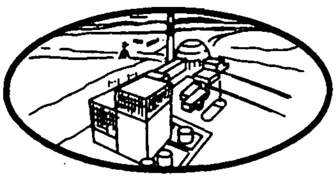
DRESDEN NUCLEAR POWER STATION

UNIT 3

PLANT DESIGN AND ANALYSIS REPORT

AMENDMENT 6



Commonwealth Edison Company

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Commonwealth Edison Company

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May 19, 1967

Dr. Peter A. Morris, Director
Division of Reactor Licensing
U. S. Atomic Energy Commission
Washington, D.C. 20545

In the Matter of the Application of Commonwealth Edison Company) Docket 50-249

Dear Sir:

Commonwealth Edison Company respectfully submits herewith Amendment No. 6 to the Plant Design and Analysis Report for Unit 3 at the Dresden Nuclear Power Station.

Said Amendment No. 6 proposes changes in the components of the core spray system and the plant electrical systems as originally proposed. The proposed changes in such systems will make them substantially similar, if not identical, to corresponding systems of the Quad-Cities Station Units 1 and 2 for which construction permits CPPR 23 and 24 were issued February 15, 1967, in Docket Nos. 50-254 and 50-265, respectively.

Very truly yours,

[signature]

Assistant to the President

Subscribed and sworn
to before me this 19th
day of May, 1967

[signature]
Notary Public

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I. INTRODUCTION AND SUMMARY

Amendment No. 5 to the Dresden Unit 3 Plant Design and Analysis Report (PDAR) was submitted to the AEC as part of Docket 50-249 on August 12, 1966. This amendment presents a description and evaluation of emergency core cooling provisions which were to be incorporated into the Dresden Unit 3 plant. Additional design data and performance requirements for these emergency cooling systems were presented in Amendment No. 4 to the Quad-Cities Units 1 and 2 Dockets (50-254 and 50-265) on November 25, 1966. Although this amendment was made as part of the Quad-Cities Proceedings, the information in the amendment was also made applicable, with some specific exceptions, to Dresden Unit 3 as well. Now, however, the objectives of this amendment are the elimination of one of the remaining differences between the Dresden Unit 3 and Quad-Cities Units 1 and 2 core spray systems and to present the change in the plant electrical system.

In spite of the similarity in design of Dresden Unit 3 and Quad-Cities Units 1 and 2, the core spray systems proposed for these plants differ in their design details. The design chronology of the Dresden plants preceded that of the Quad-Cities plants, which resulted in each of the Dresden core spray systems having two independent full capacity systems; however, each system was to have redundancy of pumps and active valves. In contrast, the more recent Quad-Cities plant design utilizes only two independent full capacity systems without redundancy of pumps and active valves; but a Low Pressure Coolant Injection (LPCI) system was provided as a backup to the core spray systems.

A similar LPCI system has been subsequently incorporated into the Dresden 3 design as a result of Quad-Cities Amendment No. 4. Thus, this addition of the LPCI to Dresden Unit 3 functionally supplants the stringent redundant pump and valve requirements in the redundant core spray systems of the earlier Dresden Unit 3 design. Therefore, it is the purpose of this amendment to conform the design of the Dresden Unit 3 core spray system to that of Quad-Cities Units 1 and 2 and provide revised pages of the text describing the Plant Electrical System, Section VII. Table I summarizes the similarities between Dresden Unit 3 and the Quad-Cities Units 1 and 2 emergency core cooling systems as a result of this amendment.

II. CHANGE IN CORE SPRAY SYSTEM

A. DESIGN BASES OF CORE SPRAY

The following design bases are identical to those which have been adopted for the core spray systems of Quad-Cities Units 1 and 2; therefore, the same bases are adopted by this amendment for the core spray systems of Dresden Unit-3.

1. The core spray systems are provided to prevent any fuel clad melting as a result of the various postulated but improbable loss of primary coolant accidents over a range of failure sizes; from those for which adequate protection is offered by the high pressure coolant injection system up to and including the design basis accident - the instantaneous mechanical failure of a size equal to the largest primary system pipe.

