Hayward Tyler
PUMP COMPANY

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P. O. Box 492
80 Industrial Parkway
Burlington, Vt. 05402
(802) 863-2351

April 14, 1982

Mr. Richard C. DeYoung
Director, Office of Inspection
and Enforcement
U.S. Nuclear Regulatory Commission
4350 East-West Highway
Bethesda, Maryland 20555

Dear Mr. DeYoung:

Re: Hayward Tyler Pump Company --
Field Tests and Inspections

I have received your letter of March 25. In the third paragraph of that letter, you request that the Hayward Tyler Pump Company (HTPC) confirm certain NRC assumptions about the Company's business activities. I will address your requests for confirmation in the order presented.

(1) The "List of Domestic Customers of Hayward Tyler Nuclear Code Pumps" on page 2 of your letter appears to depart in certain respects from the list of Code pump utilization given to Mr. Potapovs of the Region IV staff in January, 1982. In this regard, I call your particular attention to the following: (a) the list provided to Mr. Potapovs shows pumps to be utilized at Hope Creek 1 as well as Hope Creek 2; (b) the Hartsville plants are designated by TVA as A-1, A-2, B-1, and B-2, rather than as 1 or 2; and (c) as shown in the list given Mr. Potapovs, we have sold nuclear Code pumps for use only in unit 1 at the Forked River site, not any other unit at that site. Based on HTPC's most recent review of the Company's contract documents, HTPC believes that its nuclear Code pumps are to be utilized at River Bend 1 but not River Bend 2, at Braidwood but not Byron, and at Yellow Creek Units 1 and 2. The available contract documents also indicate that the use of HTPC nuclear Code pumps at Palo Verde may not be limited to Unit 2.

I should point out, however, that HTPC is wholly dependent upon its customers for information concerning the intended application of nuclear Code pumps manufactured by the Company. Accordingly, while HTPC can, and has, provided NRC with the most accurate information regarding pump destination available to it, the Company cannot control the use its customers may decide to make of any particular pump sold to them by HTPC. As demonstrated by the foregoing paragraph, this feature is particularly likely to manifest itself at power station sites where more than one generating unit is located.

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PUMP COMPANY

(2) Some of the pumps supplied for use at the Hope Creek Station were manufactured to ASME Class 2 requirements. Those pumps so manufactured are designated by "CL-2" in the column labeled "National Board No." on the list given to Mr. Potapovs in January. In addition, 4 pumps for Philadelphia Electric, Limerick 1 and 2, National Board Numbers 220, 222, 224, and 226 are ASME Class 2 pumps. All remaining nuclear Code pumps on that list supplied were manufactured to ASME Class 3 requirements.

(3) Your understanding that HTPC has supplied spare parts for use in nuclear Code pumps is correct. On March 12, I sent you a list of all Code (our Quality Level 1) parts manufactured by HTPC for use in nuclear Code pumps, including pumps not manufactured by HTPC. Please refer to that list.

The Company has taken note of the statement in your letter that NRC is unable to evaluate the adequacy of the actions proposed by HTPC on March 10 until your investigation of the allegations concerning the Company's manufacture of nuclear grade pumps is completed. HTPC believes that, in light of what it hopes will be the early completion of NRC's investigation, immediately advising the Company's customers of recommendations of additional tests and inspections would be a premature and pointless exercise, except in the case of those two operating facilities (Oconee and Salem 1) using HTPC nuclear Code pumps. HTPC has already communicated with all its Code pump customers concerning the allegations. A copy is attached.

Sincerely,

HAYWARD TYLER PUMP COMPANY

Ben P. Lyons
Chief Executive

BPL/gem
Attach.

Hayward Tyler
PUMP COMPANY

P. O. Box 492
80 Industrial Parkway
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(802) 863-2351

April 13, 1982

LETTER SENT TO. CODE PUMP CUSTOMERS.

As you are most probably aware, the Hayward Tyler Pump Company (HTPC) is currently the subject of an inquiry by the NRC. This inquiry stemmed from allegations made by five of the Company's ex-employees, all of whom left HTPC more than a year ago, concerning purported failures to adhere to the Company's Quality Assurance program. These allegations were made to Congressman Edward J. Markey (D-Mass.) and to the press. Congressman Markey asked the NRC to conduct a comprehensive investigation. HTPC also asked the NRC for a full and complete audit.

In keeping with our desire that you be accurately informed on the facts, I am enclosing a copy of a letter to Congressman Markey from Marcus A. Rowden, counsel for HTPC in this matter. The enclosed letter summarizes the conclusions reached by Mr. Rowden's law firm and the technical experts working with it in the separate inquiry into these allegations conducted on behalf of the NRC. This letter was included in the record of the hearing held by Congressman Markey on April 6 concerning the NRC's investigation of the allegations.

