February 6, 2013

Ms. Alicia Fenrick
Director, Litigation and Claims
245 Market Street
San Francisco, California 94105

Via e-mail: AWF9@pge.com

Bureau Veritas Project No. 33112-012262.00

Subject: Root Cause Analysis of Fatal Injury at Kern Power Plant
Redacted

Dear Ms. Fenrick:

Bureau Veritas North America, Inc., Health Safety and Environmental Services, is pleased to provide you with a copy of the Root Cause Analysis of Fatal Injury report from the Kern Power Plant facility at Redact
Redacted

Should you have questions in regard to the enclosed report, or need assistance with other industrial hygiene issues, please contact me at Redacted

Please take a minute to share your opinion with us regarding the consultant's service by completing our web-based quality survey. Click on the following link or copy and paste it into your web browser to access the site.

http://www.us.bureauveritas.com/wps/wcm/connect/BV_USNew/Local/Home/Our-Services/Health_Safety_Environmental/Webinars_C_Technical%20Training/hse_customer_satisfaction_survey_content

Thank you again for the opportunity to be of service.

Very truly yours,

Redacted

Redacted CIH, CSP, CHMM, CPEA
Senior Managing Consultant
Bureau Veritas North America, Inc.
Health, Safety, and Environmental Services

Bureau Veritas North America, Inc.

Health, Safety and Environmental Services
2430 Camino Ramon, Suite 122
San Ramon, CA 94583

Main : (925) 426-2600
Fax : (925) 426-0106
www.BureauVeritasHSE.com

Root Cause Analysis of Fatal Injury at Kern Power Plant

Completed At: Kern Power Plant
Redacted

Bureau Veritas Project Number: 33112-012262.00

Report Date: February 6, 2013

Prepared for: Ms. Alicia Fenrick
Director, Litigation and Claims
AWF9@pge.com

Prepared by: Redacted
Senior Managing Consultant
San Ramon, California
Redacted

FINAL REPORT

Move Forward with Confidence

Table of Contents

1.0 INTRODUCTION

Ms. Alicia Fenrick, Director, Litigation and Claims, with Pacific Gas and Electric Company (PGE), retained Bureau Veritas North America, Inc. (Bureau Veritas) to conduct a root cause analysis (RCA) of the fatal accident at the Kern Power Plant located at Redacted in order to assess potential improvements in PGE's relevant (contractor) safety management systems in place at the time of the accident. The scope of work for this project was described in Bureau Veritas' Proposal No. 3303.12.365 dated November 5, 2012, and Proposal No. 3303.12.776 dated December 18, 2012 both addressed to Ms. Alicia Fenrick. The project was completed in accordance with the Master Services Agreement (MSA # 4400005800, effective 2-2-12) established between BVNA and Pacific Gas and Electric. While on-site at KPP Redacted was Bureau Veritas' primary contact.

Redacted CSP. CIH, CHMM, CPEA Senior Managing Consultant with Bureau Veritas, completed the RCA on January 11, 2013.

Bureau Veritas performed the following tasks for this project:

- Prepared a list of requested PG&E and Cleveland Wrecking Company (CWC) documents to be reviewed.
- Prepared a list of key PG&E personnel (by job function) to be interviewed.
- Prepared a list of questions for PGE's Generation Procurement group
- Prepared a list of questions for CWC
- Conducted a physical inspection of the work site
- Reviewed key documentation provided by CWC to PGE
- Reviewed key documentation provided by PGE
- Interviewed key PGE personnel associated with the KPP demolition project
- Interviewed key PGE personnel associated with the procurement process for hiring contractors for the KPP demolition project
- Interviewed three experienced tank demolition professionals
- Reviewed video recordings of the tank demolition process immediately before and during actual incident
- Performed a root cause analysis of the incident based on the available information
- Identified potential improvements to PGE's relevant (contractor) safety management systems
- Reviewed plans for completing the demolition of the tanks

2.0 BACKGROUND

The former Kern Power Plant (KPP) was comprised of two (2) main generating units, Unit 1 and Unit 2; 4 boilers two (2) house generating units; and a heavy fuel oil tank farm. KPP was removed from the roles of the country's

generating facilities in 1996. The facility was retired in 1985, (designated as in "cold standby"), and has been un-staffed since the late 1980's.

The Kern Power Plant Demolition Project is a "turn-key" project, whereby the contractor was given care, custody and control of the site and the Contractor has full responsibility for the dismantling, demolition and disposal of all the structures and equipment at the site and the safety of the people on the site.

3.0 ACCIDENT DESCRIPTION and TIMELINE

The following account of the accident was excerpted from CWC's accident investigation report provided to PGE.

Location of Incident: Kern Power Plant, Bakersfield, California
Date of Incident: Tuesday, June 19, 2012, approximately 9:20 a.m.
Type of Incident: Worker fatality; struck by collapsing tank wall

Executive Summary:

On June 19, 2012, a four-person team was in the process of dismantling a large (approximately 40 feet high and 120 feet in diameter) fuel storage tank when a section of the steel wall unexpectedly collapsed and struck the boom lift one of the employees was working from. Due to the position of the boom lift, the force of the impact drove the lift backward until the entire unit overturned causing the basket the employee was riding in to strike the ground. Co-workers immediately suspended their activities and rushed to aid the injured employee. Emergency services (via 911) were summonsed and the employee was transported by ambulance to a local hospital. Tragically the employee's injuries were too severe and he did not survive.

Investigation Methodology:

Information included in this report was obtained from on-site evaluation of the accident scene; from interviews of CWC employees who either witnessed the incident or who had first-hand knowledge of the events leading to and immediately following the incident; and from project documents including the site health and safety plan, employee training records, daily tailgate meeting notes, and equipment inspection records.

Background Information:

In March 2012, Pacific Gas and Electric (PG&E) contracted CWC to dismantle the Kern Power Plant (KPP) located at Redacted The facility includes four boilers with associated control rooms and smoke stacks, four above ground, heavy fuel storage tanks with associated piping and equipment, administrative building, hazardous waste storage building and other smaller tanks and support structures. The plant ceased operation in the mid-1980s and the site has been idle ever since.

Due to the age of the facility, a number of structures (including the boilers and above ground tanks) contained asbestos insulation. In accordance with State of California regulations, the asbestos insulation needed to be

removed prior to the initiation to the demolition of these structures. Because CWC does not normally conduct asbestos abatement work, a specialty subcontractor was retained by CWC to perform this work. The abatement activities on the four above ground tanks were completed in mid-June. Demolition activities on the four tanks began the week of June 18, 2012.

Incident Review:

The team assigned to demolish Tank 1 consisted o Redacted (field superintendent), Redacted Redacte (torch men/laborers) and Redacted (heavy equipment operator). This same team had worked together on a previous CWC project where numerous fuel tanks of similar dimensions to the four at the Kern facility were dismantled.

