Mr. Christopher M. Crane
President and Chief Nuclear Officer
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

October 4, 2007

SUBJECT: BRAIDWOOD STATION, UNITS 1 AND 2 - ISSUANCE OF AMENDMENTS RE: USE OF AREVA NP INC. ADVANCED MARK-BW(A) FUEL ASSEMBLIES (TAC NOS. MD3079 AND MD3080)

Dear Mr. Crane:

The U.S. Nuclear Regulatory Commission (the Commission) has issued the enclosed Amendment No. 145 to Facility Operating License No. NPF-72 and Amendment No. 145 to Facility Operating License No. NPF-77 for the Braidwood Station, Units 1 and 2, respectively. The amendments are in response to your application dated September 26, 2006, as supplemented by letter date August 8, 2007.

The amendments permit Braidwood Station, Unit 1 to load up to eight AREVA NP Inc. Advanced Mark-BW(A) fuel assemblies in the reactor core for operation in cycles 15, 16, and 17.

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/

Robert F. Kuntz, Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-456 and STN 50-457

Enclosures:
1. Amendment No. 145 to NPF-72
2. Amendment No. 145 to NPF-77
3. Safety Evaluation

cc w/encls: See next page

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Package: ML072620367
Amendment: ML072620362
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Accession Number: ML *NLO with comments

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DATE	9/27/2007	10/4/2007

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EXELON GENERATION COMPANY, LLC

DOCKET NO. STN 50-456

BRAIDWOOD STATION, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 145
License No. NPF-72

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

   A. The application for amendment by Exelon Generation Company, LLC (the licensee) dated September 26, 2006, as supplemented by letter dated August 8, 2007, 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 by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. NPF-72 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A as revised through Amendment No. 145 and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into this license. The licensee shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 60 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Russell Gibbs, Chief
Project Directorate III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications and Facility Operating License

Date of Issuance: October 4, 2007

EXELON GENERATION COMPANY, LLC

DOCKET NO. STN 50-457

BRAIDWOOD STATION, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 145
License No. NPF-77

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

   A. The application for amendment by Exelon Generation Company, LLC (the licensee) dated September 26, 2006, as supplemented by letter dated August 8, 2007, 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 by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. NPF-77 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A as revised through Amendment No. 145 and the Environmental Protection Plan contained in Appendix B, both of which were attached to License No. NPF-72, dated July 2, 1987, are hereby incorporated into this license. The licensee shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 60 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Russell Gibbs, Chief
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications and Facility Operating License

Date of Issuance: October 4, 2007

ATTACHMENT TO LICENSE AMENDMENT NOS. 145 AND 145

FACILITY OPERATING LICENSE NOS. NPF-72 AND NPF-77

DOCKET NOS. STN 50-456 AND STN 50-457

Replace the following pages of the Facility Operating Licenses and the Appendix A Technical Specifications (TSs) with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Remove	Insert
License NPF- 72	License NPF-72
Page 3	Page 3
Appendix C, Page 2	Appendix C, Page 2
License NPF- 77	License NPF-77
Page 3	Page 3
TSs	TSs
2.0-1	2.0-1
3.7.15-1	3.7.15-1
3.7.16-1	3.7.16-1
3.7.16-2	3.7.16-2
3.7.16-3	3.7.16-3
4.0-1	4.0-1
4.0-2	4.0-2

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 145 TO FACILITY OPERATING LICENSE NO. NPF-72

AND AMENDMENT NO. 145 TO FACILITY OPERATING LICENSE NO. NPF-77

EXELON GENERATION COMPANY, LLC

BRAIDWOOD STATION, UNITS 1 AND 2

DOCKET NOS. STN 50-456 AND STN 50-457

1.0 INTRODUCTION

By letter to the Nuclear Regulatory Commission (NRC, the Commission) dated September 26, 2006 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML062700248), as supplemented by letter dated August 8, 2007 (ADAMS Accession No. ML072200453), Exelon Generation Company, LLC (Exelon, the licensee) requested changes to the technical specifications (TSs), and the facility operating licenses, for the Braidwood Station, Units 1 and 2 (Braidwood). The proposed changes would revise Technical Specification (TS) 4.2.1, "Fuel Assemblies," to allow up to eight AREVA NP Inc. (AREVA), modified Advanced Mark-BW (Advanced Mark-BW(A)) fuel assemblies containing M5 alloy to be placed in nonlimiting (i .e., for $F_{\Delta H}$, F_Q and fuel assembly average power at hot full power normal operating conditions) Braidwood, Unit 1 core regions (i.e., locations) for evaluation during Cycles 15, 16, and 17. The purpose of this evaluation is for Exelon to gain an understanding of the behavior of mixed fuel cores for a possible transition from Westinghouse to AREVA fuel. The proposed change would also revise Safety Limit (SL) 2.1.1, "Reactor Core SLs," to incorporate the peak fuel centerline temperature equations associated with the Advanced Mark-BW(A) fuel in SL 2.1.1.3 for the same operating cycles. The proposed amendment also revises Appendix C, "Additional Conditions," in the Braidwood, Unit 1 Operating License to address operation during Cycles 15, 16, and 17 with up to eight Advanced Mark-BW(A) fuel assemblies containing fuel pellets incorporating homogeneous poisons. The license for Braidwood, Unit 2 is affected only due to the fact that Unit 1 and Unit 2 use common TS.

