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Contra Costa Health  
Hazardous Materials

August 11, 2011

Mr. Randy Sawyer  
Director, Hazardous Materials Division  
Contra Costa Health Services  
4585 Pacheco Blvd.  
Martinez, CA 94553

Via Fax: (925) 646-2073  
Original will follow in the mail.

**Subject: Root Cause Analysis Report for the Refinery Wide Power Outage**

Dear Mr. Sawyer:

The Tesoro Golden Eagle Refinery is submitting a Root Cause Analysis report for the November 10, 2010 refinery wide power outage. This report is submitted as partial satisfaction of the requirements set forth in County Ordinance 98-48, the "Industrial Safety Ordinance" for root cause analysis reports.

If you have any questions regarding this report, please call me at (925) 370-3274 or Ms. Sabiha Gokcen at (925) 370-3620.

Sincerely,

Claire Spencer  
Environmental, Health and Safety Manager

Cc: Ms. Cho Nai Cheung

**Root Cause Analysis Report  
Tesoro Golden Eagle Refinery  
November 10, 2010 Refinery Wide Power Outage**

Summary of Event:

On November 10, 2010, the Tesoro Golden Eagle Refinery experienced a plant wide electrical outage at 16:05 when an event occurred on an external (non-Tesoro owned) electrical distribution system. The ensuing electrical outage triggered a plant wide shutdown, which resulted in excess flaring and visible black plumes of smoke. At 16:37, the Refinery issued a CWS Level 3 warning to the neighboring communities. Refinery Health & Safety teams, local agencies (BAAQMD & CCCHS), and contractors (Odor Science & Engineering) were dispatched into the community to measure air quality and test for possible hazards. Although black plumes of smoke were visible offsite, only grass fire type odors were reported in the neighboring communities. John Muir Hospital in Concord reported no calls or patients and no 911 calls were received. With the situation improving and flaring and smoke decreasing significantly, the Refinery downgraded to a CWS Level 2 at 19:05. Plant wide electrical power was restored at 19:53, and the Refinery subsequently downgraded to a CWS Level 1 (20:14).

A brief timeline follows:

16:05 hrs:	External power event occurs, resulting in plant wide electrical outage, flaring and visible black plumes of smoke offsite
16:23 hrs:	Odor patrols monitoring Refinery perimeter & dispatched into community
16:37 hrs:	CWS Level 3 notification
16:50 hrs:	Contra Costa County Health Services & U.S. Coast Guard onsite
17:02 hrs:	Odor patrols reporting a grass fire type odor downwind in Clyde
17:52 hrs:	BAAQMD onsite
18:45 hrs:	Odor patrols reporting similar grassfire type odors downwind in North Concord
19:05 hrs:	Downgraded to CWS Level 2
19:53 hrs:	Electrical power restored plant wide. John Muir Hospital in Concord reports no calls or patients and no 911 calls received.
20:14 hrs:	Downgraded to CWS Level 1

Agency Notification and Response:

The following agencies were immediately notified: Contra Costa Health Services (CCHS) via the CWS, the Bay Area Air Quality Management District (BAAQMD) via the CWS and phone, Contra Costa Fire Protection District, and the Contra Costa County Office of Emergency Services. The following agencies responded with personnel to the scene: CCHS, BAAQMD, Contra Costa Fire and Contra Costa Sheriff.

[Note: Notifications over the CWS terminal: CWS level 1 notifies CCHS, Contra Costa OES, and the Contra Costa Sheriff with a specific message. Additional notice informs

BAAQMD, Contra Costa Fire Protection District, Martinez Police, Antioch Police, Pinole Police and Richmond Police. CWS level 2 notifies CCHS, Contra Costa OES, Contra Costa Sheriff and BAAQMD with a specific message. Additional notice informs Contra Costa Fire Protection District, California Highway Patrol, California Dept. of Health, San Ramon Valley Fire, Martinez Police, Antioch Police, Pinole Police and Richmond Police. CWS level 3 notifies CCHS, Contra Costa OES, Contra Costa Sheriff and BAAQMD with a specific message. Additional notice informs Contra Costa Fire Protection District, California Highway Patrol, California Dept. of Health, San Ramon Valley Fire, Martinez Police, Antioch Police, Pinole Police, Richmond Police, EDIS and National Weather Service. CWS level 3 also activates sirens and the news media with a shelter in place message.]

Emergency Response Actions:

Operations personnel shut down the units and safely responded to the emergency

Material Released:

Hydrocarbon compounds were routed to the flare system as a result of the emergency shutdown. These compounds were mostly consumed (burned off) during the combustion process, resulting in the release of carbon dioxide and other gases present during combustion.

Meteorological Conditions:

The weather was clear with wind direction varying from the North with a wind speed of 2-3 mph. The temperature was about 61 degrees F.

Injuries:

No injuries were reported on or off site.

Community Impact:

A shelter in place warning was issued for the surrounding community by Contra Costa County Health Services due to the possibility of smoke – related impacts. Two odor complaints were reported to the Bay Area Air Quality Management District. One was received from a vehicle on Highway 4 and the other was received from within the business park near the Contra Costa County Sanitation Plant.

Incident Investigation of the event:

The Golden Eagle refinery receives most of its electrical power from the Foster Wheeler Martinez (FWM) Cogeneration Facility. (The Delayed Coker Unit and portions of the tank farm are fed from a different power source. The rest of the refinery is fed by FWM.) At full rate, the refinery draws 73 MW from FWM. Foster Wheeler's generating capacity

is 99.9 MW. FWM was built in 1987 and the original design intent was to allow for FWM to “island” itself from the PG&E grid, if needed, to allow the facility to continue to provide power to the refinery. FWM is connected to the PG&E grid through the Tidewater Substation.

