LABORATORY REPORT - LS3 TOP

MOUNT 15 M-4T
ID IS ON THE BOTTOM

Wed toe at the weld metal side of the crack, un-etched

Same as at left, etched

One field up along the crack edge, un-etched

Same as at left, etched

Figure 22
LABORATORY REPORT-LS3 TOP

MOUNT 15 M-4T
ID IS ON THE BOTTOM

Figure 23
LABORATORY REPORT-LS3 TOP

MOUNT 15 M-4T

ID IS ON THE BOTTOM

Crack, up from the ID. Un-etched

Same as at left, etched

Tip of the crack along fusion line, un-etched

Same as at left, etched

Figure 24
LABORATORY REPORT-LS3 TOP

MOUNT 15 M-4T
ID IS ON THE BOTTOM

Weld toe at OD. Un-etched

Cracks in the Weld Metal, un-etched

Same as at left, etched

Same as at left, etched

Figure 25
LABORATORY REPORT - LS3 TOP

MOUNT 15 M-4T
ID IS ON THE BOTTOM

One of the cracks in the Weld Metal. Four microphotographs stitched together. Un-etched

Same as at left, etched

Figure 26
### LABORATORY REPORT - LS3 TOP

**MOUNT 15 M-4T**

ID IS ON THE BOTTOM

<table>
<thead>
<tr>
<th>Fracture edge at ID, Un-etched</th>
<th>Same as at left, etched</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fracture edge, four fields up from ID, un-etched</td>
<td>Same as at left, etched</td>
</tr>
</tbody>
</table>

*Figure 27*
LABORATORY REPORT-LS3 TOP

MOUNT 15 TO
ID IS ON THE TOP

Fracture edge at OD. Un-etched

Fracture edge at ID. Un-etched

Same as at left. Etched

Figure 28
LABORATORY REPORT - LS3 TOP

MOUNT 15 TO
ID IS ON THE TOP

Figure 29
LABORATORY REPORT-LS3 TOP

MOUNT 15 TO
ID IS ON THE TOP

Area at weld toe near ID at higher magnification
(See Figure 18, top). Un-etched

Same as above. Etched

Figure 30
LABORATORY REPORT - LS3 TOP

MOUNT 15 TO ID IS ON THE TOP

Figure 31
LABORATORY REPORT-LS3 TOP

MOUNT 15 TO
ID IS ON THE TOP

Area down one field (see picture in Figure 31 above) from the ID and near the fracture edge.
Etched

Area down two fields (see picture in Figure 31 above) from the ID and near the fracture edge.
Un-etched

Area down two fields (see picture in Figure 31 above) from the ID and near the fracture edge.
Etched

Figure 32
LABORATORY REPORT - LS3 TOP

MOUNT 15 TO 10
ID IS ON THE TOP

Area at fracture edge near OD-Un-etched

Area at the fracture edge 1.5 fields up from the OD-Un-etched

Figure 33
LABORATORY REPORT-LS3 TOP
ATTACHMENT 1 TEST PROTOCOL AND ADDENDUM

Tesoro Exchanger E Failure Examination Protocol

Part 1. Field Visual and Nondestructive Examination

Part 1 of this protocol identifies visual and non-destructive testing that is approved to be conducted on the shell of exchanger 6600-E by a contractor acceptable to the parties to this agreement. Prior to performing any visual inspection or non-destructive testing, 3 business days notice must be provided to all parties to the agreement to allow the opportunity to observe. Parties to this agreement may elect not to perform aspects of the visual inspection or non-destructive testing described in this protocol. Should parties identify the need to conduct additional inspection or non-destructive testing not described in Part 1 of this protocol, 3 days notice must be provided to all parties to this agreement in order to register any objections.

Detailed visual inspection and testing will not be permitted until the equipment is placed in the secure evidence storage location.

All field visual and nondestructive tests shall be appropriately documented indicating examinations performed, scope of examinations, test equipment used in examinations, results of testing and the qualifications of the examiner as appropriate. All reports will be signed and dated by the examiner(s). Data reports shall be distributed within 48 hours of examinations by the third party conducting these examinations to all parties simultaneously. No party shall have the opportunity to review any data results in advance of the other parties. Any part requesting clarification or correction of anything in the report shall submit their request to all parties.

Data generated as a result of the execution of this protocol will be shared with all parties to the agreement simultaneously. Visual inspection reports, analysis or conclusion will not be shared.

Each party conducting field visual and nondestructive examination shall be assigned a unique set of alpha-numeric sets of markings. The format of the markings shall be XXXX, BXXX, CXXX, etc. The markings shall be applied to the external surfaces of the shell only and shall be permanent in nature (etch, stamp, etc.). Any markings shall be applied at least two (2) inches from any fracture surface. The markings shall be used for purposes described in Part 1 of this protocol and may also be used to identify locations of specific areas of interest determined by any examination conducted in Part 1. Each party using the markings shall supply a drawing identifying unique markings used and locations of these markings on the shell for information to all parties.

Field Visual Examination

1. Photographically document the heat exchanger in the “as-found” condition before initiating the metallurgical analysis. Documentation should include the following:
   - Any reference points needed
   - Fracture area and surface
   - Seams

Exchanger E Failure Examination Protocol – Rev. 3

5/15/2010
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