ATTACHMENT 1

ABB-CE TRANSMITTALS OF CESSAR-DC

REVISIONS PRINTED IN AMENDMENT K

LD-91-012	3/15/91
LD-91-066	12/17/91
LD-92-006	1/24/92
LD-92-007	1/24/92
LD-92-016	2/12/92
LD-92-020	2/14/92
LD-92-024	2/18/92
LD-92-050	4/15/92
LD-92-063	4/30/92
LD-92-078	6/15/92
LD-92-113	11/18/92

ATTACHMENT 2

<u>CESSAR-DC CHANGES IN AMENDMENT K</u>

<u>NOT PREVIOUSLY TRANSMITTED</u>

Summary of Attachment 2

Chapter 1: Minor changes were made to the general arrangement drawings in Section 1.2, based on an internal consistency review. These changes do not impact the response to any RAI or DSER open item.

Chapter 3: A small sub-section was added to Section 3.5 to indicate why no missiles are postulated to be genereated by the emergency feedwater pump turbines.

Chapter 4: Minor changes were made to Section 4.5 to clarify materials specifications, based on an internal integrated review of CESSAR-DC. It is noted that the change to the material inspection program is also the subject of DSER issues.

Chapter 6: Changes were made to Section 6.2.5 (Combustible Gas Control In Containment) to address NRC staff comments made during preparation of the DSER and to address integrated review comments.

Chapter 9: Section 9.4.5 was revised to reflect an increased capacity for the subsphere ventilation system. Section 9.5 was revised to reflect NRC comments on diesel generator support systems which arose during preparation of the DSER.

Chapter 11: Revisions were made to remove powdex-technology components from the Solid Waste Management System in order to be compatible with the bead resin of the condensate polishers in Chapter 10. The ALWR Utility Requirements Document requires bead resin for the condensate polishers.

Chapter 12: Changes were made to provide additional detail on design features for radiation protection in response to NRC comments made during preparation of the DSER. Changes were also made to reflect a lower source term due to removal of the powdex equipment from the Solid Waste Management System.

Appendix A: A minor change was made to the resolution of USI A-45 to indicate that containment isolation will be initiated upon detection of loss of decay heat removal.

Enclosure 1

DRAWING NUMBER	REVISION NUMBER
4248-00-1607.00-G001-01	2
4248-00-1607.00-G200-01	2
4248-00-1607.00-G200-02	2
4248-00-1601.00-G200-02-01	1
4248-00-1607.00-G200-03	2
4248-00-1607.00-G200-04	2
4248-00-1607.00-G200-05	2
4248-00-1607.00-G200-06	2
4248-00-1607.00-G200-07	2
4248-00-1607.00-G200-09	2
4248-00-1607.00-G200-10	2
4248-00-1607.00-G200-11	2
4248-00-1607.00-G200-12	2

These general arrangement drawings are in CESSAR-DC, Section 1.2. Revisions are minor and do not reflect significant design changes.

D. Industry pump designs are such that (and service history shows) no occurrences of impeller pieces penetrating pump casings.

← Add Insert 1

3.5.1.1.~~2~~3 **Valves**

There are no missiles postulated from valves for the following reasons:

A. All valve stems are provided with a backseat or shoulder larger than the valve bonnet opening.

B. Motor operated and manual valve stems are restrained by stem threads.

C. Operators on motor, hydraulic and pneumatic operated valves prevent stem ejection. D

D. Pneumatic operated diaphragms and safety valve stems are restrained by spring force.

E. All valve bonnets are either pressure sealed, threaded or bolted such that there is redundant retention for prevention of missile generation.

3.5.1.1.~~3~~4 **Pressure Vessels**

All pressurized vessels are considered moderate energy (275 psig) or less and are designed and constructed to the standards of the ASME Code. In addition to the ASME Code examination and testing requirements, all vessels will receive periodic in-service inspections. Where appropriate, these components are provided with pressure relief devices to ensure that no pressure buildup will exceed material design limits.

On this basis, moderate energy pressure vessels are not considered credible missile sources.

3.5.1.2 <u>Internally Generated Missiles (Inside Containment)</u>

Table 3.5-1 lists postulated missiles from equipment inside containment, and summarizes their characteristics. Included are major pretensioned studs and nuts, instruments, and the CEDM missile. Other items which were considered and specifically excluded because of redundant retention features are valve stems, valve bonnets and pressurized cover plates.

3.5.1.1.2 Emergency Feedwater Pump Turbines

There are no postulated missiles from the Emergency Feedwater (EFW) pump turbines for the following reasons:

A. Turbine overspeed protection; electrical trip at 115% of rated speed, and mechanical trip at 125% of rated speed.

B. Assurance of turbine disk integrity by design and inspection.

C. Enclosure of the EFW pumps and turbine drivers in a reinforced concrete room.

9/23/92 change

The following is a list of the major components of the reactor internals together with their material specifications:

A. Core support barrel assembly

1. Type 304 austenitic stainless steel to the following specifications:

a. SA- ~~ASTM-A~~-182
~~b. ASTM-A-213~~
b. ~~c.~~ SA ~~ASTM-A~~-240
c. ~~d.~~ SA ~~ASTM-A~~-479

2. Precipitation hardened stainless steel to the following specifications:

a. SA ~~ASTM-A~~-453, Grade 660
b. SA ~~ASTM-A~~-638, Grade 660

B. Upper guide structure assembly

1. Type 304 austenitic stainless steel to the following specifications:

a. SA ~~ASTM-A~~-182
b. SA ~~ASTM-A~~-240
c. SA ~~ASTM-A~~-213
d. SA ~~ASTM-A~~-479

D

2. Precipitation hardened stainless steel to the following specification:

a. SA ~~ASTM~~-A-638, Grade 660

3. Type 347 austenitic stainless steel to the following specifications:
a. SA-479
b. SA-312

C. Core shroud assembly

1. Type 304 austenitic stainless steel to the following specifications:

a. SA ~~ASTM-A~~-182
b. SA ~~ASTM-A~~-240

D. Holddown ring

SA-182 ALLOY F6NM

D

Latest change 9/11/92

* SPECIAL PURPOSE MATERIAL

SA 479 S 21800 (TRADE NAME NITRONIC 60) IS USED FOR SPECIAL APPLICATIONS WHERE ANTI-GALLING PROPERTIES ARE DESIRED.

E. Bolt and pin material

ASTM-A-453 and ASTM-A-638, Grade 660 material (trade name A-286) is used for bolting and pin applications. This alloy is heat treated in accordance with the ASTM specifications by precipitation hardening at 1300-1400°F for 16 hours to a minimum yield strength of 85,000 psi. Its corrosion properties are similar to those of the Type 300 series austenitic stainless steels. It is austenitic in all conditions of fabrication and heat treatment. This alloy was used for bolting in previous reactor systems and test facilities in contact with primary coolant and has proven completely satisfactory. D

~~F.~~ G. Chrome plating and hardfacing

F. ADD *

Chrome plating or hardfacing are employed on reactor core support and internals structures, components or portions thereof where required by function. Chrome plating complies with Federal Specification No. QQ-C-320. The hardfacing material employed is Stellite 25. D

All of the materials employed in the reactor internals and in-core instrument support system have performed satisfactorily in operating reactors such as Palisades (Docket-50-255), Fort Calhoun (Docket-50-285) and Maine Yankee (Docket-50-309).

4.5.2.2 Welding Acceptance Standards

Welds employed on reactor internals and core support structures are fabricated in accordance with Article NG-4000 in Section III, and meet the acceptance standards delineated in article NG-5000, Section III, Division I, and control of welding is performed in accordance with Section III, Division I, and Section IX of the ASME Code. In addition, consistency with the recommendations of Regulatory Guides 1.31 and 1.44 is described in Section 4.5.2.3. F

4.5.2.3 Fabrication and Processing of Austenitic Stainless Steel

The following information applies to unstabilized austenitic stainless steel as used in the reactor internals.

4.5.2.3.1 Control of the Use of Sensitized Austenitic Stainless Steel

The recommendations of Regulatory Guide 1.44, as described in Sections 4.5.2.3.1.1 through ~~4.5.2.3.2.5~~ 4.5.2.3.1.5, are followed except for the criterion used to demonstrate freedom from sensitization. ~~The ASTM A708, Strauss Test is used in lieu of the ASTM A262, Method E, Modified Strauss Test, to demonstrate freedom from~~

 9/23/92 change

~~sensitization in fabricated unstabilized austenitic stainless steel, since the former test has shown, through experimentation, excellent correlation with the type of corrosion observed in severely sensitized austenitic stainless steel.~~

4.5.2.3.1.1 Solution Heat Treatment Requirements

All raw austenitic stainless steel material, both wrought and cast, employed in the fabrication of the reactor internals is supplied in the solution annealed condition, as specified in the pertinent ASTM or ASME B&PV Code material specification (i.e., 1900 to 2050°F for 0.5 to 1.0 hour per inch of thickness and rapidly cooled to below 700°F). The time at temperature is determined by the size and the type of component.

Solution heat treatment is not performed on completed or partially fabricated components. Rather, the extent of chromium carbide precipitation is controlled during all stages of fabrication as described in Section 4.5.2.3.1.4.

4.5.2.3.1.2 Material Inspection Program

Extensive testing of stainless steel mockups, fabricated using production techniques, was conducted to determine the effect of various welding procedures on the susceptibility of unstabilized Type 300 series stainless steels to sensitization-induced intergranular corrosion. Only those procedures and/or practices demonstrated not to produce a sensitized structure are used in the fabrication of reactor internals components. The ASTM Standard A708 (Strauss Test) is the criterion used to determine susceptibility to intergranular corrosion. This test has shown excellent correlation with a form of localized corrosion peculiar to sensitized stainless steel. As such, ASTM A708 is utilized as a go/no-go standard for acceptability. delete

As a result of the above tests, a relationship was established between the carbon content of Type 304 stainless steel and weld heat input. This relationship is used to avoid weld heat affected zone sensitization as described in Section 4.5.2.3.1.4.

4.5.2.3.1.3 Unstabilized Austenitic Stainless Steels

The unstabilized grade of austenitic stainless steel with a carbon content greater than 0.03% used for components of the reactor internals is Type 304. This material is furnished in the solution annealed condition. The acceptance criterion used for this material, as furnished from the steel supplier, is ASTM A262, Method E.

 9/23/92 change ME-DC-012 (R2)

material is presently being used in operating reactors such as Maine Yankee (Docket 50-209), Calvert Cliffs (Docket 50-317) and St. Lucie Unit 1 (Docket 50-335) and has performed satisfactorily for the same application.

4.5.1.3 Control of the Use of Sensitized Austenitic Stainless Steel

Control of the use of sensitized austenitic stainless steel is consistent with the recommendations of Regulatory Guide 1.44, as described in Sections 4.5.1.3.1 through 4.5.1.3.3, except for the criterion used to demonstrate freedom from sensitization. The ASTM A708 Strauss Test is used in lieu of the ASTM A262 Method E, Modified Strauss Test, to demonstrate freedom from sensitization in fabricated unstabilized austenitic stainless steel. The former test has shown, through experimentation, excellent correlation with the type of corrosion observed in severely sensitized austenitic stainless steel.

4.5.1.3.1 Solution Heat Treatment Requirements

All raw austenitic stainless steel, both wrought and cast, employed in the fabrication of the control element drive mechanism structural components is supplied in the solution annealed condition, as described in Section 4.5.2.3.1.1.

4.5.1.3.2 Material Inspection Program

Extensive testing on stainless steel mockups, fabricated using production techniques, has been conducted to determine the effect of various welding procedures on the susceptibility of unstabilized Type 300 series stainless steels to sensitization-induced intergranular corrosion. Only those procedures and/or practices demonstrated not to produce a sensitized structure are used in the fabrication of control element drive mechanism structural components. ~~The ASTM Standard A708 (Strauss Test) is the criterion used to determine susceptibility to intergranular corrosion. This test has shown excellent correlation with a form of localized corrosion peculiar to sensitized stainless steels. As such, ASTM A708 is utilized as a go/no-go standard for acceptability.~~ delete

4.5.1.3.3 Avoidance of Sensitization

Homogeneous or localized heat treatment of unstabilized austenitic stainless steel in the temperature range 800 to 1500°F is prohibited.

6.2.5 COMBUSTIBLE GAS CONTROL IN CONTAINMENT

Following a design basis Loss-of-Coolant Accident (LOCA), control of combustible gas concentration in containment is provided by the Containment Hydrogen Recombiner System (CHRS). Hydrogen may be released to the containment atmosphere following a LOCA by radiolysis of water, corrosion of containment materials by the containment spray, reaction of the zirconium cladding with steam and dissolved hydrogen coming out of solution from the reactor coolant and pressurizer steam space. The CHRS prevents the concentration of hydrogen from reaching the lower flammability limit of 4% by volume in air or steam-air mixtures. The system is designed in accordance with the guidance provided by Regulatory Guide 1.7 and as required by 10 CFR 50.44, 10 CFR 50.46 and General Design Criteria 5, 41, 42 and 43. In addition, this system provides the capability for controlled purging to aid in post-accident containment atmosphere cleanup with filtration of the discharge provided by the annulus ventilation filter trains.

During a degraded core accident, hydrogen will be produced at a greater rate than that of the design basis LOCA. The Hydrogen Mitigation System (HMS) is designed to accommodate the hydrogen production from 100% fuel clad metal-water reaction and ~~meet an~~ limit the average hydrogen concentration in containment to ~~limit of~~ 10% in accordance with 10 CFR 50.34(f) for a degraded core accident. These limits are imposed to preclude detonations in containment that might jeopardize containment integrity or damage essential equipment. The HMS consists of a system of igniters installed in containment to promote the combustion of hydrogen in a controlled manner such that containment integrity is maintained.

6.2.5.1 Design Bases

6.2.5.1.1 Containment Hydrogen Recombiner System (CHRS)

A. The CHRS is an Engineered Safety Features (ESF) System designed to maintain the hydrogen concentration within the containment atmosphere below its lower flammability limit of 4% in accordance with Regulatory Guide 1.7. The system is designed to be manually initiated prior to hydrogen concentration reaching 3.5% by volume. I

B. Two independent, full capacity, parallel loops make the system fully redundant and enable it to withstand a single active failure and still perform its design function.

C. The CHRS is designed to provide sufficient suction points inside containment to eliminate stagnant pockets of air where hydrogen could accumulate.

ALWR-465

D. Recombiner inlet connections from the In-containment Refueling Water Storage Tank (IRWST) are provided to remove hydrogen produced by sump radiolysis in the IRWST.

E. Components of the CHRS are designed to sustain normal and Seismic Category I loads as well as temperature and pressure transients from a LOCA.

F. The hydrogen recombiners are protected from damage by missiles or jet impingement from pipe ruptures.

G. Components of the CHRS located in containment will be designed to meet the appropriate environmental requirements specified in Appendix 3.11A.

H. System equipment located outside of containment will be arranged to preclude failure of the CHRS due to failure of other non-Category I systems.

I. CHRS components will be designed in accordance with ASME Boiler and Pressure Vessel Code, Section III, Class 2 requirements.

J. In the event of offsite power loss, power to the Containment Hydrogen Recombiner System will be automatically supplied by the Class 1E ~~Electrical~~ 480 VAC Auxiliary Power System which is supplied by the emergency diesel generators.

K. The system valves and components will be designed in accordance with ANS Safety Class 2 requirements.

L. Access and shielding are provided to the areas where the portable hydrogen recombiner and control panel skids are to be placed along with areas where coupling operations are required.

M. Capability will be provided for a controlled purge of the containment atmosphere to aid in post-accident containment cleanup. This portion of the system is non-safety related. I

N. Redundant hydrogen analyzers provide hydrogen concentration measurement of the incoming gas from containment as well as the recombiner discharge for monitoring of recombiner performance. The hydrogen analyzers are independent of the hydrogen recombiners and are permanently installed to allow hydrogen concentration monitoring throughout the accident.

ALWR-465

hydrogen production analysis. The parameters which determine the amount of hydrogen produced during the design basis LOCA are listed in Table 6.2.5-2. Design basis LOCA hydrogen generation assumptions are discussed in the following sections.

