

U.S. Department of Energy
Office of Environmental Management

Accident Investigation Report



Fall Injury Accident at the Savannah River Site on July 1, 2011

August 8, 2011

Disclaimer

This report is an independent product of the Accident Investigation Board appointed by Dae Y. Chung, Principal Deputy Assistant Secretary for Environmental Management, U.S. Department of Energy. The Board was appointed to perform an Accident Investigation and to prepare an investigation report in accordance with Department of Energy (DOE) Order 225.1B, *Accident Investigations*.

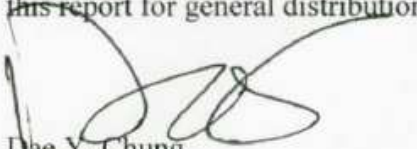
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This report neither determines nor implies liability.

Release Authorization

On July 8, 2011, an Accident Investigation Board was appointed to investigate the fall injury event during facility modifications in the Purification Area Vault of Building 105-K at the Savannah River Site (SRS) on July 1, 2011. The Board's responsibilities have been completed with respect to this investigation. The analyses and the identification of the contributing causes, the root cause and the Judgments of Need resulting from this investigation were performed in accordance with DOE Order 225.1B, *Accident Investigations*.

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



Dae Y. Chung
Principal Deputy Assistant Secretary
Environmental Management

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Legend

L1	Laborer 1
L2	Laborer 2
L3	Laborer 3
C1	Carpenter 1
C2	Carpenter 2
C3	Carpenter 3
DCF	Detailed Carpenter Foreman (also Competent Person CP)
DLF	Detailed Laborer Foreman
CS	Construction Superintendent
IW	Injured Worker

Acronyms

8Q-16	SRNS Procedure 8Q-16, Ladder and Scaffold Safety Requirements
AED	Automated External Defibrillator
AHA	Assisted Hazards Analysis
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
CA/MP	Causal Analysis/Mistake Proofing
CCR	Central Control Room
CDE	Construction Discipline Engineer
CPR	Cardiopulmonary Resuscitation
CS	Construction Superintendent
CSE	Construction Safety Engineer
DCF	Detailed Carpenter Foreman
DLF	Detailed Labor Foreman
DOE	United States Department of Energy
DOE G	DOE Guide
DOE O	DOE Order
DOE M	DOE Manual
DS	Detailed Superintendent
ECF	Events and Causal Factors
EPD	Electronic Personal Dosimeter
FR	Facility Representative
HPI	Human Performance Improvement
IH	Industrial Hygiene
ISMS	Integrated Safety Management System
JON	Judgment of Need
KAC	K-Area Complex
KAMS	K-Area Material Storage
KIS	K -Area Interim Surveillance
LWGS	Lead Work Group Supervisor
M&O	Management and Operating

MSP	Modified Safety Plan
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety & Health Administration
PAV	Purification Area Vault
POD	Plan of the Day
PPE	Personal Protective Equipment
RWP	Radiological Work Permit
SIMTAS	Savannah River Integrated Management Total Accountability System
SNM	Special Nuclear Material
SOM	Shift Operations Manager
SR	Savannah River Operations Office
SRNS	Savannah River Nuclear Solutions
SRS	Savannah River Site
SRSOC	Savannah River Site Operations Center
SRSFD	Savannah River Site Fire Department
SSA	Site Support Alliance
SWP	Safe Work Permit
TCP	Transient Combustibles Permit
TRAIN	Training Records and Information System
USQ	Unreviewed Safety Question
WO	Work Order
WSI-SRS	WSI-Savannah River Site

Executive Summary

Introduction

On July 1, 2011, a worker fell from portable scaffolding during facility modifications in the Purification Area Vault (PAV) of Building 105-K at the Savannah River Site (SRS). The worker required hospitalization due to sustained head injury and numerous broken ribs. This accident meets Accident Investigation Criteria 2.a.2 of Appendix A of DOE Order 225.1B, *Accident Investigations* (i.e. hospitalization of the injured worker for more than five calendar days, commencing within seven calendar days of the accident). Based on the severity of this accident, the Office of Environmental Management began assembling an accident investigation team on July 5, 2011. On July 8, 2011, Dae Y. Chung, Principal Deputy Assistant Secretary for Environmental Management, U.S. Department of Energy, formally appointed an Accident Investigation Board to investigate the accident in accordance with DOE Order 225.1B. The Board began the investigation on July 12, 2011, completed the investigation on July 28, 2011, and submitted findings to the Principal Deputy Assistant Secretary for Environmental Management on August 5, 2011.

Accident Description

On the afternoon of July 1, 2011 while performing construction activities on a scaffold (Tele-Tower®) to support the Purification Area Vault (PAV) a detailed superintendent fell onto a concrete floor. The injured worker (IW) was immediately attended to by co-workers in the area and emergency response was summoned via phone and radio within several minutes. First responders arrived at the scene of the accident within about five minutes. After assessing the workers condition, the worker was transported to the MCG Health Medical Center via SRS helicopter. The worker sustained head trauma and broken ribs. The IW remains under medical care and has not returned to work.

Direct, Root, and Contributing Causes

Direct Cause - the immediate events or conditions that caused the accident. The Board concluded the direct cause of the accident was the IW fell from the Tele-Tower® scaffold.

Root Cause(s) – are causal factors that, if corrected, would prevent recurrence of the same or similar accidents. The Board identified the root cause of this accident as SRNS did not recognize and correct unsafe work practices being performed prior to or during the work on the day of the accident.

Contributing Causes - events or conditions that collectively with other causes increased the likelihood of an accident but that individually did not cause the accident. The Board identified 21 contributing causes to the accident.

Conclusions and Judgments of Need

Based upon the results of this accident investigation, the Board concluded that this accident was preventable.

Table ES-1 summarizes the conclusions and Judgments of Need (JON) determined by the Board. The conclusions are those the Board considered significant and are based on facts and pertinent analytical results. Judgments of Need are managerial controls and safety measures believed by the Board to be necessary to prevent or minimize the probability or severity of a recurrence of this type of accident. Judgments of Need are derived from the conclusions and causal factors and are intended to assist managers in developing corrective actions.

Note: Some of the following Judgments of Need address broad actions of analyzing programs and procedures to address the issues identified by the Board. It is recommended that the JONs be reviewed with the corresponding conclusions and causal factor analyses in this report to ensure a comprehensive corrective action plan is developed.

Table ES-1: Conclusions and Judgments of Need

Conclusions	Judgments of Need
<p>The Board concluded:</p> <p>There was no defined process for detailing workers to foreman and superintendent positions.</p> <p>No management expectations or position responsibilities were identified for the position of foreman or detailed foreman.</p> <p>There was no established process to assure all workers at the job site understood who the detailed foremen and detailed superintendent were on the day of the accident.</p> <p>Also, risky behaviors being displayed by the group coupled with a lack of safety professional and supervisory oversight indicates that resources may not have been effectively allocated to support the task.</p> <p>SRNS failed to ensure clear lines of authority and responsibility were defined, communicated and understood for the detailed superintendent and foremen.</p>	<p>SRNS needs to establish and ensure clear lines of authority and responsibility are defined, communicated and understood for detailing personnel into a supervisory or leadership role.</p>

Conclusions	Judgments of Need
<p>The Board concluded that ambiguities in the requirements, inconsistencies in the steps, and lack of Safety Professional involvement (outside of electronic document approval) in the planning process to ensure hazards are mitigated resulted in the creation of a WO that did not establish the necessary controls to safely execute the specified work scope.</p> <p>The Board concluded that on the day of the accident, the work crew improvised additional methods for wallboard removal and handling that deviated from the prescribed hazard controls in the WO and the AHA without consideration to reanalyze the hazards.</p> <p>The execution of the AHA process did not drive the planning to consider alternate methods to provide elevated work platforms involving less risk.</p> <p>The Board concluded that the prescribed hazard controls for the work were not sufficiently tailored to the work activity, placing the workers at increased risk to workplace injury.</p>	<p>In accordance with 48 CFR 970.5223-1 and 10 CFR 851 SRNS needs to strengthen implementation of the work planning process to include:</p> <ul style="list-style-type: none"> • Application of the graded approach to consider more rigorous means of identifying hazards • Remove the ambiguities (e.g., when necessary, as required) which are left to the craft's decision for implementation • Clearly identify hazards and controls such that when workers approach safety boundaries a re-evaluation is performed. <p>SRNS should conduct an extent of condition review to determine the breadth of work planning improvements necessary to complete a comprehensive corrective action plan.</p>
<p>The company construction management (CMP11-1.1, Rev 5) policy and the AHA failed to identify the appropriate work shoes for the activity.</p> <p>The selection and condition of the IW's footwear was not appropriate for the work environment.</p>	<p>SRNS needs to evaluate and modify (with justification) construction management procedures and AHA process for specifying proper footwear for construction activities in consideration of the abrasion, impact hazards of falling objects, slip hazards and sole penetrations encountered during construction activities.</p> <p>SRNS need to ensure workers are complying with the requirements for proper footwear in construction areas.</p>

Conclusions	Judgments of Need
<p>The Board concluded that the training equivalency of ES200027 Fall Protection does not cover the scope of scaffolding assembly, use and disassembly of current scaffolding available for use at SRS as contained in the current “Scaffold and Ladder Safety for Users” Course number TMAR4400.</p> <p>The Board concluded that six of eight workers present during the accident were not formally trained on the Tele-Tower® scaffolding.</p> <p>Scaffolding inspections by scaffold users and competent persons did not assure the configuration, placement and condition of the scaffold was safe to use.</p> <p>The Board concluded that the configuration, inspections, and use of scaffolding did not meet the requirements of OSHA.</p> <p>SRNS failed to review changing requirements and assure workers have the knowledge, skills and abilities to safely operate Tele-Tower® portable scaffolding.</p>	<p>SRNS needs to evaluate and modify the procedures, training and proficiency for scaffold users and competent persons to ensure that scaffolding is erected and used in accordance with OSHA requirements and 10 CFR 851.</p>
<p>SRNS management and safety professionals were not present to ensure the safe performance of work while work was in progress.</p>	<p>SRNS needs to evaluate and modify their oversight process to ensure all activities that pose a risk to worker injury are receiving appropriate oversight including backshifts.</p>

Conclusions	Judgments of Need
<p>DOE oversight was not present to ensure the safe performance of work while work was in progress on that day.</p> <p>The Board concluded that the oversight is being conducted of higher risk and high visibility activities. However, the oversight of low/medium risk activities is not being given the same attention. Program support personnel should increase field oversight presence.</p> <p>The frequency and quality of communication between the project and program office (subject matter experts) could be improved to better share emerging issues and integrate oversight resources.</p>	<p>DOE needs to evaluate and modify their oversight process to ensure all activities that pose a risk to worker injury are receiving appropriate oversight including backshifts. The program support personnel need to increase field oversight presence.</p>
<p>SRNS failed to identify and resolve conflicts between the vendor's instructional video (required training) and 8Q-16 requirements for ladder access.</p>	<p>SRNS needs to review and resolve differences between 8Q-16, OSHA, and vendor requirements.</p>
<p>The pre-job briefs were conducted inconsistently and did not result in all workers having a common understanding of the scope of work and hazard controls to mitigate work place risk.</p>	<p>SRNS needs to evaluate and modify the process for conducting pre-job briefings to ensure that workers have a full understanding of the scope of work and the prescribed hazard controls.</p>
<p>The Board concluded that the work authorization process, as executed for this WO, did not ensure that the control of work contained the necessary level of rigor to ensure that facility conditions continued to support the work being performed.</p>	<p>SRNS needs to evaluate and modify the process for authorizing work to ensure that the SOM keeps informed of on-going work activities to ensure there are no impacts on Operations or vice versa.</p>
<p>The Board concluded that the work environment and Personal Protective Equipment (PPE) requirements did not constitute a condition which may have led to a heat stress related accident.</p>	<p>No action required.</p>

Conclusions	Judgments of Need
<p>The Board concluded that there are several opportunities for SRNS to learn from this event to improve the implementation of their HPI program. Implementation needs to ensure:</p> <ul style="list-style-type: none"> - People are consistently using the HPI tools to: <ol style="list-style-type: none"> 1. Catch human errors before they have unwanted consequences, and 2. Identify and eliminate organizational weaknesses that provoke error. - Leaders are: <ol style="list-style-type: none"> 1. Facilitating open communications, 2. Reinforcing desired behaviors 3. Eliminating latent organizational weaknesses, and 4. Demonstrating a value for error prevention. 	<p>SRNS needs to evaluate the implementation of HPI to ensure that it is effectively implemented.</p>
<p>The Board concluded that numerous feedback mechanisms are implemented at SRS. These feedback mechanisms did not identify similar deficiencies as identified by the Board.</p>	<p>SRNS needs to evaluate and modify the utilization of feedback mechanisms in planning and execution of work in accordance with 48 CFR 970.5223-1.</p>
<p>The Board concluded that the accident scene was adequately preserved.</p> <p>The Board also concluded that the worker's participation in CA/MP exercise could have impacted their ability to recall events surrounding the accident.</p> <p>The WO was not obtained and controlled following the accident. Several changes and updates occurred as late as 7/6/11.</p>	<p>SRNS needs to evaluate and modify the process to control associated documents and take appropriate measures to preserve the integrity of individual testimony.</p> <p>DOE needs to evaluate and modify the process to control associated documents and take appropriate measures to preserve the integrity of individual testimony.</p>

1.0 Introduction

The content of this report identifies additional issues that did not result in a conclusion or a judgment of need. However, the Board recommends they be considered when developing corrective action plans.

1.1. Background

The K-Area Complex (KAC) is centrally located within the Savannah River Site (SRS), in Barnwell County, South Carolina. The nearest site boundary to the KAC is 5.5 miles (or 8.86 kilometers). The principle operations building within the KAC (i.e., Building 105-K) formerly housed the K Reactor, which was originally constructed and operated in the 1950's to produce nuclear material to support the United States during the Cold War.

1.2. Facility Description

The KAC was originally known as K Area, which included the K Reactor Facility, Building 105-K. The K Reactor Facility operated until it entered an outage in April 1988. In 1996, Department of Energy (DOE) directed the site contractor to place the K Reactor Facility into a shutdown condition with no capability for restart. The KAC was directed to begin plutonium storage in 1997. In some cases, areas continue to be referred to by their former designation, as used when Building 105-K was an operating reactor. These areas include the Purification Area Vault (PAV). Modifications are being made to the PAV to prepare the area for a future storage mission.

1.3. Facility Mission

The KAC mission provides for the handling and interim storage of excess plutonium and other Special Nuclear Material (SNM) in a safe and environmentally sound manner.

1.4. Contractual Relationship

The SRS M&O contract is a cost-plus award-fee contract valued at approximately \$4 billion. The contract has a five-year base period with the option to extend it for up to five additional years. The key mission areas include: environmental cleanup, operation of the Savannah River National Laboratory (SRNL), NNSA activities, and landlord services and site support. Environmental cleanup activities include management of spent nuclear fuel, nuclear materials, and high-level radioactive waste; deactivation and decommissioning of excess facilities; and remediation of soil and groundwater. In support of the DOE national security and non-proliferation programs, the NNSA activities include operation of the tritium facilities, completion of the plutonium disposition program, and disposition of highly enriched uranium. SRNS assumed management and operation of the Savannah River Site under the new contract on August 1, 2008. The base period of the contract is from August 1, 2008 through July 31, 2013, with an option to extend up through July 31, 2018.

1.5. Scope, Purpose, and Methodology

The Board began its investigation on July 12, 2011, and completed the investigation and submitted its final report to Dae Y. Chung, Principal Deputy Assistant Secretary for Environmental Management, on August 5, 2011. The Board reviewed and analyzed the circumstances surrounding the accident to determine its causes including deficiencies, if any, in safety management systems and understand lessons learned to reduce the potential for recurrence of similar accidents.

The Board conducted its investigation using the following methodology:

- Facts relevant to the accident were gathered through interviews, document and evidence reviews, and examination of physical evidence.
- 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, judgments of need were developed for corrective actions to prevent recurrence.

