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

May 21, 2009

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

Attention: Mr. Jeffery A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-09246

Subject: MHI's Response to US-APWR DCD RAI No. 322-1999 (45-day response)

References: 1) "Request for Additional Information No. 322-1999 Revision 0, SRP Section: 03.08.03 – Concrete and Steel Internal Structures of Steel or Concrete Containments, Application Section: 3.8.3" dated 4/8/2009.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No. 322-1999 Revision 0."

Enclosed are the responses to questions 3.8.3- 2, 3, 4, 5, 6, 9, 10, 11, and 12 of the RAI (Reference 1). Responses to the remaining six questions of this RAI have 60-day response times as agreed to between the NRC and MHI. The responses for these questions will be issued at a later date by a separate transmittal.

As indicated in the enclosed materials, this submittal contains information that MHI considers proprietary, and therefore should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential. A non-proprietary version of the document is also being submitted with the information identified as proprietary redacted and replaced by the designation "[ ]".

This letter includes a copy of the proprietary version (Enclosure 2), a copy of the non-proprietary version (Enclosure 3), and the Affidavit of Yoshiki Ogata (Enclosure 1) which identifies the reasons MHI respectfully requests that all materials designated as "Proprietary" in Enclosure 2 be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

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 provided below.

Sincerely,

Y. Ogata

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

D081
NRO

Enclosures:

1. Affidavit of Yoshiki Ogata

2. Response to Request for Additional Information No. 322-1999, Revision 0 (45-day response) (proprietary)

3. Response to Request for Additional Information No. 322-1999, Revision 0 (45-day response) (non-proprietary)

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

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

Docket No. 52-021
MHI Ref: UAP-HF-09246

MITSUBISHI HEAVY INDUSTRIES, LTD.

AFFIDAVIT

I, Yoshiki Ogata, state as follows:

1. I am General Manager, APWR Promoting Department, of Mitsubishi Heavy Industries, LTD ("MHI"), and have been delegated the function of reviewing MHI's US-APWR documentation to determine whether it contains information that should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential.

2. In accordance with my responsibilities, I have reviewed the enclosed document entitled "Response to Request for Additional Information No. 322-1999, Revision 0 (45-day response)", dated May 2009, and have determined that portions of the document contain proprietary information that should be withheld from public disclosure. Those pages contain proprietary information are identified with the label "Proprietary" on the top of the page, and the proprietary information has been bracketed with an open and closed bracket as shown here "[ ]". The first page of the document indicates that all information identified as "Proprietary" should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

3. The information identified as proprietary in the enclosed document has in the past been, and will continue to be, held in confidence by MHI and its disclosure outside the company is limited to regulatory bodies, customers and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and is always subject to suitable measures to protect it from unauthorized use or disclosure.

4. The basis for holding the referenced information confidential is that it describes the unique design parameters developed by MHI for the RCS components and support structures.

5. The referenced information is being furnished to the Nuclear Regulatory Commission ("NRC") in confidence and solely for the purpose of information to the NRC staff.

6. The referenced information is not available in public sources and could not be gathered readily from other publicly available information. Other than through the provisions in paragraph 3 above, MHI knows of no way the information could be lawfully acquired by organizations or individuals outside of MHI.

7. Public disclosure of the referenced information would assist competitors of MHI in their design of new nuclear power plants without incurring the costs or risks associated with the design of the subject systems. Therefore, disclosure of the information contained in the referenced document would have the following negative impacts on the competitive position of MHI in the U.S. nuclear plant market:

A. Loss of competitive advantage due to the costs associated with the development of the unique design parameters.

B. Loss of competitive advantage of the US-APWR created by the benefits of SC Modules application.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information and belief.

Executed on this 21st day of May 2009.

Y. Ogata

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

Enclosure 3

UAP-HF-09246
Docket No. 52-021

Response to Request for Additional Information No. 322-1999, Revision 0 (45-day response)

May 2009
(Non-Proprietary)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

5/21/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 322-1999 REVISION 0**
SRP SECTION:	**03.08.03 – Concrete and Steel Internal Structures of Steel or Concrete Containments**
APPLICATION SECTION:	**03.08.03**
DATE OF RAI ISSUE:	**4/8/2009**

QUESTION NO.: 3.8.3-2

In DCD Subsection 3.8.3.1.1, the paragraph (Page 3.8-31) states "The supports are formed by sliding surfaces between the shim plates and support pads to allow radial thermal growth of the RCS and RV. The vessel position is maintained unchanged by controlling the horizontal load through the support brackets and the base plate."

