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SUBJECT: Discusses proposed hardware mods that will increase reliability of auxiliary feedwater motor driven pumps in event of break in high energy line feeding steam driven pump,per License Condition 2,C(25),Alternatives examined.

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October 29, 1982

Director, Office of Nuclear Reactor Regulation
Attention: Mr. George W. Knighton, Branch Chief
Licensing Branch No. 3
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
San Onofre Nuclear Generating Station
Units 2 and 3

License condition 2.C(25) of Facility Operating License NPF-10 requires that SCE submit a proposed hardware modification and schedule for implementation that will increase the reliability of the auxiliary feedwater (AFW) motor driven pumps in the event of a break in the high energy line feeding the steam driven pump. The purpose of this letter is to satisfy license condition 2.C(25).

SCE has reviewed a substantial number of hardware modifications which address this license condition. From these the following three modifications were further reviewed and analyzed. They are: (1) relocation of the turbine-driven pump, (2) replacement of the existing motors with environmentally qualified motors, and (3) addition of a forced, cooled lube oil system.

1. Relocate Turbine Driven Pump to Another Room.

   Removing the steam line from the pump room eliminates the potential steam environment for the motor driven pumps. This requires relocation of the chemical treatment equipment, and erection of a missile proof building around the turbine and pump. The implementation schedule is provided in Enclosure (1). The total implementation cost is $13,455,000 per Unit and requires a plant outage time of 44 days per unit. This modification could be implemented at second refueling for each unit.

2. Purchase Class 1E Environmentally Qualified Motors.

   The implementation schedule is provided in Enclosure (1). The total implementation cost is $5,250,000 per Unit and requires a plant outage time of 37 days per unit. Three vendors were contacted for

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supplying qualified motors. Each stated that they have not installed antifriction or hard babbitt material bearings in production motors of the size and speed as those presently installed in the AFW system. To provide motors, the three vendors would have to enter into research and development efforts that would require up to six months to complete. Once the research and development effort has been completed, a production motor would have to be modified to accommodate the new bearings and then a rigorous verification testing program undertaken. Two of the three vendors have expressed doubts that antifriction bearings can function properly at the high operating speed. Additionally, experience has demonstrated that the close tolerances required by the unforgiving nature of hard babbitt material bearings is not compatible with lower tolerances experienced in standard production motors. These facts give SCE a low confidence level in the possibility of obtaining qualified motors. This modification could be implemented at second refueling for each unit.

3. Add Forced, Cooled Lube Oil System.

A forced, cooled lube oil system will maintain the babbitt bearings in the AFW pump motors at acceptable temperatures during a steam environment. The schedule for implementation is provided in Enclosure (1). This system would primarily be located outside the AFW pump room with only the supply and return oil lines running through the pump room to the motors. The system is further described in Enclosures (2) and (3). The total implementation cost is $2,500,000 per Unit and requires a plant outage time of 28 days per unit. This modification could be implemented at first refueling for each unit.

SCE cannot justify the large additional expense of the proposed hardware modifications described above as compared to the small benefit that is gained for environmental qualification. In lieu of the above modifications SCE is currently evaluating two options. One is an augmented inservice inspection program which would essentially eliminate the possibility of a steam line break in the AFW pump room. This option was described in SCE's letter to the NRC on this subject of July 12, 1982. The second option is the use of acoustic monitoring devices on the steam line inside the pump room to alert the operators to potential pipe cracking and leakage as a supplement to the augmented ISI program. A detailed cost/benefit analysis which compares these options with the forced, cooled lube oil system described above will be submitted to the NRC by January 1, 1983. As shown in Enclosure 4, the probability of being unable to provide adequate feedwater flow for plant shutdown as a result of a break in the steam supply piping to the steam driven AFW pump is less than 3.6×10^{-7} per year. Thus, reliability of the AFW system will not be compromised by choosing this alternative.