6.2.5.1.3.1 Core Solution Radiolysis

Radiolysis of the emergency core cooling solution occurs as a result of the decay energy of fission products in the fuel. The hydrogen production analysis by core cooling solution radiolysis is based on the TID-14844 release model. Per Regulatory Guide 1.7, it is assumed that all of the beta energy is absorbed within the fuel and cladding with a maximum of 10% of the gamma energy being absorbed by the cooling solution in the core. A conservative hydrogen yield of 0.5 molecules per 100 eV was assumed for both core and sump solution radiolysis. All noble gases are assumed to be released to containment. The assumptions for hydrogen production due to radiolysis in the core and sump solutions are listed in Table 6.2.5-3.

6.2.5.1.3.2 Sump Solution Radiolysis

Radiolysis of the sump solution occurs due to the radiolytic decomposition of the containment sump water by the fission products. The TID-14844 release model is assumed where 50% of the total core halogens and 1% of all other fission products, excluding noble gases, are released from the core to the sump solution. The total decay energy from the released fission products is assumed to be fully absorbed in the sump solution.

The containment sump includes areas in containment (i.e., holdup volume, horizontal surfaces, etc.) and the IRWST. Since ~~50%~~ of the containment sump water is enclosed in the IRWST, ~~50%~~ 57% of the sump radiolysis is assumed to occur in the IRWST. I

6.2.5.1.3.3 Corrosion of Containment Materials

Corrosion of metal surfaces, primarily aluminum and zinc, are significant contributors to hydrogen production in containment during a LOCA when subjected to the borated containment spray. The inventory of aluminum and zinc in containment is minimized to the extent practical to limit these hydrogen sources. The inventories used in the hydrogen production analysis are conservative in that they are the maximum limit of aluminum and zinc to be used in containment. The actual inventories are anticipated to be lower.

ALWR-465

56,130 lbm of Zirconium cladding surrounding the active fuel.

corresponds to 5% of the ~~71,758 lbm of Zircaloy-4 cladding reacting to form hydrogen.~~ Per Regulatory Guide 1.7, the hydrogen is assumed to be released into containment over a 2 minute period from the start of the transient.

6.2.5.1.3.5 Dissolved Hydrogen in Reactor Coolant

The maximum equilibrium quantity of hydrogen in the reactor coolant is 3890 scf. This quantity includes both the maximum allowable hydrogen concentration in the primary coolant water at 100 cc (STP) per kilogram of water and the equilibrium hydrogen in the pressurizer steam space at the maximum concentration of 2/10 of 1% by weight of steam. The entire 3890 scf of hydrogen is assumed to be released immediately into containment at the initiation of the LOCA.

6.2.5.1.4 Design Basis LOCA Hydrogen Accumulation

Besides containment, the IRWST is the only other enclosed compartment which could experience hydrogen pocketing. Hydrogen recombiner inlet connections are provided for the IRWST which account for one-half of the 100 cfm flow to each recombiner.

To account for single failure, only one of the 100 cfm recombiners is considered in the analysis. The flow split per recombiner is 50 cfm from containment and 50 cfm from the IRWST. Hydrogen concentration versus time is shown in Figure 6.2.5-2 for containment and Figure 6.2.5-3 for the IRWST. These figures show hydrogen concentration without recombiner flow and with a single recombiner started 72 hours after the LOCA.

6.2.5.2 <u>System Design</u>

6.2.5.2.1 Containment Hydrogen Recombiner System

The CHRS consists of two redundant loops. Within containment, each loop of the CHRS is comprised of a suction header (influent piping) with motor operated valves and a discharge header (effluent piping) with a check valve. Outside of containment, in the Nuclear Annex, each loop consists of influent piping, manual and motor operated isolation valves, sample piping, a hydrogen analyzer, a mobile recombiner and control panel skid, test and calibration connections, an isolated nitrogen supply connection, an isolated ~~service~~ instrument air connection, a safety valve, and effluent piping. I

The recombiners and control panels are skid-mounted, self-contained units. Flanged piping connections are used for ease of

ALWR-465

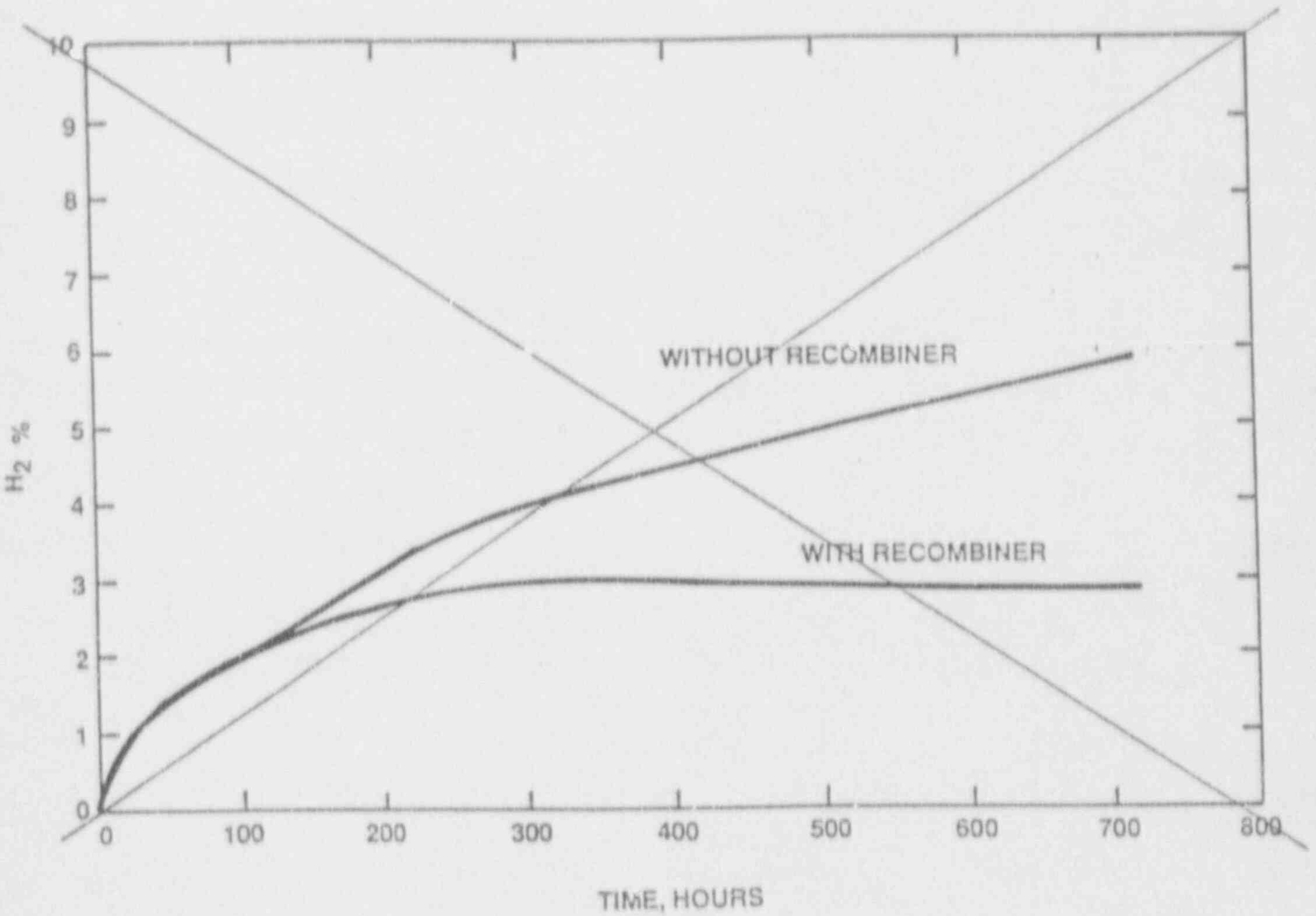
TABLE 6.2.5-2

HYDROGEN PRODUCTION PARAMETERS

Parameter	Value
Reactor Power (Full power plus 2% uncertainty), MWt	3876
Reactor Operating Time, Months	18
Containment Net Free Volume (Minimum), ft^3	3.377×10^6
IRWST Freeboard Volume (Design basis LOCA), ft^3	1.032×10^5
Initial Temperature, °F	110
Initial Pressure, psia	15.1
Initial Relative Humidity	10%
Cladding Zirconium Mass (Surrounding active fuel), lbm	56,130 ~~53,123~~
Dissolved Hydrogen in Reactor Coolant (Maximum), cc(STP) per kg of water	100
Dissolved Hydrogen in Pressurizer Steam Space (Maximum), by Weight	2/10 of 1%

I

ALWR-465

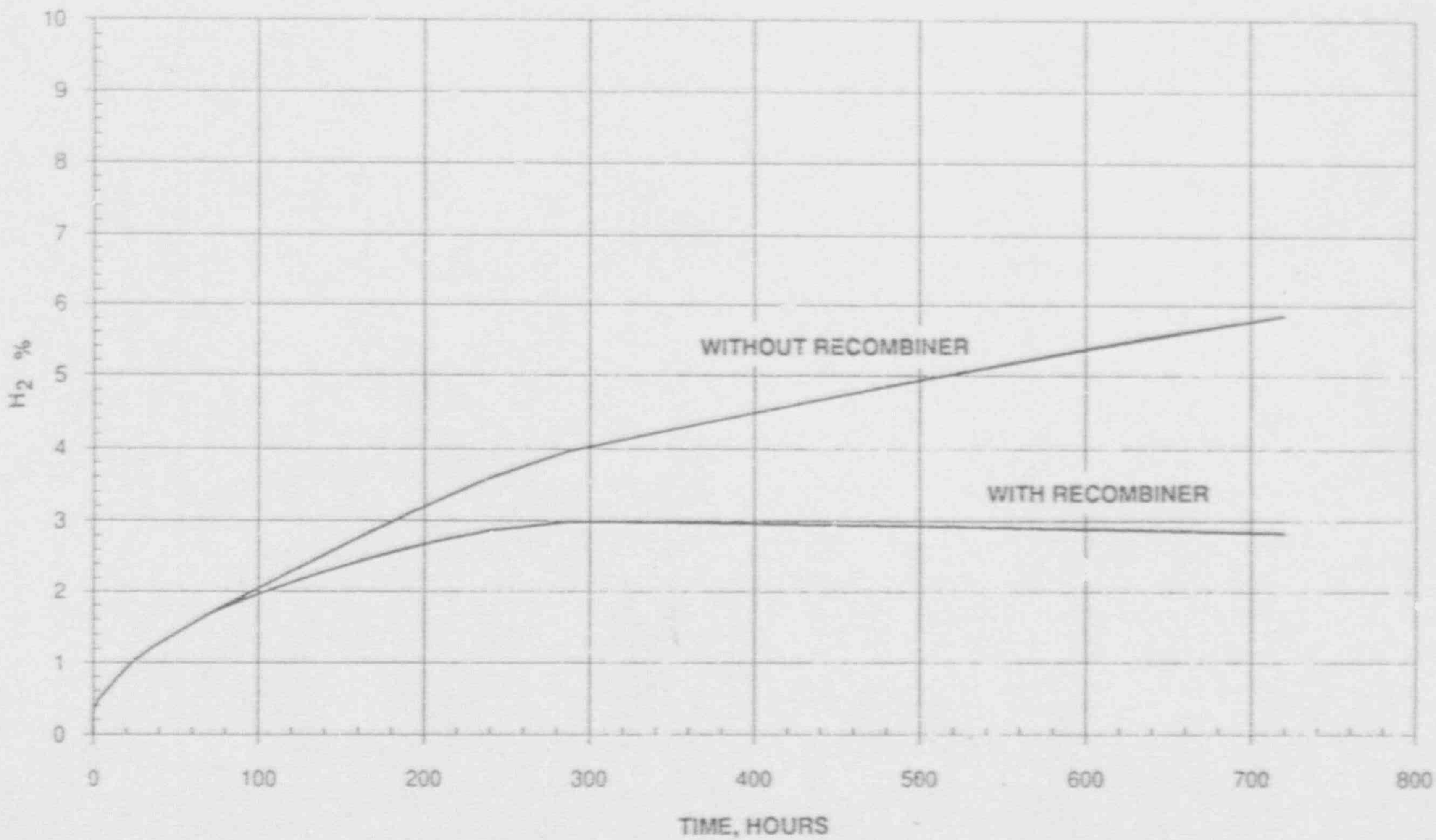


Replace With Following Page

Amendment I
December 21, 1990

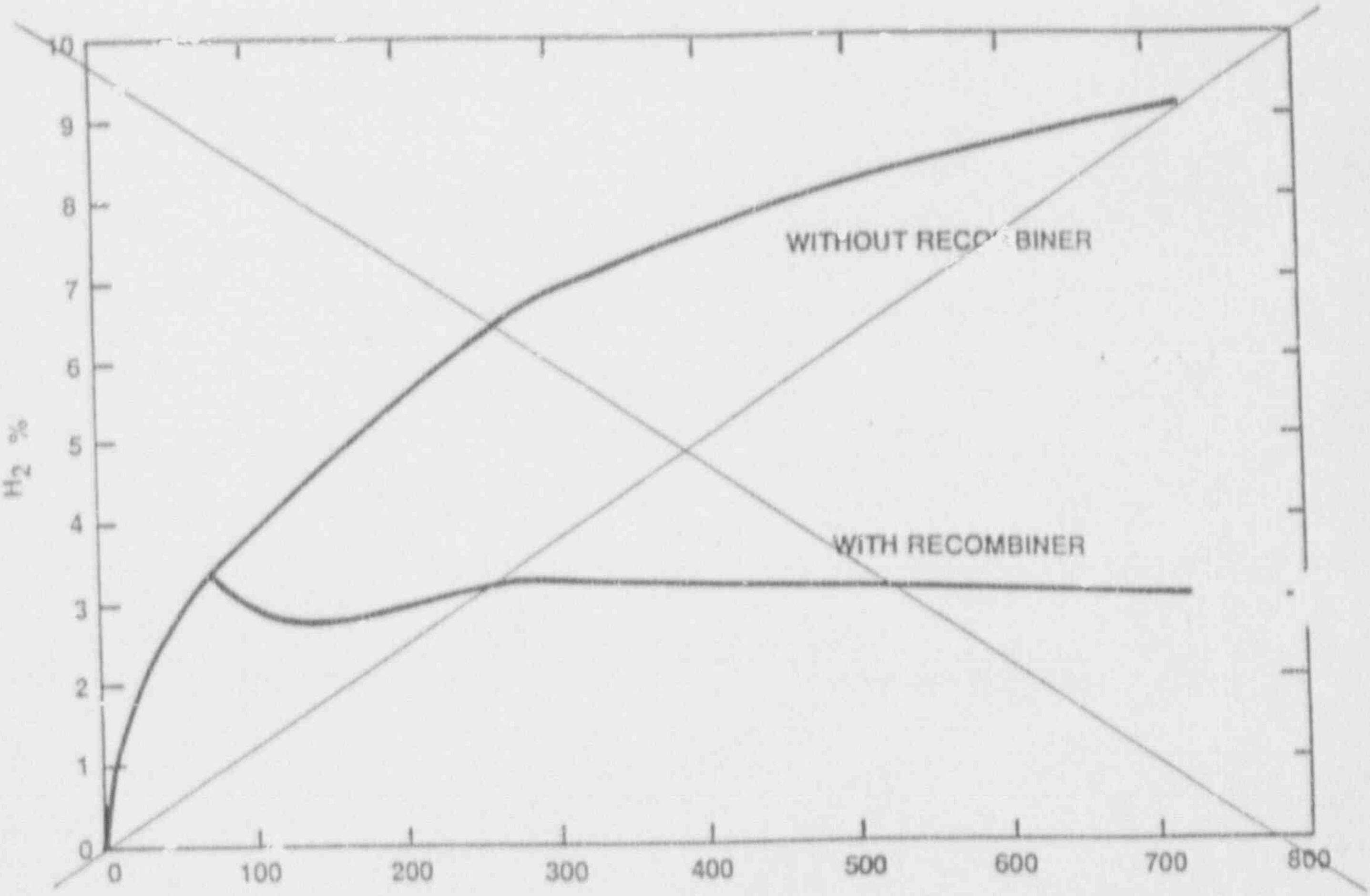
SYSTEM 80+™	CONTAINMENT HYDROGEN CONCENTRATION vs TIME AFTER LOCA (WITHOUT RECOMBINERS AND WITH A SINGLE RECOMBINER START TIME OF 72 HOURS)	Figure 6.2.5-2

