Enclosure 2

MFN 15-003

GEH Response to RAIs 12.02-2 and 12.02-3

ABWR DCD DRAFT Revision 6 Markups

Table 3.2a Plant Shielding Design (Continued)

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
3. (continued)	3. (continued) a. Liquid containing systems: 100% of the core equilibrium noble gas inventory, 50% of the core equilibrium halogen inventory and 1% of the equilibrium core inventory of the remaining radionuclides are assumed to be mixed in the reactor coolant and recirculation liquids recirculated by the Residual Heat Removal (RHR) System, the High Pressure Core Flooder (HPCF) System, and the Reactor Core Isolation Cooling (RCIC) System. b. Gas containing systems: 100% of the core equilibrium noble gas inventory and 25% of the core equilibrium halogen activity are assumed to be mixed in the containment atmosphere. For vapor containing systems (such as the main steam lines), these core inventory fractions are assumed to be contained in the reactor coolant vapor space.	3. (continued) For areas requiring continuous occupancy (such as the main control room, technical support center, and emergency operations support center), design dose rates shall not exceed 150 μSv/h (averaged over 30 days).
Design Commitment	**Inspections, Tests, Analyses**	**Design Acceptance Criteria**
41. The plant design shall provide radiation shielding to protect the general public outside of the controlled area.	41. Using the methods identified in (1) above, the radiation dose to the maximally exposed member of the general public outside of the controlled area from direct and scattered radiation shine shall be determined.	41. As a result of normal operations, the radiation dose from direct and scattered radiation shine to the maximally exposed member of the public outside of the controlled area is equal to or less than 25 μSv/year.

Table 1.9-1 Summary of ABWR Standard Plant COL License Information (Continued)

Item No.	Subject	Subsection
9.28	Plant Security System Criteria	9.5.13.11
9.29	Not Used	9.5.13.12
9.30	Diesel Fuel Refueling Procedures	9.5.13.13
9.31	Portable and Fixed Emergency Communication Systems	9.5.13.14
9.32	Identification of Chemicals	9.5.13.15
9.33	NUREG/CR-0660 Diesel Generator Reliability Recommendations	9.5.13.16
9.34	Sound-Powered Telephone Units	9.5.13.17
9.35	Fire-Related Administrative Controls	9.5.13.18
9.36	Periodic Testing of Combustion Turbine Generator (CTG)	9.5.13.19
9.37	Operating Procedures for Station Blackout	9.5.13.20
9.38	Quality Assurance Requirements for CTG	9.5.13.21
10.1	Low Pressure Turbine Disk Fracture Toughness	10.2.5.1
10.2	Turbine Design Overspeed	10.2.5.2
10.3	Turbine Inservice Test and Inspection	10.2.5.3
10.4	Procedures to Avoid Steam Hammer and Discharge Loads	10.3.7.1
10.5	MSIV Leakage	10.3.7.2
10.6	Radiological Analysis of the TGSS Effluents	10.4.10.1
11.1	Plant-Specific Liquid Radwaste Information	11.2.5.1
11.2	Compliance With Appendix I to 10CFR50	11.3.11.1
11.3	Plant-Specific Solid Radwaste Information	11.4.3.1
11.4	Calculation of Radiation Release Rates	11.5.6.1
11.5	Compliance with the Regulatory Shielding Design Basis	11.5.6.2
11.6	Provisions for Isokinetic Sampling	11.5.6.3
11.7	Sampling of Radioactive Iodine and Particulates	11.5.6.4
11.8	Calibration Frequencies and Techniques	11.5.6.5
12.1	Regulatory Guide 8.10	12.1.4.1
12.2	Regulatory Guide 1.8	12.1.4.2
12.3	Occupational Radiation Exposure	12.1.4.3
12.4	Regulatory Guide 8.8	12.1.4.4
12.5	Compliance with 10CFR20 and 10CFR50 Appendix I	12.2.3.1
12.5a	Condensate Storage Tank Source Term and Shielding	12.2.3.2

11.2 Liquid Waste Management System

Additional Liquid Radwaste System information is provided in Section 11A.2.