The applicant is requested to provide the following information:

(a) Do the sliding support pads use non-metallic materials such as Teflon, Neoprene or graphite? If so, provide information on the temperature and radiation effect on these materials, including any aging effects.

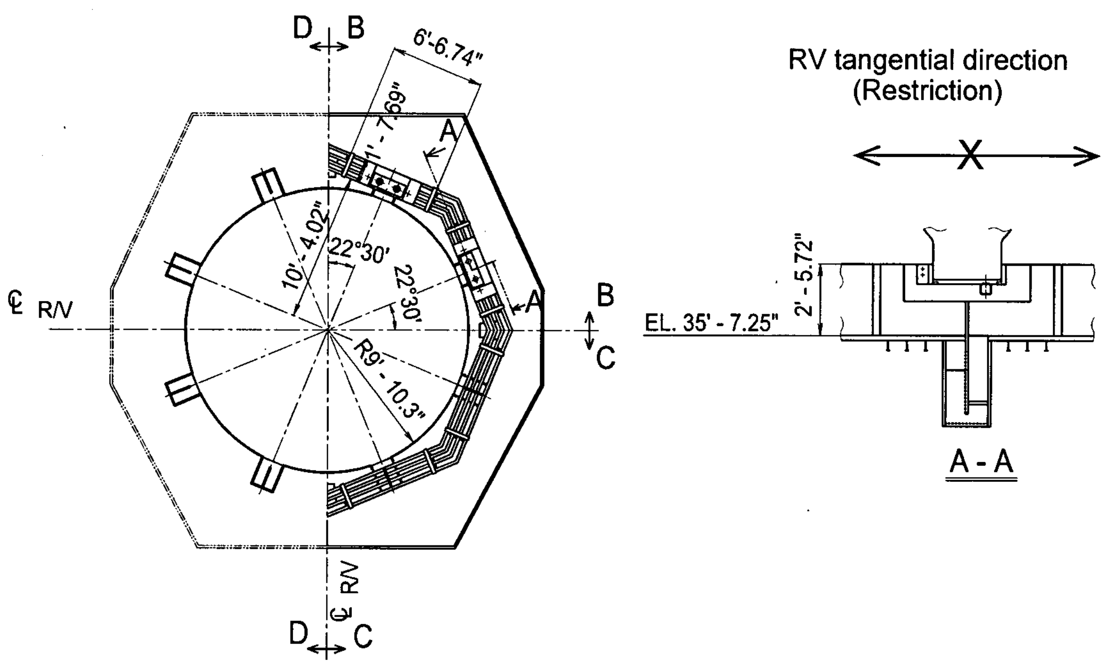
(b) Describe how the control of the horizontal load through the support brackets and the base plate is accomplished such that the vessel position is unchanged while allowing radial thermal growth.

(c) How is the RV modeled in the seismic analysis? Was the rocking mode of vibration of the RV included in the model?

ANSWER:

(a) The sliding support pads and shim plates are made of metallic materials only. No non-metallic materials will be used for sliding support pads.

(b) The Reactor Vessel (RV) supports of US-APWR are located at the RV outlet and inlet nozzles, eight locations as shown in figure below. The RV support allows radial displacement of the RV, but does not allow tangential displacement of the RV, as shown in section A-A of the figure. When a horizontal load acts on the RV, the RV support in the tangential direction of the RV will restrict the displacement of the RV.



(c) The RV is modeled by a vertical single beam, which is corresponding to the center axis of the RV, since it is cylindrical and isotropic. The mass of the body and the internal water is applied to the beam as an equally distributed mass. The mass of the members such as the nozzle and brackets are treated as a concentrated mass. The mass of the reactor internals are applied as a concentrated mass to the interface of the RV.

In the model, virtual rigid bars are connected from the vertical single beam of the RV to the support points of RV nozzles. The horizontal and vertical spring elements are attached to the rigid bars at the RV support points. Therefore, the rocking and translation movements have been considered in the RV model.

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.

