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Consumers Power Company

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January 14, 1972

Dr. Peter A. Morris, Director
Division of Reactor Licensing
United States Atomic Energy Commission
Washington, DC 20545

Re: Docket 50-255
License No DPR-20

Dear Dr. Morris:

This letter is written to apprise you of a failure of a two-inch, motor-operated valve on the high-pressure safety injection (HPSI) system at the Palisades Plant.

On January 5, 1972, the time the difficulty was detected, the plant was in a cold shutdown condition. Maintenance activities were being completed so that plant heatup could begin later the same day. These maintenance activities included the repair of a flow transmitter for a flow indicator (FI-0313) that is common to the discharge of HPSI valve CV-3013 and its redundant HPSI valve CV-3062. After completion of this repair to the flow transmitter, tests were performed on this portion of the HPSI system, following an approved test procedure. When CV-3013 was opened, no flow indication was received. The redundant injection valve (CV-3062) was opened and the flow indicator worked properly. To verify proper valve lineup to the HPSI header, another valve was opened and its flow indicator indicated flow. It was concluded that HPSI valve CV-3013 was inoperable and plans for heatup of the primary system postponed until the cause of the problem with the valve could be determined and the valve repaired.

Preliminary investigations revealed that the motor operator for the valve was operating normally. In addition, the valve stem travel indicated that the valve was opening and closing normally. Radiographs were taken of the valve in the open position. These radiographs revealed that the valve plug (disc) had broken. It appeared that the lower portion of the plug was in the valve body seat and the upper portion was attached to the stem.

The valve was disassembled. Removal of the stem confirmed that the upper portion of the plug was attached to the stem while the lower portion of the plug remained in the seat in the valve body. A small hole

RPZ - 1/19
JH - 1/20
HH - 1/20
RH
RL - 2/1
DW - 2/1
VT - 2/7
ZH - 2/21

Incident (11)

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was drilled in the valve body below the valve seat. A small rod was inserted through the hole such that the remaining portion of the plug could be pushed out the top of the valve body. The plug came out easily.

The valve is a two-inch, motor-operated, bonnetless globe valve. The valve body material is stainless steel, Grade F-316. The valve plug is made from a Stellite 6B casting. The plug has a "T"-shaped slot at the top which slips over the end of the valve stem so that it can be withdrawn by the stem when opening the valve. There are two cylindrical guiding surfaces, one at the top of the plug and the second near the middle of the valve just above the seating surface. The middle guide tapers at about 45 degrees to a smaller diameter above the seating surface. Below the seating surface, the plug is hollow. The outer surface of the hollowed portion of the plug is tapered slightly and has four narrow axial slots for flow throttling purposes.

Examination of the removed valve plug revealed that the valve failed after closing on an object which had become trapped between the taper of the valve plug's lower guide (above the plug seating surface) and the valve body. This object was wedged under the plug's guiding surface at the end of the "T"-shaped slot. The valve closing force was thus concentrated in a small area of the brittle Stellite material which was unsupported from above because it was beneath the open end of the "T" slot. The result was the cracking of the plug at the junction of the 45-degree bevel of the lower guide and the plug surface above the seating surface. Eventually there was some spalling of plug material from the lower guide at the bottom surface of the slot above. It was concluded from the impression on the plug that the object that caused the initial cracking was small, probably about 1/8-inch in diameter. As about three quarters of the fracture surface area of the cracked plug had accumulated a red oxide deposition, it was concluded that the initial damage had been present for some time, probably since pre-core loading hot-functional testing or flushing operations. The valve appeared to have operated a number of times in this condition. Ultimately, some object (probably pieces spalled from the plug) became trapped between the seating surfaces of the valve, causing tension and bending forces again to be applied to the valve plug. At this closing cycle or the next opening cycle, the remainder of the material cracked. About one fourth of the surface area of the crack appeared very fresh (no red oxide deposition).

Several small pieces of spalled material from the valve plug were found in the valve body. Marks were found on both the valve plug seating surface and the valve body seating surface. These pieces of material were removed.

The hole that had been drilled through the bottom of the valve body was repaired by tapping the valve body and inserting a threaded plug of stainless steel 316 material in the hole. This threaded plug was seal-welded and the seal weld was dye-penetrant tested. This repair was approved by the valve manufacturer's design engineer. (Check valves

used at the Palisades Plant in a similar service have a seal-welded threaded plug inserted in the lower portion of the valve body in an identical manner. The lower portion of the check valve bodies are identical to the lower body of this two-inch HPSI valve.)

The new valve plug (disc) was radiographed prior to its installation. No defects were present in this plug. The remaining three identical two-inch HPSI valves and the four identical redundant HPSI valves were radiographed as assembled. No defects were detected. In addition, all eight HPSI valves were test-operated and it was verified that flow was established through each of these eight valves.

It was concluded from the differences in deposition of red oxide material on the fracture surface of the plug that the initial failure had occurred sometime ago, most likely during the pre-core loading hot-functional testing or flushing operations. The foreign object was probably either removed from the system during the reactor vessel cleanout prior to core loading or has settled into area piping where flow is very low. From the impression on the lower guide of the valve plug, we have concluded that this object must have been very small, probably about 1/8-inch diameter. In addition, the valve configuration precludes any object of greater size than about 1/4-inch diameter and 1-1/2 inches long from passing through the valve.

The valve plug was reconstructed to insure that all of the spalled material was accounted for. This reconstruction revealed that several very small chips of the valve plug were missing. These pieces were sufficiently small and light so that there are no concerns about cladding wear if they did reach the reactor vessel.

There is no danger of this foreign material reaching the control rod drive mechanisms. The control rod drive mechanisms are mounted vertically on top of the reactor vessel head; therefore, this material will not settle into them. A moderately strong flow would be required to move this material; no such flow exists through the control rod drive mechanisms. In addition, these chips are sufficiently small such that they probably would not cause a malfunction of a control rod drive mechanism even if they were to get into this mechanism.

The effects of plant operation with a similar valve failure have been considered. Sufficient flow indication is available to detect a failure of this nature in the HPSI system. Plant procedures require the operators to verify flow conditions if the HPSI system is actuated. In the event of failure to attain flow through one of these valves, the operator can initiate flow through the redundant HPSI system.

To insure that the plant is not operated with an unknown failure existing in one of these valves, a testing program has been established. This testing program consists of:

(1) Prior to plant start-up from a cold shutdown condition, HPSI system valves CV-3007, -3009, -3011 and -3013 and redundant HPSI system valves CV-3062, -3064, -3066 and -3068 will be test-operated. Flow through these valves will be established and verified.

(2) The same testing as in (1) above will be conducted on a monthly basis during plant operation.

If these tests reveal a failure of an HPSI valve, the appropriate technical specification limits will be followed.

From our review of this valve failure, we have concluded that this incident does not involve an unreviewed item with regard to reactor plant safety considerations. The cause of the failure of this valve has been determined and the valve has been repaired. In the unlikely event that a similar failure were to recur, a testing program has been established that will insure prompt detection of a valve failure.

Yours very truly,

Ralph B. Sewell (Signed)

RBS/map

Ralph B. Sewell
Nuclear Licensing Administrator

CC: Boyce H. Grier
USAEC