AmerGen SM

Exelon SM

An Exelon/British Energy Company
AmerGen Energy Company, LLC
200 Exelon Way
Suite 345
Kennett Square, PA 19348

www.exeloncorp.com

Nuclear

Exelon Generation
4300 Winfield Road
Warrenville, IL 60555

RS-03-176
5928-03-20184

September 22, 2003

United States Nuclear Regulatory Commission
ATTN: Document Control Desk
11555 Rockville Pike
Rockville, Maryland 20852

Braidwood Station, Units 1 and 2
Facility Operating License Nos. NPF-72 and NPF-77
NRC Docket Nos. STN 50-456 and STN 50-457

Byron Station, Units 1 and 2
Facility Operating License Nos. NPF-37 and NPF-66
NRC Docket Nos. STN 50-454 and STN 50-455

Three Mile Island, Unit 1
Facility Operating License No. DPR-50
NRC Docket No. 50-289

Subject: Thirty-Day Response to NRC Bulletin 2003-02, "Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity"

On August 21, 2003, the NRC issued NRC Bulletin 2003-02, "Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity." The NRC issued this bulletin to:

(1) advise pressurized water reactor (PWR) addressees that current methods of inspecting the reactor pressure vessel (RPV) lower heads may need to be supplemented with additional measures (e.g., bare-metal visual inspections) to detect reactor coolant pressure boundary leakage,

(2) request PWR addressees to provide the NRC with information related to inspections that have been or will be performed to verify the integrity of the RPV lower head penetrations, and

(3) require PWR addressees to provide a written response to the NRC in accordance with the provisions of Section 50.54, "Conditions of licenses," paragraph (f) of Title 10 of the Code of Federal Regulations.

A109

Specifically, all subject PWR addressees are requested to provide the below information. The responses for facilities that will enter refueling outages before December 31, 2003, should be provided within 30 days of the date of the bulletin. All other responses should be provided within 90 days of the date of the bulletin.

(a) A description of the RPV lower head penetration inspection program that has been implemented at your plant. The description should include when the inspections were performed, the extent of the inspections with respect to the areas and penetrations inspected, inspection methods used, the process used to resolve the source of findings of any boric acid deposits, the quality of the documentation of the inspections (e.g., written report, video record, photographs), and the basis for concluding that your plant satisfies applicable regulatory requirements related to the integrity of the RPV lower head penetrations.

(b) A description of the RPV lower head penetration inspection program that will be implemented at your plant during the next and subsequent refueling outages. The description should include the extent of the inspections which will be conducted with respect to the areas and penetrations to be inspected, inspection methods to be used, qualification standards for the inspection methods, the process used to resolve the source of findings of boric acid deposits or corrosion, the inspection documentation to be generated, and the basis for concluding that your plant will satisfy applicable regulatory requirements related to the structural and leakage integrity of the RPV lower head penetrations.

(c) If you are unable to perform a bare-metal visual inspection of each penetration during the next refueling outage because of the inability to perform the necessary planning, engineering, procurement of materials, and implementation, are you planning to perform bare-metal visual inspections during subsequent refueling outages? If so, provide a description of the actions that are planned to enable a bare-metal visual inspection of each penetration during subsequent refueling outages. Also, provide a description of any penetration inspections you plan to perform during the next refueling outage. The description should address the applicable items in paragraph (b).

(d) If you do not plan to perform either a bare-metal visual inspection or non-visual (e.g., volumetric or surface) examination of the RPV lower head penetrations at the next or subsequent refueling outages, provide the basis for concluding that the inspections performed will assure applicable regulatory requirements are and will continue to be met.

Braidwood Station Unit 2, Byron Station Unit 1, and Three Mile Island Unit 1 all have refueling outages prior to December 31, 2003; therefore, in accordance with 10 CFR 50.54, "Conditions of licenses," paragraph (f), we are providing a 30-day response for all units at each station, as requested, in Attachments 1, 2, and 3, respectively. This response is due to the NRC by September 22, 2003.

In addition, the bulletin requests that within 60 days of plant restart following the next inspection of the RPV lower head penetrations, the subject PWR addressees submit to the NRC a summary of the inspections performed, the extent of the inspections, the methods used, a description of the as-found condition of the lower head, any findings of relevant indications of

through-wall leakage, and a summary of the disposition of any findings of boric acid deposits and any corrective actions taken as a result of indications found.

Braidwood, Byron, and Three Mile Island Stations will provide this information in a future response consistent with the bulletin's requested schedule.

Should you have any questions concerning this letter, please contact J. A. Bauer at (630) 657-2801.

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

Executed on 9/22/03

Keith R. Jury
Director – Licensing and Regulatory Affairs
Exelon Generation Company, LLC
AmerGen Energy Company, LLC

Attachments: Attachment 1, Thirty-Day Response to NRC Bulletin 2003-02, Braidwood Station, Units 1 and 2
Attachment 2, Thirty-Day Response to NRC Bulletin 2003-02, Byron Station, Units 1 and 2
Attachment 3, Thirty-Day Response to NRC Bulletin 2003-02, Three Mile Island, Unit 1

cc: Regional Administrator – NRC Region I
Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Braidwood Station
NRC Senior Resident Inspector – Byron Station
NRC Senior Resident Inspector – TMI

ATTACHMENT 1

Thirty-Day Response to NRC Bulletin 2003-02

"Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity"

Braidwood Station, Units 1 and 2

Exelon Generation Company, LLC

Attachment 1

Thirty-Day Response to NRC Bulletin 2003-02

Braidwood Station, Units 1 and 2

On August 21, 2003, the NRC issued NRC Bulletin 2003-02, "Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity." The Bulletin requested the following information.

(1) All subject pressurized water reactor (PWR) addressees are requested to provide the following information. The responses for facilities that will enter refueling outages before December 31, 2003, should be provided within 30 days of the date of this bulletin. All other responses should be provided within 90 days of the date of this bulletin.

Response to Item (1)

Braidwood Station, Unit 2 is scheduled to enter its 10th refueling outage (i.e., A2R10) in November 2003; therefore, Exelon Generation Company, LLC (EGC) is providing a 30-day response to Bulletin 2003-02.

(a) A description of the reactor pressure vessel (RPV) lower head penetration inspection program that has been implemented at your plant. The description should include when the inspections were performed, the extent of the inspections with respect to the areas and penetrations inspected, inspection methods used, the process used to resolve the source of findings of any boric acid deposits, the quality of the documentation of the inspections (e.g., written report, video record, photographs), and the basis for concluding that your plant satisfies applicable regulatory requirements related to the integrity of the RPV lower head penetrations.

Response to Item (a)

Inspection Schedule

Unit 1

Braidwood Station began performing RPV lower head bare metal visual (BMV) examinations in April 2003 during the tenth Braidwood Station, Unit 1 refueling outage (A1R10). This was the first time that a visual examination was performed of the bare metal surface with the RPV lower head insulation removed. Previous visual (i.e., VT-2) examinations were performed with insulation in place, with a minimum four-hour hold time at nominal operating pressure and temperature, consistent with the requirements of American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel (B&PV) Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components."

Unit 2

A BMV examination of the Braidwood Station, Unit 2 RPV lower head surface and penetrations has not been previously performed. As described in the response to bulletin item (1)(b), this examination is planned for the upcoming 2003 fall refueling outage. All previous visual examinations, (i.e., VT-2 examinations) were performed with insulation in place, with a minimum four-hour hold time at nominal operating pressure and temperature, consistent with the requirements of ASME Section XI.

Extent of Inspections

Unit 1

The examination of the Braidwood Station, Unit 1 RPV lower head during A1R10 was accomplished by removing four insulation panels around the periphery of the lower head insulation enclosure. The BMV examination of the RPV lower head surface and the 58 bottom mounted instrumentation (BMI) penetrations was performed using direct visual techniques from four different vantage points supplemented, when necessary, with an extendable mirror. The initial examination, performed prior to refueling activities, and a subsequent inspection upon completion of fuel movement, provided 100% coverage that identified surface rust and a minor boric acid streak trailing from above. The source of the past leakage was concluded to be refueling water leaking past the reactor cavity boot seal.

