

Subcooling in Cycling Boilers

Purpose

This plant service bulletin provides customers with information concerning possible furnace tube failures caused by subcooling in drum type (RB) boilers that are subject to cycling operation and to provide recommendations for preventive action on a particular boiler.

Problem

Some cycling units experience longitudinal cracking of the lower furnace tubes, particularly adjacent to attachments. The cracks initiate on the inside diameter (ID) surface of the tubes and may not be visible from the outside until the cracks penetrate the complete tube wall. If the cracking goes undetected, a major tube leak problem may develop, requiring extensive lower furnace tube repair or replacement. Figure 1 shows a typical cracking location.

Cause

Following shutdowns, the lower furnace generally cools at a faster rate than the upper furnace. Upon starting up, when circulation is re-established in the furnace tubes, hot water in the windbox area of the furnace is rapidly displaced by cooler water from the lower furnace causing thermal shock to the tubes. The resulting thermal stresses are highest in the areas where the furnace tubes are restrained, such as at the filler bars shown in Figure 1, as well as where other attachments are welded

(continued on reverse side)

Figure 1:
Lower windbox tube failures

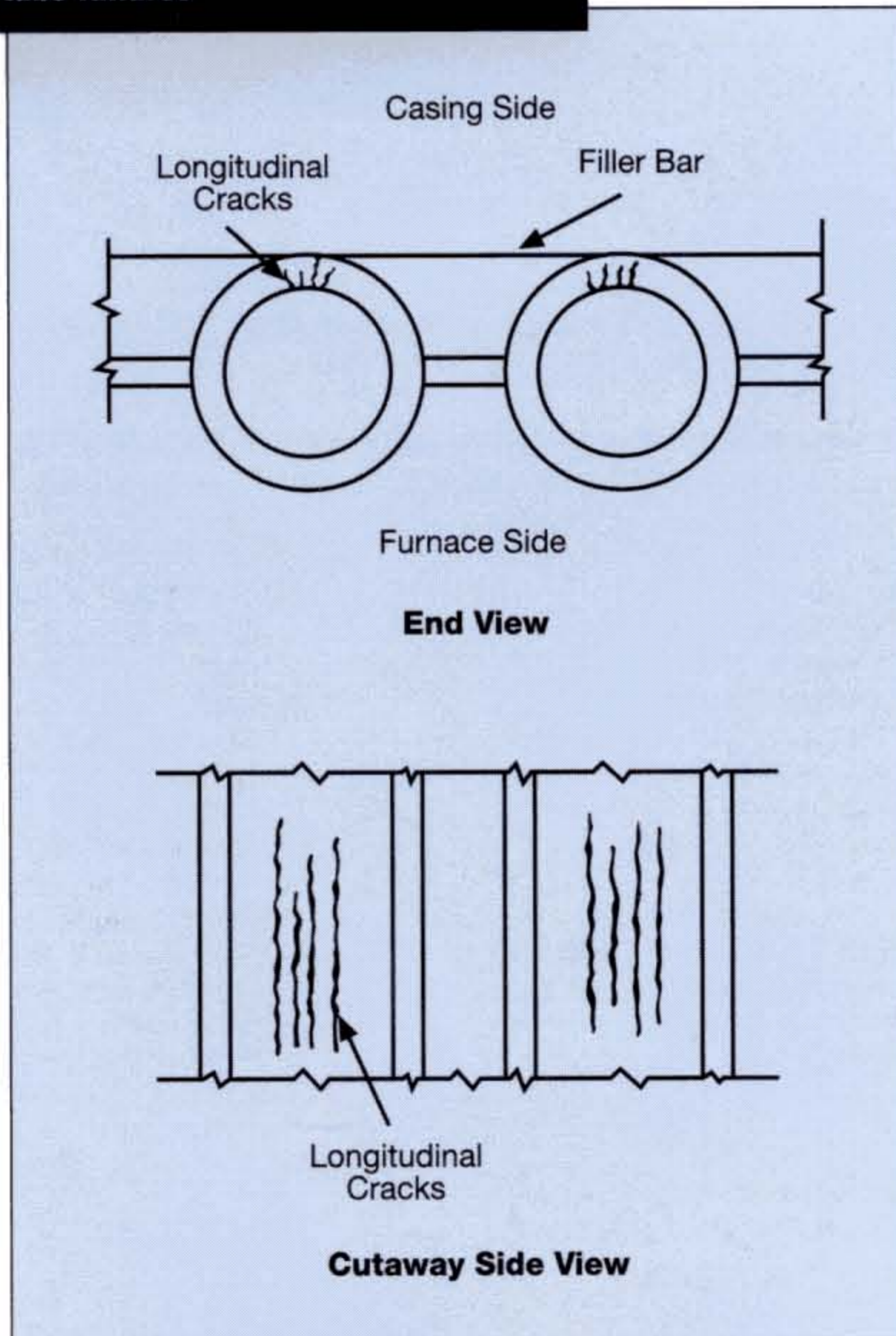
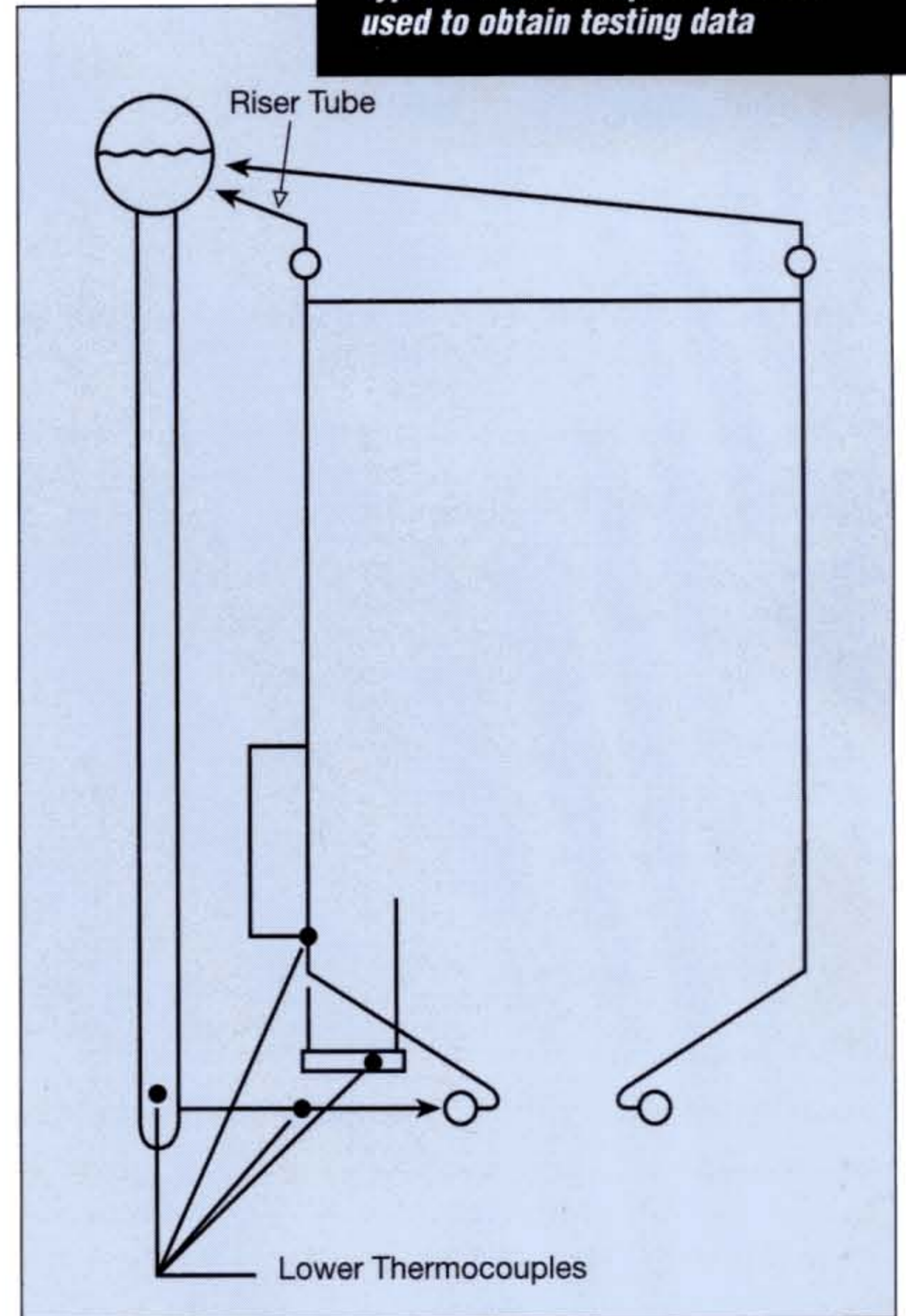


Figure 2:
Typical thermocouple locations used to obtain testing data



to the furnace tubes. These are the areas where the most severe problems have been observed. Due to the variety of operating conditions, the extent of the thermal shock experienced varies widely from unit to unit, and can occur in the absence of any weld attachments.

Recommendations

Units that cycle should be tested to evaluate the risk of failure and to determine necessary corrective actions. Detailed inspections should be carried out if test results indicate a problem is likely. The tests should evaluate temperature gradient information during boiler shutdowns and start-ups.

Figure 2 shows the typical locations of thermocouples in the lower furnace and on riser tubes, which

are used to obtain the required data. For consistency and proper interpretation of the data, readings should be obtained from at least four (4) overnight and two (2) weekend shutdowns. An engineering evaluation of the data is required to assess the data and develop a recommended course of action.

Support

If assistance is required in thermocouple location, testing, data evaluation and problem resolution, contact your nearest Babcock & Wilcox Field Engineering Service office.

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