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May 31, 2011

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-11164

Subject: MHI's Amended Responses to US-APWR DCD RAI 629-4973 Rev.2 (SRP 11.03)

Reference: 1) Request for Additional Information No.629-4973 Revision 2, SRP Section: 11.03 –Gaseous Waste Management System, Application Section: 11.3" dated September 7,2010.
2) "MHI's Responses to US-APWR DCD RAI 624-4972 Rev.2 and RAI 629-4973 Rev.2", UAP-HF-10257, dated September 23, 2010.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") documents as listed in Enclosures.

Enclosed are the responses to RAIs contained within Reference 1.

This letter amends the previously transmitted answers submitted under MHI References UAP-HF-10257 on September 24, 2010 (Reference 2) to resolve the open item 11.05-1 identified in the Safety Evaluation Report with Open Items for Chapter 11, for Mitsubishi US-APWR DCD (ML110660127).

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.

Enclosures:

1. Responses to Request for Additional Information No.629-4973 Rev.2 (non-proprietary)

D081
NRO

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

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Enclosure 1

UAP-HF-11164
Docket No. 52-021

Responses to Request for Additional Information No.629-4973
Revision 2

May 2011
(Non Proprietary)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

05/31/2011

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 629-4973 REVISION 2**
SRP SECTION:	**11.03 – Gaseous Waste Management System**
APPLICATION SECTION:	**11.3**
DATE OF RAI ISSUE:	**09/07/2010**

QUESTION NO. : 11.03-18

Staff review of DCD Tier 2, Section 11.3 and applicant responses to RAIs found some design details were not fully described and/or exhibited inconsistencies for compliance with 10 CFR Part 20, Appendix B, Table 2, Column 1; 10 CFR Part 50, Appendix I; 10 CFR 20.1301; 10 CFR.1302; 10 CFR 50.34a; 10 CFR 50.36a; 10 CFR 50, Appendix A; 10 CFR 50.9; and 40 CFR Part 190. In response to the following questions, please revise the DCD and provide a markup.

1. DCD Tier 2, Section 11.3.1.6, "Mobile or Temporary Equipment" was revised to state that the GWMS does not include the use of mobile or temporary equipment. However, DCD Tier 2, Section 14.3.7, "ITAAC for Plant Systems" describes ITAAC for verifying the performance of the gaseous waste management system (as permanently installed systems or in combination with mobile processing equipment). Please correct this apparent inconsistency.

2. Please submit for staff review the following calculation packages that support demonstration of compliance to the NRC regulations: a) MHI PWR-GALE code calculations of gaseous effluent releases (both normal and maximum releases) and comparisons to the ECLs in 10 CFR Part 20, Appendix B, Table 1, and the GASPAR II code calculations of gaseous effluent doses. b) MHI PWR-GALE code calculations of waste gas surge tank leak and charcoal bed analysis. In addition, DCD Tier 2, Section 11.3.3.2.1, "Waste gas surge tank leak" assumes a transfer (decay) time of 24 hours for the decay of noble gases in the reactor coolant after reactor shut down to evaluate the radiological consequence of the waste gas surge tank leak and satisfy the 300 µg Xe-133 dose equivalent TS limit. Please provide the basis for the 24 hours decay time.

3. DCD Tier 2, Revision 2, Section 11.3.4, "Ventilation System" describes a discharge isolation valve located downstream of the discharge radiation monitor which closes on a low ventilation system exhaust flow rate to minimize the potential for release of treated gaseous waste and the accumulation of hydrogen in the vent stack. DCD Tier 2, Section 11.3.2.1.4, "Hydrogen/Oxygen Analyzers" describes isolation of gas sources to the charcoal bed by closing this valve when a high-high alarm occurs. DCD Tier 2, Section 11.3.2, "System Description" describes the discharge valves as remaining open when the radiation setpoint is not exceeded and closure when there is a lack of ventilation flow in the vent stack. Further, DCD Tier 1, Section 2.7.4.2.1, "Design Description" verifies automatic closure of the GWMS effluent discharge valves in the ITAAC. The principal design criteria given in 10 CFR Part 50, Appendix A establish the necessary design, fabrication, construction, testing, and performance requirements for SSCs important to safety that provide reasonable assurance that the facility can be operated without

undue risk to the health and safety of the public. Please describe the safety function of the GWMS isolation value in DCD Tier 2, Section 11.3 and identify its preoperational test in DCD Tier 2, Section 14.2.12.1.81. Please also address the same, as needed, for the LWMS dual isolation values installed on the sole discharge line to monitor and control liquid effluent releases to the environment in the corresponding DCD Tier 1 and 2 sections.

