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MFN 08-607

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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 105 - Related to ESBWR Design Certification Application – RAI Number 21.6-92 Supplement 1**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by the Reference 1 NRC letter. GEH response to RAI Number 21.6-92 Supplement 1 is addressed in Enclosures 1 and 2.

If you have any questions or require additional information, please contact me.

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN 07-460, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 105 Related to the ESBWR Design Certification Application*, dated August 16, 2007.

Enclosure:

1. MFN 08-607 – Response to Portion of NRC Request for Additional Information Letter No. 105 - Related to ESBWR Design Certification Application – RAI Number 21.6-92 S01
2. MFN 08-607 – Response to Portion of NRC Request for Additional Information Letter No. 105 - Related to ESBWR Design Certification Application – RAI Number 21.6-92 S01 – DCD Page Markup

cc: AE Cubbage USNRC (with enclosure)
RE Brown GEH/Wilmington (with enclosure)
DH Hinds GEH/Wilmington (with enclosure)
eDRF 0000-0087-1141

Enclosure 1

MFN 08-607

Response to Portion of NRC Request for

Additional Information Letter No. 105

Related to ESBWR Design Certification Application

RAI Number 21.6-92 S01

NRC RAI 21.6-92 S01

Provide specific codes used to perform analyses in the DCD.

GEH's response to RAI 21.6-92 did not provide enough detail regarding the codes used in Chapters 4, 6, and 15. In the original RAI, staff specifically requested the "exact version, revision. and modification designations."

The purpose of this RAI is to have a docketed record for of the codes for each analysis performed In Chapters 4, 6, and 15. At the time of a COL application, staff will use this record as benchmark to compare the revised/changed versions in order to ensure any code changes have not adversely impacted the efficacy of the codes. It is not staff's intention to freeze all code changes. Staff understands the codes will most likely be modified throughout the licensing of the DCD. Therefore, staff may request this information for each future revision of the DCD and especially the final revision of the DCD to be Incorporated by referenced Into 10 CFR Part 52.

Provide as a RAI response a table similar to Table 15.0-8 that includes greater detail regarding the codes used In Chapters 4, 6, and 15. This table should specify the code version, platform, and error revision number or program library version number for each code. It should also list all upstream code Inputs, for example, the TRACG calculations accept input from PANACEA and GSTRM in the form of the wrap-up file or gap conductance input. Please specify the exact PANACEA, GSTRM, or other codes used for similar purposes. PANACEA in turn, receives upstream code input from TGBLA, provide these details for TGBLA as well. Specify the DCD revision number that this table describes.

GEH Response

Table 21.6-92-1 provides the codes used in each safety analysis shown in Chapters 4, 6 and 15 of DCD Tier 2 Revision 5. Each category of safety analysis has been broken down in more detail relative to DCD Tier 2 Table 15.0-8 due to the potential that different code modifications are used in different analyses. Table 21.6-92-2 provides the code details based on the abbreviated code version/modification description provided in Table 21.6-92-1. The table lists a code only if there are results presented in the DCD and the results are specific to the ESBWR. The table does not list codes related to stress, dynamic and seismic analyses of structural, mechanical and piping components. For GEH/GNF codes, the GEH/GNF QA level, the hardware platform / operating system and executable revision date is given.

References

21.6-92-1 GE Hitachi Nuclear Energy Letter # MFN 08-350 dated April 14, 2008, to USNRC, "Response to Portion of NRC Request for Additional Information Letters No. 115 and No. 137- Related to ESBWR Design Certification Application - RAI Numbers 4.6-23 Supplement 2 and 4.6-38, Respectively."

