Joint Accident Investigation Report

Construction Lifting Accident at the Los Alamos National Laboratory Results in Serious Injuries to a Subcontract Employee on December 19, 2018

February 1, 2019

Disclaimer

This report is an independent product of the Joint Accident Investigation Board appointed by Theodore A. Wyka, Cognizant Secretarial Officer for Safety, Office of Safety, Infrastructure and Operations. The Board was appointed to perform an accident investigation and to prepare an investigation report.

The discussion of the facts as determined by the Board and the views expressed in the report do not assume, and are not intended to establish, the existence of any duty at law on the part of the U.S. Government, its employees or agents, contractors, their employees or agents, or subcontractors at any tier, or any other party.

This report neither determines nor implies liability.

Release Authorization

On December 21, 2018, an Accident Investigation Board was appointed to investigate the December 19, 2018, construction lifting accident that resulted in serious injuries to a subcontract employee at the Los Alamos National Laboratory (LANL). This was a joint investigation involving NNSA employees and Triad employees (as the M&O contractor, or simply the M&O). The Board's responsibilities have been completed with respect to this investigation. The analysis and the identification of the contributing causes, the root cause, and the Judgments of Need resulting from this investigation were consistent with methodology discussed in the Department of Energy Order 225.1B, *Accident Investigations*, dated March 4, 2011.

The report of the Accident Investigation Board has been accepted, and the authorization to release this report for general distribution has been granted.

Theodore A Wyka

Theodore Wyka
Cognizant Secretarial Officer for Safety
Office of Safety, Infrastructure and Operations

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Date

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Acronyms & Abbreviations

AIB	Accident Investigation Board (Board)
ALDCP	Associate Laboratory Director for Capital Projects
ALDSC	Associate Laboratory Directorate for Simulation and Computation
ASP	Associate Safety Professional
CAIH	Certified Associate Industrial Hygienist
CAP	Corrective Action Plan
CCI	Cross Connection, Inc. (Subcontractor)
CFR	Code of Federal Regulations
CHST	Construction Health and Safety Technician
CON	Conclusion
CPR	Cardiopulmonary resuscitation
CSO	Cognizant Secretarial Office
DOE	U.S. Department of Energy
ECCCE	Exascale Class Computer Cooling Equipment
ECF	Events and Causal Factors
EOSC	Emergency Operations Support Center
ESH	Environment, Safety, and Health
EVMS	Earned Value Management System
FOD	Facility Operations Directorate
FPD	Federal Project Director
HPI	Human Performance Improvement
IPT	Integrated Project Team
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
IWD	Integrated Work Document
JHA	Job Hazard Analysis
JLG	JLG Industries, Inc.
JON	Judgment of Need
LAFD	Los Alamos Fire Department
LAMC	Los Alamos Medical Center
LANL	Los Alamos National Laboratory
M&O	Management and Operations (Triad National Security, LLC)
MOA	Memorandum of Agreement
MOV	Management Oversight Verification
MST	Mountain Standard Time
NA-APM	National Nuclear Security Administration – Acquisition Project Management
NA-LA	National Nuclear Security Administration Los Alamos Field Office

NNSA	National Nuclear Security Administration
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration
PEP	Project Execution Plan
PIC	Person(s) in Charge
PPE	Personal Protective Equipment
RFP	Request for Proposal
SCC	Strategic Computing Complex
SFO	Sandia Field Office
SME	Subject-Matter Expert
SSESHP	Site-Specific Environment, Safety, and Health Plan
STR	Subcontract Technical Representative
TA	Technical Area
UI	Utilities & Infrastructure
WSH	Worker Safety and Health

Construction Lifting Accident at the Los Alamos National Laboratory Results in Serious Injuries to a Subcontract Employee on December 19, 2018

Executive Summary

On Wednesday, December 19, 2018, at approximately 3:00PM local time, employees working for Cross Connection, Inc. (CCI), which is a construction project subcontractor to Los Alamos National Laboratory (LANL), were lifting a flange onto a welding table using a small skid steer loader with fork lift tines, referred to as a Bobcat. To accomplish the lift, an attachment that was not designed for use on the Bobcat was placed on the forks of the Bobcat. The flange was then rigged by a sling to the bottom of the lifting attachment. While the forks of the Bobcat were suspended overhead, the attachment and flange on the forks slid off, striking a journeyman. The journeyman suffered severe injuries requiring hospitalization for three nights.

The NNSA and Triad, the Management and Operations (M&O) contractor at LANL, considered various strategies to investigate this accident shortly after it occurred. One of the criteria noted in DOE O 225.1B to determine if an Accident Investigation Board (AIB) should be considered includes, "*Any single accident that results in the hospitalization for more than five calendar days…of one or more DOE, contractor, or subcontractor employees or members of the public due to a serious personal injury or acute chemical or biological exposure*." One CCI employee was injured, and initial accounts suggested that the employee could potentially be in the hospital for several days. (Note: The injured employee was released from the hospital after three nights, so the criterion in DOE O 225.1B did not apply.)

NNSA and the M&O management worked together and determined that the accident was serious enough to warrant a rigorous investigation. On December 21, 2018, the NNSA Cognizant Secretarial Officer (CSO) commissioned a joint AIB comprising of qualified staff members from both NNSA and the M&O contractor. The memo appointing the federal employees was then followed by a memo from the M&O management, appointing the M&O team members.

Accident Description

At approximately 1:00PM, the CCI work crew conducted several evolutions of staging 24-in. flanges onto a welding table for tack-welding at the laydown yard of the job-site. These actions would be the last flange-staging activities for the day.

The crew used a Bobcat to lift the flange from a pallet on the ground up to the table. Two crew members retrieved the lifting attachment that was in the laydown yard and slid it onto the forks of the Bobcat. However, at that time, they did not secure the attachment with the set of safety pins that are essential to properly secure the attachment. The first three evolutions of this activity

were conducted without incident. However, during the fourth evolution, the accident occurred when the attachment slid off the forks.

Accounts indicated that on this last evolution, a different technique was used to stage the flange. Using this different technique, the journeyman inserted two bolts through the holes on opposite sides of the flange face and held them from above as the flange was lowered onto the table, which placed the journeyman under the load.

At the beginning of the lift, the Bobcat forks were approximately eight feet high and inclined. As the flange was lowered and getting close to lying flat on the table, the forks dropped below horizontal and the 350-pound lifting attachment with the 268-pound flange slid off the forks. The lifting attachment then struck the journeyman in the face, arms, and upper torso.

Emergency response rapidly arrived to the scene to provide emergency medical response and transport to the Los Alamos Medical Center (LAMC). The M&O began making the appropriate notifications and securing the scene.

Direct, Root, and Contributing Causes

The Board determined the following causes of the accident:

Direct Cause (DC) – The immediate events or conditions that caused the accident.

DC: The unsecured forklift attachment slipped off the forks of the Bobcat and struck Journeyman 1 in the face, arms, and upper torso causing serious injuries.

Root Cause (RC) – Causal factors that, if corrected, would prevent recurrence of the same or similar accidents.

RC-1: CCI management systems did not establish effective processes for work planning and control in the laydown yard to ensure worker safety.

RC-2: CCI did not ensure job specific hazards were recognized, appreciated, and addressed during work execution.

Contributing Causes (CC) – Events or conditions that collectively with other causes increased the likelihood or severity of an accident but that individually did not cause the accident.

CC-1: Tasks were performed inconsistently and without necessary safeguards in place, especially during recognized abnormal conditions.

CC-2: Work planning and control, including application of lessons learned, was inadequate for specific tasks.

CC-3: CCI management viewed the development of safety documents to be more of a contractual obligation than a tool for the safe conduct of work.

CC-4: Ineffective oversight by CCI, the M&O, and NNSA missed opportunities to observe and/or correct potentially unsafe or abnormal work practices and ensure effective work planning and control for all work in the laydown yard.

CC-5: Ineffective flow down of contract safety requirements to CCI's safety plan, work control documents, and actual work practices.

Table ES-I summarizes the Conclusions (CONs) and Judgments of Need (JONs) determined by the Board. The CONs are derived from the analytical results performed during this accident investigation for determining what happened and why it happened. Also listed are JONs determined by the Board as managerial controls and safety measures necessary to prevent or minimize the probability or severity of a recurrence of this type of accident.

Conclusions and Judgments of Need

Table ES-I: The Conclusions and Judgments of Need as determined by the Joint AIB

Conclusions	Judgments of Need
Hazards Analysis, Work Planning and Control	
Activity-level work planning and control, including hazard analysis for lifting and handling the flange, that would have prevented this accident was not conducted in a formal or documented manner. [CON-1] CCI management viewed the development of Integrated Work Documents (IWD) and the Site Specific Environment, Safety and Health Plan (SSESHP) as contractual obligations rather than valuable tools for the safe conduct of work. [CON-2]	CCI needs to develop an effective process to define activity-level work, and to formally conduct and document job planning as required by the awarded contract and implementing documents. [JON-1] See JON-12.
The viewpoint of CCI employees that the load in this activity consisted only of the flange was incorrect; the attachment was a part of the load since the safety pins were not used. [CON-3]	CCI needs to provide training to all workers on hoisting, rigging, and material handling to ensure all CCI activities are performed to meet Exhibit F safety requirements and M&O expectations. [JON-2] The M&O contractor needs to provide clarity in Exhibit F as to what qualifies as a "lift" and which activities require formal work planning. [JON-3]
In the absence of task specific work planning and control in the IWD, CCI relied on pre-task briefings to discuss tasks, steps, hazards and controls. The Board's review of pre-task briefing documents showed that pre-task briefings were inadequate to address specific tasks and associated hazards and controls. [CON-4]	CCI needs to improve methods for pre-task briefings that actively involve workers, define clear roles and responsibilities, and identify specific steps, hazards and controls that are commensurate with the task being performed. [JON-4] See JON-1.

Conclusions	Judgments of Need
Oversight and Lessons Learned	
Lessons from the earlier accident in which an angle iron was dropped and struck an employee were not effectively applied to other work activities on the project, including the lifting and material handling work in the laydown yard. These lessons included maintaining a "cone of safety," securing the load, and proper use of heavy equipment to move material. [CON-5]	CCI needs to review and improve their approach to address lessons learned from incidents to include extent of condition reviews for all projects at LANL. [JON-5]
The M&O contractor was ineffective in ensuring applicable ES&H contract requirements were executed during project activities. [CON-6]	The M&O contractor needs to develop and implement rigorous processes to confirm that CCI and all other construction subcontractors are implementing Exhibit F and other requirements and expectations. [JON-6]
CCI and the M&O contractor did not ensure IWD elements were implemented in daily work activity planning. [CON-7]	See JONs-1, -3, -4, and -6.
There is a disconnect between the M&O contractor and NA-APM regarding appropriate resource allocation for the ES&H function versus all other project management functions. [CON-8] NNSA oversight activities did not emphasize effectiveness of M&O's oversight of CCI's implementation of work planning and control requirements such as Exhibit F, IWD, and safety plans. [CON-9]	NNSA and the M&O contractor need to work together to develop and implement effective oversight strategies to ensure that resources are aligned and adjusted as necessary throughout all project phases. [JON-7]
Routine work monitoring and inspections focused more on work area conditions such as signage, PPE, and housekeeping versus hazards analyses, changes in work, and how daily work activities were planned or performed. [CON-10]	The M&O contractor and CCI need to develop and implement a strategy that ensures line management and ES&H professionals are focused on hazard recognition during work activities and take positive and timely action to improve performance. [JON-8]
The M&O contractor does not have an effective mechanism to apply appropriate oversight resources based on risk and hazards during various phases of the project. [CON-11]	The M&O contractor needs to develop and implement a risk-based staffing plan to ensure appropriate resources are assigned during various phases of the project. [JON-9]

Conclusions	Judgments of Need
CCI, with M&O contractor oversight, did not incorporate all Exhibit F safety requirements, such as developing clearly defined work steps, into their SSESHP and IWD documents. [CON-12]	The M&O contractor needs to improve their review and approval process for ensuring that all requisite requirements from Exhibit F are incorporated into subcontractor implementing documents. [JON-10] CCI needs to improve their method to ensure that all Exhibit F requirements are appropriately included in their implementing documents. [JON-11]
Risk Perception and Tolerance	
Because of the unsafe method used to lift the load, the crew relied solely on the positioning of the forks to keep the attachment from sliding off. However, at the time of the incident, there was no designated spotter to focus on the position of the forks. [CON-13]	See JON-1.
The technique used to stage the flange on the last lift of the day, which was different from the other technique used earlier in the day, increased the likelihood of an accident and placed workers underneath the load. [CON-14]	See JONs-1, and -8.
Unsafe work behaviors had been previously observed and reported; however, no formal measures were implemented to ensure sustainable safe behaviors. [CON-15]	See JONs-1, and -5.
Workers experienced various abnormal conditions the day of the accident (including safety pins not inserted and different technique used), however, they accepted the risk and proceeded with the work. [CON-16] Inadequate risk-informed decision making at the task-level ultimately resulted in the accident. [CON-17]	CCI line management needs to model behaviors and ensure that their workforce has adequate training and experience in hazard recognition and risk appreciation and that all CCI employees fulfill their obligation to pause work and perform a real time discussion of hazards when abnormal conditions are encountered. [JON-12]

Conclusions	Judgments of Need
CCI supervisors, safety personnel and workers did not consider the flange material handling task as a lift. [CON-18] Requisite elements of the SSESHP and IWD were not considered or implemented, which allowed the crew to be under the load. [CON-19]	See JONs-1, -3, and -4.
The JLG Industries, Incorporated (JLG) forklift attachment was designed solely for use with JLG equipment. The attachment was not intended nor approved for the Bobcat. However, the attachment was frequently used with the Bobcat. [CON-20]	CCI line management needs to significantly improve their processes to ensure that all equipment is used in accordance with manufacturer requirements. [JON-13] The M&O contractor needs to confirm that all equipment used by subcontractors is being used in accordance with manufacturer requirements. [JON-14]
CCI, the M&O contractor, and NNSA performed limited oversight in the laydown yard. Oversight was primarily focused on work being conducted in the basement and at the cooling towers, as that work was considered more hazardous. [CON-21]	CCI, the M&O contractor, and NNSA need to work together to develop and implement an effective strategy to maintain balanced oversight that considers the hazards of the work and not simply the facility. [JON-15]

1.0 Background and Investigation Appointment

1.1 Los Alamos National Laboratory

LANL was established in 1943 as a part of the Manhattan Project for the purpose of designing and building an atomic bomb. Today, Los Alamos National Laboratory, which is operated by Triad National Security, LLC., works on nuclear weapons stockpile programs, nuclear nonproliferation, broader energy and infrastructure security, and countermeasures to nuclear and biological terrorist threats. The Laboratory currently sits on over 40 square miles and employs more than 10,000 staff, which are supplemented by a number of subcontractors.

1.2 Exascale Class Computer Cooling Equipment Project

The construction lifting accident that is the subject of this report occurred on the Exascale Class Computer Cooling Equipment (ECCCE) project. This construction project is intended to increase cooling capacity to accommodate a series of supercomputers. Specifically, this project is envisioned to provide a minimum of 3,800 tons of additional warm-water cooling capacity to LANL's Strategic Computing Complex (SCC) at Technical Area 3 (TA-3). The ECCCE project is funded by the NNSA Office of Defense Programs, Assistant Deputy Administrator for Research, Development, Test and Evaluation, NA-11. The project is managed by the M&O's Associate Laboratory Directorate for Capital Projects (ALDCP) for the Associate Laboratory Directorate for Simulation and Computation (ALDSC). Henceforth, when the M&O is cited in this report, it represents both the current and previous responsible M&O contractor since a contract transition occurred at LANL effective November 1, 2018.

In April 2018, the ECCCE project team awarded CCI a subcontract for this project that involved the construction of five cooling towers, four heat exchangers, seven pumps, and associated piping and electrical upgrades. The project involves installing piping at both the cooling tower near TA-3 and in the basement of the SCC. The piping is fabricated in a fenced parking lot nearby, which is the project's "laydown yard" (Fig. 1) where the accident occurred.

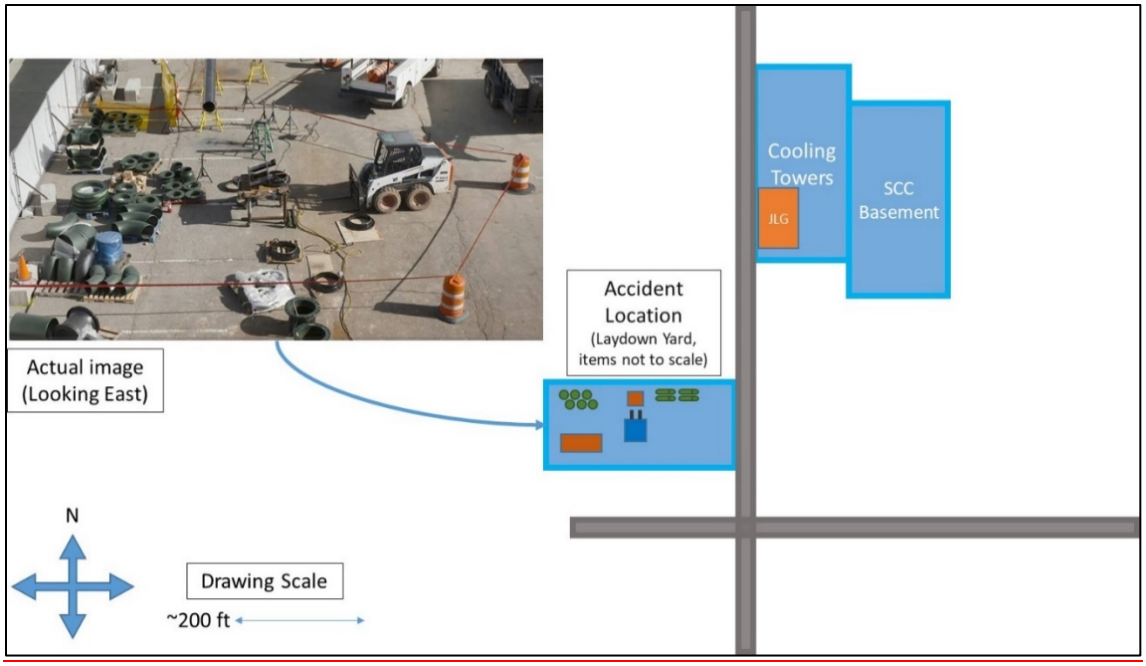


Figure 1: ECCCE Project site diagram with view of the laydown yard.

1.3 Accident Investigation Process

The Joint Accident Investigation Board, comprised of staff from NNSA and the M&O, was formally appointed on December 21, 2018. This report documents the facts of the accident and the analyses and conclusions of that investigation. Though this investigation was not a Federal Accident Investigation Board that required strict compliance with DOE Order 225.1B, *Accident Investigations*, the analysis was conducted using the core analytical techniques discussed in the order. The Board conducted its investigation using the following methodology:

- Facts relevant to the accident were gathered through interviews, document reviews, examination of physical evidence, and accident condition simulations.
- Event and causal factor charting, along with barrier analysis and change analysis techniques were used to analyze the facts and identify the cause(s) of the accident.
- Based on the analysis of information gathered, CONs and JONs were developed that are to be used to develop corrective actions to prevent recurrence.

Additionally, the Board conducted a series of accident condition simulations to gain insight regarding a number of areas of uncertainty at the beginning of the investigation. Figure 2 describes the accident investigation terminology used throughout this report.

Accident Investigation Terminology
A **causal factor** is an event or condition in the accident sequence that contributes to the unwanted result. There are three types of causal factors: direct cause(s), root causes(s), and the contributing causal factors. The **direct cause** of an accident is the immediate event(s) or condition(s) that caused the accident. **Root causes** are the causal factors that, if corrected, would prevent recurrence of the same or similar accidents. Root causes may be derived from or encompass several contributing causes. They are higher-order, fundamental causal factors that address classes of deficiencies rather than single problems or faults. **Contributing causes** are events or conditions that, collectively with other causes, increased the likelihood or severity of an accident but that individually did not cause the accident. Contributing causes may be longstanding conditions or a series of prior events that, alone, were not sufficient to cause the accident but were necessary for it to occur. Contributing causes are the events and conditions that "set the stage" for the event and, if allowed to persist or re-occur, increase the probability or severity of future events or accidents. **Event and causal factors analysis** includes charting, which depicts the logical sequence of events and conditions (causal factors that allowed the accident to occur), and the use of deductive reasoning to determine the events or conditions that contributed to the accident. **Barrier analysis** reviews the hazards, the targets (people or objects) of the hazards, and the controls or barriers that management systems put in place to separate the hazards from the targets. Barriers may be physical or administrative. **Change analysis** is a systematic approach that examines planned or unplanned changes in a system that caused the undesirable results related to the accident.

Figure 2: Accident Investigation Terminology.

1.4 Appointment of a Joint Accident Investigation Board

The NNSA and its M&O partner considered various strategies to investigate this accident shortly after it occurred. One of the criteria noted in DOE O 225.1B to determine if an AIB should be considered includes, "*Any single accident that results in the hospitalization for more than five calendar days…of one or more DOE, contractor, or subcontractor employees or members of the public due to a serious personal injury or acute chemical or biological exposure*." One CCI employee was injured, and initial accounts suggested that the employee could potentially be in the hospital for several days. (Note: The injured employee was released from the hospital after three nights, so the criteria in DOE O 225.1B did not apply.)

NNSA and the M&O management worked together and determined that the accident was serious enough to warrant a rigorous investigation. On December 21, 2018, the NNSA Cognizant Secretarial Officer commissioned an AIB comprising qualified staff members from both NNSA and the M&O. The memo appointing the Federal employees was then followed by a memo from the M&O management that appointed the M&O team members.

2.0 Accident Facts

2.1. Accident Description

On Wednesday, December 19, 2018, at approximately 3:00PM, CCI employees were lifting a flange onto a welding table using a small skid steer with forks, referred to as a Bobcat. To accomplish the lift, an attachment was placed on the forks of the Bobcat, and the flange was rigged by a sling to the bottom of attachment. While the forks of the Bobcat were suspended overhead, the lifting attachment and flange slid off the forks, striking a journeyman who was standing in front of and under the forklift tines. The employee suffered severe injuries to his face, arms, and upper torso that required hospitalization and multiple surgeries to repair his face and arm. He was released from the hospital on Saturday, December 22, 2018.

2.2. Chronology of Events

2.2.1 Work Control Practices on the Day of the Accident

The day of the accident, welding was being conducted in the laydown yard. As part of this work, flanges were being lifted from pallets onto welding tables. The primary work-control mechanisms used by CCI for all project work consisted of the Integrated Work Documents (IWDs) that were developed for the project, daily pre-job briefings held by the CCI superintendent with follow-up discussions held among work crews at the project work areas, and oversight by the CCI superintendent and the CCI Environment Safety and Health (ESH) manager. Two IWDs were particularly applicable to the work activities that were being performed in the laydown yard on the day of the accident. The first was IWD #464124-01, "*Site Mobilization and General Hazards*" (the General Hazards IWD), and the second was IWD #464124-03, "*Exterior Welding*" (the Welding IWD). The following is a summary of the pertinent areas of these two IWDs.

General Hazards IWD

This IWD was intended to be used in conjunction with other task specific IWDs (such as the Welding IWD) and applied to all aspects of the project. Specific to the work associated with this event, this IWD covered the use of heavy equipment for rigged lifts and material handling and rigging. The IWD discussed work tasks and steps, associated hazards and potential accidents, controls and preventive measures, reference documents, and training. Three specific hazards included in the IWD related to the welding activities in the laydown yard included "Lack of necessary planning to control the load," "Loss of control of the load," and "Crushed or struck by load or equipment." Controls included

- Determining the type of lift - ordinary or critical,
- Determining the potential need for a lift plan,
- Determining the need for a pre-lift meeting to ensure clear understanding of responsibilities,
- Conducting an unloaded dry run to ensure the lift could be conducted as planned and controls were operable,

- Ensuring employees did not have any part of their body under a suspended load, and
- Exercising caution when in the path of lifting equipment.

Welding IWD

This IWD was intended to be used in conjunction with other general and task-specific IWDs and applied to all aspects of the project. For general hazards (as noted above), the General Hazards IWD applied. The Welding IWD covered tasks and hazards specific to welding operations, but did not include any specific discussion of tasks and hazards associated with the material handling or hoisting and rigging operations associated with welding activities, including lifting the flanges onto the welding tables.

The only time these IWDs were reviewed by the crew members involved in the accident was at the beginning of their work on the project, which was several months before the day of the accident. This was common practice employed by CCI management.

2.2.4 Events on the Day of the Accident

At approximately 7:00AM on December 19, 2018, the CCI project team held their routine daily briefing to go over the various tasks that were to be performed that day. The weather was seasonably cool with no overcast or precipitation. [Note: A major snow fall occurred several days after the event, and this snow can be seen in some of the photos in this report.] One of the tasks discussed by the CCI superintendent was for four CCI crew members to continue performing welding-related activities in the laydown yard work area. The welding activities to be performed included tack-welding flanges to pipe connections and material handling and rigging associated with moving the flanges around the yard. These activities had been performed by this crew on a daily basis for several months before the accident.

Following the general daily briefing, four crew members proceeded to the laydown yard and had a short pre-task briefing to accomplish the welding activities that day. The General Hazards and Welding IWDs were not reviewed, referenced, or discussed by the CCI superintendent, the ESH Manager, or any of the four crew members at the general daily briefing or during the follow-on discussion in the laydown yard.

The four-man work crew in the laydown yard on the day of the accident consisted of two journeymen pipe-fitters/welders (J1 and J2), an apprentice pipe-fitter/welder (A1), and a laborer (L1). J1 was the injured person. Common practice with this crew in the laydown yard was for the more senior journeymen to assume a lead role in executing daily work activities. As was briefly discussed that morning, the two journeymen were going to continue their welding activities while A1 operated heavy equipment to stage flanges to be welded, with L1 assisting as necessary.

One aspect of the welding work involved staging various-sized flanges on jacks or a welding table to allow tack-welding the flanges onto sections of pipe. On the day of the event, the crew was staging flanges on both jacks and a welding table to perform tack welding. Once the tack welding was completed, the journeymen completed the welding of the flanges to pipe sections and then these sections were transported to the basement for final installation in the cooling

system. None of the project IWDs specified what equipment was to be used to perform this staging activity or any other material handling or hoisting and rigging activities in the laydown yard.

Figure 3: JLG Telehandler Forklift.

The primary machine used to stage the flanges was a JLG Forklift Telehandler (or simply, the JLG forklift) that had been rented by CCI to conduct precision material handling activities (Fig. 3).

CCI had also purchased a JLG lifting hook attachment that could be affixed to the tines (also called "forks"). The attachment, which was designed solely for use with the JLG forklift, was secured to the forks with two solid metal safety pins that were held in place with cotter pins.

During interviews, CCI employees noted that the JLG forklift and associated lifting attachment were the preferred equipment for staging flanges in the laydown yard. The JLG forklift was preferred because it provided precise control, was relatively easy to use, and A1 and the journeymen had a good deal of experience using this forklift. There was no mention in the IWDs of the JLG forklift, the lifting attachment, the safety pins, or how they were to be used or stored.

The safety pins for the JLG forklift attachment, which were required to safely secure the attachment to the forklift tines, were not permanently affixed to the attachment (Fig. 4). When not in use, the common practice was to store the safety pins in a side compartment within the cab of the JLG forklift. A1, J1, and J2 indicated they frequently used the JLG forklift with the attachment to perform material handling activities in the laydown yard.