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QUESTION NO.: 3.8.3-3

In DCD Subsection 3.8.3.1.2, the third paragraph (Page 3.8-31) states "The upper and lower ends of the columns are pin-jointed to permit movement of the SGs caused by thermal expansion of piping. Figure 3.8.3-2 depicts the SG support system."

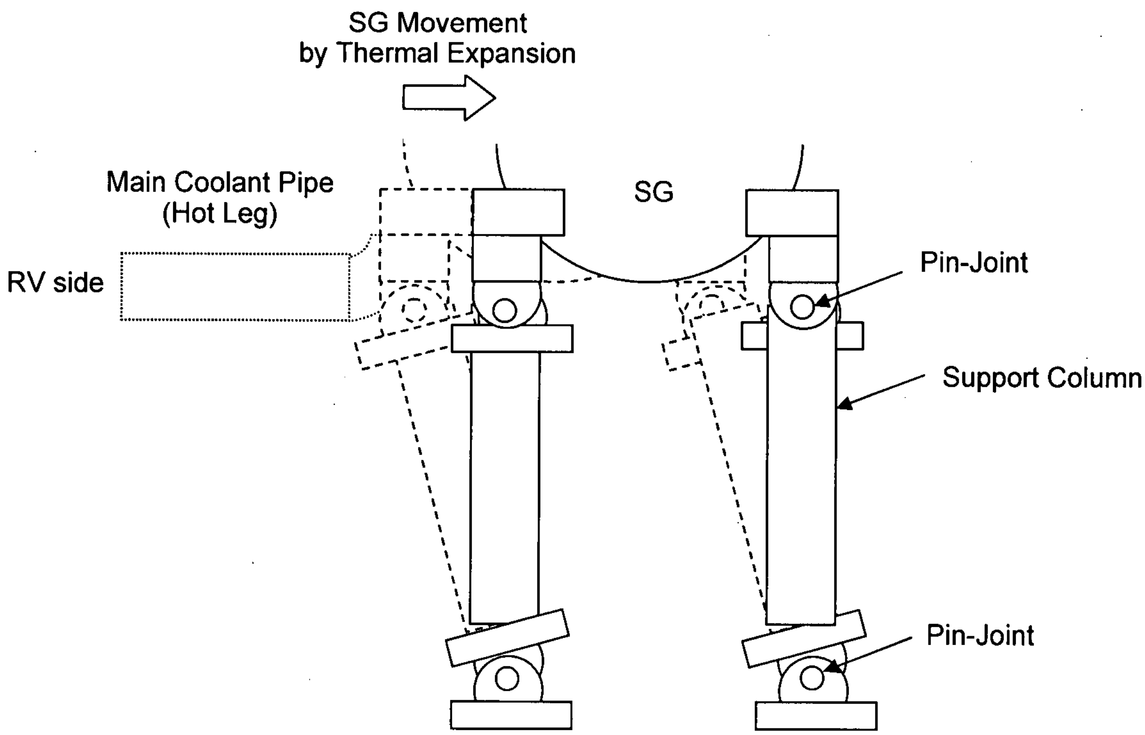
The applicant is requested to provide the following information:

(a) Provide the rationale for selecting the number and location of the lateral supports for the steam generators.
(b) Use of a pin-joint allows free rotation but does not allow displacement to take place. Provide information that shows clearly how the pin-joints permit movement of the SG caused by thermal expansion of piping that is attached to the SG.

ANSWER:

(a) In order to reduce the seismic responses of the US-APWR Steam Generators (SG), a three level lateral support system is designed as shown in the US-APWR DCD Figure 3.8.3-2. The SG support system consists of an upper shell support, an intermediate shell support, and a lower lateral support. The upper and intermediate shell supports are lateral restraints (snubbers), while the lower support is constructed of steel. This three level support system has increased the natural frequency of the SG vibration mode compared to the two level support system. And this support system of SG shows the excellent response reduction effects for earthquake conditions. This response is described in detail in Subsection 3.7.2.4.

(b) The support columns of steam generator will be set up considering the thermal expansion movement of the hot leg and SG that is calculating at 100% power operation. The upper end pin-joint of the support columns toward the lower end pin-joint of support columns will be set to the position based on calculated thermal expansion caused by hot leg and the SG-to-hot leg direction. Therefore, support columns will be set to tilt to the RV side slightly, the set of support column pin-joints, upper and lower, will not restrict thermal expansion displacement of SG as shown in figure below.



