



**ENGINE SYSTEMS, INC.**

175 Freight Road  
Rocky Mount, NC 27804

Telephone: 252/977-2720  
Fax: 252/446-1134

October 23, 2009

U.S. Nuclear Regulatory Commission  
Document Control Desk  
Washington, DC 20555-0001

Subject: 10CFR21 Reporting of Defects and Non-Compliance -  
Engine Systems, Inc. Interim Report No. 10CFR21-0098-INT, Rev. 0  
  
Amot Thermostatic Valve Element  
P/N: 9760X

Dear Sir:

Enclosed is our Interim Report 10CFR21-0098-INT, Rev. 0 for a 10CFR21 deviation evaluation about an Amot thermostatic valve element, P/N 9760X.

A copy of the report has been sent to the NRC.

Please sign below, acknowledging receipt of this report, and return a copy to the attention of Document Control at the address above (or, fax to number 252/446-1134) within 10 working days after receipt.

Yours very truly,

ENGINE SYSTEMS, INC.

Susan Woolard  
Document Control

**Please let us know if ANY of your mailing information changes - name of recipient, name of company/facility, address, etc. Mark the changes on this acknowledgment form and send to us by mail or FAX to the number above.**

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**Report No. 10CFR21-0098-INT**

Rev. 0: 10/23/09

**INTERIM REPORT  
10CFR21 REPORTING OF DEFECTS  
AND NON-COMPLIANCE**

COMPONENT: Amot thermostatic valve element  
P/N: 9760X

SYSTEM: Emergency Diesel Generator – lube oil & jacket water system

CONCLUSION: Not yet completed

Prepared By: \_\_\_\_\_

  
Engineering Manager

Date: \_\_\_\_\_

10/23/09

Reviewed By: \_\_\_\_\_

  
Quality Assurance Manager

Date: \_\_\_\_\_

10/23/09

REV	DATE	PAGE	DESCRIPTION
0	10/23/09		Initial issue.

**COMPONENT:**

Amot thermostatic valve element  
P/N: 9760X

**PURPOSE:**

This interim report is being issued because Engine Systems, Inc. (ESI) is not able to complete an evaluation of an identified deviation within the 60 day requirement of 10CFR21.21. The evaluation is expected to be completed no later than November 30, 2009.

**SUMMARY:**

ESI began an evaluation of a thermostatic valve element failure on August 24, 2009. Palo Verde Nuclear Plant notified ESI of the failure as a result of a failure analysis they were performing on a thermostatic valve that had been removed from the lube oil system of their 2A-EDG. The element was in service since April 2008 and Palo Verde verified operation of the element prior to installation.

The Palo Verde failure analysis determined that one of two elements within the valve was defective. The element failure was attributed to wax leakage past the diaphragm seal on one of two power pills within the element. Evidence of mechanical binding of the piston is believed to have caused the wax leakage. If the piston was jammed, the expanding wax could have over-pressurized the diaphragm seal leading to wax leakage. The failure analysis noted the following to support piston binding:

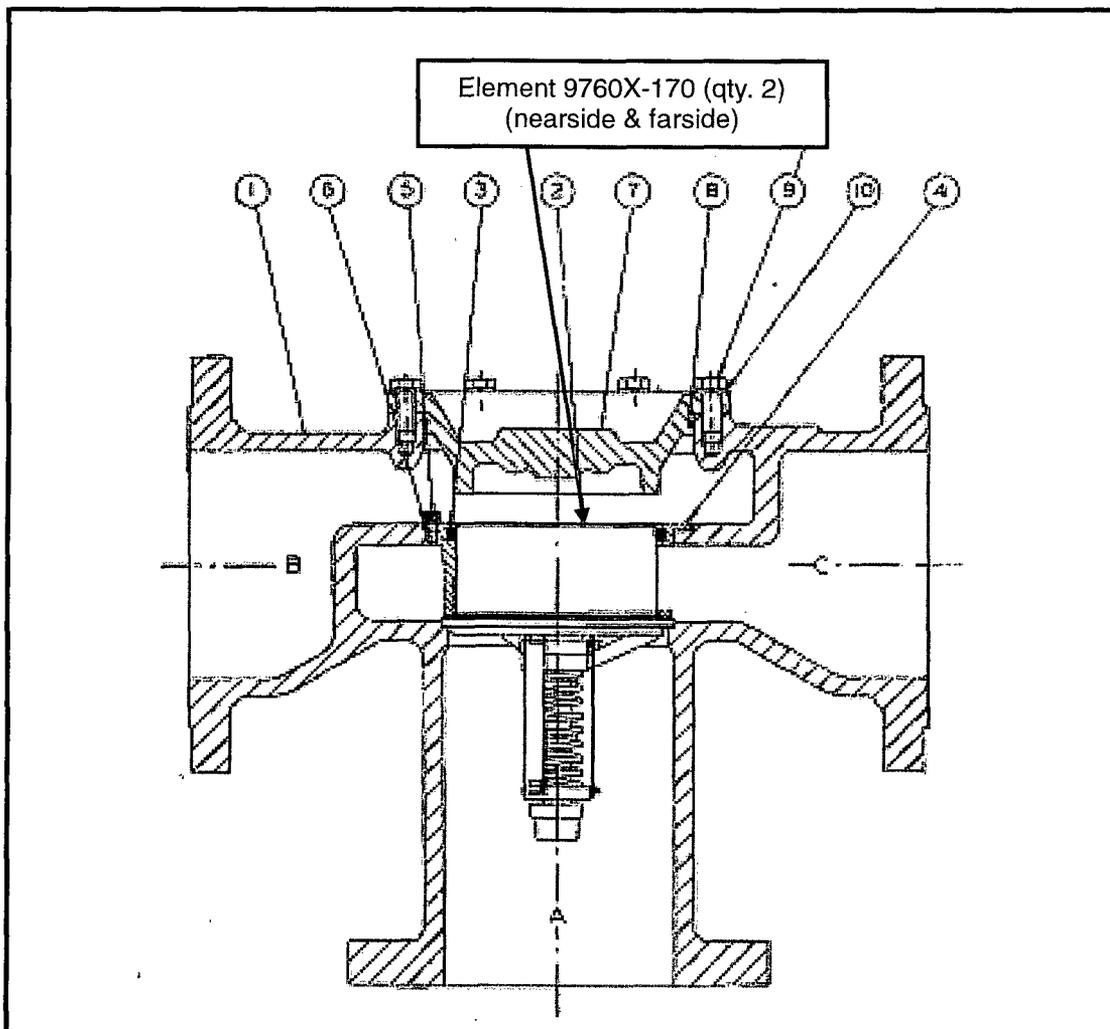
- The piston was initially difficult to remove from its guide tube.
- A gouge was observed on the piston surface.
- The rubber plug within the power pill exhibited brass machining chip debris.

ESI has been coordinating with Palo Verde and the manufacturer (AMOT) to complete our evaluation and to determine if this is a generic issue or if it is an isolated incident.

To date, no other similar failures with Amot thermostatic valves have been reported to ESI.

