DRAFT

FIRE PROTECTION SAFE SHUTDOWN ANALYSIS

SUPPLEMENT 1

COLD SHUTDOWN ANALYSIS

DRESDEN STATION

UNITS 2 AND 3

JANUARY 1980

COMMONWEALTH EDISON COMPANY

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A1.0 INTRODUCTION

A1.1 Purpose

The purpose of this analysis is to demonstrate that equipment and systems used to achieve and maintain cold shutdown conditions are either free of fire damage or the fire damage to such systems is limited such that repairs can be made and cold shutdown achieved within 72 hours. For the purpose of this analysis, cold shutdown is defined in Section 1.1 of the Dresden 2&3 Safe Shutdown Analysis. A safe cold shutdown is considered achievable if the following requirements can be satisfied:

Decay heat removal capability is available; and

Electrical power sources and distribution system are available.

A1.2 Analysis Criterion

The criterion used as a guideline for this safe shutdown analysis was that the licensee should demonstrate that the equipment and systems used to achieve and maintain cold shutdown conditions should be either free of fire damage or the fire damage to such systems should be limited such that repairs can be made and cold shutdown conditions achieved in 72 hours.

A1.3 Evaluation Method

The steps followed in conducting this evaluation are as follows:

(1) The reactor is initially in a hot shutdown condition, as discussed in the Dresden 2&3 Safe Shutdown Analysis, using the Isolation Condenser.

(2) The reactor is brought to a cold shutdown using the Shutdown Cooling System (SRC), the Reactor Building Closed Cooling Water System (RBCCW), and the Service Water (SW) System, as described in paragraph A2.0.

(3) The systems and equipment necessary for achieving cold shutdown are identified in Table A2-1 by fire area/zone and by unit in Tables A2-2 (Unit 2) and Table A2-3 (Unit 3). The fire area/zones are identified in the Dresden 2&3 Fire Protection Report.

(4) No further analysis was required for fire areas/zones which did not contain mechanical or electrical components needed for cold shutdown as identified in Table A2-1. Since the reactor can be maintained in a hot shutdown condition for greater than 72 hours, sufficient time is available to make temporary power and control cable connections, if necessary, to establish operability of system needed to bring the reactor to cold shutdown. The need for temporary cable repairs is considered highly unlikely due to the redundancy and diversity of systems available for cold shutdown as described in Section A2.0.

(5) In Section A3.0, Area Analysis, the control fire areas/zones identified as having essential mechanical and electrical components are discussed. Alternate shutdown equipment and/or procedures are discussed. Also, fire protection measures to minimize fire damage are identified.

A.14 <u>Assumptions</u>

(1) The reactor is in a stable hot shutdown configuration as described in Dresden 2&3 Fire Protection Safe Shutdown Analysis and has been depressurized and cooled to less than 350° using the hot shutdown system.

(2) The fire has been extinguished.

(3) The assumptions in Section 1.4 of the Dresden 2&3 Fire Protection Safe Shutdown Analysis also apply to this Supplement.

A2.0 <u>Shutdown Cooling</u>

The Shutdown Cooling System is the primary method used to bring the reactor to cold shutdown as shown in Safe Shutdown Diagram, Figure 1 of the Dresden 2&3 Safe Shutdown Analysis (Reference 1). Tables A2-1, A2-2, and A2-3 identify equipment necessary for cold shutdown using the shutdown cooling system. The Shutdown Cooling System is supported by the RBCCW System and the Service Water System as described in the SEP Review of Safe Shutdown Systems for Dresden Unit 2 Nuclear Power Plant, (Reference 2). Decay heat is transferred from the reactor coolant in the Shutdown Cooling Heat Exchanger to the RBCCW System water and from the RBCCW System water to the Service Water in the RBCCW Heat Exchanger. Three Shutdown Cooling and two RBCCW trains are available for each unit. One shutdown cooling train and one RBCCW train are necessary for cold shutdown at 8 hours after shutdown to maintain cold shutdown conditions. Two dedicated and one swing service water pump are provided for each unit. Shutdown cooling can be achieved with one service water pump per unit.

The LPCI can be utilized as an alternate to the Shutdown Cooling as described in Reference 2. In this method, reactor water may be cooled either by release to the Suppression pool through electromatic relief valves with flow through the containment cooling heat exchangers before returning it to the reactor or by blowdown through the Reactor Water Clean Up System to the Main Condenser. If the reactor water is circulated through the containment cooling heat exchangers, all necessary components are redundant and separated by distance and/or fire walls.

The Main Condenser and the Condensate System can also be utilized. If this method is used for cold shutdown, reactor water is blowdown to the main condenser through the Reactor Water Cleanup System or the Main Steam Lines. The reactor water is cooled in the condenser with circulating water and returned to the reactor by the condensate pumps. If blowdown to the main condenser is made through the Main Steam Line, components and systems for this method of shutdown cooling are independent of the reactor building.

