

LOUISIANA POWER & LIGHT COMPANY

WATERFORD SES UNIT NO 3

Final Report of
Significant Construction Deficiency No 5

LPSI Pumps
Impeller Shaft Retaining Mechanism Failure

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May 21, 1980

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FINAL REPORT

SIGNIFICANT CONSTRUCTION DEFICIENCY NO 5 LPSI PUMPS IMPELLER SHAFT RETAINING MECHANISM FAILURE

INTRODUCTION

This report is submitted pursuant to 10CFR50.55(e)(3). It describes a deficiency in the Low Pressure Safety Injection Pumps "A" and "B" supplied for use in the Waterford Unit 3 Safety Injection System. ✓

BACKGROUND

By telecon dated 7-18-78, Louisiana Power & Light Company confirmed notification to the NRC concerning a deficiency that had been identified during preoperational testing at Arkansas Power & Light Company's Arkansas Nuclear One - Unit 2 in Low Pressure Safety Injection Pumps manufactured by Ingersoll Rand. This deficiency involved the pump impeller locking devices (retaining washer, jam nut, and cap nut), which might not perform their function, creating the possibility of causing damage resulting from a loose impeller.

DESCRIPTION OF DEFICIENCY

On February 16, 1978, in anticipation of initiating shutdown cooling during preoperational testing at Arkansas Nuclear One - Unit 2, (ANO-2) the "A" LPSI Pump was started. Within a short period of time excessive noise and vibration was detected and the pump was secured. The "B" Pump was then started. Here, also, in a short period of time excessive noise was noted and this pump was stopped. These pumps are Ingersoll Rand 8 x 20 WD Pumps.

When the spool pieces in the suction piping of both pumps were removed, it was found that hardware was missing. Each impeller is keyed to its shaft and then retained by a washer, jam nut and cap nut. These washers and nuts were no longer on the shafts of either pump. It was apparent that the noise experienced resulted from the washers and nuts slamming around in the suction piping. The vibration in the "A" pump apparently stemmed from the retaining washers wedging between two impeller vanes.

Subsequent inspection of the ANO-2 operating logs indicated that these pumps had been initially operated under the guidance of an Ingersoll Rand service engineer; had been checked for correct rotation, and had significant hours of operation. The "A" pump had at least 499 hours of operation and the "B" pump, 1231 hours. It was also noted that these pumps had numerous starts and stops while building up these hours of operation.

Upon complete disassembly of the pumps, it was found that contact had been made between the impeller wear rings and the pump case wear rings. There are a total of four such mating wear rings in the two pumps and scoring occurred in all four cases. The impellers also showed signs of peening where the loose nuts and washers apparently contacted the impeller at a suction velocity.

The exact cause of failure is not known. The design was such that the nuts could back off and drop off. Once they fell free, so did the washers. The impellers remained keyed to their shafts with no indication of axial movement. Ingersoll Rand does not know the cause of failure, but speculates that earlier operational periods of vibration could have been the cause. Combustion Engineering concurs with this. C-E further speculates that a gasketing design feature may have been a possible cause. The torque applied to the locking hardware compresses a fibrous gasket. This gasket could have deteriorated with time, thereby relieving the torque on the locking hardware.

SAFETY IMPLICATIONS

The deficiency could possibly result in damage to the engineered safeguards for pumps affected and in their failure to operate.

CORRECTIVE ACTION

Ingersoll Rand developed modification kits for the pump impeller locking devices which provide a more positive locking design. The cap nut was deleted from the design. Only one nut is now involved. A tab washer was added and the large impeller washer was modified by the addition of a pin. The changes are such that one mating part cannot rotate with relation to the next part. This is prevented by mechanical interference as opposed to friction as in the original design.

The original design had a flat fibrous gasket to prevent leakage between the shaft and shaft sleeve in the mechanical seal area above the impeller. This gasket was deleted. An "O" ring was incorporated and an appropriate groove was machined into the shaft sleeve. Whereas torque of the previous jam and cap nuts compressed the old gasket, now the stack up of parts is all metal to metal with relation to torquing of the impeller nut.

Field Change Request Number M-72, Revision 1 documents approval of revisions to the Ingersoll Rand Technical Manual and Drawing No P-78-1, Revision 1.

Ingersoll Rand installed the new impeller locking device modification kit on LPSI Pump "A" at their Phillipsburg, New Jersey facility. Certification dated 12-19-79 of this repair is on file at the Waterford site under Purchase Order NY-403402, Suborder CE 9101524.

Installation of the modification kit on Pump "B" was performed on site by Gulf Engineering and completed 5-20-80 in accordance with the disposition of Nonconformance Report W3-983.