11.2.1 Design Basis

11.2.1.1 Design Objective

The Liquid Radwaste System is designed to segregate, collect, store, and process potentially radioactive liquids generated during various modes of typical plant operation: startup, normal operation, hot standby, shutdown, and refueling. The system is designed such that it may be operated to maximize the recycling of water within the plant, which would minimize the releases of liquid to the environment. Maximizing recycling serves to minimize the potential for exposure of persons in unrestricted areas from the liquid release pathway.

11.2.1.2 Design Criteria

The criteria considered in the design of this system include (1) minimization of solid waste shipped for burial, (2) reduction in personnel exposure, (3) minimization of offsite releases, and (4) maximizing the quality of water returned to the primary system.

Per General Design Criterion 60 of 10CFR50 Appendix A, the Radwaste System design includes means to suitably control the release of radioactive materials in gaseous and liquid effluents and to handle radioactive solid wastes produced during normal reactor operation, including anticipated operational occurrences. These operational occurrences include condenser leakage, maintenance activities, and process equipment downtime. The Liquid Radwaste System provides one discharge line to the canal. Radiation monitoring equipment is placed on this line to measure the activity discharged and to assure that specified limits are not exceeded. A high radiation signal from this monitor will close the discharge valve. The single discharge line is fed by the hot shower drain (HSD) sample tanks (a very low level radioactivity source) or one of the two sample tanks which usually contain condensate quality water.

In addition to providing a means for a controlled (i.e., batch) discharge, the sample tanks also function as surge tanks to minimize or delay the offsite discharge of liquid volume for which there is no immediate room available in condensate storage. By adminisrative control, the discharge from this single discharge line to the canal is adjusted so that it can be shown that the discharge will meet the requirements of 10CFR20 on concentration limit and Appendix I of 10CFR50.

Means are provided for monitoring effluent discharge paths that may be released from normal operations, including anticipated operational occurrences and from postulated accidents. The monitoring of liquid release as required by GDC 64 is accomplished in two steps. First, the sources of release are only from either the HSD sample tank or the LCW sample tanks. These tanks have the necessary connections to the sampling system to allow analysis prior to discharge.

The Liquid Radwaste System is designed to treat process liquids with radionuclide concentrations associated with the design basis fuel leakage and produce water suitable for recycle to condensate storage. Plant water balance considerations may require the discharge of processed liquids to the environs, in which case concentrations of radionuclides in the effluent will meet the requirements of 10CFR20. Radiation exposure to persons in unrestricted areas resulting from liquid waste discharged during normal operation and anticipated operational occurrences will be less than the values specified in 10CFR50, Appendix I. Liquid discharge to the canal may be initiated from only one sample tank at a time. The discharge sequence is initiated manually. No single error or failure will result in discharge. The design will maintain occupational exposure as low as practicable in accordance with NRC Regulatory Guide 8.8 while operating with the design basis fuel leakage.

The low conductivity waste (LCW) filters, mixed-bed demineralizers and concentrators are pressure vessels. The collection and sample tanks operate at atmospheric pressure.

The Liquid Radwaste System is essentially a manual-start and automatic-stop process. Process and radiation instruments are described in Section 11.5. The instrumentation allows for the initiation of processing from the shielded control room area. To ensure that the system performs its intended function in the event of failure of key components, redundancy is provided.

Input to parallel tankage is a feature of the design. Upon high level signals, inputs are automatically routed to a parallel tank. If input should continue, high-high level results in annunciation in the radwaste control room. The state of system operation such as water level of tanks, position of valves and pump operating condition are continuously shown on the radwaste system control panels. The operator will be able to see the changes in the system when the automatic transfer has occurred. Where practical, individual tanks and process equipment are located in separately shielded rooms. Pumps and valves in general are located in dedicated operating galleries. Piping to and from these pumps and valves penetrate shield walls only to the extent necessary to connect to the process equipment. Runs of piping between process equipment are contained either within the shielded areas or shielded pipe runs so that operating personnel exposure is kept to a minimum.

