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UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF INSPECTION AND ENFORCEMENT  
WASHINGTON, D.C. 20555

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IE Bulletin No. 79-15

## DEEP DRAFT PUMP DEFICIENCIES

### Description of Circumstances:

On October 20, 1978, Commonwealth Edison Company reported that manufacturing deficiencies had been identified in new high pressure core spray, low pressure core spray, and residual heat removal pumps manufactured by Ingersoll-Rand (I-R) Company, Cameron Pump Division.

Each of these pumps is a vertical turbine pump with impellers located in bowls in a sump or a self contained barrel. The motor (prime mover) is located at the highest pump elevation to take into account maximum flooding at the site or space considerations. The suction is at the lower end of the pump while the discharge head is just below the driver. Bearings supporting the vertical shaft segments (usually 5 to 10 segments) are either self lubricated, force fed (lubricated by fluid being pumped), or oil lubricated and maintained within their own isolated system. These pumps are designated as "Deep Draft". Figures 1&2 show typical outlines of such pumps.

The internal deficiencies, identified through dimensional and visual inspections were as follows:

#### Low Pressure Core Spray Pumps (I-R Model No. 29APKD-5) (Date of Manufacture - February 1973)

- . Loose impeller bolts and bolts improperly staked
- . Loose key - keyway fit
- . Excessive runout on pump shaft
- . Bearing showed wear
- . Bearing clearance exceeded recommended tolerance
- . Coupling thread galled
- . Wear ring clearance out-of-specification
- . Impeller-to-shaft clearance out of specification
- . Cracks found in second-and-third-stage impellers
- . Stuffing box bushings were severely galled

#### High Pressure Core Spray Pumps (I-R Model No. 12X20KD) (Date of Manufacture - September 1972)

- . Bearing clearance exceeded recommended tolerance
- . Wear ring clearance out-of-specification
- . Bearings showed wear

- . Bearing loose in casing
- . Excessive runout on pump shaft
- . Wear ring lock screws missing on eighth stage
- . Shrink fit bearing came out of casing during pump shaft removal - casing sleeve socket found to be egg shaped

Residual Heat Removal Pumps (I-R Model No. 29APKD-3) (Date of Manufacture - December 1972)

- . Loose impeller bolts and bolts not properly staked
- . Excessive runout on pump shaft
- . Bearing found cracked
- . Bearing clearance out-of-specification
- . Couplings cut because galling prevented disassembly
- . Wear ring clearance out-of-specification

The above deficiencies were identified at a facility under construction. In 1978, similar deficiencies in deep draft pumps were identified at three other facilities (North Anna 1 & 2, Surry 1 & 2, Beaver Valley 1). Problems with these pumps involved design and workmanship deficiencies which required extensive inspection, replacement of parts and major redesign. The manufacturers involved in these cases were Ingersoll-Rand, Bingham-Willamette and Byron Jackson. Some of the measures taken to assure pump operability at these locations included:

1. Pump shaft bearing redesign
2. Column redesign (stiffening) to improve vibration response
3. Upgraded pump alignment procedures
4. Pump fluid inlet condition reevaluation and redesign
5. Extensive testing

The observed deficiencies spanning the past 1 1/2 years indicate that pumps of this class may not be sufficiently reliable particularly when utilized in ECCS and RHR applications where long term cooling capability is required following a LOCA or similar event.

Action to be Taken by Licensees and Permit Holders:

All holders of reactor operating licenses and construction permits shall provide the following information within 60 days of this letter.

1. The number of deep draft pumps similar to those shown in Figures 1 and 2 utilized in safety related applications in each facility.
2. Manufacturer, model, capacity and plant application.

3. Overall dimensions of pumps.
4. Summary of startup, testing and routine maintenance history.
5. Operational problems and major repair efforts.
6. The longest interval that each pump has been available for operation without corrective maintenance. Identify the number of cycles of operation during this interval, the duration of each cycle and the operating mode(s) (recirculation, rated flow, etc.). Identify the longest continuous operation at or near rated flow conditions for each pump and the status of the pump operability at the end of the run.