The licensee is also requesting changes to TS 3.7.15, "Spent Fuel Pool Boron Concentration," TS.3.7.16, "Spent Fuel Assembly Storage," and TS 4.3.1, "Criticality." The proposed changes would remove all references to the Joseph Oat spent fuel pool storage racks that were physically removed from the spent fuel pool per Amendment 105, approving the replacement of the existing Joseph Oat spent fuel storage racks with new Boral high density spent fuel storage racks (i.e. Holtec storage racks) on March 1, 2000 (ADAMS Accession No. ML003692088). The replacement of Joseph Oat spent fuel storage racks at Braidwood was completed by December 2001.

The August 8, 2007, supplement contained clarifying information and did not change the NRC staff's initial proposed finding of no significant hazards consideration.

2.0 REGULATORY EVALUATION

The NRC staff finds that the licensee, in Section 5.2 of its submittal, identified the applicable regulatory requirements.

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Section 90 states, in part, that "[w]henever a holder of a license or construction permit desires to amend the license (including the Technical Specifications incorporated into the license) or permit, application for an amendment must be filed with the Commission."

The regulations at 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," (a)(1)(i) states that "[e]ach boiling or pressurized light-water nuclear power reactor fueled with uranium oxide pellets within cylindrical Zircaloy or ZIRLO cladding must be provided with an emergency core cooling system (ECCS) that must be designed so that its calculated cooling performance following postulated loss-of-coolant accidents conforms to the criteria set forth in paragraph (b) of this section. ECCS cooling performance must be calculated in accordance with an acceptable evaluation model and must be calculated for a number of postulated loss-of-coolant accidents of different sizes, locations, and other properties sufficient to provide assurance that the most severe postulated loss-of-coolant accidents are calculated." Since 10 CFR 50.46 does not specifically address M5 alloy, an exemption request for M5 has been requested by the licensee and an exemption has been issued.

10 CFR Part 50 Appendix K "ECCS Evaluation Models I.A.5. Metal-Water Reaction Rate" ensures that cladding oxidation and hydrogen generation from the metal/water reaction are appropriately limited during a LOCA and conservatively accounted for in the ECCS evaluation model. The rate of energy release, hydrogen generation, and cladding oxidation from the metal/water reaction shall be calculated using the Baker-Just equation. This regulation sets forth requirements for plants that use either Zircaloy or ZIRLO fuel cladding. When M5 alloy is used as fuel rod cladding and structural material, the Baker-Just correlation bounds post-LOCA scenarios, and ECCS evaluation model criteria will be met. Because the Baker-Just equation does not explicitly address M5 alloy, an exemption to 10 CFR Part 50, Appendix K has been requested by the licensee and an exemption has been issued.

3.0 TECHNICAL EVALUATION

The NRC staff has reviewed the licensee's regulatory and technical analyses in support of its proposed license amendments which are described in Sections 4.0 and 5.0 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 <u>Proposed TS and License Changes</u>

The proposed changes would revise Braidwood TS by amending the following sections:

- Current SL 2.1.1.3 states:

  In Modes 1 and 2, the peak fuel centerline temperature shall be maintained < 5080 °F decreasing by 58 °F per 10,000 MWD/MTU burnup.

- Revised SL 2.1.1.3 states:

  In MODES 1 and 2, the peak fuel centerline temperature shall be maintained as follows:

  a. < 5080 °F decreasing by 58 °F per 10,000 MWD/MTU burnup for Westinghouse fuel,

  b. < 5173 °F decreasing by 65 °F per 10,000 MWD/MTU burnup for AREVA NP fuel (Unit 1 only), and

  c. < 5189 °F decreasing by 65 °F per 10,000 MWD/MTU burnup for AREVA NP fuel containing Gadolinia [Gd] (Unit 1 only).

- Current TS 4.2.1 states:

  The reactor shall contain 193 fuel assemblies. Each assembly shall consist of a matrix of Zircaloy or ZIRLO clad fuel rods with an initial composition of natural or slightly enriched uranium dioxide (UO_2) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods or vacancies for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions.

- Revised TS 4.2.1 states:

  The reactor shall contain 193 fuel assemblies. Each assembly, with exceptions as noted below, shall consist of a matrix of Zircaloy or ZIRLO clad fuel rods with an initial composition of natural or slightly enriched uranium dioxide (UO_2) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods or vacancies for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions.

> Up to eight AREVA NP Advanced Mark-BW(A) fuel assemblies containing M5 alloy may be placed in nonlimiting Unit 1 core regions for evaluation during Cycles 15, 16, and 17.

The current operating License, Appendix C, "Additional Conditions," states in part:

> If fuel pellets incorporating homogenous poisons are used, the topical report documenting the fuel centerline melt temperature basis must be reviewed and approved by the NRC and referenced in this license condition. TS 2.1.1.3 must be modified to also include the fuel centerline melt temperature limit for the fuel with homogeneous poison.

The proposed change to the Appendix C, "Additional Conditions," incorporates the topical report documenting the fuel centerline melt basis for the AREVA fuel.