At the time Redacted crew started to work on the four fuel tanks, other workers were completing the task of emptying the fuel drain lines that were present on either side of the tanks. Once the fuel lines were empty and cleaned, the lines could be disassembled.

On June 18, the crew cut "doors" in the side of the four tanks to provide access for the laborers and equipment. Prior to cutting the doors, Redacted discussed the size of the opening and where the door should be cut. The factors bearing on this decision included the location of fuel lines and the terrain surrounding the tanks. The door to Tank 1 was the cut between the fuel lines and on the side where the pieces of the tank could be easily processed and removed from the site. After the door was cut, the floating lid on the interior of the tank was demolished and taken outside of the tank with the excavator.

On June 19, 2012, Redacted led a safety tailgate meeting to discuss the work that would be completed that day, including the demolition of Tank 1. During the meeting, the entire CWC crew discussed the days' work assignments, JSA's and PPE requirements for their respective tasks. After the meeting, Redacted crew went to Tank 1 and again reviewed the specific steps for dismantling the tank.

Redacted and his crew had previously determined that the torch men would cut the tank walls from boom lifts positioned inside the tank. This decision was driven by the surface conditions surrounding the tank. The ground outside the tank is uneven and sandy. And with a tank height of 40 feet, the crew was concerned about the difficulties of maneuvering their boom lifts to allow them access to the upper portions of the tank. In addition, other obstacles such the existing fuel lines would impede efficient work from the outside.

Working from the inside of the tank eliminated these problems. The tank floor was flat, stable, and free of obstructions. With a tank diameter of 120 feet, the crew concluded they had ample room to maneuver the lifts without compromising worker safety. The same approach had been successfully used by this same crew to demolish tanks of similar size over the past 10 years.

As had been the practice on similar jobs, the plan was to cut the top half of the tank in 20' x 20' sections and then use a Link Belt 700 excavator (operated by Redacted) to fold the cut section in to the interior of the tank. Redacted marked the initial four cut locations, spaced approximately 20 feet apart, with orange spray paint on the exterior base of the tank walls. These marks identified locations where the two torch men Redacted Redacted , working from S-60 Genie boom lifts, would make cuts.

When the torch men were set up to cut the first piece, they alerted Redacted who was stationed on the ground outside of the tank. Redacted then directed the torch men where to line up their cuts. Once they were aligned to Re Redacte satisfaction, the torch men commenced cutting.

As the torch men cut the tank walls, they would leave "stickers" on both the horizontal and vertical cuts. A sticker is a short (2"-3" long) uncut section of wall which keeps the cut wall section in place until it is ready to push in by the excavator operator.

Redacted frequently entered and exited the tank while the cuts were made to verify the cuts were made in the proper locations, monitor the position of the boom lifts, assist the torch cutters with their equipment (such as moving hoses), and coordinate communication with the excavator operator working outside the tank.

Once the section was cut and with the “stickers” intact, the torch men would signal to Redacted that the cuts had been completed. At this time, the torch men would move their boom lift back and to the center of the tank. Red Redac would look outside the tank to determine whether the area was clear. Redacted would then contact the excavator operator by radio and direct him to make the push. As directed, the operator would extend the boom of the excavator and tap the cut section of wall, breaking the “stickers”. Once pushed, the weight and momentum of the cut section would allow the steel to fold squarely into the tank. The operator would then flatten the cut section of steel against the intact portion of the wall, thus reducing the height of the tank wall by roughly half.

Following each cut, Redacted returned to the exterior of the tank and, using the orange paint as his guide, confirmed the desired location for the next cut. Due to the respirators worn by the torch men Redacted used hand signals rather than a radio to communicate where the next cut would be made. In order for the torch men to see his signals, they needed to raise their baskets above the rim of the tank to gain line of sight with Redacted .

Once the first section was down, the crew, under Redacted direction and using the same process described above, took down wall sections 2 and 3.

After the third section was down, Redacted noticed that Redacted lift was located approximately 25-30 feet from the tank wall. Redacted wanted the boom lift carriage approximately 45 feet from the tank wall. Lifts with 60' booms (rather than standard 40' booms) had been obtained for this project to allow for greater distances between the tank walls and the lift carriages.

In addition, Redacted noticed that Redacted had his boom extended perpendicular to the carriage (which happened to position the carriage wheels parallel to the tank wall). Instead, Redacted wanted the boom extended over the length of the carriage to afford greater stability when extended (which would also change the wheel alignment to be perpendicular to the tank wall). Redacted communicated his concern to Redacted and directed him to reposition the lift.

At the time that Redacted was instructing Redacted to reposition his lift, he received a telephone call that required him to go to the front gate. Prior to leaving, Redacted gave each torch cutter a bottle of water and told them to rest (conditions at the time were hot and dry and Redacted was concerned about heat stress). As he left, he told the torch cutter: "I'll be right back." The torch men nodded as Redacted turned toward the front gate, which was about 500 yards from the tank.

As he left, Redacted assumed the torch men would suspend their activities until he returned because: (1) This crew had worked together for over 10 years and their practice had been to wait for Redacted direction before starting new tasks; (2) it would take a few minutes for the torch men to drink their water; (3) Redacted would need to a few minutes to reposition his lift; (4) Redacted thought he would return from the front gate before they had finished their water.

For reasons not known, Redacted repositioned his lift and began his next cut above the tank door (note: unlike the pervious sections, the location of this cut had not been identified by orange spray paint). Upon finishing his cut, Redacted raised his bucket above the rim of the tank and motioned to the excavator operator. Using hand signals, Redacted indicates to the operator that he was ready for the newly cut section to be pushed into the tank. The operator then extended the excavator boom and taps the freshly cut section.

Unlike the 3 previous wall sections, this section did not fold squarely into the tank. Instead, because approximately 2/3 of this section extended above the doorway (and therefore was not supported), the bottom, unsupported corner of this section dipped downward, causing the upper corner to tip toward the un-cut wall. The top corner of the cut section then hung up momentarily on the un-cut wall, causing it to bend in toward the interior of the tank.

The newly cut wall section continued its downward descent, pulling the corner of the un-cut section down with it. The weight and momentum of the sagging steel drove the un-cut wall further into the tank interior. The collapsing steel struck the boom of Redacted lift and pushed the entire unit backward. Because the carriage was aligned parallel to the wall, the wheels were not positioned to allow the carriage to roll backward. As a result, the force of the sagging steel drove the boom lift upward until it passed its center of gravity. At this point, the entire lift overturned and the basket, along with Redacted fell to the ground. Because the entire lift overturned, the fall protection gear worn by Redacted could not prevent his devastating injuries.

On his way back from the gate, Redacted heard the crash of the lift overturning. Other crew members, including Redacted step brother, rushed to the scene and tended to Redacted Work was immediately suspended and emergency services (911) were called. Redacted was transported to the hospital by ambulance. Tragically, Redacted passed away as short time later.

