Widespread corrosion at the Richmond Refinery

COMMUNITIES FOR A BETTER ENVIRONMENT

This page: The pipe that ruptured in Chevron's disastrous August 2012 fire (point 1 below) is just one of at least twenty known places where corrosion damaged equipment in its crude unit alone.
Next page: Corrosion attacks process equipment refinery-wide.

1. #4 sidecut pipe from atmospheric column C-1100 to pumps P-1149/A: sulfidation corrosion leads to rupture in Aug. 2012 fire

2. Atmospheric overhead pipe from C-1100 to relief header: extensive internal corrosion pitting, found after fire-damaged pipe was removed, suggests a failure risk before the next scheduled maintenance shutdown

3. Atmospheric column C-1100 shell: corrosion under insulation

4. Atmospheric column C-1100 pressure taps PT 001 & 003: internal pitting corrosion

5. Atmospheric reflux drum V-1100 shell: internal corrosion

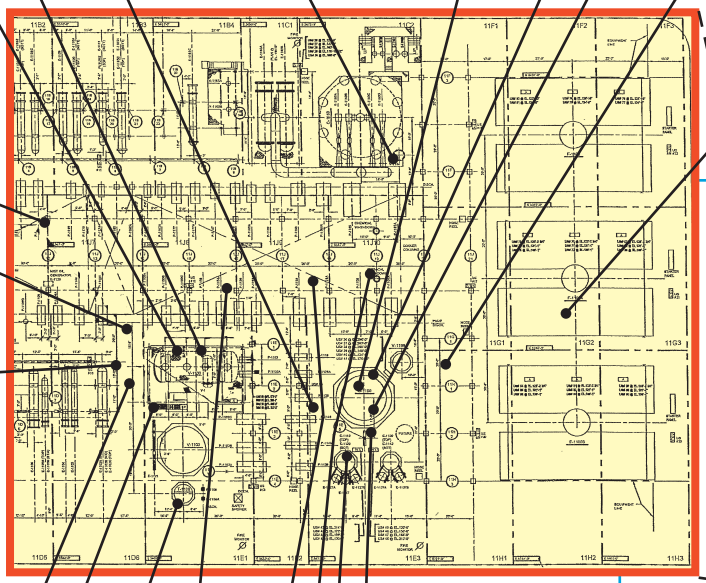
6. Condensate pipe downstream from vessel V-1164: internal & external corrosion & leaks

7. C-1100 crude feed pipe from furnaces F-1100A/B: internal weld corrosion after repair from naphthenic acid corrosion

8. Relief piping for atmospheric reflux drum V-1100: 43% of pipe wall is lost to external crevice corrosion

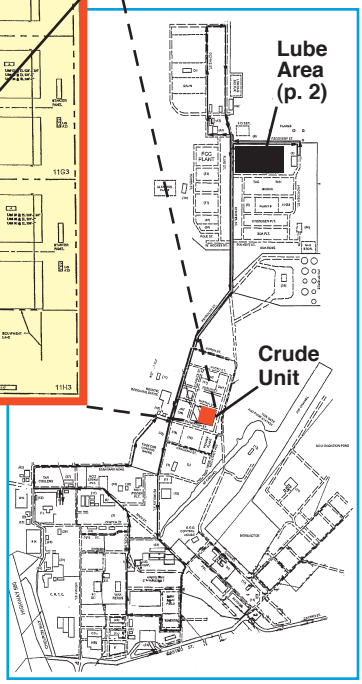
9. Smothering steam piping for furnace F-1160 firebox: localized corrosion found since 2006

10. #7 sidecut pipe from pumps P-1179 & 1189A to exchanger E-1109: sulfidation corrosion repairs



11. Atm. overhead pipe from E-1101 to condenser: external corrosion pitting

12. Atm. overhead pipe from E-1100 to V-1100: extensive internal corrosion pitting, found after fire-damaged pipe removed, suggests a failure risk before the next scheduled shutdown



The small red box in this map of Richmond refinery processing areas shows the crude unit areas in the detailed blow-up above.

13. FT-007 tubing between reflux drum V-1100 & exchanger E-1100: corrosion at compression fitting

14. Stripping steam pipe to atm. column C-1100: corroded & leaking

15. Reflux drum V-1100 pH sample pipe & tubing: repeated plugging suggests corrosion upstream

16. Stripping steam piping to column C-1130: corrosion under insulation thins pipe to 50% of recommended replacement thickness

17. Aqueous ammonia tank TK-1108: underside & internal corrosion

18. Atm. overhead pipe from C-1100 to E-1101: external corrosion, bulging & delamination

19. Medium-pressure condensate header piping: corrosion under insulation

20. Condensate pipe adjacent to C-1100 & pumps P-1105/A: corrosion under insulation

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The extensive corrosion documented above represents only a partial sample in a small part of the refinery. Chevron reported those data publicly only for crude unit equipment it sought permits to replace or repair after its August 2012 fire *(1–20)*. And some serious corrosion damage was found only after fire-damaged equipment was dismantled and easier to inspect *(e.g., 2, 12)*.

