September 17, 2003

Mr. John L. Skolds, President
Exelon Nuclear
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3 - ISSUANCE OF AMENDMENTS FOR USE OF CAST IRON MATERIALS (TAC NOS. MB6597 AND MB6598)

Dear Mr. Skolds:

The U.S. Nuclear Regulatory Commission (Commission) has issued the enclosed Amendment No. 201 to Facility Operating License No. DPR-19 and Amendment No. 193 to Facility Operating License No. DPR-25 for Dresden, Units 2 and 3. The amendments are in response to your application dated October 28, 2002.

The amendments authorize changes to the Updated Final Safety Analysis Report to describe the use of cast iron materials in the containment cooling service water and diesel generator cooling water systems.

A copy of the Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA/

Maitri Banerjee, Project Manager, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-237 and 50-249

Enclosures:
1. Amendment No. 201 to DPR-19
2. Amendment No. 193 to DPR-25
3. Safety Evaluation

cc w/encls: See next page

September 17, 2003

Mr. John L. Skolds, President
Exelon Nuclear
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3 - ISSUANCE OF AMENDMENTS FOR USE OF CAST IRON MATERIALS (TAC NOS. MB6597 AND MB6598)

Dear Mr. Skolds:

The U.S. Nuclear Regulatory Commission (Commission) has issued the enclosed Amendment No. 201 to Facility Operating License No. DPR-19 and Amendment No. 193 to Facility Operating License No. DPR-25 for Dresden, Units 2 and 3. The amendments are in response to your application dated October 28, 2002.

The amendments authorize changes to the Updated Final Safety Analysis Report to describe the use of cast iron materials in the containment cooling service water and diesel generator cooling water systems.

A copy of the Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,
/RA/
Maitri Banerjee, Project Manager, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-237 and 50-249

Enclosures: 1. Amendment No. 201 to DPR-19
2. Amendment No. 193 to DPR-25
3. Safety Evaluation

cc w/encls: See next page

<u>DISTRIBUTION</u>:

PUBLIC	PD3-2 r/f	AMendiola	MBanerjee
PCoates	OGC	ACRS	WBeckner
GHill (4)	MRing, RIII		

*See previous concurrences
ADAMS Accession Number: **ML031980579** * SE dated June 13, 2003

OFFICE	PM:LPD3-2	LA:LPD3-2	SC:EMCB	OGC*	SC:LPD3-2
NAME	MBanerjee	PCoates	TChan*	CMarco	AMendiola
DATE	09/09/03	09/08/03	06/13/03	09/03/03	09/16/03

OFFICIAL RECORD COPY

cc:

Site Vice President - Dresden Nuclear Power Station
Exelon Generation Company, LLC
6500 N. Dresden Road
Morris, IL 60450-9765

Dresden Nuclear Power Station Plant Manager
Exelon Generation Company, LLC
6500 N. Dresden Road
Morris, IL 60450-9765

Regulatory Assurance Manager - Dresden
Exelon Generation Company, LLC
6500 N. Dresden Road
Morris, IL 60450-9765

U.S. Nuclear Regulatory Commission
Dresden Resident Inspectors Office
6500 N. Dresden Road
Morris, IL 60450-9766

Chairman
Grundy County Board
Administration Building
1320 Union Street
Morris, IL 60450

Regional Administrator
U.S. NRC, Region III
801 Warrenville Road
Lisle, IL 60532-4351

Illinois Emergency Management
Agency
Division of Disaster Assistance &
Preparedness
110 East Adams Street
Springfield, IL 62701-1109

Document Control Desk - Licensing
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Senior Vice President, Nuclear Services
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Vice President - Operations Support
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Chief Operating Officer
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Vice President - Licensing and Regulatory
Affairs
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Director - Licensing
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Senior Counsel, Nuclear
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Manager Licensing - Dresden and
Quad Cities
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

EXELON GENERATION COMPANY, LLC

DOCKET NO. 50-237

DRESDEN NUCLEAR POWER STATION, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 201
License No. DPR-19

