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Root Cause Analysis

Employee Fatality on March 6, 2017 Due to the Unexpected Release of Hazardous Energy



April 12, 2017

Investigation of the Sentinel Energy Center Fatality of March 6, 2017

Summary of the Incident

On March 6, 2017, an employee was fatally injured when he removed the cover on a gas filter skid while it was still under extreme pressure (>700 PSIG).

Investigation Team

The investigation was led by [REDACTED]
[REDACTED] was assisted in the investigation by several DGC Operations ("DGCOPS") management employees.

Investigation Methodology

Data collection started on March 7, 2017. As the data was collected, a timeline was developed to properly capture possible causes of the incident. Possible causes were validated or ruled out based on interviews, technical data, and observations.

This timeline was used to guide the investigation to areas where more data collection may be necessary to determine why the event occurred. The timeline helped clearly depict the relationship of key events and conditions related to the incident. The timeline was also used to identify causal factors for the incident. Causal factors include equipment and/or frontline personnel performance gaps which led to the incident or made the consequences of the incident more severe.

Once the causal factors were identified, a root cause map was used to guide the investigation in identifying root causes associated with each causal factor. The root cause map helps to appropriately identify root causes and associated recommendations. By tracing through each "node" of the map, the investigator (or investigation team) can help identify (again addressing the why the event occurred) the underlying basis for of each causal factor and can consider a broad range of possible causes.

Finally, recommendations were developed for plant and corporate leadership team members to consider. The recommendations relate to reducing or eliminating (or at least explaining) the causal factors and root causes; therefore, addressing these recommendations should help to prevent recurrence in the future.

Each causal factor is entered into a "Root Cause Summary Table" (see Attachment 2). The table is split into three sections:

1. Causal Factor: The identified causal factor is described with relevant background information.
2. Path through the "root cause map": This is the charted path by the investigator (or team) in which the root cause (or causes) has been identified.

3. Recommendations: Recommendations for addressing the causal factors are identified and summarized. There are four types of recommendations, as follows:
 - **Level 1** – Addresses the causal factor. This level includes the front line personnel performance gaps (FLPPGs) and equipment performance gaps that have been identified.
 - **Level 2** – Addresses the intermediate causes of the specific problem. These recommendations seek to prevent recurrence of the causal factors.
 - **Level 3** – Fixes similar problems. This will help prevent failures in other areas of the process or organization.
 - **Level 4** – Corrects the process that creates these problems. These recommendations are generally the most effective in addressing the root cause and are more proactive in nature.

It is important to note that each causal factor does not always have all recommendation levels listed. In many cases a Level 3 or 4 recommendation will be adequate to cover the entire causal factor. Or in the case of the Level 1 recommendation, it may not be practical to address the causal factor due to timing or other issues.

Personnel Involved in the Incident

Several employees were involved in the immediate incident: [REDACTED]

[REDACTED] Other employees were also interviewed, but these employees were not involved, but did provide information and observations to the investigator.

Fuel Filter Maintenance Process Description

Each combustion turbine at Sentinel Energy Center is equipped with a filter skid assembly for the fuel gas supply system. The filter skid assemblies are designed to capture particulate matter and also to coalesce and capture any liquids such as oil, natural gas distillates or moisture that may be present in the fuel gas supply. The filter process ensures a clean, dry source of fuel gas prior to admission to the gas turbine. The filters are typically changed during the annual maintenance outages.

Description of the Incident

On March 6, 2017, a routine maintenance outage was in progress on Unit 5. A morning safety meeting occurred at 05:45. After the morning safety meeting concluded, [REDACTED] and [REDACTED] proceeded to start the isolation process on Unit 5 in preparation for the outage work. The isolation and lock out tag out ("LOTO") incorporated several different sub-systems including electrical, fire protection, water, oil systems, ammonia and natural gas supply (see Attachment 4: LOTO – 17-00061).

[REDACTED] all participated in the isolation of various systems required in preparation for the Unit 5 outage work, including isolation of the gas supply. Each person reported they had operated parts

of the gas system to complete the isolation. [REDACTED] was the LOTO Initiator that printed off the LOTO Sheet and tags. Below is a sequence of relevant events:

At approximately 07:30:

- [REDACTED] meets up with [REDACTED] and [REDACTED] near the Unit 5 gas filter skid
- [REDACTED] closes #1 Valve
- [REDACTED] opens the Unit 5 gas filter vent valve but closed it immediately because it was loud. The group agrees to wait until they can get some earplugs. A short venting of gas is heard in the plant.

Note - [REDACTED] discussed the #2 Valve and confusion around where it was located in the LOTO sequence and found it later on the second page of the LOTO Sheet.

- [REDACTED] went to the turbine package and closed the package Manual Fuel Isolation Valve and opens Maintenance Valves 1 and 2. [REDACTED] announces this on the radio as he vents the system.
- [REDACTED] closes Isolation Valve #2 and opens Final Filter Vent Valves 1 and 2. A short gas vent occurs of the gas trapped between Isolation Valve #1 Final Fuel Filter and Isolation Valve #2 Final Fuel Filter.
- Gas pressure remains on the system as indicated by post-incident review of the DCS Controls Screen trend data from PI 51609 (see Attached 10: Trend Data).

08:00 – 09:00:

[REDACTED] starts planned work with the Unit 5 turbine controls. As the control system component power supplies are cycled on and off, the automated turbine control valves cycle to their “fail safe” conditions. FSV 2061 opens intermittently and vents gas from the line after the Package Manual Fuel Isolation Valve. [REDACTED] noted that this was unexpected and went outside the package to investigate.

[REDACTED] is observed (by [REDACTED]) discussing the venting evolution with [REDACTED] as to why the venting sequences “sounded different” this time from other isolations in the past. [REDACTED] all confirmed that a brief conversation occurred and that the assumption is that [REDACTED] was going to investigate. No other follow up occurred or was reported prior to the loss event.

Note: Gas pressure is not verified at the Final Filter Pressure Gauge or through the plants control system.

Note - To clear any assumption that the Final Filter Pressure Gauge may have been checked by [REDACTED] or others but did not function properly, a multipoint check was performed on the gauge to ensure its function and accuracy. The gauge was checked on March 9, 2017 and found to be functional and accurate within 10-15 PSI (see Attachment 6: Photos).