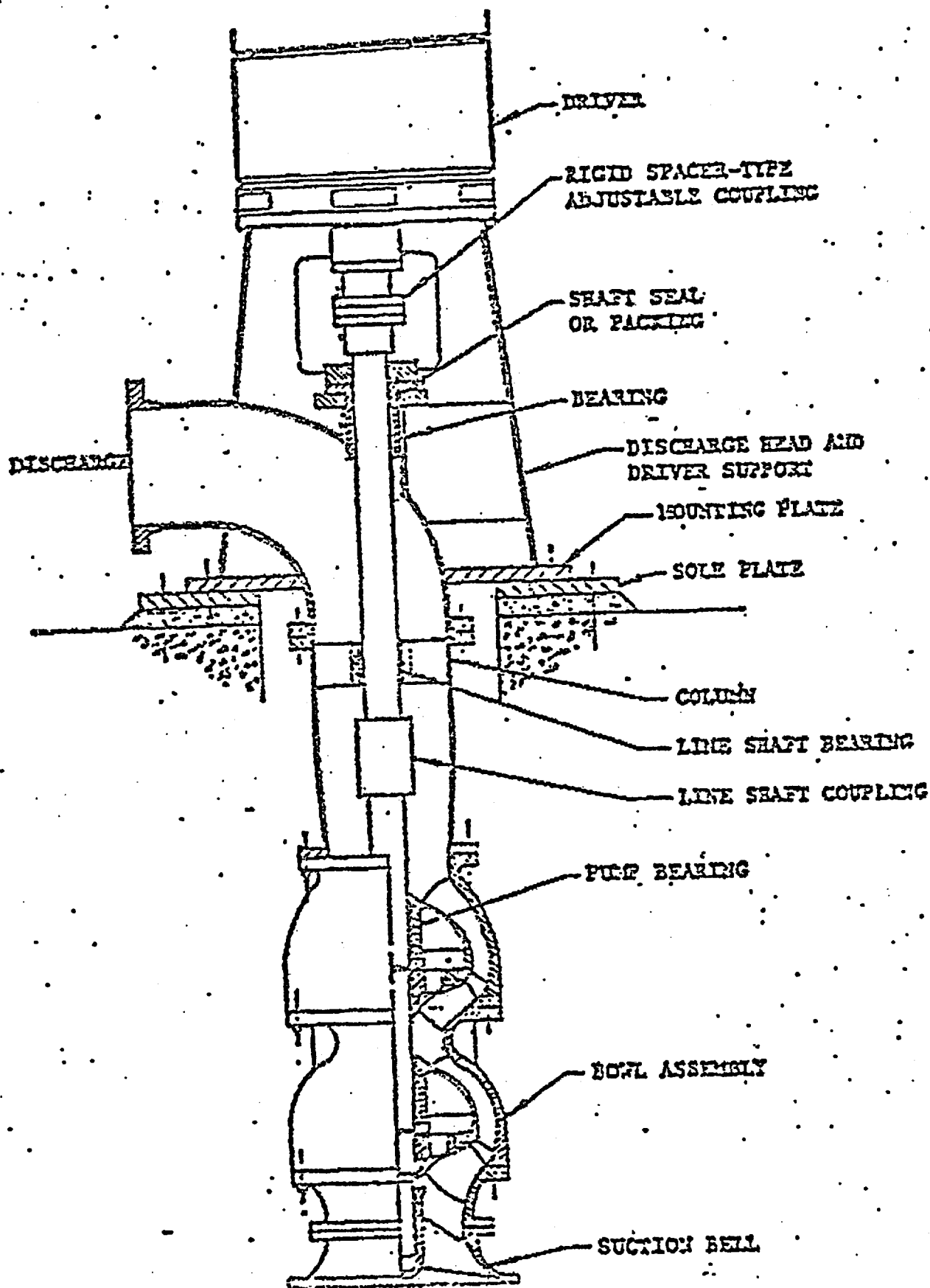
In addition licensees shall accumulate and make available for inspection at the licensees plant site the following information on the above identified pumps.

1. Drawings, sectional assemblies and parts list.
2. Detailed history of pump maintenance (alignment, parts replacement, etc) including bearing wear data, replacement frequency and a comparison with the manufacturers rated life for wearing surfaces.
3. Quality assurance and reliability testing requirements.
4. Design specifications
5. Results of tests performed during operation or prior to licensing.
6. Details of the procedures used to align the pump column.

For those cases where the maintenance or operating history of a particular pump indicates that the design specifications are not being met, initiate appropriate actions that will demonstrate conformance to design requirements. Provide a description of planned actions within 60 days including a schedule for implementation of any actions that will not be completed within 120 days. In addition describe any planned or completed tests involving long term operation of prototypes or pumps of similar design, which demonstrate the long term operability of such deep draft pumps at your facility.