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by the Exelon Generation Company, LLC (the licensee) dated October 28, 2002, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended to authorize revision of the Updated Final Safety Analysis Report (UFSAR) as set forth in the application for amendment by the licensee, dated October 28, 2002. The licensee shall update the UFSAR to describe the use of cast iron materials in the containment cooling service water and diesel generator cooling water systems.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 30 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Anthony J. Mendiola, Chief, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Date of Issuance: September 17, 2003

EXELON GENERATION COMPANY, LLC

DOCKET NO. 50-249

DRESDEN NUCLEAR POWER STATION, UNIT 3

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 193
License No. DPR-25

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by the Exelon Generation Company, LLC (the licensee) dated October 28, 2002, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended to authorize revision of the Updated Final Safety Analysis Report (UFSAR) as set forth in the application for amendment by the licensee, dated October 28, 2002. The licensee shall update the UFSAR to describe the use of cast iron materials in the containment cooling service water and diesel generator cooling water systems.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 30 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Anthony J. Mendiola, Chief, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Date of Issuance: September 17, 2003

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 201 TO FACILITY OPERATING LICENSE NO. DPR-19

AND AMENDMENT NO. 193 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

1.0 INTRODUCTION

By letter dated October 28, 2002 Exelon Generating Company, LLC (Exelon, the licensee) submitted an application for amendment to describe the use of cast iron materials in the containment cooling service water (CCSW) and diesel generator cooling water (DGCW) systems at Dresden Nuclear Power Station (DNPS), Units 2 and 3. Specifically, the proposed changes will allow Exelon to revise the DNPS Updated Final Safety Analysis Report (UFSAR) to describe the use of cast iron materials in the CCSW and DGCW systems. Cast iron materials are currently being used in the CCSW and DGCW systems. However, information regarding the use of cast iron materials in these systems was not provided to the Nuclear Regulatory Commission (NRC) by Commonwealth Edison Company (now Exelon) and thus was not addressed in NRC Safety Evaluations for Systematic Evaluation Program (SEP) Topic III-1, "Quality Group Classification of Components and Systems," for DNPS Unit 2 (References 1, 2, and 3). Therefore, the licensee concluded pursuant to Section 50.59, "Changes, Tests, and Experiments," of Title 10 of the Code of Federal Regulations (10 CFR), that a license amendment is required since the use of cast iron materials represents a departure from a method of evaluation described in the UFSAR used in establishing the design basis for DNPS.

2.0 REGULATORY EVALUATION

The staff finds that the licensee, in Attachment A of its submittal, identified the applicable regulatory requirements. The regulatory requirements for which the staff based its acceptance are 10 CFR 50.90 and 10 CFR 50.59.

2.1 Summary of the Proposed Changes (as stated):

> In accordance with 10 CFR 50.90, "Application for amendment of license or construction permit," Exelon Generation Company (Exelon), LLC, is requesting changes to Facility Operating License Nos. DPR-19 and DPR-25, for Dresden Nuclear Power Station (DNPS), Units 2 and 3. Specifically, the proposed changes will allow Exelon to revise the DNPS Updated Final Safety Analysis Report (UFSAR) to describe the use of cast iron materials in the Containment Cooling Service Water (CCSW) and Diesel Generator Cooling Water (DGCW) Systems, subject to material acceptance criteria that will be

included in the proposed UFSAR revision. Cast iron materials are currently being used in the CCSW and DGCW systems. However, information regarding the use of cast iron materials in these systems was not provided to the NRC by Commonwealth Edison Company (now Exelon) and thus was not addressed in NRC Safety Evaluations (SEs) for Systematic Evaluation Program (SEP) Topic III-1, "Quality Group Classification of Components and Systems," for DNPS Unit 2 (References 1, 2, and 3). Therefore, this license amendment request is required by 10 CFR 50.59, "Changes, tests, and experiments," since the use of cast iron materials represents a departure from a method of evaluation described in the UFSAR used in establishing the design bases for DNPS.