By letter dated July 29, 1982, SCE committed to install a sheet metal barrier to separate the turbine driven (P-140) and second motor driven (P-504) AFW pumps. The purpose of this sheet metal barrier was to provide additional fire protection by preventing an oil leak in the turbine lube oil system from spraying on and becoming a fire hazard to the second motor driven pump. As stated in and supported by photographs included with SCE's August 31, 1982 letter on the same subject, a sheet metal barrier cannot be readily installed due to the confined space in the AFW pump room. In lieu of the sheet metal barrier, SCE will (1) install a shroud around the turbine lube oil piping and (2) install additional open head sprinklers directed at the P-140 turbine and the P-504 motor. The configuration of these proposed modifications is shown schematically in Enclosures (5) and (6). The shrouding around the turbine lube oil piping will prevent an oil leak in the turbine lube oil system from spraying on and presenting a fire hazard to P-504 motor. The installation of additional open head sprinklers directed at the P-140 turbine and P-504 motor will prevent a fire from spreading from the turbine to the motor driven pumps and will supplement the existing pre-action deluge system which protects the overall AFW pump room area. Because both protection from oil spray and additional fire suppression are provided, these modifications are superior to the sheet metal barrier. The fire protection modifications can be installed during the first refueling outage.

If you have any questions or comments, please contact me.

Very truly yours,

K P Baskin

cc: Mr. R. H. Engleken,
Director, Region V,
Office of Inspection and Enforcement

ESTIMATED OUTAGE TIMES FOR THE THREE ALTERNATIVES[1]

Relocate Turbine Driven Pump

Construction Outage Time		=	30 Days*
Startup Testing		=	14 Days
	Total		44 Days

*The above estimate assumes adding a parallel turbine driven pump train and providing the proper valving and instrumentation such that the original turbine driven pump may be abandoned. Alternatively, the outage time is estimated at 90 days for Construction.

Forced-Cooled Lube Oil System

Construction Outage Time		=	21 Days
Startup Testing		=	7 Days
	Total		28 Days

Replacement Motors (Assumes New Baseplates are Required)

Construction Outage Time		=	30 Days**
Startup Testing		=	7 Days
	Total		37 Days

**Assuming rework of the base plate is required.

NOTE:

1 Unit Outage Required is time plant is down due to implementation of the Alternative only. Refueling outage is assumed to be 30 days (time Auxiliary Feedwater is not required).

DESCRIPTION OF FORCED-COOLED LUBE OIL SYSTEM

The system will consist of a skid mounted oil receiver, a filter, an oil pump and a heat exchanger. There will be one skid for each Auxiliary Feedwater pump motor. Piping will run from the heat exchanger to the top of the bearings. A second line will come out of the bearing sump, through a weir box, such that excess oil will drain off by gravity to the oil reservoir. From the reservoir, the piping will run to the oil pump and then to the heat exchanger where the oil will be cooled either by passing air through the exchanger (air-to-oil) or cooled by circulating water (water-to-oil heat exchanger).

Operation of the system is tied to the Auxiliary Feedwater Pump Start/Stop circuitry such that the oil pump will operate when its respective Auxiliary Feedwater pump is operating. The cooled lube oil will be supplied to the bearings at a rate such that heat is removed in sufficient quantities to maintain the bearing temperature at no greater than 300°F.

Loss of system piping will not affect Auxiliary Feedwater motor operability due to the fact that the return line leaving the bearing sump exits the sump at the same elevation as the normal oil level. In the event that the return line is lost, the oil will drain out down to the normal level. The oil rings will still be in oil and will lubricate the bearing in their normal operating fashion. Loss of the supply line to the bearings would result in loss of the oil in the reservoir only, after which, the oil pump would lose suction. This would cause a loss of forced cooling but would not affect normal lubrication.

The electric power source for the oil pump shall be from a highly reliable source of power such as the UPS or from a battery with a trickle charge similar to those used in the plant emergency lighting system.