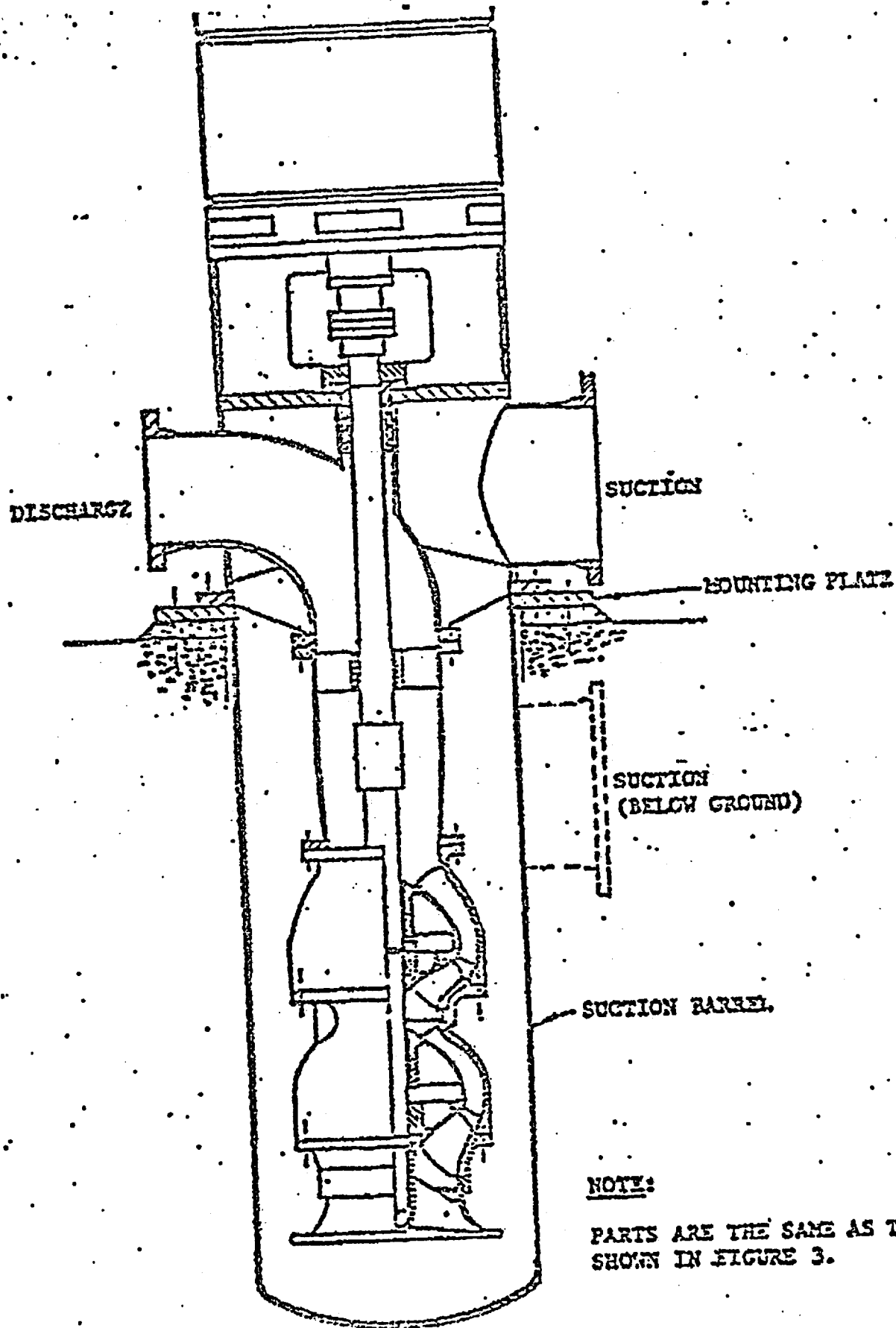
Approved by GAO, B180225 (R0072), clearance expires 7/31/80. Approval was given under a blanket clearance specifically for identified generic problems.

Enclosure:  
Figures 1 and 2



VERTICAL TURBINE PUMP

FIGURE 4



NOTE:

PARTS ARE THE SAME AS THOSE  
SHOWN IN FIGURE 3.

CROSS SECTION OF PUMP  
AND SUCTION BARREL

FIGURE 2.