In November 1999, DNPS became aware of an error in information previously provided to NRC in Reference 4 in response to questions on SEP Topic III-1. The information provided by DNPS regarding fracture toughness requirements for materials in various plant systems failed to identify the use of cast iron material in the CCSW and DGCW systems. The NRC used, in part, the inaccurate information provided by DNPS and issued the referenced SEs for DNPS, Unit 2 on this SEP topic. DNPS notified the NRC of this error in Reference 5, but did not request formal NRC approval of this condition.

2.2 Description of the Current Requirements (as stated):

The UFSAR does not discuss the use of cast iron materials in the CCSW and DGCW piping systems. The only location in the UFSAR that specifies material composition for these systems is Table 6.1-1, "Fracture Toughness Requirements." This table specifies that the material composition of these systems, including pump casings and valves, is carbon steel.

2.3 Basis for the Current Requirements (as stated):

UFSAR Section 3.2, "Classification of Structures, Components, and Systems," describes the classification of structures, components, and systems (SSCs) for DNPS, Units 2 and 3. The CCSW and DGCW piping systems were originally designed to Safety Class I requirements as indicated in UFSAR Section 3.2. During original design of DNPS, Units 2 and 3, the term Safety Class I was equivalent to a safety-related classification in today's terminology. Like other safety-related systems, the CCSW and DGCW piping systems are designed to remain within the allowable stress levels of USA Standard (USAS) Code for Pressure Piping B31.1-1967, "Power Piping," during a design basis earthquake. The design of the CCSW and DGCW piping systems is consistent with the proposed General Design Criteria (issued 1967) which were used by the Atomic Energy Commission to evaluate the original design of DNPS, Units 2 and 3.

In addition, based on the classification criteria in Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," Revision 3, both the CCSW and DGCW systems would be classified as Quality Group C systems. Current design criteria for nuclear power plants would require that these systems be designed and constructed to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code Section III, Class 3.

2.4 Need for Revision of the requirements (as stated):

> In the early 1980's, DNPS Unit 2 was part of the NRC's SEP. Under SEP Topic III-1, "Quality Group Classification of Components and Systems," the NRC reviewed the classification of SSCs of plants designed and constructed from the late 1950's to late 1960's against current (i.e., early 1980's) classifications, codes, and standards for seismic and quality groups. The DNPS, Unit 2 safety-related systems, which were designed to the USAS B31.1-1967 Code, were evaluated against the fracture toughness requirements of the ASME B&PV Code, Section III, 1977 Edition as supplemented by the Summer 1978 Addenda. Of particular interest are the significant ASME Section III Code changes in fracture toughness requirements that occurred in 1972.
>
> During the SEP evaluation process, DNPS failed to identify that the CCSW and DGCW systems contained cast iron valves, and that the CCSW system also contained cast iron pump casings. Following DNPS discovery of this error in late 1999, the NRC was notified (Reference 5), but DNPS did not request formal NRC approval of this condition. Because the use of cast iron in safety-related systems was not evaluated at the time of the SEP, cast iron was not addressed in the NRC SEs (References 1, 2, and 3) regarding SEP Topic III-1 for DNPS, Unit 2. Cast iron has lower ductility and fracture toughness than other materials typically used in safety-related piping systems. Although it is an acceptable material in the USAS B31.1-1967 Code, there are no material specifications for cast iron that are acceptable in the 1977 ASME Section III Code, which formed the basis for the evaluation criteria of SEP Topic III-1.
>
> Therefore, this license amendment request is required by 10 CFR 50.59, "Changes, tests and experiments," since the use of cast iron materials represents a departure from a method of evaluation described in the UFSAR (i.e., SEP Topic III-1 evaluation criteria) used in establishing the design basis for DNPS.

