Shell Oil Products US

Martinez Refinery
P.O. Box 711
Martinez, CA 94553-0071

January 19, 2017

Via hand delivery to CCC Hazardous Materials Division

Randall L. Sawyer
Chief Environmental Health and Hazardous Materials Officer
Contra Costa Hazardous Materials Programs
4585 Pacheco Boulevard, Suite 100
Martinez, CA 94553

Re: 30-day Report for 12/19/16 Incident (Partial Power Outage and Flaring)

Dear Mr. Sawyer,

Attached is the 30-day report regarding the flaring incident which occurred at Shell Martinez Refinery on December 19, 2016. This report meets the requirements in the "Hazardous Materials Incident Notification Policy" dated January 22, 2016.

If you have any questions, please contact me at 925-313-3079 or via email at ha.nguyen@shell.com

Sincerely,

Ha Nguyen

Ha Nguyen
Process Safety Manager

Attachments: 30-day Follow-up Notification Report Form
Investigation Report

CC: Cho Nai Cheung, CCCHMD
Michael Dossey, CCCHMD

ATTACHMENT C

30-DAY FOLLOW-UP NOTIFICATION REPORT FORM
CONTRA COSTA HEALTH SERVICES

For CCHS Use Only:
Received By: _____
Date Received: _____
Incident Number: _____
Copied To: _____
Event Classification Level: _____

INSTRUCTIONS: A hardcopy and an electronic copy of this report is to be submitted for all Level 2 and 3 incidents or when requested by CCHS. See Attachment C-1 for suggestions regarding the type of information to be included in the report. Attach additional sheets as necessary. This form is to be used for update reports after the initial 30-day report has been submitted. Forward the completed form to:

ATTENTION: Randall L. Sawyer
Chief Environmental Health and Hazardous Materials Officer
Contra Costa Hazardous Materials Programs
4585 Pacheco Boulevard, Suite 100
Martinez, CA 94553

INCIDENT DATE: December 19, 2016
INCIDENT TIME: 1:15 PM (approximately)
FACILITY: Shell Martinez Refinery

PERSON TO CONTACT FOR ADDITIONAL INFORMATION
Ha Nguyen 925-313-3079

PROVIDE ANY ADDITIONAL INFORMATION THAT WAS NOT INCLUDED IN THE 72-HOUR REPORT WHEN THE 72-HOUR REPORT WAS SUBMITTED, INCLUDING MATERIAL RELEASED AND ESTIMATED OR KNOWN QUANTITIES, COMMUNITY IMPACT, INJURIES, ETC.:

I. INCIDENT INVESTIGATION RESULTS

Is the investigation of the incident complete at this time? ___X___ Yes _____ No
If the answer is no, when do you expect completion of the Investigation?
_____
If the answer is yes, complete the following:

SUMMARIZE INVESTIGATION RESULTS BELOW OR ATTACH COPY OF REPORT:

SEE ATTACHED INVESTIGATION REPORT

SUMMARIZE PREVENTATIVE MEASURES TO BE TAKEN TO PREVENT RECURRENCE INCLUDING MILESTONE AND COMPLETION DATES FOR IMPLEMENTATION:

Recommendations	Estimated Completion Date
1. Update Electrical Job Safety Analysis (JSA) template to include verbiage to evaluate the need for additional electrical staff while troubleshooting of breaker controls and protective relaying in main substations (Substations 1, 2, and 3).	8/31/2017
2. Install labels for protective relays on Panel 2 in Sub 1. Labels will identify the corresponding breakers that will trip upon activation of the protective relay.	2/28/2018
3. Install informational label for alarms associated with breaker trips on alarm panel (Panel 6) in Sub 1.	2/28/2018
4. Review incident investigation learnings with all applicable electrical personnel.	6/30/2017

STATE AND DESCRIBE THE ROOT-CAUSE(S) OF THE INCIDENT:

