steel from corrosion.
Fuel Oil	Same as NUREG-1801, Reference: VII.G.8-a
Fuel Oil, water (as contaminant)	Same as NUREG-1801, Reference: VII.H1.4-a
Generator Hydrogen Seal Oil	Lubricating oil, an organic fluid, used to reduce friction between moving parts. Lubricating oil does not cause or promote aging of the internal surfaces of the materials. However, moisture and other contaminants may become entrained in the oil and cause or promote components aging.
Hot Diesel Engine Exhaust Gases Containing Moisture and Particulates	Same as NUREG-1801, Reference: VII.H2.4-a
Indoor	Same as NUREG-1801, Reference: VII.G.5-a, VII.G.5-b, and VII.G.5-c
Indoor and Outdoor Environments	Same as NUREG-1801, Reference: VII.G.3-b, VII.G.3-c, VII.G.3-d, VII.G.4-b, VII.G.4-c, VII.G.4-d, VII.G.1-b, VII.G.1-c, VII.G.1-d, VII.G.2-b, VII.G.2-c, and VII.G.2-d
Inside or Outside Containment	Same as NUREG-1801, Reference: II.B2.2.1-e, II.B2.2.1-c, II.B2.2.1-d, II.B2.2.1-g, II.B3.2.1-f, II.B3.2.1-c, II.B3.2.1-d, II.B3.2.1-h, II.B3.2.1-e, II.B3.1.2-b, II.B3.1.2-g, II.B4.1-b, II.B4.1-a, II.B4.1-d, II.B4.1-c, II.B4.2-b, II.B4.2-a, II.B2.2.3-a, II.B4.3-a, II.B1.1.1-c, II.B1.1.1-a, II.B1.1.1-b, II.B1.1.1-d, II.B1.1.1-e, II.B2.2.2-b, II.B2.2.2-c, II.B2.1.1-a, II.B2.2.2-a, II.B2.2.2-e, II.B2.1.1-d, II.B2.1.1-b, II.B3.2.2-a, II.B3.2.2-b, II.B3.1.1-a, II.B3.1.1-b, II.B3.1.2-e, II.B3.1.2-d, II.B3.1.2-c, II.B2.1.1-c, II.B2.2.2-d, II.B2.2.3-b, II.B2.2.1-bIII.B1.2.1-a, III.B1.2.1-c, III.B1.2.2-a, III.B1.2.3-a, III.B1.3.1-a, III.B1.3.1-b, III.B1.3.2-a, III.B1.3.3-a, III.B2.1-a, III.B2.2-a, III.B3.1-a, III.B3.2-a, III.B4.1-a, III.B4.2-a, III.B4.3-a, III.B5.1-a, and III.B5.2-a
Internal: Occasional Exposure to Moist Air; External: Ambient Plant Air Environment	Same as NUREG-1801, Reference: V.B.1-a, V.B.1-b, and V.B.2-a
Leaking Reactor Coolant Water and/or Steam up to 288°C (550°F)	Same as NUREG-1801, Reference: IV.A1.1-d

Environment	Environment Definition or Reference
Lubricating Oil (with contaminants and/ or moisture)	Same as NUREG-1801, Reference: VII.G.7-b, and VII.G.7-a
Moist Air	Same as NUREG-1801, Reference: VII.H2.3-a, VII.H2.2-a, and VII.D.6-a
Moist Containment Atmosphere (air/ nitrogen), Steam, or Demineralized Water	Same as NUREG-1801, Reference: V.D2.1-e
Open-Cycle Cooling Water (raw water) Side	Same as NUREG-1801 Reference: VIII.E.4-b, and VIII.E.4-c
Outdoor Ambient Conditions	Same as NUREG-1801 Reference: VII.H1.1-a, VII.H1.2-a, VII.H1.3-a, and VII.H1.4-b
Outdoors: Sun, Weather, Humidity, and Moisture	Same as NUREG-1801, Reference: VIII.E.5-c
Outside Containment	Same as NUREG-1801 Reference: II.B2.2.1-a, II.B3.1.2-a, II.B3.2.1-a, II.B3.2.1-b, III.A1.1-j, III.A2.1-j, III.A3.1-j, and III.A5.1-j
Oxygenated Water 93°C -288°C (200°F-550°F)	Same as NUREG-1801, Reference: VII.E3.1-a, and VII.E3.2-a
Oxygenated Water, up to 288°C (550°F)	Same as NUREG-1801 Reference: VII.E3.1-a, VII.E4.1-a, VII.E4.1-b, VII.E4.1-c, VII.E4.2-a, and VII.E4.3-a
Raw Water	Same as NUREG-1801 Reference: VII.G.6-b, and VII.G.6-a
Raw Water (submerged)	Raw water typically contains a dilute solution of mineral salt impurities, dissolved gases and biological organisms. These dissolved gases (oxygen and carbon dioxide) are the prime corrosion-initiating agents. Raw water samples typically show pH values greater than 7.0 and the presence of chlorides and sulfates.
Raw, Untreated Fresh Water	Same as NUREG-1801, Reference: VII.C3.1-a, VII.C3.3-a, and VII.C3.2-a
Raw, Untreated Salt Water or Fresh Water	Same as NUREG-1801, Reference: VII.C1.6-a, VII.H2.1-b, VII.C1.4-a, VII.C1.1-a, VII.C1.5-a, and VII.C1.2-a
Reactor Coolant Water (< 140°F)	Similar to NUREG-1801 Reference: IV.A1.2-e, IV.C1.1-i, IV.C1.2-a, IV.C1.2-b, IV.C1.2-c, IV.C1.3-a, IV.C1.3-c, IV.C1.3-b, and IV.C1.3-d, except with a lower temperature. Note that this environment was not part of the original License Renewal Application, nor was contained in the original response provided to RAI 3.0-1, submitted to the NRC on 6/11/03. This piping was originally considered to be in the 288^{0} C (550^{0} F) reactor water coolant environment, similar to the piping to which it is attached. However, the actual normal operating environment is < 140^{0} F.
Refrigerant	Refrigerants constitute a large family of fluorinated hydrocarbon compounds that exhibit similar chemical

Environment	Environment Definition or Reference
	properties and a wide range of physical characteristics. Their inert character and the range of their vapor pressures, boiling points and other physical properties make them suited for use in refrigeration and air conditioning systems. Fluorocarbons show no appreciable decomposition at temperatures up to 400°F, and oxidize only with extreme difficulty at very high temperatures. Fluorocarbons are non-corrosive to all common metals except at very high temperatures. Unless the system experiences contamination with moisture and/or sulfur, the conditions necessary for internal corrosion do not exist.
Saturated Air	Same as NUREG-1801, Reference: VII.D.3-a, VII.D.5-a, VII.D.1-a, VII.D.1-a, VII.D.4-a, and VII.D.2-a
Saturated Steam/Condensate	Saturated steam produced in the auxiliary boilers for building heating steam and the condensate return to the auxiliary boilers from steam heating coils, steam traps, etc. is typically 195 to 205 psig.
Sodium Pentaborate Solution at 21° - 32°C (70° - 90°F) (24,500 ppm B)	Same as NUREG-1801, Reference: VII.E2.4-a, VII.E2.1-a, VII.E2.2-a, and VII.E2.3-a
Soil and Groundwater	Same as NUREG-1801, Reference: VII.H1.1-b, and VIII.E.5-d
Steam	Same as NUREG-1801, Reference: VIII.A.1-b, VIII.A.1-a, VIII.A.2-b, and VIII.A.2-a
Submerged (torus grade water) and Inside or Outside Containment	<u>Inside Containment</u>: The drywell is made inert with nitrogen to render the primary containment atmosphere non-flammable by maintaining the oxygen content below 4% by volume during normal operation. The drywell has an average temperature of 135°F during normal operations. The torus air space above the torus water level, is also inerted to maintain the oxygen content below 4% by volume during normal operation. The air temperature follows the normal, maximum operating torus water temperature of 95°F and the relative humidity is between 20 and 90%. Torus Water is water that has been demineralized, and contains no added corrosion inhibitors. Torus Water has not been deaerated/deoxygenated, and may contain fine corrosion product particulates. Torus water quality is maintained in accordance with station procedures that include recommendations from EPRI TR-103515 BWR Water Chemistry Guidelines. <u>Outside Containment</u>: The Reactor Building (outside the drywell, torus, and steam tunnel) normal operating area temperatures range from 65°F to 103°F for Dresden and 65 °F to 104

Environment	Environment Definition or Reference
	°F for Quad Cities with relative humidity ranging between 20% and 90%.
Treated Water	Same as NUREG-1801, Reference: VIII.D2.1-a, VIII.D2.1-b, VIII.D2.1-c, VIII.D2.2-a, VIII.D2.2-b, VIII.D2.3-a, VIII.D2.3-b, VIII.E.2-a, VIII.E.2-b, VIII.E.6-a, and VIII.E.3-a
Treated Water (BWRs: reactor coolant; PWRs: secondary side water)	Same as NUREG-1801, Reference: VIII.E1-a, and VIII.E.1-b
Tube Side: Closed Cooling Water; Shell Side: Warm Moist Air	See Chemically Treated Demineralized Water < 90°C (194°F) (TTA-Nitrite based chemical treatment) and Warm Moist Air
Tube Side: Condensate (demineralized water); Shell Side: Lubricating Oil	See Condensate and Lubricating Oil
Tube Side: Condensate (demineralized water); Shell Side: Reactor Coolant Water and Warm Moist Air	See Condensate, 288°C (550°F) Reactor Coolant Water, and Warm Moist Air
Tube Side: Glycol-based Cooling Water (closed-cycle cooling water); Shell Side: Lubricating Oil	See Chemically Treated Demineralized Water <90°C (194°F) (Glycol based chemical treatment) and Lubricating Oil.
Tube Side: Glycol-based cooling water (closed-cycle cooling water); Shell Side: Warm Moist Air	See Chemically Treated Demineralized Water <90°C (194°F) (Glycol based chemical treatment) and Warm Moist Air.
Tube Side: Lubricating Oil; Shell Side: Closed Cooling Water	See Lubricating Oil and Chemically Treated Demineralized Water < 90°C (194°F) (TTA-Nitrite based chemical treatment)
Tube Side: Open Cycle Cooling Water (raw water); Shell Side: Closed Cooling Water (treated water)	Same as NUREG-1801, Reference: VII.C1.3-a, and VII.C1.3-b
Tube Side: Open Cycle Cooling Water (raw water); Shell Side: Refrigerant	See Raw Water and Refrigerant
Tube Side: Open Cycle Cooling Water (raw water); Shell Side: Torus Water (demineralized water)	Same as NUREG-1801, Reference: V.D2.4-b, and V.D2.4-a
Tube Side: Open Cycle Cooling Water (raw water); Shell Side: Warm Moist Air	See Raw Water and Warm Moist Air
Tube Side: Reactor Coolant Water; Shell Side: Closed-Cycle Cooling Water	Same as NUREG-1801, Reference: VII.E4.4-a
Tube Side: Refrigerant; Shell Side: Warm Moist Air	See Refrigerant and Warm Moist Air
Tube Side: Steam; Shell Side: Demineralized Water	Same as NUREG-1801, Reference: IV.C1.4-a, and IV.C1.4-b
Tube Side: Torus Water (demineralized water); Shell Side: Open Cycle Cooling Water (raw	See 25°-288°C (77°-550°F) Demineralized Water and Raw, Untreated Salt Water or Fresh Water

Environment	Environment Definition or Reference
water)	
Turbine EHC Fluid	A phosphate ester based hydraulic oil with additives including fire retardant compounds. EHC fluid is corrosive to bronze and aluminum.
Up to 288°C (550°F) Reactor Coolant Water	Same as NUREG-1801, Reference: IV.A1.3-b, IV.A1.3-c, IV.A1.3-d, IV.A1.4-a, IV.A1.4-b, IV.A1.5-a, IV.A1.5-b IV.A1.6-a, and IV.B1.5-c
Various	Same as NUREG-1801, Reference: III.A1.2-a, III.A2.2-a, III.A3.2-a, III.A5.2-a, III.A6.2-a, III.A6.3-a, III.A7.2-a, and III.A8.2-a
Warm, Moist Air	Same as NUREG-1801, Reference: VII.F2.2-a, VII.F3.2-a, VII.F1.2-a, VII.F4.2-a, VII.F2.1-a, VII.F2.1-b, VII.F2.1-c, VII.F3.1-a, VII.F3.1-b, VII.F3.1-c, VII.F1.1-a, VII.F1.1-b, VII.F1.1-c, VII.F4.1-a, VII.F4.1-b, VII.F4.1-c, VII.F2.4-a, VII.F2.4-b, VII.F2.4-a, VII.F3.4-a, VII.F3.4-b, VII.F1.4-a, and VII.F1.4-b
Weather Exposed, Standing and Flowing Water	Same as NUREG-1801, Reference: III.A6.4-a
Wet Gas	Wetted gas environments include air-containing moisture, air/nitrogen-containing moisture, and diesel exhaust gas. Air is either ambient or compressed air without air dryers in the system. Diesel exhaust can contain sulfur residues and has the potential for moisture and sulfuric acid in exhaust system components.

Section 3.2 Aging Management of Engineered Safety Features

RAI 3.2-1

(a) To satisfy the "Further Evaluation Criteria" for the components covered by LRA Tables 3.2-1, Items 3.2.1.3 and 3.2.1.5, GALL recommends a plant-specific aging management program. The aging effects identified for the components covered by Items 3.2.1.3 and 3.2.1.5 are loss of material due to general corrosion and pitting/crevice corrosion, respectively. LRA Sections 3.2.1.1.3 and 3.2.1.1.5 state that the one-time inspection (B.1.23) will be used rather than an aging management program that requires periodic monitoring of these components to manage loss of material. Since these components are carbon steel and may be subjected to moisture, an aging management program requiring periodic inspections should be used rather than a one-time inspection. Justify the use of the one-time inspection program for the components covered by Table 3.2-1, Items 3.2.1.3 and 3.2.1.5.

(b) LRA Table 3.2-1, Items 3.2.1.3 and 3.2.1.5, states that further evaluation of loss of material due to general corrosion, and pitting/crevice corrosion, are described in Sections 3.2.1.1.3 and 3.2.1.1.5, respectively, for the components in standby gas treatment, containment isolation, and emergency core cooling systems. In Sections 3.2.1.1.3 and 3.2.1.1.5 of the LRA, the applicant provides a description of an one-time inspection, which consists of four ultrasonic tests to detect reduction in wall thickness at specific locations. The applicant states that engineering will specify one safety relief

(SR) discharge piping inspection location at Dresden and another at Quad Cities, and that engineering will also specify one HPCI piping inspection location at Dresden and another at Quad Cities. No sample RCIC piping at Quad Cities was specified, however. Provide the basis for the determination of the sample size and location for inspection and justify why the proposed one-time inspection of the HPCI and SR piping will be adequate to ensure that the effects of aging to the RCIC piping will be adequately managed during the extended operation.

Response:

(a) The one-time inspection ten-element programs associated with LRA Table 3.2-1, Aging Management References 3.2.1.3 and 3.2.1.5, contain allowances for implementing further condition monitoring contingent upon the results of the initial inspections. For the HPCI turbine exhaust piping inspection, engineering will determine the thickness measurement acceptance criteria prior to conducting the examinations. Results of the examinations will be evaluated by engineering to determine a) if loss of material aging is occurring and, if so, b) the rate at which the material is being lost. Engineering evaluations of the test results will also c) determine the need for follow-up examinations to monitor the progression of aging degradation, and d) identify appropriate corrective actions to mitigate any excessive rates of loss of material discovered. Corrective actions, if necessary, would expand to include other components.

For the safety relief valve discharge piping inspection, any ultrasonic examination that reveals material loss will be documented and evaluated. The inspection results will determine the amount and rate of corrosion at the waterline. Given the corrosion rate, the remaining life of the piping will be calculated to determine if it is adequate for the extended period of operation. If the projected life of the piping is insufficient for the extended period of operation, engineering will determine if there is a need for altering the water chemistry, replacing the piping, or whether an aging management activity is required to be put in place to manage loss of material in piping during the license renewal period.

The inspection of the ventilation system ductwork and components will determine if penetrating corrosion indicating a loss of material aging degradation is occurring. Results of the examinations will be evaluated by engineering to determine a) if penetrating corrosion indicating a loss of material aging is occurring and, if so, b) the rate at which the material is being lost. Engineering evaluations of the examination results will also c) determine the need for follow-up examinations to monitor the progression of aging degradation, and d) identify appropriate corrective actions to mitigate any excessive rates of loss of material discovered. Corrective actions, if necessary, would expand to include other components.

Evaluations are performed for test or inspection results that do not satisfy established criteria and a condition report is initiated to document the concern in accordance with the corrective actions program. The corrective actions program ensures that the conditions adverse to quality are promptly corrected. If the deficiency is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude repetition.

(b) An ultrasonic examination will be conducted on the carbon steel safety relief valve discharge piping around the torus waterline. The safety relief valve discharge piping is coated on the outside of the piping but not on the inside; therefore, the examination will consist of an ultrasonic test to detect reduction in wall thickness due to loss of material on the inside of the piping. The water level in the torus fluctuates approximately four inches between high and low water level, subjecting the section of carbon steel safety relief valve discharge piping at the waterline to repeated wetting and drying. That action makes the piping more susceptible to general pitting and crevice corrosion. The number of pipes within the total sample population for each unit is small (5 pipes per unit). Each line contains a carbon steel thermowell and two carbon steel vacuum breakers. The sample location chosen is representative of the material and environmental conditions that this piping and components experience.
Dresden and Quad Cities will perform an inspection of selected components in the Dresden and Quad Cities HPCI piping systems, Quad Cities RCIC piping systems, Low Pressure Coolant Injection System (Dresden only) (drywell and torus spray piping and components subject to a containment atmosphere environment), and Residual Heat Removal System (Quad Cities only) (drywell and torus spray piping and components subject to a containment atmosphere environment). The inspection will consist of an examination of a representative sample of carbon steel piping system components, including piping and fittings, within the scope of License Renewal that are exposed to a wet gas or air environment to verify that there is no unacceptable loss of material.

The population to be sampled includes: 1) carbon steel piping in the drywell and suppression chamber spray headers from the closed motor-operated spray valves, up to but not including the spray nozzles. Dresden and Quad Cities have brass/bronze spray nozzles, 2) HPCI and RCIC (Quad Cities only) turbine exhaust piping, 3) suppression chamber level gauge upper stop valve. Note that there should have been references in Table 2.3.2-1, HPCI system, and Table 2.3.4-1, RCIC system, in the Piping and Fittings Component Group, to Aging Management References 3.2.1.3 and 3.2.1.5.

The suppression chamber level normally fluctuates approximately four inches. Within the sample population, the HPCI and RCIC turbine exhaust piping are most likely to experience a loss of material aging effect within this zone of fluctuation due to differential aeration. Therefore, the inspection shall be conducted on a HPCI turbine exhaust line as a representative sample that is the bounding loss of material condition for all piping within the systems. The containment piping and components that are located above the waterline are subjected to a humid wetted air environment that is less corrosive than the selected sample location. The number of pipes within this total bounding sample population is small and the sample location chosen is representative of the material and environmental conditions that all remaining pipes experience. The approach to this one-time inspection is similar to the approach approved in NUREG-1769, "Peach Bottom SER, Related to the license renewal of Peach Bottom Atomic Power Station, Units 2 and 3," Section 3.0.3.21.1.

RAI 3.2-2

LRA Table 3.2-1, Items 3.2.1.3 and 3.2.1.5, address loss of material due to general corrosion and pitting/crevice corrosion, respectively, for components in standby gas treatment, containment isolation, and emergency core cooling systems. LRA Table 2.3.2-1, for HPCI system, and Table 2.3.2-4, for RCIC system (Quad Cities only), however, does not provide Items 3.2.1.3 and 3.2.1.5 as the AMR links for components in the two systems. Explain why Items 3.2.1.3 and 3.2.1.5 are not included in Tables 2.3.2-1 and 2.3.2-4 as the AMR links.

Response:

LRA Table 3.2-1, Aging Management References 3.2.1.3 and 3.2.1.5, are not included in LRA Tables 2.3.2-1 and 2.3.2-4 as aging management references because NUREG 1801, Chapter V, does not address HPCI and RCIC carbon steel piping and fittings with an "air and steam up to 320°C (608°F)(primarily air)" environment and with a loss of material aging effect due to general, pitting, and crevice corrosion. As such, a non-NUREG 1801 aging management reference was utilized. Table 2.3.2-1 (component group of "Piping and Fittings (Includes thermowells)") and Table 2.3.2-4 (component group of "Piping and Fittings (Quad Cities only)(includes rupture discs)") refer to Aging Management Reference 3.2.2.126 for a loss of material due to pitting and crevice corrosion. Aging Management Reference 3.2.2.126 should also have included the aging mechanism of general corrosion.

RAI 3.2-3

LRA Table 3.2-2, Items 3.2.2.40 and 3.2.2.42, define loss of material from galvanic corrosion as an aging effect/mechanism for heat exchanger for the defined material and environment. The referenced AMPs in Table 3.2-2, Water Chemistry (B.1.2), Selective Leaching of Materials (B.1.24), and Heat Exchanger Test and Inspection Activities (B.2.6), for this component grouping, as described in Appendix B of the LRA, do not address the management of the aging effects loss of material due to galvanic corrosion.

Industry experience has shown that loss of material from galvanic corrosion is typically managed utilizing specifically designed aging management programs. Provide justification for the adequacy of the specified AMPs' ability to manage aging of the HPCI heat exchangers due to galvanic corrosion.

Response:

The two Dresden and Quad Cities HPCI heat exchangers that are in scope of license renewal are the HPCI Turbine Gland Seal Condensers and the HPCI Lubrication Oil Coolers. Aging Management Reference 3.2.2.40 addresses the HPCI Lubrication Oil Coolers, and Aging Management Reference 3.2.2.42 addresses the HPCI Turbine Gland Seal Condensers. LRA Appendix B, B.1.2, "Water Chemistry" and B.2.6, "Heat Exchanger Test and Inspection Activities," are credited with managing the loss of material aging effect due to galvanic corrosion.

Sandia National Laboratory Report SAND93-7070 UC-523, "Aging Management Guideline for Commercial Nuclear Power Plants – Heat Exchangers," identifies that galvanic corrosion is not a significant aging mechanism for the primary water (shell) side of the HPCI Turbine Gland Seal Condensers and for the oil (shell) side of the HPCI Lubrication Oil Coolers. SAND93-7070 states that galvanic corrosion can be significant for the tube side of both heat exchangers, which are cooled by treated (demineralized) water. EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools", Revision 3, Section 3.1.3 states that control of galvanic corrosion in treated water systems is possible by following the EPRI Chemistry Guidelines for treated water systems. LRA Appendix B, B.1.2, "Water Chemistry," is based on EPRI Report TR-103515, "BWR Water Chemistry Guidelines."

SAND93-7070 identifies such activities as inspection, eddy current testing, and performance testing as being effective for the detection and mitigation of galvanic corrosion. LRA Appendix B, B.2.6, "Heat Exchanger Test and Inspection Activities," provides for performance monitoring of the HPCI system and visual inspection and eddy current testing of the HPCI Turbine Gland Seal Condensers and the HPCI Lubrication Oil Coolers.

SAND93-7070 identifies that only about 1% of the total number of aging failures of heat exchangers reported in industry operating experience documents were attributed to galvanic corrosion, because heat exchanger design specifications require that materials of construction be compatible and that galvanic couples between adjacent materials be minimized. The Dresden and Quad Cities HPCI Turbine Gland Seal Condensers and the HPCI Lubrication Oil Coolers have been previously visually inspected and eddy current tested. No failures due to galvanic corrosion were detected.

<u>RAI 3.2-4</u>

LRA Table 3.2-1, Item 3.2.1.8, lists drywell and suppression chamber spray system nozzles and flow orifices as components to be subject to the aging effect of plugging of nozzles and flow orifices due to general corrosion. The applicant states that Dresden and Quad Cities have brass/bronze spray nozzles, while GALL specifies carbon steel material for this component group. This would seem to imply that Item 3.2.1.8 is

applicable to only flow orifices. However, the applicant did not provide the plant-specific AMR results for the flow orifices in Item 3.2.1.8, including the required "Further Evaluation" as recommended for this GALL item. In addition, in LRA Tables 2.3.2-1 through 2.3.2-11, the staff was not able to identify Item 3.2.1.8 as a link for the flow orifices. In Table 2.3.2.1, where the only flow orifice components are identified, the applicant provides Table 3.2-1, Items 3.2.1.2 and 3.2.1.4, and Table 3.2-2, Item 3.2.2.137, as links. The applicant is requested to explain the above stated discrepancies in the Application.

Response:

None of the spray nozzles at Dresden or Quad Cities are made of carbon steel. Neither drywell nor suppression chamber spray loops contain flow orifices. As such, the material and environment combination specified in Aging Management Reference 3.2.1.8 could not be credited. Dresden and Quad Cities have brass/bronze spray nozzles. For this reason, non-NUREG 1801 Aging Management References 3.2.2.12 and 3.2.2.78 were created for the external and internal environments of the nozzles.

The spray nozzles are included in LRA Table 2.3.2-6, under the Component Group, "Spray Nozzles (Quad Cities only)", and in Table 2.3.2-7, under Component Group, "Spray Nozzles (Dresden only)". Both tables provide Aging Management References of 3.2.2.12 and 3.2.2.78 for the table line items with a "pressure boundary" component intended function and an Aging Management Reference of 3.2.2.78 for table line items with a "spray" component intended function.

<u>RAI 3.2-5</u>

In LRA Table 2.3.2-6, Items 3.2.2.22, 3.2.2.23, and 3.2.2.30 were identified as AMR links for RHR dampeners (Quad Cities only). In all items, stainless steel is listed as the material of construction. Items 3.2.2.22 and 3.2.2.23 identify air, moisture, and humidity as the external environment, whereas air is identified as environment for Item 3.2.2.30. Explain the effects of environmental temperature, of less than 100 EC (212 EF) vs. greater than 100 EC (212 EF), as indicated in Items 3.2.2.22 and 3.2.2.23, respectively, on the AMR review for the dampeners. Also provide the basis for having identified loss of material as an aging effect due to pitting and crevice corrosion in Item 3.2.2.30, but not in Items 3.2.2.22 and 3.2.2.23.

Response:

LRA Table 3.2-2, Aging Management References 3.2.2.22 and 3.2.2.23 pertain to dampener (pulsation dampener) external surfaces. For Aging Management Reference 3.2.2.23, with an environment of "Air, moisture and humidity >100°C (212°F)," the external surfaces of the associated components are normally in excess of 212°F. EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 3, Appendix E, considers 212°F as a "threshold temperature" for all materials in an external environment since moisture must be present (in contact with the material) for corrosion to occur. Therefore, components whose external surface temperatures are > 212°F do not require aging management of their external surfaces.

For Aging Management Reference 3.2.2.22, with an environment of "Air, moisture and humidity < 100°C (212°F)," the external surfaces of the associated components are in contact with the NUREG 1801 "Air, moisture and humidity < 212°F" environment. These general plant environmental conditions were assumed for the majority of the NUREG 1801 and non-NUREG 1801 system piping and component external surfaces. System piping and component materials under 212°F exposed to moisture and humidity were evaluated separately for their susceptibility to corrosion degradation. EPRI 1003056, Appendix E, concludes that for component external surfaces material used in the indoor (air, moisture and humidity < 212°F) ambient environment, stainless steel that is not subjected to frequent moisture can be excluded from further consideration.

Aging Management Reference 3.2.2.30 pertains to dampener (pulsation dampener) internal surfaces. The "air" environment is ambient plant air with humidity to 100% and a temperature less that 212°F. EPRI 1003056, Appendix D, concludes that pitting and crevice corrosion is a concern for stainless steel in an environment with a potential for concentrating contaminants and when the material is susceptible to becoming wetted.

<u>RAI 3.2-6</u>

LRA Table 2.3.2-6 identifies an AMR link of 3.2.2.14 for the external surfaces of carbon steel piping and fittings (Quad Cities only), exposed to a containment nitrogen environment. Provide justification for the determination that a containment nitrogen environment is not conducive to promoting aging degradation.

Response:

The containment nitrogen environment exists inside the drywell and in the suppression chamber air space. These areas are made inert with nitrogen to render the primary containment atmosphere non-flammable by maintaining the oxygen content below 4% by volume during normal station operation. For loss of material corrosion degradation to occur, both moisture and oxygen must be present. For containment nitrogen component external surfaces that are not in contact with an aqueous environment, Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, EPRI 1003056, Appendix D, does not consider corrosion to be a concern.

<u>RAI 3.2-7</u>

LRA Table 2.3.2-8 identifies Item 3.1.1.1 as a AMR link for closure bolting in the Standby Liquid Control System. The applicant states in Item 3.1.1.1 that further evaluation of cumulative fatigue is described in LRA Section 3.1.1.1.1. LRA Section 3.1.1.1.1, Cumulative Fatigue Damage BWR/PWR, states that no fatigue analysis exists for reactor coolant pressure boundary valves or valve closure bolting. NUREG 1801 states that fatigue is a time-limited aging analysis (TLAA) to be performed for the period of extended operation. Justify why no TLAA was performed for reactor coolant pressure boundary valves or closure bolting in accordance with NUREG 1801.

Response:

With the exception of the Dresden Unit 3 recirculation piping replaced under the IGSCC mitigation program, all other Dresden and Quad Cities reactor coolant pressure boundary (RCPB) piping and components were designed to USAS B31.1, 1967 Edition. Neither the B31.1 piping design nor the additional nuclear code and code case rules applied to this piping invoke a piping fatigue analysis. USAS B31.1 does apply a stress range reduction factor based on an assumed finite number equivalent full-range thermal cycles for the design life. The stress range reduction factor is 1 as long as the number of cycles is less than 7000. For this reason, the piping and component design for the reactor coolant pressure boundary was considered a TLAA. LRA Sections 4.3.3.1 and 4.3.3.2 provide a more complete discussion of the Dresden and Quad Cities RCPB piping and component fatigue analysis.

RAI 3.2-8

The applicant states in LRA Section 2.3.2.10 that Dresden and Quad Cities design basis documents treat the Automatic Depressurization System (ADS) relief valves and associated piping, solenoids, pressure controllers and position switches as components of the main steam system. These mechanical components of the ADS subject to an aging management review are, therefore, included as components of the main steam system in the Application. In LRA Table 3.4-2, Item 3.4.2.51, under Discussion, the applicant states that NUREG-1801 does not address crevice and pitting corrosion of stainless steel valves in a treated water environment. Under Aging Effect/Mechanism of Item 3.4.2.51, however, crack initiation and growth/stress corrosion cracking and intergranular stress corrosion cracking are identified as aging effects/mechanisms requiring management, in a 288 °C steam environment. Clarify whether these valves, identified in Item 3.4.2.51, apply to ADS system. Also, explain the above discrepancies found and provide the correct AMR review results.

Response:

The valves in LRA Table 3.4-2, Aging Management Reference 3.4.2.51 are main steam system valves in applications such as main steam line drains, pressure switch and pressure transmitter isolation, and pressure control valve bypass. There are no valves that apply to the ADS system . Since the ADS system utilizes valves and other components from the main steam system, the Aging Management References for them can be found in Table 2.3.4-1, with a Component Group of "Valves." The specific reference for each particular valve will depend on its materials of construction, and internal environment. For example, a main steam line PORV has an internal environment of "288 °C (550 °F) steam" and an Aging Management Reference of 3.1.1.11. The pressure controller shutoff valve for the same PORV has an internal environment of "288 °C (550 °F) reactor coolant water," and an Aging Management Reference of 3.1.1.15. The drywell pneumatic air shutoff valve for the same PORV has an internal environment of "saturated air," and an Aging Management Reference of 3.1.2.53.

The aging effect/mechanism of "crack initiation and growth/stress corrosion cracking and intergranular stress corrosion cracking" and the environment of "288°C (550°F) steam"

are correct as stated. The text in the "discussion" column of Aging Management Reference 3.4.2.51 was intended to explain why this line is a non-NUREG 1801 item, but is inappropriate for the attributes listed. The text should have read, "NUREG 1801, Chapter VIII, does not address stainless steel components in a 550°F steam environment."

RAI 3.2-9

In LRA Table 2.3.2-11, Item 3.2.1.12 is identified as an AMR link for valves in the ATWS system. The aging effect/mechanism identified for Item 3.2.1.12 is wall thinning due to flow-accelerated corrosion, with Flow-Accelerated Corrosion (B.1.11) identified as an AMP. The applicant identifies exceptions to Flow-Accelerated Corrosion in LRA Section 3.2.1.2.1, where it states, "Flow accelerated corrosion is an applicable aging mechanism for the Quad Cities HPCI steam line drains. However, carbon steel components in the ATWS, isolation condenser, core spray, LPCI (Dresden only), RHR (Quad Cities only), primary containment and suppression pool piping, HPCI (except as previously noted) and RCIC (Quad Cities only) systems are not susceptible to flow accelerated corrosion and do not require aging management." Clarify the above discrepancy for the AMR for valves in ATWS system, and verify that the aging effect/mechanism of wall thinning due to flow-accelerated corrosion, as addressed in Item 3.2.1.12, is applicable to the ATWS system.

Response:

All of the ATWS system valves are installed in piping associated with reactor vessel pressure and level process instrumentation. The valves are used to isolate, vent, drain, calibrate, and pre-pressurize these instruments. There is no flow in the process lines associated with these instruments; therefore, wall thinning due to flow-accelerated corrosion is not an applicable aging effect/mechanism for the ATWS system valves. This was not a discrepancy in the LRA. The ATWS system valves are emergency core cooling system valves that have the same component group-material-environment as in NUREG-1801, V.D2.3-a. NUREG-1801, V.D2.3-a identifies an aging effect/mechanism of "Wall thinning/Flow-accelerated corrosion." The ATWS valves were included in the SRP line for V.D2.3-a to be in alignment with NUREG-1801 but, since there is no flow in the process lines associated with them, an exception was taken.

Section 3.3 Aging Management of Auxiliary Systems

The following RAIs (RAI 3.3-1 through 3.3-9) are applicable to more than one specific SSC in the auxiliary systems.

RAI 3.3-1

Metals and alloys that are in contact with different, more cathodic metals or alloys in the presence of an electrolyte fluid may be subjected to the aging effect of loss of material from galvanic corrosion. Many system/components of the auxiliary system described by various items in Table 3.3-2 of the LRA have materials/environment combinations to which loss of material from galvanic corrosion may be an applicable aging effect/mechanism. The specific system/components and materials/environment

combinations that may be subjected to galvanic corrosion as well as applicable parts of Table 3.3-2 of the LRA are discussed below:
For some components in the refueling equipment system and the HVAC - main control room system, the applicant does not include loss of material due to galvanic corrosion as an aging effect/mechanism that requires management for the period of extended operation. For example, for the refueling equipment system, Table 3.3-2, reference numbers 3.3.2.74, 75, and 76 identified loss of material due to crevice and pitting corrosion for stainless steel components and the loss of material due to general and pitting corrosion for aluminum components as aging effects and mechanisms in a chemically treated oxygenated water environment, but does not include loss of material due to galvanic corrosion for this environment. Also for Air Handlers Heating/Cooling (CR HVAC) with a pressure boundary intended function, Table 2.3.3-7 identified the Aging Management Ref No 3.3.1.5 in Table 3.3-1and the Ref No 3.3.2.11 in Table 3.3-2 as the applicable aging management program identifiers. It does not include loss of material due to galvanic corrosion as an applicable aging effect/mechanism. However, the staff noted that for some components in the HVAC - diesel generator building (air handler component described in Ref No 3.3.2.14 in Table 3.3-2) the applicant includes loss of material due to galvanic corrosion as an aging effect/mechanism that requires management for the period of extended operation. Provide the technical basis, including plant operating experience for determining whether loss of material due to galvanic corrosion is an applicable aging effect/mechanism for the applicable components included in the auxiliary system.

Aluminum and aluminum alloys components may experience galvanic corrosion when in contact with dissimilar materials while exposed to moisture and humidity environments, especially with the presence of contaminants and water (condensation from moist air). However, in Table 3.3-2, Ref No 3.3.2.126 of the LRA, the applicant identifies only loss of material due to general and pitting corrosion as plausible aging effects for aluminum components exposed to moist air. In Table 3.3-2, Ref No 3.3.2.21 of the LRA, the applicant concludes that there is no aging effect on aluminum components of the air handlers heating/cooling system exposed to air, moisture, and humidity environments. Provide technical basis for not including loss of material due to galvanic corrosion as an applicable aging effect.

Similarly in Ref. No 3.3.2.49 in Table 3.3-2 of the LRA, the applicant states that aluminum-zinc alloy duct in an environment consisting of warm, moist air experience no aging effect. However, if these aluminum components are attached to ducts used to transport cold air, surface condensation may occur and lead to galvanic corrosion of these components. Provide justification for not including loss of material due to galvanic corrosion as an aging effect/mechanism that requires management for the period of extended operation.

Cast iron and carbon steel components in raw water environment may be subjected to loss of material from galvanic corrosion if they are in contact with different metallic materials. Clarify whether this is an applicable aging effect/ mechanism for these components in the ultimate heat sink. If so, provide the applicable AMP. If not, provide the basis including applicable operating experience.

Clarify whether any part of the external surface of carbon steel, brass or bronze components of the carbon dioxide system in an air, moisture, humidity environment are in contact with different metallic components and specify whether loss of material due to

galvanic corrosion is an applicable aging effect. If so, provide the applicable AMP(s).

For the plant heating system, cast iron, carbon steel, and copper, brass or bronze components in saturated steam/condensate environment may be subjected to loss of material from galvanic corrosion if they are in contact with more cathodic metallic materials. Clarify whether this is an applicable aging effect/aging mechanism for these components in the plant heating system. If so, provide the applicable AMP. If not, provide the basis including applicable operating experience.

For components in the service water system described with item 3.3.2.208 of Table 3.3-2 of the LRA for the material/environment of cast iron/raw, untreated salt water or fresh water the applicant has listed loss of material/galvanic corrosion as an applicable aging effect/aging mechanism. But in item 3.3.2.179 loss of material/galvanic corrosion is not included as an applicable aging effect/ mechanism for the same material/environment. Clarify whether the cast iron components described in item 3.3.2.179 are susceptible to loss of material due to galvanic corrosion. Susceptible locations may include parts of the component that are in contact with different metallic materials. If so, specify the applicable AMP. If not, provide technical basis including applicable operating experience.

Response:

Design and installation techniques were utilized at Dresden and Quad Cities including galvanic corrosion control mechanisms. Following good industry practices for the design of power plant piping systems and heat exchangers, materials that would be in electrical contact were selected from groups as close as possible in the galvanic series. Wherever practical, dissimilar metals were electrically insulated by the use of insulated flanges or dielectric unions. Coatings were applied in many cases to address potential galvanic corrosion concerns. In general, these techniques have been successful is preventing occurrences of galvanic corrosion. For example, Sandia National Laboratory Report SAND93-7070 UC-523, "Aging Management Guideline for Commercial Nuclear Power Plants – Heat Exchangers" identifies that only about 1% of the total number of aging failures of heat exchangers reported in industry operating experience documents were attributed to galvanic corrosion because heat exchanger design specifications require that materials of construction be compatible and that galvanic couples between adjacent materials be minimized.

There have been few occurrences of galvanic corrosion identified in the operating experience history of Dresden and Quad Cities piping systems and heat exchangers. The piping system occurrences were identified mainly in raw water systems and the heat exchanger occurrences were all related to design errors in the Quad Cities RHR, TBCCW, and RBCCW heat exchangers that coupled carbon steel covers with fiber gaskets that were wrapped with stainless steel in the presence of a raw water environment. The TBCCW and RBCCW heat exchangers were modified to utilize a plain fiber gasket and the covers were replaced with new ones. The RHR heat exchangers were modified to utilize a stainless steel tongue in the lower head along with a graphite gasket.

The following sections were developed to specifically address the material/environment combinations questioned in the RAI. To provide a clear link to the RAI, the RAI text has

been annotated with references to the appropriate response sections.

a. Aging Management Reference 3.3.2.74 is for the stainless steel fuel grapples, which are connected to the refueling bridge. Neither the grapple nor the bridge are electrically connected to the stainless steel fuel pool liner and could therefore not be electrically connected to the aluminum components suspended from the liner. Additionally, when not in use, the grapples are routinely raised out of the fuel pool water environment. Finally, stainless steel is less active in the galvanic series than aluminum and would not experience corrosion if a galvanic coupling with aluminum would occur. As a result, galvanic corrosion is not a credible aging mechanism for the fuel grapples.

b. Aging Management References 3.3.2.75 and 3.3.2.76 are for the aluminum fuel pool gates and fuel preparation machines, which are suspended from the fuel pool liners. Galvanic corrosion was not listed as a credible aging mechanism for them because corrosion of the gates and fuel preparation machines has not been identified to date in the Dresden and Quad Cities operating experience. Additionally, EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 3, states that as water treated per the EPRI Chemistry Guidelines for treated water systems is a poor electrolyte, the dissimilar metals in this environment would experience little or no galvanic corrosion. It further states that this is evidenced by the lack of operating experience of galvanic corrosion failures in treated water systems. LRA Appendix B, B.1.2, "Water Chemistry" is based on EPRI Report TR-103515, "BWR Water Chemistry Guidelines."

c. The Dresden and Quad Cities control room air handling unit material/ environment combinations are evaluated by NUREG 1801, Section VII.F1.2-a, and are included in Aging Management Reference 3.3.1.5. NUREG 1801 does not include the aging mechanism of galvanic corrosion. The Dresden and Quad Cities materials of construction for the diesel generator building air handling unit did not match NUREG 1801, so the aging effects were evaluated based on EPRI 1003056, which resulted in the inclusion of galvanic corrosion as an aging mechanism. The results of this evaluation were included in Aging Management Reference 3.3.2.14. LRA Appendix B, B.2.6, "Heat Exchanger Test and Inspection Activities," manages the "loss of materials" aging effect for both the control room and diesel generator building air handling units by performing periodic inspections. Corrosion would be detected during these periodic inspections, regardless of the mechanism involved.

d. Aging Management Reference 3.3.2.11 is for the aging effect of cracking. Since galvanic corrosion is an aging mechanism associated with the aging effect of loss of material, it would not be appropriate to include galvanic corrosion in 3.3.2.11.

e. Aging Management Reference 3.3.2.126 addresses the aluminum lubricators installed in the carbon steel piping supplying the SBO diesel air start motors. Aluminum and carbon steel are very close in the galvanic series and galvanic corrosion would not be expected to be a credible aging mechanism, even if the design of the piping system did not require that the material joints use insulating flanges or dielectric unions. The gas systems at Dresden and Quad Cities contain components of varying alloys, There have been no cases identified in the

gas systems at Dresden and Quad Cities which would indicate potential problems with galvanic corrosion, such as could occur at the interface of metals of differing electrolytic potential. Based on equipment design and the Dresden and Quad Cities operating histories, there is reasonable assurance that galvanic corrosion does not cause a loss of material aging effect requiring management.

f. Aging Management Reference 3.3.2.21 contains generic components that represent the external surfaces of all aluminum components installed in auxiliary systems and with a plant indoor environment. Aluminum piping and components are used indoors on various plant systems at both Dresden and Quad Cities. The plant indoor environment is assumed to contain moisture and humidity that will induce oxidation of metal surfaces. Aluminum is a reactive metal, but it develops an aluminum oxide film that protects it from further corrosion. As stated previously, following good industry practices for the design of power plant piping systems and heat exchangers, materials that would be in electrical contact were selected from groups as close as possible in the galvanic series. Wherever practical, dissimilar metals were electrically insulated by the use of insulated flanges or dielectric unions. These good practices applied to the installation of aluminum components in Dresden and Quad Cities piping systems containing other metals. Station history also shows no history of indoor aging degradation of aluminum components from galvanic corrosion as well as from other aging mechanisms. Therefore, indoor aluminum piping and components do not require aging management for the period of extended operation.

g. Aging Management Reference 3.3.2.49 contains generic components that represent all aluminum alloy duct fittings, hinges, and latches that are installed on carbon steel ductwork, and with a warm, moist air environment. Aluminum-zinc alloy is used for ventilation system access door latches and hinges at Dresden and Quad Cities. Aluminum-zinc alloy exhibits a high degree of corrosion resistance in air. In most indoor atmospheres where pools of contaminated water do not remain in prolonged contact with aluminum alloys or where extended contact with moist, porous materials is avoided, no appreciable loss of mechanical properties through corrosion will occur. In particular, aluminum alloys are highly resistant to warm, humid conditions where there is appreciable moisture condensation so long as contact with porous materials is avoided. Aluminum alloy and carbon steel are very close in the galvanic series and galvanic corrosion would not be expected to be a credible aging mechanism, given the above environmental considerations.