4. DCD Tier 2, Revision 2, Section 11.3.1.2 describes a design criterion on interconnections between the GWMS and other plant systems to preclude contamination of non-radioactive systems and minimize uncontrolled and unmonitored releases of radiation to the environment, but does not fully identify compliance with IE Bulletin 80-10 for the described GWMS design features. In the appropriate subsections to DCD Tier 2, Section 11.3, please identify compliance with IE Bulletin 80-10 as considered in the GWMS design. Please also address the same in DCD Tier 2, Sections 11.2, 11.4, and 11.5; and DCD Tier 2, Section 1.9.

5. Staff review of DCD Tier 2, Section 11.3 and Table 11.3-3, "Equipment Malfunction Analysis" and DCD Tier 2, Appendix 9A.3, "Fire Hazards Analysis Results" indicates that a fire hazards analysis for an external fire involving the charcoal delay beds in the GWMS located in the A/B is not evaluated. DCD Tier 2, Appendix 9A.3.129 FA4- 101, "Auxiliary Building" describes the potential for a radioactive materials release resulting from a fire within the radwaste areas. Please evaluate whether a fire due to an external source causing charcoal in the delay beds to reach auto ignition temperatures would have offsite dose consequences and discuss the results of such analysis in DCD Tier 2, Section 11.3. Please also include charcoal as a potential combustible item in DCD Tier 2, Table 9A-2, "Fire Hazard Analysis Summary (Sheet 236 of 293)" or provide justification why it should not be included in this table.

6. DCD Tier 2, Sections 11.3.2, "System Description," and 11.3.3.1, "Radioactive Effluent Releases and Dose Calculation in Normal Operation," describe the vent stack and release point design information. In DCD Tier 2, Section 11.3.3.1, the detailed design information for the vent stack is to include the height of release, stack diameter, effluent temperature and flow rate, effluent exit velocity, and the size and shape of flow orifices. The vent stack runs alongside containment and is the only release point above the top of containment for the GWMS and HVAC systems associated with the R/B, A/B, and AC/B. DCD Tier 2, Figures 9.4.3-1, "Auxiliary Building HVAC System Flow Diagram" and 9.4.5-1, "Annulus Emergency Exhaust System Flow Diagram" do not show the presence of HEPA and carbon filtration in the A/B ventilation system for gaseous effluent discharges to the environment via the plant vent stack. Please justify the absence of such filtration in the A/B ventilation system.

ANSWER:

A1
Our gaseous waste management system has no mobile or temporary equipment.
We corrected the sentences in page 14.3-21 as follows in DCD rev.3..

Verifying the performance of the gaseous waste management system (as permanently installed systems ~~or in combination with mobile processing equipment~~)

A2
MHI provided the calculation package as Technical Report MUAP-10019.

We have estimated the necessary time for degassing whole reactor coolant.
We assume that the time for degassing is equal to dissolved noble gas transfer time from reactor coolant to a gas surge tank.
As a result of working in collaboration with Japanese research institute, we found the time for degassing is over two days.
Accordingly, in the terms of time of radionuclide decay, we choose 24hr for the transfer time as conservative value.

A3
Our liquid waste management system has containment isolation valves which accomplish safety function. The applied isolation valves are located in the reactor coolant drain pump discharge line, containment sump pump discharge line, connecting line between C/V reactor coolant drain tank gas phase, vent header belongs to the gaseous waste management system and nitrogen gas supply system and connecting line between above tank gas phase and gas analyzers.
However there isn't any other safety-related function in the system except for containment isolation in liquid waste management system.
Furthermore there is no safety-related function in the gaseous system because it has no containment isolation valves.

First of all, the safety related system is defined as follows according to 10 CFR 50.2 definitions.

Safety-related structures, systems and components means those structures, systems and components that are relied upon to remain functional during and following design basis events to assure:
(1) The integrity of the reactor coolant pressure boundary
(2) The capability to shut down the reactor and maintain it in a safe shutdown condition; or
(3) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in § 50.34(a)(1) or § 100.11 of this chapter, as applicable.

We believe that appropriate item related with our liquid and gaseous waste management system is (3) and "the capability" means containment isolation function.

Therefore, this is the reason why the gaseous waste management system serves no safety function and the containment isolation valves in the liquid waste management system serve safety function.

