12.4 Dose Assessment

The information in this section of the reference ABWR DCD, including all subsections and tables, is incorporated by reference with the following departures and supplements.

STD DEP Admin (Table 12.4-1)

STD DEP 9.1-1

STD DEP 11.2-1 (Table 12.4-1)

12.4.1 Drywell Dose

STD DEP Admin

The following provides the basis by which the drywell dose estimates for occupational exposure were made.

(1) *Early studies on dose rates during MSIV maintenance showed increases in dose rate directly proportional to recirculation line activity. The ABWR has deleted the recirculation lines entirely, thereby removing the singly most significant source of radiation in the drywell. The second most significant dose for MSIV operations will be the deposited and suspended activity in the feedwater lines. The deposited activity in the feedwater lines is expected to be lower than typical BWRs owing to an enhanced condensate* polishing *system ~~with full cleanup of all condensate water~~, a 2% CUW System, and titanium* or stainless steel *condenser tubes. Additionally, the ABWR is designed to limit the use of cobalt bearing materials on moving components which have historically been identified as major sources of in-water contamination. Overall, the feedwater line radiation is expected to be a factor of three lower than current BWRs. Because of these factors, it is expected that the effective dose rate in the drywell will be 18 ~~μGy/h~~*μSv/h *and 13 ~~μGy/h~~*μSv/h *in the steam tunnel outboard of the primary containment.*

12.4.2 Reactor Building Dose

STD DEP 9.1-1

STD DEP Admin

The following provides the basis by which the Reactor Building dose estimates for occupational exposure were made.

(2) *ABWR refueling is accomplished via an automated refueling ~~bridge~~* machine*. All operations for refueling are accomplished ~~from an enclosed automation center off the refueling floor~~* as described in Section 9.1.4.2.7.1*. Time for refueling is reduced from a typical 4,400 person-hours down to 2,000 person*-hours *and from an effective dose rate of 25 ~~μGy/h~~*μSv/h *to less than 2 ~~μGy/h~~*μSv/h*.*

The following supplement addresses operator doses based on spent fuel movement operations. Refer to supplemental information provided in Tables 12.2-5a and 12.2-5b for Spent Fuel Storage, and Appendix 12B.

The dose rate from the highest activity irradiated fuel bundle elevated to the maximum up-position in the spent fuel pool (SFP) with water coverage of 8.5 ft (2.6 m) from the top of the fuel assembly active fuel was calculated. The dose rate at the refueling machine trolley platform 8.8 ft (2.7 m) above the refueling floor is approximately 1.2 mrem/hr (12 µSv/hr). This dose rate of 1.2 mrem/hr (12 µSv/hr) is conservative because of the additional 1 ft (0.3 m) of air space between the water surface and refueling floor, and the attenuation through the refueling machine lower structure and platform. Additionally, it is below the criteria of 2.5 mrem/hr from an irradiated fuel unit, control component, or both, as required by ANSI/ANS-57.1-1992. Note that this value does not include dose from radionuclides contained in Spent Fuel Pool water, which is expected to be no greater than 0.7 mrem/hr at approximately 1.2 meters above the refueling floor, based on data from currently operating plants utilizing the ABWR spent fuel pool design. This value takes no credit for attenuation through refueling machine construction material or the additional distance to the refueling machine trolley platform, which adds additional conservatism.

12.4.3 Radwaste Building Dose

STD DEP 11.2-1

This subsection is replaced in its entirety with the following.

Radwaste Building work consists of water processing, pump and valve maintenance, shipment handling, radwaste management, and general cleanup activity. Radwaste building doses result from routine surveillance, testing, and maintenance of the solid and liquid waste treatment equipment. The liquid treatment system collects liquid wastes from equipment drains, floor drains, filter backwashes, and other sources within the facility. The solid treatment system processes resins, backwash slurries, and sludge from the phase separator. It also processes dry active waste from the plant. Some examples of radwaste activities include resin dewatering, movement of casks and liners, filter handling, resin movement, and installation and removal of mobile radwaste processing skids. Both waste treatment systems are based on current mobile radwaste processing technology and avoid complex permanently installed components. All radwaste tankage and support systems are permanently installed. More of the radwaste operations involve remote handling than in a typical BWR. This more flexible radwaste system and building design, simpler operation, and improved maintenance procedures result in a reduction in the number of total hours in the Radwaste Building radiation areas. The results of an industry assessment indicate that there was a substantial reduction in radiation dose (one plant experienced a factor of eight reduction in radiation dose) relative to the doses specified in the reference DCD. Based on this experience, it is estimated that the departures involving the Liquid Waste Management System (LMWS) will result in a reduction of the Radwaste Building annual radiation dose by a factor of approximately four (Reference 12.4-5). The average radiation dose rate to workers is assumed to be the same as specified in the reference DCD and the number of hours in the Radwaste Building radiation areas is changed from 4200 hours per year to 1000 hours per year. This results in a radiation dose associated with the Radwaste Building of 25 person-mSv/year (approximately a factor of four reduction), a total of 54,040 hours per year in radiation areas, and a total radiation exposure of 909 person-mSv/year. This is presented in Table 12.4-1.