Accident Investigation Terminology
<p>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), which is the immediate event(s) or condition(s) that caused the accident; root causes(s), which is the causal factor that, if corrected, would prevent recurrence of the accident; and the contributing causal factors, which are the causal factors that collectively with the other causes increase the likelihood of an accident, but which did not cause the accident.</p> <p>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.</p> <p>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.</p> <p>Change analysis is a systematic approach that examines planned or unplanned changes in a system that caused the undesirable results related to the accident.</p>

Figure 1-1: Accident Investigation Terminology

2.0 Facts and Analysis

2.1. Event Description

On the afternoon of July 1, 2011 workers were performing facility modifications in the PAV at building 105-K, in the K Area Complex, Savannah River Site. The work required the use of portable scaffolding (Tele-Towers[®]) to demolish and remove sections of gypsum wallboard and metal studs. At approximately 1335 a worker fell from a Tele-Tower[®] and was seriously injured.

The IW was immediately attended to by co-workers in the area and emergency response was summoned via phone within several minutes. First responders arrived at the scene of the accident within about five minutes. After assessing the workers condition, the worker was transported to the MCG Health Medical Center via SRS helicopter. The worker sustained head trauma and broken ribs. The IW remains under medical care.



**Figure 2-1: Tele-Tower@s A, B & C
Left to right**



**Figure 2-22: Tele-Tower@ A
Safety Chains unhooked**

2.2. Chronology of Events

Construction Work Package #1085377-01, *Install Wall Modifications to KAMS for PAV*, was created in part, to accomplish the disassembly and removal (D&R) of gypsum wallboard from the PAV within the building 105-K, KAC building. The work package included a Safe Work Permit (SWP), Hot Work Permit, Radiological Work Permit (RWP), Assisted Hazard Analysis (AHA) #13638, Revision 0, and other pertinent work control documentation.

The work package was approved and the initial pre-job briefing (sometimes called a Pre-Plan meeting) was held on June 23. That meeting was attended by the work planner, the Detailed Carpenter Foreman (DCF), Detailed Labor Foreman (DLF), Detailed Superintendent (DS, also the IW), and laborer (L2). The meeting was held to discuss the work scope and review potential issues, including task specific hazard identification and hazard controls. Of those workers present on the day of the accident, L2, the DCF, the DLF and the DS attended the initial pre-job briefing.

The work package was authorized to start by the shift manager on June 24, 2011. Work commenced on June 24 and continued on June 25, 27, 28, 29, 30 and through July 1st, the day of the accident. The work performed on June 24, 25 and July 1st was considered “backshift” as it was performed outside the normal four days-ten hours work week. Crews consisted generally of two carpenters and four laborers. The work required the use of general hand and power tools and working at elevation using Tele-Tower[®] scaffolding. Required personal protective equipment included hard hats, sturdy work shoes, gloves, safety glasses, hearing protection (if noise levels warranted it), and optional dust masks. Three Tele-Tower[®] scaffolds were used to accomplish the majority of the work on the day of the accident, although other scaffolds were in the area.

Table 2-1: Summary Event Chart and Accident Chronology

CHRONOLOGY OF EVENTS	
Time	Event
5/97	Six of eight workers working the day of the accident completed fall protection training
11/30/10	Tele-Tower [®] A was green tagged ready for use
6/23/11	Work order was modified to allow removal of gypsum wallboard prior to dust curtain installation
6/23/11 (1500)	Initial pre-job held by Work Planner
6/24/11 (0715)	Safe Work Permit Authorized by shift Manager
6/24/11	Pre-job briefing held for additional personnel
6/24/11	Wallboard removal performed using respirators
6/25/11	Pre-job briefing held for additional personnel
6/25/11	Workers removed gypsum wallboard.
6/27/11	Additional workers signed the pre-job briefing.
6/29/11	Pre-job briefing and SWP signed by additional workers.
6/29/11	SWP pen & ink modified per telecon w/ IH to no longer require respirators.
6/30/11	SWP signed by two individuals that are not on the pre-job briefing.
6/30/11	Injured worker and DLF "detailed" to supervisory positions
6/30/11	Hot Work Permit stamped with date & time- verified to be the latest version.
7/1/11 (0600)	C2 met DCF "in the village"
7/1/11 (0630)	Injured worker conducted pre-job briefing for laborers
7/1/11 (0730)	"Pre-plan meeting" conducted at work site for carpenters.
7/1/11	Workers gathered at 105-K building
7/1/11	DLF conducted pre-job briefing for carpenters.
7/1/11 (0800)	Work crews started the D&R task
7/1/11	C1 delayed arrival at 105-K work site.

CHRONOLOGY OF EVENTS	
Time	Event
7/1/11	Workers continue morning work tasks
7/1/11 (1000)	Workers took morning break.
7/1/11 (1030)	Workers returned to work.
7/1/11 (1145)	Workers stopped for lunch.
7/1/11 (1300)	Workers returned to 105-K PAV.
7/1/11 (1310)	WSI arrived to provide access to 105-K PAV.
7/1/11 (1310)	Workers enter PAV and resume tasks.
7/1/11 (1330)	Injured worker returned to PAV.
7/1/11	Injured worker relocated and adjusted height of Tele-Tower® A.
7/1/11	Injured worker seen on top of Tele-Tower® A "about midway"
7/1/11 ~1335	DLF heard "chain noise". L1 heard IW fall. C1 heard noise.
7/1/11	Injured Worker Fell
7/1/11 (1338)	3-3911 call to SRSOC
7/1/11/(1338)	SRSFD EMS Med 3 Dispatched
7/1/11 (1340)	Facility First Aid responders notified by CCR
7/1/11 (1342)	Facility First Aid responders arrive at scene.
7/1/11 (1345)	SRS helicopter placed on standby
7/1/11 (1346)	SRSFD EMS Med3 arrived at K Area
7/1/11 (1348)	SRSFD Med3 at the patient
7/1/11 (1353)	SRS helicopter enroute to KAC
7/1/11 (1357)	SRS helicopter landed at KAC
7/1/11 (1406)	SRS helicopter enroute to Medical College of Georgia hospital
7/1/11 (1419)	SRS helicopter arrived at MCG
7/1/11 (1435)	Occurrence Reportable Event declared

About 0600 hours on the morning of July 1, 2011 Carpenter 2 (C2) met the detailed carpenter foreman (DCF) in area locally known as "The Village," - an area of crafts office trailers - prior to the start of the work in the building 105-K PAV. About 0630 the IW conducted a pre-job briefing for the laborer crafts acting as the Detailed Superintendent (DS). The workers processed through the protected area and arrived at the building 105-K work site about 0725. Worker C1 was delayed and arrived just before 0800. All the workers signed the RWP between 0716 and 0751 and received an electronic personal dosimeter (EPD) with the exception of the IW.

About 0730 the DCF conducted a pre-job briefing at the building 105-K PAV work site to bring new worker C2 "up to speed." C2 did not sign the pre-job briefing checklist.

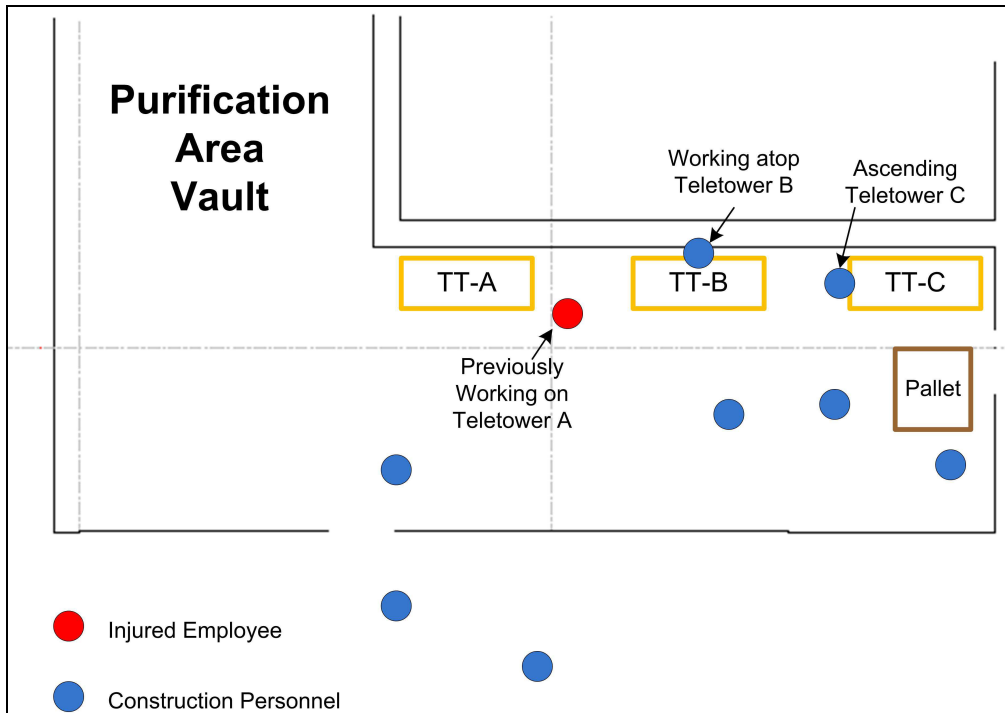


Figure 2-33: PAV Accident Scene Layout

To provide access to the elevated work location, the workers elected to use Tele-Tower[®] Adjustable Work Platforms (scaffolds) Model 1101. The Tele-Towers[®] were adjustable from 2’ to 11’ in six inch intervals. An extension may be added to provide a working platform height from 12’ 6” to 17’ 6”. Two of the Tele-Towers[®] used by the workers (unit B and unit C) had the vertical extensions installed. One (unit A) did not. The static load rating of the scaffold was 550 lbs. without the extension installed with a weight restriction of 400 lbs. with the extension installed.

The work crew began the D&R activity of removing gypsum wallboard about 0800. The IW and C1 worked together on Tele-Tower[®] “C” starting at the west end of the room, removing gypsum wallboard and passing the pieces down to L2 who was on Tele-Tower[®] “A.” Once the studs were exposed the IW and C1 removed the studs from the wall cavity. During the morning D&R, activities scaffolds were moved while workers were on the scaffold.

As the work progressed gypsum wallboard was removed by pulling or using pry bars to break the gypsum wallboard loose from the metal studs and using saws to cut the gypsum wallboard into smaller pieces. The stated goal was to limit the size of the gypsum wallboard to approximately 2’ x 2’ pieces. At some point larger pieces were removed and at one point a worker needed to descend the Tele-Tower[®] and support a large piece so it could be cut into smaller pieces. The principle task for the laborer crafts was to remove the debris using pallets and pallet jacks to a “dumpster” outside the building. Prior to moving any of the scaffolds the floor was cleared of debris and other obstructions.

Hand tools and power tools were laid on the walking surfaces of the Tele-Tower® scaffolds as well as the lower decks of the units that had extensions installed.

At about 1000 the work crew took a break outside the PAV at a nearby picnic table and returned to the PAV at about 1030. No workers stated they saw the IW come down from the scaffold or attend the break period. Upon returning to the PAV the IW was observed by other workers on the scaffold removing studs.

The work crew stopped for lunch about 1145 and returned about 1300. When they arrived at building 105-K, entry into the PAV area was delayed for about ten minutes until security arrived to allow access to the PAV area. C1 and L2 returned to work removing gypsum wallboard from the wall using Tele-Tower® “C.”

C2 and the DCF returned to Tele-Tower® “B” and removed the upper railings to allow it to be moved under an overhead conduit run. C2 returned to work, using a hammer and chisel to break some tack welds on a “stuffing box” structure which enclosed a conduit run through the wall. C2 was sitting on the work platform while chiseling. C2 allowed grout pieces to fall to the floor. Several workers reported the chiseling as “very noisy.” As they worked in the afternoon, the crew left tools lying on the walking surfaces of the Tele-Towers®.

The IW did not return with the other workers, but returned about 1330. On entering the building, the IW asked C1 and L2 if they needed anything and asked the same of C2. After receiving a negative response from the other workers, the IW relocated Tele-Tower® “A” to the east end of the north facing wall and climbed the scaffold. While moving the scaffold, the IW picked up the scaffold with one hand to get over some extension cords that were in the way.

The scaffold was placed either against or close to the east end of the north facing wall. The IW was seen climbing the Tele-Tower® and several moments later he was seen on the scaffold about in the middle of the work platform by C1 and C2. The workers stated they did not see any tools in his hands.

At about 1335, the DLF heard what was described as a “chain noise,” looked in the direction of Tele-Tower® “A” and saw the IW falling, in a horizontal position in mid-air and landed on his right side. Other workers reported hearing what was described as “a horrible noise” and turned to see the IW lying on the floor. The beginning of the IW’s fall was not witnessed by any of the co-workers or captured by any surveillance equipment.

Co-workers responded immediately to the fall accident. C1 yelled for someone to call “3-3911” (the site local emergency number), the DLF used a nearby phone to summon help. Additionally, other personnel called for help. Facility first aid responders arrived at 1342 and provided basic first aid until the site EMS arrived at 1346. The IW was air lifted to MCG Health Medical Center hospital at 1406 and arrived at 1419. The IW remained under medical care at the writing of this report.

SRNS categorized the accident as reportable under the Occurrence Reporting and Processing System (ORPS) at 1435 on 07/01/11 and filed the occurrence report on 07/06/11 at 1232.

SRNS conducted an analysis of the fall accident using the Causal Analysis /Mistake Proofing (CA/MP) tool. The analysis was developed by the workers in the work area facilitated by a trained individual.

2.3. Contractor Management Response

2.3.1. Reporting

The ORPS report for this event (EM-SR-SRNS-KAREA-2011-002) was categorized on 7/1/11 at 1435 ETZ as a 2A (6) SC3, *Any single occurrence resulting in a serious occupational injury*. On 7/6/11 at 1232 ETZ, the report was submitted and included an additional categorization of 10(1) SC2, *Any event resulting in the initiation of a Type A or B investigation as categorized by DOE O 225.1A, Accident Investigation*. The ORPS report met the requirements of DOE M 231.1-2, Occurrence Reporting and Processing of Operations Information. The contractor's immediate actions were included in the occurrence report.

2.3.2. Causal Analysis

SRNS report SRNS-RP-2011-01212, *SRNS Preliminary Investigation Report K Area Complex Fall Injury*, July 11, 2011, documents the SRNS internal investigation into the fall accident. The SRNS Team reviewed documents, interviewed personnel, and performed a limited review of the accident scene. The Team analyzed the information gathered by the personnel who were working in the PAV at the time of the accident using the CA/MP tool. The Team concluded that "Based on the inconclusive nature of witness observations, lack of full access to the physical scene/equipment, and injured employee's current medical status, no definitive conclusions relative to the cause can be made". No immediate actions were identified but several potential improvement actions were suggested.

2.4. Examination of Evidence

The Board arrived on site on July 12, 2011, 11 days after the accident occurred. Documents, combined with oral interviews, provided the Board with valuable information pertaining to work control and industrial safety practices that were in place at the time of the accident. In addition, a Board member visited the hospital to discuss the IW's condition with the medical staff and review records. Based on discussions with the medical staff, review of medical records, and discussion the IW's family, the Board determined that the IW would not be able to provide pertinent information at the time of this investigation. The IW was not interviewed.