Mr. Rowden, as you may know, was formerly Chairman of the Nuclear Regulatory Commission. HTPC asked Mr. Rowden and his law firm to conduct a separate inquiry into the merits of the allegations to assure that the relevant evidence was developed and that it was fairly and competently evaluated. To provide technical assistance, Mr. Rowden's firm retained the services of Systems Research Applications Corporation and its President, Dr. Ernst Volgenau, former NRC Director of Inspection and Enforcement.

The separate inquiry focused on the merits of the issues to which NRC attached primary importance. As set forth in the enclosed letter, the conclusions are that the ex-employees' allegations regarding the safety and reliability of HTPC pumps are not substantiated and that the Company did not withhold any records from the NRC nor falsify any records, as alleged.

Hayward Tyler
PUMP COMPANY

The NRC inquiry is continuing and its report has yet to be issued. The April 6 hearing was not intended to address the merits of the allegations. However, according to reports in the public press, various NRC representatives have previously stated that NRC's investigation failed to uncover any indication that any pumps were unacceptable and that the deficiencies in paperwork "were not very significant and didn't really have any bearing on the quality of workmanship that went into the pumps themselves."

We believe that we make products to the highest quality standards and that our pumps are among the safest and most reliable in the industry. Many of the press reports on this matter have been fragmentary and incomplete. The enclosure, in our view, is a straightforward summary of relevant facts and responsible conclusions. As such, we hope it will be helpful. If you wish any additional information, please do not hesitate to contact me.

Sincerely,

David J. Woodcock
Vice President, Manager of
Engineering and Customer Service

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WRITER'S DIRECT NUMBER IS

OUR REFERENCE

July 30, 1982

Hand Deliver

Mr. Roger Fortuna
U.S. Nuclear Regulatory Commission
4350 East-West Highway
East-West West Building
5th Floor -- Room 568
Bethesda, Maryland

Re: Hayward Tyler Pump Company

Dear Roger:

Enclosed are materials which were prepared by Hayward Tyler Pump Company ("HTPC") relating to the inspection and investigation of HTPC. As we have stated to you previously, these documents were generated by HTPC, and we consider them HTPC documents and not in any way Nuclear Regulatory Commission documents. We expect that these documents will be returned to us immediately after your review of them.

Very truly yours,

John T. Boese

John T. Boese

JTB:dlg
Enclosures

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Ultrasonic Testing for HTPC by Trutom

DATE	MATERIAL	HTPC CONTRACT
1/11/80	Bar Stock A479-347	5-0173-1073
10/1/80	Shafting A479-347	5-0273-3871
10/23/80	Plate SA182 304	PO 53993-3957
12/1/80	Shafting A276 316	2-0173-8274
1/26/81	Shafting A322 4140	2-0173-8166

Mag Testing for HTPC by Trutom

DATE	MATERIAL	HTPC CONTRACT
8/10/79	Steel Bar	3860
9/21/81	Carbon Steel	2-0278-55040
11/6/81	Carbon Steel/Bronze	2-0278-55052
1/20/82	Carbon Steel	183A7795
3/22/82	Carbon Steel	183A7795
6/8/82	Carbon Steel	55100
1/15/80	Steel Bar	5-0276-3882

Mag Testing Vermont Air National Guard - Off Site

DATE	MATERIAL	HTPC CONTRACT
6/11/81	Dynalloy	3876
	Coated	3900
	Shaft	

Hayward Tyler
PUMP COMPANY

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P. O. Box 492
80 Industrial Parkway
Burlington, Vt. 05402
(802) 863-2351

July 28, 1982

Mr. Roger Fortuna
Acting Chief of Investigations
Office of Inspection & Enforcement
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Hayward Tyler Pump Company (HTPC)

Dear Mr. Fortuna:

During their visit to HTPC's Burlington plant the week of July 12, Messrs. Dromerick and Peranich of your staff asked for HTPC's analysis of certain matters. The subject matters involved certain N-3 pumps manufactured for use at the Pilgrim 2 nuclear generating facility and the anti-rotation pin in the casing wear ring in pumps produced under Shop Orders 8105/06. The requested analyses are enclosed.

HTPC calls your attention to the fact that these analyses consist of proprietary engineering and design information. HTPC incurred significant expenses in obtaining and (in some cases) creating this information, and it would be of significant value to HTPC's competitors. Accordingly, HTPC expects that NRC will not release this information to the public under any circumstances. Should NRC receive a request to release the enclosed analyses, HTPC expects that the agency will notify the Company immediately, and at least ten working days before the agency makes any decision with respect to such request.

