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TOKYO, JAPAN

August 3, 2009

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-09412

Subject: **MHI's Response to US-APWR DCD RAI No. 418-3228 Rev. 1 and RAI No. 420-3109 Rev. 1**

Reference: 1) "Request for Additional Information 418-3238 Revision 1, SRP Section: 15.00.03 – Design Basis Accidents Radiological Consequence Analyses for Advanced Light Water Reactors, Application Section: 15.0.3" dated 7/6/2009.
2) "Request for Additional Information 420-3109 Revision 1, SRP Section: 15.00.03 – Design Basis Accidents Radiological Consequence Analyses for Advanced Light Water Reactors, Application Section: 15.0.3" dated 7/6/2009.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") documents entitled "Response to Request for Additional Information No. 418-3228 Rev. 1" and "Response to Request for Additional Information No. 420-3109 Rev. 1".

Enclosed are the responses to 2 RAIs contained within References 1 and 2.

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

Sincerely,

Y. Ogata

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

Enclosure:

1. Response to Request for Additional Information No. 418-3238 Revision 1
2. Response to Request for Additional Information No. 420-3109 Revision 1

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

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NRO

Contact Information

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Enclosure 1

UAP-HF-09412
Docket No. 52-021

Response to Request for Additional Information No. 418-3228
Revision 1

August 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

8/3/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 418-3238 REVISION 1**
SRP SECTION:	**15.00.03 – DESIGN BASIS ACCIDENTS RADIOLOGICAL CONSEQUENCE ANALYSES FOR ADVANCED LIGHT WATER REACTORS**
APPLICATION SECTION:	**15.0.3**
DATE OF RAI ISSUE:	**7/6/2009**

QUESTION NO.: 15.00.03-30

Background

It is required to demonstrate that during accident sequences, pH in containment sumps and pools remains above 7. As mentioned in SRP 6.5.2, such calculation must include possible additions of acids due to radiolysis of cable insulation and jacketing. The generation of acids from chlorine-based jacketing materials such as Hypalon has been measured experimentally and documented. However, newer materials that are fluorinebased, such as Tefzel, have not been evaluated, so the acid production from them is not known.

RAI 15.00.03-28 (Reference 1) requested that the applicant provide information on the amount of cable jacketing and radiation dose rates in containment airspace during severe accidents. The applicant responded (Reference 2) with a table for dose rates, and an estimate of 6,000 kg of cable in containment. The key quantity is the amount of cable insulation, not including the actual conductor itself. Also, the type of material comprising the insulation is important, since acid generation depends on the material being irradiated. Hence the staff is requesting clarification of the amount and type of materials used for cable insulation.

Requested Information

Provide estimates for the amount and type of material used for cable insulation and jacketing in containment:

a. If total cable amount is given, provide estimates of what fraction comprises the jacketing and insulation, as opposed to the wire.

b. Provide details of the type of materials to be used for cable jacketing, such as Hypalon or Tefzel. If a material other than Hypalon (or closely related compound) is to be used, provide data (or literature citation) on the radiolytic acid generation rate of this material under accident conditions.

References

1. "Request for Additional Information No. 176-1987 Revision 1, SRP Section: 15.00.03 – Design Basis Accidents Radiological Consequence Analysis for Advanced Light Water Reactors, Application Section: Section 15.0.3" dated February 3, 2009. (ADAMS Accession No. ML0903603770)

2. Letter from Yoshiki Ogata, MHI, to NRC dated March 3, 2009; Docket No. 52-021 MHI Ref: UAP-HF-09068; Subject: MHI's Response to US-APWR DCD RAI No. 176-1987, Rev. 1 (ADAMS Accession No. ML0906802290)

ANSWER:

a. The weight of cable jackets is 6,000 kg (which includes an allowance for the expected value of 5,204 kg. The change with respect to time of pH of recirculation water as replied in RAI No.234 was taken as twice the expected value to be on the conservative side).

The pH analysis of recirculation water does not take into account the generation of hydrochloric acid due to radiolysis of insulating materials, which can be justified as mentioned below.

As all the β-rays are assumed to be absorbed by the cable jackets, it is not necessary to take into consideration any additional absorption of β-rays by insulating materials (i.e. generation of Cl from insulating materials).

