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Exelon Generation

RS-12-046

10 CFR 50.90

March 30, 2012

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

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

Subject: Supplemental Information Related to License Amendment Request Regarding Measurement Uncertainty Recapture Power Uprate

References:
1. Letter from Craig Lambert (Exelon Generation Company, LLC) to U. S. NRC, "Request for License Amendment Regarding Measurement Uncertainty Recapture (MUR) Power Uprate," dated June 23, 2011
2. Letter from Kevin F. Borton (Exelon Generation Company, LLC) to U. S. NRC, "Additional Information Supporting Request for License Amendment Regarding Measurement Uncertainty Recapture Power Uprate," dated February 20, 2012

In Reference 1, Exelon Generation Company, LLC (EGC) requested an amendment to Facility Operating License Nos. NPF-72, NPF-77, NPF-37 and NPF-66 for Braidwood Station, Units 1 and 2, and Byron Station, Units 1 and 2, respectively. Specifically, the proposed changes revise the Operating License and Technical Specifications to implement an increase in rated thermal power of approximately 1.63% based on increased feedwater flow measurement accuracy.

Subsequent to the June 23, 2011 amendment request (Reference 1), EGC has identified portions of that submittal where the NRC could benefit from several clarifications and corrections described in the following paragraphs. These clarifications and corrections pertain to the referenced sections of Attachments 5 "NRC Regulatory Information Summary 2002-03 Requested Information (Proprietary Version)," Reference 1. These changes also apply to Attachment 7, Reference 1, which is the Non-Proprietary version of Attachment 5.

- Section III.15, "LOCA Long Term Mass and Energy Release and Containment Response," and Section VII.6.C, "Appendix J Testing Program," indicated that the MUR reanalyzed peak containment pressure was lower than the current Technical Specification (TS) 5.5.16, "Containment Leakage Rate Testing Program," $P_a$ value and

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the reanalyzed value was bounded by the current TS value. In Section VII.6.C EGC stated that no changes or modifications are required to the existing Appendix J Program or procedures. Subsequent review of the Appendix J procedures by EGC identified that certain Appendix J procedures at Byron Station will be revised. As such, EGC is modifying the statement in Section VII.6.C to reflect that certain Appendix J procedures will be revised. Please note that the current Appendix J Program and the current TS $P_a$ value remains unchanged for the MUR power uprate.

- Section V.1.D, "Grid Stability," documented that the PJM Interconnection completed a system stability analysis for Braidwood. The results of this analysis were provided in Attachment 10a, "Generator Transient Stability Study and Interim Generator Deliverability Study for Braidwood Generating Station Units 1 and 2 MUR Upgrade." The study indicated that three of the breaker failure scenarios that were studied were unstable. The study provided remediation measures involving the adjustment of the critical clearing time (CCT). Subsequent to application submittal, PJM Interconnection provided a revised Generator Transient Stability Study and Interim Generator Deliverability Study report for the Braidwood Station Units 1 and 2 MUR power uprate. The revised Generator Transient Stability Study and Interim Generator Deliverability Study report for the Braidwood Station Units 1 and 2 is provided in Attachment 1 to this letter. The revised study indicated that following the implementation of new ComEd criteria, all of the breaker failure scenarios, considered in this study, were found to be stable. The revised ComEd criteria included removal of a requirement that a 1-cycle margin be maintained in the delayed-cleared portion of tested fault scenarios that involved breaker failure. ComEd determined that the one-cycle margin required for the primary-cleared portion of tested faults was adequate for both primary-cleared and delay-cleared fault scenarios. The revised ComEd generator stability criteria continue to be more conservative than the related NERC Standards.

Subsequent to the February 20, 2012 EGC Request for Additional Information (RAI) response letter (Reference 2), EGC has identified corrections described in the following paragraphs.

- Regarding RAI request number 12, the NRC asked that EGC discuss further information relative to, before and after uprate, the maximum stress intensity and the cumulative fatigue usage factors for the critical components of the primary and secondary sides, including nozzles, of the replacement steam generators and the respective service conditions for the replacement steam generators. EGC provided the requested information in the form of a series of tables. Subsequent to submittal of the RAI response, EGC was notified by the manufacturer of the replacement steam generators (i.e., Babcock & Wilcox Canada, Ltd.) that they had identified an error in the calculations for the MUR power uprate qualification analysis of the Braidwood and Byron replacement steam generators. It was determined that this error was carried forward in values provided to the NRC in Reference 2.