Figure 4: JLG Telehandler Forklift Attachment with Safety Pins Not Inserted.

CCI had also rented a Bobcat S450 Skid Steer Loader (or simply, "Bobcat") (Fig. 5), which they used to move materials and equipment for the project. The Bobcat had interchangeable forks and a bucket that CCI used as needed. Generally, the Bobcat with forks attached was used to move pallets loaded with materials or equipment, and the bucket was used to move earth. Multiple accounts from CCI employees and other personnel who were present in the laydown yard indicated that the Bobcat with forks attached had previously been used to perform material handling and hoisting and rigging.

Figure 5: Bobcat S450 Skid Steer Loader used on day of the accident.

Although not designed or intended to be used with the Bobcat, the JLG forklift attachment fit over the Bobcat's forklift tines. The crew in the laydown yard placed this lifting attachment onto the Bobcat's forks and used it to perform material handling activities (Fig. 6). According to eyewitness accounts, on previous occasions when the Bobcat was used for lifting flanges, the crew had secured the attachment with the safety pins that held the lifting attachment in place. A1, who operated the Bobcat, was qualified to use both the JLG forklift and the Bobcat. Employees who were familiar with both machines indicated that the JLG forklift had more precise- and smoother- controls and that the boom assembly was more versatile.

Figure 6: JLG Forklift Attachment on Bobcat with Safety Pins Installed.

At approximately 1:00PM on the day of the accident, the journeymen's tasks included tack-welding several 24-in.-diameter flanges to 4-in.-deep piping connections. This tack-welding was being performed in preparation for follow-on welding work. The tack-welding could be performed on welding tables or jacks, and each journeyman had their own welding table as they often simultaneously performed welding work. J1's metal welding table was about 39-in. high, had a rectangular top, and was equipped

with composite castors to allow it to be moved around the laydown yard (Fig. 7). The castors could be locked to prevent incidental movement.

Figure 7: J1's Welding Table and 4-in. piping connections.

At this time, the JLG forklift was not available in the laydown yard as it was being used across the street near the cooling towers. However, the Bobcat was available in the laydown yard and had the forks attached. The crew therefore used the Bobcat to perform the material handling necessary to stage and tack-weld the flanges.

Although the JLG forklift was across the street, the JLG lifting attachment was on the ground in the laydown yard. As was usual practice however, the safety pins for the JLG forklift attachment were stored in the JLG forklift. At this time, A1 then slid the Bobcat's forks into the JLG lifting attachment but did not retrieve the safety pins from the JLG forklift. The JLG forklift attachment was thus not secured to the Bobcat's forklift tines. L1 noted the absence of the safety pins, but A1 decided to continue without them. Using the Bobcat's boom, A1 inclined the forks to keep the lifting attachment from sliding off. [Note: All four members of the crew indicated that they noticed the absence of the safety pins that afternoon prior to the accident.]

To lift the 24-in.-diameter flanges from the pallet to the table or visa-versa, L1 needed to rig the flange to the hook of the JLG forklift attachment using a 1-in. rigging strap. The combined length of the attachment's hook, the rigging strap, the vertically positioned flange, and the height of J1's welding table meant the forklift tines of the Bobcat needed to be raised approximately 8 feet off the ground to allow the flange to clear the edge of the table. At this height, the forks were inclined. However, without the safety pins in place, it was important to control the angle of the Bobcat's forks throughout the lift to keep them inclined enough to keep the attachment from sliding off.

After retrieving the JLG lifting attachment, A1 and L1 proceeded to J1's welding table to remove a flange assembly that was still on the table. With the forks inclined, L1 attached a rigging strap to both the flange assembly and the hook of the lifting attachment. A1 then elevated the Bobcat's boom to raise the flange assembly off the table and placed it on a pallet on the ground. During this operation, A1 watched the forks to ensure they remained inclined to prevent the attachment from sliding off the forks. A1 and L1 then retrieved another 24-in. flange from a pallet, and with L1 performing the rigging, they placed the flange on J1's welding table. A1 again watched the angle of the forks to ensure they remained inclined while L1 performed the role of rigger to control the movement of the flange as it was placed flat on the table.

J1 and J2 used an arc-welder to tack-weld the 4-in. pipe sections onto the flanges. When the flange was initially staged on the welding table, the flange was situated with the seal-side face down and flush on the top of the metal welding table. To minimize the possibility of any damage to the seal from arcing between the seal face and the table-top during tack-welding, the

journeymen elevated the flange off the welding table about ½ in. with bolts. To accomplish this, the journeymen inserted four bolts through the loose-fitting, unthreaded holes in the flange seal with the heads facing the table. The bolts were not secured with nuts. According to the journeymen, the extra space that the bolts provided was sufficient to minimize the possibility of damage to the flange seal from arcing. The insertion of the bolts also ensured proper grounding during welding activities.

One technique to insert the bolts that was used by J2 (Technique 1) required the flange to be initially staged on the table so that a small area of the flange hung over the edge of the table. Following Technique 1, A1 and L1 staged the flange on the table with a small area hanging over the edge as depicted in Figure 8.

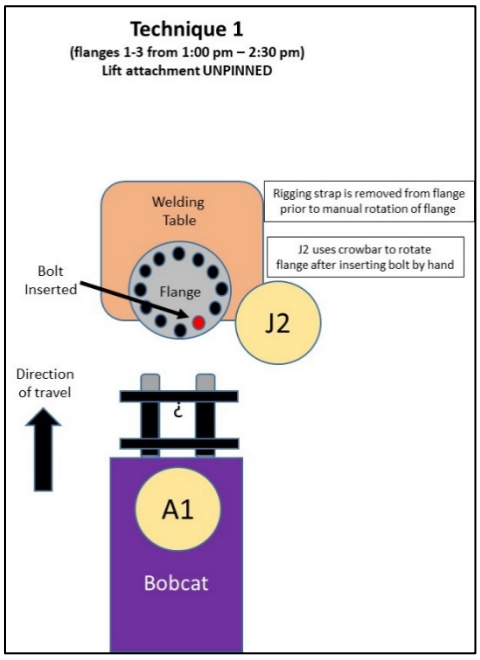


Figure 8: Technique 1 used for flange lifts 1–3 from 1:00PM–2:30PM.

After the flange was placed, L1 removed the rigging, and A1 moved the Bobcat away from the table. J2 came over to further position the flange for tack-welding. J2 placed a bolt through the flange seal where it hung over the table and, using a crowbar, lifted and rotated the 268-pound flange on the table until another bolt-hole hung over the edge of the table. J2 inserted another bolt and repeated this operation until he had inserted four equally spaced bolts in the flange. When finished, the flange rested on the heads of the bolts about ½ in. off the table top. Inserting the bolts and rotating the flange in this way took several minutes to complete. After positioning the bolts, J2 tack-welded the 4-in. pipe section to the flange and then left the table to continue welding on his own welding table.

When J2 finished tack-welding, A1 and L1 removed the flange assembly as they had done before and then placed a new flange on the table. Using Technique 1, A1, L1, and J2 repeated this process for two more flanges. Each time, A1 monitored the position of the tines to ensure they remained inclined, L1 assisted with the rigging and initial positioning of the flange, and J2 inserted the bolts in the flange and performed the tack-welding. According to eyewitness accounts, only A1 and L1 were present around the table during these lifts, with A1 using the boom of the Bobcat to raise and lower the flanges onto the welding table and L1 helping to guide the flange down and hold it in place as it lowered to position it correctly.

2.2.5 The Accident

At approximately 3:00PM, A1 and L1 prepared to stage a fourth 24-in. flange for tack-welding using the same lifting method and equipment as previously used. This would be the last flange-staging activity for the day, as the crew would need to clean their area before they left. Accounts indicated that J1 and J2 discussed a different technique than Technique 1 for staging the flange. This different technique would entail placing the flange on the center of the table rather than hanging over the edge and placing the bolts through the holes as the flange was being lowered.

This different technique would remove the steps of inserting the bolts one at a time and using a crowbar to rotate the flange on the table, which took several minutes.

At this point, there was no formally assigned lead for work in the laydown yard; however, J1 assumed a lead role in using this different technique to position the flange on the table. Unlike Technique 1, this different staging technique (Technique 2, Fig. 9) involved all four crew members: A1 operated the Bobcat, L1 and J2 controlled the movement and position of the flange as it was lowered onto the table, and J1 held onto the bolts. From the perspective of A1 in the Bobcat, J2 was on the left side of the table, L1 was on the right, and J1 was in front of A1 on the opposite side of the table.

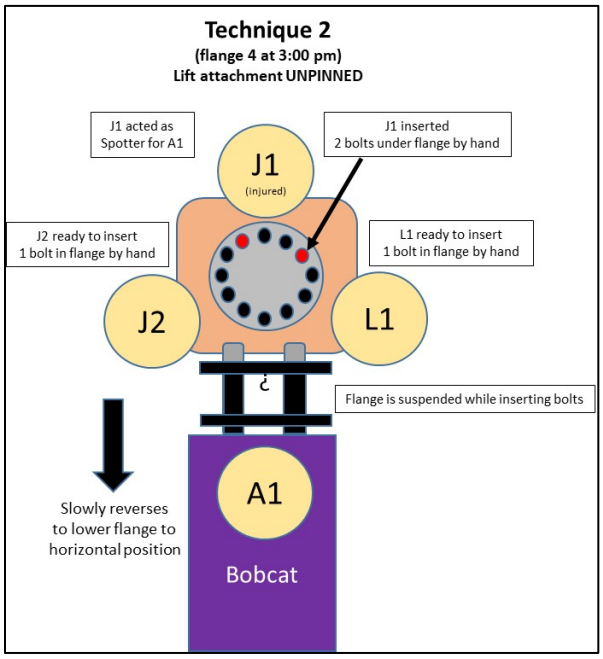


Figure 9: Technique 2 used for flange lift 4 at 3:00PM.

Using Technique 2, A1 began lowering the flange while J1 inserted two bolts through the flange holes as depicted in Figure 9. J1 held the bolts in place from above as the flange was lowered onto the table to eventually rest on the bolt heads. J2 and L1 continued to assist.

The four crew members were aware that the safety pins were not installed to secure the JLG forklift attachment to the Bobcat forks. As in the previous evolutions that day, there was no assignment of a designated spotter who would be responsible for continually monitoring the position of the tines while the crew was so close to the table and to the load. At this point, J1 was providing verbal instructions to A1 about the position of the flange as it was being positioned on the table.

At the beginning of this last lift, the forklift tines were approximately 8-ft high, and the forks of the Bobcat were inclined. However, as A1 lowered the flange with the Bobcat's boom, the angle of the tines gradually declined toward horizontal. Using Technique 2 required all crew members to focus on the position and placement of the flange. Consequently, their attention was more on the flange immediately in front of them rather than the tines overhead. In using Technique 2, L1, J1, and J2, and to a lesser extent A1, were all within the restricted work area boundary and under the load beneath the attachment's lifting hook (Fig. 10). J1 was also directly in the path of the JLG forklift attachment and flange.

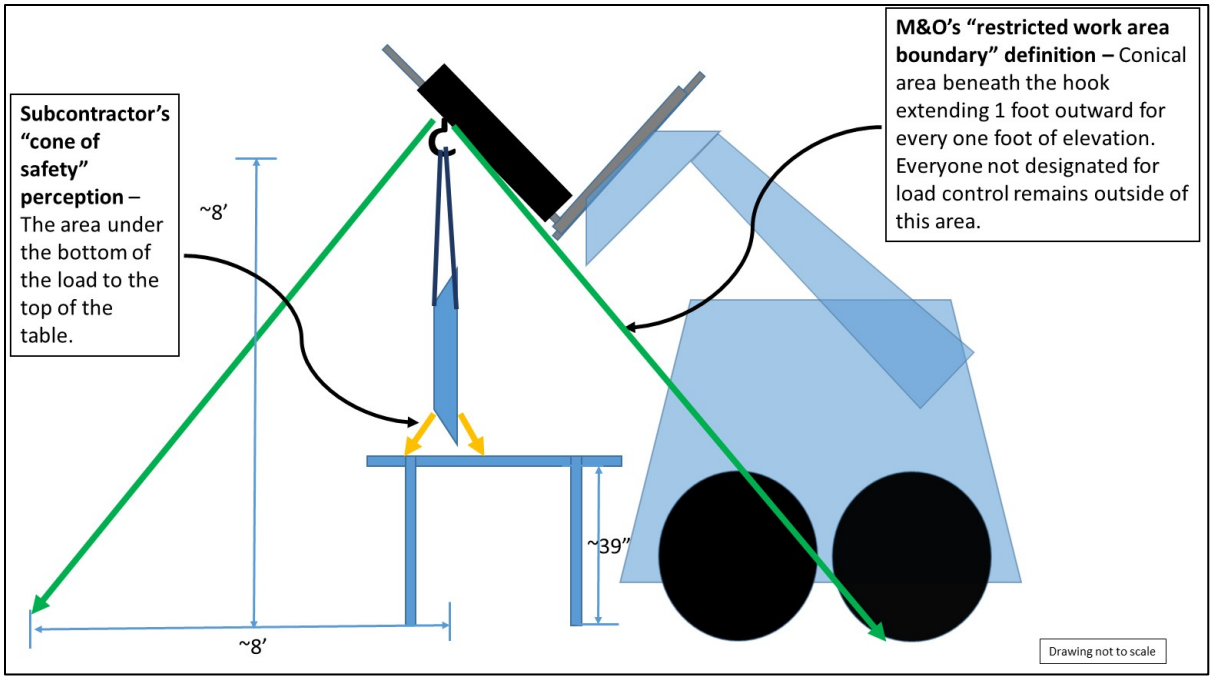


Figure 10: Diagram of restricted work area boundary for flange lift.

As the flange was getting close to lying flat on the bolts, J1 was leaning over the end of the table opposite the Bobcat, which positioned his arms, head, and upper torso above the flange but under the JLG forklift attachment. A1 continued to position the flange in the middle of the table and over the bolts by lowering the boom and slowly backing the Bobcat. When the flange was almost flat on the bolts, the 350-pound JLG attachment suddenly slid off the forks of the Bobcat and struck J1 in the face, arms, and upper torso (Fig. 11).

Figure 11: Welding Table with JLG Forklift Attachment and Flange after Accident.

Because all of the crew members were focused on the placement of the flange at the time of the accident, none of them could recall or explain exactly how the forks dropped below horizontal or how the attachment slipped off of the forks. A1 did not recall making any movements to the Bobcat controls that would have resulted in the forks suddenly shifting to a downward position. However, during the simulation following the accident, the operator for the simulation noted that the Bobcat controls were very sensitive and even touching the foot pedal that controlled the fork angle resulted in a sudden, jerky, downward motion. Absent clear recollections of the eyewitnesses at the scene, inadvertent tapping of the foot pedal could have caused a sudden response of the controls and caused the forks to unexpectedly tilt below horizontal, which could have resulted in the attachment sliding off the forks.

2.2.6 Responding to the Accident

Upon observing J1's injuries, A1 backed the Bobcat away from the table, lowered the forks, and turned it off. A1 then exited the Bobcat and held his hand on the portion of J1's face that was cut to hold the skin in place. A1 had J1 sit down on a chair near the welding table.

At approximately 3:06PM, L1 called 9-1-1, which is managed by Los Alamos Dispatch. J2 ran to the Project Office and notified the Project Superintendent of the event who then responded to the scene. L1 did not know the location of the laydown yard while on the phone with the Los Alamos Dispatch operator, and the responders were initially dispatched to the SCC building across the street from the laydown yard. Concurrently, an M&O Emergency Manager, who was the duty officer that day, overheard the 9-1-1 medical call, which was issued at 3:07PM, on the radio. He notified an Emergency Operations Support Center (EOSC) operator that he was responding to the scene.

At approximately 3:15PM, as the M&O Emergency Manager approached the laydown yard, an ECCCE Project worker flagged him to the yard. He entered the laydown yard from the south side and observed J1 sitting on a chair while A1 provided pressure with his unprotected hand to the face of the injured worker. Per Section F6.0, *Injury Reporting/First Aid/Medical Treatment*, of CCI's SSESHP, "at least one first aid kit will be present at the site at all times." Subsequent review found that a first aid kit was available in the transportainer located in the laydown yard. First aid kits were also available at each of the work locations (ECCCE Project field office, cooling tower transportainer, and the TA-3-2327 basement) as well as the CCI vehicles used by their supervisors. LANL first aid kits (#LA019050) include gauze, bandages, trauma pads, gloves, antiseptic wipes, and a biohazard bag. The Emergency Manager observed J1 was awake, breathing, and complaining of pain in both arms. The CCI Project Superintendent was on scene at the time. [Note: Although no First Aid kits were used by any of the work crew, the Board understands that there was a blood-born pathogen concern and the use of the First Aid kit should have been used to control the bleeding prior to emergency response arriving on the scene. However, this did not adversely affect the response to this accident.]

At 3:17PM, the Los Alamos Fire Department (LAFD) paramedics arrived on scene via an ambulance and began to tend to J1. The Emergency Manager began to take photographs of the accident scene. Once J1 was stabilized and loaded into the ambulance, the LAFD paramedics transported him to the LAMC for evaluation and treatment. J2 accompanied J1 to LAMC. The immediate area where the accident occurred was cordoned off by the Utilities and Infrastructure (UI) Facility Operations Directorate (FOD) on site at approximately 3:20PM, and pictures of the site were taken. At 3:30PM, the Emergency Manager cleared the scene and turned it over to the CCI Project Superintendent. Other events that occurred after the injured worker was transported to public emergency medical facilities were outside the scope of this investigation.

The CCI Project Superintendent notified the ECCCE Subcontract Technical Representative (STR) of the accident, who in turn notified the UI FOD Duty Officer. Notifications were also made to the ECCCE Project Manager and the Associate Laboratory Director for Capital Projects (ALDCP).

At 4:43PM, the UI FOD Designee initially categorized the event a reportable occupational injury under Group 2A (5), Report Level Low.

The EOSC operator made further notifications to M&O Occurrence Investigation, ES&H, and Occupational Health. The NA-APM Federal Project Director also made notifications regarding the accident but did not include NA-LA on the messages on the day of the accident.

The laydown yard is outside, exposed to the elements, and surrounded by temporary fencing for safety and protection of the work area. Upon learning that an accident investigation was to be performed, the UI FOD Representative secured the gates to the laydown yard at approximately 6:30PM and provided the key to the Project Manager in order to maintain and preserve the scene. With the exception that the Bobcat had been moved back and its forks lowered, the scene was left as it was at the time of the accident, including biomaterials that were within the laydown yard.

Later that evening, medical personnel airlifted J1 to the University of New Mexico Trauma Center in Albuquerque, New Mexico, for further evaluation. J1 was hospitalized until released on Saturday, December 22, 2018.

There were issues with the use of available first aid kits and being able to identify the location of the accident. However, the Board determined that these issues did not exacerbate J1's injuries or significantly affect the timing of the medical response.

2.2.7 Events Subsequent to the Day of the Accident

December 20, 2018

At 07:04AM, the Federal Project Director notified the Los Alamos Field Office (NA-LA) of the accident.

At 10:00AM, the UI FOD Designee held a fact finding where the initial event categorization was confirmed. There were approximately 60 people in attendance. Personnel in attendance included A1 and J2, CCI and M&O management, as well as NA-APM and NA-LA personnel. After the fact finding, the ALDCP paused all CCI construction activities on the ECCCE Project pending an accident investigation.

The M&O Subcontract Administrator and STR issued CCI a safety citation as a result of the accident. The safety citation indicated that this event was noncompliant with Exhibit F 1.12, "SUBCONTRACTOR shall perform work in a safe and compliant manner that ensures adequate protection for employees." The citation specifically cited that the security pins were not used to secure the attachment to the lifting equipment, which caused the attachment to slide off the forks striking a worker who sustained significant injuries. Similarly, on July 20, 2018, the M&O Subcontract Administrator and STR had issued a safety citation to CCI for an event that also cited noncompliance with Exhibit F 1.12. The previous safety citation specifically issued a stop work due to placing personnel in the "line of fire" during demolition, barricade issues and exterior site safety concerns. CCI developed a Corrective Action Plan (CAP) for each citation for M&O review and approval prior to the resumption of work activities on the ECCCE Project.

December 21, 2018

At 2:45PM, the UI Deputy FOD added the following reporting criteria to the event categorization:

- Group 2A (3), Report Level High. This was a conservative re-categorization as it was unclear at that point if J1's injuries would require in-patient hospitalization for five or more days.
- Group 10(2), Near Miss. Since J2 and L1, who did not experience physical injuries, stood on either side of the table and were exposed to the falling JLG forklift attachment and flange with no barriers in place.

NNSA and the M&O contractor commissioned a joint NNSA/Triad accident investigation board.

2.2.8 Project Restart

All CCI project operations remained suspended until formal, robust compensatory measures were developed and implemented by CCI and the M&O contractor. These measures included the following:

Pre-Start (all pre-starts have been completed)

1. Revised IWDs to eliminate potential inconsistencies, particularly in the area of "Use of heavy equipment for rigged lifts – material handling and rigging."
2. Mandatory Human Performance Improvement (HPI) briefings for CCI workers, Persons in Charge (PICs), Superintendents, Safety Supervisors, craft, and sub-tier contractors.
3. CCI and M&O laid out, by work-front, supervision coverage to ensure either the M&O and/or CCI personnel were present on all work-fronts.
4. CCI provided additional safety oversight and PICs.
5. CCI provided a documented plan to ensure the Bobcat will not be used for lifting activities with the JLG forklift attachment. The IWD was updated with this detail, and the equipment was labeled accordingly.

Post-Start and Ongoing

1. Augment the presence of ES&H personnel at the site by increasing the support of the M&O ES&H lead for the remainder of the project.
2. CCI will develop and implement a number of restart actions, including providing OSHA 30-hr training to workers, making IWDs more accessible to workers, ensuring that IWD requirements are incorporated into specific tasks, training all workers in using the Safety Task Analysis Risk Reduction Talk method for pre-job briefings.
3. Monitor and mentor CCI work activities and pre-job briefings.
4. M&O will conduct an assessment of subcontractor pre-job briefings, job-specific hazard analysis, supervisor/PIC, and rigging and heavy material handling contractual requirements to identify opportunities for improvement in current and future subcontracts.
5. Assign two additional construction oversight/mentors to the project for the duration of the restart period.

6. Clearly identify and assign daily oversight for all project areas.
7. CCI and M&O will hold a rigging and material-handling alignment session to clarify and agree on hoisting, rigging, and material-handling terminology and requirements. This session will occur before initial hoisting and rigging activities resumed on the project.
    - Hoisting and rigging activities will not resume until proper classification of lifts and the associated lift plans have been prepared and approved for each specific lift.
    - A gantry crane will be assembled and used in the laydown yard along with a new strategy/lift plan for tack-welding activities.
8. CCI, in conjunction with the M&O qualified person for hoisting and rigging, will verify that all equipment and devices used for lifting and material handling on the project met the requirements applicable to its intended use. Based on the outcome of the work site inspection on January 17, 2019, industrial lift plans will be required, prepared, and approved before proceeding.
9. CCI and the M&O will monitor CCI rigging and heavy material handling activities.
10. The M&O will document a Lessons Learned at the completion of the restart period to capture learning for application to current and future construction subcontractors.

The accident investigation scene remained under continual control from the time of the accident on December 19, 2018, through January 17, 2019. Extensive photographs and video footage were taken of the event scene after the accident. The only modification to the accident scene was that the JLG forklift attachment safety pins were retrieved from the JLG forklift and placed at the accident scene on December 21, 2018. No other changes occurred other than the removal of snow from the scene that occurred on January 17, 2019, in preparation for the Accident Investigation simulation. After completing tours and observing various accident condition simulations, the joint AIB released the scene to the M&O on January 17, 2019.

3.0 Accident Analyses

The Board used different analytical techniques to determine the causal factors of the accident, including barrier and change analyses and event and causal factors. Causal factors are the events or conditions that produced or contributed to the occurrence of the accident. The Board then assessed the causal factors, using them to develop direct, contributing, and root causes. The direct, contributing, and root causes as identified by the Board are included at the end of this section.

In turn, the Board developed conclusions (CONs) and judgments of need (JONs) that come from these identified causes. Table I, in Section 4.0 of this report, presents the JONs developed by the Board.

3.1 Barrier Analysis

Barrier analysis considers hazards that result in an accident or event. For an accident/event to occur there must be an exposure of the hazard to the target (worker) because the barriers or controls were not in place, not used, or failed.

- A hazard is the potential for unwanted energy flow to result in an accident or other adverse consequence.
- A target is a person or object that a hazard may damage, injure, or fatally harm.
- A barrier is any means used to control, prevent, or impede the hazard from reaching the target, thereby reducing the severity of the resultant accident or adverse consequence. Barriers are a part of a system or work process to protect personnel and equipment from hazards.

The Board reviewed multiple potential barriers, which may have kept this accident and its subsequent results from occurring. Appendix B contains a summary of those barriers and their effectiveness. As examples, this analysis identified potential barriers such as use of safety pins to secure the attachment to the Bobcat, identifying the position of the forks as the boom was lowered, effective work planning, and safety reviews of the task-level activities being conducted.

3.2 Change Analysis

Change is anything that disturbs the "balance" of a system from operating as planned. Change is often the source of deviations in system operations and can be planned, anticipated, and desired, or it can be unintentional and unwanted. Change analysis examines planned or unplanned changes that caused undesired results or outcomes related to the event. The process analyzes the difference between what is normal (or "ideal") and what actually occurred.

The Board analyzed multiple changes identified during the investigation. Appendix C provides a summary of those changes that the Board felt were applicable to this accident. The analysis identified several factors involving the use of pins, level of the forks, identification and

understanding of the hazards of the work, oversight, and identification of safer methods to conduct the activity. In this analysis, the board considered both the change from normal and ideal practices because the board felt that, even though the activity of lifting the flange to and from the welding tables had been conducted without incident in the past, the techniques used were not ideal and represented a series of deviations from preferred practices.

3.3 Events and Causal Factors Analysis

An events and causal factors analysis was performed in accordance with the DOE *Workbook for Conducting Accident Investigations*. The events and causal factors analysis begins with identifying the facts that are identified as events or conditions in place at the time of the accident. This analysis requires deductive reasoning to determine which events and/or conditions contributed to the accident. The analyses conducted by the Board are based on the events and conditions identified and the causal factors are then included on the Events and Causal Factor chart. A summary of the chart is located in Appendix D. Causal factors determined as direct, contributing, and root causes (as determined by the Board) are identified on the chart.

Please note the Events and Causal Factors Chart is meant to be a comprehensive reflection of the timeline. Not all of the items reflected on the Events and Causal Factors Chart are developed in the narrative in this report. However, the narrative developed was sufficient to fully support the causes, conclusions, and judgments of need.

3.4 Accident Conditions Simulation

At the beginning of the investigation, there were conflicting accounts regarding some of the basic events and conditions. Some of the conflicts included: How well the attachment could fit onto the Bobcat? Could the safety pins even fit into the slots when the attachment was on the Bobcat? Even if the safety pins had been inserted into the slots on the attachment on the Bobcat, could they hold the load because the attachment was not designed for the Bobcat forks? How easily could the Bobcat be controlled to accomplish precision lifts? How was the angle of the forks affected by movement of the boom of the Bobcat?