During the course of the investigation, it was found that there was no automatic separation scheme that allowed for the “islanding” as originally intended. It was also found that power for the North Concord area was supplied through the Tidewater Substation. Therefore, whenever FWM is disconnected from PG&E, it would be supplying both the refinery and North Concord with power. The North Concord load is typically 30-40 MW. When that load is added to the refinery’s 73 MW load, it exceeds the generating capacity of FWM. Note: the Tidewater Substation is typically fed by two 230 KV lines from PG&E.

On November 10<sup>th</sup>, the operations at both the refinery and FWM were normal and steady. The refinery was drawing 68.5 MW from FWM and FWM was sending 31 MW to the PG&E grid. That morning, at 8:16 AM, PG&E was conducting maintenance on the Tidewater Substation. PG&E opened circuit breaker 232, which isolated the Tidewater Substation from the El Sobrante 230 KV line. At 2:52 PM, circuit breaker 232 was closed, restoring the El Sobrante 230 KV line to the substation. At 3:09 PM, circuit breaker 232 reopened isolating the Substation from the El Sobrante 230 KV line. At 4:00 PM, circuit breaker 212 opened; this isolated the Tidewater Substation from the Pittsburg 230 KV line. The cause of both of these circuit breakers opening was not able to be determined.

At this point both 230 KV lines were isolated from the Tidewater Substation and FWM became the sole power supply for both the refinery and North Concord. The turbine generators at FWM tripped off at 4:02 PM. This triggered FWM’s automatic load shedding system and power was no longer supplied to the refinery. The refinery’s processing units depressurized to the flare system as designed. In addition, circuit breakers 472 and 482, which tie FWM into the Tidewater Substation, opened isolating FWM from the substation.

Circuit breaker	Function
212	Connects Tidewater Substation with El Sobrante 230 KV line
232	Connects Tidewater Substation with Pittsburg 230 KV line
472	Connects FWM with Tidewater Substation
482	Connects FWM with Tidewater Substation
202	Connects buss D with buss E in the Tidewater Substation (this ties the two sides of the substation together)

In order to safely analyze some of the equipment involved in this incident, PG&E and FWM worked with Tesoro and conducted testing when the refinery electrical load was low. The testing occurred when the refinery had a number of units down for turnaround in May 2011 and the power demand was less than 50 MW on FWM.

The analysis determined that the “Synch” switches for circuit breakers 202, 212 and 232 did not have keyed faceplates that allowed only one of those switches to be in the “on” position. (Note: only one should be keyed in the “on” position) The analysis also determined that the Programmable Logic Controller (PLC) at the substation had failed. The exact nature of the failure could not be determined due to a lack of data recording capability at the substation. However, it was determined that the Input/Output circuit board on the PLC had failed and that the PLC had issued at least one incorrect “Power Fail” trip commands to the “Automatics Controller”. During the analysis, PG&E found that the line side C-phase bushing potential devices were damaged on both circuit breakers 212 and 232.

As a result of this analysis and testing, PG&E made the following modifications to the PG&E Tidewater Substation during May 2011.

- New “synch” switches were installed. These were designed to PG&E’s latest engineering standards.
- The existing single PLC was replaced with three micro-processor based controllers (one per phase). These were designed to PG&E’s latest engineering standards.
- The bushing potential devices on circuit breakers 212 and 232 were replaced with new, free-standing capacitor-coupled voltage transformers (CCVT).
- Existing electromechanical relays were also replaced by micro-processor based controllers. These were designed to PG&E’s latest engineering standards.

#### Root Causes:

The causal analysis for this incident yielded the following root causes and corrective actions (see table):

**Root Cause #1:** The “Synch” switches for both Circuit Breakers 212 and 232 were left in ON position in error. The design of the faceplates on the three circuit breakers (202, 212 and 232) did not prevent this from occurring.

**Root Cause #2:** There was a failed Input/Output (I/O) module on the Programmable Logic Controller (PLC) used for “Automatics” controller.

**Root Cause #3:** The circuit breaker 212 Line Side C-phase bushing potential device and circuit breaker 232 Line Side C-phase bushing potential device were damaged.

**Root Cause #4:** There was no automatic separation scheme or established operating procedure for opening of Circuit Breakers 472 and 482 due to the loss of both PGE 230 KV lines to the Tidewater substation.

Corrective Actions:

	<b>Tesoro's Corrective Actions</b>	<b>Anticipated Date of Completion</b>	<b>Root Cause</b>
1	Communicate to PG&E that they should install the Direct Transfer Trip (DTT) device to improve the fault mitigation capability of their 230 kV system serving the Tidewater Substation. This will improve PG&E's ability to conduct testing at the substation.	Completed by PG&E in May 2011	(Not related to a specific root cause but needed to prevent a recurrence)
2	Communicate to PG&E that they should install the Separation Scheme protective devices to separate Foster Wheeler Martinez automatically from the PG&E grid whenever there is a problem at the Tidewater Substation that would make them supply PG&E load in addition to the refinery load.	Completed by PG&E in May 2011	4
3	Communicate to PG&E that they should expedite completion of the MRTU (Market Redesign Technology Upgrade) system. This will improve the control and monitoring capability at the substation.	Tesoro portion is complete. PG&E has scheduled work for December 2011	(Not related to a specific root cause but needed to prevent a recurrence)
4	Communicate to PG&E that they should proceed with equipment testing at the Tidewater Substation, and that they should implement any repairs that the testing shows to be needed.	Completed by PG&E in May 2011	1, 2, 3