2. The core spray systems are provided in such a manner as to have two independent full capacity systems.

3. Either of the two independent core spray systems shall meet the above design basis requirements without reliance on external power supplies to the core spray or the reactor system.

4. The core spray systems are designed so that each component of the system can be tested periodically.

TABLE I

SUMMARY OF PROVISIONS FOR EMERGENCY CORE COOLING
COMPARISON OF
DRESDEN UNIT-3 AND QUAD CITIES UNITS 1 AND 2

1. Loss of Normal Auxiliary Power

	Provision		
Dresden-3	Isolation Condenser	or	HPCI
Quad Cities 1 and 2	RCIC	or	HPCI

2. Small Line Break Only (No Loss of Normal Aux. Power)

	Provision		
Dresden-3	Feedwater Pumps	or	HPCI
Quad Cities 1 and 2	Feedwater Pumps	or	HPCI

3. Large Line Break Only (No Loss of Normal Aux. Power)

	Provision
Dresden-3	2 Core Spray & LPCI
Quad Cities 1 and 2	2 Core Spray & LPCI

4. Small Line Break Plus Loss of Normal Aux. Power (Standby Diesel Avail.)

	Provision	Backup
Dresden-3	HPCI & Core Spray and/or LPCI	Auto. Press. Relief & Core Spray and/or LPCI
Quad Cities 1 and 2	HPCI & Core Spray and/or LPCI	Auto. Press. Relief & Core Spray and/or LPCI

5. Large Line Break Plus Loss of Normal Aux. Power (Standby Diesel Avail.)

	Provision	Backup
Dresden-3	1 Core Spray & LPCI	2nd Core Spray
Quad Cities 1 and 2	1 Core Spray & LPCI	2nd Core Spray

6. Post Accident Recovery

	Provision
Dresden-3	Standby Coolant Supply System
Quad Cities 1 and 2	Standby Coolant Supply System

NOTE:

Sensible heat is removed from the primary containment by operation of the low pressure coolant injection system.

RCIC = Reactor Core Isolation Cooling System

HPCI = High Pressure Coolant Injection System

LPCI = Low Pressure Coolant Injection System; on Dresden-3 this system is not shared with another reactor

Core spray systems of Dresden-3 and Quad-Cities 1 and 2 to be similar to one another and include two independent full capacity spray systems per reactor.

B. DESCRIPTION OF CORE SPRAY SYSTEM

The core spray systems to be provided for Dresden Unit-3 will be identical in design concept and performance to the core spray systems, incorporated in the Quad-Cities Units 1 and 2. Two independent full capacity core spray systems are provided to each reactor. Each system consists of a pump, piping, valves, instrumentation and a spray ring header. Each of the two core spray systems is designed to pump water directly from the suppression pool into the reactor vessel. The piping and instrument diagram for the systems is shown in Figure I. The capacity of each of these systems is sufficient to provide core cooling and prevent fuel clad melting under the loss of coolant conditions which might result from large pipe breaks and reactor vessel depressurization.

The design flow capacity of the pump in each core spray system is approximately 4700 gpm at a total delivered pump head of 230 psig; the power required for each pump is approximately 860 HP. The water source for the pump suction is the 800,000 gallon suppression pool. The other core spray system equipment specifications are shown in Table II.

Each core spray system supplies water to a spray ring header located inside the core shroud of the reactor vessel directly above the core. Water is sprayed directly onto the top of fuel assemblies in a pre-established pattern through approximately 130 spray nozzles mounted on the spray ring header. The required flow rate was based upon prototype testing of a full scale fuel assembly under actual power conditions, using the actual core spray distribution. To verify that the test conditions did indeed simulate the most limiting situation, the test fuel rods were allowed to overheat (1250°F) prior to core spray activation. In addition, the channel boxes were allowed to stay at high temperature. Each core spray system has been sized to provide at least the minimum required flow rate to each fuel assembly in the core. Flow distribution in the upper plenum as well as leakage flow available to fuel rods were accounted for in determining the core spray flow requirements.