Incident Analysis:

The fatality at the Kern facility is confounding for a number of reasons:

- The crew assigned to the Kern project were some of CWC's most experienced and talented workers; many with 10 or more years with the company.

- Over the past 5 years, the 4-person team involved in the Tank 1 incident had dismantled numerous tanks of similar size without serious incident using similar procedures. CWC management considered this crew to be their "A team" for dismantling elevated structures.

- Redacted is an experienced field superintendent, fluent in both English and Spanish, and is well respected and liked by his field crews.

- The Tank 1 team reviewed the written JSAs for this assignment during the June 19 tail gate meeting. In addition, the team had physically inspected the tank prior to the initiation of site activities and had discussed their specific steps for cutting the tank.

- Redacted was wearing the required personal protective equipment including:
-Fall protection harness with attached lanyard -Disposable coverall, gloves, ear plugs, and safety glasses -½ face respirator with HEPA cartridges -Hard hat and work boots

- The Tank 1 team was not under any time pressure to remove the tank. In fact they were assigned the Tank 1 task while waiting for the completion of the asbestos abatement work elsewhere in the facility.

Redacted was an excellent employee. He was known as hard worker who was diligent about following health and safety requirements. He was very well liked by other members of the crew and was considered to be a mentor to many.

It is not possible to know why Redacted decided to make his next cut without waiting for direction from the Field Superintendent Redacted. Clearly Redacted assumed that this section of wall would fold into the tank like the previous 3 sections. However, crew members interviewed for this investigation expressed surprise that Red Redacted would make a cut near the door because they believed that a cut in this location could jeopardize the structural integrity of that section of the tank wall.

Several crew members mentioned that Redacted had "not been himself" during the days leading up to the incident. Redacted was normally an outgoing person, very talkative, and enjoyed joking with coworkers. However, prior to the accident, he had apparently become quiet and reserved.

This was so unusual that on Monday (June 18) before the incident, Redacted pulled Redacted aside to ask if there was something wrong. During this conversation, Redacted mentioned that he was seeing a doctor about a health condition. Redacted apparently had been having issues with his heart and on the Friday before the incident, his doctor prescribed a new medicine for the condition.

Redacted had a work mandated physical last March and was cleared for duty. Redacted apparently indicated that he was OK and was able to continue to work. According to Redacted and other members of the crew, Re Redacte did not exhibit signs of impairment, he just seemed quite and a bit distracted. Note: the coroner's report did not indicate the presence of illegal or recreational drugs.

Kern Power Plant Fatality Event Timeline - 6/19/2012:

0600: Daily safety tailgate meeting

0620: Crew assignments are made and work begins

0730 - 0846: First 3 section of the tank are successfully cut

~0850 - 0855: Superintendent Reda is notified that he needs to meet a contractor at the front gate.

Superintendent Reda cted gives the 2 laborers bottles of water and informs his crew that he will return shortly

0855 - 0907: Laborer Redacted begins to cut unmarked tank wall section above doorway

Laborer Redacted signals to equipment operator Redact ed to push in freshly cut wall section

0908: Newly cut wall section snags top, left corner (as viewed from outside the tank) of un-cut wall and bend it down into the tank toward the Redacted boom lift.

Force of collapsing wall drives boom backward causing the carriage to overturn.

~0910 - 0920: Co-workers come to the aid of Redacted Emergency services are called. Site operations are halted

~0920 - 0930: Emergency personnel arrive, tend to Redacted and transport him to hospital

4.0 ROOT CAUSE ANALYSIS METHODOLOGY

A modified Systematic Causal Analysis Technique (SCAT) was used to perform a root cause analysis (RCA) of the accident. SCAT is an accident investigation tool developed by Frank Bird at the International Loss Control Institute (ILCI) [1] and first published in 1985. Based on ILCI's Loss Causation Model (see Appendix A), it uses a familiar "5 Whys" approach that starts out by identifying the types of substandard acts and/or conditions that were immediate causes of the loss event (accident). Effective corrective actions focus attention on eliminating these immediate causes.

Asking why each substandard act or condition occurred helps identify the underlying types of personal and/or work-environment factors (root causes) of the loss event. Eliminating these root causes contributes to effective long term preventive actions.

Asking why these factors were present helps identify program failures and management system weaknesses. Addressing these failures and weaknesses produces permanent improvements in the organization's management and control of risk.

For example:
An employee slipped and fell to the floor injuring his wrist.
Investigation shows that an immediate cause of the fall was an unsafe condition, oil on the floor.
Cleaning up the oil was a corrective action.

Asking why there was oil on the floor resulted in discovering that a root cause of the accident was inadequate maintenance, (a forklift was leaking oil).
Fixing the leaky forklift was a preventative action.

Asking why the forklift was leaking resulted in discovering a forklift program flaw: forklift maintenance was on a "run until failure" schedule.
Changing to a preventive maintenance schedule for forklifts was a program improvement.

Asking why forklift maintenance was on a "run until failure" schedule resulted in discovering a management system problem: that the maintenance department was understaffed due to a Human Resources department backlog in filling open positions.
Developing a system of prioritizing the hiring process for Human Resources was a management systems improvement for the company.

Note: [1] ILCI was bought by Det Norske Veritas (DNV) in 1991.

5.0 POTENTIAL ISSUES FOR EXAMINATION

After reviewing the documents provided, inspecting the accident site, and interviewing key personnel and outside experts, and viewing the videos of the accident, the following observations / potential issues were noted and used to help populate the tables.

Note: Given the circumstances surrounding this incident and the inability to directly interview and interact with CWC employees, the words "possible," "potential," and "proposed" are used liberally throughout this RCA in describing observations, immediate causes, and root causes.

1 PGE Procurement did not validate CWC safety data.
2 Experience Modification Rates (EMRs) reported for CWC and their 2 main subcontractors for 2010 and 2011 do not corrolate with reported OSHA rates for the same time period (reported as zeros). This can be possible if all workers compensation costs for all 3 companies over the 2 year period were due to non-OSHA recordable cases, i.e. first aid) but such conditions seem unlikely given the nature of the business operations..
3 PGE Procurement did not validate CWC compliance with required safety programs
4 CWC elected to not follow their agreed upon demolition work plan method for demolishing tanks
5 CWC elected to use manual means with manlifts and cutting torches instead of purely mechanical means to demolish tanks when mechanical means were available.
6 PGE's Representative did not approve nor object to CWC's change in method for demolishing tanks
7 CWC's use of manlifts and cutting torches is an obsolete approach and carries a higher safety risk and is no longer general industry practice now that taller excavators with shears are available
8 Victim's behavior was noticeably out of character on the day of the accident
9 Victim informed superintendent that he was taking a new medication
10 CWC Superintendent accepted victim's answer that he was okay to work and took no further action
11 Victim, an experienced employee, positioned his manlift in an unsafe location: too close to the tank wall with the manlift's wheels parallel to the tank wall
12 CWC Superintendent instructed victim to reposition the manlift before continuing work
13 CWC Superintendent was called away from the worksite temporarily, expecting the work crew to wait until his return before restarting work
14 Victim resumed working while superintendent was still away
15 Victim ignored superintendent's instruction to safely reposition the manlift
16 Victim finished cutting section over doorway (not the correct section)
17 Victim raised manlift over tank wall to signal excavator operator to push tank wall in
18 CWC Excavator operator did not wait for superintendent to return and proceeded to push on tank wall
19 CWC Superintendent, safety officer, and work crew did not stop work each time excavator pushed tank wall into tank while workers were inside the tank
20 CWC's method for testing the Integrity of tank floor to insure its ability to support men and equipment before they entered the tank is to use a "tracked vehicle" first.

