Enclosure 1

MFN 16-001, Revision 1, Supplement 1

GEH Response to NRC's Request for Supplemental Information on ABWR COPS Redesign

IMPORTANT NOTICE REGARDING CONTENTS OF THIS DOCUMENT
Please Read Carefully

(Below, for convenience, is GEH's response to the NRC's first request for Supplemental Information provided in MFN 16-001, Revision 1)

NRC Request for Supplemental Information:

In a public teleconference with the NRC on February 5, 2016, the Staff's PRA team requested that:

1) *GEH provide a listing of analyses which were reviewed for the Containment Overpressure Protection System (COPS) change in the sizes of the COPS discharge pipe and rupture disk.*
2) *The Staff's PRA team requested clarification on the Modular Accident Analysis Program (MAAP) inputs for the COPS pipe loss.*
3) *The NRC's PRA Staff also noted there were some legacy typographical errors in a few formulas in ABWR DCD subsection 19E.2.3.5.1.*

GEH Response to Supplemental Information Request:

1) *GEH provide a listing of analyses which were reviewed for the Containment Overpressure Protection System (COPS) change in the sizes of the COPS discharge pipe and rupture disk.*

   The following ABWR DCD analyses were reviewed and confirmed they were not impacted by the proposed change:

   - Debris Entrainment and Direct Containment Heating 19E.2.1.5.3.1
   - Core Concrete Interaction and Debris Coolability 19E.2.1.5.3.2
   - Steam Explosions 19E.2.3.1 and 19E.2.3.1.4
   - Pool Bypass 19E.2.3.3.3(4)
   - Suppression Pool Bypass 19E.2.3.3 and 19E.2.7.3
   - Critical Time Constant for Blowdown Response 19E.2.3.5.2
   - Residual Heat Removal (RHR) Heat Exchanger Failure Due to Seismic Event 19E.2.4.5
   - In-vessel Core Melt Scenarios 19E2.6.1
   - Fission Product Release from Core 19E2.6.2
   - Ex-vessel Core Melt Scenarios 19E2.6.6
   - Fission Product Release Flow Area 19E.2.6.10
   - Debris Coolability 19E.2.7.2
   - Fission Product Release Location 19E.2.8.1.1
   - Accident Sequences Table 19E.2-3
   - Loss of all Core Cooling with Vessel Failure at Low Pressure (LCLP) 19E2.2.1

- Loss of all Core Cooling with Vessel Failure at High Pressure (LCHP) 19E2.2.2
- Station Blackout with Reactor Core Isolation Cooling (RCIC) Available (SBRC) 19E.2.2.3
- Loss of Containment Heat Removal (LHRC) 19E.2.2.4
- Large LOCA with Failure of All Core Cooling (LBLC) 19E.2.2.5
- Concurrent Loss of All Core Cooling and ATWS with Vessel Failure at Low Pressure (NSCL)
- Concurrent station blackout with ATWS (NSRC)
- Consequence Analysis 19E.3

As a result of this review, the following analyses were determined to be impacted by the change in the sizes of the COPS discharge pipe and rupture disk:

- Impact of Suppression Pool Flashing 19E.2.3.5
- Response to Suppression Pool Surface Decompression Wave 19E2.5.1
- Containment Overpressure Protection System 19E2.8.1

The markups to the affected sections of the ABWR DCD Revision 5 are attached.

2) *The Staff's PRA team requested clarification on the MAAP inputs for the COPS pipe loss.*

For the ABWR DCD the following reference was used: "*MAAP-3.0B – Modular Accident Analysis Program for LWR Power Plants*" (EPRI NP-7071-CCML, Nov 1990). The reference document is EPRI proprietary and is available at GEH for the NRC to audit, upon request. In this program there is a function, "KRESIS" which computes the flow path resistance based on first engineering principals (differential pressure [inlet to outlet], specific volume and flow).

This process of determining pipe loss was used in the ABWR DCD COPS evaluations since there were no piping isometric drawings available to determine an as-built pipe loss. The maximum mass rate flow (35 kg/s) was based on the calculated steam flow at an effective area of the 8-inch rupture disk with an opening pressure of 0.72 MPaA. The minimum acceptable COPS flow rate is 28 kg/s. These two flow rates were then used in the above formula to determine the pipe loss for the various COPS associated evaluations.

3) *The NRC's PRA staff also noted there were some legacy typographical errors in a few of the formulas in ABWR DCD subsection 19E.2.3.5.1.*

GEH has entered this issue into our GEH Corrective Action Program. The design record file with the original calculation has been reviewed. The results in the COPS analysis in ABWR DCD Revision 5 was determined to be correct and it was

determined the formulas in the DCD contained typographical errors. The formulas have been corrected in the attached ABWR DCD Revision 5 markups

Impact on DCD of COPS Redesign

The following ABWR DCD Revision 5 subsections, tables, and figures are revised as shown in the markups provided in Enclosure 2 (*of MFN 16-001, Revision 1, February 19, 2016*) as a result of the COPS redesign:

- Table 6.2-7
- Table 19.8-7
- Section 19E.2.3.5.1.1 through Section 19E.2.3.5.1.6
- Section 19E.2.3.5.2
- Section 19E.2.6.10
- Section 19E.2.8.1
- Section 19E.2.8.1.3
- Figure 19E.2-25
- Figure 6.2-39

NRC Request for Supplemental Information #2:

In a phone call with the NRC on February 5, 2016, the Staff's PRA team requested that GEH provide a listing of analyses that were reviewed for the Containment Overpressure Protection System (COPS) change in the sizes of the COPS discharge pipe and rupture disk.