In the fire areas/zones where the potential for fire damage to Shutdown Cooling System Components exists, credit is taken for these alternate methods, if they are available.

TABLE A2.1

DRESDEN 2&3 COLD SHUTDOWN EQUIPMENT LOCATION

Fire Area/Zone	Mechanical & Electrical Equipment	Valves
1.1.1.1	None	MO 3-1001-5A MO 3-1001-5B
1.1.1.2	Shutdown Cooling Pumps 3A-1001 3B-1001 3C-1001	MO 3-1001-2A MO 3-1001-2B MO 3-1001-2C
1.1.1.3	RBCCW Pumps. 3A-3701 3B-3701 RBCCW Heat Exchangers 3A-3702 3B-3702 Shutdown Cooling Heat Exchangers 3A-1003 3B-1003 3C-1003 4kV SWGR 33-1 34-1	MO 3-3704 MO 3-1001-4A MO 3-1001-4B MO 3-1001-4C TCV 3-3904A TCV 3-3904B
1.1.1.4	None	None
1.1.1.5	None	None

TABLE A2.1

DRESDEN 2&3 COLD SHUTDOWN EQUIPMENT LOCATION
(Cont'd)

Fire Area/Zone	Mechanical & Electrical Equipment	Valves
1.1.1.6	None	None
1.1.2.1	None	MO 2-1001-5A MO 2-1001-5B
1.1.2.2	Shutdown Cooling Pumps 2A-1001 2B-1001 2C-1001	MO 2-1001-2A MO 2-1001-2B MO 2-1001-2C
1.1.2.3	RBCCW Pumps 2A-3701 2B-3701 2/3-3701 RBCCW Heat Exchangers 2A-3702 2B-3702 2/3-3702 Shutdown Cooling Heat Exchangers 2A-1003 2B-1003 2C-1003	MO 2-3704 MO 2-1001-4A MO 2-1001-4B MO 2-1001-4C TCV2-3904A TCV2-3904B TCVC-3904C

TABLE A2.1

DRESDEN 2&3 COLD SHUTDOWN EQUIPMENT LOCATION
(Cont'd)

Fire Area/Zone	Mechanical & Electrical Equipment	Valves
1.1.2.3 (Cont'd)	4-kV SWGR 23-1 24-1	
1.1.2.4	None	None
1.1.2.5	None	None
1.1.2.6	None	None
1.2.1	None	MO3-1001-1A MO3-1001-1B
1.2.2	None	MO 2-1001-1A MO 2-1001-1B
2.0	Unit 2 & Unit 3 Control Panels	None

TABLE A2.1

DRESDEN 2&3 COLD SHUTDOWN EQUIPMENT LOCATION
(Cont'd)

Fire Area/Zone	Mechanical & Electrical Equipment	Valves
6.1	Unit 3 125V DC Turbine Bldg. Distribution Panel	
6.2	Unit 2 & Unit 3 Panels & Cabinets	None
7	Unit 2 125V DC Battery Unit 2 125V TC Dist. Panel	None
8.1	None	None
8.2.1	None	None
8.2.2	None	None
8.2.3	None	None

TABLE A2.1

DRESDEN 2&3 COLD SHUTDOWN EQUIPMENT LOCATION
(Cont'd)

Fire Area/Zone	Mechanical & Electrical Equipment	Valves
8.2.4 (Unit 2)	None	None
8.2.4 (Unit 3)	None	None
8.2.5 Unit 2	None	None
8.2.5 Unit 3	None	None
8.2.6 Unit 2	4kV SWGR 23 24	None

TABLE A2.1

DRESDEN 2&3 COLD SHUTDOWN EQUIPMENT LOCATION
(Cont'd)

Fire Area/Zone	Mechanical & Electrical Equipment	Valves
8.2.6 Unit 3	4kV SW 33 34	None
8.2.7	None	None
8.2.8	None	None
9.0	None	None
11.1.1	None	None
11.1.2	None	None
11.1.3	None	None
11.2.1	None	None
11.2.2	None	None
11.2.3	None	None

TABLE A2.1

DRESDEN 2&3 COLD SHUTDOWN EQUIPMENT LOCATION
(Cont'd)

Fire Area/Zone	Mechanical & Electrical Equipment	Valves
11.3	Service Water Pumps 2A-3901 2B-3901 2/3-3901 3A-3901 3B-3901 Service Water Strainers 2-3902 3-3902 2/3-3902	None
14.1	None	None
14.2	None	None
14.3	None	None
14.4	None	None
14.5	None	None
14.6	None	None

