

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

Original

October 6, 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-08222

**Subject:** MHI's Responses to US-APWR DCD RAI No.67-715

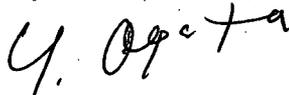
**References:** 1) "Request for Additional Information No. 67-715 Revision 0, SRP Section: 09.04.04 - Turbine Area Ventilation System, Application Section: Tier 2 FSAR Section 9.4.4," dated September 8, 2008.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Responses to Request for Additional Information No. 67-715 Revision 0"

Enclosed are the responses to 6 RAIs contained within Reference 1.

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,



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

Enclosure:

1. Responses to Request for Additional Information No. 67-715 Revision 0

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

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NRO

Docket No. 52-021  
MHI Ref: UAP-HF-08222

Enclosure 1

UAP-HF-08222  
Docket Number 52-021

Responses to Request for Additional Information  
No. 67-715 Revision 0

October 2008

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**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

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10/6/2008

**US-APWR Design Certification**

**Mitsubishi Heavy Industries**

**Docket No. 52-021**

**RAI NO.:** NO.67-715 REVISION 0  
**SRP SECTION:** 09.04.04 - TURBINE AREA VENTILATION SYSTEM  
**APPLICATION SECTION:** TIER 2 FSAR SECTION 9.4.4  
**DATE OF RAI ISSUE:** 9/8/2008

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**QUESTION NO. : 09.04.04-2, RAI 9.4.4-7**

For the temperature and humidity ranges listed in US APWR DCD Table 9.4-1 for "Abnormal Conditions" it not clear from the text of DCD Section 9.4.4 what these minimum and maximum values represent. For example, for the Electrical Equipment Area and SBO, what do these Min and Max values assume? Is the assumption that the function of the Turbine Building Ventilation System has been lost for the duration of the SBO coping event (i.e. 8 hours)? DCD Section 8.3.2.1.2 second paragraph reads "...For conservatism, the batteries are sized to carry the worst case dc load profile for a duration of one hour. The loading conditions following a LOOP and an SBO have been considered to determine the worst case profile for the battery. ...." Without any ventilation from the Turbine Building Area Ventilation System, what happens to the hydrogen levels within the battery rooms for the duration of the SBO or LOOP event?

Section 9.2.7.2.2 "Non-Essential Chilled Water System" third paragraph reads "During the LOOP condition, the non-essential chilled water system is powered from the alternate AC power source." Is the TAVS subsystem Electrical Equipment Areas HVAC System powered from the AAC during a LOOP to allow the chilled water system to ventilate the Turbine building areas?

SRP 9.4.4 section III.1 requires a review for normal and emergency operations, and the ambient temperature limits for the areas serviced. Additional information needs to be included within DCD Section 9.4.4 to identify the implications (if any) of these questions with respect to TAVS operation.

**ANSWER:**

The Min and Max values assumed for the Electrical equipment areas in Table 9.4-1 are the design conditions as the Electrical Equipment Areas HVAC system operating.

The assumption that the Turbine Building Ventilation System (Electrical Equipment Area) is lost is not correct. The Turbine Building Ventilation system (Electrical Equipment Areas) including the battery rooms exhaust fans are powered by the Alternate AC power source. This system is operational for the SBO and LOOP events, when the Alternate AC sources are made available.

Therefore, this system can maintain the hydrogen level and ambient temperature below the design conditions during the SBO and LOOP conditions.

The Electrical Equipment Areas HVAC system is powered from the Alternate AC power source during a LOOP and SBO to allow the chilled water system to supply chilled water to the cooling coils of the Non-class 1E Electrical Equipment Area AHU to maintain a suitable environment for the equipment operating in all the Electrical Equipment Areas.

