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September 25, 1973

Mr. Angelo Giambusso
Deputy Director for
Reactor Projects
Directorate of Licensing
Office of Regulation
U.S. Atomic Energy Commission
Washington, D.C. 20545

Subject: Supplement B to Special Report No. 18
for Dresden Unit 2/3 - AEC Dkts 50-237 and 50-249

Dear Mr. Giambusso:

Attached is Supplement B to Special Report No. 18 for Dresden Station, entitled, "Dresden 2/3 Safety Valve Investigation." This report describes the final results of the testing programs undertaken to investigate safety valve phenomena at Dresden Station. The report also discusses alternate corrective measures which we are evaluating for each of the identified contributing phenomena. It is expected that final corrective measures will be defined by January, 1974. If you request, these measures will be reported to you as a further supplement to this special report. If not, they will be reported following normal procedures for plant modifications.

If you have any questions or comments we will be pleased to meet with you to discuss this report.

One signed original and 39 copies of this report are provided for your use.

Very truly yours,

J. S. Abel
Nuclear Licensing Administrator -
Boiling Water Reactors

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DRESDEN STATION

Supplement B to Special Report No. 18

Dresden 2/3 Safety Valve Investigation

COMMONWEALTH EDISON COMPANY

September, 1973

The following information outlines the current status of the investigations undertaken to determine the cause(s) of premature safety valve actuation. As indicated in Supplement A to Special Report No. 18, "Dresden 2/3 Safety Valve Investigation," seven sources or mechanisms of premature safety valve actuation were identified as follows:

1. Safety Valve spring relaxation due to temperature effects.

2. Mechanical shock effects on safety valve operation due to electromatic relief valve actuations.

3. Pressure pulse effects on safety valve operation due to electromatic relief valve actuations.

4. Safety valve spindle and spring washer design effects on valve operation.

5. Safety valve body temperature effects on valve operation.

6. Safety valve alignment effects on valve operation.

7. Safety valve nozzle seat distortion effects on valve operation.

Following is a discussion of the action taken to eliminate these mechanisms as a source of premature safety valve actuation.

Elimination of Temperature Effects on Spring Relaxation (Mechanism 1)

It has been definitely established that the safety valve springs do relax under service conditions. As indicated in Supplement A to Special Report No. 18, tests were being conducted by Wyle Laboratories and have since been completed. Results reported have indicated drops in set point pressure of up to 81 psi due to temperature effects. The solution to this problem requires two steps:

1. The safety valves should be set on a steam test stand with an environmental temperature equal to that in service. The valve should be allowed to reach thermal equilibrium before the setting of the valve is attempted. If this procedure is followed, it can be expected that the safety valve will lift at about 1% higher pressure initially when it is put in service but will "pop" as set after 20 hours when equilibrium

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is achieved. The spring modulus variation and valve body dimension changes (Mechanism %) due to temperature effects will be eliminated as a cause of premature actuation when the safety valve test facility currently under construction at Dresden is utilized in setting safety valves. This facility is expected operational by November, 1973.

2. The insulation on all safety valves above the bottom flange which mates with the main steam line spindle should be removed so that the spring temperature will not be above the ambient drywell temperatures. This has been done on the Quad-Cities and Dresden Units.

Elimination of the Mechanical Shock and Pressure Pulse Effects (Mechanism 2 & 3)

Since it has been proven that operation of an electromatic valve on the same main steam line as a safety valve has a potential for prematurely actuating the safety valve, the two most plausible solutions are:

1. Pipe the safety valve discharge to the torus, or

2. relocate the electromatic relief valves and safety valves so that electromatics and safeties are not on the same main steam line. Thus the safety valve discharge would either be controlled or isolated from the mechanical shock and pressure pulse effects of electromatic relief valve operation.

The following preliminary design work has been initiated to determine the practibility of routing the safety valve discharge to the torus:

a. Capability of the torus to structurally and thermally handle the safety valve discharge.

b. The effect on reactor peak pressure of piping the safety valve discharge to the torus.

c. The feasibility and optimum routing for piping the safety valve discharged to the torus.

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Elimination of Spindle and Spring Washer Effects and Valve Alignment Effects (Mechanism 4 & 6)

The postulated mechanisms for reduction of safety valve popping point due to the safety valve alignment problems and spindle and spring washer effects can be negated by a redesign of these components. The redesign might involve the following.