ALWR-465



10
9
8
7
6
5
4
3
2
1
0
H_2 %
WITHOUT RECOMBINER
WITH RECOMBINER
0
100
200
300
400
500
600
700
800
TIME, HOURS

ALWR-465

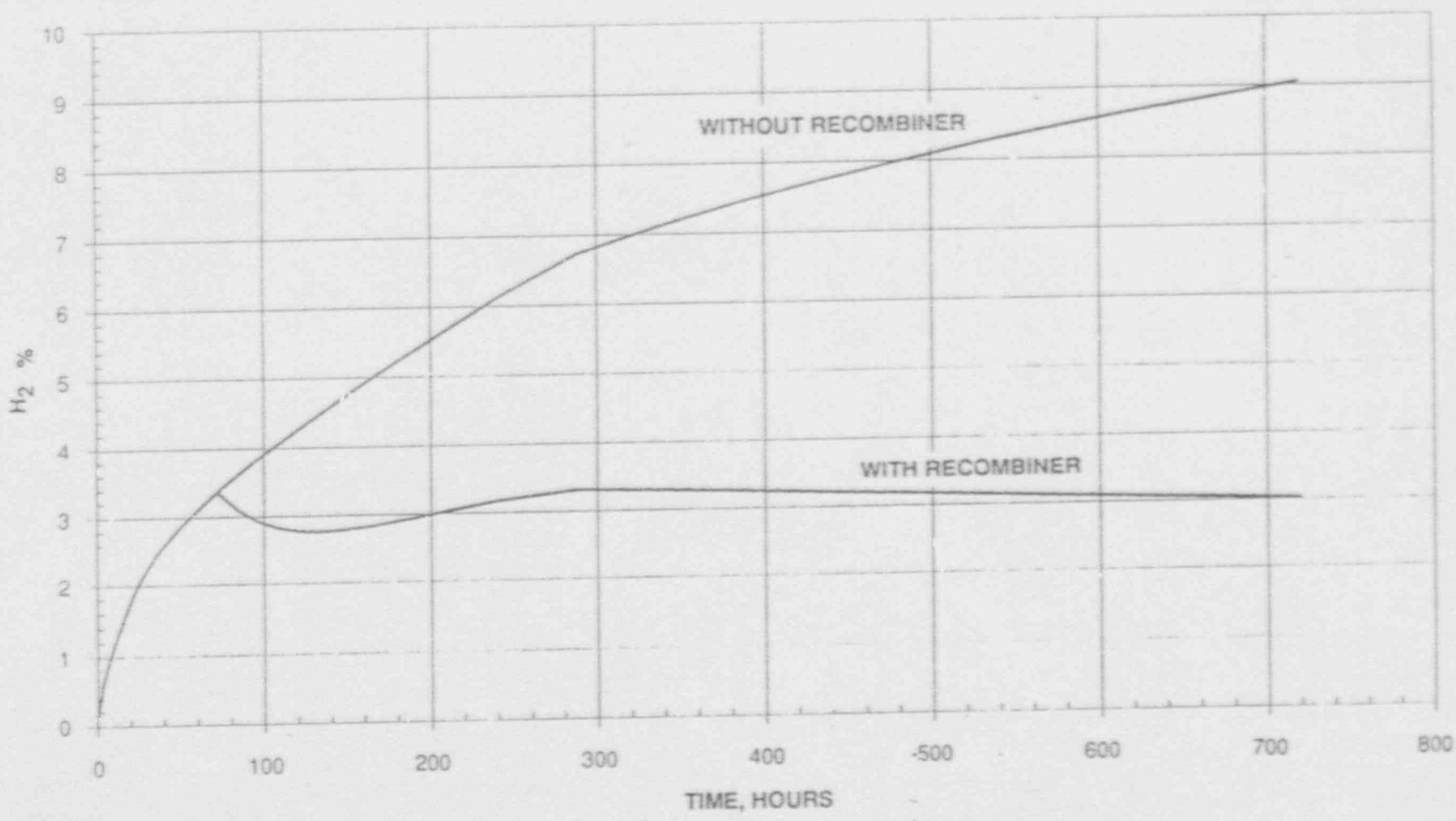


Replace With Following Page

Amendment I
December 21, 1990

SYSTEM 80+™	IRWST HYDROGEN CONCENTRATION vs TIME AFTER LOCA (WITHOUT RECOMBINERS AND WITH A SINGLE RECOMBINER START TIME OF 72 HOURS)	Figure 6.2.5-3

ALWR-465


WITHOUT RECOMBINER
WITH RECOMBINER
H_2 %
10
9
8
7
6
5
4
3
2
1
0
0
100
200
300
400
-500
600
700
800
TIME, HOURS

earthquake, and are able to withstand the effects of appropriate natural phenomena such as tornadoes, floods, and hurricanes (GDC 2).

The essential mechanical equipment room cooling systems are protected from the effects of internally generated missiles, pipe break effects, and water spray (GDC 4).

The Subsphere Building essential HVAC System is designed to limit the offsite and control room dose following a LOCA or DBA within the guidelines of 10 CFR 100 and Standard Review Plan Section 6.4 respectively. Radiological consequences are discussed in Section 15. I

The Subsphere Building Ventilation Systems are separated according to Divisions with each ~~50%~~ 100% exhaust system containing a filter train complete with particulate filters and carbon adsorbers and two 50% fans as shown in Figure 9.4-5.

The essential mechanical room cooling units are shown in Figure 9.4-4.

9.4.5.1.1 **Codes and Standards**

Equipment, work, and materials utilized conform to the requirements and recommendations of the codes and standards listed below:

A. Fan ratings conform to the Air Moving and Conditioning Association (AMCA) Standards. E

B. Fan motors conform to applicable standards of the National Electrical Manufacturers Association (NEMA) and the Institute of Electrical and Electronic Engineers (IEEE).

C. Essential equipment, fans, coils, dampers, and ductwork will be manufactured in accordance with ASME/ANSI AG-1-1988.

D. Ventilation ductwork conforms to applicable standards of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

E. Cooling coils in the essential cooling units are designed in accordance with the ASME B&PV Code, Section III, Class 3.

F. High-efficiency particulate air (HEPA) filters conform to ERDA-76-21, "Nuclear Air Cleaning Handbook." I

G. Carbon filter media, Nuclear Grade as defined by the Institute for Environmental Sciences.

also print page 24 & 26 it is page 23 now

~~A. Motor-driven emergency feedwater pump rooms.~~

~~B. Steam-driven emergency feedwater pump rooms.~~

9.4.5.2.1 Component Description

The essential mechanical equipment room cooling units consist of chilled water cooling coil, direct-drive centrifugal recirculation fan, and dampers and controls to achieve the desired operation. The chilled water coils are served from the essential chilled water system.

The essential mechanical equipment room ventilation units contain intake filters, direct-drive centrifugal supply and exhaust fans, and dampers and controls to achieve the desired operation. There are heating and cooling coils to temper the outside air as required.

9.4.5.2.2 System Operation

~~During normal operation of the general ventilation system, outside air is supplied by two 50% capacity supply units and two 50% capacity supply fans.~~ The air is filtered and then conditioned as needed by the heating and cooling coils. The exhaust air is processed through ~~two 50%~~ one 100% capacity filter train~~s~~ complete with particulate filters and carbon adsorbers and is discharged to the unit vent by two 50% capacity exhaust fans. Supply and exhaust fans are electrically interlocked such that the building will always remain under a slight negative pressure. In the event of a loss-of-coolant-accident, the general ventilation equipment will continue to operate normally as long as offsite power is available. On LOOP, the exhaust fans will be powered from the Class 1E diesel generators. ~~This maintains the subsphere pump rooms at a slight negative pressure~~ to direct all releases through the exhaust filter train. ~~Ducts to areas with non-essential cooling units will be isolated to enable proper operation of the emergency equipment.~~

Normal operation of the essential mechanical equipment room cooling and ventilation units is ~~with the equipment operating~~ as required to maintain space temperatures. The cooling systems will operate based on heat load as indicated by room temperature. In the event of a LOCA or DBA, all units are automatically started and will operate ~~at full capacity~~ throughout the event. ~~Individual room units will start when the equipment in the room starts.~~

The Subsphere Building Ventilation System is comprised of two divisionally separate, fully redundant ventilation systems each capable of being provided outside air by one 100% capacity supply unit and two 50% capacity supply fans per division.

I

Comment make these changes, this paragraph was changed in Amend J also print Table 9.4-2

it is Table 9.4-3 now

TABLE 9.4-4

INPUT FOR RELEASE ANALYSIS
FILTER EFFICIENCIES

Area Identity	Design/ Testing Standard	Ventilation CFM*	Recirculation CFM*	Charcoal (Elem.)	HEPA (Particulate)	HEPA (Organic)	Maximum In-Leakage CFM
Control Room	RG 1.52	2,000	4,000	95	99	95	10
Subsphere	RG 1.52	~~5,000~~ 13,200	N/A	95	99	95	N/A
Annulus	RG 1.52	18,000	18,000	95	99	95	1,000
Fuel Building	RG 1.52	25,000	N/A	95	99	95	N/A
Containment	RG 1.140	30,000	60,000	95	99	95	N/A

*Ventilation CFM is shown for each Division.

K

Amendment ~~1~~
~~December 21, 1990~~
October 30, 1992

it is 1 now, sheets 8 & 9

also print sheet 7 & 10

TABLE 9.4-2 (Cont'd)

(Sheet 8 of 12)

HVAC SYSTEM DESIGN PARAMETERS

Area or Location	Operational Mode		Type System	Heat Load Btu/hr	Flow Rate/Unit		No Units % Capacity	Power Supply	Equipment
	Normal	Essential			Air CFM	Cool Water gpm			
Containment	X		High Purge Exhaust	-	30,000	-	1/100 Filter 2/100 Fan	Normal 460V	Filter train and 2 fans, 100 HP
Containment	X		Low Purge Exhaust	-	1,250	-	1/100 Filter 2/100 Fan	Normal 460V	Filter train and 2 fans, 5 HP
Subsphere Vent. Sup. I	X		Heat/Cool		11,000 ~~4,000~~		2/50 ~~100~~ Fans	120/460 7.5 HP	Prefilter, cooling heat coil, fan
Subsphere Vent. Sup. II	X		Heat/cool		11,000 ~~4,000~~		2/50 ~~100~~ Fans	120/460 7.5 HP	Prefilter, cooling heat coil, fan
Subsphere I Vent Exh		X	Exh. to Unit Vent	-	13,200 ~~5,000~~	-	2/50 ~~100~~ Fans	120/460 20 HP	Filter train
Subsphere II Vent Exh		X	Exh. to Unit Vent	-	13,200 ~~5,000~~	-	2/50 ~~100~~ Fans	120/460 20 HP	Filter train
Fuel Pool Heat Div. II [17]	X	X	Recirculating AHU	150,000	3,200	25	1/100	Train D 120/460 1.5 BHP	Cooling coil, fan, filter

Amendment ~~I~~ K
~~December 21, 1990~~
[illegible handwritten date]

 ALWR-477

(DONE)

9.5.4 DIESEL GENERATOR ENGINE FUEL OIL SYSTEM

9.5.4.1 Design Bases

E

The Diesel Generator Engine Fuel Oil System is designed to provide for storage of a seven-day supply of fuel oil for each diesel generator engine and to supply the fuel oil to the engine, as necessary, to drive the emergency generator. The system is designed to meet the single failure criterion, and to withstand the effects of natural phenomena without the loss of operability.

All components and piping are located, diesel fuel storage structure in a Seismic Category I structure (diesel generator building), except for ~~the fuel oil storage tanks and~~ a portion of the piping from the fuel oil storage tanks to the day tank, which is seismically qualified and protected. All essential components and piping are fully protected from floods, tornado missile damage, internal missiles, pipe breaks and whip, jet impingement and interaction with non-seismic systems in the vicinity. I | J

9.5.4.2 System Description

The Diesel Generator Engine Fuel Oil System is shown in Figure 9.5.4-1 (Sheets 1 and 2).

9.5.4.2.1 General

A separate and complete fuel oil storage and transfer system is provided for each diesel generator engine. Two ~~underground~~ storage tanks provide fuel oil for each engine, which is sufficient to operate at full load for a period of time no less than seven days plus a margin to allow periodic testing. E | J

Typically, this requires a combined usable volume of 135,000 gallons. The site-specific SAR shall verify that this is adequate for the diesel generators purchased.

Fuel oil is transferred by gravity ~~the fuel oil transfer pump~~ from the storage tanks to the day tank which is located within retaining walls inside the diesel generator building. ~~The fuel oil transfer pump is also located in the diesel generator building and is typically sized for 75 gpm.~~ The day tank has a sufficient capacity of fuel oil to operate the diesel generator engine in excess of 60 minutes at full load. Typically, this requires a day tank of 900 gallons. The site-specific SAR shall verify that ~~fuel oil transfer pump flow and~~ day tank capacity ~~are~~ is adequate for the diesel generators purchased. I | K | K

ADD INSERT 5→

ALWR-477

ADD INSERT 1

~~A set of level switches located within the day tank control the operation of the fuel oil transfer pump: starting the pump at day tank low level; stopping the pump at day tank high level. High and low level alarms are also provided both on the storage tanks and on the day tank. In the event of a transfer pump failure to start, the day tank low level alarm, indicating 60 minutes of fuel reserve at full load, allows the operator to take corrective action. In the event of a transfer pump failure to stop, an overflow line is provided on the day tank to divert the excess fuel oil to the day tank containment (or back to the fuel oil storage tank depending upon storage tank elevation relative to the day tank).~~ I K

During normal operation, fuel oil is pumped from the day tank to the engine by the engine-driven fuel oil pump. The motor-driven fuel oil booster pump is normally isolated both electrically and mechanically, but may be operated if required during maintenance. The day tank provides sufficient positive suction to both the motor-driven fuel oil booster pump and the engine-driven fuel oil pump.

Each pump is provided with a duplex suction strainer and a discharge pressure relief valve, and an engine-mounted dual element fuel oil filter is provided on the common discharge header. Pressure gauges are located on the inlet and outlet sides of both strainers for local indication and an alarm is provided with each strainer to alert the operator of high differential pressure. Differential pressure indication and a high differential pressure alarm are also provided with the fuel oil filter. E

Two fuel oil drip headers, one located on each bank of the diesel generator engine, contain unburned fuel leakage within the engine. The unburned fuel is removed from the drip headers through a piloted valve and ejector driven by the pressurized fuel oil return from the bypass headers to the day tank. The main circulation headers are fitted with a relief valve which prevents the engine fuel oil pressure from exceeding a certain maximum and which discharges back to the day tank.

The day tank is surrounded by a fire wall which serves as a containment in the event of leaks or ruptures. The containment drain line is isolated by a normally closed, solenoid-operated valve. A high level signal from a level transmitter located within the containment opens this valve, allowing the oil to drain to the suction side of the lube oil transfer pump which is simultaneously activated and delivers the oil to a waste oil storage tank.

ALWR-477

CESSAR-DC Attachment (Refer to page 9.5-52)

INSERT 1:

A set of level switches located within the day tank control the position of the fuel oil transfer valve: opening the valve to allow fuel to flow to the day tank at low level and closing the valve to shut off the supply of fuel at high level. High and low level alarms are also provided both on the storage tanks and the day tank. In the event of a transfer valve failure in the closed position, the day tank low level alarm, indicating 60 minutes of fuel reserve at full load, allows the operator to take corrective action. In such an event, a bypass line allows for manual filling of the day tank. In the event of a transfer valve remaining in the open position, fuel oil would continue to flow from the storage tanks to the day tank until the system reached hydrostatic equilibrium. Since there is no day tank overflow line, oil would rise in the Safety Class 3 day tank vent pipe to an elevation equivalent to that of the fuel oil in the storage tank but well below the top of the vent. The day tank vent is missile protected.

