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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-09269

Subject: Update of Chapter 3 and Chapter 10 of US-APWR DCD

Reference:

1) CP-200801264 Log # TXNB-08024 from M. L. Lucas (Luminant) to U.S. NRC,"COMBINED LICENSE APPLICATION FOR COMANCHE PEAK NUCLEAR POWER PLANT, UNITS 3 AND 4 PROJECT NO. 0754" dated on September 19, 2008
2) Letter MHI Ref: UAP-HF-08153 from Y. Ogata (MHI) to U.S. NRC, "Submittal of US-APWR Design Control Document Revision 1 in Support of Mitsubishi Heavy Industries, Ltd.'s Application for Design Certification of the US-APWR Standard Plant Design" dated on August 29, 2008.
3) NRC Request for Additional Information No. 2614 Revision 0, RAI #6, 4/29/2009, Comanche Peak Units 3 and 4, Luminant Generation Company, LLC. Docket No. 52-034 and 52-035, SRP Section: 10.02.03 – Turbine Rotor Integrity, Application Section: 10.2.3.

During the review process of the Combined License Application for Comanche Peak 3 and 4 (Reference 1, "R-COLA"), which incorporates by reference the Mitsubishi Heavy Industries, Ltd. (MHI) Design Certification Application for the US-APWR Standard Plant Design (Reference 2, "DCD"), the U.S. Nuclear Regulatory Commission ("NRC") Staff has requestes additional information about the turbine rotor inspection program (Reference 3).

Based on our response to this RAI, updates of Chapters 3 & 10 of our US-APWR Design Control Document are required.

With this letter, MHI transmits to the NRC Staff the proposed updates to be made to the DCD based on our response to this RAI. These updates will be incorporated into future DCD revisions.

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

Sincerely,

Y. Ogata

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

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Enclosure:

1. Update of Chapter 3 and Chapter 10 of US-APWR DCD

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-09269
Docket No. 52-021

Update of Chapter 3 and Chapter 10 of US-APWR DCD

June 2009

Mitsubishi received an NRC Request for Additional Information No. 2614 Revision 0, RAI #6, dated on 4/29/2009.

In response to the above RAI #6, it became necessary to revise Chapters 3 & 10 of our US-APWR Design Control Document.

Table 1 shows the change list of Chapters 3 and 10 of the DCD, which gives the positions, the contents and the reasons of changing DCD. Mark-up drafts of the DCD are also attached in this document.

Table 1 Change List of Chapter 3 and Chapter 10 of DCD (Sheet 1 of 2)

Page	**Location** (e.g., subsection with paragraph/sentence/item, table with column/row, or figure)	**Description of Change**
3.5-10	First paragraph,11th line	Editorial: Reference number changed from "MUAP-070028-NP" to "MUAP-07028-NP"
3.5-10	First paragraph, last sentence	The last sentence shall be replaced by the following sentence, "Inservice inspection programs are to be maintained as outlined in SRP 3.5.1.3, Section II, Acceptance Criteria, Section 4 ~~5~~(Reference 3.5-7)~~. for turbine installations without NRC approved reports describing methods and procedures for calculating turbine missile generation probabilities."~~ Mitsubishi submitted two technical reports, MUAP-07028-P and MUAP-07029-P, showing the missile generation probability for designed overspeed and destructive overspeed respectively. Those reports are prepared on the basis of detail turbine design and control system design and submitted to NRC for approval. Should the NRC approval be given for ISI interval described in the reports, we believe that we will be able to develop our ISI program based on the criteria prescribed in SRP 3.5.1.3 TURBINE MISSILES, II ACCEPTANCE CRITERIA, SRP Acceptance Criteria 4 (Page 3.5.1.3-3).
3.5-17	The last paragraph	Editorial: Reference number changed from "MUAP-070028-NP (R0)" to "MUAP-07028-NP (R0)".