CALCULATION SHEET

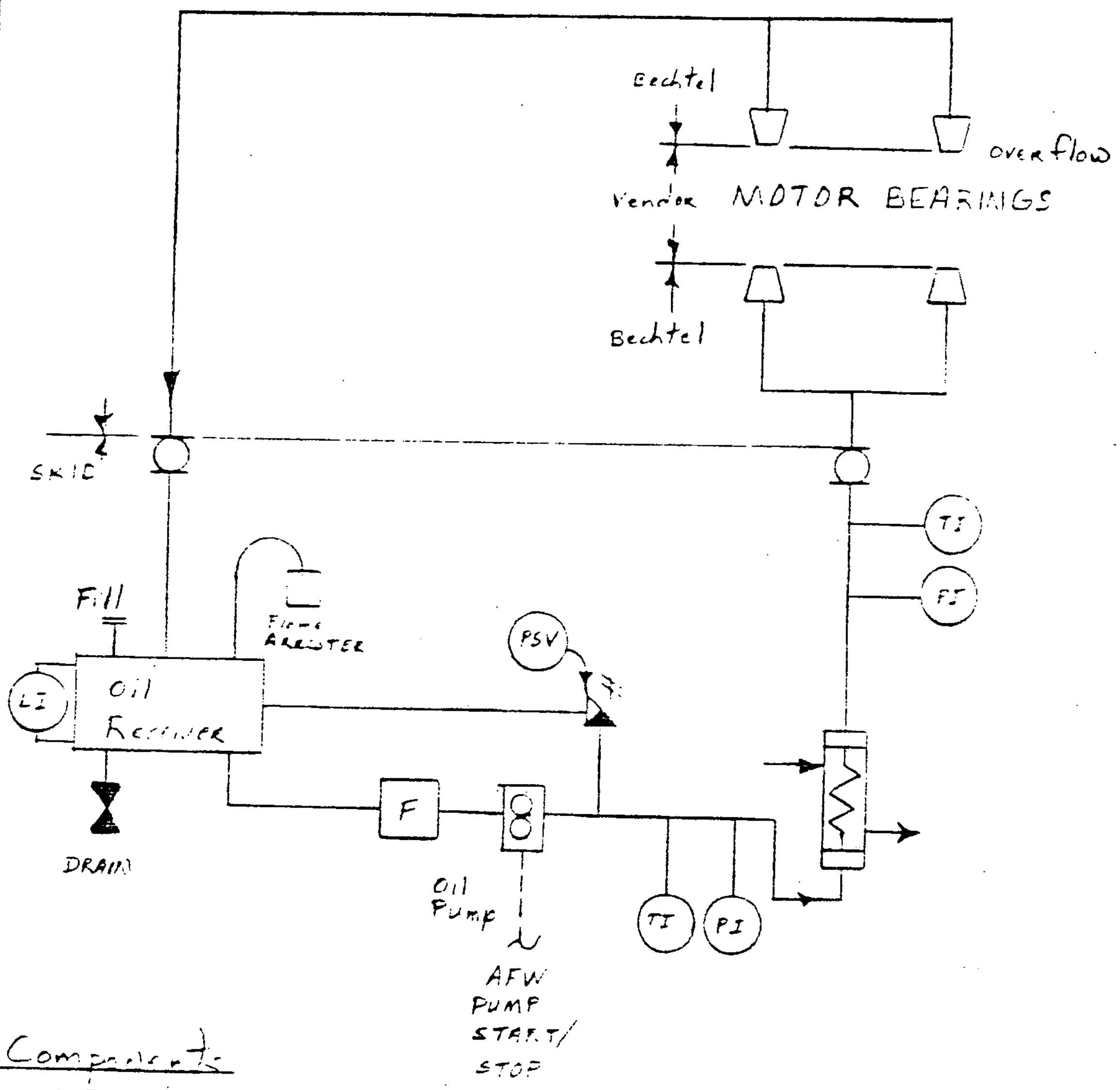
ENCLOSURE (3)

CALC. NO. ______

SIGNATURE ______ DATE ______ CHECKED ______ DATE ______

PROJECT ______ JOB NO. ______

SUBJECT Forced-Cooled Lube Oil Sys. Schematic SHEET ______ OF ______ SHEETS



Components:

Oil Receiver
Heat Exchanger
Filter
Oil Pump
Piping
Valves
Instruments

Oil Flow — 1.33 gpm
Temps.: oil to cooler 150°F
oil from cooler 130°F
Press. delivery at bearings = 12 psig

ENCLOSURE (4)

PROBABILITY OF PIPE BREAK IN

AUXILIARY FEEDWATER PUMP ROOM

TYPE OF FAILURE	FAILURE PROBABILITY (FAILURES PER FOOT YEAR)	FAILURE PROBABILITY IN AFW PUMP ROOM (FAILURES PER YEAR)
ALL LEVELS OF FAILURE	1×10^{-5} *	4×10^{-4}
CATASTROPHIC OR NEAR CATASTROPHIC FAILURE	9×10^{-7} *	3.6×10^{-5}

Probability of the inability to provide adequate feedwater is the joint probability of a catastrophic failure in AFW pump room and the probability of loss of offsite power = (Probability of a catastrophic failure in the AFW pump room.) x (Loss of offsite power probability) = $(3.6 \times 10^{-5}) \times (< 1 \times 10^{-2})^{**}$ = Less than 3.6×10^{-7}.