3.0 TECHNICAL EVALUATION

The staff has reviewed the licensee's regulatory and technical analyses in support of its proposed license amendment which are described in Attachment A of the licensee's submittal. The detailed evaluation below will support the conclusion that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

3.1 Description of the Proposed Changes (as stated):

> Exelon proposes to revise the DNPS UFSAR to describe the use of cast iron materials in the CCSW and DGCW systems, subject to material acceptance criteria that will be included in the proposed UFSAR revision.
>
> The components containing cast iron materials are the CCSW pump casings (eight CCSW pumps), certain CCSW valve bodies (eight valves), and certain DGCW valve bodies (41 valves). Cast iron valve bodies and pump casings shall be considered

acceptable for service at DNPS provided they meet the requirements stated below. The cast iron components will be listed in the UFSAR as not requiring impact testing.

The specific proposed revisions to the UFSAR are provided in Attachment B [of the submittal]. The proposed acceptance criteria are also included below.

3.1.1 Compliance with Code of Construction (as stated):

General

1. The CCSW and the DGCW system piping are designed to USAS B31.1, 1967 Edition.
2. All cast iron valves and the CCSW pump meet the manufacturers specified pressure and temperature service ratings.
3. The design temperature is not higher than 400 °F, and not lower than 32 °F.
4. The material of the cast iron components meets American Society for Testing and Materials (ASTM) Specification A-126 or A-48.
5. All cast iron valves are manually operated, and meet the American National Standards Institute (ANSI) B16.10 Standard.
6. The cast iron components are not used with flammable, combustible, or toxic fluids.
7. The cast iron components are not subject to water hammer or rapid thermal or pressure transients. Mechanical impact such as hammering to disassemble flanged joints is not permitted.
8. There are no pipe supports at the cast iron valves.
9. Welding to cast iron components is not permitted.

3.1.2 Fracture Toughness Acceptance Criteria (as stated):

1. All cast iron components are connected to piping of wall thickness 5/8" or smaller.
2. The lowest service temperature is not lower than 32 °F.
3. The cast iron components are not subject to water hammer or rapid thermal or pressure transients. Mechanical impact such as hammering to disassemble flanged joints is not permitted.
4. There are no pipe supports at the cast iron valves. Displacements of the cast iron components are limited such that they do not contact other components in a seismic event.
5. Welding to cast iron components is not permitted.

3.2 Safety Analysis of Proposed Changes (as stated):

Exelon has determined that the current use of cast iron materials in the CCSW and DGCW systems at DNPS is acceptable. The following analysis supports this determination. The analysis discusses the material properties of cast iron and supports the proposed acceptance criteria, including the reasons that impact testing is not required.

3.2.1 Material Properties of Cast Iron (as stated):

The primary disadvantage of cast iron when compared to ferritic steel, is that cast iron has much lower ductility and fracture toughness. The ASME Code Section III equations are based on the assumption that the material has sufficient ductility to deform plastically under a high load, so as to provide an acceptable margin of safety between initial local yielding and ultimate fracture. The low fracture toughness makes castings vulnerable to shock loadings such as pressure spikes, thermal shock, and mechanical impact. However, these two issues can be addressed by limiting the design loads to below yield, and by placing restrictions on the system service to avoid shock loads.

The cast iron material used in the CCSW and DGCW systems is ASTM Specification A-126 Class B (Reference 6). That specification references ASTM A-48 and shows the equivalent A-48 Class to be 30B. Specification A-126 lists Class B cast iron as having a minimum tensile strength of 31 ksi. The tensile strength does not change significantly between 32 °F and 450 °F, with the tensile strength at 32 °F being slightly higher than at 70 °F (Reference 7).

In general, the compressive strength of cast iron is about 3.5 times the tensile strength, and the shear strength is about 1.4 times the tensile strength. Unlike carbon steels, the bending strength is higher than the tensile strength. The minimum bending strength can be determined from a transverse test. Following the method described in ASTM A-126, the minimum bending strength resulting from an acceptable transverse test is 58.4 ksi. Using a stress allowable based on tension and applying it to bending loads is very conservative for cast iron.