  As a result of the revised calculation EGC is providing revised tables to Reference 2 in Attachment 2 to this letter. Tables EMCB R12-1, "Stress Intensity (SI) and Fatigue Usage Factors (FUF) for Level A & B Conditions," EMCB R12-2, "Primary Membrane and Bending Stresses for Level C Conditions," and EMCB R12-3, "Primary Membrane and Bending Stresses for Level D Conditions," are to replace the same referenced tables provided in the response to RAI number 12 in Reference 2 in their entirety. Additionally, to clarify our response, the values identified as "Orig." in these tables, as well as in Table EMCB R12-4, "Average and Maximum Stresses for Studs/Bolts," in

Reference 2, represent values based on the original power conditions for the replacement steam generators at 3425 MWt and not the current power level of 3586.6 MWt.

Babcock & Wilcox has since entered the error into their corrective action program, performed a review of the affected engineering report and all associated calculations, and completed the necessary revisions to the calculation. The values previously provided were incorrectly taken from lower tier calculation documents instead of the correct values from the Design Reports. Babcock & Wilcox has verified that the error did not change the conclusion that the Byron and Braidwood Unit 1 replacement steam generators meet the structural requirements for Class 1 components of the ASME Code for Design, Test, Level A, B, C and D Service Levels under the MUR power uprate conditions.

EGC has reviewed the information supporting a finding of no significant hazards consideration and the environmental consideration provided to the NRC in Reference 1. The information provided in this supplement letter does not affect the previously stated bases in Reference 1 for concluding that the proposed license amendment does not involve a significant hazards consideration. In addition, the information provided in this submittal does not affect the bases for concluding that neither an environmental impact statement nor an environmental assessment needs to be prepared in connection with the proposed amendment.

There are no regulatory commitments contained in this letter.

Should you have any questions concerning this letter, please contact Leslie E. Holden at (630) 657-3316.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 30th day of March 2012.

Respectfully,

Kevin F. Borton
Manager, Licensing - Power Uprate

Attachments:

| | |
|---|---|
| Attachment 1 | Generator Transient Stability Study and Interim Generator Deliverability Study report for the Braidwood Station Units 1 and 2 |
| Attachment 2 | Revised Stress Intensity and Cumulative Usage Factors Tables for Braidwood and Byron Replacement Steam Generators |

cc: NRC Regional Administrator, Region III
NRC Senior Resident Inspector – Braidwood Station
NRC Senior Resident Inspector – Byron Station
Illinois Emergency Management Agency – Division of Nuclear Safety

**Braidwood and Byron Stations**

**Supplemental Information Related to License Amendment Request Regarding Measurement Uncertainty Recapture Power Uprate**