6.0 ROOT CAUSE ANALYSIS

The following descriptions refer to and expand upon the color coded: **observations,** **substandard acts and conditions (immediate causes),** and **personal and work-environment factors (root causes)** that appear in the root cause analysis tables.

RCA BY: MODIFIED - SYSTEMATIC CAUSAL ANALYSIS TECHNIQUE ©

Proposed Observation	1.0	**Manlift was parked too close to and parallel to the tank wall**	
Potentially Substandard Acts	1.1	Improper Position for Task	
	1.2	Improper Placement	
	1.3	Using Equipment Improperly	
Possible Personal Factors	1.01	**Inadequate Mental or Psychological Capability**	**- emotional disturbance**
	1.02	**Inadequate Mental or Psychological Capability**	**- mental illness**
	1.03	**Mental or Psychological Stress**	**- mental illness**
	1.04	**Mental or Psychological Stress**	**- preoccupation with problems**
	1.05	**Mental or Psychological Stress**	**- emotional overload**
	1.06	**Physical or Psychological Stress**	**- injury or illness**
	1.07	**Physical or Psychological Stress**	**- blood sugar insufficiency**
	1.08	**Physical or Psychological Stress**	**- drugs**

Proposed Observation - Black font Potential Immediate Cause - Blue font **Possible Root Cause - Green font**

Proposed Observation 1.0

Manlift was parked too close to and parallel to the tank wall.

Potentially Substandard Act 1.1 - Improper Position for Task

Potentially Substandard Act 1.2 - Improper Placement

Potentially Substandard Act 1.3 - Using Equipment Improperly

Victim was an experienced employee who would be expected to be familiar with the proper positioning of a manlift for maximum stability. Instead, he parked with the wheels parallel to the tank wall. When the lift was extended towards the tank wall it was perpendicular to the direction of the wheels. Consequently, when the tank wall collapsed and fell against the extended manlift, the wheels could not roll back away from the wall. Instead the lift truck was tipped over.

Possible Personal Factors 1.01 - 1.08

Victim's health issues are not known at this time.

RCA BY: MODIFIED - SYSTEMATIC CAUSAL ANALYSIS TECHNIQUE ©

Proposed Observation	2.0	**Victim did not follow superintendent's instructions to reposition manlift (with wheels perpendicular to tank wall) before resuming work**	
Potentially Substandard Acts	2.1	**Failure to React - Correct**	
	2.2	**Failure to Follow Procedure - Policy - Practice**	
	2.3	**Using Equipment Improperly**	
Possible Personal Factors	2.01	**Inadequate Mental or Psychological Capability**	**- emotional disturbance**
	2.02	**Inadequate Mental or Psychological Capability**	**- mental illness**
	2.03	**Mental or Psychological Stress**	**- mental illness**
	2.04	**Mental or Psychological Stress**	**- preoccupation with problems**
	2.05	**Mental or Psychological Stress**	**- emotional overload**
	2.06	**Physical or Psychological Stress**	**- injury or illness**
	2.07	**Physical or Psychological Stress**	**- blood sugar insufficiency**
	2.08	**Physical or Psychological Stress**	**- drugs**
	2.09	**Lack of Knowledge**	**- misunderstood directions**
Possible Work-Env Factors	2.10	**Improper Motivation**	**- improper performance is rewarded**
	2.11	**Improper Motivation**	**- inadequate discipline**
	2.12	**Inadequate Work Standards**	**- inadequate communication of standards**

Proposed Observation - Black font | **Potential Immediate Cause - Blue font** | **Possible Root Cause - Green font**

Proposed Observation 2.0

Victim did not follow superintendent's order to reposition the manlift (with wheels perpendicular to tank wall) before resuming work.

Potentially Substandard Act 2.1 - Failure to React - Correct

Potentially Substandard Act 2.2 - Failure to Follow Procedure - Policy - Practice

Potentially Substandard Act 2.3 - Using Equipment Improperly

Victim was using the manlift in an unsafe manner contrary to good practice, and did not respond to superintendent's instructions to correct the situation. This was apparently unusual behavior for the victim.

Possible Personal Factors 2.01 - 2.08

Victim's reasons for failing to follow superintendent's instructions may have been related to health issues which are not known at this time.

Possible Personal Factor 2.09 - Lack of Knowledge - misunderstood directions

Victim may have misunderstood the superintendent's instructions.

Possible Work Env. Factor 2.10 - Improper Motivation - improper performance s rewarded

Victim may have ignored instructions to save time. Company culture may reward productivity over safety.

Possible Work Env. Factor 2.11 - Improper Motivation - inadequate discipline

Inadequate disciplinary policy and/or practice may not discourage rule breaking.

Possible Work Env. Factor 2.12 - Inadequate Work Standards - inadequate communication of standards

It's possible that the victim was not aware of the right/safe way to position the manlift's wheels.

RCA BY: MODIFIED - SYSTEMATIC CAUSAL ANALYSIS TECHNIQUE ©

Proposed Observation	3.0	**Torch cutting and excavator pushing on tank wall took place w/o site superintendent present**	
Potentially Substandard Acts	3.1	**Operating Equipment Without Authority**	
	3.2	**Failure to Follow Procedure - Policy - Practice**	
Possible Personal Factors	3.01	**Inadequate Mental or Psychological Capability**	**- emotional disturbance**
	3.02	**Inadequate Mental or Psychological Capability**	**- mental illness**
	3.03	**Mental or Psychological Stress**	**- mental illness**
	3.04	**Mental or Psychological Stress**	**- preoccupation with problems**
	3.05	**Mental or Psychological Stress**	**- emotional overload**
	3.06	**Physical or Psychological Stress**	**- injury or illness**
	3.07	**Physical or Psychological Stress**	**- blood sugar insufficiency**
	3.08	**Physical or Psychological Stress**	**- drugs**
	3.09	**Lack of Knowledge**	**- misunderstood directions**
Possible Work-Env Factors	3.10	**Improper Motivation**	**- improper performance is rewarded**
	3.11	**Improper Motivation**	**- inadequate discipline**
	3.12	**Inadequate Work Standards**	**- inadequate communication of standards**

Proposed Observation - Black font **Potential Immediate Cause - Blue font** **Possible Root Cause - Green font**

Proposed Observation 3.0

Torch cutting and excavator pushing on tank wall took place w/o site superintendent present.