For cast iron, there is very little elongation prior to fracture. The elongation is only 0.6 percent (Reference 7), and the yield stress is very close to the ultimate tensile stress. The design stresses must therefore be kept below yield. The fatigue endurance limit is 14 ksi for Class 30 cast iron (Reference 7), which is similar to carbon steel. The fatigue strength does not change appreciably between 32 °F and 450 °F (Reference 7). The fatigue strength of grey cast iron is less sensitive to geometric discontinuities than carbon steel, as the fatigue strength already includes the effects of micro-notches that are present in the casting. Thus, stress intensification factors related to geometric discontinuities such as fillets and tapers, which are applied to the cast iron, are a source of conservatism.

The fracture toughness of grey cast iron is about 20 ksi $\sqrt{in}$ (Reference 8). It does not have a transition temperature, so the fracture toughness does not reduce further at low temperatures. Although this value indicates reduced resistance to cracking from high strain rates, such as are associated with impact loads, the potential for brittle fracture can be controlled by limiting the service conditions to non-shock loading. Cast iron is commonly used in service water systems due to its wear resistance and the moderate service conditions.

3.2.2 Justification for Proposed Acceptance Criteria (as stated):

The proposed acceptance criteria for the currently installed cast iron components in the CCSW and DGCW systems at DNPS will ensure that these components possess adequate fracture toughness to maintain their integrity under all expected conditions. Since the ASME Code does not provide acceptance criteria for cast iron materials, the proposed acceptance criteria reflect a combination of the requirements of the ASME Codes and the original code of construction. The discussion is subdivided into general requirements, valve stresses, pump stresses, and impact testing.

General Requirements

The original code of construction, USAS B31.1-1967, permits the use of cast iron in piping systems. In paragraph 123.2.4, it places a caution on its use, stating that its low ductility should be recognized and applications where shock loading can occur should be avoided. Table 126.1 lists the acceptable material specifications, which includes A-126 cast iron. Appendix A of the code provides values for S, the stress allowable, for cast iron, by fabrication process. For a sand mold casting, which is the most common process for valves and pump casings, the S value is 6.0 ksi for temperatures from -20 °F to 400 °F. Although B31.1-1967 gives some design guidance applicable to nuclear piping systems, it does not provide load combinations and allowable stresses for occasional loads, nor does it address valve and pump nozzle allowable stresses. In areas where B31.1 is silent, it is appropriate to obtain guidance from the ASME codes.

The following requirements are specified in the 1989 Edition of ASME B31.1 (Reference 9) regarding the use of cast iron in piping systems:

- Cast iron pipe may be used within the ratings established by the material specifications listed, which include A-126 and A-48 (105.2.1(B)).
- Cast iron may be used in components meeting the standards listed, which include B16.10 for cast iron valves. This standard specifies minimum valve dimensions for each pressure rating.
- Table A-5 provides some stress allowables for cast iron materials. It lists an S value of 3.0 ksi for A-126 Class B, between -20 °F and 400 °F. However, Note (g) to the table is significant, as discussed below.
- Cast iron pipe shall not be used for flammable, combustible, or toxic fluids.
- Possible shock loadings (pressure, temperature, or mechanical) and consequences of failure must be considered before specifying the use of cast iron (124.4).
- There are restrictions for the use of cast iron in boiler external blowoff and blowdown piping. This is not applicable to the CCSW and DGCW systems.
- Piping stress combinations, allowables, and stress intensification factors are provided (as they have been in Editions since 1973). These apply equally to cast iron.

Note (g) to Table A-5 of B31.1-1989 states that the allowable stresses provided are for use in designing components that are not manufactured in accordance with the referenced standards. The cast iron valves in use at DNPS are all manufactured to the referenced Standard ASA B16.10. This standard specifies minimum radii so as to minimize stress concentrations; a component that does not have these radii would presumably require a penalty factor in the allowable stress. B31.1-1989 does not state what the stress allowable is for components that do meet the standard. The S value of 3.0 ksi would be very conservative, as it is about 10 percent of minimum tensile stress, in contrast to the code basis for the S value, which is 25 percent of minimum tensile.