Unit 2

As discussed above, all previous visual examinations, (i.e., VT-2 examinations) were performed with insulation in place, with a minimum four-hour hold time at nominal operating pressure and temperature, consistent with the requirements of ASME Section XI.

Inspection Methods and Process to Resolve Sources of Findings

Unit 1

Four insulation panel openings were removed to access 100% of the RPV lower head surface and BMI penetrations. The insulation at the bottom of the RPV is a flat, horizontal deck of stainless steel mirror panels. The deck stands off from the bottom of the lower head providing a clearance of eight inches. The center panels are fixed around the 58 in-core guide tubes and are not designed for removal. The peripheral panels are removable and allow access to the lower RPV head surface.

The Braidwood Station, Unit 1 BMV examination was performed, and the results evaluated, by certified VT-2 examiners. The examination was performed using EGC standard procedure ER-AA-335-015, "VT-2 Visual Examination," supplemented by site specific instruction SSI-A1R10-RV LOWER HEAD, "Visual Inspection of Braidwood Unit 1 Reactor Vessel Lower Head Surface."

Condition Report (CR) 155728 was initiated to document the condition of the Braidwood Station, Unit 1 RPV lower head and to provide guidance for cleaning and follow-up examinations. An as-left visual examination was also performed after cleaning was completed prior to start-up. The rust was minor and easily removed with Scotch-Brite brand plastic abrasive pads. The boric acid trail was insignificant, having no discernable thickness and was easily removed with a damp rag. The boric

acid did not originate from a penetration and did not interfere with the examination of the BMIs. There was no degradation of the RPV lower head surface from either the rust or the boric acid trail. Also, there was no sign of any active refueling cavity leakage. The source of leakage was concluded to be through the reactor cavity boot seal.

Unit 2

Previous examinations, as discussed above, did not identify any leakage.

Quality of Inspection Documentation

Unit 1

The results of the Spring 2003 examination were documented in a written report. In addition, the as-left condition of the lower head was recorded in digital photos. Previous examinations (i.e., VT-2 examinations with insulation in place after a four hour hold) were documented in a written report.

Unit 2

Previous VT-2 examinations, as discussed above, were documented in a written report. No video records or photographs exist for these examinations.

Basis for Concluding Regulatory Requirements are Satisfied

For Braidwood Station, Unit 1, the successful completion of the RPV lower head BMV examination, without any evidence of through wall leakage or any recordable wastage of the carbon steel surface, is added assurance of the integrity of the BMI penetrations. As noted above, the previous VT-2 examinations for Braidwood Station, Unit 2 were documented in a written report. No video records or photographs exist for these examinations.

The specific regulatory requirements are listed below with the associated response addressing how the requirement is met.

Design Requirements: 10 CFR 50, Appendix A – General Design Criteria (GDC)

The three referenced GDC state the following:

Criterion 14 – Reactor Coolant Pressure Boundary

> *"The reactor coolant pressure boundary shall be designed, fabricated, erected and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture."*

Criterion 31 – Fracture Prevention of Reactor Coolant Pressure Boundary

> *"The reactor coolant pressure boundary shall be designed with sufficient margin to assure that when stressed under operating, maintenance, testing, and postulated accident conditions (1) the boundary behaves in a non-brittle manner, and (2) the probability of rapidly propagating fracture is minimized. The design shall reflect consideration of service temperatures and other conditions of the boundary material under operating, maintenance,*

testing and postulated accident conditions and the uncertainties in determining (1) material properties, (2) the effects of irradiation on material properties, (3) residual, steady state and transient thermal stresses, and (4) size of flaws."

Criterion 32 – Inspection of Reactor Coolant Pressure Boundary

"Components which are part of the reactor coolant pressure boundary shall be designed to permit (1) periodic inspection and testing of important areas and features to assess their structural and leak tight integrity, and (2) an appropriate material surveillance program for the reactor pressure vessel."

Compliance with GDC Requirements

Braidwood Station continues to be in compliance with the requirements of GDC 14, 31 and 32.

The Braidwood Station reactor vessel is designed, fabricated, tested, and examined in accordance with the requirements of ASME Section III, "Requirements for Design and Manufacture of Nuclear Power Plant Components," and ASME Section XI. In general, the controls established by these construction and inspection codes assure that the RPV maintains an extremely low probability of rapidly propagating failure and gross rupture.

Although stress corrosion cracking of BMI penetrations was not originally anticipated during plant design, it has occurred in the RPV lower head nozzles at the South Texas Project (STP) Unit 1 plant. However, the robust design of this area has been demonstrated by the small amounts of the leakage that has occurred and by the fact that the cracks in the STP Unit 1 BMIs were very tight with very low leakage rates. The design of the Braidwood Station BMI tubes includes an increased diameter portion, (i.e., 1.75 inch nominal above the tube nominal diameter of 1.5 inch) to act as a collar. The collar was incorporated to aid in preventing the BMI nozzle from being ejected in the event of a complete attachment weld failure.

The BMV examination technique used at Braidwood Station, Unit 1 in the Spring 2003 refueling outage and planned for the Braidwood Station, Unit 2 Fall 2003 refueling outage, is a reliable means for identifying the very low leakage rates potentially associated with BMI cracking. Therefore based on the design, materials, and examination methods, the Braidwood Station reactor vessel continues to comply with the requirements of GDC 14.

The Braidwood Station reactor vessel, as stated above, has been constructed in accordance with ASME Section III to assure structural integrity under operating, testing, transient, and accident conditions. The design basis of the Braidwood Station reactor vessel includes consideration for residual, steady state and transient stresses. Examination requirements of both ASME Section III and Section XI address the required reactor vessel and BMI penetration weld attachment non-destructive examination (NDE) requirements to assure that flaws are well within acceptable size limits to assure design life reliability. Braidwood Station also maintains an NRC-approved RPV material surveillance program to monitor the effects of irradiation on reactor vessel material properties. Therefore, based on the design, materials, monitoring and examination methods, the Braidwood Station reactor vessel continues to comply with the requirements of GDC 31.

By design, the Braidwood Station components, which are part of the reactor coolant pressure boundary (RCPB), have the capability of being periodically inspected to assess their structural and leaktight integrity. These inspections are performed under the provisions of the ASME B&PV Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Part Components," as modified by the requirements of, or alternatives approved by, the NRC. As noted above, Braidwood Station maintains an NRC-approved RPV material surveillance program to monitor the effects of irradiation on reactor vessel material properties. Therefore, based on the RCPB inspections performed and material surveillance program, Braidwood Station continues to comply with the requirements of GDC 32.

Compliance with Operating Requirement: 10 CFR 50.36 – Plant Technical Specifications

Braidwood Station Technical Specifications include requirements and associated action statements addressing RCPB leakage. The Technical Specification limits for reactor coolant system (RCS) operational leakage are one gallon per minute (gpm) for unidentified leakage, 10 gpm for identified leakage, and no pressure boundary leakage (reference Braidwood Station Technical Specifications, Section 3.4.13, "RCS Operational Leakage"). Compliance with the zero non-isolable leakage criterion is met by conducting inspections and repairs in accordance with ASME B&PV Code, Section XI, and 10 CFR 50.55a, "Codes and standards," as described below.

The unidentified leakage limit of one gpm is established as a quantity, which can be accurately measured while sufficiently low to ensure early detection of leakage. Leakage of this magnitude can be reasonably detected within a short time, thus providing confidence that cracks associated with such leakage will not develop into a critical size before mitigating actions can be taken. If a pressure boundary leak of a BMI nozzle was detected by the various means of RCS leakage detection (i.e., containment floor drain sump monitor, reactor cavity sump monitor, containment atmosphere radiation monitors, RCS mass balance calculation), the reactor would be shut down in accordance with the above Technical Specification requirements.