In DCD Subsection 9.4.4.2.2, add a last sentence to the first paragraph as follows:

**“This HVAC system is powered from the alternate AC power source and operated during SBO and LOOP conditions.”**

SRP 9.4.4, III.1 states that the review based on the FMEA, determines that the “safety-related” portion of the system is capable of functioning in spite of the loss of any active component. Subsection 9.4.4.3 states that “The turbine building area ventilation system “does not” serve any “safety-related” functions and thus, requires no safety evaluation”. Therefore, information addressing SRP section 9.4.4 III.1 review procedure is not required.

#### **Impact on DCD**

This revision impacts revision 1 of the DCD of Section 9.4.4.

Add a last sentence to the first paragraph in Subsection 9.4.4.2.2 as follows.

**This HVAC system is powered from the alternate AC power source and operated during SBO and LOOP conditions.**

#### **Impact on COLA**

There is no impact on COLA.

#### **Impact on PRA**

There is no impact on PRA.

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**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

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10/6/2008

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**Docket No. 52-021**

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**DATE OF RAI ISSUE:** 9/8/2008

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**QUESTION NO. : 09.04.04-2, RAI 9.4.4-8**

Tier 1 ITAAC Section 2.7.5.5 Turbine Building Area Ventilation System identifies three key design features for the system: (1) provide a suitable environment for equipment operation; (2) provide effective smoke evacuation in the building; and (3) maintain the hydrogen concentration below the explosive limit in the battery room.

10 CFR 52.47(b)(1) reads:

"The proposed inspections, tests, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations..."

Similar words are contained in Item 4 of the Requirements in SRP Section 9.4.4, II Acceptance Criteria.

Appendix A to SRP 14.3, Section I.D.iii "Tier 2" reads .... "Tier 2 information includes.... iii. Supporting information on the inspections, tests, and analyses that should be performed to demonstrate that the acceptance criteria in the ITAAC have been met"

Tier 2 DCD Section 9.4.4.4 "Inspection and Testing Requirements" does not require any system testing to demonstrate the three key design features. More directly, the ITAAC criteria for the acceptance criteria are too vague. The acceptance criteria need to be quantifiable. The staff requests that the DC applicant provide appropriate ITAAC for Tier 1 Section 2.7.5.5 and appropriate testing requirements for Tier 2 Section 9.4.4.4.

For example:

For (1) definition of a suitable environment would be defined by the minimum and maximum temperature and humidity values of Table 9.4-1 for normal and abnormal plant conditions. But these criteria could be very difficult to demonstrate during plant startup and before fuel load

without all normal heat loads "on line" and active. It would be even more difficult to demonstrate these temperature and humidity values for abnormal conditions.

For (2) the Turbine Building Area Ventilation System has two subsystems each with a smoke purge function. What are the minimum flows measured at particular locations for each subsystem to be certified as acceptable system performance (i.e. with respect to smoke removal)?

For (3) the Electrical Equipment Area HVAC System is designed to maintain the hydrogen concentration within both battery rooms well below 2% by volume. By the ITACC statement, if the explosive limit for hydrogen is 4%, then a hydrogen concentration of 3.9% could be certified as acceptable system performance (i.e. with respect to hydrogen dilution)?

Adding an HVAC flow balancing table to the DCD that includes flows, inlet and outlet temperatures to particular areas within the Turbine Building could resolve some of the above noted deficiencies for Section 9.4.4.

SRP 14.3.7 II "SRP Acceptance Criteria" 1 reads "...Tier 1 should be reviewed for consistency with the initial test program described in DCD Tier 2 Chapter 14.2. ....". Neither Tier 2 Section 14.2.121.110 Turbine Building Area Ventilation System (General Mechanical Area) Preoperational Test nor Tier 2 Section 14.2.121.111 Turbine Building Area Ventilation System (Electrical Equipment Area) Preoperational Test establishes a consistency with the requirements of the ITAAC acceptance criteria.