11:03 – Loss Event occurs

Causal Factors and Supporting Comments

Causal factors are equipment and frontline personnel performance gaps that led to the incident or that made the consequences of the incident more severe.

The Existing LOTO Procedure was Not Followed.

The Sentinel Energy Project had a Lockout / Tagout Procedure in place on the date of the incident, and is referred to as Procedure No. SMP-3, rev. 0, dated April 17, 2013 (SMP-3). According to SMP-3, management and plant employees violated several procedural requirements (as discovered through interviews and documentation):

- Page 20, Section 6 states: “The **Installer** shall install the LOTO in the order the components are listed on the Equipment Lockout/Tagout Sheet.” *From interviews with employees, it appears that [REDACTED], did not properly follow the steps to isolate the equipment in the order listed on the Equipment Lockout/Tagout Sheet. Employees indicated that the isolation procedure had previously been used, in order, safely and effectively.*
- The LOTO validation check (as defined on page 5, Section D) was not performed by “someone different than the person posting and locking equipment”. *In fact, the verification and isolation was being performed at the same time and by multiple employees. As a result, the verification was performed improperly.*
- Page 16, Section 2, d states: “At no time shall LOTO work be performed while a component is under high pressure or high temperature”. *According to the DCS data screen, the vessel in question was pressurized at [REDACTED].*
- Page 16, Section 2, f states: “Before the issuance of a LOTO, systems and components shall be drained, deactivated and depressurized before work begins. Two valve isolation of the work area shall be used whenever possible”. *The vessel was not properly drained and vented and furthermore, was only double blocked and bled on the inlet side. It was noted during the investigation that the bypass line to the filter was only single block protection and needed to be corrected.*
- Page 21, Section 16 states “The **Work Supervisor**” shall walk out the LOTO prior to acceptance to verify all Danger Tags are in the proper location and position and to verify the system is drained, de-pressurized, de-activated and to also verify components de-energized for the LOTO.” *No such action took place as evidenced by review of the tags, LOTO forms and through interviews.*
- Page 8, Section r defines a LOTO Verifier as “Any qualified employee who verifies a Lockout / Tagout has been installed correctly. The **Verifier** shall walk out the Lockout / Tagout and verify all components have been properly isolated, tagged, drained depressurized, and / or deactivated. The **Verifier** shall initial all Lockout / Tagout tags installed and also sign the Lockout / Tagout Sheet to acknowledge their accomplished task.” *Both [REDACTED] were involved with verifying the LOTO performed by [REDACTED] but neither performed the verification correctly.*

Items of Note and Major Concern

During the investigation process, several key items of note and major concern were identified. While these items were not considered **direct** contributors to the incident (or firm root causes), they establish some key understandings as to how an incident like this could occur in an on-site organization and present a picture of cultural issues that have developed at the facility and within the on-site organization. In order to strengthen the safety program at this facility and all other DGC Operations facilities, the following items should be evaluated and addressed.

#1 The LOTO Procedure Requires Careful Review & Specificity

██████████ Review Responsibilities – ██████████ failed to perform several items per the requirements of SMP-3. Section 5.0 requires LOTO audits to be performed on a monthly and annual basis.

- *During the interview process, ██████████ stated that he had no audit records for the LOTO procedure per page 13. Subsequently, plant staff later produced completed monthly audit forms for most of the months (about 80%) between 2014 and 2017 that had been completed by ██████████. It appeared that none of the monthly audits were reviewed by ██████████ as required by SMP-3.*
- Page 13 Section c,3 states the annual inspection shall: “Insure that ██████████ is aware of the success of the Lockout / Tagout program by conducting the annual review, interviewing all DGC OPS **Qualified Employees**, and looking for ways to improve the Lockout / Tagout program. ██████████ shall also sign a copy of each LOTO that was audited, including the date of the inspection and the **Qualified Employees** that was included in the review.” No ██████████ annual audits were conducted per requirements of SMP-3. Also, see Figure 1 below for inspection audit requirements which, per SMP-3, cannot be delegated:

Figure 1 – Excerpt from Annual LOTO Inspection Report (SMP-3 Exhibit “E”)



Although SMP-3 has numerous statements and requirements for LOTO, it does not specifically reference Hazardous Energy Control Procedures (“ECPs”) as a basis for isolation.

- **Title 8, Cal. Code of Regs. 3314(g)(1)(B)** specifically requires that ECPs have:
“Procedural steps for shutting down, isolating, blocking and securing machines or equipment to control hazardous energy;”

- **Title 8, Cal. Code of Regs. 3314(g)(1)(D)OSHA 1910.147(c)(4)(ii)(D)** also requires that ECPs have:

“Requirements for testing a machine or equipment, to determine and verify the effectiveness of lockout devices, tagout devices, and other hazardous energy control devices.”

Although SMP-3 does specify on page 12, Section FF under the heading “Zero Energy State” that the “specific Clearance Procedure must list the methods necessary to verify energy isolation...”, it does not specifically refer to or incorporate the ECPs.

Additionally, the current revision of SMP-3 being utilized is revision 0 from 2013. It appears that there have been no updates to the procedure from its inception nearly 4 years ago. In the case of any LOTO procedure / program, it is rare to have a procedure that has not been revised from the original to be made more specific to respond to conditions in the field if it is being properly reviewed by [REDACTED] and site staff members. To further illustrate the need for update, the procedure references OSHA 1910.269 as opposed to Title 8, Cal. Code of Regs., which applies in California.

#2: Venting and Purging Procedures Improvement

The facility recently updated its version of the ECPs (i.e., the sequence for isolating and venting the lines) in January 2017, as part of the upgrade to TK Pro from Taglink, in order to ensure that the procedures properly isolate and vent the lines. While the procedures had been used successfully and safely for outages on other units prior to March 6, 2017, the recent revisions potentially add confusion and require further improvement.

