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MARTIN,J.B. Document Control Branch (Document Control Desk)

SUBJECT: Forwards results of study re restoration of three charging pump configuration,per exercise of enforcement discretion granted by 930713 ltr,allowing continued operation of Unit 2 while repairs being made to west centrifugal charging pump.

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INDIANA MICHIGAN POWER

AEP:NRC:1191A

Donald C. Cook Nuclear Plant Units 1 and 2
Docket Nos. 50-315 and 50-316
License Nos. DPR-58 and DPR-74
COURSE OF ACTION REGARDING
OPERATION WITH THREE CHARGING PUMPS

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555

Attn: Mr. J. B. Martin

October 15, 1993

Dear Mr. Martin:

By letter dated July 13, 1993, Unit 2 of the Donald C. Cook Nuclear Plant was granted an Exercise of Enforcement Discretion to allow continued operation of the unit while repairs were being made to the west centrifugal charging pump. The repairs involved replacement of the pump's internal assembly, which was necessary because of high pump vibration. As discussed in the NRC's letter, we committed to provide to the NRC the results of a study we were conducting regarding possible restoration of a third charging pump in each unit, which was the original design. The results of our study are contained in the attachment to this letter. Necessary changes to the updated FSAR associated with the results of this study will be submitted during the next regular FSAR update.

Sincerely,

E. E. Fitzpatrick
Vice President

dr

Attachment

cc: A. A. Blind
G. Charnoff
T. E. Murley - NRR
NFEM Section Chief
NRC Resident Inspector
J. R. Padgett

190061

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ATTACHMENT TO AEP:NRC:1191A

RESULTS OF STUDY REGARDING

RESTORATION OF THREE CHARGING

PUMP CONFIGURATION

SUMMARY

A review of Cook Nuclear Plant's centrifugal charging pumps' (CCPs) operating and maintenance history was performed and it has been determined that the CCPs should continue to provide charging service for normal unit operation. Restoration or replacement of the reciprocating charging pumps is not warranted considering the high reliability of the CCPs and cost to upgrade the reciprocating pumps.

BACKGROUND

Each unit of the Cook Nuclear Plant's Chemical and Volume Control System (CVCS) is equipped with three charging pumps: one reciprocating pump and two centrifugal pumps. The two CCPs also function as the Emergency Core Cooling System high head injection pumps. During normal unit operation, the original design of the CVCS provided for a maximum charging rate of 100 gpm. This corresponded to the maximum flow rate of the reciprocating pump. The CCPs were designed to inject into a fully pressurized reactor coolant system (RCS). Each pump can provide CVCS charging flow up to approximately 150 gpm. The current practice is to operate at the highest CVCS charging/letdown rate possible to improve RCS chemistry and minimize system radiation levels. Given the limited capability of the reciprocating pump and its high maintenance requirements, the CCPs have been operated for normal charging service for over 12 years on both units. The CCPs are Pacific Pumps (now Ingersoll Dresser Pump Co.) 2 1/2 inch type RLIJ, 11 stage barrel pumps. These pumps are a boiler feedpump type, designed for long term continuous operation. Though this pump model had early design problems at the shaft balance drum locknut threads, modifications by the pump manufacturer have improved the pump's reliability significantly. Until the incident this past July, the Cook Nuclear Plant CCPs have not had a shaft failure since June of 1982. Following the 1982 failure, a program was implemented to incorporate the manufacturer's recommended shaft and locknut upgrades. Both Cook Nuclear Plant and the rest of the industry have experienced a significant increase in reliability since the upgrades were installed.

CURRENT EXPERIENCE

The July 1993 high vibration incident was attributed to a shaft crack at the No. 9 impeller shaft keyway. A metallurgical evaluation is underway to determine possible crack initiation and propagation mechanisms. Results of this evaluation are expected in early November. This crack is not at the location found in other shaft failures. Typically, cracks have been found at the balance drum locknut area. A review of 1993 control room logs did not indicate any recent operating experience which could have been detrimental to the pump. Furthermore, neither unit's CVCS has a history of operational problems that could detrimentally impact the CCPs. This pump has operated satisfactorily since 1986 when this specific assembly was installed, passing all flow balance and ASME Section XI requirements. At this time, no specific cause of the shaft crack has been determined.

A review of recent industry CCP incidents was performed to attempt to identify a common failure mode. Information on similar events at other utilities was researched through INPO notices, NPRDS, NRC notices, and discussions with Westinghouse, Pacific Pumps and various utility personnel. The recent (1991-1993) shaft failures that were found occurred at the balance drum locknut area, previously identified as a susceptible area. Upon further review of these failures, it appears that operating anomalies were significant contributors. These pumps at one time or another may have been operated with a partially closed suction valve, may have not been properly vented and primed, or may have operated with significant gas concentrations. Such misoperation could impose high shaft stresses which could lead to initiation of shaft cracks. Normal operating loads would then propagate the crack. In one case, the shaft was not cracked but bent. High gas concentrations may have been a contributor to this incident as well.

There is no apparent correlation between the Cook Nuclear Plant's CCP failure and the aforementioned failures. The crack location is different and no misoperation has been identified. As this crack appears to be unique, the metallurgical examination may help to identify contributing failure mechanisms. However, a generic concern is not believed to exist.

DISCUSSION

Use of the CCPs for charging service is not considered detrimental to the safety function of the CCPs. As stated above, these pumps when operated properly, are highly reliable. The CCP's capability to perform their safety function has been demonstrated by their actual operating experience. This is no different from operating other safety related pumps for normal unit operation services such as the residual heat removal pumps, essential service water pumps, auxiliary feedwater pumps, component cooling water pumps, and boric acid transfer pumps. Proper operation, surveillance testing and scheduled maintenance ensures the ability of all of the above pumps to fulfill their safety function.

The high reliability of these pumps is reflected in the Cook Nuclear Plant's IPE. The ECCS High Head System Notebook indicates a PRA reliability consistent with other safety related systems. This notebook is based, in part, on the maintenance, testing and operating inputs associated with the CCPs. During a review of CCP operation for the development of the IPE, only one pump operational failure was identified, covering over 75,000 hours of operation of the four charging pumps. A study using PRA techniques was conducted that evaluated the impact to core damage frequency by adding a third safety related centrifugal charging pump. Only a 1% reduction in core damage frequency was realized. The addition of a non-safety related charging pump would have no reduction in core damage frequency.

An extensive stock of spare parts is also available to support the CCPs including a full spare pump and a spare internal assembly. A second spare assembly is presently being rebuilt for delivery in early 1994. In addition, the spare pump's assembly is available as a spare assembly if needed.

CONCLUSION

Replacing the reciprocating pump is not warranted given the reliable service obtained from the CCPs. The estimated cost for replacement of both unit's reciprocating pumps with non-safety related centrifugal pumps is approximately $4,000,000 in 1993

dollars. This expenditure is not justifiable when considering that, except for this recent failure, the CCPs at the Cook Nuclear Plant have had an excellent operating history.

Pump and/or system issues that may effect the CCP's safety function will continue to be evaluated as part of our practice to monitor and evaluate industry and in-house experiences. Appropriate corrective/preventive actions will be taken as required.