ASME Section IV, Subsection HC (Reference 10), which is for heating boilers, is significant in that it provides more comprehensive allowable stress guidance for cast iron. It specifies a design stress allowable in tension for cast iron of 6 ksi. It also specifies a bending stress allowable that is 1.5 times the allowable in tension, or 9 ksi, and an allowable in compression of 12 ksi. In the cast iron applications at DNPS, which include only low-pressure systems, nearly all of the stress in the code piping stress qualification equations is bending stress.

In view of the above, the cast iron evaluation criteria at DNPS will use an allowable stress S of 6 ksi in the code stress equations. This value is sufficiently conservative, is consistent with the original code of construction, and will hold the stresses to magnitudes where the reduced ductility is not a concern.

<u>Valve Stresses</u>
ASME B31.1 does not specify stress allowables for valves. ASME Section III, ND-3521 (Reference 11) provides guidance for Class 3 valves. It states the following:

- Valves with extended structures must satisfy the stress allowables of Table ND-3521-1. The CCSW and DGCW system cast iron valves in service at DNPS are manually operated valves with rigid, compact bodies, with no extended structures.

- If there is no extended structure, the valve must only meet the pressure rating of the specification, and must be able to withstand the piping end loads. The valve is considered adequate to withstand piping end loads if 1) the valve nozzle section modulus is at least 10 % greater than that of the attaching pipe, and 2) the stress allowable of the valve material is equal or better than the attaching pipe. Condition 1 is inherently met if the valve conforms to the B16.10 Standard. Condition 2 is not inherently met, but the intent can be met by restricting the allowable stress in the pipe material, at the pipe-to-valve connection, to the valve material stress allowable. The cast iron CCSW and DGCW valves at DNPS meet these conditions.

<u>Pump Stresses</u>
The adequacy of the cast iron CCSW pump casing to withstand design loads consists of three considerations.

1. The service conditions must be within the pressure-temperature rating of the pump.
2. The external loads applied at the nozzle by the attached piping do not overstress region of the nozzle/shell junction.
3. The pump supports meet component support criteria.

Meeting the pressure-temperature rating of the pump satisfies Item 1. Item 3 is met by applying the DNPS generic component support design criteria; the fact that the pump casing is made of cast iron does not affect the pump supports, which are made of steel.

Regarding Item 2, ASME B31.1 does not specify stress allowables for the pump nozzle loads. ASME Section III, ND-3410 (Reference 10) provides guidance for Class 3 pumps. Table ND-3416-1 gives the stress limits for the various service levels in terms of S. The S value defined above will be conservatively used in these equations. The pump nozzle stress combination equations differ from the B31.1 piping equations in that thermal expansion loads are combined with other primary mechanical loads, but stress intensification factors are not applied.

Impact Testing

The ASME Section III Code (Reference 10) requires that the materials be one of the approved specifications of Section II. Neither the SA-126 nor SA-48 specifications are listed in Section II. Under SEP Topic III-1, DNPS's safety-related systems, which were designed to USAS B31.1-1967, were evaluated against the fracture toughness requirements of ASME Section III, Classes 1, 2, and 3. This evaluation did not recognize that cast iron materials were used in the CCSW and DGCW systems. USAS B31.1-1967 does not require impact testing to verify adequate fracture toughness. It merely includes a caution that the low ductility of cast iron should be recognized and the use of cast iron where shock loading may occur should be avoided.

