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Downers Grove, Illinois 60515

October 24, 1990

Mr. A. Bert Davis
Regional Administrator
U.S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, IL 60137

Subject: Zion Station Units 1 and 2
Response to Unresolved Items
I.R. No. 295/90018 and 304/90020
NRC Docket Nos. 50-295 and 50-304

Reference: (a) H.J. Miller letter to C. Reed dated September 24, 1990.

Dear Sir:

This letter is in response to the NRC special safety inspection conducted by Mrs. S.D. Burgess and other members of your office on July 30 through August 3, 1990, which was conducted in response to Diagnostic Evaluation Team (DET) inspection findings regarding the operability of the service water (SW) system and component cooling water (CCW) system. Reference (a) indicated that although both the SW and CCW systems were operable, several weaknesses were noted with the design and operating configuration of both systems. These weaknesses were documented as unresolved items 01 and 03-05. Also a programmatic weakness was identified regarding CCW pump maintenance.

Although no violations of NRC requirements were identified, Commonwealth Edison (CECo) was requested to provide a response to these four unresolved items and the programmatic weakness. The following enclosure provides that response.

Additionally, although not requested in Reference (a), a response is also provided to unresolved item 02, which dealt with reviewing certain accident scenarios for service water operability, and to the inspectors concerns regarding CCW heat exchanger maintenace.

If you have any further questions on these matters, please direct them to this office.

Very truly yours,

P.C. Zolan
Nuclear Licensing Department

Enclosure
cc: Senior Resident Inspector - Zion
NRC Document Control Desk

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IE01

ENCLOSURE

COMMONWEALTH EDISON COMPANY
RESPONSE TO NRC INSPECTION REPORT
NOS. 50-295/90018 and 50-304/90020

Unresolved Item 295/90018-01 and 304/90020-01:
Requirement for Open Crosstie Valves

One concern that prompted this inspection was the capability of the service water (SW) pumps to provide adequate flow with the 48 inch crosstie valves open as described in the FSAR and as shown on FSAR Figure 9.6.1-(1). The inspectors determined that this concern did not constitute an operability problem based on the licensee's issuance of a standing order to operate with a minimum of four SW pumps (as described in Paragraph 3.2.1 of Reference (a)) which provides additional flow. However, as a result of examining this issue, the inspectors noted an additional concern regarding SW operation with the crosstie valve closed. The licensee indicated that earlier practice, particularly 1973 through 1981, was to operate with the crosstie closed. The Technical Specification (TS) permitted operation with the crosstie valves open or closed. With the crosstie valves closed, an accident scenario was identified that could lead to station blackout if the normal lineup of SW cooling water supply was not also changed to the diesel generators coolers. The licensee was aware of this situation. Since it was possible for other accident scenarios due to other inter-unit SW crossties, the inspectors concluded that operation with the 48 inch crosstie closed was not described in the FSAR and would required a safety evaluation in accordance with 10 CFR 50.59.

Response:

CECo does not agree with the Inspection Report's implication that operation with the SW crosstie valves closed has not been previously evaluated. CECo acknowledges that the FSAR and NRC's SER of October 6, 1972 lack detail regarding the preferred mode of operation of the crosstie valves. However, the NRC's SER of December 31, 1981, for license amendments 72/66, explicitly addresses operation with the crosstie valves closed. These amendments clarified the technical specifications to state that, with the crosstie valves open, the stated pump operability requirements can be reduced by one. Although its purpose was to provide the basis for relaxation of the pump operability requirements with the crosstie valves open, the SER also served to confirm the acceptability of operation with the crosstie valves closed. The SER states the following:

> "The Zion FSAR (Reference 4) and the NRC's SER (Reference 5) state that only two service water pumps are required for each unit for normal

operation and that only one service water pump is required for each unit for emergency shutdown or accident conditions. Emergency requirements are less because various non-safety related systems are isolated during accident conditions. The Zion FSAR and the NRC's SER also address and approve the cross-tied operation of the 48-inch service water discharge header.

Based on our review of CECo's proposal, as well as a review of the above noted references, we agree that two operable service water pumps and an operable standby pump are sufficient for reactor operation and one pump is sufficient for any accident if the units are operated with the 48-inch discharge header split between the units. This split is accomplished by two motor operator valves in the common header."