The Condensate storage tank, which is located outdoors, has liquid level monitoring with alarms in the control room. The tank overflows, drains and sample lines are routed to the radwaste system. A dike is provided around the tank to prevent runoff in the event of a tank overflow. A drain within the dike is routed to the radwaste system. The structure for the transfer pumps will be integrated in the dike, as well as the interfaces with any pipe chases or guard pipes. The buried portion of the condensate storage tank piping will be enclosed within a pipe chase or a guard pipe and monitored for leakage.

All tanks located outside reactor containment and containing radioactive liquids are indoors and are provided with liquid level monitoring and high liquid level conditions are alarmed locally and in the main control room. All Tank overflows, drains and sample lines are sent to the radwaste system. All tanks have curbs or elevated thresholds with floor drains routed to the from the probe and cable. Since there are two specific types of probes (a neutron and a gamma), both types are described in Table 12.2-24.

12.2.1.2.9.4 Radioactivity in the Reactor Internal Pumps

The reactor internal pumps (RIP) are located on the lower exterior portion of the pressure vessel and connect to an impeller located in the pressure vessel. A constant flow of clean water is maintained from the pump into the pressure vessel to minimize contamination of the lower pump housing and components. A complete description of the internal pump is given in Subsection 5.4.1. Contamination of the pump nevertheless occurs primarily on the upper impeller and components and to a lesser extent throughout the water bearing components into the lower pump housing. Table 12.2-25 presents the expected levels of contamination based upon operating experience.

12.2.1.2.9.5 Radioactivity in the Standby Gas Treatment System

The Standby Gas Treatment System (SGTS) is described in Section 6.5. For the determination of the potential activity associated with the operation of the SGTS, the primary containment source term developed in Subsection 12.2.2.1 for Table 12.2-19 was used as the basis for input to the SGTS. Six purges per year were assumed with a SGTS replacement lifetime of five years. The inventory is given in Table 12.2-30.

12.2.1.2.9.6 Radioactivity in the Condensate Storage Tank

The COL applicant shall determine the CST source term information (including source geometry) and provide adequate shielding to ensure the dose rate in the area surrounding the CST is ≤ 6 μSv/hr, thus maintaining a radiation zone A which allows for uncontrolled, unlimited access to the area surrounding the CST (see Subsection 12.2.3 for COL license information).

12.2.1.2.10 Post-accident Radioactive Sources

The ABWR general design criteria limit potential radiation exposure from accidents both to plant personnel and to the public by the use of containment and treatment of accident sources. The following describes those features of the ABWR germane to post- accident radiation sources in the Primary Containment, Reactor Building, Radwaste Building, and the Turbine Building.

The Primary Containment is an inerted steel-lined pressure boundary capable of containing all accident sources with minimal leakage to the environment or other plant areas. Sufficient redundancy in the ECCS and spray systems exists to insure, within a reasonable probability, that this primary boundary will not exceed design criteria. In the case of a degraded core event, additional passive features such as the suppression pool and passive flooder system have been incorporated to flood the containment and scrub airborne fission products. Therefore, for all but

Guides 1.109 and 1.111 as implemented in References 12.2-8 and 12.2-9. Results of the airborne evaluations are given in Table 12.2-21. For the ingestion doses given in Table 12.2-21, ingestion values given in Table E-5 of Regulatory Guide 1.109 were used. COL applicants need to update the airborne dose calculations to conform to the as-designed plant and site-specific meteorology (see Subsection 12.2.3 for COL license information).

The evaluations above provide airborne sources and offsite doses for compliance with 10CFR50 Appendix I. For complete evaluations for compliance to 40CFR190, gamma shine evaluations are not contained in this document, since adequate detail for skyshine evaluations from the turbine complex are required in DAC Table 3.2.