Although the list of steps set forth as ECPs in the Equipment Lockout/Tagout Sheet, if followed correctly and in sequence, safely isolate and vent the lines, there are no separate procedures or steps that specifically direct employees to verify the success of the isolation and venting by checking the pressure indicator for zero pressure. Additionally, there does not appear to be a consistent and clear naming convention for vents and valves in the field; specific labeling of vents and valves may serve to eliminate potential confusion. Consideration should also be given to manufacturer warnings in designing energy control procedures.

#3: Clarify the Job Hazard Analysis (JHA) / Job Safety Analysis (JSA)

A guidance document published by the federal Occupational Safety and Health Administration ("OSHA"), OSHA 3071, explains a job hazard analysis as “a technique that focuses on job tasks as a way to identify hazards before they occur. It focuses on the relationship between the worker, the task, the tools, and the work environment. Ideally, after you identify uncontrolled hazards, you will take steps to eliminate or reduce them to an acceptable risk level.” Although a procedure for how to issue a JHA / JSA does exist (see Attachment 5), there is no guidance document or training that details the step-by-step process of performing a proper JHA / JSA.

Furthermore, the JSA at issue in this incident, JSA-17-00035, was reviewed at the morning safety meeting. The JSA was written for a broad range of tasks and hazards associated with the maintenance work, and made no mention of the specific LOTO associated with this specific job, high pressure natural gas, or the hazards associated with the work that [REDACTED] was performing. The JHA reviewed was also a general and non-specific broad stroke and appeared to be developed primarily for efficiency in that it did not address the safety considerations in detail for each type of job to be performed. Additionally, even though SMP-3, page

16, Section 2, g, directs that “precautions and job planning (JSA) shall be completed and discussed between the workers and their supervisor. Potential hazards and contingencies for coping with them shall be reviewed,” the JSA contains no listing or mention of high pressure systems, natural gas or anything specifically tied to LOTO -17-00061. While the procedural steps to isolate the gas filter should have been sufficient to protect employees, better identifying the nature of the risks at issue for the equipment is important.

#4: Improve Implementation of the Injury and Illness Prevention Plan (IIPP)

The IIPP found for the site was the initial version issued in 2012. The IIPP does not appear to have been updated since that time. While some evidence of training on the IIPP exists, the IIPP should nevertheless be re-evaluated and refresher training should be provided.

#5: Emphasize “Near Miss” and Safety Reporting Program

During the interviews of several employees (including the O&M Manager), it was evident that the facility did not have a strong near miss reporting culture. In several cases, the employees stated that they reported near misses to their supervisor and it was either treated with minimal attention by management or “brushed off”.

In fact, during this investigation, an operator ([REDACTED]) reported that a similar issue was encountered in 2014 on the gas system of Unit 3. Fortunately for this employee, a coworker recognized the hazard and stopped him before he opened up the gas filter. The employee stated that he reported it to his supervisor. No documentation for that near miss was issued based on the review undertaken to date.

#6: Evaluate Personnel and Organizational Issues

[REDACTED] - During the interviews, it was noted by several employees (including Management and Supervision) that [REDACTED]. To illustrate this, here are noted issues and quotes:

[REDACTED]

The Plant Manager and O&M Manager noted that this was discussed with [REDACTED] on several occasions, that [REDACTED] took some steps towards improvement, but additional care was still needed.

Although this may not have contributed to *this* incident, it was likely only a matter of time before this type of behavior could have caused an injury or incident.

It's also important to note the [REDACTED] was identified as safety contact for the facility (as included in the sites safety orientation video). As a result, others may model their behavior (both positive and less desirable) based on his behavior. Care should be taken that the on-site organization's safety culture promotes care and thoroughness in following procedures and reporting events that will be important to maintain functional procedures and safety.

EHS Coordinator – The EHS Coordinator is not an integral member of the on-site management team and has limited role and authority in safety at the site.

During the interview, the EHS Coordinator indicated that [REDACTED]. She also mentioned that the [REDACTED]. The EHS Coordinator also stated that she was [REDACTED] by the [REDACTED] from contacting the corporate Senior Compliance Manager for support or consultation.

#7: Corporate Audit Frequency

While internal facility audits are important, audits by corporate compliance or third parties should be performed to ensure that facilities Standards, Policies, and Administrative Controls are effective and consistent with the corporation's expectations, as well as with current safety regulations. A compliance audit was performed at the Sentinel Energy Project in Fall 2014 by an outside contractor [REDACTED] with involvement from corporate compliance. New corporate Policies and Standards were issued with the expectation and understanding that the facility would update its procedures to meet the corporate Standards during 2015 and 2016. The first annual corporate safety audit on the new Standards was scheduled on December 15, 2016 to take place in September 2017. Corporate compliance should not allow as large of a gap between audits. The corporation should further develop a "Trust But Verify" approach to its facilities.

#8: Training Specificity

During many of the interviews following the incident, employees expressed concern for training at the facilities. Although the facility utilizes online training programs, such as [REDACTED], to supply general awareness training, and has also included some specific training on SMP-3 by the O&M Manager, in most cases the specific training provided is "on the job" with little guidance from management. The approach appears to rely heavily on institutional knowledge from other employees. As a result, it is not clear that the training is effective or sufficiently detailed.

Several newer employees indicated that they have received minimal training and are concerned that they may not have all of the proper qualifications to perform their job properly.

#9: A Questioning Attitude and Avoiding Complacency Should be Encouraged

As indicated in the incident description, several venting events were observed that do not typically occur and were unexpected by several employees (including [REDACTED]). There was no follow through by supervision, including [REDACTED], to inspect the entire isolation for abnormal conditions.

After reviewing documentation and interviewing the team members at Sentinel, it was clear that complacency is a systematic issue at the facility. For example, several of the team members cannot recall ever checking the filter housing pressure prior to starting work or during the isolation process. Additionally, safety forms that were reviewed are incomplete or not descriptive enough, and signature lines are not signed on LOTO and other documents.

Complacency is defined as "self-satisfaction especially when accompanied by unawareness of actual dangers or deficiencies." As with any facility with excellent performance metrics such as Sentinel (Plant

Performance, financial, and safety), there is always a chance that a high performing team can become complacent.

#10: Incorrect Tools Should Not Be Used

During the investigation, it was noted that employees typically use regular tools on gas line components. Non-sparking tools should always be used when opening natural gas line components.