PHYSICAL EVIDENCE

The Board visited the accident scene on July 12, 2011, to examine and document the scene and any related physical evidence. At this time the Board took control of the accident scene from DOE Facility Representative. The Board noted the following:

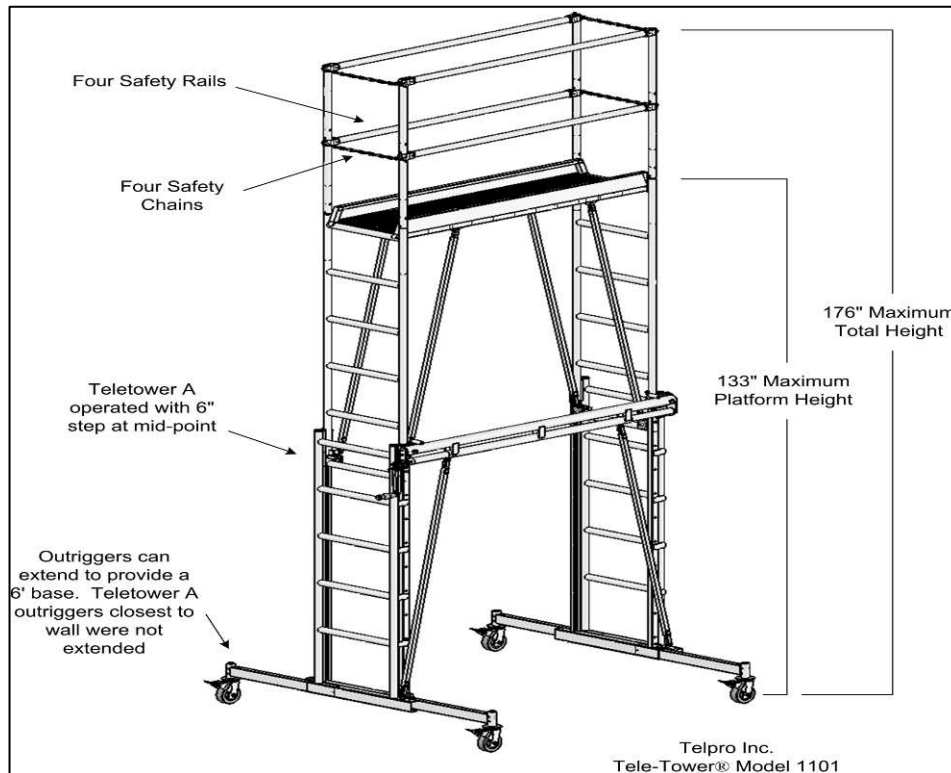
The Board examined Tele-Tower® "A" and noted the following:

- The scaffold was "green tagged" (approved for use) and the tag was dated 11/30/2010
- All four safety chains were down

- The outriggers on the wall side of the scaffold were not extended and locking pins were not engaged
- The outriggers on the room side of the scaffold were fully extended and pins engaged
- The wing nuts securing the support bracing were not tight
- A chisel was lying on the working platform
- The ladder rung spacing near the upper/lower transition was non-uniform (6" vs. 12")
- An extension cord was tied around the upper hand rail opposite the wall

The Board noted the area was generally clear of debris and clutter on the floor. A pair of shoes (one of which contained a watch), safety glasses, a hard hat, and leather gloves were on the floor near the area where the IW fell. Those items reportedly belonged to the IW. Other items included a zipper pull, and blue coated stretch gloves. A screw driver was noted near the base of Tele-Tower® "A". A reciprocating saw was noted on the floor near Tele-Tower® "B".

Figure 2-44: Tele-Tower® "A"



The Board inspected Tele-Tower® “A”, “B” and “C” and identified a number of items located on the working platforms and lower support platforms as listed in the table below.

Table 2-22: Tele-Tower® Inventory

Tele-Tower® “A” Working Platform	Tele-Tower® “B” Upper Working Platform	Tele-Tower® “C” Upper Working Platform
Green Tagged – 11/30/2010	Green Tagged – 1/25/2011	Green Tagged – 1/25/2010
Cold Chisel	Upper hand railings were removed from the platform Cordless drill Hammer	Ball peen hammer Pry bar Screw drivers (2) Cordless drill Crescent wrench Splitting wedge Chisel Pry bar Wood block One unrecognizable item An extension cord was tied around the upper hand railing
No Lower Support Platform	Tele-Tower® “B” Lower Support Platform	Tele-Tower® “C” Lower Support Platform
	Pry bar 6” course reciprocating saw blade 6” metal reciprocating blade	Reciprocating saw (AC) Sledge hammer Straight claw hammer Chisel with safety handle Small split ring (blue)

Gypsum wallboard had been removed from above the 8’ 6” level to the ceiling – a distance of approximately 16’. In the wall area near Tele-Tower® “A” (the area of the fall injury) the 9-1/4” metal cavity studs had been completely removed leaving the remaining (back side) wallboard unsupported.

The Board examined the IW’s shoes and noted the following: The work shoes were worn and in questionable condition. Sides of the shoes were broken down. The right shoe had a piece of the heel missing and a slice mark and showed considerably more wear than the left. The uppers were constructed of soft leather and the soles were soft rubber. The shoes had no American Society for Testing and Materials (ASTM) or American National Standards Institute (ANSI) label.



Figure 2-55: Pictures of IW's footwear

The Board examined the contents of a Bio-Bag containing the IW's coveralls and other items contaminated during the accident and accident response with SRS Medical personnel. The Board identified nothing in the contents of the bag that could have been useful in the course of the investigation.

The Board examined gypsum wallboard that had been removed from the wall and placed in "skid dumpsters" staged for removing construction materials from the site. The Board noted a number of pieces larger than 2' x 2'.

The Board also asked for and received assistance from subject matter experts in the areas emergency response, industrial safety, and from the DOE Office of the Chief Medical Officer

2.4.1. Work Planning and Control

At the time of the accident, the crew was performing D&R of the gypsum wallboard and metal 9 and 1/4 inch cavity wall studs utilizing Construction Work Order (WO) 01085377-01, (SC) *Install Wall Modifications to KAMS for PAV*.

2.4.1.1. Planning of Work

WO development was conducted using procedure 8.20, *Work Control Procedure*, which is part of Manual Number 1Y, *Conduct of Maintenance*. The process included a series of walk-down activities beginning with a design walk-down with the design authority. Additional walk-downs included craft personnel and their foremen, operations, and design engineers. When questioned, the planner stated that Construction Safety personnel were not involved in the planning walkdowns for this particular WO, however the package was sent to the Construction Safety Engineer (CSE) for review and approval. The planner stated that the CSE who reviewed the WO had previously participated in walkdowns when asked to during the preparation of previous packages associated with the construction project. During conversations with the carpenter craft personnel, the planner became aware of their desire to use the Tele-Tower® as the scaffold of choice. The planner then prepared the draft WO with a stated scope of work and work steps were developed.

Work steps included sections for; precautions and limitations, prerequisites, and task performance. No post maintenance testing was identified. A hazard analysis was also conducted as part of the planning process.

Precautions included pertinent information related to the identified scope. Precaution 2.6 required all electric powered tools to be connected to a ground fault circuit interrupter (GFCI) device. Precaution 2.14 listed in Section 2.0 allows the job steps to be performed “in any order other than in sequence written or in parallel provided associated Prerequisites or HOLD POINTS are not bypassed and only after discussion with the Superintendent and CDE.”

Prerequisites that were identified in the WO verified that particular activities had been completed and initial conditions to perform the work were met. Prerequisite 3.3 states, “Construction WGS: ENSURE that the following permits are available to support the scope of work:” The list contains the AHA, RWP, Unreviewed Safety Question (USQ), Modified Safety Plan (MSP), and Transient Combustibles Permit (TCP). This prerequisite was signed as complete on 6/24/2011 by the work planner. The TCP was listed as “PENDING” at the time the prerequisite was signed for, but later, pen and ink changed to reflect specific numbers on 6/27/2011 which coincides with the approval date of the TCP. Prerequisites 3.8 through 3.10 cover compliance with procedure 18.01 attachments 4 and 5 as well as the need to coordinate all work with WSI and the Shift Operations Manager (SOM). Prerequisite 3.11 requires the “appropriate DSA/TSR revision for Firewall modifications be implemented prior to the start of this task” and 3.12 are to verify that the Crane Maintenance Process Area is in the “correct operating mode” prior to bringing in materials and starting installation of scaffolds and dust curtain.

Task performance steps were developed based on the scope statement. Task performance steps 4.1 and 4.2, which are listed as hold points in the package, are identical to Prerequisite 3.11 and 3.12 discussed above. The step specific to the work being performed at the time of the accident (Step 4.19) called for the Construction work group to “REMOVE/ D&R gypsum wallboard and 9 ¼” cavity wall studs from above steel at Elevation +8’-6” to bottom of ceiling at Elevation 25’-0” between Columns SC4 and SC10. D&R from PAV side per A-DCP-K-10001, R0, DCN A-00001.” There are additional steps called “Action Steps” that require various work disciplines to perform specific actions. For example, Step 4.18 requires Construction to contact IH to request monitoring of gypsum wallboard D&R as needed due to silica dust hazard. The step further required an IH to perform that monitoring by providing sampling as needed to establish additional controls and PPE requirements. Step 4.21 was a RPD Action Step which required a radiation survey on the PAV side after the gypsum wallboard was removed to determine if the area needed to be posted as a radiation area. In an interview with the Radiological Manager, the intent was to conduct surveys as the work progressed rather than waiting until all of the wallboard had been removed.

Additionally, the planner initiated a hazard analysis process by executing an Assisted Hazard Analysis (AHA) as required by Procedure 122, *Task Level Hazard Analysis*, which is part of Manual 8Q, *Employee Safety Manual*. According to the procedure, the planner could either perform the analysis with or without a team approach. The planner was required to identify the main task and further identify subtasks, where main tasks hazards relate to the entire job and sub-task hazards only apply when that sub-task is being performed. The WO identified the main task as the wall modification and had two specific tasks. One specific task was to D&R portions of

the existing walls and the other was to install the new wall components. The planner then progressed through the electronic process of checking boxes relating to hazards that were determined to be pertinent to the task. Each checked box opened additional windows in the software that further broke down the hazard in greater detail. For example, scaffolding was selected as being used. The next tier of that field identified requirements for competent person and user inspections. It also identified head protection from impact due to falling or flying objects. The adjacent column under “Additional Text” stated, “Other falling object protection in addition to hard hats if falling objects are possible.” No other falling object protection was evident. The hazard analysis also determined that it would be necessary for the workers to work under the protection of a RWP and be required to wear EPD when working on this WO.

ANALYSIS:

The decision not to include a safety professional in the walkdowns of the work represents a missed opportunity to obtain a clear representation of the conditions and nature of the work to be performed. While Construction Safety did ultimately review and approve the WO, it was done so with bias to the content of the WO and without the benefit of group discussion/involvement. The precaution allowing deviation from the job sequence did not provide for enough specificity regarding how to address HOLDPOINTS and Action Steps. Further, during interviews it was clear to the Board that the intent of a HOLDPOINT was that they were not to be worked beyond until the condition in the HOLDPOINT was met; the glossary definition did not clearly convey its intent. The term “Action Step” was not defined in the glossary with other work control terminology. Although there was some level of expectation associated with such steps, the intent was not specified in the company level work control procedures reviewed. The prerequisites listed in the WO contain a variety of different statements. The understanding of the Board is that prerequisites are actions that need to be taken or conditions that need to be established prior to authorizing work to begin. Prerequisites 3.8, 3.9, and 3.10 represent compliance with enclosed attachments or coordination with other organizations and would be better contained in the precautions and limitations section of the WO. Signing for verification that permits are available when the TCP is listed as pending demonstrates a lack of rigor on the part of the signer. HOLDPOINTS 4.1 and 4.2 are redundant in that those conditions were contained in the Prerequisites section of the WO. This can lead to confusion among workers as to the intent of a prerequisite and what a task performance step accomplishes. The Board determined that Step 4.19 contains what amounts to a broad scope statement that, on its own, lacked sufficient detail and controls to ensure that the specified work activity could be safely executed. There was also inconsistency within the WO regarding format for requesting and accomplishing Action Steps. Some had a spot to initial the request and sign for the action, where others broke it out into two distinct and separate steps. This inconsistency resulted in the Construction Superintendent (CS) signing for Industrial Hygiene (IH) performance of sampling in Step 4.18.

The Board concluded that ambiguities in the requirements, inconsistencies in the steps, and lack of Safety Professional involvement (outside of electronic document approval) in the planning process to ensure hazards are mitigated resulted in the creation of a WO that did not establish the necessary controls to safely execute the specified work scope.

2.4.1.2. Approval and Authorization of Work

According to the planner, the completed draft WO and AHA were electronically routed to a set of reviewers via e-mail notification utilizing the Passport Asset Suite. The various disciplines reviewed both documents and provided comments which were incorporated into the package. Approvals started being recorded as early as 2/28/2011. The CSE provided electronic approval on 3/7/2011. Ultimately, all reviews were completed and the WO was approved on 6/23/2011.

The Safe Work Permit (SWP) was authorized by the SOM at 0715 on 6/24/2011 and given a period of authorization through 7/1/2011. The SOM signature indicates hazards and controls indicated for the scope of work have been reviewed and are appropriate for the job scope, facility conditions will support performance of the work, and approval to commence work has been granted. A Lead Work Group Supervisor (LWGS) signature is required each shift that “signifies overall concurrence with and approval of the hazard analysis; applicable controls have been implemented or will be implemented prior to work execution; assigned personnel are qualified; current conditions and hazards are as analyzed; and the required pre-job briefing will be conducted before execution of work.” LWGS signatures on the SWP only cover 6/24/2011 and 6/25/2011. A review of the Plan of the Day (POD) for the week of 7/1/2011 did not have a line item specific to WO# 01085377-01. However, there was one general line covering the broad scope of KAMS Wall Modification work in 105-K.

ANALYSIS:

The Board determined that the practice of the SOM to authorize work that requires specific conditions to be verified does not ensure conflicting activities will be identified between the facility operations and construction activity. Additionally, the LWGS failure to document verification of conditions listed on the SWP also weakens the effectiveness of authorizing a one week window.

<p>The Board concluded that the work authorization process, as executed for this WO, did not ensure that the control of work contained the necessary level of rigor to ensure that facility conditions continued to support the work being performed.</p>

2.4.1.3. Execution of Work

Although the SWP was not approved until the morning of 6/24/2011, the CS signed for completion of two task performance steps on 6/23/2011. The CS signed for a majority of the work steps that have been completed. The scope of the task being performed in step 4.19 was to D&R the gypsum wallboard and the metal studs. During interviews, the workers described the process they followed to accomplish the task. Actions ranged from using wrecking bars to cutting with a reciprocating saw. On occasion, larger pieces than anticipated were encountered which were dropped to the ground. The scaffolding needed to be adjusted and moved to accommodate access to the working face of the wall. Workers were required to sign RWP# 11 NMM-110 and also wear an EPD. Records indicate that there were occasions (including the IW on the day of the accident) where workers did not sign the RWP for the shift they worked. Other than two KAMS-side wall surveys and one survey of the opening on the east wall, the Board did not receive any additional radiation surveys that supported wallboard removal to ensure that

radiation levels had not appreciably changed. The workers disclosed several practices regarding scaffolding work that were not consistent with OSHA or company level procedures. Precaution 2.6 required the use of a GFCI device when using portable power tools. The Board found no evidence that GFCI devices were being used as required. Although required by the 1Y 8.20 procedure, there was no Work Management System (WMS) entries to support the work history and progress on this package. Additionally, the WO provided to the Board did not contain Jobsite Reviews, as required by a November 2008 management memo.

ANALYSIS:

The board determined that the level of detail contained in the WO (specifically step 4.19) was not sufficient to provide the necessary direction to safely accomplish the work. The actions described by the workers conveyed to the Board that the work group needed to improvise as changing conditions were encountered. Hazard controls were not consistently employed per the SWP. The ambiguity of the WO allowed the craft workers to improvise methods to remove wallboard and studs. Much of the process, although discussed in some of the pre-job briefings was determined through trial and error rather than following the defined work steps. This led to taking unnecessary risks involving falling objects and scaffold safety. Additionally the remaining wallboard following metal stud removal represents an unstable and poorly supported structure that presents a new hazard to personnel in the vicinity. The Board immediately notified SRNS of the wallboard hazard. The potential change in radiation levels in the PAV which is an unposted area has not been determined since the removal of the wallboard and is only addressed in the WO. Although surveys taken on the east wall indicated that radiation levels were below that requiring posting, failure to adequately monitor as the wallboard was being removed could result in levels requiring additional controls. The board found no other mechanism in place (other than for scene preservation post accident) to control access to the area.