GEH Response to Supplemental Information Request #2:

The following ABWR DCD analyses were reviewed to confirm that they were not impacted by the proposed change. The analyses will be grouped by justification.

Group 1

Since the rupture disk setpoint (0.72 MPa) and minimum COPS flow rate (28 kg/s) are unchanged, the following evaluations are not impacted by the two ABWR DCD Revision 6 COPS changes (sizes of the rupture disk and discharge pipe diameter).

- SRV Operability 19E.2.1.2.2.2 (b)
- Accident sequences Table 19E.2-3 – see below
    - Loss of all Core Cooling with Vessel Failure at Low Pressure (LCLP) 19E.2.2.1
    - Loss of all Core Cooling with Vessel Failure at High Pressure (LCHP) 19E.2.2.2
    - Station Blackout with RCIC available (SBRC) 19E.2.2.3
    - Loss of Containment Heat Removal (LHRC) 19E.2.2.4
    - Large LOCA with Failure of All Core Cooling (LBLC) 19E.2.2.5
    - Concurrent Loss of All Core Cooling and ATWS with Vessel Failure at Low Pressure (NSCL) 19E.2.2.6
    - Concurrent Station Blackout with ATWS (NSRC) 19E.2.2.8
- Suppression Pool Bypass 19E.2.3.3, 19E.2.6.11, 19E.2.7.3, 19E.2.8.1.5, 19EE
- Pool Swell 19E.2.3.5.3
- Time of Firewater System Initiation 19E.2.4.1
- In-Vessel Recovery 19E.2.4.2
- System Recovery After Vessel Failure and Normal Containment Leakage 19E.2.4.3
- Core Melt Progression and Hydrogen Generation 19E.2.6.1
- Fission Product Release From Core 19E.2.6.2
- Implications of Recriticality 19E.2.6.5
- Fission Product Release Flow Area 19E.2.6.10
- Suppression Pool Decontamination Factor, 19E.2.6.13
- Debris Coolability 19E.2.7.2/19EC
- Comparison of ABWR Performance With and Without COPS 19E.2.8.1.4
- Potential Impact of Hydrogen Burning and Detonation 19E.2.8.1.6
  Consequence Analysis 19E.3

Group 2

The COPS setpoint is unchanged from previous analyses:

- Pressure Setpoint Determination 19E.2.8.1.1
- Variability in Rupture Disk Setpoint 19E.2.8.1.2
- Fission Product Release Location 19E.2.6.9
- Recriticality During In-Vessel Recovery 19E.2.6.5

Group 3

COPS is not part of the analyses:

- Configuration Basis (excluding SRVs) 19E.2.1.2
- Accident Sequences Table 19E.2-3 – see below
    - Concurrent Loss of All Core Cooling and ATWS with Vessel Failure at High Pressure (NSCH) 19E.2.2.7
- Steam Explosions 19E.2.3.1
- 100% Metal-Water Reaction 19E.2.3.2
- Evaluation of Ex-Containment LOCA Core Damage Frequency 19E.2.3.3.4
- RHR Heat Exchanger Failure due to Seismic Event 19E.2.3.4
- Behavior of Access Tunnels 19E.2.3.6
- Early Drywell Head Failure 19E.2.4.4
- Suppression Pool Drain 19E.2.4.5
- CsI Revaporization 19E.2.6.3
- Time of Vessel Failure 19E.2.6.4
- Direct Containment Heating 19E.2.6.6/ 19E.2.7.1/19EA
- Fuel Coolant Interactions 19E.2.6.7/19EB
- Core Concrete Interactions and Debris Coolability 19E.2.6.8
- High Temperature Failure of Drywell 19E.2.6.12
- Suppression Pool pH Control 19E.2.6.14
- Lower Drywell Flooder 19E.2.8.2
- Corium Shield 19E2.8.3/19ED

Group 4

Current DCD analyses are conservative:

- Critical Time Constant for Blowdown Response 19E.2.3.5.2 – The original analysis assumed a maximum of 35 kg/s would flow through the effective cross sectional area of the rupture disk. Since the ABWR DCD Revision 6 COPS flow rate is slightly less (33.7 kg/s), the conclusion of the evaluation provided in the last sentence of the section is still true.
- Sizing of the Rupture Disk (ATWS analysis) 19E.2.8.1.3 – Following failure of containment heat removal the existing flow rate is sufficient to limit the containment pressure below service level C.

- Fission Product Release Flow Area 19E.2.6.10
- Sizing of the Rupture Disk 19E2.8.1.3
    - ABWR DCD Revision 6 COPS capability is still twice the required steam flow when COPS operation is required. The capability is 2.3% rated power and less than 1% decay heat will be present at the time COPS operation occurs.

  Therefore, there is no impact on the Fission Product Release Flow Area analysis and the Sizing of the Rupture Disk analysis due to the two ABWR DCD Revision 6 COPS changes (sizes of the rupture disk and discharge pipe diameter).

As a result of this review, the following analyses were determined to be impacted by the change in the sizes of the COPS discharge pipe and rupture disk:

- Impact of Flashing During Venting 19E.2.3.5
- Fission Product Release Flow Rate (DCD text only) 19E.2.6.10
- Containment Overpressure Protection System 19E.2.8.1 (excluding 19E.2.8.1.1 and 19E.2.8.1.2)
- Limiting Configuration for COPS Blowdown Study Figure 19E.2-25

Impact on DCD

There is no impact on the ABWR DCD Revision 6 as a result of GEH's response to NRC's Supplemental Information Request #2.