In addition, Braidwood Station has implemented controls and expectations to address RCS leakage below Technical Specification limits. EGC procedure ER-AP-331-1003, "RCS Leakage Monitoring and Action Plan," has been implemented to assure adequate monitoring of RCS leakage and to provide minimum actions that could be taken at various RCS leakage levels.

Compliance with Inspection Requirements: 10 CFR 50.55a and ASME Section XI

10 CFR 50.55a, "Codes and standards," requires that inservice inspection and testing be performed per the requirements of the ASME B&PV Code, Section XI, "Rules for Inservice Inspection of Nuclear Plant Components." Section XI contains applicable rules for examination, evaluation and repair of code class components, including the RCPB.

Braidwood Station is currently in the second inservice inspection (ISI) interval. The second ISI interval is being conducted in accordance with the 1989 Edition, no addenda, of the ASME Section XI Code. Unit 1 began Interval 2 on July 29, 1998, and Unit 2 began Interval 2 on October 17, 1998.

Quality Assurance Requirements: 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"

Criterion V of Appendix B to 10 CFR 50

> *Criterion V of Appendix B to 10 CFR 50 states that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings. Criterion V further states that instructions, procedures, or drawings shall include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished. Visual and volumetric examinations of VHP nozzles are activities that should be documented in accordance with these requirements.*

Response – Compliance with 10 CFR 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings"

ASME Code required visual and volumetric examinations, including visual examinations performed in accordance with Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants," are performed using procedures that contain specific acceptance criteria or detailed recording criteria that are subsequently evaluated for acceptability. The visual examinations are performed using detailed instructions with a combination of qualitative and quantitative standards for the essential examination variables. Visual examinations of the RPV lower head at Braidwood Station are addressed by standardized EGC procedures, which address qualification of examiners and examination requirements.

Criterion IX of Appendix B to 10 CFR 50

> *Criterion IX of Appendix B to 10 CFR 50 states that special processes, including nondestructive testing, shall be controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements.*

Response – Compliance with 10 CFR 50, Appendix B, Criterion IX, "Control of Special Processes"

The RPV lower head visual examinations at Braidwood Station are performed by certified VT Level II or Level III examiners using EGC approved procedures with additional detailed instructions as necessary.

Criterion XVI of Appendix B to 10 CFR 50

> *Criterion XVI of Appendix B to 10 CFR 50 states that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected. For significant conditions adverse to quality, the measures taken shall include root cause determination and corrective action to preclude repetition of the adverse conditions.*

Response – Compliance with 10 CFR 50, Appendix B, Criterion XVI, "Corrective Action"

The identification of an unacceptable visual indication requires repair, replacement or acceptance by analytical evaluation. In all cases, these indications would be tracked by the Braidwood Station Corrective Action Program (CAP). In the case of a significant adverse condition, the CAP requires determination of the cause of the failure, evaluation of the extent of condition, and assignment of appropriate corrective actions to preclude recurrence. The Braidwood Station CAP meets the requirements of Appendix B, Criterion XVI. In addition, the repair and replacement requirements of ASME Section XI are implemented as applicable. Boric acid accumulation on the RPV lower head surface would also be assessed and evaluated by EGC procedure ER-AP-331-1002, "Boric Acid Corrosion Control Program Identification, Assessment, and Evaluation."

(b) *A description of the RPV lower head penetration inspection program that will be implemented at your plant during the next and subsequent refueling outages. The description should include the extent of the inspections which will be conducted with respect to the areas and penetrations to be inspected, inspection methods to be used, qualification standards for the inspection methods, the process used to resolve the source of findings of boric acid deposits or corrosion, the inspection documentation to be generated, and the basis for concluding that your plant will satisfy applicable regulatory requirements related to the structural and leakage integrity of the RPV lower head penetrations.*

Response to Item (b)

Extent of Inspections

Braidwood Station plans to perform a BMV examination of the Unit 2 RPV lower head surface and penetrations during the next refueling outage, (A2R10). This outage is scheduled to begin in November 2003. The examination is planned to cover 100% of the 58 lower penetrations as well as the lower head surface. The examination will be performed using remote visual examination equipment, (i.e., video cameras) mounted on a remotely controlled crawler supplemented, if required, with a pole-mounted camera.

Although a BMV examination of the RPV lower head surface and penetrations on the Unit 1 reactor vessel was performed in the Spring 2003 refueling outage, (A1R10), Braidwood Station plans on performing a follow-up examination during the next Unit 1 refueling outage, (A1R11), currently scheduled for Fall 2004 so that the condition of the RPV lower head surface and penetrations can be recorded on video tape for more accurate record keeping.

Inspection Methods and Qualification Standards

Both the Braidwood Station, Unit 1 and Unit 2 examinations will be performed by certified VT-2 examiners using EGC procedure ER-AP-335-1012, "Visual Examination of PWR Reactor Vessel Head Penetrations," specifically developed for these locations. The resolution capability of the examination technique will be demonstrated and documented on videotape. The examination technique will be able to resolve the required character size on a near distance test chart.

Process to Resolve Sources of Findings

The EGC CAP will require that the source of any boric acid deposits be determined and that the necessary corrective actions be implemented. Specifically, EGC examination procedure ER-AP-335-1012 requires that the source of any boron be identified and any recordable condition (i.e., excessive corrosion or wastage) be documented and resolved in a CR. Within the CAP process, Braidwood Station will be using the standardized EGC process for documenting and assessing the impact of any boric acid deposits in accordance with ER-AP-331-1002, "Boric Acid Corrosion Control Program Identification, Assessment, and Evaluation."

More specifically, EGC will utilize the CAP process to evaluate all findings of leakage found during the BMI penetration examination. The process will include methodic evaluations to determine if the findings of leakage are relevant or non-relevant as an RCS leak, as well as the source of the leakage. Examples of relevant leakage are identified in Electric Power Research Institute (EPRI) Report 1006296, "Visual Examination for Leakage of PWR Reactor Head Penetrations," dated March 2002, supplemented by the as-found pictures of the boric acid accumulation at STP, Unit 1 at BMI locations #1 and #46 (discussed in Operating Experience OE 16114). Reactor cavity seal ring leakage, which occurs during a refueling outage, only occurs at low temperature and results in staining without "popcorn like" accumulation features of an RCS leak at normal operating temperature. Methods available to evaluate relevant indications of leakage (i.e., boric acid residue, not staining) include sample collection for chemical and isotopic analysis.

Inspection Documentation

The examination and the as-found condition of the RPV lower head surface and penetrations will be recorded on videotape and documented in a written report. The as-left condition of the RPV lower head surface and penetrations will also be documented in a written report.

Basis for Concluding Regulatory Requirements are Satisfied

The successful completion of RPV lower head BMV examinations on Braidwood Station, Unit 1, and the future completion of these examinations on Braidwood Station, Unit 2 in the Fall of 2003, assures the structural and leakage integrity of the RPV lower head penetrations and confirms that Braidwood Station continues to comply with the applicable regulatory requirements.

The basis for concluding that the applicable regulatory requirements are satisfied is addressed in the response to item (1)(a) above.

Subsequent Inspections

The extent and frequency of subsequent visual examinations of the Braidwood Station RPV lower head surface and penetrations beyond refueling outages A1R11 and A2R10 will follow appropriate NRC and industry guidance as well as standardized EGC procedure ER-AP-331-1001, "Boric Acid Corrosion Control (BACC) Inspection Locations, Implementation, and Inspection Guidelines."

(c) If you are unable to perform a bare-metal visual inspection of each penetration during the next refueling outage because of the inability to perform the necessary planning, engineering, procurement of materials, and implementation, are you planning to perform bare-metal visual inspections during subsequent refueling outages? If so, provide a description of the actions that are planned to enable a bare-metal visual inspection of each penetration during subsequent refueling outages. Also, provide a description of any penetration inspections you plan to perform during the next refueling outage. The description should address the applicable items in paragraph (b).