The Board concluded that on the day of the accident, the work crew improvised additional methods for wallboard removal and handling that deviated from the prescribed hazard controls in the WO and the AHA without consideration to reanalyze the hazards.

2.4.2. Industrial Safety

The following table identifies questionable conditions found in the PAV, various requirements from either OSHA, SRS procedures, or the vendor, and the source of identification of the issue.

Table 2-55: Scaffold Observations

Conditions found in the PAV	Requirements			Source of Observation
	Note: Requirements may be paraphrased for brevity.			
PAV	OSHA	SRS	Telpro Inc.	

Conditions found in the PAV	Requirements Note: Requirements may be paraphrased for brevity.			Source of Observation
PAV	OSHA	SRS	Telpro Inc.	
<p>Tele-Tower® wing nuts that fasten the end frames to the connecting beam in a wedge type clamp were loose.</p> <p>{“TT-A”}</p>	<p>29 CFR 1926.451(f)(3)-</p> <p>Scaffolds and scaffold components shall be inspected for visible defects by a competent person before each work shift, and after any occurrence which could affect a scaffold's structural integrity</p>	<p>8Q-16 Rev.12, Pg 17 (Tele-Tower® Scaffolds) L1</p> <p>Comply with manufacturer’s assembly and use instructions..</p>	<p>Model 1101: Page 5 - Place connecting beam in tapered socket and secure with bolt and wing nut as shown.</p>	<p>Per Accident Investigation Team scene inspection.</p>
<p>Locking pins to outrigger sections nearest wall were not engaged.</p> <p>{“TT-A, TT-B, TT-C”}</p>	<p>29 CFR 1926.451(f)(3)-</p> <p>Scaffolds and scaffold components shall be inspected for visible defects by a competent person before each work shift, and after any occurrence which could affect a scaffold's structural integrity</p>	<p>8Q-16 Rev.12, Pg 17 (Tele-Tower® Scaffolds) L1</p> <p>Comply with manufacturer’s assembly and use instructions.</p>	<p>Model 1101: Page 8 – Always engage the outrigger latch pin before climbing the Tele-Tower® Adjustable Work Platform.</p>	<p>Per Accident Investigation Team scene inspection.</p>

Conditions found in the PAV	Requirements Note: Requirements may be paraphrased for brevity.			Source of Observation
PAV	OSHA	SRS	Telpro Inc.	
<p>Non-uniform ladder spacing due to height adjustment by worker.</p> <p>{TT-A”}</p>	<p>29 CFR 1926.451(f)(7)- Scaffolds shall be erected, moved, dismantled, or altered only under the supervision and direction of a competent person qualified in scaffold erection, moving, dismantling or alteration. Such activities shall be performed only by experienced and trained employees selected for such work by the competent person.</p> <p>29 CFR1926.451(e)(6)(iv)- Be uniformly spaced within each frame section;</p>	<p>None</p>	<p>None</p>	<p>Per Accident Investigation Team scene inspection.</p>
<p>Competent Person did not perform daily inspection and find the above violations.</p> <p>User did not verify Competent Person inspected Tele-Tower® for that shift. (No mechanism in place for User to assure the CP shift inspection was completed.)</p> <p>{“TT-A, TT-B, TT-C”}</p>	<p>29 CFR 1926.451(f)(3)- Scaffolds and scaffold components shall be inspected for visible defects by a competent person before each work shift, and after any occurrence which could affect a scaffold's structural integrity</p>	<p>8Q-16 Rev.12, Pg 2, 3,& 11, F.2 &3 For shift inspections, CP must inspect the scaffold each shift and replace tag, if necessary (if damaged or altered).</p>	<p>None</p>	<p>User findings per employee interviews.</p> <p>Per Accident Investigation Team inspection of scaffold.</p>

Conditions found in the PAV	Requirements Note: Requirements may be paraphrased for brevity.			Source of Observation
PAV	OSHA	SRS	Telpro Inc.	
<p>Tele-Tower® was moved by the IW but Competent Person did not re-inspect.</p> <p>{“TT-A”}</p>	<p>29 CFR1926.451(f)(3)-</p> <p>Scaffolds and scaffold components shall be inspected for visible defects by a competent person before each work shift, and after any occurrence which could affect a scaffold's structural integrity.</p> <p>29 CFR1926.451(f)(7)-</p> <p>Scaffolds shall be erected, moved, dismantled, or altered only under the supervision and direction of a competent person qualified in scaffold erection, moving, dismantling or alteration. Such activities shall be performed only by experienced and trained employees selected for such work by the competent person</p>	<p>8Q-16 Rev.12, Pg 2 & Pg 9, E.10</p> <p>For shift inspections, CP must inspect the scaffold each shift and replace tag, if necessary (if damaged or altered); inspecting scaffold for proper placement, erection technique, & structural integrity.</p>	None	Per Accident Investigation Team inspection of scaffold.
<p>Users did not inspect Tele-Tower® before use</p> <p>{“TT-A, TT-B, TT-C”}</p>	N/A	<p>8Q-16 Rev.12, Pg 3</p> <p>User must inspect a scaffold before each use for hazards and consult with CP on questionable conditions.</p>	None	Per employee interviews

Conditions found in the PAV	Requirements Note: Requirements may be paraphrased for brevity.			Source of Observation
PAV	OSHA	SRS	Telpro Inc.	
<p>: Safety chains not in place while worker on platform.</p> <p>{“TT-A”}</p>	<p>29 CFR 1926.451(g)(1)-</p> <p>Each employee on a scaffold more than 10 feet (3.1 m) above a lower level shall be protected from falling to that lower level.</p> <p>Paragraphs (g)(1)(i) through (vii) of this section establish the types of fall protection to be provided to the employees on each type of scaffold. Paragraph (g)(2) of this section addresses fall protection for scaffold erectors and dismantlers.</p>	<p>8Q-16 Rev.12, Pg 10, E.16 The last person to ascend the scaffold closes the ladder access gate, chain, or sliding bar, where provided, to complete the scaffold handrail system.</p>	<p>Model 1101, Pg 7, Step 11- Attach all four safety chains between the guard rails on each end.</p>	<p>Per Accident Investigation Team scene inspection.</p>
<p>PPE-Shoes were not per the standard as specified by the employer for construction work.</p> <p>(Work permit does not specify safety shoes/boots)</p> <p>{TT-A”}</p>	<p>29 CFR 1926.96-</p> <p>Safety-toe footwear for employees shall meet the requirements and specifications in American National Standard for Men's Safety-Toe Footwear, Z41.1-1967.</p> <p>29 CFR 1910.136(a)-</p> <p>General requirements. The employer shall ensure that each affected employee uses protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where such employee's feet are exposed to electrical hazards.</p>	<p>WCP #01085377-01</p> <p>Calls for Sturdy work shoes</p> <p>CMP 11-1.1 Rev. 5, dated 2/5/07 - Sturdy work shoe is shoe or boot a thick leather or equivalent top, a hard rubber or equivalent sole or heel.</p> <p>8Q-61, Rev.12, Pg 13, 5.6.1.2 &CMP 11-1.1 Rev. 5, dated 2/5/07</p> <p>Paraphrase: The need for a safety shoe is determined by and IH or SE of the individual or formal hazard analysis and the scope of the work.</p>	<p>N/A</p>	<p>Per Accident Investigation Team document review and examination of shoes.</p> <p>Right heel worn & split.</p>

Conditions found in the PAV	Requirements Note: Requirements may be paraphrased for brevity.			Source of Observation
PAV	OSHA	SRS	Telpro Inc.	
<p>Obstructions & tripping hazards left on working surface (work platform).</p> <p>{“TT-A, TT-B, TT-C”} -Tools to include cold chisel & possibly a large screwdriver“ TT-A”</p>	<p>29 CFR 1926. 451(f) - Use & 29 CFR 1910.28 (a)(20)-</p> <p>Tools, materials, and debris shall not be allowed to accumulate in quantities to cause a hazard.</p>	<p>8Q-16 Rev.12, Pg 10, L23 – Do not allow tools, materials, and debris to accumulate in quantities that will cause a hazard to employees working on the scaffold or passing nearby.</p>	<p>Model 1101, Pg 2 -</p> <p>Tools, materials, and debris shall not be left to accumulate so as to create a hazard on the Tele-Tower® Adjustable Work Platform.</p>	<p>Per Accident Investigation Team inspection of scaffold.</p>
<p>CP allows workers to use Tele-Tower® without fall protection (handrail removed & no personal fall protection)</p> <p>{“TT-B”}</p>	<p>29CFR 1926.451(e)(9)(i)-</p> <p>The employer shall provide safe means of access for each employee erecting or dismantling a scaffold where the provision of safe access is feasible and does not create a greater hazard. The employer shall have a competent person determine whether it is feasible or would pose a greater hazard to provide, and have employees use a safe means of access. This determination shall be based on site conditions and the type of scaffold being erected or dismantled.</p>	<p>8Q-16 Rev. 12, Pg 11, G - Fall protection must be provided for employees erecting or dismantling supported scaffolds where the installation and use of such protection is feasible and does not create a greater hazard. A designated CP shall determine feasibility.</p>	<p>Model 1101, Pg 2 -</p> <p>Before climbing, inspect the Tele-Tower® Adjustable Work Platform to see that all guardrails, chains, and anti-sway braces are correctly and securely installed.</p>	<p>Per employee interviews.</p>

Conditions found in the PAV	Requirements Note: Requirements may be paraphrased for brevity.			Source of Observation
PAV	OSHA	SRS	Telpro Inc.	
Employee working from Tele-Tower® platform without fall protection {“TT-B”}	29 CFR 1926.451(g)(1)(vii)- For all scaffolds not otherwise specified in paragraphs (g)(1)(i) through (g)(1)(vi) of this section, each employee shall be protected by the use of personal fall arrest systems or guardrail systems meeting the requirements of paragraph (g)(4) of this section	8Q-16 Rev. 12, Pg 9, e.8 Personnel must use fall protection while on incomplete scaffold platforms six feet or higher where an unguarded/unprotected surface exists.	When using the 1177 Tele-Tower® Extension, work only from the top platform. The lower platform is not designed as a work area.	Per employee interviews
Castors not locked, manufacturer’s instructions {“TT-B, TT-C”}	29 CFR 1926.452(w)(2)- Scaffold casters and wheels shall be locked with positive wheel and/or wheel and swivel locks, or equivalent means, to prevent movement of the scaffold while the scaffold is used in a stationary manner.	8Q-16 Rev.12, Pg 20, H4 (Manually Propelled Rolling Scaffold)	Model 1101: Pg 2 – For use be sure all four casters are securely installed with bolts and brakes set.	Per Accident Investigation Team scene inspection.
Two people on extension platform overloading maximum weight limit. (Manufacturer’s weight limit was 400 lbs; two people + tools and materials exceeded 400 lbs) {TT-B”}	29 CFR 1926.451(f)(1)- Scaffolds and scaffold components shall not be loaded in excess of their maximum intended loads or rated capacities, whichever is less.	8Q-16 Rev.12, Pg 10, L 14 – Users must know safe working load of the scaffold. L 18 - Scaffolds must never be loaded beyond their intended load capacity.	Model 1177, Pg 3 – Do not exceed 400 lbs with installed Extension 1177	Per Accident Investigation Team document reviews and employee interviews.

Conditions found in the PAV	Requirements Note: Requirements may be paraphrased for brevity.			Source of Observation
PAV	OSHA	SRS	Telpro Inc.	
Extension turnbuckle assembly bent (holds extension section ladder to lower ladder) not addressed by CP, manufacturer's instructions {"TT-C"}	29 CFR 1926.451(f)(3)- Scaffolds and scaffold components shall be inspected for visible defects by a competent person before each work shift, and after any occurrence which could affect a scaffold's structural integrity	8Q-16 Rev.12, Pg 17 Comply with manufacturer's assembly and use instructions.	Model 1177: Turnbuckle Fastening Assembly – inspect all parts	Per Accident Investigation Team scene inspection.
Scaffold was moved by employees while employees were still on it. {TT-B & C}	29 CFR 1926.451(f)(5) Scaffolds shall not be moved horizontally while employees are on them, unless they have been designed by a registered professional engineer specifically for such movement or, for mobile scaffolds, where the provisions of 1926.452(w) are followed	8Q-16 Rev.12, Pg 10 L17 Paraphrase; Do not move scaffolds while they are occupied, unless the CP determines the applicable requirements per OSHA	Model 1101, Pg 2. – Persons shall be prohibited from riding on the Tele-Tower® Adjustable Work Platform while it is being moved. Materials, tools, or equipment shall not be stored on the platform while the Tele-Tower® Adjustable Work Platform while it is being moved.	Per employee interviews.

Conditions found in the PAV	Requirements Note: Requirements may be paraphrased for brevity.			Source of Observation
PAV	OSHA	SRS	Telpro Inc.	
Employee working from Tele-Tower® intermediate platform without fall protection, manufacturer's instructions (above 6 ft) {"TT-C"}	29 CFR 1926.451(g)(1)(vii)- For all scaffolds not otherwise specified in paragraphs (g)(1)(i) through (g)(1)(vi) of this section, each employee shall be protected by the use of personal fall arrest systems or guardrail systems meeting the requirements of paragraph (g)(4) of this section	8Q-16 Rev. 12, Pg 9, e.8 Personnel must use fall protection while on incomplete scaffold platforms six feet or higher where an unguarded/unprotected surface exists.	None	Per Accident Investigation Team scene inspection & employee interviews.
Workers dropping materials from elevation without establishing safe zones with barriers {"TT-B, TT-C"}	29 CFR 1926.850(h) – When debris is dropped without the use of chutes, the area onto which the material is dropped shall be completely enclosed with barricades. Removal shall not be permitted in this lower area until debris handling ceases above.	SWP- Protect employees below platform from exposure to falling objects. Other falling object protection is required in addition to hard hats if falling object are possible.	None	Per Accident Investigation Team scene inspection & employee interviews.
Tele-Tower® exceeded 4:1 height to base ratio {"TT-B, TT-C"}	29 CFR 1926.451(c)(1)- Supported scaffolds with a height to base width (including outrigger supports, if used) ratio of more than four to one (4:1) shall be restrained from tipping by guying, tying, bracing, or equivalent means, as follows: (various means specified)	8Q-16 Rev. 12, Pg 17, L8 - The height of a free standing scaffold tower shall not exceed four times the minimum base dimensions.		Per Accident Investigation Team scene inspection

ANALYSIS:

The Board could not positively establish the exact cause of the IW's fall. In the absence of objective evidence such as an eye witness or a video of the accident, the Board evaluated several factors that could contribute to this accident. While all potential fall scenarios are not specifically documented in this report, many of the potential contributors are analyzed below.

The PAV is an air conditioned space. The outside weather conditions were approximately 94 degrees and 50 percent relative humidity at 1300. Based on information provided by workers in the area, the IW was just coming back from a lunch break. The IW had changed into clean/dry work clothes. The IW's co-workers described his changing of clothes as common since the IW is known to perspire heavily. None of the workers in the area at the time of the accident described the temperature as a concern. The Board requested and received a review of medical documentation from the IW's admission to MCG Health Medical Center by the DOE Chief Medical Officer. The review of information on the admissions report did not reflect or suggest any heat stress related concerns.

The Board concluded that the work environment and Personal Protective Equipment (PPE) requirements did not constitute a condition which may have led to a heat stress related accident.

A large door to the PAV was open to allow for foot traffic and to allow pallet jacks to be used to remove the debris created by the work. Because of the dusty conditions created by the work activity, some workers were wearing paper dust masks. The requirement in the work package to wear respirators was removed and changed to allow workers to wear dust masks at their own discretion.

Deficiencies attributed to the Competent Person inspections of scaffold erection and/or modification and User inspections indicate that these were not completed as required at the beginning of shift, subsequent to a modification, or prior to use. The noted deficiencies include the loose wing nuts, non-uniform ladder spacing, locking pins not engaged for wall side outriggers (which were completely in to accommodate work close to the east wall), etc. Each of these issues places the stability of the Tele-Tower® in question. It should be noted that the narrowness of the Tele-Tower® work platform itself and its construction, as erected according to manufacturer's instructions, even when space allows for full outrigger extension, is not as stable as other available options.