To address these and related questions, the joint AIB requested M&O Project and Craft Support to initiate an exercise to safely reconstruct activities related to the December 19, 2018, accident. On January 17, 2019, a series of condition simulations was conducted to simulate activities and actions under safely controlled conditions associated with the use of material handling equipment, riggers applications and handling of materials involved in the accident. The intent of this exercise was to observe and ascertain the following conditions and/or actions as directed by the joint AIB:

- Demonstrate that the JLG forklift attachment could be physically attached to the Bobcat forks.
- Demonstrate that the Bobcat with the affixed JLG forklift attachment and load (268-pound steel flange) could be securely held in place with the safety pins while

maneuvering the Bobcat through various positions and configurations (e.g., boom up, forks tilted, including adjusting the forks to be in a declined position).

- Evaluate the Bobcat controls to determine if use of the machine was appropriate for material handling jobs that required precision, such as lifting the flange onto a particular place on the welding table with personnel in proximity to the load.

The operation was performed under Integrated Work Document #632185-01 and lift plan that included the evaluation of the hazards with established controls and included the necessary steps to cover the scope of the Board's request. Because there was still blood on the equipment from the accident, the scope was expanded to include decontamination of the equipment for any potential blood-borne pathogens that resulted from the incident. The work was executed per the established plan in a safe and effective manner. The results and observations from the series of simulations included the following:

- The JLG forklift attachment could be attached to the Bobcat forks, and the safety pins could be inserted to secure the attachment to the forks. Observers noted that the insertion of safety pins required physical manipulation, as the clearance was limited.

- The JLG forklift attachment and flange were secured by the pins through various motions. Motions included lifting the flange from horizontal to a vertical position and vice versa, with the fork attachment in various configurations, including with the forks in a declined position, without any observable displacement of the attachment or the flange load.
- An anomaly was observed during a boom-down movement, as the Bobcat appeared to exhibit "jerky" movements that were unexpected. The simulation operator noted that the controls of the Bobcat were sensitive and that he only "touched" the foot pedal but the result was that the boom lowered in a jerky manner. This movement of the Bobcat forks was so dramatic that accident simulation observers initially thought the operator had intentionally actuated the foot pedal to have this effect. This simulation demonstrated that the Bobcat was not well-suited to perform this type of precision placement work.

The accident condition simulation showed the following:

1. The safety pins would secure the lifting attachment to the forks so it could not slip or slide off.
2. The JLG forklift attachment was not designed for use with the Bobcat.
3. Lowering the boom without continually correcting the fork angle causes the forks on the Bobcat to approach a horizontal plane.
4. Absent clear recollections of the eyewitnesses at the scene, inadvertent tapping of the foot pedal could have caused a sudden response of the controls that caused the forks to unexpectedly tilt below horizontal thus allowing the attachment to slide off the forks.
5. Lifting the flange onto the table with the Bobcat and JLG forklift attachment required the forklift tines to be approximately 8 ft above the ground. In this configuration, the technique used to stage the flange when the accident occurred meant that L1, J1, and J2, and to a lesser extent A1, were all in the restricted work area boundary under the load. J1 was also in the path of the JLG forklift attachment and flange.

3.5 Examination of the Evidence

3.5.1 Work Planning and Control

Effective work planning and control for activities at the job site should have commenced with the development of clear documents outlining the planning process at the beginning of the job. CCI developed a SSESHP and IWDs. If these documents had comprehensively laid out an approach to job/work planning, then the activity of lifting the flanges in the laydown yard would have been planned and formally documented as a procedure with specific steps, hazards, and required controls laid out. Any deviations from either the steps to conduct the activity or controls that should be in place to prevent mishaps would have triggered a pause in the work until the procedure could be followed or a safe alternative could be determined. Unfortunately, on the day of the accident, this process was not in place. Regardless of whether formal procedures were not in place, nor well communicated, anyone observing safety issues could have paused to evaluate work.

The concept for effective work planning by the M&O, including applying the principles of Integrated Safety Management (ISM) requires that safety measures flow down to sub-tier contractors. This flow down is achieved using the Exhibit F to the contract Request for Proposal (RFP), which drives the subcontractor to complete the SSESHP and work-specific IWDs. In response to Exhibit F, *Environmental, Safety, and Health Requirements for High or Moderate Consequence Work Construction, Demolition, Remediation, Maintenance, Repair or Service*, CCI developed a SSESHP and IWDs; however, these documents lacked specificity at the level to demonstrate thoughtful planning of the lifting activities that were occurring in the laydown yard on the day of the incident. Exhibit F contained several requirements related to Job Planning and Execution, including

- Holding supervisors accountable for providing and documenting informative daily pre-job safety briefings and ensuring site-specific safety requirements are communicated to each employee.
- Developing a consolidated set of clearly defined work tasks/steps linked to hazards and controls of sufficient detail to ensure that the work can be accomplished with all hazards and controls identified using an IWD.
- Linking work tasks/steps to the hazards and controls, and requiring a walk-down of the work activity to validate the tasks/steps, hazards, and controls that have been identified for implementation.
- Germane to the activity occurring at the time of the accident, Section 32.19 notes that, additional precautions must be taken when utilizing special hoisting and rigging application devices such as track-hoes with lifting attachments and forklifts with boom attachments. Such situations require a lift plan that outlines the procedures, hazards and controls associated with the operation

The SSESHP is the contract submittal document detailing how the subcontractor fulfills the Exhibit F requirements. The SSESHP does not have implementing procedures to describe subcontractor implementation for work planning. The IWDs that were developed were general in nature and did not contain procedures for welding activities that would address the hazards and

controls specific to the related tasks needed to stage the flanges for welding. For example, item 3 in the General Hazards IWD, Part 1 "Activity Specific Information", was intended to cover the "Use of Heavy Equipment for Rigged Lifts." A note in this section indicated that it covered material handling that occurred on a daily basis such as moving piping and large fittings. This should have included activities such as the movement of flanges that was occurring in the laydown yard. The controls noted included documenting the type of lift (even if it was not considered a critical lift), documenting the pre-lift meeting to ensure all participants had clear understanding of their responsibilities, reviewing hand signals, and performing a dry run prior to the lift to ensure that, "The lift can be accomplished as planned and all systems and controls are operable." The Board could find no evidence, either through multiple interviews or document reviews, that any of these controls ever occurred for the lifts that were performed in the laydown yard. Also, the IWD notes that Rigger and Operator qualifications training was required. However, training records provided to the Board indicated that the individual performing rigging the day of the accident was not trained or qualified to perform this function.

Part of the reason the controls in the IWD may not have been implemented is that CCI management indicated that the IWDs were intended to comply with contract requirements and that the document was not considered valuable for use at the job site. The IWDs are developed at the CCI corporate office with little or no input from the workers. Interviews with CCI employees confirmed that the only time they saw the IWDs was to review and sign them at the beginning of the contract.

Absent an effective activity-specific IWD that would have ensured safe lifting of flanges in the laydown yard, CCI management noted that they relied on daily meetings at the job site to discuss the work to be done. Their SSESHP states, "Pre task planning will be performed daily and more frequently as needed due to a change in the scope of work or the introduction of new hazards." Though pre-job briefing documentation from the day of the accident could not be found, the Board reviewed the plan of the day for previous days when similar work was conducted in the laydown yard. The *Daily Work Documentation Form* for the day before the accident has the entry, "Fabricate piping @ laydown yard," as the only reference to that work. The *Pre-Task Briefing Form* is supposed to be completed daily. The form includes several safety topics to be checked if they are applicable, and three columns at the top for Tasks, Hazards, and Controls. A *Pre-Task Briefing Form* from earlier in the week just before the accident was provided to the Board. The briefing has a number of topics checked, including 'rigging' and 'heavy equipment,' indicating that lifting activities occurred that day. However, the only task noted was 'Weld;' the hazards noted were 'burns, fires, debri (sic) in eyes; and the controls were 'wear PPE, use fire watch.' No mention was made in either the tasks, hazards, or controls related to rigging, hoisting, and lifting activities in the laydown yard. This briefing process appears to have been ineffective in planning activity related work such as those occurring the day of the accident. Therefore, neither the IWD nor meetings at the job site were effective in facilitating the job planning that needed to occur to ensure that activities in the laydown yard were performed safely.

The lack of clear planning guidance that allowed an activity like the flange-lifting activities in the laydown yard to be accomplished with no formal planning or standardized method was a primary factor that led to the accident. This activity was complex enough to require rigging of

the flanges and an attachment to be secured to heavy equipment, yet the work was done each time through a series of ad-hoc decisions that resulted in different machines and techniques being used, and ultimately different controls being in place. The lack of formality in work planning and control allowed a series of breakdowns to culminate on the day of the accident, including no standard procedure for conducting lifts, no consistent list of minimal controls (including safety pins) that were required to be in place, no designated spotter who was watching the operation and ready to intervene if abnormal conditions were encountered, and use of equipment that was contrary to recommendations from the manufacturer. The SSESHP, IWD, and pre-task briefing of how work was to be done were all ineffective in ensuring safe work planning and control, which resulted in the accident.

3.5.2 Risk Perception

Like many previous incidents throughout NNSA, the perception of risks played a fundamental role in this accident. This misperception was apparent on two levels: At the job site where the work was being performed and at the higher level where oversight of the work was supposed to be occurring.

The terms "hazard" and "risk" are often used synonymously. However, these terms have different meanings as a "hazard" is a potential energy source that when released through work conditions (a scenario) could cause harm, whereas a "risk" is the coupling of the likelihood and consequences of mishaps to characterize significance of accidents or losses. Those executing work in the laydown yard and those charged with overseeing that work did not have an accurate perception of either the hazards present or the associated risks they were accepting. An inaccurate risk perception led to missed opportunities for effective hazard evaluation, work planning and execution, and the need to pause work. Interviews with multiple personnel involved with either the execution or oversight of the work in the laydown yard indicated that they did not consider work there to be hazardous. The work that was being conducted, in their minds, involved welding by experienced personnel, who could easily and safely handle the routine associated activities that needed to occur. Collective ineffectiveness in recognizing hazards, understanding the risk, and responding to such awareness allowed continued work in unsafe conditions.

Though the activity that was occurring the day of the incident involved using heavy machinery, rigging, lifting a load of approximately 600 pounds (considering both the attachment and the flange), and setting it on a table, the job was not seen as hazardous and in need of additional controls. In contrast, project work in the basement of the SCC was the focus of extensive oversight and job planning, with some focus paid to the work that was occurring at the cooling tower. This perception of risks that was illuminated in interviews was also evident in the observation reports from subcontractor and M&O personnel in which comparatively few observations occurred in the laydown yard.

First, since the process for work planning and identification of controls was ineffective to ensure safe planning and execution of work in the laydown yard, then there was a complete reliance on the ability of the workers to make appropriate real-time decisions during actual work execution based on their knowledge, abilities and experience, which is often called the "skill of the craft." However, for this approach to be successful and result in safe work practices, there must be

hazard recognition and hazard appreciation so that steps to accomplish the work and controls that need to be in place are taken seriously. Also, there must be recognition of the need to pause work when abnormal conditions are encountered so that the situation can be re-considered and a safe path forward can be developed. Interviews with the CCI crew that were on the job site that day confirmed that their perception of the work in the laydown yard was that it was routine and not hazardous. This perception was demonstrated by their Pre-Task Briefing documentation, which noted that the hazards in the laydown yard consisted of burns, fires, and debris in eyes. There was no documentation or apparent appreciation of, the hazards of rigging the flanges, securing heavy equipment, and lifting the flanges on and off the welding tables.

As evidence of this mentality, consider the changes that occurred with the lifting activity that day in the laydown yard, none of which triggered a re-examination of the approach to the work. The Board does not consider the way that activity had been performed previously to be inherently safe; however, even taking that approach as a benchmark, consider the changes.

- The JLG forklift was the preferred heavy equipment machine to use for making lifts, but because it was being used elsewhere, the less-precise Bobcat was used. The Bobcat's controls were not conducive to making precision lifts like the JLG forklift was designed to do.
- The JLG forklift attachment was designed to be used with the JLG forklift. Yet, contrary to the manufacturer's recommendation, this attachment was placed onto the Bobcat.
- The safety pins were supposed to be used with the attachment. However, the day of the incident, they were across the road in the JLG and were not retrieved. Instead, CCI personnel felt they were safe as long as they simply paid attention and kept the forks of the Bobcat inclined. This final barrier to dropping the load was not sustainable (i.e., forks lowered below horizontal), and points to an unhealthy appreciation of the risks of working without controls at the job site.

Any one of these changes should have prompted a pause work and additional review, but they didn't because of the inaccurate perception that the crew on the ground had of risks. Some of these deviations from standard work practices had occurred previously, such as using the Bobcat instead of the JLG forklift shift from jacks to table, changes to bolt insertion, and new lifting steps. In this instance, the gradual accumulation of small accepted changes and additional risks became the overall norm for work steps as well as how work was planned. These deviations from the original norm became the currently accepted norm, which was not recognized as having greater risk. Thus, there were no indications driving change to safer work.

On another level, the same perception that the work in the laydown yard was not hazardous was shared by parties that were in a position to exercise oversight over the work. This mentality framed the way people viewed work in the laydown yard and why it received so little attention. Interviews and document reviews confirmed that subcontractor management and M&O staff charged with conducting oversight of safety viewed the work in the laydown yard as relatively safe and instead focused their attention on other work occurring in the SCC next door that involved lifting heavier equipment with cranes. The Board observed that there is a propensity to evaluate oversight needs on the uncontrolled hazards and risk with little effort to evaluate the veracity of controls leading to confidence that risk is managed. In this accident the oversight in

the basement was prioritized due to the fear of dropping a pipe even though many controls and oversight were stronger there. In the laydown yard, a drop of pipe was perceived as low hazard and low risk. Without adequate work-planning and -control, the residual risk at the laydown yard manifested as greater than in the basement. While a graded approach to oversight is appropriate, an inaccurate mental picture of what is actually occurring in an area leads to less-than-adequate oversight in areas where hazardous activities are occurring. Also, when oversight and focus is based more on geography (e.g., focus on the work in the basement of the building and not on work activities in the perceived low hazard laydown yard), then that mental picture becomes locked in. Hazardous work activities can still occur in areas that are more generally considered to be low hazard areas. When these activities occur, then oversight needs to shift to those areas, in this case the laydown yard, while these activities are being planned and executed. However, if the general assumption is that no hazards exist in an area like the laydown yard, at least relative to other work areas, then appropriate hazard evaluations and job planning are considered unnecessary.

As mentioned at the beginning of this section, this inaccurate perception of risks is not unique to this accident. This problem will likely only become more pronounced over time as resource limitations force the NNSA enterprise to rely on the graded approach. One example of this problem was documented in the Accident Investigation Board report of the accident of Site 9920 at Sandia National Laboratories that was released in January 2014.[1] In that accident, the Board noted that the team at the worksite had "accepted, and then executed, work that their existing hazards analysis and operating procedures did not address, without first analyzing the hazard and then identifying and implementing controls." One conclusion was that, "During the test activities, neither Site 9920 personnel nor the project team took a conservative approach to decision making." Another conclusion stated that, "Current Sandia Field Office (SFO) oversight approach does not ensure that every facility is visited. Graded approach for periodicity should not equal zero." In response to this last conclusion, the Board in that investigation developed the following Judgment of Need: "SFO needs to develop and implement a plan for oversight of *all* operations using a graded approach."

Many of the conclusions from that earlier investigation could apply directly. Performing work without analyzing hazards and implementing a true graded approach to oversight as opposed to a binary one where facilities considered to be high hazard have extensive oversight and those considered low hazard have essentially no oversight and themes that continue to recur. Unless NNSA can effectively address these fundamental recurring problems, we are unfortunately destined to continue having accidents due to these same causes.

3.5.3 Oversight

Although oversight might not have changed the direct events, effective oversight that engages workers and strives for honest accountability is likely to have increased everyone's awareness of expectations and improved use of processes supportive of safe behaviors and attitudes. For this investigation, oversight was considered in terms of roles, responsibilities and expectations to

[1] https://www.energy.gov/sites/prod/files/2014/03/f13/12-11-2013_FINAL_Sandia_Site_9920_AIB_Report.pdf

verify that Worker, Safety, and Health requirements were being implemented. Due to the nature of the work activities for the ECCCE project, the oversight roles and responsibilities include those: 1) specific to CCI and their safety professionals and line management, 2) specific to the M&O and their STR and ESH Deployed staff in the M&O Integrated Project Team, and 3) specific to NA-APM and their Safety professionals as part of the NNSA Integrated Project Team. The following sections describe the requirements that establish the oversight roles for each party, and an analysis of what the Board found related to these oversight activities.

3.5.3.1 Cross Connection, Inc.

Per the contract between CCI and the M&O contractor (Exhibit F, *Environmental, Safety, and Health Requirements for High or Moderate Consequence Work Construction, Demolition, Remediation, Maintenance, Repair or Service*) establishes the Environmental, Safety, Health, and Waste Management requirements for High or Moderate Consequence Work. Since this project is a construction project, it is considered High Consequence Work per the Exhibit.

Overall, CCI line management is responsible to ensure a safe and healthy workplace for all of their employees. This includes conducting effective oversight to ensure all work is conducted per the requirements of the contract and in a safe manner. Throughout the investigation, the Board identified various instances where there was a lack of overall effective oversight from CCI's line management. For example, CCI line management had a misconception that the SSEHSP and the IWDs were considered more contractual submittal obligations rather than valuable safety tools. CCI management can delegate authorities to their employees or contracted personnel, but this does not remove their oversight responsibilities.

To perform subcontract work at LANL, in addition to 10 CFR 851, CCI is required to comply with the M&O contractor's Worker Safety and Health (WSH) Program, environmental permits, agreements, orders, and waste management processes. Specifically, Exhibit F translates the M&O's 10 CFR 851 WSH plan into a set of requirements for subcontract work at LANL. Per Exhibit F, *General Requirements,* Section F1.2, CCI is required to develop a SSESHP for all subcontract work that it is awarded, including the ECCCE Project. This SSESHP is submitted to the M&O contractor for review and approval prior to issuing the Notice to Proceed.

Based on an analysis of the requirements in Exhibit F and the language in CCI's SSESHP, there were a number of gaps in the flow down of pertinent requirements. Examples of such gaps include the lack of any formal ISM System in CCI's SSESHP, as required in Section F11.0-F12.7. There was also a gap in information related to the use of special hoisting and rigging application devices, as required in Section F32.19.

With respect to the oversight expectations for CCI, there are several specific sections in Exhibit F that are germane to the investigation. Each of these sections has a subsequent Section in the SSESHP developed by CCI and approved by the M&O.

Section F4.0 – Subcontractor ES&H Representative Duties and Responsibilities

This section describes the requirements for CCI safety professionals for the duration of the project lifecycle. Different levels of competency may be selected based on the hazards and risks related to the project activities. For the ECCCE project, F4.0, Option B (ES&H Specialist) was selected and agreed to by the M&O and CCI.

Option B requires the following minimum acceptance criteria for the dedicated ES&H Specialist:

- Certified Associate Industrial Hygienist (CAIH) certification by the American Board of Industrial Hygiene, or Associate Safety Professional (ASP), Occupational Health Safety Technical or Construction Health Safety Technician (CHST) certification by the Board of Certified Safety Professionals or equivalent nationally recognized organization, or eligible for certification;
- An Associate degree (or equivalent) in safety engineering or industrial hygiene or an equivalent technical field;
- At least three (3) years of full-time work experience in the field of environment, safety and health.
- A minimum of 40 hours of formal environmental training in erosion control, waste management, or other environmental discipline, or pre-approved equivalent having other environment related training and/or job experience.
- Current training in cardiopulmonary resuscitation (CPR) and First Aid.

Through interviews and document reviews, the Board identified the dedicated ES&H Specialist identified for the project to have met the above requirements. Note that the subcontractor providing the CHST has strong experience working to M&O requirements and would reasonably be expected to fulfill oversight required by Exhibit F.

The dedicated ESH Specialist has various roles and responsibilities as defined in Exhibit F section F4.2-4.4. Roles include but are not limited to

- Managing the implementation of CCI's approved SSESHP, including review of integrated work documents;
- Pausing work and taking immediate actions, as necessary, to remove personnel from hazardous areas if the safety or health of CCI's personnel, other site personnel, or third parties is jeopardized by CCI's work activities;
- Interfacing with the M&O's ES&H personnel and the STR to resolve ES&H issues; provide hazard-specific training for new employees and orientations for visitors; and
- Continuously evaluating the site for any hazards not previously identified or adequately controlled, initiate measures required to protect personnel, the public and the environment, and revise documents accordingly.

Section F8.0 – ES&H Meetings/Pre-Job Briefings/Daily Briefings

From an ES&H oversight role, CCI is required to conduct ES&H meetings, to ensure all workers are aware of the potential hazards they may be exposed to and understand what controls are in place in order to eliminate or mitigate those hazards. Contract requirements also include applying Integrated Safety Management System to work activities.

Specifically, Section F8.5 in Exhibit F states:

> *[CCI] shall provide a daily briefing for its workers which specifically addresses the hazards and mitigating controls for work to be performed that day. This daily briefing or pre-task planning briefing shall be documented and made available to the M&O on request. Pre-task planning documentation shall be available at the work location and provided to the STR upon request.*

Workers present at the work site during the accident indicated that a pre-task discussion occurred that morning related to the welding activities they planned to conduct that day. Neither their superintendent, who was the designated Person in Charge (PIC), nor the ESH Specialist were present for that pre-task discussion. When asked what kind of hazards were discussed, the employees mentioned items such as, "wear safety glasses, hard hats, safety vests, and watch out for pinch points." No documents of the pre-task briefing for the day of the incident were provided; however, Pre-task documents from earlier days when similar work was conducted in the laydown yard did not indicate any hazards associated with rigging and necessary controls to ensure that material handling and lifting tasks were accomplished successfully. For example, on the Pre-Task Briefing sheet for December 15, 2018, though the boxes for "rigging" and "use of heavy machine" are checked, the only tasks to be completed was "weld" and the only hazards listed were "burns", "fires", and "debri (sic) in eyes."

As part of these welding activities, to prepare the material for welding, a material movement step was required. The welders need to lift a 24-in. flange from the pallet laying on the ground onto a welder's table to properly tack-weld a piping piece to the flange, before completing the weld. When asked during their interviews, if any material handling discussions occurred during their pre-task planning meeting, one worker recalled that they needed to pay attention to pinch points, but no discussion occurred about how to properly secure the load prior to movement, no discussion about having a dedicated spotter, and there was no discussion about other hazards associated with lifting the flange onto the table. Based on interviews and document reviews, the board concluded that CCI is not following their own SSESHP (Section F8.0) or Exhibit F Section F8.5 related to documenting pre-task briefings as well as not adequately identifying all the associated hazards and developing controls related to activities that are to be conducted.

The requirements of Exhibit F Section F32.19 were applicable to the material handling configuration for the lifting of the flanges onto the welding tables. Specifically, for [CCI] to utilize special hoisting and rigging application devices such as track-hoes with lifting

attachments and forklifts with boom attachments, the following minimum requirements must be met:

- Past year's maintenance records on the subject equipment and attachment (annual inspection by a qualified person);
- Documented training records of the operator on the specific equipment;
- Equipment and lifting attachment owners' manuals/specifications to assure of capacity/application and manufacturer authorization that attachment can be used as an assembly;
- Documented pre-use inspection which requires both a visual and operational check; and
- Lift plan that outlines the procedures, hazards and controls associated with the operation.

Although these requirements were applicable to the lifting activity related to this event, the SSESHP, the IWDs, or qualified CCI personnel determined this activity was not considered a lift, requiring the adherence to Exhibit F Section F32.19. In addition to CCI's role in staffing and overseeing their own implementation of safety requirements, the M&O reviews and approves the SSESHP and the IWDs prior to the Notice to Proceed. This includes a review by specific Subject Matter Experts to ensure appropriate and adequate flow down of requirements are documented. The oversight of the M&O personnel and CCI line management was inadequate to ensure the flow down of safety requirements from Exhibit F into the SSESHP or the job specific IWDs.

Section F9.0 – ES&H Inspections

CCI is required to conduct various types of ES&H inspections as defined in Exhibit F. Specifically, Section F9.1 notes that "CCI shall conduct and maintain records daily of initial, and other periodic inspections of the work areas to monitor compliance with ES&H requirements and provide a written report to the M&O STR" (see Attachment F9-1, *Samples of Inspection Checklist for Subcontractors*).

During interviews and documentation reviews, the Board identified that, although the ES&H specialist was using his company specific safety and health checklist as part of his daily walk-throughs, he indicated that he did not maintain any of his daily records or submit them to the STR, but instead would 'wipe them' clean at the end of each day. This is inconsistent with the Exhibit F Section F9.0, and with the CCI SSESHP, Section F9.0.

That the contracted CHST did not observe any evolutions of flange lifting activity, instead placing the majority of attention to the installation critical lifts in the building, also indicates significant misunderstanding of the roles of a safety representative. It also indicates that risk-informed decision making to allocate ESH resources was ineffectively applied. Finally, CCI employees in interviews indicated that they considered the laydown yard to be a 'low risk' work area, which likely was a factor in the low amount of attention that was paid to work occurring there.

3.5.3.2 M&O Contractor

The M&O personnel have various oversight roles and responsibilities. The STR is the primary technical oversight person responsible to ensure the subcontractor is abiding by the terms and conditions of the subcontract. This individual is the interface between and the subcontractor's line management. The M&O ESH Deployed Representative assigned to this project is the other primary oversight position and their job is to ensure the subcontractor is adhering ESH requirements defined in Exhibit F of the contract, as well as the sub-contractor's SSESHP and the IWDs. These roles and responsibilities are defined in three locations:

- P101-12, ES&H Requirements for Subcontractors,
- P850, Subcontract Technical Representative Procedure, and
- Exhibit F, Section F9.0 ESH Inspections.

The STR's role is to perform technical oversight of the subcontract throughout the lifecycle of the project. Responsibilities associated with this role include identifying any non-compliances with respect to Exhibit F, the subcontractor's SSESPH, and with any IWDs identified from the subcontractor. Per P850, Section 3.9.2a states that the STR responsibilities include determining if a subcontractor is completing work in accordance with the terms and conditions specified in the subcontract, including Exhibits D through I. The STR must document noncompliances in the Subcontract Field Files and notify the subcontractor in writing. Based on interviews and document reviews, the Board determined that Section 3.9.2a was not being adhered to in all cases as non-compliances with Exhibit F were identified but not documented and submitted. Examples of these noncompliances included observations of subcontractors walking/working at elevated heights without any fall protection equipment, and use of incompatible lifting devices (the JLG forklift attachment) per the manufacture with the Bobcat.

From an ESH Deployed Representative standpoint, the M&O contractor's expectation of these employees is to conduct oversight of the various aspects of the project related to the Exhibit F, SSESHP, and IWDs. The ESH Deployed staff have observation checklists they use during routine walk-throughs of the job sites that details roughly 25 different requirements to be evaluated. These include daily-brief records and observations, lift plans, and excavation shoring requirements. These requirements for oversight expectations are define in P101-12, *ES&H Requirements of Subcontractors*, Section 3.4, Subcontractor Oversight and Evaluation. Additionally, Exhibit F Section F9.0, ES&H Inspections, states the following:

> *"…[Triad] will also perform periodic inspections including compliance monitoring/sampling of the work areas and provide a written report to the STR who will communicate issues to [CCI]."*

Based on interviews and document reviews, the ESH Deployed representative adheres to the requirements of Section F9.0. The ESH Deployed Staff Manager indicated that, in addition to conducting staff's oversight inspections, they also conduct Management

Oversight Verifications (MOVs) of various project sites. They typically observes and documents projects with critical/high risk/consequence activities occurring.

Similar to CCI, interviews with M&O personnel indicated that they considered the laydown yard to be a 'low-risk' work area, which likely was a factor in the reduced amount of attention that was paid to work occurring there.

