DRESSER PUMP DIVISION

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U.S.N.R.C.
Washington, DC 20555

Attention: Charles E. Rossi
Director of Division of Events Accessment

The purpose of this letter is to describe the efforts made by Pacific Pumps to notify customers that they have received potentially defective Pressure Reducing Sleeves described in our letter to the NRC dated 11/13/89.

A list of part numbers for Pressure Reducing Sleeves was generated. The data base of shipped jobs was sorted by each part number over the time period covered by the in-house flame hardening procedure. A manual search was made for the time period prior to the computer data base. This produced a list of jobs with Pressure Reducing Sleeves. A search for each of these jobs was made to review the manufacturing records. If the records indicated that the in-house flame hardening procedure was used; the Pressure Reducing Sleeve was considered potentially defective.

The customers with potentially defective Pressure Reducing Sleeves were notified by telephone followed by a one page instruction on how to inspect the sleeve by rapifax or mail. If a customer requested written notification it was supplied. Notification was given to 7 customers. We feel that a minimum of 85% of the customers with potentially defective Pressure Reducing Sleeves were identified and notified.

After completing the above notifications; and as a result of further study we are now able to report that the concern for the fracture and subsequent failure of Pressure Reducing Sleeves that were inadvertently thru hardened have been isolated to commercial pumps and one model of nuclear safety related pumps. The investigation of the fractured hydraulic thrust Pressure Reducing Sleeve has shown that failures will occur only in pumps that have interference (shrink type) fits between the Pressure Reducing Sleeve and shaft. All nuclear application pumps, except the 2" RL model, are equipped with 'loose' fit Pressure Reducing Sleeves and are not subject to the high stresses imposed by the typical shrink fit.

The failure experienced on our test stand occurred in a commercial pump. Failure of a component on test is a rare occurrence and was discussed considerably in our work shop. When it was determined that the cause of failure was improper heat treatment one of our machinist informed Quality Assurance that he had machined some nuclear components that were unusually hard and he was concerned about their integrity. We had the customer return the two suspect components and found that one of them was properly heat treated while the other had been thru hardened. In addition, the one that

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had been thru hardened had survived operation on our test stand during the normal production hydraulic performance test without failure. It was my opinion that if a hardened component was going to fail it should fail during or shortly after start up of the pump and the survival of this thru hardened component was a bit confusing.

The stress analysis shows that the failure of the commercial pump on the test stand was caused by two factors: 1) the Pressure Reducing Sleeves had been thru hardened and 2) the Pressure Reducing Sleeve was fitted onto the shaft with an interference fit. Calculation of the Von-Mises stresses due to the our "standard" (as defined in our Engineering Standards) interference fit indicate that we could experience brittle fractures upon assembly and complete failure upon start-up. The stress is comprised of three components; hoop stress due to shrink fit, hoop stress due to centrifugal force and axial compressive stress due to the pump discharge pressure acting on one end of the Pressure Reducing Sleeve and reacted by a nut or split ring on the other end of the sleeve. The interference fit causes hoop stresses that are 20 times greater than the hoop stresses due to centrifugal forces.

Most nuclear application pumps do not have an interference fit, in fact all but the 2" RL model have a loose fit between the Pressure Reducing Sleeve and shaft. The stresses in these loose fit Pressure Reducing Sleeves are caused by the centrifugal force coupled with the axial compression. The worst case analysis for a loose fit nuclear safety related pump involves the 2 1/2" RL model where the maximum stresses are 1,052 psi. Using the same maximum stress concentration factor of 3 results in low stress intensity values less than 4,000 psi leaving a safety margin of at least 10.

The 2" RL model does have a shrink fit and can develop stresses high enough to fracture an improperly heat treated Pressure Reducing Sleeves.

This narrows the customers with potentially defective pressure reducing sleeves to one customer who has been notified.

Sincerely,

DRESSER INDUSTRIES, INC.
Dresser Pump Division

Darrell J. Moyer
Quality Assurance Manager

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