Department of Energy
Washington, D.C. 20545

Docket No. 50-537
HQ:S:83:183

JAN 12 1983

Mr. Paul S. Check, Director
CRBR Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Check:

ADDITIONAL AND REVISED INFORMATION REGARDING THE PLANT AUXILIARY SYSTEMS, PRELIMINARY SAFETY ANALYSIS REPORT (PSAR) CHAPTER 9

Reference: Letter HQ:S:82:148, J. R. Longenecker to P. S. Check, "Additional Information Resulting from December 15, 1982, Meeting on Plant Auxiliary Systems, Preliminary Safety Analysis Report (PSAR) Chapter 9," dated December 20, 1982

In response to comments from the staff reviewer of PSAR Chapter 9, the enclosed pages should be inserted as new or replacement pages to the reference letter. The pages are separated and identified as attachments to the enclosure with appropriate instructions.

Questions regarding this submittal may be directed to Mr. D. Robinson (FTS 626-6098) of the Project Office Oak Ridge staff or Mr. W. Murphie (353-5313) of my staff.

Sincerely,

John R. Longenecker

John R. Longenecker
Acting Director, Office of
Breeder Demonstration Projects
Office of Nuclear Energy

Enclosure

cc: Service List
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Licensing Distribution

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ENCLOSURE

ATTACHMENT 1

Replacement pages for the first, third, and sixth pages of Section 9.1, Enclosure 1

Enclosure 1

PSAR Section 9.1

RESPONSES TO NRC COMMENTS

1. Comment: Equipment with active cooling (i.e., EVST, EVTM, FHC, and fuel transfer port cooling insert) should include diesel power provisions or otherwise satisfy clad temperature limits for loss of offsite (normal) power as an anticipated event; the PSAR is unclear with respect to applicability of such a requirement.

   Response: Fuel Clad Failure and subsequent fission product release will result in site boundary doses well below established limits as discussed in PSAR Chapter 15.5. Cooling loops supplied with backup electrical power by diesel generator are provided for EVST sodium and FHC argon cooling. The forced convection cooling system for the EVTM is supplied with normal electrical power but is backed by a natural convection cooling system which can maintain the cladding temperature within its limits. The FHC cooling grapple blowers are supplied with ~~normal electrical power~~ diesel power provisions. ~~In the event of an extended loss of power while handling a bare fuel assembly in the FHC, the cladding might be heated to the point of failure. Fission products released would be contained in the FHC because the diesel power-supplied argon circulation system would maintain the FHC pressure negative relative to surrounding areas.~~ Diesel power (from one diesel) is provided to the FHC cooling systems to minimize exposure to operators on a loss of offsite power. However, the FHC boundary is not considered safety-related and credit is taken only for the safety-related RSB confinement to limit the release. The reactor, EVST, and FHC fuel transfer ports have cooling capability provided by blowers supplied with normal electrical power. In the event of a loss of this power and immobilization of a fuel assembly-containing core component pot (the EVTM grapple drive is also supplied with normal electrical power), the peak cladding temperature remains below the clad temperature limit for anticipated events. In any case, emergency power is not required because in case of power failure, the manual drive capability of the EVTM can be used without electrical power to raise or lower a core component pot to a location in which it is passively cooled.

   The enclosed markup of the PSAR revises Section 9.1 to clarify the type of electrical power supplied for each situation in which cooling is needed and the consequences of loss of normal power. The revision consists of a new Table 9.1-2A to list the peak fuel assembly cladding temperature for loss-of-power cases and text in the description of each applicable facility to describe the power supplied and to reference the new table.

9.1 Response 2 cont'd

circulation system (ACS), which removes heat from the FHC argon atmosphere to maintain the cell pressure negative relative to the pressure in surrounding cells. . The redundant ACS loops are supplied with power from a standby diesel generator in the event of loss of off-site power. The postulated two-hour station blackout includes loss of this backup diesel power. The ACS and grapple blowers would no longer operate to remove fuel assembly decay heat, and the temperature of the FHC atmosphere would rise. The FHC pressure would become positive relative to the pressure of surrounding cells. The FHC liner would remain intact; however, there would be some leakage from the FHC to the atmospheres of adjacent cells. The conservative assumption is made that the FHC liner would provide no holdup of fission products.

The FHC cooling grapple blowers remove heat from grappled assemblies to the FHC atmospher These blowers are als supplied with power from a standby diesel gener in the event of loss of off-site power.

The second system which normally operates to minimize radiation releases from the FHC is the reactor service building (RSB) ventilation sytem, which provides RSB confinement in the event of a radiation release. In a station blackout the ventilation fans would be inoperative and the RSB pressure would no longer be maintained negative relative to atmospheric pressure. Fission products released from the FHC into the RSB interior are conservatively assumed to be released directly to the atmosphere.

The building structure is assumed to provide no holdup of fission products released during a station blackout from a fuel assembly in the FHC. All noble gas fission products would thus be released directly to the environment. There would, however, be plateout of volatile fission products on the relatively cold surfaces of the FHC and the RSB interior. It is assumed that 50% of volatile fission products released from a fuel assembly would be plated out before release to the environment. This factor is consistent with the guideline value for iodine releases from LWR design basis accidents used in NRC Regulatory Guide 1.4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors." The 50% factor is conservative in that it does not consider formation of CsI in the oxygen-depleted atmosphere of the FHC. This reaction would lead to a higher rate of removal for cesium and iodine particulates penetrating the FHC liner. The release of particulate forms of these isotopes would be expected to be reduced to less than 10% of the total amount released from a fuel assembly instead of the 50% assumed.