**March 30, 2012**

# ATTACHMENT 2

## Revised Stress Intensity and Cumulative Usage Factors Tables for Braidwood and Byron Replacement Steam Generators

**Tables EMCB R12-1 through 3**

**Braidwood Station, Units 1 and 2**

**Byron Station Units 1 and 2**

**Facility Operating License Nos. NPF-72, NPF-77, NPF-37 and NPF-66**

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| Table EMCB R12-1 - Stress Intensity (SI) and Fatigue Usage Factors (FUF) for Level A & B Conditions | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Component / Location** | **MUR SI Range** (ksi) | **Orig. SI Range** (ksi) | **MUR SI Limit** (ksi) | **Orig. SI Limit** (ksi) | **MUR FUF** | **Orig. FUF** | **FUF Limit** |
| **Tubesheet** | | | | | | | |
| Primary Head / Tubesheet Juncture | ***38.5**** | 82.1 | 80.1 | 87.3 | 0.880 | 0.741 | 1.0 |
| Secondary Shell / Tubesheet Juncture | 86.4 | 85.4 | 95.0 | 87.3 | 0.160 | 0.223 | 1.0 |
| Tubesheet Perforated Region | 90.1 | 90.0 | 95.0 | 93.6 | 0.330 | 0.387 | 1.0 |
| **Primary Nozzle** | | | | | | | |
| Primary Nozzle | 67.85 | 67.85 | 80.1 | 80.1 | 0.839 | 0.839 | 1.0 |
| Primary nozzle safe end | 57.37 | 57.37 | 60.3 | 60.3 | 0.096 | 0.096 | 1.0 |
| **Primary Manway** | | | | | | | |
| Cover | 30.3 | 30.3 | 80.1 | 80.1 | 0.006 | 0.006 | 1.0 |
| Shell/flange | 46 | 46.0 | 80.1 | 80.1 | 0.121 | 0.121 | 1.0 |
| Stud | See Table EMCB R12-4 for Average and Maximum Bolt Stresses | | | | 0.871 | 0.871 | 1.0 |
| **Primary Head Support Pad** | 79.4 | 79.4 | 80 | 80 | 0.67 | 0.67 | 1.0 |
| **Primary Divider Plate** | 63.9 | 63.9 | 69.9 | 69.9 | 0.905 | 0.904 | 1.0 |
| **Small Nozzles** | | | | | | | |
| ¾" Nozzles | 13.96 | 11.83 | 26.7 | 26.7 | 0.81 | 0.734(1) | 1.0 |
| **Steam Drum/Cone Lower Shell Assembly** | 74.22 | 62.9 | 80.1 | 80.1 | 0.025 | 0.021 | 1.0 |
| **8" Shell Cone Handhole** | | | | | | | |
| Shell/cover/flange | 67.3 | 57 | 80 | 80 | 0.256 | 0.074 | 1.0 |
| Stud | See Table EMCB R12-4 for Average and Maximum Bolt Stresses | | | | 0.987 | 0.975 | 1.0 |
| **6" Feedring Handhole** | | | | | | | |
| Shell/cover/flange | 78.0 | 76.5 | 80 | 80 | 0.823 | 0.374 | 1.0 |
| Stud | See Table EMCB R12-4 for Average and Maximum Bolt Stresses | | | | 0.823 | 0.84 | 1.0 |

**NON-PROPRIETARY**

**Table EMCB R12-1 - Stress Intensity (SI) and Fatigue Usage Factors (FUF) for Level A & B Conditions**

| Component / Location | MUR SI Range (ksi) | Orig. SI Range (ksi) | MUR SI Limit (ksi) | Orig. SI Limit (ksi) | MUR FUF | Orig. FUF | FUF Limit |
|---|---|---|---|---|---|---|---|
| **2" Inspection Port** | | | | | | | |
| Shell/cover/flange | 77.6 | 65.8 | 80 | 80 | 0.214 | 0.205 | 1.0 |
| Stud | See Table EMCB R12-4 for Average and Maximum Bolt Stresses | | | | 0.864 | 0.807 | 1.0 |
| **Secondary Manway** | | | | | | | |
| Flange/Steam Drum Head | 55.2 | 46.8 | 80 | 80 | 0.02 | 0.019 | 1.0 |
| Diaphragm | 60.4 | 60.4 | 69.9 | 69.9 | 0.02 | 0.015 | 1.0 |
| Cover | 25.5 | 21.6 | 80 | 80 | 0.02 | 0.000 | 1.0 |
| Stud | See Table EMCB R12-4 for Average and Maximum Bolt Stresses | | | | 0.973 | 0.752 | 1.0 |
| **Pressure Boundary Attachments** | | | | | | | |
| Seal Skirt Transition Juncture | ***44.6**** | ***44.6**** | 56.1 | 56.1 | 0.538 | 0.476 | 1.0 |
| Skirt Weld | ***41.2**** | ***41.2**** | 56.1 | 56. 1 | 0.74 | 0.559 | 1.0 |
| Steam Drum Head/Steam Drum Juncture | 48.6 | 48.6 | 80.1 | 80.1 | 0.401 | 0.209 | 1.0 |
| Steam Drum / Trunion Juncture | ***64.8**** | 80 | 80.0 | 80.0 | 0.688 | 0.239 | 1.0 |
| Primary Deck Lug/Steam Drum Juncture | 72 | 61 | 80 | 80 | 0.608 | 0.546 | 1.0 |
| Shroud Lug | 40.6 | 34.4 | 58.5 | 58.5 | 0.652 | 0.545 | 1.0 |
| Shroud Lug/ Shell Juncture | 54.7 | 46.4 | 80 | 80.1 | 0.652 | 0.545 | 1.0 |
| Upper Vessel Support! Steam Drum Juncture | 70.6 | 59.8 | 80.1 | 80.1 | 0.021 | 0.010 | 1.0 |
| **Main Feedwater Nozzle** | | | | | | | |
| Shell/nozzle juncture | 77.6 | 77.6 | 80 | 80 | 0.408 | 0.346 | 1.0 |
| Nozzle | 69.3 | 58.7 | 80 | 80 | 0.046 | 0.039 | 1.0 |
| Transition Ring /Thermal Sleeve | ***27.2**** | ***27.2**** | 69.9 | 69.9 | 0.985 | 0.945 | 1.0 |