CECo acknowledges the NRC's concern that, in the event that the crosstie valves are closed and one unit is in cold shutdown, should the Station desire to take out-of-service all the SW pumps and/or diesel generators (D/G) on the cold shutdown unit, one or more SW supply valves to the D/G coolers on the operating unit would have to be repositioned to assure SW supply under Loss of Offsite Power (LOOP) conditions. CECo will re-examine the normal operating practice of allowing one unit's SW header to supply cooling to components on the opposite unit. This process will include a review of probabilistic risk assessments, applicable regulatory criteria, and Zion specific licensing bases. The review will determine recommended operating valve alignment which satisfies the objective of minimizing operator actions necessary to perform maintenance or to respond to failures.

This review will be completed by February, 1991.

Unresolved Item 295/90018-02 and 304/90020-02:
Test of SW in Crosstie Configuration

The DET was concerned that in the crosstied configuration the TS would permit the plant to be in an accident condition with insufficient SW to essential loads because the crosstied configuration had not been tested. With one unit operating and the other shutdown, the TS allowed the plant to be configured with only three operable SW pumps and the SW supply piping crosstied. If a LOCA occurred with this configuration on the operating unit, and one of the SW operable pumps or its power supply failed, only two SW pumps would be available to supply both units. The SW system was never tested in this configuration nor were system head curves created that showed the adequacy of two pumps. Standing Order 90-24 was issued on August 1, 1990, that required a minimum of four operable SW pumps. The licensee also stated that calculations would be performed and confirmed by tests to justify returning to operation with three operable SW pumps. If the calculations and testing are not conclusive, the FSAR and TS will be revised to reflect the standing order for four operable SW pumps. The licensee confirmed a target completion date for February 1991.

Response:

The Zion FSAR, the NRC's SER of October 6, 1972, and the NRC's SER for License Amendments 72/66 of December 31, 1981, state that only one service water pump is required for each unit for emergency shutdown or accident conditions. These statements in the licensing basis indicate that both CECo and the NRC had concluded that accident scenarios which resulted in two pumps available were within the design capability of the SW system. However, CECo acknow- ledges that there appears to have been a lack of detailed calculations and testing which demonstrates the capacity of various SW pump combinations in the accident scenarios of interest. For example, system head curves were not calculated as part of the original plant design for a shared-unit alignment, two pump accident scenario, nor did the pre-operational test specifically measure system performance under those conditions.

Some information is provided, however, by the existing design calculations and testing, which suggests that CECo and the NRC reached the proper conclusions during the initial plant licensing process in determining that two pumps would provide adequate capability. This information, which was provided to the DET, includes the following:

1.) Original design calculations which confirmed that sufficient head would be developed at key points in the system with design flows being delivered to the essential heat exchangers.

2.) Pre-operational testing which measured individual pump capacities in excess of 23,000 gpm.

3.) Pre-operational testing performed on a single-unit basis which confirmed that a single pump could provide design flows to all essential heat exchangers.

4.) Recent testing which confirmed that pump capacities remain within 10% of the pre-operational pump curves.

As described in Reference (a), a Standing Order was issued on August 1, 1990 to require a minimum of four SW pumps operable. This action precludes the possibility of occurrence of any accident scenario which could result in only two pumps available. In an effort to reconfirm the validity of the conclusions of the FSAR and NRC's SERs regarding the adequacy of two pumps, CECo will investigate the feasibility of performing calculations and/or testing of the specific scenarios of interest. Although testing might appear to be an attractive option in that it might provide a definitive resolution, it is not clear that such testing could be performed safely without a simultaneous cold shutdown and/or core offload on both units. Therefore, the costs, benefits, and risks of the calculation and testing options will be weighed against the alternative of changing the plant's licensing basis (Technical Specifications and FSAR) to require an additional pump available.

A decision as to which alternative to pursue will be made by February, 1991.