There is no history of degraded access door latches and hinges attributable to loss of material or loss of strength in the Dresden and Quad Cities records. Based on the information provided above, there is no appreciable aging of aluminum-zinc alloy in an indoor plant ventilation air (warm, moist air) environment that would require aging management.

h. Only Dresden station has cast iron components in the ultimate heat sink system. These cast iron components are pump and valve bodies connected to carbon steel piping and fittings. Carbon steel and cast iron have the same corrosion potential in the galvanic series, and galvanic corrosion would not occur with one metal electrically connected to the other. Both Dresden and Quad Cities stations have carbon steel components in their ultimate heat sink systems. With the

exception of the cast iron in the Dresden system, these carbon steel components are only connected to other carbon steel components. Therefore, galvanic corrosion is not an applicable aging effect/ mechanism for these components in the Dresden and Quad Cities ultimate heat sink systems.

i. The carbon dioxide system piping is carbon steel, with cast iron, brass or bronze valves, depending on the piping and valve sizes. The moist air environment is ambient plant air with humidity to 100% and a temperature less than 212°F. Generally, the effects of galvanic corrosion were precluded in the original design at the material joints by the use of insulating flanges or dielectric unions.

No modifications were noted for the Dresden and Quad Cities carbon dioxide systems that would indicate that materials have been substituted, potentially changing the original design to defeat corrosion protection measures from a galvanic corrosion standpoint. There have been no cases identified which would indicate potential problems with galvanic corrosion, such as could occur at the interface of metals of differing electrolytic potential. Based on equipment design and the Dresden and Quad Cities operating histories, there is reasonable assurance that galvanic corrosion in the Dresden and Quad Cities carbon dioxide systems does not cause a loss of material aging effect requiring management.

j. The plant heating system contains brass or bronze valves installed in a carbon steel piping system. This creates the potential for the occurrence of galvanic corrosion. However, the effects of galvanic corrosion were precluded in the original design at the material joints by the use of insulating flanges or dielectric unions. Additionally, the plant heating system contains treated water. As treated water is a poor electrolyte, the dissimilar metals in this environment would experience little or no galvanic corrosion. Therefore, components in the plant heating system do not require aging management for galvanic corrosion for the period of extended operation.

k. According to EPRI 1003056, Appendix B, galvanic corrosion is an applicable aging mechanism for cast iron components that are in contact with metals higher in the galvanic series.

Aging Management Reference 3.3.2.208 of LRA Table 3.3-2 is associated with cast iron strainer bodies in raw water environments. These strainer bodies house and are in contact with strainer filters made of stainless steel, which is higher in the galvanic series than cast iron. Therefore, galvanic corrosion is an applicable aging effect for the strainer bodies.

Aging Management Reference 3.3.2.179 of LRA Table 3.3-2 is associated with cast iron pump casings in raw water environments. Specifically, this item involves the casings of pumps in the Dresden CCSW and service water systems. These pump casings are not in contact with any metals higher in the galvanic series. Therefore, galvanic corrosion is not an applicable aging mechanism for the pump casings associated with Aging Management Reference 3.3.2.179 of LRA Table 3.3-2.

<u>RAI 3.3-2</u>

For HVAC - main control room system, shutdown cooling system, and control rod drive hydraulic system, the applicant identifies in Ref No 3.3.2.130 of Table 3.3-2 the material environment combination and applicable aging effects on components of NSR vents or drains, piping and valves. The description in Ref No 3.3.2.130 lists "Loss of material/corrosion" as Aging Effect/Mechanism for carbon steel, stainless steel, brass or bronze components in an environment of "Air, moisture, humidity and leaking fluid." However, the applicant does not specifically identify which type of corrosion is responsible for the loss of material. It should be noted that the adequacy of aging management programs to manage the aging effect of loss of materials due to corrosion may depend on correctly identifying the type of corrosion responsible. For example the appropriate susceptible locations for inspection (in One-Time Inspection AMP (B.1.23)) for general, crevice, galvanic and pitting corrosion may not be the same. Provide a specific description of the types of corrosion responsible for the aging effect of loss of materials for these systems and components so that the staff is able to evaluate the aging management of these systems and components. In addition, in the One-Time Inspection AMP (B.1.23), which is credited with managing the aging effects on these components, the applicant states that this AMP will inspect a sample of the NSR vents or drains, piping and valves in the shutdown cooling system (Dresden only) and the control rod drive hydraulic system for general, crevice, galvanic, and pitting corrosion. Provide the criteria for selecting these samples including susceptible locations for inspections.

Response

The types of corrosion responsible for loss of material for the subject systems (HVAC-main control room system, shutdown cooling system, and control rod drive system) and their descriptions are as follows:

Corrosion Type	**Description**
General	This type of corrosion is characterized by a uniform attack resulting in material dissolution and sometimes corrosion product buildup.
Crevice	This type of corrosion occurs at lap joints, flanges and under bolt surfaces where flow is low or stagnant.
Pitting	This type of corrosion can be either general or localized. Localized pitting corrosion takes the form of various shapes and sizes and is typically concentrated on surface locations at which the protective film has been broken, and where non-protective deposits of scale or other substances are present. General pitting corrosion takes the form of a roughened and irregular appearance over the entire material surface.

The aging mechanism description for Aging Management Reference 3.3.2.130 of LRA Table 3.3-2 should have been "General, pitting, and crevice corrosion." The inspections to be performed as part of the One-Time Inspection AMP B.1.23 will include the appropriate inspection information.

A list of the various in-scope NSR vents and drains throughout the plants was compiled. That list included various systems, including the shutdown cooling system (Dresden only) and the control rod drive system. The One-Time Inspection AMP will inspect a selected

number of NSR vents and drains for the affected systems. The sample population will be representative of all material and environmental combinations associated with vents and drains for those systems included within the scope of license renewal. The sample population may not necessarily include components from every system. The criteria used for selection of susceptible inspection locations for NSR vents and drains in general are as follows:

1) Corrosiveness of fluid passing through the vent, drain, or piping when in service. Those components servicing more corrosive fluids are given preference.
2) Duration of service when performing venting and draining operations. Those components with higher durations of service are given preference.
3) Frequency of performance of venting and draining operations through the selected components. Those components with higher performance frequencies are given preference.
4) Period that component has been in service. Those components that have been in service longest are given preference.

RAI 3.3-3

Carbon steel and stainless steel components exposed to moist gas (moist nitrogen) or moist air environment may experience aging effects of loss of material due to general (for carbon steel only), pitting, and crevice corrosion (for both carbon steel and stainless steel) when pollutants such as oxygen, SO_2, NO_x, or CO are present in the moist air, particularly when the humidity is greater than 60%. However, in Table 3.3-2, item Ref No 3.3.2.27 (for carbon steel), and item Ref No 3.3.2.40 (for stainless steel) of the LRA, the applicant concludes that no aging effects are identified for the external surfaces of the carbon steel and stainless steel piping and fittings, accumulators, dampeners, filters/strainers, flow elements, pumps, orifices, rupture discs, tanks, tubing, and valves components exposed to either the containment nitrogen gas environment or air, moisture, humidity environment because these components "are not subject to any viable aging mechanism in the absence of aggressive chemical species." Provide information on whether the pollutants such as oxygen, NO_x, SO_2, or CO are present and if so, to what extent in the containment gas or air, moisture, humidity environments to justify the conclusions in Table 3.3-2, items Ref No 3.3.2.27 and 3.3.2.40.

The LRA does not identify any aging effect for stainless steel, brass or bronze components in "the air, moisture, and humidity < 100 □C environment" for components in the containment atmosphere monitoring system. The staff notes that the LRA identifies stainless steel components in apparently similar environments (such as warm moist air, wet gas, and moist containment atmosphere in items Ref No 3.3.2.166, 3.3.2.299, 3.3.2.195) as being subjected to loss of materials from pitting and crevice corrosion. Clarify the differences.

Response:

Aging Management Reference 3.3.2.27 of LRA Table 3.3-2 is for the external surfaces of carbon steel components in containment nitrogen environments. The conclusion in Aging Management Reference 3.3.2.27 that there was no aging effect for carbon steel components exposed to containment nitrogen environments was based on information

provided in Appendix E of Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, EPRI 1003056 regarding external surfaces. EPRI 1003056 does not identify any applicable aging mechanisms for carbon steel in a non-aggressive environment. A review of Dresden and Quad Cities operating experience was conducted as part of the aging management review for external surfaces. No site operating experience involving age-related degradation of the external surfaces of carbon steel components in nitrogen environments was identified.

Aging Management Reference 3.3.2.40 of LRA Table 3.3-2 is for the external surfaces of stainless steel components in indoor (sheltered) environments. The conclusion in Aging Management Reference 3.3.2.40 that there was no aging effect for stainless steel components exposed to air, moisture, and humidity < 100°C (212°F) was also based on information provided in EPRI 1003056, Appendix E, regarding external surfaces. EPRI 1003056 does not identify any applicable aging mechanisms for stainless steel in the absence of aggressive chemical species. No site operating experience involving age-related degradation of the external surfaces of stainless steel components in indoor (sheltered) environments was identified for Dresden or Quad Cities.

Pollutants in the form of oxygen, NO_x, SO_2, or CO are present in the containment gas and air, moisture, humidity environments at minimal levels. The nitrogen concentration of the containment gas environment is controlled, monitored, and maintained at above 96%. The air, moisture, humidity environment is for areas that are controlled indoor (sheltered) environments. EPRI 1003056, Appendix E, assumes that the level of contaminants in external environments cannot be concentrated to levels that will promote corrosion unless subjected to factors such as cyclic (wet-dry) condensation, contaminated insulation, accidental contamination, or leakage. Neither of the environments associated with Aging Management References 3.3.2.27 and 3.3.2.40 of LRA Table 3.3-2 are subjected to these factors. However, LRA Table 3.3-2 does include items addressing materials in aggressive environments. For example, Aging Management Reference 3.3.2.26, which involves external surfaces of carbon steel components in air, moisture, humidity, and leaking fluid environments, identifies loss of material due to general, pitting, and crevice corrosion as applicable aging effects/mechanisms.

The difference between the conclusion made in Aging Management Reference 3.3.2.40 and that for Aging Management References 3.3.2.166, 3.3.2.299, and 3.3.2.195 of LRA Table 3.3-2 is that Aging Management Reference 3.3.2.40 involves component external surfaces in indoor (sheltered) environments and Aging Management References 3.3.2.166, 3.3.2.299, and 3.3.2.195 involve component internal surfaces. As indicated above, the conclusion in Aging Management Reference 3.3.2.40 that there was no associated aging effect was based on information provided in EPRI 1003056, Appendix E. The aging effects/mechanisms determined for Aging Management References 3.3.2.166, 3.3.2.299, and 3.3.2.195 were loss of material due to pitting and crevice corrosion. This determination was based on information provided in EPRI 1003056, Appendix E, regarding component internal surfaces in a variety of different gas mixtures.

RAI 3.3-4

Aluminum and aluminum alloys components may experience general, pitting, and crevice corrosion when exposed to moisture and humidity environments, especially with the

presence of contaminants and water (condensation from moist air). However, in Table 3.3-2, Ref No 3.3.2.126 of the LRA, the applicant identifies only loss of material due to general and pitting corrosion as plausible aging effects for aluminum components exposed to moist air. In Table 3.3-2, Ref No 3.3.2.21 of the LRA, the applicant concludes that there is no aging effect on aluminum components of the air handlers heating/cooling system exposed to air, moisture, and humidity environments.

Explain why different conclusions on aging effect were arrived in Table 3.3-2, Ref No 3.3.2.21 and Ref No 3.3.2.126 for the same material/environment combination.

Provide technical basis for not including loss of material due to crevice corrosion as an applicable aging effect.

Clarify if there is any condensate on the aluminum fins of cooling coils. If so, provide technical basis for the conclusion in Table 3.3-2, Ref No 3.3.2.21 of the LRA.

Response:

The difference between the conclusions made in Aging Management References 3.3.2.126 and 3.3.2.21 of LRA Table 3.3-2 is that Aging Management Reference 3.3.2.126 involves component internal surfaces and Aging Management Reference 3.3.2.21 involves component external surfaces in indoor (sheltered) environments.

The aging mechanisms associated with Aging Management Reference 3.3.2.126 were derived from information provided in Chapter 20 of Uhlig's Corrosion Handbook, 2nd Edition. This source did not identify crevice corrosion as a viable aging mechanism for internal surfaces of aluminum and aluminum alloy components in moisture and humidity environments. Therefore, crevice corrosion was excluded as a viable aging mechanism for this item.

The external surfaces of aluminum fins of cooling coils are exposed to condensate. The conclusion in Aging Management Reference 3.3.2.21 that there was no aging effect on aluminum components of air handler heating cooling systems exposed to air, moisture, and humidity environments was based on information provided in Appendix E of Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, EPRI 1003056, regarding external surfaces. EPRI 1003056 does not identify any applicable aging mechanisms for aluminum alloys in a non-aggressive environment. The subject aluminum components are not exposed to an aggressive environment. Furthermore, although aluminum is a reactive metal, it develops an aluminum oxide film that protects it from further corrosion. Therefore, no viable aging effect exists in an indoor environment with variable humidity and temperature less than 100°C (212°F) for this item. A review of Dresden and Quad Cities operating experience was conducted as part of the aging management review for external surfaces. No operating experience involving age-related degradation of the external surfaces of aluminum fins in air, moisture, and humidity environments was identified.

<u>RAI 3.3-5</u>

In LRA Table 3.3-2, Ref No 3.3.2.18, the applicant states that high strength low alloy

steel closure bolting components in the outdoor ambient conditions are subject to aging effects of loss of material due to general corrosion and wear. However, the applicant does not include crack initiation and growth due to SCC or other mechanisms as applicable aging effect/mechanisms. Provide technical basis for not including this aging effects/mechanisms.

Response:

For closure bolting in the high-pressure or high-temperature portions of systems, the applicable aging effect is crack initiation and growth due to SCC. The bolts associated with LRA Table 3.3-2, Aging Management Reference 3.3.2.18, are on the portion of piping with low pressure and low temperature, which are not subject to cyclic loading.

EPRI 1003056, Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, Appendix F, Closure bolting, states that stress corrosion cracking is not an applicable aging effect for bolting material with a tensile strength of less than 150 ksi. The bolts used are ASTM A193 Grade B7 with a tensile strength of 125 ksi. EPRI 1003056 states, "The use of appropriate materials (such as ASTM A193, Gr. B7) for bolting also reduces the potential for SSC of fasteners by maintaining fastener minimum yield strengths below threshold values found in ["Degradation and Failure of Bolting in Nuclear Power Plants, EPRI NP-5796]."

For bolting in the low-pressure or low-temperature portion of the system (in the outdoor ambient condition), loss of material due to general corrosion or wear is the only applicable aging effect and is covered by LRA Table 3.3-2, Aging Management Reference 3.3.2.18.

<u>RAI 3.3-6</u>

Loss of material due to general, pitting, and crevice corrosion may be an applicable aging effect on carbon steel components exposed to chemically treated demineralized water. However, in Table 2.3.3-17, Table 2.3.3-18, and Table 3.3-2, Ref No 3.3.2.68, Ref No 3.3.2.137, 3.3.2.267 of the LRA, loss of material due to general, pitting, and crevice corrosion was not identified as an applicable aging effect/aging mechanism on carbon steel components exposed to chemically treated demineralized water < 90 °C. Provide the technical basis for not including this aging effect/mechanisms from the aging management review. If loss of materials due to general, pitting, and crevice corrosion are applicable aging effect/mechanisms, provide information on the AMP(s) that can adequately manage the identified aging effect.

Response:

Based on NUREG 1801, Chapter VII, loss of material due to general, pitting, and crevice corrosion is an applicable aging effect on carbon steel components exposed to chemically treated demineralized water. LRA Table 3.3-1, Aging Management Reference 3.3.1.13, addresses the loss of material due to general, pitting, and crevice

corrosion that is an applicable aging effect on carbon steel components exposed to chemically treated water.

For carbon steel components, crack initiation growth is to be addressed only for a nitrite-based chemically treated water environment, per EPRI 1003056, Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, Appendix A and Appendix B. Since NUREG 1801 does not address crack initiation growth as an aging effect on carbon steel components exposed to nitrite-based chemically treated demineralized water, Aging Management References 3.3.2.68, 3.3.2.137, and 3.3.2.267 are included in LRA Table 3.3-2.

RAI 3.3-7

In numerous system/structure/component scoping tables in Section 2.3.3 of the LRA, the applicant uses Ref No 3.3.1.5 of Table 3.3-1 to describe the aging management of various in-scope components of the auxiliary systems. In Ref No 3.3.1.5 of Table 3.3-1 the applicant stated that the applicable AMPs are plant-specific and further evaluation of loss of material due to general, microbiologically influenced, pitting, and crevice corrosion is described in Section 3.3.1.1.7 of the LRA. The staff reviewed Section 3.3.1.1.7 of the LRA and determined that the following additional information is needed to complete its review:

(a) In order to understand how the aging will be managed for the corrosion mechanisms addressed in Section 3.3.1.1.7 of the LRA, the staff needs a better description how the cited programs will be used to manage the various corrosion mechanisms for the components included in this LRA Section. For each component that uses Reference 3.3.1.5 (which refers to LRA Section 3.3.1.1.7), clarify which specific AMP(s) is applicable for managing the specific corrosion mechanism, and explain how the AMP(s) manage that corrosion mechanism.

(b) The LRA indicates that either the Structure Monitoring Program (B.1.30) or the Bolting Integrity (B.1.12) and the Structure Monitoring Program (B.1.30) programs will be used for managing the aging effects on non-structural components in the service water system. These components include orifices, piping and fittings, piping and fittings attached support, strainer bodies, thermowells, and valves. The Structure Monitoring Program (B.1.30), as described in the LRA, is consistent with GALL program XI.S6, which is specific to structural steel. If the Structure Monitoring Program (B.1.30) is used, explain how the program is used for non-structural carbon steel components. The Bolting Integrity (B.1.12) program, as described in the LRA, is consistent with GALL program XI.M18 (with exceptions), which is specific to bolting and bolted joints. The Bolting Integrity (B.1.12) program description also states that non-safety component inspections rely on detection of visible leakage during preventative maintenance and routine observation activities. If the Bolting Integrity (B.1.12) program is used, explain how the program is used for non-bolting-related inspections. If leakage detection is employed, explain how the AMP manages the aging effects so that the intended functions of the in-scope components will be maintained.

Response:

a) Exelon has reviewed LRA Table 3.3-1, Aging Management Reference 3.3.1.5 (which refers to LRA Section 3.3.1.1.7), and a clarification is provided for each component group that uses Aging Management Reference 3.3.1.5 in the attached table.

The following aging management programs are applicable for managing each specific corrosion mechanism.

- Bolting Integrity Program (B.1.12)

Routine system walk downs primarily manage system component external surfaces as part of the Bolting Integrity Program (B.1.12). These walk downs check both the general external surface condition of the system components and also the leakage integrity of the components and bolted joints.

- Bolting Integrity Program (B.1.12) and Structural Monitoring Program (B.1.30)

Routine system walk downs primarily manage system component external surfaces as part of the Bolting Integrity AMP (B.1.12). These walk downs check both the general external surface condition of the system components and also the leakage integrity of the components and bolted joints. In addition, a spaces approach implemented by the Structures Monitoring AMP (B.1.30) inspects a sampling of piping and component supports and the adjacent exposed piping and component surfaces. This sampling provides confirmation that external surface aging degradation of like materials in like environments are not occurring.

- One Time Inspection – Compressed Gas (B.1.23)

The inspection will be conducted in accordance with ASME Code VT-3 visual inspection requirements and will verify that there is no unacceptable loss of material in the compressed gas piping systems. The one time inspection will be conducted on a sample of components that represent or bound the piping system components within the scope of LR. The one-time inspections do not provide for preventive or mitigative actions. The one-time inspections provide a verification that unacceptable losses of material or elastomer degradation in the compressed gas systems are not occurring.

- Heat Exchanger Testing and Inspection (B.2.6)

The Dresden-Quad Cities Heat Exchanger Test and Inspection Activities (B.2.6) provide condition monitoring, inspection, and performance testing activities to manage loss of material, cracking, and buildup of deposit aging effects in heat exchangers in the scope of license renewal that are not tested and inspected under the other AMPs identified for management of heat exchanger aging.

- One Time Inspection – Ventilation System (B.1.23)

Dresden and Quad Cities will perform a one-time visual inspection of ventilation systems (B.1.23) including ductwork, equipment frames and housings, valves, debris screens, access doors, and closure bolting. The ventilation systems will be inspected to confirm that there is no penetrating corrosion, which could indicate an unacceptable loss of material condition. Drip pan drain piping will be inspected for corrosion that could result in a pipe wall perforation. The one-time inspection will include a representative sample of the ventilation system ductwork, piping, and components within the scope of LR. The visual inspection will be

conducted using VT-3 techniques and criteria.

- <u>Open Cycle Cooling Water (B.1.13)</u>

The Dresden and Quad Cities OCCW System procedures direct the inspection and testing for monitoring of aging degradation in raw water system heat exchangers in the scope of license renewal. Procedures and work orders direct the visual and NDE inspection of components for detection of degradation. The corrosion rates of corrosion coupons are also used for determining general corrosion rates. System and component performance testing for acceptable flowrates, operating temperatures, operating pressures and visual inspections for system and component fouling and silting are used to identify and remove any accumulated buildup of deposits. Periodic inspection of component linings will provide for the early detection of degradation prior to any resulting system flow blockage. Heat transfer capabilities as required to support system operability requirements are tested for all heat exchangers in the scope of license renewal.

- <u>Bolting Integrity Program (B.1.12) and Buried Piping and Tanks Inspection (B.1.25)</u>

Above ground Tanks: Periodic system walk downs primarily manage system component external surfaces as part of the Bolting Integrity AMP (B.1.12). These walk downs check both the general external surface condition of the system components and also the leakage integrity of the components and bolted joints.

Buried Tanks: The Buried Piping and Tanks Inspection AMP (B.1.25) activities provide for managing loss of material (general corrosion, pitting, crevice corrosion and MIC) through the use of piping and component coatings and wrappings, periodic inspections, and pressure testing. Coatings on buried ferrous piping and tanks perform a mitigative function by preventing metal contact with the aggressive soil/groundwater. Acceptable coatings at Dresden and Quad Cities stations include Polyken primer and tape wrap or epoxy primer and finish. The condition of the coatings is inspected whenever buried components are uncovered during station excavation activities. Since this could be infrequent, additional periodic leak testing and component inspections are being credited. These include ISI leakage testing for buried Class 3 piping, operational pressure monitoring for buried fire protection piping, periodic fuel oil storage tank inspections, 'one-time' UTs of the buried fuel oil storage tank internals and the internal bottom surface of an outdoor aluminum tank (such as a CCST) and a 'one-time' inspection of buried piping. These tests and inspections will provide early detection of buried component aging degradation.

- <u>Fire Protection (B.1.18)</u>

The fire protection aging management program (B.1.18) provides for managing the effects of aging of the external piping and component surfaces of the station halon (Dresden only) and cardox systems (both stations). The program is based on NFPA 12A and 72E standards and provides for periodic system operability testing. While performing the operability testing, it is recommended that visual aging degradation inspections also be performed.

- <u>One Time Inspection – NSR/SR Inspection (B.1.23)</u>

Dresden and Quad Cities will perform a one-time visual inspection of a representative sample of components Material – Environment "pairs" that are

deemed in the scope of License Renewal solely because they meet Criteria 10CFR54(a)(2). The one-time inspection is to provide assurance that corrosion of system components is not occurring or is occurring at an acceptable rate. The inspection will consist of a visual inspection for the presence of general, crevice, galvanic, and pitting corrosion. At least one representative component for each Material –Environment pair will be selected at each station as applicable.

LRA Table 2.3.3-3, Component Groups "Dampeners (Quad Cities Only)", "Dampeners (Spatial Interaction)(Quad Cities Only)", "Flow Element (Spatial Interaction)", and "Flow Element (Dresden Only)" refers to Aging Management Reference 3.3.1.5, which is incorrect. The correct Aging Management Reference is 3.3.2.40, which is included in LRA Table 2.3.3-3 to manage aging of these Component Groups.

LRA Table 2.3.3-11, Component Group "Restricting Orifices" refers to Aging Management Reference 3.3.1.5, which is incorrect. The correct Aging Management Reference is 3.3.2.40, which is included in LRA Table 2.3.3-11 to manage aging of this Component Group.

LRA Section 3.3.1.1.7 should have included Component Groups "Air Handler Heating/Cooling Coils" and "Valves" for Aging Management Program "One-Time Inspection-Ventilation Systems (B.1.23)", and Component Group "Doors, Closure Bolts, Equipment Frames" for Aging Management Program "One-Time Inspection-Compressed Gas (B.1.23)". In addition, note 2 in LRA Section 3.3.1.1.7 should have included liquid filled accumulators part of carbon steel components.

The table below provides a breakdown of applicable aging management programs for each component group for each system.

System	*Component Group*	*Applicable AMP*
Standby Liquid Control System	Accumulators (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Shutdown Cooling System (Dresden Only)	Filters/Strainers (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Heat Exchanger (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Pumps (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Restricting Orifices (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Sight Glasses (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Thermowells (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Control Rod Drive Hydraulic System	Accumulators (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Tanks (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Tubing (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Reactor Water Cleanup System	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Fire Protection System	Filters/Strainers (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Mufflers	One Time Inspection - Compressed Gas (B.1.23)
	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Sprinklers (Carbon Steel Components)	Bolting Integrity Program (B.1.12)

System	*Component Group*	*Applicable AMP*
	Tanks (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Emergency Diesel Generator and Auxiliaries	Air Accumulator Vessels Includes tanks)	Bolting Integrity Program (B.1.12)
	Doors, Closure Bolts, Equip. Frames (Includes dampers, ducts and housings)	One Time Inspection - Compressed Gas (B.1.23)
	Filters/Strainers	One Time Inspection - Compressed Gas (B.1.23)
	Heat Exchanger (Includes coolers)	Bolting Integrity Program (B.1.12)
	Lubricators	One Time Inspection - Compressed Gas (B.1.23)
	Mufflers	One Time Inspection - Compressed Gas (B.1.23)
	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Pumps (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Restricting Orifices (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Tanks (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Thermowells (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Tubing (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
HVAC - Main Control Room	Air Handlers Heating/Cooling (CR HVAC)	Heat Exchanger Testing & Inspection (B.2.6)
	Diffusers (carbon steel components)	Bolting Integrity Program (B.1.12)
	Doors, Closure Bolts, Equip. Frames (Includes dampers, ducts, housings and silencers)	One Time Inspection - Ventilation System (B.1.23)
	Filters and Strainers (carbon steel components)	Bolting Integrity Program (B.1.12)
	Heat Exchangers (carbon steel components)	Bolting Integrity Program (B.1.12)
	Housings and Supports	One Time Inspection - Ventilation System (B.1.23)

System	*Component Group*	*Applicable AMP*
	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
HVAC - Reactor Building	Doors, Closure Bolts, Equip. Frames (Includes dampers, ducts, housings, piping and valves)	One Time Inspection - Ventilation System (B.1.23)
	Housings and Supports (Dresden Only)	One Time Inspection - Ventilation System (B.1.23)
	Valves (Includes dampers-Dresden only)	One Time Inspection - Ventilation System (B.1.23)
ECCS Corner Room HVAC	Ducts & Fittings, Access Doors, Closure Bolts, Equip. Frames	Open Cycle Cooling Water (B.1.13)
Station Blackout Building HVAC	Doors, Closure Bolts, Equip. Frames	One Time Inspection - Ventilation System (B.1.23)
Station Blackout System (diesel and auxiliaries)	Air Accumulator Vessels	One Time Inspection - Compressed Gas (B.1.23)
	Filters/Strainer	One Time Inspection - Compressed Gas (B.1.23)
	Heat Exchanger (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Lubricators	One Time Inspection - Compressed Gas (B.1.23)
	Mufflers	One Time Inspection - Compressed Gas (B.1.23)
	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Pumps (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Tanks (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Thermowells (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Valves	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Diesel Generator Cooling Water System	Doors, Closure Bolts, Equip. Frames (Quad Cities Only)	Heat Exchanger Testing & Inspection (B.2.6)

System	Component Group	Applicable AMP
	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Diesel Fuel Oil System	Filters/Strainer (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Flame Arrestors	One Time Inspection - Compressed Gas (B.1.23)
	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Pumps (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Tanks (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Process Sampling System	Piping and Fittings (Quad Cities Only)	Bolting Integrity Program (B.1.12)
	Valves	Bolting Integrity Program (B.1.12)
Carbon Dioxide System	Piping and Fittings (Carbon Steel Components)	Fire Protection (B.1.18)
	Tanks (Carbon Steel Components)	Fire Protection (B.1.18)
	Tubing (Carbon Steel Components)	Fire Protection (B.1.18)
	Valves (Carbon Steel Components)	Fire Protection (B.1.18)
Service Water System	Flow Orifices (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Strainer Bodies (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Thermowells (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Reactor Building Closed Cooling Water System	Flow Element (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Heat Exchanger (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Orifices Bodies (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)

System	*Component Group*	*Applicable AMP*
	Pumps (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Tanks (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Turbine Building Closed Cooling Water System	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Demineralized Water Make-up System	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Restricting Orifices (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Strainers (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Residual Heat Removal Service Water (Quad Cities Only)	Ducts & Fittings, Access Doors, Closure Bolts, Equip. Frames (Quad Cities Only)	Open Cycle Cooling Water (B.1.13)
	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Sight Glass (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Strainer Bodies (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Thermowells (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Containment Cooling Service Water System (Dresden Only)	Ducts & Fittings, Access Doors, Closure Bolts, Equip. Frames (Dresden Only)	Open Cycle Cooling Water (B.1.13)
	Heat Exchanger (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Thermowells (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)

System	*Component Group*	*Applicable AMP*
Ultimate Heat Sink	Piping and Fitting (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Fuel Pool Cooling and Filter Demineralizer System	Piping and Fittings (Dresden Only)	One Time Inspection - Compressed Gas (B.1.23)
	Sight Glass (Spatial Interaction-Dresden Only)	One Time Inspection - Compressed Gas (B.1.23)
	Valves (Dresden Only)	One Time Inspection - Compressed Gas (B.1.23)
	Valves (Spatial Interaction-Dresden Only)	One Time Inspection - Compressed Gas (B.1.23)
Plant Heating System	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Sight Glass (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Tanks (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
Drywell Nitrogen Inerting System	Flow Elements (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Piping and Fitting (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Tanks (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Thermowells (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Traps (Quad Cities Only)	Bolting Integrity Program (B.1.12)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
Safe Shutdown Makeup Pump System (Quad Cities Only)	Ducts & Fittings, Access Doors, Closure Bolts, Equip. Frames (Quad Cities Only)	Open Cycle Cooling Water (B.1.13)
	Filters/Strainers (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Piping and Fittings (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)
	Pumps (Carbon Steel Components)	Bolting Integrity Program (B.1.12)
	Valves (Carbon Steel Components)	Bolting Integrity Program (B.1.12) & Structural Monitoring Program (B.1.30)

b) The Bolting Integrity program (B.1.12) consists of visual inspections, which rely on detection of visible leakage during preventive maintenance and routine system walk downs (routine observation activities). The routine system walk downs are also credited for detecting aging degradation on the external surfaces of system piping and components. The Bolting Integrity program credits the routine system walk downs as routine observation activities, which detect aging degradation on the external surfaces of system piping and components. The routine system walk downs manage loss of material due to general corrosion so that the intended functions of the in-scope components will be maintained.

   In addition, a spaces approach implemented by the Structures Monitoring AMP (B.1.30) inspects a sampling of piping and component supports and the adjacent exposed piping and component surfaces. This sampling provides confirmation that external surface aging degradation of like materials in like environments are not occurring. The Structural Monitoring program consists of visual inspection of piping and piping components by area rather than by systems.

<u>RAI 3.3-8</u>

A one-time inspection program may be used to verify the effectiveness of the Water Chemistry program. However, in Table 3.3-2 Ref No 3.3.2.120, Ref No 3.3.2.186 and Ref No 3.3.2.257 of the LRA, the applicant credited the Water Chemistry (B.1.2) with managing the aging effects on components exposed to demineralized water with temperature ranges of 25 to 288 □C but without one-time inspection. Although the Selective Leaching of Materials (B.1.24) program, which is used in conjunction with the Water Chemistry (B.1.2) program in Ref No 3.3.2.120, has a one-time inspection component, the one-time inspection component in Selective Leaching of Materials (B.1.24) program is designed only to detect the presence of the dealloying of the materials. It is not designed to be a general purpose one-time inspection. Provide technical basis for why a one-time inspection program is not needed to augment the Water Chemistry (B.1.2) program for managing the identified aging effects.

Response:

Exelon has reviewed LRA Table 3.3-2, Aging Management References 3.3.2.120, 3.3.2.186, and 3.3.2.257, and the following technical explanation is provided for water chemistry one-time inspection.

Aging Management Reference 3.3.2.120, Component Group "Heat Exchanger," also credits Open Cycle Cooling Water aging management activities that involve chemistry control, performance monitoring, periodic inspections, and periodic flushing in order to control biofouling, verify heat transfer, monitor degradation, and to ensure compliance with the current licensing bases for affected heat exchangers. Performance monitoring, periodic inspections, and flushing will verify the effectiveness of the chemistry program to ensure that significant degradation is not occurring and the component intended function would be maintained. Therefore, a one-time inspection program to augment the Water Chemistry (B.1.2) program is not required.

NUREG 1801, Chapter XI, Section XI.M2, states that the water chemistry program is effective in removing impurities from intermediate and high flow areas. It also states that water chemistry program may not be effective in low flow or stagnant flow areas. In low flow or stagnant flow areas, verification of the effectiveness of the chemistry program is undertaken to ensure that significant degradation is not occurring and the component intended function will be maintained. Aging Management Reference 3.3.2.186 address the restricting orifice Component Group. Restricting orifices are not typically in a low flow or stagnant flow areas. Therefore, verification of the effectiveness of the chemistry program through a one-time inspection, B.1.23, is not required.

Components addressed in Aging Management Reference 3.3.2.257 are brass or bronze valves in clean demineralized water hose stations. These components are in scope of license renewal for spatial interaction component intended function. Both pitting and crevice corrosion typically occur in low flow or stagnant flow areas. Oxygen is needed to initiate all three types of corrosion. Stainless steel is more susceptible to crevice and pitting corrosion than carbon steel. Carbon steel is more susceptible to general corrosion than stainless steel. Brass or bronze material is less susceptible to these types of corrosion than either stainless or carbon steel. This is further supported by plant operating experience. One-time inspections are performed for carbon and stainless steel components to verify the effectiveness of the chemistry program, which will ensure that significant degradation is not occurring and the component intended function would be maintained. Since valves addressed in Aging Management Reference 3.3.2.257 are of brass or bronze material that is less susceptible to these types of corrosion than stainless and carbon steel, verification of the effectiveness of the chemistry program through a one-time inspection, B.1.23, is not required.

RAI 3.3-9

Items 3.3.2.300 and 3.3.2.29 in table 3.3-2 of the LRA are used by the applicant to describe the AMR of many components in the auxiliary systems. In these items general corrosion on external surfaces is managed with the Bolting Integrity Program (B.1.12). The staff notes that the Bolting Integrity AMP states: "The program consists of visual inspections for external surface degradation that may be caused by loss of material or cracking of the bolting, or by an adverse environment." This suggests that in this AMP only the bolting material will be inspected for aging degradation. The description in item 3.3.2.300 and 3.3.2.29 includes many non-bolting components. Provide an explanation (including the acceptance criteria and inspection interval) of the way the Bolting Integrity Program (B.1.12) is used to manage general corrosion on external surfaces of non-bolting components such as piping, valves, mufflers, and others.

Response:

Chapter XI of NUREG 1801, Generic Aging Lessons Learned, does not contain any program to monitor the effects of aging for the exterior surface of auxiliary system components. As such, Exelon made the decision to include the aging management for non-bolting components such as piping, valves, and mufflers within the Bolting Integrity Program. The Bolting Integrity program (B.1.12) consists of visual inspections, which rely on detection of visible leakage during preventive maintenance and routine walkdowns

(routine observation activities). The routine walkdowns are also credited for detecting aging degradation (general corrosion) on the external surfaces of system piping and piping components. Therefore, external surfaces of non-bolting components included in LRA Section 3.3.2, Table 3.3-2, Aging Management References 3.3.2.29 and 3.3.2.300, are managed with the Bolting Integrity program. Depending on the accessibility of the systems or components, walkdown inspection intervals vary from quarterly to every refueling outage. The presence of component external surface corrosion requires engineering evaluation.

3.3.2.4.1 Refueling Equipment

RAI 3.3.2.4.1

Table 3.3-2, Ref No 3.3.2.74 identifies the loss of material due to pitting corrosion for stainless steel components in a chemically treated oxygenated water environment. It does not however, identify crack initiation and growth due to stress corrosion cracking (SCC) as a plausible aging effect/mechanism even though the same environmental conditions generally exist for pitting corrosion as for SCC. Provide justification for not including crack initiation and growth due to SCC as an aging effect/mechanism that requires management for the period of extended operation.

Response:

The cracking aging effect is discussed in EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 3, Appendix A, Section 3.2.2. Stress Corrosion Cracking (SCC) of stainless steel in Fuel Storage and Handling Equipment. This aging effect has not been detected by industry experience or by actual site operating experience. SCC tendency increases with temperature applications greater than 140°F and the introduction of chlorides (in excess of permissible limits). This is the upper-most limit for long term operating temperature in the Spent Fuel Pool (because higher operating temperatures are detrimental to Fuel Pool Cooling system demineralizer resin). As such, crack initiation and growth due to stress corrosion cracking was not considered a credible aging effect/mechanism.

3.3.2.4.2 Shutdown Cooling System (Dresden only)

RAI 3.3.2.4.2

In LRA Table 3.3-2, item Ref No 3.3.2.293, the applicant indicates that stainless steel valves in the shutdown cooling system are exposed to saturated air and subject to aging effect of loss of material due to pitting and crevice corrosion. However, valves are the only component type that are identified as exposed to saturated air environment in the shutdown cooling system. Clarify if there are any other associated components such as piping, pipe fittings, tubing, and tube fittings in the Shutdown Cooling System that may be exposed to the same environment and hence subject to the same aging effects. If so, specify the applicable AMPs.

Response:

"Valves" is the only component type that is identified as exposed to saturated air internal environment in the shutdown cooling system. The reason for this is that the shutdown cooling valves in this group are 2-1099-X111A & B for Dresden Unit 2, and 3-1099-X111A & B for Dresden Unit 3. These valves are utilized when local leak rate testing the shutdown cooling system primary containment penetrations X-111A and B. The penetrations are shown on boundary diagrams LR-DRE-M-32 (coordinate C-9) and LR-DRE-M-363 (coordinate C-9), but the level of detail of this diagram does not include the valves. There are piping and fittings connecting these valves to the penetrations. These piping and fittings are included in LRA Table 2.3.2-3, under Component Group, "Isolation Barriers (including piping, tubing, valves and vacuum breakers)," and Component Intended Function of "Pressure Boundary." The Aging Management Reference is 3.2.2.52. Valves 2(3)-1099-X111A&B should have been included in the LRA Section 2.3.2.3, "Containment Isolation Components and Primary Containment Piping System," in the Table 2.3.2-3 Component Group of "Isolation Barriers (including piping, tubing, valves and vacuum breakers)," along with the other test valves utilized for local leak rate testing of containment penetrations.

3.3.2.4.3 Control Rod Drive Hydraulic System

RAI 3.3.2.4.3

Copper and copper alloy components exposed to moist air environment may experience aging effects of loss of material due to pitting and crevice corrosion, especially when the humidity is at 60% or higher and/or with the presence of pollutants such as Oxygen, SO_2, NOx, and NH_4. In LRA Table 3.3-2, item Ref No 3.3.2.23 and 3.3.2.34, the applicant concludes that no aging effects were identified for the external surfaces of copper tanks and accumulators and the external surfaces of brass or bronze valves in the control rod drive hydraulic system exposed to the moisture and humidity air environment because "The plant indoor environment is not an aggressive wetted environment conducive to promoting aging degradation of brass or bronze (3.3-2, Ref No 3.3.2.23) or copper (3.3.2.34) components." Provide the technical basis (including the level of humidity and the level of pollutants) for this conclusion.

Response:

Copper, brass and bronze materials are used in the indoor (air, moisture and humidity <212°F) ambient environment for various system piping and tubing. This environment, specified for Aging Management References 3.3.2.23 and 3.3.2.34, is the same as NUREG 1801, References: V.E.1-b, VII.I.1-b, and VIII.H.1-b. EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Revision 3, Appendix E, conservatively concludes that the indoor ambient environment is an aggressive environment for copper and copper alloy components if subjected to periodic wetting. However, for the specific indoor environment being considered, periodic wetting of the external surfaces would be rare. In addition, in M. G. Fontana and N. D. Greene, "Corrosion Engineering," Second Edition, McGraw-Hill, New York, 1978, it states that copper and copper alloys are specifically chosen for their ambient condition corrosion resistance. Additionally, other than one instance of copper/brass corrosion found at

Quad Cities station, there has no operating experience related to corrosion of copper, brass or bronze components in an indoor, ambient environment at either Quad Cities or Dresden stations. This one example at Quad Cities station was due to leakage from sodium hypochlorite system piping joints in the area of an instrument rack . The use of the sodium hypochlorite system has since been terminated, and the system has been removed. Therefore, copper brass and bronze components located in the air, moisture and humidity <212°F environment will not require aging management.

3.3.2.4.4 Reactor water cleanup system

<u>RAI 3.3.2.4.4</u>

(a) What is the difference between the environment of moist air and (air, moisture, and humidity < 100 °C (212 °F)) as stated by applicant in Table 3.3-2, p. 3-141 and p. 3-96 respectively of the LRA? In the former case the applicant stated that loss of materials due to pitting and crevice corrosion for stainless steel components is an applicable aging effect and that One-Time Inspection (B.1.23) is the applicable aging management program. In the latter environment stainless steel components are claimed by the applicant to have no applicable aging effect. Justify the different conclusions drawn in terms of the combination of components/materials/environment/applicable aging effects.

(b) In NUREG-1801 (Vol II, Chapter VII, Section E4) carbon steel components in auxiliary systems such as piping and fittings and pump casing in oxygenated water environment are addressed. Applicable aging effect is loss of materials and fatigue. For loss of materials the recommended AMP is Chapter XI M2 "Water Chemistry" augmented by verification of the effectiveness of the chemistry control. NUREG-1801 suggests that for these cases the detection of aging effects is to be further evaluated. In Table 3.3-2 (p. 3-116, item 3.3.3-140) of the LRA the applicant states that NUREG- 1801 does not address carbon steel components in oxygenated water environment. Clarify this statement using the above information provided by NUREG-1801.

Response:

(a) The environment of moist air (identified in LRA Table 3.3-2, p. 3-141) and the environment of air, moisture, and humidity < 100°C (212°F) (identified in LRA Table 3.3-2, p. 3-96) are the same. The only difference is in how they are described, which is verbatim as identified in NUREG-1801, Vol II, Chapter VII for the respective systems. For example, NUREG-1801, Vol II, Chapter VII, Items F1.1-a and H2.2-a are aligned with the control room ventilation and the emergency diesel generator systems, respectively. Item F1.1-a identifies the environment as "Warm, moist air" while Item H2.2-a identifies the environment as "Moist air."

The subject Aging Management Reference (3.3.2.291) identified on p. 3-141 of the LRA and those Aging Management References (3.3.2.37, 3.3.2.38, and 3.3.2.40) on p. 3-96 are associated with internal environments and external environments, respectively.