Response to Item (c)

Not applicable - all Braidwood Station units will be performing the inspections recommended by this Bulletin as described above.

(d) If you do not plan to perform either a bare-metal visual inspection or non-visual (e.g., volumetric or surface) examination of the RPV lower head penetrations at the next or subsequent refueling outages, provide the basis for concluding that the inspections performed will assure applicable regulatory requirements are and will continue to be met.

Response to Item (d)

Not applicable - Braidwood Station, Units 1 and 2 will be performing the inspections recommended by this Bulletin as described above.

ATTACHMENT 2

Thirty-Day Response to NRC Bulletin 2003-02

"Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity"

Byron Station, Units 1 and 2

Exelon Generation Company, LLC

Attachment 2

Thirty-Day Response to NRC Bulletin 2003-02

Byron Station, Units 1 and 2

On August 21, 2003, the NRC issued NRC Bulletin 2003-02, "Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity." The Bulletin requested the following information.

(1) All subject pressurized water reactor (PWR) addressees are requested to provide the following information. The responses for facilities that will enter refueling outages before December 31, 2003, should be provided within 30 days of the date of this bulletin. All other responses should be provided within 90 days of the date of this bulletin.

Response to Item (1)

Byron Station, Unit 1 is scheduled to enter its 12th refueling outage (i.e., B1R12) in September 2003; therefore, Exelon Generation Company, LLC (EGC) is providing a 30-day response to Bulletin 2003-02.

(a) A description of the reactor pressure vessel (RPV) lower head penetration inspection program that has been implemented at your plant. The description should include when the inspections were performed, the extent of the inspections with respect to the areas and penetrations inspected, inspection methods used, the process used to resolve the source of findings of any boric acid deposits, the quality of the documentation of the inspections (e.g., written report, video record, photographs), and the basis for concluding that your plant satisfies applicable regulatory requirements related to the integrity of the RPV lower head penetrations.

Response to Item (a)

Inspection Schedule

Unit 1

Byron Station began performing RPV lower head general area visual examinations in November 1997 during the eighth Byron Station, Unit 1 refueling outage (B1R08) in Mode 5. This was the first time that a visual examination was performed of the bare metal surface with the RPV lower head insulation removed. Byron Station, at the end of each refueling outage, has performed the required American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel (B&PV) Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," visual examination (i.e., VT-2 examination) during Mode 3 with insulation in place with a minimum four-hour hold time at nominal operating pressure and temperature.

Unit 2

Byron Station began performing RPV lower head general area visual examinations in May 1998 during the seventh Byron Station, Unit 2 refueling outage (B2R07) in Mode 5. This was the first time that a visual examination was performed of the bare metal surface with the RPV lower head insulation removed. Byron Station, at the end of each refueling outage, has performed the required ASME Section XI, VT-2 examination during Mode 3 with insulation in place with a minimum four-hour hold time at nominal operating pressure and temperature.

Extent of Inspections

Unit 1

The examination of the Byron Station, Unit 1 RPV lower head during the Spring 2002 refueling outage (B1R11) was accomplished by removing insulation panels around the periphery of the lower head insulation enclosure. The visual examination of the RPV lower head surface and the 58 bottom mounted instrumentation (BMI) penetrations was performed using direct visual techniques from different vantage points. The examination, performed after completion of fuel moves, provided 100% coverage and identified surface rust and a minor boric acid streak trailing from above. The source of the past leakage was concluded to be refueling water leaking past the reactor cavity boot seal.

Unit 2

The examination of the Byron Station, Unit 2 RPV lower head during the Fall 2002 refueling outage (B2R10) was accomplished by removing insulation panels around the periphery of the lower head insulation enclosure. The visual examination of the RPV lower head surface and the 58 BMI penetrations was performed using direct visual techniques from different vantage points. The examination, performed after completion of fuel moves, provided 100% coverage and identified surface rust and a minor boric acid streak trailing from above. The source of the past leakage was concluded to be refueling water leaking past the reactor cavity boot seal.

Inspection Methods and Process to Resolve Sources of Findings

Unit 1

Insulation panel openings were removed to access 100% of the RPV lower head surface and BMI penetrations. The insulation at the bottom of the RPV is a flat, horizontal deck of stainless steel mirror panels. The deck stands off from the bottom of the lower head providing a clearance of eight inches. The center panels are fixed around the 58 BMI penetrations and are not designed for removal. The peripheral panels are removable and allow access to the lower RPV head surface.

The Byron Station, Unit 1 visual examination was performed, and the results evaluated, by certified VT-2 examiners. The examination was performed using EGC standard procedure SPP VT-2-1, "VT-2 Visual Examination."

Condition Report (CR) 100795 was initiated to document the condition of the Byron Station, Unit 1 RPV lower head. There was no degradation of the RPV lower head surface from either the rust or the boric acid trail. The source of leakage was concluded to be through the reactor cavity boot seal.

Unit 2

Insulation panel openings were removed to access 100% of the RPV lower head surface and BMI penetrations. The insulation at the bottom of the RPV is a flat, horizontal deck of stainless steel mirror panels. The deck stands off from the bottom of the lower head providing a clearance of eight inches. The center panels are fixed around the 58 BMI penetrations and are not designed for removal. The peripheral panels are removable and allow access to the lower RPV head surface.

The Byron Station, Unit 2 visual examination was performed, and the results evaluated, by certified VT-2 examiners. The examination was performed using EGC standard procedure, ER-AA-335-015, "VT-2 Visual Examination."

CR 124964 was initiated to document the condition of the Byron Station, Unit 2 RPV lower head. There was no degradation of the RPV lower head surface from either the rust or the boric acid trail. The source of leakage was concluded to be through the reactor cavity boot seal.

Quality of Inspection Documentation

Unit 1

The results of the Spring 2002 examination were documented in a written report and the as-left conditions were recorded in digital photographs.

Unit 2

The results of the Fall 2002 examination were documented in a written report and the as-left conditions were recorded in digital photographs.

Basis for Concluding Regulatory Requirements are Satisfied

For Byron Station, Units 1 and 2, the successful completion of the RPV lower head visual examination, without any evidence of through wall leakage or any recordable wastage of the carbon steel surface, is added assurance of the integrity of the BMI penetrations.

The specific regulatory requirements are listed below with the associated response addressing how the requirement is met.

Design Requirements: 10 CFR 50, Appendix A – General Design Criteria (GDC)

The three referenced GDC state the following:

Criterion 14 – Reactor Coolant Pressure Boundary

> *"The reactor coolant pressure boundary shall be designed, fabricated, erected and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture."*

Criterion 31 – Fracture Prevention of Reactor Coolant Pressure Boundary

> *"The reactor coolant pressure boundary shall be designed with sufficient margin to assure that when stressed under operating, maintenance, testing, and postulated accident conditions (1) the boundary behaves in a non-brittle manner, and (2) the probability of rapidly propagating fracture is minimized. The design shall reflect consideration of service temperatures and other conditions of the boundary material under operating, maintenance, testing and postulated accident conditions and the uncertainties in determining (1) material properties, (2) the effects of irradiation on material properties, (3) residual, steady state and transient thermal stresses, and (4) size of flaws."*

Criterion 32 – Inspection of Reactor Coolant Pressure Boundary

> *"Components which are part of the reactor coolant pressure boundary shall be designed to permit (1) periodic inspection and testing of important areas and features to assess their structural and leak tight integrity, and (2) an appropriate material surveillance program for the reactor pressure vessel."*

Compliance with GDC Requirements

Byron Station continues to be in compliance with the requirements of GDC 14, 31 and 32.

The Byron Station reactor vessel is designed, fabricated, tested, and examined in accordance with the requirements of ASME Section III, "Requirements for Design and Manufacture of Nuclear Power Plant Components," and ASME Section XI. In general, the controls established by these construction and inspection codes assure that the RPV maintains an extremely low probability of rapidly propagating failure and gross rupture.