Table 1 Change List of Chapter 3 and Chapter 10 of DCD (Sheet 2 of 2)

Page	Location (e.g., subsection with paragraph/sentence/item, table with column/row, or figure)	Description of Change
10.2-19	The beginning of section 10.2.3.5	At the beginning of section 10.2.3.5, we added the following sentence to show the overall concept for the ISI programs. These sentences are almost same as those prescribed in SRP 10.2.3 TURBINE ROTOR INTEGRITY, SRP Acceptance Criteria, section 5 Inservice Inspection. "The insevice inspection program for the LP turbine is to provide assurance that................is conducted"
10.2-20	Second paragraph	Second paragraph was deleted: Because, those sentences are included in the sentences which we added at the beginning of section 10.2.3.5.
10.2-20	Forth paragraph (first bullet under the third paragraph), third sentence	We changed the expression for the ISI interval from " at intervals of about 10 years" to "at intervals equal or less than 10 years" for the purpose to make the sentence more clear.
10.2-20	Seventh paragraph	Valve maintenance interval is changed from "3 years" to "4 years" to make it compatible with the refueling interval of 2 years (24 months).
10.2-20	The second sentence from the last	Editorial: The second sentence from the last is moved to the above position to avoid the confusion of main valve and extraction valves and for easy understanding.
10.2-21	The first sentence	Editorial: The word "develop" is changed by the word "establish". The sentence "Plant startup procedure including warm up time will be completed therein" is deleted because this sentence is of no means in the ISI section.
10.2-21	10.2.5, the first sentence	Editorial: Same reason as the above.

outlined in the geometry Section 3.5.1.3, the product of P_2 and P_3 is conservatively estimated as 10^{-3} per year. The determination of P_1 (probability of turbine failure resulting in the ejection of turbine rotor (or internal structure) fragments through the turbine casing) is strongly influenced by the program for periodic inservice testing and inspection. Criteria as described in NUREG-0800 Standard Review Plan 3.5.1.3, Table 3.5.1.3-1 (Reference 3.5-7) correlates P_1 to operating cases necessary to obtain P_4 in an acceptable risk rate of 10^{-7} per year, where P_1 is less than $P_4 / (P_2 \times P_3)$ or 10^{-4}. The P_1 applicable to the US-APWR is described in Subsection 10.2.2. The COL Applicant is to commit to actions to maintain P_1 within this acceptable limit as provided by turbine and rotor design features, material specifications and recommended inspections during preservice and inservice periods based on Technical Report, MUAP-07028-~~070028-~~NP, Probability of Missile Generation From Low Pressure Turbines (Reference 3.5-17). Inservice inspection programs are to be maintained as outlined in SRP 3.5.1.3, Section II, Acceptance Criteria, Section 4 ~~5~~ (Reference 3.5-7) ~~for turbine installations without NRC approved reports describing methods and procedures for calculating turbine missile generation probabilities~~.

3.5.1.4 Missiles Generated by Tornadoes and Extreme Winds

The US-APWR design basis spectrum of tornado missiles conforms to the spectrum of missiles defined in Table 2 of "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants", RG 1.76, Rev.1 (Reference 3.5-8) for a region I tornado, the most severe. The spectrum of missiles is chosen to represent: (1) a massive high-kinetic-energy missile that deforms on impact, (2) a rigid missile that tests penetration resistance, and (3) a small rigid missile of a size sufficient to pass through any opening in protective barriers.

Therefore, the spectrum of tornado missiles is as follows:

- A 4,000 pound automobile, 16.4 ft by 6.6 ft by 4.3 ft, impacting the structure at normal incidence with a horizontal velocity of 135 ft/s or a vertical velocity of 90.5 ft/s. This missile is considered to potentially impact at all plant elevations up to 30 ft above grade for all grades within 0.5 mile of the plant structures.
- A 6.625 inch diameter by 15 ft long schedule 40 pipe, weighing 287 pounds, impacting the structure end-on at normal incidence with a horizontal velocity of 135 ft/s or a vertical velocity of 90.5 ft/s.
- A 1 inch diameter solid steel sphere assumed to impinge upon barrier openings in the most damaging direction with a velocity of 26 ft/s in any direction.

Because of the higher wind speed and the resulting higher kinetic energy, the design for wind-generated missiles is governed by tornado missiles and not hurricane missiles. Therefore, US-APWR seismic category I and II structures are not designed for hurricane missiles, because the design for tornado missiles envelopes the design for hurricane missiles.