*References:

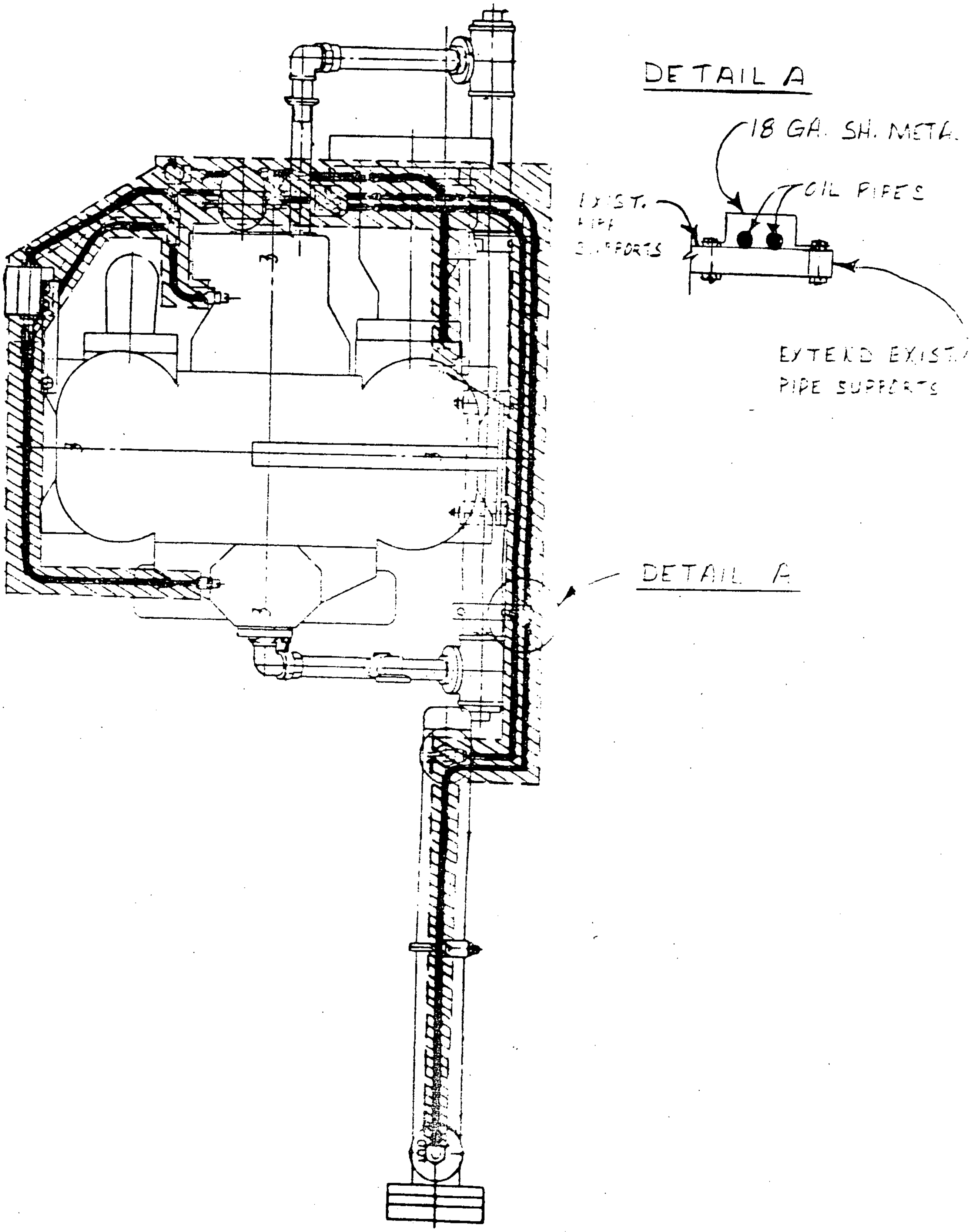
1. Draft paper by Hall, R.E., et.al., "Large Bore Pipe Rupture Probabilities as applied to a steam line break," Brookhaven Nat.Lab., Upton, N.Y. 11973.

2. Reactor Safety Study, "An Assessment of Accidental Risk in U.S. Commercial Nuclear Power Plants," U.S. NRC, WASH-1400, NUREG-75/014(Oct.1975).