K

ALWR-477

this was incorporated in Am. J

ADD INSERT 2

~~To prevent settling, stratification and deterioration of the fuel oil during extended periods, a system is provided to recirculate or transfer filtered fuel oil. Four fuel oil tanks (two half capacity storage tanks per redundant diesel) are centrally located and integrally connected with normally closed isolation valves and check valves to prevent backfilling and possible contamination of fuel oil between tanks. A manually operated, positive displacement recirculation pump takes suction from the flush mounted sample connection on the bottom of the storage tank and discharges the fuel oil through a simplex filter with alternate bypass line to the storage tank fill connection.~~ The filtering and recirculation process is performed on a tank by tank basis with the frequency of operation dependent on the results of a fuel oil inspection program. Since two half capacity storage tanks are provided per diesel, one tank will be aligned to supply fuel oil to its respective diesel while isolating the second tank through administrative control. The contents of the isolated storage tank would be filtered and recirculated. Prior to realigning the tank to its respective diesel, a period of not less than 24 hours is required to allow any stirred sediment to settle. J E

Should the recirculation system be operating in the event of a LOCA, a redundant, safety related interlock is provided to shutdown the recirculation pump to prevent possible stirring of sediment. A redundant safety-related interlock is also provided to shutdown the recirculation pump should the fuel oil in the storage tanks drop below a level to preclude loss of fuel oil in the event of a recirculation system pipe rupture.

These two safety-related and redundant interlocks protect the Diesel Generator Fuel Oil System during operation of the recirculation system. They assure uninterrupted operation of the essential emergency diesels in the event of a Loss of Offsite Power or LOCA.

Fuel oil amenders are added as necessary to extend oil life by preventing oxidation and stratification. A sample is used to inspect the oil for water content or degradation and if degradation is determined, the oil may be pumped out for disposal. Accumulated water in the fuel oil storage tanks will be removed by the recirculation system through a sample connection provided on the recirculation pump discharge.

ADD INSERT 3

new

~~The day tank vent and fuel oil storage tank vents and fill connections which are exposed outdoors, are protected from tornado missiles through the construction of the vents using heavy gauge pipe and are located above the probable maximum flood level.~~ Each fill connection is provided with a locking dust cap K I

ALWR-477

CESSAR-DC Attachment (Refer to page 9.5-53)

INSERT 2:

To prevent settling, stratification, and deterioration of the fuel oil during extended periods, a system is provided to recirculate or transfer filtered fuel oil. A separate and complete recirculation system is provided for each set of half capacity fuel oil storage tanks. Each set of storage tanks shall be integrally connected with normally closed isolation valves and check valves to prevent backfilling and possible contamination of the fuel oil between tanks. A manually operated positive displacement pump provided for each set of storage tanks takes suction from the flush mounted sample connection on the bottom of the storage tank and discharges the fuel oil through a simplex filter with alternate bypass line to the storage tank fill connection.

J

INSERT 3:

The day tank vent and fuel oil storage tank vents and fill connections which are exposed outdoors are constructed using heavy gauge pipe to provide protection against tornado missiles. These vent and fill lines are located above the probable maximum flood level.

K

and each vent line is down turned. The storage tanks can be filled and vented through the manway should the fill or vent lines become impaired.

9.5.4.2.2 Component Description

ADD INSERT 4

~~Fuel is recirculated within the storage facility to prevent deterioration by a recirculation pump.~~ K

The motor-driven fuel oil booster pump is normally isolated, both electrically and mechanically, but may be operated if required during maintenance to deliver fuel oil to the diesel.

E

9.5.4.3 Safety Evaluation

The Diesel Generator Engine Fuel Oil System is a ANSI Class 3 piping system with the exception of the Fuel Oil Recirculation System and the fuel oil storage tank fill line strainer which are ANSI Class 4 piping systems. The Fuel Oil Recirculation System and the fuel oil storage tank fill line strainer are separated from the essential Diesel Generator Fuel Oil System by normally closed ANSI Class 3 isolation valves. An ANSI Class 4 flexible rubber hose is used to connect the ANSI Class 4 fill line strainer to the ANSI Class 3 fuel oil storage tank fill lines. The diesel engine and engine mounted components are constructed in accordance with IEEE Standard 387. The fuel oil system is designed and constructed in compliance with ANSI Standard N195, except in regards to the flame arresters on the storage tanks, an overflow line from the day tank, and excluding all references to fuel oil transfer pumps. I
Each diesel generator unit is housed separately in a Seismic Category I structure.

Diesel fuel oil 2D, as specified by ASTM D975, is normally delivered to the site by private carriers. The fuel oil storage capacity is based on continuous operation of the diesel generator engines at rated load for a period of seven days. A 10 percent margin in storage capacity is provided to preclude the necessity of refilling the tanks following routine performance testing. The exterior of carbon steel tanks and other underground carbon steel components is coated. In addition to being coated, the external surfaces of buried metallic piping and tanks are protected from corrosion by an impressed current cathodic protection system in accordance with NACE Standard RP-01-69 or other means as deemed appropriate based on site specific conditions. E
The interior of the fuel oil storage tanks are not coated since the presence of fuel oil will act as a deterrent to internal corrosion. Requirements assure that the fuel oil storage tanks are maintained essentially full to provide a seven day supply.

ALWR-477

CESSAR-DC Attachment (Refer to page 9.5-54)

INSERT 4:

Fuel oil is recirculated by a recirculation pump within each storage facility to prevent deterioration. K

AZWR-477

The starting air receiver tanks also supply air at reduced pressure to the engine control panel instrumentation. Air enters the engine control panel where it is filtered and a self-contained pressure regulator maintains constant pressure for the diesel automatic safety shutdown system. The automatic safety shutdown system is made up of a network of vent on fault pneumatic devices which monitor the engines parameters, tripping the engine when a manufacture's recommended temperature, pressure, overspeed, or vibration setpoint has been exceeded. There are two types of engine trips. ~~Group "A" trips are active only during the periodic testing of the diesel to prevent damage to the engine and are locked out during the emergency mode (i.e., LOOP or LOCA) allowing the engine to continue to run. Group "A" trips include and are activated upon: low lube oil pressure, low left and right turbocharger oil pressure, high crankcase pressure, excessive engine vibration, high lube oil temperature, high temperature main bearings, and high-high jacket water temperature. Group "B" trips remain active during the emergency mode to shutdown the engine should a setpoint be exceeded. Group "B" trips include and are activated upon; engine overspeed, low-low lube oil pressure, and generator differential.~~ The low-low lube oil pressure trip contains redundant (two out of three) logic which must be affected to activate a diesel shutdown. The pneumatic logic for Group "A" and "B" trips consumes negligible volume, operating on pressure rather than flow capacity. Sufficient air pressure remains available for operating the pneumatic logic following five successive start attempts. ~~In addition, the starting air compressors, air dryers, aftercoolers, piping and valves are Seismic Category I, seismically qualified to remain operable following a design basis earthquake. The starting air compressors and air dryers receive Class 1E power from their associated diesel.~~

ADD INSERT 1

K

E

K

Relief valves on the compressor discharge line and on the air receiver tanks protect the starting air system from overpressurization.

9.5.6.2.2 Component Description

ADD INSERT 2

~~The starting air compressors are driven by electric motors which are powered from the Essential Auxiliary Power Supply.~~ Each compressor discharges compressed air and the heat of compression is removed by a water-cooled aftercooler. The component cooling water system provides cooling water on the tube side.

K

To minimize the accumulation of moisture, the diesel engine starting air system is equipped with a multi-stage drying and filtering unit located in line between the aftercooler and the receiver tank to supply air with a dew point at least 10°F lower than the lowest expected ambient temperature. The air is first ~~thrown~~ passed through a cyclone-type

This was done with Am.

K

Azwe-477

CESSAR-DC Attachment (Refer to page 9.5-64)

INSERT 1:

Group "A" trips are active only during the periodic testing of the diesel to prevent damage to the engine. These trips are locked out during the emergency mode (i.e. LOOP or LOCA) to allow the engine to continue to run should alarm conditions exist. Group "A" trips include and are activated upon the following:

1. Low Lube Oil Pressure.
2. Low Left and Right Turbocharger Oil Pressure.
3. High Crankcase Pressure.
4. Excessive Engine Vibration.
5. High Lube Oil Temperature.
6. High Temperature Main Bearings.
7. High-High Jacket Water Temperature.
8. Generator Instantaneous Overcurrent Protecton.
9. Generator Loss of Field Protection.
10. Generator Reverse Power Protection.
11. Generator Ground Protection.

K

Group "B" trips remain active during all diesel generator operational modes (test and emergency) to shutdown the engine should a setpoint be exceeded. Group "B" trips include and are activated upon the following:

1. Engine Overspeed.
2. Low-Low Lube Oil Pressure.
3. Generator Differential.
4. Generator Voltage-Controlled Overcurrent (Protection from external faults).

INSERT 2:

The starting air compressors are powered from a non-Class 1E motor control center. During a loss of offsite power, the starting air compressors are powered from the alternate AC (AAC) power source. K

ALWR-477

9.5.6.5 Instrumentation Application

Each starting air receiver is equipped with a set of pressure switches which control the operation of the air compressor on its associated train; starting the compressor on low pressure and stopping the compressor on high pressure. Pressure gauges are located on the tanks for local indication. ~~with a low pressure alarm~~. A separate pressure switch on the engine control panel alarms if the air receiver tank pressure falls to a low setpoint. K

If the starting air pressure to the starting air manifold drops to a specified value with the engine failing to start, an automatic lockout will prevent further start attempts and an alarm alerts the operator to take corrective action. The automatic lockout ensures there will be sufficient reserve for a manual restart. E

All starting air system alarms are annunciated separately on the local diesel engine control panel and signals a general diesel trouble alarm in the control room.

The periodic testing and maintenance of all diesel engine starting air system instruments is controlled by a preventative maintenance program. This program insures that instruments are periodically calibrated and tested, assuring reliability. J E

An alarm is provided at the local diesel generator control panel to alert personnel when the air pressure drops below a preset value.

also read page -65

9.5.7 DIESEL GENERATOR ENGINE LUBE OIL SYSTEM

9.5.7.1 Design Bases

The Diesel Generator Engine Lube Oil System is designed to deliver clean lubricating oil to the diesel generator engine, its bearings and crankshaft, and other moving parts. By means of heaters, the lube oil system is designed to deliver warmed oil to the engine during standby to assure its fast-starting and load-accepting capability. The system also provides a means by which used oil may be drained from the engine and its components, and replaced with clean oil. E

All essential components and piping are located within a Seismic Category I structure (diesel generator building) and all essential components are fully protected from floods, tornado missile damage, internal missiles, pipe breaks and whip, jet impingement and interaction with non-seismic systems in the vicinity. K I

9.5.7.2 System Description

The Diesel Generator Engine Lube Oil System is shown in Figure 9.5.7-1 (Sheets 1 through ~~3~~ 4). K

9.5.7.2.1 General

Each diesel generator unit utilizes the "dry sump" lube oil system, in which the supply of lubricating oil for the engine is stored in a separate sump tank, independent of, and located ~~set~~ at a lower elevation than the engine crankcase. As oil accumulates in the crankcase, it drains by gravity into the sump tank. Additions of clean oil are made to the sump tank from a storage tank located ~~underground and~~ outside the diesel generator building, and used oil is removed from the sump tank via a transfer pump to a used oil storage tank. Each diesel generator has a separate and complete clean lube oil and used lube oil transfer system. K K I K

The engine-driven lube oil pump ~~picks up oil~~ takes suction from the sump tank through a built-in suction pipe with foot valve and delivers the oil in sequence from the pump discharge first to the oil pressure regulating valves which limit the maximum pressure on the pump discharge, and then in series through the lube oil cooler, the full-flow lube oil filter and finally to the full-flow lube oil strainer. From the strainer, the oil enters the engine internal circulation system.

During engine standby, the motor-driven prelube oil pump operates continuously to ensure complete filling of the lube oil system. Oil which is circulated by the prelube oil pump passes over a set of thermostatically controlled electric heating elements before leaving the sump tank to maintain the engine in a warmed state. From the prelube oil pump, the oil passes in series through the prelube oil filter, the prelube oil strainer and enters the engine internal circulation system. A separate drip lube system provides a continuous, metered flow of oil to the turbocharger bearings during engine standby to ensure adequate bearing lubrication for startup.

The diesel generator engine crankcase is vented to the atmosphere through the roof of the Diesel Generator Building. The lube oil filters and strainers are also vented, but into the room itself. The lube oil sump tank is vented to the atmosphere through the roof. The crankcase is equipped with blowout panels to prevent high pressures from damaging the engine.

ADD INSERT 1

~~The design of the lube oil storage tank is provided with an individual fill and vent line located outdoors. To prevent entrance of water into the storage tanks the vent and fill lines terminate above grade elevation. The fill connection is provided with a locking dust cap and the vent is down turned.~~ K

Each diesel is provided with a lube oil sump tank. The sump tank is equipped with a low level alarm which is set below the normal operating level. With an established oil consumption at full load, this volume is sufficient to operate the diesel in excess of seven days without requiring replenishment. E

Should it become necessary to make additions of lube oil to the diesel, lube oil is available in a storage tank located ~~underground and~~ outside the Diesel Generator Building. A manually operated, positive displacement clean lube oil pump takes suction from the storage tank and discharges lube oil through a simplex filter to the intended diesel. The pump suction is raised above the storage tank floor to prevent any accumulated water from entering the diesel lube oil sump tank. Accumulated water in the bottom of the storage tank is removed through a sample connection flush on the bottom of storage tank.

The lube oil in the clean lube oil storage tank is inspected monthly to determine the purity of the oil. Parameters monitored include viscosity, neutralization number, and percentage of water. Any accumulated water detected in the bottom of the storage tank will be removed. If degradation of the oil is detected, the oil may be pumped out for disposal.

Lubricating oil leakage is detected by:

A. Routine surveillance

ALWR-477

CESSAR-DC Attachment (Refer to page 9.5-68)

INSERT 1:

The clean lube oil storage tanks are provided with individual fill, drain, and vent lines located outdoors. The used lube oil storage tanks are provided with individual drain and vent lines located outdoors. All vent lines terminate above grade elevation and are down turned. The fill and drain connections terminate above grade elevation and are provided with a locking dust cap.

ALWR-477

The used lube oil transfer pump transfers oil from the used lube oil storage tank to a truck or tanker for disposal. The pump is driven by an electric motor.

The clean and used lube oil transfer pump motors are powered from the Station Normal Auxiliary Power Supply.

9.5.7.3 Safety Evaluation

The Diesel Generator Engine Lube Oil System is an ANSI Class 3 piping system with the exception of the Clean and Used Lube Oil Transfer System which is an ANSI Class 4 piping system. The two systems are separated by ANSI Class 3 isolation valves. The diesel engine and engine mounted components are constructed in accordance with IEEE Standard 387. The off engine essential equipment and components and the nonessential (i.e., Clean and Used Lube Oil Transfer System) equipment and components are designed in accordance with the requirements of the applicable codes.

ADD INSERT 2

~~The exterior of carbon steel tanks and other underground carbon steel components is sandblasted to a SSPC-SP10-63, Near White Metal Blast Cleaning. A coal tar epoxy coating which meets the requirements of Corps of Engineers Specification C-200 and Government Specification MIL-P-23236 is applied to exterior surfaces at a dry film thickness of 16 mils. This coal tar epoxy is also applied to the exterior of stainless steel piping.~~

~~In addition to being coated, the external surfaces of buried metallic piping and tanks are protected from corrosion by an impressed current cathodic protection system in accordance with NACE Standard RP-01-69 Periodic monitoring, as described by the maintenance procedure, will remove any accumulated moisture from the tanks.~~

E K

The governor lube oil coolers on the diesel generator engines are located at an elevation below the governor lube oil level, thereby, not affecting the starting reliability of the engines.