TABLE A2.2

UNIT 2 COLD SHUTDOWN

Nomenclature	Number	Elevation	Column/Row	Fire Area/Zone (1)	Comments
Service Water Pumps	2A-3901	509'-6"	1-2, B-C	11.3	
	2B-3901	509'-6"	2-3, B-C	11.3	
	2/3-3901	509'-6"	3-4, B-C	11.3	
Service Water Strainers	2-3902	517'-6"	3-4, B	11.3	
	2/3-3902		3-4, B	11.3	
Service Water Valves	TCV-2 -3904A	545'-6"	38-L	1.1.2.3	FO
	TCV-2-3904B	545'-6"	38-L	1.1.2.3	FO
	TCV-2-3904C	545'-6"	38-L	1.1.2.3	FO
Shutdown Cooling Heat Exchangers	2A-1003	545'-6"	39-41, H-J	1.1.2.3	
	2B-1003	545'-6"	39-41, H-J	1.1.2.3	
	2C-1003	545'-6"	39-41, H-J	1.1.2.3	
Shutdown Cooling Pumps	2A-1002	517'-6"	39-40, H-J	1.1.2.2	
	2B-1002	517'-6"	39-40, H-J	1.1.2.2	
	2C-1002	517'-6"	39-40, H-J	1.1.2.2	
Shutdown Cooling System MOs	2-1001-1A	517'-6"	41-J	1.2.2	NC/O
	2-1001-1B	517'-6"	41-L	1.2.2	NC/O
	2-1001-2A	517'-6"	40-H	1.1.2.2	NC/O
	2-1001-2B	517'-6"	39-H	1.1.2.2	NC/O
	2-1001-2C	517'-6"	39-J	1.1.2.2	NC/O
	2-1001-4A	545'-6"	40, H	1.1.2.3	NC/O
	2-1001-4B	545'-6"	39-40, J-H	1.1.2.3	NC/O
	2-1001-4C	545'-6"	40-39, J-H	1.1.2.3	NC/O
	2-1001-5A	476'-6"	39, K	1.1.2.1	NC/O
	2-1001-5B	476'-6"	42-43, K-L	1.1.2.1	NC/O

TABLE A2.2

UNIT 2 COLD SHUTDOWN
(Cont'd)

Nomenclature	Number	Elevation	Column/Row	Fire Area/Zone	Comments
RBCCW Pumps	2A-3701 2B-3701 2/3-3701	545'-6" 545'-6" 545'-6"	39-40, L-M 39-40, L-M 39-40, L-M	1.1.2.3 1.1.2.3 1.1.2.3	
RBCCW Mo's	2-3704	545'-6"	39, J	1.1.2.3	NC/O
RBCCW HX	2A-3702 2B-3702 2/3-3702	545'-6" 545'-6" 545'-6"	38-39, L-M 38-39, L-M 38-39, L-M	1.1.2.3 1.1.2.3 1.1.2.3	
4kV SWGR	23-1	545'-6"	39-42, M-N	1.1.2.3A	Feeds Pumps 2A-1001, 2A-3701, 2C-1001,
4kV SWGR	24-1	545'-6"	39-42, M-N	1.1.2.3A	Feeds Pumps 2B-1001, 2B-3701, 2/3-3701
4kV SWGR	23	534	31-33, D-E	8.2.6A	Feeds 4kV SWGR 23-1 (if avail-able off-site power 2A-39[illegible]
4kV SWGR	24	534	31-33, D-E	8.2.6A	Feeds 4kV SWGR 2H-1 (if offsit power avai able) 2B-3901, 2/3-3901
Transformers	T21 T22	Ground Ground		Outside Plant Structures	Feed 4Kv SWGR 23 &2

TABLE A2.3

UNIT 3 COLD SHUTDOWN
(Cont'd)