There were several oversight observation reports conducted by the ESH Deployed representative that indicated "daily briefing did not describe all of the activities" being conducted for a particular day. During follow-up interviews, the ESH Deployed representative recalled having verbal conversations with the superintendent about the gap between the daily briefing information and the activities being observed. However, there was no evidence of any noncompliances generated as required by the STR to document these issues that the ESH Deployed representative raised. Additionally, there was no evidence of real-time work planning and control actions taken related to the activities identified that were not discussed during the daily briefings. These work planning and control activities would have included conducting a real-time hazards analysis; discussing with the workers to ensure all hazards were adequately identified, understood and evaluated; adequate controls were identified to appropriately mitigate all hazards; and discussions to ensure that work was conducted within the controls identified.

Finally, the Board could find no evidence that the M&O contractor oversight had reviewed work practices in the laydown yard to ensure that all activities—including hoisting, rigging, and material handling tasks—were being performed in accordance with the SSESHP and IWDs.

3.5.3.3 NNSA

The NNSA Los Alamos Field Office (NA-LA) is the authorizing official for all work that occurs at LANL. NA-LA has an established Memorandum of Agreement (MOA) with NA-APM-1.5 that is specific for capital projects executed at LANL and that describes the Federal roles and responsibilities. This MOA states the following:

"The FPD [Federal Project Director] for each LANL [capital] project is the primary contact between federal and contractor staffs for all matters relating to the project and its performance, and serves as the Contracting Officer's Representative for the project."

The MOA states that the Director of the NA-APM-1.5 has a dedicated full time Project Office staff (including the FPDs) that perform project management and oversight responsibilities and that each FPD can charter an Integrated Project Team (IPT) composed of highly qualified professionals from across the enterprise to assist with project management and oversight responsibilities.

The MOA also states that NA-LA is an integral part of these IPTs and retains some specific responsibilities that provide support such as security, safety basis review and approval, and several other areas. Specifically, the NA-LA Field Office Manager also serves as the NNSA line management and site-level mission integrator for activities at LANL on behalf of the NNSA Administrator and Deputy Administrators for Defense

Programs, Nuclear Non-Proliferation, and Defense Nuclear Security. The NA-LA Field Office Manager serves as the Federal start-up authorization authority and safety basis approval authority for NNSA to execute mission requirements and ensure adequacy of security and safety controls.

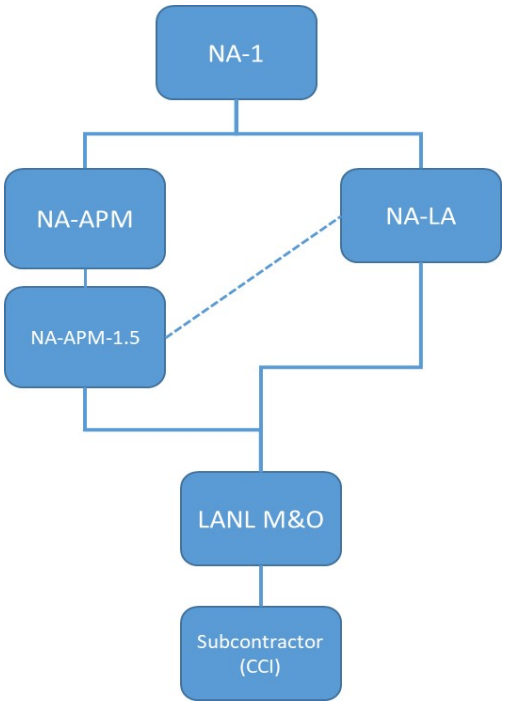


Figure 12: Flow down of oversight from NNSA to the subcontractor.

Figure 12 displays the flow and relationship of oversight from NNSA to the M&O contractor to the subcontractor.

The NNSA ECCCE Project Execution Plan (PEP) defines the role of Federal oversight in ensuring that ES&H requirements are developed, flowed down, and overseen by the project. Safety and health activities are planned and implemented over the full life cycle of the Project to ensure that the design incorporates features that demonstrates that the facility can be built and operated in a manner that protects workers, the public, and the environment. The integration of safety requirements into the project are driven by DOE O 440.1, *Worker Protection Management, for DOE Federal and Contractor Employees,* and applicable Code of Federal Regulations (CFR) 10CFR851, *Worker Safety and Health Program*. The *LANL ISM System Description Document* (SD100) embeds 10CFR851 and DOE O 151.1D, *Comprehensive Emergency Management System*, collectively.

Existing and approved M&O procedures are in place for self-performed work and serve as a basis for managing subcontractor safety and performance. For the M&O subcontracted work, P101-12, *ES&H Requirements for Subcontractors*, is flowed down to the subcontractor through Exhibit F. Therefore, NNSA's oversight related to ESH requirements is ensuring that the M&O is properly executing their various systems, policies and procedures to ensure adequate and appropriate flow-down of requirements to the subcontractor.

During the interview, the NNSA-APM FPD indicated responsibility for design, construction, environmental, safety, security, health, and quality efforts and complying with the contract, public law, regulations, and executive orders, consistent with the defined roles in the PEP. The FPD indicated that they conduct frequent management walk-throughs along with other Federal staff on the IPT, i.e., the Safety Professional who conducts more-specific safety-related inspections of the job site and activities but ensures that the interface between NNSA and CCI is through the M&O STR, who is the appropriate communication line. Six months of Safety Observation Checklists from the IPT members were provided for this project as proof of the observations. Also, similar to

CCI and the M&O contractor, NNSA personnel considered work in the laydown yard to be relatively low risk.

Overall, with respect to requirements flow down and oversight, there is an expectation by NNSA and the M&O contractor that

1) Based on the Exhibit D Scope of Work, all of the necessary and appropriate ESH requirements are properly identified and documented in the Exhibit F for each subcontract that occurs at LANL.
2) Each awarded subcontractor develops a comprehensive SSESHP and corresponding IWDs that adequately flow down all requirements of Exhibit F, document all of the requirements, and identify all of the hazards and corresponding controls related to all project work activities.
3) Exhibit F, Option A or Option B, requires the subcontractor to hire and maintain a dedicated ESH representative full time on the project to ensure the subcontractor implements and administers the requirements of the subcontractor's SSESHP along with all of their IWDs. (This project used Option B.)
4) Therefore, the M&O's oversight resource-loading is reduced based on the Option A or B process, and oversight is primarily focused on high-hazard work activities since the full-time ESH representative is expected to implement the requirements of the SSESHP and IWDs, which covers all risk areas and all activities.

For the specific project, the Board found the following:

1) Exhibit F comprehensively described the majority of the requirements necessary for the execution of the project but with clarification in some sections needed (e.g., F32.0 clarification for lift determinations/definitions)
2) The awarded subcontractor's SSESHP and IWDs were more high level, were not used as activity-level work control documents, and did not adequately flow down the requirements within Exhibit F appropriately, which was not identified or mitigated by the M&O contractor's review and approval process (e.g., Exhibit F1.12, F9.0, F32.19).
3) The CCI ESH Specialist would conduct condition reviews of work areas (PPE, fire extinguisher checks, housekeeping inspections), but their inspections of actual work activity and work specifically in the laydown yard were limited because they were not considered hazardous activities.

NNSA oversight activities did not emphasize effectiveness of M&O's oversight of CCI's implementation of work-planning and control requirements such as Exhibit F, SSESHP, IWDs, and implementing practices. NNSA's and the M&O contractor's expectations were not being followed, as oversight in the laydown yard where the accident occurred was insufficient. Additionally, NNSA and the M&O contractor were not effectively aligned with appropriate staffing to ensure subcontractor performance to the project's safety requirements.

3.5.4 Contract Process and Safety Expectations

For capital projects at LANL, several requirements must be followed to perform activities safely and compliantly that originate from National Codes and Standards and DOE Orders, as well as good operating practices. The M&O process for hiring a competent subcontractor must ensure the flow down of these requirements from the onset of the procurement process all the way through safe performance in the field.

As noted in the Oversight Section, the process to select a competent subcontractor starts by specifying the various contractual requirements within the Request for Proposal (RFP). The Safety Requirements are specified within Exhibit F, *ES&H Requirements*. LANL uses an Exhibit F template to specify the minimum safety requirements for a typical scope of work that is tailored to create a project-specific Exhibit F that is submitted in the RFP.

After proposals are submitted and evaluated, a contract is awarded to the successful subcontractor. Before executing the contract, LANL personnel meet with the subcontractor and perform a "Contract Page Turn." At a minimum, the LANL review team consists of the Contract Administrator, the STR, and various Subject-Matter Experts (SMEs). This process is a review of each of the contract requirements to ensure the contractor fully understands the requirements prior to signing the contract (Fig. 13).

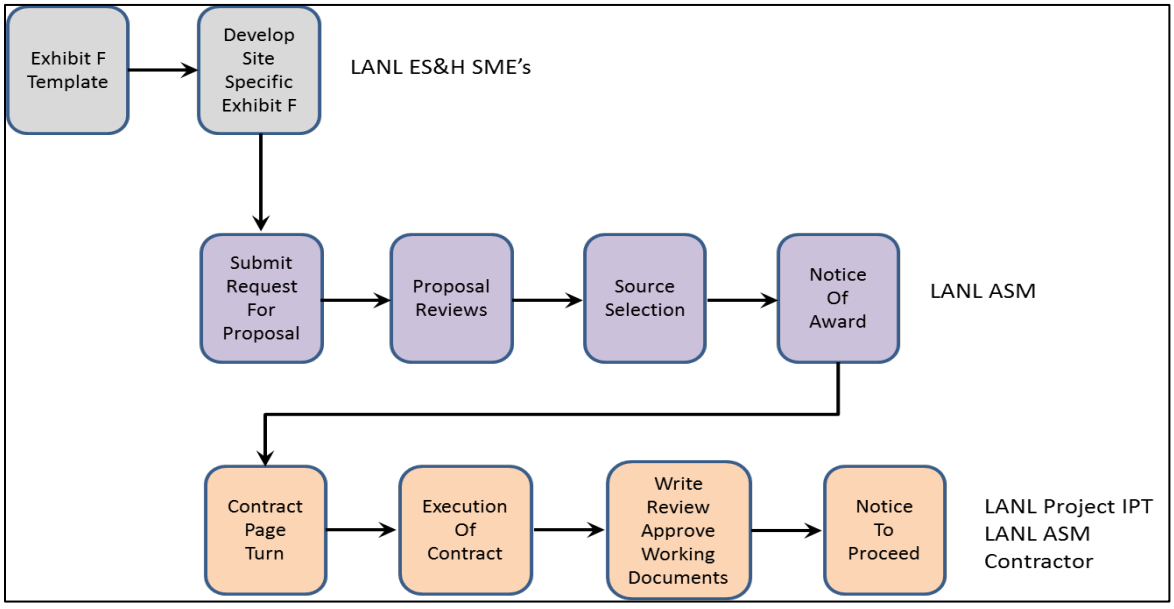


Figure 13: Flow down of safety requirements through Exhibit F.

Following contract execution, the contractor is responsible to produce its SSESHP and various IWDs. These working level documents describe their process to safely complete the scope of work while compliantly meeting the requirements defined in Exhibit F. The review and approval processes are followed with the LANL review team until all of the subcontractor's documents have satisfied the Exhibit F. Once achieved, the Notice to Proceed is given to the subcontractor to commence work.

The investigation team reviewed this process, looking for any indication that flow down of requirements contributed to the event. Numerous interviews and document reviews were conducted by the investigation team.

- The Board concluded that several areas need improvement to ensure future Exhibit F requirements are completely captured in the working-level documents. In some instances, the statements in Exhibit F were contradictory. Also, language in the Exhibit F, including Lifting and Rigging requirements, was not specific enough and led to an incorrect interpretation by CCI. As an example, the contractor did not interpret the activity of hoisting the flanges onto the welding table as a "Lift" that would require additional administrative controls or oversight although the activity (as performed) required an attachment to be secured to the Bobcat. The Board also noted that there is not a Compliance Matrix to ensure the working-level documents capture all Exhibit F requirements.
- Based on interviews and document reviews, the Board concluded that some requirements were not sufficiently clear for the subcontractor to adequately address to meet the M&O expectations. The STR review team supporting the subcontractor to guide SSESHP development and answering ongoing questions did not recognize the gaps between M&O expectations and what the subcontractor thought were appropriate implementation measures. A more-thorough evaluation of the SSESHP could have identified gaps and resolution. The first STR-approved SSESHP (5/2/2018) addressing Exhibit F, February 2018, was largely devoid of Section F32, *Hoisting and Rigging Requirements*. The SSESHP does not reference any other subcontractor procedures, forms, or reference material necessary to manage the work safely.

3.5.5 Resolution of Previous Incidents

At 4:45PM on Wednesday, July 18, 2018, during removal of sheet metal from a plenum with an aerial lift in the basement of the SCC, a piece of angle iron weighing over 100 pounds fell approximately five feet before striking the hard hat of a CCI employee (E1). E1, who was part of the demolition crew, stood at floor-level, accepting sheet metal panels and performing cleanup activities. CCI management immediately paused work, and E1 obtained medical services at a hospital later that evening. After treatment, the employee was released to return to work on Monday, July 23, 2018, without restrictions.

Following the event, the Deputy UI FOD tasked the M&O Occurrence Investigation Team to conduct an investigation and a causal analysis of the event and to identify the direct, contributing, and root causes.

- Contributing causes to this event included inadequate Job Scoping and Hazard Analysis and a Pause-and-Stop-Work process. The investigation found that the IWD 464124-05 "*Demo of the Air Handlers, as well as Sheet Metal and Gypsum Board Plenums and All Associated Activities"* did not identify specific work-site conditions and how to address those changes safely. In addition, P101-18, *Pause/Stop Work*, policy had not been used when the new condition was reached in the work and was not well understood by the workers.
- The root cause of the event was Project/Work Oversight. CCI employs a full-time ES&H professional that was observing other work during the time of the incident and had not noticed the safety hazard that was presented with the material handling. Therefore,

management direction created insufficient awareness of impact of actions on safety/responsibility.

After the causal analysis, CCI was tasked with creating a CAP and Controlled Restart memo to address the causes identified in the causal analysis. Noted in the CAP, CCI briefed all personnel on how to look for and identify hazardous conditions when conducting work. In addition, CCI management was to engage each worker at each location and have those workers state the hazards identified with their specific site. Finally, when it came to material lifts, all workers would observe a "cone of safety" to prevent a reoccurrence. These discussions and observations were to be documented and sent to the STR. All these documents were prepared and signed by the CCI president, Site Superintendent, and ES&H representative. In addition, the documents were signed by the M&O Safety Representative, project STR, and UI FOD representative.

The Board found that the lessons from this previous incident had not been adequately applied to the rest of the worksite, as many of these conditions were present in the laydown yard on the day of the accident. Workers did not effectively identify hazardous conditions, worked within the unsafe zone under the load, and were in the line of fire of the unsecured load (both attachment and flange). In addition, the M&O contractor did not perform an Effectiveness Evaluation to verify the sustainable effectiveness of the actions from the CAP.

3.5.6 Integrated Safety Management System and Human Performance Review

3.5.6.1 Integrated Safety Management System

The principles of ISM and Human Performance that led to this accident are discussed in specific sections of this report, most notably in the Work Planning and Control and Risk Perception sections. The accident was the result of a breakdown of all aspects of ISM. In particular, there was no identification of hazards, implementation of controls, or performance of work within controls. The unmerited assumption by the M&O contractor that the safety requirements developed early in the contract process were being effectively implemented in the actual work activities, the failure of the subcontractor to develop and implement such processes, and the lack of appreciation of the actual hazards of conducting the lifting activities in the laydown yard combined to cause this accident.

The DOE Acquisition Regulation (DEAR) 970.5223.1, *Integration of Environment, Safety, and Health into Work Planning and Execution*, defines the requirements for the M&O contractor to implement related to ISM for all levels of work activity at LANL, including subcontracted work. Exhibit F, as part of the flow down of requirements, identifies in section F1.12 the following:

> *The M&O is committed to implementing an Integrated Safety Management System and Environmental Management System that promotes the M&O's core values and the principles set forth by the Department of Energy [DEAR 970.5223-1 2000].*

However, during the review of the CCI SSESHP, the CCI IWDs, various work control documents, as well as during interviews, the Board concluded that ISMS guiding principles and core functions were not fully implemented and there had been no record that ISM has

been evaluated at the subcontractor level by the M&O. Specifically, weaknesses were identified in the following ISM Guiding Principles and Core Functions:

- *Guiding Principle 1 - Line Management is directly responsible for the protection of the public, workers, and the environment*: The top-level line managers were not leading advocates of safety and did not demonstrate their commitment in both word and action. Evidence that their walk-throughs to verify that their expectations were being met were not found in the laydown yard, as described in the Oversight section of this report. Additionally, the misconception that the SSESHP and IWDs were contract obligations versus actual working-level safety documents leads to this breakdown as well.
- *Guiding Principle 2 - Clear and unambiguous lines of authority and responsibility for ensuring safety is established and maintained at all organizational levels:* The CCI organizational safety responsibilities were not sufficiently comprehensive to address all work activities and all hazards involved. This is further discussed in the Work Planning and Control and Oversight sections of this report.
- *Guiding Principle 4 - Resources are effectively allocated to address safety, programmatic, and operational considerations. Protecting the workers, the public, and the environment is a priority*: CCI did not recognize that aggressive mission and production goals could appear to send mixed signals on the importance of safety. They did not appear sensitive to detect and avoid these misunderstandings, or deal with them effectively if safety issues were identified or raised. Also, the CCI organizational staffing did not provide sufficient depth or redundancy to ensure that all safety functions were adequately performed. This is further discussed in the Work Planning and Control and Oversight section of this report.
- *Guiding Principle 6 - Administrative and engineering controls to prevent and mitigate hazards are tailored to the work being performed and associated hazards*: There were breakdowns in the safety analyses identifying work hazards, as they were not comprehensive, at times left up to non-safety personnel, and there was a lack of sound engineering judgment and data. The Work Planning and Control and Oversight sections of this report provide examples of these breakdowns.
- *Guiding Principle 7 - Operations Authorization – The conditions and requirements to be satisfied for operations to be initiated and conducted are clearly established and agreed upon*: The work authorization process at the activity level was inadequate in verifying that appropriate preparations had been completed so that work could be performed safely. Examples of these are discussed in the Work Planning and Control and Oversight section of this report.
- *Core Function 1 - Define the Scope of Work – Missions are translated into work, expectations are set, tasks are defined and prioritized, and resources are allocated*: There were clear breakdowns in ISM where the scope of work is insufficiently defined in order to identify and address all types of hazards. The Work Planning and Control and Oversight section of this report describes these breakdowns in detail.
- *Core Function 2 - Hazards associated with the work are identified, analyzed and categorized*: Hazards analysis methods were not applied to all types of work, and

when they were conducted, they were lacking sufficient detail, which resulted in not having the proper controls for the actual hazards of the activity. The Work Planning and Control and Oversight sections describe examples of this breakdown.

- *Core Function 3 - Develop and implement hazard controls – Applicable safety standards and requirements are identified and agreed-upon, controls to prevent/mitigate hazards are identified, the safety envelope is established, and controls are implemented*: There appeared to be no method or process to recognize the hierarchy of controls and integrate those controls into work planning. Additionally, as discussed in various sections of this report, not all work activities were adequately defined, evaluated, or analyzed to ensure all hazards were identified in order to implement the appropriate controls.
- *Core Function 4 - Perform work within established controls – Readiness is confirmed and work is performed safely*: As described further in the Risk Perception and Work Planning and Control sections, there was a clear breakdown in the work crew as they continuously work outside of the 'established' controls for the work activity related to the event.
- *Core Function 5 - Provide feedback and continuous improvement – Feedback information on the adequacy of controls is gathered; opportunities for improving the definition and planning of work are identified and implemented*: There was a clear breakdown in this area, including the lack of any extent of condition review after the previous material handling angle iron event to identify and evaluate all lifting activities for the project. Opportunities were missed for improving work execution and planning due to abnormal conditions the work crew continued to encounter but never paused to properly understand, evaluate, identify and control the hazards and controls when changes to the work activity occurred.

3.5.6.2 Human Performance Review

The Human Performance considerations of this accident investigation were undertaken per DOE Handbook 1028-2009, *Human Performance Improvement Handbook*, Volume 1, Section 1-14, *Anatomy of an Event*. It was determined during the inquiry that among the initiators were a number of individual actions (active errors) in which personnel at several levels departed from expected behaviors, thus meeting the very definition of "human error." As is common in complicated events such as this, at times the crew unintentionally took actions that departed from standards they were aware of, and at other times their efforts failed to meet standards that they did not know of due to deficiencies in management control processes and values.

Specific examination of human factors and their direct relationship to other project deviations and failed barriers can be found in Appendix B- Barrier Analysis Worksheet, and in Appendix C – Change Analysis Worksheet. Here we will discuss those factors that were deemed by the Board to be the most prevalent and to have the most significant impact on the event.

Human Error Precursor and Flawed Defenses (Barriers) Analysis

The Board determined that the human error precursors and flawed defenses associated with worker-specific aspects of this accident related to the decisions and actions taken relating to peer interactions (questioning and coaching), questioning attitude, pre-job brief performance, and recognition of risk. Leader deficiencies revolved around failing to promote error reduction and risk management within the work control and fieldwork execution aspects. Leaders failed to foster an error-reducing culture and often did not recognize when performance failed to meet established standards.

Throughout the day of the event, each of the crew recognized that the pins required to secure the lifting attachment to the forks were not installed, but failed to address the deficiency. Some workers felt that the operator of the Bobcat could sufficiently control the hazard of the device falling from the forks, others did not raise the concern due to an unwillingness to question the actions and behaviors of the more-senior members of their crew. The absence of these pins throughout the day is a significant symptom of an organizational culture that was inadequate to prevent errors overall. This culture was driven by multiple precursors at the individual contributor level, including tunnel vision, inaccurate risk perception, and habit patterns. Workers knew the pins were missing, but did not appreciate the increased risk and felt they could adequately control the hazard via application of worker skills and attention. Their focus was upon what they viewed as "the task," the end goal of weld completion, rather than on the supporting tasks required to achieve it.

Organizational defenses (barriers) that, if used appropriately, could have prevented the errors from leading to the event included Supervisory field presence, coaching, the establishment of error reduction and risk management as priorities, and promotion of a self-critical culture among the workforce. An environment strongly accepting of work pauses or stop work would have been valuable. Fundamentally, leadership viewed performance from a results-oriented perspective and reinforced behaviors in the field accordingly. Success was considered as the completion of work product with quality, with inadequate consideration of how the steps are taken to achieve that end are performed. Behaviors and habits that placed workers at risk were not noticed or corrected by leadership. Work planning and control were considered to be a contractual necessity, rather than a tool to be used directly by field workers. Planned controls were not carried forward to the workers for field implementation, and specific procedures to be followed were not embedded in the documents that were in the field in the hands of the workers.

Human Performance Tool Use Analysis

Presence of error precursors and weak programmatic and administrative defenses were not the only Human Performance weaknesses contributing to the event. While the Board identified that Peer Checking and Peer Coaching were present regarding successful weld completion, which was the primary measure of "successful performance," aspects of their work considered less important often lacked this peer checking and coaching function. This entailed tasks such as material handling, safe and repeatable setup for repetitive tasks, and individual worker safety behaviors.

Further, individual workers either did not feel compelled or did not feel it was appropriate to question more senior workers or their in-field supervision (foreman). Pre-Job briefs were not adequate to identify and mitigate error traps in work being performed for several reasons. Hazards discussed in the pre-job brief typically focused on the goal of welding, and hazards identified were direct hazards rather than precursors. As an example, the crew regularly discussed the risk of fires but did not often review supporting steps such as movement of equipment and materials or discussion of error precursors. Pre-job briefs had become rote to some degree, citing the same job site hazards with regularity, e.g., "pinch points, trip hazards, the usual stuff" were called out, and a common mitigator was to "be careful." Potential consequences and recovery methods were not discussed because the crew did not consider a significant event to be a likely occurrence. The primary cause of this weakness in consideration of precursors, consequences, mitigators, and recovery is the lack of crew familiarity (via training and practice) with the identification of traps and application of effective tools to prevent falling into them. This function would have been better served by employment of a more robust pre-job brief model such as the "S.A.F.E.R." brief, a nuclear industry and LANL "best practice" for low- and moderate-risk tasks. The S.A.F.E.R. brief is designed to move the mindset of the team from learning into verifying, and to help the crew focus more concisely on the work steps required to assure proper performance. A pre-job brief following the "S.A.F.E.R." model or similar would have helped the team to **S**ummarize the actual tasks or critical steps being performed. Workers would then discuss **A**nticipated error precursors (traps), **F**oresee the potential consequences of those errors should they come to pass, **E**valuate tools to mitigate the pitfalls and recover from mistakes should they occur, and **R**eview previous failures (lessons learned) to understand how those events related to the evolution at hand. Neither leadership nor safety personnel recognized these pre-job brief deficiencies and therefore could not correct them.

3.6 Causes

The Board determined the following causes of the accident.

Direct Cause (DC) – the immediate events or conditions that caused the accident.

DC: The unsecured forklift attachment slipped off the forks of the Bobcat and struck Journeyman 1 in the face, arms, and upper torso causing serious injuries.

Root Cause (RC) –causal factors that, if corrected, would prevent recurrence of the same or similar accidents.

There were two enablers to safely plan and accomplish task-level work activities, such as lifting and handling the flanges: Effective work planning and control processes, and in the absence of that, effective hazard recognition by the work crew such that appropriate decisions could be made when abnormal conditions were encountered during actual work execution. Both of these enablers failed. Therefore, the Board identified the root causes of this accident to be:

RC-1: CCI management systems did not establish effective processes for work planning and control in the laydown yard to ensure worker safety.

RC-2: CCI did not ensure job specific hazards were recognized, appreciated, and addressed during work execution.

Contributing Causes (CC) – events or conditions that collectively with other causes increased the likelihood or severity of an accident but that individually did not cause the accident.
Inadequate oversight to catch and correct safety problems manifested by the root causes and the lack of an effective system to ensure that safety requirements flowed down through the sub-contract process to the actual work execution both contributed to this accident. Therefore, the Board identified five contributing causes to this accident:

CC-1: Tasks were performed inconsistently and without necessary safeguards in place, especially during recognized abnormal conditions.

CC-2: Work planning and control, including application of lessons learned, was inadequate for specific tasks.

CC-3: CCI management viewed the development of safety documents to be more of a contractual obligation than a tool for the safe conduct of work.

CC-4: Ineffective oversight by CCI, the M&O, and NNSA missed opportunities to observe and/or correct potentially unsafe or abnormal work practices and ensure effective work planning and control for all work in the laydown yard.

CC-5: Ineffective flow down of contract safety requirements to CCI's safety plan, work control documents, and actual work practices.

4.0 Conclusions and Judgments of Need

In summary, the Board concluded that the likelihood of this accident would have been greatly reduced if:

- More robust and structured work management systems had been implemented and overseen, and
- Job specific hazards had been better recognized, appreciated, and addressed during work execution,

Further details on Conclusions and Judgments of Need are provided in Table I.