It is also assumed for simplicity that cables are laid in the center of CV, where they are irradiated from all directions. Practically, however, as they are laid in contact with walls or floors, it is logical to consider that only one side of the cables is irradiated by β-rays, while the other side is not exposed to radiation. It is therefore reasonable to think that the amount of β-ray dose absorbed by the cable jackets is only one half, and that the contribution of β-rays to the generation of hydrochloric acid can be reduced to half.

On the other hand, some of γ-rays go through cable jackets to be absorbed by insulating materials inside the jackets. Since γ–rays are absorbed by insulating materials at a similar rate to cable jackets, the amount absorbed by both the cable jackets and the insulating materials will be about twice that by the cable jackets alone.

β–rays are predominant in terms of contribution to the generation of hydrochloric acid, approximately five times greater than that due to radiolysis of cable jackets by γ-rays. Considering that contribution due to radiolysis by β-rays can be reduced to one half, the amount of hydrochloric acid generated will be decreased even when taking into account the contribution due to radiolysis of insulating materials by γ-rays.

Cables are basically installed in cable trays or conduits. For cables installed in conduits, no contribution by β– rays is assumed in the same way as with NUREG-1081 and NUREG/CR-5950. In actuality, reduction due to this could be estimated, but assessment does not take this into account. It can thus be said that an adequately conservative assumption is made in pH analysis as to the generation of hydrochloric acid.

b. The amount and specification of cables for US-APWR are given in Table 1 and Table 2, which are assumed typical specification of cables based on data of actual installations in Japan.

Table 1: Amount of cables in CV

Cable Type	Cable length
FR-CSHVT	250m
FR-PH	2750m
FR-PSHV	5800m
FRCPHS	11250m
FR-CPSHVS	9700m
FR-STQ-IN	32300m

Table 2: Specification of cables in CV

Cable Type	Insulator		Jacket	
	Material	Mass (kg/m)	Material	Mass (kg/m)
FR-CSHVT	Cross-linked polyethylene	0.988	Flame-retardant, low hydrochloric acid, super heat-resistant polyvinyl chloride	1.465
FR-PH	Flame-retardant ethylene-propylene EP rubber	0.06	Flame-retardant, chlorosulfonated polyethylene	0.092
FR-PSHV	Flame-retardant ethylene-propylene rubber	0.06	Flame-retardant, low hydrochloric acid, super heat-resistant polyvinyl chloride	0.095
FRCPHS	Flame-retardant ethylene-propylene rubber	0.049	Flame-retardant, chlorosulfonated polyethylene	0.088
FR-CPSHVS	Flame-retardant ethylene-propylene rubber	0.0165	Flame-retardant, low hydrochloric acid, super heat-resistant polyvinyl chloride	0.064
FR-STQ-IN	Flame-retardant ethylene-propylene rubber	0.032	Flame-retardant, chlorosulfonated polyethylene	0.075

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.

Enclosure 2

UAP-HF-09412
Docket No. 52-021

Response to Request for Additional Information No. 420-3109
Revision 1

August 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

8/3/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 420-3109**
REVISION 1	
SRP SECTION:	**15.00.03 – DESIGN BASIS ACCIDENTS RADIOLOGICAL CONSEQUENCE ANALYSES FOR ADVANCED LIGHT WATER REACTORS**
APPLICATION SECTION:	**15.0.3**
DATE OF RAI ISSUE:	**7/6/2009**

QUESTION NO.: 15.00.03-31

Background

In order to verify compliance with the guidelines of SRP 15.0.3 Acceptance Criterion 1 [based on 10 CFR Part 50.34(a)(1)], as it relates to evaluation and analysis of fission product releases, the pH of the containment sump water must be raised above 7.0 after a LOCA to prevent revolatilization of iodine. The staff requires additional information in order to complete its confirmatory calculation of the sump pH.

RAI 15.00.03-28 (Reference 1) requested that the applicant provide information on radiation dose rates in containment airspace during severe accidents. This radiation, due to release of fission products from the primary system, is absorbed by electrical cable jacketing and produces acids (primarily HCl and H2SO4) which can be released to the airspace and washed into containment pools and sumps. The cumulative effect of this action is to lower pH of water in which fission-product iodine is dissolved. If sufficient acids are produced, the pH could decrease below 7, at which point iodine is assumed to revolatilize and possibly be released from the containment.

