Communities for a Better Environment

BY ELECTRONIC MAIL

19 September 2012

Mayor Gayle McLaughlin
Members of the City Council
Members of the Planning Commission
City of Richmond
450 Civic Center Plaza
Richmond, CA 94804–1630

Re: **Chevron Richmond Refinery Crude Unit Fire of 6 August 2012**

Dear Mayor McLaughlin, Council and Planning Commission members:

The Richmond refinery's third and most catastrophic crude unit fire in five years injured six workers,[1] caused massive pollutant emissions that sent more than 15,000 to hospitals,[2] and rendered Chevron's whole crude distillation capacity here inoperable.[3] It was a disaster—and a stark warning that if we do not act now, the next refinery "incident" could kill. As you know, the City is unique among agencies responding to this disaster in holding local land use authority for industrial land uses such as this refinery in Richmond, and has reaffirmed and strengthened this authority in your recently updated General Plan, which states in part that the City will:

> "Fully utilize Richmond's police power to regulate industrial and commercial emissions."
> *General Plan Policies EC5.3, CN4.1, HW9.1 and ED1.4 (Air Quality)*

This letter renews and further supports CBE's urgent request that the City fully utilize its authority to ensure that damaged and unsafe equipment involved in the 6 August fire, including the refinery's crude unit, is rebuilt using the safest and least-emitting equipment designs and construction materials available.

Ample evidence exists now—even before the ongoing investigation into additional and perhaps even more important causal factors is completed—to demonstrate the need for action to ensure rebuilt equipment will be safe. Briefly:

- The 6 August fire started when a carbon steel pipe section in the crude unit that had lost 80% of its pipe wall thickness due to corrosion ruptured, releasing hot (~680 ºF) gas oil that vaporized and ignited.[4] (See Figure 1.)

- Before this 6 August pipe failure, another corroded pipe section on the same gas oil line was replaced in November 2011,[4] and yet another carbon steel pipe failed due to corrosion in yet another major crude unit fire on January 15, 2007,[5] demonstrating a pattern of pipe corrosion problems in the crude unit.

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- The thinning of the pipe that failed in the 2007 crude unit fire—the only one of the three above for which metallurgical testing is reported publicly to date—was caused by sulfur from the crude feed attacking the carbon steel at high temperature.[5]

- Sulfur corrosion ("high-temperature sulfidation") is a well known problem in refineries, and in refinery crude distillation units specifically.[6–12] (See Figure 2.)

- The sulfur content of the Richmond refinery crude feed increased substantially, forcing roughly *180 tonnes/day more sulfur* through the crude unit during the 12 month period ending May 31, 2012 than in the years before Chevron began a switch from Alaskan to Persian Gulf crude oils in 1998. (See Figure 3.)

- Corrosion problems caused by refining denser and/or higher-sulfur crude have been confirmed at other refineries[6–12] and contributed, for example, to the fatal crude unit fire in 1999 at the Tosco Avon refinery near Martinez (now owned by Tesoro).[13]

- More broadly, corrosion by sulfur and/or other corrosive chemicals is a causal factor in many major chemical incidents at refineries. (See Table 1.)

- Construction materials reportedly used in the 35 year old Richmond refinery crude unit (carbon steel)[4,5] are known to be inadequately resistant to some common types of corrosion in refineries.[8–11]

- However, different construction materials better resist different types of corrosion,[9–11] and other design conditions, such as flow velocity and operating temperature, also affect corrosion rates.[9–12]

**Figure 1. The pipe rupture involved in the 6 August Richmond crude unit fire.** Photo CSB.

**Figure 2. Sulfidation corrosion failure of a pipe elbow at another refinery.** Photo API (2003).

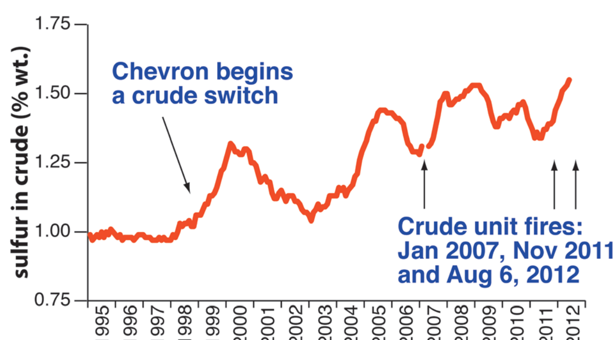


**Figure 3. Sulfur in crude refined at Richmond, January 1995–May 2012.** Rolling annual average of monthly data from USEIA and Chevron. Chart by CBE.