SEE ATTACHED INVESTIGATION REPORT

Investigation Report

Loss of Power to Substations 1203 & 1206

Date & Time the Incident Began: 12-19-2016 (~13:15)
Investigation began on 12-19-2016 (~13:15) **with the collection of data**

Note: all times are approximate and based on a 24 hour clock (military time), unless otherwise noted

1.0 Summary of Event

At approximately 13:15, on December 19, 2016, Substation (Sub) 1 Bus Section G main breaker (1700/2) tripped causing loss of power to two 12kV distribution substations, Sub 1203 and Sub 1206. Sub 1 is one of Shell's three main electrical substations that feed the refinery. This resulted in loss of power to multiple units in LOP, OPCEN, Utilities and Logistics Vine Hill area. Subsequently, the affected units were shut down due to loss of power. The Sub 1 Bus G main breaker (1700/2) was manually reclosed at 13:17, restoring power to Sub 1203 and Sub 1206.

2.0 Impact

The multiple unit's shutdown caused flaring at the LOP and FXG flares, which resulted in multiple odor and noise complaints from the community.

As a precaution, a Community Warning Level (CWL) 2 was activated. An incident that triggers an activation of CWL 2 is considered a Major Chemical Accident or Release (MCAR) per the CCHS Guidance Document Definition.

3.0 Background and Process Description

Martinez has three main substations. Each main substation receives power from two-115kV PG&E transmission lines and steps down the voltage to 12kV for distribution to unit substations. Shell purchased Sub1 from PG&E in the early 1980's. The substation was designed per PG&E standards at the time. The other two Shell substations, Sub 2 and Sub 3, were designed to Shell standards.

Under normal configuration and operation, both 115kV PG&E lines into Sub 1 are in-service and provide power through two transformers (T106 and T107). A steam turbine generator (STG) also distributes and provides power to Sub 1. In this configuration, the F/G Tie breaker remains in the open position.

When the F/G Tie breaker is closed, it connects Bus Section G and Bus Section F which allows a path for power to be distributed between the two bus sections. After the addition of the STG and associated power distribution system in 1995, the F/G Tie breaker remains in the open position during normal operation because the breaker is under-rated for the available fault current from both transformers (T106 and T107) and the STG. Please reference associated Electrical Diagrams in Attachment A for more detail.

Several times during the year, Sub1 is switched to a one transformer service (using T106 or T107) in order for Shell to perform substation maintenance or at the request of PG&E for switching. When Sub 1 is being supplied power by one transformer, the F/G Tie breaker is manually closed in order to allow for a redundant path of power to and from Bus Section F and Bus Section G.

Sub1 is unique from other main substations in that it is comprised of *outdoor* breakers (15kV and 115kV) and open buses. The indoor control building for Sub 1 contains separate panels for breaker control and relaying. The F/G Tie breaker control and relays are located in the Sub 1 control building, while the wires are run external from Sub 1 control building to the outdoor F/G Tie breaker. This substation was originally designed and owned by PG&E but was purchased by Shell in the 1980's.

Unlike Sub 1, Shell's other major substations (Sub 2 and Sub 3) were designed to Shell specifications. They are comprised of a power distribution center with an *indoor* line up of 12kV switchgear, which contains the breakers, relays and associated control wiring inside the control building.

4.0 Narrative Sequence of Events/Timeline

On Tuesday December 13, 2016, PG&E requested a clearance in order to operate their tie breaker. This required Shell to switch to one transformer service at Sub 1, Sub 2, and Sub 3. During the switching activity on December 13th, it was discovered that the F/G Tie breaker would not close when the breaker control switch, located in Sub 1 control building, was moved to the "closed" position. Upon activating the F/G Tie breaker control switch in the closed position, an alarm lit up on the panel indicating "12kV Bus Section Switch F/G Tie Trip". The PG&E switching was completed successfully with the F/G Tie breaker in the open position. Shell personnel determined to complete the switching activity while the F/G Tie breaker remained in open position because operating off of a one transformer service was going to be for a short duration (couple of hours).