Figure 2-66: Example of locking pin not properly engaged on Tele-Tower® B

The Board inspected the Tele-Tower® scaffolds used during the gypsum wallboard D&R work with attention to the OSHA requirement to maintain the height to base ratio of 4:1 or less. The Board determined that Tele-Tower® A (used without the extension installed) which measured 133” high by 51” wheel base, resulted in a ratio of 2.61:1.

Testimony indicated that Tele-Tower® B and C, were used at full height with extensions installed which would have measured 210” high by 51” wheel base. This would have resulted in a ratio of 4.11:1. This height to base ratio would exceed the OSHA 1926.451(c)(1) requirement of 4:1.

The worker could have been affected by an overhead cable that was located near the west ladder of the scaffold. All four safety chains at the platform edges were unhooked indicating the IW may have been exiting the scaffold. The overhead cable within 15” of the end of the platform (possible interference to egress) is the item that may have contributed. The cable height was 63” above the working platform. This would have been about chin high to the IW while standing on the platform.



Figure 2-77: Cable near end of scaffold where IW fell

The non-uniform ladder spacing between approximately 5' and 7' off the ground provided another potential opportunity for a misstep and fall.

The activity of the IW at the time of the injury only required sturdy work shoes/boots as indicated by the Work Package. The shoe has no ANSI or ASTM rating per manufacturer's information or found on the shoe itself. The soles of the shoes are soft rubber. But, most critical was the condition of the soles of these shoes; they showed obvious wear particularly on the right foot at the heel's right side a $\frac{3}{4}$ " split limiting the grabbing ability on that portion of the heel. The shoe does not have a definite heel separate from the sole or a raised heel distinct from the rest of the sole. In addition, previous activities by the majority of the work crew included potential material falling on toes and use of tools that should have required safety shoes. i.e. handling/using a reciprocating saw, handling wallboard pieces of 25 or more pounds at heights, and the need for good slip resistant footing to work in settled wallboard dust.

Obstructions and tripping hazards were found on (cold chisel) the work platform. In addition, the screwdriver on the floor near the base of the Tele-Tower® cannot be excluded as a possible slipping/tripping item that may have been knocked from the work platform. The accident Team did not find any gouge/scrape on the floor or any marks on the tool indicating it fell from the 12' high platform, although it's entirely possible it did so without leaving such indication. Both 8Q-16 & the manufacturer's instructions caution against these hazards. The other two Tele-Tower®s also had tools and debris found on them.

The following items are not directly related to the accident but identify other unsafe behaviors or conditions:

- The handrails removed by the Competent Person and a worker on Tele- Tower® “B” from their positions on the side ladders is an unsafe activity that requires each to hold the frame’s vertical ladder with a three-point stance and using the frame’s remaining free hand to remove each handrail.
- Tele-Tower® “C” was being used by the IW and another worker earlier in the morning with tools and materials that exceeded the 400 lbs weight restriction for an extension Model 1177 Tele-Tower® set up. In addition, the workers moved the Tele-Tower® while workers were still on the scaffold.
- Tele-Tower® “B” two of the four casters nearest the wall were also not locked and the outrigger pins were not engaged at the “in” position.
- Tele-Tower® “C” four of the four casters were not locked and the outrigger pins were not engaged at the “in” position.
- Tele-Tower® “C” had its extension stabilizers (“Turnbuckle Assembly” for extension ladder stabilizing) bent such that the “C” connecting fitting at both ends was stretched to the point that it could have sprung off if further stressed. This would have seriously affected the extension’s stability. This was not caught and corrected by either the Competent Person in his daily inspection or by the user. This stretched condition was almost certainly a long term (number of days or even weeks) phenomenon from over tightening many times.
- Tele-Tower® “C” intermediate platform was used by a worker to help secure a larger than planned section of wallboard being cut. This piece was so large that the workers had to cut it before they could safely lower it. Their solution was for one worker to climb down to the intermediate platform, used to store tools, and steady the piece of wallboard while the person above finished cutting it up. This meant that the intermediate platform without rails was used by the holder. The worker used the Tele-Tower® bracing for the upper level to secure his body while holding the wallboard. Nonetheless, the worker was above the 6’ elevation on this platform without mid-rails and handrails or personal fall protection.
- Materials being removed from the wall included wallboard pieces, metal wall studs, and small pieces of concrete. Initially, these were handed down to lower level Tele-Tower® work platforms to workers at floor level. Later, some of this material was simply dropped to the floor. This is in violation of OSHA regulations for demolition which requires such areas to be barricaded off at a safe distance for workers during that period and later stopping that type of work for cleanup of the drop zone area.
- The Tele-Tower® working platform height was 133” high which resulted in 6” spacing in the ladder rungs at the transition point from the lower to upper section. All other ladder

rungs were on 12” centers.

The Board concluded that the configuration, inspections, and use of scaffolding did not meet the requirements of OSHA.

2.4.3. Fitness for Duty

The Board was provided information from several sources that the IW was known to have walked with a limp due to a chronic medical condition affecting the knee. The Board discussed this information with the IW’s supervisor, with the site medical staff, and reviewed the IW’s medical file. No work restrictions were identified for the IW. The IW has successfully met the requirements of the Human Reliability Program. Based upon analyzing the information provided, the Board concluded that fitness for duty was not an issue.

2.4.4. Emergency Response to Injury

On 7/1/2011, at approximately 1335 Friday afternoon, while climbing on a Tele-Tower® scaffold to support work in the PAV, an employee fell to the floor. At 1338, a call was made on the Savannah River Site 3-3911 emergency number to the Savannah River Site Operations Center (SRSOC) from a fellow worker requesting medical assistance at 105-Kilo Area. The SRSOC dispatched Stations 3 and 903 immediately to the area at 1338 for a man who had fallen. Upon dispatch paramedics requested additional information from the SRSOC as it became available. Squad 3, Medic-103 and 903 responded to the scene with Medic 101 advising from the Central Shops area. The shift manager contacted the SRSOC via phone at 1341 and stated that the man who had fallen was unconscious and bleeding. At 1343 the WSI-Savannah River Site (WSI- SRS) helicopter was placed on standby by the responding Savannah River Site Fire Department (SRSFD) Captain when he received information that an employee had fallen approximately 8’-10’ and was unconscious. The SRSFD Captain also requested Medic-101 to respond for assistance. The Facility Emergency Response Organization was activated at approximately 1340 by the Facility Central Control Room (CCR). The facility first aid responders whose training include Basic First Aid, Cardiopulmonary Resuscitation (CPR), Blood Borne Pathogen training, and Automated External Defibrillator (AED) training, along with the Operations First Line Manager arrived on scene with first aid kits in approximately 2 minutes after being activated by the CCR. Once on scene the first aid responders observed the injured person bleeding from the head lying on his back with his arm around the Tele-Tower® outrigger wheel. Per interviews the first aid responders and facility workers attempted to restrain the patient from moving to prevent further injury. The facility first aid responders also placed a towel near the patients head for padding and attempted to control the bleeding from the head by placing bandage material to the wound.

At 1345, the first paramedics arrived at the KAC and at 1348 were on scene with the patient. The paramedics stated upon arrival that they observed the injured person lying supine on the floor being restrained by the first aid responders and the facility employees. The patient was bleeding from a laceration to the back of his head and that the facility first aid responders were attempting to control the bleeding. The patient was combative and verbalizing incoherent statements. At 1348 the SRSFD Captain requested that the SRSOC have the WSI helicopter respond to the KAC and to coordinate the landing with the KAC WSI personnel. The

paramedics continued to control bleeding and to attempt the stabilization of the Cervical-Spine. The paramedics from Medic-103 arrived at the KAC at 1346 and at the patient scene via foot from the DAC-2 (security gate) at approximately 1350. Medic-103 paramedic advised that Medic-103 would be delayed due to a security gate malfunction. Paramedics from Medic-101 arrived next at the KAC at 1348 and noticed that the DAC-2 gate was shut down so they abandoned their truck outside DAC-2 gate and grabbed equipment off of Medic-103 and preceded to the scene. The paramedics prepared the patient for transport with full spinal precautions per approved protocols by applying a C-collar and Reeves sleeve. While packaging the patient in the Reeves sleeve the Tele-Tower® was moved by the paramedics by unlocking the wheels and moving it to the left approximately 18”-24” so they could safely care for the patient without restrictions. At 1357 the WSI Helicopter landed in the KAC outside the gated area. Also, at this time Medic -101 requested that the SRSOC contact the Medical College of Georgia (MCG) Health Medical Center to advise them that a patient was being transported to their facility by helicopter. The patient was transported to the WSI helicopter at 1359 and at 1406 the WSI helicopter departed en route to the MCG Health Medical Center with two (2) paramedics to maintain care. The patient arrived at the MCG Health Medical Center in 13 minutes. The SRSFD EMS Report stated that oxygen was administered at a flow rate of 15 liters/min and that an IV was attempted 3 times without success because of the combative nature of the IW.

ANALYSIS:

Although there was a delay caused by the DAC-2 security gates, the total time from the SRSOC dispatch to the paramedics responding, assessing, treating, packaging and transporting the patient was acceptable.

- Paramedics were on scene in 8 minutes after dispatch
- Paramedics were on scene for approximately 20 minutes
- Patient was transported to the MCG Health Medical Center in 13 minutes

Note: Facility First Aid Responders were on scene in approximately two (2) minutes after being dispatched by the facility CCR and approximately four (4) minutes from the initial 3-3911 call.

The Savannah River Site is aware of the emergency response vehicle access delays at the KAC vehicle trap during this incident and is taking this opportunity to evaluate operational procedures to eliminate this issue in the future. Also, during this investigation it should be noted while reviewing many resources for timelines, small variations of response times were observed especially when trying to investigate times for the response vehicles accessing the KAC.

The Board concluded that although the vehicle access delays did not adversely affect this accident, SRNS should evaluate and improve the vehicle access control during emergencies.

The Board also concluded the overall emergency response for this incident was timely and proficient.

2.4.5. Human Performance Improvement (HPI)

The goal of Human Performance Improvement (HPI) is to facilitate the development of a facility structure that recognizes human attributes and develops defenses that proactively manage human error and optimize the performance of individuals, leaders, and the organization. The DOE handbook DOE-HDBK-1028-2009, *Human Performance Improvement Handbook Volumes 1 and 2* describes the Human Performance program and tools used at DOE sites. For purposes of this investigation, the Board looked at Human Performance to determine if there were any issues played a part in this event. Human error is not a cause of failure, alone, but rather the effect or symptom of deeper trouble in the system. A review of Human Performance is a review of people's abilities, tasks, and operating environment to determine if the organization supported them for success.

During the interviews, personnel stated that they were uncertain what the roles and responsibilities were for the Superintendent and Foremen. Previous to the event day, personnel stated they were unsure who the Superintendent and Foremen were until sometime in the afternoon. The facility had no defined roles and responsibilities for Foremen. Workers and supervision asked to describe supervisory functions for Foreman and Superintendents only described them giving the pre-jobs.

The pre-job briefing checklist section III covered HPI tools but there are no marks on section III of the pre-job briefing checklist used for the PAV job. None of the personnel interviewed indicated that section III was reviewed in the Pre-jobs performed. As the job progressed over several days the pre-job briefs to new workers who were not given the original pre-job did not use the pre-job checklist. The pre-job briefings on the day of the accident did not discuss all of the hazards, did not involve all of the workers, and did not review HPI other than to remind people to remember to perform peer checks. The DS (IW) directed one worker to start work after a discussion of how to perform the task without a discussion of the hazards or signing the SWP and pre-job briefing.

On the day of the accident, the Superintendent and both Foremen were appointed (detailed) to their positions. As detailed superintendent and foremen, they were not provided any additional training on performing their appointed supervisory role. On the day of the accident, all three designated supervisors were actively engaged in removing wallboard.

As the job progressed, questions were raised about the methods being used to remove the wallboard. The DS (IW) responded with "let me show you" and the task was performed even when the action involved reaching beyond the end of the scaffolding or pulling on the wallboard with enough force to cause the Tele-Tower® to rock. Additionally, there were two instances where supervision directed the scaffolding to be moved by workers on the ground to a new location while it was extended (~ 16'), while it contained tools on the work platform, and while workers were on top of the scaffold.

After lunch, C2 and DCF removed the upper handrails of a Tele-Tower® while standing on the ladders at each end. The scaffold was approximately 12' 6" high when they removed the upper handrails. C2 used the scaffolding without properly installed handrails. Additionally, scaffold users were moving and adjusting the height of scaffolding without an inspection by a "competent

person” being performed before use. Workers working from scaffolding allowed materials to drop to the floor without controls to prevent workers from being struck. Workers were removing pieces of wallboard about 2’ by 3’. A worker removed a large piece of wallboard (3’-4’ by 5’). To reduce the size of this large piece of wallboard, a worker stood on an unapproved section (middle) of the scaffold to hold the wallboard while another worker cut the piece to a manageable size. The wallboard was dropped to the floor.

None of the workers interviewed by the Board stated that they used HPI tools. The Superintendent reminded workers to do “peer checks”. When asked how a peer check might be used on this job, workers gave an example “as having someone look at a broom to see if it was safe to use”. Managers, when asked how a peer check might be used, said that supervisors and field engineers performed peer checks of the craft workers when they review their work. No evidence of peer checking being performed by the participants was found by the Board.

HPI Training for the workers (craft and supervisors) was provided starting in 2008. The HPI training was about 2.5 hours long. Management stated that that were not sure all of the craft workers had received the 2.5 hours of HPI training due to personnel being out when the training was given and due to new personnel being hired. Personnel periodically receive briefings on HPI during “Heads up briefings” and Monday morning safety meetings.

Management expectation was that craft supervision would oversee the workers HPI tool usage and coach workers on proper tool usage. Management issued a memo to construction craft supervision in November 2008 directing craft supervision to perform Jobsite Reviews. The requirement to perform Jobsite Reviews is still in effect but no Jobsite Review documentation was found in the WO.

ANALYSIS:

2.4.5.1 Human Performance During the Event

The conditions surrounding this event included error precursors and organizational weaknesses that likely contributed to the event. Error precursors increase the error rates of personnel. Organizational weaknesses set conditions that can cause errors or where a human error can cause an event. The Board reviewed the event scene, reviewed the associated documents, and interview personnel to identify the error precursors and organizational weaknesses

2.4.5.2 Error Precursors

Based on the testimony of the personnel involved, on the day of the accident, error precursors involving task demands, individual capabilities, and human nature were apparent. Error precursors are unfavorable conditions at the job site that increase the probability of personnel making an error while performing their tasks. The effect of the error precursors on the accident is not directly known but error precursors increase the probability of error and human error is the cause of most events. The Board identified the following error precursors;

- **Unclear goals, roles, or responsibilities** – Personnel stated they were uncertain what the roles and responsibilities were for the Superintendent and Foremen. The role of the supervision was not clear to the work force. For example, on one of the days leading up

to the accident, personnel were unsure who the Superintendent and Foremen on the PAV job were until sometime in the afternoon. The facility had no defined roles and responsibilities for Foremen and workers and supervision were unable to define supervisory functions except for giving the pre-job. On the day of the accident, both the Superintendent and both Foremen were detailed to their positions but the organization had not provided any additional training on performing their assigned duties. Evidence was presented that all three supervisors (Superintendent and 2 Foremen) were actively engaged in the work the same as craft workers the day of the accident and not focused on overseeing the work to ensure that it was being performed safely. The evidence indicated this error precursor directly affected management's role of coaching workers on proper behavior and reinforcing expectations for working within the controls on the day of the accident.