LISTING OF IE BULLETINS  
ISSUED IN LAST TWELVE MONTHS

Bulletin No.	Subject	Date Issued	Issued To
79-14	Seismic Analyses for As-Built Safety-Related Piping System	7/2/79	All Power Reactor facilities with an OL or a CP
79-13	Cracking In Feedwater System Piping	6/25/79	All PWRs with an OL for action. All BWRs with a CP for information.
79-02 (Rev. 1)	Pipe Support Base Plate Designs Using Concrete Expansion Anchor Bolts	6/21/79	All Power Reactor Facilities with an OL or a CP
79-12	Short Period Scrams at BWR Facilities	5/31/79	All GE BWR Facilities with an OL
79-11	Faulty Overcurrent Trip Device in Circuit Breakers for Engineered Safety Systems	5/22/79	All Power Reactor Facilities with an OL or a CP
79-10	Requalification Training Program Statistics	5/11/79	All Power Reactor Facilities with an OL
79-09	Failures of GE Type AK-2 Circuit Breaker in Safety Related Systems	4/17/79	All Power Reactor Facilities with an OL or CP
79-08	Events Relevant to BWR Reactors Identified During Three Mile Island Incident	4/14/79	All BWR Power Reactor Facilities with an OL
79-07	Seismic Stress Analysis of Safety-Related Piping	4/14/79	All Power Reactor Facilities with an OL or CP
79-06B	Review of Operational Errors and System Misalignments Identified During the Three Mile Island Incident	4/14/79	All Combustion Engineering Designed Pressurized Water Power Reactor Facilities with an Operating Licensee

LIST OF IE BULLETINS  
ISSUED IN LAST TWELVE MONTHS

Bulletin No.	Subject	Date Issued	Issued To
79-06A (Rev 1)	Review of Operational Errors and System Misalignments Identified During the Three Mile Island Incident	4/18/79	All Pressurized Water Power Reactor Facilities of Westinghouse Design with an OL
79-06A	Review of Operational Errors and System Misalignments Identified During the Three Mile Island Incident	4/14/79	All Pressurized Water Power Reactor Facilities of Westinghouse Design with an OL
79-06	Review of Operational Errors and System Misalignments Identified During the Three Mile Island Incident	4/11/79	All Pressurized Water Power Reactors with an OL except B&W facilities
79-05A	Nuclear Incident at Three Mile Island	4/5/79	All B&W Power Reactor Facilities with an OL
79-05	Nuclear Incident at Three Mile Island	4/2/79	All Power Reactor Facilities with an OL and CP
79-04	Incorrect Weights for Swing Check Valves Manufactured by Velan Engineering Corporation	3/30/79	All Power Reactor Facilities with an OL or CP
78-12B	Atypical Weld Material in Reactor Pressure Vessel Welds	3/19/79	All Power Reactor Facilities with an OL or CP
79-03	Longitudinal Welds Defects In ASME SA-312 Type 304 Stainless Steel Pipe Spools Manufactured by Youngstown Welding and Engineering Co.	3/12/79	All Power Reactor Facilities with an OL or CP
79-02	Pipe Support Base Plate Designs Using Concrete Expansion Anchor Bolts	3/2/70	All Power Reactor Facilities with an OL or CP

LISTING OF IE BULLETINS  
ISSUED IN LAST TWELVE MONTHS

Bulletin No.	Subject	Date Issued	Issued To
79-01A	Environmental Qualification of Class IE Equipment (Deficiencies in the Environmental Qualification of ASCO Solenoid Valves)	6/6/79	All Power Reactor Facilities with an OL or CP
79-01	Environmental Qualification of Class IE Equipment	2/8/79	All Power Reactor Facilities with an OL or CP
78-14	Deterioration of Buna-N Component In ASCO Solenoids	12/19/78	All GE BWR facilities with an OL or CP
78-13	Failures in Source Heads of Kay-Ray, Inc., Gauges Models 7050, 7050B, 7051, 7051B, 7050, 7060B, 7061 and 7061B	10/27/78	All general and specific licensees with the subject Kay-Ray, Inc. gauges
78-12A	Atypical Weld Material in Reactor Pressure Vessel Welds	11/24/78	All Power Reactor Facilities with an OL or CP
78-12	Atypical Weld Material in Reactor Pressure Vessel Welds	9/29/78	All Power Reactor Facilities with an OL or CP
78-11	Examination of Mark I Containment Torus Welds	7/21/78	BWR Power Reactor Facilities for action: Peach Bottom 2 and 3, Quad Cities 1 and 2, Hatch 1, Monticello and Vermont Yankee