The analyses were carried out using the SIROCO aerosol generation code and the procedure in NRC Regulatory Guide 1.25 to determine the integrated radiation doses at offsite locations. The integrated doses to the whole body and to designated body organs are listed in Table 1.

Insert A

The AHM also has inflatable seals on the closure valve, one on top of the gate and two on the bottom of the gate, supplied by gas bottles or the AHM. The gas supply is adequate to maintain the seal inflation for at least two hours. (Note: any failure of the AHM inflatable seal system is enveloped by the accident described in PSAR 15.5.2.4)

The AHM and EVTM floor valves, located at the reactor, EVST and FHC during operation of refueling equipment, receive electrical power from the EVTM or AHM as appropriate. Inflation gas is supplied from the inert gas receiving and processing system. Prior to motion of the respective machine from the floor valves, the inflation gas is locked into the seals by the respective control valves in the floor valve. Upon loss of gas supply, the inflation gas is locked into the seals by a check valve until the control valves are closed. Leakage rates will be low enough to maintain the seals adequately inflated for two hours. A single failure to one inflation system, i.e. failure of the control valve, will only disable one of two redundant seals.

ATTACHMENT 2

Insert pages at the end of Section 9.1, Enclosure 1

Enclosure

9.1 - 12 Comment

Provide additional justification why the Fuel Handling Cell cooling system and boundary are not safety related.

Response

Off-site doses from a combined argon cooling system failure and cooling grapple blower failure with a bare core assembly in the FHC are enveloped by the accident in PSAR Section 15.5.2.3 and the RSB fuel handling accident margin source term. Therefore safety related FHC equipment is not required to support the safety analysis of PSAR Chapter 15.

The RSB HVAC system described in PSAR 9.6.3 is designed to mitigate the consequences of an RSB fuel handling accident margin source term. This margin source term is a 20kw fuel assembly with a release of 100% of fission product inert gases, 100% of halogons, 1% of other fission products and 1% of Pu. The off-site doses from this fuel handling accident margin source term are:

Site Boundary Dose	0-2 hr
Whole Body	1.27 Rem
Thyroid	64 Rem
Lung	2.4 Rem
Bone	1.3 Rem

Low Population Zone Dose	0-30 day
Whole Body	.57 Rem
Thyroid	25 Rem
Lung	1.1 Rem
Bone	.81 Rem

On site doses from the above FHC cooling system and grapple blower failure accident have been evaluated to confirm that operator action can be taken in the RSB to further mitigate this accident and to operate other equipment.

For a 15kW bare assembly in the FHC, the RSB would have to be evacuated or breathing apparatus donned approximately 10 min after a loss of argon cooling system plus failure of the FHC cooling grapple blower. Dose to an operator with breathing apparatus in the FHC gallery would be .43 Rem in the first hour, 1.2 Rem in the second hour and the dose rate will not exced 1.65 Rem/hr.

For a 6kW bare assembly in the FHC, the RSB would have to be evacuated or breathing apparatus donned approximately 30 min after a loss of the argon cooling system plus failure of the FHC cooling grapple blower. Dose rate to an operator with breathing apparatus in the FHC operating gallery will not exceed 1 mrem/hr.

Even upon the loss of offsite power, actions could be taken to return the fuel assembly to the core component pot by remote-manual operation of the FHC crane. The above dose rates will allow this effort to continue until the fuel assembly is in a core component pot where it can be left unattended.

Comment 9.1-13:

Provide seismic classification of brakes on hoists of the EVTM, IVTM, AHM and FHC crane.

Response:

The brakes on the hoists for the EVTM and FHC crane are Seismic I. The brakes on the hoists for the AHM and IVTM are Seismic II, but have been analyzed to confirm that brakes will engage during an SSE.

ATTACHMENT 3

Insert page at the end of Section 9.5, Enclosure 1

Question 9.5-5

Where in the HVAC system does the nitrogen bleed go to from inerted cells in the RSB?

Response

The N_2 distribution subsystem exhaust is sent to HVAC upstream of the safety-related radiation detectors and the RSB cleanup system as discussed in Section 9.6.3. Upon defection of high radiation, the RSB HVAC system switches into the "recirculation" mode. RSB cells not within the confinement boundary are automatically isolated from the RSB cells located within the confinement boundary. The nitrogen filled RSB cells will be automatically isolated from the HVAC exhaust system in this recirculation mode. Thus, safety related diversion of the cell N_2 exhaust system to CAPS is not required.

ATTACHMENT 4

Replacement page for the first page of Section 9.16, Enclosure 1

Enclosure 1

PSAR Section 9.16

Section 9.16, Question 1

The design temperatures and pressures of the subsystems should be made the same as those of the cells which they serve in order to ensure that a sodium or a NaK leak in a cell will not rupture the gas cooling system, even assuming that an isolation valve fails to close. Added assurance of cooling system integrity will preclude opening a path for combustion product release of air in-leakage to the liquid metal.

Response

The design pressure of the subsystems is at least equal to the maximum cell design pressure.