Recommendations

As a result of this RCA, 46 specific recommendations have been developed for consideration. The goal of these recommendations is to prevent a similar incident from occurring again at Sentinel and in the entire organization. DGC Operations Leadership and Management should thoroughly review the list of recommendations and discuss an action plan to accomplish the items. For items that are not implemented, a reason and justification for not implementing should be clearly described in the “Reason for Not Implementing” section included in Attachment 1.

It's also important to note that the list in Attachment 1 may not be exhaustive, and the Leadership and Management team are encouraged to add items to this list, or modify the recommendations in an effort to prevent future incidents and strengthen DGC Operations safety programs.

See the attached Summary Table forms for recommendations.

Attachments

Attachment 1 – Corrective Action Recommendations

Attachment 2 – Root Cause Table Summary Documents

Attachment 3 – SMP 3

Attachment 4 – Sentinel LOTO-17-00061

Attachment 5 – Sentinel JSA-17-00035

Attachment 6 – Photos

Attachment 7 – Filter Skid Drawings

Attachment 8 - DCS Controls Screen Trend Data

Attachment 1

Corrective Actions / Items of Note and Major Concern Matrix					
Causal Factor	#	Recommendations	Implement? (Y / N) If no, explain why below.	Assigned to	Date Completed
The Existing LOTO Procedure Was Not Followed	1	Level 1 - Immediately train site employees on the SMP-3. Ensure that employees are competent per the requirements of the procedure. Ensure that employees understand the specific roles and requirements of the procedure.			
	2	Level 1 - Immediately require all Sentinel staff (including management) to undergo procedure use and adherence training.			
	3	Level 2 - Plant Manager will immediately perform a LOTO audit and any other requirements of the program as required by SMP-3.			
	4	Level 3 - Send out a (required reading) safety communication to all DGCOPS-operated facilities regarding the use and adherence to LOTO and other safety program policies and procedures (including IIPP, Near Miss Reporting, Procedure Updating and Energy Control Procedures).			
	5	Level 4 - Require an annual documented LOTO audit by a designated corporate safety person to ensure that all DGCOPS-operated facilities are following their safety procedures and programs effectively.			
	6	Level 4 – Review and update corporate policies and standards to ensure that appropriate guidance exists for procedure use and adherence. Consider a requirement for initial and annual training for all DGCOPS employees.			
Items of Note and Major Concern	#	Recommendations	Implement? (Y / N) If no, explain why below.	Assigned to	Date Completed
#1 The LOTO Procedure Requires Careful Review & Specificity	7	Immediately review and revise Energy Control Procedures for systems at the facility.			
	8	Ensure that facility employees are properly trained in the use and importance of the Energy Control Procedures.			
	9	Review and update the LOTO procedure, including a Plant Manager LOTO audit, as listed in #3 above. Perform a gap analysis of the procedure utilizing current 8 CCR 3314 requirements. Ensure that “Specific requirements for testing a machine or equipment to determine and verify the effectiveness of lockout devices, tag out devices, and other energy control measures” and “Specific procedural steps for shutting down, isolating, blocking and securing machines or equipment to control hazardous energy” are included.			
	10	Ensure / verify that all DGC Operations are utilizing Energy Control Procedures.			
	11	Perform a gap analysis on corporate LOTO standards and all facility LOTO procedures and programs to ensure that they are adequate per the requirements of 8 CCR 3314			
	12	Develop an annual review process by a designated corporate safety person to ensure DGCOPS corporate policies, standards and procedures are in compliance with Cal/OSHA and any other applicable regulations. Ensure that all DGC Operations LOTO procedures are compliant with the corporate standard.			
#2 Venting and Purging Procedures Improvement	13	Consider the development of natural gas safety procedures by DGC Operations. Utilize references such as NFPA 56, Cal/OSHA, etc. Also consider consulting company insurance carriers for guidance on natural gas safety. Items to be included are the safe venting, purging and isolation procedures, preventative maintenance procedures, inspection and coatings and the safe restoration to service of gas systems and components.			
	14	As part of training on LOTO or other energy control procedures, provide training to all DGCOPS personnel on the hazards of natural gas venting and purging.			

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	15	Review the gas filter skid instructions and evaluate whether and how they should be incorporated into the current LOTO / ECP process at Sentinel.			
	16	Develop and implement a plan to review site O&M manuals and other relevant documentation to include special safety recommendations for installed systems as necessary. Incorporate applicable recommendations into the appropriate LOTO and ECP procedures and processes, including updating based on in-field experiences.			
	17	Update SMP-3 to ensure that reference materials such as Piping and Instrumentation Diagrams (P&ID's), Electrical Schematics and Drawings, manufacturers' specific instructions, etc. are included in the LOTO packages where appropriate. These references will be considered in developing ECP's and LOTO isolation lists for the application of LOTO.			
	18	Develop and implement plans for DGC Operations to review O&M manuals and other relevant documentation to include special safety recommendations for installed systems. Incorporate applicable recommendations into the appropriate LOTO and ECP procedures and processes, including a process for updating as appropriate based on in-field experiences.			
	19	Update corporate policies and standards (where applicable) to ensure that reference materials such as Piping and Instrumentation Diagrams (P&ID's), Electrical Schematics and Drawings, manufacturers specific instructions, etc. are included in the LOTO packages for the facility as built. These references will be considered in developing ECP's and LOTO isolation lists for the application of LOTO. Ensure that DGC Ops incorporate this into facility procedures.			
#3 Clarify the Job Hazard Analysis (JHA) / Job Safety Analysis (JSA)	20	Perform a specific JHA/JSA for all jobs and tasks in progress.			
	21	Review and update or develop the JHA procedure. Perform a gap analysis of the procedure utilizing current Cal/OSHA requirements. Ensure that the JHA/JSA procedure incorporates techniques that focus on job tasks as a way to identify hazards before they occur. Ensure that all employees receive updated training on the procedure and process. The training must include verification of comprehension by the trainees (competency exams, walk downs, etc.).			
	22	Perform a gap analysis on corporate JHA standards and all facility JHA/JSA procedures and programs to ensure that they are adequate per the requirements of Cal/OSHA.			
	23	Develop an annual review process by a designated corporate safety person to ensure DGCOPS corporate JHA/JSA standards are in compliance with Cal/OSHA and any other applicable regulations. Ensure that all DGCOPS-operated facilities JHA / JSA procedures are compliant with corporate standards.			
	24	Ensure that all facilities operated by DGCOPS include training in the JHA / JSA process The training must include verification of comprehension by the trainees (competency exams, walk downs, etc.).			
#4 Improve Implementation of the Injury and Illness Prevention Plan (IIPP)	25	Review and Update the IIPP. Provide refresher training to site personnel. Ensure documentation of these items.			
	26	Input the annual IIPP training and review process tasks into the appropriate tracking tools (Maximo, Gensuite, Gpilearn, etc.) for the Sentinel site.			
	27	Ensure that all other facilities operated by DGCOPS have IIPPs in place and that annual training and review has occurred. Ensure documentation of these items.			
	28	All other sites input the annual IIPP training and review process tasks into the appropriate tracking tools (Maximo, Gensuite, GPiLearn, etc.) for the Sentinel site.			
	29	Consider reviewing and updating corporate standards to include an annual audit / review of all DGCOPS-operated facilities IIPP's to ensure continuous compliance with Title 8, Section 3203 of the California Code of Regulations (CCR).			
#5 Emphasize "Near Miss" and Safety	30	Ensure that the Sentinel site has a formal near miss reporting procedure and policy. Train all employees (including management) on the importance and value of near hit reporting, and follow-through as appropriate with procedure updating in light of in-field experiences,			

