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ALERT

High Temperature Hydrogen Attack Fatal Accident at Tesoro Anacortes Refinery, State of Washington, USA

For pressure equipment, the hazard due to high temperature hydrogen attack (HTHA) is well known. However, incidents involving HTHA may still occur, particularly for older equipment built at a time when the high temperature hydrogen attack mechanism was not as well understood.

In the case of an incident at the Tesoro Anacortes Refinery in the State of Washington on April 2, 2010, the incident investigation concluded that failure of a carbon steel heat exchanger as a result of high temperature hydrogen attack caused an explosion and fire which fatally injured seven employees.

It is very important to note that there is probably similar equipment operating in Alberta. We must learn from others' incidents. Our industry is again reminded of the need to review their plant operations, and in this case, the possible hazards of HTHA.

There are a number of ways to mitigate the concerns associated with HTHA and the Anacortes Refinery Investigation report provides information that may assist owners in preventing HTHA on their equipment. The American Petroleum Institute Recommended Practice API 941 "Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants" also provides very good background information and appropriate considerations on this subject matter including Setting of Operating Limits, Inspection for HTHA and others.

The following is the link to the Anacortes incident investigation report of Tesoro:
http://www.tsocorp.com/stellent/groups/corpcomm/documents/gt_contribution/001347.pdf

The "Executive Summary" and the "Summary of Contributing Factors" in the report are provided hereunder for quick reference:

Executive Summary ***Summary of the Incident***

On April 2, 2010, at approximately 12:35 a.m., a heat exchanger, E-6600E, in the Naphtha Hydrotreater unit at the Tesoro Anacortes Refinery ruptured, releasing a mix of hydrogen and naphtha. The dispersed material auto-ignited, causing an explosion and fire which fatally injured seven employees who were in the area while a parallel bank of E-6600s were being placed in service. Following the incident and subsequent shutdown of the NHT unit, the refinery was shut down for over six

months. New heat exchangers were designed and rebuilt. Additionally, other equipment was repaired or replaced. Analysis of post-failure laboratory data showed advanced stages of high temperature hydrogen attack near the fracture surfaces in E-6600E.

Summary of Contributing Factors

- 1. Seven personnel were in the area at the time of the failure.*
- 2. At times over the life of E-6600E, sufficient hydrogen partial pressure and temperature existed for high temperature hydrogen attack (HTHA).*
- 3. E-6600E shell was fabricated of carbon steel and was not post-weld-heat-treated.*
- 4. High temperature hydrogen attack (HTHA) damage was not detected prior to failure.*
- 5. Stress existed in the E-6600s sufficient to cause rupture of the high temperature hydrogen attack (HTHA) damaged shell.*

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