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SUBJECT: Supplements 970930 & 1218 ltrs re weldments on opposed piston & Coltec-Pielstick emergency stand-by diesel gen-set lube-oil & jacket water piping sys.Burst testing concludes that welding of joints,adequate.Proprietary App A withheld.

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INTERIM LETTER

SUPPLEMENT NO.: 97-002-02

To: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC. 20555

From: Coltec Industries – Fairbanks Morse Engine Division (FMED)

Date: 3 March 1998

Subject: Weldments on Opposed Piston and Coltec-Pielstick Emergency Stand-By Diesel Gen-Set Lube-Oil and Jacket Water Piping Systems

This supplement to the Interim Letter dated 30 September 1997, and to supplement 97-002-01 dated 18 December 1997, is intended to inform the U.S. Nuclear Regulatory Commission, and the affected nuclear utilities on the progress of the root cause investigation, and corrective/preventative actions associated with the Coltec-FMED Part 21 File No. 97-002.

Supplement 97-002-01 stated that "Results from the burst test should be available by the end of January 1998, at which time the review of customer contract requirements should also be complete. A final letter of notification should be available by the end of February 1998.".

The burst testing portion of the investigation is complete. Twenty-two welded joints were individually pressurized between 2100 psig and 5000 psig, and then evaluated. A draft copy of the engineering report text is attached. The preliminary conclusion is that the welding of the joints is adequate for the service intended, and that no steps need to be taken to replace or rework piping runs in the field.

Yet to be completed are the metallurgical portion of the investigation, and the review of customer contract requirements. These are scheduled to be completed by the end of April 1998, at which time a final notification should be available.

The attached engineering report references appendices A through E. Appendix C exhibits photos of the sections of piping as received. Appendix D exhibits photos of the test sections after completion of the burst testing. Appendix E provides a summary of the detailed analysis of each of the tested joints, which includes metallurgical investigation results. These three appendices (C, D, and E) are not included in this supplement. They will be included in the final notification.

Sincerely,

Jeanne A. Conway
Jeanne A. Conway
Quality Assurance Engineer

For Paul Danyluk
Vice President, Engineering

Cc: M. Armfield
T. Gill
B. Hall

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Several methods of testing previously produced welded pipe joints were investigated. Of these methods, it was concluded that the burst test was the most likely to determine if a weld joint was adequate for the service intended. A test procedure was written outlining the method of doing the burst test. A copy of the test procedure (10 561 148) is attached as Appendix A. In summary, it was decided that if the test specimen were subjected to a very high pressure, one of several outcomes would be evident:

1. An inadequate weld would break apart under the extreme pressure of the burst test, which would subject the pipe and welded joints to 50 to 100 times the pressure they were intended to see in service. The limiting pressure was set at 5000 psig.

2. If the welded joints were adequate, the test would cause the pipe/tube to yield or break, indicating that the weld was at least as good as the parent material.

3. While the Burst Test would not address the case of repeated cyclical loading due to pressure or temperature fluctuations, it was felt that at the pressures at which the burst test was to be run, the existence of any inadequate weld would still be determined simply by the magnitude of the over-pressure.

Welded pipe joints were received from several sources, mostly Florida Power, whos units were being modified with a new radiator system. Others included Baltimore Gas and Electric, Virginia Electric and Carolina Power. A number of sections of pipe were also received from other locations, but too late to be put into this program.

Each joint was prepared by cutting it from the piping sections and adding a cap to one end. In the case of there not being a flange involved on the other end of a specimen, it was also closed on the other end with a cap having a hydraulic fitting and filling hole. On the joints involving flanges, a mating flange was prepared having an 'O' ring grove to provide a seal to the test specimen flange. This mating flange was also equipped with a hydraulic fitting and filling hole.

In the following descriptions, each test joint was assigned a letter to identify the joint. In addition, each joint was identified with a code indicating the source and type of test joint. The table immediately below shows the legend for the terminology.

TABLE I - Legend

Source:
FP = Florida Power; VP = Virginia Electric (VEPCO)
BG = Baltimore Gas and Electric; CP = Carolina Power.