Sincerely,

B.P. Lyons
Chief Executive

BPL/gem

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Hayward Tyler
PUMP COMPANY

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7/28/82

Plant: Boston Edison Pilgrim Unit #2

Service: Equipment Drain Pumps

Pump Type: Hayward Tyler Type N3, Size 1-1/2 x 2 x 7 (BH1)

ABSTRACT

During 1977 Hayward Tyler developed a pump product line for nuclear auxiliary and radwaste system applications. This range of pumps, which comprises fourteen (14) sizes, was named "N3". The N3 range of pumps is an end suction, vertically split configuration with a cantilever shaft/bearing arrangement designed for low stress/deflection and high bearing life. The range of 14 pumps is subdivided into 3 groups, i.e., BH1, BH2 and BH3, according to the bearing housing associated with each pump unit. See Figure 1.0 for a sectional view of the BH1 group.

The first HTPC pumps of this range became available for testing during the second quarter of 1978. These pumps were of sizes 1-1/2 x 2 x 7 N3 (BH1) and 2 x 3 x 10 N3 (BH2), two of each size, and were to be shipped to the Boston Edison, Pilgrim 2 generating facility. (This analysis is limited to the BH1 size.) The pumps were all hydrostatically and performance tested, during which vibration and bearing temperature readings were taken and recorded.

The initial BH1 bearing design was comprised of a cylindrical roller radial bearing (NU208) and a single row deep groove split inner race thrust bearing (QJ308). During assembly of the Boston Edison BH1 pumps, a considerable amount of radial displacement was observed at the impeller. HTPC determined that this excessive displacement was due to internal clearances at the anti-friction bearing. In an effort to remedy this problem, a number of different bearing configurations were tested. (See Hayward Tyler Report dated June 28, 1978, attached). As a direct result of these tests, the bearing design in the Boston Edison BH1 pumps was changed to incorporate a single row deep groove ball radial bearing (SKF 6208). The thrust bearing (QJ308) remained unchanged from the original bearing design.

It was recognized that, although this new bearing combination was acceptable for the comparatively lightly loaded Boston Edison BH1 pumps (1-1/2 x 2 x 7, which has the least load of all the BH1 sizes), it was unlikely that such combination was acceptable for the full range of BH1 pumps, especially not for such pump sizes with higher loads as the 1-1/2 x 3 x 8 or the 2 x 3 x 8 sizes. Accordingly, the Boston Edison pumps were shipped on August 1, 1978, but the bearing investigation regarding the BH1 pump range continued thereafter.

After the Boston Edison pumps had been shipped, additional pumps of the initial BH1 bearing configuration (including some of the 1-1/2 x 3 x 8 size) were manufactured for other contracts and became available for testing. The 1-1/2 x 3 x 8 pump size exhibits the second highest load conditions of the BH1 group. During performance tests of these larger size pumps, contact of the rotating impeller and the stationary case ring was observed. As a result of the ongoing bearing investigation program, HTPC concluded that the initial design of a single row

deep groove split inner race ball bearing (QJ308) for the thrust bearing did not provide the rotating element sufficient stiffness during the maximum design operating conditions. To overcome this insufficiency of stiffness, the BH1 design was changed to incorporate a double row angular contact bearing as the thrust bearing, the same bearing configuration originally incorporated into the BH2 and BH3 designs. Again, based upon the relatively light hydraulic load of the Boston Edison BH1 pumps, HTPC concluded that these pumps would operate satisfactorily with the bearing configuration as shipped.

This paper provides information concerning the Boston Edison 1-1/2 x 2 x 7 pumps in the form of additional technical detail to that generated at the time the redesign of those pumps' bearing configuration took place. The paper reconfirms HTPC's earlier determination that the bearing configuration as supplied in the Boston Edison BH1 pumps (SKF 6208 for the radial bearing and SKF QJ308 for the thrust bearing) is satisfactory for those pumps.

Boston Edison BH1 Pumps

Service:	Equipment Drain
Pump Size:	1-1/2 x 2 x 7 (BH1)
Rating:	50 GPM at 185 FT
Speed:	3500 RPM

Seismic OBE condition and DBE condition

The following analysis provides further justification for retaining the bearing configuration fitted in the 1-1/2 x 2 x 7 Boston Edison pumps. The factors considered in this analysis are those both necessary and sufficient for reaching such conclusion:

1. Shaft Displacement
2. Bearing Life and Temperature
3. Shaft Stress
4. Materials
5. Performance Test

1. Shaft Displacement

Shaft displacement is a result of the combination of deflection due to hydraulic and dead weight loads plus the displacement due to anti-friction bearing clearance. No shaft loads are transmitted from the motor to the pump, or vice versa, because a flexible coupling installed between these components precludes such transmission.

Hydraulic (i.e., dynamic) loads encountered within a centrifugal pump are both axial and radial. Axial loads, however, do not increase shaft displacement. In fact, axial loads add some degree of stiffness to the thrust bearing, thereby tending to reduce shaft displacement; but for purposes of the evaluation in this paper the beneficial effects from axial loads will not be taken into account. Hydraulic radial loads result from pressure distribution around the periphery of the impeller within the volute section of the casing. When a pump's flow differs from its best efficiency point (BEP), this pressure distribution becomes unsymmetrical and shaft deflection is increased. Dead weight (static) loads are simply the result of the weight of the impeller and the shaft overhang.