Table 21.6-92-1 ESBWR DCD Safety Analysis Code Versions[1]		
Safety Analysis	**Primary Analysis Code**	**DCD Rev. 5 Code Information**
Stability Evaluation (DCD Appendix 4D)		
Baseline Decay Ratio Analysis- BOC	TRACG04	T4N2,P11-5,TG6-4,G8-1
Baseline Decay Ratio Analysis - MOC	TRACG04	T4PN53,P11-9,TG6-4,G8-1
Baseline Decay Ratio Analysis - EOC	TRACG04	T4N2,P11-5,TG6-4,G8-1
AOO Decay Ratio Analysis	TRACG04	T4PN53,P11-9,TG6-4,G8-1
Startup Stability Constant Power Analysis	TRACG04	T4N2,G8-1
Startup Stability 3-D Kinetics Analysis	TRACG04	T4N3,P11-5,TG6-4,G8-1
LOCA Containment Pressurization Analysis (DCD Section 6.2)		
Feedwater Line Break – Nominal Analysis	TRACG04	T4PN5704A,G8-1
Main Steam Line Break – Nominal Analysis	TRACG04	T4PN5704,G8-1
GDCS Line Break – Nominal Analysis	TRACG04	T4PN5704A,G8-1
Bottom Drain Line Break – Nominal Analysis	TRACG04	T4PN5704,G8-1
Feedwater Line Break – Bounding Analysis	TRACG04	T4PN5704,G8-1
Main Steam Line Break – Bounding Analysis (0-72 hrs)	TRACG04	T4PN5704,G8-1
Main Steam Line Break – Bounding Analysis: (72 – 168 hrs, 6 PCCS Vent Fans with PARS)	TRACG04	T4PN5704,G8-1
Main Steam Line Break – Bounding Analysis: (72 – 168 hrs, 4 PCCS Vent Fans with PARS)	TRACG04	T4PN5704A,G8-1
Main Steam Line Break – Bounding Analysis: (72 – 168 hrs, 6 PCCS Vent Fans without PARS)	TRACG04	T4PN5704A,G8-1
Main Steam Line Break – Bounding Analysis: (168+ hrs)	TRACG04	T4PN5704A,G8-1
Reactor Building Compartment Pressurization Analysis (DCD Subsection 6.2.3)		
All Analyses	CONTAIN	CT2.0,RL5M3.3
LOCA ECCS Analysis (DCD Section 6.3)		
Feedwater Line Break – Nominal Analysis	TRACG04	T4PN5704, G8-1
Main Steam Line Break – Nominal Analysis	TRACG04	T4PN5704A, G8-1
Main Steam Line Break – Nominal Analysis (One SRV Failure)	TRACG04	T4PN5704, G8-1

Table 21.6-92-1 ESBWR DCD Safety Analysis Code Versions[1]		
Safety Analysis	**Primary Analysis Code**	**DCD Rev. 5 Code Information**
Bottom Drain Line Break – Nominal Analysis	TRACG04	T4PN5704, G8-1
GDCS Line Break – Nominal Analysis	TRACG04	T4PN5704, G8-1
IC Drain Line Break – Bounding Analysis	TRACG04	T4PN5704A, G8-1
LOCA Analysis (DCD Chapter 6 Appendices)		
Appendix 6B – Figures 6B-5 through 6B-18 – Case MSLB-CB5	TRACG04	T4N1A, G8-1
Appendix 6B – Figures 6B-5 through 6B-18 – Case MSLB-NL2_V40	TRACG04	T4N1B, G8-1
Appendix 6B – Figures 6B-5 through 6B-18 – Case MSLB-CB6	TRACG04	T4N1A, G8-1
Appendix 6B – Figures 6B-19 through 6B-24	TRACG04	T4PN53, G8-1
Appendix 6C	TRACG04	T4PN53, G8-1
Appendix 6E	TRACG04	T4PN53, G8-1
Appendix 6F	TRACG04	T4PN53, G8-1
Appendix 6G	TRACG04	T4-1, G8-1
Appendix 6H	TRACG04	T4PN53, G8-1
Appendix 6I	TRACG04	T4PN5704A,G8-1
Anticipated Operational Occurrence Analysis (DCD Section 15.2)		
Loss of Feedwater Heating	TRACG04	T4PN53, P11-5, TG6-4, G8-1
Closure of One Turbine Control Valve	TRACG04	T4-1, P11-5, TG6-4, G8-1
Generator Load Rejection with Turbine Bypass	TRACG04	T4-1, P11-5, TG6-4 ,G8-1
Generator Load Rejection with a Single Failure in the Turbine Bypass System	TRACG04	T4-1, P11-5, TG6-4, G8-1
Turbine Trip with Turbine Bypass	TRACG04	T4-1, P11-5, TG6-4, G8-1
Turbine Trip with a Single Failure in the Turbine Bypass System	TRACG04	T4-1, P11-5, TG6-4, G8-1
Closure of One Main Steamline Isolation Valve	TRACG04	T4-1, P11-5, TG6-4, G8-1
Closure of All Main Steamline Isolation Valves	TRACG04	T4-1, P11-5, TG6-4, G8-1
Loss of Condenser Vacuum	TRACG04	T4-1, P11-5, TG6-4, G8-1
Loss of Shutdown Cooling Function of RWCU/SDC	N/A	N/A
Inadvertent Isolation Condenser Initiation	TRACG04	T4PN53, P11-5, TG6-4, G8-1
Runout of One Feedwater Pump	TRACG04	T4-1, P11-5, TG6-4, G8-1

