



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

Report:	Chevron Richmond Refinery Fire
Recommendation Number(s):	2012-03-I-CA-R26
Date Issued:	January 28, 2015
Recipient:	American Petroleum Institute (API)
New Status:	Closed - Acceptable Alternative Action
Date of Status Change:	January 20, 2021

Recommendation Text:

Revise API RP 939-C: Guidelines for Avoiding Sulfidation (Sulfidic) Corrosion Failures in Oil Refineries to establish minimum requirements for preventing catastrophic rupture of low-silicon carbon steel piping. At a minimum:

- a) Require users to identify carbon steel piping circuits susceptible to sulfidation corrosion that may contain low-silicon components. These circuits have the potential to contain carbon steel components that were not manufactured to the American Society for Testing and Materials (ASTM) A106 specification and may contain less than 0.10 weight percent silicon content.*
- b) For piping circuits identified to meet the specifications detailed in 2012-03-I-CA-R26(a), require users to either (1) enact a program to inspect every component within the piping circuit once, known as 100 percent component inspection (per the requirements established pursuant to recommendation 2012-03-I-CA-R28(c)), or (2) replace the identified at-risk carbon steel piping with a steel alloy that is more resistant to sulfidation corrosion.*
- c) If low-silicon components or components with accelerated corrosion are identified in a carbon steel piping circuit meeting the specifications detailed in 2012-03-I-CA-R26(a), require designation of these components as permanent Condition Monitoring Locations (CMLs) until the piping components are replaced.*

Board Status Change Decision:

A. Rationale for Recommendation

On August 6, 2012, the Chevron Refinery in Richmond, California, experienced a catastrophic pipe rupture in the #4 Crude Unit. This caused the release of flammable hydrocarbon process fluid which partially vaporized into a large vapor cloud that engulfed 19 Chevron U.S.A. Inc. (“Chevron”) employees. Approximately two minutes following the release, the released process

fluid ignited. Six Chevron employees suffered minor injuries during the incident and subsequent emergency response efforts. The release, ignition, and subsequent burning of the hydrocarbon process fluid resulted in a large plume of vapor, particulates, and black smoke, which traveled across the area. This chain of events resulted in a shelter-in-place for nearby communities. In the weeks following the incident, approximately 15,000 people from the surrounding communities sought medical treatment at nearby medical facilities for ailments including breathing problems, chest pain, shortness of breath, sore throat, and headaches. Approximately 20 of these people were admitted to local hospitals for inpatient treatment. The CSB's investigation of the incident found that the pipe failure was caused by sulfidation corrosion, a damage mechanism that causes piping walls to thin over time.

The U.S. Chemical Safety and Hazard Investigation Board (CSB) identified several causal factors of the incident relating to various American Petroleum Institute (API) codes, recommended practices, and guidelines, specifically with regard to piping corrosion, damage mechanisms, inspections, material verification, and fire protection. Specifically, the CSB found that API failed to require comprehensive inspections or effective facility upgrades. *API Recommended Practice (RP) 939-C: Guidelines for Avoiding Sulfidation (Sulfidic) Corrosion Failures in Oil Refineries* is the primary industry guidance document on ways to monitor and control sulfidation corrosion. It states that carbon steel piping can contain components with low silicon concentrations, and these components can corrode at a faster rate than adjacent piping components. However, the CSB found that at the time of the incident it did not specifically require users to perform 100 percent component inspection or recommend that facilities upgrade high-risk carbon steel piping circuits to steel alloys that are more resistant to sulfidation corrosion. As a result of these findings the CSB issued a recommendation to API to revise *API RP 939-C*.

B. Response to the Recommendation

In January 2019, API published the Second Edition of *RP 939-C, Guidelines for Avoiding Sulfidation (Sulfidic) Corrosion Failures in Oil Refineries*. API explained in detail in its most recent letter to the CSB how its 2019 updates satisfy each element of this recommendation. The CSB purchased the second edition of the API standard to review and verify API's response. As an initial issue, all three parts (a, b, and c) of the CSB recommendation use "require" language, but the recommendation was made to an API recommended practice and the CSB did not recommend API strengthen the API 939-C recommended practice by converting it to a standard. API addressed the issues raised by the CSB recommendation, but API retained the typical "should" language associated with its recommended practice guidance documents. The CSB determined that the new guidance fulfilled the requirements of the recommendation through its numerous improvements, including:

- Requiring that all carbon steel piping components be specified to have a 0.10 weight percent minimum silicon (Si) content for improved sulfidation corrosion resistance;
- Stating that thickness surveys are appropriate for both carbon steel and low-alloy piping systems,
- Stating that risk assessments should be performed to determine replacement of piping;

- Encouraging use of more sulfidation-corrosion-resistant materials to minimize the reliance on inspection; and
- Requiring the designation of low-Si components as permanent Condition Monitoring Locations (CMLs) and incorporating those into an inspection program in accordance with *API 570, Piping Inspection Code: In-Service Inspection, Rating, Repair and Alteration of Piping Systems*.

C. Board Analysis and Decision

Based upon the information provided in API's updated 939-C recommended practice, along with references to *API 570*, the Board concluded that the updated document appeared to meet the intent of the recommendation. Although the recommended practice uses "should" language instead of "shall" language, and does not directly address replacement of piping following its designation as CML, companies following the guidance in these updated documents should be able to prevent the type of catastrophic sulfidation failure that the Chevron Richmond refinery experienced in August 2012. As such, the Board voted to designate **CSB Recommendation No. 2012-03-I-CA-R26** as: "**Closed – Acceptable Alternative Action.**"