Aging Management Reference 3.3.2.291 of LRA Table 3.3-2 is associated with

components made of stainless steel with an indoor ambient internal environment. It specifically addresses components in the emergency diesel generator and SBO diesel generator air start systems. Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, EPRI 1003056, Appendix D, was utilized to perform the aging management review for these components. It specifically identifies loss of material due pitting and crevice corrosion as the aging effect/mechanism.

Aging Management References 3.3.2.37, 3.3.2.38 of LRA Table 3.3-2 are associated with components made of ductile iron and malleable iron, respectively, with indoor ambient external environments. EPRI 1003056, Appendix E, was utilized to perform the aging management review for these components although it does not specifically address the associated material types. However, it does address gray cast iron, which is considered to be less corrosion-resistant than ductile iron and malleable iron. Therefore, the conclusions of EPRI 1003056, Appendix E for gray cast iron should bound those for the subject material types. EPRI 1003056, Appendix E, conservatively considers an indoor ambient environment to be aggressively corrosive. Since the indoor ambient environment is only marginally corrosive, a determination was made that it was unnecessary to manage the aging of ductile iron and malleable iron components in this environment.

Aging Management Reference 3.3.2.40 of LRA Table 3.3-2 is associated with components made of stainless steel with an indoor ambient external environment. EPRI 1003056, Appendix E, was utilized to perform the aging management review for these components. EPRI 1003056, Appendix E, indicates that stainless steel materials are not subject to any viable aging mechanism in the absence of aggressive chemical species. The affected components are not subject to any aggressive chemical species. Therefore, a determination was made that it was unnecessary to manage the aging of stainless steel components in this environment.

(b) The statement in Aging Management Reference 3.3.2-140 (identified as 3.3.3-140 in the RAI) of LRA Table 3.3-2, indicating that NUREG-1801 does not address carbon steel components in an oxygenated water environment, is in reference to carbon steel piping and fittings in the reactor water cleanup system. The cited NUREG-1801 section (Vol II, Chapter VII, Section E4) addresses carbon steel components in the shutdown cooling system. The NUREG-1801 section corresponding to the reactor water cleanup system is Vol II, Chapter VII, Section E3, which does not address carbon steel piping and fittings. However, for clarification, Aging Management Reference 3.3.2-140 of LRA Table 3.3-2 should have stated that NUREG-1801 does not address carbon steel piping and fittings in an oxygenated water environment for the reactor water cleanup system.

3.3.2.4.6 Emergency diesel generator and auxiliaries

<u>RAI 3.3.2.4.6</u>

(a) In Table 2.3.3-6, page 2-119, Aging Management Ref. 3.3.1.7 refers to piping and fitting (and attached support) and valve (and attached support). Aging Management Ref. 3.3.1.7 credits Fuel Oil Program and One-time Inspection for managing the aging effect of the fuel oil tank and day tank. The AMPs are not related to piping, fitting and valves. On other hand, the tanks group in Table 2.3.3-6 does not include Aging Management Ref. 3.3.1.7 that links to the Fuel Oil Program and One-time Inspection. Provide clarification of the discrepancy.

(b) Cracking is identified as aging effect of Brass or Bronze valves exposed to chemical treated demineralized water in the Aging Management Ref 3.3.2.258 in Table 2.3-6. Loss of material is, however, not identified as aging effect. Provide justification on not identifying loss of material as aging effect for brass or bronze valves exposed to chemical treated demineralized water.

Response:

a) Aging Management Reference 3.3.1.7 includes piping, fittings, and valves, as shown in the "components evaluated" column under "Evaluated with NUREG-1801 components." The tanks referred to in Aging Management Reference 3.3.1.7 are the tanks in the Diesel Fuel Oil system discussed in LRA Section 2.3.3.13, Table 2.3.3-13 (Page 2-140). The tanks shown in LRA Table 2.3.3-6 (Page 2-119) are the Diesel Generator Cooling Water expansion tanks. The Aging Management References for these tanks are 3.3.1.5, 3.3.1.13, and 3.3.2.21

b) Aging Management Reference 3.3.2.258 refers to the aging mechanism of cracking due to stress corrosion cracking, not loss of material. Exelon agrees with the NRC staff that loss of material applies for brass or bronze in (nitrite) treated water environment. An aging management reference similar to 3.3.2.134 should have been added in LRA Section 3.3.2 for Component Group "Valves," with this aging management reference listed in LRA Table 2.3.3-6 under "Aging Management Ref," for the Component Group, "Valves. The closed cycle cooling water system AMP (B.1.14) and the selective leaching of materials AMP (B.1.24) will also manage aging for these components

3.3.2.4.7 HVAC - Main Control Room

RAI 3.3.2.4.7

The relevant conditions could exist in the treated water environment of the HVAC - main control room for crack initiation and growth due to stress corrosion cracking (SCC) to occur in carbon steel components. However, this aging effect/mechanism was only addressed for heat exchanger tubes in the auxiliary systems aging management review. Provide justification for not including crack initiation and growth due to SCC in carbon steel components other than heat exchanger tubes in a treated water environment.

Response:

For carbon steel components, stress corrosion cracking occurs only in nitrile treated water, per Appendix A of Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, EPRI 1003056. For Dresden and Quad Cities Stations, the emergency diesel generator jacket water, Reactor Building Closed Cooling Water system and Turbine Building Closed Cooling Water system utilize nitrile treated water; therefore, are subject to stress corrosion cracking and resulting crack initiation and growth. These aging mechanisms, aging effects, and required aging management programs are shown for these systems in LRA Section 3.3 – Aging Management References 3.3.2.68 (Flow Elements), 3.3.2.77 or 3.3.2.117 (Heat Exchangers), 3.3.2.137 (Piping and Fittings), 3.3.2.174 (Pumps), 3.3.2.211 (Tanks), 3.3.2.233 (Tubing), 3.3.2.267 (Valves). These reference numbers apply to the following component groups for the above-mentioned systems.

- Emergency diesel generator jacket water (LRA Section 2.3.3.6): Piping and Fittings, Pumps, Tanks, Tubing, Valves.
- Reactor Building Closed Cooling Water system (LRA Section 2.3.3.17): Flow Elements, Heat Exchangers (3.3.2.117 for Dresden Heat Exchangers and 3.3.2.77 for Quad Heat Exchangers), Piping and Fittings, Pumps, Tanks, Tubing, Valves.
- Turbine Building Closed Cooling Water system (LRA Section 2.3.3.18): Piping and Fittings, Valves.

The heat exchanger tubes, including those of the control room HVAC coolers, for Dresden and Quad Cities are not made of carbon steel. Additionally, the environment for the main control room HVAC coolers is raw water, refrigerant, and warm moist air. Therefore, the conditions relevant to stress corrosion cracking do not exist.

3.3.2.4.8 HVAC – Reactor Building

RAI 3.3.2.4.8

Loss of material due to selective leaching maybe an applicable aging effect for copper alloy components exposed to saturated air environment where water condensation on the surfaces of these components may occur. However, in LRA Table 3.3-2, Ref No 52, 242, and 262, loss of material due to selective leaching was not identified as an applicable aging effect for copper alloy components in saturated air. Provide technical basis for not including this aging effect from aging management review.

Response:

The copper alloy materials of Aging Management References 3.3.2.52, 3.3.2.242 and 3.3.2.262 are used in compressed gas and ventilation systems at Dresden and Quad Cities. These are not installed in areas where water would be expected to pool. For Aging Management References 3.3.2.52, 3.3.2.242, and 3.3.2.262, the susceptible materials, copper alloys, are not exposed to water for prolonged periods and, therefore, selective leaching is not considered an aging mechanism for Dresden and Quad Cities applications.

3.3.2.4.9 ECCS Corner Room HVAC

RAI 3.3.2.4.9

Normally Heating, Ventilation, and Air-Conditioning systems contain elastomer materials in hose connection seals, duct seals, flexible collars between ducts and fans, rubber boots, etc. For some plant designs, elastomer components are also used as vibration isolators to prevent transmission of vibration and dynamic loading to the rest of the system. The aging effects on those elastomer components are hardening and loss of material. However, no elastomer component is identified for the ECCS Corner Room HVAC in Table 2.3.3-9 of the LRA. Clarify if there is any elastomer component in the ECCS Corner Room HVAC.

Response:

The ECCS Corner Room HVAC system consists of room coolers that contain a cooling coil, a fan and a housing. There is no ductwork attached to the cooler. There are no flexible collars, damper or door gaskets, seals or other soft parts associated with the ECCS Corner Room HVAC system.

3.3.2.4.11 Station Blackout System (diesels and auxiliaries)

RAI 3.3.2.4.11

(a) Loss of material due to selective leaching may be an applicable aging effect for cast iron components in moist air and humidity environment, especially when there is water condensation on the surfaces of these components. However, in LRA Table 3.3-2, Ref No 55, loss of material due to selective leaching was not identified as an applicable aging effect for cast iron components in moist air. Provide technical basis for not including this aging effect from aging management review.

(b) Loss of material due to pitting and crevice corrosion is a plausible aging effect on stainless steel exposed to chemically treated and demineralized water environment. However, in Table 2.3.3-11 of the LRA, the applicant did not identify any loss of material aging effect on the stainless steel components exposed to chemically treated and demineralized water environment. Provide technical basis for not including this applicable aging effect.

Response:

(a) The cast iron material components referenced in LRA section 3.3.2.55 are not installed in areas where water or condensation would be expected to pool. They are not exposed to water for prolonged periods and, therefore, selective leaching is not considered an aging mechanism for Dresden and Quad Cities applications.

(b) Exelon concurs that stainless steel in treated water environment may be susceptible to loss of material due to pitting and crevice corrosion. Aging management references (3.3.2.305, 3.3.2.306, 3.3.2.307, 3.3.2.308, 3.3.2.309,

and 3.3.2.310) addressing this aging effect/mechanism for stainless steel in treated water environment should have been included in LRA Table 3.3-2 for the following Component Groups listed in LRA Table 2.3.3-11.

Table 2.3.3-11 Component Groups Requiring Aging Management Review – Station Blackout (diesels and auxiliaries)

Component Group	Component Intended Function	Aging Management Ref
Flow Elements	Pressure Boundary	3.3.2.40, 3.3.2.70, **3.3.2.305**
Piping and Fittings (includes heaters, orifices, and thermowells)	Pressure Boundary	3.3.1.5, 3.3.1.7, 3.3.1.13, 3.3.2.23, 3.3.2.29, 3.3.2.34, 3.3.2.38, 3.3.2.40, 3.3.2.135, 3.3.2.136, 3.3.2.139, 3.3.2.148, 3.3.2.149, 3.3.2.151, 3.3.2.155, 3.3.2.156, 3.3.2.160, 3.3.2.162, 3.3.2.163, 3.3.2.300, **3.3.2.306**
Restricting Orifices	Pressure Boundary	3.3.1.5, 3.3.2.40, 3.3.2.190, 3.3.2.191, 3.3.2.192, **3.3.2.307**
Restricting Orifices	Throttle	3.3.2.190, 3.3.2.192. **3.3.2.307**
Thermowells	Pressure Boundary	3.3.1.5, 3.3.1.7, 3.3.2.23, 3.3.2.40, 3.3.2.222, 3.3.2.224, 3.3.2.226, **3.3.2.308**
Tubing	Pressure Boundary	3.3.2.34, 3.3.2.40, 3.3.2.238, 3.3.2.246, 3.3.2.247, 3.3.2.249, **3.3.2.309**
Valves	Pressure Boundary	3.3.1.5, 3.3.1.7, 3.3.1.13, 3.3.2.23, 3.3.2.40, 3.3.2.261, 3.3.2.269, 3.3.2.287, 3.3.2.288, 3.3.2.290, 3.3.2.291, **3.3.2.310**

Table 3.3-2 should have included the following Aging Management References.

Table 3.3-2 Aging management review results for the auxiliary systems that are not addressed in NUREG-1801

Ref No	Component Group	Material	Environment	Aging Effect/Mechanism	Aging Management Program	Discussion
3.3.2.305	Flow Elements	Stainless Steel	Chemically treated demineralized water <90°C (194°F) (Glycol based chemical treatment)	Loss of material/Pitting and crevice corrosion	Closed-Cycle Cooling Water System (B.1.14)	NUREG-1801 does not consider stainless steel in a diesel generator cooling water subsystem
3.3.2.306	Piping and Fittings	Stainless Steel	Chemically treated demineralized water <90°C (194°F) (Glycol based chemical treatment)	Loss of material/Pitting and crevice corrosion	Closed-Cycle Cooling Water System (B.1.14)	NUREG-1801 does not consider stainless steel in a diesel generator cooling water subsystem
3.3.2.307	Restricting Orifices	Stainless Steel	Chemically treated demineralized water <90°C (194°F) (Glycol based chemical treatment)	Loss of material/Pitting and crevice corrosion	Closed-Cycle Cooling Water System (B.1.14)	NUREG-1801 does not consider stainless steel in a diesel generator cooling water subsystem
3.3.2.308	Thermowells	Stainless Steel	Chemically treated demineralized water <90°C (194°F) (Glycol based chemical treatment)	Loss of material/Pitting and crevice corrosion	Closed-Cycle Cooling Water System (B.1.14)	NUREG-1801 does not consider stainless steel in a diesel generator cooling water subsystem
3.3.2.309	Tubing	Stainless Steel	Chemically treated demineralized water <90°C (194°F) (Glycol based chemical treatment)	Loss of material/Pitting and crevice corrosion	Closed-Cycle Cooling Water System (B.1.14)	NUREG-1801 does not consider stainless steel in a diesel generator cooling water subsystem
3.3.2.310	Valves	Stainless Steel	Chemically treated demineralized water <90°C (194°F) (Glycol based chemical treatment)	Loss of material/Pitting and crevice corrosion	Closed-Cycle Cooling Water System (B.1.14)	NUREG-1801 does not consider stainless steel in a diesel generator cooling water subsystem

3.3.2.4.12 Diesel Generator Cooling Water System

RAI 3.3.2.4.12

(a) LRA table 3.3-2, ref. 3.3.2.16 identifies loss of material from erosion or flow accelerated corrosion (FAC) as applicable aging effects/mechanisms. Open-cycle cooling water system AMP B.1.13 is identified as the applicable AMP. Clarify whether erosion or FAC is the applicable aging mechanism for components in the diesel generator cooling water system identified in table 2.3.3-12 in the LRA. If erosion is the applicable aging mechanism and not FAC state so explicitly in the LRA. Otherwise address the following issue. Flow accelerated corrosion (FAC) AMP B.1.11 is used to manage wall-thinning due to FAC. A key component in that AMP is the use of analytical evaluations to predict and determine the critical locations for detecting, monitoring, and inspection of FAC. Clarify the role of analytical evaluations in the AMP Open-Cycle Cooling Water System (B.1.13). If analytical evaluation is not a component in the Open-Cycle Cooling Water System B.1.13 AMP, justify its absence and the resulting effectiveness of the AMP in managing the aging effect of loss of material due to FAC.

(b) NUREG-1800 Section 3.3.2.2.11 states that loss of material due to general, pitting and crevice corrosion and MIC could occur in the underground piping and fittings in the open-cycle cooling water system. Dresden UFSAR Section 9.5.5 states that the remaining part of the system's piping and valves traverse to and from the missile-protected diesel and reactor buildings via a reinforced concrete tunnel that runs below ground. Clarify if there is any underground piping in the diesel generator cooling water system that is buried or inaccessible. If buried or inaccessible piping does exist, explain how such piping will be managed for loss of material during the period of extended operation.

Response:

a) Exelon has reviewed LRA Table 3.3-2, Aging Management Reference 3.3.2.16, for loss of material due to erosion or flow accelerated corrosion (FAC) as applicable aging effects/mechanisms. As stated in EPRI TR-1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3" erosion is the aging mechanism induced by flowing fluid. Raw water systems (Open-Cycle Cooling Water Systems) are particularly susceptible to this mechanism since they usually contain a large amount of particulate. This particulate in the fluid stream can impinge upon the surface of the metal and result in a loss of material at that point. FAC is not the valid aging mechanism for heat exchangers in the scope of license renewal since heat exchangers are operated within their design flow and operating parameters. LRA Table 3.3-2, Aging Management Reference 3.3.2.16, should have stated only erosion as the aging mechanism instead of erosion or FAC.

b) The Diesel Generator Cooling Water system piping traverses to the crib house from the missile-protected diesel and turbine buildings via a reinforced concrete tunnel. However, the tunnel does not extend completely from the turbine building to the cribhouse. Portions of the diesel generator cooling water piping do run

underground (buried) to the crib house. LRA Section 2.3.3.12, Table 2.3.3-12, should have included buried piping Aging Management Reference 3.3.1.16 under "Piping and Fittings" with pressure boundary as the component intended function. LRA Table 3.3-1, Aging Management Reference 3.3.1.16, discusses the aging management of buried piping and fittings for loss of material due to general, pitting, and crevice corrosion, and Microbiologically Influenced Corrosion (MIC). The Buried Piping and Tank Inspection aging management program (B.1.25) will manage the aging of diesel generator cooling water system buried piping and piping components.

3.3.2.4.13 Diesel Fuel Oil System

RAI 3.3.2.4.13

(a) NUREG-1800 Section 3.3.2.2.11 states that loss of material due to general, pitting and crevice corrosion and MIC could occur in the underground piping and fittings in the diesel fuel oil system. LRA Table 2.3.3-13 references 3.3.1.5, 3.3.1.7, 3.3.2.29 and 3.3.2.139 for managing piping and fittings. None of these AMR references include an aging management program for buried piping in the diesel fuel oil system. LRA AMP B.1.25 identifies a one-time visual inspection of the external surface of a buried piping section, but the system is not identified. LRA section 3.3.1.1.14 indicates that a buried section of fire mains is included in the Buried Piping and Tanks Inspection AMP. Explain how buried piping in the Diesel Fuel Oil System will be managed, including the justification based on operating experience.

(b) Filters and strainers are included in Table 2.3.3-13 as passive components with a filter function. Table 3.3-1 ref. 3.3.1.7 identifies loss of material due to general, pitting and crevice corrosion, MIC and biofouling as an aging effect for filters and strainers in the diesel generator fuel oil system. The Fuel Oil Chemistry Program and One-Time Inspection are credited for managing the aging effect. Explain how the fuel oil chemistry program and one-time inspection manage biofouling in the filter and strainer elements. For example, how do these programs provide for inspection and replacement of filters or cleaning strainers and at what frequency to assure that they are performing their filter function? Also clarify if filter elements are considered replaceable or long-lived passive components.

Response:

(a) LRA Table 2.3.3-13, with a Component Group of "Piping and Fittings," should have referred to Aging Management Reference 3.3.1.16, which addresses NUREG 1801, Item VII.H1.1-b, "Diesel Fuel Oil System underground piping and fittings", and addresses the aging effects of loss of material due to general, pitting and crevice corrosion and MIC.

(b) Filter elements are replaced on a frequent basis and are therefore not considered long-lived. Biofouling is not considered as an aging mechanism for strainers that requires aging management to be demonstrated. Biofouling is managed at its source within the fuel oil storage tanks. The aging management of filter/strainers was evaluated in Aging Management Reference 3.3.1.7, with the NUREG 1801

component of "Diesel fuel oil tanks in diesel fuel oil system and emergency diesel generator system." The Fuel Oil Chemistry Program manages biofouling in the fuel oil tanks and includes the following preventive actions.

- Periodic emergency and station blackout diesel generator, diesel driven fire pump, and Dresden Isolation Condenser Makeup Pump fuel oil samples are analyzed for the presence of water and particulates.
- Storage tank bottoms are periodically sampled for the presence of water.
- Fuel oil storage tank samples are routinely analyzed for biological growth.
- Samples of new fuel deliveries are analyzed for water, sediment, and the quality of the fuel being delivered.
- A biocide is added to new fuel oil when the fuel is delivered.
- Water and particulates are removed from the fuel whenever the fuel oil analysis acceptance criteria are approached or exceeded.
- Fuel oil storage tanks are periodically cleaned and inspected for evidence of internal corrosion.
- During normal operations, fuel oil day tanks are filled from the bulk fuel oil storage tanks to which the biocide has been added.

3.3.2.4.15 Carbon Dioxide System

RAI 3.3.2.4.15

(a) In item 3.3.2.260 of Table 3.3-2 of the LRA for the material/environment of brass or bronze/dry gas the applicant has listed no applicable aging effect. In the discussion column the applicant explained that "A moisture free gaseous environment (nitrogen) is not conducive to promoting aging degradation of brass or bronze components." Clarify whether dry carbon dioxide should be included in this discussion. Otherwise explain the applicability of this discussion to the carbon dioxide system.

In item 3.3.2.212 of Table 3.3-2 of the LRA the applicant identifies an environment of dry gas for the tank component of the carbon dioxide system. In section 2.3.3.15 (p. 2-144) of the LRA the applicant describes part of the Cardox unit as a liquid carbon dioxide tank. Resolve the apparent discrepancy between a dry gas environment and liquid carbon dioxide.

(b) The applicant identified no aging effect for carbon steel, or brass or bronze components in a dry gas environment. Dry carbon dioxide is not a degrading environment for carbon steel, or brass or bronze components. But carbon steel components may be sensitive to the presence of moisture in the carbon dioxide environment. Moisture may induce corrosion and corrosion -erosion. Clarify the degree of dryness of the carbon dioxide environment. Specify the activities in place to verify and maintain the degree of dryness of the carbon dioxide environment necessary to minimize aging degradation of carbon steel components during the period of subsequent operation including after periods in which carbon dioxide needs to be replenished or refilled.

Response:

(a) Aging Management Reference 3.3.2.260 of LRA Table 3.3-2 explicitly addresses a nitrogen gaseous environment. This statement applies to dry gases in general, including dry carbon dioxide (see EPRI 1003056, Non-Class 1 Mechanical

Implementation Guideline and Mechanical Tools, Revision 3, Appendix D). The discussion column for Aging Management Reference 3.3.2.260 of LRA Table 3.3-2 should not have included the parenthetical reference to nitrogen in the second sentence.

The discussion column of Aging Management Reference 3.3.2.212 in LRA Table 3.3-2 identifies an environment of dry gas for the tank component of the carbon dioxide system. The environment is further clarified in that section as "dry gas (moisture free)" indicating that the environment is free of water. LRA Section 2.3.3.15 (p. 2-144) describes part of the Cardox unit as a liquid carbon dioxide tank. The description in this section is correct as the carbon dioxide in the tank is maintained in its pressurized liquid form. However, little or no moisture in the form of water is contained in the tank. Therefore, there is no discrepancy between the environments identified in Aging Management Reference 3.3.2.212 of LRA Table 3.3-2 and LRA Section 2.3.3.15.

(b) The carbon dioxide environment at Dresden Station and Quad Cities Station is associated with the Cardox System. The carbon dioxide environment in this system is dry (anhydrous) carbon dioxide, which is at least 99.5% carbon dioxide. There are no activities specifically involving quantifying tank moisture levels. However, tank moisture levels are maintained sufficiently low enough to preclude any appreciable amount of corrosion or corrosion-erosion by:

1) Performing tank filling operations with vendor assistance in accordance with vendor recommendations.
2) Periodically monitoring tank pressure and temperature, and condition, limiting the possibility of undetected leaks.
3) Periodically calibrating tank pressure and temperature instrumentation.

3.3.2.4.16 Service Water System

<u>RAI 3.3.2.4.16</u>

The AMR of this system specifies References 3.3.2.208 and 3.3.2.179 for cast iron components in raw water. Reference 3.3.2.208 includes galvanic corrosion as a mechanism for loss of material, but Reference 3.3.2.179 does not. Clarify whether the components covered by Reference 3.3.2.179 (pump casings) are also susceptible to galvanic corrosion and provide the applicable aging management program(s).

Response:

According to EPRI 1003056, Non Class 1 Mechanical Guide Implementation and Mechanical Tools, Revision 3, Appendix B, galvanic corrosion is an applicable aging mechanism for cast iron components that are in contact with metals higher in the galvanic series.

Aging Management Reference 3.3.2.208 of LRA Table 3.3-2 is associated with cast iron strainer bodies in raw water environments. These strainer bodies house and are in contact with strainer filters made of stainless steel, which is higher in the galvanic series

than cast iron. Therefore, galvanic corrosion is an applicable aging effect for the strainer bodies.

Aging Management Reference 3.3.2.179 of LRA Table 3.3-2 is associated with cast iron pump casings in raw water environments. Specifically, this item involves the casings of pumps in the Dresden CCSW and service water systems. These pump casings are not in contact with any metals higher in the galvanic series. Therefore, galvanic corrosion is not an applicable aging mechanism for the pump casings associated with Aging Management Reference 3.3.2.179 of LRA Table 3.3-2.

3.3.2.4.19 Demineralized Water Makeup System

RAI 3.3.2.4.19

Loss of material due to pitting and crevice corrosion may be an applicable aging effect on aluminum components exposed to outdoor ambient conditions or cast iron exposed to treated water. However, in Table 3.3-2, Ref No 3.3.2.22, the applicant identified loss of material due to pitting corrosion as the only aging effect/mechanism on the aluminum components exposed to outdoor ambient conditions and in Table 3.3-2, Ref No 3.3.2.182, the applicant identifies only loss of materials due to selective leaching as the applicable aging effect/mechanism on cast iron exposed to treated water. Provide the technical basis for the not including the aging effect of loss of material due to crevice corrosion and/or pitting corrosion from the AMR.

Response:

Metals Handbook, 9th Edition, Volume 13, states that the aging effect/mechanism that may affect aluminum components exposed to outdoor ambient environment is loss of material due to pitting. Aluminum alloys have excellent resistance to atmospheric corrosion and in many outdoor applications, such alloys do not require shelter, protective coatings, or maintenance. Corrosion of most aluminum alloys by weathering is restricted to mild surface roughening by shallow pitting, with no general thinning. Therefore, loss of material due to pitting is the only applicable aging effect on aluminum components exposed to an outdoor environment, as evaluated in Aging Management Reference 3.3.2.22.

Loss of material due to pitting and crevice corrosion of cast iron components is addressed by Aging Management Reference 3.3.2.300. Aging Management Reference 3.3.2.182 addresses the aging effect of loss of material due to selective leaching on cast iron exposed to a treated water internal environment. Aging Management Reference 3.3.2.300 addresses the aging effect of loss of material due to pitting and crevice corrosion on cast iron exposed to an external environment of air, moisture, and humidity<100 ^{0}C (212 ^{0}F).

3.3.2.4.21 Containment Cooling Service Water System (Dresden only)

RAI 3.3.2.4.21

(a) The Aging Management Ref No 3.3.2.8 and 3.3.2.9 in Table 2.3.3-21 deal with air handlers. The applicant identified loss of material and cracking as applicable aging effects for the components on the tube side exposed to raw water and credited Open-Cycle Cooling Water System (B.1.13) with managing these aging effects. No aging effect is identified for the components on the shell side exposed to warm moist air. Provide justification for not identifying any aging effects for the components on the shell side exposed to warm moist air, especially if there is condensation on the tubes.

(b) The AMR of this system specifies References 3.3.2.208 and 3.3.2.179 for cast iron components in raw water. Reference 3.3.2.208 includes galvanic corrosion as a mechanism for loss of material, but Reference 3.3.2.179 does not. Clarify whether the components covered by Reference 3.3.2.179 (pump casings) are also susceptible to galvanic corrosion and provide the applicable aging management program(s).

Response:

(a) Condensation is present on the tubes of the shell side of air handlers (heat exchangers). Aging Management References 3.3.2.8 and 3.3.2.9 of LRA Table 3.3-2 address open/coil fin type air coolers. The materials of these components that are exposed to a warm moist air environment are stainless steel, copper, aluminum, and carbon steel. Appendix G of Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, EPRI 1003056, identifies aging effects/mechanisms applicable to air handlers in air environments. It identifies loss of material due to wear, buildup of deposit due to fouling, and cracking due to fatigue as the applicable aging effects/mechanisms for stainless steel, copper, and aluminum air handling components in air environments. EPRI 1003056, Appendix D, identifies aging effects/mechanisms applicable to carbon steel components in air/gas environments. It identifies loss of material due to general corrosion, galvanic corrosion, and MIC as aging effects/mechanisms for carbon steel in air environments. LRA Table 3.3-2, Aging Management References 3.3.2.8 and 3.3.2.9, along with Aging Management Reference 3.3.2.7, include aging effects for both tube side and shell side surfaces. These aging management references appropriately identify the aging effects/mechanisms identified in EPRI 1003056 appendices referenced above for the subject air handler surfaces in a warm moist air environment. The associated aging management program is B.1.13, Open-Cycle Cooling Water System, which includes provisions for inspection of the external surfaces of air handler cooling water components.

(b) Per EPRI 1003056, Appendix B, galvanic corrosion is not an applicable aging mechanism for cast iron components that are not in contact with metals higher in the galvanic series. Aging Management Reference 3.3.2.208 of LRA Table 3.3-2 is associated with cast iron strainer bodies in raw water environments. These strainer bodies house and are in contact with strainer filters made of stainless steel, which is higher in the galvanic series than cast iron. Aging Management Reference 3.3.2.179 of LRA Table 3.3-2 is associated with cast iron pump casings in raw water environments. Specifically, this item involves the casings of pumps in the Dresden CCSW and service water systems. These pump casings are not in contact with any metals higher in the galvanic series. Therefore, galvanic corrosion is not an applicable aging mechanism for the pump casings

associated with Aging Management Reference 3.3.2.179 of LRA Table 3.3-2.

3.3.2.4.22 Ultimate Heat Sink

RAI 3.3.2.4.22

(a) Loss of materials from erosion and flow blockage from biofouling, silting and corrosion product buildup may also be applicable aging effects/aging mechanisms for some cast iron components in raw water environment. Clarify whether these are applicable aging effects/aging mechanisms for these components in the ultimate heat sink. If so, provide the applicable AMP(s). If not, provide the basis for not including erosion and flow blockage as applicable aging effect/aging mechanisms, including applicable operating experience.

(b) In table 2.3.3-22 and in item 3.3.2.28 of Table 3.3-2 of the LRA for the material/environment of carbon steel components encased in concrete the applicant has stated that there is no applicable aging effect. Good design and construction practices are necessary to prevent steel corrosion in an environment of being embedded in concrete. Provide specifics of the design and construction practices used for the carbon steel components encased in concrete in the ultimate heat sink, including applicable standards and operating experience.

Response:

(a) Loss of material from erosion and flow blockage from biofouling, silting and corrosion product buildup are not applicable aging effects/aging mechanism for cast iron components in raw water environment in the ultimate heat sink. Cast iron components within the scope of license renewal in the ultimate heat sink are pumps and valves with a pressure boundary component intended function. The aging effect/mechanism for these components is "Loss of material/ General, pitting and crevice corrosion, selective leaching and microbiologically influenced corrosion". A review of plant operating history did not reveal any loss of intended function for cast iron components in the ultimate heat sink due to erosion and flow blockage aging mechanisms. Aging Management Reference 3.3.2.172 addresses the aging management of cast iron components internal surfaces. Aging Management Reference 3.3.2.300 addresses the aging management of cast iron components external surfaces.

(b) EPRI TR-114881, "Aging Effects for Structures and Structural Components (Structural Tools)" states that 'the high alkalinity of concrete (pH > 12.5) provides an environment around embedded steel and steel reinforcement which protects them from corrosion'. EPRI TR-114881 further states that the corrosion rate is insignificant until a pH of 4.0 is reached. The concrete structures and structural members are designed and constructed in accordance with ACI-318-63 and ASTM standards which provide a good quality, dense, low permeability concrete that provides adequate concrete cover over the encased steel. A review of plant operating history did not reveal any loss of intended function for the carbon steel components encased in concrete in the ultimate heat sink.

Aging Management Reference 3.3.2.28 discusses the aging management of carbon steel components (underground corrugated steel ice melting piping) external surfaces encased in concrete. Aging Management Reference 3.3.1.15 discusses the aging management of carbon steel component (underground corrugated steel ice melting piping) internal surfaces in raw water environment.

3.3.2.4.23 Fuel Pool Cooling and Filter Demineralizer System (Dresden only)

RAI 3.3.2.4.23

NUREG 1801 identifies loss of material due to corrosion is an aging effect for shell side components (shell and access cover, channel head and tubes) of heat exchanger of fuel pool cooling and cleanup system exposed to close-cycle cooling water. Provide justification for not identifying any aging effect for the shell side components of the heat exchanger of the fuel pool cooling and filter demineralizer system in LRA Table 2.3.3-23.

Response:

Exelon does not consider the Dresden heat exchangers associated with the fuel pooling cooling and cleanup system, as shown on boundary diagrams LR-DRE-M-31 and LR-DRE-M-362, to be within the scope of license renewal. None of the Quad Cities fuel pooling cooling and cleanup system is within the scope of license renewal.

The fuel pool cooling and cleanup system is a non-safety related closed-loop system that is normally in continuous operation. In normal operation, the fuel pool cooling and cleanup system interfaces directly with the spent fuel pool, which is a Class I structure, and during refueling operations it may be aligned to support filling or draining the reactor cavity and/or the equipment storage pool. The non-safety related reactor building closed cooling water system provides the cooling medium for the fuel pool cooling heat exchangers and the non-safety related demineralized water make-up system is the normal make-up water supply for the fuel storage pool. Each of the two spent fuel pool cooling system return lines to the spent fuel pool have openings in the pipe about 6 inches below the pool surface to act as antisiphon devices by allowing air into the pipe to break the vacuum if siphoning begins. This precludes uncontrolled draining of the spent fuel pool in the event of a pipe failure. Additionally, the heat exchangers are not located near safety related equipment that could be affected by failure of these components.

The complete loss of fuel pool cooling could result in overheating of fuel rods stored in the fuel pool if makeup systems were not activated and the fuel pool were allowed to boil away. However, this is not a design or licensing basis event and several hours would be available for restoration of makeup systems. Makeup systems available include the condensate transfer system, the demineralized water system, and the fire water system, any of which could be connected by hoses to provide makeup to the spent fuel pool. Calculations performed as part of the extended power uprate evaluation determined that with a complete loss of cooling to the spent fuel pool, it would take at least 8 hours for the Dresden fuel pool to reach 212°F. This would provide adequate time to establish alternative sources of make-up water to the pool. Because failure of the fuel pool cooling system does not threaten to cause consequential failure of other safety related systems or components and because postulated failure of the fuel pool cooling system allows

ample time to implement alternative make-up to the fuel pool, failure of the fuel pool cooling system is not considered a failure of a non-safety related system whose failure could prevent satisfactory accomplishment of any of the safety related functions identified in 10 CFR 54.4(a)(1).

3.3.2.4.24 Plant Heating System

RAI 3.3.2.4.24

(a) Loss of materials from selective leaching may be an applicable aging effect/aging mechanism for cast iron and brass components in saturated steam/condensate as well as air, moisture, humidity, and leaking fluid environments, if stagnant liquids are present in these environments. Clarify whether these are applicable aging effects/aging mechanisms for these components in the plant heating system (including applicable operating experience) and provide appropriate AMP(s), if applicable.

Loss of materials from selective leaching may be an applicable aging effect/aging mechanism for cast iron and brass components in saturated steam/condensate as well as air, moisture, humidity, and leaking fluid environments if stagnant liquids are present in these environments. Clarify whether these are applicable aging effects/aging mechanisms for these components in the plant heating system. Provide the applicable AMP(s) or the basis not including these aging effects (including applicable operating experience).

(b) In item 3.3.3.214 in table 3.3-2 of the LRA the applicant describes the aging management of the carbon steel tank component in the plant heating system using the AMP one-time inspection (B.1.23). Clarify whether all parts of the tank(s) are accessible to inspection. If not, clarify the aging management of the inaccessible parts of the tank(s) component of the plant heating system.

Response:

(a) In the Plant Heating System, cast iron and brass components that are in a saturated steam/condensate environment or in an air, moisture, humidity, and leaking fluid environment are subject to loss of material due to general corrosion. They may also be subject to loss of material due to selective leaching if stagnant liquids are present in these environments. The aging effect, loss of material, is managed by a one-time inspection, which requires the inspection of a representative sample of components in these environments to detect for signs of degradation.

With regard to loss of material due to selective leaching, the most common example of selective leaching in brass alloys results in either a uniform attack or a localized plug attack. Selective leaching of gray cast iron results in iron being dissolved, leaving a porous mass consisting of graphite, voids, and rust. The AMP, "One-Time Inspection" (B.1.23), is credited for managing the loss of material due to general corrosion in the components exposed to a saturated steam/condensate environment and also an air, moisture, humidity, and leaking fluid environment. The AMP requires an inspection of a representative sample to confirm the absence of degradation or that degradation is managed adequately.

The results of the inspection direct further action to be taken. If loss of material occurs in these components, whether it is due to selective leaching or general corrosion, it will be detected by the one-time inspection and further action will be taken.

(b) The tanks grouped under Aging Management Reference 3.3.3.214 in LRA Table 3.3-2 are not buried or embedded in a way that makes large areas of the tanks inaccessible for inspection. In response to RAI B.1.23-2 Exelon has stated that it will perform periodic inspections of Dresden and Quad Cities plant heating system components using processes based on the One-Time inspection AMP. Consistent with Exelon's response to RAI B.1.23-2, one or more components in the plant heating system with material consisting of carbon steel exposed to an environment of saturated steam / condensate will be periodically inspected. The inspected component(s) will serve as a representative sample for all carbon steel components in the plant heating system, encompassing both the accessible parts of the plant heating system and any small areas of the tank where access may be difficult.

3.3.2.4.27 Drywell Nitrogen Inerting System

RAI 3.3.2.4.27

In Table 3.3-2, Ref No 124 of the LRA, the applicant identified carbon steel material exposed to warm, moist air as subject to aging effect of loss of material due to pitting and crevice corrosions. However, in Ref No 273 for the same material/environment combination, the applicant identifies loss of material due to general, pitting, and crevice as applicable aging effect. Clarify why different AMR results were arrived for components with the same material/environment combinations.

Response:

Aging Management Reference 3.3.2.124 assigned to Table 3.3-2 (Aging management review results for the engineered safety features that are not addressed in NUREG-1801) inadvertently omitted general corrosion. Table 3.3-2, Aging Management Reference 3.3.2.124 should have read "Loss of material/ General, pitting and crevice corrosion as shown below:

Table 3.3-2 - Aging management review results for the engineered safety features that are not addressed in NUREG 1801

Ref No	Component Group	Material	Environment	Aging Effect/Mechanism	Aging Management Program	Discussion
3.3.2.124	Isolation Barriers	Carbon Steel	Warm, moist air	Loss of material/ General, pitting and crevice corrosion	10 CFR Part 50, Appendix J (B.1.28)	NUREG-1801 does not address carbon steel components in a warm, moist air environment.

3.3.2.4.28 Safe Shutdown Makeup Pump System (Quad Cities only)

RAI 3.3.2.4.28

LRA Table 2.3.3-28 includes filters/strainers with a filter function and references 3.3.1.19 in section 3.3. It appears that reference 3.3.1.19 applies to fire protection rather than the safe shutdown makeup pump system and this reference does not indicate how the filter function is managed. LRA section 2.3.3.28 indicates that the evaluation boundary includes the safe shutdown room cooler and its associated piping from the service water system (evaluated with the service water system). If the strainer screens in the safe shutdown makeup pump system (such as the safe shutdown room cooler strainer) are evaluated with the service water system in table 3.3-1 ref. 3.3.1-15 which credits the B.1.13 AMP, please so clarify and include in Table 2.3.3-28. If the filters/strainers in the safe shutdown makeup pump system are not evaluated with the service water system, clarify how the strainer screens are managed. If the pump suction strainers (shown in boundary diagram LR-QDC-M-70) are temporary start-up strainers that are replaced by a spool piece once in operation, so clarify. If these suction strainers are permanent, identify their appropriate AMR reference.

Response:

The safe shutdown room cooler strainer is not evaluated with the service water system. The strainer is evaluated with the safe shutdown makeup pump system, which was scoped as a subsystem of the fire protection system. This strainer is cleaned on a monthly basis. The cleaning requirements are defined in a station procedure. The AMP associated with Aging Management Reference 3.3.1.19 is B.1.19, Fire Water System, and is appropriately assigned to this strainer.

The section of piping labeled "spool piece for in line strainer" in the suction of the safe shutdown makeup pump is not a strainer. No additional aging management reference is required for this spool piece.

Section 3.4 Aging Management of Steam and Power Conversion System

RAI 3.4-1 (General)

Table 3.4-1, "Aging Management Programs Evaluated in NUREG-1801 that are Relied On for License Renewal for the Steam and Power Conversion System," Ref No 3.4.1.8, page 3-150, refers to the open-cycle cooling water system in the component column. This appears to be a typo in that Ref No 3.4.1.7 also refers to the open-cycle cooling water system. The AMP for Ref No 3.4.1.8 is the Closed-Cycle Cooling Water System (B.1.14). Verify that the components of Ref No 3.4.1.8 is associated with the open-cycle cooling water system or revise Table 3.4-1.

Response:

A review of LRA Table 3.4-1, Aging Management Reference 3.4.1.8, has determined that there was a typographical error in transferring the text from NUREG 1800, Table 3.4.1, to

Aging Management Reference 3.4.1.8. Table 3.4-1, Aging Management Reference 3.4.1.8, should read "Heat exchangers and coolers/condensers serviced by closed-cycle cooling water", as shown below.

Ref No	Component	Components Evaluated	Aging Effect/Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.4.1.8	Heat exchangers and coolers/ condensers serviced by closed-cycle cooling water	See Discussion Column	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Closed-cycle cooling water system (B.1.14)	No	Components are not in the scope of license renewal.

3.4.1 Main Steam System

RAI 3.4.1-1

Table 3.4-2, Ref No 3.4.2.51, page 3-161, the Discussion does not agree with the Aging Effect/Mechanism. The Discussion addresses crevice and pitting corrosion in a treated water environment, while the Aging Effect/Mechanism addresses crack initiation and growth/stress corrosion cracking and intergranular stress corrosion cracking in a 288 °C steam environment. Verify that the Aging Effect/Mechanism should be Loss of material/Pitting and crevice corrosion in a treated water environment or include the BWR Stress Corrosion Cracking AMP as an AMP and correct the Discussion column for Ref No 3.4.2.51.

Response:

The discussion in Table 3.4-2, Aging Management Reference 3.4.2.51, should have read "NUREG 1801 does not address stress corrosion cracking of stainless steel in a steam environment."

The NUREG 1801 BWR Stress Corrosion Cracking AMP XI.M7 is not being used as an AMP for this aging management reference because it is applicable to piping components that are part of the reactor coolant pressure boundary piping made of stainless steel that contains reactor coolant at or above temperature of 93°C. The components associated with Aging Management Reference 3.4.2.51 are not part of the reactor coolant pressure boundary. The components are main steam system valves with an environment of 288°C Steam. Therefore, the appropriate AMP is B.1.2, Water Chemistry, which is used to mitigate the effects of cracking in stainless steel by reducing the presence of impurities such as sulfates and chlorides.

RAI 3.4.1-2

Table 2.3.4-1, for component groups piping and fittings, rupture disks, thermowells, and vacuum breakers refer to Aging Management Ref. 3.2.1.3 of Table 3.2-1. The discussion column of 3.2.1.3 refers to Section 3.2.1.1.3 of the LRA. Section 3.2.1.1.3 does not address the main steam system. Verify that Aging Management Ref 3.2.1.3 is applicable to the main steam system, revise Section 3.2.1.1.3 of the LRA to address the main steam system, or delete the reference in Table 2.3.4-1.

Response:

The component description for Aging Management Reference 3.2.1.3 does not list main steam system because the component description in Table 3.2-1 uses the NUREG 1801 wording. In NUREG 1801, the safety relief discharge piping is classified as part of the automatic depressurization system, is listed in NUREG 1801, Item V.D2.1-e, and is included in the component description as part of the emergency core cooling system. However, at Dresden and Quad Cities, the safety relief discharge piping is classified as part of the main steam system.

Aging Management Reference 3.2.1.3 is applicable to the main steam system. LRA Section 3.2.1.1.3 addresses the Dresden and Quad Cities safety relief discharge piping, which is part of the main steam system.

The components in the main steam system that refer to Aging Management Reference 3.2.1.3 of LRA Table 3.2-1 are associated with the Dresden and Quad Cities safety relief discharge piping. These components are shown on boundary diagrams LR-DRE-M-12-1, LR-DRE-M-25, LR-DRE-M-345-1, LR-DRE-M-356, LR-QDC-M-13-1, LR-QDC-M-34-1, LR-QDC-M-60-1, and LR-QDC-M-76-1.