Although stress corrosion cracking of BMI penetrations was not originally anticipated during plant design, it has occurred in the RPV lower head nozzles at the South Texas Project (STP) Unit 1 plant. However, the robust design of this area has been demonstrated by the small amounts of leakage that have occurred and by the fact that the cracks in the STP Unit 1 BMIs were very tight with very low leakage rates. The design of the Byron Station BMI tubes includes an increased diameter portion, (i.e., 1.75 inch nominal above the tube nominal diameter of 1.5 inch) to act as a collar. The collar was incorporated to aid in preventing the BMI nozzle from being ejected in the event of a complete attachment weld failure.

The visual examination technique used in the Byron Station, Unit 1 Spring 2002 refueling outage, and in the Unit 2 Fall 2002 refueling outage, is a reliable means for identifying the very low leakage rates potentially associated with BMI cracking. Therefore, based on the design, materials, and examination methods, the Byron Station reactor vessel continues to comply with the requirements of GDC 14.

The Byron Station reactor vessel, as stated above, has been constructed in accordance with ASME Section III to assure structural integrity under operating, testing, transient, and accident conditions. The design basis of the Byron Station reactor vessel includes consideration for residual, steady state and transient stresses. Examination requirements of both ASME Section III and Section XI address the required reactor vessel and BMI penetration weld attachment non-destructive examination (NDE) requirements to assure that flaws are well within acceptable size limits to assure design life reliability. Byron Station also maintains an NRC-

approved RPV material surveillance program to monitor the effects of irradiation on reactor vessel material properties. Therefore, based on the design, materials, monitoring and examination methods, the Byron Station reactor vessel continues to comply with the requirements of GDC 31.

By design, the Byron Station components which are part of the reactor coolant pressure boundary (RCPB) have the capability of being periodically inspected to assess their structural and leaktight integrity. These inspections are performed under the provisions of the ASME B&PV Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Part Components," as modified by the requirements of, or alternatives approved by, the NRC. As noted above, Byron Station maintains an NRC-approved RPV material surveillance program to monitor the effects of irradiation on reactor vessel material properties. Therefore, based on the RCPB inspections performed and material surveillance program, Byron Station continues to comply with the requirements of GDC 32.

Compliance with Operating Requirement: 10 CFR 50.36 - Plant Technical Specifications

Byron Station Technical Specifications include requirements and associated action statements addressing RCPB leakage. The Byron Station Technical Specification limits for reactor coolant operational leakage are one gallon per minute (gpm) for unidentified leakage, 10 gpm for identified leakage, and no pressure boundary leakage (reference Byron Station Technical Specifications Section 3.4.13, "RCS Operational Leakage"). Compliance with the zero non-isolable leakage criterion is met by conducting inspections and repairs in accordance with ASME B&PV Code, Section XI, and 10 CFR 50.55a, "Codes and standards," as described below.

The unidentified leakage limit of one gpm is established as a quantity which can be accurately measured while sufficiently low to ensure early detection of leakage. Leakage of this magnitude can be reasonably detected within a short time, thus providing confidence that cracks associated with such leakage will not develop into a critical size before mitigating actions can be taken. If a pressure boundary leak of a BMI nozzle was detected by the various means of reactor coolant system (RCS) leakage detection (i.e., containment floor drain sump monitor, reactor cavity sump monitor, containment atmosphere radiation monitors, RCS mass balance calculation), the reactor would be shut down in accordance with the above Technical Specification requirements.

In addition, Byron Station has implemented controls and expectations to address RCS leakage below Technical Specification limits. EGC procedure ER-AP-331-1003, "RCS Leakage Monitoring and Action Plan," has been implemented to assure adequate monitoring of RCS leakage and to provide minimum actions that could be taken at various RCS leakage levels.

Compliance with Inspection Requirements: 10 CFR 50.55a and ASME Section XI

10 CFR 50.55a, "Codes and standards," requires that inservice inspection and testing be performed per the requirements of the ASME B&PV Code, Section XI, "Rules for Inservice Inspection of Nuclear Plant Components." Section XI contains applicable rules for examination, evaluation, and repair of code class components, including the RCPB.

Byron Station is currently in the second inservice inspection (ISI) interval. The second ISI interval is being conducted to the 1989 Edition, no addenda, of the ASME Section XI Code. Unit 1 began Interval 2 on July 1, 1996, and Unit 2 began Interval 2 on August 16, 1998.

Quality Assurance Requirements: 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"

Criterion V of Appendix B to 10 CFR 50

> *Criterion V of Appendix B to 10 CFR 50 states that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings. Criterion V further states that instructions, procedures, or drawings shall include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished. Visual and volumetric examinations of VHP nozzles are activities that should be documented in accordance with these requirements.*

Response – Compliance with 10 CFR 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings"

ASME Code required visual and volumetric examinations, including visual examinations performed in accordance with Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants," are performed using procedures that contain specific acceptance criteria or detailed recording criteria that are subsequently evaluated for acceptability. The visual examinations are performed using detailed instructions with a combination of qualitative and quantitative standards for the essential exam variables. Visual examinations of the RPV lower head at Byron Station are addressed by standardized EGC procedures, which address qualification of examiners and examination requirements.

Criterion IX of Appendix B to 10 CFR 50

> *Criterion IX of Appendix B to 10 CFR 50 states that special processes, including nondestructive testing, shall be controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements.*

Response – Compliance with 10 CFR 50, Appendix B, Criterion IX, "Control of Special Processes"

The RPV lower head visual examinations at Byron Station are performed by certified VT Level II or Level III examiners using EGC approved procedures with additional detailed instructions as necessary.

Criterion XVI of Appendix B to 10 CFR 50

> *Criterion XVI of Appendix B to 10 CFR 50 states that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected. For significant conditions adverse to quality, the measures taken shall include root cause determination and corrective action to preclude repetition of the adverse conditions.*

Response – Compliance with 10 CFR 50, Appendix B, Criterion XVI, "Corrective Action"

The identification of an unacceptable visual indication requires repair, replacement or acceptance by analytical evaluation. In all cases, these indications would be tracked by the Byron Station Corrective Action Program (CAP). In the case of a significant adverse condition, the CAP requires determination of the cause of the failure, evaluation of the extent of condition, and assignment of appropriate corrective actions to preclude recurrence. The Byron Station CAP meets the requirements of Appendix B, Criterion XVI. In addition, the repair and replacement requirements of ASME Section XI are implemented as applicable. Boric acid accumulation on the RPV lower head surface would also be assessed and evaluated by EGC procedure ER-AP-331-1002, "Boric Acid Corrosion Control Program Identification, Assessment, and Evaluation."

(b) *A description of the RPV lower head penetration inspection program that will be implemented at your plant during the next and subsequent refueling outages. The description should include the extent of the inspections which will be conducted with respect to the areas and penetrations to be inspected, inspection methods to be used, qualification standards for the inspection methods, the process used to resolve the source of findings of boric acid deposits or corrosion, the inspection documentation to be generated, and the basis for concluding that your plant will satisfy applicable regulatory requirements related to the structural and leakage integrity of the RPV lower head penetrations.*

Response to Item (b)

Extent of Inspections

Byron Station plans to perform a bare metal visual (BMV) examination of the Unit 1 RPV lower head surface and penetrations during the next refueling outage (B1R12) scheduled to begin in September 2003. The examination is planned to cover 100% of the 58 BMI penetrations as well as the lower head surface. The examination will be performed using remote visual examination equipment (i.e., video cameras), mounted on a remotely controlled crawler and supplemented, if required, with a pole-mounted camera.

Byron Station plans to perform a BMV examination of the Unit 2 RPV lower head surface and penetrations during the next refueling outage (B2R11) scheduled to begin in March 2004. The examination is planned to cover 100% of the 58 BMI penetrations as well as the accessible areas of the lower head surface. The examination will be performed using remote visual examination equipment (i.e., video cameras), mounted on a remotely controlled crawler and supplemented, if required, with a pole-mounted camera.