Table 21.6-92-1 ESBWR DCD Safety Analysis Code Versions[1]		
Safety Analysis	**Primary Analysis Code**	**DCD Rev. 5 Code Information**
Opening of One Turbine Control or Bypass Valve	TRACG04	T4-1, P11-5, TG6-4, G8-1
Loss of Non-Emergency AC Power to Station Auxiliaries	TRACG04	T4-1, P11-5, TG6-4, G8-1
Loss of All Feedwater Flow	TRACG04	T4-1, P11-5,TG6-4,G8-1
Infrequent Event Analysis (DCD Section 15.3)		
Loss of Feedwater Heating With Failure of Selected Control Rod Run-In	TRACG04	T4-1, P11-5,TG6-4,G8-1
1000 Fuel rod Failure Radiological Consequences Analysis	RADTRAD	RT3.03
Feedwater Controller Failure – Maximum Demand	TRACG04	T4-1, P11-5, TG6-4, G8-1
Pressure Regulator Failure - Opening of All Turbine Control and Bypass Valves	TRACG04	T4-1, P11-5, TG6-4, G8-1
Pressure Regulator Failure – Closure of All Turbine Control and Bypass Valves	TRACG04	T4-1, P11-5, TG6-4, G8-1
Generator Load Rejection with Total Turbine Bypass Failure	TRACG04	T4-1, P11-5, TG6-4, G8-1
Turbine Trip with Total Turbine Bypass Failure	TRACG04	T4-1, P11-5, TG6-4, G8-1
Control Rod Withdrawal Error During Refueling	N/A	N/A
Control Rod Withdrawal Error During Startup	PANAC11	P11-9/TG6-5
Control Rod Withdrawal Error During Power Operation	N/A	N/A
Fuel Assembly Loading Error, Mislocated Bundle	N/A	N/A
Fuel Assembly Loading Error, Misoriented Bundle	N/A	N/A
Inadvertent SDC Function Operation	N/A	N/A
Inadvertent Opening of a Safety/Relief Valve	TRACG04	T4-1, P11-5, TG6-4, G8-1
Inadvertent Opening of a Depressurization Valve	N/A	N/A
Stuck Open Safety/Relief Valve	TRACG04	T4-1, P11-5, TG6-4, G8-1
Liquid-Containing Tank Failure	RADTRAD	RT3.03
Accident Analysis (DCD Section 15.4)		
Fuel Handling Accident	RADTRAD	RT3.03
LOCA Inside Containment – Radiological	RADTRAD	RT3.03, MC1.8.6
Main Steamline Break Outside Containment	RADTRAD	RT3.03
Control Rod Drop Accident[2]	TRACG04 / PANAC11	P11-9