> If fuel pellets incorporating homogenous poisons are used, the topical report documenting the fuel centerline melt temperature basis must be reviewed and approved by the NRC and referenced in this license condition. TS 2.1.1.3 must be modified to also include the fuel centerline melt temperature limit for the fuel with homogeneous poison. During operation in Cycles 15, 16, and 17, up to eight (8) AREVA NP Advanced Mark-BW(A) fuel assemblies containing fuel pellets incorporating homogeneous poisons may be placed in nonlimiting Unit 1 core regions (i.e. ., locations). The design basis for the AREVA NP fuel rod centerline melt follows that given in BAW-10162P-A, "TACO3 - Fuel Pin Thermal Analysis Computer Code," October 1989, and BAW-10184P-A, "GDTAC0 - Urania Gadolinia Fuel Pin Thermal Analysis Code," February 1995.

3.2 Background

The Braidwood, Unit 1 core consists of 193 fuel assemblies. The core may consist of any combination of Westinghouse VANTAGE 5 and VANTAGE+ fuel assemblies arranged in a checkered low-leakage pattern. Each fuel assembly consists of 264 fuel rods arranged in a 17 by 17 array. The VANTAGE+ fuel assembly design includes the following features: ZIRLO™ clad fuel rods, ZIRLO™ thimble and instrumentation tubes, and a variable pitch plenum spring. The VANTAGE 5 design has added features, known as PERFORMANCE+ design features, which are: ZIRLO™ intermediate grids and flow mixer grids, an oxide protective coating at the lower end of the fuel rod cladding, and a protective bottom grid.

Exelon proposes to place up to eight Advanced Mark-BW(A) fuel assemblies in nonlimiting regions (i.e., locations) of the core for evaluation during Cycles 15, 16, and 17. The Advanced Mark-BW(A) fuel assemblies are similar in design to the Advanced Mark-BW assemblies generically approved for use in Westinghouse 3- and 4-loop pressurized water reactors with 17 by 17 fuel rod arrays. The Advanced Mark-BW(A) fuel assemblies incorporate the following minor modifications relative to previously irradiated Advanced Mark-BW assemblies: removable upper end fitting with quarter-turn quick-disconnect feature, M5 MONOBLOC™ guide tubes (and corresponding diameter changes to the central instrument tube), welded connections between the M5 intermediate spacer grids and guide tubes, use of a standard M5 vaned mixing grid in the second position from the bottom of the assembly replacing the otherwise M5 non-vaned grid, use of Alloy 718 HMP (High Mechanical Performance) spacer grids at both the top and bottom positions of the assembly, and a FUELGUARD™ lower end fitting.

The Advanced Mark-BW(A) fuel assemblies use an advanced zirconium-based M5 alloy for the fuel assembly structural tubing, fuel rod cladding, and grids. Currently, TS 4.2.1 permits a limited number of lead test assemblies that have not completed representative testing to be placed in nonlimiting core regions (i .e., locations). Representative testing of Advanced Mark-BW(A) lead test assemblies has been completed, as described in the licensee's September 26, 2006, letter. However, the current TS 4.2.1 restricts fuel rod cladding materials to Zircaloy or ZIRLO™. Changes to TS 4.2.1 are therefore required to allow the use of fuel assemblies containing M5 alloy as a cladding and structural material. By letter dated July 1, 2004 (ADAMS Accession No. ML041840164) the NRC approved for licensees with Westinghouse three- and four-loop reactors that use a 17 by 17 fuel array to reference Framatome-ANP Inc. Topical Report BAW-10239(P)-A (dated July 2004) for use of the Advanced Mark-BW fuel assemblies, subject to the following two conditions:

1. The fuel assembly design is approved for use with low enrichment uranium (LEU) fuel, which has been enriched to less than or equal to 5 percent, and

2. The Advanced Mark-BW fuel assembly design is licensed for a maximum fuel rod burnup of 62,000 MWD/MTU.

3.2.1 Summary of Advanced Mark-BW(A) Fuel Assembly Design Features

The Advanced Mark-BW(A) fuel assembly design proposed for use in Braidwood, Unit 1 for Cycles 15, 16, and 17 incorporates several minor modifications to the Advanced Mark-BW fuel assemblies. The NRC approval letter of Topical Report BAW-10239(P)-A included a process by which changes could be made to the Advanced Mark-BW fuel design without requiring prior NRC review and approval. The licensee's submittal included a discussion of the changes in the Advanced Mark-BW(A) fuel permitted without prior NRC review and approval. Specific differences include a removable upper end fitting with quarter-turn quick-disconnect feature, M5 MONOBLOC™ guide tubes (and corresponding diameter changes to the central instrument tube), welded connections between the M5 intermediate spacer grids and guide tubes, use of a standard M5 vaned mixing grid in the second position from the bottom of the assembly replacing the otherwise M5 non-vaned grid, use of Alloy 718 HMP spacer grids at both the top and bottom positions of the assembly, and a FUELGUARD™ lower end fitting. A description of each of these specific modifications appears in the following paragraphs. These minor modifications are permitted by the NRC's approval of the subject topical report. However, the Advanced Mark-BW(A) fuel assemblies are still subject to the two conditions (listed above) for use of Advanced Mark-BW fuel assemblies.

The Advanced Mark-BW(A) upper end fitting is very similar to the upper end fitting of the Advanced Mark-BW fuel assembly design. The upper end fitting assembly for the Advanced Mark-BW(A) incorporates a similar grillage design and the same spring system. There will, however, be some minor dimensional differences, such as a thicker grillage to increase the design stress margin and greater lead-in for the machined features at the bottom of the grillage for reduced pressure drop. The licensee will ensure that all critical interface dimensions are verified to ensure the fit-up with the upper core plate is acceptable. The quick-disconnect feature is also modified with a new attachment that has been used extensively in other AREVA fuel designs.