- The type(s) of corrosion involved in Chevron's August 6 crude unit fire, as well as the potential roles of other design factors in the fire and the extent of fire-damage and the corrosion resistance of materials and designs throughout the unit, remain to be confirmed by ongoing investigation.[4]

In sum, evidence available now demonstrates a significant probability of flaws in the design or materials of construction used in the old crude unit that—if left unidentified and carried forward in rebuilding the damaged equipment—might cause another, and potentially even more catastrophic, chemical incident. Thus, it cannot be assumed that rebuilding without substantial changes in design or materials is appropriate. Further, it cannot be assumed that other agencies will ensure Chevron waits for the ongoing investigation to identify such potential design and materials flaws before rebuilding the unit. In fact, after its 2007 fire Chevron rebuilt and put this same unit back into operation *before* its root cause analysis of that incident was even reported publicly.[5] The only responsible course is to use the City's full authority to ensure that, this time, the refinery is rebuilt to operate as safely as possible.

In Health,

Greg Karras, Senior Scientist
Communities for a Better Environment (CBE)

Copy: Interested organizations and individuals

Attachments: References cited (attached hereto)
Table 1 (attached hereto)
Full copies of references cited (submitted as a separate PDF file)

**References cited**


(1) *30-Day Report for the CWS Level 3 Event of August 6, 2012;* submitted to Contra Costa County Health Services Department by Chevron on September 5, 2012.

(2) *Chevron Refinery Aug. 6 fire, health impacts and FAQs;* Contra Costa Health; http://cchealth.org/special/richmond-refinery-response.php; accessed 9/19/2012.

(3) *Incident Report: Chevron Refinery (Site #A0010) 841 Chevron Way, Richmond, California, August 6, 2012;* Bay Area Air Quality Management District.

(4) *Item L-1, Richmond City Council 9/11/2012 Meeting;* U.S. Chemical Safety Board preliminary results presented to the Richmond City Council and community.

(5) *Final investigation report of the fire that occurred on Monday, January 15, 2007 in the crude unit at the Chevron Richmond Refinery;* submitted to the Contra Costa Health Services Department, Hazardous Materials Program Director by Chevron Products Company on April 18, 2007.

(6) Dettman et al., 2010. The influence of naphthenic acid and sulphur compound structure on global crude corrosivity under vacuum distillation conditions. NACE Northern Area Western Conference, February 15–18, Calgary, Alberta.

(7) *Battling Corrosion in Refineries With the Power of In-line Analysis;* ChemEurope White Paper; www.chemeurope.com/en/whitepapers/print/126308 (dnldd. 9/13/12).

(8) Bush et al., 2004. Introduction to NACE standard MR0103: Use these materials to reduce sulfide stress cracking in corrosive refinery environments. *Hydrocarbon Processing* November 2004 Issue, pp. 73–77.

(9) Shalaby, 2010. Refining of Kuwait's heavy crude oil: materials challenges. Workshop on Corrosion and Protection of Metals, Arab School for Science and Technology, December 3–7, Kuwait (document date 2010).

(10) John et al., 2004. Assessing corrosion in oil refining and petrochemical processing. *Materials Research* **7**(1): 163–173.

(11) Bagdasarian et al., 2010. *Crude Unit Corrosion and Corrosion Control;* GE Power & Water, Water & Process Technologies Technical Paper; Tp1105en.doc. November 2010.