A4

The DCD is modified as described in the mark-up attached to this document. The markups regarding the section 11.2, 11.3 and 11.4 were incorporated in the DCD revision 3(See attachment-1). The markup regarding section 11.5 will be incorporated in the next revision of the DCD(See attachment-2).

A5
As stated in DCD Table 1.9.2-11, the gaseous waste management system is complying with SRP 11.3 Acceptance Criteria 6.D. The criterion states that the system designed to operate below 4 percent hydrogen and below 4 percent oxygen should be analyzed for either hydrogen or oxygen.
The system is designed to maintain the oxygen concentration below 4 % by volume by providing sufficient dilution of nitrogen gas as described in DCD 11.3.2. Even though external fire causes the inside temperature of the charcoal beds to reach up to the auto ignition temperature of the charcoal, the charcoal doesn't explode under the oxygen concentration below 4 %. As above mentioned, the charcoal beds are not required to be included as a potential combustible items because the charcoal beds are managed to be protected from fire. Therefore, there is no increase of the gaseous effluent release due to the external fire which could affect the charcoal bed.

A6

The figures 9.4.3-1 and 9.4.5-1 of DCD chapter 9, describe the HVAC system flow diagrams related to the exhaust system of US-APWR. In the figure 9.4.3-1, all the lines coming from the different buildings are gathered to the vent stack (described in figure 9.4.5.1). All these lines are monitored before following their way right to the vent stack. But they can be routed to the containment low volume purge exhaust filtration units which are equipped with charcoal and HEPA filters in case the monitored value exceed the releases activity requirements (e.g. DCD section 9.4.3.2.1).
However in the normal operation conditions exhaust gas are routed directly to the vent stack without any filtration as it is described in figure 9.4.5-1.

As responded in the response of the Question 11.03-13 of RAI 402-3028, the gaseous doses are less than the numerical ALARA guidance given in 10 CFR 50 Appendix I (as discussed in DCD Section 11.3.3.1). Therefore, the MHI design meets the release objectives without the charcoal and HEPA filters in the auxiliary HVAC system.

Impact on DCD

In page 14.3-21 as follows.

Verifying the performance of the gaseous waste management system (as permanently installed systems ~~or in combination with mobile processing equipment~~)

Please refer to the mark-up of chapter 11 attached to this RAI.

Impact on R-COLA

There is no impact on the R-COLA

Impact on S-COLA

There is no impact on the S-COLA

Impact on PRA

There is no impact on the PRA

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

- The LWMS is designed so that no potentially radioactive liquids can be discharged to the environment unless they have first been monitored and confirmed to be within acceptable limits. Offsite radiation doses measured on an annual basis will be within the limits of 10 CFR 20 (Ref. 11.2-1) and 10 CFR 50, Appendix I (Ref. 11.2-2).

- The LWMS has cross-connections, adequate storage capabilities and the ability to connect to and return from mobile systems to accommodate anticipated waste surge volumes.

- Interconnections between the LWMS and other plant systems are designed so that contamination of non-radioactive systems are precluded and the potential for uncontrolled and unmonitored releases of radiation to the environment from a single failure are minimized. This feature meets the requirements of IE bulletin 80-10 (Ref. 11.2-25).

- Design features minimize maintenance, equipment downtime, and leakage of radioactive liquid into the building atmosphere. Table 11.2-1 details the equipment codes for design and construction as required in Table 1 of RG 1.143 (Ref. 11.2-3). The Equipment Class 6 components are designed in compliance with applicable codes and standards, and guidelines provided in RG 1.143 (Ref. 11.2-3).

- The waste collection and monitor tanks are provided with an overflow connection at least as large as the inlet. The location of the overflow is above the high-level alarm setpoint. Each cell housing these tanks is coated with an impermeable epoxy liner (coating), up to the cubicle wall height equivalent to the full tank volume, to facilitate decontamination of the facility in the event of tank leakage and failure. This design feature, in conjunction with early leak detection, drainage and transfer capabilities, serves to minimize the release of the radioactive liquid to the groundwater and environment in accordance with the BTP 11-6 (Ref.11.2-17) and 10 CFR 20.1406 (Ref.11.2-7).

- The LWMS tanks are provided with a vent piping connected to the heating, ventilation, and air conditioning (HVAC) system. (See Chapter 9, Section 9.4) with the exception of the containment vessel reactor coolant drain tank (CVDT), which is routed to the vent header in the gaseous waste management system (GWMS).