As in the Advanced Mark-BW fuel assemblies, the Advanced Mark-BW(A) guide tubes are fabricated from M5 alloy. Both versions incorporate two inner diameters. The larger diameter at the top provides a relatively large annular clearance that permits rapid insertion of the rod cluster control assembly during a reactor trip and accommodates coolant flow during normal operation. A reduced diameter section, at the lower end of the tube, provides a dashpot action that decelerates the control rods near the end of the control rod travel during a reactor trip. This deceleration limits the magnitude of the rod cluster control assembly impact loads on the top of the end fitting. Four small holes located just above the dashpot allow both outflow of water during rod cluster control assembly insertion and coolant flow to components during operation. The Advanced Mark-BW(A) MONOBLOC™ guide tubes differ in that the outside diameter is the same over the entire length of the guide tube to provide additional lateral stiffness to reduce fuel assembly twist and bow. Corresponding with this change to MONOBLOC™ guide tubes, the central instrument tube diameters are changed to match those of the upper region of the MONOBLOC™ guide tubes.

The Advanced Mark-BW design incorporates stops on selected guide tubes that limit grid movement in order to ensure axial alignment of intermediate spacer grids with adjacent fuel assemblies. In contrast, the Advanced Mark-BW(A) assembly is a welded cage design, which is based on the successful experience of many other AREVA fuel assembly designs. The design utilizes spot-welded connections between weld tabs extending from the edges of the M5 grid strips and the M5 guide tubes.

The Advanced Mark-BW(A) intermediate spacer grids in the active fuel region are made of M5 alloy. The Advanced Mark-BW(A) design utilizes the same vane grid type as in the Advanced Mark-BW fuel assemblies in all six locations for additional thermal performance.

Similar to the Advanced Mark-BW top and bottom end grids, the Advanced Mark-BW(A) fuel assembly utilizes Alloy 718 end grids. However, they are the HMP type, which are similar in design to the High Thermal Performance type grid, and has been successfully used in numerous other AREVA assembly designs.

The Advanced Mark-BW fuel assembly design incorporates the TRAPPER™ lower end fitting, which was designed with debris-resistant features. The Advanced Mark-BW(A) fuel assembly design incorporates the FUELGUARD™ lower end fitting. This end fitting is a cast, machined and brazed assembly that is fastened to the guide tubes with mechanically captured stainless steel screws. A combination of curved blades and perpendicular bars, which provides a "no-line-of-sight" flow path for the coolant, minimizes debris entering from the bottom of the fuel assembly.

3.2.2 Comparison of AREVA Advanced Mark-BW(A) fuel assemblies to Westinghouse Resident Fuel Assemblies

The AREVA Advanced Mark-BW(A) fuel assemblies are mechanically similar to, and fully compatible with the resident Westinghouse fuel. The primary differences between the resident Westinghouse fuel design and the AREVA fuel design include the use of the different zirconium based alloys for fuel rod cladding, fuel assembly structural tubing, and spacer grids; use of higher nominal fuel pellet density in the Advanced Mark-BW(A) fuel assemblies; use of a different burnable absorber (i.e.,Gd) and larger diameters for fuel pellets, fuel rods, guide tubes, and instrument tubes. Table 3.2.2 compares selected AREVA Advanced Mark-BW(A) and Westinghouse optimized fuel assembly (OFA) fuel parameters. The differences in density and in fuel pellet diameter will result in a higher uranium loading than in the Westinghouse fuel design.

The design differences for Advanced Mark-BW(A) fuel assemblies described above are not expected to affect the compatibility of the AREVA fuel assemblies with the resident fuel.

Table 3.2.2 Comparison of Selected AREVA Advanced Mark-BW(A) and Westinghouse OFA Fuel Parameters

Parameter	AREVA Advanced Mark-BW(A)	Westinghouse OFA	Westinghouse RFA[1]
Fuel pellet diameter (in)	0.3225	0.3088	0.3225
Fuel rod inside diameter (in)	0.329	0.315	0.329
Fuel rod outside diameter (in)	0.374	0.360	0.374
Fuel pellet density (%)	96.0	95.0	95.5
Clad material	M5	ZIRLO	ZIRLO
End grid material	Inconel 718	Inconel 718	Inconel
Mid grid material	M5	ZIRLO	ZIRLO
Burnable absorbers	Gd	IFBA/WABA	IFBA/WABA

[1] Robust Fuel Assembly

3.3 Technical Evaluation

Braidwood TS 5.6.5.c requires that core operating limits be determined such that all applicable limits (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, ECCS limits, nuclear limits such as shutdown margin (SDM), transient analysis limits, and accident analysis limits) of the safety analysis are met. In order to assure that the current bounding evaluations performed for Braidwood, Unit 1 reloads will remain valid, the licensee has committed to place the AREVA test fuel assemblies in non-limiting (i.e., $F_{\Delta H}$, F_Q and fuel assembly average power at hot full power (HFP) normal operating conditions) core regions. The nuclear design of the Braidwood, Unit 1 for Cycles 15, 16, and 17 cores performed will ensure sufficient margin between the lead Westinghouse fuel assembly and the Advanced Mark-BW(A) assemblies for $F_{\Delta H}$, F_Q, and for fuel assembly average power; these margins will be a minimum of 5 percent. In addition, the reload analysis is expected to ensure that the applicable acceptance criteria continue to be met. The licensee has made a commitment that the Advanced Mark-BW(A) fuel assemblies will not be placed in locations containing rod cluster control assemblies.