ASME Section III requires that under certain conditions where fracture toughness may be a concern, impact testing shall be performed to assure adequate ductility and energy absorption. ND-2311 specifies the impact testing requirements for materials in Class 3 systems. It provides a series of exemptions from impact testing, one of which is for pump and valve material connected to piping of nominal wall thickness of 5/8" or less. The cast iron components at DNPS are all connected to pipe of wall thickness below 5/8". This exemption from impact testing applies regardless of material (some materials are exempt altogether). ND-2332 requires that impact testing be done at the lowest service temperature. The lowest service temperature in the CCSW and DGCW systems is 32 °F. There are a number of Section III approved materials that at 32 °F are close to their lower shelf fracture toughness, such as SA-216 and SA-352 annealed or normalized cast carbon steel. At the lower shelf, these materials are not much different than cast iron in their fracture toughness, however they are still exempt from impact testing (when used as pump or valve material) if the connecting pipe wall thickness is less than 5/8". Thus, it is inferred that the cast iron components in the CCSW and DGCW systems at DNPS do not require impact testing.

Conclusion

From a practical standpoint, fracture toughness is a concern only in applications that involve shock loading. Paragraph ND-3622 of ASME Section III requires that impact loads, whether internal or external, be considered in design. The use of cast iron at DNPS is exclusively in service water systems. These systems are not currently vulnerable to water hammer as they are kept full, there is no change of phase of the contained liquid, and there are no rapidly closing valves or rapidly starting pumps. Although these systems are designed for seismic loading, the seismic loads do not produce impact loads in the cast iron components. This is because the use of cast iron is limited to valve bodies and pump casings. The valve bodies are not enclosed in pipe supports, and therefore do not impact the support members during seismic motion. The pump casings also do not impact against other components during an earthquake.

The proposed acceptance criteria for cast iron are consistent with guidance in Section D of Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," and Section 3.2.1, "Seismic Classification," of the Standard Review Plan (NUREG-0800). Both of these documents allow an applicant to propose an acceptable alternative method for complying with specified portions of the NRC's regulations.

The proposed cast iron acceptance criteria for DNPS address the concerns regarding the fracture toughness of cast iron. This is performed by limiting the allowable stress level (S) in the cast iron valves and pump casings to 6 ksi in the code stress equations. This value is sufficiently conservative, is consistent with the original code of construction, and will hold the stresses to magnitudes where the reduced ductility is not a concern. Additional restrictions are placed on the use of cast iron to avoid brittle fracture.

Based on the considerations discussed above, Exelon has concluded that the current use of cast iron materials in the CCSW and DGCW systems is acceptable, since these components meet applicable standards to ensure they will maintain their integrity under all expected service conditions.

3.3 Staff Evaluation

In support of its request, Exelon performed an evaluation of the cast iron materials present in the DNPS CCSW and DGCW systems. The evaluation included a review of the cast iron fracture toughness acceptance criteria. The licensee determined that the fracture toughness of grey cast iron is about 20 ksi $\sqrt{\text{in}}$. This value was obtained from the ASTM Metals Handbook, Volume 19, Fatigue and Fracture Properties of Cast Iron. Exelon stated that the potential for brittle fracture of cast iron components can be controlled by limiting the service conditions to non-shock loading. The evaluation also included a summary of allowable stress values and applicable service temperatures for cast iron components that are permitted by USAS B31.1-1967, Appendix A. The licensee proposed an acceptance criteria for cast iron materials that is being used at DNPS based on the requirements specified in the 1989 Edition of ANSI/ASME B31.1, Power Piping Code. The proposed acceptance criteria is listed in "Insert A" of the licensee's submittal. Specifically, the following requirements will be added in the DNPS UFSAR:

1. The CCSW and the DGCW system piping are designed to USAS B31.1, 1967 Edition.
2. All cast iron valves and the CCSW pump meet the manufacturers specified pressure and temperature service ratings.
3. The design temperature is not higher than 400 °F, and not lower than 32 °F.
4. The material of the cast iron components meets ASTM Specification A126 or A48.
5. All cast iron valves are manually operated, and meet ANSI B16.10 Standard.
6. The cast iron components are not used with flammable, combustible, or toxic fluids.
7. The cast iron components are not subject to water hammer or rapid thermal or pressure transients. Mechanical impact such as hammering to disassemble flanged joints is not permitted.
8. There are no pipe supports at the cast iron valves. Displacement of the cast iron components are limited such as they do not contact other components in a seismic event.