The interior of the clean lube oil storage tank is not coated since the presence of lube oil will act as a deterrent to internal corrosion. During the surveillance intervals for sampling the lube oil in the storage tanks, any accumulated water will be removed.

9.5.7.4 Inspection and Testing Requirements

System components and piping are tested to pressures designated by appropriate codes. Inspection and functional testing are performed prior to initial operation.

also see page -69

ALWR-477

CESSAR-DC Attachment (Refer to page 9.5-70)

INSERT 2:

The exterior of carbon steel tanks and other underground carbon steel components is coated. In addition to being coated, the external surfaces of buried metallic piping and tanks are protected from corrosion by an impressed current cathodic protection system in accordance with NACE Standard RP-01-69 or other means as deemed appropriate based on site specific soil conditions. Periodic monitoring, as described by the maintenance procedure, will remove any accumulated moisture from the tanks.

K

9.5.7.5 Instrumentation Application

Each diesel generator engine is provided with sufficient instrumentation and alarms to monitor the operation of the lube oil system. All alarms are separately annunciated on the local diesel engine control panel which also signals a general diesel trouble alarm in the control room. The lube oil system is provided with the following instrumentation and alarms:

The lube oil sump tank is equipped with a local level indicator along with a low level annunciator to alert the operator to take corrective action.

The full flow filters are equipped with locally-mounted pressure gauges. A high differential pressure alarm alerts the operator to manually switchover to the alternate clean filter; there is no filter bypass line. K

The engine mounted full flow strainers are equipped with a high differential pressure alarm which alerts the operator to manually switchover to the alternate clean strainer; there is no strainer bypass line. K

The diesel generator engine is equipped with both temperature and pressure monitoring systems with separate alarm and trip switches to alert the operator of abnormal operating conditions. If a shutdown setpoint/alarm is exceeded while the engine is operating during the test mode, a diesel trip will automatically shutdown the engine to prevent incurring any damage. ADD INSERT 3 15 E

However, if such a shutdown/alarm is received during the emergency mode (i.e., LOOP or LOCA) the trip is locked out and the engine continues to run. The alarms alert the operator to prepare to switch over to the redundant diesel for power. Only a low-low engine lube oil pressure shutdown/alarm will trip the engine regardless of the diesel operating mode.

The engine inlet and outlet lube oil temperatures are also recorded by a multipoint recorder and may be monitored by a multi-channel pyrometer (in the manual mode). Both the recorder and pyrometer are located on ~~the~~ the generator control panel in the diesel generator building.

The periodic testing and maintenance of all diesel engine lube oil system instruments is controlled by a preventative maintenance program. This program insures that instruments are periodically calibrated and tested, assuring reliability.

also need page -72

AZWP-477

9.5.8 DIESEL GENERATOR ENGINE AIR INTAKE AND EXHAUST SYSTEM

9.5.8.1 Design Bases

The Diesel Generator Engine Air Intake and Exhaust System is designed to supply clean air for combustion to the diesel generator engine and to dispose of the engines exhaust. The system is housed in a building designed to withstand the effects of natural phenomena and credible missiles. E

All components and piping are located within a Seismic Category I structure (diesel generator building) and all essential components are fully protected from floods, tornado missile damage, internal missiles, pipe breaks and whip, jet impingement and interaction with non-seismic systems in the vicinity. I

9.5.8.2 System Description

The Diesel Generator Engine Air Intake and Exhaust System is shown in Figure 9.5.8-1.

9.5.8.2.1 General

Each diesel generator is provided with a two pipe combustion air intake system. Combustion air is drawn in through in line air filters prior to entering the turbocharger.

Each diesel generator is provided with a two pipe exhaust system. The waterjacketed exhaust manifold discharges directly into the engine-mounted turbochargers. The exhaust piping then joins to pass through a single exhaust silencer and exits the building. E

Outside air intakes are located at one end of the building and exhausts (both Diesel and Ventilation System) at the opposite end of the structure. The intake and exhaust structures are separate for each diesel building and are similar in design. Each intake and exhaust structure is served by a ~~100% capacity~~ floor drain. |K In addition a sump, formed by the curb at the bottom of the intake and exhaust structures, provides capacity for preventing accumulation of snow, ice, or freezing rain from interfering with emergency diesel generator system operation.

9.5.8.2.2 Component Description

The turbocharger, driven by the hot exhaust gases on one side, compresses the intake air on the other side and forces it through the engine aftercooler.

Amendment ~~I~~ K
~~December 21, 1990~~
October 30, 1992

ALWR-477

The aftercooler removes heat from the compressed intake air, decreasing the air temperature. Cooling water flows through the tube side and its temperature increases. E

There are no active components in the air intake and exhaust system. I

9.5.8.3 **Safety Evaluation**

The Diesel Generator Engine Air Intake and Exhaust System is an ANSI Class 3 piping system. The diesel engine and engine mounted components are constructed in accordance with IEEE Standard 387. The off engine essential components are designed in accordance with the requirements of the applicable codes. The intake filter, intake silencer, and exhaust silencer are not ASME Section III Class 3 code approved. These components are seismically qualified by shaker table tests or analysis performed by the manufacturer. The components are installed in the diesel generator building with Seismic Category I restraints. E | K

The intake air plenum and the exhaust gas plenum for each diesel generator unit are at opposite ends of the diesel generator building. This fact and site-specific analysis of the diesel generator engine exhaust will establish that the rise of exhaust gases is sufficient to preclude the possibility of recirculation to the point that system integrity is jeopardized. Normal ventilation flowrate is 5% of the diesel run mode ventilation flowrate. Normal ventilation is filtered to maintain engine room cleanliness. All diesel generator building interior surfaces are painted to minimize concrete dust. Diesel intake air is taken at a height of ~~10~~ 20 feet above grade to minimize the intake of dust. I E

~~Primary fire protection is provided by an automatic carbon dioxide system. The system is activated by temperature detectors which alarm and annunciate in the control room.~~ | K

Onsite storage of gases is discussed in Section 9.5.10. These gases are stored at a distance from the diesel generator building such that there is no threat to the proper operation of the diesel engines. I

9.5.8.4 **Inspection and Testing Requirements**

System components and piping are tested to pressures designated by appropriate codes. Inspection and functional testing are performed prior to initial operation. E

9.5.8.5 **Instrumentation Application**

Each diesel generator engine unit is provided with sufficient instrumentation and alarms to monitor the combustion intake and

ALWR-477

exhaust system. A multipoint recorder on the local generator control panel records the individual cylinder exhaust temperatures and the inlet and outlet turbocharger exhaust temperatures. A pyrometer, also on the local generator control panel, automatically monitors each cylinder temperature and compares it to the average temperature of the other cylinders. The pyrometer will annunciate a high/low temperature alarm on the local diesel engine control panel and signal a general diesel trouble alarm in the control room if a cylinder temperature exceeds the average temperature differential setpoint, with the pyrometer automatic sequencer stopping to display the out-of-tolerance cylinder. A high or low exhaust temperature will not initiate ~~effect~~ a trip on the engine. A manual advance is also provided on the pyrometer to allow each individual cylinder to be checked as well as the inlet and outlet turbocharger exhaust temperatures. The turbocharger temperatures do not affect the cylinder temperature averaging circuit. E |K

also need page #6

Insert B

Am. J

Am. K

11.3.7 GASEOUS WASTE MANAGEMENT SYSTEM LEAK OR FAILURE

11.3.7.1 Identification of Causes and Accident Description

The Gaseous Waste Management System (GWMS), as discussed in section 11.3 designed to collect, monitor, and store radioactive waste gases which originate in the reactor coolant system and require processing by holdup for decay prior to release. The GWMS utilizes ambient temperature charcoal adsorption beds to provide sufficient decay of noble gases.

The accident is described as an unexpected and uncontrolled release of radioactive Xenon and Krypton gases from the GWMS resulting from an inadvertent bypass of the main decay portion of the charcoal adsorber beds. It is assumed to take as long as 2 hours to isolate or terminate the release.

11.3.7.2 Analysis of Effects and Consequences

A. Bases

1. The assumptions and methodology are consistent with guidance provided in Branch Technical Position ESTB 11-5.

2. An effective holdup time of 30 minutes is assumed for the bypass flow to account for transport time of the gases through the GWMS components via the release point to the nearest exclusion area boundary.

3. In accordance with ESTB 11-5, the Waste Gas System maximum design capacity source term (at sustained power) is assumed to seven times the source term considered for normal operation, including anticipated operational occurrences. PWR-GALE is run for a 30 minute decay case and the results are multiplied by seven to calculate the maximum design capacity source term.

4. The total source term is equal to the maximum design basis source term plus the normal operations source term shown in Table 11.3-4.

5. Particulates and radioiodines are assumed to be removed by pretreatment, gas separation, and intermediate radwaste treatment equipment. Therefore, only the whole body dose is calculated in this analysis.

Am K

new (A-K)

Insert B (cont'd)

6. In the absence of site specific meteorological data and exclusion area boundary information, an atmospheric dispersion factor (X/Q) of 1.00×10^{-3} is assumed for the exclusion area boundary (500 meters) based on Chapter 15, Appendix A. | C1N

B. Methodology

To calculate the dose consequences for a Waste Gas System failure methodology consistent with Branch Technical ESTB 11-5 is used.

$$D = \Sigma K(i) * Q(i) * X/Q * 7.25$$

Where:

D = Dose (mrem)

K(i) = the total-body dose factor given in Table B-1 of Regulatory Guide 1.109 for the i^{th} isotope (mrem-m^3/pCi/yr)

Q(i) = the noble gas nuclide release rate for the i^{th} isotope (Ci/yr)

X/Q = atmospheric dispersion factor at the exclusion area boundary

X/Q = 1.00×10^{-3} s/m^3 new Am. K | C1N

7.25 = conversion factor for 2 hour release (pCi-yr^2/Ci-event-sec)

C. Results and Conclusions

The resulting Exclusion Area Boundary noble gas dose to the whole body is 29.8 mrem. This meets the guidelines specified in the Standard Review Plan Section 11.3. | C1N

Insert A

11.3.8 Concentration of Normal Effluents

The Gaseous Waste Management System (GWMS) processes gaseous waste through a charcoal delay system which holds up noble gases and allows them to decay prior to release. The concentration at the exclusion area boundary during normal operation, including anticipated operating occurrences, was analyzed to verify it is less than 10 CFR 20, Appendix B, Table II, Column 1.

11.3.8.1 Analysis of Effects and Consequences

A. Bases

The bases for the estimated concentration of effluent are as follows:

1. This system continuously discharges at a uniform rate.
2. The concentration of the eff' ent is based on the design basis source term.
3. The total gaseous effluent calculated using NUREG-0017 methodology shown in Table 11.3-4 is multiplied by seven to yield a conservative approximation of the design basis source term. This methodology is consistent with the suggested methodology in Branch Technical Position ESTB 11-5 for a Waste Gas System Leak of Failure consequence analysis.
4. In the absence of site specific meteorological data and site Exclusion Area Boundary (EAB) information, an atmospheric dispersion factor of 1.00 x 10^{-3} s/m^3 was assumed for the EAB (500 meters) based on Chapter 15, Appendix A.

CLN: new (page 11.3-11) Am. K

B. Methodology

The methodology used to calculate the concentration of the effluent at the Exclusion Area Boundary is as follows:

$$C(i) = CF * 7R(i) * X/Q_{EAB}$$

Where:

C(i) ≡ Concentration of the i^{th} isotope at the EAB (µCi/ml)

new Am. K

Insert A (cont'd)

CF ≡ Conversion Factor
= 3.17×10^{-11} (s-μCi-m³/yr-Ci-ml)

R(i) ≡ Release Rate of i^{th} isotope (Ci/yr)

X/Q_{EAB} = Atmospheric dispersion factor at EAB (s/m³)
= 1.00×10^{-3} (s/m³) | CH

new Am. K

C. Results and Conclusions

The concentration of the effluent at the Exclusion Area Boundary is shown in Table 11.3-5. The concentration at the Exclusion Area Boundary is well within 10 CFR 20 guidelines. Although there are periodic purges of containment during normal operation, these purges will be controlled by precedures developed by the Owner Operator to ensure compliance with 10 CFR 20 limits.

TABLE 11.3-1

SOURCES, VOLUMES AND FLOW RATES OF STRIPPED GASES FROM THE PRIMARY COOLANT

Waste Gas Source	Flow Rate(1) (SCFM)	Annual Volume(2) (SCF/yr)
PROCESS GAS HEADER (HYDROGENATED)		
CVCS Gas Stripper	.32	145,000
Volume Control Tank	.004	1,624
Equipment Drain Tank		
Reactor Drain Tank (3)	.02	7,759
PROCESS VENT HEADER (AERATED)		
Blowdown Recycle IX (2)	32	112
Purification IX (2)	32	112
Deborating IX	16	56
Lithium Removal IX	16	56
Pre-Holdup IX	16	56
Boric Acid Condensate IX	16	56
Liquid Waste Process IX (6)	96	336
Boric Acid Concentrator	1	2,626
Reactor Makeup Water Tank	22	127,480
Holdup Tank	22	127,480
Boric Acid Tank		
Laundry & Hot Shower Tank (2)	7	17,567
Floor Drain Waste Tank (2)		
Equipment Waste Tank (2)		
Waste Monitor Tank (4)	7	53,325
SG Drain Tank (2)		
~~HA~~ Spent Resin Tank (~~2~~ 3)	22	1,337
~~Powdex Storage Tank~~	~~22~~	~~1,337~~
~~Gas Stripper~~ Vent		
Process Gas Adsorp'n Bed Drain		
Misc. Vents and Drains		

new Am. K

NOTES: (1) Flow rates are estimated maximums, not continuous.

(2) Volumes include anticipated operational occurrences.

(This was updated in Am. J (see book))

I

K

6

Table 11.3-5: Average Annual Concentration of Gaseous Effluents at the Exclusion Area Boundary (a)

Nuclide	C(i) (μCi/ml)	MPC(i) (μCi/ml)	FMPC(i)
I-131	3.99E-15	1.00E-10	3.99E-05
I-133	1.20E-14	4.00E-10	2.99E-05
Kr-85M	8.87E-13	1.00E-07	8.87E-06
Kr-85	1.71E-10	3.00E-07	5.69E-04
Kr-87	8.87E-13	2.00E-08	4.44E-05
Kr-88	1.77E-12	2.00E-08	8.87E-05
Xe-131M	3.55E-11	4.00E-07	8.87E-05
Xe-133M	2.22E-13	3.00E-07	7.39E-07
Xe-133	1.57E-11	3.00E-07	5.25E-05
Xe-135M	8.87E-13	3.00E-08	2.96E-05
Xe-135	5.32E-12	1.00E-07	5.32E-05
Xe-138	8.87E-13	3.00E-08	2.96E-05
Cr-51	7.32E-18	8.00E-08	9.15E-11
Mn-54	4.44E-18	1.00E-09	4.44E-09
Co-57	5.32E-19	6.00E-09	8.87E-11
Co-58	6.65E-17	2.00E-09	3.33E-08
Co-60	2.13E-17	3.00E-10	7.10E-08
Fe-59	1.91E-18	2.00E-09	9.54E-10
Sr-89	1.57E-17	3.00E-10	5.25E-08
Sr-90	6.21E-18	3.00E-11	2.07E-07
Zr-95	2.44E-18	1.00E-09	2.44E-09
Nb-95	6.65E-18	3.00E-09	2.22E-09
Ru-103	1.24E-18	3.00E-09	4.14E-10
Ru-106	2.22E-19	2.00E-10	1.11E-09
Sb-125	1.35E-19	9.00E-10	1.50E-10
Cs-134	7.32E-18	4.00E-10	1.83E-08
Cs-136	2.22E-18	6.00E-09	3.70E-10
Cs-137	1.29E-17	5.00E-10	2.57E-08
Ba-140	1.40E-18	1.00E-09	1.40E-09
Ce-141	9.54E-19	5.00E-09	1.91E-10
H-3	2.66E-10	2.00E-07	1.33E-03
C-14	1.62E-12	1.00E-07	1.62E-05
Ar-41	7.54E-12	4.00E-08	1.89E-04
		Total:	2.57E-03 MPC

new for Am. K

same as in Am. J, pls verify

CLW

(a) Based on the design basis source term.