The piping of each core spray system is fabricated of carbon steel from the suppression chamber to the outer isolation valve. Safety valves are utilized for pressure protection of this section of the system. From the outer isolation valve into the reactor, the system is fabricated of stainless steel and designed for service at 1,250 psig and 575°F. The spray ring header and nozzles are fabricated from 304 stainless steel to ASME, Section III Code. The core structure supporting the spray ring header is also fabricated of 304 stainless steel material. The vessel nozzle entry material is Ni-Cr-Mo forging fabricated to ASME SA336 and modified by ASME Code Case 1332.

The piping of the core spray system inside the reactor vessel connects each spray ring header to a reactor pressure vessel penetration. This piping is designed and located to meet the necessary thermal expansion requirements and to accommodate vessel movement from postulated accidents. The pipe runs of each system are physically separated, and are located to take maximum advantage of the protection afforded by structural beams and columns. Drywell penetrations for the core spray pipes are located to achieve minimum length pipe runs within the drywell and to provide maximum circumferential distance between main steam and feedwater lines.

The core spray pumps and motors are located in the lowest level of the reactor building. The maximum ambient environment under accident condition to be 150°F at a relative humidity of 100%. Each system is physically separated by locating pumps in different corners of the reactor building. Pump suction is provided from the pressure suppression pool by a common ring header which has four stainless steel screened suction