Potentially Substandard Act 3.1 - Operating Equipment Without Authority

Potentially Substandard Act 3.2 - Failure to Follow Procedure - Policy - Practice

CWC superintendent could see both the inside and outside of the tank putting him in a position to decide if he felt the manlift was in a safe position, far enough away from the tank wall, before signaling the excavator operator to push in the tank wall. CWC company procedure calls for supervision during tank demolition. With the superintendent called away to the front gate, the victim raised the manlift cage higher than the edge of the tank and signaled the excavator operator to push in the tank wall. In doing so, the victim increased the likelihood of tipping over and the severity of falling from a greater height. The excavator operator was not in a position to judge the distance of the manlift from the tank wall, and should have waited for the superintendent to return before pushing the wall in.

Possible Personal Factors 3.01 - 3.08

Victim's reasons for failing to wait for the superintendent to return may have been related to health issues which are not known at this time. Excavator operator's actions could be grounds for disciplinary action.

Possible Personal Factor 3.09 - Lack of Knowledge - misunderstood directions

Victim and excavator operator may have misunderstood the superintendent's instructions.

Possible Work Env. Factor 3.10 - Improper Motivation - improper performance is rewarded

Victim and excavator operator may have ignored instructions to save time. Company culture may reward productivity over safety.

Possible Work Env. Factor 3.11 - Improper Motivation - inadequate discipline

Inadequate disciplinary policy and/or practice may not discourage rule breaking.

Possible Work Env. Factor 3.12 - Inadequate Work Standards - inadequate communication of standards

It's possible that the company has not communicated rules regarding work while not under direct supervision of the superintendent.

RCA BY: MODIFIED - SYSTEMATIC CAUSAL ANALYSIS TECHNIQUE ©

Proposed Observation	4.0	**Victim was said to be acting sufficiently strangely, out of character, (but not apparently under the influence), for co-workers to take notice, and for the site superintendent to ask him if everything was all right. Victim reported that he felt ok to work and that his doctor had very recently given him a new prescription. Autopsy did not detect the presence of alcohol or illegal drugs. CWC reports that their company program requires employees to report the use of prescription medications that may affect their ability to work safely. CWC also reported that the victim followed company policy in this regard. Given these facts it is unclear why the superintendent allowed the victim to continue to perform his normal duties on the day of the accident.**	
Potentially Substandard Act	4.1	**Under The Influence of Alcohol or Other Drugs**	
Possible Personal Factors	4.01	**Inadequate Mental or Psychological Capability**	**- emotional disturbance**
	4.02	**Inadequate Mental or Psychological Capability**	**- mental illness**
	4.03	**Mental or Psychological Stress**	**- mental illness**
	4.04	**Mental or Psychological Stress**	**- preoccupation with problems**
	4.05	**Mental or Psychological Stress**	**- emotional overload**
	4.06	**Physical or Psychological Stress**	**- injury or illness**
	4.07	**Physical or Psychological Stress**	**- blood sugar insufficiency**
Possible Work Env. Factor	4.08	**Inadequate Leadership and/or Supervision**	**- inadequate identification and evaluation of loss exposures**

Proposed Observation - Black font **Potential Immediate Cause - Blue font** **Possible Root Cause - Green font**

Proposed Observation 4.0

Victim was said to be acting sufficiently strangely, out of character, (but not apparently under the influence), for co-workers to take notice, and for the site superintendent to ask him if everything was all right. Victim reported that he felt ok to work and that his doctor had very recently given him a new prescription. Autopsy did not detect the presence of alcohol or illegal drugs. CWC reports that their company program requires employees to report the use of prescription medications that may affect their ability to work safely. CWC also reported that the victim followed company policy in this regard. Given these facts it is unclear why the superintendent allowed the victim to continue to perform his normal duties on the day of the accident.

Potentially Substandard Act 4.1 - Under The Influence of Alcohol or Other Drugs

It is not known what prescription drugs the victim was taking or their potential effect of the victim's ability to perform his duties safely. It is also not known if the victim had a medical condition that was causing him distress at the time of the accident.

Possible Personal Factors 4.01 - 4.07

Victim's reasons for acting out of character may have been related to health issues which are not known at this time.

Possible Work Env. Factor 4.08 - Inadequate Leadership and/or Supervision – inadequate identification and evaluation of loss exposures

Superintendent may not have the training, skill, or knowledge to assess the victim's condition.

Superintendent's assessment of the victim's condition may have been inaccurate.

Superintendent may not have considered the severity of the consequences of allowing the victim to proceed with work on the day of the accident.

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Proposed Observation	5.0	**CWC was using manual means with hand-held cutting torches (manual labor) to take apart the tanks - (in conflict with the methods stated in their Demolition Work Plan)**	
Potentially Substandard Acts	5.1	**Failure to Identify Hazard/Risk**	
	5.2	**Failure to Follow Procedure - Policy - Practice**	
Possible Work Env. Factors	5.01	**Inadequate Engineering**	**- inadequate assessment of loss exposures**
	5.02	**Inadequate Leadership and/or Supervision**	**- inadequate identification and evaluation of loss exposures**
	5.03	**Inadequate Tools & Equipment**	**- inadequate availability**

Proposed Observation - Black font	**Potential Immediate Cause - Blue font**	**Possible Root Cause - Green font**

Proposed Observation 5.0

CWC used men on elevated work platforms (manlifts) with cutting torches performing manual labor to cut apart the tanks - (in conflict with the methods stated in their Demolition Work Plan – see italicized text below)

Demolition of all buildings and structures at the facility will be performed by mechanical means utilizing heavy equipment with specialized demolition attachments. CWC's track excavators will be equipped with specialized attachments such as hydraulic breakers, shears, grapples, and pulverizers. As a rule, CWC will use heavy equipment to complete the demolition and site clearing on this project for a majority of the structures and buildings. CWC's procedures will limit the use of labor to the most controlled and safe conditions and rely upon mechanized means of removal wherever possible.