The licensee has made a commitment that the Advanced Mark-BW(A) fuel assemblies do not have an adverse impact on the co-resident Westinghouse fuel. Confirmatory evaluations shall be performed to demonstrate that the Advanced Mark-BW(A) fuel assemblies shall satisfy the inputs and assumptions of the current Westinghouse Analysis of Record (AOR). The Advanced Mark-BW(A) fuel assemblies will meet AREVA's own mechanical and thermal hydraulic limits per Topical Report BAW-10239(P)-A and other approved methodologies as discussed in the September 26, 2006, submittal. Therefore, the list of approved methodologies in TS 5 .6.5 will not require updating to include the AREVA methodologies.

The Westinghouse RFA will be used to model the Advanced Mark-BW(A) fuel assemblies for LOCA and seismic purposes. The Westinghouse RFA differs from the Advanced Mark-BW(A) assemblies in the use of the different zirconium-based alloys for fuel rod cladding, fuel assembly structural tubing, and spacer grids; use of higher nominal fuel pellet density in the Advanced Mark-BW(A) fuel assemblies; use of a different burnable absorber (i .e., Gd); and larger diameters for the guide tubes and instrument tubes. However, the Westinghouse RFA assemblies have the same diameters for fuel pellets and fuel rods as the Advanced Mark-BW(A) assemblies and have similar axial locations for the spacer grids; therefore, they provide a good model for determining the effects of the Advanced Mark-BW(A) assemblies on these two analyses.

3.3.1 Mechanical Design Methodology

The licensee will evaluate the Advanced Mark-BW(A) fuel assembly mechanical performance using the methods outlined in Topical Report BAW-10239(P)-A. The mechanical analyses take into consideration the changes in the fuel assembly structure relative to the Advanced Mark-BW design (e.g., the use of MONOBLOC^{TM} guide tubes, the welded structure, the application of different spacer grid types, and different upper and lower end fittings). Also, the Advanced Mark-BW(A) fuel assemblies will be evaluated with respect to Braidwood, Unit 1 specific operating conditions. The mechanical analyses shall evaluate the following:

1. The fuel assembly will be evaluated for axial growth of both the fuel bundle and the fuel rods. Growth models and methods for the M5 fuel rod cladding and guide tube material described in Topical Report BAW-10227P-A will be utilized, in accordance with NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” Section 4.2, “Fuel System Design”.

2. Fuel assembly lift off shall be evaluated using the LYNXT code in conjunction with the NRC approved statistical fuel assembly hold down methodology described in Framatome ANP Inc. Topical Report BAW-1 0243(P)(A). This methodology statistically treats mechanical and thermal-hydraulic uncertainties while maintaining compliance to NUREG-0800, “Standard Review Plan for the review of Safety Analysis Reports for Nuclear Power Plants,” Section 4.2, “Fuel System Design” and Section 4.4, “Thermal and Hydraulic Design.” The analysis will show that the fuel assembly does not lift off from the lower core plate under mechanical design flow conditions.

3. The Advanced Mark-BW(A) fuel assembly components will be evaluated for stress and fatigue as appropriate for normal operating conditions. This includes the M5 assembly which be evaluated for cladding stress, fatigue, creep collapse and transient strain performance using the methods described in Topical Report BAW-10227P-A.

4. Advanced Mark-BW(A) fuel rod oxide and corrosion levels shall be evaluated using the COROS02 code as described in Topical Report BAW-10227P-A assuming a bounding power history along with a bounding fuel rod lifetime.

5. The fuel rod internal gas pressure predictions for the Advanced Mark-BW(A) fuel assemblies shall be made using the TACO3 code for the UO_2 fuel and the GDTACO code for the Gd-bearing fuel. The TACO3 and GDTACO codes are approved for a maximum fuel rod burnup of 62,000 MWD/MTU which is also approved burnup for the Advanced Mark-BW(A) fuel.

3.3.2 Seismic

The licensee will perform a set of evaluations to confirm that the seismic impacts of up to eight Westinghouse RFA-2 fuel assemblies (i .e., the fuel assemblies used to model the Advanced

Mark-BW(A) fuel assemblies) would not invalidate the grid deformation analysis. Exelon will review grid strength information for the analysis and the Advanced Mark-BW(A) design, and independently confirm that the analysis maintains adequate margin to limits with the Advanced Mark-BW(A) fuel.

3.3.3 Core Physics

Core Physics analysis for the Advanced Mark-BW(A) fuel assemblies shall be modeled, using current methodologies as described in TS 5.6.5.b, using Advanced Mark-BW(A) fuel geometry. The nuclear design of the Braidwood, Unit 1 for Cycles 15, 16, and 17 cores will ensure sufficient margin between the lead Westinghouse fuel assembly and the Advanced Mark-BW(A) assemblies for $F_{\Delta H}$, F_Q , and for fuel assembly average power. The amount of margin required will be determined by the amount needed to show that the Advanced Mark-BW(A) fuel satisfies the inputs and assumptions of the current Westinghouse AOR; these margins will be a minimum of 5 percent.