Table I: The Conclusions and Judgments of Need as determined by the AIB

Conclusions	Judgments of Need
Hazards Analysis, Work Planning and Control	
Activity-level work planning and control, including hazard analysis for lifting and handling the flange, that would have prevented this accident was not conducted in a formal or documented manner. [CON-1] CCI management viewed the development of IWDs and SSESHP as contractual obligations rather than valuable tools for the safe conduct of work. [CON- 2]	CCI needs to develop an effective process to define activity-level work, and to formally conduct and document job planning as required by the awarded contract and implementing documents. [JON-1] See JON-12.
The viewpoint of CCI employees that the load in this activity consisted only of the flange was incorrect; the attachment was a part of the load since the safety pins were not used. [CON-3]	CCI needs to provide training to all workers on hoisting, rigging, and material handling to ensure all CCI activities are performed to meet Exhibit F safety requirements and M&O expectations. [JON-2] The M&O contractor needs to provide clarity in Exhibit F as to what qualifies as a "lift" and which activities require formal work planning. [JON-3]
In the absence of task specific work planning and control in the IWD, CCI relied on pre-task briefings to discuss tasks, steps, hazards and controls. The Board's review of pre-task briefing documents showed that pre-task briefings were inadequate to address specific tasks and associated hazards and controls. [CON-4]	CCI needs to improve methods for pre-task briefings that actively involve workers, define clear roles and responsibilities, and identify specific steps, hazards and controls that are commensurate with the task being performed. [JON-4]

Conclusions	Judgments of Need
Oversight and Lessons Learned	
Lessons from the earlier accident in which an angle iron was dropped and struck an employee were not effectively applied to other work activities on the project, including the lifting and material handling work in the laydown yard. These lessons included maintaining a "cone of safety," securing the load, and proper use of heavy equipment to move material. [CON-5]	CCI needs to review and improve their approach to address lessons learned from incidents to include extent of condition reviews for all projects at LANL. [JON-5]
The M&O contractor was ineffective in ensuring applicable ES&H contract requirements were executed during project activities. [CON-6]	The M&O contractor needs to develop and implement rigorous processes to confirm that CCI and all other construction subcontractors are implementing Exhibit F and other requirements and expectations. [JON-6]
CCI and the M&O contractor did not ensure IWD elements were implemented in daily work activity planning. [CON-7]	See JONs-1, -3, -4, and -6.
There is a disconnect between the M&O contractor and NA-APM regarding appropriate resource allocation for ES&H function versus all other project management functions. [CON-8] NNSA oversight activities did not emphasize effectiveness of M&O's oversight of CCI's implementation of work planning and control requirements such as Exhibit F, IWD, and safety plans. [CON-9]	NNSA and the M&O contractor need to work together to develop and implement effective oversight strategies to ensure that resources are aligned and adjusted as necessary throughout all project phases. [JON-7]
Routine work monitoring and inspections focused more on work area conditions such as signage, PPE, and housekeeping versus hazards analyses, change in work, and how daily work activities were planned or performed. [CON-10]	The M&O contractor and CCI need to develop and implement a strategy that ensures line management and ES&H professionals are focused on hazard recognition during work activities and take positive and timely action to improve performance. [JON-8]
The M&O contractor does not have an effective mechanism to apply appropriate oversight resources based on risk and hazards during various phases of the project. [CON-11]	The M&O contractor needs to develop and implement a risk-based staffing plan to ensure appropriate resources are assigned during various phases of the project. [JON-9]

Conclusions	Judgments of Need
CCI, with M&O contractor oversight, did not incorporate all Exhibit F safety requirements, such as developing clearly defined work steps, into their SSESHP and IWD documents. [CON-12]	The M&O contractor needs to improve their review and approval process for ensuring that all requisite requirements from Exhibit F are incorporated into subcontractor implementing documents. [JON-10] CCI needs to improve their method to ensure that all Exhibit F requirements are appropriately included in their implementing documents. [JON-11]
Risk Perception and Tolerance	
Because of the unsafe method used to lift the load, the crew relied solely on the positioning of the forks to keep the attachment from sliding off. However, at the time of the incident, there was no designated spotter to focus on the position of the forks. [CON-13]	See JON-1.
The technique used to stage the flange on the last lift of the day, which was different from the other technique used earlier in the day, increased the likelihood of an accident and placed workers underneath the load. [CON-14]	See JONs-1 and -8.
Unsafe work behaviors had been previously observed and reported; however, no formal measures were implemented to ensure sustainable safe behaviors. [CON-15]	See JONs-1 and -5.
Workers experienced various abnormal conditions the day of the accident (including safety pins not inserted and different technique used), however, they accepted the risk and proceeded with the work. [CON-16] Inadequate risk-informed decision making at the task-level ultimately resulted in the accident. [CON-17]	CCI line management needs to model behaviors and ensure that their workforce has adequate training and experience in hazard recognition and risk appreciation and that all CCI employees fulfill their obligation to pause work and perform a real-time discussion of hazards when abnormal conditions are encountered. [JON-12]

Conclusions	Judgments of Need
CCI supervisors, safety personnel and workers did not consider the flange material handling task as a "lift." [CON-18] Requisite elements of the SSESH Plan and IWD were not considered or implemented, which allowed the crew to be under the load. [CON-19]	See JONs-1, -3, and -4.
The JLG Industries, Incorporated (JLG) forklift attachment was designed solely for use with JLG equipment. The attachment was not intended nor approved for the Bobcat. However, the attachment was frequently used with the Bobcat. [CON-20]	CCI line management needs to significantly improve their processes to ensure that all equipment is used in accordance with manufacturer requirements. [JON-13] The M&O contractor needs to confirm that all equipment used by subcontractors is being used in accordance with manufacturer requirements. [JON-14]
CCI, the M&O contractor, and NNSA performed limited oversight in the laydown yard. Oversight was primarily focused on work being conducted in the basement and at the cooling towers, as that work was considered more hazardous. [CON-21]	CCI, the M&O contractor, and NNSA need to work together to develop and implement an effective strategy to maintain balanced oversight that considers the hazards of the work and not simply the facility. [JON-15]

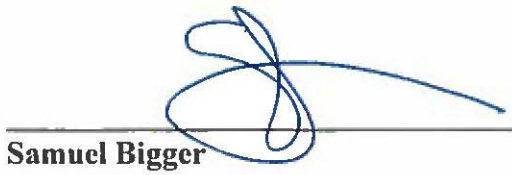
5.0 Board Signatures

Stephen Wallace
Board Co-Chair
National Nuclear Security Administration
Office of Safety, Infrastructure and Operations

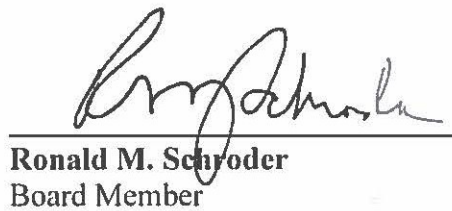
Marc Clay
Board Co-Chair
Triad National Security, LLC

Nathan Morley
Team Member/Trained Accident Investigator
National Nuclear Security Administration
Office of Safety, Infrastructure and Operations

William Schleyer
Team Member
National Nuclear Security Administration
Office of Safety, Infrastructure and Operations

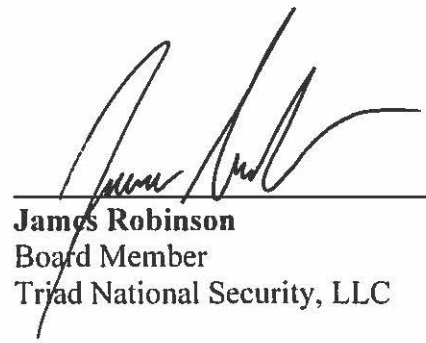


Samuel Bigger
Team Member
National Nuclear Security Administration
Los Alamos Field Office



Ronald M. Schroder
Board Member
Triad National Security, LLC

Alva Yazzie
Board Member
Triad National Security, LLC



James Robinson
Board Member
Triad National Security, LLC

Philbert Romero

Philbert Romero
Board Member
Triad National Security, LLC

Tony Shurter
Board Member
Triad National Security, LLC

Appendix A: Appointment of an Accident Investigation Board

Federal Appointment Letter

Department of Energy
National Nuclear Security Administration
Washington, DC 20585

December 21, 2018

MEMORANDUM FOR STEPHEN WALLACE
CO-CHAIRPERSON
DEFENSE NUCLEAR FACILITIES SAFETY BOARD
OFFICE OF SAFETY, INFRASTRUCTURE & OPERATIONS

FROM: THEODORE WYKA
COGNIZANT SECRETARIAL OFFICER FOR SAFETY
APPOINTING OFFICIAL
OFFICE OF SAFETY, INFRASTRUCTURE & OPERATIONS

SUBJECT: Joint Federal and M&O Accident Investigation Board into the Los Alamos Laboratory Accident on December 19, 2018, involving Injuries to a Sub-contract Employee at the Exascale Computing Project in TA-3

Based on the currently known facts about the incident referenced in the subject line, I am establishing a joint Federal and Management and Operating (M&O) Partner accident investigation board. Though the incident has not yet met the criteria of DOE O 225.1B, *Accident Investigations*, I believe the seriousness of the incident warrants an investigation of this rigor.

You are appointed as the Board Co-Chairperson. Marc Clay of TRIAD will be the other Co-Chairperson. The Federal personnel on the board will include the following members:

- Nathan Morley, Office of Safety, Infrastructure and Operations - Trained Accident Investigator
- William Schleyer, Office of Safety, Infrastructure and Operations
- Sam Bigger, NA-LA Field Office

TRIAD will be responsible for assigning personnel to be part of the investigation team within three business days. All Federal members of this investigation board are released from their normal regular duty assignments to serve on the joint investigation board while the board is convened.

The scope of the joint investigation is to include, but not be limited to, identifying all relevant facts, determining direct, contributing, and root causes of the event. This includes management and organizational systems, policies, and line management

oversight processes in accordance with Department of Energy Integrated Safety Management core functions and guiding principles, developing conclusions, and determining the judgments of need to prevent recurrence.

The scope of the investigation includes, but is not limited to, interviewing individuals as appropriate, reviewing documentation related to the accident, as well as applicable DOE programs and oversight activities. Furthermore, I expect the outcome of the investigation to include the following:

- A comprehensive articulation of the facts including timeline, involved organizations, actions, and outcomes;
- An assessment of the accident facts and circumstances, and recommendations regarding identified judgments of need;
- An assessment of the emergency response, and recommendations regarding any necessary judgments of need; and,
- Human Performance Improvement and causal analysis supporting the identified judgments of need.
- An Extent of Conditions assessment based on the accident facts

The investigation shall address the core analytical techniques discussed in the DOE O 225.1B, *Accident Investigations*, (i.e., events and casual factors, change analysis, and barrier analysis) and subsequently develop judgments of need that lead to corrective actions that will prevent recurrence. Lessons learned shall also be disseminated from the event as required by the Order.

The Board shall provide my office with periodic reports on the status of the investigation. Please submit draft copies of the factual portion of the investigation report to me, the Los Alamos Field Office, and TRIAD for factual accuracy review prior to finalization. The Co-Chairs should provide the draft report to the Office of the Associate Under Secretary for Environment, Health, Safety and Security, for quality review prior to public release. The final report should be provided to me within 45 days of the incident. Discussion of the investigation and copies of the draft report will be controlled until I authorize release of the final report.

If you have any further questions, please contact Daniel Sigg, Deputy Associate Administrator for Safety at (505) 845-4404.

cc:
William White, NA-3
Douglas Fremont, NNSA-COS
Bruce Diamond, NA-GC
Nora Khalil, NA-EA
James McConnell, NA-50
Robert Raines, NA-APM-1
Keith Hamilton, NA-APM-1
Steven Goodrum, NA-LA
Richard Verhaagen, NA-LA
Gabe Pugh, NA-LA
Daniel Sigg, NA-51
Greg Hatchett, NA-51
Nathan Morley, NA-512
Lynn Maestas, NA-513
William Schleyer, NA-513
Matthew Moury, AU-1
Todd Lapointe, AU-1
Gary Staffo, AU-23
Thom Mason, TRIAD
Marc Clay, TRIAD

M&O Appointment Letter

Los Alamos
NATIONAL LABORATORY
EST. 1943

memorandum
DDOPS

To: Marc Clay, MISSASSR, MS K778
Tony Shurter, LOG-SUP, MS P911
Alva Yazzie, IQPA, MS A147
James Robinson, IQPA, MS A147
Philbert Romero, DESH-CPCS, MS P908
From: Jay Johnson, DDOPS, MS A102
Phone: 505-606-2222
Symbol: DDOPS: 18-001
Date: December 21, 2018

Subject: Joint Federal and M&O Accident Investigation Board into the Los Alamos Laboratory Accident on December 19, 2018 involving Injuries to a Sub-contract Employee at the Exascale Computing Project in TA-3

The Cognizant Secretarial Officer for Safety National Nuclear Security Administration and the Los Alamos National Laboratory (LANL) Director have directed Stephen Wallace, NNSA Office of Safety, Infrastructure, and Operations and Marc Clay to co-chair a joint Federal and Management and Operating (M&O) Partner Accident Investigation Board (AIB). The LANL AIB membership is:

- Marc Clay, Co-Chair
- Tony Shurter, Member, HPI
- Alva Yazzie, Member, Causal Analyst
- James Robinson, Member, Causal Analyst
- Philbert Romero, Technical Advisor
- Capital Projects, Member TBD

As a member of the AIB, you are released from your normal regular duty assignments to serve on the AIB during the period that the board is convened. The scope of the joint investigation is to include, but not be limited to, identifying all relevant facts, determining direct, contributing, and root causes of the event. This includes management and organizational systems, policies, and line management oversight processes in accordance with Department of Energy (DOE) Integrated Safety Management core functions and guiding principles, and developing conclusions, and determining the judgments of need to prevent recurrence.

The scope of the investigation includes, but is not limited to, interviewing individuals as appropriate, reviewing documentation related to the accident, as well as applicable DOE programs and oversight activities. Furthermore, I expect the outcome of the investigation to include the following:

- A comprehensive articulation of the facts including timeline, involved organizations, actions, and outcomes;

- An assessment of the accident facts and circumstances, and recommendations regarding identified judgments of need;
- An assessment of the emergency response, and recommendations regarding any necessary judgments of need; and,
- Human Performance Improvement (HPI) and causal analysis supporting the identified judgments of need.

The investigation shall address the core analytical techniques discussed in DOE O 225.1B, *Accident Investigations*, (i.e., events and casual factors, change analysis, and barrier analysis) and subsequently develop judgments of need that lead to corrective actions that will prevent recurrence. Lessons learned shall also be disseminated from the event as required by the Order.

Discussion of the investigation and copies of the draft report will be controlled until the Cognizant Secretarial Officer for Safety National Nuclear Security Administration authorize release of the final report.

MEC:JDC:bjb

Copy: Steve Goodrum, LASO-OOM, steve.goodrum@nnsa.doe.gov
Jose R. Munoz, LASO-O, jrmunoz@lanl.gov
Richard K. Verhaagen, LASO-OOM, rkv@lanl.gov
Thomas E. Mason, DIR, masont@lanl.gov
Kelly J. Beierschmitt, DDOPS, beierschmitt@lanl.gov
Michael Hazen, ALDESHQSS, mhazen@lanl.gov
Kathye Segala, ALDCP, segalak@lanl.gov
Bret Simpkins, ALDFO, simpkins@lanl.gov
Marc E. Clay, MISSASSUR, mclay@lanl.gov
Tony Shurter, LOG-SUP, tchurter@lanl.gov
Alva Yazzie, IQPA-PA, alva@lanl.gov
James Robinson, IQPA-PA, jnrob@lanl.gov
Philbert Romero, DESH-CPCS, philr@lanl.gov

Appendix B: Barrier Analysis

Hazard: Injury to worker by falling attachment		**Target**: Workers conducting lift		
What were the barriers?	How did each barrier perform?	Why did the barrier fail?	How did the barrier affect the accident?	Context: ISM/HPI
Safety pins to keep the attachment secured to the Bobcat or JLG	The barrier was ineffective	• The pins were not used • The pins were left in the JLG across the street • Crew chose not to get pins • Lack of appreciation of the risk of not using the pins • Previous work evolutions accomplished successfully without the pins	• No risk-informed decision making when knowing pins are missing • Would have secured the attachment on the forks of the Bobcat, no matter the position of the forks • Did not prevent the attachment to slide off of the forks and strike Journeyman 1	• Scope of the work was considered low hazard and routine • Hazards not recognized and controlled CF • Proper hierarchy of controls to eliminate hazards not followed CF • Work not conducted within controls CF • Changes to work method not reviewed and accepted CF • Followed direction of Journeyman 1 • Change off-normal, first-time evolution • Activities were allowed to be performed in an error-prone environment CF

Hazard: Injury to worker by falling attachment		**Target**: Workers conducting lift		
What were the barriers?	How did each barrier perform?	Why did the barrier fail?	How did the barrier affect the accident?	Context: ISM/HPI
Maintaining forks above horizontal	The barrier was ineffective	• Unrealistic to assume that the crew would consistently be watching the position of the forks • The forks were in the correct position before the boom was lowered • The Bobcat is not designed to be a precision lifting device • The Bobcat does not self-adjust the position of the forks as the boom is moved up and down as the JLG does • No one on the crew was checking on the position of the forks as the boom was lowered • No designated spotter involved in activity	• The forks were allowed to be positioned below horizontal where the attachment could slide off and strike an individual in front of the attachment • Allowed the attachment to slide off of the forks and strike Journeyman 1 • No appreciation of hazards when abnormal "circumstances" encountered CF	• Scope of the work was considered low hazard and routine • Hazards not recognized and controlled CF • Work not conducted within controls CF • Changes to work method not reviewed and accepted CF • Followed inappropriate direction of Journeyman 1 • Unclear roles and responsibilities CF
Adequate hazard recognition	The barrier was ineffective	• Work was not conducted consistently, which created new hazards • Hazards were not recognized or controlled • Workers did not identify the risks associated with	• The activity was conducted in a manner that placed Worker's safety in jeopardy CF • No appreciation of hazards when abnormal	• Hazards not recognized and controlled CF • Implementation of requirements that could have provided a safer operation were missed CF

Hazard: Injury to worker by falling attachment		**Target**: Workers conducting lift		
What were the barriers?	How did each barrier perform?	Why did the barrier fail?	How did the barrier affect the accident?	Context: ISM/HPI
		the change in the activity	"circumstances" encountered CF • Allowed the attachment to slide off of the forks and strike Journeyman 1	• Opportunities to identify a safer method for conducting this activity were missed CF
Required work planning and control documents implemented	The barrier was ineffective	• IWDs not routinely used • IWDs not always specific to tasks • There is a work planning and control gap between the IWD and actual work practices • No understanding of the risks of performing tasks in a nonstandardized manner • No effective process on when work planning and control documents are needed • Work-specific procedures not identified in the IWDs • Work planning and control documents were considered to be contractual necessities rather than useful tools	• No standardized process for the material handling activities in the laydown yard CF • The activity was conducted in a manner that placed Worker's safety in jeopardy CF • Workers allowed to be in the "line of fire" or within the "cone of safety" • Allowed the attachment to slide off of the forks and strike Journeyman 1	• Hazards not recognized and controlled CF • Implementation of requirements that could have provided a safer operation were missed CF • Opportunities to identify a safer method for conducting this activity were missed CF • Training and qualification not adequate CF • The core functions and guiding principles of Integrated Safety Management were neither solidified nor exhibited in CCI's management systems or work behaviors. CF

Hazard: Injury to worker by falling attachment		**Target**: Workers conducting lift		
What were the barriers?	How did each barrier perform?	Why did the barrier fail?	How did the barrier affect the accident?	Context: ISM/HPI
		for field work • Work planning and control documents were not implemented • Work planning documents were not adequately monitored and enforced • Activity considered routine • Activity not specifically called out in safety documents • The activity was done as skill of the craft • Changes to conduct the activity were not reviewed or assessed for safety • No lift plan was developed as required by the IWD and SSESHP		
Safety documentation flow down (Exhibit F, Safety Plan, IWD, POD, Pre-Job Brief)	The barrier was ineffective	• No consensus between LANL and CCI as to whether a CCI lift plan is required • Implemented safety	• No risk-informed decision making CF • Solely relied on the daily work meeting and pre-task briefings that did not address	• Hazards not recognized and controlled CF • Implementation of requirements that could have provided a safer

Hazard: Injury to worker by falling attachment		**Target**: Workers conducting lift		
What were the barriers?	How did each barrier perform?	Why did the barrier fail?	How did the barrier affect the accident?	Context: ISM/HPI
		documents not available • Pre-task briefs and daily work meetings are informal and not specific to the flange activity • The activity was done as skill of the craft • Changes to conduct the activity not reviewed or assessed for safety • Workers allowed to be placed in the "line of fire" or within the "cone of safety"	task specific hazards and controls CF • Inadequate process for ensuring "requirements" are implemented in the work CF • Inadequate process of ensuring that Exhibit F requirements end up in safety documents CF • Flow down of Exhibit F to the CCI site-specific ES&H plan and WPC documents ineffective CF • The activity was conducted in a manner that placed Worker's safety in jeopardy CF	operation were missed CF • Opportunities to identify a safer method for conducting this activity were missed CF • No appreciation of hazards when abnormal "circumstances" encountered CF • Vague or unclear guidance not recognized as an error trap (precursor) • Training and qualification not adequate CF
CCI Oversight	The barrier was ineffective	• Activity considered routine, not deserving recurring oversight • CCI Owner charged with conducting independent assessments • Inadequate recognition and appreciation of the hazards with the work • Safety inspections became a check of the	• The activity was conducted in a manner that placed Worker's safety in jeopardy and Journeyman 1 to be struck by the attachment • Workers allowed to be in the "line of fire" or within the "cone of safety" • Opportunities to identify a safer method for conducting this activity were missed CF	• Hazards not recognized and controlled CF • Implementation of requirements that could have provided a safer operation were missed CF • Opportunities to identify a safer method for conducting this activity were missed CF

Hazard: Injury to worker by falling attachment		**Target**: Workers conducting lift		
What were the barriers?	How did each barrier perform?	Why did the barrier fail?	How did the barrier affect the accident?	Context: ISM/HPI
		box exercise • More focus in the high-hazard areas • Conduct of the activity was not observed or assessed • Changes to conduct the activity were not observed or assessed for safety		
M&O Oversight to ensure CCI is effectively monitoring and meeting project contract obligations	The barrier was ineffective	• Conduct of the activity was not observed or assessed • Changes to conduct the activity were not reviewed or assessed for safety • M&O oversight did not monitor and enforce the implementation of the IWDs and other work control documents • M&O oversight concentrated at the beginning of the project for project planning • Focus more on project EVMS than on work	• The activity was conducted in a manner that placed Worker's safety in jeopardy CF • Opportunities to identify a safer method for conducting this activity were missed CF • Workers allowed in the "line of fire" or within the "cone of safety" • The way the activity was conducted allowed the attachment to slide off of the forks and strike Journeyman 1 • Inadequate process for ensuring "requirements" are implemented in the work CF • Flow down of Exhibit F to the CCI site specific ES&H plan	• Hazards not recognized and controlled CF • Implementation of requirements that could have provided a safer operation were missed CF • Opportunities to identify a safer method for conducting this activity were missed CF • Hazards not recognized and controlled CF • Implementation of requirements that could have provided safer operations were missed CF

Hazard: Injury to worker by falling attachment		**Target**: Workers conducting lift		
What were the barriers?	How did each barrier perform?	Why did the barrier fail?	How did the barrier affect the accident?	Context: ISM/HPI
		• Assumed that CCI was fulfilling its contractual obligations to monitor and enforce of the IWDs for the work performed • Repeated issues identified were not systemically addressed (done individually as verbally on the spot)	and WPC documents ineffective CF • Oversight did not ensure adequate balance of safety oversight versus EVMS drivers CF • Activities were allowed to be performed in an error-prone environment CF • Activities were conducted without an effective hazard analysis process CF	
Federal oversight to ensure M&O and CCI are effectively monitoring and meeting project contract obligations	The barrier was ineffective	• Identified issues are poorly communicated and not tracked to closure • NA-APM activities not looking at the effectiveness of the M&O's oversight into CCI's implementation of work planning and control requirements (i.e., Exhibit F, IWD, safety plan) • Assumed that M&O and CCI were fulfilling their	• Opportunities to identify improvements for effective assurance and oversight by the M&O were missed CF	• Unclear roles and responsibilities CF • Vague/interpretive guidance • Opportunities to identify a safer method for conducting this activity were missed CF

Hazard: Injury to worker by falling attachment		**Target**: Workers conducting lift		
What were the barriers?	How did each barrier perform?	Why did the barrier fail?	How did the barrier affect the accident?	Context: ISM/HPI
		contractual obligations to monitor and enforce the IWDs for the work performed • Lack of clarity in the role of NA-LA in ensuring that the M&O ensures that work is performed safely		
Spotter	The barrier was ineffective	• The laydown work crew did not consider the activity as a lift • CCI line management and ES&H did not consider the activity to be a lift • No one was identified and assigned as a dedicated spotter • CCI practice was that anyone in the laydown yard could be a spotter • Crew members were concentrating their attention on positioning the flange on the welding table • No one was checking	• The activity was conducted in a manner that placed worker's safety in jeopardy CF • A spotter could identify the position of the forks and pause the job • Spotter could have identified individuals within the "cone of safety" • The way the activity was conducted allowed the attachment to slide off of the forks and strike Journeyman 1	• Work not conducted within controls CF • Changes to work method not reviewed and accepted CF • Followed direction of Journeyman 1 • Poor use of effective communication techniques • Roles and responsibilities not recognized as an error precursor – therefore, no defense was employed • Unclear roles and responsibilities CF

Hazard: Injury to worker by falling attachment		**Target**: Workers conducting lift		
What were the barriers?	How did each barrier perform?	Why did the barrier fail?	How did the barrier affect the accident?	Context: ISM/HPI
		the position of the forks on the Bobcat as the boom was lowered		
Questioning Attitude (Safety Conscious Work Environment)	The barrier was ineffective	• Implementing Behavior-Based Safety, such as "see something – say something," not effective • The Laborer's concern on not having the pins was disregarded • Journeyman 1's feedback that pins should always be kept with the attachment, following the angle iron event, was not acted upon • Thought keeping the forks inclined was sufficient • Last job of the day • Working to get the job done • Following direction from Journeyman 1	• No pins were used in the activity • The job was not paused to retrieve the pins • No one questioned the need to retrieve the pins from the JLG • No one questioned the use of the Bobcat vs the JLG • Safety Pins were not used with the JLG Forklift Attachment CF • Without the pins, there was a total reliance on the correct position of the forks on the Bobcat to keep the attachment from sliding off • Bobcat forks were placed in a below-horizontal position CF • Allowed the attachment to slide off of the forks and strike Journeyman 1	• Work not conducted within controls CF • Followed direction of Journeyman 1 • Roles and responsibilities not recognized as an error precursor – therefore, no defense was employed • Unclear roles and responsibilities CF • Workers were not held accountable to previously observed unsafe behaviors CF • The core functions and guiding principles of Integrated Safety Management were neither solidified nor exhibited in CCI's management systems or work behaviors. CF

Hazard: Injury to worker by falling attachment		**Target**: Workers conducting lift		
What were the barriers?	How did each barrier perform?	Why did the barrier fail?	How did the barrier affect the accident?	Context: ISM/HPI
		• Previously observed unsafe behaviors on this project were not questioned or addressed • Crew was confident with the process due to previous evolutions performed without incident		
Use equipment per manufacturer's operating manual	The barrier was ineffective	• Contrary to manufacturer requirements, the attachment was used on Bobcat • The pins were a part of the attachment • The pins were not kept in proximity to the attachment	• Equipment not used as designed or required CF • Without the pins there was a total reliance on the correct position of the forks on the Bobcat to keep the attachment from sliding off • The forks were allowed to be placed in a position where the attachment could slide off of the forks and strike an individual in front of the attachment • Allowed the attachment to strike Journeyman 1	• Violates consensus standards for material handling equipment • Work not conducted within controls CF