In addition, Appendix A to SRP 14.3, Section I.C.v "Tier 1" reads "Tier 1 information includes: v. Significant interface requirements." Tier 1 Section 2.7.5.5 does not contain a section for significant interface requirements. For example, Fire Protection System(i.e. HVAC dampers ) and Chilled Water System.

The staff requests that the DCD be revised to address these deficiencies for: Tier 1 Section 2.7.5.5, Tier 2 Section 9.4.4, Tier 2 Section 14.2.121.110 and Tier 2 Section 14.2.121.110.

**ANSWER:**

Tier 1 and ITAAC for Turbine Building Area Ventilation System

The portions of this question pertaining to Tier 1 level of detail and ITAAC for the turbine building area ventilation system are addressed in MHI's response to RAI No. 54, Question No. 14.03.07-4, RAI 14.3.7.3.5-1 (MHI Ref: UAP-HF-08184 dated September 19, 2008).

"Interface requirements" as used in the US-APWR Tier 1 DCD are "the design attributes and performance characteristics that ensure that the site-specific portion of the design is in conformance with the certified design." Additional details on consistency of US-APWR interface requirements with NRC regulatory criteria are provided in MHI's response to RAI No. 54, Question No. 14.03.07-4, RAI 14.3.7.3.2-1. The turbine building area ventilation system is part of the certified design and does not have any interface requirements.

Tier 2 Subsections 9.4.4.4 and 14.2.121

In DCD Revision 1, Subsections 14.2.12.1.110 and 14.2.12.1.111 address preoperational testing of the turbine building area ventilation system mechanical area and electrical equipment area, respectively. The acceptance criteria for each of these preoperational test abstracts are that the ventilation system operates as described in DCD subsection 9.4.4 (i.e., that would include the

ability to maintain acceptable environmental conditions, hydrogen levels and smoke purge satisfactorily). MHI believes this to be the appropriate level of detail for the DCD test description. The acceptance criteria for parameters measured during testing, such as ventilation flow rate, are supported by design calculations to show that system performance meets the design requirements. MHI considers the addition of specific minimum flow rates for hydrogen and smoke purge, or turbine building area ventilation system flow balance tables, to be too much detail for the DCD

**Impact on DCD**

There is no impact on DCD.

**Impact on COLA**

There is no impact on COLA.

**Impact on PRA**

There is no impact on PRA.

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**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

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10/6/2008

**US-APWR Design Certification  
Mitsubishi Heavy Industries  
Docket No. 52-021**

**RAI NO.:** NO.67-715 REVISION 0  
**SRP SECTION:** 09.04.04 - TURBINE AREA VENTILATION SYSTEM  
**APPLICATION SECTION:** TIER 2 FSAR SECTION 9.4.4  
**DATE OF RAI ISSUE:** 9/8/2008

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**QUESTION NO. : 09.04.04-2, RAI 9.4.4-9**

SRP 14.3.7 Section II "SRP Acceptance Criteria" 1 reads "...Tier 1 should be reviewed for consistency with the initial test program described in DCD Tier 2 Chapter 14.2. ....".

SRP 14.3.7 Section II "SRP Acceptance Criteria" 2 reads "... The following issues are identified to ensure comprehensive and consistent treatment in Tier 1 based on safety significance of the system being reviewed: ... (6) Control, alarms, and displays; (7) Logic; (8) interlocks ..."

Tier 2 DCD Section 14.3.4.7 ITAAC for Plant Systems pertains to HVAC systems. The seventh bullet reads that "Commensurate with the importance of the design attribute to safety, verifying the following design attributes for plant systems:...

- Controls, alarms, and displays ...
- Logic and interlocks...
- Required interfaces with other systems"

DCD Section 9.4.4.2.1 "General Mechanical Areas Ventilation System" 3<sup>rd</sup> paragraph reads "In the event of the presence of smoke, selected roof fans are actuated to purge the smoke."