As stated previously (see section 3.2 of this SE), the NRC staff's approval of the Advanced Mark-BW Topical Report BAW-10239(P)-A contained two conditions. The nuclear designs for the Braidwood, Unit 1, Cycles 15, 16, and 17 cores will ensure that those two conditions are met.

3.3.4 Loss of Coolant Accidents (LOCA)

One of the potential concerns to the LOCA evaluation is mixed core effect: the Advanced Mark-BW(A) assemblies are expected to have a higher axial pressure drop than the resident Westinghouse fuel. The pressure drop difference between the two fuel designs is expected to be small. The peak cladding temperature (PCT) for the Advanced Mark-BW(A) fuel assemblies will be qualified to a net value (i.e., the F_Q reduction plus any potential mixed core increase) that is lower than the Westinghouse AOR value for the resident Westinghouse fuel. This PCT qualification fixes the magnitude of the peaking reduction required; the F_Q reduction will be a minimum of 5 percent. This assessment will also be used to show that the Advanced Mark-BW(A) fuel assemblies meet the 17 percent fuel rod cladding oxidation limit.

Small break LOCA (SBLOCA) is assumed to be bounded by large break LOCA (LBLOCA), because the resultant PCT associated with SBLOCA is significantly less than for LBLOCA. The SBLOCA event is driven by decay heat, safety injection flow rates and break size. Small differences in fuel rod characteristics have little effect on the event. SBLOCA is characterized by fuel rod heatup after core uncovery due to decay heat. Fuel thermal conductivity and gap conductance are of little importance during the heat up phase since the temperature distribution across the fuel rod is fairly uniform. Realizing the fact that the dominant effect is the reduced decay heat in the Advanced Mark-BW(A) fuel integrated over a long time period, the fuel assembly average power reduction in the Advanced Mark-BW(A) fuel should be sufficient to assure that it will not be limiting relative to the co-resident Westinghouse fuel for SBLOCA. Hence, LBLOCA will be the area of interest and concentration.

For rods with Gd, there is a 5 percent reduction in U-235 weight percent for every 1 weight percent of Gd. This cutback is consistent with past practice at AREVA, and is used to show that the Gd rods are non-limiting for LOCA, when compared to the non-Gd rods in the same assembly. The licensee shall evaluate Westinghouse RFA-2 assemblies without Gd in the Advanced Mark-BW(A) fuel assembly core locations for their impact on the co-resident Westinghouse fuel. The evaluation shall also use a method that uses the enrichment cutback to ensure that the Gd rods are not limiting. The LOCA evaluation shall quantify and evaluate the RFA-2 assembly for PCT impacts on the resident Westinghouse fuel, as applicable. The licensee will also evaluate the resident Westinghouse fuel assemblies and the Advanced Mark-BW(A) fuel assemblies with respect to maximum hydrogen generation, coolable geometry, and long-term cooling.

3.3.5 Non-LOCA Events

The licensee in its September 26, 2006, submittal stated that it will perform thermal margin calculations to evaluate the Advanced Mark-BW(A) fuel assemblies for DNB performance using the generically approved XCOBRA-IIIC code as detailed in Framatome ANP Inc. Topical Report XN-NF-75-21(P)(A) (January 1986) with the approved Critical Heat Flux (CHF) correlation discussed in Framatome ANP Inc. Topical Report BAW-10244P-A. Axial pressure drop profiles of the resident Westinghouse fuel design and their fuel assembly geometry data will be used to to determine loss coefficients for the Advanced Mark-BW(A) fuel assemblies. The licensee will determine the localized flow distribution occurring in the mixed core environment when assessing the DNB performance. An appropriate mixed core penalty will be applied for the Advanced Mark-BW(A) fuel. Statepoint conditions associated with the TS Safety Limits and the limiting safety analyses for the DNB assessment will reflect the DNB limiting safety analysis statepoint conditions and will contain the respective operating conditions and axial power shape.

The nuclear design of the Braidwood, Unit 1, Cycles 15, 16, and 17 cores will ensure sufficient margin between the lead Westinghouse fuel assembly and the Advanced Mark-BW(A) assemblies for $F_{\Delta H}$, F_Q, and for fuel assembly average power; these margins shall be a minimum of 5 percent. The statepoint conditions, $F_{\Delta H}$, and COLR limit, will be evaluated at Braidwood, Unit 1, and the results will be used to quantify the necessary power reduction on the Advanced Mark- BW(A) fuel assemblies. This will ensure that the Advanced Mark-BW(A) fuel assemblies have more DNB margin than the resident Westinghouse fuel assemblies, and satisfy the TS Safety Limits and the COLR operating limits.

The surveillance of the Advanced Mark-BW(A) fuel assemblies to the Westinghouse $F_{\Delta H}$ shall assure:

1. The Advanced Mark-BW(A) fuel assemblies will operate with acceptable DNB performance,

2. the overtemperature differential temperature (OTΔT) trip function, developed for the Westinghouse fuel, will provide DNB protection for the Advanced Mark-BW(A) fuel assemblies, and

3. the DNB analysis is in compliance with the DNB protection defined in NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” Section 4 .4, “Thermal and Hydraulic Design.”