Inspection Methods and Qualification Standards

Both the Byron Station, Unit 1 and Unit 2 examinations will be performed by certified VT-2 examiners using EGC procedure ER-AP-335-1012, "Visual Examination of PWR Reactor Vessel Head Penetrations," specifically developed for these locations. The resolution capability of the examination technique will be demonstrated and documented on videotape. The examination technique will be able to resolve the required character size on a near distance test chart.

Process to Resolve Sources of Findings

The EGC CAP will require that the source of any boric acid deposits be determined and that the necessary corrective actions be implemented. Specifically, EGC examination procedure ER-AP-335-1012 requires that the source of any boron be identified and any recordable condition (i.e., excessive corrosion or wastage) be documented and resolved in a CR. Within the CAP process, Byron Station will be using the standardized EGC process for documenting and assessing the impact of any boric acid deposits in accordance with ER-AP-331-1002, "Boric Acid Corrosion Control Program Identification, Assessment, and Evaluation."

More specifically, EGC will utilize the CAP process to evaluate all findings of leakage found during the BMI penetration examination. The process will include methodic evaluations to determine if the findings of leakage are relevant or non-relevant as an RCS leak, as well as the source of the leakage. Examples of relevant leakage are identified in Electric Power Research Institute (EPRI) Report 1006296, "Visual Examination for Leakage of PWR Reactor Head Penetrations," dated March 2002, supplemented by the as-found pictures of the boric acid accumulation at STP, Unit 1 at BMI locations #1 and #46 (discussed in Operating Experience OE 16114). Reactor cavity seal ring leakage, which occurs during a refueling outage, only occurs at low temperature and results in staining without "popcorn like" accumulation features of an RCS leak at normal operating temperature. Methods available to evaluate relevant indications of leakage (i.e., boric acid residue, not staining) include sample collection for chemical and isotopic analysis.

Inspection Documentation

The examination and the as-found condition of the RPV lower head surface and penetrations will be recorded on videotape and documented in a written report. The as-left condition of the RPV lower head surface and penetrations will also be documented in a written report.

Basis for Concluding Regulatory Requirements are Satisfied

The successful completion of the previously discussed RPV lower head BMV examinations on Byron Station, Units 1 and 2, assures the structural and leakage integrity of the RPV lower head penetrations and confirms that Byron Station continues to comply with the applicable regulatory requirements.

The basis for concluding that the applicable regulatory requirements are satisfied is addressed in the response to item (1)(a) above.

Subsequent Inspections

The extent and frequency of subsequent visual examinations of the Byron Station RPV lower head surface and penetrations beyond refueling outages B1R12 and B2R11 will follow appropriate NRC and Industry guidance as well as the standardized EGC procedure ER-AP-331-1001, "Boric Acid Corrosion Control (BACC) Inspection Locations, Implementation, and Inspection Guidelines."

(c) If you are unable to perform a bare-metal visual inspection of each penetration during the next refueling outage because of the inability to perform the necessary planning, engineering, procurement of materials, and implementation, are you planning to perform bare-metal visual inspections during subsequent refueling outages? If so, provide a description of the actions that are planned to enable a bare-metal visual inspection of each penetration during subsequent refueling outages. Also, provide a description of any penetration inspections you plan to perform during the next refueling outage. The description should address the applicable items in paragraph (b).

Response to Item (c)

Not applicable - all Byron Station units will be performing the inspections recommended by this Bulletin as described above.

(d) If you do not plan to perform either a bare-metal visual inspection or non-visual (e.g., volumetric or surface) examination of the RPV lower head penetrations at the next or subsequent refueling outages, provide the basis for concluding that the inspections performed will assure applicable regulatory requirements are and will continue to be met.

Response to Item (d)

Not applicable - Byron Station, Units 1 and 2 will be performing the inspections recommended by this Bulletin as described above.

ATTACHMENT 3

Thirty-Day Response to NRC Bulletin 2003-02

"Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity"

Three Mile Island, Unit 1

AmerGen Energy Company, LLC

Attachment 3

Thirty-Day Response to NRC Bulletin 2003-02

Three Mile Island, Unit 1

On August 21, 2003, the NRC issued NRC Bulletin 2003-02, "Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity." The Bulletin requested the following information.

(1) All subject pressurized water reactor (PWR) addressees are requested to provide the following information. The responses for facilities that will enter refueling outages before December 31, 2003, should be provided within 30 days of the date of this bulletin. All other responses should be provided within 90 days of the date of this bulletin.

Response to Item (1)

TMI Unit 1 is scheduled to enter its 15th refueling outage (i.e., T1R15) in October 2003; therefore, AmerGen Energy Company, LLC (AmerGen) is providing a 30-day response to Bulletin 2003-02.

(a) A description of the reactor pressure vessel (RPV) lower head penetration inspection program that has been implemented at your plant. The description should include when the inspections were performed, the extent of the inspections with respect to the areas and penetrations inspected, inspection methods used, the process used to resolve the source of findings of any boric acid deposits, the quality of the documentation of the inspections (e.g., written report, video record, photographs), and the basis for concluding that your plant satisfies applicable regulatory requirements related to the integrity of the RPV lower head penetrations.

Response to Item (a)

Inspection Schedule

TMI Unit 1 performs a visual examination (i.e., VT-2 examination) with the insulation in place, with a minimum four-hour hold time at nominal operating pressure and temperature, consistent with the requirements of American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel (B&PV) Code, Section XI, "Rules for Inservice Inspection of Nuclear power Plant Components," during startup from each refueling outage since at least 1991 (i.e., the T1R09 refueling outage). This inspection covers the area underneath the reactor vessel contained in the concrete shielded area. An access door is viewed for any fluid coming out through the access door. This inspection also looks at the incore instrument chase area.

Proceduralized reactor cavity drain line leakage inspections are also performed during hot shutdown conditions.

During past refueling outages, a visual inspection of the area from the bottom of the insulation to the reactor building floor, including all incore tubes, has been performed which looks for signs of boric acid as part of the Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants," boric acid control program inspections.

No documented visual examinations of the bottom head bare metal at TMI Unit 1 have been performed to date.

Extent of Inspections

The examination of the TMI Unit 1 RPV lower head area during previous refueling outages was accomplished by visual examination of the area beneath the reactor vessel. No insulation was removed for these inspections. These VT-2 inspections did not specifically examine the bottom of the reactor vessel where the incore instrument nozzles penetrate the vessel because insulation completely covers this area and prevents visual inspection of the actual penetrations. These inspections did assess the general condition of this area and did identify indications of boron accumulation (most likely from canal seal plate leakage). Based on the above noted results, we are confident that these visual inspections would have identified any significant indications of leakage from the incore instrument nozzles.

Inspection Methods and Process to Resolve Sources of Findings

During the 1991 refueling outage (i.e., T1R09) inspection, boron deposition was found on numerous incore tubes and the interior wall of the primary shield opposite the exhaust of the air handling fans (i.e., the AH-E-2 fans). It was noted that water was dripping down from the cooling annulus in the vicinity of the incore chase. Boron was removed from six suspect stainless steel guide tubes. An inspection for a leak was performed followed up by a surface dye-penetrant non-destructive examination (NDE), application of a freeze seal and a 1000 psi hydrostatic test of each tube from the incore seal plate. Each of the six guide tubes was successfully tested with no leakage identified. It was eventually determined that this water came from the seal plate while the transfer canal was flooded, as noted below.

Boron removal work was then performed within the primary shield followed by a water flush of the area including the vessel insulation, primary shield walls and guide tubes. After this work was completed, a water flush was also performed within the cooling annulus conducted from the seal plate area. The seal plate leakage had been detected earlier. A final entry was made to remove standing water and clean the floor. The final assessment of boron accumulation was as follows:

- three to four inches of standing water were being retained within the primary shield;
- water leakage was identified from the seal plate while the transfer canal was flooded; and
- the dispersion of boron was due to the air turbulence induced by the AH-E-2 fans entering the cavity near the floor level to the left of the primary shield entrance.