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Reporting Program	31	Ensure that all other facilities operated by DGCOPS have a formal near miss reporting procedure and policy. Train all employees (including management) on the importance and value of near hit reporting and follow-through with procedure updating when needed.			
	32	Review corporate policies and standards to ensure that near miss reporting is included. Include an annual review process to ensure that all facilities operated by DGCOPS are following the procedures and that the procedures adhere to the corporate standards and policies.			
#6 Evaluate Personnel and Organizational Issues	33	Provide updated training to Management and Supervision to address employee performance monitoring. The training should include ways to provide employee feedback on a continual basis, to identify performance issues within the team, and to correct behaviors that lead to or affect safety issues.			
	34	Site Management and Supervision should meet with corporate leadership to understand the roles and responsibilities of the EHS Coordinator at the site, as well as the relationship of the EHS Coordinator and corporate safety personnel.			
	35	DGC Operations leadership should review the corporate safety leadership positions roles and responsibilities. Consider updating the org chart to include dotted line reporting from the site EHS Coordinator to corporate EHS Management / Leadership.			
#7 Corporate Audit Frequency	36	Corporate EHS and Executive Leadership should meet with Plant Management and Supervision teams to discuss and underscore the importance of critical safety procedure audits, roles and responsibilities, and expectations for site leadership, including updating of procedures based on in-field experience or OEM updated information.			
	37	Input the Annual and Monthly audit process tasks into the appropriate tracking tools (Maximo, Gensuite, Gpilearn, etc.) for the Sentinel site.			
	38	Input the annual and monthly process tasks into the appropriate tracking tools (Maximo, Gensuite, Gpilearn, etc.) at all other facilities operated by DGC Ops.			
	39	Ensure that DGC Operations develops and implements a periodic and recurring safety audit and support program for all DGCOPS-operated sites. This audit should include a review of the site safety procedures, their implementation, safety training status and discussions with employees on safety culture at the facility.			
#8 Training Specificity	40	Review site technical and safety programs to ensure that minimum training standards are addressed for qualifying facility personnel. Utilize third party support if necessary (GP Strategies, etc.)			
	41	Ensure that all facilities operated by DGCOPS have similar technical and safety training program reviews. Utilizing third party support as necessary.			
	42	Ensure that all employees receive annual training on the facilities LOTO procedure and process. The training must include verification of comprehension by the trainees (competency exams, walk downs, etc.).			
	43	Ensure that all facilities operated by DGCOPS Develop Job Performance Measures with a sign off process that requires employees to demonstrate competence in the LOTO process. Require final sign off by the EHS Coordinator, O&M Manager and Plant Manager.			
	44	Consider adding the requirement for Job Performance Measures to corporate standards to ensure all new facilities are required to implement this into their LOTO programs.			
#9 A Questioning Attitude and Avoiding Complacency Should be Encouraged	45	Consider utilizing a third party consulting firm to perform a <i>safety culture assessment</i> of Sentinel, DGCOPS and all DGCOPS-operated sites. Include interviews of Employees, Supervisors, Managers, and Corporate Leadership Team Members. Develop and action plan based on the results.			

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#10 Incorrect Tools Should Not Be Used	46	Ensure that non-sparking tools are used on natural gas system components where applicable.			
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Attachment 2

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Prepared at the Direction of Counsel
Attorney Work Product

Root Cause Summary Table Form

Incident Number: SEN-001-2017
 Incident Description: Employee Fatality Due to the Unexpected Release of Hazardous Energy
 Incident Date: 3/6/2017
 Investigator: [REDACTED]

Causal Factor #	Paths Through Root Cause Map	Recommendations
<p>Causal Factor # 1</p> <p>Description:</p> <p>The existing LOTO procedure was not followed.</p> <p>Background:</p> <p>Per Sentinel Energy Project Procedure SMP-3 rev.0, management and plant employees violated several procedural requirements (as discovered through interviews and documentation).</p>	<p>Company Personnel Issue</p> <p>Procedure Issue</p> <p>Correct Procedure Not Used</p> <p>Procedure Use Discouraged (or not encouraged)</p> <p>Company Standards, Policies, and Administrative Controls (SPAC) Not Used</p> <p>Standards, Policies or Administrative Controls Enforcement Issue</p>	<p>Level 1 – Immediately train site employees on the SMP-3. Ensure that employees are competent per the requirements of the procedure. Ensure that employees understand the specific roles and requirements of the procedure.</p> <p>Level 1 – Immediately require all Sentinel (including management) staff to undergo procedure use and adherence training.</p> <p>Level 2 – Plant Manager will immediately perform a LOTO audit and any other requirements of the program as required by SMP-3.</p> <p>Level 3 – Send out a (required reading) safety communication to all DGCOPS regarding the use and adherence to LOTO and other safety program policies and procedures (including IIPP, Near Miss Reporting, Procedure Updating and Energy Control Procedures).</p> <p>Level 4 – Require an annual documented LOTO audit by a designated corporate safety person to ensure that all DGCOPS are following their safety procedures and programs effectively.</p> <p>Level 4 – Review and update corporate policies and standards for procedure use and adherence. Consider a requirement for initial and annual training for all DGCOPS employees.</p>