The piping and system components are located outside the cells cooled, and thus are not directly exposed to the cell environment unless an isolation valve fails to close. The piping design temperatures used are based upon the maximum cell temperature due to Na/NaK leak, the piping and component location is related to cell, whether natural or forced circulation is present, thermal inertia of the system, and thermal conductance of the piping system. In all cases the design temperature will be equal to or greater than the maximum expected temperature.

Section 9.16, Question 2

If control rod cooling from subsystem CR is required to ensure a safety function, then that subsystem should be safety class 3, and a minimum of seismic II (also ASME code III, class 3).

Response

Primary Control Rod Drive Mechanisms are cooled by nitrogen gas, supplied by Subsystem CR of the Recirculating Gas cooling System.

The effect of a failure in any part of these systems to supply this cooling gas has been investigated by a series of tests at W-ARD. The results of these tests were presented to NRC (R. Stark, D. Moran) in a meeting on 10/14/82 and officially transmitted to NRC by DOE letter HQ:S:82:107, J. R. Longenecker to P. S. Check. A summary of these tests and results is presented below.

The PCRDM Loss of Stator Coolant Flow tests were conducted with prototypic hardware in 1000°F sodium flowing at the design flow rate of 45,000 lbs/hr. The PCRDM stator temperature is normally measured by redundant thermocouples located in the outlet of the stator coolant flow. For these tests, additional thermocouples were located in the stator winding to measure the maximum stator winding temperature as a function of coolant flow.

Normal stator coolant flow is 157 scfm N_2 at 95 psig. For these

ATTACHMENT 5

Insert page at the end of Section 9.16, Enclosure 1

Section 9.16, Question 7

The discussion of recirculating gas cooling system shutdown on leak detection is inconsistent between PSAR Section 9.16 and 7.6.6.

Response

Automatic shutdown of Recirculating Gas Cooling Subsystem due to moisture and leak detection signals have been deleted from PSAR Section 9.16.3 to avoid automatic shutdown due to spurious signals. The attached change to PSAR Section 7.6.6.2.1.1.2 deleted the discussion of shutdown on high water vapor, but adds a shutdown due to high temperature in the return piping. Automatic shutdown of the Recirculating Gas Cooling Subsystems due to high water level in the cooler is retained in the discussion of PSAR Section 7.6.6.2.1.1.2 and 9.16.3 (pg 7.6-12, 9.16-7).

Enclosure 2

a) A discrimination system shall be provided to insure against a refueling error which could result in a significant reactivity error or undercooling of the control assemblies. This system shall prevent the following situations:

Insertion of any assembly other than a control assembly into a control assembly position.

Insertion of a control assembly into a fuel assembly position or a wrong control assembly position (i.e. interchange of a primary and secondary control assembly).

b) The relative location of the absorber pellet column within the pin shall be maintained under shipping, handling and scram arrest loadings by a properly designed axial spring support system.

51

4.2.3.1.6 Environmental Requirements

The control rod system shall provide safe reliable shutdown and control capability when subjected to the following environmental conditions. with the ability to withstand the total loss of N_2 cooling without a loss of CRDM safety function.

The external surfaces of the Control Rod Drive Mechanisms are exposed to the head access area environment at temperatures between 70 and 150°F during full power operation. The internal atmosphere of the CRDM is inert gas at temperatures ranging from 70 to 400°F. Normal primary mechanism internal pressures range from 15 to 30 psia.

The control rod drivelines are exposed to an environment of liquid sodium containing 2 (>800°F) to 5 (<800°F) PPM oxygen over the lower 60 percent of its length (approx.). The remaining upper portion is exposed to an atmosphere of inert cover gas and sodium vapor.

The control assemblies are exposed to an environment of liquid sodium containing 2 (>800°F) to 5 (<800°F) PPM oxygen.

51 The design of the CRBRP Primary CRDM/CRD is conceptually the same as that used on the FFTF program. This design employs some proven
53 design concepts, (References 145, 146 and 147) that inhibit the upward movement of sodium vapor laden cover gas by reducing the annulus width while increasing the length thereby minimizing the effect of natural convection.

To further insure the reliability of the Primary CRDM/CRD a continuous purge system consisting of recycled cover gas will be utilized to provide a constant downward flow through the annuli into the reactor.

ATTACHMENT 6

Insert page immediately prior to page 9.1-8, Section 9.1, Enclosure 2

Replacement pages for pages 9.1-31, 39a, 57, 65a, 65da, 68a, 68b of Section 9.1, Enclosure 2

(d) Motor thermal overload.

The bypass identified in item (b) above is initiated by a Key Operated Selector Switch located on the Local Control Panel and administratively controlled.

(5) The fan start/stop indication is provided on the local control panel as well as on the back panel. "Fan stopped" is alarmed on the local control panel, and alarmed as "Fan trouble" in the computer. Bypass switch status is indicated on the local control panel. "Fan stopped" is alarmed as "Inoperable Status (IS)" in the computer located in the control room.

7.6.6.2.1.1.2 Automatic Isolation Valve Operation (Figures 7.6-39, 40 & 42)

The Automatic Isolation valves are fail ~~open~~ as-is valves.

(1) The Automatic Isolation valves can be operated from an "open-auto-close" switch (spring return to auto) located on the back panel and the local control panel.