Subsequent inspections of the reactor cavity area, performed each refueling outage, have not identified any significant indications of leakage associated with the RPV bottom head nozzles.

Quality of Inspection Documentation

The results of these examinations have been documented in operations surveillance document OPS-S419, "Ops Inspection of Remote Areas During Cold Shutdown Outages." A videotape was made during the 1991, 1995, and 1999 refueling outage inspections (i.e., T1R09, T1R11, T1R13). Photographs were taken in 2001, during the T1R14 refueling outage, due to dose rates that limited entry into the cavity area.

Basis for Concluding Regulatory Requirements are Satisfied

For TMI Unit 1, the successful completion of the reactor cavity area examinations during each refueling outage since 1991, without any evidence of identified significant indications of leakage associated with the lower head nozzles, is added assurance of the integrity of the bottom mounted instrumentation (BMI) penetrations.

The specific regulatory requirements are listed below with the associated response addressing how the requirement is met.

Design Requirements: 10 CFR 50, Appendix A – General Design Criteria (GDC)

The three referenced GDC state the following:

Criterion 14 – Reactor Coolant Pressure Boundary

> *"The reactor coolant pressure boundary shall be designed, fabricated, erected and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture."*

Criterion 31 – Fracture Prevention of Reactor Coolant Pressure Boundary

> *"The reactor coolant pressure boundary shall be designed with sufficient margin to assure that when stressed under operating, maintenance, testing, and postulated accident conditions (1) the boundary behaves in a non-brittle manner, and (2) the probability of rapidly propagating fracture is minimized. The design shall reflect consideration of service temperatures and other conditions of the boundary material under operating, maintenance, testing and postulated accident conditions and the uncertainties in determining (1) material properties, (2) the effects of irradiation on material properties, (3) residual, steady state and transient thermal stresses, and (4) size of flaws."*

Criterion 32 – Inspection of Reactor Coolant Pressure Boundary

> *"Components which are part of the reactor coolant pressure boundary shall be designed to permit (1) periodic inspection and testing of important areas and features to assess their structural and leak tight integrity, and (2) an appropriate material surveillance program for the reactor pressure vessel."*

Compliance with GDC Requirements

Based upon AmerGen's evaluation of the TMI Unit 1 previous reactor cavity area inspections, the T1R14 refueling outage 100% bare metal RPV upper head inspections, the vessel head penetration (VHP) nozzle inspections and repair, and plans for future inspections, AmerGen concludes that the applicable regulatory requirements will continue to be met at TMI Unit 1. The following discusses each of the criteria addressed in Bulletin 2003-02 and demonstrates that the criteria will continue to be met by TMI Unit 1.

During the initial plant licensing of TMI Unit 1, it was demonstrated that the design of the reactor coolant pressure boundary (RCPB) met the regulatory requirements in place at that time, as documented in the safety evaluation by the Atomic Energy Commission (AEC) dated July 11, 1973. The safety evaluation stated:

> "The Three Mile Island Unit 1 was designed and constructed to meet the intent of the AEC's General Design Criteria, as originally proposed in July 1967. Construction of the plant was about 60% complete and the Final Safety Analysis Report (FSAR) had been filed as Amendment 12 with the Commission before publication of the revised General Design Criteria in February 1971 and the present version of the criteria in July 1971. As a result, we did not require the applicant to reanalyze the plant on the basis of the revised criteria. However, our technical review did assess the plant against the General Design Criteria now in effect and we conclude that the plant design conforms to the intent of these newer criteria."

This demonstrates that although TMI Unit 1 was not originally designed to the present GDC, including the three GDC noted, the NRC did review and conclude that TMI Unit 1 met the intent of these criteria.

PWRs licensed both before and after issuance of Appendix A to 10 CFR Part 50 (1971) complied with these criteria in part by: 1) selecting Alloy 600 or austenitic materials with excellent corrosion resistance and extremely high fracture toughness for RCPB materials, and 2) following ASME Codes and Standards and other applicable requirements for fabrication, erection, and testing of the pressure boundary parts. NRC reviews of operating license submittals subsequent to issuance of Appendix A to 10 CFR Part 50 included evaluating designs for compliance with the GDC. The Standard Review Plans in effect at the time of licensing do not address the selection of Alloy 600. They only required that ASME code requirements be satisfied.

The RCPB components at TMI Unit 1 meet Criterion 32. Access is provided for non-destructive examination during plant shutdown and an RPV material surveillance program, conforming to this criterion, has been established as described in the TMI Unit 1 Updated Final Safety Analysis Report (UFSAR), Section 4.4.5, "Material Irradiation Surveillance."

As described above, the intent of the requirements established for design, fracture toughness, and inspectability in GDC 14, 31, and 32 were satisfied during the initial licensing review of TMI Unit 1, and continue to be satisfied during operation, even in the presence of the potential for primary water stress corrosion cracking (PWSCC) of the BMI nozzle penetrations of the RPV lower head. In part, the selection of Alloy 600 materials provide excellent corrosion resistance and extremely high fracture toughness of the RCPB.

Access is available to perform a 100% bare metal visual (BMV) examination of the BMI nozzles in refueling outage T1R15. This provides reasonable assurance that the TMI Unit 1 RCPB maintains a low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture due to BMI nozzle cracking.

By design, the TMI Unit 1 components, which are part of the RCPB, have the capability of being periodically inspected to assess their structural and leaktight integrity. These inspections are typically performed under the provisions of the ASME Boiler and Pressure Vessel (B&PV) Code, Section XI, "Requirements for the Inservice Inspection of Nuclear Power Part Components," as modified by the requirements of, or alternatives approved by, the NRC. Direct visual examinations of the RPV lower head have not been performed prior to the upcoming refueling outage, T1R15; however, they are now part of an augmented program.

Compliance with Operating Requirement: 10 CFR 50.36 – Plant Technical Specifications

The RCPB provides one of the critical barriers that guard against the uncontrolled release of radioactivity. Therefore, TMI Unit 1 Technical Specifications include requirements and associated action statements addressing RCPB leakage. The TMI Unit 1 Technical Specification limits for reactor coolant leakage are one gallon per minute (gpm) for unidentified leakage, 10 gpm for total leakage (i.e., identified plus unidentified leakage), and no leakage from a non-isolable fault in the reactor coolant system (RCS) pressure boundary (reference TMI Unit 1 Technical Specifications Section 3.1.6, "Leakage"). Compliance with the zero non-isolable leakage criterion is met by conducting inspections and repairs in accordance with ASME B&PV Code, Section XI, and 10 CFR 50.55a, "Codes and standards," as described below.

The unidentified leakage limit of one gpm is established as a quantity, which can be accurately measured while sufficiently low to ensure early detection of leakage. Leakage of this magnitude can be reasonably detected within a short time, thus providing confidence that cracks associated with such leakage will not develop into a critical size before mitigating actions can be taken. If a pressure boundary leak of a BMI nozzle was detected by the various means of RCS leakage detection (i.e., containment radiation monitor, RCS mass balance calculation, reactor building sump level monitor), the reactor would be shut down in accordance with the above Technical Specification requirements.

In addition, TMI Unit 1 has implemented controls and expectations to address RCS leakage below Technical Specification limits. EGC procedure ER-AP-331-1003, "RCS Leakage Monitoring and Action Plan," has been implemented to assure adequate monitoring of RCS leakage and to provide minimum actions that could be taken at various RCS leakage levels.

Compliance with Inspection Requirements: 10 CFR 50.55a and ASME Section XI

10 CFR 50.55a, "Codes and standards," requires that inservice inspection and testing be performed per the requirements of the ASME B&PV Code, Section XI, "Rules for Inservice Inspection of Nuclear Plant Components." Section XI contains applicable rules for examination, evaluation and repair of code class components, including the RCPB.