Am K

print all pages ~~section~~ ~~11.4.2~~ 11.4-5 to the end. (11.4-12?)

11.4.2 SYSTEM DESCRIPTION

11.4.2.1 General Description

Primary functions of the SWMS include providing means by which inputs from the LWMS and primary letdown systems are processed to ensure economical packaging within regulatory guidelines, as well as handling dry, low activity wastes for shipment to a licensed burial facility.

The ~~powdex tank and~~ spent resin tank trains provide settling capacity for radioactive ~~condensate powdex and~~ bead resins transferred from various demineralizers. Capability is provided for solidification of dewatered resins or sluicing to containers approved for shipping and disposal of dewatered ion exchange resins. Also, connections are provided for use of vendor supplied services such as rapid dewatering or waste drying systems when it is determined that the use of these methods represents a savings over the permanently installed alternatives. I

A shielded onsite storage area is provided to allow for interim storage of higher activity packaged wastes. The facility is sized such that it is capable of storing the maximum number of full shipping containers generated in any six month period containing the greatest expected waste generation. The process and storage areas include a dedicated overhead crane with direct access to adjacent truck bays with sufficient overhead clearance to facilitate direct trailer loading of waste packages. Crane operation may be performed remotely with the aid of crane-mounted video cameras or locally to provide additional flexibility. J I

Building space is also provided to sort miscellaneous contaminated dry solids from uncontaminated solids for appropriate and cost effective packaging and disposal. Miscellaneous solid waste consisting of contaminated or potentially contaminated rags, paper, clothing, glass, and other small items is received by the Solid Radwaste System when it arrives at the low-level handling and packaging area. Although waste forms are segregated and bagged at generation points throughout the plant, this area provides space where the waste is further segregated (e.g., compactible versus non-compactible, radioactive versus non-radioactive) on sorting tables. When a sufficient quantity of contaminated waste has been accumulated, the compactor is operated. Radioactivity of filled containers is J I

October 30, 1992

monitored so that proper handling, storage, and disposal are assured. Filled containers may be stored in the low-level package storage area until shipped.

11.4.2.2 Components Description

Design parameters for the equipment in the SWMS are provided in Table 11.4-1. Component arrangement is shown on the system flow diagrams provided in Figure 11.4-1 (Sheet 1 and 2).

11.4.2.2.1 Spent Resin Storage Tank

~~Two~~ Three stainless steel ~~5000 gallon~~ spent resin storage tanks with conical bottoms hold resins from radioactive or potentially radioactive plant demineralizers. Non-clogging screens prevent the flow of resins out of the tank through the spent resin tank dewatering pump suction lines and the service air injection and vent lines. Multiple spent resin tank dewatering pump suction screens are provided on each spent resin storage tank to reduce the possibility of clogging when operating the spent resin dewatering pump. Instrumentation which monitors resin and water levels in the tank and resin water content is read from a remote panel located in the radwaste control room. I

Normally, the tank is vented to the room exhaust duct which is handled by the Radwaste Building filtered exhaust system. During resin transfers, the vent line is closed to allow tank pressurization. A relief valve on each tank prevents overpressurization due to service air pressure regulating valve failure. Resin transfers may be terminated from the control room or the dewatered waste processing area using an emergency cutoff to actuate valve closure in the resin transfer line and service air supply to the spent resin storage tank.

11.4.2.2.2 Powdex Storage Tank

The powdex storage tank is a 30,000 gallon tank which receives radioactive powdex from the condensate ion exchangers. The tank provides capacity for holdup and settling of powdex before it is processed and shipped. The tank is a stainless steel right cylinder with a conical bottom. Mixing of the powdered resin prior to sampling is provided by a recirculation line and a fluid powered mixer. Multiple connections are provided for tank dewatering, and the instrumentation monitoring powdex level in the tank is read from a remote panel located in the radwaste control room. J I

close spacing
46

close spacing

~~11.4.2.2.3 Powdex Dewatering Pump~~

~~The pump is capable of recirculating storage tank contents for resin mixing or transferring decant to the LWMS. Material of construction is stainless steel, and the pump controls are located in the radwaste control room.~~

~~11.4.2.2.4 Powdex Transfer Pump~~

~~This pump is capable of transferring powdex resin from the powdex storage tank to the dewatered waste processing area. The pump is a stainless steel, positive displacement pump. Controls are located in the radwaste control room, and an emergency cutoff is located in the dewatered waste processing area for use during resin transfer to the shipping containers.~~

11.4.2.2.~~5~~2 Dry Solids Compactor

The Dry Solids Compactor is used to reduce the volume of such material as cloth, paper, and plastic that is contaminated. Sorting and staging space is available in the low level waste handling and packaging area to separate non-contaminated materials for ordinary landfill disposal. I

11.4.2.2.~~6~~3 Radwaste Building Crane

The Radwaste Building Crane provides service to the areas occupied by the:

A. LWMS Process Vessels

B. LWMS Process Pumps

C. Shielded Storage Area

D. Container Filling Platform

E. Shipping Truck Bay

F. Vendor Solidification Bay

G. Miscellaneous Contractor Space

H. Low-level Handling and Packaging Area

I. Low-level Waste Storage Area

The crane is equipped with remote controls and surveillance cameras to minimize operational exposure.

Insert C

11.4.2.3 System Operation

11.4.2.3.1 Spent Resin Storage and Handling

The powdex tank process train is used to collect, dewater, and transfer spent radioactive powdex from the condensate demineralizers. Powdex resin is sluiced from condensate demineralizers to the powdex storage tank where it is allowed to settle. Decant is removed and transferred to the LWMS for sampling prior to release or recycled to the condensate system. The resins are batched to the dewatered waste processing area where the remaining water is removed and the container is prepared for shipment. Process line connections allowing the use of vendor-supplied rapid equipment are provided.

When low activity resin beds are expended, they are usually batched directly to the disposal containers for vendor-service processing and direct shipment to a licensed burial facility. However, a low activity spent resin storage tank is provided to allow for settling and holdup of these resins prior to processing if necessary. Decant from the resin storage tanks and disposal container dewatering operations is directed back to the LWMS.

By injecting service air or water through the resin outlet line at the bottom of each tank, the resins may be agitated prior to transfer to the processing area. Sampling of the tank is performed to ascertain the radionuclide content of the spent resins. At the time of transfer, service air is allowed to flow through the service air header to provide the necessary overpressure required to propel the resins out of the tank to the dewatered waste process area. I

High activity resins are sluiced to the high activity spent resin storage tank and transferred to the processing area using the methods described above for transfer of low activity spent resins. In some cases high activity resins may be blended with low activity resins to reduce shipping and disposal costs. Blending may be accomplished by utilizing a cross connection which allows transfer of low activity spent resins to the high activity spent resin storage tank.

When solidification of spent resins is desired, instrumentation on the spent resin storage tank is used to assure that the appropriate water-to-resin ratio is present. Adjustments to this ratio may be made using available water supplies or the spent resin tank dewatering pump as necessary. Following mixing, valve alignments are made to direct the resins through the resin metering pump to the binding area. Filled containers may be stored in the shielded storage area until shipped.

Insert C

11.4.2.3 System Operation

11.4.2.3.1 Spent Resin Storage and Handling

Spent resin is sluiced from various plant demineralizers or ion exchangers to spent resin storage tanks where it is allowed to settle prior to processing. Spent resin is segregated based on level of activity. High activity spent resin from demineralizers used to process primary coolant, such as the purification and pre-holdup ion exchangers in the Chemical Volume and Control System, are sluiced to the high activity spent resin storage tank. Low activity spent resin from the fuel pool and boric acid concentrator ion exchangers and the LWMS demineralizers are sluiced to the low activity spent resin storage tank.

Service air or water injected through the resin outlet line at the bottom of each tank is used to agitate the resins prior to transfer to the processing area. At the time of transfer, service air is allowed to flow through the service air header to provide the necessary overpressure required to propel the resins out of the tank to the dewatered waste processing area.

If necessary, low activity spent resin are sluiced to the low activity spent resin tank to allow for settling and holdup prior to processing. Otherwise, they are batched directly to disposal containers for vendor-service processing and direct shipment to a licensed burial facility.

High activity spent resin is sluiced to the high activity spent resin storage tank to allow settling and decay of short-lived isotopes. Resin are then transferred to the processing area. In some cases, high activity resins may be blended with low activity resins. Blending may be accomplished by utilizing a cross connection which allows transfer of low activity spent resins to the high activity spent resin storage tank.

Decant from the resin storage tanks and the disposal containers, removed during the dewatering process, is directed back to the LWMS for sampling and processing prior to release to the environment. Non-clogging screens on the spent resin tank and filters in the process line are provided to prevent the carryover of spent resin beads or fines to the LWMS during the transfer of decanted water.

When solidification of spent resins is desired, instrumentation on the spent resin storage tank is used to assure that the appropriate water-to-resin ratio is present. Adjustments to the ratio may be made using available water supplies or the spent resin tank dewatering pump as necessary. Following mixing, valve alignments are made to the binding area. Filled containers may be stored in the shielded storage area until shipped.

12.4-3

am K

B. Flow and Pressure Indicators

Pump discharge flow and suction metering as well as pump discharge pressure indication will be provided to properly control the bed transfer process. I

C. Radiation Monitoring

Area radiation monitors will be provided as discussed in ~~Chapter 12~~. Section 11.5

11.4.7 STORAGE CAPACITY

System 80+ will provide an Interim Onsite Storage Facility to provide adequate shielded storage space for solid waste (i.e., wet, dry, solidified waste). The Interim Onsite Storage Facility is located in close proximity to the Radwaste Building to facilitate the transfer of shipping containers from the Radwaste Building to the Interim Onsite Storage Facility. This facility is designed in accordance with Standard Review Plan, Section 11.4, EPRI Electric Utility Document, Chapter 12, and Regulatory Guide 1.143 requirements. These include:

A. This facility provides sufficient shielded storage capacity to accommodate the maximum expected waste generated in a six month period. J

B. All potential release pathways shall be controlled and monitored in accordance with 10 CFR 50, Appendix A (General Design Criteria 60 and 64). This will be ensured by the following:

- Provision of curbing or elevated thresholds to retain spills of waste, such as dewatered resins or sludges.
- Provision of floor drains to collect and route spills back to LWMS for processing.
- Provision of area, airborne, and process radiation monitors.

C. The foundation and walls shall be designed in accordance with Regulatory Guide 1.143 to withstand an Operating Basis Earthquake (OBE).

D. Sufficient shielding is provided to limit the radiation level to less than 2.5 mrem/hr in adjacent areas, permitting unrestricted access.

TABLE 11.4-1

(Sheet 1 of 2)

SOLID WASTE MANAGEMENT SYSTEM COMPONENT DESIGN

~~POWDEX STORAGE TANK~~

~~Quantity~~	~~1~~
~~Total Volume (Gal)~~	~~30,000~~
~~Material~~	~~Stainless Steel~~
~~Geometry~~	~~Right Cylinder, Conical Bottom~~

HIGH ACTIVITY SPENT RESIN STORAGE TANK

Quantity	~~2~~ 1
Total Volume (Gal)	5000
Material	Stainless Steel
Geometry	Right Cylinder, Conical Bottom

I

Insert

SPENT RESIN TANK DEWATERING PUMP

Quantity	~~1~~ 2
Type	Canned, Horizontal Centrifugal
Material	Stainless Steel

DEWATERING PUMP

Quantity	1
Type	Single Stage Turbine
Material	Stainless Steel

~~POWDEX DEWATERING PUMP~~

~~Quantity~~	~~1~~
~~Type~~	~~Canned, Horizontal Centrifugal~~
~~Material~~	

~~POWDEX TRANSFER PUMP~~

~~Quantity~~	~~1~~
~~Type~~	~~Positive Displacement~~
~~Material~~	~~Stainless Steel~~

LOW ACTIVITY SPENT RESIN TANK

QUANTITY	2
TOTAL VOLUME (GAL)	62000
MATERIAL	Stainless Steel
Geometry	Right Cylinder, Conical Bottom

TABLE 11.4-1 (Cont'd)

(Sheet 2 of 2)

SOLID WASTE MANAGEMENT SYSTEM
COMPONENT DESIGN

SPENT RESIN METERING PUMP

Quantity	~~2~~ 3
Type	Positive Displacement
Material	Stainless Steel

SPENT RESIN SLUICE FILTER

Quantity	~~1~~ 2
Type	Disposable Cartridge
Material	Stainless Steel
Retention % (@ 25 Micron)	98
Material	Stainless Steel

I

TABLE 11.4-2

ESTIMATED MAXIMUM VOLUMES
DISCHARGE FROM THE SWMS
(1 UNIT)

Waste Type	Volumes (ft^3/yr)
Spent Bead Resins	2920 (1)(2) ~~420~~ (1)
~~Powdex Resins~~	~~1800 (2)~~
Filters	30
Miscellaneous Solids	2400

NOTES: 1. 180 cubic feet high activity resin and 240 cubic feet low activity resin

2. Assumes ~~1~~ 8 condensate demineralizer resin beds discharge per fuel cycle

I

ALWR-489

12.2.1.6 Radwaste Building

Radwaste building tanks and process component source terms are summarized in Tables 12.2-17 through 12.2-19. The radwaste building source terms provided include waste fluid and ion exchange resin specific activities calculated for CVCS and condensate cleanup components as well as calculated radwaste process equipment source terms.

Equipment and floor drain tank fluid specific activities are calculated using Table 12.2-5 degassed reactor coolant equilibrium radionuclide concentrations and Table 11.2.6-2 activity fraction assumptions (i.e., equipment and floor drain tanks receive fluids with average primary coolant activity fractions of 0.2 and 0.02, respectively). The laundry and hot shower tank specific activities are calculated using NUREG-0017 annual detergent waste radionuclide release projections and assuming 540 gallon per day of detergent wastes are treated and released. The chemical waste tank will receive fluids of varying radioactive contamination levels and is shielded assuming relatively high levels (consistent with the equipment waste drain tank) may be received. The waste monitor tank source term is calculated using equipment waste tank radionuclide specific activities and an assumption that liquid waste processing equipment achieves an overall decontamination factor of 1000.

Specific activity source terms for waste process filters and demineralizers are calculated using an activity build-up and decay model. Process flow rate assumptions consistent with Table 11.2.6-2 and process fluid activity levels provided in Table 12.2-17 are used. For the purposes of the source term calculation, waste process filters and resin beds are assumed to have a 3 month useful service life. Although radwaste process filtration media source terms and useful service life will realistically vary, component sources will be controlled (i.e., media replacement based on elevated dose rate levels, if necessary) to assure occupational exposures associated with radwaste system operations remain ALARA.

Specific activities for the high activity spent resin storage tanks are the same as calculated for the CVCS purification demineralizer resins presented in Table 12.2-10. The low activity spent resin storage tank source terms are taken from Table 12.2-18 values for waste process demineralizer resins. ~~Powdex storage tank source terms are taken from Table 12.2-15 specific activities for powdex.~~

also need page 12

page 11 now

Intake louvers for ventilation systems are located on the exterior of buildings draw outside air into the plant. This air may be contaminated. The concentration of the radionuclides in the air at the intake is a function of site specific characteristics, such as the atmospheric dispersion coefficient (X/Q), the wake effect from the surrounding structure. The release of low level of radioactivity from the unit vent is a continuous process. In general the airborne material will rise, due to the momentum and the buoyancy of the effluent of the exhaust, and will be carried away by wind currents. However, fumigation of the effluent may occur due to inversion of the plume compounded by wake effects of nearby structures. This may cause the effluent to linger around the plant ventilation intakes where it can be drawn into the plant recirculating contaminated air discharged from the plant.