Potentially Substandard Act 5.1 - Failure to Identify Hazard/Risk

Three independent experienced tank demolition practitioners were consulted by Bureau Veritas to comment on the methods as planned and as deployed by CWC. They are:

1. Redacted with Sequoia Tank Redacted has over 50 years in the tank demolition business
2. Redacted currently with Chevron Environmental Management Company, Redacted has been involved in tank demolition for over 40 years for CEMC
3. Redacted with Hulcher Services,

All are familiar with tank demolition in the Bakersfield area and knowledgeable of both floating and non-floating top tank demolition. Each confirmed that the torch cutting method employed by CWC is outdated and is no longer an accepted industry best practice. All three agreed that as equipment improved to work at greater heights the accepted industry best practice is to use mechanical means (excavators with shears for example) exclusively to dis-assemble tanks avoiding manual labor, and the hazards inherent in torch cutting (burns, fumes, lead exposure, etc.), and working at height (falls). Further, on the specific topic of demolition of floating top tanks, each agreed that tank height was irrelevant, since shearing could be initiated from the bottom of the tank rather than the top. It is unclear why CWC continues to use a work method acknowledged by experts to be more hazardous.

Possible Work Env. Factor 5.01 - Inadequate Engineering - inadequate assessment of loss exposures

Possible Work Env. Factor 5.02 - Inadequate Leadership and/or Supervision - inadequate identification and evaluation of loss exposures

The risks of torch cutting and working at height have contributed to making this method no longer an industry best practice, now that other safer mechanical methods are available. It is not known why this change in proposed work method was allowed to proceed in the manner that it did without an additional assessment of hazards and risks.

Potentially Substandard Act 5.2 - Failure to Follow Procedure - Policy - Practice

The mechanical method for cutting up tanks (described in the Demolition Work Plan) that was agreed to as part of bid process was not being followed.
It is not known why CWC decided to change the method of cutting up the tanks after committing to using mechanical means and minimizing manual labor in their Demolition Work Plan. This decision was directly responsible for putting employees at risk.

Possible Work Env. Factor 5.03 - Inadequate Tools and Equipment - inadequate availability

It's not clear whether CWC had the right equipment available to do the job mechanically. Evidence was presented by the PGE site representative that excavators (Link Belt 5800) with a shears capable of shearing at heights up to 35 feet, according to manufacturer specifications, were on site. Excavators capable of shearing up to 40 feet high, according to manufacturer specifications was on site (Link Belt 700) but did not have shears attached. Their operational readiness at the time of the incident are not known at this time.

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Proposed Observation	6.0	**Excavator pushed tank wall in while workers were "working at height" inside the tank - (in the line of fire)**	
Potentially Substandard Acts	6.1	**Failure to Identify Hazard/Risk**	
	6.2	**Failure to Follow Procedure - Policy - Practice**	
	6.01	**Lack of Knowledge**	**- lack of experience**
Possible Work Env. Factors	6.02	**Inadequate Leadership and/or Supervision**	**- inadequate identification and evaluation of loss exposures**
	6.03		**- lack of supervisory/management job knowledge**
	6.04		**- inadequate instructions, orientation and/or training**
	6.05	**Inadequate Engineering**	**- inadequate assessment of loss exposures**
	6.06	**Inadequate Tools and Equipment**	**- Inadequate availability**

Proposed Observation - Black font **Potential Immediate Cause - Blue font** **Possible Root Cause - Green font**

Proposed Observation 6.0

Excavator pushed tank wall in while workers were "working at height" inside the tank - (in the line of fire).

Potentially Substandard Act 6.1 - Failure to Identify Hazard/Risk

Accident prevention during this procedure relies on the CWC superintendent's presence and unfailing ability to accurately judge how far away the manlifts must be before the tank wall can be safely pushed in. While this may not have resulted in an accident in the past, it seems an unnecessary (and therefore unacceptable) risk to allow workers to be working at height inside the tank when the tank wall is being pushed in.

Possible Work Env. Factor 6.01 - Lack of Knowledge - lack of experience

Possible Work Env. Factor 6.02 - Inadequate Leadership and/or Supervision - inadequate identification and evaluation of loss exposures

Possible Work Env. Factor 6.03 - Inadequate Leadership and/or Supervision - lack of supervisory/management job knowledge

None of the employees and/or people in an oversight role recognized the unnecessary risk involved and the simple solution of having workers leave the tank each time a section of the cut tank wall was about to be pushed into the tank.

Potentially Substandard Act 6.2 - Failure to Follow Procedure-Policy-Practice

CWC superintendent could see both the inside and outside of the tank putting him in a position to decide if he felt the manlift was in a safe position, far enough away from the tank wall, before signaling the excavator operator to push in the tank wall. CWC company procedure calls for supervision during tank demolition. With the superintendent called away to the front gate, the victim raised the manlift cage higher than the edge of the tank and signaled the excavator operator to push in the tank wall. In doing so, the victim increased the likelihood of tipping over and the severity of falling from a greater height. The excavator operator was not in a position to judge the distance of the manlift from the tank wall, and should have waited for the superintendent to return before pushing the wall in.

Possible Work Env. Factor 6.02 - Inadequate Leadership and/or Supervision - inadequate identification and evaluation of loss exposures

None of the people in an oversight role recognized the unnecessary risk involved

Possible Work Env. Factor 6.04 - Inadequate Leadership and/or Supervision - inadequate instructions, orientation and/or training

While leaving the work area the superintendent may not have told the excavator operator to wait until his return before restarting work.

Possible Work Env. Factor 6.05 - Inadequate Engineering - inadequate assessment of loss exposures

CWC management condoned the practice of allowing employees to be working at height inside the tank when the tank wall is being pushed in.

Potentially Substandard Condition 6.3 - Inadequate Preparation - Planning

It is not known why CWC did not follow the Demolition Work Plan. Inadequate preparation and planning are plausible components.

Possible Work Env. Factor 6.06 - Inadequate Tools and Equipment - inadequate availability

It's not clear whether CWC had the right equipment available to do the job mechanically. Evidence was presented by the PGE site representative that excavators (Link Belt 5800) with a shears capable of shearing at heights up to 35 feet, according to manufacturer specifications, were on site. Excavators capable of shearing up to 40 feet high, according to manufacturer specifications were on site (Link Belt 700) but did not have shears attached. Their operational readiness at the time of the incident,, are not known at this time.

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Proposed Observation	7.0	**Contractors' in-house safety programs required by regulation for the kind of work they perform were not evaluated against established criteria prior to their being accepted as an approved vendor and being allowed to bid on proposals. Contractor self-reported safety performance data is not checked for accuracy. Experience Modification Rates (EMRs) reported for CWC and their 2 main subcontractors for 2010 and 2011 do not match OSHA rates for the same period (which were zeros). This is possible but very unlikely.**	
Potentially Substandard Acts	7.1	**Failure to Identify Hazard/Risk**	
	7.2	**Failure to Check/Monitor**	
Potentially Substandard Condition	7.3	**Inadequate Information or Data**	
Possible Personal Factor	7.01	**Lack of Knowledge**	**- lack of experience**
Possible Work-Env. Factor	7.02	**Inadequate Leadership and/or Supervision**	**- inadequate identification and evaluation of loss exposures**
	7.03	**Inadequate Purchasing**	**- inadequate contractor selection**

Proposed Observation - Black font | **Potential Immediate Cause - Blue font** | **Possible Root Cause - Green font**

Proposed Observation 7.0

Contractors' in-house safety programs required by regulation for the kind of work they perform were not evaluated against established criteria prior to their being accepted as an approved vendor and being allowed to bid on proposals. Contractor self-reported safety performance data is not checked for accuracy. Experience Modification Rates (EMRs) reported for CWC and their 2 main subcontractors for 2010 and 2011 do not match OSHA rates for the same period (which were zeros). This is possible but very unlikely.