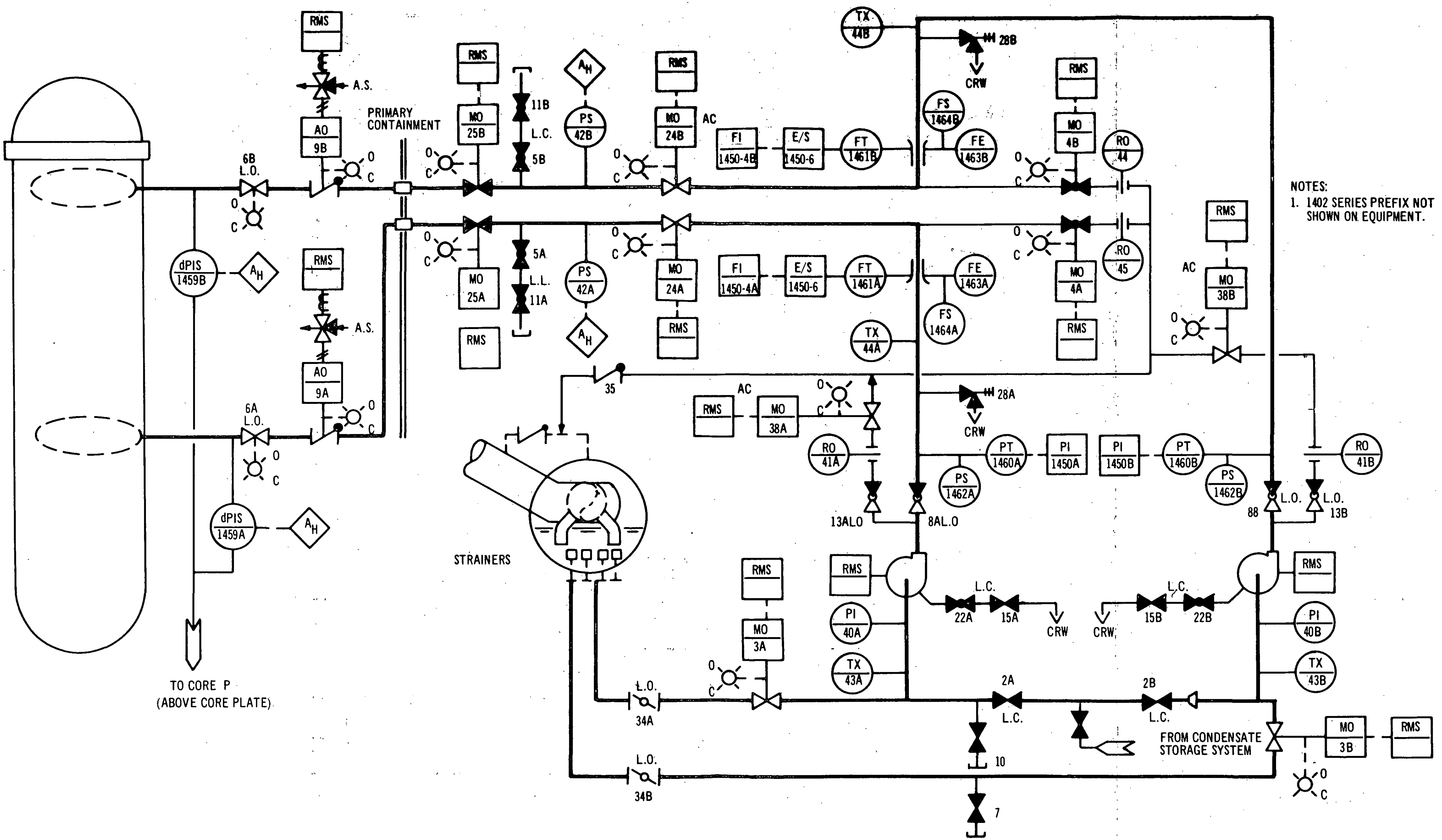

Figure I. Core Spray System

lines. These screens are positioned above the bottom of the suppression pool but are well below the pool surface to minimize the risk of plugging the screens with debris. Sufficient system flow area is available (with one completely plugged suction screen) to meet the combined requirements for the use of the core spray systems, the LPCI system and the High Pressure Coolant Injection System. Screen size (1/8" openings) has been selected to eliminate entry of particles capable of plugging the smallest spray nozzles.

The power for each core spray system is provided from a separate emergency bus. Power for this emergency bus is supplied from the auxiliary power transformer or the standby diesel generator. The control system is arranged to provide two independent and separately isolated control and power circuits for operation of the two independent core spray systems. The core spray systems are automatically actuated by the reactor protection system from a low water level signal in the reactor vessel. The core spray systems can also be manually actuated from the control room and each core spray system can be tested during reactor operation.

TABLE II

CORE SPRAY EQUIPMENT SPECIFICATIONS
FOR
TWO-FULL CAPACITY SYSTEMS

Pumps	
Number	2 (only 1 required to meet design basis of no fuel clad melt)
Type	Single stage - vertical - centrifugal
Speed	3600 rpm
Seals	Mechanical
Drive	Electric motor
Power Source	Normal auxiliary or standby diesel
Pump casing	Cast steel
Impeller	Bronze
Shaft	Stainless Steel
Code	ASME Section III B
Flow	4700 gpm
Head	580 feet
Power	860 hp
NPSH (Available)	34 feet
Spray Ring Headers	
Number	2
Number of nozzles	130 per header (approximately)
Type of nozzles	1-inch Fulljet - Stainless Steel
Piping	
Code	ASA B31.1

C. OPERATIONAL SEQUENCE

1. Plant on Standby AC Power

Initiation of the core spray systems occurs from reactor low-water level signal or manual actuation. Low reactor water level is detected by four independent level sensing switches connected in a one out of two-twice logic array. The same low water level signal also initiates startup of the standby diesel generator.

A low-water level signal starts the core spray pump in each system and provides one-of-two permissive signals to the startup valves MO-25-A and MO-25-B (see Figure I). These valves actually open only after reactor pressure decays below pump discharge pressure, at which time the second permissive signal occurs to open the startup valves. A low pressure indication from either core spray system provides the necessary second permissive signal to open both startup valves. In the event a core spray system pump fails to deliver flow within 10 seconds after the valves start to open, the pump in the other full capacity core spray system will start automatically.

2. Plant on Normal Auxiliary AC Power

The core spray systems are initiated from a reactor low water level signal or manual activation, as above. However, instead of actuation of only one core spray system pump, the core spray pump in each system is started. Automatic opening of the startup valves is initiated in the same manner as above.