Appendix C: Change Analysis

Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
WHAT Conditions, occurrences, activities, equipment	Safety pins not used to secure the attachment to the Bobcat	Safety pins used to secure the attachment to the Bobcat	• The attachment is not secured on the forks with safety pins on each side • Pins were not with attachment – instead they were within the JLG • Did not appreciate the hazard of using the attachment without the pins • Attention to maintain fork tilt becomes critical • Eliminated a barrier to the safety of the activity • Bobcat not designed for precision movements • The forks needed deliberate attention to keep forks tilted upward • Uncontrolled load when forks are tilted below the horizontal	Allowed the attachment to slide off of the forks and strike Journeyman 1
	Bobcat used instead of JLG for lifting activity	JLG was the preferred method to be used for the lifting activity	• JLG is usually located in the laydown yard • JLG not available throughout the day	• Inability to precisely control Bobcat movements contributed to the

Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
			• JLG smoother control of the load • Pins were with JLG • Attachment authorized for use with the JLG • Attachment not authorized other than for JLG use, but will fit on the forks of the Bobcat • Forks automatically remain horizontal on the JLG with elevation • Bobcat is designed for moving earth and pallets • Bobcat is versatile and was used for applications beyond its intended purpose • Bobcat is "jerky" and difficult to maintain precise movement control • Pins will secure the attachment on the Bobcat forks • Bobcat was not the preferred tool • Using the Bobcat without angle correction allows forks to go below	Attachment sliding off of the forks CF • Inherently lowering the Bobcat boom causes the forks to tilt downward • Allowed the attachment to slide off of the forks and strike Journeyman 1

Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
			horizontal when lowering the load • Attention to maintain fork tilt becomes critical	
	This lifting activity was perceived as a low hazard task being conducted in a low hazard area not requiring work planning and within the skill of the craft	Tasks are reviewed and work areas are surveyed, hazards are evaluated and appreciated even though an area is viewed as less hazardous	• Oversight, safety walkthroughs were infrequent and focused on compliance on other project activities such as PPE requirements and safety signage • Significant variation on how this activity was being conducted • No standard method was prescribed or evaluated by any work control documents as required by project documents • Oversight was not provided on how this activity was being conducted • Controls would have made a consistent process • The method used for this activity was not reviewed by safety personnel	• Specific controls were not developed for this activity CF • Lessons Learned from previous incidents on controls and work area LTA CF • No appreciation of hazards when abnormal "circumstances" encountered CF • No risk-informed decision making CF • Opportunities to identify human performance improvement and a safer method for conducting this activity were missed CF

Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
			• Lessons learned from the angle iron incident were not incorporated into this activity • Opportunities to promote error reduction and manage risk were not pursued in corporate documents	
	Safety requirements and expectations in contract documents, such as Exhibit F and Site Specific Safety and Health Plan (SSESHP), are not consistently viewed as value added	Contract documents, such as Exhibit F and SSESHP, contain clear requirements that are value added and understood, and the subcontractor develops tasks in compliance with the requirements	• There was a disconnect ensuring that tasks complied with the safety requirements in the documents. • It was not understood that according to section 32.19, forklifts with boom attachments and track-hoes with attachments requires the contractor to develop a lift plan.	• Inadequate process for ensuring "requirements" are implemented in the work CF • Inadequate process of ensuring that Exhibit F requirements end up in safety documents CF • Flow down of Exhibit F to the CCI site specific ES&H plan and WPC documents ineffective CF • Implementation of requirements that could have provided a

Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
				safer operation were missed CF
	Lessons from previous incidents were not incorporated and used to prevent further incidents	Lessons from previous incidents are incorporated and used to prevent further incidents even in other areas	• Lessons learned from the angle iron accident were not addressed in the activities conducted in the laydown yard • "Line of fire" and "cone of safety" concepts not addressed in the conducting the lift	• Lessons Learned from previous incidents on controls and work area LTA CF • Opportunities to identify and correct safety issues with the activity were missed CF
	M&O project safety hours routinely underrunning the approved budget	M&O safety hours should be commensurate with necessary safety oversight	• Planned safety resources for the project did not meet project needs • Resources are provided to look more at low and moderate hazard activities • Some resource mobilization were not available as needed • Current safety resources are stretched thin to oversee multiple work fronts	Opportunities to identify and correct safety issues with the activity were missed CF

Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
			• Cannot look at how activities are being conducted • Safety oversight on low hazard areas cannot go to zero	
	First Aid kit at laydown yard not used	Availability of first aid kit at laydown yard used to treat injured employee	• Used rag for compression • No gloves were used to hold compression • First aid kit in transportainer in the laydown yard • First aid supplies and expertise not used until the arrival of Los Alamos Fire Department personnel • Fire extinguisher was at the laydown yard	• Recognition of the availability of the first aid equipment was not made by the workers in the laydown yard • Biohazards not controlled
WHEN Occurred, identified, facility status, schedule	Last flange material handling evolution of the day using a new technique	Regardless of time and technique all flange material handling operations are planned and performed safely within required controls	• Working to get one more job done before the end of the day • Last lifting activity of the day • Rushing to get the job done • Changed to an unanalyzed technique to save time that put	• Crew not wanting to take time to get the pins CF • Creates critical reliance on ensuring forks are always pointed upward • Operator distracted watching the other crew members

Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
			personnel in the "line of fire"	• Lack of focus on the position of the forks CF • New technique placed crew within "cone of safety" and direct "line of fire" CF
	Close to winter closure	No winter closure upcoming	Potential rushing to get the work area ready for the upcoming shutdown	• Crew looking to get work done • Crew not wanting to take time to get the pins CF
WHERE Physical location, environmental conditions	Operators unsure of their location	Operators know location to provide to 911	• Emergency responders did not know the exact location of the accident • Possibility of delay in providing needed emergency support to Journeyman 1	Change did not have a significant effect on this accident – people were in place to direct emergency responders to the scene
WHO Staff involved, training, qualification, supervision	Four men exposed to the potential swinging/falling hazard	No one exposed to the swinging/falling hazard, as proper supervision and assignment of roles are achieved	• Task changed without a hazard analysis • Operators working under the load • No assigned roles and responsibilities • All workers are within the "line of fire" or "cone of safety"	Journeyman 1 hit by the attachment as it slipped off of the forks

Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
			• Journeyman 1 in front of flange and attachment • Use of pins and level of forks are critical to protect workers • Operators vulnerable to being struck by the load	
	Designated safety persons' priority was to attend critical activities in the basement	Balanced safety coverage for all work fronts	• This lifting activity was not reviewed by Project personnel • Laydown yard considered lower risk and common industrial hazards • CCI ES&H oversight not inclusive of the laydown yard for this activity	• No appreciation of hazards when abnormal "circumstances" encountered CF • Oversight priorities of the project was placed on the basement activities following the angle iron incident CF • Opportunities to identify and correct safety issues with the activity were missed CF
	Crew members were not involved in the development of the IWD for their work	Crew members, and skilled work planners, are actively engaged in the hazard analysis and development of controls for all of their work	• Those doing the work had no direct input into the development of the documents effecting their work • Project is risk tolerant	• No risk-informed decision making CF • Opportunities to identify and correct safety issues with the

Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
			• Planning for identifying hazards and controls were incomplete • Workers do not have ownership in the work planning process being conducted • Only the Crew conducting the work was aware of the method they were using to conduct the activity	activity were missed CF
	Crew members did not plan and document this specific task; and its associated steps, hazards, and controls	Crew members, with involvement of line management and ES&H personnel, would plan and document this specific task; and its associated steps, hazards, and controls	• Work planning and control gaps exists between the IWD and the actual conduct of the activity • Everything was considered within the nexus of a welding evolution • Planning was inadequate for the lifting activity • Task was done "by the seat of their pants" • Walk down and validation of task steps did not occur	• No appreciation of hazards when abnormal "circumstances" encountered CF • Opportunities to identify and correct safety issues with the activity were missed CF

Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
	CCI safety SME did not review this activity	CCI safety SME evaluates the activity specifying effective hoisting, rigging, and lifting requirements	• This activity was not reviewed before being conducted • Not considered as a lift	Opportunities to identify and correct safety issues with the activity were missed CF
	No questioning attitude (Safety Conscious Work Environment)	Workers, management, and safety oversight continuously review their work within a conservative decision making framework	• Crew knew the pins were not in place during the evolution • No one questioned the changing of the technique and the new hazards that were created • The activity proceeded without the pins being in place	• Opportunities to identify and correct safety issues with the activity were missed CF • The core functions and guiding principles of Integrated Safety Management were neither solidified nor exhibited in CCI's management systems or work behaviors. CF
	Greater than 3 times more hours for Project Controls than for STR and safety in FY 2018	Risk-based resource allocation approach based on critical activities throughout the project lifecycle	• EVMS pressure drives lopsided resource allocation towards reporting versus field ops oversight of work execution • Balance of assuring safety, construction, and operations against meeting EVMS requirements and	Opportunities to identify and correct safety issues with the activity were missed CF

Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
			operations controls has not consistently conducted • There is an improper balance of administrative personnel compared to personnel performing field oversight • Safety personnel are stretched thin, and look primarily at more critical activities	
	Personnel do not have required training to perform the material movement tasks conducted	Personnel conducting the hoisting and rigging of the flange have required training	• Flange was rigged to the attachment by personnel without the appropriate training • Only one member of the crew was PIC trained • Crew did not have incidental crane training that includes spotter training • Only one crew member had forklift training although all have operated forklifts • None of the crew members have the requisite training	• Lift allowed to continue by personnel unqualified to conduct the task • Training and qualification not adequate CF

Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
			applicable to hoisting and rigging	
HOW Control chain, hazard analysis monitoring	Task of tacking the weld included inconsistent practices	Task of tacking the weld is accomplished with consistent, well-planned practices and techniques	• Jacks used for larger flanges and longer pipe links • Using different vehicles to lift the flange onto the table (i.e., JLG forklift or Bobcat) • Placing the flange at different places on the table to insert the bolts (partially off table verses completely on table) • Doing the welding at different tables and on jacks • A job safety analysis should have been conducted with input from the employees doing the work for each technique • Adherence to standard process is communicated and enforced	• Opportunities to identify and correct safety issues with the activity were missed CF • The core functions and guiding principles of Integrated Safety Management were neither solidified nor exhibited in CCI's management systems or work behaviors. CF • The attachment slid off of the forks and struck Journeyman 1

Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
	Task of hoisting the flange onto the table was conducted in a manner that put multiple employees in vulnerable positions	The task will be planned to ensure that employees are not in harm's way.	• Three operators were allowed to be in front of the attachment and the flange • Operators were working within the "cone of safety" • Engineered controls and eliminating hazards could have been designed and used	Journeyman 1 was struck by the attachment as it slipped off of the forks
	Deferring to the knowledge and skills of the workers (i.e., skill of the craft)	Planning and documenting the task specific steps, hazards, and controls for the work	• Operators were able to work the activity the way they wanted • There was no safety review of the activity • Walk down and validation of task steps did not occur	• There was no evidence of this welding activity being observed and evaluated by any oversight organization CF • Opportunities to identify a safer method for conducting this activity were missed CF • The core functions and guiding principles of Integrated Safety Management were neither solidified nor exhibited in CCI's

Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
				management systems or work behaviors. CF • Journeyman 1 was struck by the attachment as it slipped off of the forks
	Portions of IWD-01 are subject to different interpretation regarding what constitutes a lift, what equipment to be used, etc.	IWDs provide clear work planning, hazards identification, and specific controls to safely conduct all activities	• Operators were able to work the activity the way they wanted • There was no safety review of the activity	• Opportunities to identify a safer method for conducting this activity were missed CF • Journeyman 1 was struck by the attachment as it slipped off of the forks
	IWD development is largely viewed to satisfy a M&O requirement and is not used in work execution	IWD is viewed and implemented as an important and useful work planning and control execution document	• CCI's expectation is to only have all workers read the IWD initially when they first arrive on the project • The workers were not part of the work development process • Operators were able to work the activity the way they wanted	• Opportunities to identify a safer method for conducting this activity were missed CF • Journeyman 1 was struck by the attachment as it slipped off of the forks

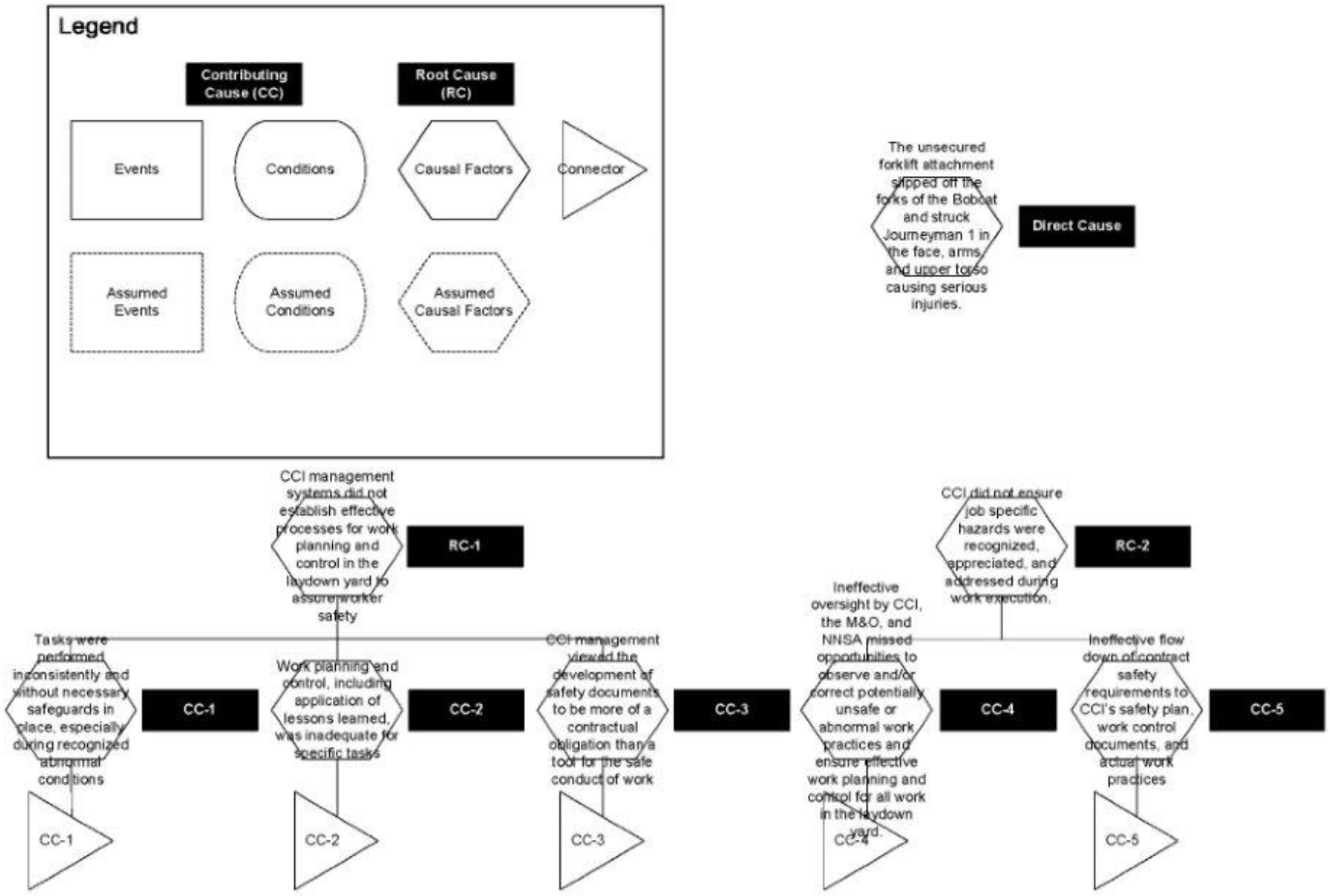
Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
			• There was no safety review of the activity	
	Lift plan not developed for the activity	IWD requires everyday lifts to have a written lift plan	• This activity is required to have a lift plan • IWD did not specify steps for performing the lift or the equipment to be used • Work not considered a lift requiring planning	• Opportunities to identify a safer method for conducting this activity were missed CF • Journeyman 1 was struck by the attachment as it slipped off of the forks
	Pre-task briefs and daily work meetings do not address changing methods for activities	Changing methods for activities are briefed and discussed before being conducted	• Pre-task briefs and daily work meetings were informal and did not address this activity • Changes in conducting the activity were not addressed	• Solely relied on the daily work meeting and pre-task briefings that did not address task specific hazards and controls CF • Opportunities to identify a safer method for conducting this activity were missed CF • Journeyman 1 was struck by the attachment as it

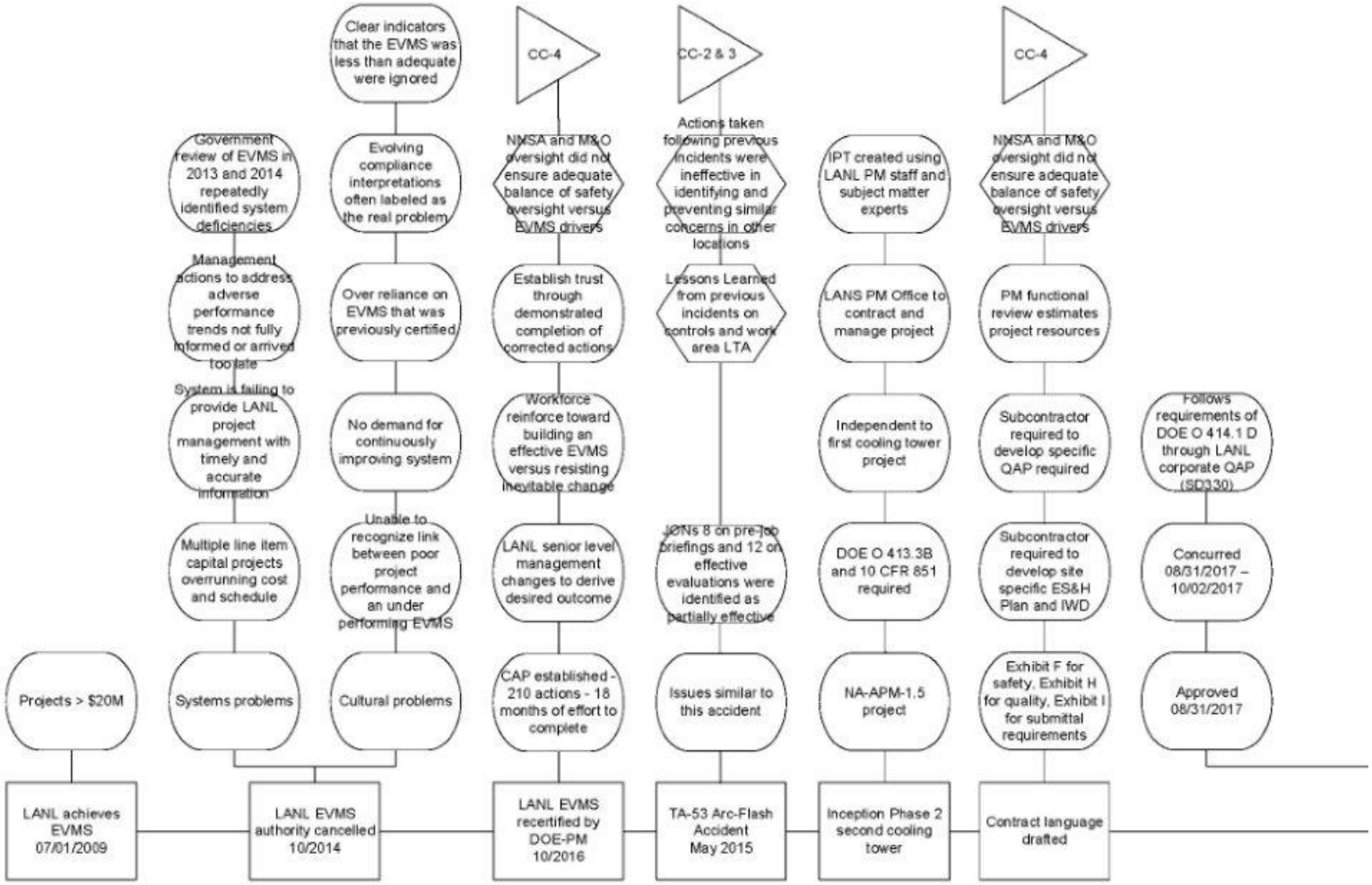
Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
				slipped off of the forks
	Sparse oversight conducted in this area and of these tasks	Balanced safety coverage for all work fronts	• Looking primarily for PPE use • Area is viewed as less hazardous • Hazards are not evaluated and appreciated • Management had confidence in the knowledge and ability of the work crew • Work areas are not surveyed	• No appreciation of hazards when abnormal "circumstances" encountered CF • There was no evidence of this welding activity being observed and evaluated by any oversight organization CF • Oversight priorities of the project was placed on the basement activities following the angle iron incident CF • Opportunities to identify a safer method for conducting this activity were missed CF • Journeyman 1 was struck by the

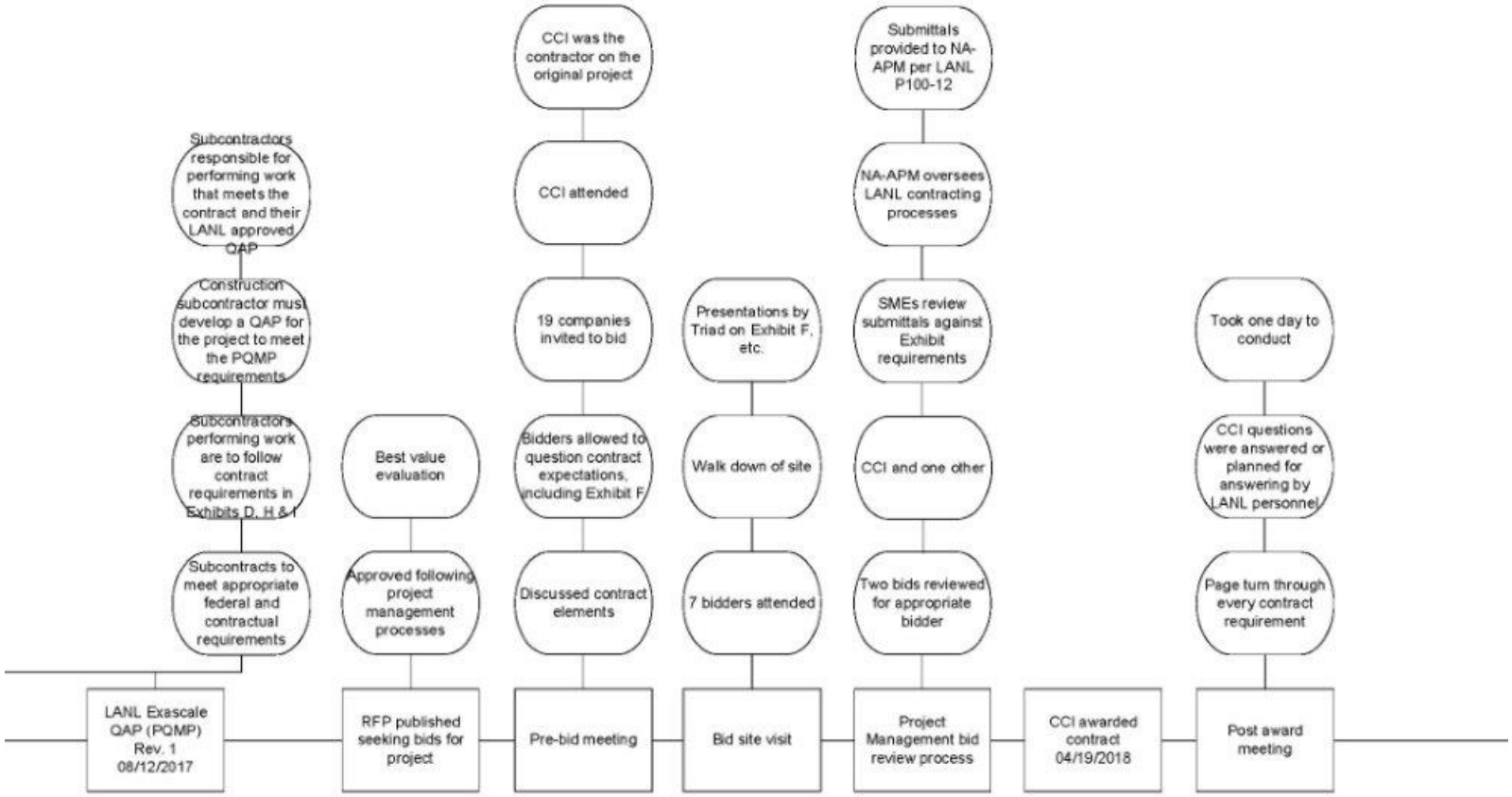
Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
				attachment as it slipped off of the forks
	M&O oversight mechanisms did not ensure that CCI was consistently performing work in accordance with the contract and work control documents	M&O contract oversight ensures performance in accordance with contract requirements	• Missed deficiencies in CCI implementation of contract and work control documentation • The activity was not effectively planned or reviewed	• The contractual process was ineffective to flowing down requirements to the work conducted CF • Opportunities to identify a safer method for conducting this activity were missed CF
	NA-APM/NA-LA oversight mechanisms did not ensure that M&O has a systematic approach to oversight	NA-APM/NA-LA ensures that the M&O has a systematic approach to oversight	• Missed deficiencies in M&O implementation of contract and work control documentation • The activity was not effectively planned or reviewed • The contractual process was ineffective beyond the point of award to guarantee that safety requirements developed early in the process	• The contractual process was ineffective to flowing down requirements to the work conducted CF • Opportunities to identify a safer method for conducting this activity were missed CF