(2) When the switch is in the "open" position, valves will open when all of the following conditions are satisfied:

~~(a) No high water vapor in the supply gas stream.~~

(~~b~~ a) No high water level in the cooler.

(3) When the switch is in "auto" position, valves will open when fan start demand switch signal is received and all of the following conditions are satisfied:

~~(a) No high water vapor in the supply gas stream.~~

(~~b~~ a) No high water level in the cooler.

(4) The valves can be closed manually by placing the switch in the close position.

(5) When the switch is in "auto" position, valves will automatically close under any of the following conditions:

~~(a) High water vapor in the supply gas stream, provided no manual bypass for high water vapor is initiated.~~

(~~b~~ a) High water level in the cooler.

(~~c~~ b) The fan has stopped and there is no fan start demand.

(c) High temperature in return piping

(6) The Automatic Isolation valve open/close indication is provided on the back panel and local control panel. Closure of the valve is alarmed as "Inoperable Status (IS)" in the computer located in the control room.

between the double seals. The purpose of this buffer pressure is for leak detection and is not required to prevent seal leakage, although it would mitigate an inner seal leak. The inflatable seals are the only ones which depend on a continuous source of electrical power and inflation gas for operation. In case of loss of offsite power, the seal inflation system valves would fail open, providing the seals with a continuous source of inflation gas from the normal supply system. (The valves are closed during normal operation to provide more sensitive seal leak detection.) The gas supply is from two separate gas bottles and is independent of loss of plant gas supply. The gas supply in the bottles is adequate to maintain seal inflation in excess of two hours. Because the supply valves fail open, loss of offsite power would not affect seal inflation. The piping and valves from the gas bottles to the inflatable seals are ANSI B31.1. The seal inflation system and controls have been investigated to ensure that there are no common cause failures which would disable both inner and outer seals.

The EVTM is hermetically sealed to a refueling station by lowering the closure valve which mates with a floor valve. The actual sealing at this interface is accomplished by elastomer double seals, which are periodically leak checked.

and Pressure Vessel Code, Seismic Category I, and is located within a hardened structure.

The crane handled gas cooling grapple, shown schematically in Figure 9.1-9, is mainly used to transfer bare fuel assemblies from the spent fuel transfer station to the spent fuel shipping cask. Design of the grapple finger actuation mechanism prevents actuation of the fingers to release a core assembly while the fingers are supporting the weight of the assembly. The crane hook includes a latch to prevent inadvertent disengagement of a cooling grapple from the hook. In the event of a loss of electric power, the crane will stop at its position at the time of the power failure. Design of the crane includes the capability for manual operation. Access to the crane for manual operation is through ports in the wall and roof closure.

Two redundant argon gas-cooling blowers are mounted on the upper end of the gas-cooling grapple. These blowers draw argon gas from the surrounding cell environment and blow it through the grapple and fuel assembly, discharging it back into the cell through the nozzles at the bottom of the fuel assembly. The argon gas flow rate will be large enough to maintain the cladding temperature of a fuel assembly below the normal cladding temperature limit for decay heat loads up to 15 kW. The blowers are ~~supplied with normal electrical power~~. non-class 1E systems supplied with standby electrical power by the same diesel generator (see Section 8.3.1.1.1).

9.1.3.2.3 Safety Evaluation

A CCP containing a fuel assembly is cooled sufficiently by natural convection of the adjacent FHC atmosphere to maintain the peak fuel cladding temperature below the limits given in Table 9.1-2. The peak temperatures, given in Table 9.1-2A for normal operations in which the FHC atmosphere temperature is maintained by the argon circulation system and for the unlikely event of loss of cooling of the FHC atmosphere, are within the limits.

The argon cooling gas flow rate through the spent fuel assemblies while being handled by the gas cooling grapple is sufficient to maintain the maximum steady-state cladding temperature of a 15 kW fuel assembly below 600°F. In the event of loss of argon cooling gas, sufficient time exists for the assembly to be transferred back to a Na-filled CCP in the spent fuel transfer station within the FHC before the fuel cladding reaches 1500°F.

Adequate cooling of a spent fuel assembly suspended from the cooling grapple is maintained by the following means:

1) The grapple blowers are redundant to protect against loss of cooling capability by failure of one blower.

2) Each blower will be tested before beginning FHC spent fuel shipping operations to ensure its operability.

Evaluation of the loss of power for cooling systems for fuel assemblies in the FHC shows that the consequences are acceptable. In the event of loss of normal offsite power, operation of the cooling blowers would stop and the temperature of a suspended fuel assembly would rise. The loss of power would also prevent movement of the FHC in-cell crane to return the assembly to a sodium-filled CCP. The extent of the temperature rise would depend on the

1. FHC Normal Fuel Handling

In a typical spent fuel handling sequence, a spent fuel assembly in a core component pot is lowered through the fuel transfer port (see Figure 9.1-7) by the EVTM, into the spent fuel transfer station directly below the port. A lazy susan assembly, with three transfer positions supported by a stainless steel gridwork, provides the storage locations. Each position holds one fuel assembly, in a sodium-filled core component pot. Decay heat is removed by natural convection to the FHC atmosphere.