- **Hazardous attitude for critical tasks** – On numerous occasions' personnel demonstrated a perception of invulnerability while performing safety critical tasks. When personnel questioned work activities they were told “let me show you” and the task was performed while demonstrating risky behaviors. For example, after lunch on the day of the accident, C2 and DCF removed the upper handrails of a scaffold while standing on the ladders at each end of the scaffold. This resulted in both workers working from ladders approximately 12' 6” off of the floor without fall protection. More importantly, the handrails were removed so C2 could work on the scaffold without the handrails being installed. During the day of the accident there were two instances where scaffolding was moved by workers on the ground to a new location while it was extended and workers were on top of the scaffold. When, in an effort to demonstrate that the wallboard could be removed faster, a worker removed a large piece of wallboard, another worker stood on an unapproved section of the scaffold to hold the wallboard so the first worker could cut the piece into a manageable size. Because there was no lower worker on a scaffold to hand the piece to, the wallboard was dropped to the floor. Although it is uncertain what the role this error precursor might have played in the IWs fall, the evidence indicated that this error precursor placed workers at risk of injury on the day of the accident.
2. **Inaccurate risk perception** – The Board determined that, on the day of the accident, personnel were taking risks with an inaccurate understanding of a potential consequence or danger. Personnel defeated defenses or failed to recognize degraded defenses without recognizing that people are fallible, and even the best people make mistakes. For example, moving the scaffold to a new location while it was extended and workers were on top of the scaffold defeated several safety features of the scaffold. A simple error like jerking the scaffold could have resulted in the scaffold tipping over and two workers falling 16' to the floor. With the defenses defeated or degraded all it would take is an error to cause an event yet the first principle of Human Performance is “People are fallible, and even the best people make mistakes.” Personnel that have been trained in HPI should have had a “healthy uneasiness,” knowing that people will make mistakes. They should be watching for errors so they can be corrected before there are unwanted consequences. The error that caused this accident is unknown, but it is known that the defenses were not adequate to prevent an error from resulting in an accident. The accident could have easily been fatal and yet the risks taken throughout the day of the accident that could have resulted in a similar accident or injuries.

2.4.5.3 Accident Failed Defenses/Organizational Weakness

Defenses are comprised of any human, technical, or organizational features used to defend the facility, property, environment, and personnel against the hazards. The primary hazard is human error. Defenses against hazards include things like procedures, physical interlocks, redundant equipment, and shielding, as well as those that rely on people, such as self-checking, peer-checking, three-way communication, reviews and approvals, and supervisory oversight. Based on the testimony of the personnel involved, on the day of the accident, the degraded defenses that were found by the Board are listed below.

- **Self Checking** – None of the workers interviewed by the Board stated that they performed self checking. Self checking is an attention management technique to help focus attention on the appropriate component, to think about the intended action and its expected outcome *before* performance, and to verify results after performance. It is particularly effective during skill-based tasks like the activities being performed in the PAV. If used correctly, self checking boosts attention at important points in an activity before an important action is performed. Had workers checked that scaffolding wheels were locked (scaffold C) before climbing on the scaffold; workers would not have been put at risk of falling, due to a sudden shift of the scaffold.
- **Peer Checking** – The Board was told that the Designated Superintendent (IW) often reminded workers to do “peer checks”. When the Board asked personnel how a peer check might be used in this work activity, workers described having someone look at a broom to see it was safe to use. When managers were asked the same question they said that supervisors and field engineers performed peer checks of the craft workers when they review their work. No evidence of peer checking being performed was found by the Board.

Peer checking involves two individuals working together at the same time and place, before and during a specific action where a human error could cause unwanted consequences. Peer checking augments self checking by the performer—it does not replace it. The purpose of peer checking is to *prevent* an error by the performer. This technique takes advantage of a fresh set of eyes. The peer, an individual familiar with the activity, may see hazards the performer does not see. Peer checking is intended to be informal; people can apply peer checks at any time to any work situation to help them avoid mistakes. Peer checks can be requested by anyone and performed by anyone familiar with the task and trained in the peer checking technique.

- **Knowledge/Training** – The evidence that the Board reviewed indicated that the workers involved in this accident had received training on HPI several years before the accident. Additionally, personnel receive periodic briefings on HPI during “Heads up briefings” and Monday morning safety meetings. The Board was told that the DS (IW) often reminded workers to do “peer checks”. No other HPI tools were evident in this work activity.

The peer check tool was weakened by the vagueness of the application. Applying the defense to relatively insignificant actions degrade people’s application over time. Many

activities are not important. The potential exists that peer check might not be applied when it is really important. Recurring use of the peer check tool for all actions, regardless of their risks, will dilute the effectiveness of the tool in the long run.

Implementation of HPI tools needs to be supported by supervision setting expectations for HPI tools usage and coaching workers on proper tool usage. In this instance, there was no evidence that craft supervision reinforced expectations for HPI tool usage or coached employees for inappropriate behavior. The craft supervision was given the same HPI training that the workers received but management expectation was that craft supervision would oversee the HPI tool usage and coach workers on proper tool usage.

Another example of HPI implementation not well being supported is the Jobsite Review. In response to a series of site incidents, management issued direction for craft supervision to perform Jobsite Reviews in November of 2008. Even though this direction had been effect for 2-½ years it had not been formalized. The Board was provided no documentation to support that the detailed supervisors had been trained in its use. In accordance with the issued direction, there should have been multiple Jobsite Review sheets in the work package. No Jobsite Review documents were found in the work package. Management did provide a copy of one Jobsite Review sheet that was performed on 6/23/11 (before the work was started). No Jobsite Reviews were documented for the subsequent shifts.

The knowledge and training of workers and craft supervisors failed to support successful implementation of the HPI tools to mitigate for expected human error.

- **Pre-Job Briefing** – The pre-job is an important part of understanding the planned task, associated hazards, for reviewing the controls, and to discussing the HPI tools that will be applied. The pre-job briefing checklist section III covered HPI tools but there are no marks to indicate which tools were discussed and none of the personnel interviewed indicated that section III was reviewed in the Pre-jobs performed. The lack on the initial pre-job briefing inhibited the ability of supervisors to consistently cover key elements in subsequent briefings as new personnel were assigned the task. As the job progressed over several days the pre-job briefs to new workers who were not given the original pre-job did not use the pre-job checklist. The pre-job briefings on the day of the accident were informal, failed to fully discuss the hazards, did not involve all of the workers, did not review HPI other than to mention for people remember to perform peer checks. The Board concluded that on the day of the accident, the pre-job failed to prepare the workers to properly perform the task safely.
- **Management/Supervisor Involvement and coaching** - Managers and supervisors must provide specific feedback to the performer when at-risk practices are observed. Without coaching and correction, personnel tend to become comfortable with the hazards and the use of HPI tools tend to diminish.

Further, a high performing organization nurtures the belief that when production and safety conflict, safety will prevail. Leadership practices must demonstrate safety over

production. The true values of an organization are reflected in the observed acts of its people, especially its managers.

The Board did not see any evidence of management placing production over safety. However, the dynamics in this work group were such that this crew made decisions to take risks. On the day of the accident, the Board determined that DS, DLF and DCF did not demonstrate and reinforce safe work practices. Examples of the craft supervision defense failing include:

- To allow a worker to work without necessary handrails, supervision assisted in the removal of scaffold handrails while standing on the scaffolding ladders without fall protection,
- Supervision directed the movement of scaffolding while it was raised, loaded with tools, and with personnel on board,
- Supervision demonstrated risky behavior by reaching beyond the ends of the scaffold to perform work and pulling hard against the scaffold when removing wallboard, and
- Supervision encouraged one worker to start work after a discussion of how to perform the task and without a discussion of the hazards or signing the work package.

The Board determined instead of demonstrating a value for safety and providing feedback to workers when at-risk practices were observed, the detailed supervisors demonstrated or allowed risky behavior. Although it is not apparent that the failure of this defense directly led to the accident, the actions listed above represent numerous instances of personnel being placed at risk of a significant accident that day.

The Board concluded that there are several opportunities for SRNS to learn from this event to improve the implementation of their HPI program. Implementation needs to ensure:

- People consistently use the HPI tools to:

1. Catch human errors before they have unwanted consequences and
2. Identify and eliminate organizational weaknesses that provoke error.

- Leaders are:

1. Facilitating open communications,
2. Reinforcing desired behaviors,
3. Eliminating latent organizational weaknesses and
4. Demonstrating a value for error prevention.

2.4.6. Integrated Safety Management System Implementation

As required by 48 CFR 970.5223 – 1, Integration of Environment, Safety, and Health into Work Planning and Execution, the contractor has established an Integrated Safety Management System (ISMS) program description with a suite of procedures for program implementation. SRNS successfully completed a Phase II verification of ISMS as validated by DOE-SR on 6/29/2011. The following describes the determination of the Board in relation to implementation of the ISMS core functions and guiding principles into the work activity.

2.4.6.1. Define the Scope of Work

The Board determined that the scope of work for the WO being performed on the day of the accident contained sufficient information to develop detailed work instructions. However, Step 4.19 contained what amounts to a broad scope statement that, on its own, lacked sufficient detail and controls to ensure that the specified work activity could be safely executed. The lack of a coordinated approach to wallboard and stud removal did not consider the instability of the remaining wallboard on the backside of the wall directly in front of Tele-Tower® “A”.

2.4.6.2. Identify and Analyze Hazards Associated with the Work

The decision of the planner to develop the initial draft of the AHA and routing it electronically for review and approval bypassed an opportunity for group synergy and discussion regarding approach to the task and hazard mitigation. Identifying the type of scaffold upfront (although the Board acknowledges the benefit of worker input into the process) did not allow evaluation of an alternate methodology for the elevated work.

The Board concluded that identifying the type of scaffold upfront did not allow evaluation of an alternate methodology for the elevated work.

2.4.6.3. Develop and Implement Hazard Controls

Mitigation for the hazards identified for the work was ambiguous and relied heavily on the training and qualification of the individual workers. Scaffold inspection records and the as found condition of the equipment indicate that there are weaknesses regarding compliance for both the scaffold user and competent person inspections. The AHA identified “other falling object protection” in addition to hard hats, but the Board was unable to verify that any such measures were in place, such as roping and posting the area. The use of proper lifting techniques was stated in the SWP, but there was no correlation to the weight and size of the wallboard being removed. Finally, the jobsite contained both falling object hazards (creating a foot impact risk) and a sharp object puncture hazard from the various screws taken out during D&R. Only sturdy shoes (as defined by company procedure) were prescribed for the work.

The Board concluded that the prescribed hazard controls for the work were not sufficiently tailored to the work activity, placing the workers at increased risk to workplace injury.

2.4.6.4. Perform Work Within Controls

During interviews, workers cited numerous instances where actions taken on the day of the accident deviated from prescribed hazard controls in the SWP. Scaffold inspections did not reflect that the required inspections were conducted or verified following adjustments and modifications as required by the green tag. Additionally, the vague content of the work step being performed at the time the accident occurred caused the group to develop different approaches to task accomplishment as they progressed without re-evaluating potential hazards and implementing additional controls.

The Board concluded that the work was not being performed within the controls specified in the WO on the day of the accident.

2.4.6.5. Provide Feedback on Adequacy of Controls and Continue to Improve Safety Management

The Board reviewed feedback and improvement mechanisms by both DOE and SRNS.

The DOE-SR technical assessment program is governed by Savannah River Manual SRM 226.1.1D, *Integrated Performance Assurance Manual*. DOE-SR AMNMSP and the Office of Safety and Quality Assurance uses an annual assessment plan to schedule planned technical assessments for the year. These assessments are documented in the Site Integrated Management Total Assessment System (SIMTAS). Assessments that identify a Concern, Deficiency, Observation, or Good Practice are reviewed by the DOE-SR Management Review Board and forwarded to the appropriate contractor for resolution or for information in the Monthly Assessment Reports.

Day-to-day field oversight of K-Area activities are performed by the two assigned Facility Representatives from AMNMSP (line management). The Office of Safety and Quality Assurance also provides AMNMSP matrix support in the oversight of construction safety. Management walkthroughs are also conducted by senior DOE management. The Board reviewed the assessments in SIMTAS and found that the Facility Representatives and OSQA safety personnel have performed assessments in K-Area including the PAV area. A variety of functional areas were assessed over the last twelve months including scaffolding, work control and planning, safety basis verifications, material receipts and construction activities. When necessary, deficiencies were identified and formally communicated to SRNS via the Monthly Assessment Reports and monthly contractor performance feedback meetings.

Contractor Assessment Activities

SRNS implements the self-assessment process in accordance with Manual 12Q, Site Assessment Manual, Procedures SA-1, Self-Assessment. The Board reviewed the SRNS self-assessments which consist of the Management Field Observations. The main purpose of the Management Field Observation Program is to get managers in the field. The VP, Division, Department, and Group managers are asked to complete the following main tasks: 1) Meet the personnel in the field, 2) Better understand the field processes and how their disciplines affect the site mission, 3) Periodically take senior management's messages on safety, president's directives, and other

areas directly to the workers. Ten MFO's were found that had reviewed the PAV work area but all of the MFO's occurred before the wallboard removal activities commenced. Only one issue was found (barrier rope down) in the ten MFO's. The Board interviewed a Project Manager who had looked at the work area but he did not enter the PAV work area because of the dusty conditions. The project manager did not write a MFO. For the wallboard removal activities, 4 out of the 7 days worked were backshift days. No MFO's were found for backshift (outside normal work hours) work activities in the 105-K building for the last 12 months. The Board also interviewed the Deputy Construction Manager who stated that MFO were performed but not always formally documented.

SRNS also has a Facility Evaluation Board (FEB) that provides SRNS senior management with an independent contractor assurance system. The FEB consists of subject matter experts who assess certain areas of a facility or program in two week intervals. The Board reviewed the recent FEB assessments for K-Area which included the following functional areas; conduct of operations, safety and health, engineering, fire protection, maintenance, and radiological controls. The functional area of work planning and control was included in these assessments. No major or minor deficiencies were identified by these FEB assessments that are pertinent to this accident.

The Board reviewed feedback from the SRNS Behavior-Based Safety (BBS) program. In BBS observations, trained observers monitor their peers' safety behavior on a regular basis. The objective of the observation and feedback discussion is to allow the worker to identify the hazards associated with a particular task. BBS observations Functional Area 14.0 for Ladder/Scaffold Safety utilizes the following lines of inquiry, ladder selection is appropriate, ladder setup is correct, ladder use, verified tag before use, selected appropriate alternative, properly mounted scaffold, properly loaded scaffold. The Board reviewed the last twelve months of BBS observations and noted no adverse trend in the area of Ladder/Scaffold Safety.

The Board recommends that SRNS modify its oversight approach to increase the frequency of oversight activities on off-shift work and observing work evolutions involving "industrial" hazards

Performance Analysis (PA) – Performance Analysis is a method of reviewing data (issues, incidents, events, problems, etc.) to determine if commonalities exist within, and among, the previously identified problems and/or events. The basis for these reports is DOE M 231.1-2, *Occurrence Reporting and Processing Operations Information*, but also includes non-ORPS reportable events. This PA process has been used for several years and the Board reviewed the quarterly PA reports from 4QFY10 through 3QFY11. The Board's review of the PA reports showed an upward trend in the construction functional area because of quality assurance issues at the Waste Solidification Building under construction in F-Area. There were no adverse trends or recurring open issues identified in any area related to this accident.

Previous Occurrences and Lessons Learned

The Board reviewed fifty-one prior ORPS events related to scaffolding. Only one has similar effects to this accident but has no effective lessons learned that could have prevented this accident. EM-ID--CWI-IWTU-2011-0004, Employee Falls from Scaffolding Ladder, Fracturing Foot. On 4/12/11, a URS laborer employee was ascending a scaffold ladder. As the employee was climbing the ladder, he lost his grip and fell approximately nine feet to the ground where he landed feet first and then rolled on his side. The fall resulted in a fracture to the laborer's right foot.

The Board reviewed forty two DOE Lessons Learned reports (2004 – 2011) from the Operating Experience System related to scaffolding. None of the lessons learned were directly pertinent to this accident from which preventative measures could have been taken.

In K-Area from January 1, 2011 to July 1, 2011 the contractor conducted five Site Tracking and Reporting (STAR). Self assessment reports examining scaffolds; and from July 1, 2010 to July 1, 2011 the contractor conducted seven STAR self assessments. Of these, all were conducted by supervisors and project personnel; none were conducted by safety professionals. None of these assessments found any items of significance.