RAI 3.4.1-3

For flexible hoses in the main steam system, the LRA uses Ref. No. 3.4.2.18, which addresses flexible hoses made of elastomers of neoprene and similar materials, in a containment nitrogen environment, and no aging effects. Environmental conditions such as temperature and radiation can affect the aging of neoprene and similar materials. Clarify the environment with respect to temperature, radiation levels, and time when the containment is not or has not been inerted, to justify that the neoprene hoses do not require aging management.

Response:

Elastomer degradation of Neoprene may result from rupture of the polymer bonds due to exposure to ultraviolet radiation, thermal exposure, or ionizing radiation. The flexible hoses in question are the hoses in the Main Steam System, which are attached to the air accumulators for the MSIVs. LRA Table 3.4-2, Aging Management Reference 3.4.2.18, for flexible hoses exposed to a containment nitrogen environment, should have shown the aging effect / aging mechanism as hardening and loss of strength due to elastomer degradation. The aging management program credited should have been B.1.23 "One-Time Inspection" to inspect a sample of compressed gas system flexible hoses for elastomer degradation. No changes are required to LRA Appendix B.1.23 because these hoses are currently included in the program to manage hardening and loss of strength due to elastomer degradation caused by exposure to their internal environment.

LRA Table 3.4-2, Aging Management Reference 3.4.2.18 should have read as follows:

Ref No	Component Group	Material	Environment	Aging Effect/Mechanism	Aging Management Program	Discussion
3.4.2.18	Flexible Hoses	Elastomers Neoprene and Similar Materials	Containment Nitrogen	Hardening and loss of strength/ Elastomer degradation	One-Time Inspection (B.1.23)	NUREG-1801 does not address elastomers in a saturated air environment.

3.4.3 Condensate and Condensate Storage System

RAI 3.4.3-1

Table 3.4-2, Ref No 3.4.2.2, page 3-154, lists high strength low alloy steel closure bolting in outdoor ambient conditions are subject to the aging effects/mechanism loss of material/general corrosion and wear. NUREG 1801, Chapter VIII H.2-a&b, however, lists carbon steel low alloy steel closure bolting, in air, moisture, humidity and leaking fluid environments are subject to the aging effects of loss of material due to general corrosion and crack initiation and growth due to cyclic loading and/or stress corrosion cracking, as is all other closure bolting in the steam and power conversion systems referenced in the LRA (See Table 3.4-2, Ref No 3.4.1.6, page 3-150, of the LRA). Provide justification for excluding the aging effects of loss of material due to general corrosion and crack initiation and growth due to cyclic loading and/or stress corrosion cracking for Ref No 3.4.2.2 closure bolting or revise Table 3.4.2 of the LRA.

Response:

NUREG 1801 Chapter VIII H.2-b refers to closure bolting in high-pressure or high-temperature systems. For bolting in the high-pressure or high-temperature portions of steam and power conversions systems, the applicable aging effects from NUREG 1801 are in LRA Table 3.4-1, Aging Management Reference 3.4.1.6. The bolts associated with LRA Table 3.4-2, Aging Management Reference 3.4.2.2, are in the Condensate and Condensate Storage System on the piping to the condensate storage tanks. This piping is low-pressure and low-temperature and is not subject to cyclic loading (see boundary diagrams LR-DRE-M-35-1 and LR-QDC-M-16-5).

EPRI 1003056, Non-Class 1 Mechanical Guideline and Mechanical Tools, Appendix F-Closure Bolting, states that stress corrosion cracking is not an applicable aging effect for bolting material with a tensile strength of less than 150 ksi. The bolts used are ASTM A193, Grade B7 with a tensile strength of 125 ksi. EPRI 1003056, Appendix F, states, "The use of appropriate materials (such as ASTM A193, Gr. B7) for bolting also reduces the potential for SSC of fasteners by maintaining fastener minimum yield strengths below threshold values found in ["Degradation and Failure of Bolting in Nuclear Power Plants, EPRI NP-5796]."

For bolting in the low-pressure, low-temperature portion of the Condensate and Condensate Storage System, loss of material due to general corrosion or wear is the only applicable aging effect and is covered by LRA Table 3.4-2, Aging Management Reference 3.4.2.2.

3.4.4 Main Condenser

RAI 3.4.4-1

Table 2.3.4-4, page 2-193 of the LRA lists the component group of the main condenser hotwells, false floor (includes hatches) and refers to the aging management reference number 3.4.2.27 in Table 3.4-2, pages 3-154 to 3-162 of the LRA. In Table 3.4-2, Reference Number 3.4.2.27, the component group includes the main condenser waterboxes, hatches; however, it does not include hotwells or false floors. Verify that Reference Number 3.4.2.27 should include the hotwells and false floors within its component group or revise Table 2.3.4-4 of the LRA.

Response:

LRA Table 2.3.4-4 (Component Groups Requiring Aging Management Review – Main Condenser) refers to Aging Management References 3.4.2.24 and 3.4.2.27. Aging Management Reference 3.4.2.24 addresses the internal steam environment for the main condenser shell, hotwells and false floors. Aging Management Reference 3.4.2.27 address the external air, moisture, and humidity environment for the main condenser, waterboxes, hatches, and hotwells.

The hotwells should have been added to Aging Management Reference 3.4.2.27. The false floors should not have been included in Aging Management Reference 3.4.2.27 because the false floors are internal to condenser and experience only the primary environment of steam.

LRA Table 3.4-2, Aging management review results for the steam and power conversion system that are not addressed in NUREG 1801, should have read as follows.

Ref No	Component Group	Material	Environment	Aging Effect/Mechanism	Aging Management Program	Discussion
3.4.2.27	Main Condenser, Hotwells, Waterboxes, Hatches	Carbon Steel	Air, moisture, and humidity < 100°C (212°F)	None	None	NUREG-1801 does not address the main condenser components. There are no main condenser aging effects requiring management. Therefore, no aging management is required to maintain the intended function of containment holdup plate-out.

RAI 3.4.4-2

Table 2.3.4-4, page 2-193 of the LRA lists the component group of the main condenser tubes, tubesheets (includes hatches) and refers to the aging management Reference

Numbers 3.4.2.25 and 3.4.2.26 in Table 3.4-2, pages 3-154 to 3-162 of the LRA. In Table 3.4-2, the component group for Reference Numbers 3.4.2.25 and 3.4.2.26 includes the main condenser tubes, and tubesheets; however, it does not include hatches. Verify that Reference Numbers 3.4.2.25 and 3.4.2.26 should include hatches within its component group or revise Table 2.3.4-4 of the LRA.

Response:

The words "(includes hatches)" were inadvertently added to LRA Table 2.3.4-4 (Component Groups Requiring Aging Management Review – Main Condenser), Component Group Main Condenser Tubes, Tubesheets. This line should only refer to main condenser tubes and tubesheets, not the hatches. The hatches are evaluated in LRA Table 2.3.4-4, under Component Group, "Main Condenser Hotwells, False Floors". Table 2.3.4-4 should have removed "(includes hatches)" from the main condenser tubes, tubesheets line. The applicable Aging Management References for this Component Group are 3.4.2.24 and 3.4.2.27.

Table 2.3.4-4 Component Groups Requiring Aging Management Review – Main Condenser) should have read as follows.

Component	Component Intended Function	Aging Management Ref
Main Condenser Tubes, Tubesheets	Containment Holdup and Plateout	3.4.2.25, 3.4.2.26

RAI 3.4.4-3

The AMR for the main condenser does not identify any aging mechanisms that require management. However, the material/environment combinations include carbon steel in steam, carbon steel in raw water, stainless steel in raw water, and carbon steel in air, moisture, and humidity <100°C. All of these material/environment combinations are subject to aging effects that may require management. Provide justification for the conclusion that the components in the main condenser do not require aging management.

Response:

10 CRF 54.21 (ii) (3) requires that for each structure and component identified in 10 CRF 54.21 (a)(1), licensees are to demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation.

The license renewal intended function of the main condenser is to provide post-accident containment, hold up and plate-out of iodine for MSIV bypass leakage. This intended function of the main condenser is dependent on the condenser's surface area, volume, and leakage integrity. Material conditions resulting from any creditable aging effects

have no substantive effect on the main condenser's ability to maintain the intended function of providing a post-accident hold up volume or surface plate-out of iodine from MSIV bypass leakage.

Hold-up is a function of the main condenser's volume and leak rate. The condenser's volume is invariant with age; therefore, aging will not affect the condenser volume. Dresden and Quad Cities Loss of Coolant Accident (LOCA) and Control Rod Drop Accident (CRDA) analyses assume the main condensers leak to the atmosphere at a rate of 1% per day throughout the accident. During a LOCA or CRDA, the condenser loses vacuum as it approaches atmospheric conditions. There is no leakage from the condenser while the condenser's pressure is lower than atmospheric. Changes in barometric pressure could cause some out-leakage from the condenser when it finally reaches nominal atmospheric conditions. The assumption of 1% continuous external leakage throughout the accident is judged ample to account for the net effects of any small leaks in the post-accident period. The ability of the condenser to operate in the steam power conversion cycle during the license renewal period demonstrates integrity commensurate with the leakage assumed in the analyses. Condenser integrity sufficient to perform the post-accident intended function (holdup and plateout of MSIV leakage) is continuously confirmed by normal plant operation because the main condenser must perform a significant pressure boundary function (maintain vacuum) in support of normal, continued plant operation.

Surface plate-out of iodine in the main condenser following a LOCA or CRDA is based on surface area and is unaffected by aging of the condenser's surfaces. The condenser's iodine removal credited in the Dresden and Quad Cities accident analyses is unaffected by surface condition.

In summary, there are no creditable aging effects that affect the post-accident intended function of the main condenser. Furthermore, no aging management program is required to manage the aging effects because the main condenser integrity is continuously confirmed during normal plant operation. Thus, the condenser post-accident function will be ensured consistent with the current licensing bases throughout the extended period of operations. This position has been previously accepted by the NRC staff as documented in NUREG 1769, Safety Evaluation Report Related to the License Renewal of Peach Bottom Atomic Power Station, Units 2 and 3, Section 3.4.2.

3.5 Aging Management of Containments, Structures and Component Supports

RAI 3.5-1

In LRA Section 3.5, on page 3-163, it is stated that:

"The aging management reviews for this section have incorporated the proposed NRC guidance provided in Enclosure 2 to the letter from Christopher I. Grimes, Chief, Licensing and Standardization Branch, Office of Nuclear Reactor Regulation, to Mr. Alan Nelson, Nuclear Energy Institute, "Proposed Staff Guidance on the Position of the GALL Report Presenting One Acceptable Way to Manage Aging Effects for License Renewal," dated November 23, 2001. Table 3.5-1 incorporates revisions provided in Enclosure 2 to this letter."

The staff believes that the applicant intended to reference a different letter that has the same date and from/to, entitled "Proposed Revision of Chapters II and III of Generic Aging Lessons Learned (GALL) Report on Aging Management of Concrete Elements." Enclosure 2 to this letter documents the revisions to the SRP and GALL report, to clarify aging management of concrete. The applicant is requested to verify that the staff is correct.

Response:

Exelon has reviewed page 3-163 of the LRA and agrees with the Staff. Section 3.5 of the LRA should have referenced letter from Christopher I. Grimes, Chief, Licensing and Standardization Branch, Office of Nuclear Reactor Regulation, to Mr. Alan Nelson, Nuclear Energy Institute, "Proposed Revision of Chapters II and III of Generic Aging Lessons Learned (GALL) Report on Aging Management of Concrete Elements," dated November 23, 2001.

RAI 3.5-2

In LRA Section 3.0, under the heading "Operating Experience," it is stated that:

"A review of plant-specific operating experience was conducted to identify aging effects requiring management. Industry-wide operating experience since the preparation of NUREG-1801 was also reviewed to identify aging effects requiring management. These reviews concluded that the aging effects identified by plant-specific and industry-wide operating experience were consistent with those identified in NUREG-1801. On-going review of plant-specific and industry operating experience is performed in accordance with corrective action programs and operating experience programs."

The applicant has not identified the source material utilized in the plant-specific operating experience review or in the industry-wide operating experience review. The applicant is requested to submit details of its operating experience review, including the time frame covered by the review, the information sources used, and any key findings that led to exclusion of aging effects identified in NUREG-1801.

Response:

The operating experience reviews included a search of the Dresden and Quad Cities Corrective Action databases, which contain Condition Reports (CR) and the predecessor program Problem Identification Forms (PIF) (from 1993 to present), the work control database which contains maintenance work orders and modifications (from 1984 to present), and a search of the NRC website for regulatory correspondence, such as Generic Letters, Information Bulletins, and Information Notices (from April 2001, the date NUREG 1801 was issued, to the present). Additionally, the EPRI Electrical, Mechanical, and Structural Tools were used to identify relevant industry operating experience.

The Dresden and Quad Cities License Renewal Application (LRA) identifies the exceptions to aging effects identified by NUREG-1801 in the Chapter 3 Tables under the

Discussion column. These tables provide the basis for excluding the aging effect or a reference to further discussion of why the aging effect is not applicable. The below table provides a summary of those aging effects and where they are discussed in the LRA.

NUREG-1801 Aging Effect	LRA Reference	Basis for Exclusion
Crack initiation and growth due to stress corrosion cracking and intergranular stress corrosion cracking	3.1.1.6 and 3.1.2.44	This aging effect is for stainless steel. The Dresden leak detection line is made of carbon steel.
Wall thinning due to flow-accelerated corrosion	3.1.1.11	The exceptions to flow accelerated corrosion are described in Section 3.1.1.2.2.
Loss of preload due to stress relaxation	3.1.1.12	The exceptions to loss of preload aging degradation are described in Section 3.1.1.2.1.
Loss of material due to general pitting, and crevice corrosion	3.1.1.20	Dresden and Quad Cities have cladded top head enclosure and nozzles. The NUREG-1801 line item for top head nozzles is for unclad carbon steel. Therefore, this aging effect is not applicable. For aging management of the clad top heads see Table 3.1-2, Ref. No. 3.1.2.59.
Wall thinning due to flow-accelerated corrosion	3.2.1.12	The exceptions to flow accelerated corrosion are described in Section 3.2.1.2.1.
Crack initiation and growth due to stress corrosion cracking and intergranular stress corrosion cracking	3.2.1.13	The exceptions to BWR stress corrosion cracking are described in Section 3.2.1.2.2.
Biofouling; buildup of deposit due to biofouling	3.3.1.15	The exceptions to biofouling for a(2) components are described in Section 3.3.1.2.2. Additionally, it should be noted that the intended functions of a(2) components is structural integrity and pressure boundary. Therefore, biofouling is not an aging effect that requires management on these components.
Loss of material due to selective leaching	3.3.1.27	The Dresden and Quad Cities piping and pump material is carbon steel and therefore not susceptible to selective leaching.
Concrete cracking and spalling due to freeze-thaw, aggressive chemical attack, and reaction with aggregates;	3.3.1.28	The exceptions to structural aging effects due to aggressive chemical attack, reaction with aggregates, freeze-

NUREG-1801 Aging Effect	LRA Reference	Basis for Exclusion
and loss of material due to corrosion of embedded steel		thaw & corrosion of embedded steel are described in Section 3.3.1.2.1.
Wall thinning due to flow-accelerated corrosion	3.4.1.4	The exceptions to flow accelerated corrosion are described in Section 3.4.1.2.1.
Cracking due to cyclic loading (CLB fatigue analysis does not exist)	3.5.1.2	CLB fatigue analyses exist for penetration bellows. Therefore, NUREG-1801 line II.B4.1-c does not apply.
Cracking due to cyclic loading (CLB fatigue analysis does not exist)	3.5.1.17	CLB fatigue analyses exist therefore NUREG-1801 line II.B1.1.1-b (Mark 1 Containments) does not apply.
All types of aging effects, including loss of material due to abrasion, cavitation, and corrosion	3.5.1.22	The exceptions to structural aging effect for concrete due to settlement are described in Section 3.5.1.2.1. The exceptions to structural aging effect due to freeze-thaw are described in Section 3.5.1.2.2. The exceptions to structural aging effect due to leaching of calcium hydroxide are described in Section 3.5.1.2.3. The exceptions to structural aging effect due to reaction with aggregates are described in Section 3.5.1.2.4. The exceptions to structural aging effect due to abrasion and cavitation are described in Section 3.5.1.2.5. The exceptions to structural aging effects due to corrosion of embedded steel are described in Section 3.5.1.2.6. The exceptions to structural aging effects due to aggressive chemical attack are described in Section 3.5.1.2.7.
Crack Initiation and growth due to SCC; Loss of material due to crevice corrosion	3.5.1.28	The exceptions to NUREG-1801 for cracking due to crack initiation and growth due to SSC and loss of material due to crevice corrosion are described in Section 3.5.1.2.8.
Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced IR; electrical failure caused by thermal/ thermoxidative degradation of organics; radiation-induced oxidation; moisture intrusion	3.6.1.3	The exceptions to instrumentation cable insulation are described in Section 3.6.1.2.1.
Formation of water trees, localized damage leading to electrical failure (breakdown of insulation); water trees caused by moisture intrusion	3.6.1.4	The exceptions to formation of water treeing are described in Section 3.6.1.2.2.

RAI 3.5-3

For Groups 1-3, 5-9 Class I structures, the applicant states in LRA Section 3.5.1.1.1 that reduction in foundation strength, cracking, and differential settlement due to erosion of porous concrete subfoundation are not applicable to Dresden and Quad Cities and no aging management is required. Dresden and Quad Cities evaluations of Information Notices 97-11 and 98-26 concluded that no porous materials were used. The Dresden and Quad Cities licensing basis does not include a program to monitor concrete for settlement nor is a de-watering system in place. Dresden and Quad Cities structures are founded on rock or natural compacted soil and there is no documented change in groundwater conditions or history of settlement.

In LRA Table 3.5-1, Ref. No. 3.5.1.25 and 3.5.1.26, the applicant credits Structures Monitoring (B.1.30) for managing aging due to settlement and erosion of porous concrete subfoundation, and indicates "Consistent with NUREG-1801." This appears to be inconsistent with the further evaluations presented in LRA Section 3.5.1.1.1. The applicant is requested to clarify this apparent inconsistency.

Response:

Exelon concurs with the staff assessment of LRA Table 3.5-1, Aging Management References 3.5.1.25 and 3.5.1.26. Each reference should have stated the aging management evaluations were "Exception to NUREG-1801" as defined in section 3.0 of the LRA.

Table 3.5-1 should have read as follows:

Ref No	Component	Components Evaluated	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.5.1.25	Groups 1-3, 5, 7-9: foundation	NUREG-1801 Components Concrete Slabs Foundations	Cracks, distortion, and increases in component stress level due to settlement	Structures Monitoring (B.1.30)	No, if within the scope of the applicant's structures monitoring program	Exception to NUREG-1801. Further evaluation of Cracking, Distortion, and Increase in Component Stress Level due to Settlement; Reduction of Foundation Strength due to Erosion of Porous Concrete Subfoundations is described in Section 3.5.1.1.1. Fuel storage facility, refueling canal identified in NUREG-1801, lines III.A5.1-h is evaluated as part of the reactor building in NUREG-1801, lines III.A2.1-h.
3.5.1.26	Groups 1-3, 5-9: foundation	NUREG-1801 Components Concrete Slabs Foundations	Reduction in foundation strength due to erosion of porous concrete subfoundation	Structures Monitoring (B.1.30)	No, if within the scope of the applicant's structures monitoring program	Exception to NUREG-1801. Further evaluation of Cracking, Distortion, and Increase in Component Stress Level due to Settlement; Reduction of Foundation Strength due to Erosion of Porous Concrete Subfoundations is described in Section 3.5.1.1.1. Fuel storage facility, refueling canal identified in NUREG-1801, lines III.A5.1-i is evaluated as part of the reactor building in NUREG-1801, lines III.A2.1-i.

<u>RAI 3.5-4</u>

For Groups 1-5 structures, the applicant states in LRA Section 3.5.1.1.2 that reduction of strength and modulus due to elevated temperature is not applicable for Dresden and Quad Cities concrete structures and no aging management is required since Dresden and Quad Cities normal operating temperatures are less than 150 °F general and are less than 200 °F local. The staff requests the applicant to (1) clarify whether the local concrete temperature or the local ambient air temperature was compared to the 200 °F limit; and (2) describe what provisions exist to ensure that the concrete surrounding hot piping penetrations does not exceed 200 °F.

Response:

1) The Dresden and Quad Cities Groups 1-5 concrete structures were installed in

accordance with ACI 349-85, Code Requirements for Nuclear Safety Related Concrete Structures, Appendix A. The operating temperature limits associated with these structures are consistent with the guidance provided in NUREG 1801 (which states that temperatures shall not exceed 150°F except for local areas which are allowed to have increased temperature not to exceed 200°F).

2) All hot pipe penetrations at Dresden and Quad Cities Nuclear Power Stations are designed such that the local area ambient temperature near the surrounding concrete does not exceed 200°F. Hot pipe air gaps through wall penetrations are large enough by design to maintain the area concrete temperature below 200°F. Dresden and Quad Cities normal operating ambient temperature limits do not exceed 150°F. The following provisions exist to ensure that the local area temperature near concrete surrounding the hot piping penetrations do not exceed 200°F.

   - Penetration sleeves are designed and installed to maintain the area concrete temperature below 200°F, based on the penetrating piping temperature.
   - The Drywell Coolers support the Primary Containment by maintaining the Primary Containment bulk temperature within limits during normal operation (an average temperature of approximately 135°F).

RAI 3.5-5

LRA Section 3.5.1.1.3 provides information on the aging management review of loss of material due to corrosion in inaccessible areas of the steel containment shell for both Dresden and Quad Cities. The staff requests the following additional information regarding this review:

(a) How was it determined that Dresden Unit 3 had more leakage in the drywell sand pocket area than Dresden Unit 2 and Quad Cities?

(b) Define the quantitative basis for concluding that " significant corrosion was not occurring" in Dresden Unit 3.

(c) What is the technical basis for concluding that corrosion in the sand pocket area is insignificant at Dresden Unit 2 and Quad Cities?

(d) What controls exist on all four units to limit future leakage into the sand pocket areas and how will the leakage be monitored?

(e) What were the results of the augmented inspection of the sand pocket area for Dresden Unit 3, which was scheduled for the second half of 2002?

(f) How often will the augmented UT inspection of the sand pocket area be conducted for Dresden Unit 3, and what is the basis for not conducting similar inspections for Dresden Unit 2 and Quad Cities?

(g) It is stated that a general visual inspection of the moisture barrier at the junction of the steel drywell shell and the concrete floor is performed once each inspection period in accordance with the B.1.26 AMP. Is the inspection conducted each inspection period for all four units? If not, explain why not.

(h) Confirm that the concrete floor inside the drywell of all four units (1) meets "the

requirements of ACI 318-63 and the guidance of ACI 201.2R-77" and (2) "is monitored for penetrating cracks that provide a path for water seepage in accordance with Structures Monitoring Program (B.1.30)." This is the staff's interpretation of the fourth paragraph of LRA Section 3.5.1.1.3. If this interpretation is incorrect, please explain.

Response:

This response incorporates the NRC revision to question part (h).

(a) Dresden Unit 3 had significant quantities of water introduced to the drywell annulus to extinguish a fire in the drywell expansion foam. Additionally, the sand pocket drain lines were found to be clogged at Dresden Units 2 and 3 when performing the initial investigation in response to Generic Letter 87-05. When the drain lines were unclogged, there was water present in the sand pocket region of both units. At Quad Cities, both units had three of the four drain lines essentially dry and unplugged. This information was provided to the NRC in response to Generic Letter 87-05 and is the only information that could be found in the current licensing basis. Additional information provided in responses (b) through (h) below provide justification for concluding that Dresden Unit 3 is the most limiting of the units with respect to leakage.

(b) The design of the containment vessel is such that margin exists between the required shell thickness and the actual thickness of steel plate provided. A reevaluation of the required shell thickness (based on loads and data compatible with the original certified containment vessel stress report by Chicago Bridge & Iron Company) was performed on the containment shell in the region of the sand pocket. The thickness of the plates in the sand pocket region may be reduced to approximately 1/4-inch below nominal and still be within ASME Code allowable stress limits.

In response to IE Information Notice 86-99 and NRC Generic Letter 87-05, an extensive review was conducted of the potential for drywell steel corrosion in the area of the containment sand pocket. This review included an evaluation of the actual plate thickness at Dresden Unit 3. Ultrasonic Test (UT) results indicated that in over 18 years of operation of Dresden Unit 3, no detrimental corrosion occurred in the drywell steel plate at the sand pocket level. This conclusion was further supported by the fact that all of the thickness measurements were greater than the nominal 1.0625-inch thickness. The initial drywell plate thickness measurements along with subsequent thickness measurements are shown in the table below. The initial thickness measurements supported the conclusion that significant corrosion was not occurring.

Dresden Unit 3 Drywell Liner UT Thickness Measurements (Sand Pocket Region)

Sample Location	1988 Measurement Inches	1997 Measurement Inches	1999 Measurement Inches	2000 Measurement Inches	2002 Measurement Inches
112.5.1.1A	1.12	1.15	1.1	1.12	1.13
112.5.1.1B	1.12	1.12	1.09	1.08	1.09
112.5.1.2A	1.1	1.12	1.12	1.09	1.07
112.5.1.2B	1.08	1.08	1.08	1.12	1.13
157.5.1.1A	1.14	1.2	1.15	1.17	1.18
157.5.1.1B	1.14	1.16	1.14	1.15	1.11
157.5.1.2A	1.14	1.18	1.14	1.14	1.13
157.5.1.2B	1.12	1.16	1.11	1.1	1.12
202.5.1.1A	1.08	1.09	1.1	1.11	1.13
202.5.1.1B	1.08	1.1	1.08	1.1	1.11
22.5.1.1A	1.1	1.12	1.08	1.12	1.09
22.5.1.1B	1.14	1.1	1.12	1.15	1.12
22.5.1.2A	1.18	1.14	1.09	1.07	1.09
22.5.1.2B	1.1	1.12	1.1	1.06	1.04
292.5.1.1A	1.18	1.16	1.1	1.08	1.1
292.5.1.1B	1.12	1.16	1.12	1.1	1.12
292.5.1.2A	1.12	1.12	1.08	1.09	1.10
292.5.1.2B	1.26	1.12	1.12	1.14	1.15
337.5.1.1A	1.2	1.17	1.15	1.16	1.15
337.5.1.1B	1.08	1.11	1.1	1.09	1.09
337.5.1.2A	1.12	1.14	1.12	1.08	1.04
337.5.1.2B	1.24	1.12	1.09	1.06	1.08

(c) In response to IE Information Notice 86-99 and NRC Generic Letter 87-05, an extensive review was conducted of the potential for drywell steel corrosion in the area of the containment sand pocket. This review included an evaluation of the actual plate thickness at Dresden Unit 3. Ultrasonic Test (UT) results indicated that in over 18 years of operation of Dresden Unit 3, no detrimental corrosion occurred in the drywell steel plate at the sand pocket level. This conclusion was further supported by the fact that all of the thickness measurements were greater than the nominal 1.0625-inch thickness. These results have been obtained in spite of the fact that substantial moisture has previously been found in the sand pocket.

Since the as-found material thickness in Dresden Unit 3 was greater than or equal to design thicknesses, there was no reason to expect a reduction in thickness on Dresden Unit 2. A surveillance procedure had been established to monitor sand pocket drain lines during refuel activities and analysis of water samples taken from the lines reflected a non-corrosive environment.

At Quad Cities, the drywell sand pocket detail is identical to the Dresden detail. The moisture found at the in the sand pocket drains during inspections around the same time period as Dresden in the late 1980s was considered negligible in comparison to Dresden Unit 3. Therefore, it was not expected that any corrosion had occurred at either Quad Cities unit and the ongoing surveillance program will ensure active assessment of future

potential problems. No leakage through the drywell liners was detected during the most recent refuel outage inspections following cavity flood-up. Accordingly, Quad Cities continues to be bounded by the routine UT results from Dresden Unit 3.

(d) No special controls exist at either station for limiting leakage. Formal inspections occur at each station during refuel outages that monitor for leakage from the sand pocket drains following reactor cavity flood-up. Corrective action is taken based on the results of these inspections.

(e) The results of the last four Dresden Unit 3 drywell wall thickness measurements are provided in the table shown above in the response to question (b). The augmented inspection completed in October 2002 on Dresden Unit 3 was evaluated as acceptable with no drywell liner degradation noted. The design of the containment vessel is such that margin exists between the required shell thickness and the actual thickness of steel plate provided. The thickness of the plates in the sand pocket region may be reduced to approximately 1/4-inch below nominal (1.0625 inch) and still be within ASME Code allowable stress limits. As shown in the table, all of the thickness measurements remain above the minimum wall thickness allowed.

(f) The augmented UT inspection for Dresden Unit 3 is currently completed every refueling outage. The frequency of future examinations will be evaluated based on inspection results. This inspection was specially configured to accommodate UT inspections by drilling 22 core holes for UT measurements. As long as Dresden Unit 3 remains the bounding condition for corrosion potential, there is no need to drill holes and conduct routine UT measurements on the remaining three units.

(g) A general visual inspection of the moisture barrier at the junction of the steel drywell shell and the concrete floor is performed once each inspection period for Dresden Units 2 and 3 and once each inspection interval for both Quad Cities units. The difference in the two inspection periods is attributed to the ASME Section XI Code edition in effect at each plant. Dresden performs this inspection in accordance with the 1998 Edition of ASME Section XI and Relief Request MCR-02. Quad Cities performs the in accordance with the 1992 Edition of ASME Section XI, 1992 Addenda, Table IWE-2500-1. The original Quad Cities drywell moisture barriers in both units were replaced during outages in the year 2002 due to age degradation

(h) The concrete floor inside the drywell of all four units (1) was designed per ACI 318-63 and meets the guidance of ACI 201.2R-77 and (2) is periodically monitored for penetrating cracks that provide a path for water seepage, in accordance with the Structures Monitoring Program (B.1.30).

RAI 3.5-6

Based on information provided in LRA Section 2.4 and referenced UFSAR sections, stainless steel expansion bellows are utilized in (1) primary containment mechanical penetrations; (2) vent line-to-suppression chamber connections; (3) the reactor vessel-to-drywell refueling seal; and (4) the drywell-to-reactor building refueling seal. The LRA specifically identifies the containment penetration and vent line bellows. The refueling seals and bellows are not specifically identified in the LRA. In SER Section 2.4, the staff has requested additional information about the refueling seals, in order to understand how the applicant has evaluated the seals for license renewal.

The staff recognizes that loss of material due to general corrosion is not an applicable aging effect for stainless steel. However, stainless steel bellows and associated dissimilar metal welds are potentially susceptible to cracking due to SCC, when exposed to certain environmental conditions. Degradation of stainless steel bellows has occurred at nuclear power plants; consequently, close attention to loss of intended functions(s) is warranted.

In the LRA Section 3.5.1.1.5, the applicant indicates that the stainless steel bellows at Dresden and Quad Cities do not require augmented aging management beyond general visual examination conducted under IWE Examination Category E-A and Appendix J leak rate testing. The staff position is that the potential for cracking exists; that a crack would not be detected by a general visual examination (i.e., VT-3) before intended function is compromised; and that more detailed examination (e.g., IWE 1992 Examination Categories E-B and E-F) is warranted.

To complete its evaluation of the applicant's conclusion that augmented inspection of stainless steel bellows and associated dissimilar metal welds is not necessary at Dresden and Quad Cities, the staff needs additional plant-specific information. The applicant is requested to submit the following information for all four (4) units covered by this LRA:

(a) A detailed description of plant-specific operating experience for all stainless steel bellows (including any not within the scope of license renewal that serve a similar function in a similar environment), identifying all specific incidences of degradation, how degradation was detected, the root cause, corrective actions taken, and current inspection procedures.

(b) The environment (temperature, pressure, humidity, presence of aggressive agents) to which stainless steel bellows are exposed, both on a continuing basis and on a periodic or intermittent basis.

(c) Identification of the applicable aging effects requiring management for stainless steel bellows at Dresden and Quad Cities.

(d) The detailed technical basis, including identification of supporting reference material, for concluding that Appendix J leak rate testing and IWE Examination Category E-A general visual inspection are sufficient for managing aging of stainless steel bellows.

Response:

Expansion bellows are used at Quad Cities and Dresden on primary containment mechanical penetrations, vent line-to-suppression chamber connections, on extraction steam piping that penetrates the turbine casings, and as a refueling cavity area seal during flood up for refueling. The information that follows is provided to address stainless steel bellows assemblies and their attachment welds.

(a) The refueling bellows are made of stainless steel and are not in scope of license renewal. Justification for excluding the refueling bellows from the scope of license renewal is discussed in the response to RAI 2.4.3. The refueling bellows experience a different environment and have a different function. As such, they are excluded from further discussion.

Extraction steam piping bellows are made of Inconel and experience different environments than the primary containment penetration bellows. Additionally, the

extraction steam piping bellows are not included in the scope of license renewal. For these reasons, they are excluded from further discussion.

Expansion bellows are installed on the Dresden and Quad Cities primary containment mechanical penetrations on the following process lines. The list includes the vent line-to-suppression chamber connections. All of the mechanical penetration expansion bellows are in scope of license renewal.

(1) Main Steam (4 per unit)
(2) Steam Line Drain (1 per unit)
(3) Feedwater (2 per unit)
(4) RCIC Steam Supply (1 per unit, at Quad Cities only)
(5) Isolation Condenser Steam Supply (1 per unit, at Dresden only)
(6) Isolation Condenser Condensate (2 per unit, at Dresden only)
(7) Shutdown Cooling Suction (2 per unit, at Dresden only)
(8) RHR Suction from Reactor (1 per unit, at Quad Cities only)
(9) LPCI Injection (2 per unit, at Dresden only)
(10) RHR Injection (2 per unit, at Quad Cities only)
(11) Reactor Water Clean Up Supply (1 per unit)
(12) HPCI Steam Supply (1 per unit)
(13) RBCCW Supply (1 per unit)
(14) RBCCW Return (1 per unit)
(15) Vent from Drywell (1 per unit)
(16) Vent to Drywell (1 per unit)
(17) Core Spray Injection (2 per unit)
(18) Standby Liquid Control Injection (1 per unit)
(19) Head spray (1 per unit, at Dresden only)
(20) Drywell to Suppression Chamber Vent Lines (8 per unit)

There have been no recordable indications identified on any bellows assemblies or attachment welds at either Dresden or Quad Cities utilizing Examination Category E-A, Containment Surfaces, of ASME Boiler and Pressure Vessel Code, Subsection IWE.

Degradation was detected on 16 bellows assemblies at Dresden and 8 bellows assemblies at Quad Cities over the history of plant operation while conducting 10 CFR Part 50, Appendix J, testing. The degradation was significant enough to require bellows replacement. Fifteen of the 16 degraded bellows assemblies at Dresden were replaced. One penetration with a degraded bellows assembly at Dresden was sealed inside containment as part of an unrelated modification to remove the return line to the vessel for the control rod drive water. For this reason, replacement of the sixteenth bellows was unnecessary. The eight degraded bellows assemblies at Quad Cities were replaced.

The root cause of the bellows assembly degradation was attributed to cracking due to transgranular stress corrosion cracking (TGSCC). Several degraded bellows that were replaced were metallurgically analyzed. Quad Cities Unit 1 X-16A bellows, replaced in 1984, was found to be contaminated with "magnesium salts." The corrosive species responsible for the crack initiation on Quad Cities Unit 1 X-25 bellows was identified as chlorides, fluorides, and sulfides. Since operating conditions do not introduce these materials, it has been concluded they were most probably introduced during construction. Additionally, the method of bellows manufacturing introduces residual stresses in the bellows. Bellows are cold-formed from cylinders fabricated from sheet stainless steel.

A listing of identified degraded bellows assemblies, Unit, and date replaced is provided below. A discussion of current inspection procedures is included in part (d) to this question.

Site, Unit	Penetration	Date
Dresden, Unit 2	X-113 (Reactor Water Clean Up Supply)	September, 1990
Dresden, Unit 3	X-105A (Main Steam)	December, 1991
Dresden, Unit 3	X-107B (Feedwater)	March, 1992
Dresden, Unit 2	X-125 (Vent from Drywell)	May, 1993
Dresden, Unit 2	X-149A (Core Spray Injection)	May, 1993
Dresden, Unit 2	X-149B (Core Spray Injection)	May, 1993
Dresden, Unit 2	X-144 (Control Rod Drive Water Return)	Sealed inside drywell
Dresden, Unit 3	X-111A (Shutdown Cooling Suction)	May, 1994
Dresden, Unit 3	X-125 (Vent from Drywell)	May, 1994
Dresden, Unit 3	X-138 (Standby Liquid Control Injection)	May, 1994
Dresden, Unit 3	X-149B (Core Spray Injection)	May, 1994
Dresden, Unit 2	X-108A (Isolation Condenser Steam Supply)	February, 1997
Dresden, Unit 2	X-116A (LPCI Injection)	February, 1997
Dresden, Unit 2	X-126 (Vent to Drywell)	February, 1997
Dresden, Unit 2	X-116B (LPCI Injection)	January, 2003
Dresden, Unit 2	X-124 (RBCCW Return)	January, 2003
Quad Cities, Unit 2	X-16B (Core Spray Injection)	September, 1983
Quad Cities, Unit 1	X-16A (Core Spray Injection)	September, 1984
Quad Cities, Unit 1	X-16B (Core Spray Injection)	November, 1989
Quad Cities, Unit 1	X-12 (RHR Suction from Reactor)	March, 1991
Quad Cities, Unit 1	X-25 (Vent from Drywell)	March, 1991
Quad Cities, Unit 2	X-14 (Reactor Water Clean Up Supply)	May, 1993
Quad Cities, Unit 1	X-7B (Main Steam)	August, !994
Quad Cities, Unit 2	X-12 (RHR Suction from Reactor)	December, 1996

(b) The bellows assemblies are exposed to two environments; inside containment (either drywell or suppression chamber air space) on the inner surface of the bellows, and outside containment on the outer surface of the bellows. Neither environment contains aggressive agents. The environments are further described as follows.

<u>Inside Containment</u>
The drywell is made inert with nitrogen to render the primary containment atmosphere non-

flammable by maintaining the oxygen content below 4% by volume during normal operation. The drywell has an average temperature of 135°F during normal operations. The relative humidity in the drywell ranges from 20% - 90%. During normal operation, the drywell pressure is maintained at approximately one psig. The suppression chamber air space above the water level, is also inerted to maintain the oxygen content below 4% by volume during normal operation. The air temperature follows the normal, maximum operating suppression chamber water temperature of 95°F and the relative humidity is between 20 and 90%. During normal operation, the suppression chamber pressure is maintained at approximately zero psig. Periodically, each entire containment is subjected to a pressure of 48 psig during the performance of a 10 CFR Part 50, Appendix J, Type A, Primary Containment Integrated Leak Rate Test (ILRT).

Outside Containment
The Reactor Building (outside the drywell, suppression chamber, and steam tunnel) normal operating area temperatures range from 65°F to 103°F for Dresden and 65°F to 104°F for Quad Cities, with relative humidity ranging from 20% - 90%.

(c) The applicable aging effects requiring management for stainless steel bellows assemblies at Dresden and Quad Cities are cumulative fatigue damage (NUREG 1801 line II.B4.1-b and LRA Reference 3.5.1.1) and crack initiation and growth due to SCC (NUREG 1801 line II.B4.1-d and LRA Reference 3.5.1.2).

(d) Based on Dresden and Quad Cities operating experience, there is potential for cracking in the bellows assemblies, but not in the dissimilar welds associated with the assemblies. 10 CFR Part 50, Appendix J testing has been effective in identifying past bellows assembly degradation due to cracking.

The primary containment mechanical penetration expansion bellows assemblies originally installed at Quad Cities and Dresden were each constructed of two-plies of Type 304 Stainless Steel, formed together into a cylindrical corrugated bellows assembly. 10 CFR Part 50, Appendix J Type B LLRT testing was performed on them by pressurizing the volume between the plies. In 1990, Quad Cities discovered that it was not always possible to quantify the bellows assembly leakage rate due to the design and construction of the bellows assemblies. This was reported to the NRC by Exelon and then communicated by the NRC to the industry in IN 92-20. An exemption for certain Type B LLRT testing requirements for Quad Cities and Dresden was requested from the NRC in 1991 and was granted in February, 1992. A revision to the exemption was requested in October 1994, and was granted in February 1995. The exemptions apply to the original two-ply bellows assemblies. As they are replaced, the new bellows fall under the full Type B LLRT testing requirements.

Replacement bellows are single ply. This ply becomes the primary containment pressure boundary. Transition rings are added to the bellows assemblies to allow for the installation of an outer bellows over the first one. The installation of this outer bellows allows for the performance of a Type B LLRT test. Replacement bellows are cold-formed during fabrication, as were the original bellows. To minimize the potential for contamination, installation instructions for the replacement bellows include cleaning the entire outer surface of the inner bellows after welding of the transition rings, and cleaning of the entire inner and outer surfaces of the outer bellows before it is welded.

Degraded bellows assemblies identified since 1991 were identified utilizing the methodology developed to comply with the exemptions. Briefly, this testing methodology

is:

(1) All two-ply bellows assemblies are pressurized between the plies. Any bellows assembly with measured leakage ≥ 0.5 scfh are further tested with helium.

(2) The bellows assembly is pressurized between the plies with helium, and the inner and outer plies are sniffed with a helium sniff detector.

(3) If helium is detected through both plies, the outer ply is examined with penetrant and/or snoop testing. All flaws are measured and mapped.

(4) All indications are evaluated by Engineering to assess current and projected leakage rates, and for structural integrity.

(5) The 1992 exemption required a Type A ILRT upon completion of all two-ply testing. The 1995 revision provides the option of performing a test in accordance with Type B LLRT requirements on all bellows assemblies with leaks through both plies, or performing a Type A ILRT.

(6) The 1992 exemption required that all two-ply bellows assemblies with demonstrated leakage through both plies be replaced during the subsequent refueling outage. There is reasonable assurance that the leaking bellows assemblies will not degrade excessively during this period because TGSCC is characterized by the slow development and propagation of cracks. The 1995 revision provides the option of performing a test in accordance with Type B LLRT requirements to demonstrate license limits are met or replacing the bellows assemblies.

The bellows assembly welds at Dresden and Quad Cities are inspected utilizing Examination Category E-A, Containment Surfaces, of ASME Boiler and Pressure Vessel Code, Subsection IWE.

RAI 3.5-7

With regard to the discussion in LRA Section 3.5.1.1.6 concerning loss of material in Drywell Radial Beam Lubrite Baseplates, the staff requests the following additional information:

(a) Describe the prior operating experience of the torus saddle support lubrite baseplates and under what program have they been inspected? Are lubrite baseplates used at any other locations in Dresden and Quad Cities? If so, what has been the operating experience?

(b) The torus saddle support lubrite baseplates are covered under GALL Item III B1.3.2-a and it is expected that they would be managed by ASME Section XI, Subsection IWF. This GALL item is part of LRA Table 3.5-1, Ref. No. 3.5.1.31, which states that Dresden and Quad Cities is consistent with GALL, with one exception. The only exception discussed in LRA Table 3.5-1 for this item pertains to aging of downcomer bracing. Explain why aging management of loss of material due to galvanic corrosion, lock-up or wear of the torus saddle support lubrite baseplates will be performed by One-Time Inspection (B.1.23) and not by ASME Section XI, Subsection IWF (B.1.27).

(c) What is the sample size for the inspection of the torus saddle support lubrite baseplates that will be used to confirm the condition of the inaccessible drywell radial beam lubrite

baseplates?

(d) Confirm that all radial beam lubrite baseplates inside the drywell are inaccessible and explain the conditions that make them inaccessible.

(e) Discuss the environments that the torus saddle support lubrite baseplates and the drywell radial beam lubrite baseplates are exposed to and explain why they are considered to be similar.

Response:

Exelon has reviewed the LRA Section 3.5.1.1.6 and the following additional information is provided for clarification.