The applicant's response (Reference 2) provided cumulative dose rates in containment at a number of time points through the accident. These doses included effects of both γ - and β - radiation combined. According to models used by the staff, the acid production rates from these two types of radiation are somewhat different. Hence, the staff is requesting that the applicant supply dose rates for γ- and β-radiation separately, so that a verifying calculation can be performed regarding acid production and the lowering of pH in containment water.

Requested Information

Provide dose rates for γ - and β -radiation (separately) in the containment due to fission product decay during the course of a design-basis accident. These doses should be to the containment airspace, to be absorbed by electrical cable insulation and jacketing

References

1. "Request for Additional Information No. 176-1987 Revision 1, SRP Section: 15.00.03 – Design Basis Accidents Radiological Consequence Analysis for Advanced Light Water Reactors, Application Section: Section 15.0.3" dated February 3, 2009. (ADAMS Accession No. ML0903603770)

2. Letter from Yoshiki Ogata, MHI, to NRC dated March 3, 2009; Docket No. 52-021 MHI Ref: UAP-HF-09068; Subject: MHI's Response to US-APWR DCD RAI No. 176-1987, Rev. 1 (ADAMS Accession No. ML090680229)

ANSWER:

Regarding the integral absorbed dose for γ - and β -radiation (separately) in the containment for electrical cable jacketing and water during the accident, refer to Table 15.00.03-31-1 below.

Table 15.00.03-31-1: Absorbed Doses Used in pH Analysis

Time (hr)	Integral absorbed dose for electrical cable jacketing exposed to radiation in containment (kGy)			Integral absorbed dose for water exposed to radiation in containment (kGy)		
	γ	β	Total	γ	β	Total
0.1	4.2E+00	2.2E+01	2.6E+01	1.9E+00	6.6E-01	2.5E+00
0.2	8.3E+00	4.3E+01	5.2E+01	3.6E+00	1.3E+00	4.9E+00
0.3	1.2E+01	6.4E+01	7.6E+01	5.3E+00	1.8E+00	7.1E+00
0.4	1.6E+01	8.5E+01	1.0E+02	6.8E+00	2.3E+00	9.2E+00
0.5	1.9E+01	1.0E+02	1.2E+02	8.3E+00	2.8E+00	1.1E+01
1	3.5E+01	2.0E+02	2.3E+02	1.5E+01	4.8E+00	1.9E+01
2	5.8E+01	3.4E+02	4.0E+02	2.4E+01	7.6E+00	3.2E+01
3	7.5E+01	4.5E+02	5.3E+02	3.1E+01	9.7E+00	4.1E+01
5	1.0E+02	6.3E+02	7.3E+02	4.3E+01	1.3E+01	5.6E+01
10	1.5E+02	9.7E+02	1.1E+03	6.6E+01	2.1E+01	8.7E+01
20	2.1E+02	1.3E+03	1.5E+03	9.5E+01	3.2E+01	1.3E+02
30	2.5E+02	1.6E+03	1.8E+03	1.2E+02	4.0E+01	1.6E+02
50	3.2E+02	2.0E+03	2.3E+03	1.5E+02	5.3E+01	2.0E+02
70	3.7E+02	2.3E+03	2.6E+03	1.7E+02	6.2E+01	2.4E+02
100	4.3E+02	2.7E+03	3.1E+03	2.1E+02	7.3E+01	2.8E+02
200	6.0E+02	3.6E+03	4.2E+03	2.9E+02	9.9E+01	3.9E+02
300	7.2E+02	4.2E+03	4.9E+03	3.6E+02	1.2E+02	4.8E+02
400	8.3E+02	4.7E+03	5.5E+03	4.2E+02	1.3E+02	5.6E+02
500	9.1E+02	5.0E+03	5.9E+03	4.7E+02	1.5E+02	6.2E+02
600	9.9E+02	5.3E+03	6.3E+03	5.2E+02	1.6E+02	6.8E+02
700	1.1E+03	5.5E+03	6.5E+03	5.6E+02	1.7E+02	7.3E+02
720	1.1E+03	5.5E+03	6.6E+03	5.7E+02	1.7E+02	7.4E+02

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.