Joint Type:
TU/FL = Tube (Mechanical Tubing - .125 wall) to Flange
TU/FI = Tube (.125 wall) to Pipe Fitting (.237 wall)
TU/TU = Tube to Tube (both .125 wall - usually mitered joints)
Pipe Fittings could include Elbows, Tees, Half-Els, and Reducers.
Flanges were generally welded to the tube/pipe inside and outside with fillet welds.

Otherwise, the joints are numbered chronologically for the source.

The term 'test joint' refers to the welded joint under investigation. Some sections of the piping were cut into more than one test joint. The diagram attached shows the general character of the pipe sections from which samples were taken.

BURST TEST RESULTS:

Joint A - FP-TU/FL-1

Joint was pressurized to 5000 psig (the test limit). Some deformation of the pipe was measured at .010" difference in the diameter after pressure was relieved than before pressure was applied. No cracking of the paint was evident. The pipe did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint B - FP-TU/FL-2

Joint was pressurized to 4700 psig and could be pumped no higher. The test flange was yielding and the pipe was also yielding. The pipe was .005" larger in diameter after pressure was relieved than it was before pressure was applied. The test flange was permanently deformed by being crowned approximately 1/8 inch. The pipe did not break and no leakage was noted at any of the welded joints, nor the flanged joint, including the 'test joint'.

Joint C - FP-TU/FL-3

Joint was pressurized to 2700 psig at which point is was not possible to pump up more pressure. The test flange was yielding due to the great radius to the bolt circle. There was no measureable deformation of the pipe. It is suspected that the 'O' ring installed in the test flange was beginning to weep due to the crowning of the test flange plate. The pipe did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint D - FP-TU/FL-4

Joint was pressurized to 2100 psig at which point is was not possible to pump up more pressure. The tube was yielding as evidenced by the cracking of the paint on the OD of the tube. Also, the tube was .058" larger in diameter after pressure was relieved than it was before pressure was applied. The tube did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint E - FP-TU/FL-5

Joint was pressurized to 4000 psig and could be pumped no higher. The tube was yielding as evidenced by the cracking of the paint on the OD of the tube. Also, the tube was .020" larger in diameter after pressure was relieved than it was before pressure was applied. The tube did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint F - FP-TU/FI-1

Joint was pressurized to 3000 psig at which point is was not possible to pump up more pressure. The tube was yielding as evidenced by the cracking of the paint on the OD of the tube. Also, the tube was .053" larger in diameter after pressure was relieved than it was before pressure was applied. The tube did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint G - FP-TU/FI-2

Joint was pressurized to 2500 psig at which point is was not possible to pump up more pressure. The tube was yielding as evidenced by the cracking of the paint on the OD of the tube. Also, the tube was .175" larger in diameter after pressure was relieved than it was before pressure was applied. The tube did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint H - FP-TU/FI-3

Joint was pressurized to 5000 psig (the upper limit) at which point is was not possible to pump up more pressure. The pipe was yielding as evidenced by some cracking of the paint on the OD of the pipe. Also, the pipe was .040" larger in diameter after pressure was relieved than it was before pressure was applied. The pipe did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint J - FP-TU/FI-4

Joint was pressurized to 5000 psig (the test limit). Some deformation of the pipe was measured at .002" difference in the diameter after pressure was relieved than before pressure was applied. No cracking of the paint was evident. The pipe did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint K - FP-TU/FI-5

Joint was pressurized to 4800 psig (near the test limit) at which point is was not possible to pump up more pressure. The pipe was yielding as evidenced by the cracking of the paint on the OD of the pipe. Also, the pipe was .040" larger in diameter after pressure was relieved than it was before pressure was applied. The pipe did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint L - FP-TU/TU-1

Joint was pressurized to 2400 psig at which point is was not possible to pump up more pressure. The tube was yielding as evidenced by the cracking of the paint on the OD of the tube. Also, the tube was .040" larger in diameter after pressure was relieved than it was before pressure was applied. The tube did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint M - FP-TU/TU-2