Completed by: [REDACTED]
 Date: 4/9/2017

Attachment 3

The entirety of Attachment 3 is Confidential

Attachment 4



Diamond Generating Corporation

A Subsidiary of Mitsubishi Corporation

Management approval prior to installing LOTO: YES

EQUIPMENT LOCKOUT / TAGOUT SHEET

Unit Affected: Unit 5

System/Component Affected: Unit 5 Main Outage Tagout Number: LOTO-17-00061

Description of Work Under This LOTO: Various Jobs

LOTO Kit ID A(24 LOCKS)

LOTO Initiator : 

Date / Time: 03/06/17 5:22AM

LOTO Authorizer : 

Date / Time: 03/06/17 5:23AM

LOTO Work Supervisor : 

Date / Time: 3/6/17 0523

LOTO Work Supervisor Transfer : _____

Date / Time: _____

LOTO Work Supervisor Release: _____

Date / Time: _____

Work Performed / Comments Various Jobs

LOTO Work Sup. Final Release: _____



Date / Time: _____

LOTO Authorizer Lock Removed _____

Date / Time: _____

LOTO Authorizer Final Release: _____

Date / Time: _____

Tag #	Equipment / Tag Location	Required Position	Date Installed	Installed By	Verified By	Date Removed	Restored Position	Release Initials
1	Air Switch 220 SW	Open	3-6-17				Closed	
2	CO2 Block Valve	Closed	3-6-17				Open	
3	Isolation Valve 1 Final Fuel Filter	Closed	3-6-17				Open	
4	Final Filter Vent Valve 1	Open	3-6-17				Closed	
5	Final Filter Vent Valve 2	Open	3-6-17				Closed	
6	Intercooler Suction From Cooling Tower	Closed	3-6-17				Open	
7	CT Raw Water Fill Discharge Valve RW0004	Closed	3-6-17				Open	
8	CT Raw Water Bypass Valve	Closed	3-6-17				Open	
9	Package Manual Fuel Isolation Valve	Closed	3-6-17				Open	
10	Maint Valve 1	Open	3-6-17				Closed	
11	Maint Valve 2	Open	3-6-17				Closed	
12	SLO Supply Isolation Valve	Closed	3-6-17				Open	

Tag #	Equipment / Tag Location	Required Position	Date Installed	Installed By	Verified By	Date Removed	Restored Position	Release Initials
13	Demin Supply Valve DW002	Closed	3-6-17				Open	
14	Isolaton Valve 2 Final Fuel Filter	Closed	3-6-17				Open	
15	Bypass Fuel Valve Final Fuel Filter	Closed	3-6-17				Closed	
16	SCR Instrument Air Inlet to Skid Isolation Valve	Closed	3-6-17				Open	
17	SCR Instrument Air Bypass Valve	Closed	3-6-17				Closed	
18	Ammonia Inlet Valve	Closed	3-6-17				Open	
19	Ammonia Outlet Valve to FCV	Closed	3-6-17				Open	
20	Ammonia Bypass of FCV	Closed	3-6-17				Closed	
21	Ammonia Drain Valve at FCV	Open	3-6-17				Closed	

Attachment 5

JSA #: JSA-17-00035

CPV Sentinel
JOB SAFETY ANALYSIS

WorkOrder #:

Equipment: Unit 5 Annual outage-Unit 5 Annual outage

Inspector(s): [REDACTED]

Work to be Performed: Various jobs

Work Scope / Special Instructions: PREFORMING VARIOUS OUTAGE RELATED JOBS

Hazard Evaluation / Job Safety Analysis

Job Safety Brief Conducted Yes No

SAFETY PROCEDURE

Steps in Doing the Job	Accident Potential with Step	Action to Prevent Accident
PRE-JOB SAFETY BRIED	WORKER MISINFORMED OF WORK BEING PREFORMED	Ensure all involved attend safety brief
ENSURE PERSONNEL SIGN ONTO REQUIRED LOTO	WORKER SAFETY	ENSURE PERSONNEL SIGNED ONTO CORRECT LOTO
TOOL SELECTION	DAMAGE TO EQUIPMENT	USE CORRECT TOOLS
SLIPS, TRIPS, AND FALL	INJURY TO WORKER	BE AWARE OF YOUR SURROUNDING
OVERHEAD WORK		BE AWARE OF SURROUNDING
FILTER REPLACEMENT	SPILLED OIL/WRONG FILTER INSTALLED	ENSURE CORRECT FILTER
OIL REPLACEMENT	DAMAGE TO EQUIPMENT	ENSURE CORRECT OIL IS BEING USED
LADDER USAGE	INJURY TO WORKERS	ENSURE LADDER IS SECURE
MANLIFT USAGE	SERIOUS INJURY TO WORKERS	ENSURE FALL PROTECTION IS USED
WASTE DISPOSAL	ENVIORMENTAL DAMAGE	ENSURE ALL WASTE IS CLEANED AND STOWED PROPERLY
CONFINED SPACES	TRAPPED/INJURED WORKER	ENSURE COMMUNICATION WITH ATTENDENT
CLEAN WORK AREA	INJURY/LOST TOOLS	KEEP WORK AREA CLEAN
COMMUNICATION	WORKER INJURY	NOTIFY PERSONNEL OF ANY CHANGE WITH THE EQUIPMENT
ENSURE THE LOTO IS IN PLACE	ROTATING EQUIPMENT, RELEASE OF ENERGY	ENSURE LOTOT IS HUNG CORRECTLY AND VERIFIED