The spent fuel assembly is removed from the core component pot by the in-cell crane, using a gas-cooling grapple, and allowed to drip dry. If for some reason not identified as a part of normal procedures, it is deemed necessary to remove a sodium film from the exterior surfaces, the exterior surfaces will be wiped with alcohol wetted swabs.

Then the spent fuel assembly is lowered into the spent fuel shipping cask located in a shaft below the cell floor. The sequence is repeated for the number of assemblies necessary to fill the shipping cask. The above functions within the FHC are performed remotely by operators in the adjacent operating gallery, and can be observed through the viewing windows.

Normal core assembly handling operations in the FHC are conducted with assemblies having a decay heat of 6 kW or less. Infrequently, it may be necessary to examine a high-powered core assembly. This will be done only when (1) it is necessary to complete refueling or to commence reactor startup, or (2) use of the FHC is necessary to recover from an EVTM grapple malfunction occurring while grappled to a high-powered core assembly.

During these operations, special precautions shall be observed, including removal of all other spent core assemblies from the FHC prior to introduction of the high-powered core assembly. In addition, only one core assembly greater than 6 kW shall be permitted in the FHC at any time.

2. Spent Fuel Examination

Spent fuel examination in the FHC is limited to inspecting the exterior surfaces of fuel assemblies to determine their geometrical condition before loading into the spent fuel shipping cask. Spent fuel assemblies will not be disassembled or sectioned in the FHC.

It is planned that only a few selected spent fuel assemblies will be examined, after the plant operation has reached its equilibrium. During the first few refuelings, it is expected that more spent fuel assemblies may be inspected.

The extent of the spent fuel examination covers the following operations, all of which will be performed in the fuel examination fixture:

1) Visual inspection of all exterior surfaces

2) Determination of axial and radial dilation of fuel assembly by measuring its length and distances across flats

3) Measurement of the fuel assembly bow

assemblies

provide a second, redundant load path from the handling bail to the polar crane hook. When not in use, the AHM is stored at a parking station located in the northeast quadrant of the building.

The parking station is designed for the SSE seismic loads which are carried into the RCB structure.

In the event of a loss of electric power, a braking system automatically stops the grapple at its position at the time of power failure.

Electric power to the AHM can be manually disconnected at either the AHM console or the substation supplying the floor service station from which the AHM is being supplied.

The vertical position of the AHM grapple is displayed on the AHM control console.

When the AHM is in position at the reactor, only the extender mating flange is resting on the floor valve, which in turn is supported from the small rotating plug (SRP) by an adaptor. If the two components were firmly attached to each other, the resulting combined structure, in effect, would represent a tall, vertical cantilever rising from the SRP, attached at its upper end to the polar crane. The large bending moments and shear loads in this combined structure, resulting from horizontal excitation due to an OBE or SSE, are relieved by structurally decoupling the AHM from the floor valve at the extender/floor valve joint interface. At a predetermined horizontal ground acceleration, complete severance of the AHM from the floor valve ("breakaway" concept) eliminates the cantilever beam effect and significantly reduces all seismic loads.

The joint between lower extender flange and floor valve is designed with shear pins which fail upon reaching a predetermined horizontal load. This enables the AHM to separate from the floor valve during a seismic event. The design incorporates a pneumatic reservoir which initiate raising of the AHM extender following the shearing-off of the shear pins. The actuators can raise the extender by about 3 inches in less time than it takes for the extender to clear the floor valve during the horizontal movement due to an OBE or SSE.

9.1.4.5.3 Safety Evaluation

The radial and axial shielding provided by the AHM limits the integrated dose to personnel to less than the maximum allowable dose rate during the installation or removal of the components handled by the AHM. As with the EVTM (see 9.1.4.3) the radiation source in the machine is intermittent and short term.

The AHM has adequate seals to prevent radioactive emissions to the RCB operating floor. Radioactivity released does not exceed the limits as set forth in Sections 12.1.1 and 12.1.2.

transfer drawer.

seals are provided continuously with a buffer pressure between the double seals. This pressure is monitored continuously for leak detection and is not required to prevent seal leakage, although it would mitigate an inner seal leak. The inflatable seals are the only ones which depend on a continuous source of electrical power and inflation gas for operation. In case of loss of offsite power or gas supply, ~~the seal inflation system valves would fail open, providing the seals with a continuous source of inflation gas pressure.~~ (The valves are closed during normal operation to provide more sensitive seal leak detection.) Since the supply valves fail open, loss of offsite power would not affect seal inflation.

a check valve in the inflation piping will prevent ~~[illegible]~~ deflation. Should a failure cause the seals to deflate, additional in-leakage to the FHC would occur. ~~No credit~~

TABLE 9.1-2A

SPENT FUEL ASSEMBLY CLADDING TEMPERATURES
(Sheet 1 of 2)

Location of Fuel Assembly	Frequency Class (3)	Peak Fuel Assembly Cladding Temperature (°F)
CCP in EVST storage location 20 kW Assembly		
Normal operation	Normal	660 ~~650~~ (1) (510° pool)
Natural convection loop cooling	Unlikely	750 ~~610~~ (1) (600° pool)
CCP in FHC (15-kWt assembly)		
Argon circulation system operative	Unlikely	1060(1)
Argon circulation system inoperative	Extremely Unlikely	1265
CCP in FHC (6kW assembly)		
ACS operative	Normal	710 ~~700° (Bottom 710 fuel~~)
ACS inoperative	Unlikely	900°
CCP in EVTM cold wall 20 kW Assembly		
Cold wall blower on	Normal	1240(1)
Cold wall blower off		
	Anticipated (4)	935
	Unlikely	1350(1)
CCP immobilized in EVTM stack assembly (assemblies below the cask body assembly, see Figure 9.1-14)		
20 kW Assembly		
	Anticipated (2)	1230
	Unlikely	1415(1)