Joint was pressurized to 2700 psig at which point is was not possible to pump up more pressure. The tube was yielding as evidenced by the cracking of the paint on the OD of the tube. Also, the tube was .008" larger in diameter after pressure was relieved than it was before pressure was applied. The tube did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint N - FP-TU/TU-3

Joint was pressurized to 2250 psig at which point is was not possible to pump up more pressure. The tube was yielding as evidenced by the cracking of the paint on the OD of the tube. Also, the tube was .025" larger in diameter after pressure was relieved than it was before pressure was applied. The tube did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint P - BG-TU/FI-1

Joint was pressurized to 2700 psig at which point is was not possible to pump up more pressure. The tube was yielding as evidenced by the cracking of the paint on the OD of the tube. Also, the tube was .025" larger in diameter after pressure was relieved than it was before pressure was applied. The tube did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint R - BG-TU/FI-2

Joint was pressurized to 3400 psig at which point is was not possible to pump up more pressure. The tube was yielding as evidenced by the cracking of the paint on the OD of the tube. Also, the tube was .280" larger in diameter after pressure was relieved than it was before pressure was applied. The tube did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint S - VP-TU/FL-1

Joint was pressurized to 4100 psig and could be pumped no higher. The pipe was yielding as evidenced by the cracking of the paint on the OD of the pipe. Also, the pipe was .065" larger in diameter after pressure was relieved than it was before pressure was applied. The pipe did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint T - VP-TU/TU-1

Joint was pressurized to 4650 psig at which point is was not possible to pump up more pressure and the pressure began to decay. Upon examination of the 'test joint', a small crack had developed between the first weld pass and the second weld pass. Fluid was leaking from this crack in the weld.

No cracking of the paint on the OD of the pipe was noted and the pipe OD was not measured. No leaks were noted at any of the other welds.

Joint U - CP-TU/FL-1

Joint was pressurized to 4000 psig and could be pumped no higher. The tube was yielding as evidenced by the cracking of the paint on the OD of the tube. The tube was not measured before and after the testing. The tube did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint V - FP-TU/FI-6

Joint was pressurized to 5000 psig (the test limit). Some deformation of the pipe was noted by some cracking of the paint on the OD of the pipe. However, there was no measurable difference in the diameter after pressure was relieved than before pressure was applied. The pipe did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint W - FP-TU/FI-7

Joint was pressurized to 3200 psig at which point is was not possible to pump up more pressure. The tube was yielding as evidenced by the cracking of the paint on the OD of the tube. Also, the tube was larger in diameter after pressure was relieved than it was before pressure was applied. The tube did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint X - FP-TU/FI-8

Joint was pressurized to 3050 psig at which point is was not possible to pump up more pressure. The tube was yielding as evidenced by the cracking of the paint on the OD of the tube. Also, the tube was .060" larger in diameter after pressure was relieved than it was before pressure was applied. The tube did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

Joint Y - FP-TU/FI-9

Joint was pressurized to 3400 psig at which point is was not possible to pump up more pressure. The tube was yielding as evidenced by the cracking of the paint on the OD of the tube. Also, the tube was .200" larger in diameter after pressure was relieved than it was before pressure was applied. The tube did not break and no leakage was noted at any of the welded joints, including the 'test joint'.