**NON-PROPRIETARY**

| Table EMCB R12-1 - Stress Intensity (SI) and Fatigue Usage Factors (FUF) for Level A & B Conditions | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Component / Location** | **MUR SI Range** (ksi) | **Orig. SI Range** (ksi) | **MUR SI Limit** (ksi) | **Orig. SI Limit** (ksi) | **MUR FUF** | **Orig. FUF** | **FUF Limit** |
| **Steam Outlet Nozzle** | | | | | | | |
| Nozzle/Safe End Juncture | 26.8 | 22.7 | 70 | 70 | 0 | 0 | 1.0 |
| Nozzle & Head Juncture | 69.5 | 58.9 | 80 | 80 | 0.050(2) | 0.035 | 1.0 |
| Steam Drum Head | 71.3 | 60.4 | 80 | 80 | 0.049 | 0.033 | 1.0 |
| Perforated Zone | 76.7 | 65 | 80 | 80 | 0.080 | 0.059 | 1.0 |
| **Small Nozzles** | | | | | | | |
| 3" Blowdown Nozzle | 12.02 | 10.19 | 26.7 | 26.7 | 0.85 | 0.928 | 1.0 |
| 3" Recirculation Nozzle | 17.70(3) | 15 | 26.7 | 26.7 | 0.99(3) | 0.938 | 1.0 |
| ¾" Nozzles | 13.96 | 11.83 | 26.7 | 26.7 | 0.81 | 0.734(1) | 1.0 |
| Acoustic Sensor Pad | 54.63 | 46.3 | 56 | 56 | 0.81 | 0.777 | 1.0 |
| **Tubes** | 76.27(4) | 73.8 | 79.8 | 79.8 | 0.19 | 0.19 | 1.0 |

Notes:

* ***Bold/Italicized*** stress range values were determined using simplified elastic-plastic analysis in accordance with NB-3228.5.

(1) Value changed from Table EMCB R12-1 in Reference A1-1. Revised due to transcription error from Reference A1-2. Revised value for Orig. FUF from 0.679.

(2) Value changed from Table EMCB R12-1 in Reference A1-1. Revised due to transcription error from Reference A1-2. Revised value for MUR FUF from 0.048.

(3) Value changed from Table EMCB R12-1 in Reference A1-1. Revised to accommodate increased external loads as reported in Reference A1-2. Revised values for MUR SI Range from 12.02 ksi and for MUR FUF from 0.5.

(4) Value changed from Table EMCB R12-1 in Reference A1-1. Reanalyzed to reflect MUR flow-induced vibration (FIV) analysis results Reference A1-3. Revised value for MUR SI Range from 73.8 ksi.