TABLE 9.1-2A

SPENT FUEL ASSEMBLY CLADDING TEMPERATURES
(Sheet 2 of 2)

Location of Fuel Assembly	Frequency Class	Peak Fuel Assembly Cladding Temperature (°F)
CCP immobilized in reactor fuel transfer port		
20 kW Assembly		
Blower on		
	Anticipated (2)	950
	Unlikely	1444(1)
Blower off	Anticipated (2)(4)	970
Blower off	Extremely Unlikely	1482
CCP immobilized in EVST fuel transfer port		
20 kW Assembly		
Blower on		
	Anticipated (2)	<1250
	Unlikely	1389(1)
Blower off	Anticipated (2)(4)	<1250
Blower off	Extremely unlikely	1482
CCP immobilized in FHC spent fuel transfer port		
15 kW Assembly		
Blower on		
	Anticipated (2)	<1225 F
	Unlikely	1249(1)
Blower off	Anticipated (2)(4)	1225
Blower off	Extremely Unlikely	1275 (2hrs)

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(1) Steady-state temperature

(2) For a stopped CCP with the fuel transfer port blower inoperative, the operator is required to take action as described in PSAR Section 9.1.4.3.2 within 30 minutes to raise or lower the CCP.

Footnotes to Table 9.1-2A

(3) Loss of off-site electrical power during a fuel handling operation is classified as an unlikely event. This classification is based upon the number of hours per year that this fuel handling equipment is operating and the conditional probability of loss of off-site power at such a time. (For the probability of loss of off-site power, see question response 222.24.)

(4) Upon failure of power to the EVTM, the operator is required to connect a temporary power cable to a Floor Service Station.

9.1-68(b) con't

ATTACHMENT 7

Replacement page for page 6 (top), section 9.4, Enclosure 2 cases, i.e., selected piping smaller than eight inches O.D., the heat is applied by mineral insulated heating cable that consists of a metal sheath drawn down over a MgO insulated single heating element.

Separate Chromel-alumel thermocouples are used throughout the systems for the feedback signal to control the operation of the electric heaters and for monitoring the temperature of the metal boundary of the sodium containing piping and equipment. Furthermore, separate signal processing/indication is provided for in the control and monitoring thermocouples. Thermocouple compensation is provided for all thermocouples.

Thermocouples on piping are located at a point on the pipe to enable control of the average temperature of the pipe within specified limits. On equipment, the thermocouples are located in the spaces between heaters for both monitoring and control purposes. The placement of thermocouples, combined with heat transfer characteristics, precludes undetected cold spots.

Control of any heater or bank of heaters is by automatic control. This control provides for continuous and automatic adjustment of heat based on an error signal generated from the difference between the temperature setpoint, as set by the plant

ATTACHMENT 8

Replacement pages for pages 10, 11 (top) and 9.4-5 of Section 9.4, Enclosure 2, with new pages 9.4-12, 13, and insert c

9.4

none is required, and current flow through piping and other non-wiring components due to shorts concurrent with multiple failures of the over current protection components. The effects of these potential failures on the safe shutdown of the plant is discussed in this section.

As discussed in PSAR Section 3.~~8~~2.3, the Piping and Equipment Electrical Heating and Control System is not safety-related. The heating system is not essential for the safe shutdown of the reactor, nor will failure of the system result in a release of radioactive material. However, considerations for trace heating of selected safety related components have been taken.

A Technical specification will be provided to address failures of trace heating in the primary equalization line, the IHTS cover gas equalization line, the argon lines leading to the primary argon relief system, and the overflow heat exchanger. Relief protection for the IHTS is provided by the rupture discs to either the dump tank or the Sodium Water Reactions Products tank. The large eighteen-inch lines downstream of the rupture discs are normally empty and are not trace heated. The eighteen-inch line up to the rupture discs (approximately five foot long) has trace heating installed, but during normal operation the heat transfer from the flowing IHTS sodium is sufficient to maintain the temperature in the line above the heater setpoints. The six-inch gas line between the IHTS expansion tank, with its associated rupture discs, is trace heated to reduce sodium frosting. Should this six-inch line become plugged due to trace heater failure, the effect of a sodium water reaction would be neutralized by blow down of the water side of the SG modules and, if needed by rupture of the large rupture discs in the eighteen-inch line. Thus, failure of the trace heating of the six-inch line will not cause a safety problem.

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The EVST is cooled by three cooling circuits, two redundant "normal" forced circulation circuits, and a backup natural circulation circuit. Each of the circuits contains a sodium loop, circulating EVST sodium, and a NaK loop, which transfers the heat to the atmosphere. All of the sodium and NaK loops are electrically preheated. The preheat is segmented into multiple control zones, each zone having at least one control thermocouple. Preheat temperatures higher or lower than the setpoint band are alarmed. The preheaters are not redundant and the preheat system is not on emergency power.

