Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

May 28, 1980

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Zion Station Units 1 and 2
Additional Fire Protection Information
NRC Docket Nos. 50-295 and 50-304

Reference (a): April 30, 1980, letter from D. L. Peoples to H. R. Denton.

Dear Mr. Denton:

In Reference (a), Commonwealth Edison Company provided the NRC staff with additional information concerning the Zion Fire Protection Program. Attachment 2 of that reference contained a safe shutdown analysis which takes the plant to a hot shutdown. A supplement to that analysis which will take the plant to a cold shutdown is provided in Attachment 1 to this letter.

Please address any questions that you might have concerning this matter to this office.

One (1) signed original and thirty-nine (39) copies of this transmittal are provided for your use.

Very truly yours,

for D. L. Peoples
Director of Nuclear Licensing

DLP:WFN:al

Attachment

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ATTACHMENT 1

SAFE COLD SHUTDOWN ANALYSIS

ZION STATION
UNITS 1 & 2

COMMONWEALTH EDISON COMPANY

MAY, 1980

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 Zion 1 & 2 Safe Shutdown Analysis. A safe cold shutdown is considered achievable if the following requirements can be satisfied.

Reactor is subcritical per Tech Specs;
Decay heat removal and pressure control 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

(1) The reactor is initially in a stable shutdown condition, as discussed in the Zion 1 & 2 Safe Hot Shutdown

Analysis.

(2) The reactor is brought to a cold shutdown using the Residual Heat Removal System (RHR), the Component Cooling System (CC), the Service Water (SW) System, and Supporting Auxiliaries, as described in paragraph A2.0.

(3) The systems and equipment necessary for achieving cold shutdown are identified in Section A3.0.

(4) Since the reactor can be maintained in a hot shutdown condition for greater than 72 hours, as discussed in the Zion Safe Hot Shutdown Analysis, 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.

(5) In Section A3.0, System Analysis, the systems necessary to achieve cold shutdown are discussed. Alternate shutdown methods and any proposed modifications are also discussed.

A1.4 Assumptions

(1) The reactor is in a stable hot shutdown configuration as described in the Zion 1 & 2 Fire Protection Safe Hot Shutdown Analysis and the primary coolant system has been depressurized and cooled to an average temperature less than 350° F using the hot shutdown method.

(2) The fire has been extinguished.

(3) The assumptions in Section 1.4 of the Zion 1 & 2 Fire Protection Safe Shutdown Analysis also apply to this Supplement.

A2.0 Cold Shutdown

Cold shutdown is defined as a plant condition in which the reactor is subcritical with a shutdown margin per the Technical Specifications, the reactor coolant system is reduced to 200°F or less and decay heat is removed by the residual heat removal system.

Therefore in order to proceed to cold shutdown from a hot shutdown condition primary system temperature and pressure must be reduced and boron must be added to the primary system to maintain negative reactivity. This report discusses in Section A3.0 the systems needed to perform these functions and demonstrate their availability in spite of a fire. A brief overview of these systems is also provided below.

The Residual Heat Removal (RHR) System is the method used to reduce and maintain primary system temperature for cold shutdown as shown in Figure 2.4-1 of the Zion 1 & 2 Fire Protection Report. Decay heat is removed from the primary system by the RHR system and is transferred via heat exchangers to the Component Cooling Water System and then to the Service Water System with the lake being used as an ultimate heat sink.

Primary System pressure can be controlled by two methods. The preferred method is the normal pressurizer spray path which requires operation of the reactor coolant pumps to supply driving head. As operation of the reactor coolant pumps also requires operation of several other systems this mode of control may not always be available and therefore the alternate method would be utilized. This method is use of the auxiliary spray valve as stated in FSAR Section 4.2.

Boration to the cold shutdown boron concentration may be accomplished using the Boric Acid Transfer Pumps taking suction from the Boric Acid Tanks (BAT). Alternately, borated water may be supplied from the Refueling Water Storage Tank (RWST). The Boric Acid Tanks contain a 12 weight percent boric acid solution. The RWST contains a minimum 2000 ppm boron solution. Boration may also be accomplished using the Boron Injection Tank (BIT) containing 12 weight percent of boric acid solution.