Nomenclature	Number	Elevation	Column/Row	Fire Area/Zone	Comments
Service Water Pumps	3A-3901	509'-6"	4-5, B-C	11.3	
	3B-3901	509'-6"	5-6, B-C	11.3	
	2/3-3901	509'-6"	3-4, B-C	11.3	
Service Water Strainers	3-3902	517'-6"	4-5, B	11.3	
Service Water Valves	TCV-3-3904A	545'-6"	50-L	1.1.1.3	FO
	TCV-3-3904B	545'-6"	50-L	1.1.1.3	FO
Shutdown Cooling Heat Exchangers	3A-1003	545'-6"	47-44, H-J	1.1.1.3	
	3B-1003	545'-6"	47-49, H-J	1.1.1.3	
	3C-1003	545'-6"	47-49, H-J	1.1.1.3	
Shutdown Cooling Pumps	3A-1002	517'-6"	48-49, H-J	1.1.1.2	
	3B-1002	517'-6"	48-49, H-J	1.1.1.2	
	3C-1002	517'-6"	48-49, H-J	1.1.1.2	
Shutdown Cooling System MO's	3-1001-1A	517'-6"	48-47, J	1.2.1	NC/O
	3-1001-1B	517'-6"	47-L	1.2.1	NC/O
	3-1001-2A	517'-6"	48, J-H	1.1.1.2	NC/O
	3-1001-2B	517'-6"	48-H	1.1.1.2	NC/O
	3-1001-2C	517'-6"	49-48, J-H	1.1.1.2	NC/O
	3-1001-4A	545'-6"	48-H	1.1.1.3	NC/O
	3-1001-4B	545'-6"	48-J	1.1.1.3	NC/O
	3-1001-4C	545'-6"	48-J	1.1.1.3	NC/O
	3-1001-5A	476'-6"	45-K	1.1.1.1	NC/O
	3-1001-5B	476'-6"	48-49, K	1.1.1.1	NC/O

TABLE A2.3

UNIT 3 COLD SHUTDOWN

(Cont'd)

Nomenclature	Number	Elevation	Column/Row	Fire Area/Zone	Comments
RBCCW Pumps	3A-3701 3B-3701	545'-6" 545'-6"	48-49, L-M 48-44, L-M	1.1.1.3 1.1.1.3	
RBCCW MO's	3-3704	545'-6"	49, J	1.1.1.3	NC/O
RBCCW HX	3A-3702 3B-3702	545'-6" 545'-6"	49-50, L-N 49-50, L-N	1.1.1.3 1.1.1.3	
4Kv SWGR	33-1	545'-6"	46-48, M-N	1.1.1.3	Feeds Pumps 3A-1001, 3A-3701, 3C-1001
4Kv SWGR	34-1	545'-6"	47-49, M-N	1.1.1.3	Feeds Pumps 3B-1001, 3B-3701, 2/3-3701
4Kv SWGR	33	538'-6"	54-55, D-E	8.2.6B	Feeds 4Kv SWGR 33-1 (if offsite power is available) 3A-3901
4Kv SWGR	34	538'-6"	54-55, D-E	8.2.6B	Feeds 4Kv SWGR 34-1 (if offsite power available), 3B-3901, and 2/3-3901
Transformers	T31 T32	Ground Ground		Outside Plant Structures	Feed 4Kv SWGR 33 and 34

A3.0 Area Analysis

The fire areas/zones which contain essential components needed for cold shutdown are listed in Table 3-1. The cold shutdown analyses in each of these areas/zones are in paragraphes 3.1 through 3.9.

TABLE A3-1

SECTION	FIRE AREA/ZONE	LOCATION
3.1	1.1.1.1	Unit 3 Reactor Building Floor Elevation 476 Feet 6 Inches
	1.1.2.1	Unit 2 Reactor Building Fllor Elevation 476 Feet 6 Inches
3.2	1.1.1.2	Unit 3 Reactor Building Floor Elevation 517 Feet 6 Inches
	1.1.2.2	Unit 2 Reactor Building Floor Elevation 517 Feet 6 Inches
3.3	1.1.1.3	Unit 3 Reactor Building Floor Elevation 545 Feet 6 Inches
	1.1.2.3	Unit 2 Reactor Building Floor Elevation 545 Feet 6 Inches
3.4	1.2.1	Unit 3 Drywell
	1.2.2	Unit 2 Drywell
3.5	2.0	Control Room
3.6	6.1	Unit 3 Safety Related DC Panel Room
3.7	6.2	Auxiliary Electric Equipment Room
3.8	7(Unit 2)	Unit 2 Battery Room and D-C Panels
3.9	8.2.6	Turbine Building Mezzanine Floor
3.10	11.3	Crib House

A3.1 Fire Zones 1.1.1.1 (Unit 3) and 1.1.2.1 (Unit 2). (Reactor Building Floor, Elevation 476 feet, 6 inches - Fire Protection Figure No. 2/3 . 2-1-1)

This fire zone contains normally closed shutdown cooling valves Mo-1001-5A and 5B. The fire loading in this zone consists only of cable insulation and is negligible. Sufficient time is available to allow any fire to be extinguished and to allow access for manual operation of these valves, if necessary.

A3.2 Fire Zones 1.1.1.2 (Unit 3) and 1.1.2.2 (Unit 2). (Reactor Building Elevation 517 feet, 6 inches - Fire Protection Figure No. 2/3.2-1-2)

Shutdown Cooling Pumps 3A(2A)-1001, 3B(2B)-1001 and 3C(2C)-1001 and Valves MO-1001-2A, 2B, and 2C are located in a cubical area between column rows 48-49, H-J. (Unit 3) and 39-40/H-J (Unit 2) This cubicle is separated from the rest of the area by radiation shield walls. Therefore, a fire outside this area would not affect those pumps or vice versa. The only fire loading in the cubicle is 12¼ gallons of oil in each shutdown cooling pump.