- The LWMS is designed in compliance with the as low as reasonable achievable (ALARA) principle for occupational doses. Sufficient shielding is provided for all equipment located in the radiological controlled area (RCA) that could cause unacceptable radiation doses.

- The LWMS is capable of controlling releases of radioactive material within the numerical design objectives of 10 CFR 50, Appendix I (Ref. 11.2-2).

- The LWMS is designed to meet the requirements of 10 CFR 50, Appendix A (Ref. 11.2-4) Criteria 60, 61, and 64 and the guidance of RG 1.143, (Ref. 11.2-3)

- Interconnections between the GWMS and other plant systems are designed so that contaminations of non-radioactive systems are precluded and the potential for uncontrolled and unmonitored releases of radiation to the environment from a single failure are minimized. This feature meets the requirements of IE bulletin 80-10 (Ref. 11.3-27).

- The GWMS is designed to provide redundancy and storage capacity to process anticipated surge volumes due to equipment downtime and maintenance activities.

- The GWMS design is in compliance with ANSI/ANS-55.4 (Ref. 11.3-6).

- The GWMS is designed to comply with the ALARA principle for occupational doses. Shielding is provided to the equipment cubicles for the equipment containing design basis source terms to keep doses to personnel ALARA.

- The GWMS is designed to meet the requirements of GDC 60, 61, and 64 and the guidance of RG 1.143 (Ref. 11.3-2) so that waste gases are successfully processed. The GWMS includes radiation monitors, which continuously monitor the effluents prior to release into the environment.

- In accordance with ANSI/ANS-55.4 (Ref. 11.3-6), the A/B that houses the GWMS equipment is designed to withstand the effect of OBE.

- The GWMS equipment, piping, monitors, and controls are in compliance with ANSI/ANS 55.4 (Ref. 11.3-6) and RG 1.143 (Ref. 11.3-2). The GWMS is provided with hydrogen and oxygen monitors so that a lower explosive limit is not reached.

- The GWMS is designed to process the waste gases generated from normal operation and including AOOs. Stored gas that is not reused is treated and is discharged, provided that the gas meets release criteria.

- Streams in the GWMS are monitored for both hydrogen and oxygen content so that a flammable mixture is not reached. This feature complies with 10 CFR 50 Appendix A, GDC 3 (Ref. 11.3-7) and RG 1.189 (Ref. 11.3-8).

- The GWMS is designed so that the average annual dose at the site boundary does not exceed the limits of 10 CFR 50, Appendix I (Ref. 11.3-3) during normal operation including AOOs.

- The GWMS equipment is designed, located, and shielded in accordance with RG 8.8 (Ref. 11.3-9).

11.3.1.3 Other Design Considerations

In addition to the listed design criteria, the following consideration is satisfied:

gases using design source term and design conditions that bound normal operation including AOOs. The equipment is also housed in the A/B with sufficient shielding such that the average annual dose at the site boundary from direct radiation from the gaseous sources does not exceed the limits of 10 CFR 50, Appendix I (Ref. 11.3-3). Charcoal beds significantly remove and reduce the fraction of radioactive iodine in the effluent stream. Noble gases can be stored in the gas surge tank or HTs to allow decay prior to release.

GWMS equipment is designed, located, and shielded to comply with the guidance of RG 8.8 (Ref. 11.3-9), thus maintaining occupational doses ALARA.

The GWMS includes radiation monitoring to continuously measure the radioactivity in the effluent stream prior to release into the environment to comply with the requirements of GDC 60 and 64. Additional and redundant radiation monitors are provided in the vent stack to verify the radiation level. Upon detection of radiation levels above the setpoint, the monitor activates an alarm and sends signals to close the GWMS discharge valves.

The GWMS is designed so that interconnection between plant systems precludes the contamination of non-radioactive systems and uncontrolled releases of radioactivity to the environment to meet the requirements of IE bulletin 80-10 (Ref. 11.3-27). At least two isolation valves are located between the clean and contaminated systems to minimize the potential for contamination of clean systems. This feature meets the requirements of 10 CFR 20.1406 (Ref. 11.3-10).

The design standards and materials for all GWMS structures, systems, and components (SSCs) are consistent with the specifications provided in RG 1.143 (Ref. 11.3-2). A list of the major equipment for the GWMS, including the number of units supplied, rates, process conditions, materials, and relevant design codes, is provided in Tables 11.3-2 and Figure 11.2-1 (sheet 3 of 3).

11.3.1.5 Site-Specific Cost-Benefit Analysis

The GWMS is designed to be used for any site. This report provides the justification that the design is flexible so that site-specific requirements such as preference and upgrade of technologies, degree of automated operation, and radioactive waste storage, can be incorporated into the design with minor modifications.