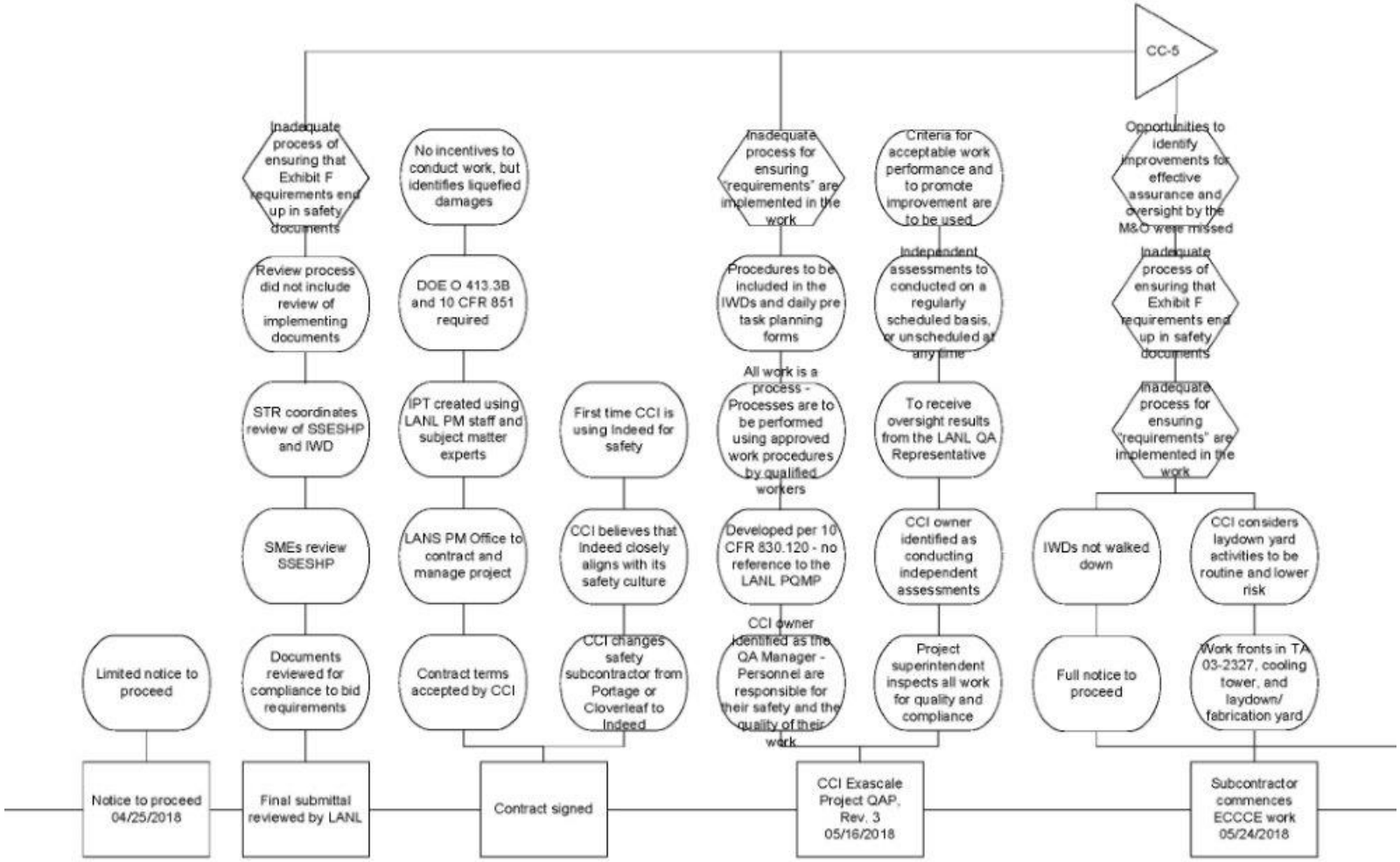
Factors	Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
			carried through to the actual job site	
OTHER	None			

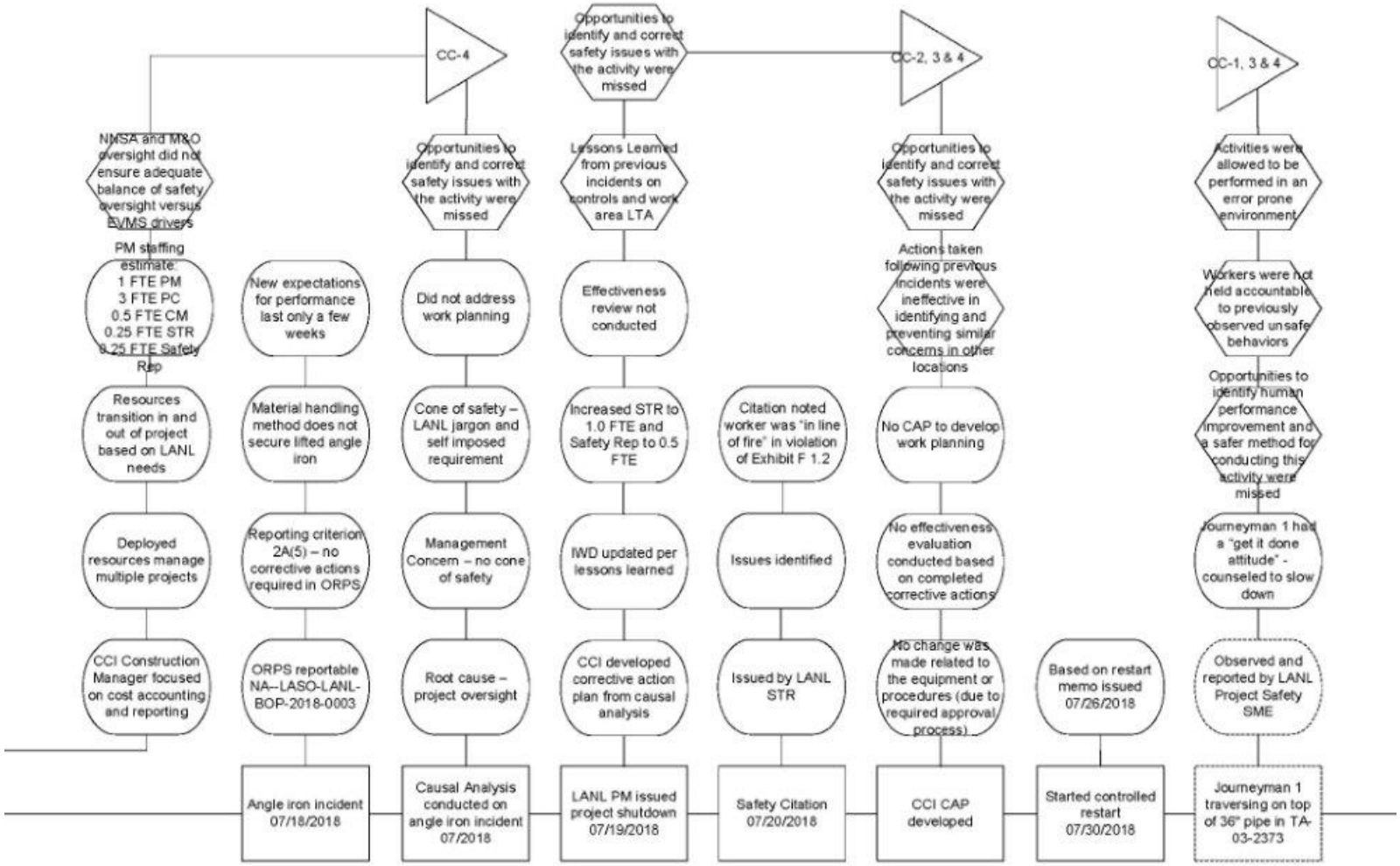
Appendix D: Events and Causal Factor Analysis

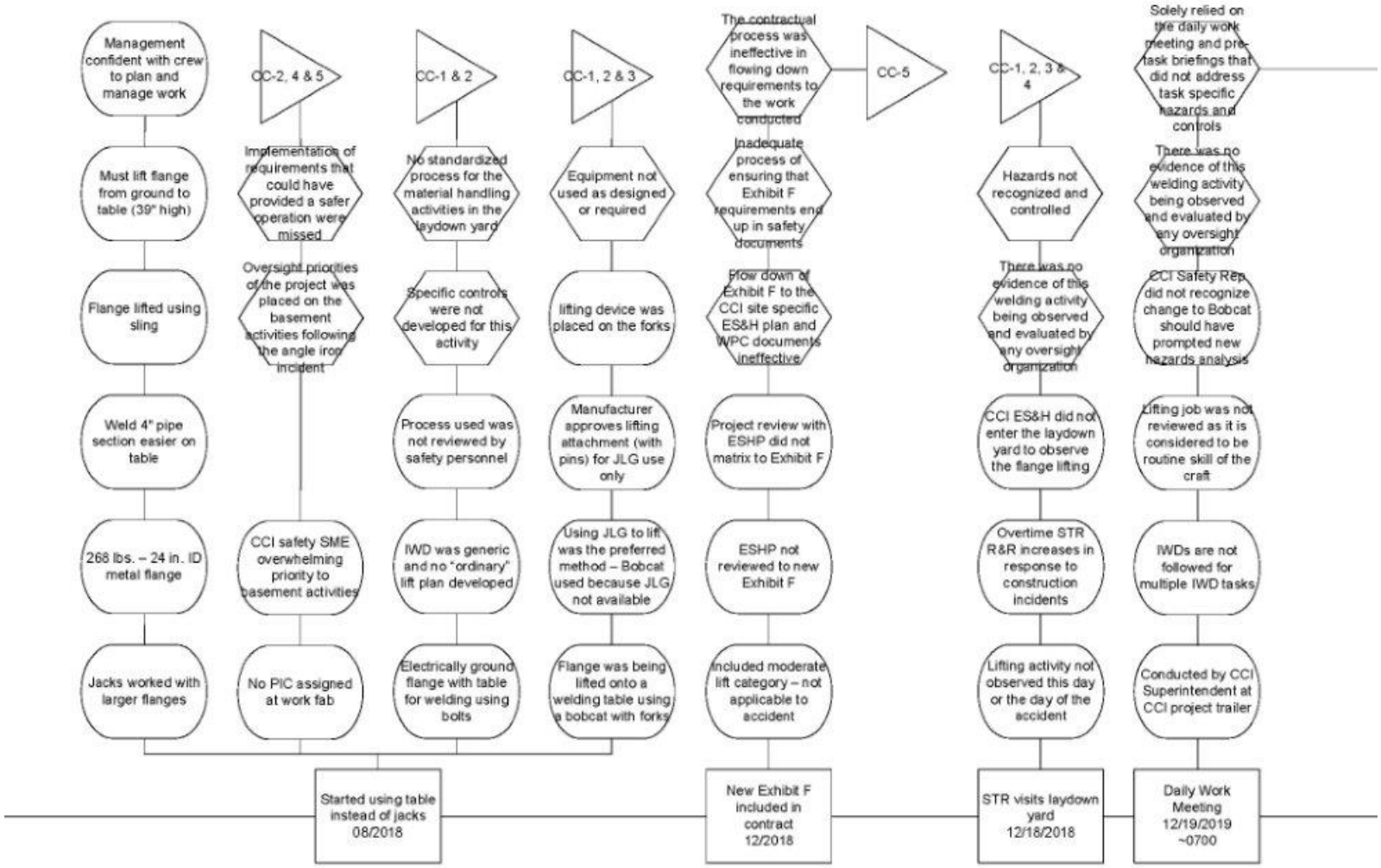


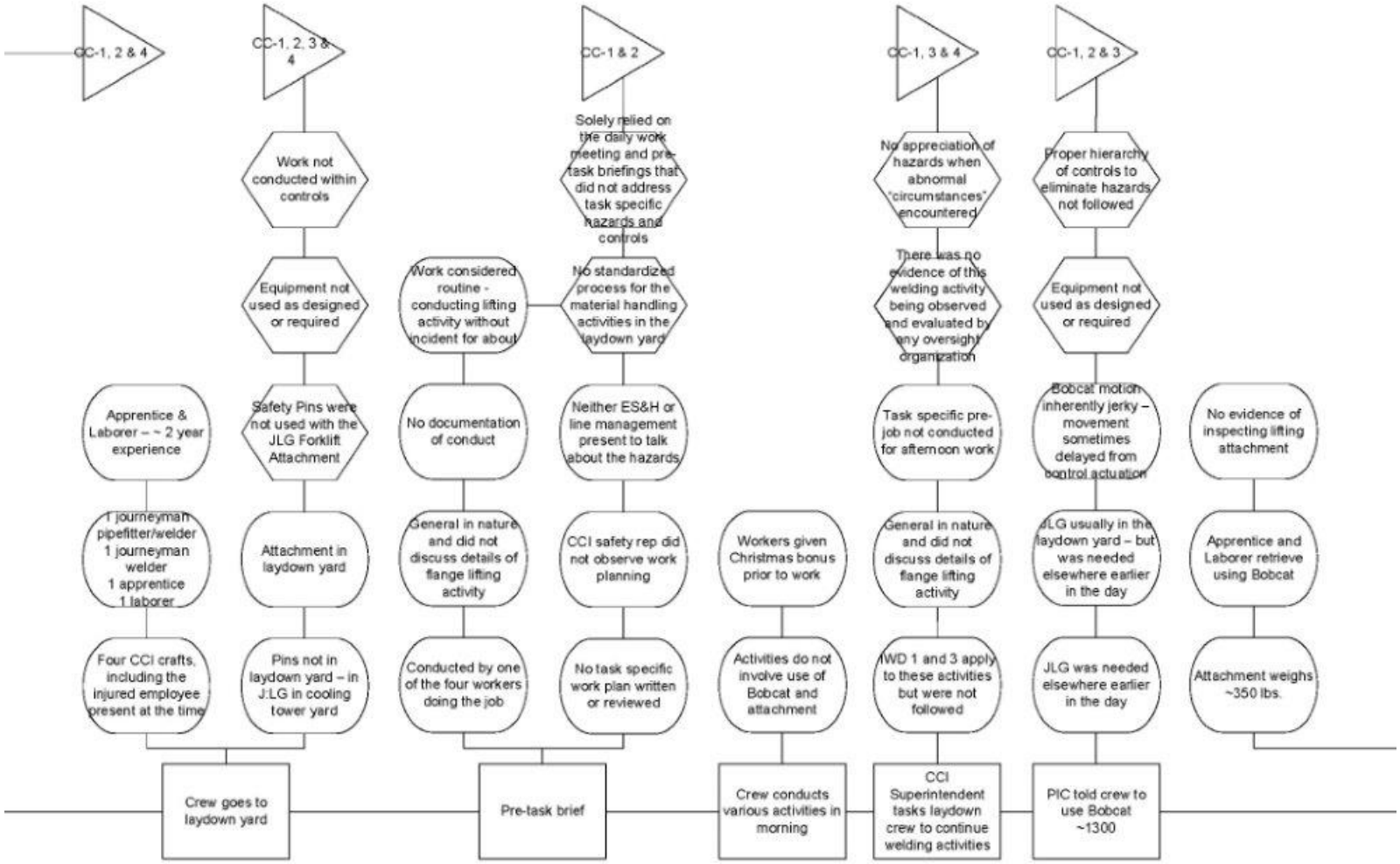

Clear indicators that the EVMS was less than adequate were ignored
CC-4
CC-2 & 3
CC-4
Government review of EVMS in 2013 and 2014 repeatedly identified system deficiencies
Evolving compliance interpretations often labeled as the real problem
NNSA and M&O oversight did not ensure adequate balance of safety oversight versus EVMS drivers
Actions taken following previous incidents were ineffective in identifying and preventing similar concerns in other locations
IPT created using LANL PM staff and subject matter experts
NNSA and M&O oversight did not ensure adequate balance of safety oversight versus EVMS drivers
Management actions to address adverse performance trends not fully informed or arrived too late
Over reliance on EVMS that was previously certified
Establish trust through demonstrated completion of corrected actions
Lessons Learned from previous incidents on controls and work area LTA
LANS PM Office to contract and manage project
PM functional review estimates project resources
System is failing to provide LANL project management with timely and accurate information
No demand for continuously improving system
Workforce reinforce toward building an effective EVMS versus resisting inevitable change
Independent to first cooling tower project
Subcontractor required to develop specific QAP required
Follows requirements of DOE O 414.1 D through LANL corporate QAP (SD330)
Multiple line item capital projects overrunning cost and schedule
Unable to recognize link between poor project performance and an under performing EVMS
LANL senior level management changes to derive desired outcome
JONs 8 on pre-job briefings and 12 on effective evaluations were identified as partially effective
DOE O 413.3B and 10 CFR 851 required
Subcontractor required to develop site specific ES&H Plan and IWD
Concurred 08/31/2017 – 10/02/2017
Projects > $20M
Systems problems
Cultural problems
CAP established - 210 actions - 18 months of effort to complete
Issues similar to this accident
NA-APM-1.5 project
Exhibit F for safety, Exhibit H for quality, Exhibit I for submittal requirements
Approved 08/31/2017
LANL achieves EVMS 07/01/2009
LANL EVMS authority cancelled 10/2014
LANL EVMS recertified by DOE-PM 10/2016
TA-53 Arc-Flash Accident May 2015
Inception Phase 2 second cooling tower
Contract language drafted

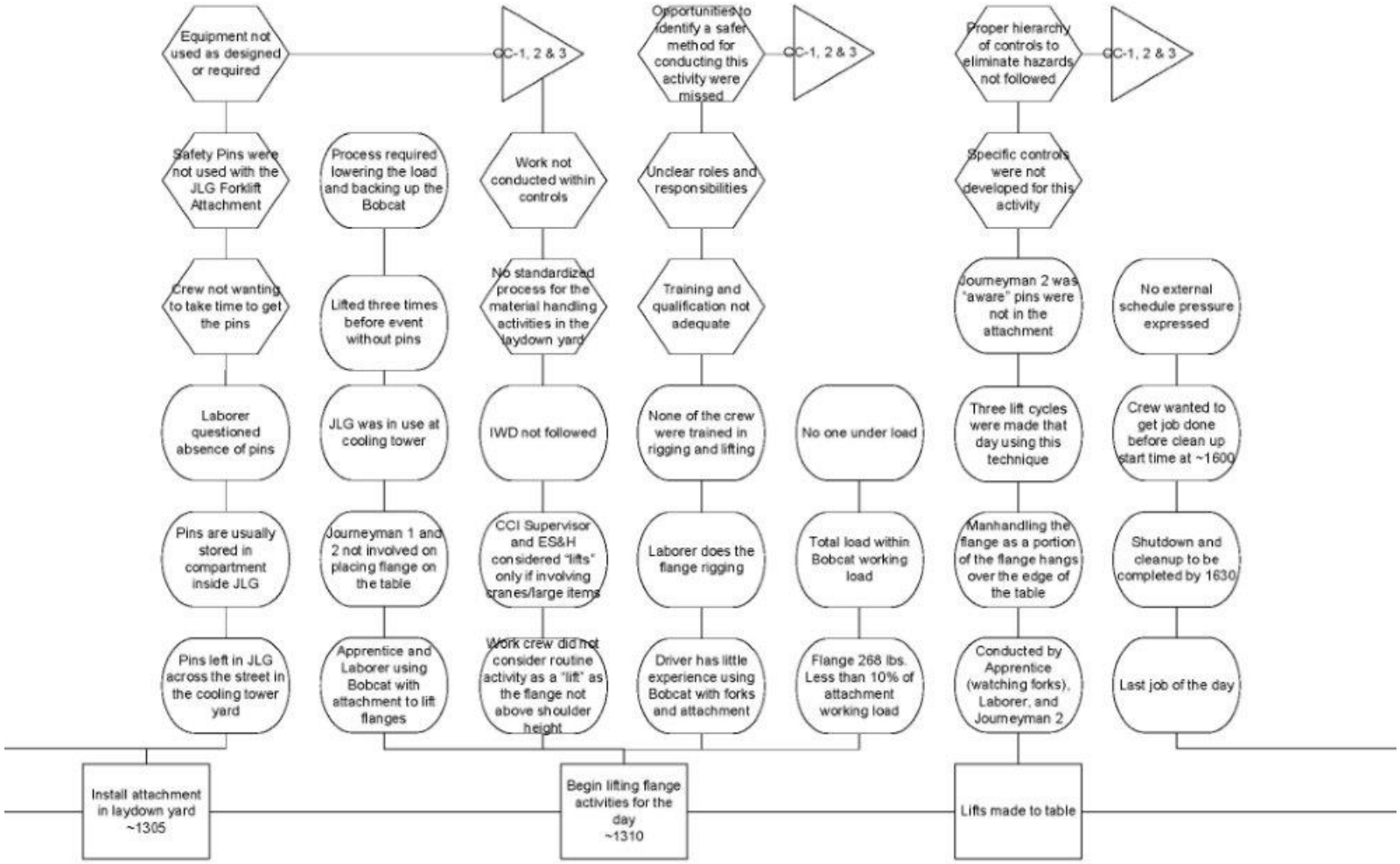

LANL Exascale QAP (PQMP) Rev. 1 08/12/2017
Subcontracts to meet appropriate federal and contractual requirements
Subcontractors performing work are to follow contract requirements in Exhibits D, H & I
Construction subcontractor must develop a QAP for the project to meet the PQMP requirements
Subcontractors responsible for performing work that meets the contract and their LANL approved QAP
RFP published seeking bids for project
Approved following project management processes
Best value evaluation
Pre-bid meeting
Discussed contract elements
Bidders allowed to question contract expectations, including Exhibit F
19 companies invited to bid
CCI attended
CCI was the contractor on the original project
Bid site visit
7 bidders attended
Walk down of site
Presentations by Triad on Exhibit F, etc.
Project Management bid review process
Two bids reviewed for appropriate bidder
CCI and one other
SMEs review submittals against Exhibit requirements
NA-APM oversees LANL contracting processes
Submittals provided to NA-APM per LANL P100-12
CCI awarded contract 04/19/2018
Post award meeting
Page turn through every contract requirement
CCI questions were answered or planned for answering by LANL personnel
Took one day to conduct

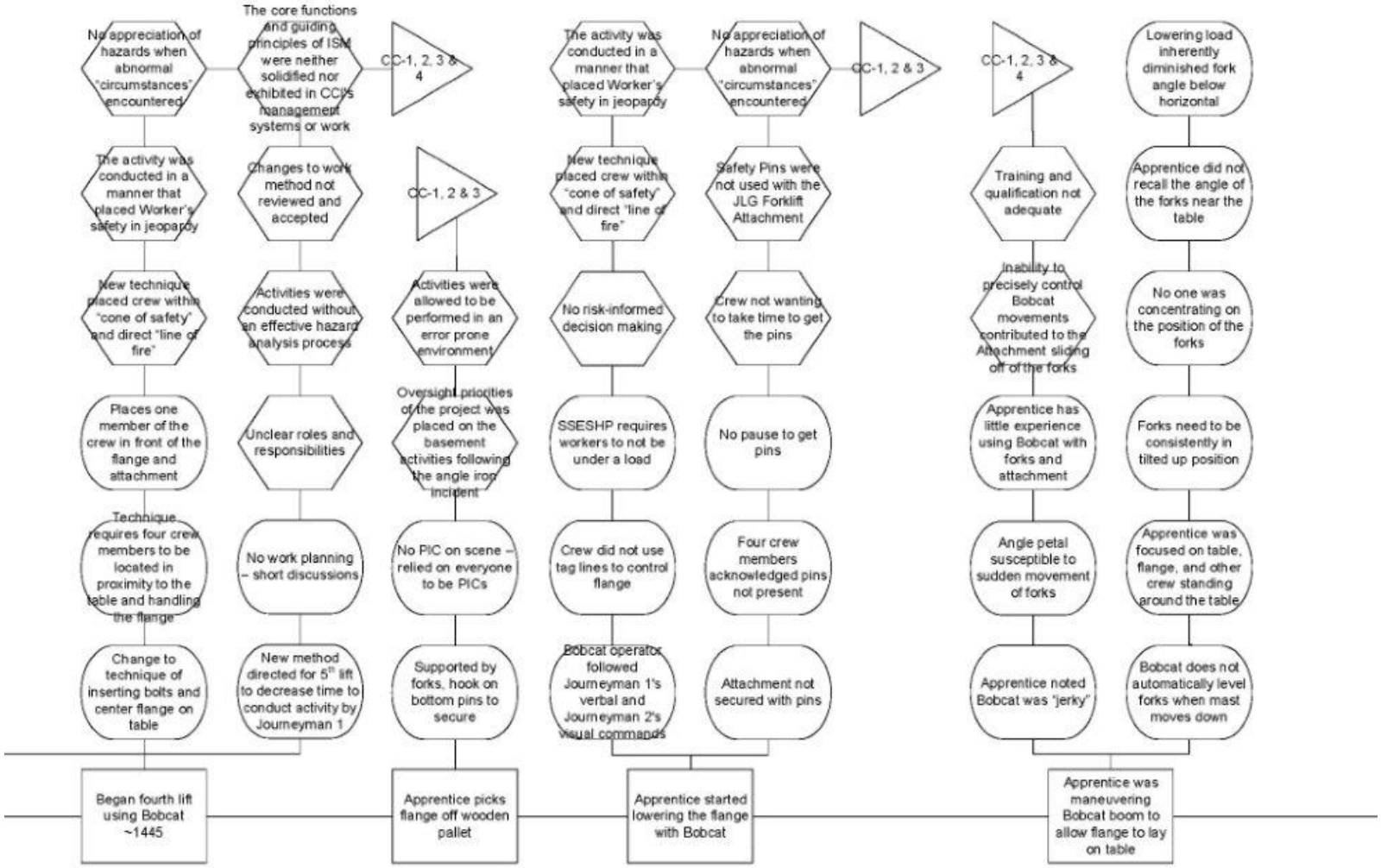

CC-5
Inadequate process of ensuring that Exhibit F requirements end up in safety documents
No incentives to conduct work, but identifies liquefied damages
Inadequate process for ensuring "requirements" are implemented in the work
Criteria for acceptable work performance and to promote improvement are to be used
Opportunities to identify improvements for effective assurance and oversight by the M&O were missed
Review process did not include review of implementing documents
DOE O 413.3B and 10 CFR 851 required
Procedures to be included in the IWDs and daily pre task planning forms
Independent assessments to conducted on a regularly scheduled basis, or unscheduled at any time
Inadequate process of ensuring that Exhibit F requirements end up in safety documents
STR coordinates review of SSESHP and IWD
IPT created using LANL PM staff and subject matter experts
First time CCI is using Indeed for safety
All work is a process - Processes are to be performed using approved work procedures by qualified workers
To receive oversight results from the LANL QA Representative
Inadequate process for ensuring "requirements" are implemented in the work
SMEs review SSESHP
LANS PM Office to contract and manage project
CCI believes that Indeed closely aligns with its safety culture
Developed per 10 CFR 830.120 - no reference to the LANL PQMP
CCI owner identified as conducting independent assessments
IWDs not walked down
CCI considers laydown yard activities to be routine and lower risk
Limited notice to proceed
Documents reviewed for compliance to bid requirements
Contract terms accepted by CCI
CCI changes safety subcontractor from Portage or Cloverleaf to Indeed
CCI owner identified as the QA Manager - Personnel are responsible for their safety and the quality of their work
Project superintendent inspects all work for quality and compliance
Full notice to proceed
Work fronts in TA 03-2327, cooling tower, and laydown/ fabrication yard
Notice to proceed 04/25/2018
Final submittal reviewed by LANL
Contract signed
CCI Exascale Project QAP, Rev. 3 05/16/2018
Subcontractor commences ECCCE work 05/24/2018