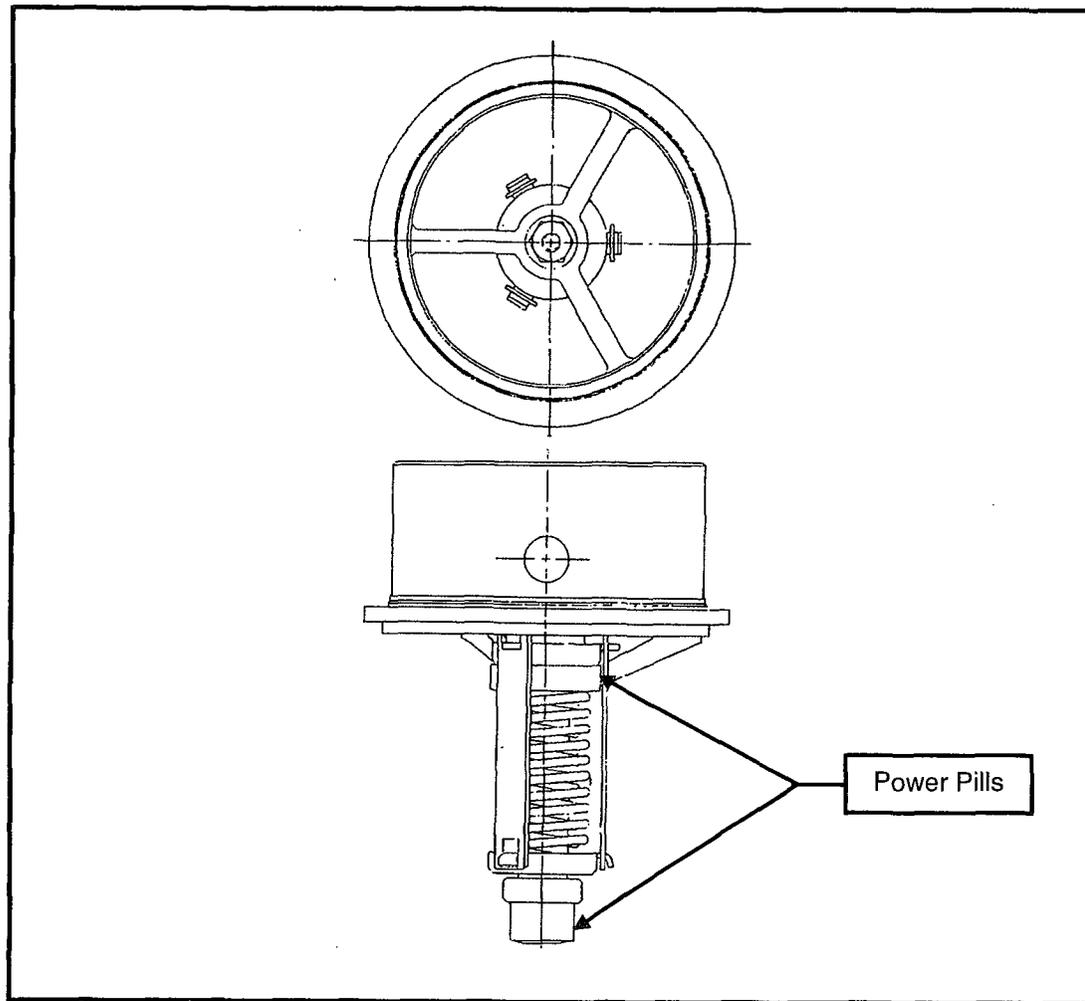
**Discussion:**

The Cooper Bessemer KSV-20T diesel engine uses one 6" thermostatic valve in the engine jacket water system and one in the engine lube oil system to regulate system temperatures during engine operation. The thermostatic valve is an Amot model 6HAS. Each valve uses 2 thermostatic elements, Amot type 9760X (Figure 1). The element being investigated for the Palo Verde application have a nominal temperature setting of 170°F and therefore the element part number is 9760X-170.