If a postulated fire were to disable the Shutdown Cooling Pumps, cold shutdown can still be achieved by letdown to the condenser and water makeup using the condensate pumps. In addition, one division of LPCI and electromatic relief valves would be available for cold shutdown in spite of a fire in this zone. Provisions to prevent simultaneous fire damage to cable at both electrical divisions are described in Reference 1, paragraph 3.2.1.2.

A3.3 Fire Zones 1.1.1.3 (Unit 3) and 1.1.2.3 (Unit 2) (Reactor Building Floor Elevation 545 feet, 6 inches - Fire Protection Figure No. 2/3.2-1-3).

This fire zone contains the RBCCW Pumps 3A(2A)-3701 and 3B(2B) - 3701, the two RBCCW heat exchangers, the three Shutdown Cooling Heat Exchangers valves MO-3704, MO-1001-4A, 4B, and 4C, TCV-3904A and TCV 3904B and the 4kV SWGR 33-1 (23-1) and 34-1 (34-1).

It is not plausible to postulate a fire affecting RBCCW pumps in Unit 3 and in Unit 2 simultaneously because they are separated by a 3-hour rate fire wall. Only one pump per unit is needed for cole shutdown after 72 hours. Even if both pumps in one unit were disabled, the capability exists to cross connect the Unit 3 RBCCW Pumps System with the Unit 2 RBCCW Pumps System by opening a normally closed valve in the Unit 2 Reactor Building. Because of the low fire loading, the integrity of the RBCCW Heat Exchangers will not be affected. The Shut-down Cooling Heat Exchangers are separated from the rest of the area by radiation shield walls. This cubicle has negligible fire loading.

The fire protection measures to prevent simultaneous fire damage to both SWGR 33-1 (23-1) and 34-1 (24-1) are described in paragraph 3.1.1.2 of Reference 1. The fire protection measures described in paragraph 3.1.1.2 also insure that at least one division of LPCI and electromatic relief valves are available. Also, cold shutdown can be achieved and maintained by blowdown of reactor water to the main condenser and makeup using the condensate pumps. These systems are indepenent of this fire area.

TCV-3904A and TCV-3904B fail in the open position.

A 3.4 Fire Zones 1.2.1 (Unit 3) and 1.2.2 (Unit 2) (Drywell - Fire Protection Figure No.s 2/3.2-1-7, 2/3.2-1-2, and 2/3.2-1-3).

The drywell contains normal closed shutdown cooling valves MO-1001-1A and 1B. The drywell fire analysis shows that safe hot shutdown is not affected by an inerted or deinerted drywell condition. Sufficient time is then available to enter the drywell and manually operate these valves, if necessary.

A 3.5 Fire Area 2.0 (Control Room - Fire Protection Figure No. 2/3.2-2-1).

Hot shutdown capability independent of the control room has been provided as discussed in the "Dresden 2&3 Fire Protection Safe Shutdown Analysis." (Reference 1).

Because of the fire protection measures described in paragraph 3.1.5.2 of Reference 1, it is not credible to postulate a fire occuring and developing into proportions that would affect a significant amount of equipment.

Manual breaker control at switchgear is possible, if necessary.

A3.6 Fire Area 6.1 (Unit 3 Safety Related DC Panel Room - Fire Protection Figure No. 3.2-8-4)

Located in this fire zone are 125 V DC Main Bus 3A and 125V DC Reserve Bus 3B. These power sources are necessary for breaker control at 4Kv Buses 33 and 34 and 4Kv Switchgear 33-1 and 34-1. However, if necessary, manual breaker control at Bus 33 and 34 and Switchgear 33-1 and 34-1 is possible.

An early warning automatic fire detection system is provided in this area. A water fire hose well and a portable extinguisher are available for use.

A 3.7 Fire Zone 6.2 (Auxiliary Electric Equipment Room - Fire Protection Figure No. 2/3.2-2-1)

Hot shutdown capability independent of the Auxiliary Electric Equipment Room has been provided as discussed in the Dresden 2&3 Fire Protection Safe Shutdown Analysis. (Reference 1)

Because of the fire protection measures described in paragraph 3.1.6.2 of Reference 1, it is not credible to postulate a fire occurring and developing into proportions that would affect a significant amount of equipment.

Manual breaker control at the switchgear is possible, if necessary.