(a) The torus saddle support lubrite baseplates have not been inspected to date and are currently not included in the ASME Section XI, Subsection IWF aging management program. Exelon will revise this program to include the torus saddle support lubrite baseplates. However, this program will not be revised before the end of the current 10-year ISI program interval expires. To ensure that a baseline inspection is performed before the current operating license expires, a one-time inspection of the torus saddle support lubrite baseplates will be performed. This initial inspection will be performed under aging management program, B.1.23, One-Time Inspection. It will be replaced by aging management program B.1.7, ASME Section XI, Subsection IWF, once it has been revised and approved by the NRC.

A historical review of the Exelon corrective action program did not identify any problems with the torus saddle support lubrite baseplates. These plates are used on the torus column supports and other piping systems and component supports to reduce friction between sliding supports and the bearing plates.

(b) As stated above in item (a), torus saddle support lubrite baseplates will be managed by ASME Section XI, Subsection IWF, and are addressed under NUREG 1801 Item III.B.1.3.1-a in the aging management review. The torus saddle support lubrite baseplates are addressed in LRA Section 2.4.15, Table 2.4-15, under Component Group "Sliding Surfaces". LRA Table 3.5-1, Aging Management Reference 3.5.1.31, discusses the aging management of the saddle support lubrite baseplate. A sample of the torus saddle support lubrite baseplates has been selected for a one time inspection that is representative of the inaccessible drywell radial beam lubrite baseplates. The lubrite baseplates are addressed in LRA Section 2.4.1, Table 2.4-1, under Component Group "Beam Seats" requiring aging management.

(c) The one-time inspection of the torus saddle support lubrite baseplate sample will consist of one saddle support baseplate located in a dry area of the Reactor Building basement. An additional inspection will be performed on a saddle support lubrite baseplate in an area that has experienced water exposure, if such a location can be found. Otherwise, a second dry area inspection will be performed.

(d) The drywell lubrite bearing plates are hidden behind the base plates of the radial floor beams located on the main floor of the drywell. These radial floor beams are located between the reactor vessel biological shield and the drywell shell and provide structural support for the main floor grating and major components located on that elevation.

Removal of the radial floor beams would jeopardize the structural integrity of the attached equipment. For this reason, the primary containment radial lubrite beams are considered inaccessible.

(e) The drywell radial beam lubrite baseplates are exposed to the Inside Drywell Environment. The drywell is made inert with nitrogen to render the primary containment atmosphere non-flammable by maintaining the oxygen content below 4% by volume during normal operation. The drywell has an average temperature of 135°F during normal operation. The relative humidity in the drywell ranges from 20% - 90%.

The torus saddle support lubrite baseplates are exposed to the Outside Drywell Environment which is identical to that found in the Reactor Building. The Reactor Building (which includes the area containing the torus saddle supports) normal operating area temperatures range from 65°F to 103°F for Dresden and 65°F to 104°F for Quad Cities with relative humidity ranging from 20% - 90%.

The drywell radial beam lubrite baseplates are exposed to a milder environment than the torus saddle support lubrite baseplates because of the lack of oxygen in the nitrogen-inerted environment. The temperature of the Inside Drywell Environment is constant during power operation, reducing the likelihood of condensation accumulation on the steel components. The higher temperature itself is not detrimental to the steel components. For this reason, the torus saddle support lubrite baseplates are considered to be representative and bounding of the drywell radial beam lubrite base plates.

RAI 3.5-8

The "Discussion" column of LRA Table 3.5-1, Ref. No. 3.5.1.20 states that "Dresden and Quad Cities do not use stainless steel lined, carbon steel tanks as evaluated in NUREG-1801, line III.A8.2-a." The staff notes that NUREG-1801, line III A8.2-a addresses loss of material due to corrosion for unlined carbon steel tanks, and that NUREG-1801, line III A8.2-b addresses stainless steel liners in steel tanks. The "Discussion" column of LRA Table 3.5-1, Ref. No. 3.5.1.28 states that "Dresden and Quad Cities do not use steel tanks lined with stainless as identified in NUREG-1801, line III.A8.2-b."

Based on the information provided in LRA Table 3.5-1, the staff cannot determine (1) whether any unlined carbon steel tanks are included in the license renewal scope; and (2) if so, where the aging management review results are located in the LRA. The applicant is requested to identify any unlined carbon steel tanks in the license renewal scope; and, if applicable, describe the aging management review and the credited aging management programs.

Response:

The statement "Dresden and Quad Cities do not use stainless steel lined, carbon steel tanks as evaluated in NUREG-1801, line III.A8.2-a" in LRA Table 3.5-1, Aging Management Reference 3.5.1.20, was inadvertently placed in this line entry.

Tanks are evaluated with the primary system in which they were installed. Some examples of carbon steel tanks can be found in LRA Table 2.3.2-1, High Pressure Coolant Injection, LRA Table 2.3.2-3, Containment Isolation Components and Primary Containment Piping System, and

LRA Table 2.3.3-6, Emergency Diesel Generator and Auxiliaries. None of the LRA Chapter 2 component tables requiring aging management containing tanks are linked to Chapter 3 Aging Management Reference 3.5.1.20.

Table 3.5.1 should have been revised as follows:

Ref No	Component	Components Evaluated	Aging Effect/ Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion

3.5.1.20	All Groups except Group 6: accessible interior/ exterior concrete & steel components	NUREG 1801 Components Beam Seals Blowout Panels Concrete Beams Concrete Columns Concrete Curbs Concrete Manholes Concrete Shield Plugs Concrete Slabs Concrete Walls Foundations Metal Decking Metal Siding Misc. Steel Penetration Sleeves Precast Concrete Panels Steel Doors Steel Embedments Steel Panels and Cabinets Steel Plates Structural Steel	All types of aging effects	Structures Monitoring (B.1.30)	No, if within the scope of the applicant's structures monitoring program and a plant-specific aging management program is required for inaccessible areas as stated	Consistent with NUREG-1801. Further evaluation of Aging of Structures Not Covered by Structures Monitoring Program is described in Section 3.5.1.1.6. Dresden and Quad Cities are Group 2 reactor buildings with steel superstructures (NUREG-1801, line III.A2.2-a. Fuel storage facility, refueling canal identified in NUREG-1801, lines III.A5.1-a,b,c,d,f are evaluated as part of the reactor building in NUREG-1801, lines III.A2.1-a,b,c,d,f. Spent fuel pool identified in NUREG-1801, line III.A5.2-a is evaluated as part of the reactor building in NUREG-1801, line III.A.2.2-a.

<u>RAI 3.5-9</u>

LRA Section 3.5.1.2.9 discusses an exception to GALL for evaluation of the ECCS Suction Header identified under Ref. Nos. 3.5.1.12 and 3.5.1.14 in LRA Table 3.5-1. The applicant states that this item is evaluated with GALL item V.D2.1-a, with the results presented in Ref. Nos. 3.2.1.2 and 3.2.1.4 in LRA Table 3.2-1. LRA Table 3.2-1 references Water Chemistry (B.1.2) and One-time Inspection (B.1.23) as the aging management programs for these items. It is the staff's position, as discussed in GALL item II.B1.1.1-a, that aging of the ECCS suction header should be managed by ASME Section XI, Subsection IWE. The applicant is requested to (a) explain why the ECCS Suction Header was evaluated as part of the ECCS piping and not as part of the containment, and (b) submit a detailed technical basis demonstrating that an equivalent level of safety is achieved with the applicant's approach, when compared to Subsection IWE requirements.

Response:

NUREG 1801 addresses the ECCS Suction Headers in two locations. Item II.B.1.1.1-a addresses the Primary Containment (ASME Class MC components) and manages Loss of Material due to Corrosion. Item V.D2.1.a addresses Piping and Fittings, (generally ASME Class 2 components) and manages Loss of Material due to General, Pitting, and Crevice Corrosion.

The current design bases for the Dresden and Quad Cities ECCS Suction Headers classify these as ASME Class 2 components. This is reflected on boundary diagrams LR-DRE-M-29 (drawing coordinates C-3 to C-6), LR-DRE-M-360-1 (drawing coordinates C-3 to C-6), LR-QDC-

M-39-1 (drawing coordinates E-3 and E-7), and LR-QDC-M-81-9 (drawing coordinates E-3 and E-7). The ASME Code Class flags are defined on boundary diagrams LR-DRE-M-11-2 and LR-QDC-M-12-3. Since both NUREG-1801 line items provide an NRC-accepted method to manage the loss of material due to corrosion in carbon steel components, the Dresden and Quad Cities LRA selected the applicable NUREG-1801 line item based on current design bases. For this reason, the ECCS Suction Headers are managed by the Water Chemistry (B.1.2) and One-time Inspection (B.1.23) aging management programs.

Note: The ECCS Suction Header shown on boundary diagram LR-DRE-M-29 is shown in black. It should have been shown in green as an in-scope component.

RAI 3.5-10

In LRA Table 3.5-2, Ref No. 3.5.2.8 "Drywell Expansion Foam," the applicant references a plant-specific TLAA that is described in LRA Section 4.7.4. The polyurethane drywell expansion foam installed on the outside of the containment was originally evaluated for hardening due to radiation exposure assuming a 40-year operating life. As discussed in Section 6.2.1.2.1.1 of the Dresden UFSAR, this foam has caught on fire twice in Dresden Unit 3 (January 20, 1986 and June 4, 1988). The staff requests the applicant to submit the following information for all four units:

(a) Describe any other instances of fires or other degradation experiences related to the drywell expansion foam;

(b) Describe the programs and procedures put in place to prevent future fires in the drywell expansion foam. If none, explain why they are not necessary;

(c) Describe any investigations that determined whether there was any significant change in material properties due to the fires, or other operating experiences, that would prevent the foam from performing its intended function. If none, explain the technical basis for concluding that there has been no change in material properties;

(d) Identify all the environments that the expansion foam may be exposed to, including leaking water, and discuss what effect each environment may have on the material properties of the foam.

(e) Concerning the January 26, 1986 fire, it is stated in Dresden UFSAR Section 6.2.1.2.1.1 that "The polyurethane in the gap burned for several hours resulting in a postulated upper bounding temperature of 500 degree F for both the steel containment and the primary containment shield wall." It is also stated that, "Structural integrity of both the concrete and containment steel were determined not to be impaired to perform as designed in the event of a design basis accident (DBA)." Concerning the June 4, 1988 fire, it was determined that "this fire was bounded by the analyses conducted for the 1986 fire and no further analyses were conducted." Provide a detailed technical basis demonstrating that the evaluation of the concrete and containment steel for the effects of the fires remains valid for the period of extended operation.

Response:

(a) The polyurethane foam is installed on the outside of the steel drywell containment vessel, but inside the surrounding concrete shield, providing an expansion gap between the steel and concrete surfaces. No other instances of degradation of Drywell Expansion Foam other than those discussed in the Dresden UFSAR could be found.

(b) Procedures originally developed to prevent recurrence of these fires include Dresden Maintenance Procedure DMP 4100-1 and Dresden Administrative Procedure DAP 3-2, which have been superceded by, OP-AA-201-004, "Fire Prevention For Hot Work". This new procedure still emphasizes the requirement for a Fire Watch during hot work (welding, cutting, grinding and open flame operations) for 30 minutes after completion or suspension of the hot work.

(c) The fires were evaluated as part of the initial event and the results accepted by the NRC in "Safety Evaluation Report By The Office of Nuclear Reactor Regulation of The Expansion Gap Fire on January 20, 1986 at Dresden Station Unit 3" dated August 31, 1987. The foam's intended function(s) is "Expansion/Separation – Provides for thermal expansion and/or seismic separation". Test results from the burning of polyurethane foam samples showed that the residuals are easily crushed by finger pressure and would therefore allow the thermal expansion of the drywell liner for the period of extended operation. Additionally, Section 4.7.4 of the LRA provides the basis for concluding that no change in material properties is expected for the extended term of operation.

(d) The expansion foam was evaluated as exposed to an "Outside Containment" environment. This environment is defined as: The Reactor Building (outside the drywell, torus, and steam tunnel) normal operating area temperatures range from 65°F to 103°F for Dresden and 65°F to 104°F for Quad Cities with relative humidity ranging between 20% and 90%. As discussed in LRA Section 4.7.4, this environment in addition to the expected radiation exposure will not affect the resilient characteristics of this polyurethane foam. This foam is not typically exposed to leaking fluid.

(e) The original function of the foam was to provide separation between the drywell steel liner and the concrete as the concrete was poured. The remaining function of the foam is to allow thermal expansion of the steel liner. Test results from the burning of polyurethane foam samples showed that the residuals are easily crushed by finger pressure and would therefore allow the thermal expansion of the drywell liner for the period of extended operation. The structural integrity of the containment steel and surrounding concrete was not affected by the drywell fires. Temperatures experienced by the drywell liner fires never approached 850°F, which is the minimum temperature that steel begins to lose tensile strength. The surrounding concrete was also not affected as concrete spalling does not occur below 1000°F.

RAI 3.5-11

For Group 6 Structures (Water-Control Structures), LRA Section 3.5.1.2.5 states that loss of material due to abrasion and cavitation of concrete in accessible areas is managed by RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.1.31). The applicant further states that Dresden and Quad Cities water flow velocity (3.68 fps) is less than the industry abrasion erosion threshold velocity of 4 fps, and also less than the industry

cavitation threshold velocity of 25 fps; and concludes that loss of material due to abrasion and cavitation of concrete in inaccessible areas is not applicable and no aging management is required. As discussed under GALL Item III A6.1-h, the staff expects that for Group 6 Structures (Water-Control Structures), loss of material due to abrasion and cavitation of reinforced concrete in a flowing water environment will be managed by the RG 1.127 program. This applies to all concrete: exterior above and below grade; foundation; interior slab. The applicant is requested to provide the following information: (1) clarify what is meant by "accessible" and "inaccessible" areas for all Group 6 components, (2) identify the reference for the stated industry abrasion erosion and cavitation threshold velocities, and (3) provide the technical basis for the reported Dresden and Quad Cities water flow velocity.

(It is noted that clarification of the scope of Group 6 components at Dresden and Quad Cities is the subject of staff RAI 2.4-7.)

Response:

(1) For Group 6 Structures, the term inaccessible applies to those structures and portions of structures that are either buried or submerged under water where the confined area access or high flow rates make diver entrance unsafe without a dual unit outage.

(2) Abrasion and cavitation are limited to concrete exposed to flowing water containing abrasives. Industry sources use an abrasion erosion threshold velocity for concrete of 4.0 feet per second (Ref.: EPRI TR-110025, Concrete Structural Aging References Manual of Nuclear Power Plants) and a cavitation threshold velocity for concrete of 25 fps when abrupt changes occur in closed conduits and 40 fps in continuously flowing water (Refs. EPRI TR-114881, Aging Effects for Structures and Structural Components (Structural Tools), Final Report and EPRI TR-103842, Class-I Structures - License Renewal Industry Report). Cavitation is not applicable for concrete structures continuously exposed to flowing water if the water velocity is less than these values.

(3) The maximum water velocity in the crib houses for Dresden and Quad Cities is based on the velocity of the circulating water pump combined with the diesel generator cooling water pump, due to their close proximity and the reduced flow area in the intake tunnel where these pumps are located. The circulating water pump capacity is 157,000 gpm and the diesel generator cooling water pump capacity ranges from 1100 gpm to 1304 gpm. Flow area in the intake tunnel adjacent to the circulating water pump is conservatively 8ft x 12ft or 96 ft^2.

$$\text{Velocity in fps} = (158{,}304 \text{ gal/min}) \times (1 \text{ min}/60 \text{ sec}) \times (0.134 \text{ ft}^3/\text{gal}) / (96 \text{ ft}^2)$$
$$= 3.68 \text{ fps} < 4.00 \text{ fps}$$

<u>RAI 3.5-12</u>

For Group 6 Structures (Water-Control Structures), LRA Section 3.5.1.2.6 indicates that cracking, loss of bond, and loss of material (spalling, scaling) due to corrosion of embedded steel of concrete is managed by RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.1.31) only for accessible areas. Similarly, LRA Section 3.5.1.2.7 indicates that increase in porosity and permeability, cracking, and loss of material (spalling, scaling) due to aggressive chemical attack of concrete is managed by RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants (B.1.31) only for accessible

areas. LRA Sections 3.5.1.2.6 and 3.5.1.2.7 indicate that aging management is not required for these aging effects/mechanisms in inaccessible areas, based on the following considerations: (1) Dresden and Quad Cities ground water test data obtained during construction, the 1980's, 1990's, and 2000's shows that the below-grade environment is not aggressive based on NUREG-1801 criteria, with chlorides less than 500 ppm, sulfates less than 1500 ppm, and pH greater than 5.5; (2) examination of representative samples of below-grade concrete, when excavated for any reason, is included as part of the Structures Monitoring Program (B.1.30.); and (3) to ensure conditions are maintained throughout the period of extended operation, the Structures Monitoring Program (B.1.30) will be enhanced to include monitoring of below grade water chemistry to demonstrate that the environment remains non-aggressive.

As indicated in GALL Items III A6.1-d and e, for Group 6 Structures (Water-Control Structures), these aging effects/mechanisms are managed by the RG 1.127 program for all concrete. In the special case of water-control structures, the applicant's technical bases for excluding inaccessible areas from aging management may only be applied to interior concrete and above-grade concrete. The ultimate heat sink raw water is considered aggressive by its nature, and all concrete exposed to it needs to be managed for these aging effects/mechanisms. The applicant is requested to provide the following additional information: (a) define "inaccessible areas" as it relates to the subject aging effects/mechanisms in water-control structures; specifically discuss whether below-grade and below-water concrete in water-control structures is being excluded from aging management; and (b) if applicable, submit a detailed technical justification for not managing aging of below-grade/below water concrete in water-control structures, in light of past industry operating experience indicating there is a significant potential for degradation. (It is noted that clarification of the scope of Group 6 components at Dresden and Quad Cities is the subject of staff RAI 2.4-7.)

Response:

(a) The term inaccessible applies to those structures and portions of structures that are either buried or submerged under water where the confined area access makes diver entrance unsafe without a dual unit outage. The term accessible applies to those structures and portions of structures that are interior, above-grade exterior, or under water accessible.

(b) Aging Management Reference 3.5.1.22 states that this aging management evaluation is "Consistent with NUREG 1801, with exception". The exceptions to NUREG 1801 are described in LRA sections 3.5.1.2.6 and 3.5.1.2.7. The technical bases for exceptions 3.5.1.2.6 and 3.5.1.2.7 apply to the below-grade and inaccessible under water environments.

This technical justification for Group 6 structures is the same as the evaluation for Groups 1, 2, and 3 structures as discussed under NUREG 1801, Items III A1, 2, 3.1-e and III A1, 2, 3.1-g. Dresden and Quad Cities ground water test data obtained during construction, in the 1980's, 1990's, and 2000's shows that the below-grade environment is not aggressive based on NUREG-1801 criteria with chlorides less than 500 ppm, sulfates less than 1500 ppm, and pH greater than 5.5. The specified aging effects are not significant and no aging management is required of components in inaccessible areas. As recommended in the letter from Christopher I. Grimes to Alan Nelson dated 4/5/02, Subject: "Staff response to industry's proposed revisions of chapters II and III of generic aging lessons learned (GALL) report on aging management of concrete elements" that further evaluation of concrete components in inaccessible areas is not

required for which non-aggressive environment can be demonstrated. Therefore, Exelon is in compliance with the Interim Staff Guidance (ISG) on concrete for inaccessible area concrete components. To ensure conditions are maintained throughout the period of extended operations, the Structures Monitoring Program (B.1.30) includes monitoring of below-grade water chemistry to demonstrate that the environment remains non-aggressive.

RAI 3.5-13

LRA Section 3.5.1.2.10 discusses an exception to GALL for XI.M18, "Bolting Integrity" identified under Ref. No. 3.5.1.32 of LRA Table 3.5-1. The applicant states that Dresden and Quad Cities recirculation piping loop component supports inside the containment have ASTM 193 Grade B7 high strength low alloy steel bolting, which will be managed by ASME Section XI, Subsection IWF (B.1.27). The applicable GALL item number is III.B.1.1.2-a, which identifies XI.M18, "Bolting Integrity," as an acceptable aging management program for high strength low-alloy steel bolts (yield strength>150 ksi) used in NSSS component supports. The applicant is requested to provide the following information:

(a) It is stated in LRA Section 3.5.1.2.10 that "the specification for ASTM 193 Grade B7 lists minimum yield strength of 105 ksi, with no upper yield strength installed. " Clarify what is meant by the phrase "no upper yield strength installed."

(b) Verify that the actual yield strengths of the Dresden and Quad Cities recirculation piping loop component support bolting do not exceed 150 ksi.

(c) Clarify whether other Class 1, 2, 3 and MC component supports use high strength low-alloy steel bolts. If so, describe the materials used and the corresponding aging management program.

Response:

Exelon has reviewed LRA Section 3.5.1.2.10 and the following additional information is provided:

(a) Table 2, "Mechanical Requirements", found in ASTM A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service, specifies a minimum yield strength of 105 ksi. No upper limit is specified in the ASTM standard. The phrase "no upper yield strength installed" means there is no upper yield strength mentioned in the ASTM standard.

(b) ASTM A193, Standard Specification for A193, Grade B7 material, specifies a maximum Brinell Hardness number of 321 HB for recirculation piping loop component support bolting that is less than 2-½ inch diameter. Based on ASTM A370, Standard Specification, Section 1, volume 01.01, a maximum Brinell Hardness number of 321 HB (interpolated between 319 HB and 327 HB) equates to a tensile strength of 153 ksi (interpolated between 152 ksi and 156 ksi). Therefore, the maximum yield strengths of the recirculation piping loop component support bolting are rounded to an approximate tensile strength of 150 ksi threshold value.

(c) Dresden UFSAR Section 3.9.3.1.1.3.3 and Quad Cities UFSAR Section 3.9.3.1.1.3 state that there are high strength bolts used in a friction type connection at the reactor skirt

base. The material used for these high strength bolts is assumed to be ASTM A193, Grade B7 or equivalent. ASME Section XI, Subsection IWF (B.1.27) aging management program inspects the bolting. There are no other documented uses of high strength bolting found on Class 1, 2, 3 and MC Component supports at Dresden and Quad Cities Nuclear Power Stations.

RAI 3.5-14

LRA Section 3.5.1.2.11 discusses an exception to GALL for the aging management program XI.S3, "ASME Section XI, Subsection IWF." This exception is identified under Ref. No. 3.5.1.31 of LRA Table 3.5-1. The applicant proposes to manage aging of downcomer bracing by inspections performed under the applicant's aging management program ASME Section XI, Subsection IWE (B.1.26). The applicable GALL item number is III.B1.3.1-a, which identifies ASME Section XI, Subsection IWF as an acceptable aging management program for support members. The staff requests the applicant to (1) describe any inspections and schedules that would be required under Subsection IWF, that will not be performed under the applicant's proposed use of Subsection IWE, and (2) provide the technical bases for any deviations from the requirements of Subsection IWF.

Response:

(1) There are no inspections required by Subsection IWF that will not be performed by the use of Subsection IWE. Per the 1989 Edition and the 1992 Edition, with the1992 Addenda of ASME Section XI, Table IWE-2500-1, Item E1.11, the Class MC integral attachments are subject to a General Visual Examination (as described in IWE-3510.1) prior to each Type A Test. Additionally, per Item E1.12, these integral attachments are subject to a VT-3 each inspection interval. Per the 1995 Edition, with the 1996 Addenda of ASME Section XI, Table IWF-2500-1, supports are subject to a VT-3 each inspection interval.

(2) The bases for making this change is the comprehensive containment inservice inspection (CISI) which was recently mandated by the Nuclear Regulatory Commission final rulemaking per an amendment to the Code of Federal Regulations (10 CFR 50.55a). This rulemaking incorporates, by reference, the requirements of the 1992 Edition with the 1992 Addenda of the ASME Boiler and Pressure Vessel Code, Section XI, Division 1, Subsections IWE and IWL with specified modifications. The final rulemaking was published on August 8, 1996 and specified an effective date of September 9, 1996 as well as an expedited implementation of these requirements within five years of the effective date (September 9, 2001). In response, the Dresden and Quad Cities CISI program included these supports as part of the IWE examination boundary.

RAI 3.5-15

LRA Table 3.5-2, Ref No. 3.5.2.5 "Clevis Pins" identifies three different component groups (torus columns, vent systems and ESF lines), two materials (carbon steel and stainless steel), and three environments (submerged in torus grade water, inside and outside containment). For each of the three different component groups, at both Dresden and Quad Cities, the applicant is requested to (1) identify all aging effects/mechanisms that were evaluated for each combination of material and environment, including those not requiring aging management; and (2) submit the technical basis for each aging management conclusion.

Response:

For evaluation of carbon steel and stainless steel materials, "inside or outside containment" is treated as one environment. Thus, as evaluated, there are two materials and two environments associated with each of the three different clevis pin component groups. These are

Carbon Steel - Submerged (torus grade water)
- Inside or outside containment

Stainless Steel - Submerged (torus grade water)
- Inside or outside containment.

The table below identifies all aging effects/mechanisms evaluated for each combination of material (carbon steel or stainless steel) and environment (torus water, or inside and outside containment). There are no aging effects that do not require aging management.

Component	Material	Environment	Aging Effect/ Mechanism	AMP
Clevis Pin	Carbon Steel	Inside or outside containment	Loss of material/ Environmental corrosion (i.e. pitting corrosion, general corrosion)	ASME Section XI, Subsection IWF (B.1.27)
			Loss of Material/ Mechanical wear	ASME Section XI, Subsection IWF (B.1.27)
		Submerged (torus grade water)	Loss of material/ General galvanic pitting, and crevice corrosion	Water Chemistry (B.1.2) and One-Time Inspection (B.1.23
			Loss of Material/ Mechanical wear	ASME Section XI, Subsection IWF (B.1.27)
	Stainless Steel	Inside or outside containment	Loss of material/ Pitting and crevice corrosion	ASME Section XI, Subsection IWF (B.1.27)"
			Loss of Material/ Mechanical wear	ASME Section XI, Subsection IWF (B.1.27)"
		Submerged (torus grade water)	Loss of material/ Pitting and crevice corrosion	Water Chemistry (B.1.2) and One-Time Inspection (B.1.23)
			Cracking/ Stress corrosion cracking	Water Chemistry (B.1.2)

			Loss of Material/ Mechanical wear	ASME Section XI, Subsection IWF (B.1.27)

The Table 2.4-15 line items for Clevis Pins and for Support Members have incorrect Aging Management References. The line items for these two components in Table 2.4-15 should have read shown below with the correct Aging Management References.

The line item for Clevis Pins in Table 2.4-15 correctly referenced 3.5.2.5 for clevis pins in an environment "Submerged (torus grade water) and inside and outside containment". Additional Aging Management References should have included 3.5.1.31 (which is in the application) and 3.5.2.210, 3.5.2.21, 3.5.2.22, and 3.5.2.23 (which are new aging management references not originally included in the application). These new aging management references are shown in the table below.

The line item for Support Members in Table 2.4-15 incorrectly referenced 3.2.2.79, 3.2.2.80, and 3.2.2.81. These references should have been designated as aging management references for Support References. Aging Management References 3.5.1.29, 3.5.1.31, and 3.5.2.14 are correct. New Aging Management References should have included 3.5.2.17, 3.5.2.18, and 3.5.2.19, as shown below in Table 3.5-2.

LRA Table 2.4-15 should have read as follows:

Component	Component Intended Function	Aging Management Ref
Clevis Pins: Suppression chamber Columns, Vent Systems, ESF Lines	Structural Support	3.5.1.31, 3.5.2.5, 3.5.2.20, 3.5.2.21, 3.5.2.22, 3.5.2.23
Support Members (Includes Spring Hangers)	Structural Support	3.5.1.29, 3.5.1.31, 3.5.2.14, 3.5.2.17, 3.5.2.18, 3.5.2.19

LRA Table 3.5-2 should have read as follows:

Ref No	Component Group	Material	Environment	Aging Effect/ Mechanism	Aging Management Program	Discussion
3.5.2.17	Support Members	Carbon Steel	Submerged (torus grade water)	Loss of material/ General galvanic pitting and crevice corrosion	Water Chemistry (B.1.2) and One-Time Inspection (B.1.23)	NUREG-1801 does not address support members in submerged environments.
3.5.2.18	Support Members	Stainless Steel	Submerged (torus grade water)	Cracking/ Stress corrosion cracking	Water Chemistry (B.1.2)	NUREG-1801 does not address support members in submerged environments.
3.5.2.19	Support Members	Stainless Steel	Submerged (torus grade water)	Loss of material/ Pitting and crevice corrosion	Water Chemistry (B.1.2) and One-Time Inspection (B.1.23)	NUREG-1801 does not address support members in submerged environments.
3.5.2.20	Clevis Pins: Suppression chamber Columns, Vent Systems, ESF Lines	Carbon Steel	Submerged (torus grade water)	Loss of material/ General galvanic pitting and crevice corrosion	Water Chemistry (B.1.2) and One-Time Inspection (B.1.23)	NUREG-1801 does not address clevis pins in submerged environments
3.5.2.21	Clevis Pins: Suppression chamber Columns, Vent Systems, ESF Lines	Stainless Steel	Submerged (torus grade water)	Loss of material/ Pitting and crevice corrosion	Water Chemistry (B.1.2) and One-Time Inspection (B.1.23)	NUREG-1801 does not address clevis pins in submerged environments
3.5.2.22	Clevis Pins: Suppression chamber Columns, Vent Systems, ESF Lines	Stainless Steel	Submerged (torus grade water)	Cracking/ Stress corrosion cracking	Water Chemistry (B.1.2)	NUREG-1801 does not address clevis pins in submerged environments
3.5.2.23	Clevis Pins: Suppression chamber Columns, Vent Systems, ESF Lines	Stainless Steel	Inside or outside containment	Loss of material/ Pitting and crevice corrosion	ASME Section XI, Subsection IWF (B.1.27)"	NUREG-1801 does not address stainless steel clevis pins.

RAI 3.5-16

LRA Table 3.5-2, Ref No. 3.5.2.14 "Support Members," states that stainless steel pipe support stanchions are used on the recirc piping 28" lines at Dresden and Quad Cities. ASME Section XI, Subsection IWF (B.1.27) is credited to manage the stainless steel support members, inside or outside containment, for loss of material due to pitting and crevice corrosion. LRA Table 3.5-2, Ref No. 3.5.2.15 "Thermowells," states that stainless steel thermowells are installed in the torus. ASME Section XI, Subsection IWE is credited to manage the stainless steel/dissimilar metal welds for thermowells, inside or outside containment, for loss of material due to general galvanic pitting and crevice corrosion. For both the stainless steel pipe support stanchions and the thermowells, the applicant is requested to: (1) describe the location of all the stainless steel components and identify the specific environments to which they are exposed; (2) identify all aging effects/mechanisms that were evaluated, including those not requiring aging management, and provide the technical basis for each conclusion; and (3) discuss the technical basis for the selection of the aging management program used to manage the applicable aging effects.

Response:

(1) The stainless steel pipe support stanchions are located on the "A" and "B" Recirculation Pump suction and discharge piping, inside the drywell portion of the containment at both Quad Cities and Dresden. The lines are identified on boundary diagrams LR-QDC-M-35-2 and LR-QDC-M-77-2 at Quad Cities, and on LR-DRE-M-26-2 and LR-DRE-M-357-2 at Dresden. The line numbers are:

- Quad Cities: 1-0201A-28"-A, 1-0202A-28"-A, 1-0201B-28"-A, 1-0202B-28"-A, 2-0201A-28"-A, 2-0202A-28"-A, 2-0201B-28"-A, 2-0202B-28"-A
- Dresden: 2-0201A-28"-A, 2-0202A-28"-A, 2-0201B-28"-A, 2-0202B-28"-A, 3-0201A-28"-AM, 3-0202A-28"-AM, 3-0201B-28"-AM, 3-0202B-28"-AM

The specific environment assigned to the stainless steel pipe supports is "Inside Containment." The drywell is made inert with nitrogen to render the primary containment atmosphere non-flammable by maintaining the oxygen content below 4% by volume during normal operation. The drywell has an average temperature of 135°F during normal operations. The relative humidity in the drywell ranges from 20% - 90%.

The thermowells are installed in the suppression chamber shell. All are located below the waterline, with the exception of four thermowells at Quad Cities, two on each unit, that are located in the air space above the water line. The suppression chamber air space above the suppression chamber water level is made inert with nitrogen to maintain the oxygen content below 4% by volume during normal operation. The air temperature follows the normal, maximum operating suppression chamber water temperature of 95 °F and the relative humidity is between 20 and 90%.

The suppression chamber air space environment encompasses the following NUREG 1801 environment description:

Moist Containment Atmosphere (air/nitrogen), steam, or demineralized water

The suppression chamber water environment encompasses the following NUREG 1801

environment description:
25-288 °C (77 ° – 550 °F) demineralized water

(2) All aging effects/mechanisms that were evaluated for the pipe support stanchions and suppression chamber thermowells are described below along with the technical basis used to determine whether aging management was required.

Stainless Steel Pipe Support Stanchions
The aging effects degradation of stainless steel external surfaces in indoor/outdoor atmospheric environments is evaluated in EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools" (EPRI Mechanical Tools) Appendix E, Table 4-1 and Figure 1.

- Loss of material/crevice, pitting corrosion: This is the only aging effect/mechanism identified for stainless steel in EPRI 1003056.

Suppression Chamber Thermowells
EPRI 1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools" (EPRI Mechanical Tools), Appendix A, Tables 4-1 and 4-2 and Figures 1 and 2, were utilized to identify potential aging effects/mechanisms for the thermowells and are the bases for the following discussions.

- Loss of material/general, pitting, and crevice corrosion: This is applicable to the thermowells installed in either the suppression chamber water or air space environments. While stainless steel itself is not susceptible to general corrosion, it was conservatively assumed to be an applicable aging mechanism for the installation due to the fact that thermowells are welded to carbon steel half-couplings, which are in turn are welded to the suppression chamber shell.

- Loss of material/galvanic corrosion: The stainless steel thermowells are welded to carbon steel half-couplings or sleeves, which are welded to the exterior of the suppression chamber shell. This dissimilar metal weld is outside the suppression chamber where an electrolytic environment does not exist. However, an electrolytic environment does exist between the half-coupling / sleeves and the thermowell. For this reason, this aging effect/mechanism is considered applicable to the thermowell installations.

- Crack initiation and growth/SCC: This is not considered applicable to the thermowells installed in either the suppression chamber water or air space environments. Stress Corrosion Cracking (SCC) has been observed in high purity water at temperatures greater than 200°F and dissolved oxygen levels greater than 100 ppb. The normal, maximum operating suppression chamber water temperature is 95°F. Suppression chamber water quality is maintained within EPRI recommended levels. Therefore, suppression chamber thermowells are not susceptible to SCC.

(3) The stainless steel pipe supports on the "A" and "B" Recirculation Pump suction and discharge lines inside the drywell are ISI Class 1 component supports. The ASME Section XI, Subsection IWF ISI Aging Management program is credited with managing the aging effect of loss of material due to corrosion for these stainless steel supports. This program provides for the inspection of ASME Class 1, 2, and 3 supports and is also

credited for managing the loss of material due to corrosion for NUREG 1801 Section III.B1 component supports.

The stainless steel thermowells installed in the suppression chamber are included in ASME Section XI, Subsection IWE ISI Program. This aging management program is credited with managing the loss of material due to corrosion for these thermowells. The program provides for the inspection of ASME Class MC pressure retaining components and their integral attachments and is also credited for managing the loss of material aging effects due to corrosion for NUREG 1801 Section II.B components with dissimilar metal welds.

RAI 3.5-17

LRA Table 3.2-2 (Ref Nos: 3.2.2.79, 3.2.2.80 and 3.2.2.81) states that Water Chemistry (B.1.2) and One-Time Inspection (B.1.23) will be used to manage loss of material/pitting and crevice corrosion in carbon and stainless steel support members submerged in 25-288 degree C (77-550 degree F) demineralized water. The Water Chemistry program will also be used to manage *cracking/stress corrosion cracking* in stainless steel support members submerged in the same environment. In order to complete the aging management review, the staff requests the applicant to submit the following information:

(a) Identify the specific supports covered by references 3.2.2.79, 3.2.2.80 and 3.2.2.81 and the plant-specific operating experience.

(b) Explain why ASME Section XI, Subsection IWF is not credited for aging management of these supports.

(c) Explain the number, type and location of the supports that will be included in the one-time inspection.

(d) Explain why the supports covered by reference 3.2.2.80 are not included in the one-time inspection.

Response:

Exelon has reviewed LRA Table 3.2-2, Aging Management References 3.2.2.79, 3.2.2.80, and 3.2.2.81, and following information is provided.

(a) LRA Aging Management References 3.2.2.79, 3.2.2.80, and 3.2.2.81 discuss support members submerged in a torus water environment. The submerged supports in the Low Pressure Coolant Injection System (LPCI) at Dresden Station and the Residual Heat Removal System (RHR) at Quad Cities Station are addressed by these aging management references. All supports were evaluated for aging as a commodity group. No specific support numbers are cited by Aging Management References 3.2.2.79, 3.2.2.80, and 3.2.2.81. Generic supports are grouped by system, material type, and environment combination. A review of plant operating history did not reveal any loss of intended function for systems for which Suppression Pool / Torus Chemistry control exists.

The following are some plant specific operating experience of Suppression Pool / Torus water chemistry. These examples demonstrate the effectiveness of the Suppression Pool / Torus water chemistry Aging Management Program (AMP).

- Dresden: Chemistry samples taken on the LPCI (shell) side of the 3A LPCI Heat Exchanger on 1/21/00 and again on 1/26/00 show that water conductivity, chloride concentration, and sulfate concentration are considerably higher than normal torus water chemistry conditions. The shell side chemistry concentrations are indicative of a service water in-leakage.

- Dresden: Chemistry took the monthly Unit 2 torus water sample from the shell side of the 2B LPCI Heat Exchanger (8/17/00) and found out-of-specification concentrations of chlorides and sulfates as well as out-of-specification conductivity. On 8/19/00, the existence of a leak in the 2B LPCI Heat Exchanger was confirmed.

- Quad Cities: Nuclear Oversight identified that the Station had been running with Unit 2 torus water at an elevated specific conductivity since October 1995. Readings had fluctuated above and below the 'goal' value (less than or equal to 3 μS/cm) but less than the limit (5 μS/cm).

- Quad Cities: Unit 2 torus. On 7/2/96, a sample was found to be over the administrative limit for conductivity of 5.0 μmho. The conductivity was 5.6 μmho as compared to 4.6 μmho from the last sample (6/26/96). The results of an investigation indicated there was work in progress in the Unit 2 torus to replace an instrument air line hanger. The torus hatch was removed on 6/29/96 in preparation for the work to commence and this may have caused the water chemistry administrative limit to exceed.

(b) 10CFR 50.55a does not require inspecting ASME Section XI, Subsection IWF supports that are associated with ASME Section XI, Subsection IWE. Supports in a submerged (torus water) environment are associated with ASME Section XI, Subsection IWE (components that are part of the reactor coolant pressure boundary) and do not require inspection in accordance with ASME Section XI, Subsection IWF.

(c) A one-time inspection will be performed to verify the effectiveness of the torus water chemistry. One time inspection of HPCI torus suction check valves is credited for the one-time inspection of all submerged supports. The HPCI torus suction check valves and the supports have a similar environment and material condition. The HPCI torus suction check valves are carbon steel typically exposed to stagnant flow conditions but with occasional flow. The one-time inspection utilizes the Preventive Maintenance (PM) program to inspect check valves. The acceptance criteria for the HPCI check valves inspections are based on ASME Section XI, Examination Category B-M-2 (Valve Body). Control of chemistry in accordance with EPRI guidelines (TR-103515) does not preclude loss of material due to general, crevice, or pitting corrosion at locations of stagnant flow conditions. This one-time inspection includes measures to verify the effectiveness of the Suppression Pool / Torus Chemistry and confirm the absence of loss of material in

stagnant flow areas as required by NUREG 1801. Examinations are to be conducted in an area where typically stagnant flow is present but occasionally there is flow, which will cause replenishment of the oxygen supply. Therefore, the one-time inspection of the Dresden and Quad Cities HPCI torus suction check valves is credited for verifying the effectiveness of the Suppression Pool / Torus Chemistry and confirming the absence of loss of material in stagnant flow areas.

(d) EPRI TR-1003056, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3" states that cracking due to Stress Corrosion Cracking (SCC) is not likely in a high purity environment below 200°F. The support members that are exposed to torus water do not reach temperatures above 200°F and, therefore, cracking due to SCC is less likely to occur in these support members. Control of torus water chemistry in accordance with EPRI guidelines (TR-103515) will provide high purity water and, therefore, provides assurance that the potential for SCC is minimized. Because of this, a one-time inspection of components in torus water environment for cracking due to SCC is not required to verify the effectiveness of the Suppression Pool / Torus water chemistry for Aging Management Reference 3.2.2.80.

Section 4.3 Metal Fatigue of the Reactor Vessel, Internals, Structures and Component Supports

RAI 4.3.0

(a) As noted in NRC Information Notice 2002-26, "Failure of Steam Dryer Cover Plate After a Recent Power Uprate," dated September 11, 2002, Quad Cities (Unit 2) experienced a failure of steam dryer cover plate in March 2002 following implementation of the 17.8% power uprate of the Unit. One piece of the dryer cover plate had fallen onto the separator; another piece was found in the dryer; a third piece had lodged in the A main steam line flow venturi (upstream of the main steam isolation valves); and several other pieces had been swept down the A main steam line downstream of the MSIVs into a turbine stop valve strainer. It was reported, however, that there was no apparent damage other than minor scratches and gouges to the main steam nozzle and piping.

On June 12, 2003, inspections of the steam dryer at Quad Cities Unit 2 identified the following: (1) through-wall cracking (about 90-inches in length) in the vertical and horizontal outer hood plate, (2) one vertical and two diagonal internal braces detached on the outer hood, (3) one severed vertical internal brace on the outer hood, and (4) three cracked tie bars on top of the dryer.

While components such as steam dryer and steam separator are non-safety related, the staff is concerned that failure of these components (as experienced at Quad Cities Unit 2) could potentially impact other safety related components. Please provide additional information regarding potential impact of non-safety related component failure (such as steam dryer or steam separator) on safety related components based on this recent operating experience, and the applicant's determination whether these components are within the scope of license renewal in accordance with 54.4(a)(2).

(b) Dresden Units 2 and 3, and Quad Cities Units 1 and 2 have recently implemented 18% power uprates. The same four units are currently being considered for license renewal. How has the applicant considered or examined the potential synergistic effects of large power uprates and plant aging (for those SSCs within the scope of license renewal)? Please describe your

evaluation and provide the results.

Response:

(a) Additional information regarding the steam dryer failure was provided to the NRC in report GENE-0000-0018-3359-P, "Technical Assessment, Quad Cities Unit 2 Steam Dryer Failure – Determination of Root Cause and Extent of Condition," Revision 1, dated August 2003, which was transmitted to the NRC by letter from P. R. Simpson (Exelon Generation Company) to U.S. NRC, "Transmittal of General Electric Technical Assessment Regarding Quad Cities Nuclear Power Station Unit 2 Steam Dryer Failure," dated August 11, 2003. The failure of the steam dryer as described in the above technical assessment was attributed to high cycle fatigue resulting from low frequency pressure loading on the outer hoods during normal operation. The failure did not prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4 (a)(1) (i), (ii) or (iii). Based on the recent operating experience and the investigation into the failure, the steam dryer and steam separator do not perform a safety function, are not required to prevent or mitigate the consequences of accidents; and any loose parts that may be generated during a design basis event will not interfere with the ability to shut down the reactor, provide adequate core cooling, and isolate the main steam lines. Therefore, the steam dryer and steam separator are not within the scope of license renewal under criteria 10 CFR 54.4(a)(2). Those portions of non-safety related SSCs that could spatially or structurally interact with a safety related SSC in such a manner that would prevent the accomplishment of a safety related SSC intended function were included within the scope of License Renewal as described in LRA Section 2.1.2.2 and in response to RAI 2.1-2: CFR 54.4(a)(2) Scoping Criteria for Non-safety related SSCs.