A3.0 System Analysis

The systems utilized to perform a cold shutdown of the reactor are discussed in detail in the following subsections. The equipment used by these systems to achieve cold shutdown are identified in Tables A3-1 through A3-5.

A3.1 Decay Heat Control

As stated in Section A[illegible].0 the Residual Heat Removal (RHR) system is used to reduce primary system temperature and maintain primary system temperature at cold shutdown conditions.

The RHR System is supported by the Component Cooling System and the Service Water System. Decay heat is transferred from the reactor coolant in the RHR Heat Exchangers to the Component Cooling System water, and from the Component Cooling System water to the Service Water in the Component Cooling Heat Exchangers. Two RHR trains are provided for each unit. Each RHR train is sized to remove one-half of the residual heat load at approximately 20 hours after a reactor trip. One RHR pump and both RHR Heat Exchangers will bring the plant to a cold shutdown within 10 hours from 350° F. 425 psig conditions. However, one RHR train is sufficient to bring the plant to cold shutdown conditions as discussed in FSAR Section 9.4. The five Component Cooling Pumps and three Component Cooling Heat Exchangers can be shared between the two units. The six Service Water Pumps can be shared between the two units.

A3.1.1 RHR System - (Unit 1)

Table 3-1 identifies by fire zone/area equipment used by the Unit 1 RHR system to achieve safe cold shutdown. The redundant RHR pumps, RHR pump cubicle unit coolers and RHR pump suction isolation valves 1MOV-8700A and 1MOV-8700B for each unit are located in separate fire zones, 11.1A-1 and 11.1B-1, so that a single fire would not affect both RHR loops. However, to ensure the availability of at least one RHR Pump for safe shutdown, the power cables to one pump and its Unit Cooler for each unit will be rerouted in order to provide adequate separation so that a single fire will not affect both loops.

The redundant RHR Heat Exchangers and the RHR Heat Exchanger Component Cooling Side Discharge Valves for each Unit are located in separate fire zones, therefore a single fire would not affect both RHR loops.

Redundant Valves 1RH-HCV606 and 1RH-HCV607, the RHR Heat Exchanger Discharge Valves, and 1RH-8726A and 1RH-8726B, the RHR Heat Exchanger Bypass Valves, are located in close proximity to each other, 6 feet and 15 feet respectively, in Fire Zone 11.1-0 and could be affected by a single fire. The RHR Heat Exchanger Bypass Valves are manually operated valves and thus would be operable after the fire is extinguished. The RHR Heat Exchanger Discharge Valves 1RH-HCV606 and 1RH-HCV607 are diaphram type flow control valves and a fire could affect the ability to control flow with those valves. These valves fail open however. Therefore, the RHR system can still be operated if necessary until repairs are made to the valve's control system and cool-down rate can be controlled by manually throttling flow through the RHR Heat Exchanger on either the RHR or Component Cooling Water side or both.

Redundant Valves 1MOV-SI8809A and 1MOV-SI8809B are located approximately 9 feet apart in Fire Zone 11.4-0. These valves are normally open, however, and thus a fire in this area would not affect cold shutdown.

The RHR loops share three valves; the RHR Pump Suction Containment Isolation Valves 1MOV-RH8701 and 1MOV-RH8702 and the RHR Heat Exchanger Bypass Valve 1RH-HCV618. The Pump Suction Containment Isolation Valves can be manually operated and thus would be available for use after a postulated fire is extinguished. The RHR Heat Exchanger Bypass Valve is a diaphram type flow control valve and could be affected by a fire. This valve fails open however and therefore can still be utilized to bypass flow around the RHR Heat Exchangers for system warmup with bypass flow being controlled by throttling with the manual bypass valves if necessary while repairs are being made to the flow control system.

A3.1.2 RHR System - (Unit 2)

Table A3-2 identifies by fire zone/area equipment used by the Unit 2 RHR system to achieve cold shutdown. The configuration of this equipment is the mirror image of the equipment for Unit 1 and the cold shutdown analysis for this system is identical to the Unit 1 RHR System analysis.

A3.1.3 Auxiliary Systems

The auxiliary systems utilized by the RHR System are the Service Water System, the Component Cooling Water System, and the Instrument Air System.

Section 9.6 of the Zion FSAR states that one Service Water Pump per unit is required for emergency shutdown conditions. The six Service Water Pumps at Zion can be shared between the two units and as demonstrated in the Zion Safe Hot Shutdown Analysis at least three Service Water Pumps will remain available to support a safe shutdown in spite of a fire anywhere in the plant.