(12) Kanakuntla et al., 2009. *Experimental study of concurrent naphthenic acid and sulfidation corrosion;* Paper No. 2764, 11th International Corrosion Congress, Corrosion Control in the Service of Society; NACE International: Houston TX.

(13) *Investigation Report, Refinery Fire Incident, Tosco Avon Refinery, Martinez, California, February 23, 1999;* Report No. 99-014-I-CA; Issue Date March 2001; U.S. Chemical Safety and Hazard Investigation Board: Washington, D.C.

**Table 1. Corrosion is a causal factor in many major refinery incidents: some examples**

| Incident | Investigation status | Role of corrosion in the incident[a] | Type of corrosion |
|---|---|---|---|
| Chevron, Richmond, crude unit fire, August 6, 2012[b]<br>• 6 workers injured<br>• 15,000 go to hospitals | ongoing | Rupture of corroded carbon steel gas oil pipe section that lost 80% of its original thickness | Not yet confirmed: metallurgical testing in progress |
| Motiva, Port Arthur TX,<br>fuel gas corrosion, May 2012[c]<br>crude unit loss, June 9, 2012 | unknown | Extensive corrosion reported to cause total loss of new crude unit | Not yet confirmed: caustic system fault suspected |
| Tesoro, Anacortes WA, fire & explosion, April 2, 2010[d]<br>• 7 killed | ongoing | Rupture of carbon steel heat exchanger weakened by hydrogen exposure | Hydrogen |
| Silver Eagle Woods Cross UT, explosion, November 4, 2009[d,e]<br>• 4 injured<br>• >100 homes damaged | ongoing | Failure to detect pipe erosion and thinning leads to dewaxing unit pipe rupture | Hydrogen suspected |
| Chevron, Richmond, crude unit fire, January 15, 2007[f]<br>• 1 injured<br>• offsite impact from flaring | complete | Rupture of corroded carbon steel "spooling" pipe that was thinned by sulfidation corrosion | Sulfur (from crude) |
| BP, Texas City TX, explosion and fire, March 23, 2005[g]<br>• 15 killed<br>• 180 injured | complete | High level alarm for overfilled blowdown drum fails due to alarm float corrosion | Not reported |
| Giant/Ciniza, Jamestown NM refinery fire, April 8, 2004[h]<br>• 6 injured | complete | Failure to investigate why corrosion plugging of valves caused repeated pump seal failures | Iron fluoride |
| Motiva, Delaware City, fire & explosion, July 17, 2001[i]<br>• 1 killed<br>• 8 injured; offsite impact | complete | Acceleration of localized corrosion from dilution of sulfuric acid with water entering carbon steel tank | Sulfuric acid (also carbonic acid) |
| Tosco Avon (Martinez) crude unit fire, February 23, 1999[j]<br>• 4 killed<br>• 1 injured | complete | Accelerated corrosion due to running heavier crude through desalter plugs crude unit valves | Ferric oxide, ammonium chloride, and sulfur compounds (from crude) |

[a] Table describes only corrosion-related factors; other causes are more important in some incidents.
[b] U.S. Chemical Safety Board preliminary results presented to City Council 9/11/12.
[c] Reuters (6/18/12); Texas Council on Environmental Quality emission event reports (RN100209451).
[d] U.S. Chemical Safety Board preliminary results reported in S.F. Chroniclee 9/10/12.
[e] U.S. Chemical Safety Board Statement of November 17, 2009.
[f] Chevron, 2007a, b. Final Investigation Report submitted to Contra Costa County on April 18, 2007; and Chevron Richmond Refinery January 2007 Flaring Cause Analysis Report submitted to AQMD 3/29/07.
[g] U.S. Chemical Safety Board Investigation Report No. 2005-04-I-TX (March 2007).
[h] U.S. Chemical Safety Board Case Study No. 2004-08-I-NM (October 2005).
[i] U.S. Chemical Safety Board Investigation Report No. 2001-05-I-DE (October 2002).
[j] U.S. Chemical Safety Board Investigation Report No. 99-014-I-CA (March 2001).