Corrosive chemicals—such as hydrogen sulfide formed in high-temperature processing of oil feedstock that is contaminated by sulfur—can attack processing equipment refinery-wide.

Workers "downstream" from the Richmond crude unit warned in 2011 that Chevron was ignoring widespread and accelerating corrosion following its switch to higher sulfur crude oils *(21)*. At the Richmond lube oil processing area alone (see the black rectangle in the map above), the refinery workers identified at least seven examples of corrosion-damaged equipment:

- Accelerating internal corrosion of the V-1410 High Pressure Separator process vessel;
- Internal corrosion damage of the Column C-1500 process vessel and trays;
- Corrosion and cracking of the Column C-1500 impingement plate and cladding;
- Plugging of the Column C-1500 sidecuts by corrosion products ("scale");
- Corrosion damage in Vessel V-1110, which is upstream of Column C-1200;
- Plugging of the Column C-1200 reboilers by corrosion products (scale); and
- A corroded furnace tube elbow failed in a fire at Heavy Neutral Cracker Furnace F-1551 *(21)*.

Refiners can install clamps on corroded pipes to stop leaks as a temporary stop-gap measure. Reported data on this practice at Richmond reveals a refinery-wide corrosion problem:

- Refinery-wide, Chevron relied on as many as 2,000 of these temporary clamps in 2012 *(22)*.
- Cal-OSHA inspected a portion of these temporary clamps and cited Chevron for relying on at least nine of these clamps long after the corroded equipment should have been replaced *(23)*.

Ignoring worsening corrosion greatly increases catastrophic incident risk refinery-wide.

References for points of corrosion damage in the Richmond refinery Crude Unit:
(1) Chevron, 2012. Tracking–Additional Work (TAW) 17531, City of Richmond Permit 12-05068 sub 12-05740. **(2)** Chevron 2012. TAW 18111, City Permit 12-05068 sub 12-05383. **(3)** Chevron, 2012. TAW 17933, City Permit 12-05068 sub 12-05069. **(4)** Chevron, 2012. TAW 18437, City Permit 12-05068 sub 12-05740. **(5)** Chevron, 2012. TAW 17881, City Permit 12-05068 sub 12-05072. **(6)** Chevron, 2012. TAW 18467, City Permit 12-05068 sub 12-05596. **(7)** Chevron, 2012. TAW 17568, City Permit 12-05068 sub 12-05069. **(8)** Chevron, 2012. TAW 18410, City Permit 12-05068 sub 12-05491. **(9)** Chevron, 2012. TAW 18067, City Permit 12-05068 sub 12-05493. **(10)** Chevron, 2012. TAW 18606, City Permit 12-05068 sub 13-00079. **(11)** Chevron, 2012. TAW 18206, City Permit 12-05068 sub 12-05385. **(12)** Chevron, 2012. TAW 18096, City Permit 12-05068 sub 12-05153. **(13)** Chevron, 2012. TAW 17916, City Permit 12-05068 sub 12-05153. **(14)** Chevron, 2012. TAW 17594, City Permit 12-05068 sub 12-05486. **(15)** Chevron, 2012. TAW 17737, City Permit 12-05068 sub 12-05689. **(16)** Chevron, 2012. TAW 18238, City Permit 12-05068 sub 12-05600. **(17)** Chevron, 2012. TAW 17910, City Permit 12-05068 sub 12-05490. **(18)** Chevron, 2012. TAW 18149, City Permit 12-05068 sub 12-05489. **(19)** Chevron, 2012. TAW 18068, City Permit 12-05068 sub 12-05493. **(20)** Chevron, 2012. TAW 17845, City Permit 12-05068 sub 12-05596.

Reference for points of corrosion damage in the Richmond refinery Lube Processing Area:
(21) Cal-OSHA, 2012. Inspection report, Inspection 314328980 (unsafe working conditions complaint).

References for clamps on corroded piping at Richmond refinery-wide:
(22) Garrett Brown, Senior Safety Engineer & Special Assistant to the Chief, Cal-OSHA, personal communication with Greg Karras, CBE, on 31 January 2013. **(23)** Cal-OSHA, 2013. Inspection 314332370 (Citation 8 Item 1).