PERMIT HAZARD ANALYSIS

Tools / Parts / Equipment Needed	Safety Precautions	Additional Protective Equipment
Various wrenches Filters Chain falls Oil Ladders Manlift	(X Appropriate Precautions) <input checked="" type="checkbox"/> Equipment Isolation <input checked="" type="checkbox"/> Lighting <input checked="" type="checkbox"/> Confined Space <input checked="" type="checkbox"/> Ventilation <input type="checkbox"/> Hot Work Permit <input checked="" type="checkbox"/> Hand / Power Tools <input type="checkbox"/> Chemical Hazard <input checked="" type="checkbox"/> Strain Prevention <input checked="" type="checkbox"/> Slips / Falls <input checked="" type="checkbox"/> Pre-Job Clean	(X Appropriate Precautions) <input checked="" type="checkbox"/> Hearing Protection <input checked="" type="checkbox"/> Eye / Face <input checked="" type="checkbox"/> GFCI <input type="checkbox"/> Respirator <input checked="" type="checkbox"/> Ladder / Scaffolding <input checked="" type="checkbox"/> Protective Clothing <input checked="" type="checkbox"/> Lifting Equipment <input type="checkbox"/> Other _____ <input checked="" type="checkbox"/> Fall Protection

Completed by Signature(s):
 Reviewed By:



Date: 3/6/17
 Date: 3/6/17

JOB SAFETY ANALYSIS INJURY PREVENTION BASICS

1. APPROACH TO WORK - No aspect of injury prevention is more important than each individual's approach to work. Personal safety is by far the most important consideration in every job we do and each action we take. Each person must think and act with that priority to prevent injury. The purpose of this job briefing is to provide a means to maintain awareness and focus on personal safety. Conscious and unconscious toleration of unsafe acts and conditions by far the leading cause of injury. Use his briefing to maintain a high degree of safety awareness and focus. Don't take safety shortcuts. In the interest of injury prevention, do not tolerate unsafe acts and conditions either personally, or by fellow employees. A facility culture is the sum of individual attitudes. Your attitude can keep you injury free, and can go a long way in influencing others to be safe...remember...the only right way to do a job is the safe way!

2. EQUIPMENT ISOLATION - Improper equipment isolation can/will result in serious injury or fatality...approach the job of equipment isolation with exactly that in mind. Take the time to do the job well. The correct equipment must be isolated, double check and where possible, test equipment to be sure its isolated. Carefully and strictly follow equipment isolation procedure to provide the checks and balances to catch mistakes before there is an injury. When isolating equipment, be prepared for the unexpected. Communicate well and take any appropriate action to prevent unwanted equipment operation during the isolation process. Be prepared for mechanical failure of components being isolated. Clear personnel of areas of danger wear protective equipment, stand clear of potential missiles/projectiles should components fail violently. Be absolutely certain that all persons are clear and isolation can be safely removed before returning equipment to service.

3. HAND/FINGER INJURIES - Are the most common injury experienced at the facility, most frequently sustained by striking something. Careful and appropriate use of tools instead of hands will prevent injury. Insuring tools are in good shape using them as they were intended to be used, and awareness of basic hand/power tool safety will further prevent injury. Body positioning and tool movement must be considered. An awareness of what can happen, body positioning to prevent falling or striking something, and actions like pulling instead of pushing on a tool, product, or object can prevent injury if a fastener, part, object, or product frees/moves suddenly. Use of mechanical advantage/tools instead of muscle will prevent both hand/finger, and strain injuries.

4. STRUCK BY INJURIES - Occur frequently and are avoidable. Because gravity is generally working, serious consideration should be given to refraining from working in an area where objects could fall either from equipment, workstands, and like (same elevation), or from above...NEVER WORK UNDER SUSPENDED LOADS...maintain an awareness of what is happening ALL THE WAY AROUND the work area. Don't position yourself under material or objects that could fall. When working at elevations, establish the means to warn others that could inadvertently walk below. PLACE OBJECTS, don't throw them...take precautions prevent objects from falling before it happens. If things must be dropped take ALL precautions to prevent people from walking under those falling objects. Taking shortcuts can injure someone. Be aware of and take precaution to prevent injury from projectiles that could be ejected from work activities(hand/power tools, power cleansers, shop equipment, and the like).

5. STRAINS/SPRAINS - Are one of the most debilitating injuries experienced. Usually result from overexertions and to lesser degree, slips, falls, and overextension. Strains are preventable...prevention generally starts with a state of mind. Use stretching exercises at shift start to maintain awareness. Don't hesitate to stretch whenever necessary (not just at shift start). Don't get caught in the "immediacy of the job"...be aware of consequences of strains/sprains...lift properly and don't overexert (the plant doesn't hurt backs, people do...don't be victim of yourself). Get help, use lifting equipment, MAKE a better position to work from...no job is worth what a person endure with serious strain. Keep the work area you are standing on reasonably clear of debris, watch where you are walking and what you are stepping on...don't step on unstable objects or unknown debris...clean it up or walk around. Don't overextend when entering/exiting mobile or in-plant equipment...use ladders/steps or find safe alternative...the back you save may be your own!

6. FALLS - Are a classic way to be seriously injured...again injury prevention starts with thing of the consequences of falls and taking the time to prevent them before they happen. Don't climb on equipment/components where falls are a hazard...get, and properly use ladders (in the way they were intended to be used, set up at proper angles, the right length, tied off, paced on stable surfaces, etc....) whenever possible. Once again the "immediacy of the moment" comes into play... there is no job worth risking life and limb...the facility can recover from anything, with one exception...someone getting killed or crippled...ALWAYS think of personal safety and don't take shortcuts...the minute you save is not worth the risk of a fall. If you must access areas where work platforms are not provided, exercise cautions and use safe work practices. Where slips could cause falls, use safety bets/harnesses, or other fall protection. Were equipment or component parts could move(e.g. rotors, shafts, etc.) and cause falls or other types of injuries (contusion, crushing, etc.), lock those components before you start work. Properly barricade/cover floor and wall openings. Think about and understand the potential fall hazards at the job site...assume anything that can go wrong will, be prepared and don't let something preventable hurt someone.