A3.8 Fire Area 7 (Unit 2) (Fire Protection Figure No. 2/3.2-2-1)

The Unit 2 125V DC Main Bus 2A and 125V DC Reserve Bus 2B are located in this fire zone. These power sources are necessary for breaker control at 4Kv Buses 23 and 24 and 4Kv switchgear 23-1 and 24-1. However, if necessary, manual breaker control at Buses 23 and 24 and Switchgear 23-1 and 24-1 is possible.

The panels are separated from combustibles in the battery room by fire rated enclosure around the batteries. Fire detection is provided in the vicinity of these panels. Portable fire extinguishers and fire water hose are readily available for use.

A3.9 Fire Zone 8.2.6 (Turbine Building Mezzanine Floor Elevation 534 feet - Fire Protection Figure No.s 2.2-8-4, 3.2-8-4, and 2/3.2-2-1)

Buses 33 and 34 are located at column rows D-E/53-56 and Buses 23 and 24 at columns rows D-E/31-33 in this fire zone. Buses 33 and 34 (23 and 24) provide primary power feed to switchgear 33-1 and 34-1 (23-1 and 24-1). They also provide power feed to the Service Water Pumps in their respective units. Due to the separation at the switchgear between units, a fire can be postulated in only one unit. Because of the fire protection measures discussed in paragraph 3.1.10.2 and 3.1.11.2, of Reference 1, it is not credible to postulate a fire occurring and developing into proportions that would affect both division of cable in either Unit 2 or Unit 3.

Switchgear 33-1 and 34-1 (23-1 and 24-1) can be fed by the diesel generators or alternately switchgear 23-1 (Unit 2) and 33-1 (Unit 3) can be cross connected through normal open breakers. This capability is also available for SWGR 24-1 and 34-1. The Service Water pumps are connected to a common header which provides water to both units. Therefore cold shutdown can be achieved and maintained in both units even if only one units switchgear is available.

A3.10 Fire Area 11.3 (Crib House - Fire Protection Figure No. 2/3.2-11-1)

Service Water Pumps 2A-3901, 2B-3901, 2/3-3901, 3A-3901 and 3A-3901 are located in this fire area.

The only significant fire loading in this area is contributed by oil in the service water pumps (28 gallons each), circulating water pumps (50 gallons each), the fire pump diesel (8 gallons) and diesel day tank, (250 gallons). A water suppression system is provided for the diesel driven fire pump.

It is not credible that a single fire would damage the service water pumps in both units. Only one pump is needed for cold shutdown of each unit.

The LPCI, ADS, and Containment Cooling Service Water are available for cold shutdown as discussed in Reference 2 completely independent of this fire area.

A4.0 Modification

None.

A5.0 Conclusion

The Dresden 2&3 Fire Protection Safe Shutdown Analysis and Supplement 1 to the Fire Protection Safe Shutdown Analysis shows that with the modifications listed in Section 4.0, local control and manual valve operation, the plant has been designed such that if a fire does start and burns for a considerable length of time, in spite of the fire prevention program and fire fighting activities, the plant can be brought to a cold shutdown condition safety. Therefore, the safe shutdown analysis and its supplements together with the report Information Relevant to Fire Protection Systems and Programs Part 3 Dresden Units 2 & 3, April 1977 (Revision 1, August 1977), verify that an adequate balance of all three of the following fire protection defense-in-depth objectives has been acheived:

a. Fires will be prevented from starting.

b. Fires will be quickly detected, suppressed, and extinguished, thus limiting their damage.

c. The plant has been designed such that if a fire does start and burns for a considerable length time, in spite of the fire prevention program and fire fighting activities, the plant can be shut down safely.

The present operation of the plant will not jeopardize the health and safety of the public.

A6.0 References

1. Dresden 2&3 Fire Protection Safe Shtudown Analysis, June 1978.
2. SEP Review of Safe Shutdown Systems for the Dresden Unit 2 Nuclear Power Plant, Draft.

DRAFT

SEP REVIEW

OF

SAFE SHUTDOWN SYSTEMS

FOR THE

DRESDEN UNIT 2 NUCLEAR POWER PLANT

(Selected Pages of this SEP Review are included and are marked to show sections applicable to this cold shutdown analysis).

As noted above, the isolation condenser discharge (condensate) DC valve can be throttled to maintain a constant cooldown rate or maintain whatever temperature is desired. When the reactor is sufficiently cooled down and depressurized by this means (or others discussed below) another system (shutdown cooling) is brought on the line to continue cooling and to serve as the long term residual heat (decay heat) removal system.

The maintenance of temperature is noted above, because if the systems function properly, the operator can maintain desired temperature and reactor water level by use of the isolation condenser, the relief valves, the control rod drive system to provide makeup to the vessel, and the reactor water cleanup system to allow letdown to the main condenser or the radioactive waste treatment system.

