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Docket No. 50-334

Duquesne Light Company
ATTN: Mr. C. N. Dunn, Vice President
Operations Division
435 Sixth Avenue
Pittsburgh, Pennsylvania 15219

Gentlemen:

Enclosed is a signed original of an Order for Modification of License, dated September 30, 1977, issued by the Commission for the Beaver Valley Power Station Unit No. 1.

This Order amends Facility Operating License DPR-66. This Order provides the details of our authorization of interim plant modifications to assure adequate net positive suction head to the recirculation spray and low head safety injection pumps in the recirculation mode of operation following a postulated loss of coolant accident.

A copy of the Order is being filed with the Office of the Federal Register for publication.

Sincerely,

Original signed by M. Fairtile for

Robert W. Reid, Chief
Operating Reactors Branch #4
Division of Operating Reactors

Enclosure:
Order for Modification
of License

cc w/enclosure:
See next page

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Concur subject to changes discussed with J. Siegel

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Duquesne Light Company

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of DUQUESNE LIGHT COMPANY OHIO EDISON COMPANY PENNSYLVANIA POWER COMPANY (Beaver Valley Power Station Unit No. 1)	))))))))	Docket No. 50-334

ORDER FOR MODIFICATION OF LICENSE

I.

Duquesne Light Company (DLC), Ohio Edison Company, and Pennsylvania Power Company (the licensees), are the holders of Facility Operating License No. DPR-66 which authorizes the operation of a nuclear power reactor known as Beaver Valley Power Station, Unit No. 1 (the facility) at steady state reactor power levels not in excess of 2652 thermal megawatts (rated power). The facility is a pressurized water reactor (PWR) located at the licensees' site in Beaver County, Pennsylvania.

II.

As a result of the operating license review of the North Anna Power Station, it appeared that the net positive suction head (NPSH) available to the containment recirculation spray (RS) and low head safety injection (LHSI) pumps might be insufficient for the post loss-of-coolant accident (LOCA) operation of the RS and LHSI systems. The NRC staff review of this matter for the North Anna Power Station is

ongoing. Beaver Valley Power Station Unit No. 1 (BVPS-1) is an operating plant with a design similar to that at North Anna.

To determine whether a similar problem existed at BVPS-1, we requested DLC to meet with us on August 19, 1977. As a result of this meeting and subsequent conversations with DLC, it was determined that in the event of a major LOCA, the vapor pressure of the water in the containment sump supplying the RS and LHSI pumps may be closer to the containment pressure than previously indicated. This is due to a number of original assumptions which have been determined to be inappropriate for analysis purposes. This situation would occur for only a short period of time following a loss-of-coolant accident and could result in inadequate NPSH at the RS and LHSI pumps. DLC advised us that the assumptions made in the original analysis were based on assuring maximum containment pressure. However, these assumptions are not conservative when determining the available NPSH for the RS and LHSI spray pumps. They indicated that more conservative assumptions for the NPSH analysis in the following areas must be made:

(a) mixing the emergency core cooling system (ECCS) water at the break to reduce the amount of energy to flash steam to the containment atmosphere and thereby increase the sump water temperature.

(b) flashing of the break effluent at the total containment pressure (pressure flash) to reduce the fraction of effluent which becomes steam and thereby increase the sump water temperature.

(c) 100 percent spray efficiency to maximize the heat removed from the containment atmosphere and thereby increase the sump temperature.

Items a through c above will result in a lower containment pressure and higher sump water vapor pressure. In addition to the above, minimizing initial containment pressure and using the coldest service water temperature also result in a more conservative NPSH calculation. It was determined that a lower calculated NPSH for the RS and LHSI pumps would exist at specific times during the recirculation phase of long term cooling at BVPS-1. This could result in either damaging of the pumps or reducing pump flow.

By a letter dated August 25, 1977, DLC informed us that the BVPS-1 had shutdown to perform routine maintenance work which would require approximately three weeks. DLC also stated that prior to startup of the plant, they would provide us with the details of a proposed interim design modification supported by analyses which would demonstrate the capability of the RS and LHSI systems to function as required.