12.4.5 Work at Power

STD DEP Admin

*Work at power typically requires 5,000 hours per year at an effective dose rate of 66 ~~μGy/h~~*μSv/h *for the BWR. This category covers literally all aspects of plant maintenance performed during normal operations from health physics coverage to surveillance, to minor equipment adjustment, and minor equipment repair. Overall, the ABWR has been designed to use more automatic and remote equipment. It is expected that items of routine monitoring will be performed by camera or additional instrumentation. Most equipment in the ABWR is palatalized, which permits quick and easy replacement and removal for decontamination and repair. Therefore, a reduction in actual hours needed at power is estimated at 1,000 hours less than the typical value. In the area of effective dose rate, the ABWR is expected to have significantly lower general radiation levels over current plants, owing to more stringent water chemistry controls, a full flow condensate flow system, a 2% cleanup water program, titanium* or stainless steel *condenser tubes, Fe feedwater control, and low cobalt usage. In addition, the ABWR has in the basic design, compartmentalized all major pieces of equipment so that any piece of equipment can be maintained or removed for maintenance without affecting normal plant operations. This design concept thereby reduces radiation exposure to personnel maintaining or testing one piece of equipment from both shine and airborne contamination from other equipment. Finally, the ABWR has incorporated in the basic design the use of hydrogen water chemistry (HWC) and the additional shielding necessary to protect from the factor of six increase in N-16 shine produced through the steamlines into the Turbine Building. For normally occupied areas, sufficient shielding is provided to protect from N-16 shine. In areas which may be occupied temporarily for specific maintenance or surveillance tasks and where additional shielding is not appropriate (for the surveillance function) or deemed reasonable, the HWC injection can be stopped causing the N-16 shine to decrease to within normal operating BWR limits within 90 seconds and thus permitting those actions needed. Overall, it is estimated that the effective dose rate for work at power will be slightly over two thirds the typical rate or 40 ~~μGy/h~~*μSv/h*.*

12.4.6 References

12.4-5 “Performance Evaluation of Advanced LLW Liquid Processing Technology, Boiling Water Reactor Liquid Processing” EPRI Technical Report 1003063, November, 2001.

Table 12.4-1 Projected Annual Radiation Exposure

Operation Task	Tier 2 Section	hours per year	~~µGy/h~~ µSv/h	person-mSv/yr
Drywell				
MSIV	12.4.1(1)	~4,200	15	63
SRV, RIP, etc	12.4.1(2)	1,150	75	86
FMCRD	12.4.1(3)	370	65	24
LPRM/TIP	12.4.1(4)	200	500	100
ISI	12.4.1(5)	1,200	55	66
Other	12.4.1(6)	3,500	35	123
Total		10,620		462
Reactor Building				
Vessel	12.4.2(1)	1,200	15	18
Refueling	12.4.2(2)	2,000	2	4
RHR/CUW	12.4.2(3)	400	54	22
FMCRD	12.4.2(4)	120	45	5
Instrument	12.4.2(5)	1,000	30	30
Other	12.4.2(6)	4,400	15	66
Total		9,120		145
Radwaste Building	12.4.3	~~4200~~ **1,000**	25	~~105~~ **25**
Turbine Building				
Valve Maintenance	12.4.4(1)	1,000	39	39
Turbine Overhaul	12.4.4(2)	15,500	2	31
Condensate	12.4.4(3)	1,000	35	35
Other	12.4.4(4)	11,800	1	12
Total		29,300		117
Work at Power	12.4.5	4,000	40	160
Totals		~~57,240~~ **54,040**		~~989~~ **909**