3. Bush, S.H., "Reliability of Piping in Light Water Reactors," IAEA-SM-218/12,(Oct.1977).

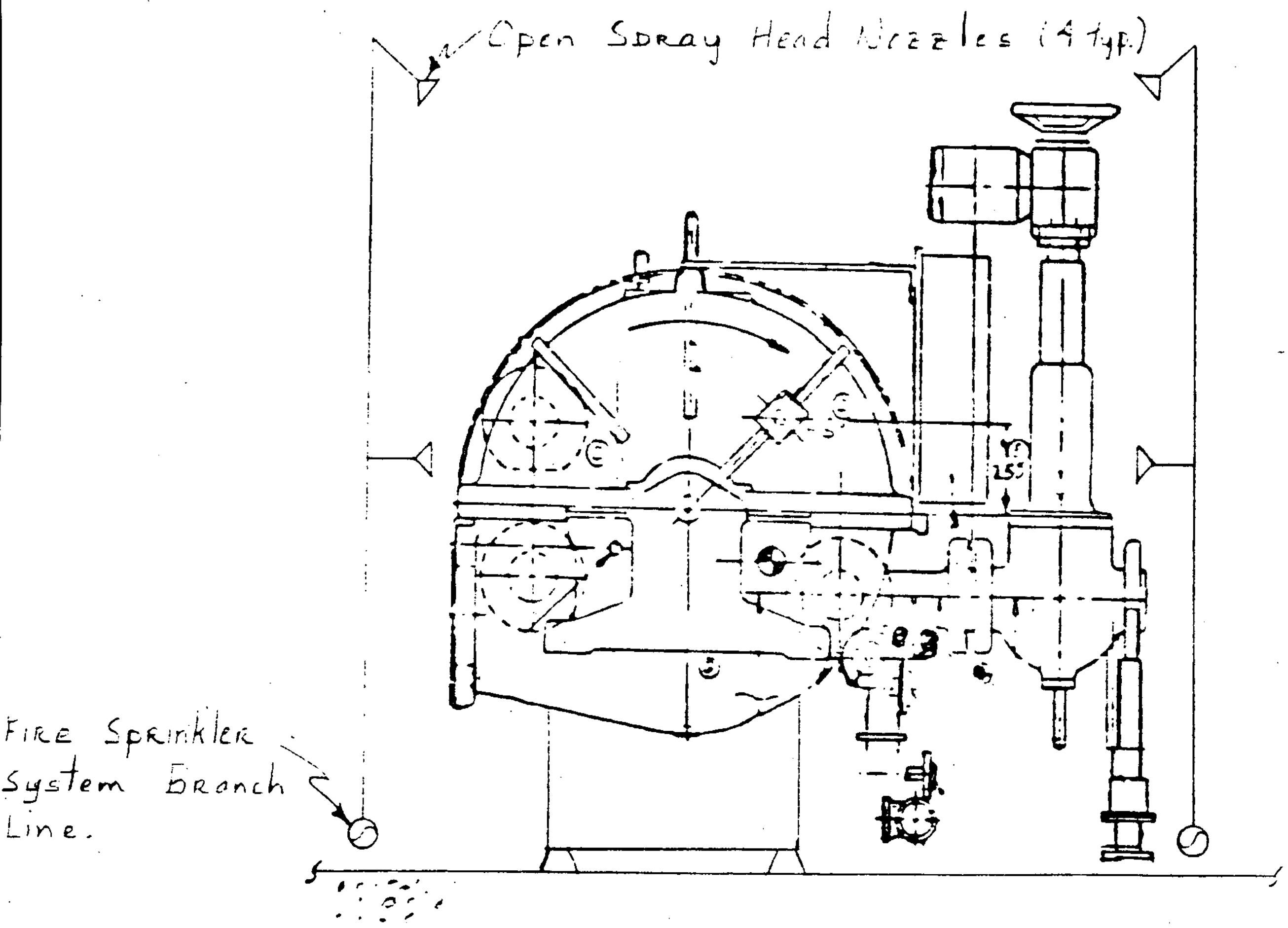
** San Onofre Nuclear Generating Station Units 2 and 3 FSAR Section 8.2.2.3

ENCLOSURE (5)



Aux. Feedwater Pump Turbine Oil Pipe Guard

Aux. Feedwater Pump Turbine
Fire Sprinkler Configuration



Aux. Feedwater Pump Motor Fire Sprinkler Configuration