During EVST cooling operation, the forced circulation circuit in operation does not require electrical preheat; the heat is provided by the fuel within the EVST. The natural circulation loop also does not require electrical preheat, as long as a heat source is present in the EVST, since a small flow of sodium and NaK is always maintained in this loop. The standby forced curculation loop does require preheat to maintain temperature. Should a heater circuit, or circuits, fail in the standby cooling circuit (or in any circuit) the cooling circuit can be isolated and the heater repaired while still maintaining two means of EVST cooling. Consequently, failure of individual heater circuits is not considered a significant safety problem. In the event of loss of plant power or a total loss of the preheat system, the normally operating forced cooling circuit and the natural circulation circuit would be unaffected from a standpoint of EVST cooling. In the standby circuit, NaK temperature can be maintained by pump heat (pump on emergency power); only the stagnant sodium loop is susceptible to decreasing temperature (and ultimately freezing) and this situation could be monitored by the safety-related themocouples on the EVST sodium outlet lines (post-accident monitors). In this situation, plant procedures call for periodically switching EVST cooling from one circuit to another in order to use EVST heat to maintain sodium temperature well above freezing. In any event, loss of power or preheat can cause loss of no more than one of three available cooling circuits, if no operator action is taken, and will result in no loss of cooling circuits if EVST cooling is alternated between circuits. Consequently, neither redundant heater circuits nor safety-related heating is considered required to ensure continued EVST cooling.

The DHRS circuit consists of the normally operating reactor overflow/makeup circuit, the normally stagnant OHX and NaK "crossover" piping, and the EVST NaK forced circulation loops previously discussed. Redundant heaters are currently used on the overflow/makeup circuit and OHX, and a change is being made to add redundancy to the NaK "crossover" piping. Failure of heater circuits on any of these components (including the standby EVST NaK circuit) will be signaled by an alarm. Where redundant heaters are installed, the redundant heater can be connected and energized from accessible areas (outside the inerted cells) within an hour, well within the time when cooldown of an isolated circuit could have significant impact. As previously noted, the preheat on the EVST NaK loop can either be repaired or temperatures maintained by pump heat, at the operator's option. Consequently, loss of individual preheat circuits should impact neither reactor operation nor capability to perform the DHRS function. If the entire preheat system (or substantial portions of it) is lost due to some electrical or mechanical failure, then the reactor should be shut down. With the reactor shut down and primary sodium temperature reduced, the DHRS function is not compromised even without preheat, as discussed below.

An evaluation of DHRS capability following loss of plant power was made to ensure that DHRS is not compromised during the plant event. Upon loss of power, the reactor is tripped and sodium temperature automatically reduced to 600°F. Both EVST NaK flow and overflow/makeup sodium flow are continued after a short interruption since these pumps are on emergency power. The stagnant OHX and NaK "crossover" piping slowly begin to cool since the electrical preheat is out of service without normal plant power. This cooling will increase the startup thermal transient stresses, which the preheating is designed to minimize, should DHRS be invoked 1/2 hour or more after scram. The increase in these stresses in the controlling components involved in DHRS (e.g., overflow heat exchanger) was determined to have minor impact on their structural integrity. The worst case thermal condition in the DHRS startup time from 1/2 to 24 hours after scram was analyzed to find that these components are designed to withstand many cycles (>100) of this event. The conclusion is that the additional thermal stresses due to cooldown in this event are not controlling and DHRS can be successfully initiated and carried out. If the loss of power is long enough, ultimately the OHX will freeze; however, calculations indicate that this will take approximately 48 hours, an extremely unlikely situation. If the loss of power does appear to be extensive, for example, if not restored within 24 hours, then at that time the reactor sodium could be reduced to refueling temperature (400°F) and the makeup sodium stream diverted such that it flows through the OHX. Under these circumstances, freezing would be precluded and DHRS could be initiated at any time, indefinitely, after power loss.

Insert C →

Considering the above capability, a safety-related, 1E-powered preheat system is not considered necessary.

Insert C

A number of sodium valves are active components, used either for EVST cooling or DHRS initiation. The valves are preheated by separate preheat circuits. The preheat system is not safety-related and is not on 1E power. Safety-related preheat is not considered necessary for these valves, for the same reasons discussed above ~~under Item 9.4.4~~, since these valves are part of the circuits involved in that discussion. The redundancy noted also applies to the valve heater circuits.

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The unwanted additional heating of sodium lines (sensed and controlled normally) due to multiple failures in the trace heating and control system which t on trace heaters (which should be off) is less than five percent of the long term subsystem heat removal capability per loop. The unwanted heat is less than one percent of the short term subsystem heat removal capability per loop, and it is less than one-half of one percent of the total plant power removal capability. These percentages are sufficiently small in terms of heat transport system capability that the occurrence of this failure mechanism would not compromise the safe shutdown function.

The third potential failure mechanism is a short to a non-wiring component occurring with concurrent failures of the ground heater sheath, the ground fault detectors, and the over current protective devices. This mechanism would not compromise the safe shutdown ~~of the plant.~~ The smallest pipe where a short could occur is greater than ten times the cross-sectional diameter of the electrical wiring. Therefore, for the smallest pipe, the conductivity of the electrical wiring is one-half the conductivity of the pipe, and the conductivity of the pipe is over forty times higher than the heater wire. In either a short or an arcing situation, the pipe would not fail.