After the switching was completed, on December 13th, 2016, the electrical group still needed to determine what initiated the alarm and why the F/G Tie breaker remained open. On Monday December 19th, 2016, troubleshooting on the F/G Tie breaker was planned to occur. This date was chosen to avoid the previous week's inclement weather.

At 10:28, on December 19th the Electrical Staff member (E.S.) received a safety permit from the Utilities department to inspect the wiring and components of the F/G Tie breaker and the associated "12kV Bus Sectionalizing F&G" panel (Panel 2) as part of his initial troubleshooting. Upon inspecting the outdoor F/G Tie breaker internals, the E.S. found all the electrical components to be in physically good condition (i.e. no burnt or corroded wiring or terminals). He had identified during the inspection that the mechanical breaker mechanism was in need of lubrication.

The E.S. identified and traced out the wiring from the outdoor F/G Tie breaker to the back of Panel 2, located inside the Sub 1 control building. From the back of Panel 2, the E.S. identified the terminal block that the wires had landed on, and traced the corresponding wires to the back of an auxiliary relay (51NX-G). The auxiliary relay 51NX-G is activated by a corresponding electro-mechanical relay "Bus Section G Ground Overcurrent" (51N-G).

A relay is an electrical protective device, similar to a process safety relief valve. It is common for electro-mechanical relays to be designed with visual "flags" indicating that a relay is in the tripped position. Unlike electro-mechanical relays, auxiliary relays are commonly designed without a visual indication when in the tripped position, and the state of the auxiliary relay would be checked by physically looking at the position of the relay contacts (i.e. in the closed or open position).

After tracing out the wires, the E.S. returned to the F/G Tie breaker in the early afternoon with three Electricians to continue troubleshooting the breaker. An Electrical Joint Safety Analysis (JSA) was reviewed, completed and signed with the three electricians and E.S. prior to commencing any additional troubleshooting work.

The following sequence of events describes the troubleshooting that was done leading up to the loss of power to Subs 1203 and 1206, and occurred in the sequence outlined below:

- The 15kV isolation switches for the F/G Tie breaker were physically opened to isolate the F/G Tie breaker from Bus Section G and Bus Section F (located on either side of the F/G Tie breaker).
- The F/G Tie breaker isolation switches were inspected once open and were visually in good condition.
- The E.S. and Electrician #1 went inside Sub 1 control building to manually close the F/G Tie breaker control switch located on Panel 2.
- Electrician #2 and #3 stayed outside at the F/G Tie breaker to visually observe the operation of the breaker mechanism and observe if any components were bound up upon the control switch being activated.
- At 13:14:45 the E.S. manually closed the F/G Tie breaker control switch on Panel 2 of Sub 1 and an alarm annunciated on Panel 6 indicating "12kV Bus Section Switch F/G Tie Trip".
- Electricians #2 and #3 observed no mechanical movement in the F/G Tie breaker, and the breaker did not close upon manually closing the F/G Tie breaker control switch.
- Electrician #1 was told to silence the alarm by the E.S. at the alarm panel which was located in Panel 6, approximately10 feet away from Panel 2.
- While Electrician #1 responded to the alarm, the E.S. had thought that the alarm could be caused by a relay that was in the tripped position. The E.S. thought, in particular, an auxiliary relay was possibly in the tripped position and removed the cover of auxiliary relay (51NX-G) on Panel 2.
- The E.S. pulled out the auxiliary relay (51NX-G) to check that the contacts were open and then pushed in the auxiliary relay, with the thought that this would change the state of the trip contacts, and the alarm would clear.
- Upon pushing in the auxiliary relay 51NX-G, the contacts of the 51NX-G closed, this immediately activated a trip of Bus Section G's main breaker (1700/2) resulting in loss of power to Sub 1203 and Sub 1206. These substations feed power to multiple units in LOP, OPCEN, Utilities and Logistics Vine Hill area.
- At 13:15:39, "12kV Bus Tie TX-7 Switch 1700/2 trip" alarm came in on the alarm panel at Panel 6, indicating Bus Section G main breaker (1700/2) had tripped.
- Electricians # 2 and #3 heard noise of a breaker opening outside of Sub1.
- Approximately 30 seconds later, a call was received on the radio from Utilities operator that power was lost.
- Once the E.S. confirmed the Bus Section G main breaker (1700/2) did in fact trip, the E.S. performed an electrical check on all associated equipment and components before proceeding to safely close the Bus Section G main breaker (1700/2).
- At 13:17:57, Bus Section G main breaker (1700/2) was closed and power was restored to Subs 1203 and 1206.