Unresolved Item 295/90018-03 and 304/90020-03
Weakness in Abnormal Operating Procedure for Loss of Cooling Water

The inspectors reviewed the design bases of the CCW system as described in the FSAR. The CCW system is designed to supply cooling water to various plant components during normal operations, remove residual heat from the reactor coolant system during the second phase of plant cooldown, and supply cooling to safeguard equipment loads during and after a postulated accident. Component Cooling Water was provided by five CCW pumps arranged in parallel and operated as needed to supply cooling water for the combined heat load of both units through a common header which could be split with installed valves. According to FSAR CCW system diagrams, the design intent was to operate in a split header configuration. Based on information provided by the licensee, the CCW system was not being operated in its original design bases configuration; that is, it was typically being operated in a crosstied configuration, which was permitted by the TS for most plant operating modes.

In 1990 Westinghouse submitted a CCW system design bases document for Zion. This document was in draft form and, at the time of the DET follow-up inspection, had not been approved by the licensee. Westinghouse analyzed LOCA scenarios for different operating conditions and also recognized that during normal operation, Units 1 and 2 were crosstied in a common header configuration.

Westinghouse determined that the CCW system's heat transfer capability was adequate with the minimum of three pumps and two heat exchangers with a full spent fuel pit heat load. Additionally, Westinghouse calculated that failure of any one of the minimum complement of components in use would increase the time required for plant shutdown, but would not affect safe operation of the plant.

In the event of a single active or passive failure, Westinghouse provided that either unit might be aligned with two completely independent, parallel CCW paths each consisting of one pump and one heat exchanger. (i.e., a split header configuration). However, changing the system configuration to split header, or isolating a pipe break or a failed component was not considered an option in abnormal operating procedure (AOP)-4.1, "Loss Of Cooling Water." If the operators followed AOP-4.1 and did not isolate the point of component cooling water loss, it would eventually result in cavitation of the CCW pumps. If cavitation became evident, AOP-4.1 would direct operators to "Trip Both Reactors". Reactor operation would then be governed by the emergency operating procedures. For these reasons, AOP-4.1 was considered weak and is an unresolved item.

Response

The Abnormal Operating Procedure (AOP)-4.1 currently provides actions for isolating a leak or a failed component during a loss of component cooling water. Specifically, Appendix G, Component Cooling Leakage, provides the Operating Department with the guidance necessary to identify and isolate a leak.

Splitting the units in the event of a component cooling water loss is an option that will be considered for inclusion in AOP-4.1. However, the valve lineup required to split the units, and the point during the event sequence at which the units should be split needs further evaluation. This evaluation will be performed by the Zion Operating Procedures Group, with an expected completion by December 31, 1990.

Unresolved Item 295/90018-04 and 304/90020-04
Weakness in CCW Pump Operability Testing

Operability of the CCW pumps is demonstrated monthly by use of surveillance procedure PT-8A, "Component Cooling Pumps Operability Test." CCW pump performance acceptance criteria is that the pump started upon actuation, operated for at least four hours, and satisfied the cooling requirements necessary for the routine operation of the component cooling system. The acceptance criteria were easily met for pump starting and operating for four hours. However, satisfying the cooling requirements necessary for the routine operation of the CCW system could not be determined by performing PT-8A. PT-8A tested individual pump operability with the CCW system in the crosstied configuration and the TS required a minimum of three pumps running at all times. A defective pump would pass the PT-8A performance test since the pump would start, operate for four hours and "appear" to satisfy the cooling requirements of the CCW system loads, but the other pumps would actually carry the cooling load for the defective pump; that is, operating in the crosstied configuration would result in header pressure developed by operating pumps which may mask low pressure caused by a defective pump. For the reasons stated above, PT-8A was considered weak and is part of this unresolved item.

There was no specific surveillance test that demonstrated the operability of CCW heat exchangers; therefore, operability was demonstrated with generic procedure PT-14, "Inoperable Equipment Surveillance Tests." The inspectors concluded that PT-14 tests did not determine performance degradation of the heat exchangers because neither flows, inlet and outlet pressures, nor thermal capacity data were obtained due to lack of instrumentation. Operability of heat exchangers is a generic concern within the industry. The inspectors noted that the CCW/SW heat exchangers would be expected to be evaluated by the licensee in response to Generic Letter 89-13. However, the weaknesses noted above in testing of the CCW heat exchangers are considered part of this unresolved item.