From this passage it is not clear whether the actuation of the roof fans to purge the smoke from the General Mechanical Areas is manual or automatic. What controls, alarms and displays and/or logic and interlocks are relevant for smoke or fire detected in this area? If a fire were detected in the Turbine Building, would the 27 roof fans automatically shut down until the fire is extinguished? Are there different fan speeds associated with the roof fans for normal operation versus the smoke purge mode?

The staff requests that the DC applicant provide additional information in answer to the above questions. This missing information should be added to Tier 2 Section 9.4.4.2.1.

## **ANSWER:**

If a Fire is detected in the Turbine building, all 27 roof fans shut down automatically. Once the fire has been extinguished, smoke purge operation is initiated manually by restarting fans as needed from the MCR. Different fan speeds are not required for Turbine Building Roof Ventilation Fans for Normal operation versus the smoke purge mode. There is enough flexibility in selecting numbers of fans required for smoke purge mode.

Smoke control and removal function for the turbine building is identified in DCD Appendix 9A, section 9A.3.96 Turbine Building.

However, Smoke Control Features is addressed in DCD Tier 2 Appendix 9A, Section 9A.3.96 FA6-101, as follows:

### **Smoke Control Features**

The turbine building is provided with automatic opening smoke vents in the building roof. Supplementary smoke removal can be accomplished by the plant fire brigade using portable fans and ducting and standard fire fighting techniques. Except for isolated rooms, smoke accumulation is not expected to be a problem due to the tremendous internal volume of the building.

This is different from what is stated in DCD Section 9.4.4.2.1 General Mechanical Areas Ventilation System, which states that selected roof fans are actuated to purge the smoke.

DCD Appendix 9A, Section 9A.3.96 FA6-101 under "Smoke Control Features" is to be revised as follows"

The turbine building area ventilation system may be manually actuated to purge the smoke. Supplementary smoke removal can be accomplished by the plant fire brigade using portable fans and ducting and standard fire fighting techniques. Except for isolated rooms, smoke accumulation is not expected to be a problem due to the tremendous internal volume of the building.

### **Impact on DCD**

This revision impacts revision 1 of the DCD Appendix 9A.

Revise 3<sup>rd</sup> paragraph in DCD Section 9.4.4.2.1 as follows

**In the event of the presence of smoke, selected roof fans are actuated to purge the smoke. If a fire is detected in the Turbine building, all 27 roof fans shut down automatically. Once the fire has been extinguished, smoke purge operation is initiated manually by restarting fans as needed from the Main Control Room.**

Revise DCD Appendix 9A, Section 9A.3.96 FA6-101 under "Smoke Control Features" as follows.

**The turbine building area ventilation system is manually actuated to purge the smoke.**

Supplementary smoke removal can be accomplished by the plant fire brigade using portable fans and ducting and standard fire fighting techniques. Except for isolated rooms, smoke accumulation is not expected to be a problem due to the tremendous internal volume of the building.

### **Impact on COLA**

There is no impact on COLA.

**Impact on PRA**

There is no impact on PRA.

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**QUESTION NO. : 09.04.04-2, RAI 9.4.4-10**

Tier 2 DCD Section 14.2.12.1.110 "Turbine Building Area Ventilation System (General Mechanical Area) Preoperational Test", subsection C "Test Method" identifies four verifications required for preoperational test completion. C.1 reads "Verify manual and automatic controls and functions in the operation and shutdown modes." DCD Section 9.4.4.2.1 does not discuss a shutdown mode. C.3 reads "Verify alarms and status indications are functional". DCD Section 9.4.4.2.1 does not contain any information about alarms and status indications (e.g. locations of remote and/or local). SRP 9.4.4 section III.1 requires a review for normal and emergency operations. The staff requests additional information about this absence of detail in Section 9.4.4.2.1.