Although power was restored in about 2 minutes after the initial trip, many of the units had already begun depressuring the units to the flare via the refinery safety systems.

5.0 Cause Analysis

It was determined that Bus Section G main breaker (1700/2) tripped, resulting in loss of power to Subs 1203 and 1206, due to the manual closing of auxiliary relay's (51NX-G) contacts, which sent a trip signal to Bus Section G main breaker (1700/2). The investigation team focused the investigation on the human interfacing and decision making to determine the causes as to why the E.S. manually interacted with auxiliary relay (51NX-G).

The following causes were identified as to why the E.S. determined to manually close auxiliary relay 51NX-G:

- The annunciator "12kV Bus Section switch F/G Tie trip" alarmed when the F/G Tie breaker remained open, after manually activating the control switch to the "close" position.
- The E.S. believed there was a trip signal, likely from a relay, keeping the F/G Tie breaker from closing basis the alarm description.
- The E.S. believed that by mechanically closing the contacts of auxiliary relay 51NX-G the alarm would clear.
- The E.S. had identified auxiliary relay 51NX-G by tracing wires from F/G Tie breaker to the back of Panel 2 in Sub 1 control building.
- The E.S. believed any action taken on Panel 2 was safe from consequence.

When the "12kV Bus Section switch F/G Tie trip" alarmed upon manually activating the control switch to the "closed" position, the alarm description led the E.S. to believe that a tripped relay was possibly sending a signal to the F/G Tie breaker to remain open. Panel 2 has several electro-mechanical relays with corresponding auxiliary relays. The 51NX-G auxiliary relay is activated by its corresponding electro-mechanical relay, "Bus Section G Ground Overcurrent" (51N-G). The flag of electro-mechanical relay 51N-G remained in the un-tripped position when the alarm annunciated, which directed the E.S. to believe that 51N-G's auxiliary relay (51NX-G) could possibly be sending a "false" trip signal, causing the alarm. The E.S. believed that by mechanically closing the contacts of the auxiliary relay, the alarm would clear. This would indicate that the auxiliary relay (51NX-G) was sending a "false" trip signal to the F/G Tie breaker which would cause it to remain open upon activating the control switch to the "closed" position.

The auxiliary relay 51NX-G and the electro-mechanical relay 51N-G are both located on the "12kV Bus Sectionalizing F&G" panel (Panel 2). The E.S. believed that manually closing auxiliary relay 51NX-G was safe from consequence, because the E.S. believed the F/G Tie breaker components located on Panel 2 were isolated from the neighboring panels, Bus Section F, 1600/2 (Panel 1) and Bus Section G, 1700/2 (Panel 3).The labeling of the components on Panel 2 corresponded to the F/G Tie breaker and typically panels were organized by their associated components. The E.S. also had reason to believe that manually closing auxiliary relay 51NX-G on Panel 2 was safe from consequence, because the outdoor F/G Tie breaker was physically isolated from Bus Section G and F when the isolation switches were manually opened in the field. See photo below of Panel 2 inside Sub 1.