For SRS, there have been 270 STAR Self assessments by supervisors, project personnel, & safety professionals looking at scaffolds in the years' time from July 1, 2010 through July 1, 2011. Various findings have arisen but none changing the program aspects or requiring major changes to the procedures or processes or creating major changes to performance of scaffold work.

Worker Feedback - Documentation was not found for worker feedback except that the carpenters were asked on what type of scaffolding they preferred during the work planning phase and they said Tele-Towers®. Personnel indicated that they raised issues informally to their managers but there was no documentation on the issues being raised or how the issues were addressed. For example, a worker spoke up when the scaffold was moved with people on it and the person said it did not occur again. This was a missed opportunity for management to pause the job and reinforce expectations for safety. When asked personnel said that they felt that adequate action had been taken when they raised issues. Additionally, the Board reviewed both DOE and SRNS Employee Concerns cases and found no issues similar to the accident.

The Board concluded that numerous feedback mechanisms are implemented at SRS. These feedback mechanisms did not identify similar deficiencies as identified by the Board.

2.4.6.6. Guiding Principles of ISMS

In addition to the guiding principles indicated above, the absence of defined roles and responsibilities for the detailed superintendent/foremen indicates a weakness in establishing and enforcing clear and unambiguous lines of authority and responsibility. Competence, commensurate with responsibility issues are evident in the deficiencies found on the scaffolds and lack of rigor in performing required inspections. Additionally, risky behaviors being displayed by the group coupled with a lack of safety professional and supervisory oversight indicates that resources may not have been effectively allocated to support the task.

The Board concluded:

There was no defined process for detailing workers to foreman and superintendent positions. No management expectations or position responsibilities were identified for the position of foreman or detailed foreman.

There was no established process to assure all workers at the job site understood who the detailed foremen and detailed superintendent were on the day of the accident.

Also, risky behaviors being displayed by the group coupled with a lack of safety professional and supervisory oversight indicates that resources may not have been effectively allocated to support the task.

2.4.7. Scaffold Safety Training

SRNS Manual 8Q, Procedure 16 (8Q-16), Rev. 12, 01/31/2007 requires employees who perform before shift inspections or perform work while on scaffolding must attend site scaffold training or have attended equivalent training as prescribed by OSHA. Site training shall be based on training criteria provided in OSHA 1926.454 (a) (1-5) scaffolds, (b) 1926.1060 (a)(1)(i-v) ladders and 1926.503 (a)(1)(2)(i-viii) fall hazards. Personnel who erect, disassemble, move, operate, repair, or maintain scaffolds must attend site ladder, scaffold, and erectors training or have attended equivalent training as prescribed by OSHA 1926.454 (a) (1-5) scaffolds, (b) (1-4) erectors, (c) 1926.1060 (a)(1)(i-v) ladders and 1926.503 (a)(1)(2)(i-viii) fall hazards.

8Q-16 requires that employees who erect, use or disassemble Tele-Tower® scaffolds must review the manufacturer's training video if it was not part of the initial training before performing such tasks. The current training course for Scaffold and Ladder Safety for Users" is SRNS Course number TMAR4400. The Board reviewed the lesson plans both for the classroom portion and the practical exercise (Job Performance Measure) and took the computer-based training version. The current training course does discuss scaffolding currently in use at SRS including the Tele-Tower® scaffold assembly/disassembly and use.

8Q-16 requires employees who serve, as scaffold and related fall protection competent persons must attend site training or have attended equivalent training as noted in the OSHA requirements above.

8Q-16 states that the decision to retrain employees shall be based on changes at the work place or changes in the types of equipment or related work that present hazards to which as employee has not been previously trained. Retraining shall also be based on supervision's evaluation and belief that an employee lacks the skill or understanding needed for safe work involving the erection, use or dismantling of scaffolds, and ladders. Each such employee shall be retrained to recognize the new hazards in the workplace, or so that the requisite proficiency identified by management is regained. The retraining program shall be aligned with the criteria and training elements described in the OSHA 1926.454(c)(1-3).

A qualification card is required for an OSHA Scaffold Competent Person (Supervisor) as required in Attachment "D". The qualification standard delineates the process for meeting the requirements of OSHA Competent Person 1926.451 associated with the inspection of scaffolds. A current completed qualification card was submitted to the Board for DFC dated 10/11/2010.

Training Courses

SRNS Training Department provided the Board with a matrix of training equivalency for scaffold work qualifications. The equivalency is shown in Table 2-6 below at the time of the accident. The training equivalency extends to a 1997 training course titled “Fall Protection” for six of the craft workers. This scaffold equivalency was determined by SRNS training to be equivalent to the current SRNS training course “Scaffold and Ladder Safety for Users” Course number TMAR4400 as shown in Table 2-6. This current course for scaffold and ladder safety has been available since 05/24/2007. Only two of the eight craft workers had completed the current course TMAR4400 prior to the accident.

The Board reviewed the training course ES200027 Fall Protection that has been credited as an equivalency in 1997 to the current training and noted that it only discusses fall protection and not the specifics on assembly, use and disassembly of scaffolding types currently in use at SRS.

Table 2-66: Training Equivalency

Worker	A	B
	Current Course Scaffold and Ladder Safety for Users TMAR4400 Date Completed	Equivalent Training Course Fall Protection E5200027 Date Completed
L1	10-07-08	
DFC	Equivalency granted 05-24-07	05-27-97
DFL	Equivalency granted 05-24-07	05-13-97
L2	Equivalency granted 05-24-07	05-20-97
IW	Equivalency granted 05-24-07	05-21-97
L3		Not trained.
C1	Equivalency granted 05-24-07	05-14-97
C2	03-11-10	

The Board concluded that the training equivalency of ES200027 Fall Protection does not cover the scope of scaffolding assembly, use and disassembly of current scaffolding available for use at SRS as contained in the current “Scaffold and Ladder Safety for Users” Course number TMAR4400.

The Board concluded that six of eight workers present during the accident were not formally trained on the Tele-Tower® scaffolding.

2.4.8. DOE-SR Oversight

The Board reviewed local DOE oversight conducted during the past two years preceding the accident. DOE-SR develops annual oversight plans to guide the conduct of activities during the fiscal year. KAC Facility Representatives (FR) develops quarterly assessments plans from the Annual Assessment Plan and assessments are assigned by name. FR assessments in the K Area in October of 2010 indicated issues regarding the application of Green Tags on scaffolding in two consecutive weeks. The Board also reviewed selected assessments in the Savannah River Integrated Management Total Accountability System (SIMTAS) database using keyword searches for scaffolding, pre-job briefings and fall protection. The Board interviewed the FRs assigned to the K area as well as the Nuclear Materials Operations Division Director and the Assistant Manager for Nuclear Material Stabilization Project. Both FRs indicated that they had been to the jobsite once during the week previous to the accident, although neither indicated they had observed anything out of the ordinary. Oversight conducted by the Office of Safety and Quality Assurance was also reviewed. Personnel indicated there was an expectation that a portion of their work consist of field oversight (15% of the time). Of the records reviewed, the Board did not find any assessments specific to the assembly and use of Tele-Tower® portable scaffolds. Although scaffolding is mentioned in several assessments documented in SIMTAS, only a few cite observing anything of significance. The April 2010 and October 2010 Monthly Assessment Reports contain surveillances that identified weaknesses in work planning and execution similar to those identified by the Board.

ANALYSIS:

The Board determined that the local DOE oversight process relies heavily on field oversight being conducted by the FR. While there are several examples of oversight being conducted regarding high risk and high planned activities, the work in the PAV did not receive sufficient attention. Safety oversight at the program level did not demonstrate that elements of OSHA relevant to scaffold use and fall protection have been assessed in sufficient detail. The frequency and quality of communication between the project and program office (subject matter experts) could be improved to better share emerging issues and integrate oversight resources. The Board recommends that DOE modify its oversight approach to increase the frequency of oversight activities on off-shift work and observing work evolutions involving “industrial” hazards

The Board concluded that the oversight is being conducted of higher risk and high visibility activities. However, the oversight of low/medium risk activities is not being given the same attention. Program support personnel should increase field oversight presence. The frequency and quality of communication between the project and program office (subject matter experts) could be improved to better share emerging issues and integrate oversight resources.

2.5. Investigative Readiness and Scene Preservation

The scene of the accident was secured by WSI-SRS law enforcement officers about the time the IW was air lifted from the scene, about 1406. The DOE FR was notified of the accident at 1409 who then informed the DOE-SR management of the accident. The DOE FR attended the Fact Finding meeting at 1610 and assumed control of the accident scene from WSI-SRS at 1715. At

1730, the DOE FR and three to four others toured the accident scene. At that time, the DOE FR allowed a first aid kit used in the accident response to be removed for restocking.

Prior to the Board arriving onsite the Board Chairman granted access to SRNS, with DOE FR escort, to take pictures and inspect the scene. SRNS interviewed workers that were at the scene of the accident with a Board representative present. SRNS also conducted a CA/MP exercise that involved workers in the immediate vicinity (work crew). The Board was provided numerous pictures that were taken by WSI-SRS and SRNS shortly after the accident and recordings of interviews. SRNS bagged, tagged and secured the coveralls and other personal items using appropriate Bio-hazard controls.

The scene was well controlled by WSI-SRS. It should be noted that the accident occurred in a room that was easily locked/secured.

The custody of the scene was turned over to the Board on 7/12/11. The Board retained custody of the scene through 7/19/11.

The WO was not obtained and controlled following the accident. Several changes and updates occurred as late as 7/6/11.

The Board concluded that the accident scene was adequately preserved. The Board also concluded that the worker's participation in CA/MP exercise could have impacted their ability to recall events surrounding the accident. The WO was not obtained and controlled following the accident. Several changes and updates occurred as late as 7/6/11.

2.6. Event and Causal Factors Chart

After performing the barrier and change analyses, the Board assigned results from each analysis to events on the chronology of events. This involved assigning the analyses results as conditions that were related or caused the events on the chronology. Assigning these conditions with events resulted in the events and causal factors (ECF) chart as seen in Appendix D.

Once conditions were assigned, the Board examined the chart to determine which events were significant (meaning which events played a role in causing the accident). The Board then assessed the significant events (and the conditions of each) to determine the causal factors of the accident. Causal Factors are the significant events and conditions that produced or contributed to the Direct Cause, the Contributing Causes and the Root Cause(s) of the accident. This investigation followed the processes required by DOE O 225.1B, *Accident Investigations* as described in the DOE Workbook, *Conducting Accident Investigations*, Revision 2, where the Direct, Contributing and Root Causes are defined as:

2.7. Barrier Analysis

Barrier analysis is based on the premise that hazards are associated with all tasks. A barrier is any management or physical means used to control, prevent, or impede the hazard from reaching the target (i.e., persons or objects that a hazard may damage, injure, or harm). The results of the barrier analysis were integrated into the events and causal factors chart to support the

development of causal factors. Appendix B contains the complete Barrier Analysis of physical and management barriers that did not perform as intended and thereby contributed to the accident.

2.8. Change Analysis

Change analysis examines planned or unplanned changes that caused undesirable results related to the accident. This process analyzed the difference between what is normal, or expected, and what actually occurred before the accident. The results of the change analysis conducted by the Board were integrated into the events and causal factors chart to support the development of causal factors. Appendix C contains the Change Analysis, which reinforces the Barrier Analysis.

3.0 Conclusions and Judgments of Need

Judgments of Needs (JONs) are the managerial controls and safety measures determined by the Board to be necessary to prevent or minimize the probability or severity of a recurrence. These JONs are linked directly to the causal factors which are derived from the facts and analysis. They form the basis for corrective action plans which must be developed by line management. The Board's conclusions and JONs are listed below in Table 4-1.

The Board concluded this accident was preventable.

Direct Cause - the immediate events or conditions that caused the accident. The Board concluded the direct cause of the accident was the IW fell from the Tele-Tower® scaffold.

Root Cause(s) – are causal factors that, if corrected, would prevent recurrence of the same or similar accidents. The Board identified the root cause of this accident as SRNS did not recognize and correct unsafe work practices being performed prior to or during the work on the day of the accident.

Contributing Causes - events or conditions that collectively with other causes increased the likelihood of an accident but that individually did not cause the accident. The Board identified the following contributing causes:

1. SRNS failed to provide sufficient field oversight to ensure that work activities were conducted safely during off hours.
2. In the role of detailed the Superintendent should not have been on the Tele-Tower®.
3. The Roles & Responsibilities for oversight by the detailed Superintendent and detailed Foremen were not defined.
4. Not all workers recognized unsafe conditions or took actions to correct unsafe actions by others.
5. Leaving the hand tools and power tools on the Tele-Tower® walking surface demonstrated at risk behavior that resulted in potential for tripping/slipping hazards.

6. The pre-job briefing(s) did not ensure that workers understood and implemented appropriate hazard controls.
7. Removal of larger pieces of wallboard (heavier, more difficult to manage) resulted in workers demonstrating "at risk" behavior.
8. Workers did not adhere to the hazard controls and did not comply with directed implementation identified in the SWP and other safety training
9. The company policy (CMP11-1.1, Rev. 5) and selection of foot wear were not consistent with the work environment, e.g., impact hazard from dropped materials and tools, puncture hazard from pulled screws, etc.
10. Scaffolds had deficiencies that were not identified during inspections or corrected prior to use (structural deficiencies and overhead obstructions).
11. Work practices in the use of Tele-Towers® do not meet OSHA requirements for ladders (spacing).
12. SRNS safety professionals were not present to promote the safe performance of work while work was in progress.
13. DOE oversight was not present to promote the safe performance of work while work was in progress on that day.
14. DOE oversight focus was toward the higher risk and high visibility programs and activities, and provided less focus and depth of review of industrial type activities.
15. The detailed superintendent and detailed foreman participated in un-safe work practices.
16. Supervision was unsuccessful in maintaining a safe work environment.
17. Workers had to climb to access working platforms and were at higher risk of falling using Tele-Towers®.
18. Planners/workers did not consider specific work actions / movements that resulted in workers reaching outside the boundaries of the scaffolding (extended reach) and accessing scaffolds.
19. Safety chains were down and provided no barrier to a fall accident.
20. The initial pre-job briefing did not include all workers. Subsequent pre-job briefings did not assure all workers were documented as having received the pre-job briefing.
21. Management system did not assure workers were trained to the updated (2007) requirements for Tele-Tower® scaffolds.

Note: Some of the following Judgments of Need address broad actions of analyzing programs and procedures to address the issues identified by the Board. It is recommended that the JONs be reviewed with the corresponding conclusions and causal factor analyses in this report to ensure a comprehensive corrective action plan is developed.