Operationally, the failure mechanism requires the failure of the temperature sensing system and one of the following: (1) excess current application, (2) cross-over in mounting of adjacent heaters, and (3) improper setting of protective devices. For design related failures, the failure mechanism can be caused by improper heating wire design, fissures in the magnesium oxide, and bends less than the minimum bend radii. The effect of the failure will not cause failure of the sodium containment.

9.4.4 Design Reliability Evaluation

In order to prevent the effects of heater failure from propagating to the piping or equipment to which heaters are attached, the following operational criteria are used:

(1) For normal operation, the heaters are operated at less than 1/2 rated power. For abnormal operation, each heater control circuit is protected against overcurrent by thermal overload circuit breaker and temperature sensors on the heated component. Ground fault interrupters (GFI) will be used for protection against ground currents.

(2) High and low temperature alarms are provided for all control and monitor thermocouples in all heater control zones.

(3) The cold ends of the heaters are bent 90° and brought out from the component. A spacing is maintained between adjacent heaters to prevent crossover of heaters and significant mutual heating by radiation.

ATTACHMENT 9

Insert pages to follow page 9.15-2, Section 9.15, Enclosure 2

In order to maintain the integrity of the cell liner, the piping from the cell liner up to and including isolation valves for non-safety related subsystems which serve cells containing Na or Nak is designed to the requirements of Seismic Category I.

All the safety related subsystems are designed in accordance with the requirements of ASME Section III Class 3, Seismic Category I, supplied Class IE electrical power and emergency chilled water.

Safety related subsystems MA and MB serve the two primary Na makeup pumps. Since the primary Na makeup pumps are redundant to one another, no further redundancy in components is provided for subsystems MA and MB.

Safety related subsystems EA and EB serve the two EVS Na pumps in the two active EVS Na cooling loops. No redundancy in components is provided for subsystems EA and EB since there is redundancy in the EVS Na cooling loops themselves.

All the subsystems using water as the coolant and serving areas containing Na or Nak are provided redundant water leakage detection sensors. On detection of water leakage in a subsystem, the operation of the subsystem is stopped automatically, the automatic isolation valves in the gas lines and chilled water system lines are closed and the redundant drain valves on the cooler are opened automatically.

In the case of a sodium or Nak spill or leak in a cell, an ~~In case of a sodium or Nak spill or leak in a cell, the operation of the subsystem serving the cell is stopped and the automatic isolation valves in the gas stream are closed.~~ alarm is provided. Sodium leak detection is discussed in Section 7.5.5.

Insert for Sect 9.16.3

9.16.4 Tests and Inspection

Each individual component of the system is tested at the factory and, before the plant startup, entire system is tested and the gas flow rate is balanced and set at design flow conditions. Periodic inspection of the components is scheduled to ensure proper system operation. In-service inspection will be conducted according to ASME Section XI for safety related subsystems as described in detail in Section 3.1.

9.16.5 Instrumentation and Control

The RGCS instrumentation is designed to provide for measurements, controls and alarms of system parameters. Each subsystem is provided with a control panel located near the fan. The panels include the control switches, monitors and system alarms.

All non-safety related subsystems are provided with local monitoring and alarm and a remote alarm in the main control room.

All safety related subsystems are provided with local monitoring and alarm and remote monitoring and alarms in the main control room. 47

A list of compressed air operated safety related valves which are provided with safety class 3 air accumulators is contained in Table 9.16-3. 59

Amend. 59
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'Insert for Section 9.16.3

~~9.16-4~~ Cell Cooling Loss Impacts on DHRS

The loss of cell cooling should not prevent the capability of acceptable DHRS operation.

In containment, the cells containing the DHRS components are separated into two groups of cells, each group being cooled by a safety-related cooler. Each of the coolers cools one of the two primary sodium makeup pumps. The coolers are on emergency power and each cooler has redundant fans sized such that a fan failure does not result in unacceptable cell temperatures. Consequently, neither loss-of-plant power nor fan failure has any impact on DHRS. Should an entire cooler unit be lost for other reasons, the makeup pump (direct gas cooled from the cooler) associated with that cooler would be lost. However, performance tests of the makeup pumps have shown that a single pump alone can provide the required DHRS flow. In addition, it is a plant requirement that all components maintain pressure boundary under loss of cell cooling for an indefinite period of time.

In the reactor service building, the only DHRS components in inerted cells cooled by cell coolers are piping and the EVS sodium coolers (these coolers are not "used" for DHRS; however, the DHRS NaK flows through them; in this sense only, they are called "DHRS components"). Neither the piping nor the coolers are impacted by loss of cell cooling. The remaining DHRS components (ABHXs, NaK pumps, piping) are located in two air-atmosphere cells (one for each of the two NaK loops comprising the DHRS heat sink) cooled by the plant H&V system coolers. The coolers are safety-related on emergency power. Even with loss of cooling, the large cell coupled with relatively low heat input make it unlikely that even lengthy loss of cell cooling would interfere with DHRS operation. Even if cooling for one of the NaK cells was lost and temperatures did reach unacceptable limits, a thermal analysis conducted as part of a "DHRS with single failure" study has shown that a single Nak loop can by itself provide sufficient DHRS heat rejection to ensure adequate core cooling.

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