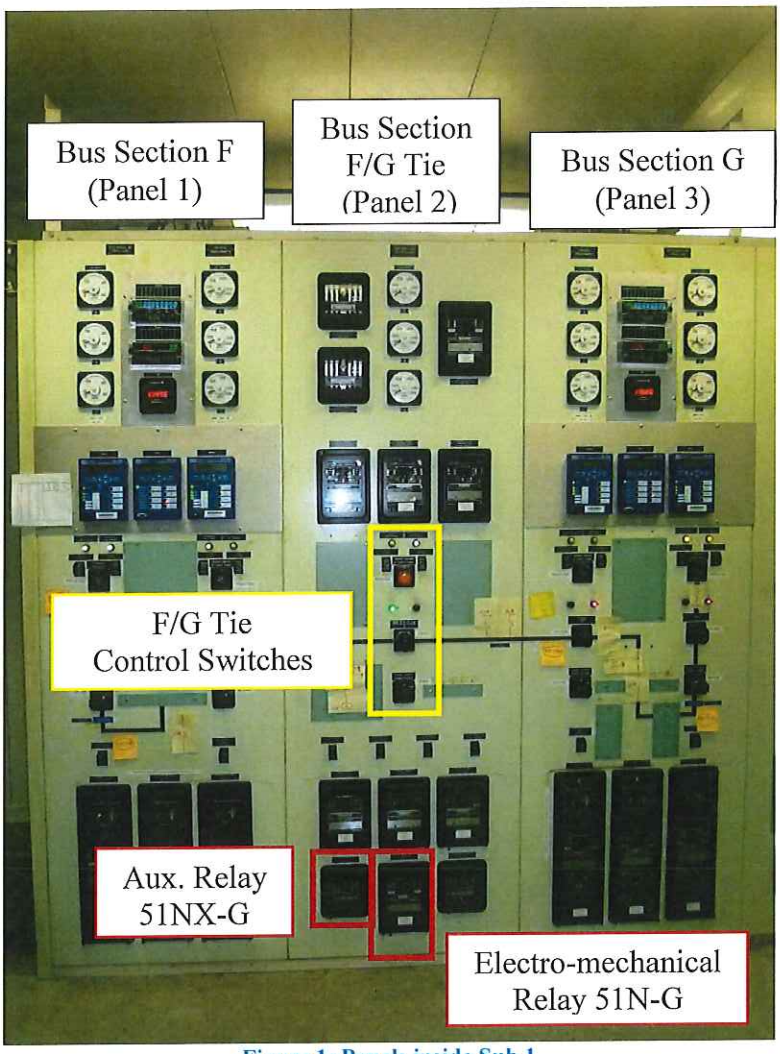

Figure 1: Panels inside Sub 1

Lastly, the E.S. had followed out the wires from his initial troubleshooting from the outdoor F/G Tie breaker into Sub 1 control building. These wires were chosen, because the E.S. was aware of the alarm and F/G Tie breaker issue on December 13th and was looking for wiring that ran external from the F/G Tie breaker to Panel 2 in Sub 1 control building. The wires were traced out and believed to land on a terminal block at the back of Panel 2, and were subsequently traced to auxiliary relay 51NX-G. The wires that were identified and traced to the back of Panel 2 were distinctive from the other wires, internal and external to the F/G Tie breaker and Panel 2, in that: they were a pair of red and black wires, the wires had similar gauge, wire numbers, wire tags, and yellow wire lugs. See photo below of wires that were traced from the outdoor F/G Tie breaker to the back of Panel 2.