9. All cast iron components are connected to piping of wall thickness five eighths of an inch or smaller.
10. Welding to cast iron components is not permitted.

The licensee evaluated the ASME Section III Code and SEP Topic III-1 requirements for the cast iron fracture toughness acceptance criteria and the allowable stress values for cast iron components in the CCSW and DGCW systems and concluded that these components do not require impact testing. The staff reviewed the licensee's evaluation and determined that USAS B31.1-1967 does not require impact testing to verify adequate fracture toughness and that ND-2311 exempts from impact testing piping of nominal wall thickness of 5/8" or less, which applies to all cast iron components at DNPS. Thus, except for a caution in USAS B31.1-1967 that the use of cast iron should be avoided where shock loading may occur, there are no requirements for impact testing of cast iron components at DNPS.

The staff reviewed the licensee's reasoning in support of its request for license amendment to document the use of cast iron components in the CCSW and DGCW systems at its DNPS, Units 2 and 3. Based upon its review of the information presented in the licensee's submittal the staff finds the proposal acceptable. This finding is based on the fact that the licensee has specified acceptable acceptance criteria for the use of cast iron materials at DNPS Units 2 and 3. Further, as stated above, the licensee will include requirements in its UFSAR to control the use of cast iron materials. These requirements will restrict the use of cast iron components to areas where the cast iron components will not be subject to impact loading, which is the main concern associated with cast iron materials. Also, the staff noted that cast iron components have been in service at DNPS for a considerable length of time and have performed well in service because of their wear resistance and moderate service conditions.

The staff concludes that the proposed license amendment is acceptable. The proposed amendment describes an existing condition at DNPS, Units 2 and 3, and thus accurately describes the actual plant configuration.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Illinois State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendments change a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding (67 FR 75875). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

7.0 REFERENCES

1. Letter from U. S. NRC to L. DelGeorge (Commonwealth Edison Company), "SEP Topic III-1, Quality Group Classification of Components and Systems (Dresden Unit 2)," dated March 9, 1982.

2. Letter from U. S. NRC to H. E. Bliss (Commonwealth Edison Company), "IPSAR Topic 111-1, Classification of Structures, Systems and Components, Radiography Requirements," dated June 28, 1988.

3. Letter from U. S. NRC to T. J. Kovach (Commonwealth Edison Company), "Fracture Toughness Evaluation for Dresden Unit 2, IPSAR Topic 111-1," dated May 1, 1989.

4. Letter from T. J. Rausch (Commonwealth Edison Company) to P, O'Connor (U. S. NRC), "Dresden Unit 2, SEP Topic III-1, Quality Group Classification of Components and Systems," dated July 16, 1982.

5 Letter from Preston Swafford (Commonwealth Edison Company) to U. S. NRC, "Revision to Information Previously Submitted Regarding SEP Topic III-1, Quality Group Classification of Components and Systems," dated March 31, 2000.

6. ASTM Standard Specification for Grey Iron Castings for Valves, Flanges, Pipe Fittings, A-126-93, 1993.

7. ASM Metals Handbook, Volume 1, "Grey Cast Iron," Tenth Edition, ASM International, 1990.

8. ASM Metals Handbook, Volume 19, "Fatigue and Fracture Properties of Cast Iron," ASM International, 1996.

9. ANSI/ASME B31.1 Power Piping Code, 1967 and 1989 Editions.

10. ASME Boiler and Pressure Vessel Code, Section IV, Subsection HC, 1989 Edition.

11. ASME Boiler and Pressure Vessel Code, Section III, Subsection ND, 1989 Edition.

Principal Contributor: G. Georgiev

Date: September 17, 2003