Response

Periodic Test (PT)-8A, "Component Cooling Pumps Operability Test", is a monthly surveillance that has been performed by the Operating Department to comply with Technical Specification 4.8.6.A. This test is used to ensure pump readiness. During the performance of PT-8A, the component cooling pump is run for a period of four hours with suction pressure, discharge pressure, heat exchanger outlet temperature, and pump motor bearing temperature being recorded. Vibration readings on the component cooling pump and motor are also recorded. The pump has been considered acceptable if the pump starts upon actuation, operates for four hours and the cooling requirements of the component cooling water loads have been satisfied. In addition, if vibration readings are found in the action level range, the pump is declared inoperable.

In addition to PT-8A, Technical Staff performs a quarterly Technical Staff Surveillance (TSS 15.6.106), "Component Cooling Pump Performance and Check Valve Operability" to comply with the Zion Station In-service Testing Program. This test is used to identify pump degradation. During the performance of TSS 15.6.106, suction pressure, discharge pressure, and pump flows are recorded. The inlet pressure and the outlet pressure are used to calculate the required head using the manufacturers pump curves. The component cooling pump is acceptable if the pump starts upon actuation and if the flow and measured head are within ± 7% of reference point on the pump curve. If pump flow falls within ± 7% and ± 10% of the pump curve, the testing frequency is increased to monthly until the pump condition is corrected. If the pump falls outside ± 10% of the pump curve, the pump is declared inoperable.

To strengthen the monthly surveillance, TSS 15.6.106 or an equivalent procedure will be performed on a monthly basis. A Technical Specification amendment is being developed patterned after the Westinghouse Standard Technical Specifications which will require quarterly ASME pump runs to determine operability. This amendment will be submitted by June 1, 1991.

The component cooling heat exchanger inspections, tests, and overall operability will be evaluated as part of the action taken in response to Generic Letter 89-13, for which a response has already been submitted for Zion Station. This is described in greater detail in our response to unresolved item 295/90018-05 and 304/90020-05 above.

Unresolved Items 295/90018-05 and 304/90020-05:
Inaccurate SW Flow Instrumentation

The inspectors were concerned with the long term testing consequences of inaccurate SW flow instrumentation. Flow imbalances and high flow readings on essential equipment were noted during the system walkdown. The licensee indicated that much of the SW flow instrumentation was considered inaccurate because of silt in the SW water. (This weakness did not apply to the reactor containment fan cooler (RCFC) flow instrumentation used to validate RCFC throttle valve adjustments). The accuracy of these measurements would become important if the licensee returned to a minimum of three operable pumps because of the reduced flow margin over minimum. A review of installed instrumentation was being made by the system engineer. Modification requests were to be submitted to the corporate engineering department by November 1990. This schedule was not consistent with the February 1, 1991 target date to resolve the pump configuration mentioned above. The inspector did not consider these uncertain flow balances an immediate concern because the standing order that required four operable pumps would assure sufficient flow margins to bound these uncertainties. Adequacy and accuracy of the SW system flow instrumentation is considered an unresolved item.

Response:

As described to the DET, a comprehensive heat exchanger cleaning and testing program has been developed for Zion in response to Generic Letter 89-13. All safety-related Service Water heat exchangers will either be cleaned or performance tested to ensure design heat transfer capability. For the heat exchangers for which it has been determined that cleaning is more feasible (such as oil coolers), maintenance work requests will be written for inspection and cleaning. For the heat exchangers for which it has been determined that testing is more feasible, testing procedures are currently being written. The design heat loads have been identified and incorporated into the test procedures with the appropriate extrapolation methodology. The instrumentation accuracies necessary to achieve acceptable extrapolation results have been identified, and a study is currently being performed to determine which instruments will achieve the required accuracies and the budgetary estimates for plant modifications. This study is scheduled for completion by November 16,1990. The necessary instrumentation will be procured and installed as necessary to support the required testing program. Testing, inspections, and cleaning of heat exchangers is scheduled to be completed prior to startup from the next refueling outages for both Units. These outages are currently scheduled for September, 1991 (Unit 1) and January, 1992 (Unit 2).

Following completion of the initial testing, the continued maintenance of adequate flow to each heat exchanger will be addressed by one or more of the following measures:

a) an integrated test which verifies adequate heat transfer capability in post accident alignment.

b) periodic measurement and procedural control of flow.

c) periodic measurement and procedural control of valve positions.