The licensee shall also confirm that the Advanced Mark-BW(A) fuel assembly fuel temperatures do not exceed bounding temperatures (i.e., pellet average and pellet surface) provided. These temperatures will be calculated using the NRC approved TAC03 and GDTACO codes as discussed in Framatome ANP Inc. Topical Report BAW-10162P-A (October 1989) and Framatome ANP Inc. Topical Report BAW-10184PA (February 1995).

The licensee shall perform evaluations of the non-LOCA events to ensure the Advanced Mark-BW(A) fuel assemblies do not adversely impact the analyses for these transients. The transients will be evaluated based on the imposed power and peaking factor constraints on the Advanced Mark-BW(A) fuel assemblies.

The licensee will use the current AOR for the Westinghouse fuel as the basis for confirming the reload. The thermal-hydraulic mixed core methodology is to evaluate the core as a full core of one fuel type and apply any mixed core penalties, if appropriate.

3.3.6 Thermal Hydraulics

The licensee shall perform Advanced Mark-BW(A) fuel thermal hydraulic analyses using the Braidwood, Unit 1, cycles 15, 16 and 17 operating conditions. The licensee shall evaluate Advanced Mark-BW(A) fuel assemblies for the fuel rod bow and its impact on mechanical and thermal hydraulic performance. The evaluation involves application of standard Mark-BW bow penalty because of the equivalence of Advanced Mark-BW(A) fuel rod design and the spacer grid design to the Advanced Mark-BW(A) fuel design. The standard Mark-BW bow penalty is based on Zircaloy-4 fuel rod bow, which is expected to be greater than that of M5 fuel rods given the same operating conditions because M5 rods exhibit less axial growth.

The licensee will use guide tube and instrument tube flow data to confirm whether there is an impact to bypass flow due to the Advanced Mark-BW(A) assemblies. In addition, the calculation of core lift will incorporate the results of the analysis on flow redistribution resulting from the mixed core.

3.3.7 Fuel Centerline Melt Temperature (FCM)

Depending on the limiting (minimum) linear heat rate for the Advanced Mark-BW(A) fuel, the licensee shall determine the amount of $F_{\Delta H}$ cutback that is required in the cycle nuclear design to demonstrate that the Advanced Mark-BW(A) assemblies have greater uranium oxide (UO_2) FCM margin than the resident Westinghouse UO_2 fuel; this $F_{\Delta H}$ cutback will be minimum of 5 percent. For the Mark-BW(A) fuel with Gd, the enrichment cutback of the Gd-bearing fuel rods will be used to demonstrate that the Advanced Mark-BW(A) Gd-bearing fuel rods have more FCM margin than the Advanced Mark-BW(A) UO_2 fuel rods.

These analyses shall ensure that the Overpower Differential Temperature (OPΔT) trip function provides the necessary protection for the Advanced Mark-BW(A) fuel assemblies.

3.3.8 Fuel Handling and Fuel Storage

Exelon will review the design of the Advanced Mark-BW(A) fuel assemblies to ensure mechanical compatibility with the Braidwood fuel handling and fuel storage systems. The applicable reviews include thermo-hydraulic, criticality and mechanical analyses to ensure compatibility of Advanced Mark-BW(A) fuel assemblies. This assessment to ensure the Advanced Mark-BW(A) assemblies compatibility with the Braidwood fuel handling and storage systems shall be documented in the plant modification package for the Advanced Mark-BW(A) fuel in accordance with the Exelon configuration control process.

The licensee completed the specific review of the Braidwood spent fuel pool Holtec storage racks thermo-hydraulic and criticality analyses compatibility with the Advanced Mark-BW(A) fuel assemblies, and found that the Advanced Mark-BW(A) fuel assemblies are compatible with the current analyses of record.

3.3.9 Best Estimate Analyzer for Core Operations Nuclear (BEACON) Core Monitoring System

The licensee will determine a set of limits, such as, linear heat rate (kW/ft) limit to preclude fuel melt, a kW/ft limit for clad stress/strain, and a rod internal pressure limit along with the associated operating conditions, for the Advanced Mark-BW(A) fuel assemblies. The licensee will evaluate the fuel's performance against these criteria at the given operating conditions to show that the Advanced Mark-BW(A) fuel is nonlimiting. The licensee will determine the limits such that, if it is determined that the Advanced Mark-BW(A) fuel meets the criteria, the allowable operating space for the reload will not be adversely impacted by the presence of the Advanced Mark-BW(A) fuel assemblies.

Statepoint conditions associated with the Operating Limits for the BEACON™ assessment will reflect the BEACON operating limits and will contain the respective operating conditions and axial power shapes. The statepoint conditions, $F_{\Delta H}$, and COLR limit, shall be evaluated at the Braidwood, Unit 1, and to quantify the necessary power reduction on the Advanced Mark-BW(A) fuel assemblies. This will ensure that the Advanced Mark-BW(A) fuel assemblies have more DNB margin than the resident Westinghouse fuel for the statepoints provided. The licensee will then confirm that the allowable operating space for the reload will not be adversely impacted by the presence of the Advanced Mark-BW(A) fuel assemblies. To account for differences in vendor fuel types, conservatisms may be used for core monitoring by BEACON™.