A. Upper Spring Washer

The connection between the upper spring washer and the spring compression nut is not adequate to resist the eccentric load applied by the safety valve spring without tilting. The compression nut can be increased in diameter so that the eccentric load applied by the spring to the upper spring washer can be resisted without tilting of the upper spring washer. (See Figure 1)

B. Lower Spring Washer

The connection between the lower spring washer and the safety valve spindle is a spherical surface whose purpose is to permit the lower washer to tilt to accommodate the eccentric load that the spring exerts on the washer. This tilt capability is believed to be responsible for the alignment problem. Briefly stated, this design feature can be postulated to allow tilt angle changes when the valve is subjected to shaking forces. Tilting of the washer to a different degree relative to the tilt angle when the valve was set can result in variations in pop point since the tilting causes variations in the compressed length of the spring. One solution to this problem would be to make the lower spring washer and the spindle an integral component of the valve thus eliminating the tilt capability and the problems which appear to be associated with it. (See Figure 2)

C. Safety Valve Spindle

The safety valve spindle is subjected to a large entire load from the safety valve spring which tends to bend it at the stress concentration where the lower spring washer rests on the spindle. The spindle is also subjected to high bending loads due to inertial loads that the spring exerts on the spindle when the valve is accelerated. This bending load is also concentrated on the region where the lower spring washer rests on the spindle. A possible redesign to eliminate the bent spindles would be to increase the spindle diameter to

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account for these loads and also to possibly change the spindle material to one with a higher yield point.

The redesign outlined in B & C above would mitigate and probably eliminate the value alignment problem also. This redesign appears as the only practical solution to the valve alignment effects since valves are presently being handled with the best care possible and handling does not appear to be improveable.

The safety valve manufacturer has indicated that he is evaluating corrective measures.

Elimination of the Valve Body Temperature Effects (Mechanism 5)

The solution here is the same as for the spring relaxation problem; remove the insulation from the safety valve and initially set the popping point on steam in an environmental temperature the same as experienced in the drywell, allowing the valve body to reach an equilibrium temperature before setting the pop point. Again, until the valve reaches equilibrium in the service condition it can be expected to have about a one percent higher popping point relative to the setpoint pressure.

Elimination of the Nozzle Seat Distortion Problem (Mechanism 7)

Because testing of the above hypotheses is not yet completed a final solution cannot be proposed. However, the following solutions may be relevant depending on the results of the test program currently in progress by Edison's Operational Analysis Department:

(a) To eliminate the thermal-stress-induced seat warpage, a different nozzle material (with a higher thermal conductivity) and/or a different nozzle configuration may be required.

(b) To eliminate the residual stress problem full annealing of the nozzle may be required.

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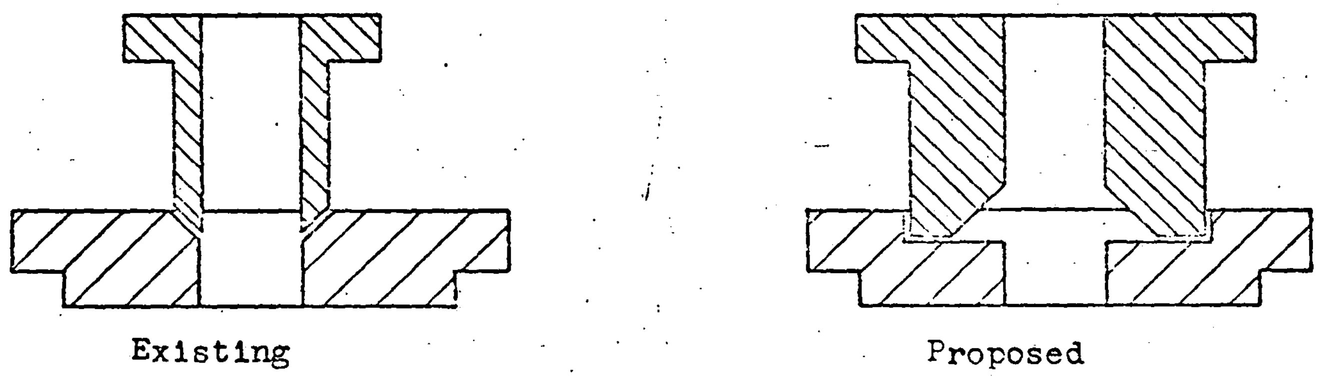

Figure 1   Proposed modification of the upper spring washer and compression nut.