**ANSWER:**

In DCD Section 9.4.4.1.2, 1<sup>st</sup> bullet item, "The general mechanical areas ventilation system is designed to maintain a suitable environment in the general mechanical areas during normal operating condition." is addressed. In DCD Section 9.4.4.1.2, 2<sup>nd</sup> bullet item, "In the event of the presence of smoke, the general mechanical areas ventilation system purges the smoke in the general mechanical areas" is addressed.

In DCD Section 9.4.4.2.1, the system description of the general mechanical areas ventilation system during normal operating condition and the event of the presence of smoke is described.

"the operation and shutdown modes" which is addressed in DCD Section 14.2.12.1.110 are meant to denote normal power operation and normal shutdown modes. Both the operating modes are included in normal operating condition.

In DCD Section 9.4.4.5, instrumentation requirements about alarms and status indications (e.g. locations of remote and/or local) are described.

SRP 9.4.4, III.1 states that the review based on the FMEA, determines that the "safety-related" portion of the system is capable of functioning in spite of the loss of any active component. Subsection 9.4.4.3 states that "The turbine building area ventilation system "does not" serve any

"safety-related" functions and thus, requires no safety evaluation". Therefore, information addressed in SRP section 9.4.4 III.1 review procedure is not required.

#### **Impact on DCD**

This revision impacts revision 1 of the DCD Section 14.2.12.1.110.

Revise DCD Section 14.2.12.1.110 as follows:

#### **C. Test Method**

1. Verify manual and automatic controls and functions in the **normal power operation, and normal shutdown and smoke purge modes.**

#### **Impact on COLA**

There is no impact on COLA.

#### **Impact on PRA**

There is no impact on PRA.

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**QUESTION NO. : 09.04.04-2, RAI 9.4.4-11**

SRP 14.3.7 Section II "SRP Acceptance Criteria" 1 reads "...Tier 1 should be reviewed for consistency with the initial test program described in DCD Tier 2 Chapter 14.2. ....".

SRP 14.3.7 Section II "SRP Acceptance Criteria" 2 reads "... The following issues are identified to ensure comprehensive and consistent treatment in Tier 1 based on safety significance of the system being reviewed: ... (6) Control, alarms, and displays; (7) Logic; (8) interlocks ..."

Tier 2 DCD Section 14.3.4.7 ITAAC for Plant Systems pertains to HVAC systems. The seventh bullet reads that "Commensurate with the importance of the design attribute to safety, verifying the following design attributes for plant systems:...

- Controls, alarms, and displays ...
- Logic and interlocks...
- Required interfaces with other systems"

DCD Section 9.4.4.2.2 "Electrical Equipment Areas Ventilation System" 4th paragraph reads "The battery rooms common exhaust has two 100% exhaust fans, with one in standby. This system maintains the hydrogen concentration well below 2% by volume in both battery rooms."

From this passage it is not clear what controls, alarms and displays and/or logic and interlocks are relevant in event of an abnormal hydrogen build up in the battery rooms. If abnormal hydrogen builds up in either of the battery rooms, how would the two exhaust fans react?

The fifth paragraph indicates the automatic response of the air handling units in the presence of smoke. Would the presence of smoke cause any type of response by the two Non-Class 1E battery Room Exhaust Fans?

The staff requests that the DC applicant provide additional information in answer to the above questions. This missing information should be added to Tier 2 Section 9.4.4.2.2.

## **ANSWER:**

The two non-class 1E battery rooms are each located within separate electrical rooms on different floors adjacent to the turbine building. Each electrical room has an air-handling unit supplying and exhausting air from them. The battery rooms supply air also comes from the AHUs. However, the battery rooms have a common but separate exhaust system (Figure 9.4.4-1, sheet 2 of 2). The battery rooms exhaust system consists of a common exhaust duct and two 100% exhaust fans. One fan is running and the other is on standby. If one fan fails, the fan failure is alarmed in the main control room and the other one starts automatically. Therefore, abnormal levels of hydrogen do not build up in the battery rooms.