3.3.10 ECCS Sump Screens

As part of the response to NRC Generic Letter 2004-02, “Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors,” the licensee is installing new ECCS sump screens at the Braidwood Station. The effect of the new screens on the resident Westinghouse OFA fuel has been evaluated by the licensee and found to be acceptable as noted in the licensee’s September 26, 2006 submittal. The licensee will ensure that the new sump screens are compatible with the Advanced Mark-BW(A) fuel and will be in accordance with Exelon configuration process. The sump screen evaluation was reviewed and found to be applicable, without change, for the Advanced Mark-BW(A) assemblies. This assessment of the Advanced Mark-BW(A) fuel and its applicability to the existing evaluation shall be documented in the plant modification package for the Advanced Mark-BW(A) fuel in accordance with the Exelon configuration control process.

3.3.11 Alternate Source Term

The Advanced Mark-BW(A) fuel design shall be evaluated for impact on the Fuel Handling Accident (FHA) dose consequences contained in the recently approved License Amendments (letter dated September 8, 2006, ADAMS Accession No. ML062340420) for Braidwood that utilized the alternate source term (AST) methodology. The Advanced Mark-BW(A) fuel assemblies do not result in a significant increase in dose consequences and radiological dose limits continue to be met. This evaluation of the Advanced Mark-BW(A) fuel and is applicability to the AST license amendment safety evaluation shall be documented in the plant modification package for the Advanced Mark-BW(A) fuel in accordance with the Exelon configuration control process.

3.3.12 Administrative Change to remove all references to Joseph Oat spent fuel storage racks

Braidwood TS 3.7.15, TS 3.7.16, and TS 4.3.1, currently contain references to the Joseph Oat spent fuel pool storage racks that have been physically removed from the spent fuel pool. Amendment 105 approved the installation of new Boral high-density spent fuel storage racks (Holtec Racks) on March 1, 2000. This amendment supported the removal of all 23 of the then existing spent fuel storage racks (Joseph Oat spent fuel storage racks) and the replacement with 24 new (Holtec) spent fuel storage racks.

During the installation of the new Holtec spent fuel storage racks, both Holtec and the then existing Joseph Oat spent fuel storage racks were in the spent fuel pool at the same time. The approved changes to TS 3.7.15, TS 3.7.16 and TS 4.3.1 addressed the requirements for both the new Holtec storage racks, during and after installation, and the then existing Joseph Oat storage racks, during the Holtec rack installation.

The replacement of Joseph Oat spent fuel storage racks with Holtec spent fuel storage racks at Braidwood was completed in December 2001. Braidwood currently has only Holtec spent fuel storage racks in the spent fuel pool and therefore all references to Joseph Oat spent fuel storage racks are no longer needed since they are physically removed from the spent fuel pool.

Accordingly, the proposed revisions to TS 3.7.15, TS 3.7.16 and TS 4.3.1, to remove all references to Joseph Oat spent fuel pool storage racks, is editorial only and will delete wording that is no longer required. As a result of the proposed revision to TS 3.7.16, Surveillance Requirement 3.7.16.3, and existing Figures 3.7.16-1, 3.7.16-2, and 3.7.16-3 will be deleted in their entirety.

3.3.13 Technical Evaluation Conclusion

In conclusion, based on the NRC staff's evaluation, the use of Advanced Mark-BW(A) fuel in Braidwood, Unit 1 core would not alter the plant's relevant design and performance criteria. The proposed change, regarding removal of all references in TS to the Joseph Oat spent fuel racks, is an administrative deletion of unnecessary wording relating to equipment that is physically removed from Braidwood spent fuel pool and does not alter the design, configuration, operation, or function of any plant system, structure or component. The administrative change does not affect the ability of any operable structure, system, or component to perform its designated safety function.

3.4 Commitments

The licensee made the following commitments related to the proposed amendment:

> To provide assurance that the current bounding evaluations performed for Braidwood Station, Unit 1 reloads will remain valid the AREVA fuel assemblies being used for Braidwood Station, Unit 1 Cycles 15, 16, and 17 will be placed in nonlimiting core regions (i.e., for $F_{\Delta H}$, F_Q and fuel assembly average power at hot full power normal operating conditions) and the nuclear design of the Braidwood Station, Unit 1 Cycles 15, 16, and 17 cores preformed by Westinghouse will ensure sufficient margin between the lead Westinghouse fuel assembly and the Advanced Mark-BW(A) assemblies for $F_{\Delta H}$, F_Q and fuel assembly average power; these margins will be a minimum of 5%. The reload safety evaluation (RSE) will ensure that:

- The applicable reload analysis acceptance criteria continue to be met.

- The AREVA fuel assemblies are not placed in locations containing rod cluster control assemblies.

- The AREVA fuel assemblies do not have an adverse impact on the co-resident Westinghouse fuel. The Westinghouse fuel will be shown to meet its mechanical and thermal-hydraulic limits as described in the Braidwood Station UFSAR.

- Confirmatory analyses demonstrate that the AREVA fuel assemblies satisfy the operating and safety limits established by the current Westinghouse Analysis of Record (AOR).

The AREVA fuel assemblies will meet AREVA's own mechanical and thermal-hydraulic limits per Topical Report BAW-10239(P)(A) and other approved methodologies as discussed in this submittal.

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 requirements with respect to installation or use of a facility's components 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 (72 FR 152; January 3, 2007). 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.

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Braidwood Station, Units 1 and 2

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