(b) The Dresden/Quad Cities extended power uprate (EPU) evaluations that explicitly included an assumption of 60 years operation (54 effective full power years [EFPY]) were the Reactor Fracture Toughness Evaluation and the Reactor Internals Flow Induced Vibration Evaluation.

The Reactor Fracture Toughness Evaluation determined that there is an increase in the ART (adjusted reference temperature) of the limiting beltline material and a corresponding increase in the beltline portion of the pressure-temperature (P-T) curves is required to include the increase in fluence and licensed EFPY for the P-T curves for 54 EFPY. Exelon will submit revised Dresden P-T curves to the NRC for 54 EFPY.

The Reactor Internals Flow Induced Vibration Evaluation concluded that, except for the Dresden Unit 2 jet pump riser braces, the Dresden and Quad Cities units can operate at the increased flow associated with EPU conditions for a 60-year plant life without exciting the safety-related reactor internal components above their established vibration criteria limits during balanced (dual loop) recirculation flow operation and without developing resonance problems due to vane passing frequency excitation. Additionally, the EPU analyses considered single recirculation loop operation and concluded that with the existing flow restrictions that apply for single recirculation loop operation there is no resonance problem due to vane passing frequency excitation at EPU conditions. The exception involving the Dresden Unit 2 jet pump riser braces occurs because these riser braces are designed differently from the Dresden Unit 3 and the Quad Cities Units 1 and 2 jet pump riser braces. LRA Section 4.3.2.2 includes a commitment to repair or replace the Dresden Unit 2 jet pump riser braces prior to the period of extended operation.

The Dresden/Quad Cities license renewal evaluations were based upon the plant environmental conditions associated with EPU implementation. Prior to the period of extended operation, the Environmental Qualification (EQ) Binders for components within the scope of 10 CFR 50.49 will be updated to include environmental conditions associated with EPU implementation together with an extended operating period of 60 years.

No other synergistic effects of large power uprates and plant aging were considered for those SSCs within the scope of license renewal.

RAI 4.3.1

(a) This section refers to a re-analysis that was performed for reactor vessel cumulative usage factors (CUF) as a part of the extended power uprate (EPU) implementation at the Dresden and Quad Cities plants. Provide a reference to an NRC safety evaluation, indicating review and acceptance, of the Extended Power Uprate implementation at the Dresden and Quad Cities plants.

(b) This section states that a re-analysis was performed under the EPU on the feed water nozzles along with the modifications to reduce or eliminate the causes. This revised analysis included the appropriate effects from rapid thermal cycling that were attributed to the original cause of cracking in the feedwater nozzles. Both Dresden and Quad Cities also follow the improved BWR Owners Group inspection and management methods.

Provide a reference to "the improved BWR Owners Group inspection and management methods," and a reference to a staff safety evaluation indicating staff review and acceptance.

Provide clarification of the context in which these methods are applied with respect to the EPU.

Response:

(a) NRC safety evaluations indicating review and acceptance of the Extended Power Uprate (EPU) implementation at the Dresden and Quad Cities plants were included as enclosures in the following letters:

1) NRC letter, Lawrence W. Rossbach (NRC) to Oliver D. Kingsley (Exelon), "Dresden Nuclear Power Station, Units 2 and 3 – Issuance of Amendments for Extended Power Uprate (TAC Nos. MB0844 and MB0845)," December 21, 2001. Enclosure: "Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment No. 191 to Facility Operating License No. DPR-19 and Amendment No. 185 to Facility Operating License No. DPR-25"; Exelon Generation Company, LLC; Dresden Nuclear Power Station, Units 2 and 3; Docket Nos. 50-237 and 50-249.

2) NRC letter, Stewart N. Bailey (NRC) to Oliver D. Kingsley (Exelon), "Quad Cities Nuclear Power Station, Units 1 and 2 – Issuance of Amendments for Extended Power Uprate (TAC Nos. MB0842 and MB0843)," December 21, 2001. Enclosure: "Safety Evaluation by the Office of Nuclear Reactor Regulation Related to

Amendment No. 202 to Facility Operating License No. DPR-29 and Amendment No. 198 to Facility Operating License No. DPR-30"; Exelon Generation Company, LLC, and MidAmerican Energy Company; Quad Cities Nuclear Power Station, Units 1 and 2; Docket Nos. 50-254 and 50-265.

(b) References to the improved BWR Owners Group inspection and management methods and to the staff safety evaluation are as follows:

1) BWR Owners' Group Letter to NRC dated September 24, 1999; W. G. Warren (BWR Owners' Group Chairman) to R. M. Pulsifer (NRC); BWR Owners' Group Licensing Topical Report, "Alternate BWR Feedwater Nozzle Inspection Requirements," GE-NE-523-A71-0594, Revision 1, August 1999.

2) NRC Letter to Chairman, BWROG dated June 5, 1998; Thomas Essig (NRC) to Thomas Rausch (Commonwealth Edison Company); BWROG – Safety Evaluation of Proposed Alternative to BWR Feedwater Nozzle Inspections (TAC M94090).

3) NRC Letter to BWR Owners Group dated March 10, 2000; S. Dembek acting for Stuart A. Richards (NRC) to W. Glenn Warren (BWR Owners' Group); Final Safety Evaluation of BWR Owner's Group Alternate Boiling Water Reactor (BWR) Feedwater Nozzle Inspection (TAC No. MA6787).

The EPU reanalysis calculated reactor vessel cumulative fatigue usage factors at limiting locations, including the feedwater nozzles, to account for changes at EPU conditions in vessel temperatures, pressures, nozzle flow rates, and other loads. This is described in the second paragraph of the "Analysis" discussion in LRA Section 4.3.1.

The third paragraph of the "Analysis" discussion in LRA Section 4.3.1 provides historical information about an analysis of the feedwater nozzles that evaluated the modifications made to reduce or eliminate the causes of feedwater nozzle cracking. This analysis appropriately included the effects from rapid thermal cycling that was attributed to be the cause of the feedwater nozzle cracking. This analysis was not related to EPU.

The BWR Owners Group inspection and management methods for feedwater nozzles eliminates the need for routine liquid penetrant surface examinations and provide guidance for allowable inspection intervals. The allowable UT inspection interval is based on the ultrasonic (UT) inspection method and defined by a fraction of the time until an 0.25 inch or greater depth crack reaches its allowable value as obtained from a plant-specific fracture mechanics analysis. The methodology is not changed by the implementation of EPU.

RAI 4.3.2.2

(a) Provide justification why vibration levels due to conditions such as increased core flow or single recirculation loop operation do not cause concerns for fatigue of jet pump riser braces or other internal components at Dresden 3 and Quad Cities 1 and 2, similar to those at Dresden 2.

(b) In the Analysis section, provide an explanation of the term "maximum extended load line limit analysis (MELLA) region."

Response:

(a) The potential for flow induced vibration of reactor internals at Dresden and Quad Cities

was evaluated as part of the extended power uprate (EPU). The EPU analyses concluded that except for the Dresden Unit 2 jet pump riser braces, the Dresden and Quad Cities plants can operate at the increased flow associated with EPU conditions for a 60-year plant life without exciting the safety-related reactor internal components above their established vibration criteria limits during balanced (dual loop) recirculation flow operation and without developing resonance problems due to vane passing frequency excitation. Additionally, the EPU analyses considered single recirculation loop operation and concluded that with the existing flow restrictions that apply for single recirculation loop operation there is no resonance problem due to vane passing frequency excitation at EPU conditions. The exception involving the Dresden Unit 2 jet pump riser braces occurs because these riser braces are designed differently from the Dresden Unit 3 and the Quad Cities Units 1 and 2 jet pump riser braces. LRA Section 4.3.2.2 includes a commitment to repair or replace the Dresden Unit 2 jet pump riser braces prior to the period of extended operation.

(b) The MELLLA region is discussed briefly in Dresden UFSAR Section 4.4.3.1.9 and in Quad Cities UFSAR Section 4.4.3.1.8. The MELLLA region is an area of the power/flow operating map that is above the power/flow load line that passes through the 100% power, 100% flow point on the operating map. The upper boundary of the MELLLA region is defined by the maximum extended load line limit (MELLL) analysis line and by the 100% power line. Operation in the MELLLA region is applicable to Extended Power Uprate operation only. The MELLLA region provides operating flexibility to permit flow compensation for xenon buildup following startups and for fuel depletion later in the cycle while improving the efficiency of achieving and maintaining 100% power. All anticipated transient and loss-of-coolant accident (LOCA) analyses performed for cycle operation support operation in the MELLLA region.

RAI 4.3.3.3

This section of the TLAA indicates that the design analyses (fatigue analysis of the isolation condenser) remain valid for the extended period of operation. Aging Management Program B.1.34 states that, as an enhancement to the metal fatigue of reactor coolant pressure boundary aging management program, "the program will provide for tracking of fatigue stress cycles for the Dresden isolation condenser." Provide an explanation/justification as to why this statement does not conflict with the disposition stated in this section.

Response:

The Isolation Condenser is included in the manual cycle counting because it is part of the reactor coolant pressure boundary and has piping locations with predicted cumulative usage factors (CUF) >0.4. See Table 4.3.3.1-1 in the LRA. Because cycle counting is being performed to monitor cumulative fatigue at bounding locations on the isolation condenser system piping, cycles are monitored for the isolation condenser itself. This is performed even though the TLAA analysis in LRA Section 4.3.3.3 shows that the predicted number of cycles at 60 years is less than the design number of cycles.

Since the Isolation Condenser thermal transients can affect the Reactor Coolant Pressure Boundary components and the 40-year expected CUFs will exceed 0.4, Exelon has conservatively selected the Isolation Condenser locations in the FatiguePro monitoring program.

RAI 4.3.4

The disposition of this TLAA indicates that Exelon will perform plant-specific calculations for Dresden and Quad Cities for the locations identified in NUREG/CR 6260 for older BWRs, except for a limiting Class 1 location in a feedwater line. Provide the following additional information: (a) state where the limiting Class 1 feedwater piping location will be identified; and (b) provide the calculated cumulative usage factors for these locations.

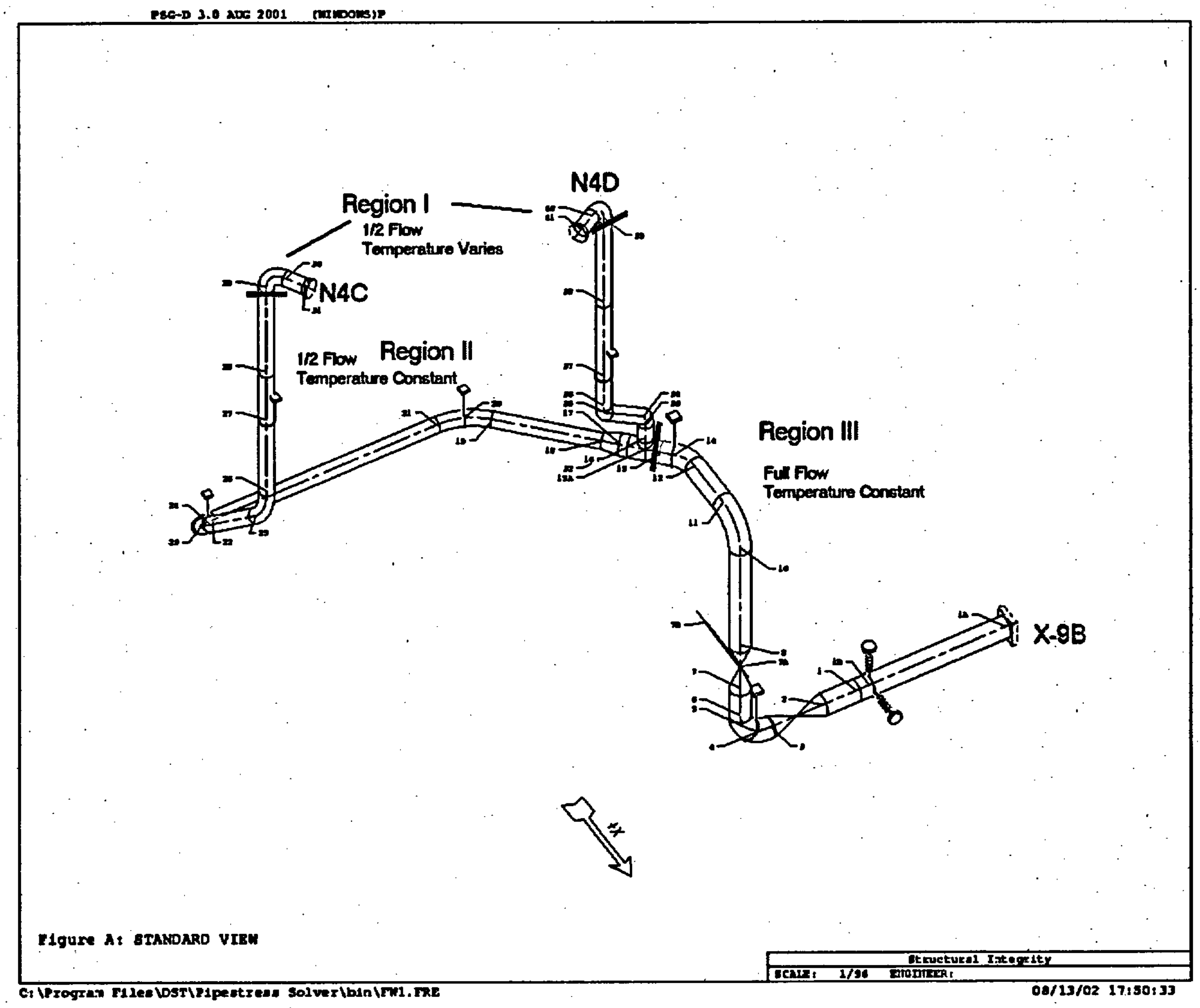
Response:

(a) As stated in LRA Section 4.3.4, the feedwater/RCIC location evaluated for environmental effects in NUREG/CR-6260 for the older-vintage GE plants does not exist at either Dresden unit because the Dresden units do not possess a RCIC system. At Quad Cities, the subject tee is located outside of containment in the Class 2 portion of the feedwater line. Therefore, consistent with the selection criteria utilized in NUREG/CR-6260 (where the limiting location in the Class 1 portion of the line was evaluated for environmental effects), the entire Class 1 portion of the feedwater line was modeled as shown in Figure 1 and a fatigue analysis was performed using ASME Code, Subsection NB-3600 methodology.

(b) Review of the B31.1 stress reports for all four Dresden/Quad Cities units was performed and the bounding geometry from all eight feedwater loops (2 loops per unit, four units) was selected for modeling. The results of the fatigue analysis determined that the location with the highest fatigue usage (U = 0.0859) was at the tee joining the N4D riser pipe to the header (Node 15A), as shown in Figure 1. This limiting location will be used to perform plant-specific environmental fatigue calculations. Note that this selection excludes the reactor pressure feedwater nozzle location, because that location will be separately evaluated for environmental effects as was done in NUREG/CR-6260.

Figure 1. Finite Element Model of Class 1

Portion of Feedwater Line



RAI 4.6 **Fatigue of Primary Containment, Attached Piping and Components**

This section indicates that in the absence of hydrodynamic loads, fatigue is not a concern in containment design except at penetrations or other stress concentration areas. Provide the Aging Management Program under which fatigue in the drywell, the drywell penetrations, the process penetration bellows and other stress concentration areas will be managed for the period

of extended operation.
[Note: this RAI was revised per email from T.J. Kim, USNRC, on 9/22/2003]

Response:

Section 4.6 of the LRA includes the following statement:

"In the absence of hydrodynamic loads, fatigue is not a concern in containment design expect at penetrations or other stress concentration areas."

The following is a clarification of that statement.

The primary containments for Dresden and Quad Cities were designed in accordance with the ASME Code Section III, 1965 edition with addenda up to and including Winter 1965. The Dresden and Quad Cities are Mark I containments that were originally designed to stress limit criteria without fatigue analysis (Class B Vessels). No fatigue analyses have been applied to the drywell containment boundaries, nor to their penetrations, except for qualification of process penetration bellows. The process penetration bellows were designed for a maximum number of operating thermal cycles over the design life at normal, test, and limiting design containment pressures. The process penetration bellows are discussed in section 4.6.4 of the LRA which concludes that the fatigue analysis for the penetration bellows is valid for the 60 year extended operating period. Therefore, no aging management is required.

The capability of the Mark I containment suppression chamber to withstand suppression pool hydrodynamic loads that were not considered in the original design of the structures was designated as an "Unresolved Safety Issue" by the NRC. This discovery of significant hydrodynamic loads ("new loads") caused by safety relief valve (SRV) and small, intermediate, and design basis pipe break discharges (SBA, IBA, DBA) into the torus suppression pool required the reanalysis of the torus, vents, and torus attached piping and internal structures, including some fatigue analyses at limiting locations. NUREG-0661, Safety Evaluation Report – Mark I Containment Long Term Program, described the generic suppression pool hydrodynamic load definition and structural assessment techniques that were to be used to design plant modifications necessary to restore the margins of safety in the Mark I containments. Because the hydrodynamic loads were associated with the suppression pool, no further analysis was required on the drywell.
NUREG-0661 identified a Long-Term Program (LTP) to establish the structural and mechanical elements that were to be reanalyzed in the plant unique analysis (PUA). Three groups of structural and mechanical elements were identified by NUREG-0661 as noted in Exhibit 1 and summarized as follows:
Torus shell and vent ring header including vents between the drywell and vent ring header
Internal Structures (deflectors, catwalks, monorails, and their supports)
Torus Attached Piping (TAP) systems including SRV discharge piping and process piping.

The LTP plant unique analysis was performed and documented in the PUAR (one PUAR for Dresden and one PUAR for Quad Cities). The PUAR establishes that all applicable Mark I criteria noted in NUREG-0661 have been met. The NRC staff performed a post-implementation audit review of the PUAR and concluded that the PUAR verified that the containment modifications have restored the original design margin to the primary containment (Reference Dresden and Quad Cities UFSAR 6.2.1.3). Aging management for fatigue of the suppression pool is discussed in sections 4.6.1, 4.6.2, and 4.6.3 of the LRA.

RAI 4.6.2

The analysis section "SRV Discharge Line-Vent Line Penetrations ("Sleeves") and the associated sections of the SRV Discharge Lines" states that the fatigue analysis of these MC components considered two separate cases in order to identify bounding analysis. Case 1 considered all 220 SRV actuations as single-valve actuations, to maximize the number of cycles of full-range *Ta- Tb* stress. Provide an explanation of the "full-range *Ta- Tb*" term.

Response:

The drywell-to-suppression pool vents connect the drywell to the suppression pool. The SRV discharge lines traverse through the drywell-to-suppression chamber vents and discharge their steam under the water in the suppression pool. Ta is the temperature of the SRV discharge line. Tb is the temperature of the drywell-to-suppression chamber vent surrounding the outside of the SRV discharge line.

LRA Section 4.6.2 should have read as follows:

4.6.2 Fatigue Analysis of SRV Discharge Piping Inside the Suppression Chamber, External Suppression Chamber Attached Piping, and Associated Penetrations

Case 1: All 220 SRV actuations are single-valve first actuations (i.e., no subsequent actuations). This maximizes the number of cycles of full-range $|T_{SRVDL} - T_{Vent}|$ stress, where T_{SRVDL} is the temperature of the SRV discharge line and T_{Vent} is the temperature of the drywell-to-suppression chamber vent.

RAI 4.7.2.3

The Analysis section states that the existing design calculation for the modified strainer support flanges assumes a corrosion loss of 4 mils/year for 33 years which is not sufficient to encompass the entire period of extended operation.

(a) State the nature of this design calculation, what was calculated and explain how the corrosion loss of 4 mils/year was included in the calculations.

(b) Provide the basis for the assumed corrosion rate of 4 mils/year for 33 years.

(c) State the corrective measures that will be taken in the event that the revised galvanic corrosion calculation indicates an unacceptable wall thickness prior to the end of the 60-year licensed operating period.

Response:

Per an email from T.J. Kim, USNRC, on 8/21/2003, this RAI is replaced by RAI 4.7.2.3 in a later correspondence.

B.1.13 Open-Cycle Cooling Water System

RAI B.1.13

(a) The following exception to NUREG-1801 is stated in LRA AMP B.1.13: "NUREG-1801 indicates that program testing and inspections are performed annually and during refueling outages. The Dresden and Quad Cities open-cycle cooling water system aging management program activities provide for adjustment of inspection intervals due to specific inspection results as stated in the response to GL 89-13." Clarify that these adjustments are in accordance with the information provided in GL 89-13 concerning a routine inspection and maintenance program and section D, "frequency of testing and maintenance," in GL 89-13, Supplement 1.

(b) LRA AMP B.1.13 identifies enhancements which include the statement, "The program will provide for inspection of cooling water pump internal linings, additional heat exchangers and sub-components, inspection of external surfaces of various submerged pumps and piping." Identify the specific additional heat exchangers and sub-components that are to be inspected and the inspection frequency. Provide the technical basis, including operating experience for the inspection frequency.

(c) LRA AMP B.1.13 identifies enhancements which include the statement, "The program will provide for new periodic component inspections in the pump vaults that have a high humidity/moisture environment." Specify the inspection frequency and its technical basis, including operating experience.

(d) LRA AMP B.1.13 states in part that "the open-cycle cooling water system aging management activities have detected aging degradation and implemented appropriate corrective actions to maintain system and component intended functions..." This operating experience suggests that the preventive actions prescribed in this AMP may not be as effective as expected. Provide justifications on the effectiveness of the preventive actions based on the plant operating experience, with consideration of Information Notice 94-03.

(e) The operating experience section of AMP B.1.13 states in part that "Engineering evaluations have resulted in various specific component and programmatic enhancements and correction actions. In addition, program assessments have been reviewed for heat sink performance." Describe the appropriate corrective actions made and the operating experience since these corrective actions were implemented. In addition, provide the results on the assessment for the heat sink performance review in regard to the adequacy of this AMP.

(f) LRA AMP B.1.13 states in part that "The open-cycle cooling water AMP... provides for managing loss of material aging degradation on the outside surfaces... by condition monitoring of the accessible external surfaces of components in moist air (indoor) or submerged (raw water) environments." However, this AMP does not address managing the loss of material on inaccessible outside surfaces. Provide an explanation of how the loss of material aging effects on the outside surfaces in inaccessible locations is managed for the period of extended operation. Indicate to what extent eddy current testing is used.

(g) LRA Table 3.3-2 credits the Open-Cycle Cooling Water System (AMP B.1.13) for managing galvanic corrosion.

- Identify any preventive measures used to minimize the effects of galvanic corrosion in heat exchangers such as sacrificial anodes or internal coatings and indicate if inspections verify that they are performing their intended function.

- Ref. 3.3.2.208 of Table 3.3-2 of the LRA for the material/environment of cast iron/raw, untreated salt water or fresh water identifies loss of material/galvanic corrosion as an applicable aging effect/aging mechanism. The Open-Cycle Cooling Water System (B.1.13) is identified as the applicable AMP. LRA AMP B.1.13 states in part that "With enhancements the open-cycle cooling water system aging management program is consistent with the ten elements of the aging management program XI.M20, "Open-Cycle Cooling Water System," specified in NUREG-1801" with exceptions. The staff notes that loss of material due to galvanic corrosion is location-dependent. Adequate aging management may need to target susceptible locations for inspection and testing. Clarify whether the inspection and testing described in the AMP "Open-Cycle Cooling Water System" (B.1.13) are targeted or opportunistic with respect to managing loss of material due to galvanic corrosion. If the testing/inspection are opportunistic, justify the adequacy including any applicable operating experience. If the testing/inspection are targeted, provide the targeting criteria and their technical basis.

Response:

(a) The adjustments to the inspection intervals for the Dresden and Quad Cities open-cycle cooling water system aging management program activities are in accordance with the information provided in GL 89-13 concerning routine inspection and maintenance programs and section D, "frequency of testing and maintenance", in GL 89-13, Supplement 1. However, according to the Exelon response to GL 89-13, evaluations were/are to be performed to identify one representative heat exchanger for each heat exchanger type with similar operating conditions. Only this heat exchanger would be tested/inspected as required by Supplement 1 of GL 89-13 to establish the appropriate test frequency for that type of heat exchanger.

(b) Additional inspection requirements were added for the heat exchangers as shown in the table below. The table below also includes the associated inspection frequencies. The frequencies of these inspections are based on templates provided in the Exelon Performance Centered Maintenance (PCM) Program and input provided by cognizant system/program engineers. The recommended frequencies provided in the PCM templates are based on reviews of industry, company, and vendor operating experience. Station and corporate procedures and policies contain provisions for adjustment of inspection frequencies based on periodic reviews of operating experience, inspection results, and vendor recommendations.

Heat Exchanger	EPN(s)	Frequency
Dresden TBCCW Heat Exchangers (tube side only)	2(3)-3802-A(B)	6-year
Dresden RBCCW Heat Exchangers	2/3-3702, 2(3)-3702-A(B)	3-year

In addition, the new inspection requirements delineated specific sub-components to be inspected for the affected heat exchangers. The specific sub-components include:

- Inlet/outlet end bells, divider plates, joint welds as applicable
- Inlet/outlet tube sheets, divider plates, joint welds as applicable
- Inlet side tubes
- Outlet side tubes
- Inlet/outlet piping
- Anodes
- The supports (particularly tube/support joint and support/shell joint areas)
- Shell/fins as applicable
- Inlet/outlet nozzles, primary and secondary process sides as applicable.

(c) The frequency for the new periodic component inspections in the pump vaults is once per year. These rooms include the Dresden CCSW Pump Vaults and the Quad Cities RHRSW Pump Vaults and primarily consist of CCSW or RHRSW and DGSW system piping and components. The frequency of these inspections is based on input provided by cognizant system/program engineers. Furthermore, less intensive inspections of the affected areas are conducted on a more frequent basis as part of operator rounds, maintenance activities, and routine walkdowns. Surface degradation, leakage or other adverse conditions would be noted as part of these inspections.

Operating experience supports this frequency. Both stations have experienced corrosion of component external surfaces. In all cases, the degradation was identified and corrective actions implemented prior to loss of system or component intended functions. Corrective actions included cleaning and re-inspecting degraded surfaces and replacements of degraded sub-components such as bolting.

(d) Information Notice 94-03 was issued to alert addressees to deficiencies identified by the NRC during service water system operational performance inspections to assess licensee actions in response to GL 89-13. Among the deficiencies identified was the area involving testing programs and procedures. The testing and procedures governing service water system and performance at Dresden Station and Quad Cities Station are part of the station GL 89-13 Program. Periodic GL 89-13 system performance tests and component visual inspections provide for timely detection of loss of material and flow blockage. The periodicity of the testing and inspections is based on previous findings and are adjusted accordingly. NDE tests consist of eddy current testing (for heat exchangers) and piping UTs and/or RTs to detect loss of material aging effects. Available flow to the heat exchangers and coolers is used to determine the extent of blockage (fouling) in the system. The station GL 89-13 Program procedures outline the requirements to ensure that the testing and inspection activities have been performed and the results have been documented and sent to the appropriate station personnel for trending and analysis. The piping and components that are periodically inspected form a representative sampling for evaluating potential system-wide aging degradation.

In addition, IST procedures provide for the periodic monitoring and trending of system performance per the notification of the appropriate system engineer of test results and notification of both the system engineer and unit supervisor of any inspection deficiencies. Documentation results are maintained in accordance with ASME Section XI, IWP-6000. ISI documentation facilitates comparison with previous and subsequent inspection results and is also maintained in accordance with ASME Section XI, IWA-6000.

Prior to the implementation of the station GL 89-13 Program activities, component blockage was a recurring problem resulting in valves being unable to function. More recent periodic system flushing and component inspections and cleanings have detected minor levels of biofouling and silting, primarily in system drain lines that were removed without any loss of system function. This change in condition provides evidence that the GL 89-13 program has been effective at managing biofouling and silting.

(e) The appropriate corrective actions made included the following:

- Implementing procedure revisions for more frequent pump bay cleaning to reduce silt and clam buildup.
- Revising the ISI boundary to include additional piping for periodic inspection.
- Monitoring minor Zebra Mussel infestations to prevent flow restriction.
- Implementing new inspections to periodically inspect components found to be susceptible to blockage (Y-strainers and keep-fill check valves).
- Repairing or replacing specific piping and component minimum wall conditions and pinhole leaks. Follow-up root cause evaluations were performed.
- Implementing closer monitoring of marginal conditions (flow rates and piping wall thickness) to confirm continued system and component operability.
- Implementing additional flushing for lines determined to be susceptible to blockage.

Prior to the implementation of the station GL 89-13 Program activities, component blockage was a recurring problem resulting in valves being unable to function and flow restrictions in heat exchangers. More recent periodic system flushing and component inspections and cleanings have detected minor levels of biofouling and silting, primarily in system drain lines that were removed without any loss of system function.

Self-assessments of heat sink performance were performed for Dresden and Quad Cities in January 2001 and February 2001, respectively, to identify site heat exchanger deficiencies and verify resolution of previously identified heat sink performance issues. These self-assessments were reviewed in preparation of the LRA. The self-assessments were noted as identifying the following in support of the adequacy of the open-cycle cooling water system AMP:

- Adequately identified areas for improved inspection/testing and/or component replacement/refurbishment to ensure adequate heat exchanger performance
- Provided assurance that consideration was given to inclusion of risk significant heat exchangers, not just safety-related heat exchangers
- Adequately identified deficiencies and initiated appropriate corrective actions
- Provided on-going review of heat exchanger testing, maintenance, and performance documentation activities for incorporation of recent industry, regulatory, or vendor guidance.

The above information provides evidence that the GL 89-13 program and self-assessments have been effective at managing associated aging effects.

(f) Management of the loss of material is not provided for all outside surfaces of inaccessible locations. The piping and components that are periodically inspected form a representative sampling for evaluating potential system-wide aging degradation. Eddy

current testing is used for heat exchanger tubes, but not necessarily for all piping and components with inaccessible outside surfaces.

(g) There are no credited preventive measures used to minimize the effects of galvanic corrosion in affected heat exchangers. The aging effects of galvanic corrosion are managed through periodic heat exchanger inspections.

B.1.14 Closed-Cycle Cooling Water System

RAI B.1.14

(a) LRA AMP B1.14 states that closed-cycle cooling water system activities have detected aging degradation, and engineering evaluations have resulted in various specific component and programmatic corrective actions. This operating experience suggests that the preventive actions prescribed in this AMP may not be as effective as expected. Further, in the operating experience section, the AMP states, "engineering evaluations have resulted in various specific component and programmatic corrective actions." Describe the appropriate corrective actions made, and the operating experience since these corrective actions were implemented.

(b) LRA Table 3.3-2 (Ref. No. 3.3.2.105, 3.3.2.107, 3.3.2.109, 3.3.2.111, 3.3.2.116) credits the Closed-Cycle Cooling Water System (B.1.14) for managing galvanic corrosion. Identify any preventive measures used to minimize the effects of galvanic corrosion in heat exchangers such as sacrificial anodes or internal coatings. Indicate if inspections verify that preventive measures are performing their intended function.

Response:

(a) The preventive activities relied on by the closed-cycle cooling water system activities program include measures to maintain water purity and the addition of corrosion inhibitors to minimize corrosion. The activities will not by themselves eliminate corrosion altogether. The preventive activities of the program are only a part of a comprehensive program, which also includes periodic heat exchanger functional testing and monitoring of system parameters (i.e., flows, temperatures, pressures). The program activities, in total, will provide an effective means for management of the aging effects of the in-scope closed-cycle cooling water heat exchangers.

Examples of the program corrective actions made as a result of aging degradation are as follows:

- The Dresden 3A shutdown cooling heat exchanger experienced a tube failure on 12/02/01 while in reactor cooldown. The tube was identified and plugged, and the heat exchanger was returned to service. The apparent cause was identified as excessive shell side (RBCCW) flow. Flow balancing using ultrasonic flow instrumentation was performed for the Unit 2 and Unit 3 shutdown cooling heat exchangers to determine the timed throttle positions for the RBCCW to shutdown cooling outlet valves. These throttle positions were incorporated into the procedures that govern operation of the system. Heat exchanger flow is periodically monitored and heat exchanger inspection and eddy current testing are periodically performed. These activities will ensure flows are within limits and tubing condition is monitored.

- While running the Quad Cities Unit 1/2 diesel generator cooling water pump for heat exchanger flow reversal on April 6, 1998, the engine expansion tank filled and started overflowing. The chemistry department verified that river water had entered the coolant. It was determined that there was a leak in the tube sheet that allowed cooling water to migrate into the coolant due to galvanic corrosion. The heat exchanger was replaced. In addition, sacrificial anodes were installed in the heat exchanger. These anodes are inspected each outage.

- A review of all the closed cooling water chemistry at Quad Cities was performed as a result of INPO findings at Limerick Station. As a result, it was determined that the Unit 1/2 diesel generator jacket cooling water system had an increase of iron and copper in the system. No acceptance criteria for iron or copper levels were provided at that time. A decision was made to perform an additional analysis of the iron and copper levels subsequent to scheduled draining of the system and document the results. Acceptance criteria for iron and copper levels are presently provided in the procedure governing closed water chemistry sampling for each site.

- A routine chemistry analysis of the RBCCW heat exchangers in the Quad Cities Unit 1 reactor building indicated that the RBCCW chemistry was out of specification for pH, nitrites, and Tolyltriazole. Investigation concluded that the condition was due to work being performed on the Unit 0 RBCCW heat exchanger, which had resulted in leakage from the heat exchanger. The leakage path was isolated by operations. It was determined that a process to notify chemistry of draining of closed cooling water systems was necessary. A statement requiring such notification of chemistry is currently provided in the procedure governing filling and draining the RBCCW system.

No operating experience involving recurrence of heat exchanger degradations similar to those identified above has been identified since implementation of the associated corrective actions.

(b) Some of the heat exchangers monitored in the closed cooling water aging management program contain sacrificial anodes. However, this preventive measure has not been credited to minimize the effects of galvanic corrosion in affected heat exchangers.

B.1.15 <u>Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling System</u>

<u>RAI B.1.15</u>

Table 3.3-1, Ref No 3.3.1.14 identifies the aging management program (AMP), Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems (B.1.15) as the applicable aging management program to manage loss of material due to general corrosion and wear in the refueling system cranes for the period of extended operation. This AMP, with enhancements, claims consistency with the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems program, XI.M23 in NUREG-1801 with the exception

that it does not review the number and magnitude of lifts as in element 3 of XI.M23. The reason for the exception is because administrative controls assure "... that only allowable loads are handled and fatigue failure of structural elements is not expected." The AMP also states that a time-limited aging analysis concludes that there are no fatigue concerns for the period of extended operation. Provide justifications to demonstrate how the administrative control is adequate in lieu of tracking of the number and magnitude of lifts as in element 3 of GALL XI.M23.

The description of B.1.15 also states that the enhancements, specific inspections for rail wear and proper crane travel on rails as well as specific inspections for corrosion of crane structural components, are scheduled to be implemented prior to the period of extended operation. Provide an explanation of the statement in the Operating Experience section of B.1.15 which indicate that this program has been successful in the past at Dresden and Quad Cities if the proposed enhancements to the AMP (which are the primary attributes of XI.M23) have not yet been implemented. Also, provide a statement that clarifies that these enhanced inspections will be conducted on a routine basis as in element 4 of XI.M23.

Provide an explanation of how the conclusion that there are no fatigues concerns for the period of extended operation can be achieved without a fatigue analysis that considered the number and magnitude of lifts.

Response:

The justification for the adequacy of administrative controls in lieu of tracking the number and magnitude of lifts for the subject cranes is as follows:

1) The number and magnitude of lifts that are anticipated for any crane is significantly below the design limit. See section 4.7.1 of the LRA.

2) Various industry documents were used to develop procedures governing crane inspections at each site, including Vendor Manuals, OSHA Chapter XVII, Title 29 Part 1910.179, and ASME/ANSI B30.2, B30.10, B30.11, B30.16 Crane Standards, NUREG-0612, Control of Heavy Loads at Nuclear Power Plants, and 10CFR50.65, Maintenance Rule.

3) Crane inspections and functional checks are periodically performed in accordance with the above inspection procedures by qualified crane/structural steel inspectors.

4) Crane operating procedures require crane inspection prior to each use.

5) Crane operating procedures ensure that crane loading does not exceed crane capacities.

6) The reactor building overhead crane has the largest capacity of any in-scope crane at each site. This crane was designed to CMAA-70 Class A1 and is compatible with the requirements of the Occupational Safety and Health Act of 1970, as amended in 1971, as well as ANSI B30.2.0.

7) The capacities of the cranes other than the reactor building overhead crane are relatively

small. Consequently, any associated fatigue-related degradation of crane components would be identified via periodic inspections prior to loss of crane function.

Enhancements to the Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems program will include the addition of inspections for rail wear and proper crane travel on rails as well as for corrosion of crane structural components. The existing program includes visual inspections of various crane components. The statement in the Operating Experience section of LRA Section B.1.15 indicating that the program has been successful in the past applies to the existing program. Crane inspections under the existing program are routinely performed. Inspections under the enhanced program will also be routinely performed. A statement should have been added to the Enhancements section of LRA Section B.1.15 indicating that the subject crane inspections will be routinely performed.

The LRA Section B.1.15 conclusion that there are no fatigue concerns for the reactor building overhead cranes for the period of extended operation is valid despite that fact that there was no fatigue analysis. The basis for this conclusion is provided in LRA Section 4.7.1, Reactor Building Crane Load Cycles, which concludes that fatigue life is not significant to the operation of the reactor building overhead crane for the period of extended operation as its projected 60-year cycle estimate is only a fraction of the number of cycles for which the crane was qualified.

B.1.16 Compressed Air Monitoring

RAI B.1.16

(a) NUREG-1801, XI.M24, "Compressed Air Monitoring," is based on GL 88-14; IN 81-38; IN 87-28; IN 87-28S1; INPO SOER 88-01; EPRI-108147; ASME OM-S/G-1998, Part 17; ISA-S7.0.01-1996; and EPRI 7079. LRA B.1.16 states that the applicant's Compressed Air Monitoring program activities are consistent with Dresden/Quad Cities responses to GL88-14 and ISA-S7.0.01-1975 and that enhancements include inspection of instrument air distribution piping based on EPRI-108147. Since the applicant's program is not based on all the references included in NUREG-1801, explain why each of these references were not included in the development of the applicant's program and how the applicant's program can be considered consistent with NUREG-1801 without basing the program on these references.

(b) In LRA Table 3.3.2, item 3.3.2.262, the applicant states that brass or bronze valve components in the control rod drive hydraulic system are subject to aging effect of loss of material due to pitting and crevice corrosion and these aging effects will be managed by the Compressed Air Monitoring AMP (B.1.16). It is not readily apparent to the staff how this AMP will adequately manage the aging effect of loss of material due to corrosion, corrosion product build-up, or dirt build-up for brass or bronze valve components in the control rod drive hydraulic system. Provide explanation.

Response:

(a) Exelon did not state in the LRA that the B.1.16 (Compressed Air Monitoring) Aging Management Program was consistent NUREG 1801. LRA Section B.1.16 (Compressed Air Monitoring) stated that the Compressed Air Monitoring program is consistent with exceptions.

The Dresden and Quad Cities programs are based on GL 88-14 and ANSI/ISA-S7,3-1975 and are enhanced with inspection based on EPRI TR-108147. NUREG 1801 XI.M24 (Compressed Air Monitoring) states that GL 88-14 is augmented by References IN 81-38, IN 87-28, IN 87-28S1 and INPO SOER 88-01.

The sentence in the Exception section of LRA Appendix B, Section B.1.16, that currently reads:

> "The Dresden and Quad Cities programs are based on the guidance provided in the GL 88-14 and ANSI/ISA-S7.3-1975 documents, which are part of the current licensing basis."

should have read:

> "The Dresden and Quad Cities programs are based on the guidance provided in ANSI/ISA-S7.3-1975 and GL 88-14 which is augmented by previous NRC Information Notices IN 81-38, IN 87-28, IN 87-28 S1, and by the Institute of Nuclear Power Operations Significant Operating Experience Report (INPO SOER) 88-01."

In response to GL 88-14, Exelon committed to implementing an instrument air quality-monitoring program using ANSI/ISA-S7.3-1975. ANIS/ISA-S7.0.01-1996 is a newer revision to ANSI/ISA-S7.3-1975 that is less conservative then ANSI/ISA-S7.3-1975.

The following is a comparison of ANIS/ISA-S7.0.01-1996 to ANSI/ISA-S7.3-1975

Parameter	ANSI/ISA-S7.0.01-1996	ANSI/ISA-S7.3-1975
Dewpoint	18°F below the minimum temperature of any part of the air system. The dewpoint shall not exceed 39°F at line pressure.	18°F below the minimum temperature of any part of the air system. The dewpoint shall not exceed 35°F at line pressure.
Particle Size	40 microns maximum.	3 microns maximum. (Test procedures allow up to 4 particles/ft3 to exceed the 3 micron size limit)
Hydrocarbons (lubricant content)	As close to zero as possible, not to exceed 1ppm w/w or v/v.	As close to zero (0) w/w or v/v as possible, not to exceed 1ppm w/w or v/v under normal operating conditions.

EPRI TR-108147 is a new revision to EPRI NP-7079. Exelon has enhanced the Dresden and Quad Cities programs to include inspection of instrument air distribution piping based on ERPI TR-108147.

The scope of components included in the compressed air monitoring aging management activities includes distribution piping, valves and accumulators for air operated safety-related valves, and the containment isolation valves of the instrument air system. The instrument air system compressors, receivers, filters, and dryers are not within the scope of license renewal. Exelon takes exception to ASME OM-S/G-1998, Part 17 as specified in NUREG-1801 XI.M24. ASME OM-S/G-1998, Part 17 provides guidance concerning

the performance testing of instrument air systems in light-water reactor power plants. Because the instrument air system compressors, receivers, filters, and dryers are not within the scope of license renewal, the instrument air systems do not require performance testing for aging management. Exelon Aging Management Program B.1.16 (Compressed Air Monitoring) provides adequate aging management for the select number of instrument air system components that have been included within the scope of license renewal.

(b) The instrument air system at both sites supplies air to the CRD scram pilot valves. LRA Appendix B, Section B.1.16 Operating Experience states, "Dresden has experienced recent occurrences of corrosion, in instrument air system piping, positioners, and valve operators." However, the occurrences of corrosion have not occurred in brass or bronze valve components in the control rod drive hydraulic system. This portion of air piping receives periodic blowdown whenever the reactor scrams or scram testing is conducted. The compressed air monitoring program will be enhanced to provide periodic blowdowns of the instrument air system and will target those portions of piping that have an operating history of aging degradation.

The Compressed Air Monitoring Aging Management Program manages the loss of material due to general and pitting corrosion for portions of the instrument air system that are within the scope of license renewal. Compressed air monitoring activities consist of air quality testing, pressure decay testing, system blowdowns (Dresden only) and visual inspections at various system locations including include inspection of instrument air distribution piping.

At Quad Cities, the Compressed Air Monitoring Aging Management Program has been effective in avoiding corrosion product buildup, and dirt buildup. LRA Appendix B, Section B.1.16 Operating Experience states, "Quad Cities has not experienced a failure of a pneumatic component within the scope of license renewal due to corrosion, corrosion product buildup, or dirt buildup since 1993. The Quad Cities experience is consistent with the implementation of corrective actions in response to GL 88-14."

B.1.21 <u>Fuel Oil Chemistry</u>

<u>RAI B.1.21</u>

(a) For the second exception item, the LRA AMP B.1.21 states: "NUREG-1801 indicates that ASTM D1796 standard should be used to analyze fuel oil for water and sediment. The Dresden and Quad Cities programs use ASTM D2709 as specified by ASTM D975 for analysis of grades 1-D and 2-D fuel used at the stations." Both ASTM standards (D1796 and D2709) are referenced in the GALL Fuel Oil Chemistry (Chapter XI.M30 Fuel Oil Chemistry) program for the determination of water and sediment content in diesel fuel oil. The GALL AMP neither excludes the use of the ASTM D2709 standard nor does it include ASTM D1796 as the only applicable standard. The staff notes that based on a review of both standards, D2709 is appropriate for D 975 Grades 1D and 2D fuel oil. Per D2709, D1796 is appropriate for higher viscosity fuel oil. Please provide a basis for the statement in the LRA "NUREG-1801 indicates that ASTM D1796 standard should be used to analyze fuel oil for water and sediment," and indicate whether this item constitutes an exception to GALL, or only a clarification.