At a meeting held on September 9, 1977, DLC submitted a report entitlted "Analysis and System Modification for Recirculation Spray and Low Head Safety Injection Pumps Net Positive Suction Head," which presented: (1) proposed interim modification of the RS and LHSI systems; (2) RS pump performance curves of the minimum NPSH required to prevent cavitation as a function of flow rate (the above cited curves are based on tests performed on August 22, 1977, with a North Anna RS pump, which is the same model as that installed at BVPS-1); (3) LHSI pump performance curves of the minimum NPSH required to prevent cavitation as a function of flow rate (these curves are based on tests performed on August 30, 1977, with a North Anna LHSI pump which is identical to those at BVPS-1. The test method and procedures were essentially identical to those used to test the RS pump at North Anna on August 22, 1977); and (4) the containment pressure transient response analyses and associated NPSH available to the RS and LHSI pumps. The calculated pressure in the containment and the temperature of the water that accumulates in the containment sumps are important parameters in determining the RS and LHSI pump operability following a LOCA, in regard to available NPSH. These terms, in combination with the pump static head and associated

line friction losses, establish the available NPSH during the transient. The required NPSH may be reduced by a reduction in the pump flow rate. Alternatively, the NPSH available at a given flow rate may be increased by the injection of cold water into the pump suction. The injection of cold water lowers the water temperature at the pump suction and, therefore, lowers the vapor pressure of the water entering the pump. DLC proposes to utilize both of the above methods to resolve this problem on an interim basis.

Recirculation Spray Pumps Located Inside Containment

Using the new modeling assumptions, a minimum available NPSH of greater than 11 feet is calculated for the two RS pumps located inside containment, except for a short time interval of about 10 to 20 minutes, depending on the break location and engineered safety feature equipment available. The initiation of the time interval varies from 350 seconds to 800 seconds after a postulated accident. This amount of available NPSH assures satisfactory pump operation. Sensitivity studies performed by DLC show that for a time interval of about 13 minutes, the available NPSH reaches a minimum of 8.3 feet during which the pump could potentially operate in a mild cavitating mode with a reduced flow rate of 3000 gpm. The design flow rate is

3600 gpm. The test results, as presented in the above cited topical report, demonstrate that the pump can be operated in a cavitating mode for periods of time well in excess of the 10 to 20 minute interval discussed above, at a lower efficiency, without damage to the pump. On this basis, DLC has not proposed any interim design modification to the RS pumps which are located inside the containment.

Recirculation Spray Pumps Located Outside Containment

For the two RS pumps located outside containment, the friction loss in the suction piping is substantially larger than that for the inside pump, and therefore results in a lower available NPSH. In order to assure an adequate amount of NPSH for the RS pumps located outside of the containment, DLC proposes to divert 250 gallons per minute (gpm) of cold quench spray (QS) water from each QS header to the sump area at that point where water is drawn to the outside RS pump suctions. The cold QS water injection will lower the water temperature at the pump suction, and therefore, lower the vapor pressure of the water entering the pump. This proposed modification will allow the pumps to perform as originally specified. No reduction in flow rate to increase the available NPSH is necessary.

Low Head Safety Injection Pumps

In order to assure an adequate amount of NPSH to the LHSI pumps, DLC proposes to limit the pump flow rate from 4200 gpm to approximately

3100 gpm during the recirculation phase assuming a single pump failure. The ability to throttle the LHSI pump flow rate was demonstrated by a test at Surry Power Station, Unit 2, on September 16, 1977, and reported in a September 19, 1977, letter by DLC. The low head portion of the ECCS system for Surry Unit 2 is similar to that at BVPS-1. However, the pump discharge valves at Surry Unit 2 are Darling valves with 10 second closure times, magnetic brakes on the motor operators, and a rated pressure differential of 1750 pounds per square inch (psi). The discharge valves at BVPS-1 are Crane valves and have 120 second closure times, a rated differential pressure of 200 psi and do not have magnetic brakes on the motor operators.

To assure that a pump flow rate of 3100 gpm is not exceeded in the event one pump fails, DLC will partially close both pump discharge valves to allow a flow rate of 2100 gpm per pump. Test results at Surry, Unit 2 indicated a valve opening of 25% allowed a flow rate of approximately 2100 gpm. Although the discharge valves at BVPS-1 have a different design than those tested at Surry Unit 2, it is expected that the flow characteristics versus valve opening would be similar. The BVPS-1 discharge valves will require a longer throttling time. However, the valves will be throttled just prior

to the recirculation stage of LHSI when time is no longer a critical parameter for maintaining adequate core cooling. Additionally, the slower operating speed of the BVPS-1 discharge valves should provide a finer adjustment capability. The rated valve differential pressure is greater than the pump differential pressure of 125 psi at 2100 gpm.

