

FINAL REPORT  
ON  
LOWER PUMP CUBICLES  
AT  
BEAVER VALLEY POWER STATION-UNIT NO. 2

1.0 SUMMARY

On review of structural design calculations for the Lower Pump Cubicles (LPC), the design was found to be inadequate when all loading conditions are considered.

2.0 IMMEDIATE ACTION TAKEN

All construction work in the Lower Pump Cubicles was stopped immediately following initial review of the structural design calculations and a more detailed review of the calculations was undertaken to determine the implications of the inadequate design. The Nuclear Regulatory Commission was informed of the deficiency by telephone on August 24, 1978.

3.0 DEFICIENCY

The Lower Pump Cubicles (LPC) structure is an underground structure adjacent to the Reactor Containment and connected to it at the foundation. It is shaped to fit in the annular area between the Reactor Containment and the Reactor Containment Cofferdam over about 60 degrees of arc. It extends from elevation 686 ft. 7 1/2 in. up to elevation 701 ft. 5 in. with reinforced concrete access shafts and steel pump casings continuing up thru

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the foundation of the Safeguards Building at el. 718 ft. 6 in. The LPC foundation, which is 1 ft. 2 1/2 in. thick, is connected to the Reactor Containment foundation mat. The inner circumferential wall is the 4 ft. 6 in. thick wall of the Reactor Containment and the outer wall is reinforced concrete 12 in. thick. The end walls and radial interior walls are reinforced concrete 2 ft. 0 in. and 2 ft. 2 in. thick respectively. The roof is presently designed as a reinforced concrete slab 12 in. thick with integral beams 4 ft. 0 in. deep oriented circumferentially and 2 ft. 6 in. deep oriented radially. The LPC is enclosed within the waterproof membrane which surrounds the Reactor Containment. Structural elements of the LPC adjacent to the Reactor Containment wall are separated from it sufficiently to allow unrestricted growth of the Reactor Containment wall under internal pressure loading.

Equipment located within the LPC includes the lower portion of the recirculation spray pumps, recirculation spray piping, recirculation drain pumps and recirculation drain piping.

An initial review of structural design calculations for the LPC, in response to a construction request to modify concrete reinforcing details for ease of construction revealed that:

1. The load combinations considered did not include the combination that results in the most severe effect on the structure, and

2. Documentation for the seismic loads that were applied was incomplete.

Subsequent in-depth review of the calculations indicated that the Reactor Containment Cofferdam had been assumed to be a qualified Q/A Category I portion of the permanent plant, with the result that lateral soil pressure was not assumed to act against the outside wall of the cubicles. This was an invalid assumption.

The LPC is seismic Category I and as such must be designed to withstand seismic loadings in accordance with PSAR subsection 15.2.4. Because the entire structure is located underground, tornado loading is not considered applicable. The LPC is designed to withstand the Probable Maximum Flood (PSAR Subsection 15.2.5).

The concrete design of the LPC using the ultimate strength design method will be in accordance with PSAR Subsection 15.2.4.1.

#### 4.0 ANALYSIS OF SAFETY IMPLICATIONS

The subsequent detailed review of the design calculations revealed that they were not in accordance with the above PSAR requirements which are implemented by the Structural Design Criteria 2BVM-5. If the correct loads and loading combinations

had been used, the LPC vertical outside walls, roof and radial interior walls would have been stressed beyond allowable limits under one or more of the above referenced load combinations.

Although the mechanism of possible structural collapse has not been evaluated, it is assumed that such a failure could have occurred. This could possibly damage the recirculation spray pumps and/or piping thus impairing the ability of the plant to mitigate the effects of certain accidents.

#### 5.0 CORRECTIVE ACTION TO REMEDY DIFICIENCY

The Lower Pump Cubicles will be redesigned to meet the PSAR criteria taking into account the applicable loads.

Concrete placement in the LPC had progressed to el. 697 ft. 5 in. when construction was stopped. The unconstructed portions of the structure will be redesigned to the correct criteria and previously constructed elements will be supported as required to meet the design requirements.