12.2.2.1 Inplant Concentrations

The levels of airborne radioactivity within the plant during normal operation are based on estimates of the above sources. It is assumed that in areas where there are no potential sources of radioactive leakage or evaporation, the concentration of radioactivity is equal to the concentration in the air external to the ventilation intakes. This is reasonable because the design of ventilation systems is such that air flows from areas of lower potential airborne radioactivity to areas of higher airborne radioactivity. J

For those areas with sources of leakage or evaporation, the concentration is calculated by:

$$C=C_0 + Q/(1.7E+06\ F)$$

Where:

C=room concentration (uCi/ml)

C_0=outside air concentration for the appropriate ventilation system(uCi/ml)

Q=source term(uCi/hr)

$Q=L*PF*A_0$~~/V~~

L=leakage or evaporation rate(ft^3/hr)

PF=partition factor

A_0=initial activity of fluid stream source(uCi/ml)

~~V=free volume of air in room(ml)~~

F=room exhaust flow rate(ft^3/min)

1.7E+06=conversion factor(ft^3-hr/min) to (ml)

Credit for decay has been neglected for conservatism. The airborne concentrations in rooms or cubicles accessible by personnel throughout the plant will be maintained within maximum permissible concentrations prescribed in 10 CFR Part 20.

12.2.3 SOURCES USED IN NUREG-0737 POST-ACCIDENT SHIELDING REVIEW

Item II.b.2 of NUREG-0737 clarifies the requirement for ensuring that areas which require post-accident personnel access or contain safety-related equipment are adequately shielded in the vicinity of systems which may contain highly radioactive materials as a result of the Design Basis Accident.

A radiation and shielding design review of the System 80+ Standard Design in accordance with Item II.b.2 of NUREG-0737 is performed during the detailed design phase of the plant. The review of systems that, as a result of an accident, contain highly radioactive materials was performed using the same methodology described in Section 12.3.2.

Initial core releases are used which are equivalent to those recommended in Regulatory Guides 1.4 and 1.7 and Standard Review Plan 15.6.5. The source terms are presented in Table 12.2-20. Plant areas requiring post-accident occupation ("vital areas"), and the duration of occupation are identified.

The calculated individual personnel radiation doses and average dose rates in vital areas requiring continuous occupation are less than 5 Rem (GDC 19) and 15 mrem/hr, respectively.

TABLE 12.2-15

(Sheet 1 of 2)

TURBINE BUILDING SOURCES RADIONUCLIDE SPECIFIC ACTIVITIES

Isotope	SG (1) Water (μCi/gm)	Condensate (μCi/gm)	Steam (μCi/gm)	Blowdown Filter (μCi/ml)	Blowdown IX (μCi/ml)	~~Powdex IX (μCi/ml)~~
Volume(ft^3):				1	30	~~1800~~
Sr-89	3.9E-09	2.0E-11	2.0E-11	---	1.2E-04	~~4.8E-06~~
Sr-90	3.4E-10	1.7E-12	1.7E-12	---	5.4E-05.	~~2.0E-06~~
Sr-91	2.0E-08	1.0E-10	1.0E-10	---	5.1E-06	~~1.9E-07~~
Y-91	1.4E-10	7.2E-13	7.2E-13	---	5.1E-06	~~2.0E-07~~
Y-93	8.6E-08	4.3E-10	4.3E-10	---	2.2E-05	~~8.2E-07~~
Zr-95	1.1E-08	5.5E-11	5.5E-11	---	4.5E-04	~~1.7E-05~~
Nb-95	7.6E-09	3.8E-11	3.8E-11	---	1.7E-04	~~6.4E-06~~
Tc-99m	8.0E-08	4.0E-10	4.0E-10	---	1.3E-05	~~4.8E-07~~
Mo-99	1.7E-07	8.7E-10	8.7E-10	---	3.0E-04	~~1.2E-05~~
Ru-103	2.1E-07	1.1E-09	1.1E-09	---	5.3E-03	~~2.1E-04~~
Ru-106	2.5E-06	1.3E-08	1.3E-08	---	2.9E-01	~~1.1E-02~~
I-131	7.4E-07	7.4E-09	7.4E-09	---	3.8E-03	~~2.8E-04~~
I-132	1.8E-06	1.8E-08	1.8E-08	---	1.1E-04	~~8.1E-06~~
I-133	2.1E-06	2.1E-08	2.1E-08	---	1.2E-03	~~8.8E-05~~
I-135	3.3E-06	3.3E-08	3.3E-08	---	5.8E-04	~~4.4E-05~~
Te-129	1.7E-07	8.5E-10	8.5E-10	---	5.2E-06	~~1.9E-07~~
Te-129m	5.4E-09	2.7E-11	2.7E-11	---	1.2E-04	~~4.3E-06~~
Te-131	2.3E-08	1.2E-10	1.2E-10	---	2.5E-07	~~9.9E-09~~
Te-131m	3.8E-08	1.9E-10	1.9E-10	---	3.0E-05	~~1.1E-06~~
Te-132	4.6E-08	2.3E-10	2.3E-10	---	9.5E-05	~~3.6E-06~~
Cs-134	2.9E-07	1.4E-09	1.4E-09	---	3.6E-02	~~8.5E-04~~
Cs-136	3.5E-08	1.7E-10	1.7E-10	---	2.6E-04	~~6.2E-06~~
Cs-137	3.9E-07	1.9E-09	1.9E-09	---	5.6E-02	~~1.3E-03~~
Ba-140	3.6E-07	1.8E-09	1.8E-09	---	2.9E-03	~~1.1E-04~~
La-140	6.5E-07	3.2E-09	3.2E-09	---	6.9E-04	~~2.6E-05~~
Ce-141	4.2E-09	2.1E-11	2.1E-11	---	8.6E-05	~~3.2E-06~~
Ce-143	7.0E-08	3.5E-10	3.5E-10	---	6.1E-05	~~2.3E-06~~
Ce-144	1.1E-07	5.5E-10	5.5E-10	---	1.2E-02	~~4.4E-04~~

I

K

TABLE 12.2-15 (Cont'd)

(Sheet 2 of 2)

TURBINE BUILDING SOURCES
RADIONUCLIDE SPECIFIC ACTIVITIES

Isotope	SG (1) Water (μCi/gm)	Condensate (μCi/gm)	Steam (μCi/gm)	Blowdown Filter (μCi/ml)	Blowdown IX (μCi/ml)	~~Powdex IX (μCi/ml)~~
Kr-85	---	---	1.2E-09	---	---	~~---~~
Kr-85m	---	---	2.3E-08	---	---	~~---~~
Kr-87	---	---	2.5E-08	---	---	~~---~~
Kr-88	---	---	4.5E-08	---	---	~~---~~
Xe-131m	---	---	7.2E-09	---	---	~~---~~
Xe-133	---	---	4.7E-08	---	---	~~---~~
Xe-133m	---	---	2.6E-09	---	---	~~---~~
Xe-135	---	---	9.3E-08	---	---	~~---~~
Xe-135m	---	---	2.5E-08	---	---	~~---~~
Xe-137	---	---	6.6E-08	---	---	~~---~~
Xe-138	---	---	2.3E-08	---	---	~~---~~
Mn-54	4.5E-08	2.2E-10	2.2E-10	1.5E-01	9.9E-05	~~1.8E-04~~
Co-58	1.3E-07	6.6E-10	6.6E-10	1.7E-01	1.1E-04	~~2.2E-04~~
Co-60	1.5E-08	7.5E-11	7.5E-11	6.7E-02	4.5E-05	~~8.6E-05~~
Fe-59	8.2E-09	4.1E-11	4.1E-11	6.9E-03	4.7E-06	~~8.7E-06~~
Cr-51	8.9E-08	4.5E-10	4.5E-10	4.6E-02	3.1E-05	~~5.9E-05~~

I

(1) Also source assumed for SG Blowdown and SG Drain Tank fluid systems.

TABLE 12.2-19

(Sheet 1 of 2)

RADWASTE BUILDING SOURCES
SOLID WASTE PROCESS EQUIPMENT

Isotope	HA Spent Resin Tank (μCi/ml)	LA Spent Resin Tank(2) (μCi/ml)	Powdex Storage Tank (μCi/ml)
Volume(ft^3):	670	1240 ~~670~~	4000
Br-83	1.6E-02	2.9E-05	---
Br-84	1.6E-01	3.0E-04	---
Br-85	1.7E-03	3.2E-06	---
Rb-88	9.7E-02	3.3E-04	---
Rb-89	9.9E-02	3.3E-04	---
Sr-89	2.3E+01	3.1E-02	4.8E-06
Sr-90	6.0E+00	3.4E-03	2.0E-06
Sr-91	1.2E-01	2.2E-04	1.9E-07
Sr-92	1.6E-02	3.0E-05	---
Y-90	1.1E-02	2.1E-05	---
Y-91	5.3E+00	6.8E-03	2.0E-07
Y-91m	1.5E-04	2.9E-07	---
Y-92	4.0E-03	7.6E-06	---
Y-93	2.3E-02	4.3E-05	8.2E-07
Zr-95	7.3E+00	8.9E-03	1.7E-05
Nb-95	4.1E+00	6.5E-03	6.4E-06
Tc-99m	1.0E-02	2.0E-05	4.8E-07
Mo-99	3.7E+02	6.9E-01	1.2E-05
Rh-103m	3.0E-04	5.6E-07	---
Ru-103	3.4E+00	5.1E-03	2.1E-04
Ru-106	3.4E+00	2.3E-03	1.1E-02
I-131	3.9E+03	7.3E+00	2.8E-04
I-132	1.4E+01	2.6E-02	8.1E-06
I-133	6.6E+02	1.2E+00	8.8E-05
I-134	4.0E+00	7.6E-03	---
I-135	1.2E+02	2.3E-01	4.4E-05
Te-129	6.4E+02	1.2E-04	1.9E-07
Te-129m	5.7E+01	9.2E-02	4.3E-06
Te-131	2.7E-02	5.1E-05	9.9E-09
Te-131m	5.4E+00	1.0E-02	1.1E-06
Te-132	1.6E+02	3.1E-01	3.6E-06
Te-134	1.5E-01	2.9E-04	---
Cs-134	7.9E+03	8.9E+00	8.5E-04
Cs-136	2.1E+02	7.2E-01	6.2E-06
Cs-137	8.9E+03	9.3E+00	1.3E-03
Cs-138	7.6E-01	2.6E-03	---
Ba-137m	2.9E-07	5.5E-10	---

I

TABLE 12.2-19 (Cont'd)

(Sheet 2 of 2)

RADWASTE BUILDING SOURCES
SOLID WASTE PROCESS EQUIPMENT

I

Isotope	HA Spent Resin Tank (μCi/ml)	LA Spent Resin Tank (2) (μCi/ml)	~~Powdex Storage Tank (μCi/ml)~~
Ba-139	5.8E-03	1.1E-05	~~---~~
Ba-140	9.0E+00	1.7E-02	~~1.1E-04~~
La-140	1.7E-01	3.2E-04	~~2.6E-05~~
Ce-141	3.5E+00	5.7E-03	~~3.2E-06~~
Ce-143	1.1E-01	2.2E-04	~~2.3E-06~~
Ce-144	1.3E+01	9.2E-03	~~4.4E-04~~
Pr-144	3.2E-05	6.0E-08	~~---~~
Mn-54	1.9E+01	2.7E-03	~~1.8E-04~~
Co-58	2.4E+01	5.7E-03	~~2.2E-04~~
Co-60	8.2E+00	9.7E-04	~~8.6E-05~~
Fe-59	1.0E+00	3.0E-04	~~8.7E-06~~
Cr-51	6.7E+00	2.3E-03	~~5.9E-05~~

ALWR-489

12.3 RADIATION PROTECTION DESIGN FEATURES

12.3.1 FACILITY DESIGN FEATURES

Insert → A

This section describes some of the System 80+ design features to achieve ALARA goals.

A. Fuel Performance

The System 80+ design features assure low primary system sources with improved fuel clad leakage performance of less than 0.1% fuel clad failures, as well as an extended fuel cycle.

B. Corrosion Product Control

System 80+ design includes design features that reduce corrosion product production in the primary system.

1. Primary System Materials

The System 80+ design specifies primary system materials with low corrosion rates and very low cobalt impurities.

Steam generator tubes are fabricated to relieve stresses to reduce stress corrosion cracking. This will reduce the probability of tube plugging activities and further reduce maintenance exposures. J

Control rod drive materials are specified with low cobalt alloys to reduce RCS exposures.

2. Primary System Chemistry

Increased pH in the range of 6.9 to 7.4 reduces equilibrium corrosion rates and buildup of activated corrosion products on primary system surfaces.

C. Reactor Coolant Pump Seals

System 80+ RCPs incorporate a cartridge type of RCP seal which is a proven, reliable and easily replaceable seal design. The replacement is also facilitated by the addition of platforms around the RCPs. This design reduces the time required to perform maintenance on the RCP seals and maintenance exposure.

D. Steam Generator Maintenance

System 80+ design includes several features which enhance accessibility during maintenance and inspection. These features, described in Section 5.4.2, reduce the overall exposure to personnel during these activities. These features include:

1. Use of automatic/robotic equipment for inspection and maintenance activities
2. Adequate pull and laydown areas
3. Platforms
4. Handholes
5. Increased size of manways to 21"
6. Use of removable insulation to facilitate weld inspection
7. Use of Inconel 690 for the tubes to reduce corrosion product production. J

Also, included in the System 80+ design are features which are important to achieving ALARA goals. These include:

1. Considerations for equipment reliability, maintainability, and accessibility
2. Component design, i.e., tank design, piping design and instrument design to minimize particulate deposition
3. System flushing and decontamination capability
4. Radwaste handling operations (also discussed in Sections 11.2 - 11.4)
5. Isolation of contaminated components and proper shielding
6. Controlled access to high radiation areas via locked doors.
7. Piping containing radioactive liquids, resins, or gases are routed through shielded pipe chases.

In order to maintain exposure ALARA and to aid in the layout and shielding design, the station is divided into radiation zones. These zones indicate maximum dose rates based on design activities only. The zone limits are summarized in Table 12.3-1. I

12.3.1.~~1~~4 <u>Radiation Zone Designation</u>

The radiation zones for normal operating conditions are designated in Table 12.3-2, as well as the Associated Radiation Zone Maps illustrated in Figures 12.3-1 through 12.3-8. J

O'K to overflow the text

ALWR-489

Insert A

12.3.1 FACILITY DESIGN FEATURES

The System 80+ design incorporates ALARA principles per Regulatory Guide 8.8 and 8.10 to minimize the onsite exposure to plant personnel and operators during normal operation and maintenance activities. Section 12.1.2.1 details ALARA principles incorporated into the plant layout, component location, and material selection. The following section details specific design features to ensure operational and maintenance exposure is ALARA.

12.3.1.1 General Arrangement Design Features

A. Location of Radioactive Systems and Equipment

Nonradioactive systems are separated from radioactive systems. This helps control the spread of contamination and minimize the necessity for routing piping containing radioactive fluids or slurries through personnel corridors. This also facilitates radiation area access control.

Radioactive equipment are separated into compartments whenever possible. Equipment is compartmentalized based on frequency of access required, operational characteristics, and radiation level. For example, ion exchangers containers resin beads are typically located in a separate compartment from active components, such as pumps and valves. Valves are typically located in valve galleries. Ion exchangers are located in pits with their associated spent resin service tanks located directly below the ion exchanger to minimize the pipe lengths and the general area radiation. The compartment walls provide shielding which enables personnel to perform operation and maintenance activities in a lower radiation area.

B. Pipe Routing

Pipe lengths of radioactive systems are minimized by locating interfacing systems in close proximity. Piping for these systems are then routed through shielded pipe chases. The number of active components located in pipe chases are minimized to reduce the frequency of access required into the pipe chase for maintenance activities.

C. Spacing

The System 80+™ Standard Design is designed to provide adequate spacing around equipment for easy access of equipment for maintenance and inspection. This includes provisions for adequate laydown area or equipment pull area, as well as transport paths for removal or replacement of equipment. Rigging and lifting equipment are also provided to facilitate

Amendment K
October 30, 1992

the removal, transport, or replacement of equipment or portable shielding during maintenance activities.