(b) For the third exception item, LRA AMP B.1.21 states: "NUREG-1801 indicates that ASTM

D2276 (modified), which provides field monitoring, should be used to analyze fuel oil for particulate content. The Dresden and Quad Cities programs use ASTM D5452 as the preferred method of analysis." ASTM D2276 is concerned with testing from a line sample whereas D5452 applies to lab filtration of a sample. D5452 may be appropriate if the sample does not come from a flowing stream. Clarify the origin of the fuel oil samples to be analyzed. Provide technical basis for the use of ASTM D5452 as the preferred method of analysis for fuel oil content analysis.

(c) For the fifth exception item, LRA AMP B.1.21 states: "NUREG-1801 discusses the need to add stabilizers and corrosion inhibitors to diesel fuel oil. Quad Cities does not add stabilizers because grade 1-D low sulfur fuel oil is used and stored fuel is periodically sampled and analyzed for quality. Dresden and Quad Cities do not add corrosion inhibitors because fuel storage tank bottoms are periodically sampled and analyzed for corrosion products in accordance with ASTM D4057 and ASTM D2709." Provide justification that the periodic sampling is representative. For example, a description of the sampling method, number of samples and specific location may provide some indication of the representation. In addition, justify the effectiveness of the bottom sample procedure and apparatus in sampling corrosive particles (sediment) if they exist.

(d) For the sixth exception item, LRA AMP B.1.21 states: "NUREG-1801 indicates that fuel oil tanks should be sampled for water, biological activity, and particulate on a periodic basis... The Dresden and Quad Cities emergency diesel generator fuel oil day tanks do not have the capability of being sampled. As an alternative, Dresden and Quad Cities sample for water and sediment from the bottom of the associated storage tanks quarterly and particulate from the fuel transfer pump discharge line on a monthly basis in accordance with approved procedures." The staff finds sampling from the bottoms of the associated tanks and discharge lines of the fuel oil transfer pumps may not accurately reflect the quality of the oil in the oil tanks and the adverse impact on the internal of the oil tanks caused by the degradation of oil quality because: (1) sample results from the bottoms of the associated tanks may not be able to accurately reflect the quality of the oil in the day tanks because it depends on how often the fuel oils in these two types of tanks are exchanged or refreshed; and (2) the fuel oil samples from the discharge lines of the fuel oil transfer pumps may have already being filtered by filters in the suction head or fuel line. Provide technical explanations that address these two concerns. The staff also notes that based on the guidance in Regulatory Guide 1.137 and EPRI NP-6314, day tanks should be checked for water monthly, as a minimum, and after each operation of the diesel where the period was 1 hour or longer. Therefore, provide justification as to why the day tanks are not sampled.

(e) The purpose of monitoring and trending fuel oil sample results is to provide for timely detection of conditions conducive to corrosion of the internal surface of the diesel fuel oil tank before the potential loss of its intended function. However, in the last item of the exceptions, LRA AMP B.1.21 states: "NUREG-1801 indicates that fuel oil sample results should be monitored and trended. At Dresden, the results of analysis of new fuel oil are reviewed for acceptability, but are not trended. In the event the quantitative oil acceptance criteria in plant procedures are approached or exceeded the fuel oil is restored to within the limits or an action request or condition report is initiated." The staff finds that the applicant's approach may not be able to provide timely detection of the conditions conducive to corrosion because actions will not be taken before the quantitative oil criteria is approached or exceeded. Corrosion on the internal of the fuel tank may have already been significant when this condition is reached. Provide technical explanations that address this concern.

(f) LRA AMP B.1.21 indicates that the diesel fuel oil storage tanks are periodically cleaned

and inspected for evidence of internal corrosion and that an enhancement will provide for inspection of the fuel oil storage tank interiors. Section 3.3.1.1.8 also indicates that UT examination of the lower portion will be performed. Provide information that provides more specific UT locations, the inspection interval and operating history.

(g) The UFSAR supplement does not include criteria for fuel monitoring identified in LRA AMP B.1.21, such as specific ASTM standards. For example, specific ASTM standards are identified in NUREG-1800 Table 3.3-2. Provide a revised UFSAR supplement which includes specific ASTM standards applied in AMP B.1.21.

(h) LRA AMP B.1.21 identifies operating experience which includes plugging of fuel filters and drain lines. This operating experience suggests that the fuel oil chemistry program was not effective in preventing or detecting contamination and corrosion products at an early stage. Indicate what corrective actions have been implemented to prevent recurrence of these events. In addition, indicate if filters and strainer elements in the fuel oil system are periodically inspected to further assess the effectiveness of the fuel oil chemistry program.

Response:

(a) NUREG 1801 XI.M30 Element 3, Parameters Monitored/Inspected for the Fuel Oil Chemistry states, "The ASTM Standards D1796 and D2709 are used for determination of water and sediment contamination in diesel fuel." The literal meaning regarding the word 'and' was used such that both standards were thought to be required rather than either standard depending on the grade of fuel oil. The second exception should be deleted from the LRA Aging Management Program B.1.21 (Fuel Oil Chemistry).

(b) Bottom samples are collected from the underground fuel oil storage tank in accordance with Dresden and Quad Cities fuel oil sampling procedures. At Quad Cities, when samples are analyzed for water and sediment, the samples are taken from the tank bottom. When samples are analyzed for particulates, then samples are taken approximately one foot above the bottom of the tank. At Dresden, samples are taken from the tank bottom using a hand pump. Exelon utilizes ASTM D5452 because laboratory sample preparation and testing per ASTM D5452 produces more accurate and repeatable test results than using a field monitor as described in ASTM D2276. Additionally, the test methods for the determination of particulate contaminant in a fuel sample by laboratory filtration per ASTM D5452 is referenced by ASTM D2276 for situations where it is not possible to take field monitor samples.

(c) Quad Cities and Dresden fuel oil inspection procedures meet the requirements of ASTM D4057 and ASTM D2709. Underground storage tank fuel oil quality testing (water, sediment and bacteria) is performed quarterly while particulate contamination (evidence for corrosion products) is performed on a monthly basis. At Quad Cities, when samples are analyzed for water and sediment, one-pint samples are taken from the tank bottom. When samples are analyzed for particulates, one pint or larger samples are to be taken approximately one foot above the bottom of the tank. At Dresden, for all the analyses one-liter samples are taken from the tank bottom using a hand pump. Samples taken at or near the bottom of the tanks provide early detection for contamination since any water, sediment or particulates would settle towards the tank bottom. These samples provide the 'worse case' indication for identifying contamination.

(d) (1) The Dresden and Quad Cities diesel fuel oil day tanks do not have provisions for taking direct fuel oil samples. Approximately 1/3 of the day tanks volume of 750 is used each month during the Diesel Generator Surveillance Tests. The monthly underground storage tank sampling, periodic transfer pump discharge line sampling, and monthly drainage of accumulated water from the day tanks have proven effective in maintaining quality fuel oil to the diesel engines. The most recent Dresden EDG Self-Assessment (1999) shows EDG reliability performance of 97.7% while the most recent Quad Cities EDG Self-Assessment (2001) shows the EDGs are performing at 99% reliability and 98.4% availability. These performance results are above the Station Blackout Rule and Maintenance Rule criteria of 95%. In addition, neither station has an operating history of diesel engine in-operability attributed to contaminated fuel.

(2) Samples taken from the transfer pump discharge lines are un-filtered and representative of the fuel in the storage tank. Per the boundary drawings, the diesel generator fuel oil transfer pumps take suction directly from the underground fuel oil storage tanks and discharge directly into the day tanks. The fuel oil strainers and filters are located down stream of the day tank at the suction and discharge of the engine driven fuel pumps.

Dresden (as part of the Dresden Diesel Generator Surveillance Tests) meets the guidance in Regulatory Guide 1.137 and EPRI NP-6314 by removing any accumulated water from the day tanks on a monthly basis or following engine operation (greater than or equal to one hour) via the day tank drains. Quad Cities (as part of the Quad Cities Diesel Generator Surveillance Tests) meets the guidance in Regulatory Guide 1.137 and EPRI NP-6314 by removing any accumulated water from the day tanks on a monthly basis or following engine operation (greater than or equal to one hour) by draining the day tank to the underground fuel oil storage tank. Sampling of the underground fuel oil storage tank is then used to detect the presence of water.

(e) The LRA AMP B.1.21 exception stating that new fuel oil analysis results are not trended but are reviewed for acceptability, applies to the receipt of new fuel oil deliveries only. At Dresden and Quad Cities, oil samples of existing fuel oil are taken quarterly. These quarterly test results are evaluated and trended, noting the samples as stable, increasing, or decreasing impurities. Exelon believes that the trending of the quarterly test samples provides for timely detection of conditions conducive to corrosion.

(f) An UT examination of the lower portion of one carbon steel underground fuel oil storage tank and one day tank at each facility will be performed prior to the period of extended operation. Specific UT locations will be defined at that time. The results of the UT's will be evaluated, corrective action if required taken and the need for further UT's will be assessed.

The draining, cleaning and inspection of the underground fuel oil storage tank interiors is conducted at ten (10) year intervals. To date, no tank wall aging degradation has been identified.

(g) Exelon will revise the UFSAR supplement A.1.2.1 Fuel Oil Chemistry to read as follows.

"The fuel oil chemistry aging management program relies on a combination of surveillance and maintenance procedures. Monitoring and controlling fuel oil contamination maintains the fuel oil quality. Exposure to fuel oil contaminants such as

water and microbiological organisms is minimized by routine draining and cleaning of fuel oil tanks, and by fuel oil sampling and analysis, including analysis of new fuel before its introduction into the storage tanks. A biocide is added to the fuel oil storage tanks during each new fuel delivery. Sampling and testing of diesel fuel oil is in accordance with ASTM D2709, ASTM D4057 and ASTM D5452. Emergency diesel generator fuel oil analysis acceptance criteria are contained in the Technical Specifications and are based on the requirements of ASTM D975."

(h) The LRA AMP B.1.21 operating experience identifies flow blockage events at Quad Cities and Dresden. The station Work Orders in question identify the following:

- In 1998, fuel filters at Quad Cities were found to be plugged.
- In 1998, sludge partially blocked the Quad Cities Unit 1 'A' tank drain line.
- In 1993, the Dresden day tank drain was plugged.

Regarding the 'plugged' Quad Cities fuel filters, marginal fuel oil discharge pressure was identified during diesel surveillance testing. The backup filter also displayed marginal discharge pressure. The system was considered operable when the degraded filter conditions were identified. Upon replacement, normal filter discharge pressures were noted. No explanation for the marginal performance of the backup filter was identified; however, this appears to have been an isolated event based on successful diesel surveillance tests since that date.

Regarding the partially blocked Quad Cities Unit 1 'A' tank drain line, the condition was identified while draining accumulated water as part of SBO diesel surveillance testing. No additional information was provided in the work order. However, no further partial blockage of the drains has been identified.

Regarding the plugged Dresden fuel oil day tank drain, the condition was identified while draining accumulated water as part of diesel surveillance testing. No additional information was provided. This appears to be an isolated incident since subsequent drain plugging has not been noted. System operability was not impacted.

Exelon believes that the operating history shows that system testing confirms the adequacy of the fuel oil inspection and testing in maintaining system functions. In addition, as part of the diesel surveillance testing, the fuel oil supply pressure and fuel oil filter discharge pressure are recorded and trended. This provides indication of the performance of the fuel filters and strainers. Readings outside the nominal range are brought to the attention of the System Engineer for evaluation.

B.1.23 <u>One-Time Inspection</u>

<u>RAI B.1.23-1</u>

The applicant states that 10 CFR 54.4(a)(2) components (i.e. non-safety related affecting safety related) receive a one-time, internal, visual inspection for general, crevice, galvanic, and pitting corrosion. Based on this statement, the applicant's aging management methodology for 10 CFR 54.4(a)(2) components is not clear. Clarify: (1) if aging of 10 CFR 54.4(a)(2) components is managed only by the one-time inspection program only or is the one-time inspection program used to augment other aging management programs for these components, and (2) if any

54.4(a)(2) components are managed only by the one-time inspection program, describe the aging effects and justify use of the one-time inspection to manage these aging effects.

Response:

(1) For most 10 CFR 54.4(a)(2) components that have intended functions of "Leakage Boundary (spatial)" or "Structural Integrity (attached)," the One-Time Inspection Aging Management Program does not augment other aging management programs. However, as discussed in the response to RAI B.1.23-2, an additional aging management program is applicable for 10 CFR 54.4(a)(2) components with an environment of Lubricating Oil in the Reactor Core Isolation Cooling System and the High Pressure Coolant Injection System, or with an environment of Lubricating Oil or Fuel Oil in the Emergency Diesel Generator and Auxiliaries System and the Station Blackout Diesel System. For (a)(2) components where aging is managed only by a one-time inspection, Exelon will perform a one-time inspection of selected 10 CFR 54.4(a)(2) components to determine whether degradation, if any, caused by loss of material due to general, crevice or pitting corrosion is proceeding at an acceptably slow rate to ensure that the intended function(s) of the components is maintained during the extended period of operation. The one-time inspection will be performed near the end of the current operating term and before the period of extended operation.

(2) For 10 CFR 54.4(a)(2) components with intended functions of "Leakage Boundary (spatial)" or "Structural Integrity (attached)," the aging effect with potential to cause loss of intended function is "loss of material" which could result in degradation of the leakage boundary or reduction in material strength. The aging mechanisms that may cause loss of material are general corrosion, crevice corrosion or pitting corrosion. Based on the components material-environment combinations, Exelon believes that aging of these components, if any, is expected to progress very slowly. The visual inspections will check for indications of general corrosion, crevice corrosion and pitting corrosion. If loss of material due to corrosion is found, a determination will be made with regard to whether the rate of corrosion is sufficiently slow such that loss of intended function due to corrosion will not occur during the period of extended operation. For material-environment combinations with no evident corrosion or with sufficiently slow corrosion rates, no further actions will be taken. For material-environment combinations with corrosion rates such that loss of intended function due to excessive corrosion might occur during the extended period of operation, corrective actions will be taken. Appropriate corrective actions will be determined and may consist of component replacement and/or implementation of additional aging management activities for 10 CFR 54.4(a)(2) components with the material-environment combination in which the excessive corrosion has occurred. Additional details and discussion of the basis for acceptability of one-time inspections for (a)(2) components are provided in the Exelon response to RAI B.1.23-2.

<u>RAI B.1.23-2</u>

GALL Program XI.M32, "One-Time Inspection," is designed to verify the effectiveness of an aging management program (such as the water chemistry program) at preventing aging effects, or to otherwise confirm the absence of an aging effect. One-time inspections address concerns about the potential long incubation period for certain aging effects on structures and

components. One-time inspections confirm that either an aging effect is indeed not occurring, or an aging effect is occurring very slowly such that it will not affect the component or structure intended function.

In many portions of the LRA, the One-Time Inspection program (B.1.23) is credited as the only applicable aging management program for components where aging would be expected unless there is a program designed to manage aging. However, the LRA does not credit a corresponding program that would manage aging and thus support the use of a one-time inspection. Examples include components exposed to various steam, water, and oil environments, where proper chemistry controls are necessary to preclude aging. For these examples, a water chemistry program precludes corrosion for piping internal and the One-Time Inspection program provides verification that this aging effect is not occurring or is occurring very slowly.

Also, in many portions of the LRA, the One-Time Inspection Program is used for material/environment combinations where aging degradation is expected to occur. Periodic inspections are more appropriate for these situations.

a) For the following mechanical system links (systems), the One-Time Inspection program must be accompanied by an appropriate program to prevent the aging from occurring. Either provide an accompanying program to prevent aging (i.e., a chemistry program), or justify the use of a one-time inspection for these items.

Reactor Coolant System:

3.1.2.9 (Reactor Recirculation)
3.1.2.12 (Reactor Recirculation)
3.1.2.21 (Reactor Recirculation)
3.1.2.27 (Reactor Recirculation)
3.1.2.45 (Reactor Recirculation)

Engineering Safety Features:

3.2.2.2 (Reactor Core Isolation Cooling, HPCI)
3.2.2.8 (Reactor Core Isolation Cooling, HPCI)
3.2.2.32 (Reactor Core Isolation Cooling, HPCI)
3.2.2.33 (HPCI)
3.2.2.34 (HPCI)
3.2.2.35 (Reactor Core Isolation Cooling, Containment Isolation Components & Primary Containment Piping)
3.2.2.36 (Reactor Core Isolation Cooling, Containment Isolation Components & Primary Containment Piping)
3.2.2.37 (Reactor Core Isolation Cooling, Containment Isolation Components & Primary Containment Piping)
3.2.2.59 (Reactor Core Isolation Cooling, HPCI
3.2.2.65 (HPCI)
3.2.2.71 (Reactor Core Isolation Cooling, HPCI)
3.2.2.73 (Reactor Core Isolation Cooling)
3.2.2.84 (Reactor Core Isolation Cooling)
3.2.2.86 (HPCI)
3.2.2.92 (LPCI, Core Spray, HPCI)

3.2.2.103 (HPCI)
3.2.2.105 (RHR, HPCI)
3.2.2.110 (Reactor Core Isolation Cooling, HPCI)
3.2.2.121 (Reactor Core Isolation Cooling, HPCI)
3.2.2.130 (Reactor Core Isolation Cooling, HPCI)
3.2.2.131 (Reactor Core Isolation Cooling)
3.2.2.132 (HPCI)
3.2.2.133 (Reactor Core Isolation Cooling, HPCI)
3.2.2.135 (Reactor Core Isolation Cooling, HPCI)

Auxiliary Systems:

3.3.2.2 (Plant Heating System)
3.3.2.60 (Emergency Diesel Generator and Auxiliaries, Station Blackout)
3.3.2.135 (Station Blackout)
3.3.2.136 (Station Blackout)
3.3.2.139 (Standby Liquid Control, Emergency Diesel Generator and Auxiliaries, Station Blackout, Diesel Fuel Oil)
3.3.2.142 (Plant Heating)
3.3.2.148 (Station Blackout)
3.3.2.156 (Station Blackout)
3.3.2.162 (Station Blackout)
3.3.2.177 (Emergency Diesel Generator and Auxiliaries, Station Blackout)
3.3.2.181 (Plant Heating)
3.3.2.187 (Emergency Diesel Generator and Auxiliaries)
3.3.2.197 (Plant Heating)
3.3.2.214 (Plant Heating)
3.3.2.224 (Emergency Diesel Generator and Auxiliaries, Station Blackout)
3.3.2.235 (Emergency Diesel Generator and Auxiliaries)
3.3.2.240 (Emergency Diesel Generator and Auxiliaries)
3.3.2.243 (Plant Heating)
3.3.2.249 (Emergency Diesel Generator and Auxiliaries, Station Blackout)
3.3.2.252 (Plant Heating)
3.3.2.263 (Plant Heating)
3.3.2.269 (Emergency Diesel Generator and Auxiliaries, Station Blackout)
3.3.2.271 (Plant Heating)
3.3.2.282 (Plant Heating)
3.3.2.290 (Emergency Diesel Generator and Auxiliaries, Station Blackout)

Steam and Power Conversion Systems:

3.4.2.16 (Turbine Oil System)
3.4.2.29 (Main Turbine and Auxiliaries)
3.4.2.32 (Turbine Oil System)
3.4.2.36 (Main Turbine and Auxiliaries)
3.4.2.37 (Turbine Oil System)
3.4.2.43 (Turbine Oil System)
3.4.2.48 (Main Turbine and Auxiliaries)
3.4.2.50 (Turbine Oil System)
3.4.2.55 (Main Turbine and Auxiliaries)

b) For the following mechanical system links (systems), the aging effects are expected to occur, so that periodic inspection may be more appropriate than a one-time inspection. Provide justification for the use of the One-Time Inspection program for these items.

Reactor Coolant System:

3.1.2.19 (Head Spray, Nuclear Boiler Instrumentation, Reactor Vessel Head Vent, Reactor Recirculation)
3.1.2.22 (Reactor Recirculation)
3.1.2.48 (Reactor Recirculation)
3.1.2.51 (Reactor Recirculation)

Engineering Safety Features:

3.2.2.55 (Standby Liquid Gas Treatment, LPCI, RHR, Isolation Condenser, Reactor Core Isolation Cooling, Containment Isolation Components and Primary Containment Piping, Core Spray, HPCI)
3.2.2.62 (LPCI, Containment Isolation Components and Primary Containment Piping)
3.2.2.74 (Containment Isolation Components and Primary Containment Piping)
3.2.2.87 (Containment Isolation Components and Primary Containment Piping)
3.2.2.99 (Reactor Core Isolation Cooling, HPCI)
3.2.2.108 (Standby Gas Treatment, Containment Isolation Components and Primary Containment Piping)
3.2.2.112 (Containment Isolation Components and Primary Containment Piping)
3.2.2.113 (LPCI, Containment Isolation Components and Primary Containment Piping, Core Spray)
3.2.2.114 (Standby Gas Treatment)
3.2.2.126 (Reactor Core Isolation Cooling, HPCI)
3.2.2.127 (Standby Gas Treatment)
3.2.2.128 (Reactor Core Isolation Cooling, HPCI)

Auxiliary Systems:

3.3.2.55 (Emergency Diesel Generator and Auxiliaries, Station Blackout)
3.3.2.64 (Station Blackout, Containment Atmosphere Monitoring)
3.3.2.65 (Emergency Diesel Generator and Auxiliaries)
3.3.2.66 (Emergency Diesel Generator and Auxiliaries, Station Blackout)
3.3.2.67 (Containment Atmosphere Monitoring)
3.3.2.130 (Standby Liquid Control, Shutdown Cooling, Control Rod Drive Hydraulic, Reactor Water Cleanup, Emergency Diesel Generator and Auxiliaries, HVAC - Main Control Room, Diesel Generator Cooling Water, Process Sampling, Reactor Building Closed Cooling Water, Makeup Demineralizer, Residual Heat Removal Service Water, Plant Heating, Containment Atmosphere Monitoring)
3.3.2.145 (Fuel Pool Cooling and Filter Demineralizer)
3.3.2.146 (Control Rod Drive Hydraulic)3.3.2.149 (Station Blackout)
3.3.2.167 (Control Rod Drive Hydraulic)
3.3.2.199 (Fuel Pool Cooling and Filter Demineralizer)
3.3.2.216 (Emergency Diesel Generator and Auxiliaries, Station Blackout)
3.3.2.228 (Drywell Nitrogen Inerting)
3.3.2.229 (Plant Heating)
3.3.2.255 (Containment Atmosphere Monitoring)

3.3.2.256 (Emergency Diesel Generator and Auxiliaries, Station Blackout)
3.3.2.274 (Control Rod Drive Hydraulic)
3.3.2.281 (Service Water)
3.3.2.296 (Control Rod Drive Hydraulic)
3.3.2.299 (Containment Atmosphere Monitoring)

Steam and Power Conversion Systems:

3.4.2.30 (Main Steam, Feedwater)

Response:

(a) Exelon has reevaluated the components, materials, and environments associated with the Aging Management References ("mechanical system links") listed in part (a) of this request for additional information (RAI) and provides the following response.

- Exelon will expand the scope of Aging Management Program B.2.5 (Lubricating Oil Monitoring) or Aging Management Program B.1.21 (Fuel Oil Chemistry) to include those components in the Reactor Core Isolation Cooling (RCIC) System, the High Pressure Coolant Injection (HPCI) System, the Emergency Diesel Generator and Auxiliaries System, and the Station Blackout Diesel System that are exposed to an environment of Lubricating Oil or Fuel Oil,

- Exelon's reevaluation of the components in the following systems supports a conclusion that the Aging Management Program B.1.23 (One-Time Inspections) will provide adequate management of potential aging effects during the extended period of operation.

  1) Reactor Recirculation System components that are exposed to an environment of Lubricating Oil
  2) Turbine Oil System components that are exposed to an environment of Generator Hydrogen Seal Oil
  3) Main Turbine and Auxiliaries System components that are exposed to an environment of Turbine EHC Fluid

  A review of Dresden and Quad Cities operating experience for these systems has not identified any components in these environments whose failure was attributed to age related degradation. Based on this review, Exelon believes that a one-time inspection to confirm continued good operating history is adequate to ensure that the intended functions of these components will be maintained throughout the extended period of operation.

- Exelon believes that periodic inspection of selected Plant Heating System components that are exposed to an environment of Saturated Steam/Condensate will provide adequate management of aging effects during the extended period of operation. A review of Dresden and Quad Cities operating experience for this system has identified component failures that may be related to the effects of age related degradation. Using processes based on Aging Management Program B.1.23, Exelon will periodically inspect components in the Dresden and Quad Cities Plant Heating Systems once before the end of the current operating term and periodically at intervals of approximately every 5 years

during the period of extended operation. The intended function of the Plant Heating System is to preclude adverse effects on safety-related systems, structures or components (SSCs) by maintaining a leakage boundary sufficient to prevent spatial interactions that lead to failure of SSCs. Exelon believes that periodic inspections will provide ample warning of age related degradation that might lead to failure of the system's intended function in sufficient time for appropriate corrective actions to be taken.

A few of the Aging Management References listed in part (a) of this RAI correspond to an environment that (1) varies with normal plant operations, (2) is impractical to monitor or control routinely, and (3) is similar to the environments associated with the Aging Management References listed in part (b) of this RAI. Exelon considers the One-Time Inspection Aging Management Program (B.1.23) to provide adequate management of any aging effects during the period of extended operation. Exelon's basis for this conclusion is provided in the response to part (b) of this RAI.

The following tables provide a summary of the Aging Management Program for each of the Aging Management References based on the discussion provided above.

Four of the Aging Management Reference numbers listed in the following tables have been revised from what is listed in part (a) of this RAI. Exelon believes that where part (a) of the RAI listed Aging Management References 3.2.2.92, 3.2.2.103, 3.2.2.110 and 3.2.2.8, it should have listed Aging Management References 3.2.2.91, 3.2.2.102, 3.2.2.109 and 3.2.2.7, respectively. The basis for Exelon's belief is that the aging management programs corresponding to 3.2.2.92, 3.2.2.103, 3.2.2.110 and 3.2.2.8 are not one-time inspections, whereas the aging management programs corresponding to 3.2.2.91, 3.2.2.102, 3.2.2.109 and 3.2.2.7 are one-time inspections.

In addition, Standby Liquid Control should be removed from the parenthetic list of systems related to Aging Management Reference 3.3.2.139 as stated in the RAI. Standby Liquid Control is not related to this Aging Management Reference.

Reactor Coolant System:

Aging Management Reference	Environment	Aging Management Program in Addition to One-Time Inspection (B.1.23)
3.1.2.9 (Reactor Recirculation)	Lubricating oil (with contaminants and/or moisture)	None
3.1.2.12 (Reactor Recirculation)	Lubricating oil (with contaminants and/or moisture)	None
3.1.2.21 (Reactor Recirculation)	Lubricating oil (with contaminants and/or moisture)	None
3.1.2.27 (Reactor Recirculation)	Lubricating oil (with contaminants and/or moisture)	None
3.1.2.45 (Reactor Recirculation)	Lubricating oil (with contaminants and/or moisture)	None

Engineered Safety Features:

Aging Management Reference	Environment	Aging Management Program in Addition to One-Time Inspection (B.1.23)
3.2.2.2 (Reactor Core Isolation Cooling, HPCI)	Air and steam up to 320°C (608°F) (Primary air)	None. Discussion in Part b) response is applicable for this environment.
3.2.2.7 (HPCI) ~~3.2.2.8 (Reactor Core Isolation Cooling, HPCI)~~	Air and steam up to 320°C (608°F) (Primary air)	None. Discussion in Part b) response is applicable for this environment.
3.2.2.32 (Reactor Core Isolation Cooling, HPCI)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.2.2.33 (HPCI)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.2.2.34 (HPCI)	Moist air	None. Discussion in Part b) response is applicable for this environment.
3.2.2.35 (Reactor Core Isolation Cooling, Containment Isolation Components & Primary Containment Piping)	Moist containment atmosphere (air/nitrogen), steam, or demineralized water	None. Discussion in Part b) response is applicable for this environment.
3.2.2.36 (Reactor Core Isolation Cooling, Containment Isolation Components & Primary Containment Piping)	Saturated air	None. Discussion in Part b) response is applicable for this environment.
3.2.2.37 (Reactor Core Isolation Cooling, Containment Isolation Components & Primary Containment Piping)	Warm, moist air	None. Discussion in Part b) response is applicable for this environment.

Aging Management Reference	Environment	Aging Management, Program in Addition to One-Time Inspection (B.1.23)
3.2.2.59 (Reactor Core Isolation Cooling, HPCI	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.2.2.65 (HPCI)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.2.2.71 (Reactor Core Isolation Cooling, HPCI)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.2.2.73 (Reactor Core Isolation Cooling)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.2.2.84 (Reactor Core Isolation Cooling)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.2.2.86 (HPCI)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.2.2.91 (Containment Isolation Components & Primary Containment Piping) ~~3.2.2.92 (LPCI, Core Spray, HPCI)~~	Warm, moist air	None. Discussion in Part b) response is applicable for this environment.
3.2.2.102 (HPCI) ~~3.2.2.103 (HPCI)~~	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.2.2.105 (RHR, HPCI)	Air	None. Discussion in Part b) response is applicable for this environment.
3.2.2.109 (Reactor Core Isolation Cooling, HPCI) ~~3.2.2.110 (Reactor Core Isolation Cooling, HPCI)~~	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.2.2.121 (Reactor Core Isolation Cooling, HPCI)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.2.2.130 (Reactor Core Isolation Cooling, HPCI)	Air and steam up to 320°C (608°F) (Primary air)	None. Discussion in Part b) response is applicable for this environment.

Aging Management Reference	Environment	Aging Management, Program in Addition to One-Time Inspection (B.1.23)
3.2.2.131 (Reactor Core Isolation Cooling)	Air and steam up to 320°C (608°F) (Primary air)	None. Discussion in Part b) response is applicable for this environment.
3.2.2.132 (HPCI)	Air and steam up to 320°C (608°F) (Primary air)	None. Discussion in Part b) response is applicable for this environment.
3.2.2.133 (Reactor Core Isolation Cooling, HPCI)	Air and steam up to 320°C (608°F) (Primary air)	None. Discussion in Part b) response is applicable for this environment.
3.2.2.135 (Reactor Core Isolation Cooling, HPCI)	Air and steam up to 320°C (608°F) (Primary air)	None. Discussion in Part b) response is applicable for this environment.

Auxiliary Systems:

Aging Management Reference	Environment	Aging Management Program in Addition to One-Time Inspection (B.1.23)
3.3.2.2 (Plant Heating System)	Saturated Steam/Condensate	Periodic Inspections based on B.1.23 processes.
3.3.2.60 (Emergency Diesel Generator and Auxiliaries, Station Blackout)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.3.2.135 (Station Blackout)	Diesel fuel oil	Fuel Oil Chemistry (B.1.21)
3.3.2.136 (Station Blackout)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.3.2.139 (~~Standby Liquid Control,~~ Emergency Diesel Generator and Auxiliaries, Station Blackout, Diesel Fuel Oil)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.3.2.142 (Plant Heating)	Saturated Steam/Condensate	Periodic Inspections based on B.1.23 processes.
3.3.2.148 (Station Blackout)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)

Aging Management Reference	Environment	Aging Management Program in Addition to One-Time Inspection (B.1.23)
3.3.2.156 (Station Blackout)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.3.2.162 (Station Blackout)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.3.2.177 (Emergency Diesel Generator and Auxiliaries, Station Blackout)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.3.2.181 (Plant Heating)	Saturated Steam/Condensate	Periodic Inspections based on B.1.23 processes.
3.3.2.187 (Emergency Diesel Generator and Auxiliaries)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.3.2.197 (Plant Heating)	Saturated Steam/Condensate	Periodic Inspections based on B.1.23 processes.
3.3.2.214 (Plant Heating)	Saturated Steam/Condensate	Periodic Inspections based on B.1.23 processes.
3.3.2.224 (Emergency Diesel Generator and Auxiliaries, Station Blackout)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.3.2.235 (Emergency Diesel Generator and Auxiliaries)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.3.2.240 (Emergency Diesel Generator and Auxiliaries)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.3.2.243 (Plant Heating)	Saturated Steam/Condensate	Periodic Inspections based on B.1.23 processes.
3.3.2.249 (Emergency Diesel Generator and Auxiliaries, Station Blackout)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)

Aging Management Reference	Environment	Aging Management, Program in Addition to One-Time Inspection (B.1.23)
3.3.2.252 (Plant Heating)	Saturated Steam/Condensate	Periodic Inspections based on B.1.23 processes.
3.3.2.263 (Plant Heating)	Saturated Steam/Condensate	Periodic Inspections based on B.1.23 processes.
3.3.2.269 (Emergency Diesel Generator and Auxiliaries, Station Blackout)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)
3.3.2.271 (Plant Heating)	Saturated Steam/Condensate	Periodic Inspections based on B.1.23 processes.
3.3.2.282 (Plant Heating)	Saturated Steam/Condensate	Periodic Inspections based on B.1.23 processes.
3.3.2.290 (Emergency Diesel Generator and Auxiliaries, Station Blackout)	Lubricating oil (with contaminants and/or moisture)	Lubricating Oil Monitoring (B.2.5)

Steam and Power Conversion Systems:

Aging Management Reference	Environment	Aging Management Program in Addition to One-Time Inspection (B.1.23)
3.4.2.16 (Turbine Oil System) (Quad Cities only)	Generator hydrogen seal oil	None
3.4.2.29 (Main Turbine and Auxiliaries)	Turbine EHC fluid	None
3.4.2.32 (Turbine Oil System) (Quad Cities only)	Generator hydrogen seal oil	None
3.4.2.36 (Main Turbine and Auxiliaries)	Turbine EHC fluid	None
3.4.2.37 (Turbine Oil System) (Quad Cities only)	Generator hydrogen seal oil	None

Aging Management Reference	Environment	Aging Management Program in Addition to One-Time Inspection (B.1.23)
3.4.2.43 (Turbine Oil System) (Quad Cities only)	Generator hydrogen seal oil	None
3.4.2.48 (Main Turbine and Auxiliaries)	Turbine EHC fluid	None
3.4.2.50 (Turbine Oil System) (Quad Cities only)	Generator hydrogen seal oil	None
3.4.2.55 (Main Turbine and Auxiliaries)	Turbine EHC fluid	None

b) The following tables show the environments and materials for components associated with each of the Aging Management References listed in part (b) of this RAI. With the exception of Aging Management References 3.3.2.229 and 3.3.2.281 (which will be discussed separately), the corresponding environments are gases containing various levels of moisture and/or particulates. Although age-related degradation of components in these gaseous environments may be possible, Exelon believes that age related degradation for these components is sufficiently slow to ensure that the intended functions of the components will not be affected during the extended period of operation. Review of maintenance history records for these systems confirms that plant operating experience for components in these environments has been satisfactory, with no evidence of age related degradation leading to component failure.

NUREG 1801 XI.M32, One-Time Inspection, Program Description, states, "One-time inspection is needed to address concerns for the potential long incubation period for certain aging effects on structures and components. There are 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 is to be confirmation that either the aging effect is not occurring, or 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 an acceptable option for this verification." Exelon is consistent with NUREG 1801 in providing one-time inspections for components selected from environments where an aging effect is expected to progress very slowly.

Prior to the period of extended operation, Exelon will perform one-time inspections of selected components included under the mechanical system links listed in Part b) of this RAI. The one-time inspections will validate whether aging degradation is proceeding at an appreciably slow rate such that there is no impact on the components' intended function(s) for the period of extended operation. For a specific material-environment combination, if age related degradation is sufficiently slow to ensure that the components' intended function(s) will be maintained throughout the extended period of operation, then no further actions will be required. However, if unacceptable age related degradation is observed, the results of the initial inspection will be used to determine the

scope and frequency of subsequent examinations that are sufficient to predict degradation so that timely corrective actions can be taken. Appropriate corrective actions will be determined and may consist of component refurbishment, repair or replacement.

As noted in the first paragraph of this response to part (b) of the RAI, Aging Management References 3.3.2.229 and 3.3.2.281 are exceptions to the preceding discussion.

- Aging Management Reference 3.3.2.229 is related to components in the Plant Heating System. Other Aging Management References related to the Plant Heating System were listed in the response to part (a) of this RAI. In response to part (a), Exelon has stated that aging effects for in-scope components of the Plant Heating System will be managed by periodic inspections based on the processes of AMP B.1.23 (One-Time Inspection). The components corresponding to Aging Management Reference 3.3.2.229 will be included in the periodic inspections applicable for other components of the Plant Heating System.

- The aging of Cast Iron Valves in an environment of raw, untreated salt water or fresh water is being managed by Aging Management Program B.1.13 (Open-Cycle Cooling Water System), Aging Management Reference 3.3.2.281, and by Aging Management Program B.1.23 (One-Time Inspection), Aging Management Reference 3.3.2.280. These components are not ones for which Exelon is proposing only Aging Management Program B.1.23 to provide aging management.

One of the aging management reference numbers listed in the following tables has been revised from what is listed in part (b) of this RAI. Exelon believes that where part (b) of the RAI listed Aging Management Reference 3.1.2.19, it should have listed Aging Management Reference 3.1.2.18. The basis for Exelon's belief is that the Aging Management Program corresponding to 3.1.2.19 is not One-Time Inspection, whereas the Aging Management Program corresponding to 3.1.2.18 is One-Time Inspection.

Reactor Coolant System:

Aging Management Reference	Environment	Materials
3.1.2.18 ~~3.1.2.19~~ (Head Spray, Nuclear Boiler Instrumentation, Reactor Vessel Head Vent, Reactor Recirculation)	Air, moisture, humidity, and leaking fluid	Carbon Steel, Stainless Steel, Brass or Bronze
3.1.2.22 (Reactor Recirculation)	Wet gas	Carbon Steel
3.1.2.48 (Reactor Recirculation)	Wet gas	Carbon Steel

Aging Management Reference	Environment	Materials
3.1.2.51 (Reactor Recirculation)	Wet gas	Stainless Steel

Engineered Safety Features:

Aging Management Reference	Environment	Materials
3.2.2.55 (Standby Liquid Gas Treatment, LPCI, RHR, Isolation Condenser, Reactor Core Isolation Cooling, Containment Isolation Components and Primary Containment Piping, Core Spray, HPCI)	Air, moisture, humidity, and leaking fluid	Carbon Steel, Stainless Steel, Brass or Bronze
3.2.2.62 (LPCI, Containment Isolation Components and Primary Containment Piping)	Warm, moist air	Carbon Steel
3.2.2.74 (Containment Isolation Components and Primary Containment Piping)	Warm, moist air	Stainless Steel
3.2.2.87 (Containment Isolation Components and Primary Containment Piping)	Warm, moist air	Carbon Steel
3.2.2.99 (Reactor Core Isolation Cooling, HPCI)	Air and steam up to 320°C (608°F)	Alloy Steel Casting (A217)

Aging Management Reference	Environment	Materials
3.2.2.108 (Standby Gas Treatment, Containment Isolation Components and Primary Containment Piping)	Internal: occasional exposure to moist air; external: ambient plant air environment	Carbon Steel
3.2.2.112 (Containment Isolation Components and Primary Containment Piping)	Warm, moist air	Carbon Steel
3.2.2.113 (LPCI, Containment Isolation Components and Primary Containment Piping, Core Spray)	Wet gas	Carbon Steel
3.2.2.114 (Standby Gas Treatment)	Internal: occasional exposure to moist air; external: ambient plant air environment	Cast Iron
3.2.2.126 (Reactor Core Isolation Cooling, HPCI)	Air and steam up to 320°C (608°F)	Air and steam up to 320 deg-C (608 deg-F)
3.2.2.127 (Standby Gas Treatment)	Internal: occasional exposure to moist air; external: ambient plant air environment	Cast Iron
3.2.2.128 (Reactor Core Isolation Cooling, HPCI)	Air and steam up to 320°C (608°F)	Carbon Steel

Auxiliary Systems:

Aging Management Reference	Environment	Materials
3.3.2.55 (Emergency Diesel Generator and Auxiliaries, Station Blackout)	Moist air	Cast Iron
3.3.2.64 (Station Blackout, Containment Atmosphere Monitoring)	Dry gas	Elastomers Neoprene and Similar Materials
3.3.2.65 (Emergency Diesel Generator and Auxiliaries)	Moist air	Elastomers Neoprene and Similar Materials
3.3.2.66 (Emergency Diesel Generator and Auxiliaries, Station Blackout)	Saturated air	Elastomers Neoprene and Similar Materials
3.3.2.67 (Containment Atmosphere Monitoring)	Warm, moist air	Elastomers Neoprene and Similar Materials

Aging Management Reference	Environment	Materials
3.3.2.130 (Standby Liquid Control, Shutdown Cooling, Control Rod Drive Hydraulic, Reactor Water Cleanup, Emergency Diesel Generator and Auxiliaries, HVAC - Main Control Room, Diesel Generator Cooling Water, Process Sampling, Reactor Building Closed Cooling Water, Makeup Demineralizer, Residual Heat Removal Service Water, Plant Heating, Containment Atmosphere Monitoring)	Air, moisture, humidity, and leaking fluid	Carbon Steel, Stainless Steel, Brass or Bronze
3.3.2.145 (Fuel Pool Cooling and Filter Demineralizer)	Warm, moist air	Carbon Steel
3.3.2.146 (Control Rod Drive Hydraulic)	Wet gas	Carbon Steel
3.3.2.149 (Station Blackout)	Moist air	Cast Iron
3.3.2.167 (Control Rod Drive Hydraulic)	Wet gas	Stainless Steel
3.3.2.199 (Fuel Pool Cooling and Filter Demineralizer)	Wet gas	Carbon Steel
3.3.2.216 (Emergency Diesel Generator and Auxiliaries, Station Blackout)	Wet gas	Carbon Steel

Aging Management Reference	Environment	Materials
3.3.2.228 (Drywell Nitrogen Inerting)	Warm, moist air	Carbon Steel
3.3.2.229 (Plant Heating)	Saturated Steam/Condensate	Cast Iron
3.3.2.255 (Containment Atmosphere Monitoring)	Warm, moist air	Stainless Steel
3.3.2.256 (Emergency Diesel Generator and Auxiliaries, Station Blackout)	Hot diesel engine exhaust gases containing moisture and particulates	Cast Iron
3.3.2.274 (Control Rod Drive Hydraulic)	Wet gas	Carbon Steel
3.3.2.281 (Service Water)	Raw, untreated salt water or fresh water	Cast Iron
3.3.2.296 (Control Rod Drive Hydraulic)	Wet gas	Stainless Steel
3.3.2.299 (Containment Atmosphere Monitoring)	Wet gas	Stainless Steel

Steam and Power Conversion Systems:

Aging Management Reference	Environment	Materials
3.4.2.30 (Main Steam, Feedwater)	Air, moisture, humidity, and leaking fluid	Carbon Steel, Stainless Steel, Brass or Bronze

B.1.26 ASME Section XI, Subsection IWE

RAI B.1.26

In LRA Appendix B.1.26, the applicant describes its "ASME Section XI, Subsection IWE" aging management program, as consistent with the ten elements of program XI.S1 specified in NUREG-1801 (GALL report), but with a number of exceptions. For each exception, the applicant references a current Relief Request granted by the staff.

The staff position is that current Relief Requests granted by the staff have no bearing on License Renewal commitments, because the basis for the relief request and the period of time during which the relief request is applicable generally will not carry over to the period of extended

operation. Consequently, for license renewal the staff expects a commitment to IWE and supplemental requirements consistent with 10 CFR 50.55a. The staff notes that 10 CFR 50.55a was updated in 2002 to include the 1998 edition with the 1999 and 2000 Addenda of Subsection IWE, with the additional requirements of paragraphs (b)(2)(ix) (A), (B), and (F) through (I).

Therefore, the applicant is requested to (1) describe the extent of its commitment to the IWE requirements specified in the most recent issuance of 10 CFR 50.55a; (2) specifically identify any exceptions taken to these requirements, for the extended period of operation; and (3) submit a detailed technical basis for each exception taken.

Response:

LRA Appendix B.1.26 describes the current "ASME Section XI, Subsection IWE" aging management program and its exceptions as defined by Relief Requests. This program was developed in response to the August 8, 1996 Federal Register posting of the final rulemaking, mandating a comprehensive containment inservice inspection program. This program is valid for 120-month inspection interval. At the end of this 120-month interval, the program must be updated to comply with 10 CFR 50.55a(g)(4)(ii).