Shutdown Cooling System description pp 21-27

As stated, the shutdown cooling system would be started as soon as the reactor coolant system has been sufficiently cooled and depressurized by the isolation condenser. The shutdown cooling system (SDCS) was designed to the ASME Code, Section III, Class C, at 1250 psig (full reactor design pressure) but only to 350°F (Reference: SAR Page 10.4-1). This design was based upon decreasing reactor coolant system temperature to 125°F within 24 hours after reactor shutdown. SAR page 10.4-1 states that the system consists of three partial-capacity loops and that all three are necessary to

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perform the cooling function. However, plant operating experience has shown that, at only eight hours after normal (main condenser) shutdown commencement, when the SDCS would normally be put into service and after reactor coolant system temperature has decreased to 350°F, only one pump and one heat exchanger (comprising one loop) are necessary to cool down. Thus there is substantial excess capacity.

SDCS system influent is through motor-operated valves from either reactor recirculation loop. The valves, one from each recirculation loop, are inside containment, are AC-powered from 480 Volt AC MCC 28-1, can be supplied from the emergency diesel generators, and are closed until initiation requirements (reactor coolant system temperature less than 350°F) are met and operator action is taken.

The two inlet lines join in one header outside of containment. This header then is divided into three separate loops, each with a DC-powered motor-operated pump inlet isolation valve, a centrifugal pump rated at 6750 GPM at "full operation" (SAR page 10.4-1) a heat exchanger and a DC-powered motor-operated pump outlet isolation valve. Downstream of the isolation valves, and still outside containment, the three branches rejoin but are again divided downstream into two lines, each containing an AC-powered motor-operated isolation valve. The lines then penetrate containment and rejoin the reactor

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coolant system through connections into the Low Pressure Coolant Injection system and then into each of the reactor recirculation loops. Although the capability exists to permit flow from and to both recircu-lation loops simultaneously, normally only one loop is selected for such service.

The SDCS cannot be put into service until various interlocks are met. The first of these is a temperature interlock on all four AC-powered isolation valves, which will not allow their opening until reactor coolant system temperature, sensed on both recirculation loops, has decreased to less than 350°F. The AC and DC suction valves will also shut to isolate the SDCS (with check valves on the discharge side), if system temperature, again sensed on the recircula-tion loops, increases to 350°F. Additionally, each pump has interlocks to prevent operation until certain conditions are met. Inlet temperature, as measured in its branch line, must be less than 350°F, and pump suction pressure must be greater than 4 psig. If these conditions are not met, then the SDCS pumps can not be started. Also, the pumps will trip upon temperature increase to 350°F, or if suction pressure decreases to less than 4 psig.

Power to the AC-isolation valves is provided from 480 Volt AC MCC 28-1, and to the pumps from 4160 Volt AC buses 23-1 (pumps 2A and 2C) and 24-1 (pump 2B). Each of these is capable of being supplied from the emergency diesel generators. DC power to the three branch suction isolation valves and the 2A and 2B branch discharge isolation valves is obtained from 250 Volt DC Reactor Building MCC #2 (Bus 2A), while power for the remaining DC discharge valve (2C) comes from 250 Volt DC Reactor Building MCC #2 (Bus 2B). There is enough diversity of power supplies to the active components to assure system isolation will take place to protect the equipment from temperature which is greater than design.

The heat exchangers of the SDCS are cooled by water from the Reactor Building Closed Cooling Water (RBCCW) system. This system's heat exchangers are designed to the ASME Code, and each of the three pumps will deliver 8800 GPM (SAR Page 10.10-1). Although the SAR states that two pumps (and heat exchangers) are needed for the cooldown and shutdown modes of operation, plant experience has shown that only one pump and heat exchanger combination is necessary in the assumed scenario. Any combination of one pump with one heat exchanger is possible because of the piping and valving arrangement, and any of the loads to be cooled can be isolated, when feasible and necessary, to increase cooling to essential heat loads.

The path to the shutdown cooling system heat exchangers begins at the discharge of the three pumps, which are in separate branches. Pump 2A is powered from 4160 Volt AC Bus 23-1, while pumps 2/3 and

2B receive power from 4160 Volt AC Bus 24-1. These buses can be supplied from the emergency diesel generator. Pump 2/3 is unique in that its discharge can also be routed (through a normally locked-closed valve) to provide cooling to the RBCCW system of Dresden 3 (which has only two pumps and two heat exchangers).

The three pump discharge lines join into one line which then branches to feed all the components to be cooled (other than SDCS heat exchangers, this includes the drywell coolers, the SDCS pumps, fuel pool heat exchangers, non-regenerative heat exchangers of the Reactor Water Clean-up system, and various other loads). There is an AC-powered motor-operated isolation valve on the discharge of the SDCS heat exchangers. This valve is supplied power from "emergency" MCC 29-1, but is accessible for manual operation if necessary.