RG1.110 provides compliance with 10 CFR 50, Appendix I (Ref. 11.3-3) numerical guidelines for offsite radiation doses as a result of gaseous or airborne radioactive effluents during normal operations, including AOOs. The cost-benefit numerical analysis as required by 10 CFR 50, Appendix I (Ref. 11.3-3), Section II, Paragraph D demonstrates that the addition of items of reasonably demonstrated technology is not favorable or cost beneficial.

The COL Applicant is to perform a site-specific cost-benefit analysis to demonstrate compliance with the regulatory requirements.

11.3-21 U.S. Nuclear Regulatory Commission, Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants. NUREG-0133, Washington, DC.

11.3-22 Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors. Regulatory Guide 1.111, Rev. 1,July 1977.

11.3-23 Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I. Regulatory Guide 1.113, Rev. 1, April 1977.

11.3-24 Compliance with dose limits for individual members of the public. NRC Regulations Title 10, Code of Federal Regulations, 10 CFR Part 20.1302.

11.3-25 U.S. Environmental Protection Agency, "Environmental Radiation Protection Standards for Nuclear Power Operations," Protection of Environment. Title 40, Code of Federal Regulations, Part 190, Washington, DC.

11.3-26 Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors. Regulatory Guide 1.110, March 1976.

11.3-27 Contamination of Nonradioactive System and Resulting Potential for Unmonitored, Uncontrolled Release of Radioactivity to Environment, U.S. Nuclear Regulatory Commission, IE Bulletin No. 80-10, May 6, 1980.

11.3-28 Calculation Methodology for Radiological Consequences in Normal Operation and Tank Failure Analysis, MUAP-10019-P Rev. 1 (Proprietary) and MUAP-10019-NP Rev. 1 (Non-proprietary), March 2011.

- The SRSTs are cross-connected so that the failure or maintenance of one component does not impair the system or the plant operation. Table 11.4-5 provides typical failure scenarios. The spent resin storage tanks (SRSTs) are housed in individual cubicles, each with a shield wall thickness commensurate with the projected maximum dose rate of its content. The cubicles that contain significant quantities of radioactive material are coated with an impermeable epoxy liner (coating), up to the cubicle wall height equivalent to the full tank volume, to facilitate decontamination of the facility in the event of tank leakage and failure. This design feature, in conjunction with early leak detection, drainage and transfer capabilities, serves to minimize the release of the radioactive liquid to the groundwater and environment in accordance with the BTP 11-6 (Ref. 11.4-32) and 10 CFR 20.1406 (Ref. 11.4-16). As an additional precaution, the COL Applicant is also required to provide an environmental monitoring system (Section 11.5.5). Other design features addressing release requirements are described in Section 11.2

- Interconnections between the SWMS and other plant systems are designed so that contaminations of non-radioactive systems are precluded and the potential for uncontrolled and unmonitored releases of radiation to the environment from a single failure are minimized. This feature meets the requirements of IE bulletin 80-10 (Ref. 11.4-29).

- Storage is provided to facilitate radioactive decay of spent resin and to provide adequate holding in the case of a delay in processing due to maintenance and/or a delay in transportation for disposal.

- Any liquids and gases generated from the operation of the SWMS are processed by the LWMS (Section 11.2) and plant ventilation system (Chapter 9, Section 9.4). Based on typical PWR experience, a small quantity of sludge and oily waste is expected to be generated. Sludge is stabilized and transported to a disposal facility. Oily waste is collected and sent to appropriately licensed offsite vendors for processing and disposal.

- Collection, processing, packaging, and storage of radioactive wastes is performed to maintain any potential radiation dose to plant personnel ALARA in accordance with RG 8.8 (Ref. 11.4-2) and within the limits of 10 CFR 20 (Ref. 11.4-3). Some of the design features incorporated to maintain exposure levels ALARA include remote system operation and remotely actuated flushing, and an equipment layout that shields personnel from components containing radioactive materials.

- The SWMS is designed to package radioactive wastes in accordance with 10 CFR 61 (Ref. 11.4-4) and the applicable portions of 10 CFR 60 (Ref 11.4-5) and 10 CFR 63 (Ref. 11.4-6). The containers meet the requirement of 49 CFR 171 (Ref. 11.4-7). Solid wastes are processed and packaged for transportation and disposal according to the requirements specified in 49 CFR 173, Subpart I (Ref. 11.4-8).