If smoke is detected in the AHU supply air or from a fire in the electrical room, the AHU for that electrical room will trip. The exhaust fans for the battery room will not trip and will continue to run to maintain hydrogen venting.

### **Impact on DCD**

Revise paragraph four in Tier 2 DCD Section 9.4.4.2.2 to the following:

The battery rooms common exhaust system has two 100% exhaust fans, with one in standby. **When one fan fails, the fan failure is alarmed in the main control room and the other one starts automatically.** This system maintains the hydrogen concentration well below 2% by volume in both battery rooms.

Revise Tier 2 DCD Section 9.4.4.2.2 by adding the following sentence at the end of the last paragraph:

**The exhaust fans for the battery rooms will not trip on smoke detection.**

### **Impact on COLA**

There is no impact on COLA.

### **Impact on PRA**

There is no impact on PRA.

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**QUESTION NO. : 09.04.04-2, RAI 9.4.4-12**

10 CFR 47(a) reads ... "(a) The application must contain a final safety analysis report (FSAR) that describes the facility, presents the design bases and the limits on its operation, and presents a safety analysis of the structures, systems, and components and of the facility as a whole, and must include the following information:

(24) A representative conceptual design for those portions of the plant for which the application does not seek certification, to aid the NRC in its review of the FSAR and to permit assessment of the adequacy of the interface requirements in paragraph (a)(25) of this section;

(25) The interface requirements to be met by those portions of the plant for which the application does not seek certification. These requirements must be sufficiently detailed to allow completion of the FSAR;"

The Fire Protection system Figure 9.4.4-1 (Sheet 2 of 2) "Turbine Building Area Ventilation System Flow Diagram" displays six symbols (i.e. circle with a diagonal line) in the flow process lines. These symbols are not identified in: (1) Figure 1.7-4 Legends for Piping and Instrumentation Diagrams of HVAC System; (2) any legend contained in DCD Chapter 9; (3) Tier 1. Review of DCD Section "9.5 Fire Protection" and Appendix 9A (reference Table 9A-3 for Fire Zones FA6-101-03 & FA6-101-14 and Figures 9A-21 & 9A-22) would lead to the conclusion that the six symbols are most likely fire dampers. The staff asks that the applicant remove the ambiguity of the six symbols from the DCD. If these symbols represent fire dampers, they should be described as a Fire Protection System interface in DCD Section 9.4.4 with respect to the Turbine Building Ventilation System. The staff request that clarification of the six symbols be added to DCD Section 9.4.4.

**ANSWER:**

MHI concurs with NRC with the ambiguity of the symbols. The six symbols in Figure 9.4.4-1 (Sheet 2 of 2) represent "fire dampers". Figure 9.4.4-1 (Sheet 2 of 2) will be revised to add the legend for the fire damper symbol as a note.

MHI concurs with NRC that all fire protection attributes and interface shall be defined in Section 9.4.4 for Electrical Equipment area HVAC. Accordingly, insert the following text in the Section 9.4.4 as follows:

Insert the following text after the last paragraph of DCD Subsection 9.4.4.2.2:

**“All duct penetrations in the fire walls are protected by fire dampers to prevent the spread of fire from an affected area to the adjacent redundant component areas.”**

**Impact on DCD**

This revision impacts revision 1 of the DCD Section 9.4.4.

Insert the following text after the last paragraph of DCD Subsection 9.4.4.2.2:

**“All duct penetrations in the fire walls are protected by fire dampers to prevent the spread of fire from an affected area to the adjacent redundant component areas.”**

Revise Figure 9.4.4-1(Sheet 2 of 2) to add Legend for Fire Dampers as attachment.

**Impact on COLA**

There is no impact on COLA.

**Impact on PRA**

There is no impact on PRA.