Section 9.3 of the Zion FSAR states that three of the five Component Cooling Water Pumps and two of the three heat exchangers are needed during cooldown of one Unit with the other Unit at full power operation. The Zion Safe Hot Shutdown Analysis indicates that only two Component Cooling Water Pumps may be available in case of a postulated fire, since the power cables for three of these pumps are routed in close proximity. A fire affecting these cables which also requires either Unit to be brought to a cold shutdown condition would require the replacement of at least one of these cables in the affected fire zone/ area.

The Instrument Air System Supplies control air for the RHR system flow control valves; however, manual control can be utilized as stated in Subsection A3.1.1. The Instrument Air System at Zion is cross connected between the two units so that the loss of one compressor will not cause the loss of the Instrument Air System. Additionally a single fire cannot affect both Units Instrument Air Compressors as Instrument Air Compressor #1 is located at Elevation 592'-0" Column/Row C/37, its power supply 480V MCC 135 at Elevation 617'-0" Column/Row G/37 and its connecting power cables maintaining a separation of over 300 ft from Instrument Air Compressor #2 at Elevation 592'-0" Column/Row C/4, its power supply 480V MCC 235 at Column/Row G/4 and its connecting power cables.

A3.2 Pressure Control

As stated in Section A2.0 there are two modes of reducing primary system pressure for cooldown, the normal spray valves, and the auxiliary spray valve. The normal spray valves are the preferred means of pressure control but reactor coolant pump operation is required. As operation of the reactor coolant pumps also requires operation of several other systems this mode of control may not always be available and, therefore, the alternative method would be utilized.

The water for the auxiliary spray valve is supplied via the charging pumps, and as demonstrated by the Zion Safe Hot Shutdown Analysis one of these pumps will always be available in spite of a fire anywhere in the plant. The auxiliary spray valve, VC-8146, is a diaphram type valve whose operation could be affected by a fire. After the fire is extinguished, however, this valve can be jacked open if necessary and spray controlled by starting and stopping the charging pump. Both Unit 1 and Unit 2 have identical systems.

A3.3 Reactivity Control

As discussed in Section A2.0 boration to cold shutdown boron concentrations may be accomplished by any one of three modes. The method involving supplying water from the Reactor Water Storage Tank via the charging pumps or the safety injection pumps is always available as shown in the Zion Hot Safe Shutdown Analysis. The equipment needed for the other two modes via the Boric Acid Tank mode or the Boron Injection Tank mode is listed in Tables A3-3 and A3-4 for Unit 1 and 2 respectively. The only fire zone containing equipment for both of these modes is fire zone 11.4-0. A separation distance of approximately 100 feet exists for both Units between the two modes in this fire zone which is adequate to prevent both modes from being affected by the same fire. Therefore, at least two modes of boration are always available for both Units in the event of a fire which requires the plant to be brought to a cold shutdown condition.

A3.4 Instrumentation

Table A3-5 lists the instrumentation to be utilized to monitor the progress of safe cold shutdown of the reactor. At present adequate separation does not exist to insure against the loss of all instrumentation for these parameters in the event of a fire. In order to provide this protection local instrumentation will be installed for these parameters.

Table A3-1

Residual Heat Removal Cooling Equipment List (Unit 1)

A Loop Equipment

Nomenclature	Number	Elevation (Feet)	Column/Row	Fire Area/Zone	Comments
RHR Pump 1A	1RH001-1A	542'-0"	21/L	11.1A-1	
RHR Pump 1A Cubicle Unit Cooler	1AV001	542'-0"	21/L	11.1A-1	
RHR Heat Exchanger 1A	1RH003-1A	560'-0"	20-21/L	11.2C-1	
Pump 1A Suction Isolation Valve	1MOV-RH8700A	542'-0"	21-23/L	11.1A-1	NO/O
Heat Exchanger 1A Discharge Valve	1RH-HCV606	542'-0"	20-21/L	11.1-0	NO/O Fail Open
Heat Exchanger Bypass Valve	1RH-8726A	542'-0"	20-21/L	11.1-0	NC/O
Cold Leg Injection Isolation Valve	1MOV-SI8809A	592'-0"	23-25/P-R	11.4-0	NO/O
RHR Hx Component Cooling Side Discharge Valve	1MOV-9412A	560'-0"	20-21/K-L	11.2C-1	NC/O