Table 21.6-92-1 ESBWR DCD Safety Analysis Code Versions[1]		
Safety Analysis	**Primary Analysis Code**	**DCD Rev. 5 Code Information**
Feedwater Line Break Outside Containment	RADTRAD	RT3.03
Failure of Small Line Carrying Primary Coolant Outside Containment	RADTRAD	RT3.03
RWCU/SDC System Line Failure Outside Containment	RADTRAD	RT3.03
Spent Fuel Cask Drop Accident	N/A	N/A
Special Event Analysis (DCD Section 15.5)		
MSIV Closure With Flux Scram (Overpressure Protection)	TRACG04	T4-1, P11-5, TG6-4, G8-1
Shutdown Without Control Rods (i.e., SLC system shutdown capability)	PANAC11	P11-7
Shutdown from Outside Main Control Room	N/A	N/A
ATWS – MSIV Closure with ARI	TRACG04	T4PN53, P11-5, TG6-4, G8-1
ATWS – MSIV Closure with FMCRD Run-In	TRACG04	T4PN53, P11-5, TG6-4, G8-1
ATWS – MSIV Closure – SLC System Bounding Case	TRACG04	T4PN53, P11-5, TG6-4, G8-1
ATWS – Loss of Condenser Vacuum SLC System Bounding Case	TRACG04	T4PN53, P11-5, TG6-4, G8-1
ATWS – Loss of Feedwater Heating with Boron Injection	TRACG04	T4PN53, P11-5, TG6-4, G8-1
ATWS – Loss of Normal AC Power to Station Auxiliaries with Boron Injection	TRACG04	T4PN53, P11-5, TG6-4, G8-1
ATWS – Loss of Feedwater Flow with Boron Injection	TRACG04	T4PN53, P11-5, TG6-4, G8-1
ATWS – Load Rejection with a Single Failure in the Turbine Bypass System with Boron Injection	TRACG04	T4PN53, P11-5, TG6-4, G8-1
ATWS – Core Stability	TRACG04	T4PN53, P11-5, TG6-4, G8-1
Station Blackout	TRACG04	T4-1, P11-5, TG6-4, G8-1
Safe Shutdown Fire	N/A	N/A
Waste Gas System Leak or Failure	N/A	N/A
Notes:		
1. See Table 21.6-92-2 for details of code version.		
2. No results are presented in the DCD for control rod drop accident; however, the acceptability of the results is discussed. As discussed in the response to RAI 4.6-23 S02 (Reference 21.6-92-1) TRACG04 calculations were not required for the ESBWR equilibrium or initial core evaluation.		

Table 21.6-92-2 ESBWR DCD Safety Analysis Code Version Details				
Version ID	**Code Version**	**QA Level**	**Hardware Platform / Operating System**	**Executable Revision Date or Code Modification**
T4N1A	TRACG04A	Non-Level 2	Alpha / Open VMS	2004-04-09 19:50:30.22
T4N1B	TRACG04A	Non-Level 2	Alpha / Open VMS	2004-04-09 21:26:48.54
T4N2	TRACG04A	Non-Level 2	Alpha / Open VMS	2004-08-24 15:00:24.63
T4N3	TRACG04A	Non-Level 2	Alpha / Open VMS	2005-02-18 17:56:20.93
T4-1	TRACG04A	Level 2	Alpha / Open VMS	2005-06-27 17:12:40.20
T4PN53	TRACG04A	Non-Level 2	PC / Windows	2005-09-29
T4PN5704	TRACG04A	Non-Level 2	PC / Windows	2008-04-16 16:45:34.03
T4PN5704A	TRACG04A	Non-Level 2	PC / Windows	2008-05-21 08:47:09.02
G8-1	GESTR08V	Level 2	VAX / Open VMS	02/1994
P11-5	PANAC11A	Level 2	Alpha / Open VMS	10/14/2002
P11-7	PANAC11A	Level 2	Alpha / Open VMS	09/12/2005
P11-9	PANAC11A	Level 2	Alpha / Open VMS	06/14/2007
TG6-4	TGBLA06A	Level 2	Alpha / Open VMS	10/30/2003
TG6-5	TGBLA06A	Level 2	Alpha / Open VMS	01/18/2007
RT3.03	RADTRAD 3.03	Non-Level 2	PC / Windows	04/15/2001
MC1.8.6	MELCOR 1.8.6	Supplier QA Program	*	YN**
CT2.0	CONTAIN 2.0	Supplier QA Program	PC / Windows	Revision 0
RL5M3.3	RELAP5	Supplier QA Program	PC / Windows	Mod3.3

* Information is unavailable. GEH can provide information at a later date, if requested.

** MELCOR modification used is "YN". This is different than the modification listed in DCD Tier 2, Revision 5, Table 15.0-8, Note 3 "YK". GEH will delete the modification in Revision 6 of the DCD to be consistent with the level of detail of other codes provided in the Table.

DCD Impact

DCD Tier 2 Table 15.0-8, Note 3 will be revised as noted in the markup in enclosure 2.