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

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QUESTION NO.: 3.8.3-4

In Sheet 2 of 5 of DCD Figure 3.8.3-7 (Page 3.8-185), the elevation of 9'-2" marked on the structure is lower than the mark on the structure for the elevation of 3'-7".

The applicant is requested to provide clarification, or correct this apparent error.

ANSWER:

The correct elevation should be -9'-2".

Impact on DCD

See Attachment 1 for the markup of DCD Tier 2, Section 3.8, Revision 2, with the following changes.

- Change Figure 3.8.3-7 (Rev. 1, page 3.8-185) to read: "-9'-2""

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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QUESTION NO.: 3.8.3-5

Extensive use is made in the US-APWR of modular structural construction. It is stated that this is done to shorten field construction time and to gain improved quality control of the wall sections through controlled shop fabrication. In particular, extensive use is made of steel concrete structural modules (named as "SC Modules") for Seismic Category I Structures, as specified for example in: DCD Section 3.8.3.1.5, Primary Shield Wall; DCD Section 3.8.3.1.6, Secondary Shield Walls; DCD Section 3.8.3.1.7, Refueling Cavity; and DCD Section 3.8.3.1.9, Interior Compartments.

In DCD Section 3.8.3.1.5, these steel concrete modules are described as formed using permanently placed carbon steel faceplates and web-plates with a nominal thickness of ½ in. The faceplates, connected by tie-bars fabricated from solid carbon steel round bars, or by carbon steel web-plates, also function as formwork for concrete placed in the interior. As stated in DCD Section 3.8.3.4 (p. 3.8-38) these carbon steel faceplates also act as the primary tensile and compressive steel reinforcement for the concrete wall. The use of regular steel reinforcing bars in the interior of the wall is minimal. In the fourth paragraph on p. 3.8-38, it states that "The SC module forms a composite section once the concrete has reached sufficient strength, consisting of steel faceplates that carry inplane tension or compression from axial loads and out-of-plane bending. Structural behavior of composite sections used as SC modules inside containment is, therefore, similar to conventional concrete reinforced by steel." Several references are cited in the DCD for tests performed in the U.S. and Japan on the structural behavior of these SC modules. It is stated that these tests show the SC modules have improved ductility, higher strength, and have less decrease in stiffness as compared to the more conventional reinforced concrete walls.

There is, however, one major difference between the SC modules and conventional reinforced concrete walls. In using this type of construction it is noted that the two steel faceplates, which act as the reinforcing for the concrete wall, are exposed to the surrounding atmosphere. For the more conventional construction which uses steel reinforcing bars, national building codes such as ACI 318 and ACI 349 require minimum values of concrete cover over these steel bars, ranging from ¾ inch (for No.11 bars) to 1-1/2 inch (for No. 14 and 18 bars). In some cases, such as more severe fire resisting requirements or possible corrosive atmosphere, these values of minimum concrete cover may be increased. This requirement has been in the ACI building codes (e.g., ACI 318) for a long time, essentially since their inception. This concrete cover is intended to provide adequate resistance of the reinforced concrete to elevated temperatures such as caused by fire and possible corrosive atmosphere. In the case of the steel concrete modules, there is no concrete cover to protect the steel faceplates. All of the concrete is between the two steel faceplates. Therefore, the ACI 318 and ACI 349 requirements for minimum concrete cover over the primary steel reinforcing is not followed in the design of the SC modules.

Provide the rationale for not complying with the ACI 318 and ACI 349 code requirements for minimum concrete cover over the primary steel reinforcement. This rationale should include a discussion of the consequences of elevated temperatures in the various compartments created by these SC modules, due to fire and/or design basis accidents such as LOCA and main steam piping breaks. The discussion should include a description of the local behavior of the steel and concrete for these elevated temperatures. This rationale should also include a discussion of the possibility of any corrosive fluids or atmosphere in the various compartments, and their effect on the serviceability of the steel faceplates.

ANSWER:

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.

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QUESTION NO.: 3.8.3-6

In DCD Subsection 3.8.3.6.1, p. 3.8-44 it states "Special module construction techniques, in addition to the methodology described in Subsection 3.8.3.1 is provided as necessary in a later supplement to the DCD."

The applicant is requested to provide the supplement to the DCD that describes these special module construction techniques.