Table A3-1 (Cont'd)

B Loop Equipment

Nomenclature	Number	Elevation (Feet)	Column/Row	Fire Area/Zone	Comments
RHR Pump 1B	1RH002-1B	542'-0"	21/M	11.1B-1	
RHR Pump 1B Cubicle Unit Cooler	1AV002	542'-0"	21/M	11.1B-1	
RHR Heat Exchanger 1B	1RH004-1B	560'-0"	20-21/M	11.2D-1	
Pump 1B Suction Isolation Valve	1MOV-RH8700B	542'-0"	21-23/M	11.1-0	NO/O
Heat Exchanger 1B Discharge Valve	1RH-HCV607	542'-0"	20-21/M	11.1-0	NC/O Fail Open
Heat Exchanger 1B Bypass Valve	1RH-8726B	542'-0"	20-21/M	11.1-0	NC/O
Cold Leg Injection Isolation Valve	1MOV-SI8809B	592'-0"	23-25/P-R	11.4-0	NO/O
RHR Hx Component Cooling Side Discharge Valve	1MOV-9412B	560'-0"	20-21/K-L	11.2D-1	NC/O
Shared Equipment					
Pump Suction Containment Isolation Valves	1MOV-RH8701	568'-0"	Z5	1.2-1	NC/O
	1MOV-RH8702	568'-0"	Z7	1.3-1	NC/O
Heat Exchanger Bypass Valve	1RH-HCV618	542'-0"	20-21/M	11.1-0	NC/O Fail Open

Table A3-2

Residual Heat Removal Cooling Equipment List (Unit 2)

A Loop Equipment

Nomenclature	Number	Elevation (Feet)	Column/Row	Fire Area/Zone	Comments
RHR Pump 2A	2RH001-2A	542'-0"	18/L	11.1A-2	
RHR Pump 2A Cubicle Unit Cooler	2AV001	542'-0"	18/L	11.1A-2	
RHR Heat Exchanger 2A	2RH003-2A	560'-0"	19-20/L	11.2C-2	
Pump 2A Suction Isolation Valve	2MOV-RH8700A	542'-0"	19/L	11.1A-2	NO/O
Heat Exchanger 2A Discharge Valve	2RH-HCV606	542'-0"	20/L	11.1-0	NO/O Fail Open
Heat Exchanger Bypass Valve	2RH-8726A	542'-0"	19-20/L	11.1-0	NC/O
Cold Leg Injection Isolation Valve	2MOV-SI8809A	592'-0"	15-17/P-R	11.4-0	NO/O
RHR Hx Component Cooling Side Discharge Valve	2MOV-9412A	560'-0"	19-20/K-L	11.2C-2	NC/O

B Loop Equipment

Nomenclature	Number	Elevation (Feet)	Column/Row	Fire Area/Zone	Comments
RHR Pump 2B	2RH002-2B	542'-0"	18/M	11.1B-2	
RHR Pump 2B Cubicle Unit Cooler	2AV002	542'-0"	18/M	11.1B-2	

Table A3-2 (Cont'd)

B Loop Equipment

Nomenclature	Number	Elevation (Feet)	Column/Row	Fire Area/Zone	Comments
RHR Heat Exchanger 2B	2RH004-2B	542'-0"	19-20/M	11.2D-2	
Pump 2B Suction Isolation Valve	2MOV-8700B	542'-0"	17-19/M	11.1B-2	NO/O
Heat Exchanger 2B Discharge Valve	2RH-HCV607	542'-0"	19-20/M	11.1-0	NO/O Fail Open
Heat Exchanger 2B Bypass Valve	2RH-8726B	542'-0"	19-20/M	11.1-0	NC/O
Cold Leg Injection Isolation Valve	2MOV-SI-8809B	592'-0"	15-17/P-R	11.4-0	NO/O
RHR Hx Component Cooling Side Discharge Valve	2MOV-9412B	560'-0"	19-20/L-M	11.2D-2	NC/O