Flow to cool the SDCS pumps is routed through a normally-open AC powered motor-operated inlet isolation valve, which also serves to allow flow to or isolate flow from other loads to be cooled. This valve is supplied power from "emergency" MCC 28-1 and is also accessible for manual operation.

Discharge of RBCCW from the cooled components is routed to one header with three branches to the heat exchangers. The cooled heat exchanger effluent (service water is the cooling medium) from each heat exchanger then joins a single header prior to branching out for the suction of each pump.

The RBCCW system pressure is lower than that of both the components being cooled and the service water cooling medium, meaning that any inter-system leakage at the heat exchangers would be leakage into the RBCCW system. This prevents radioactive material from the cooled components from escaping to the environment through the ultimate cooling medium. It also prevents impurities in the cooling medium from entering the reactor coolant system. To facilitate leakage detection, the RBCCW system incorporates a radiation monitor at the heat exchanger influent. Also, the RBCCW system expansion tank has high and low level alarms to signal leakage into the system or out of the system, respectively.

As noted above, the RBCCW system is cooled by the service water (SW) system. This system has five pumps, three of which are powered from Dresden 2 buses and which, with operator action, can be supplied power from the emergency diesel generators. Pump 2A is powered from bus 23, 2B from bus 24, and 2/3 from either Dresden 2 bus 24 or Dresden 3 bus 34. All five pumps are located in the crib house, and are rated at 15,000 GPM each. There is a crossover to connect the Dresden 2 and Dresden 3 systems, and it must be noted once again that the SW system also performs the function of the fire water system for the plants. All valves in the service water piping to the RBCCW heat exchangers and then to the discharge header are manual, with the exception of air-operated temperature control valves on each heat exchanger. These valves fail open on loss of air.

As a backup to the leakage detection means of the RBCCW system (radiation detector and expansion tank level alarms), the service water system incorporates a radiation detector at the discharge header.

The above discussion has dealt with the equipment which would normally be called upon to bring Dresden 2 to a cold shutdown condition on loss of all offsite power. The auxiliary means to accomplish this goal shall now be discussed. This analysis shall go beyond the normally considered single-failure criterion and shall discuss multiple system failures. Additionally, lineups and operation not covered by procedure shall be discussed. This is being undertaken to show that substantial capability exists to insure safe shutdown of the plant in the assumed scenario.

In the event of failure of the isolation condenser, the High Pressure Coolant Injection (HPCI) system can be used to depressurize and cool the reactor coolant system to the SDCS initiation temperature of 350°F.

This is certainly sufficient for the purposes of this scenario (Note that the loss of the air supply would constitute yet another multiple failure).

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If the SDCS were inoperable for any reason (valve failure, failure of RBCCW or SW), the Low Pressure Coolant Injection (LPCI) system and Core Spray systems could be used to inject cooling water into the core, once their injection initiation limits (300 psig) are met. Those systems are both low pressure but high volume systems, capable of providing substantial volumes of cooling water to the core. Not too much detail will be devoted to the individual systems here, because each is safety-grade, and is taken into account in the Dresden 2 SAR Loss of Coolant Accident (LOCA) Analysis. The pumps in each system are powered from "emergency" buses, and all motor-operated valves are powered from "emergency" MCCS and are also outside containment, accessible for manual operation if needed.

Because a substantial amount of water would be added to the reactor vessel by the LPCI or core spray systems, a means of volume control would be necessary. This can be accomplished by let down through the Reactor Water Cleanup (RWCU) System, either to the main condenser or to radwaste. Alternatively, if RBCCW were inoperable to provide cooling to the RWCU non-regenerative heat exchanger and thus protect the RWCU resin, the vessel could be allowed to fill using LPCI alone, overflowing hot water to the pressure suppression chamber (torus) through the relief valves. The torus provides water to the LPCI and Core Spray Systems. The water of the LPCI system would then be cooled by the containment cooling heat exchangers on its way back to the reactor vessel. Core Spray receives no such cooling and was never intended as a long term cooling means.

The cycling of the water through the core and through the relief valves to the torus and back again after cooling would only be limited by the design of the relief valves themselves. These valves incorporate a spring which must be overridden by system pressure to open the valve. The spring will shut the valve at approximately 70 psig and will hold it shut until the core heats up again and raises pressure or until the pressure is increased by the LPCI pumps (design head 114 psig at 0 psi reactor pressure to 245 psig at 200 psi reactor pressure - SAR page 6.2-15).

The containment cooling service water system (which cools the containment cooling heat exchangers) pumps are provided power from buses which can be supplied by the diesel generators. All valves in the system are outside containment and are accessible for operation.