In addition to the provisions for throttling, the time of transfer will be delayed until an additional 10,000 gallons of water have been drawn into the containment from the refueling water storage tank (RWST). DLC proposes to increase the capacity of the RWST 17,000 gallons to 441,000 gallons to allow the delay in the transfer time. This time delay was selected to provide further assurance that adequate NPSH is available to support 3100 gpm flow without pump cavitation. Operation of the LHSI system during postulated accident conditions is affected by the proposed modification, since an additional 10,000 gallons of water from the RWST will be required for injection.

The proposed interim modifications assure that the LHSI pumps will be operable during long term core cooling following a LOCA by eliminating pump cavitation. The proposed modification does not cause LHSI flows to be less than the minimum flow rate required for emergency core cooling requirements in either the short term or the long term.

Effect of the System Modifications on Containment Peak Pressure and Containment Depressurization Time

Using the above containment spray flow rates which result from the proposed system modifications DLC performed a containment response analyses. The results show that the containment spray systems will function adequately. The peak containment pressure limit of 45 psia will not be exceeded and the pressure will return to subatmospheric conditions in less than 60 minutes, i.e., the depressurization time requirement for the design basis LOCA. The containment will remain in a negative pressure once it is brought to subatmospheric pressure.

Conclusion

Based on our review of the above cited topical report and on discussions with DLC, we find that in the unlikely event of a major LOCA, the containment spray and LHSI systems at BVPS-1 will operate satisfactorily to maintain adequate core cooling and assure that the containment design pressure is not exceeded and that the depressurization of time will remain under 60 minutes. We conclude that the continued operation of BVPS-1 with the proposed interim modifications is acceptable and will not pose an undue threat to the health and safety of the public.

However, we feel that operator action to partially close the LHSI pump discharge valves and the minor reduction in the inside RS pump performance for the 10 to 20 minute interval discussed above are acceptable solutions only for an interim period. Therefore, we will require DLC to propose a permanent solution and schedule of implementation by November 22, 1977. This permanent solution should provide that the containment spray and ECCS systems perform as originally designed without relying on the above operator action following a major LOCA.

Copies of the following documents are available for public inspection in the Commission's Public Document Room, 1717 H Street, N. W. Washington, D. C. 20555 and at the Beaver Area Memorial Library, 100 College Avenue, Beaver, Pennsylvania, (1) Letters from DLC dated August 20, 1977, August 25, 1977 September 8, 1977 and September 19, 1977, (2) Stone and Webster Report entitled "Analysis and System Modification for Recirculation Spray and Low Head Safety Injection Pumps Net Positive Suction Head", dated September 9, 1977, and (3) this Order for Modification of License, In the Matter of Duquesne Light Company, Ohio Edison Company, and Pennsylvania Power Company, Beaver Valley Power Station Unit No. 1, Docket No. 50-334.

III.

In view of the foregoing, and in accordance with provisions of the Atomic Energy Act of 1954, as amended, and the Commission's Rules and Regulations in 10 CFR Parts 2 and 50, IT IS ORDERED THAT Facility Operating License No. DPR-66 is hereby amended by adding the following new conditions:

1. Reactor operation shall be authorized only with the restrictions set forth below, until the permanent modifications are approved by the NRC and in place:

   a. With piping installed to divert 250 gpm of water from each quench spray header to the sump area at that point where water is drawn to the outside recirculation spray pump suctions.

   b. The volume of water in the RWST shall be maintained at equal to or greater than 441,000 gallons.

   c. Operating procedures shall be maintained which require that in the event of a loss of coolant accident necessitating use of the low head safety injection (LHSI) system, plant operators will throttle the discharge of each LHSI pump just prior to initiating the recirculation phase of core cooling. The discharge shall be throttled such that the flow shall not exceed 3100 gpm in the event of single pump operation.

2. DLC shall submit by November 22, 1977, a proposed permanent design modification and a schedule for its implementation. The proposed modification shall be based on detailed supportive analyses which include consideration of containment total pressure, containment vapor pressure, available NPSH, sump water level, and sump water temperature for a spectrum of break sizes and break locations. For each analysis, the following shall be specified: the energy release rates as a function of time throughout the blowdown, reflood, and post blowdown phases, all the containment evaluation parameters, and the recirculation spray heat exchanger characteristics.

FOR THE NUCLEAR REGULATORY COMMISSION

Edson G. Case, Acting Director
Office of Nuclear Reactor Regulation

Dated at Bethesda, Maryland
this September 30, 1977