On April 20, 2001, TMI Unit 1 began its third ten-year inservice inspection (ISI) interval and was required by NRC regulations to update the ISI program to meet the 1995 Code Edition with Addenda through 1996 for its third ten-year interval. The 1995 Code Edition, which applies to all third interval examinations and any repairs and replacement, no longer includes Category B-E. The 1995 Code includes Category B-P, Item B15.10, "Reactor Vessel Pressure Retaining Boundary," which contains requirements for system leakage tests in accordance with IWB-5220 with visual examinations (i.e., VT-2 examinations) of the RCPB using the acceptance standard in IWB-3522. Examinations, performed as a result of the repair of any BMI nozzles found leaking, will be performed as third interval examinations in accordance with the 1995 Code with Addenda through 1996 or in accordance with relief from Code requirements granted by the NRC.

Quality Assurance Requirements: 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"

Criterion V of Appendix B to 10 CFR 50

> *Criterion V of Appendix B to 10 CFR 50 states that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings. Criterion V further states that instructions, procedures, or drawings shall include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished. Visual and volumetric examinations of VHP nozzles are activities that should be documented in accordance with these requirements.*

Response – Compliance with 10 CFR 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings"

ASME Code required visual and volumetric examinations, including visual examinations performed in accordance with Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants," are performed using procedures that contain specific acceptance criteria or detailed recording criteria that are subsequently evaluated for acceptability. The visual examinations are performed using detailed instructions with a combination of qualitative and quantitative standards for the essential examination variables. Visual examinations of the RPV lower head at TMI Unit 1 are addressed by standardized Exelon Generation Company, LLC (EGC) procedures, which address qualification of examiners and examination requirements.

Criterion IX of Appendix B to 10 CFR 50

> *Criterion IX of Appendix B to 10 CFR 50 states that special processes, including nondestructive testing, shall be controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements.*

Response – Compliance with 10 CFR 50, Appendix B, Criterion IX, "Control of Special Processes"

The RPV lower head visual examinations at TMI Unit 1 are performed by certified VT Level II or Level III examiners using EGC approved procedures with additional detailed instructions as necessary.

Criterion XVI of Appendix B to 10 CFR 50

> *Criterion XVI of Appendix B to 10 CFR 50 states that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected. For significant conditions adverse to quality, the measures taken shall include root cause determination and corrective action to preclude repetition of the adverse conditions.*

Response – Compliance with 10 CFR 50, Appendix B, Criterion XVI, "Corrective Action"

The identification of an unacceptable visual indication requires repair, replacement or acceptance by analytical evaluation. In all cases, these indications would be tracked by the Corrective Action Program (CAP). In the case of a significant adverse condition, the CAP requires determination of the cause of the failure, evaluation of the extent of condition, and assignment of appropriate corrective actions to preclude recurrence. The TMI Unit 1 CAP meets the requirements of Appendix B, Criterion XVI. In addition, the repair and replacement requirements of ASME Section XI are implemented as applicable. Boric acid accumulation on the RPV lower head surface would also be assessed and evaluated by EGC procedure ER-AP-331-1002, "Boric Acid Corrosion Control Program Identification, Assessment, and Evaluation."

(b) *A description of the RPV lower head penetration inspection program that will be implemented at your plant during the next and subsequent refueling outages. The description should include the extent of the inspections which will be conducted with respect to the areas and penetrations to be inspected, inspection methods to be used, qualification standards for the inspection methods, the process used to resolve the source of findings of boric acid deposits or corrosion, the inspection documentation to be generated, and the basis for concluding that your plant will satisfy applicable regulatory requirements related to the structural and leakage integrity of the RPV lower head penetrations.*

Response to Item (b)

Extent of Inspections

TMI Unit 1 plans to perform a BMV examination of the RPV lower head surface and penetrations during the next refueling outage, (T1R15). This outage is scheduled to begin in October 2003. The examination is planned to cover 100% of the 52 lower BMI penetrations as well as the lower head surface. The examination will be performed using remote visual examination equipment, (i.e., video cameras) mounted on a remotely controlled crawler supplemented, if required, with a pole-mounted camera.

Inspection Methods and Qualification Standards

The TMI Unit 1 examinations will be performed by certified VT-2 examiners using EGC procedure ER-AP-335-1012, "Visual Examination of PWR Reactor Vessel Head Penetrations," specifically developed for these locations. The resolution capability of the examination technique will be demonstrated and documented on videotape. The examination technique will be able to resolve the required character size on a near distance test chart.

Process to Resolve Sources of Findings

The TMI Unit 1 Corrective Action Program (CAP) will require that the source of any boric acid deposits be determined and that the necessary corrective actions be implemented. Specifically, EGC examination procedure ER-AP-335-1012 requires that the source of any boron be identified and any recordable condition (i.e., excessive corrosion or wastage) be documented and resolved in the CAP. Within the CAP, TMI Unit 1 will be using the standardized EGC process for documenting and assessing the impact of any boric acid deposits in accordance

with procedure ER-AP-331-1002, "Boric Acid Corrosion Control Program Identification, Assessment, and Evaluation."

More specifically, TMI Unit 1 will utilize the CAP process to evaluate all findings of leakage found during the BMI penetration examination. The process will include methodic evaluations to determine if the findings of leakage are relevant or non-relevant as an RCS leak, as well as the source of the leakage. Examples of relevant leakage are identified in Electric Power Research Institute (EPRI) Report 1006296, "Visual Examination for Leakage of PWR Reactor Head Penetrations," dated March 2002, supplemented by the as-found pictures of the boric acid accumulation at South Texas Project, Unit 1 at BMI locations #1 and #46 (discussed in Operating Experience OE 16114). Reactor cavity seal ring leakage, which occurs during a refueling outage, only occurs at low temperature and results in staining without "popcorn like" accumulation features of an RCS leak at normal operating temperature. Methods available to evaluate relevant indications of leakage (i.e., boric acid residue, not staining) include sample collection for chemical and isotopic analysis.

Inspection Documentation

The examination and the as-found condition of the RPV lower head surface and penetrations will be recorded on videotape and documented in a written report. The as-left condition of the RPV lower head surface and penetrations will also be documented in a written report.

Basis for Concluding Regulatory Requirements are Satisfied

The successful completion of RPV lower head BMI nozzle penetration examinations on TMI Unit 1 during the T1R15 refueling outage in October 2003 will assure the structural and leakage integrity of the RPV lower head penetrations and confirm that TMI Unit 1 continues to comply with the applicable regulatory requirements.

The basis for concluding that the applicable regulatory requirements are satisfied is addressed in the response to item (1)(a) above.

Subsequent Inspections

The extent and frequency of subsequent visual examinations of the TMI Unit 1 RPV lower head surface and penetrations beyond the T1R15 refueling outage will follow appropriate NRC and industry guidance as well as the standardized EGC procedure ER-AP-331-1001, "Boric Acid Corrosion Control (BACC) Inspection Locations, Implementation, and Inspection Guidelines."

(c) *If you are unable to perform a bare-metal visual inspection of each penetration during the next refueling outage because of the inability to perform the necessary planning, engineering, procurement of materials, and implementation, are you planning to perform bare-metal visual inspections during subsequent refueling outages? If so, provide a description of the actions that are planned to enable a bare-metal visual inspection of each penetration during subsequent refueling outages. Also, provide a description of any penetration inspections you plan to perform during the next refueling outage. The description should address the applicable items in paragraph (b).*

Response to Item (c)

Not applicable - TMI Unit 1 will be performing the inspections recommended by this Bulletin as described above.

(d) If you do not plan to perform either a bare-metal visual inspection or non-visual (e.g., volumetric or surface) examination of the RPV lower head penetrations at the next or subsequent refueling outages, provide the basis for concluding that the inspections performed will assure applicable regulatory requirements are and will continue to be met.

Response to Item (d)

Not applicable – TMI Unit 1 will be performing the inspections recommended by this Bulletin as described above.