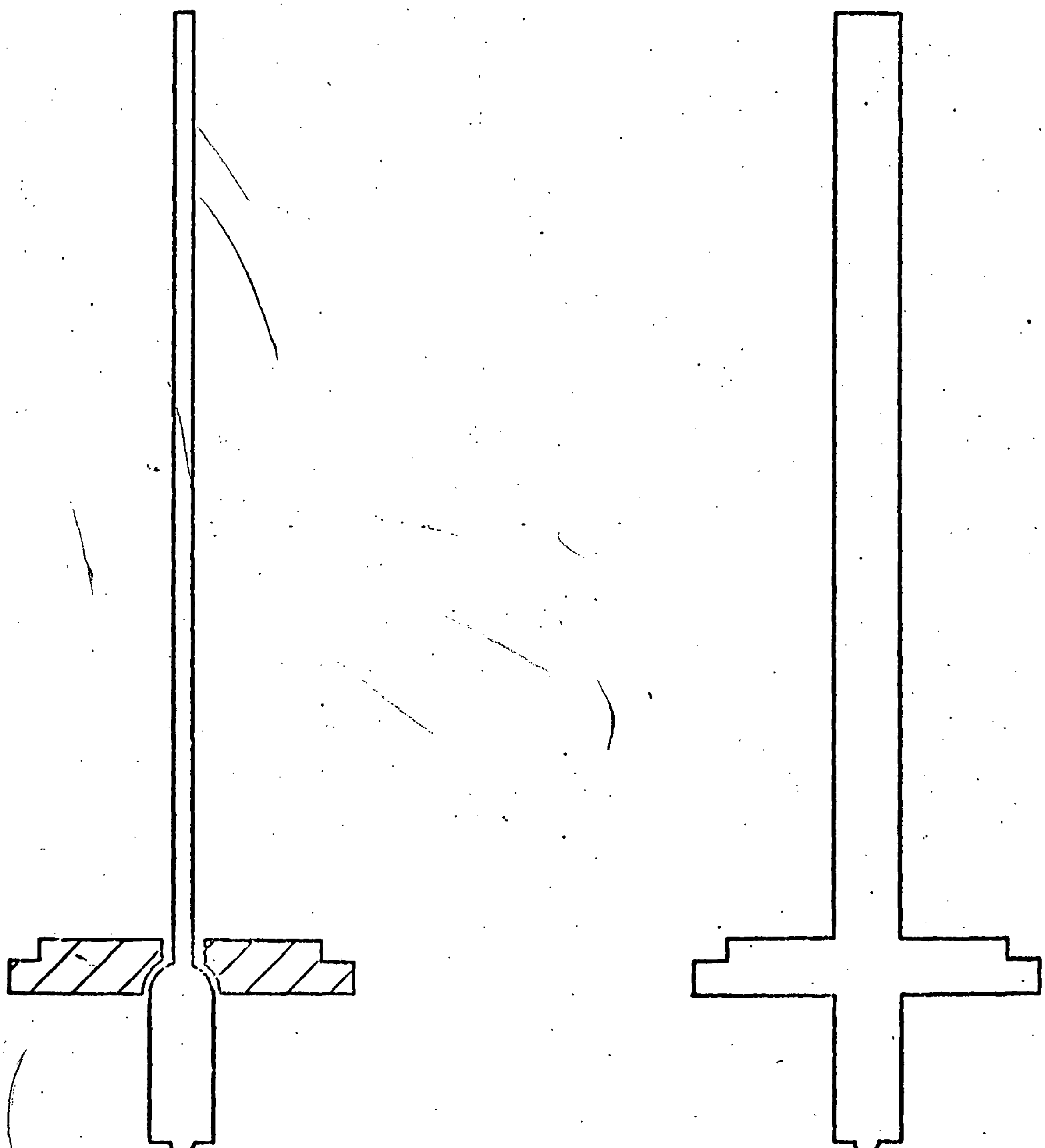

Figure 2: Proposed modification of the lower spring washer and spindle.

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