



U. S. Chemical Safety and Hazard Investigation Board RECOMMENDATIONS STATUS CHANGE SUMMARY

Report:	Tesoro Refinery Fatal Explosion Fire
Recommendation Numbers:	2010-8-I-WA-R11
Date Issued:	May 1, 2014
Recipient:	American Petroleum Institute
New Status:	Closed – Unacceptable Action
Date of Status Change:	October 4, 2016

Recommendation Text:

CSB Recommendation No. 2010-8-I-WA-R11:

Revise American Petroleum Institute API RP 581: *Risk-Based Inspection Technology* to:

- Clearly establish the minimum necessary “shall” requirements to prevent HTHA equipment failures using a format such as that used in ANSI/AIHA Z10-2012, *Occupational Health and Safety Management Systems*;
- Prohibit the use of carbon steel in processes that operate above 400 °F and greater than 50 psia hydrogen partial pressure; and
- Require verification of actual operating conditions to determine potential equipment damage mechanisms.

Board Status Change Decision:

A. Rationale for Recommendation

On May 1, 2014, the U.S. Chemical Safety Board (CSB) released its report on the April 2, 2010 catastrophic heat exchanger rupture at the Tesoro Anacortes refinery which fatally injured seven workers. The CSB found that management at the refinery failed to effectively evaluate the potential for high temperature hydrogen attack (HTHA), the damage mechanism which caused the heat exchanger rupture. HTHA occurs in process plants in steel equipment exposed to hydrogen and high temperatures. HTHA causes cracking that weakens vessels, which can lead to sudden and devastating failures, such as that which occurred at Tesoro Anacortes.

Part of the CSB’s investigation reviewed the American Petroleum Institute’s (API’s) Recommended Practice (RP) 581, *Risk-Based Inspection Technology*. The CSB found that RP 581 allows users to calculate a damage factor to determine the HTHA susceptibility of various materials of construction. API RP 581, 2nd edition, did not require users to verify actual operating conditions when determining applicable damage mechanisms. In addition, the CSB found that RP 581 is written permissively, so that there are no minimum requirements to prevent HTHA failures. As a result of these findings, the CSB made a recommendation to API to make changes to RP 581 to establish “shall” requirements”, prohibit the use of carbon steel in process that operate above 400 °F and greater than 50 psia hydrogen partial pressure and require verification of operating conditions.

B. Response to the Recommendations

API revised RP 581 and published the 3rd edition of the RP in April 2016. API’s actions for each sub-part of the recommendation are listed below:

Regarding subpart (a) of the recommendation, API did not change the format of this recommended practice, citing that they are following their internal style guide. In addition, API did not establish minimum requirements to prevent HTHA and RP 581 is still a permissive document.

Regarding subpart (b) of the recommendation, RP 581 states that API 941, *Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants*, “should” be consulted for guidance on investigation, inspection and replacement for HTHA. While RP 941 did add a new carbon steel Nelson curve for non-post-weld-heat-treated (non-PWHT) carbon steel, RP 941 does not require the use of inherently safer materials. On July 13, 2016, the Board voted to designate recommendation 2010-8-I-WA-R11, which relates to API RP 941, with the status “Closed – Unacceptable Action” in part, because it does not prohibit the use of carbon steel in processes above 400 °F and greater than 50 psia hydrogen partial pressure.¹ In addition, Part 2, Section 19.3 specifically states: “This document does not: a) Prescribe changes in materials of construction for components that exceed limits defined in Section 19.4” (Section 19.4 outlines screening for carbon steel and other low alloy steels that operate greater than 350 °F and greater than 50 psia hydrogen partial pressure).

Regarding subpart (c) of the recommendation, API has satisfied this portion of the recommendation. RP 581 adds in Part 2, Section 19.8, Table 19.1, “Data Required for Determination of Susceptibility to HTHA” includes required data for: material of construction; hydrogen partial pressure, and temperature. In addition, RP 581 now specifies that for carbon steel, a high susceptibility rating should be assigned if the exposure temperature is greater than 350 °F and greater than 50 psia hydrogen partial pressure.

C. Board Analysis and Decision

While API did fulfill part c. of the CSB’s recommendation and require the verification of operating conditions for HTHA to determine equipment susceptibility to HTHA, the document now explicitly states that it does not prescribe changes in materials of construction for those materials found to be of high susceptibility for HTHA. Instead RP 581 now refers the user to API RP 941, which the CSB has found to be ineffective in adequately preventing against HTHA. As the above analysis of API’s 3rd edition on RP 581 does not meet the intent of the CSB’s recommendation, the Board voted to designate Recommendation No. **2010-8-I-WA-R11** as “**Closed – Unacceptable Action.**”

¹ Status Change Summary available at: [http://www.csb.gov/assets/recommendation/2010-8-I-WA-R10_16_\(Revision_4\)__Status_Change_Summary_Tesoro_Anacortes_API_R10_C-UA.pdf](http://www.csb.gov/assets/recommendation/2010-8-I-WA-R10_16_(Revision_4)__Status_Change_Summary_Tesoro_Anacortes_API_R10_C-UA.pdf)