**NON-PROPRIETARY**

| Table EMCB R12-2 - Primary Membrane and Bending Stresses for Level C Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Component / Location** | **MUR Pm/PL SI** (ksi) | **Orig. Pm/PL SI** (ksi) | **MUR Pm SI Limit** (ksi) | **Orig. Pm SI Limit** (ksi) | **MUR PL/Pm+ Pb SI** (ksi) | **Orig. PL/Pm+ Pb SI** (ksi) | **MUR PL, Pm+Pb SI Limit** (ksi) | **Orig. PL, Pm+Pb SI Limit** (ksi) |
| **Primary Head /Tubesheet / Secondary Shell** | 29.6 | 29.2 | 38.79 | 38.79 | 49.9 | 49.2 | 64.65 | 64.65 |
| **Primary nozzle** | **Bounded by design conditions** | | | | | | | |
| **Primary Manway** | | | | | | | | |
| Cover | 13.33 | 13.33 | 38.8 | 38.8 | 24.39 | 24.39 | 58.2 | 58.2 |
| Shell/flange | 21.31 | 21.31 | 38.8 | 38.8 | 21.31 | 21.31 | 58.2 | 58.2 |
| **Primary Head Support Pad** | **Bounded by design conditions** | | | | | | | |
| **Primary Divider Plate** | **Bounded by design conditions** | | | | | | | |
| **Small Nozzles** | **Bounded by design conditions** | | | | | | | |
| **Steam Drum/Cone/Lower Shell Assembly** | **Bounded by design conditions** | | | | | | | |
| **8" Shell Cone Handhole** | 29.3 | 29.02 | 29.37 | 29.37 | 32.6 | 32.2 | 48.06 | 48.06 |
| **6" Feedring Handhole** | 29.3 | 29.02 | 29.37 | 29.37 | 35.0[(1)] | 34.6 | 48.06 | 48.06 |
| **2" Inspection Port** | 10.6 | 10.5 | 28 | 28 | 20.7 | 20.5 | 42 | 42 |
| **Secondary Manway** | **Bounded by design conditions** | | | | | | | |

**NON-PROPRIETARY**

| Table EMCB R12-2 - Primary Membrane and Bending Stresses for Level C Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Component / Location** | **MUR Pm/PL SI** (ksi) | **Orig. Pm/PL SI** (ksi) | **MUR Pm SI Limit** (ksi) | **Orig. Pm SI Limit** (ksi) | **MUR PL/Pm+ Pb SI** (ksi) | **Orig. PL/Pm+ Pb SI** (ksi) | **MUR PL, Pm+Pb SI Limit** (ksi) | **Orig. PL, Pm+Pb SI Limit** (ksi) |
| **Pressure Boundary Attachments** | | | | | | | | |
| Seal Skirt Transition Juncture | **Bounded by design conditions** | | | | | | | |
| Skirt Weld | **Bounded by design conditions** | | | | | | | |
| Steam Drum Head / Steam Drum Juncture | **Bounded by design conditions** | | | | | | | |
| Steam Drum / Trunion Juncture | 28.8 | 28.5 | 39.4 | 39.4 | 36 | 35.6 | 65.7 | 65.7 |
| Primary Deck Lug/Steam Drum Juncture | 29.8 | 29.8 | 43.8 | 43.8 | 65.2 | 65.2 | 65.7 | 65.7 |
| Shroud Lug | 2.32 | 2.3 | 26.37 | 26.37 | 5.8 | 5.73 | 43.95 | 43.95 |
| Shroud Lug/Shell Juncture | 24.9 | 24.63 | 36.9 | 36.9 | 26.9 | 26.61 | 65.7 | 65.7 |
| Upper Vessel Support/ Steam Drum Juncture | **Bounded by design conditions** | | | | | | | |
| **Main Feedwater Nozzle** | | | | | | | | |
| Shell/nozzle juncture | 29 | 28.7 | 43.8 | 43.8 | 46.6 | 46.1 | 65.7 | 65.7 |
| Nozzle | 28.6 | 28.3 | 43.8 | 43.8 | 28.6 | 28.3 | 65.7 | 65.7 |
| Transition ring / Thermal sleeve | 9.5 | 9.4 | 28 | 28 | 26.1 | 25.8 | 41.9 | 41.9 |
| **Steam Outlet Nozzle** | **Bounded by design conditions** | | | | | | | |
| **Small Nozzles** | **Bounded by design conditions** | | | | | | | |
| **Tubes** | 22.95 | 22.7 | 35.2 | 35.2 | 32.35 | 32 | 52.9 | 52.9 |
| **Tubes (external pressure)** | 0.168 | 0.166 | 1.424 | 1.424 | -- | -- | -- | -- |

Notes:

(1) Value changed from Table EMCB R12-2 in Reference A1-1. Revised due to transcription error from Reference A1-3. Revised value for MUR PL/Pm+ Pb SI from 34.6 ksi.