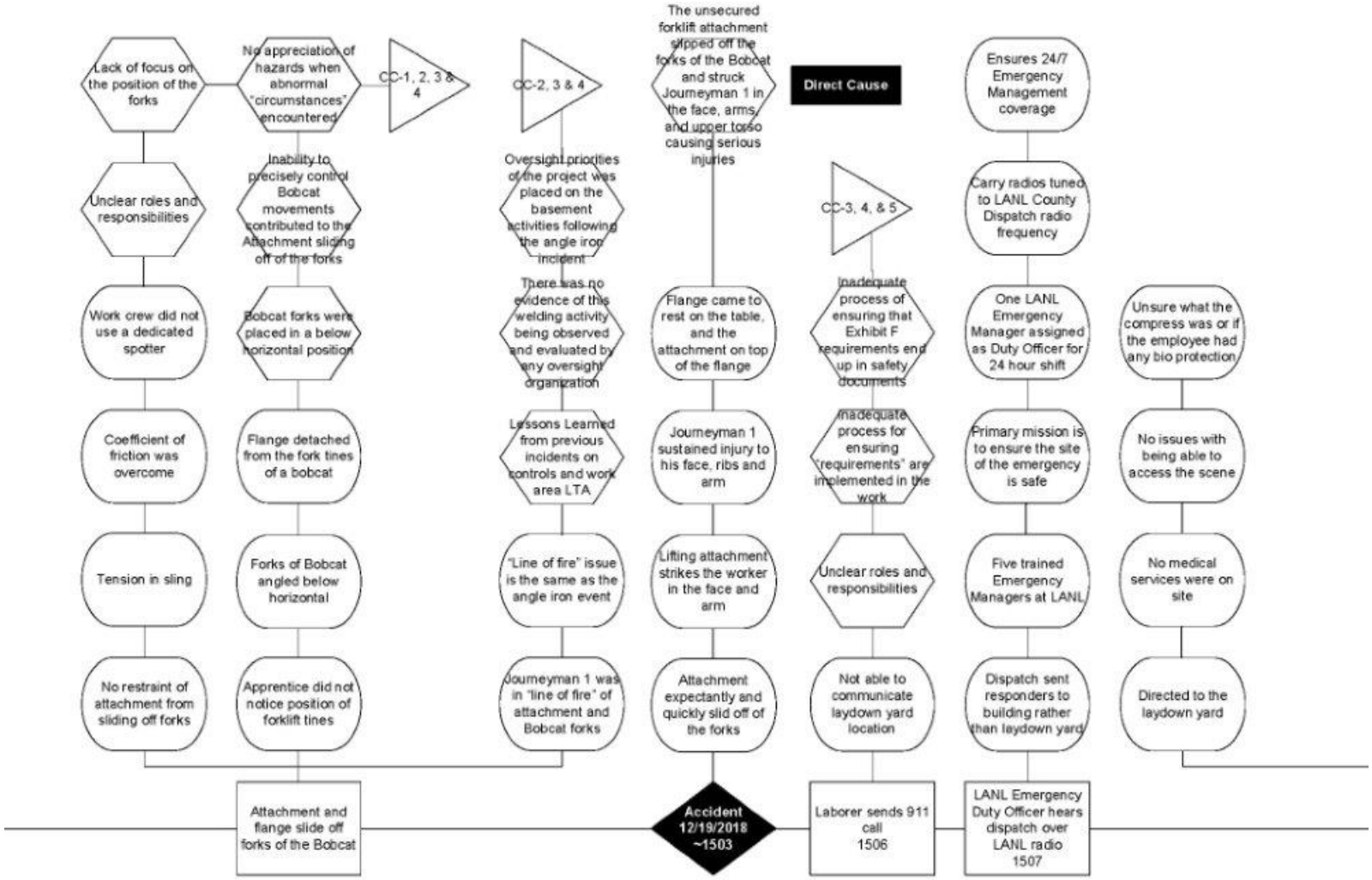

CC-4
Opportunities to identify and correct safety issues with the activity were missed
CC-2, 3 & 4
CC-1, 3 & 4
NNSA and M&O oversight did not ensure adequate balance of safety oversight versus EVMS drivers
Opportunities to identify and correct safety issues with the activity were missed
Lessons Learned from previous incidents on controls and work area LTA
Opportunities to identify and correct safety issues with the activity were missed
Activities were allowed to be performed in an error prone environment
PM staffing estimate: 1 FTE PM 3 FTE PC 0.5 FTE CM 0.25 FTE STR 0.25 FTE Safety Rep
New expectations for performance last only a few weeks
Did not address work planning
Effectiveness review not conducted
Actions taken following previous incidents were ineffective in identifying and preventing similar concerns in other locations
Workers were not held accountable to previously observed unsafe behaviors
Resources transition in and out of project based on LANL needs
Material handling method does not secure lifted angle iron
Cone of safety – LANL jargon and self imposed requirement
Increased STR to 1.0 FTE and Safety Rep to 0.5 FTE
Citation noted worker was "in line of fire" in violation of Exhibit F 1.2
No CAP to develop work planning
Opportunities to identify human performance improvement and a safer method for conducting this activity were missed
Deployed resources manage multiple projects
Reporting criterion 2A(5) – no corrective actions required in ORPS
Management Concern – no cone of safety
IWD updated per lessons learned
Issues identified
No effectiveness evaluation conducted based on completed corrective actions
Journeyman 1 had a "get it done attitude" - counseled to slow down
CCI Construction Manager focused on cost accounting and reporting
ORPS reportable NA--LASO-LANL-BOP-2018-0003
Root cause – project oversight
CCI developed corrective action plan from causal analysis
Issued by LANL STR
No change was made related to the equipment or procedures (due to required approval process)
Based on restart memo issued 07/26/2018
Observed and reported by LANL Project Safety SME
Angle iron incident 07/18/2018
Causal Analysis conducted on angle iron incident 07/2018
LANL PM issued project shutdown 07/19/2018
Safety Citation 07/20/2018
CCI CAP developed
Started controlled restart 07/30/2018
Journeyman 1 traversing on top of 36" pipe in TA-03-2373

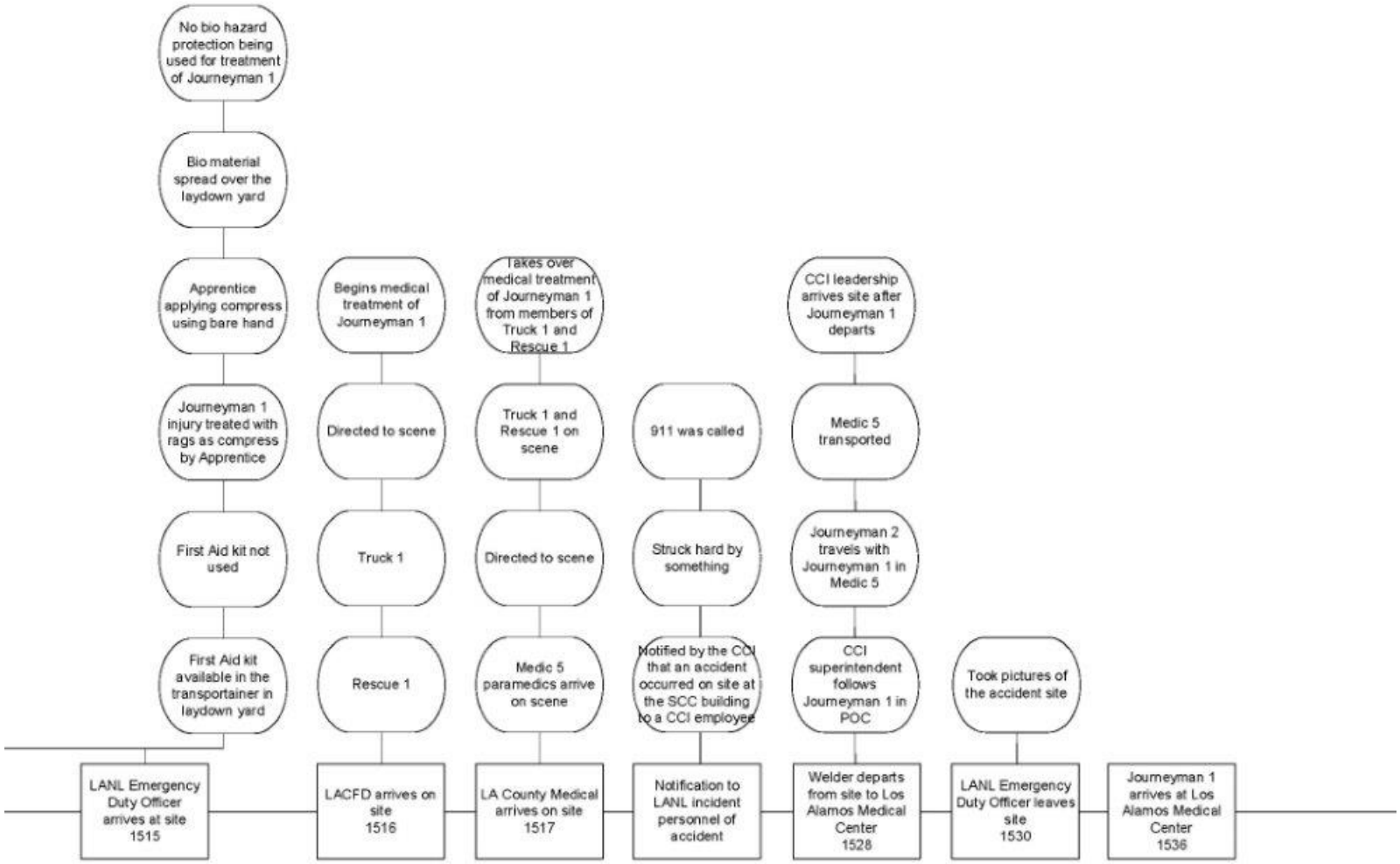

Management confident with crew to plan and manage work
Must lift flange from ground to table (39" high)
Flange lifted using sling
Weld 4" pipe section easier on table
268 lbs. – 24 in. ID metal flange
Jacks worked with larger flanges
CC-2, 4 & 5
Implementation of requirements that could have provided a safer operation were missed
Oversight priorities of the project was placed on the basement activities following the angle iron incident
CCI safety SME overwhelming priority to basement activities
No PIC assigned at work fab
CC-1 & 2
No standardized process for the material handling activities in the laydown yard
Specific controls were not developed for this activity
Process used was not reviewed by safety personnel
IWD was generic and no "ordinary" lift plan developed
Electrically ground flange with table for welding using bolts
CC-1, 2 & 3
Equipment not used as designed or required
lifting device was placed on the forks
Manufacturer approves lifting attachment (with pins) for JLG use only
Using JLG to lift was the preferred method – Bobcat used because JLG not available
Flange was being lifted onto a welding table using a bobcat with forks
The contractual process was ineffective in flowing down requirements to the work conducted
Inadequate process of ensuring that Exhibit F requirements end up in safety documents
Flow down of Exhibit F to the CCI site specific ES&H plan and WPC documents ineffective
Project review with ESHP did not matrix to Exhibit F
ESHP not reviewed to new Exhibit F
Included moderate lift category – not applicable to accident
CC-5
CC-1, 2, 3 & 4
Hazards not recognized and controlled
There was no evidence of this welding activity being observed and evaluated by any oversight organization
CCI ES&H did not enter the laydown yard to observe the flange lifting
Overtime STR R&R increases in response to construction incidents
Lifting activity not observed this day or the day of the accident
Solely relied on the daily work meeting and pre-task briefings that did not address task specific hazards and controls
There was no evidence of this welding activity being observed and evaluated by any oversight organization
CCI Safety Rep did not recognize change to Bobcat should have prompted new hazards analysis
Lifting job was not reviewed as it is considered to be routine skill of the craft
IWDs are not followed for multiple IWD tasks
Conducted by CCI Superintendent at CCI project trailer
Started using table instead of jacks 08/2018
New Exhibit F included in contract 12/2018
STR visits laydown yard 12/18/2018
Daily Work Meeting 12/19/2019 ~0700

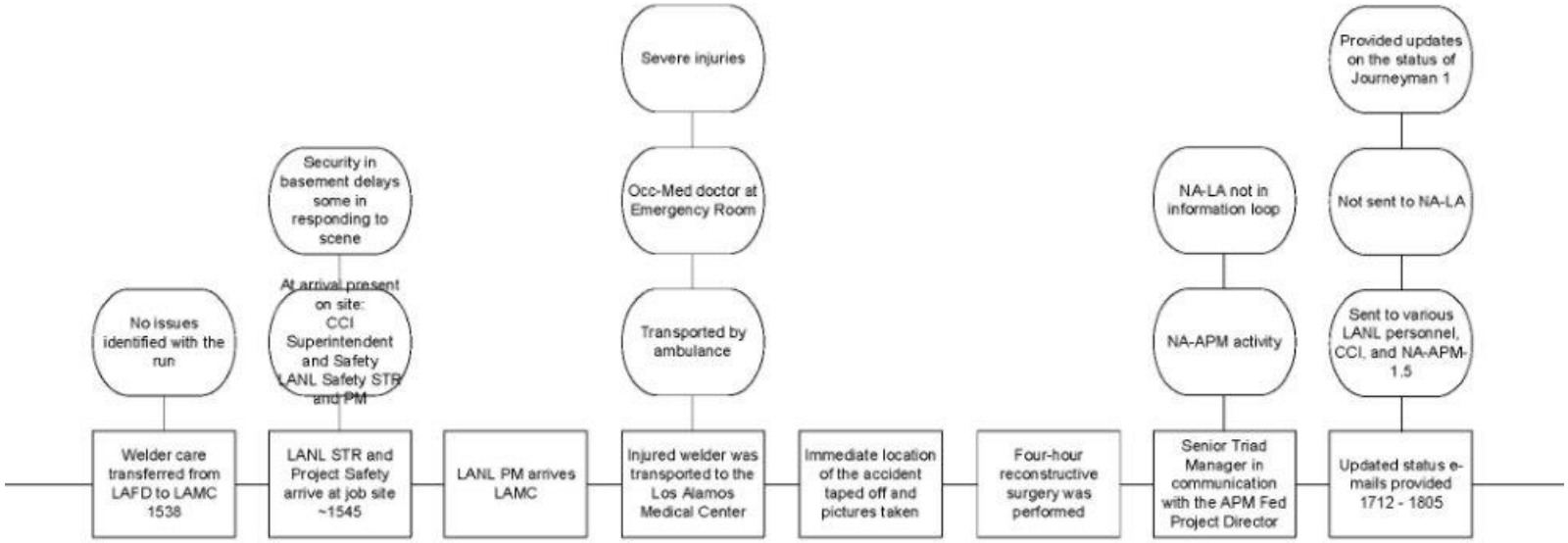

CC-1, 2 & 4
CC-1, 2, 3 & 4
CC-1 & 2
CC-1, 3 & 4
CC-1, 2 & 3
Work not conducted within controls
Solely relied on the daily work meeting and pre-task briefings that did not address task specific hazards and controls
No appreciation of hazards when abnormal "circumstances" encountered
Proper hierarchy of controls to eliminate hazards not followed
Equipment not used as designed or required
Work considered routine - conducting lifting activity without incident for about
No standardized process for the material handling activities in the laydown yard
There was no evidence of this welding activity being observed and evaluated by any oversight organization
Equipment not used as designed or required
Apprentice & Laborer – ~ 2 year experience
Safety Pins were not used with the JLG Forklift Attachment
No documentation of conduct
Neither ES&H or line management present to talk about the hazards
Task specific pre-job not conducted for afternoon work
Bobcat motion inherently jerky – movement sometimes delayed from control actuation
No evidence of inspecting lifting attachment
1 journeyman pipefitter/welder
1 journeyman welder
1 apprentice
1 laborer
Attachment in laydown yard
General in nature and did not discuss details of flange lifting activity
CCI safety rep did not observe work planning
Workers given Christmas bonus prior to work
General in nature and did not discuss details of flange lifting activity
JLG usually in the laydown yard – but was needed elsewhere earlier in the day
Apprentice and Laborer retrieve using Bobcat
Four CCI crafts, including the injured employee present at the time
Pins not in laydown yard – in J:LG in cooling tower yard
Conducted by one of the four workers doing the job
No task specific work plan written or reviewed
Activities do not involve use of Bobcat and attachment
IWD 1 and 3 apply to these activities but were not followed
JLG was needed elsewhere earlier in the day
Attachment weighs ~350 lbs.
Crew goes to laydown yard
Pre-task brief
Crew conducts various activities in morning
CCI Superintendent tasks laydown crew to continue welding activities
PIC told crew to use Bobcat ~1300

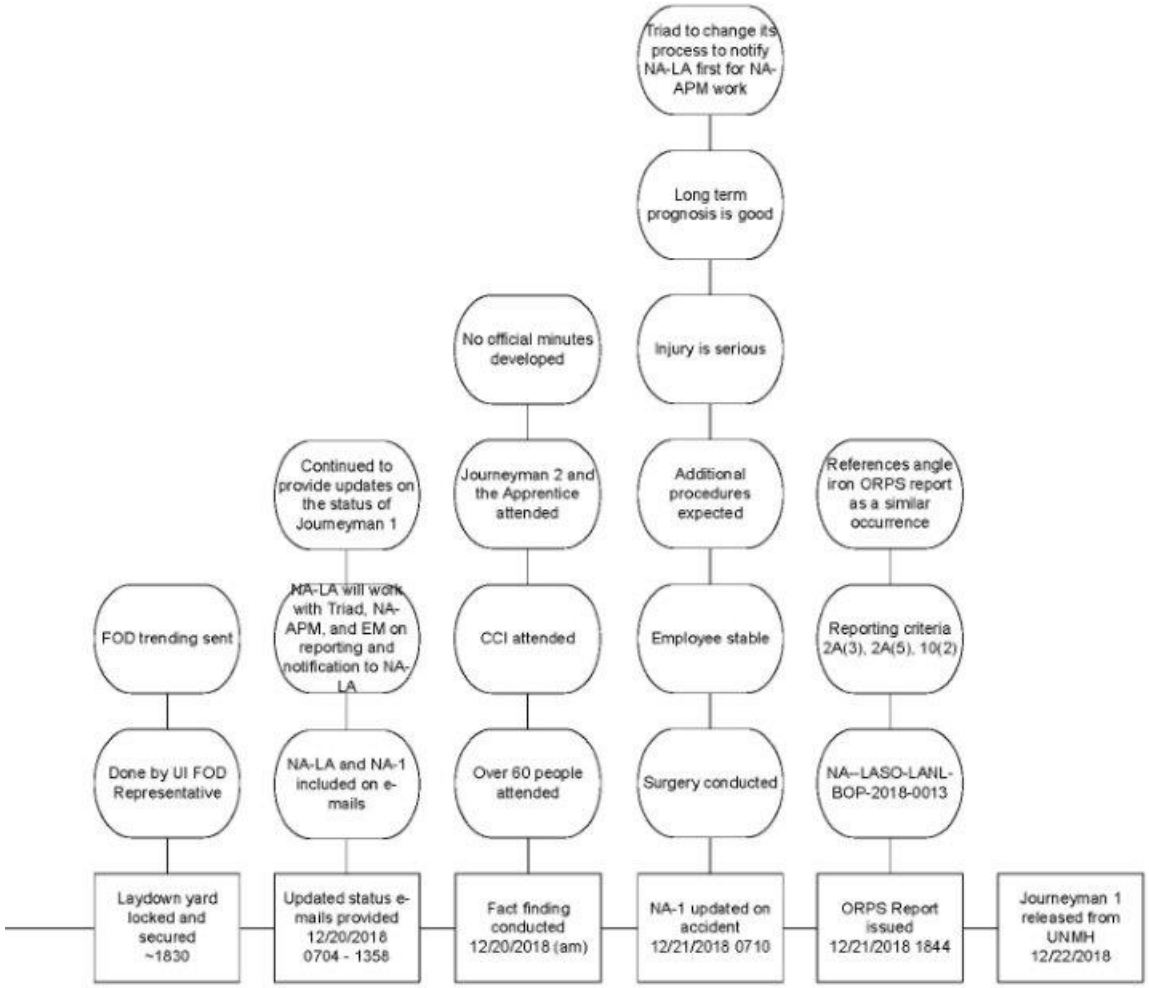

Equipment not used as designed or required
CC-1, 2 & 3
Opportunities to identify a safer method for conducting this activity were missed
CC-1, 2 & 3
Proper hierarchy of controls to eliminate hazards not followed
CC-1, 2 & 3
Safety Pins were not used with the JLG Forklift Attachment
Process required lowering the load and backing up the Bobcat
Work not conducted within controls
Unclear roles and responsibilities
Specific controls were not developed for this activity
Crew not wanting to take time to get the pins
Lifted three times before event without pins
No standardized process for the material handling activities in the laydown yard
Training and qualification not adequate
Journeyman 2 was "aware" pins were not in the attachment
No external schedule pressure expressed
Laborer questioned absence of pins
JLG was in use at cooling tower
IWD not followed
None of the crew were trained in rigging and lifting
No one under load
Three lift cycles were made that day using this technique
Crew wanted to get job done before clean up start time at ~1600
Pins are usually stored in compartment inside JLG
Journeyman 1 and 2 not involved on placing flange on the table
CCI Supervisor and ES&H considered "lifts" only if involving cranes/large items
Laborer does the flange rigging
Total load within Bobcat working load
Manhandling the flange as a portion of the flange hangs over the edge of the table
Shutdown and cleanup to be completed by 1630
Pins left in JLG across the street in the cooling tower yard
Apprentice and Laborer using Bobcat with attachment to lift flanges
Work crew did not consider routine activity as a "lift" as the flange not above shoulder height
Driver has little experience using Bobcat with forks and attachment
Flange 268 lbs. Less than 10% of attachment working load
Conducted by Apprentice (watching forks), Laborer, and Journeyman 2
Last job of the day
Install attachment in laydown yard ~1305
Begin lifting flange activities for the day ~1310
Lifts made to table


No appreciation of hazards when abnormal "circumstances" encountered
The core functions and guiding principles of ISM were neither solidified nor exhibited in CCI's management systems or work
CC-1, 2, 3 & 4
The activity was conducted in a manner that placed Worker's safety in jeopardy
Changes to work method not reviewed and accepted
CC-1, 2 & 3
New technique placed crew within "cone of safety" and direct "line of fire"
Activities were conducted without an effective hazard analysis process
Activities were allowed to be performed in an error prone environment
Places one member of the crew in front of the flange and attachment
Unclear roles and responsibilities
Oversight priorities of the project was placed on the basement activities following the angle iron incident
Technique requires four crew members to be located in proximity to the table and handling the flange
No work planning – short discussions
No PIC on scene – relied on everyone to be PICs
Change to technique of inserting bolts and center flange on table
New method directed for 5th lift to decrease time to conduct activity by Journeyman 1
Supported by forks, hook on bottom pins to secure
Began fourth lift using Bobcat ~1445
Apprentice picks flange off wooden pallet
The activity was conducted in a manner that placed Worker's safety in jeopardy
No appreciation of hazards when abnormal "circumstances" encountered
CC-1, 2 & 3
New technique placed crew within "cone of safety" and direct "line of fire"
Safety Pins were not used with the JLG Forklift Attachment
No risk-informed decision making
Crew not wanting to take time to get the pins
SSESHP requires workers to not be under a load
No pause to get pins
Crew did not use tag lines to control flange
Four crew members acknowledged pins not present
Bobcat operator followed Journeyman 1's verbal and Journeyman 2's visual commands
Attachment not secured with pins
Apprentice started lowering the flange with Bobcat
CC-1, 2, 3 & 4
Lowering load inherently diminished fork angle below horizontal
Training and qualification not adequate
Apprentice did not recall the angle of the forks near the table
Inability to precisely control Bobcat movements contributed to the Attachment sliding off of the forks
No one was concentrating on the position of the forks
Apprentice has little experience using Bobcat with forks and attachment
Forks need to be consistently in tilted up position
Angle petal susceptible to sudden movement of forks
Apprentice was focused on table, flange, and other crew standing around the table
Apprentice noted Bobcat was "jerky"
Bobcat does not automatically level forks when mast moves down
Apprentice was maneuvering Bobcat boom to allow flange to lay on table


Lack of focus on the position of the forks
No appreciation of hazards when abnormal "circumstances" encountered
CC-1, 2, 3 & 4
CC-2, 3 & 4
The unsecured forklift attachment slipped off the forks of the Bobcat and struck Journeyman 1 in the face, arms, and upper torso causing serious injuries
Direct Cause
Ensures 24/7 Emergency Management coverage
Unclear roles and responsibilities
Inability to precisely control Bobcat movements contributed to the Attachment sliding off of the forks
Oversight priorities of the project was placed on the basement activities following the angle iron incident
CC-3, 4, & 5
Carry radios tuned to LANL County Dispatch radio frequency
Work crew did not use a dedicated spotter
Bobcat forks were placed in a below horizontal position
There was no evidence of this welding activity being observed and evaluated by any oversight organization
Flange came to rest on the table, and the attachment on top of the flange
Inadequate process of ensuring that Exhibit F requirements end up in safety documents
One LANL Emergency Manager assigned as Duty Officer for 24 hour shift
Unsure what the compress was or if the employee had any bio protection
Coefficient of friction was overcome
Flange detached from the fork tines of a bobcat
Lessons Learned from previous incidents on controls and work area LTA
Journeyman 1 sustained injury to his face, ribs and arm
Inadequate process for ensuring "requirements" are implemented in the work
Primary mission is to ensure the site of the emergency is safe
No issues with being able to access the scene
Tension in sling
Forks of Bobcat angled below horizontal
"Line of fire" issue is the same as the angle iron event
Lifting attachment strikes the worker in the face and arm
Unclear roles and responsibilities
Five trained Emergency Managers at LANL
No medical services were on site
No restraint of attachment from sliding off forks
Apprentice did not notice position of forklift tines
Journeyman 1 was in "line of fire" of attachment and Bobcat forks
Attachment expectantly and quickly slid off of the forks
Not able to communicate laydown yard location
Dispatch sent responders to building rather than laydown yard
Directed to the laydown yard
Attachment and flange slide off forks of the Bobcat
Accident 12/19/2018 ~1503
Laborer sends 911 call 1506
LANL Emergency Duty Officer hears dispatch over LANL radio 1507


No bio hazard protection being used for treatment of Journeyman 1
Bio material spread over the laydown yard
Apprentice applying compress using bare hand
Journeyman 1 injury treated with rags as compress by Apprentice
First Aid kit not used
First Aid kit available in the transportainer in laydown yard
LANL Emergency Duty Officer arrives at site 1515
Begins medical treatment of Journeyman 1
Directed to scene
Truck 1
Rescue 1
LACFD arrives on site 1516
Takes over medical treatment of Journeyman 1 from members of Truck 1 and Rescue 1
Truck 1 and Rescue 1 on scene
Directed to scene
Medic 5 paramedics arrive on scene
LA County Medical arrives on site 1517
911 was called
Struck hard by something
Notified by the CCI that an accident occurred on site at the SCC building to a CCI employee
Notification to LANL incident personnel of accident
CCI leadership arrives site after Journeyman 1 departs
Medic 5 transported
Journeyman 2 travels with Journeyman 1 in Medic 5
CCI superintendent follows Journeyman 1 in POC
Welder departs from site to Los Alamos Medical Center 1528
Took pictures of the accident site
LANL Emergency Duty Officer leaves site 1530
Journeyman 1 arrives at Los Alamos Medical Center 1536


Welder care transferred from LAFD to LAMC 1538
No issues identified with the run
LANL STR and Project Safety arrive at job site ~1545
At arrival present on site: CCI Superintendent and Safety LANL Safety STR and PM
Security in basement delays some in responding to scene
LANL PM arrives LAMC
Injured welder was transported to the Los Alamos Medical Center
Transported by ambulance
Occ-Med doctor at Emergency Room
Severe injuries
Immediate location of the accident taped off and pictures taken
Four-hour reconstructive surgery was performed
Senior Triad Manager in communication with the APM Fed Project Director
NA-APM activity
NA-LA not in information loop
Updated status e-mails provided 1712 - 1805
Sent to various LANL personnel, CCI, and NA-APM-1.5
Not sent to NA-LA
Provided updates on the status of Journeyman 1


Triad to change its process to notify NA-LA first for NA-APM work
Long term prognosis is good
No official minutes developed
Injury is serious
Continued to provide updates on the status of Journeyman 1
Journeyman 2 and the Apprentice attended
Additional procedures expected
References angle iron ORPS report as a similar occurrence
FOD trending sent
NA-LA will work with Triad, NA-APM, and EM on reporting and notification to NA-LA
CCI attended
Employee stable
Reporting criteria 2A(3), 2A(5), 10(2)
Done by UI FOD Representative
NA-LA and NA-1 included on e-mails
Over 60 people attended
Surgery conducted
NA--LASO-LANL-BOP-2018-0013
Laydown yard locked and secured ~1830
Updated status e-mails provided 12/20/2018 0704 - 1358
Fact finding conducted 12/20/2018 (am)
NA-1 updated on accident 12/21/2018 0710
ORPS Report issued 12/21/2018 1844
Journeyman 1 released from UNMH 12/22/2018