As noted above, hydraulic and dead weight loads are combined and the total becomes one element in computing total potential shaft deflection. Figure 2.0 sets forth the loads and deflections, at various percentages of BEP, of the Boston Edison BH1 pumps compared to the more heavily loaded BH1 unit in which contact between the wearing surfaces was observed. To compute total potential shaft displacement, this deflection (computed based on loads) is added to shaft displacement due to the bearing clearances.

The HTPC report of June 28, 1978 (copy attached) states that, in Configuration No. 4 (used in the Boston Edison BH1 pumps), there was a radial deflection of .005 - .010 inches. This range of measurement was sufficiently accurate for that testing program and, viewed as stating total deflection in the radial plane, allowed shipment of the Boston Edison pumps with the Configuration No. 4 bearing design following unit performance tests. HTPC later conducted more definitive and exacting testing on shaft displacement due to bearing clearance. These tests, undertaken in August 1978 (copy of report attached), used bearings identical*/ to those used in Configuration No. 4 and showed radial deflection of .004 inch up and .006 inch down. This result is reconfirmed by reference to the bearing manufacturer's own published data on the radial internal clearances of its bearings. Combining that data with the shaft length of the 1-1/2 x 2 x 7 pumps, HTPC has computed a maximum radial displacement of .0054 inch (this computation appears in Figure 5.0, attached). The August 1978 testing and the computations using the bearing manufacturer's data make clear that the actual reading within the range obtained in the June 1978 testing must have been much closer to .005 inch than .010 inch.

Figure 3.0 (attached) plots on curves both total deflection based on loads and total shaft displacement at the impeller (i.e., from all loads plus displacement due to bearing clearances), using the .0054 inch figure derived from the bearing manufacturer's data. Figure 3.0 shows that the Boston Edison BH1 pumps should not exhibit contact of the rotating and stationary surfaces during operation. Furthermore, no such contact was observed in HTPC's in-house performance tests of those pumps.

2. Bearing Life and Bearing Temperature

The N3 range was designed for 50,000 hours L_{10} bearing life as determined by the Anti-Friction Bearing Manufacturers' Association (AFBMA) Standard. As the hydraulic loads for the Boston Edison BH1 pumps are low, the corresponding bearing life is high. As can be seen from Figure 4.0, bearing life for both radial and thrust bearings far exceeds this design criteria and will exceed all applicable industry requirements. Bearing temperature checks were performed on the Boston Edison BH1 pumps at near to shut valve condition (bearings at highest loaded point). Maximum bearing temperatures were 125°F for the radial bearing and 139°F for the thrust bearing (see June 28, 1978 test report), which are well within acceptance standards.

*/ See column 2 of the test report. That configuration uses the same thrust bearing QJ308 as in the Boston Edison BH1 pumps and a PRW 208S radial bearing. In accordance with AFBMA (Anti-Friciton Bearing Manufacturers' Association) standards, the PRW 208S bearing type is identical dimensionally in tolerances to the SKF 6208 bearing used as the radial bearing in the Boston Edision BH1 pumps.

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3. Shaft Stress

No additional shaft stress results from the displacement due to bearing clearances. Design shaft stress levels, therefore, remain valid.

4. Materials

As a design precaution to minimize the effect of wear ring rubbing, all pumps are supplied with opposing rings made of materials with a high differential in hardness so as to resist galling.

5. Performance Test

Full performance tests were conducted on the Boston Edison pumps in accordance with the Hydraulic Institute Standards and customer approved procedures. Performance tests were customer witnessed and included Head, Capacity, Horsepower, NPSH, Vibration and Temperature Checks. No unusual effects were encountered during these tests with the exception that, at one speed, one of the BH1 pumps did not meet the applicable standard of acceptability for the vibration test. The customer's representative, who witnessed the testing and was given the results, accepted the pump. Since the Test Engineer recorded a note "no unusual noise or vibration", the problem most probably lay in the testing loop connection rather than in the pump. In any event, HTPC will recommend that both the BH1 pumps be vibration tested again during commissioning, once they are installed and well prior to powerplant operations. Should commissioning tests confirm the validity of the high vibration reading obtained during performance testing, HTPC and its customer will take appropriate action to rectify the problem.

Conclusion

It is the opinion of HTPC that the Boston Edison BH1 pumps will perform as required by the Design Specification when operated and maintained in accordance with Hayward Tyler's Operating and Maintenance Manual.

Derek Clare
Chief Engineer

Norm Schreib
Design Engineer

DC/gm