**NON-PROPRIETARY**

| Table EMCB R12-3 - Primary: Membrane and Bending Stresses for Level D Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Component / Location** | **MUR Pm/PL SI** (ksi) | **Orig. Pm/PL SI** (ksi) | **MUR Pm SI Limit** (ksi) | **Orig. Pm SI Limit** (ksi) | **MUR PL/Pm+ Pb SI** (ksi) | **Orig. PL/Pm+ Pb SI** (ksi) | **MUR PL, Pm+Pb SI Limit** (ksi) | **Orig. PL, Pm+Pb SI Limit** (ksi) |
| **Primary Head / Tubesheet / Secondary shell** | 29.6 | 29.1 | 56 | 56 | 68.7 | 67.8 | 84 | 84 |
| **Primary Nozzle** | | | | | | | | |
| Primary nozzle | 51.51 | 51.51 | 56 | 56 | 76.27 | 76.27 | 84 | 84 |
| Primary nozzle safe end | 27.7 | 27.7 | 48.9 | 48.9 | 39.93 | 39.93 | 72.36 | 72.36 |
| **Primary Manway** | | | | | | | | |
| Cover | 13.33 | 13.33 | 56 | 56 | 24.39 | 24.39 | 84 | 84 |
| Shell/flange | 21.31 | 21.31 | 56 | 56 | 21.31 | 21.31 | 84 | 84 |
| **Primary Head Support Pad** | 15.9 | 15.9 | 56 | 56 | 53.9 | 53.9 | 84 | 84 |
| **Primary Divider Plate** | 35.4[(1)] | 35.4 | 52.5 | 52.5 | 60.4[(1)] | 60.4 | 67.5 | 67.5 |
| **Small Nozzles** | | | | | | | | |
| ¾" Nozzles | 16.9 | 16.7 | 42.8 | 42.8 | 38 | 37.5 | 64 | 64 |
| **Steam Drum/Cone/Lower Shell Assembly** | 46.2 | 35.6 | 56 | 56 | 61.5 | 60.7 | 84 | 84 |
| **8" Shell Cone Handhole** | 40.9 | 40.4 | 56 | 56 | 40.9 | 40.4 | 84 | 84 |
| **6" Feedring Handhole** | 35.3 | 34.8 | 56 | 56 | 35.3 | 34.8 | 84 | 84 |
| **2" Inspection Port** | 55.1 | 54.4 | 56 | 56 | 60.9 | 60.1 | 84 | 84 |
| **Secondary Manway** | 47.7 | 47.1 | 56 | 56 | 47.7 | 47.1 | 84 | 84 |