7. TOXICS - There is a possibility of toxics at any job site. Toxics can result from facility process, or a work generated by product(weld fumes, smoke from heating/cutting, chemicals/substances used in work activities etc.). Never assume a work area is free of toxics, test enclosed/confined spaces...be alert to your senses (smell, taste, feel, etc.) and if you suspect for any reason, or if there is any indication of toxics in the work area, leave that area immediately. Far more people die from smoke inhalation(toxics), than burns in a fire situation...avoid smoke in a fire situation. The key to elimination of toxics is control and ventilation. Control all toxics that could be introduced into a work area and open all work areas to the maximum extent possible. When necessary, use forced ventilation. Keep dust levels as low as possible with house keeping wear the proper type of respirator in dusty areas. THINK of the possibility of toxics before you start work, and do something about it...not job is worth getting sick over!

8. EMERGENCY PREPAREDNESS - Always consider the possibility of injury at the job site before you start work. Be prepared to provide assistance/get help in the "worst case" scenario. Know what could happen, how difficult it would be to reach, help, or get an injured person out of an area. Plan in advance at a tailgate conference. Establish communication, have or provide the means to get rescue equipment/first aid supplies to the site quickly and to summon medical help. Insure that extra help that may be needed can arrive quickly. Work the "buddy system" and use "outside persons" whenever there is need. The few minutes you take to plan/prepare for an emergency can save a life when seconds count!

Employee Signatures

Employee Name (print)



Date	Time In
3/6/17	0600
3/6/17	0600
3/6/17	0600
3/16/17	0600
03/16/2017	0600
3-6-2017	600
3/16/17	0600
3/16/17	0600
3/6/17	0600
3-6-17	0600
3-6-17	600
3-6-17	600
3-6-17	0600
3-6-17	0600
3-6-17	0600
3-6-17	0600
3-6-17	0600
3-6-17	0730
3-6-17	1010

Employee Signatures

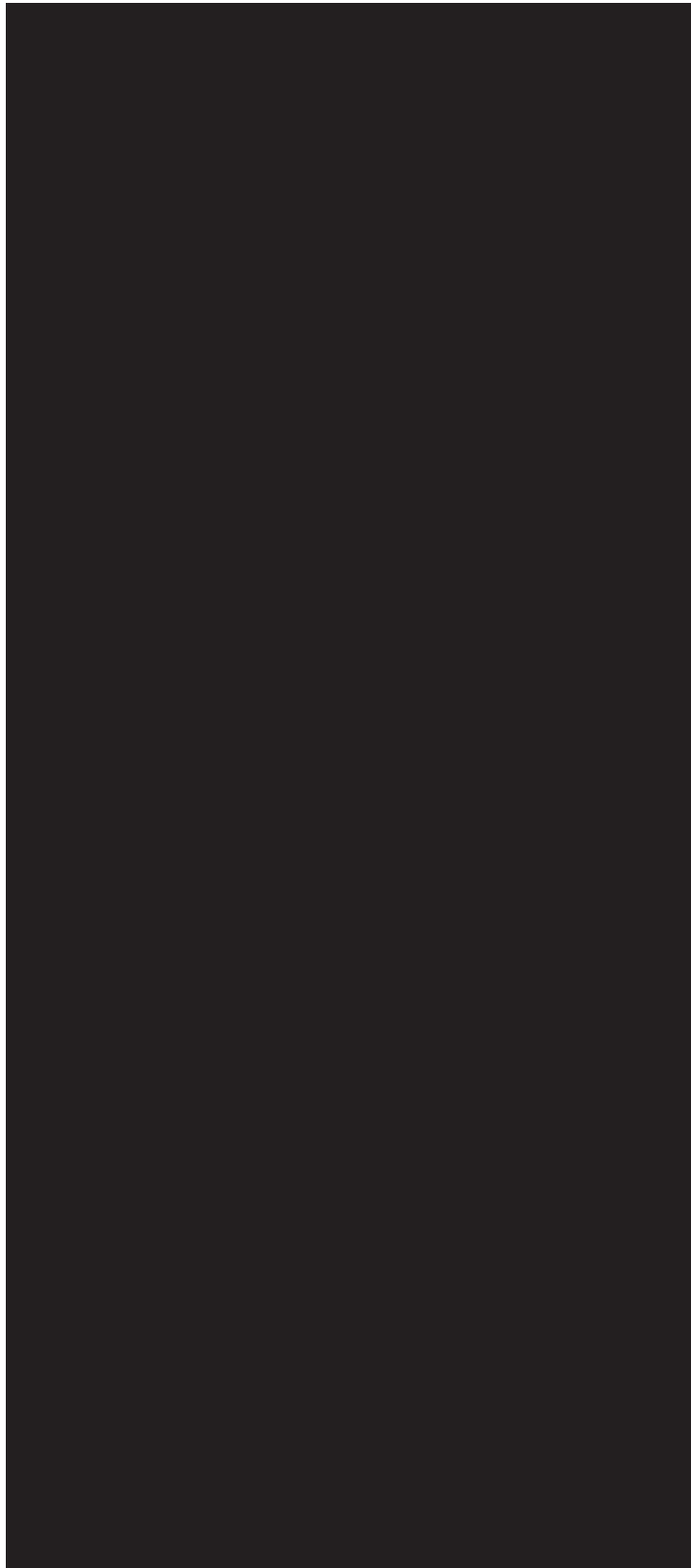
Employee Name (print)		Date	Time In
[Redacted]	[Redacted]	3/7/17	0625
[Redacted]	[Redacted]	3/7/17	0625
[Redacted]	[Redacted]	03/07/2017	0625
[Redacted]	[Redacted]		
[Redacted]	[Redacted]		
[Redacted]	[Redacted]		
[Redacted]	[Redacted]		
[Redacted]	[Redacted]		
[Redacted]	[Redacted]		
[Redacted]	[Redacted]		
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[Redacted]	[Redacted]		
[Redacted]	[Redacted]		
[Redacted]	[Redacted]		
[Redacted]	[Redacted]		

Attachment 6

Item 1 - Typical (intact) filter skid for reference



Item 2 - Photos of multi point calibration check (PI51603)



Attachment 7

The entirety of Attachment 7 is Confidential

Attachment 8

Attachment 8 – Control Screens (typical) and trend data.



Attachment 8 (continued)



Attachment 8 (continued) Trend Data