Openings through the exterior walls of the seismic category I structures, and the location of equipment in the vicinity of such openings, are arranged so that a missile passing through the opening would not prevent the safe shutdown of the plant. Otherwise, structural barriers are designed to resist tornado missiles in accordance with the design procedures discussed in Subsection 3.5.3. Tornado missiles are not postulated to

3.5-13 Ballistic Perforation Dynamics, R. F. Recht and T. W. Ipson, ASME Journal of Applied Mechanics, Volume 30, Series E, Number 3, September 1963.

3.5-14 Safety-Related Concrete Structures for Nuclear Power Plants (Other than Reactor Vessels and Containments), Regulatory Guide 1.142, Rev. 2, U.S. Nuclear Regulatory Commission, Washington, DC, November 2001.

3.5-15 Specification for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities, including Supplement 2 (2004), ANSI/AISC N690-1994, American National Standards Institute/American Institute of Steel Construction, 1994 & 2004.

3.5-16 Code Requirements for Nuclear Safety-Related Concrete Structures, American Concrete Institute (ACI) 349, 1997.

3.5-17 Probability of Missile Generation From Low Pressure Turbines, MUAP-07028-~~070028-~~NP (R0), Mitsubishi Heavy Industries, Ltd., Tokyo, Japan, December 2007.

- The natural critical frequencies of the turbine shaft assemblies existing between zero speed and 20% overspeed are controlled in the design and operation so as to cause no distress to the unit during operation.

- The turbine rotor design facilitates an inservice inspection of all high stress regions. All the turbine rotors use the mono-block rotor design instead of the conventional shrunk-on disk design.

- Tangential stresses will not cause a flaw, which is assumed to be twice the corrected ultrasonic examination reportable size, to grow to critical size in the design life of the rotor (refer to Subsection 10.2.3.2).

The low-pressure turbine has fully integral rotors forged from a single ingot of low alloy steel. This design is inherently less likely to have a failure resulting in a turbine missile than designs with shrunk-on discs. A major advantage of the fully integral rotor is the elimination of disc bores and keyways, which can be potential locations for stress risers and corrosive contaminant concentration. This difference results in a substantial reduction of rotor peak stresses, which in turn reduces the potential for crack initiation. The reduction in peak stress also permits selection of a material with improved ductility, toughness, and resistance to stress corrosion cracking.

The non-bored design of the high-pressure and low-pressure turbine rotor provides the necessary design margin by virtue of its inherently lower centerline stress. Metallurgical processes permit fabrication of the rotors without a center borehole. The use of solid rotor forgings was verified by an evaluation of the material removed from center-bored rotors for fossil power plants. This evaluation demonstrated that the material at the center of the rotors satisfied the rotor material specification requirements. Forgings for no-bore rotors are provided by suppliers who have been qualified based on bore material performance.

All the low-pressure turbine rotating blades are attached to the rotor using christmas tree, side entry type root.

10.2.3.5 Inservice Inspection

The inservice inspection program for the LP turbine is to provide assurance that rotor flaws that might lead to brittle failure of a rotor at speeds up to design speed will be detected. This inspection includes disassembly of the turbine at equal or less than 10-year intervals during plant shutdowns coincident with the inservice inspection schedule required by 2008a Section XI, Division 1 IWA-2430 of the ASME Boiler & Pressure Vessel Code. Disassembly of the turbine is conducted during plant shutdown. Inspection of parts that are normally inaccessible when the turbine is assembled for operation (couplings, coupling bolts, turbine rotors, and low pressure turbine blades) is conducted.

The maintenance and inspection program plan for the turbine assembly and valves is based on turbine missile probability calculations, operating experience of similar equipment and inspection results. The turbine missile generation probability due to rotor material failure below design overspeed was submitted in Reference 10.2-9. The analysis of missile generation probability due to failure of the overspeed protection system is used to determine turbine valve test frequency and is described in Reference 10.2-10. The maintenance and inspection program includes the activities outlined below:

~~Disassembly of the turbine is conducted during plant shutdown. Inspection of parts that are normally inaccessible when the turbine is assembled for operation (couplings, coupling bolts, turbine rotors, and low-pressure turbine blades) is conducted.~~

This inspection consists of visual, surface, and volumetric examinations as indicated below:

- Each rotor, stationary and the rotating blade path component is inspected visually and by magnetic particle testing on its accessible surfaces. Ultrasonic inspection of the side entry blade grooves is conducted. These inspections are conducted at intervals equal or less than~~of about~~ 10 years for both high-pressure and low-pressure turbines.
- A 100 percent surface examination of couplings and coupling bolts is performed.
- The fluorescent penetrant examination is conducted on nonmagnetic components.