D. SURVEILLANCE AND TESTING

1. Components Testing

The core spray systems have been designed to permit performance testing of the individual components as follows:

a. Instrumentation

Plant operational test of each system.
Periodic system tests using test lines.

b. Valves

Plant pre-operational test of each system.
Periodic system tests using test lines.
Leak-off lines between isolation valves.
Drainline on pump side of outboard isolation valves.
Safety valves can be removed and tested for set point.
Motor-operated valves can be exercised independently.

c. Pumps

Plant pre-operational test of each system.
Periodic system tests using test lines.
Pump seal leakage is monitored.

d. Core Spray Ring Header

Plant pre-operational test of each system.

e. Spray Nozzles

Plant pre-operational test of each system.

f. Safety Valves

Can be removed and tested for set point.

g. Screens

Plant pre-operational test of each system.
Periodic system test using test lines.
Pressure indicator at pump suction during above tests.

2. Core Spray System Testing

Each core spray system may be tested individually during reactor operation as follows:

a. When a system is to be tested, the other system is placed on auto-start by the system selector switch.

b. The pump of the system under test may be started by its manual control switch. The test bypass valve is opened to allow the pump to be tested at full flow. Flow and pressure instrumentation is observed for correct response and the system outside the drywell may be checked for leaks.

3. Valve Operation Checks

The startup valves and the testable, check-isolation valves may be tested independently of the pump and flow test. The following is an example of the test procedure for one system; the other system may be tested in a similar manner.

a. Maintenance valve 24A is closed by the control switch. Limit switches on the maintenance valve act as a permissive to open startup valve 25A. The latter valve may then be exercised open and closed by manual actuation of the control switch.

b. With the startup valve fully closed, the maintenance valve must be reopened at the end of the test.

c. The check valve No. AO-9A may be stroked open and closed by manual actuation of the control switches.

In the event that a low water level signal occurs during a system test, the system not under test will start automatically. The system being tested will return automatically to standby readiness.

4. Continuous Surveillance

Pressure differential between each system piping inside the vessel and an internal reference pressure will be continuously monitored during power operation. Changes in these pressure readings will provide indication of loss of integrity of piping within the reactor vessel. The pipes, pumps, valves, and other working components outside of the primary containment of both systems can be visually inspected at any time.

E. CORE SPRAY SYSTEM AVAILABILITY

Availability models for several possible arrangements of core spray equipment were presented in Amendment No. 3 Quad-Cities Dockets (50-254 and 50-265). Because the Dresden Unit-3 core spray systems will conform in design and function to the Quad-Cities Units 1 and 2 core spray systems, the respective availabilities of these systems are identical. The relevant availability analysis for these systems is shown in Appendix II of Amendment No. 3 to Quad-Cities Units 1 and 2. This analysis was based upon the assumption that each core spray system consists of two separate piping systems, with one pump per system and power only available from the standby diesel generator.

III. CHANGE IN PLANT ELECTRICAL SYSTEM

It is proposed to amend the description of the electrical system set forth in the PDAR for Dresden Unit-3 to reflect the deletion of the 34.5 kv transmission line and transformer as originally provided.

Initially one standby diesel generator for Dresden Unit-3 was adequate to provide the required A-C power for core cooling systems and auxiliary facilities originally proposed; as an alternate or backup source of electric power, a special 34.5 kv transmission line and transformer installation was to be provided.

Subsequent revisions and additions to the design of the emergency core cooling systems for Dresden Unit-3 resulted in a substantial increase in electrical power requirements. To meet these greater electric power requirements it was proposed in Amendment No. 5 to provide three diesel generators to be shared by Dresden Units 2 and 3, each of which is larger in capacity than the single diesel generator originally proposed. The capacity of each diesel generator is sized to provide all power requirements for emergency core cooling. Since the 34.5 kv transmission line and transformer installation would not have the capacity to serve as an alternate source of power for any of the three larger diesel generators, the provisions of such 34.5 kv transmission line and transformer installation would serve no useful purpose. Accordingly it is proposed that such installation be deleted.

Revised pages of Section VII of the Dresden Unit-3 PDAR reflecting this deletion are attached.