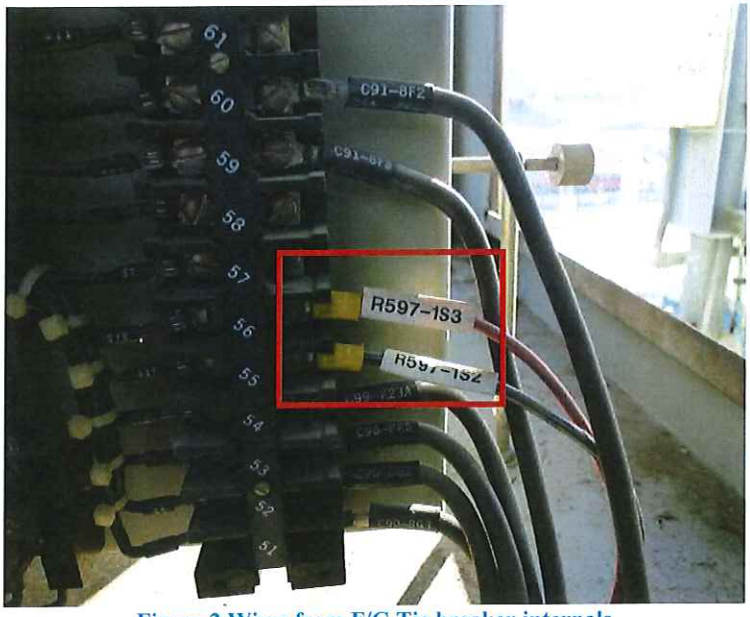

Figure 2 Wires from F/G Tie breaker internals

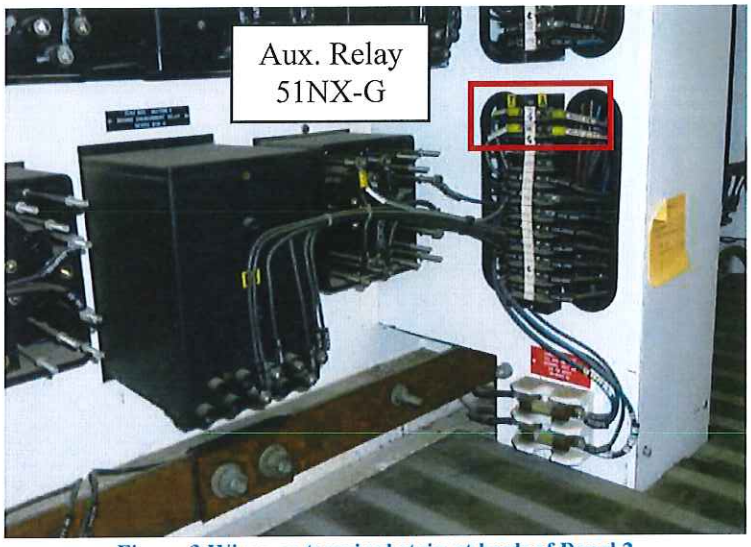

Figure 3 Wires on terminal strip at back of Panel 2

Although isolated physically in the field, auxiliary relay 51NX-G, located on Panel 2, had active wiring to trip Bus Section G's main breaker (1700/2) when manually pushed into the closed position.

The trip contacts of auxiliary relay 51NX-G to the F/G Tie breaker were shown on the associated F/G Tie breaker electrical drawing, which the E.S. had referenced during the F/G Tie breaker troubleshooting. The trip contacts of auxiliary relay 51NX-G to Bus Section G's main breaker (1700/2) were included on a different drawing.

6.0 Recommendations

Recommendation	Responsible Manager or Individual	Estimated Completion
1. Update Electrical Job Safety Analysis (JSA) template to include verbiage to evaluate the need for additional electrical staff while troubleshooting of breaker controls and protective relaying in main substations (Substations 1, 2, and 3).	Electrical Engineer	8/31/2017
2. Install labels for protective relays on Panel 2 in Sub 1. Labels will identify the corresponding breakers that will trip upon activation of the protective relay.	Electrical Engineer	2/28/2018
3. Install informational label for alarms associated with breaker trips on alarm panel (Panel 6) in Sub 1.	Electrical Engineer	2/28/2018
4. Review incident investigation learnings with all applicable electrical personnel.	Causal Learning Focal Point	6/30/2017

Attachment A: Simplified Electrical Feed Diagram (Normal Operation)

Legend:
= CLOSED
= OPEN

Sub 1