- At least one main steam stop valve, one main steam control valve, one reheat stop valve, and one intercept valve are dismantled approximately every ~~3~~4 years during scheduled refueling or maintenance shutdowns. A visual and surface examination of the valve internals is conducted. If unacceptable flaws or excessive corrosion are found in a valve, the other valves of the same type are inspected. Valve bushings are inspected and cleaned and bore diameters are checked for proper clearance.
- Main stop valves, control valves, reheat stop and intercept valves may be tested with the turbine online. The DEH control test panel is used to stroke or partially stroke the valves.
- Turbine valve testing is performed at quarterly intervals. The quarterly testing frequency is based on nuclear industry experience that turbine-related tests are the most common cause of plant trips at power. Plant trips at power may lead to challenges of the safety-related systems. Evaluations show that the probability of turbine missile generation with a quarterly valve test is less than the evaluation criteria.
- Extraction nonreturn valves are tested prior to each startup.
- ~~Turbine valve testing is performed at quarterly intervals. The quarterly testing frequency is based on nuclear industry experience that turbine-related tests are the most common cause of plant trips at power. Plant trips at power may lead to challenges of the safety-related systems. Evaluations show that the probability of turbine missile generation with a quarterly valve test is less than the evaluation criteria.~~
- Extraction nonreturn valves are tested locally by stroking the valve full open with air, then equalizing air pressure, allowing the spring closure mechanism to close the valve. Closure of each valve is verified by direct observation of the valve arm movement.

The Combined License Applicant is to ~~develop~~ establish a turbine maintenance and inspection procedure ~~and then to implement~~ prior to fuel load. ~~Plant startup procedure including warm-up time will be completed therein.~~

10.2.4 Evaluation

Components of the turbine-generator are conventional and typical of those which have been extensively used in other nuclear power plants. Instruments, controls, and protective devices are provided to confirm reliable and safe operation. Redundant, fast actuating controls are installed to prevent damage resulting from overspeed and/or full load rejection. The control system initiates turbine trip upon reactor trip. Automatic low-pressure exhaust hood water sprays are provided to prevent excessive hood temperatures. Exhaust casing rupture diaphragms are provided to prevent low-pressure cylinder overpressure in the event of loss of condenser vacuum. The diaphragms are flange mounted and designed to maintain atmospheric pressure within the condenser and turbine exhaust housing while passing full flow.

Since the steam generated in the steam generators is not normally radioactive, no radiation shielding is provided for the turbine-generator and associated components. Radiological considerations do not affect access to system components during normal conditions. In the event of a primary-to-secondary system leak due to a steam generator tube leak, it is possible for the steam to become contaminated. Discussions of the radiological aspects of primary-to-secondary leakage are presented in Chapters 11.

10.2.5 Combined License Information

COL 10.2(1) Inservice Inspection

The Combined License Applicant is to establish a ~~develop~~ turbine maintenance and inspection procedure ~~and then to implement~~ prior to fuel load. ~~Plant startup procedure including warm-up time will be completed therein.~~

10.2.6 References

10.2-1 Rules for Construction of Pressure Vessels, ASME Boiler and Pressure Vessel Code, Section VIII,Division 1.

10.2-2 U.S. Nuclear Regulatory Commission, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, NUREG-800, Section 3.5.1.3 Rev.3, March 2007.

10.2-3 U.S. Nuclear Regulatory Commission, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, NUREG-800, Section 10.2 Rev.3, March 2007.

10.2-4 U.S. Nuclear Regulatory Commission, Operating Experience Feedback Report - Turbine-Generator Overspeed Protection Systems, NUREG-1275, Vol. 11, April 1995