Shared Equipment

Nomenclature	Number	Elevation (Feet)	Column/Row	Fire Area/Zone	Comments
Pump Suction Containment Isolation Valves	2MOV-RH8701	568'-0"	Z30	1.2-2	NC/O
	2MOV-RH8702	568'-0"	Z28	1.3-2	NC/O
Heat Exchanger Bypass Valve	2RH-HCV618	542'-0"	19-20/M	11.1-0	NC/O

Table A3-3

Boron Addition Equipment (Unit 1)

Nomenclature	Number	Elevation (Feet)	Column/Row	Fire Area/Zone	Comments
Boric Acid Tank and Heaters	1VC022-0A	592'-0"	18/G	11.4-0	
	0VC022-0B	592'-0"	18-20/G	11.4-0	
Boric Acid Transfer Pumps	1VC023-1A	592'-0"	17-18/H	11.4-0	
	1VC024-1B	592'-0"	17-18/H	11.4-0	
Emergency Boration Valve	1MOV-VC8104	617'-0"	23/M	11.5-0	NC/O
Boron Injection Tank Mode					
Boron Injection Tank and Heaters	1SI002	592'-0"	23/R	11.4-0	
BIT Inlet Isolation Valves	1MOV-SI8803A	592'-0"	23/R	11.4-0	NC/O
	1MOV-SI8803B	592'-0"	23/R	11.4-0	NC/O
BIT Discharge Isolation Valves	1MOV-SI8801A	592'-0"	23/R	11.4-0	NC/O
	1MOV-SI8801B	592'-0"	23/R	11.4-0	NC/O

Table A3-4

Boron Addition Equipment (Unit 2)

Nomemclature	Number	Elevation (Feet)	Column/Row	Fire Area/Zone	Comments
		Boric Acid Tank Mode			
Boric Acid Tank and Heaters	2VC022-0C	592'-0"	20/H	11.4-0	
Boric Acid Transfer Pumps	2VC023-2A	592'-0"	17-18/H	11.4-0	
	2VC024-2B	592'-0"	17-18/H	11.4-0	
Emergency Boration Valve	2MOV-VC8104	617'-0"	17/M	11.5-0	NC/O
		Boron Injection Tank Mode			
Boron Injection Tank and heaters	2SI002	592'-0"	17/R	11.4-0	
BIT Inlet Isolation Valves	2MOV-SI8803A	592'-0"	17/R	11.4-0	NC/O
	2MOV-SI8803B	592'-0"	17/R	11.4-0	NC/O
BIT Discharge Isolation Valves	2MOV-SI8801A	592'-0"	17/R	11.4-0	NC/O
	2MOV-SI8801B	592'-0"	17/R	11.4-0	NC/O

Table A3-5

Cold Shutdown Instrumentation

Pressurizer Pressure

Reactor Coolant Temperature

RHR Temperature

RHR Flow

Charging Pump Flow

A4.0 Modifications

The following modifications are planned to ensure that a safe cold shutdown can be achieved:

1. Reroute power cables for one RHR pump and supporting Unit cooler for each Unit.
2. Install local instrumentation for the parameter listed in Table A3-5.

A5.0 CONCLUSIONS

The Zion 1 & 2 Fire Protection Safe Shutdown Analysis shows that with local control and manual valve operation, and temporary repairs (if needed), the plant has been designed with the capability for safe cold shutdown which will be independent of systems which are located within and which could be damaged by a postulated fire in any single plant fire area/zone. Therefore, this safe cold shutdown analysis together with the report Information Relevant to Fire Protection Systems and Programs Part 3, Zion Station Units 1 & 2, April 1977 (Fire Protection Report) and the subsequent Responses to NRC Site Visit Informal Positions, Questions and Enclosure 4 verify that an adequate balance of all three of the following fire protection defense-in-depth objectives has been achieved.

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 a considerable length of time, in spite of the fire prevention program and fire fighting activities, the plant can be shutdown safely.

The present operation of the plant will not jeopardize the health and safety of the public. Furthermore, the same operating margins provided by the present plant design and operating procedures will increase when the planned modifications described in Section 4.0 have been completed.

A6.0 REFERENCES

1. Information Relevant to Fire Protection Systems and Programs. Zion Nuclear Power Station Units 1 & 2 (Fire Protection Report) April, 1977.

2. Zion Station Final Safety Analysis Report.

3. Zion Station Safe Hot Shutdown Analysis.