**FIGURE 1: AMOT THERMOSTATIC VALVE**

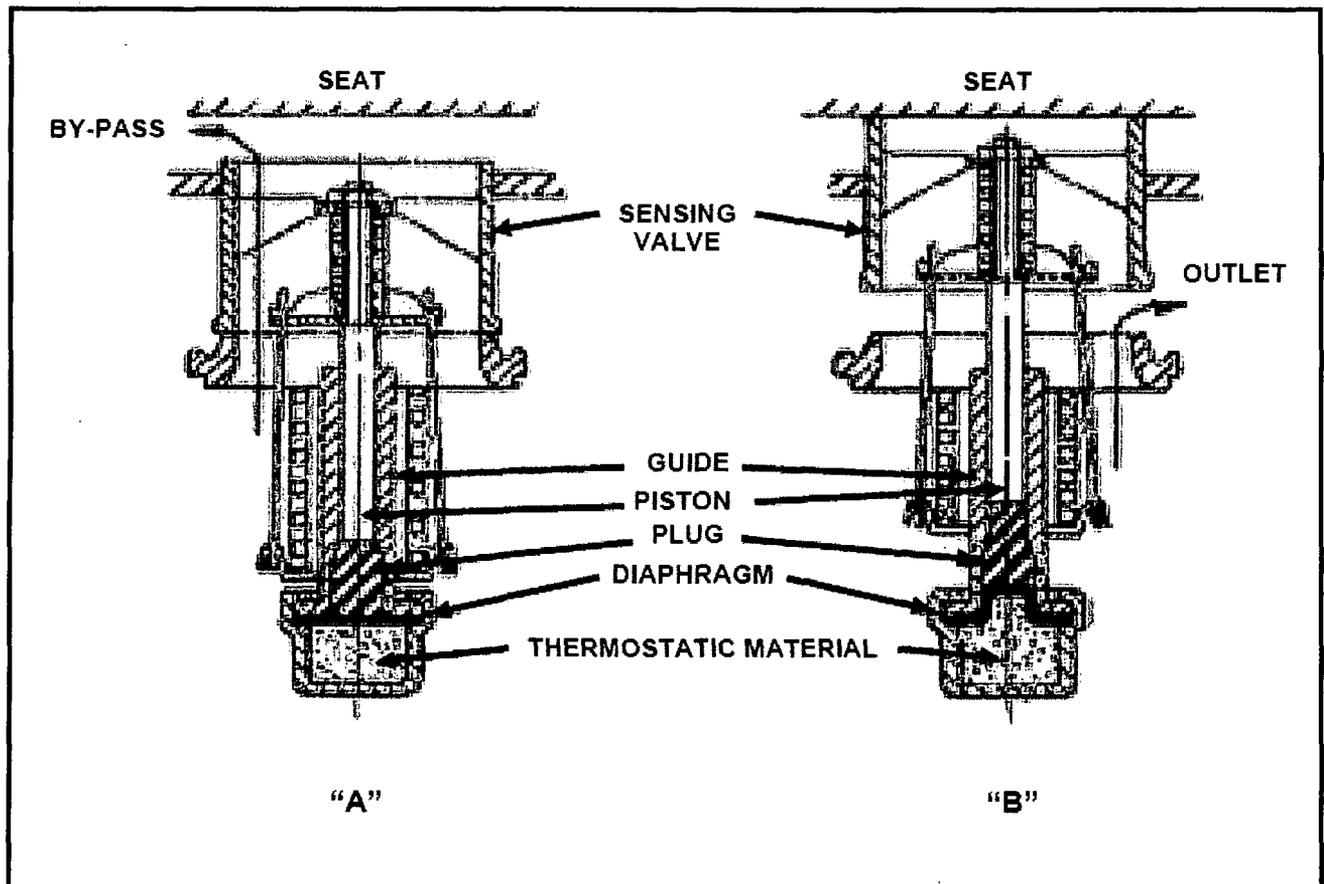
Each 9760X valve element contains two power pills (Figure 2). The power pills contain a temperature sensitive wax that expands with increasing temperature and provides the motive force to lift the element off of its seat.



**FIGURE 2 – VALVE ELEMENT 9760X**

Fig. 3 "A" shows an element assembly with the sliding valve in the cold position (the element shown only has one power pill, but the operating principal is the same as the two pill element). The fluid travels out the by-pass (Port B on the valve) as shown by the arrow.

Fig. 3 "B" shows the sliding valve moved up to the extended or warm position. The by-pass closes off as the sliding valve seats and the fluid is diverted to the outlet (Port C on the valve) as shown by the arrow. In actual operation, the sliding valve is normally in about the mid-position. When the wax material expands with rising temperature, the rubber plug is forced into a reduced diameter in the piston guide, which multiplies the movement of the piston by an extruding action.



**FIGURE 3 – ELEMENT OPERATION**