MITSUBISHI HEAVY INDUSTRIES, LTD.
16-5, KONAN 2-CHOME, MINATO-KU
TOKYO, JAPAN

October 20, 2008

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

Attention: Mr. Jeffrey A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-08230

Subject: MHI's Second Response to US-APWR DCD RAI No.38

References: 1) "Request for Additional Information No.38 Revision 1, SRP Section: 15.00.03 – Design Basis Accidents Radiological Consequence Analyses for Advanced Light Water Reactors, Application Section: 15," dated July 24, 2008.
2) Letter MHI Ref: UAP-HF-08149 from Y. Ogata (MHI) to U.S. NRC, "MHI's Responses to US-APWR DCD RAI No.38 Revision 1," dated July 24, 2008.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Second Response to Request for Additional Information No.38 Revision 1."

In the initial response submitted in Reference 2, MHI provided responses to all but two of the RAI No. 38 (Reference 1) questions. MHI committed to submit responses to the remaining two questions (15.00.03-20 and 15.00.03-21) within 90 days from the RAI issue date. The responses to questions 15.00.03-20 and 15.00.03-21 are enclosed.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of this submittal. His contact information is below.

Sincerely,

Y. Ogata

Yoshiki Ogata,
General Manager- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

Enclosures:

1. Second Response to Request for Additional Information No.38 Revision 1

CC: J. A. Ciocco
C. K. Paulson

D081
NRO

Contact Information

C. Keith Paulson, Senior Technical Manager
Mitsubishi Nuclear Energy Systems, Inc.
300 Oxford Drive, Suite 301
Monroeville, PA 15146
E-mail: ck_paulson@mnes-us.com
Telephone: (412) 373-6466

Enclosure 1

UAP-HF-08230
Docket No. 52-021

Second Response to Request for Additional Information No.38
Revision 1

October 2008

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

10/20/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.:	**NO.38 REVISION 1**
SRP SECTION:	**15.00.03 – Design Basis Accident Radiological Consequence Analyses for Advanced Light Water Reactors**
APPLICATION SECTION:	**15.0.3**
DATE OF RAI ISSUE:	**7/24/2008**

QUESTION NO. : 15.00.03-20

DCD 15A.1.1.3 states that the ORIGEN2.2 generation and depletion code was used to calculate the core fission product inventory. Oak Ridge National Laboratory (ORNL) does not support the ORIGEN2 code any longer, but instead recommends use of the ORIGEN-ARP or ORIGEN-S code included in the SCALE code package, which is kept up-to-date. SCALE 5.1 is the latest release and includes libraries for high burnup fuel, up to 72 gigawatt days per metric ton uranium (GWD/MTU). Please justify the use of an older unsupported version of the ORIGEN code.

ANSWER:

Regulatory Guide 1.183 recommends the use of ORIGEN2 or ORIGEN-ARP for the calculation of the core fission product inventory. ORIGEN2 was used for the calculation of the core fission product inventory of the US-APWR, consistent with Regulatory Guide 1.183.

It is MHI's opinion that there is almost no difference in content between the two versions of ORIGEN. In this RAI response, MHI presents the justification of the use of ORIGEN2 by comparing calculation results of ORIGEN2 with those of ORIGEN-ARP.

For the purpose of these comparisons, the core fission product inventory was calculated using the same calculation conditions in both versions of the code (i.e. burnup, power, etc.). The ORIGEN-ARP calculation uses the w17x17 cross section library, which is the most appropriate library for the US-APWR. For the calculation with ORIGEN2, the PWR-UE library (ORNL/TM-11018), which is the revised ORIGEN2 cross section library

for an extended-burnup PWR, is used. This is the same library as was used to produce the results in DCD Table 15A-10.

Table 15.00.03-20-1 compares the core fission product inventories of ORIGEN2 and ORIGEN-ARP at the end of cycle for the LOCA offsite dose case. The nuclides shown in the table are the top 20 nuclides that contribute to the LOCA offsite dose (these 20 nuclides account for 99% of the total dose). According to Table 15.00.03-20-1, the difference in the total inventory of the 20 nuclides between the codes is about 1%. Consequently, the difference between the final dose results will likely be about 1%.