Enclosure 2

MFN 08-607

Response to Portion of NRC Request for

Additional Information Letter No. 105

Related to ESBWR Design Certification Application

RAI Number 21.6-92 S01

DCD Page Markup

Table 15.0-8

ESBWR Safety Analysis Codes

Safety Analysis	Analysis Code
Stability Evaluation (Chapter 4)	TRACG04[1]
Reactor Building Compartment Pressurization Analysis (Chapter 6)	CONTAIN 2.0
Loss of Feedwater Heating	TRACG04[1]
Closure of One Turbine Control Valve	TRACG04[1]
Generator Load Rejection with Turbine Bypass	TRACG04[1]
Generator Load Rejection with a Single Failure in the Turbine Bypass System	TRACG04[1]
Turbine Trip with Turbine Bypass	TRACG04[1]
Turbine Trip with a Single Failure in the Turbine Bypass System	TRACG04[1]
Closure of One Main Steamline Isolation Valve	TRACG04[1]
Closure of All Main Steamline Isolation Valves	TRACG04[1]
Loss of Condenser Vacuum	TRACG04[1]
Loss of Shutdown Cooling Function of RWCU/SDC	N/A
Control Rod Withdrawal Error During Startup	N/A
Control Rod Withdrawal Error During Power Operation	N/A
Inadvertent Isolation Condenser Initiation	TRACG04[1]
Runout of One Feedwater Pump	TRACG04[1]
Opening of One Turbine Control or Bypass Valve	TRACG04[1]
Loss of Non-Emergency AC Power to Station Auxiliaries	TRACG04[1]
Loss of All Feedwater Flow	TRACG04[1]
Loss of Feedwater Heating With Failure of SCRRI and SRI	TRACG04[1] / RADTRAD 3.03
Feedwater Controller Failure – Maximum Flow Demand	TRACG04[1]
Pressure Regulator Failure - Opening of All Turbine Control and Bypass Valves	TRACG04[1]
Pressure Regulator Failure – Closure of All Turbine Control and Bypass Valves	TRACG04[1]
Generator Load Rejection with Total Turbine Bypass Failure	TRACG04[1]
Turbine Trip with Total Turbine Bypass Failure	TRACG04[1]
Control Rod Withdrawal Error During Refueling	N/A
Control Rod Withdrawal Error During Startup With Failure of Control Rod Block	PANAC11

Table 15.0-8

ESBWR Safety Analysis Codes

Safety Analysis	Analysis Code
Control Rod Withdrawal Error During Power Operation with ATLM Failure	N/A
Fuel Assembly Loading Error, Mislocated Bundle	N/A
Fuel Assembly Loading Error, Misoriented Bundle	N/A
Inadvertent SDC Function Operation	N/A
Inadvertent Opening of a Safety/Relief Valve	TRACG04[1]
Inadvertent Opening of a Depressurization Valve	N/A
Stuck Open Safety/Relief Valve	TRACG04[1]
Liquid-Containing Tank Failure	RADTRAD 3.03
Fuel Handling Accident	RADTRAD 3.03
LOCA Inside Containment – Containment Pressurization	TRACG04[2]
LOCA Inside Containment – ECCS Performance	TRACG04[2]
LOCA Inside Containment – Radiological	RADTRAD 3.03[3]
Main Steamline Break Outside Containment	RADTRAD 3.03
Control Rod Drop Accident	TRACG04[1] / PANAC11
Feedwater Line Break Outside Containment	RADTRAD 3.03
Failure of Small Line Carrying Primary Coolant Outside Containment	RADTRAD 3.03
RWCU/SDC System Line Failure Outside Containment	RADTRAD 3.03
Spent Fuel Cask Drop Accident	N/A
MSIV Closure With Flux Scram (Overpressure Protection)	TRACG04[1]
Shutdown Without Control Rods (i.e., SLC system shutdown capability)	PANAC11
Shutdown from Outside Main Control Room	N/A
Anticipated Transients Without Scram	TRACG04[1]
Station Blackout	TRACG04[1]
Safe Shutdown Fire	N/A
Waste Gas System Leak or Failure	N/A

1. TRACG04 is used with core inputs from PANAC11 and fuel gap thermal conductivity input from GESTR08.
2. TRACG04 is used with fuel gap thermal conductivity input ~~from~~ GESTR08.
3. RADTRAD 3.03 is used with inputs from MELCOR 1.8.6 ~~YK~~.