12.2.2.5 Liquid Releases

The ABWR is designed not to release radioactive liquid effluents. However, under certain conditions of high water inventory, up to 3.7 GBq per year, excluding tritium, may be released as described in Subsection 11.2.3. These releases are given in Table 12.2-22 and form the basis for estimating doses using methodologies consistent with Regulatory Guide 1.113 as implemented in Reference 12.2-10. The results of the liquid release, assuming dilution factors described in Subsection 11.2.3.2, are shown in the dose evaluation in Table 12.2-23. COL applicants need to update the liquid dose analysis to conform to the as-designed plant and site-specific parameters (see Subsection 12.2.3 for COL license information).

12.2.3 COL License Information

12.2.3.1 Compliance with 10CFR20 and 10CFR50 Appendix I

The COL applicant will re-evaluate the average annual airborne releases and the average annual liquid releases to the environment for the final plant design and site parameters for conformance to 10CFR20 and 10CFR50 Appendix I (Subsections 12.2.2.4 and 12.2.2.5).

12.2.3.2 Condensate Storage Tank Source Term and Shielding

The COL applicant shall determine the CST source term information (including source geometry) and provide adequate shielding to ensure the dose rate in the area surrounding the CST is ≤ 6 μSv/hr, thus maintaining a radiation zone A which allows for uncontrolled, unlimited access to the area surrounding the CST (Subsection 12.2.1.2.9.6).

12.2.4 References

12.2-1 J.E. Smith, “Noble Gas Experience in Boiling Water Reactors”, Paper No. A-54, presented at Noble Gases Symposium, Las Vegas, Nevada, September 24, 1974.

12.2-2 “Airborne Releases from BWRs for Environmental Impact Evaluations”, NEDO-21159-2 (1977).

Table 12.2-5a Radiation Sources— Radiation Sources (Continued)

Source Table	For	Drawing	Location	Approximate Geometry
12.2-15.10	Sol Condenser	12.3-40	ITEM 57	Rt Cylndr (r=0.2m, l=1.4m)
12.2-15.11	Sol Drum	12.3-39	(2,D)	Rt Cylndr (r=0.3m, l=0.8m) Box (1.5mx1.5mx1m)
12.2-16	FPC Filter Demineralizer	12.3-3	(R2,RB)	Rt Cylndr (r=0.7m, l=3.4m)
12.2-17	Suppression Pool Cleanup System*	12.3-3	(R2,RA)	Rt Cylndr (r=0.7m, l=3.4m)
12.2-18	Control Rod Drive System†	12.3-2	(R4,RF)	Distributed Source
12.2-24	Traversing Incore Probe	12.3-2	(R4,RB)	Distributed Source
12.2-25	Reactor Internal Pumps‡	12.3-2	(RF,R1)	Distributed Source
12.2-25	RIP Heat Exchanger	1.2-3b	El 3000	Rt Cylndr (r=0.322m, l=2.9m)
12.2-26	Turbine Moisture Separator/Reheater	12.3-52	(T6,TE)	Rt Cylndr (r=1.8m, l=31.m)
12.2-27	Turbine Condenser	12.3-53	(TD,TG)	Distributed Source
12.2-28	Condenser Filter/ Demineralizer			
	Filter	12.3-51	(TC,T2)	3 Tanks, Rt Cylndr(r=1.4m, l=6.1m)
	Demineralizer	12.3-51	(TC,T3)	6 Tanks, Rt Cylndr(r=1.7m, l=5.1m)
12.2-30	SGTS Filter Train	12.3-7	(R2,RB)	Surface, (3.66m x 2.54m)ƒ
Applicant	Spent Fuel Storage	12.3-6	(R4,RF)	See Drawings
Applicant	Condensate Storage Tank	12.3-50	NA	See Drawing

* Suppression pool clean up F/D uses second of Fuel Pool F/D

† Maintenance Facility

‡ Maintenance Facility, see Figure 1.2-3b Elevation 3000 for drywell location

ƒ Surface area of HEPA and charcoal filter