- Sufficient onsite storage is provided to hold solid waste for at least 30 days in accordance with ANSI 55.1 (Ref. 11.4-9).

monitoring and sampling of radioactive iodine and particulates in gaseous effluents from all potential accident release points are performed.

- Provide monitoring capability for in-plant radiation and airborne radioactivity for a broad range of routine and accident conditions in accordance with the requirements of 10 CFR 50.34(f)(2) (xvii) and 50.34(f)(2)(xxvii) (Ref. 11.5-4).

- Provide monitoring and sampling capabilities to assure plant systems operate as they are designed and installed in accordance with the requirements of 10 CFR 52.47(b)(1) (Ref. 11.5-9).

- Provide capabilities to detect, monitor, quantify, and identify leakage into the containment from the RCS in accordance with the requirements of RG 1.45 (Ref. 11.5-31) and ANSI N42.18-2004 (Ref. 11.5-11).

The process and effluent radiological monitoring and sampling system described herein is used for detailed design. The process and effluent radiological monitoring and sampling system is designed to meet the applicable requirements of ANSI N13.1-1999 (Ref. 11.5-10), ANSI N42.18-2004 (Ref. 11.5-11), RG 1.21 (Ref. 11.5-12), RG 1.33 (Ref. 11.5-17), RG 1.97 (Ref. 11.5-13), RG 4.15 (Ref. 11.5-14), NUREG-0718 (Ref. 11.5-32), NUREG-0800 BTP 7-10, ~~and~~ NUREG-0800 Appendix 11.5-A (Ref. 11.5-15) and IE bulletin 80-10 (Ref. 11.5-36).

11.5.2 System Descriptions

11.5.2.1 Process and Effluent Radiological Monitoring and Sampling System

The process and effluent radiological monitoring and sampling [illegible] various distributed sets of radiation monitors each of which con[illegible]rs, detectors, and a radiation processor, with the exception of line monitors which have no sampling component. Each sample collector and the associated radiation detector, contained in one integral unit is shielded to minimize radiation from background and adjacent equipment. This design consideration is in conformance with the RG 1.45 requirement to minimize the effect of local ambient radiation. The radiation detectors send information to the radiation processors, which are used to determine the concentration of radioactive material in the monitored stream. The processor serves as the data collection center where data is received, processed, and stored. Additionally, the processor maintains a continuous display of the radiation levels for each monitored system and transmits alarm signals in the event that radiation levels exceed the predetermined setpoints. Data and alarm signals are transmitted to the MCR and made accessible to plant operators, in conformance with the requirements of RG 1.45.

The process and effluent radiological monitoring and sampling system measures, analyzes, and displays the radioactivity levels for the main process and effluent streams as described below.

- Liquid process streams that are radioactive or have the potential of becoming radioactive from cross-contamination

11.5-23 Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors. Regulatory Guide 1.111, Rev. 1,July 1977.

11.5-24 Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I. Regulatory Guide 1.113, Rev. 1, April 1977.

11.5-25 Deleted

11.5-26 Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable. Regulatory Guide 8.8.

11.5-27 Operating Philosophy for Maintaining Occupational Radiation Exposures as Low as Is Reasonably Achievable. Regulatory Guide 8.10, May 1977.

11.5-28 Occupational dose limits for adults. NRC Regulations Title 10 Code of Federal Regulations, 10 CFR Part 20.1201.

11.5-29 Compliance with requirements for summation of external and internal doses. NRC Regulations Title 10 Code of Federal Regulations, 10 CFR Part 20.1202.

11.5-30 NEI 07-09A, "Generic Template Guidance for Offsite Dose Calculation Manual Program Description," Revision 0.

11.5-31 Guidance on Monitoring and Responding to Reactor Coolant System Leakage. Regulatory Guide 1.45, Revision 1, May 2008.

11.5-32 U.S. Nuclear Regulatory Commission, Licensing Requirements for Pending Applications for Construction Permits and Manufacturing Licenses, NUREG-0718.

11.5-33 Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors. Regulatory Guide 1.110, March 1976.

11.5-34 IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations, IEEE Std 603-1991.

11.5-35 Electric Power Research Institute, "PWR Primary-to-Secondary Leak Guidelines," Rev 3, December 2004.

11.5-36 U.S. Nuclear Regulatory Commission, Contamination of Nonradioactive System and Resulting Potential for Unmonitored, Uncontrolled Release of Radioactivity to Environment, IE Bulletin No. 80-10, May 6, 1980.