Exelon agrees that the current Relief Requests do not have a bearing on the period of extended operation. Based on the requirements of 10 CFR 50.55a(g)(4)(ii), the program will be based on the latest edition and addenda, which is approved by the NRC 12 months prior to the end of the current 120-month inspection interval.

Based on these requirements, the program will be updated by 2008 (prior to the beginning of the extended period of operation) and then again by 2018 and 2028 (both during the period of extended operation).

Exelon will continue to follow the regulations as established in 10 CFR 50.55a, which include a commitment to IWE and the established supplemental requirements.

B.1.27 ASME Section XI, Subsection IWF

<u>RAI B.1.27</u>

In LRA Appendix B.1.27, the applicant describes its "ASME Section XI, Subsection IWF" aging management program, as consistent, with enhancements, with the ten elements of program XI.S3 specified in NUREG-1801 (GALL report). In its description, the applicant specifically states that "The program is implemented through station procedures, which provide for visual examination of inservice inspection Class 1, 2, and 3 supports in accordance with the requirements of ASME Section XI, Subsection IWF, 1989 Edition and Code Case N-491-1." Inspection of Class MC supports is identified as an "enhancement" that is "scheduled for implementation prior to the period of extended operation."

The staff considers the applicant's program to be consistent with GALL, except for the element of "Scope." GALL presents a generic evaluation of IWF, an existing mandated program for inspection of ASME Class 1, 2, 3, and MC supports. The applicant's existing IWF program is NOT consistent with GALL in that it does not include the inspection of Class MC supports. The staff's acceptance of IWF (or any other existing program) for aging management during the

license renewal period is substantially based on the assumption that the components covered by the scope of the existing program are being periodically inspected during the current licensing term and any problems affecting performance of intended function(s) have been detected and corrected.

Therefore, the staff requests the applicant to describe the plant-specific operating experience for the aging of Class MC supports in terms of: (1) the current inspection method, frequency, scope, and acceptance criteria; and (2) any observed degradation and subsequent corrective actions taken to manage the aging of these components.

Response:

10 CFR 50.55a(g)(4) states in part "...components (including supports) which are classified as ASME Code Class 1, Class 2 and Class 3 must meet the requirements, ...set forth in Section XI..." It later states, "Components which are classified as Class MC pressure retaining components and their integral attachments, and components which are classified as Class CC pressure retaining components and their integral attachments must meet the requirements, ...set forth in Section XI..."

The CFR statement above specifically requires Class 1, 2, and 3 supports to meet the requirements of Section XI. However, other than integral attachments, there is no mention of the Class MC supports. The Dresden and Quad Cities Inservice Inspection programs have complied with the requirements of 10 CFR 50.55a. Therefore, containment supports are not required to be examined in accordance with Subsection IWF.

There are no inspections required by Subsection IWF that will not be performed by the use of Subsection IWE. Per the 1989 Edition and the 1992 Edition, with the1992 Addenda of ASME Section XI, Table IWE-2500-1, Item E1.11, the Class MC integral attachments are subject to a General Visual Examination (as described in IWE-3510.1) prior to each Type A Test. Additionally, per Item E1.12, these integral attachments are subject to a VT-3 each inspection interval. Per the 1995 Edition, with the 1996 Addenda of ASME Section XI, Table IWF-2500-1, supports are subject to a VT-3 each inspection interval.

The containment inservice inspection (CISI) program was developed in response to a recently mandated final rulemaking per an amendment to the Code of Federal Regulations (10 CFR 50.55a). This rulemaking incorporates, by reference, the requirements of the 1992 Edition with the 1992 Addenda of the ASME Boiler and Pressure Vessel Code, Section XI, Division 1, Subsections IWE and IWL with specified modifications. The final rulemaking was published on August 8, 1996 and specified an effective date of September 9, 1996 as well as an expedited implementation of these requirements within five years of the effective date (September 9, 2001). In response, the Dresden and Quad Cities CISI program included integral attachments as part of the IWE examination boundary.

As there is no inspection history of containment supports, there is no site operating experience related to this program to provide.

B.1.30 <u>Structures Monitoring Program</u>

<u>RAI B.1.30</u>

LRA Appendix B.1.30 describes the "Structures Monitoring Program" as consistent, with enhancements, with the ten elements of program XI.S6 specified in NUREG-1801 (GALL report). In its description of the program and the enhancements, the applicant makes several statements that need clarification before the staff can complete its evaluation. Therefore, the applicant is requested to submit the following additional information:

(a) The LRA states that "The program will provide for visual inspections of structures and components not included in the ASME Section XI, Subsection IWF (B.1.27) aging management program." Is this statement intended to encompass component supports not covered by IWF? Please clearly define the scope of structures and components encompassed by this statement.

(b) The last item under "Enhancement" states that "The program will extend inspection criteria to the structural steel, concrete, masonry walls, equipment foundations, and component support sections of the program to provide consistency with NUREG-1801 component supports." The staff is unable to interpret the meaning of this enhancement. Please describe in detail the structures and structural components included in this enhancement; the associated aging effects in need of aging management; the inspection methods to be used, and the acceptance criteria to be applied.

Response:

Exelon has reviewed LRA Appendix B.1.30 and the following clarification is provided.

(c) The Structural Monitoring Program is intended to encompass component supports that are not covered by the ASME Section XI, Subsection IWF. The ASME Section XI, Subsection IWF program provides for inspection of ASME Class 1, 2, and 3 supports. It will be enhanced to include ASME Class MC supports. The Structures Monitoring Program consists of defining and performing periodic structural evaluations which will ensure the timely identification, assessment and repair of degraded structural elements. One of the elements to be evaluated includes component supports. Component supports include:

- Pipe Whip Restraint Supports
- Jet Impingement Shield Supports
- Instrument Tubing Supports
- Tube Track Supports
- HVAC Supports
- Conduit and Junction Box Supports
- Cable Tray Supports
- Instrument Racks, panels and supports
- Electrical panels, racks, MCCs, Switchgears, junction boxes and supports
- Piping Component Supports including immediately adjacent piping/tubing

A fixed number of supports for each type of component are selected for evaluation. The selection includes representation of supports throughout the plant, considering environmental conditions as well as configuration. Component selection includes sample sizes for each component classifications mentioned above. The component support includes all auxiliary steel members (i.e., all steel plates, shapes, bolts, and anchors) between the supported component and the main structural element (i.e., the concrete

slab/beam or the structural steel floor framing). The program does not include standard components such as snubbers, struts and spring cans. Grout pads for support base plates are also in-scope.

(d) The last item under "Enhancement" in LRA Appendix B.1.30 related to consistency with NUREG 1801 component supports is not an enhancement in the sense that new areas of inspection are being added, but it is rather a clarification to NUREG 1801 terminology to ensure that the proper attributes are considered for specific types of installed plant components and structures. The following includes the types of clarifications that were added to in the structural monitoring program implementing procedure for structural steel, concrete, masonary walls, equipment foundations, and component support sections to ensure consistency with NUREG 1801.

- Added several support sub-categories under "Component Supports" for Tube Track Supports, Instrument Tubing Supports, Jet Impingement Shield Supports, and Pipe Whip Restraint Supports
- Added platform support clarification wording under "Structural Steel Elements" examination guidelines.
- Added aging effect (loss of material due to environmental corrosion-pitting, corrosion, general corrosion) to bolted connection inspection.
- Added aging effect (loss of material due to environmental corrosion-pitting, corrosion, general corrosion) to wall support inspection.
- Added aging effect (loss of material due to environmental corrosion-pitting, corrosion, general corrosion) to anchorage and welds inspection.
- Added panels, cabinets and enclosures for electrical equipment.
- Added emergency diesel generators, HVAC system components, and other miscellaneous equipment under "Equipment Foundations."
- Added aging mechanism (service induced cracking or other concrete aging degradation) to Grout Pads/Concrete Pedestals examination.

The above clarifications are not enhancements, but rather are clarifications to provide consistency with NUREG 1801 terminology. All associated aging effects in need of aging management for the structures and structural components included in the above clarifications are presently being managed.

B.1.31 <u>RG 1.127- Inspection of Water-Control Structures Associated with Nuclear Power Plants</u>

<u>RAI B.1.31</u>

In LRA Appendix B.1.31, the applicant describes its "RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants" aging management program, and asserts that, with enhancements, it is consistent with the ten elements of program XI.S7 specified in NUREG-1801 (GALL report). In its description, the applicant states that this program "is part of the structures monitoring program and consists of procedures that provide for condition monitoring of structural steel elements and concrete."

Based on the applicant's description of this aging management program, it is not readily apparent to the staff that it is consistent with the ten elements of GALL XI.S7. The staff cannot

determine whether this is an existing program, and cannot identify the specific structures and structural components, environments, and aging effects that are managed by this program. In RAI 2.4-7, the staff has questioned the apparent omission from the scope of license renewal of many structures that appear to be essential elements of the ultimate heat sinks at Dresden and Quad Cities. These structures are typically monitored using the guidance in RG 1.127, and for license renewal should be included in the scope of an aging management program consistent with GALL XI.S7.

To complete its evaluation of this aging management program, the staff requests the applicant to submit the following additional information:

(a) Clarify whether the program described in LRA Appendix B.1.31 is an existing program. If so, explain what structures and structural components, environments, and aging effects are currently inspected under this program at Dresden and Quad Cities. If not, explain how the condition of water-control structures is currently monitored at Dresden and Quad Cities.

(b) Describe the plant-specific operating experience with regard to the inspection of all essential structural elements of the ultimate heat sink, including (as applicable) the intake and discharge canals and on-site ponds.

(c) Under the first "Enhancement", the applicant states that "The program will provide for monitoring of crib house concrete walls and slabs with an opposing side in contact with river water and the Quad Cities discharge canal weir." Clarify whether the sides of the crib house concrete wall and slabs that are exposed to raw water are inspected under this program? If not, explain why not. Also, verify that the underwater surfaces of the Quad Cities discharge canal weir are inspected under this program, or explain why they are not.

(d) Under the second "Enhancement", the applicant states that "Procedures will be revised to emphasize inspecting for structural integrity of concrete and steel components and identify specific types of components to be inspected." Describe the procedures that already exist and provide a more detailed description of the revisions that will be made.

(e) Describe any additional enhancements to this program that may be required as a result of the response to staff RAI 2.4-7, related to the scope of water-control structures that serve an intended function for license renewal.

Response:

(a) The program described in LRA Appendix B.1.31 is an existing program. The structures currently monitored include the Dresden Unit 1 and 2/3 Crib Houses intake and discharge canal, and the Quad Cities Unit 1/2 Crib House. The parameters monitored at these concrete structures include cracking, movements, settlement, deflection, cavitation, in-leakage, abrasion, spalling, scaling, leaching of calcium hydroxide, corrosion of embedded steel, and others. For further details see the clarifications provided in (4) below.

(b) The Dresden intake and discharge canals were determined to be in the scope of license renewal and the Dresden cooling lake was determined to out of scope of license renewal

(Reference RAI 2.4-7). A search of the corrective action database indicated that there have been several leaks found in the cooling lake dike by various means including the bi-monthly dike inspection, and operator and security rounds. Corrective actions were taken to resolve the leaking such as installing sheet piling. However there were no conditions of canal wall degradation found. It should be noted that the canal walls are not subject to the same failure mechanisms as the cooling lake dike walls. The canals are trenched in existing ground topography, where the cooling lake dike walls were built above the grade of the surrounding topography. .

(c) The program does inspect the crib house concrete walls and slabs exposed to raw water. The existing program does not include the Quad Cities discharge canal weir. However, the discharge canal weir is being added as an enhancement as noted in (4) below.

(d) The current structural monitoring program procedures inspect concrete beams, floor and roof slabs, columns and walls. This program inspects concrete surfaces for the following conditions: leaching and chemical attack; abrasion, erosion, and cavitation; drummy areas (poorly consolidated concrete with past deficiencies); pop-outs and voids; scaling; spalling; signs of corrosion in reinforcing steel or anchorage components; corrosion of exposed embedded metal surfaces and corrosion stains around the embedded metal; and detached embedments or loose bolts. The program inspects steel elements for the following conditions: excessive deflection, cross-section distortion, or member misalignment; significant corrosion; cracks, tears, and laminations; loose or missing bolts on bolted connections.

The enhancements to be made to this procedure as it applies to water control structures include the following:

- Enhance the Monitoring and Trending section to include review of previous inspection reports, photos, etc. of elements to be inspected at the next inspection interval/period.
- Clarify scope to include inspections of all Crib House interior concrete walls with an opposing side in contact with river water and all Crib House concrete slabs with an opposing side in contact with river water.
- Add inspection parameters for joints, and structural isolation gaps.
- Add a task to review ground water chemistry data to ensure limits are not exceeded and include task frequency.
- Clarify scope for Dresden Unit 1 Crib House.
- Clarify scope to include the discharge canal weir at Quad Cities.
- Clarify inspection scope is to include condition monitoring of concrete below water line.
- Add requirements for qualifications for personnel performing inspections and personnel evaluating results.

(e) The additional component groups added to the scope of License Renewal in response to RAI 2.4-7 are already being inspected through structural monitoring program or had no viable aging mechanisms requiring aging management. The additional existing activity to be credited as license renewal commitments is monitoring the earthen structures (canal) at Dresden.

B.1.32 <u>Protective Coating Monitoring and Maintenance Program</u>

RAI B.1.32

LRA Appendix B.1.32 describes the "Protective Coating Monitoring and Maintenance Program," as consistent, with enhancements, with the ten elements of program XI.S8 specified in NUREG-1801 (GALL report). In order to complete its evaluation, the staff requests the applicant to submit the following information:

(a) It is the staff's understanding that this program is being credited for prevention/mitigation of loss of material due to corrosion of steel structural components inside containment, including the accessible inside surfaces of the containment drywell and torus. In addition, it is the staff's understanding that this program augments, but does not replace, inspections conducted under IWE, IWF, and structures monitoring program. Please confirm that these understandings are correct, or provide additional explanatory information to clarify the scope and purpose of the Protective Coating Monitoring and Maintenance Program.

(b) Does the scope of this program include monitoring and maintenance of anti-corrosion coatings applied to the sand pocket region of the drywell? If not, what program monitors the condition of these coatings?

(c) In the third paragraph under "Operating Experience," the LRA states "Inspections of drywell steel at Quad Cities have not identified any significant coating or corrosion problems requiring repair of the torus." Please clarify what is meant by this statement.

Response:

(a) The Protective Coating Monitoring and Maintenance Program is being credited for License Renewal to prevent/mitigate loss of material due to corrosion of steel structural components inside containment, including the accessible inside surfaces of the containment drywell and torus. In addition, the program does augment, but does not replace, inspections conducted under the ASME Section XI, Subsection IWE program (LRA Section B.1.26), the ASME Section XI, Subsection IWF program (LRA Section B.1.27), and the structures monitoring program (LRA Section B.1.30).

(b) The scope of the program does not include monitoring and maintenance of anti-corrosion coatings applied to the sand pocket region of the drywell. There is no program that monitors the condition of the coatings in the sand pocket region of the drywell. However, UT inspections of the drywell shell of the bounding unit (Dresden Unit 3) in the sand pocket region are performed each refueling outage as part of the ASME Section XI, Subsection IWE program. These UT inspections ensure drywell shell thickness at these locations is maintained above the minimum allowable.

(c) The subject sentence in the third paragraph under "Operating Experience" inadvertently made reference to the torus. The sentence involves drywell steel and should have read as follows:

"Inspections of the drywell steel at Quad Cities have not identified any significant coating or corrosion problems requiring repair of the drywell steel."

B.1.34 Metal Fatigue of Reactor Coolant Pressure Boundary

RAI B.1.34

The application states that, with enhancement, the metal fatigue of reactor coolant pressure boundary aging management program is consistent with the ten elements of aging management program X.M1, "Metal Fatigue of Reactor Coolant Pressure Boundary," specified in NUREG-1801. The program will use the EPRI-licensed program "Fatigue-Pro," and is scheduled to be implemented prior to the period of extended operation. The program will encompass all locations with 40-year CUFs expected to exceed 0.4.

(a) Provide clarification explaining how "Fatigue-Pro" and the aging management program will account for the cumulative fatigue usage factors at the selected monitoring locations prior to the implementation for the period of extended operation.

(b) One of the enhancements consists of providing for tracking of fatigue stress cycles for the Dresden isolation condenser. Verify that this enhancement is applicable to both Isolation condensers at Dresden.

(c) Provide a list, or a reference in the Dresden and Quad Cities UFSAR, of the transients defined and implemented in the Metal Fatigue of Reactor Coolant Pressure Boundary aging management program software.

Response:

a. As discussed in Section B.1.34 of the Dresden/Quad Cities LRA, Exelon will implement the **FatiguePro** fatigue monitoring system for tracking cycles and the cumulative usage factors (CUF) in critical plant component locations prior to the period of extended operation. **FatiguePro** monitors CUF for the selected locations in one of two ways:

   1. *Stress-Based Fatigue Monitoring*: Stress-based fatigue (SBF) monitoring consists of computing a "real time" stress history for a given component from actual temperature, pressure, and flow histories via a finite element based Green's Function approach. CUF is then computed from the computed stress history using appropriate cycle counting techniques, and appropriate ASME Code, Section III fatigue analysis methodology. SBF monitoring is intended to duplicate the methodology used in the governing ASME Code, Section III stress report for the component in question, but uses actual transient severity in place of design basis transient severity.

   2. *Cycle-Based Fatigue Monitoring*: Cycle-based fatigue (CBF) monitoring consists of a two-step process: (a) automated cycle counting, and (b) CUF computation based on the counted cycles:

      (a) Automated Cycle Counting: Categorization and counting of plant transients is accomplished by the **FatiguePro** automated cycle counting (ACC) module. The ACC module counts each transient that is defined in the plant licensing basis based on the mechanistic process or sequence of events experienced by the plant (as determined from monitored plant instruments). This approach is

conservative because it assumes each actual transient has a severity equal to that assumed in the design basis. The unique severity of any transient identified by **FatiguePro** is captured for each monitored component, for ready comparison to design basis transient severity. All transients defined in the design basis and the plant Technical Specifications are identified and considered for implementation in the ACC module. Any additional system-specific transients that are experienced by the Group I piping systems, which contribute significantly to the calculated CUF, are also monitored.

(b) CUF Computation: CUF computation calculates fatigue directly from counted transients and parameters, as determined by the ACC module, for the monitored components. CUF is computed via a design-basis fatigue calculation where the fatigue table from the governing stress report is used as a basis, but actual numbers of cycles are substituted for assumed design basis numbers of cycles. The CUF calculations are conservative in that design basis transient severity is assumed.

Limiting components throughout the Group I pressure boundary were selected for monitoring that bound or represent all other components. The components identified in NUREG/CR-6260 for the older vintage BWR plant are also encompassed by the locations selected for monitoring. Inclusion of Group I piping systems into the fatigue management program provides a complete structural assessment of the Group I pressure boundary. The monitored locations and the fatigue computation method employed are summarized in Tables 4.3.1-1, 4.3.3.1-1 and 4.6.1-2 of the Dresden/Quad Cities LRA.

For the time period prior to **FatiguePro** implementation, fatigue usage is estimated in one of two ways. For the SBF components, the initial CUF is determined based on a linear projection of the design basis CUF. For example, if the design CUF for an SBF component is 0.70 and the improved program was implemented after 20 years of plant operation, the initial CUF is estimated to be (20/40) * 0.70 = 0.35. Continued CUF monitoring into the future will be used to demonstrate the conservatism of this estimate (i.e., show that the rate of actual CUF accumulation is less than the rate of design basis fatigue accumulation). For the CBF components, the initial CUF estimate is determined based on the cycle counts to-date since initial plant startup and the design basis fatigue calculation methodology described above. These initial CUF estimates, therefore, considered all cycles experienced by the Dresden/Quad Cities units to-date and assumed design basis severity for each event.

b. All thermal events that have a significant impact on fatigue for critical isolation condenser component locations have been tabulated for all past plant operation for both Dresden units and these events will continue to be monitored in the future. The events are being monitored independently for both Dresden units. Therefore, the enhancement of tracking fatigue stress cycles for the Dresden isolation condensers is applicable to both of the Dresden isolation condensers.

c. As noted in Section 3.9.1.1 of both the Dresden/Quad Cities UFSARs, the transients listed in the UFSARs are applicable only for fatigue evaluation of the reactor pressure vessel since the Dresden/Quad Cities pumps, piping and valves were built in accordance with USAS B31.1 Power Piping Code rules. The list of transient events is included in

Table 3.9-1 of the Dresden/Quad Cities UFSARs for fatigue analysis of the reactor, pressure vessel, and is shown in Table 1.

The transients defined and implemented in the Metal Fatigue of Reactor Coolant Pressure Boundary aging management program software for Dresden and Quad Cities are listed in Table 2.

Comparing Tables 1 and 2, all UFSAR transients are included in the aging management program software for Dresden/Quad Cities except for the two Reduced Power Operation events. As noted in the UFSARs and Table 1, these events do not contribute to transient fatigue usage in the vessel, but they are tracked to establish the impact of rapid thermal cycling effects on the feedwater nozzle. Rapid cycling effects are computed for all reactor conditions for the feedwater nozzle forging location in the aging management program software for Dresden/Quad Cities.

The additional transients included in Table 2 that are not shown in Table 1 are included in the aging management program software for Dresden/ Quad Cities because of consideration of Class 1 piping transients, isolation condenser transients (for Dresden), and containment events, all of which were not originally included in the UFSAR, as stated previously. Monitoring of these transients allows for continued monitoring of Class 1 piping, isolation condenser, and torus locations as a part of the aging management program software.

Table 1. Transients Listed in Dresden/Quad Cities UFSARs

Transient Description	QC Units 1 and 2 Design Basis Allowable No.	Dresden Units 2 and 3 Design Basis Allowable No.
Plant Cooldown	286	293
Plant Heatup	298	298
Safety Relief Valve Blowdown	12	5
Reduction of Power for Plant Shutdown	119	159
Turbine Roll with Feedwater Injection	120	160
Head Spray Injection	119	119
Loss of Feedwater Heaters -- Full	114	114
Loss of Feedwater Heaters -- Partial	80	80
Loss of Feedwater Flow	80	80
Scram	294	294
Batch Feedwater Addition During Hot Standby or Plant Cooldown	202	122
Reduced Power Operation, 75% - 100%	---	10,000 (1)
Reduced Power Operation, 50% - 75%	---	2,000 (1)
Vessel Pressure Test to 1250 psig	---	130
Improper Start of Shutdown Recirculation Loop	---	10
Sudden Start of Recirculation Loop	---	10

Overpressure up to 1250 psig	---	1
Overpressure up to 1375 psig	---	1
Bolt-up	---	123
Unbolt	---	123

Notes: 1. There is no impact on vessel transient fatigue usage from reduced power operation changes. These cycles are counted as a means of tracking the impact of economic generation control (EGC) on rapid thermal cycling fatigue for the feedwater nozzles.

Table 2. Transients To Be Monitored by Dresden/Quad Cities Aging Management Program

Transient Description	Minimum Allowed No. [1]
Boltup	123
Unbolt	123
Overpressure to 1,250 psig	1
Overpressure to 1,375 psig	1
Improper Start of Recirc Loop	10
Sudden Start of Recirc Loop	10
Standby Liquid Control Injection	10
Operating Basis Earthquake (OBE)	5
Small Break Accident (SBA)	1
Hydrostatic Test (1,250 psig)	130
Heatup (100°F/hr)	298
Cooldown (100°F/hr)	286
Turbine Roll to 100%	120
Loss of Feedwater Heaters – Full	114
Loss of Feedwater Heaters – Partial	80
Loss of Feedwater Flow	80
SRV Blowdown	5
Scram	334 [2]
High Pressure Coolant Injection (HPCI)	5
Reactor Core Cooling (RCIC) Injection [3]	not specified
Reduction of Power for Plant Shutdown	119
Hot Standby Feedwater Cycling	122
Core Spray Injection	not specified
Head Spray Injection [4]	119
SRV Lift	not specified
3 "B" Recirculation Loop Cooldown in Single Loop Operation	40
Shutdown Cooling Initiation Into Idle 3 "B" Recirc Loop [4]	40
Operation of Isolation Condenser [4]	250
Shutdown Cooling In Service	120

Notes:

1. One **FatiguePro** system is developed to cover all four Quad Cities and Dresden units. Therefore, the lower number of analyzed events is shown to bound all four units.
2. This event includes both Turbine Trip events (40) and Scram events (294).
3. Applies to Quad Cities only.
4. Applies to Dresden only, as only Dresden has a head spray system.

B.1.36 Boraflex Monitoring (Quad Cities only)

RAI B.1.36

In the Aging Management Review Aid Table 2.4-2, the applicant stated that the Boraflex neutron-absorbing sheets in the reactor building exposed to chemically treated oxygenated water and subject to reduction of neutron-absorbing capacity due to Boraflex degradation are managed by the Boraflex Monitoring AMP with NUREG 1801, Item VII.A2.1-a as a reference. NUREG-1801, XI.M22, states that the AMP includes trending the results from the silica analysis in the spent fuel pool water using the EPRI RACKLIFE predictive code or its equivalent on a monthly, quarterly, or annual basis (depending on the Boraflex panel condition). However in B.1.36, the applicant stated that the evaluation is performed every two years. Clarify this statement and provide technical basis from this apparent divergence from NUREG-1801 guidelines.

Response:

Silica levels in each spent fuel pool are measured by Quad Cities' chemistry department on a weekly basis. This weekly data is used as an input into the EPRI RACKLIFE program. The modeling function of RACKLIFE has been run in accordance with a work control pre-defined activity, in conjunction with the units' outage schedules (once every two years). This is within *Guidance and Recommended Procedures for Maintaining and Using RACKLIFE Version 1.10*, published by EPRI in April 2002. Since Quad Cities must move spent fuel from one pool to another to make room for refueling outage activities on either unit and RACKLIFE is updated whenever fuel is moved, the actual update frequency for RACKLIFE for each spent fuel pool is approximately three times every two years. The predefined activity has subsequently been changed to an annual frequency to reflect this and ensure compliance with NUREG-1801 XI.M22 (Boraflex Monitoring). LRA Appendix B Aging Management Program B.1.36 description should have been revised as follows.

B1.36 Boraflex Monitoring Program (Quad Cities Only)

Program Description

The Quad Cities Boraflex monitoring program is based on EPRI TR-108761, "A Synopsis of the Technology Developed to Address the Boraflex Degradation Issue." (Note: The Boraflex monitoring aging management program is not applicable to Dresden because the station utilizes Boral as the neutron absorbing material in the spent fuel racks rather than Boraflex.) The Quad Cities Boraflex monitoring program consists of condition monitoring activities based on the maintenance rule and implemented at a predefined frequency. Station procedures provide for inspection testing and analysis of the Boraflex neutron absorbing capability to assure that the 5% subcriticality margin is maintained. Degradation monitoring is accomplished by obtaining a computer-generated (RACKLIFE) value of boron loss, which is evaluated against the acceptance criteria. The evaluation is performed on an annual basis. The RACKLIFE program was validated through neutron attenuation testing (blackness testing), and boron area density testing using the BADGER device. Between evaluations, spent fuel pool silica levels are measured weekly and adverse trends identified through chemistry programs.

B.2.3 Periodic Inspection of Ventilation System Elastomers

RAI B.2.3

(a) In the second paragraph of the Description section, the applicant stated "The improved program for periodic inspection of ventilation system elastomers provides routine inspection of certain elastomers in ventilation systems in accordance with plant procedures and predefined tasks." Elastomer wear and degradation of elasticity are functions of material composition, dynamic load, environment, and time. All elastomer components with the same material composition/dynamic load/environment will roughly have the same degree of aging. Provide information on what are the "certain elastomers" and technical basis for selecting these "certain elastomers."

(b) Element 1, Scope of Activity, states that Exelon may elect to periodically replace certain ventilation system elastomer and RTV seals instead of inspecting them and that periodic replacement will be evaluated on a case-by-case basis. Provide specific information such as replacement frequency, replacement criteria and the associated technical basis, including applicable operating experience about the proposed periodic replacement. Describe how the variable combinations of material composition, dynamic load, and environment will be weighed in determining the frequency of inspection.

(c) Element 4, Detection of Aging Effects, of this AMP does not contain a statement that the inspection will be conducted by qualified personnel, or reference to authoritative criteria to detect hardening or cracking due to elastomer degradation or loss of material due to wear. Address this deficiency.

(d) Element 6, Acceptance, does not refer to an acceptance criterion to evaluate indications related to hardening or cracking due to elastomer degradation or loss of material due to wear. Address this deficiency.

(e) The "Periodic Inspection of Ventilation System Elastomers" AMP states in LRA Section B.2.3 under element 2, Preventive Actions, that the inspections provide condition monitoring to detect degradation prior to a loss of function. The staff notes that elastomers may crack, harden, or lose strength due to relative motion between vibrating equipment, exposure to warm moist air, temperature changes, oxygen, and/or radiation. Clarify if the elastomer components are also used at D/QCNPS as vibration isolators to prevent transmission of vibration and dynamic loading to the rest of the system. If these isolators degrade, vibration and subsequent dynamic loads applied to the ductwork and fasteners cannot be eliminated. Provide the frequency of the subject inspection described in LRA Section B.2.3 for the applicable elastomer components, including a discussion of the operating history to demonstrate that the applicable aging degradations will be detected prior to the loss of their intended function.

(f) The "Periodic Inspection of Ventilation System Elastomers" AMP states in LRA Section B.2.3 under element 3, Parameters Monitored/Inspected, that the condition of elastomers used in ventilation systems will be determined by visual inspection. Describe how this visual inspection will be conducted in inaccessible areas.

(g) The "Periodic Inspection of Ventilation System Elastomers" AMP states in LRA Section B.2.3 under element 10, Operating Experience, that both Dresden and Quad Cities have experienced leaks in ventilation systems due to deterioration of or damage to elastomers, including flexible boots and access door seals and gaskets. The leaks were found and corrected in a timely manner and did not result in a loss of function of the ventilation system train. Discuss how the program has been modified to avoid seepage or leakage through boots, seals, and gaskets.

Response:

(a) The scope of the program applies to the elastomer seals in the ventilation systems that are in the scope of License Renewal. The in scope systems for Dresden and Quad Cities are Control Room Ventilation, Station Blackout Diesel Generator Building Ventilation, and Standby Gas Treatment. Additionally, the Dresden Reactor Building Ventilation and the Quad Cities Emergency Diesel Generator Building Ventilation systems are included. The "certain" elastomers include flexible boots, access door seals and gaskets, and RTV used as duct sealant. The basis for selecting these certain elastomers was to provide an inspection of the elastomers of in scope ventilation systems.

(b) There are no plans or schedules to perform replacements of ventilation system elastomers at this time. The intent of this statement was to provide the opportunity to credit replacement of elastomers in lieu of performing the inspection.

(c) Personnel that have been trained and qualified in accordance with station procedures perform these examinations. The inspections visually look for evidence of cracking and loss of material. When indications are found, additional examinations are performed for hardening of the material.

(d) The elastomers are inspected for signs of cracking, loss of material, damage, or other abnormal conditions. If signs of cracking or loss of material is noted then an inspection for hardness is performed. Discrepant conditions are recorded in the corrective action program for further evaluation and disposition.

(e) Elastomer components are not used in Dresden or Quad Cities HVAC systems as vibration isolators to prevent transmission of vibration or dynamic loading to the rest of the system.

(f) All elastomer components with the same material composition/dynamic load/environment will roughly have the same degree of aging. Therefore, the inspections of the accessible areas bound the inaccessible areas. When unacceptable age related degradation is found, the impact of the degradation will be evaluated for the remaining (inaccessible) portions of that system.

(g) The operating experience summarized in element 10 are indicative of an effective program identifying age related degradation prior to loss of intended function of a component and taking appropriate and timely corrective action. As such, there were no program enhancements made.

However, some of the specific examples cited include:

- In 1987, Dresden identified minor leakage in the reactor building ventilation access doors. The door seals were replaced and stiffeners were added to the door.
- In 1988, Dresden identified cracking in some HVAC system piping flexible boot seal. All of the HVAC system piping flexible boot seals were replaced.
- In 1988, Dresden identified minor leakage in the reactor building ventilation inspection doors. The door seals were replaced and new latches were installed.
- In 1994, Quad Cities identified a HEPA filter door leak. The damaged door and seal were replaced.
- In 1996, Quad Cities identified minor leakage in the standby gas treatment access doors. The doors were re-adjusted and the seals were replaced.

B.2.4 Periodic Testing of Drywell and Torus Spray Nozzles

RAI B.2.4

(a) Section B.2.4 of the LRA provides information for the periodic testing of drywell and torus spray nozzles as an aging managing program. Since the applicant did not specify the frequency of the testing and/or monitoring, it is requested that the applicant provide this additional information.

(b) In Section B.2.4 of the LRA, the applicant stated that the test procedures contain acceptance criteria that require that flow be observed from and through each individual drywell and torus spray nozzle. The applicant is requested to elaborate on the acceptance criteria, including, but not limited to, definition of acceptable flow or acceptable percentage of full flow.

(c) In Section B.2.4 of the LRA, the applicant stated that drywell nozzles are tested with compressed air, and torus nozzles are tested with water to verify that the drywell and torus spray nozzles are free from plugging that could result from corrosion product buildup from upstream carbon steel piping. The applicant is requested to explain how the flow tests will reveal the degree of component degradation due to general corrosion. The applicant is also requested to describe how the aging effect of general corrosion for the upstream carbon steel piping will be adequately managed.

(d) In Section B.2.4 of the LRA, the applicant stated that in 2000, a 1" x 3" block of wood was found lodged in a spray nozzle subsequent to a spray test. Although this is not an age-related problem, the applicant is requested to discuss corrective actions that have been taken (i.e., procedural controls) to avoid the recurrence of such incident.

Response:

(a) Both the Quad Cities and Dresden Technical Specification Surveillance Requirement SR 3.6.2.4.2 requires that the suppression pool spray nozzles be verified as unobstructed every 10 years. Both the Quad Cities and Dresden Technical Requirements Manual Surveillance Requirement TSR 3.6.a.2 requires that each drywell spray nozzle be verified as unobstructed every 10 years. The Quad Cities and Dresden Technical Specification Bases documents state that the 10-year frequency is adequate to detect degradation in performance due to the passive nozzle design and has been shown to be acceptable

through operating experience.

(b) Dresden procedure DOS 1500-14, "LPCI Torus Spray Test," acceptance criteria is that "water flow is detectable from each individual suppression pool spray nozzle." QCTS 0320-02, "Suppression Chamber Spray Header and Nozzle Water Spray Test," acceptance criteria is that "adequate flow is observed from all spray nozzles in RHR A and RHR B loops." The Quad Cities and Dresden Technical Specification Surveillance Requirement is to "verify each suppression pool spray nozzle is unobstructed."

Dresden procedure DTS 1500-3, "LPCI Containment Spray Test," acceptance criteria is that "air flow is detectable from each individual drywell spray nozzle." QCTS 0320-03, "Drywell Spray Header and Nozzle Air Test," acceptance criteria is that there is "sufficient flow through all spray header nozzles." The Quad Cities and Dresden Technical Requirements Manual Surveillance Requirement is to "Verify each drywell spray nozzle is unobstructed by performance of an air or smoke flow test of the drywell spray nozzles." Both DTS 1500-03 and QCTS 0320-03 specify the use of a remote sensing device such as a smoke tube to verify air flow from all spray nozzles.

(c) The flow tests will not reveal the degree of spray nozzle degradation due to general corrosion of the nozzles. The spray nozzles are bronze, not carbon steel, and are not susceptible to general corrosion. However, the nozzle material is not related to the aging effect of plugging. Repeated wetting and drying of carbon steel spray header piping can result in corrosion buildup (crud) that may break free from the pipe wall and lodge in a nozzle. The Aging Effect/Mechanism statement for Aging Management Reference 3.2.2.78 was obtained from NUREG 1801, V.D2.5-b. Although this statement is appropriate for a carbon steel component group that includes spray nozzles and flow orifices, it is not appropriate for a brass or bronze group containing only spray nozzles (neither Dresden nor Quad Cities include flow orifices in the design of their containment spray piping). To more precisely define its aging effect/aging mechanism, Aging Management Reference 3.2.2.78 should have listed an Aging Effect/Mechanism of "Plugging of spray nozzles/Crud." The aging effect of loss of material due to general corrosion for the upstream carbon steel piping is addressed in Aging Management Reference 3.2.1.3.

(d) Condition Report Q2000-00355 was screened as a Condition Adverse to Quality and no root cause evaluation was required. The cause was determined to be improper past foreign material exclusion (FME) controls. This event, along with several others, was reviewed at a Mechanical Maintenance Department weekly meeting. Additionally, an evaluation of past operability was performed that concluded that operability was not impacted by the material that was discovered in the nozzle. The evaluation also concluded that FME practices were improving.

B.2.5 <u>Lubricating Oil Monitoring Activities</u>

<u>RAI B.2.5</u>

(a) In the attribute of Parameters Monitored or Inspected, the applicant stated that the parameters monitored by the program include viscosity, total acid number, total base number, rotary bomb oxidation test, water demulsability, particle count, fuel and combustion byproducts,

sediment, water, anti-foaming characteristics, whole particle counting, air release and emission spectrum. The applicant also stated that the parameters monitored by the program depend on oil type and type of service. Loss of material due to general, crevice, and pitting corrosion and cracking are applicable aging effects for lubricating oil cooler components in a lubricating oil environment at locations containing water or contaminants such as chloride ions. Are water, moisture, and chloride ions monitored for all types of oil and service? If not, provide justification for not including these parameters in monitoring.

(b) In the attribute of Acceptance Criteria, the applicant stated that normal, alert, and fault levels have been established for the various chemical and physical properties, wear metals, additives, and contaminant levels based on information from oil manufacturers, equipment manufacturers, and industry guidelines, for the specific oil type and application. The applicant also stated that the program maintains contaminant and parameter limits within the application-specific limits. Because presence of water and contaminants such as chloride ions in the lubricating oil can cause corrosion and SCC, explain the acceptance criteria of water, moisture, and contaminants such as chloride ions.

(c) In element 10, Operating Experience, the applicant states "Lubricating oil sampling and analysis have detected particulate or water contamination (or both) in lubricating oil systems. In some cases these events resulted in systems being declared inoperable until repaired, and until the oil was flushed or replaced. Operating experience has produced procedure and program changes, which have improved the effectiveness of lubricating oil testing and inspection activities." Describe the corrective actions made and the operating experience since these corrective actions were implemented.

Response:

(a) Water/moisture is monitored as part of the Lubricating Oil Monitoring Activities program. However, no monitoring for chloride ions is provided for the systems covered by this program. The parameters monitored by the program are as identified in the Exelon corporate procedure governing analysis of equipment oil. Information from oil suppliers, equipment manufacturers, and industry guidelines were reviewed to establish action levels for the various physical parameters, wear metals, additives and contaminant levels provided in the procedure. In addition, historical trends from existing analyses were evaluated to help establish the initial guideline values. The initial guideline values were determined for various, broad categories of equipment (e.g., turbines, diesels). Chloride ion level was not one of the parameters identified by the review as required for the oil types associated with the equipment covered by this program. EPRI 1003056, Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, Revision 3, Appendices C and G were reviewed in the development of the Lubricating Oil Monitoring Activities program. These appendices address oil environments in general and lubricating oil environments for heat exchangers respectively. Appendix C identifies damaging effects associated with chlorides in fuel oil environments, but no similar effects are identified for lubricating oil environments. Similarly, Appendix G does not identify any applicable aging effects associated with chlorides for lubricating oil environments in heat exchanger components. Nor is there any site operating experience that has identified any failure or degradation in oil environments attributed to the presence of chlorides. Therefore, monitoring for chloride ions is not required for the Lubricating Oil Monitoring Activities program.

(b) Monitoring for chloride ions is not a part of the program as indicated in the response to (a) above. The acceptance criteria for water/moisture and contaminants are provided below.

For emergency diesel generator and SBO diesel components with MOBILGARD 450 NC oil:

Water/moisture:

Property	Normal	Alert	Fault	Comments
Total Water - ppm	0 to 2000	>2000 to 3000	>3000	NA
Water- % Vol	0 to 0.2	>0.2 to 0.3	>0.3	NA

Contaminants/Additives:

Element	Normal	Alert	Fault	Comments
Silicon, Si	0 to 20	>20 to 30	>30	Dirt, Clay, Abrasives, Anti foaming agent
Sodium, Na	0 to 10	>10 to 15	>15	Dirt, Clay, Abrasives
Potassium, K	0 to 10	>10 to 15	>15	Dirt, Clay, Abrasives
Boron, B	0 to 5	>5 to 10	>10	NA
Molybdenum, Mo	0 to 5	>5 to 8	>8	NA
Calcium, Ca	2850 to 8550	<2850 : >8550	<1425 : >10000	NA
Magnesium, Mg	14 to 42	<14 : >42	<7 : >49	NA
Zinc, Zn	0 to 5	>5 to 10	>10	NA
Phosphorus, P	0 to 5	>5 to 10	>10	NA

For HPCI turbine components with MOBIL VAPROTEC LIGHT oil:

Water/moisture:

Property	Normal	Alert	Fault	Comments
Total Water - ppm	0 to 1000	>1000 to 2000	>2000	NA
Free Water- % Vol	0 to 0.1	>0.1 to 0.2	>0.2	NA

Contaminants/Additives:

Element	Normal	Alert	Fault	Comments

Silicon, Si	0 to 15	>15 to 20	>20	NA
Barium, Ba	300 to 850	<300: > 850	<150: >900	NA
Calcium, Ca	10 to 30	<10: >30	<5: >40	NA
Magnesium, Mg	0 to 5	>5 to 7	>7	NA
Zinc, Zn	25 to 200	<25 : >200	<15: >240	NA
Phosphorus, P	40 to 200	<40 : >200	<20 : >250	NA

The basis for the above-listed criteria are the sources identified in the response to (a) above. Any failures to meet these criteria result in condition evaluation, identification of root causes, and correction of the adverse condition.

(c) Examples of the corrective actions made as a result of operating experience involving lube oil sampling and analysis is as follows:

- A Dresden Unit 2 HPCI lube oil sample taken on 5/7/98 and additional sample taken on 5/8/98 showed high particulate levels, out of the specified limits. An additional sample was taken and was confirmed to be within specified limits. Discussions with the maintenance department lube oil coordinator indicated that the high particulate level in the first two samples was likely caused by not taking the sample with a clean "particulate free" sample bottle. The predefine which governs performance of this sampling activity was revised to add a requirement to utilize particulate free sample bottles.

- A number of Quad Cities oil analysis results for RHRSW pump bearings showed high metal levels. It was determined that the high/increased wear level concentrations could have been indications of pump shaft, housing, rolling element bearing or bearing cage clearance wear. It was determined that the pump bearing oil analysis required large amounts of oil to be collected because smaller sample amounts had a tendency to show high/erratic wear levels. The procedure which governs performance of this sampling activity is currently provided with a requirement to draw a relatively large sample.

- The 10/19/99 oil analysis results on the Quad Cities Unit 2 emergency diesel generator crankcase indicated high percentage volume for sediment of 0.2 % (upper limit of 0.05% volume). All physical parameters other than sediment were found to be suitable for use. It was determined that the high sediment could have been caused by improper cleaning or flushing of the sample collection point prior to sample collection. A recommendation was made to continue sampling/trending oil sample results on a monthly frequency. The procedure which governs performance of this sampling activity was revised to include requirements to thoroughly clean and flush the associated sample point, perform sampling on a monthly basis, and trend results.

- The 10/28/99 oil analysis results on the Unit 1A (1B) SBO diesel engine crankcases from indicated high percentage volume for sediment of 0.3 % (upper limit of 0.05% volume). All physical parameters other than sediment were found to be suitable for use. A recommendation was made to continue sampling/trending oil sample results on a quarterly frequency. The procedure

which governs performance of this sampling activity was revised to include, requirements to perform sampling on a quarterly basis, and trend results.

No operating experience involving recurrence of heat exchanger degradations similar to those identified above has been identified since implementation of the associated corrective actions.