D. Hot Tool Cribs and Hot Machine Shops

Hot tool cribs are located in low radiation areas adjacent to maintenance areas to minimize waiting times in high radiation areas, to help prevent the spread of contamination, and to decrease the amount of decontamination work required to be performed. This reduces the radioactive wastes generated and personnel exposure.

The provision of a hot machine shop adjacent to the equipment hatch enables personnel to remove equipment from containment and perform maintenance in a lower radiation area. Access to the hot machine shop is also provided from the truck bays and maintenance areas for ease of equipment movement.

E. Staging Areas

Large staging areas inside and outside the equipment hatch and personnel airlocks allow pre-staging prior to the start of an outage, as well as provide space for efficient radiation controls for moving equipment in and out of containment.

F. Personnel Decontamination and Change Areas

Two personnel decontamination areas are provided in the System 80+™ design. One is located within the radiation access control area (RCA) and the other is located adjacent to RCA access point. Protective clothing, respirators, shower and toilet facilities, lockers, and containers for contaminated clothing are provided in these areas. Change areas are located near airlocks to minimize personnel traffic flow, distance travelled, and the potential for the spread of contamination.

G. Radiation Control Area (RCA)

The System 80+™ design provides for a single point access into the RCA on elevation 91+9; however emergency egress is provided on all elevations. The access area to the RCA provides a flexible and adaptable layout, a large area (40' x 100') sufficient to accommodate outage work crews and enhance the availability of immediate interaction with radiation protection personnel stationed at this point.

H. Accessways and Entrances to High Radiation Areas

1. Labyrinths or shield doors are provided at the entrances to high radiation areas to minimize the exposure due to scatter and streaming of radiation through entrances.

2. Shield plugs are provided as necessary to provide shielding during normal operation for adjacent corridors. These shield plugs are removable to permit components, such as heat exchangers, and their internals to be pulled during maintenance activities.

3. High radiation areas are provided with locked doors to prevent inadvertent access by plant personnel.

12.3.1.2 Equipment and System Design Features for Control of Onsite Exposure

System 80+™ specifies the use of more reliable and simplistic equipment. This reduces the frequency of maintenance and the radiation exposure to plant personnel. The following section discusses equipment design characteristics utilized in radioactive systems.

A. Pumps

1. Pumps and associated piping are flanged to facilitate pump removal to a lower radiation area for maintenance or repair. Pump internals are also removable.

2. All pump casings are provided with drain connections to facilitate decontamination. The drain connection are free of internal crevices to minimize accumulation of radioactive corrosion products (crud).

3. Pump seals are easily serviceable without removal of the entire pump or motor. The reactor coolant pump seals are a cartridge type to facilitate removal for maintenance or repair.

B. Ion Exchangers (Demineralizers)

1. Ion exchangers are designed for complete drainage.

2. Spent resin removal is designed to done remotely by hydraulic flushing from the vessel to the Solid Waste Management System (SWMS).

3. Piping, strainers and resin screens are flushable so that all spent resin is removed in the flush mode.

4. Fresh resin addition is accomplished from a low radiation area above the shielded compartment housing the ion exchanger.

5. Internal crevices are minimize to prevent accumulation of radioactive crud.

ALWR-489

6. Ion exchanger manways are easily accessible. Internal components are easily removed through manways requiring minimal disassembly.

C. Liquid Filters

1. Filter housings are provided with vents connections and are designed for complete drainage.

2 Filter housings are designed with a minimum of internal crevices to minimize the accumulation of radioactive crud.

3. Filter housings and cartridges are designed to permit remote removal of filter elements. Cartridge filter seals are an integral part of the filter cartridge so that seal removal is accomplished during cartridge removal.

4. Cartridge filter housing closure heads are designed to swing free for the unobstructed removal of the cartridge.

D. Tanks

1. Tanks are designed for complete drainage; free of internal crevices, and pockets. The drain line is connected to the bottom.

2. Tanks are provided with at least one of the following means of decontaminating the tank internals:

   a. Ample space is provided to permit decontamination of the tank manway.

   b. Internal spray nozzles are provided on potentially highly contaminated tanks for internal decontamination.

   c. Back flush capability is provided for tank inlet screens.

3. Tanks are designed with a convex or sloped bottom to facilitate drainage and minimize the accumulation of crud.

4. Tanks are provided with vents to facilitate the removal of potentially radioactive gases during maintenance.

5. Non pressurized tanks are provided with overflows, routed to a floor drain sump or other suitable collection point to avoid spillage of radioactive fluids onto the floor or ground. The floor drain system is connected to the

Liquid Waste Management System for further processing prior to release to the environment.

E. Valves

1. The following discussion summarizes valves specifications that minimize valve leakage, as well as extend valve design life.

   a. Except for modulating valve applications, packless valves are used on all valves two inches and under in diameter.

   b. Modulating valves and valves greater than two inches in diameter use live loading of the packing by conical spring washers or equivalent means to maintain a compressive force on the packing where possible.

   c. Double stem packing with a leak-off between the packing is used for valves four inches and larger, as well as normally open valves two to four inches in diameter. Stem leakage is piped to an appropriate drain sump or tank.

   d. Valves utilizing stem packing are provided with backseat capability.

   e. Radiation resistant seals, gaskets, and elastomers are utilized, when practicable, to extend the design life and reduce maintenance requirements.

2. Fully ported valves are used to minimize internal accumulation of crud.

3. Valves requiring removal during maintenance and inspection activities are flanged.

4. Internal valve surfaces are designed free of crevices to minimize the accumulation of crud.

5. Valve wetted parts are made of austenitic stainless steel or corrosion resistant material.

6. Valves are designed so that they may be repacked without removing the yoke or topworks.

F. Piping and Penetrations

1. There is no field run piping.

2. Resin and concentrate piping is designed as follows:

   a. The length of pipe runs are minimized.

   b. Piping is routed through shielded pipe chases whenever possible to minimize routing through personnel access corridors.

   c. Large diameter piping (> 5 pipe diameters) is utilized to minimize the potential for clogging during slurry or resin transfer without violating minimum flow requirements.

   d. The number of pipe fittings (e.g., elbows, tees, etc.) are minimized to reduce the potential for radioactive crud accumulation.

   e. Low points, deadlegs, and vertical pipe runs are minimized.

   f. Pipe runs are sloped and gravitational flow is used where practicable.

   g. Crevices on piping internal surfaces are minimized.

   h. Flushing capability is provided to facilitate decontamination of piping.

   i. Penetrations are located so that the source and the penetration are not in a direct line of sight. This minimizes the potential for personnel exposure due to streaming.

G. Heat Exchangers

1. Heat exchangers are designed with vents and for complete drainage.

2. Internal wetted surfaces are designed crevices free to minimize the potential for accumulation of radioactive crud on internal surfaces.

3. Corrosion resistant materials are utilized to minimize the need for replacement and reduce the frequency of maintenance required.

12.3.1.3 Source Term Control

Source term control is an important aspect of the System 80+™ design. The following design features reduce the overall dose due to operation, maintenance, and inspection activities.

A. Fuel Performance

The System 80+™ design features assure low primary system sources with improved fuel clad leakage performance of less than 0.1% fuel clad failures, as well as an extended fuel cycle.

B. Corrosion Product Control

System 80+™ design includes design features that reduce corrosion product production in the primary system.

1. Primary System Materials

The System 80+™ design specifies primary system materials with low corrosion rates and very low cobalt impurities.

Steam generator tubes are fabricated to relieve stresses to reduce stress corrosion cracking. This will reduce the probability of tube plugging activities and further reduce maintenance exposures.

Control rod drive materials are specified with low cobalt alloys to reduce RCS exposures.

2. Primary System Chemistry

Increased pH in the range of 6.9 to 7.4 reduces equilibrium corrosion rates and buildup of activated corrosion products on primary system surfaces.

12.3.1.4 Airborne Contamination Control

In the System 80+™ design, plant ventilation systems are designed so that flow is from areas of lower to areas of higher potential activity. This design minimizes the potential for the spread of contamination. In addition, the following confinement devices are utilized to minimize the spread of contamination:

A. Drip Containment

Drip containment devices are used to collect equipment leakage and prevent suspension of radioactive particulate into the air or volatile radioisotopes, such as noble gases and radioiodines.

B. Glove Bags

Glove bags are used to perform maintenance activities, such as valve refurbishments, in an enclosed area.

ALWR-489

C. Tents

Tents provide a large enclosed area to perform work such as grinding or maintenance on large equipment. These tents are provided with ventilation capabilities and essentially provide for a local hot machine shop.

D. Hot Machine and Instrument Shops

These areas provide a dedicated area where maintenance can be performed on radioactive and contaminated equipment.

12.3.1.5 Equipment Improvements

A. The System 80+™ RCPs incorporate a cartridge type of RCP seal which is a proven, reliable and easily replaceable seal design. The replacement is also facilitated by the addition of platforms around the RCPs. This design allows the seal to be removed and repaired outside the crane wall or other low dose area. Therefore, the time required to perform maintenance on the RCP seals and maintenance exposure is reduced.

B. Steam Generator Maintenance

System 80+™ design includes several features which enhance accessibility during maintenance and inspection. These features, described in Section 5.4.2, reduce the overall exposure to personnel during these activities. These features include:

1. Use of automatic/robotic equipment for inspection and maintenance activities
2. Adequate pull and laydown areas
3. Platforms
4. Handholes
5. Increased size of manways to 21"
6. Use of removable insulation to facilitate weld inspection
7. Use of Inconnel 690 for tubes to reduce corrosion product production.

Also, included in the System 80+™ design are features which are important to achieving ALARA goals. These include:

1. Considerations for equipment reliability, maintainability, and accessibility
2. Component design, i.e., tank design, piping design and instrument design to minimize particulate deposition
3. System flushing and decontamination capability
4. Radwaste handling operations (also discussed in Sections 11.2 - 11.4)
5. Isolation of contaminated components and proper shielding

ALWR - 489

6. Controlled access to high radiation area via locked doors
7. Piping containing radioactive liquid, resins, of gases are routed through shielded pipe chases.

In order to maintain exposure ALARA and to aid in the layout and shielding design, the station is divided into radiation zones. These zones indicate maximum dose rates based on design activities only. The zone limits are summarized in Table 12.3-1.

close spacing

ALWR-489

12.3.1.~~2~~7 General Design Considerations to Keep Post-Accident Exposures ALARA

Sampling capabilities with exposures kept ALARA will incorporate a post-accident sampling system that meets the requirements of NUREG-0737 and Regulatory Guide 1.97, Revision 2. I

The area of the hydrogen monitors/recombiners will also require post-accident access. Projected dose rates without the recombiners in operation is expected to be 0.5 to 2.5 mrem/hr. Since the recombiners do not have to be operational until 72 hours after the DBA, dose rates attributable to the operation of the hydrogen recombiners will have dropped due to decay. Thus, J the installed dose rate will be less than 5 rem/hr. While the dose rate would be greater than 5 rem/hr for an intact primary-degraded core event, the recombiners would not need to be installed since this event does not generate hydrogen inside of the containment. If hydrogen generation was postulated, this would necessitate a break or opening in the primary system. The consequences of this scenario would lead to the doses noted above.

I

Therefore, considering direct and airborne sources, access can be provided to those vital areas necessary for the control of the plant and personnel exposures will meet GDC 19 and NUREG-0737 guidelines.

12.3.1.~~3~~8 Post-Accident Radiation Zones

Radiation Zone maps were developed in accordance with NUREG-0737 to review access throughout the plant following a DBA. The layout assists in keeping occupational doses ALARA even following a DBA. Required access to vital areas and systems will not exceed 5 rem. Source terms are discussed in Section 12.2.2.

Continuous access will be provided during post-accident conditions with dose rates less or equal to 15 mrem/hr to the following vital areas:

Advanced Control Complex which includes: J

- Main Control Room
- Technical Support Center
- Remote Shutdown Panel
- Computer system area
- Rooms housing Instrument and Control systems and equipment

B. Diesel Generator Rooms

do not change

N237BURP is a Duke Power Company code that calculates the accumulated activity on demineralizer resins or filters and the resultant activity of the process stream. This is accomplished by solving a pair of coupled, first order differential equations. Required input is isotropic removal efficiencies and operation time. Gamma source strengths are obtained from the calculated specific activities by considering gamma yield and losses due to conversion electrons. The nearly 300 individual gamma emissions of these isotopes are divided into six discrete energy groups. Group boundaries remain fixed, but the average group energy is calculated for each spectrum of isotopes. This allows reasonably precise selections of energy dependent shield material properties for attenuation properties. J

12.3.2.2 Shielding Design

The plant shielding shall be designed to achieve the radiation zones designated in Tables 12.3-2 and 12.3-3 for normal operation and post-accident conditions respectively.

Insert B →

12.3.3 VENTILATION

The ventilation systems are discussed in detail in Section 9.4. I

12.3.4 AREA RADIATION AND AIRBORNE RADIOACTIVITY MONITORING INSTRUMENTATION

The area radiation monitoring systems are discussed in detail in Section 11.5.

ALWR-489

Insert B

Transient sources of greater than 100 R/hr are considered in the System 80+™ shielding design to ensure adequate shielding is provided. One such source is a spent fuel assembly. During transfer of a spent fuel assembly through the fuel transfer tube, adjacent corridors may experience elevated radiation levels. Streaming from this source up through the joint between the Reactor Building and the Nuclear Annex has been a concern for the current generation of nuclear plants. The System 80+™ design utilizes a connected building design to reduce the potential for streaming. In addition, a lead collar is provided around the fuel transfer tube, as well as several feet of additional concrete shielding to maintain adjacent corridors radiation levels ALARA. This permits personnel to perform maintenance and inspection activities in a lower radiation areas and reduces the potential for adverse radiation zones from impacting refueling outage schedules. An inspection area is provided beneath the fuel transfer tube. A labyrinth entrance and a lockable access point are provided to minimize personnel exposure and prevent inadvertent access to a high radiation area during fuel movement. Figure 12.3-17 provide a three dimensional view of the fuel transfer tube, the shielding provided, and the adjacent areas.

Drwg. G200-14

This is a note, do not make change to Figure 12.3-17

 Wm. R FSP-92-105

initiation of containment isolation upon detection of the loss of RHR.

done

- o Plant communication systems are described in CESSAR-DC Section 9.5.2. The system normally used for plant shutdown operation and maintenance is the Intraplant Sound-Powered Telephone System. Phone jacks connect specific areas of the plant and the control room, and the system is powered from diesel-backed power sources. The communications panel in the control room is described in CESSAR-DC Section 18.7.4.13.

- o Redundant vent lines are provided between the pressurizer and the in-containment refueling water storage tank to prevent significant pressurization of the RCS if boiling occurs with the steam generator nozzle dams installed.

- o The SCS suction isolation valves do not have an auto-closure interlock. As described in CESSAR-DC Section 7.6.1.1.1, the valves are interlocked to prevent them from being opened if the RCS pressure has not decreased to an acceptable value. The interlocks are redundant so that no single failure can prevent the operator from aligning the valves in at least one SCS inlet line after RCS pressure requirements have been satisfied. I

- o The plant design is such that both a high pressure safety injection pump and another means could be available during cold shutdown to add water to the RCS to mitigate loss of RHR capability or RCS inventory if needed.

In addition to the design features previously described, midloop operation heatup analyses are performed to provide a basis for operating procedure guidelines. These include the relationships between time after shutdown and decay heat, RCS heatup rate and boil-off rate. Guidelines are provided for reduced inventory operating and administrative procedures, including verifying availability of equipment, avoiding concurrent operations that perturb the RCS, and ~~closing containment if the RCS temperature reaches 200°F.~~ Instrumentation used during SCS operation with reduced RCS inventory is described in CESSAR-DC Section 5.4.7.2.6.

Since the foregoing design features and guidelines for operations with reduced RCS inventory meet the intent of the recommendations in GL 88-17, this issue is resolved for the System 80+ Standard Design.

REFERENCES

1. NUREG-0933, "A Status Report on Unresolved Safety Issues", U.S. Nuclear Regulatory Commission, December 1989.