Potentially Substandard Act 7.1 - Failure to Identify Hazard/Risk:

Procurement process does not identify risks associated with hiring contractors whose in-house safety programs are sub-standard.

Possible Personal Factor 7.01 - Lack of Knowledge - lack of experience:

In-house staff may not posses the knowledge or experience to evaluate contractors' compliance with regulatory requirements for contractors' in-house safety programs.

Possible Work-Env. Factor 7.02 - Inadequate Leadership and/or Supervision - inadequate identification and evaluation of loss exposure:

Procurement leadership did not identify and evaluate the risks associated with hiring contractors whose in-house safety programs may be sub-standard.

Possible Work-Env. Factor 7.03 - Inadequate Purchasing - inadequate contractor selection:

There is a lack of in-house capability to accomplish the task of evaluating a contractor's compliance with regulatory requirements, during the qualification process. An outside contractor specializing in this area should be considered to accomplish the task.

Potentially Substandard Condition 7.2

Procurement process does not check/monitor the accuracy or validity of the safety information provided by prospective contractors during the qualification process.

Possible Work-Env. Factor 7.02 - Inadequate Leadership and/or Supervision - inadequate identification and evaluation of loss exposure:

Procurement leadership did not identify and evaluate the risks associated with hiring contractors whose safety qualification data may be inaccurate or false.

Possible Work-Env. Factor 7.03 - Inadequate Purchasing - inadequate contractor selection:

There is a lack of in-house capability to accomplish the task of validating the safety data provided during the qualification process An outside contractor specializing in this area should be considered to accomplish the task.

Potentially Substandard Condition 7.3 - Inadequate Information or Data

Procurement process does not evaluate the safety programs of prospective contractors.

Procurement process does not have established criteria to evaluate the safety programs of prospective contractors.

Procurement process does not have adequate information to evaluate prospective contractors' safety programs.

Procurement process does not validate the safety qualification data provided by prospective contractors.

Procurement process does not have adequate information to evaluate prospective contractors' safety programs.

Possible Personal Factor 7.01 - Lack of Knowledge – lack of experience:

In-house staff may not posses the knowledge or experience to evaluate contractors' compliance with regulatory requirements for contractors' in-house safety programs.

Possible Work-Env. Factor 7.02 - Inadequate Leadership and/or Supervision – inadequate identification and evaluation of loss exposure:

Procurement leadership did not identify and evaluate the risks associated with hiring contractors whose in-house safety programs may be sub-standard.

Possible Work-Env. Factor 7.03 - Inadequate Purchasing - inadequate contractor selection:

There is a lack of in-house capability to accomplish the task of evaluating a contractor's compliance with regulatory requirements, and/or validating the safety qualification data provided by the contractor during the qualification process. An outside contractor specializing in this area should be considered to accomplish the task.

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Proposed Observation	8.0	**It is conceivable (though unlikely) that during the several years that the site was dormant the ground under the tank might have subsided. CWC's effort to insure the integrity of the tank floor before workers and equipment went in the tank by having "tracked vehicles" enter the tank first might not have detected smaller problems because the vehicle's tracks spread the weight of the vehicle over a large surface. They might have detected larger problems by have the tracked vehicle fall through the floor into a hole.**	
Potentially Substandard Act	8.1	**Failure to Identify Hazard/Risk**	
Possible Work Env. Factor	8.01	**Inadequate Engineering**	**- inadequate assessment of loss exposures**

Proposed Observation - Black font | **Potential Immediate Cause - Blue font** | **Possible Root Cause - Green font**

Proposed Observation 8.0

It is conceivable (though unlikely) that during the several years that the site was dormant the ground under the tank might have subsided, settled, or become unstable. CWC's effort to insure the integrity of the tank floor before workers and equipment went in the tank by having "tracked vehicles" enter the tank first might not have detected smaller problems because the vehicle's tracks spread the weight of the vehicle over a large surface. They might have detected larger problems by have the tracked vehicle fall through the floor into a hole. Although this did not prove to be an issue on this project, better methods of testing the floor for problems, (e.g. inspection and tapping by a competent person, or ground penetrating radar) are available.

Potentially Substandard Act 8.1 - Failure to Identify Hazard/Risk

Possible Work Env. Factor 8.01 - Inadequate Engineering - inadequate assessment of loss exposures

7.0 RECOMMENDATIONS FOR POSSIBLE PGE PROGRAM AND/OR MANAGEMENT SYSTEMS IMPROVEMENTS

The contract between CWC and PGE clearly states that CWC has full responsibility for the safety and safety oversight of any and all activities that take place on the site. Under these circumstances, PGE's ability to prevent an accident would largely be limited to their choice of contractor to perform the demolition. Therefore the following recommendations focus mostly on possible improvements to PGE's management systems for procuring services. These recommendations are suggestions for improvements to PGE's management systems and programs based on best practices and should not be construed in any way to suggest a failure of any due diligence on PGE's part in hiring CWC.

RECOMMENDATION #01

APPLICABLE CAUSES/FACTORS – 2.10, 2.11, 3.10, and 3.11

CONTRACTOR QUALIFICATION

PGE's procurement process should examine disciplinary policies as part of contractors' safety qualification.
In California a company's disciplinary policy should be found in the company's Injury – Illness Prevention Program. (Note: CWC has a disciplinary policy.)

RECOMMENDATION #02

APPLICABLE CAUSES/FACTOR – 1.08, 2.08, 3.08 and 4.1

CONTRACTOR QUALIFICATION

Procurement process should examine and put a high value on contractor's policies regarding prescription drugs and drug testing as part of contractors' safety qualification. (Note: CWC has a policy regarding prescription drug use.)

RECOMMENDATION #03

APPLICABLE CAUSES/FACTORS – 6.1, 6.01, 6.02, and 6.03

CONTRACTOR QUALIFICATION

The formal safety training and safety certifications of contractors' proposed site safety officers should be evaluated before they are accepted in that role during the bid process.
(Note: CWC's site safety officer at KPP has training in asbestos and hazardous waste, an undergraduate degree in construction technology, and five years experience as a site safety officer. It is possible his lack of certification and/or formal training in safety management and risk assessment may have been contributing factors to his not recognizing and addressing the hazards involved in the events leading up to the accident.)