ANSWER:

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.

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QUESTION NO.: 3.8.3-9

In DCD Subsection 3.8.3.4, "*Design and Analysis Procedures*", p. 3.8-38, 4th paragraph, several experimental tests of SC modules are cited. The results of these tests are used to support the design methodology used for the SC module walls. These tests appear to be made for single SC module walls. The applicant is requested to provide the following information:

Have tests been conducted on assemblies of more than one wall, including corner joint connections? If so, provide the references and a summary of the test results that support the design procedures.

Have tests been conducted on SC modules at elevated temperatures, including tests to determine fire resistance of the modules? If so, provide the references to these tests and a summary of the results that support the design procedures.

ANSWER:

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.

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QUESTION NO.: 3.8.3-10

In DCD Subsection 3.8.3.6.1, it states, "Special module construction techniques, in addition to the methodology described in Subsection 3.8.3.1, is provided as necessary in a later supplement to the DCD."

Provide a summary of the information in this supplement to the DCD that describes these special module construction techniques. This summary should include descriptions of special requirements placed on the fabrication, shipping, handling, and installation of the SC modules, which are necessary to avoid overstressing, excessive distortion, and/or any other degradation mechanism of the steel faceplates during these operations.

These explanations should be detailed enough to allow staff evaluation of the SC modules. As an example, in describing transportation issues, the discussion should address things such as maximum size and weight of the modules, how the modules are packaged and secured to the rail car (or truck bed). This information should address how the modules are supported to minimize vibrations and impact loading; how they are protected from the elements during transportation and storage; and how loading and unloading is to be accomplished to avoid overstressing the steel plate assemblies. Similar types of information should be provided for the other steps in the construction and inspection process.

Include in these explanations the acceptance criteria for the SC modules for loads related to fabrication, shipping and handling, erection, any other steps in the construction process and the concrete inspection process. Voids or honeycombs in reinforced concrete structures have been observed, after the removal of forms, and then repaired. Some structural members were found so deficient, after the removal of forms, that they were demolished and re-poured. Since the steel forms of the SC module walls are not to be removed, provide the method to be used to inspect or detect concrete voids/honeycombs and other types of defects for the SC concrete walls after concrete pouring.

The discussion should include a description of quality control measures needed, if any, that supplement those contained in applicable codes and standards (e.g., ACI 349; AISC N690).

ANSWER:

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.

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QUESTION NO.: 3.8.3-11

DCD Subsection 3.8.3.1.7, *Refueling Cavity, (*pg. 3.8-33) states, "The walls of the refueling cavity are formed by SC modules, which are lined with stainless steel over the ½ inch thick carbon steel faceplates, referred to as 'clad steel'. The ceiling and floor slabs are also lined with clad steel."

The applicant is requested to answer the following questions:

How are the stainless steel plates are secured to the carbon steel faceplates of the SC modules? Are any welds made between the stainless steel and the carbon steel plates?

Are the stainless steel plates considered as part of the structural member of the SC module? If so, how are they included in the structural/thermal analysis? For example, do the stainless steel plates add stiffness to the SC wall module?

ANSWER:

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.

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QUESTION NO.: 3.8.3-12

DCD Subsection 3.8.3.1.5, p. 3.8-32, 2nd paragraph, states that that steel faceplates of the SC modules are welded to adjacent plates with full penetration welds so that the weld is at least as strong as the plate. It further states that the steel faceplates are welded to a continuous embedded steel plate in the basemat.

The applicant is requested to answer the following questions:

- Are the full penetration welds connecting adjacent faceplates made from one side? If yes, are backing bars used? How is the quality of the finished weld assured? Are the welds tested by non-destructive testing, such as ultrasonic, radiographic, or dye penetrant means? If so, what are the acceptance criteria?
- How are the welds made between the steel faceplates and the embedded steel plate in the basemat? How is the quality of these welds assured? Are the welds tested by non-destructive testing, such as ultrasonic, radiographic, or dye penetrant means? If so, what are the acceptance criteria?

ANSWER:

The faceplates of adjacent SC modules are connected by single full penetrating welds. Generally, the faceplates of SC modules are welded using backing metal. In the case of fabricating faceplates before assembling to SC modules, backing metal may not be required.