**NON-PROPRIETARY**

| Table EMCB R12-3 - Primary: Membrane and Bending Stresses for Level D Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Component / Location** | **MUR Pm/PL SI** (ksi) | **Orig. Pm/PL SI** (ksi) | **MUR Pm SI Limit** (ksi) | **Orig. Pm SI Limit** (ksi) | **MUR PL/Pm+ Pb SI** (ksi) | **Orig. PL/Pm+ Pb SI** (ksi) | **MUR PL, Pm+Pb SI Limit** (ksi) | **Orig. PL, Pm+Pb SI Limit** (ksi) |
| **Pressure Boundary Attachments** | | | | | | | | |
| Seal Skirt Transition Juncture | 8.81 | 8.7 | 49 | 49 | 26.8 | 26.5 | 73.5 | 73.5 |
| Steam Drum Head/Steam Drum Juncture | 35.35 | 34.9 | 56 | 56 | 46.1 | 45.5 | 84 | 84 |
| Steam Drum / Trunnion Juncture | 35.8 | 35.3 | 56 | 56 | 42.7 | 42.2 | 84 | 84 |
| Primary Deck Lug/Steam Drum Juncture | 40.1 | 40.1 | 56 | 56 | 74 | 74 | 84 | 84 |
| Shroud Lug | 39 | 38.5 | 49 | 49 | 43.4 | 42.9 | 73.5 | 73.5 |
| Shroud Lug/ Shell Juncture | 33.5 | 33.1 | 56 | 56 | 39.5 | 39.1 | 84 | 84 |
| Upper Vessel Support / Steam Drum Juncture | 28 | 27.6 | 56 | 56 | 63.9 | 63.1 | 84 | 84 |
| **Main Feedwater Nozzle** | | | | | | | | |
| Shell/nozzle juncture | 33.9 | 33.5 | 56 | 56 | 83.8 | 83.3 | 84 | 84 |
| Nozzle | 7.9 | 7.8 | 56 | 56 | 29.5 | 29.1 | 84 | 84 |
| Transition ring/Thermal sleeve | 12.9 | 12.7 | 49 | 49 | 53 | 52.3 | 73.5 | 73.5 |
| **Steam Outlet Nozzle** | | | | | | | | |
| Pipe extension | 16.68 | 16.47 | 42 | 42 | 43.38 | 42.82 | 63 | 63 |
| Nozzle/Safe End Juncture | 14.99 | 14.8 | 49 | 49 | 40.84 | 40.32 | 73.5 | 73.5 |
| Nozzle | 25.43 | 25.1 | 56 | 56 | 54.82 | 54.12 | 84 | 84 |
| Steam Drum Head | 26.34 | 26 | 56 | 56 | 55.84 | 55.12 | 84 | 84 |
| Perforated Zone | 32.62 | 32.2 | 56 | 56 | 61 | 60.22 | 84 | 84 |
| **Small Nozzles** | | | | | | | | |
| 3" Blowdown Nozzle | 31.0[(2)] | 30.6 | 42.8 | 42.8 | 62.0[(2)] | 61.2 | 64 | 64 |
| 3" Recirculation Nozzle | 31.0[(2)] | 30.6 | 42.8 | 42.8 | 62.0[(2)] | 61.2 | 64 | 64 |
| Acoustic Sensor Pad | **Bounded by shell cone/steam drum juncture** | | | | | | | |

**NON-PROPRIETARY**

| Table EMCB R12-3 - Primary: Membrane and Bending Stresses for Level D Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Component / Location** | **MUR Pm/PL SI** (ksi) | **Orig. Pm/PL SI** (ksi) | **MUR Pm SI Limit** (ksi) | **Orig. Pm SI Limit** (ksi) | **MUR PL/Pm+ Pb SI** (ksi) | **Orig. PL/Pm+ Pb SI** (ksi) | **MUR PL, Pm+Pb SI Limit** (ksi) | **Orig. PL, Pm+Pb SI Limit** (ksi) |
| **Tubes** | 31.4 | 31 | 56 | 56 | 68.68 | 67.8 | 84 | 84 |
| **Tubes (external pressure)** | 1.142 | 1.127 | 1.780 | 1.780 | -- | -- | -- | -- |

Notes:

* Value changed from Table EMCB R12-3 in Reference A1-1.

(1) Conservatism in previous analysis in Reference A1-3 removed since level D loads on divider plate are unchanged between MUR and Original power levels. Revised values for MUR Pm/PL SI from 35.9 ksi and for MUR PL/Pm+Pb SI from 61.2 ksi.

(2) Revised to accommodate increased external loads as reported in Reference A1-2. Revised values for MUR Pm/PL SI from 21.1 ksi and for MUR PL/Pm+Pb SI from 42.1 ksi.

**NON-PROPRIETARY**

## References

A1-1 Letter from Kevin F. Borton (Exelon Generation Company, LLC) to U. S. NRC, "Additional Information Supporting Request for License Amendment Regarding Measurement Uncertainty Recapture Power Uprate," dated February 20, 2012

A1-2 B&W Canada Report: Exelon Byron and Braidwood Stations RSG Transient Analysis Report No: 222-7720-SR-2, Rev. 6.

A1-3 B&W Canada Report: Exelon Byron and Braidwood Stations Unit 1 RSG MUR Power Uprate Structural Analysis Report No: 236R-SR-01, Rev. 1.