Appropriate administrative controls (e.g., calibration and preventive maintenance procedures) will be put in place to ensure the continued availability of the instrumentation necessary to implement these measures.

Programmatic Weakness 295/90018 and 304/90020 Paragraph 4
Weakness in Preventive Maintenace on CCW pumps

Within the past two years, two of the five CCW pumps were dismantled and repaired due to mechanical failure. Both pumps had a leaking outboard mechanical seal. The first pump required new bearings, a mechanical seal, and miscellaneous small parts to correct the problem, but the pump impeller was also replaced. The reason for the impeller replacement was not documented. The second pump required repairs similar to the first except the impeller was not replaced. Results of the maintenance inspection were not documented for either pump.

With the exception of vibration testing, the remaining three pumps had not received any form of maintenance inspection or preventive maintenance (PM) since originally put into service in 1973. Without any historical maintenance information, neither the licensee nor the inspectors could determine the condition of these pumps. This was considered a programmatic weakness.

Response

The Technical Staff, along with the Operating Department, performs a variety of operability tests on the Component Cooling pumps. On a monthly basis, the Technical Staff performs TSS 15.6.106, "Component Cooling Pump Performance and Check Valve Operability". During the performance of TSS 15.6.106, the pump measured head is compared to the calculated pump head. In addition to TSS 15.6.106, Technical Staff trends vibration on the component cooling pumps, and as part of the Preventive Maintenance Program, the vibration of the motor bearing is trended. The Operating Department performs Periodic Test (PT)-8A, "Component Cooling Pumps Operability Test".The trending of vibration readings and other pump parameters is the main part of the Preventive Maintenance Program for these pieces of rotating equipment. If any of the above tests shows signs of adverse trending, the pump is taken out of service and is scheduled for maintenance. In addition, the current station requirements for recordkeeping require retrievable documentation be maintained for maintenance work performed on all safety-related equipment. This would preclude the documentation requirements noted in Paragraph 4 of Reference (a) from recurring.

CCW Heat Exchanger Maintenance

On June 2, 1990, the Unit 1 CCW Heat Exchanger was opened on the tube (SW) side to inspect and repair suspected tube leakage, which was identified by decreasing level in the surge tank. A summary report was written about the heat exchanger inspection and the impact on heat exchanger operability. The findings are paraphrased below.

> The heat exchanger had an as-found estimated performance factor of approximately 60% - 70% of design.
>
> Tube cleaning reduced the fouling of the heat exchanger to a minimum.
>
> Pressure testing identified 15 leaking tubes.
>
> Eddy current testing identified an additional 48 tubes with indications of reduced wall thickness greater than 40%.
>
> All leaking tubes (63) and those with excessive thinning were plugged.
>
> Borescope examination of the tubes' interior showed concentrated cell corrosion pitting of an undetermined chemistry.

Based on cleaning, examination, inspection, and testing, the station Technical Staff concluded that the heat exchanger was capable of acceptably performing under both normal operation and accident loads.

Silt from the SW system was identified by the station Technical Staff as the main cause of the reduced performance factor. Photographs taken of the Unit 1 CCW Heat Exchanger clearly showed a significant accumulation of silt or sediment at the bottom of the inlet water box. Based on viewing photographs of the heat exchangers the inspectors were not convinced that only silt was present. Silt build up is generally regarded as a self-limiting phenomenon and as such, accumulation is small and has a minor impact on heat exchanger performance. Besides silt, it appeared to the inspector that organic and inorganic compounds had accumulated in the heat exchanger inlet water box in the form of sediment. The sediment was cumulative rather than self-limiting; therefore, could lead to significant flow obstruction through the heat exchanger.

Response

The heat exchangers have a very large design margin, (eg. assumes 80 F service water temperature and a 45 percent performance factor).

The component cooling heat exchanger on Unit 1 was cleaned and inspected in June of 1990. Unit 2 component cooling heat exchanger will be cleaned and inspected during the next Unit 1 outage; the O component cooling heat exchanger will be cleaned and inspected during the next Unit 2 outage.

Future inspections and tests for component cooling heat exchangers will be determined as part of the Generic Letter 89-13 project.