Visual inspection will be performed for all welds. The radiographic testing and the ultrasonic testing and the liquid penetrant testing will be provided as required. The embedded plates are installed to SC modules during fabrication of steel framework at the prefabrication facility. The fillet or the full penetration welds are used to satisfy the requirements of design of each module.

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.

This completes MHI's response(s) to the NRC's question(s).

ATTACHMENT 1
to RAI 322-1999

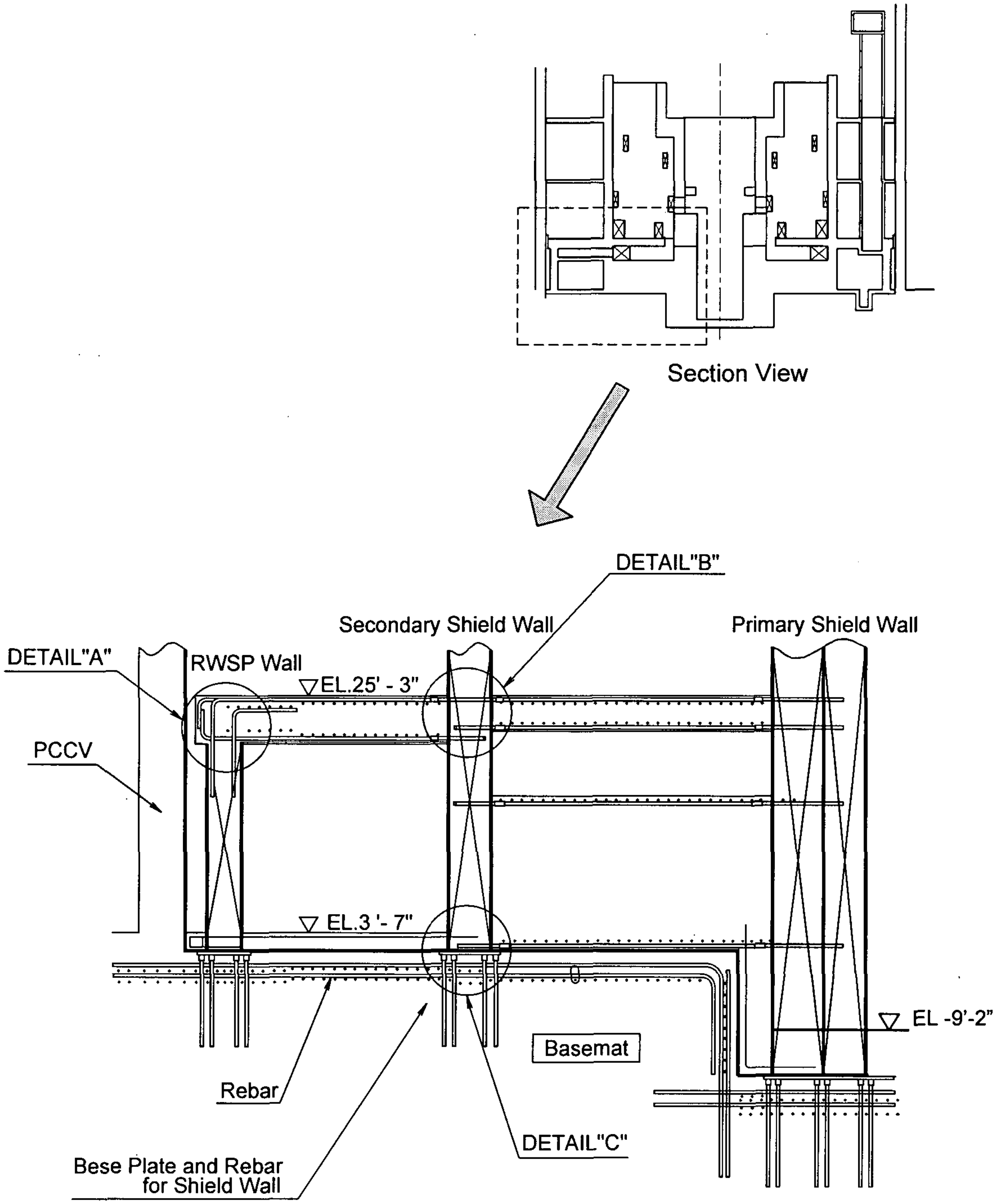

Figure 3.8.3-7 Typical Details of SC Modules
(Sheet 2 of 5)