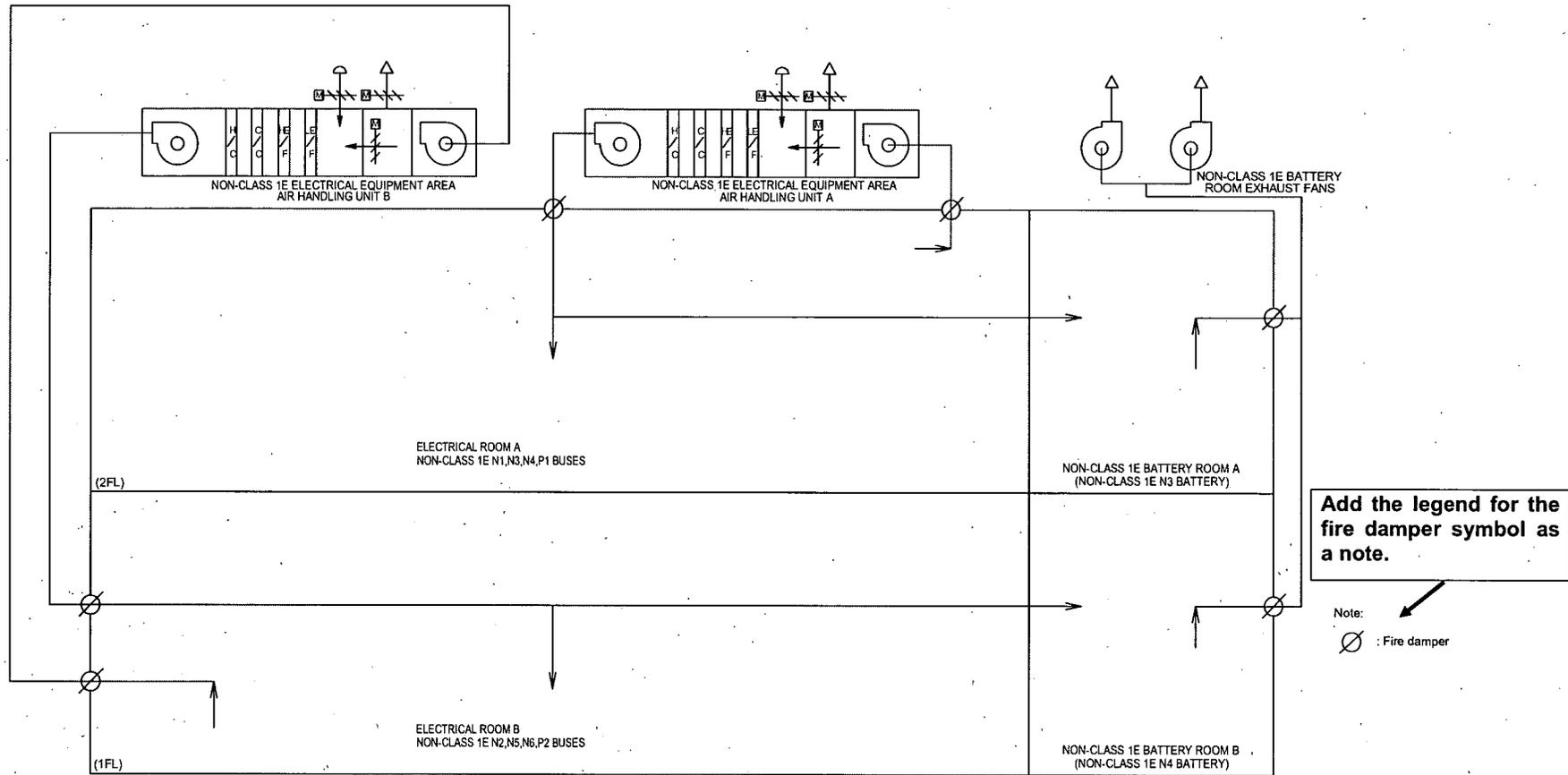


Figure 9.4.4-1 Turbine Building Area Ventilation System Flow Diagram (Sheet 2 of 2)