A detailed comparison by nuclide demonstrates that the estimated curie content of Xe-135, Cs-134, Pu-238, and Pu-241 vary by 10 to 20% between the two codes, while the estimated curie content is within 5% for all other nuclides. The specific nuclides with larger differences will not significantly affect the final dose results because I-131 accounts for more than 70% of the total dose and the corresponding I-131 component of the core fission product inventory is almost identical for the two code versions. The contributions of the remaining nuclides to the LOCA offsite dose are less than 10% each, thus having little effect on the final dose result. Consequently, the differences between the final dose results would fall within approximately 1% of each other. For doses other than the LOCA offsite dose, the noble gas and iodine nuclides constitute the majority of the dose contributors and therefore, the differences in predicted nuclide inventory described above will not significantly affect the final dose results either.

The differences in the core fission product inventory results between ORIGEN2 and ORIGEN-ARP are minor and will have a negligible effect on the final dose estimate results. Therefore, MHI believes that the application of ORIGEN2 to the US-APWR dose analysis is appropriate.

Table 15.00.03-20-1 Comparison of Core Fission Product Inventories for ORIGEN2 and ORIGEN-ARP

Nuclide	ORIGEN2 (Ci)	ORIGEN-ARP (Ci)	Ratio
Kr-88	8.14E+07	7.76E+07	1.05
Xe-133	2.44E+08	2.41E+08	1.01
Xe-135	6.89E+07	7.55E+07	0.91
I-131	1.21E+08	1.20E+08	1.00
I-133	2.43E+08	2.46E+08	0.99
I-135	2.27E+08	2.34E+08	0.97
Cs-134	3.32E+07	2.75E+07	1.21
Sr-90	1.36E+07	1.40E+07	0.97
Kr-85m	3.04E+07	2.96E+07	1.03
Kr-87	5.79E+07	5.82E+07	0.99
I-132	1.74E+08	1.76E+08	0.99
I-134	2.66E+08	2.75E+08	0.97
Cs-137	1.89E+07	1.94E+07	0.98
Te-132	1.71E+08	1.71E+08	1.00
Ru-106	7.38E+07	7.62E+07	0.97
Cm-244	7.80E+05	8.15E+05	0.96
Ce-144	1.61E+08	1.63E+08	0.99
Pu-238	7.32E+05	6.15E+05	1.19
Pu-241	1.92E+07	2.18E+07	0.88
Sr-89	1.11E+08	1.08E+08	1.03
TOTAL*	2.12E+09	2.14E+09	0.99

* Total of the top 20 nuclides contributing to the LOCA offsite dose.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

10/20/2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No.52-021

RAI NO.:	**NO.38 REVISION 1**
SRP SECTION:	**15.00.03 – Design Basis Accident Radiological Consequence Analyses for Advanced Light Water Reactors**
APPLICATION SECTION:	**15.0.3**
DATE OF RAI ISSUE:	**7/24/2008**

QUESTION NO. : 15.00.03-21

DCD 15A.1.1.3 stated that the fuel burnup is 55 GWD/MTU in two cycles. Confirm that the cross-section libraries used in the calculation of the core fission product inventory are applicable to the maximum fuel burnup assumed.

ANSWER:

Regulatory Guide 1.183 recommends the use of ORIGEN2 or ORIGEN-ARP for calculation of the core fission product inventory. ORIGEN2 was used for calculation of the core fission product inventory of the US-APWR, consistent with Regulatory Guide 1.183.

MHI presents the applicability of the library used in the calculation for the US-APWR by comparing the calculation results of ORIGEN2 (using the PWR-UE library) with those of ORIGEN-ARP (using the w17x17 library).

In the DCD calculation using ORIGEN2, the PWR-UE library (ORNL/TM-11018) is used, which is the revised ORIGEN2 cross section library for an extended-burnup PWR. The PWR-UE library is applicable for burnup up to 50 GWD/MTU. However, ORIGEN2 uses the one-group cross section extrapolated in the burnup area outside the application range of the library (the last value is used as a constant value). Generally, in the high-burnup region the change in the neutron spectrum becomes small and the burnup dependence of the one-group cross section decreases as the burnup increases. Therefore, it is acceptable to use the PWR-UE library for the assumed burnup of 55 GWD/MTU, even though it is slightly outside the 50 GWD/MTU applicability range.

For the ORIGEN-ARP calculation, the w17x17 library was used, which is the most appropriate library for the US-APWR. The w17x17 library is applicable up to 72 GWD/MTU and therefore, it is valid for the maximum burnup of 55 GWD/MTU, which is used for the US-APWR.

As described in the response to RAI No. 15.00.03-20, the difference in the inventory results between ORIGEN2 (using the PWR-UE library) and ORIGEN-ARP (using the w17x17 library) is small and results in negligible differences in the final dose results. Therefore, it can be concluded that applying the currently used ORIGEN2 cross section library to 55 GWD/MTU is acceptable.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.