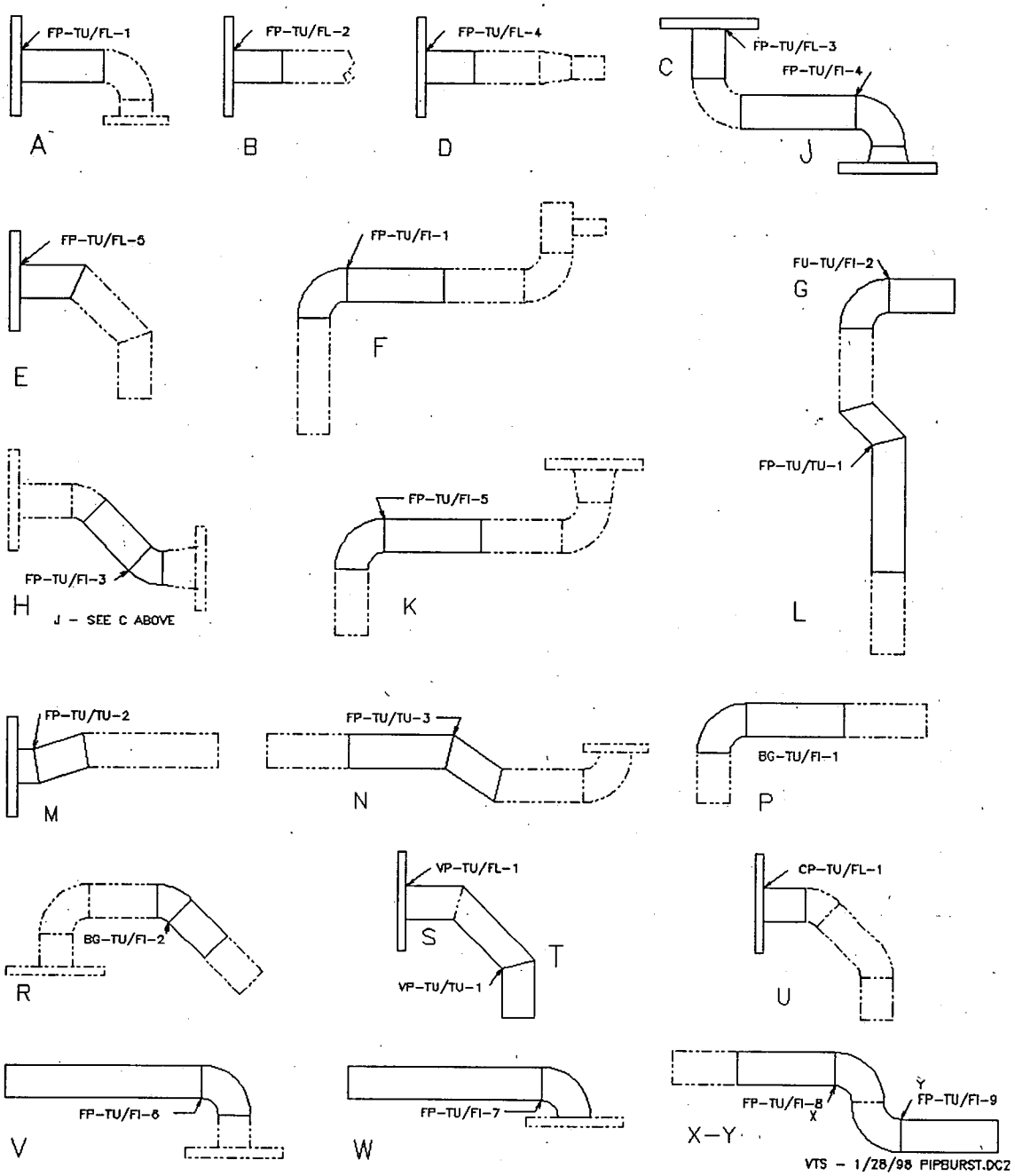
It is the conclusion that all of the weld joints tested proved that the welding of the joints, even though not full penetration, were adequate for the service intended and that no steps need to be taken to replace or rework piping runs in the field. The one case were a weld was caused to leak was at an extremely high pressure and there are indications that this was not a piece of piping furnished by FM. The joint was mitered, as if it was mechanical tubing, but in fact, the materials in that assembly were pipe (.25 wall thickness). A check of the bill of materials for that unit indicates that the original piping would have contained mechanical tubing (.125 wall thickness). In all other cases involving mechanical tubing, the tubing yielded at a moderate pressure (2250 to 3500 psig) and there was no indication of leakage at any of the 'test joints'.

Appendix B gives an overall summary of the test joints, the pipe sizes involved and other comments indicating the nature of the joint.

Appendix C shows photos of the sections of piping as received.

Appendix D will be issued later. This appendix will show photos of the test sections after completion of the burst testing. These photos have yet to be taken and compiled.

Appendix E will be issued later. This appendix will cover a summary of the results of metallurgical testing on the sample weld joints to determine the 'extent of or lack of penetration' of the weld joints, and other joints associated with the same samples of pipe. This work has yet to be completed.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