RECOMMENDATION #04

APPLICABLE CAUSES/FACTORS 5.2

CHANGE MANAGEMENT

When significant changes in the work methods agreed upon during the bidding process are proposed, there should be a risk assessment conducted on the proposed new process including a discussion of additional hazards and risks, necessary mitigation, and potential costs. It is unclear why such an assessment did not happen when CWC chose to change the agreed upon process for demolishing tanks. It is also unclear why CWC chose to change the agreed upon process for demolishing tanks. PGE's on-site representative should raise a red flag when aware of such changes so that the change can be evaluated for new hazards and risks.

RECOMMENDATION #05

APPLICABLE CAUSES/FACTORS – n/a

CONTRACTOR QUALIFICATION

The role and responsibilities of any PGE on-site representative should be clearly defined in writing and communicated to all on-site and project staff and contractors. in future similar projects, The qualifications of candidates performing that role should be carefully evaluated, especially as it pertains to any assigned safety responsibilities.

(Note: Although it was clearly understood that the PGE on-site representative at KPP has no assigned safety responsibilities since the contract unambiguously places the full responsibility for all site safety matters with CWC, the exact role and responsibilities of the PGE representative on site were not clearly defined. It was noted that his diligence in tracking the progress of the project is why we have a video record of the accident to review.)

RECOMMENDATION #06

APPLICABLE CAUSES/FACTOR – n/a

TRAINING and LEARNING FROM EVENTS

To maximize and capture learnings from events to foster continuous improvement in the training of future site representatives there should be a written record of the takeaway lessons learned during projects.

(Note: Contractors hired for their existing expertise, usually require little training to perform their work, beyond a general orientation to the company. For this reason, PGE's training management systems were not examined in detail as part of this RCA. However, it was noted that the current on-site representative received some orientation benefit by spending a limited amount of time working with the previous incumbent before he left that role. Also, there is an ongoing daily teleconference of on-site representatives from several projects that is used to discuss issues and share solutions. Lastly, the on-site representative at KPP benefits from weekly one or two day visits from his PGE manager.)

RECOMMENDATION #07

APPLICABLE CAUSES/FACTOR – 7.0

CONTRACTOR QUALIFICATION

Procurement should consider employing a 3rd party specializing in assessing contractors' safety programs and validating/tracking/ contractors' safety and insurance data. Pacific Industrial Contractor Screening (PICS) and ISNetWorld are two well respected vendors of these services. (Note: PGE's Procurement group has also identified this potential improvement as part of their review.)

RECOMMENDATION #08

APPLICABLE CAUSES/FACTOR – N/A

LEARNING FROM EVENTS

Future tank demolition should follow the agreed upon contract language and use mechanical means avoiding the use of manual labor whenever possible.

(Note: CWC's proposal for future tank demolition reduces risks significantly by prohibiting workers from being inside the tank while mechanical means are employed.)

8.0 QUALITY ASSURANCE

As a world leader in providing services that our clients depend on, we continually strive to provide the highest quality. This report has been reviewed as a part of our quality process.

This report was prepared by:

Redacted

Redacted CIH, CSP, CHMM, CPEA
Senior Managing Consultant
Bureau Veritas North America, Inc.
San Ramon Office

This report was reviewed by:

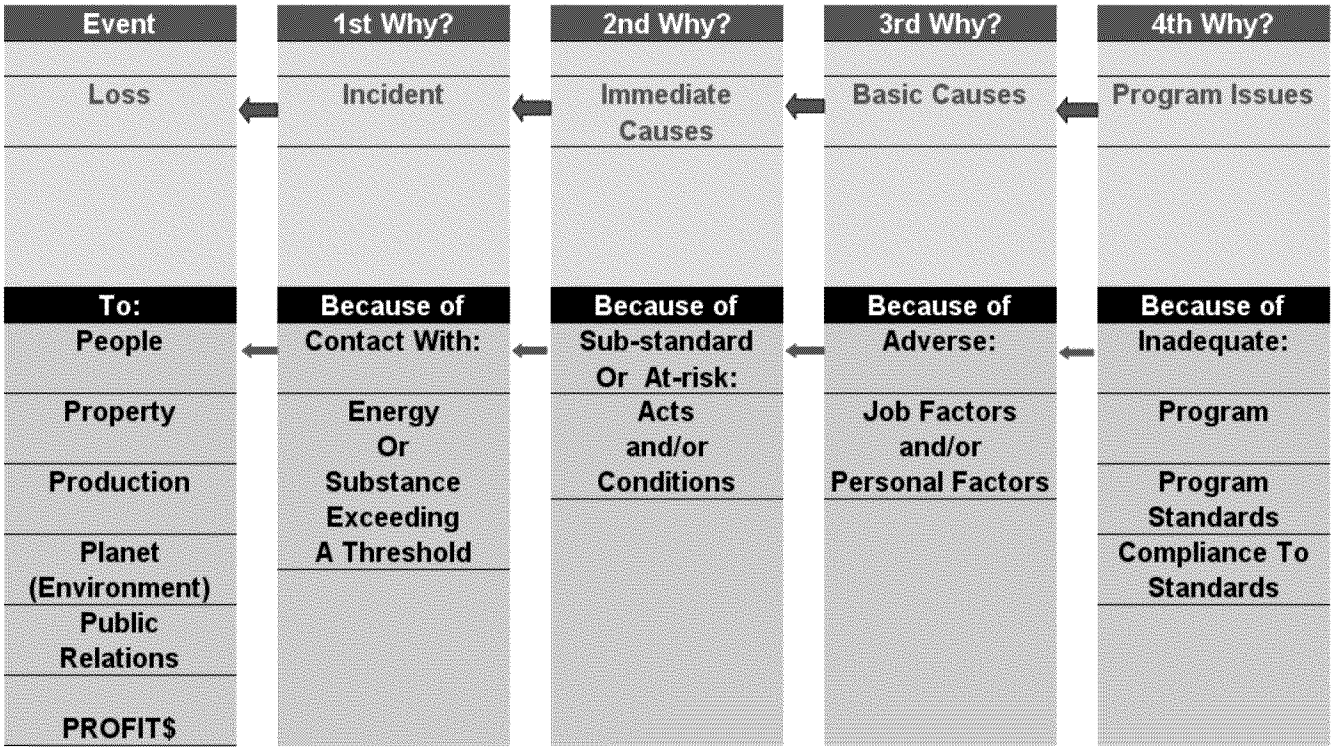
Redacted

Redacted CIH
Director, Management Consulting
Bureau Veritas North America, Inc.
San Ramon, CA Office

APPENDIX A

LOSS CAUSATION MODEL - USING "WHY?" ANALYSIS

LOSS CAUSATION MODEL* USING "WHY?" ANALYSIS



*Reference: Majewski-Modified ILCI Loss Causation Model