Table 3-1: Conclusions and Judgments of Need

Conclusions	Judgments of Need
<p>The Board concluded:</p> <p>There was no defined process for detailing workers to foreman and superintendent positions.</p> <p>No management expectations or position responsibilities were identified for the position of foreman or detailed foreman.</p> <p>There was no established process to assure all workers at the job site understood who the detailed foremen and detailed superintendent were on the day of the accident.</p> <p>Also, risky behaviors being displayed by the group coupled with a lack of safety professional and supervisory oversight indicates that resources may not have been effectively allocated to support the task.</p> <p>SRNS failed to ensure clear lines of authority and responsibility were defined, communicated and understood for the detailed superintendent and foremen.</p>	<p>SRNS needs to establish and ensure clear lines of authority and responsibility are defined, communicated and understood for detailing personnel into a supervisory or leadership role.</p>

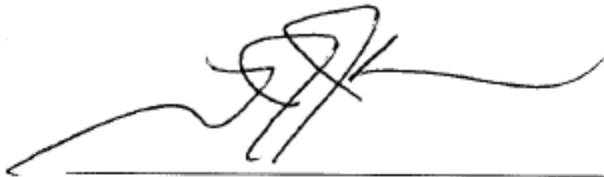
Conclusions	Judgments of Need
<p>The Board concluded that ambiguities in the requirements, inconsistencies in the steps, and lack of Safety Professional involvement (outside of electronic document approval) in the planning process to ensure hazards are mitigated resulted in the creation of a WO that did not establish the necessary controls to safely execute the specified work scope.</p> <p>The Board concluded that on the day of the accident, the work crew improvised additional methods for wallboard removal and handling that deviated from the prescribed hazard controls in the WO and the AHA without consideration to reanalyze the hazards.</p> <p>The execution of the AHA process did not drive the planning to consider alternate methods to provide elevated work platforms involving less risk.</p> <p>The Board concluded that the prescribed hazard controls for the work were not sufficiently tailored to the work activity, placing the workers at increased risk to workplace injury.</p>	<p>In accordance with 48 CFR 970.5223-1 and 10 CFR 851 SRNS needs to strengthen implementation of the work planning process to include:</p> <ul style="list-style-type: none"> • Application of the graded approach to consider more rigorous means of identifying hazards • Remove the ambiguities (e.g., when necessary, as required) which are left to the craft's decision for implementation • Clearly identify hazards and controls such that when workers approach safety boundaries a re-evaluation is performed. <p>SRNS should conduct an extent of condition review to determine the breadth of work planning improvements necessary to complete a comprehensive corrective action plan.</p>
<p>The company construction management (CMP11-1.1, Rev 5) policy and the AHA failed to identify the appropriate work shoes for the activity.</p> <p>The selection and condition of the IW's footwear was not appropriate for the work environment.</p>	<p>SRNS needs to evaluate and modify (with justification) construction management procedures and AHA process for specifying proper footwear for construction activities in consideration of the abrasion, impact hazards of falling objects, slip hazards and sole penetrations encountered during construction activities.</p> <p>SRNS need to ensure workers are complying with the requirements for proper footwear in construction areas.</p>

Conclusions	Judgments of Need
<p>The Board concluded that the training equivalency of ES200027 Fall Protection does not cover the scope of scaffolding assembly, use and disassembly of current scaffolding available for use at SRS as contained in the current “Scaffold and Ladder Safety for Users” Course number TMAR4400.</p> <p>The Board concluded that six of eight workers present during the accident were not formally trained on the Tele-Tower® scaffolding.</p> <p>Scaffolding inspections by scaffold users and competent persons did not assure the configuration, placement and condition of the scaffold was safe to use.</p> <p>The Board concluded that the configuration, inspections, and use of scaffolding did not meet the requirements of OSHA.</p> <p>SRNS failed to review changing requirements and assure workers have the knowledge, skills and abilities to safely operate Tele-Tower® portable scaffolding.</p>	<p>SRNS needs to evaluate and modify the procedures, training and proficiency for scaffold users and competent persons to ensure that scaffolding is erected and used in accordance with OSHA requirements and 10 CFR 851.</p>
<p>SRNS management and safety professionals were not present to ensure the safe performance of work while work was in progress.</p>	<p>SRNS needs to evaluate and modify their oversight process to ensure all activities that pose a risk to worker injury are receiving appropriate oversight including backshifts.</p>

Conclusions	Judgments of Need
<p>DOE oversight was not present to ensure the safe performance of work while work was in progress on that day.</p> <p>The Board concluded that the oversight is being conducted of higher risk and high visibility activities. However, the oversight of low/medium risk activities is not being given the same attention. Program support personnel should increase field oversight presence.</p> <p>The frequency and quality of communication between the project and program office (subject matter experts) could be improved to better share emerging issues and integrate oversight resources.</p>	<p>DOE needs to evaluate and modify their oversight process to ensure all activities that pose a risk to worker injury are receiving appropriate oversight including backshifts. The program support personnel need to increase field oversight presence.</p>
<p>SRNS failed to identify and resolve conflicts between the vendor's instructional video (required training) and 8Q-16 requirements for ladder access.</p>	<p>SRNS needs to review and resolve differences between 8Q-16, OSHA, and vendor requirements.</p>
<p>The pre-job briefs were conducted inconsistently and did not result in all workers having a common understanding of the scope of work and hazard controls to mitigate work place risk.</p>	<p>SRNS needs to evaluate and modify the process for conducting pre-job briefings to ensure that workers have a full understanding of the scope of work and the prescribed hazard controls.</p>
<p>The Board concluded that the work authorization process, as executed for this WO, did not ensure that the control of work contained the necessary level of rigor to ensure that facility conditions continued to support the work being performed.</p>	<p>SRNS needs to evaluate and modify the process for authorizing work to ensure that the SOM keeps informed of on-going work activities to ensure there are no impacts on Operations or vice versa.</p>
<p>The Board concluded that the work environment and Personal Protective Equipment (PPE) requirements did not constitute a condition which may have led to a heat stress related accident.</p>	<p>No action required.</p>

Conclusions	Judgments of Need
<p>The Board concluded that there are several opportunities for SRNS to learn from this event to improve the implementation of their HPI program. Implementation needs to ensure:</p> <ul style="list-style-type: none"> - People are consistently using the HPI tools to: <ol style="list-style-type: none"> 1. Catch human errors before they have unwanted consequences, and 2. Identify and eliminate organizational weaknesses that provoke error. - Leaders are: <ol style="list-style-type: none"> 1. Facilitating open communications, 2. Reinforcing desired behaviors 3. Eliminating latent organizational weaknesses, and 4. Demonstrating a value for error prevention. 	<p>SRNS needs to evaluate the implementation of HPI to ensure that it is effectively implemented.</p>
<p>The Board concluded that numerous feedback mechanisms are implemented at SRS. These feedback mechanisms did not identify similar deficiencies as identified by the Board.</p>	<p>SRNS needs to evaluate and modify the utilization of feedback mechanisms in planning and execution of work in accordance with 48 CFR 970.5223-1.</p>
<p>The Board concluded that the accident scene was adequately preserved.</p> <p>The Board also concluded that the worker's participation in CA/MP exercise could have impacted their ability to recall events surrounding the accident.</p> <p>The WO was not obtained and controlled following the accident. Several changes and updates occurred as late as 7/6/11.</p>	<p>SRNS needs to evaluate and modify the process to control associated documents and take appropriate measures to preserve the integrity of individual testimony.</p> <p>DOE needs to evaluate and modify the process to control associated documents and take appropriate measures to preserve the integrity of individual testimony.</p>

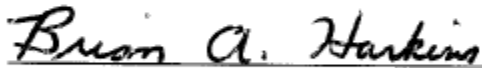
4.0 Board Signatures



T. J. Jackson
Trained Board Chair / Investigator
Board Chair, EMCBC



Roger Claycomb
Trained Investigator
Board Member, DOE-ID



Brian Harkins
Trained Investigator
Board Member, DOE-ORP



Mark A. Smith
Trained Investigator
Board Member, DOE-SRS

5.0 Board Members, Advisors, Consultants

Board Members

Chairperson	T. J. Jackson, EMCBC
Member	Roger Claycomb, Board Investigator, DOE-ID
Member	Brian Harkins, Board Member, DOE-ORP
Member	Mark Smith, Board Member, DOE-SRS

Subject Matter Experts

August Maniez, Industrial Safety, DOE-SR
Greg Campbell, Emergency Management, EMCBC
Dr. Michael Ardaiz, Chief Medical Officer, DOE-HQ

Advisor/Board Coordinator

Technical Advisor William McQuiston, MAS Consultants

Administrative Coordinator

Administrative Assistant Lynda Mayes, SR

Appendix A:
Appointment of Accident Investigation Board





Department of Energy

Washington, DC 20585

JUL 08 2011

MEMORANDUM FOR T. J. JACKSON
ASSISTANT DIRECTOR
OFFICE OF LOGISTICS MANAGEMENT
CONSOLIDATED BUSINESS CENTER

FROM: DAE Y. CHUNG *Tat for*
PRINCIPAL DEPUTY ASSISTANT SECRETARY
FOR ENVIRONMENTAL MANAGEMENT

SUBJECT: Accident Investigation into the Fall of a Worker in K-Area, at
the Savannah River Site, July 1, 2011

In accordance with the requirements of DOE Order (O) 225.1B, *Accident Investigations*, I am establishing an Accident Investigation Board (Board) to investigate the fall of a worker in K-Area at the Savannah River Site (SRS) that occurred on July 1, 2011. I have determined the event meets the criteria of item 2.a.(2) (any single accident that results in the hospitalization for more than five calendar days, commencing within seven calendar days of the accident) for the conduct of an accident investigation delineated in Appendix A, DOE O 225.1B.

You are appointed as the Board Chairperson. The Board will be composed of the following members:

- T.J. Jackson - Environmental Management Consolidated Business Center - Chair (trained investigator/lead)
- Brian Harkins - Office of River Protection - Human Performance Improvement (trained investigator)
- Mark Smith - SRS - Integrated Safety Management System implementation/ safety training (trained investigator)
- Roger Claycomb - Idaho Cleanup Project - work planning (trained investigator)
- August Maniez - Savannah River Operations Office (SR) - Occupational Safety and Health Administration/Industrial Safety
- Bill McQuiston - Consultant/Advisor
- Lynda Mayes - SR - Administrative support

The scope of the Board's investigation is to include, but not be limited to, identifying all relevant facts, determining direct, contributing, and root causes of the event, developing conclusions, and determining the judgements of need to prevent recurrence.



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The scope of the investigation is to include Department of Energy's (DOE) oversight activities.

The Board is expected to 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 Office of Safety and Security Program, the DOE SR, and the affected contractor for factual accuracy review prior to finalization. The final report should be provided to me within 30 days of the date of this memorandum. 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 Mr. James Hutton, Acting Deputy Assistant Secretary, Office of Safety and Security Program, at (202) 586-5151.

cc: D. Moody, SR
Z. Smith, SR
M. Mikolanis, SR
A. Maniez, SR
L. Mayes, SR
M. Smith, SRS
B. Harkins, ORP
R. Claycomb, ID
B. McQuiston, Consultant
D. Pegram, HS-31
I. Triay, EM-1
C. Anderson, EM-3
J. Hutton, EM-20 (Acting)
K. Picha, Jr., EM-21 (Acting)
R. Goldsmith, EM-22

Appendix B: Barrier Analysis

Barrier analysis is based on the premise that hazards are associated with all tasks. A barrier is any means used to control, prevent, or impede a hazard from reaching a target, thereby reducing the severity of the resultant accident or adverse consequence. A hazard is the potential for an unwanted condition 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. Barrier analysis determines how a hazard overcomes the barriers, comes into contact with a target (e.g., from the barriers or controls not being in place, not being used properly, or failing), and leads to an accident or adverse consequence. The results of the barrier analysis are used to support the development of causal factors.

Table B-11: Barrier Analysis

BARRIER ANALYSIS WORKSHEET			
Hazard: Fall		Target: Injured worker	
What Were the Barriers?	How Did Each Barrier Perform?	Why Did the Barrier Fail?	How Did the Barrier Affect the Accident?
Competent Person/Scaffold User Inspections	User inspections were not performed consistently and did not identify scaffolding deficiencies while in use: - non-uniform rung spacing (A) - outrigger pins not engaged (A) - safety chains not latched (A) - loose wings nuts on supports (A) - incomplete safety rails (B) - unlocked wheels (B & C) - extension connectors bent (C) - obstructions and tripping hazards on the walking surfaces - toeboards or barriers were not in place (Waco)	The non-documented scaffold inspections were cursory and did not result in workers identifying deficiencies.	The IW was placed at increased risk to a fall while working from a scaffold with unrecognized deficiencies. B1

BARRIER ANALYSIS WORKSHEET

Hazard: Fall		Target: Injured worker	
What Were the Barriers?	How Did Each Barrier Perform?	Why Did the Barrier Fail?	How Did the Barrier Affect the Accident?
ISM - Perform work within controls	<p>The workers did not establish and maintain work within the prescribed hazard control set:</p> <ul style="list-style-type: none"> - handrails were missing from scaffolding (B) - personnel on elevated scaffolding during scaffold repositioning (B & C) - dropping material from heights - working in inappropriate areas near scaffolding (under scaffolds) - falling object protection was not established - obstructions and tripping hazards on elevated walking surfaces (A, B & C) - reaching outside the boundary while elevated (C) - weight limitations of the extended scaffold were not verified during work (C) - leather gloves not worn by all workers - working from scaffold ladders (B) 	<p>Workers did not adhere to the hazard controls and did not comply with directed implementation identified in the SWP and other safety training</p>	<p>Created a work environment where risk taking was acceptable B2</p>
Safety Chains at ladder access (A)	Use unknown	<p>Safety chains were down and provided no barrier to a fall accident.</p> <p>Workers practice was to unlatch safety chains when leaving the</p>	<p>Allowed a means of unimpeded egress from the scaffold platform. B3 No effect.</p>

BARRIER ANALYSIS WORKSHEET

Hazard: Fall		Target: Injured worker	
What Were the Barriers?	How Did Each Barrier Perform?	Why Did the Barrier Fail?	How Did the Barrier Affect the Accident?
		platform.	
Sturdy Work Shoes	Failed - The work shoes were worn and in questionable condition. Sides of the shoes were broken down. The right shoe had a piece of the heel missing and a slice mark. The uppers were constructed of soft leather and the sole was soft rubber. The shoes had no ASTM or ANSI label.	The company policy (CMP11-1.1, Rev. 5) and selection of foot wear were not consistent with the work environment, e.g., impact hazard from dropped materials and tools, puncture hazard from pulled screws, etc.	Unknown. The poor condition of the work shoes provided an increased opportunity for loss of footing. B4
Proper scaffolding erection and assembly	Loose wings nuts found on two support brackets. Two of four stop pins for the outriggers were not engaged.	Scaffolding not properly assembled per vendor's instructions.	Unknown. The improper assembly of the scaffold placed the worker on a scaffold with unrecognized deficiencies. B5
Uniform spacing of ladder rungs (A)	Failed	Work practices do not meet OSHA requirements for ladders	Non-uniform spacing created non-uniform rung spacing and potential for loss of footing. B6
Proper placement and clearance of scaffold work platform relative access and egress to the scaffold	Failed	Injured worker's placement of the scaffold was not in accordance with requirements resulting in the hazard not being mitigated.	The close proximity to the overhead obstruction for access and egress created a potential for contact. B7
Work Crew Supervisory oversight	Failed	The Roles & Responsibilities for oversight by the detailed Superintendent and detailed foremen	The Supervisory oversight failed to re-enforce safe work practices. B8

BARRIER ANALYSIS WORKSHEET

Hazard: Fall		Target: Injured worker	
What Were the Barriers?	How Did Each Barrier Perform?	Why Did the Barrier Fail?	How Did the Barrier Affect the Accident?
		were not defined. The detailed superintendent and detailed foreman participated in unsafe work practices.	
Pre-job briefing	Failed	The initial pre-job briefing did not include all workers. Subsequent pre-job briefings did not assure all workers were documented as having received the pre-job briefing. The pre-job did not assure workers understood and implemented appropriate hazard controls.	The pre-job briefing failed to prepare the work group for the safe conduct of the task. (Did not prevent workers from demonstrating unsafe acts.) B9
DOE Oversight of field activities	DOE Oversight was not present that day - Scaffolding deficiencies recently identified by DOE did not include deficiencies noted by the Board.	DOE oversight focus was toward the high hazard, high risk, high dollar programs and activities, and provided less focus and depth of review of industrial type activities.	This provided a missed opportunity to identify unsafe work practices and scaffolding deficiencies. B10
SRNS Safety Overnight of field activities	There were no Manager Field Observations that documented observations of weekend activities. No safety professional oversight.	SRNS failed to provide sufficient field oversight to ensure that work activities were conducted safely during off hours.	This provided a missed opportunity to identify unsafe work practices and scaffolding deficiencies. B11
Stop Work Authority/Time Out	Not invoked.	Not all workers recognized unsafe conditions or took actions to correct unsafe actions by others.	Allowed unsafe behavior to continue during the work activities. B12

BARRIER ANALYSIS WORKSHEET

Hazard: Fall		Target: Injured worker	
What Were the Barriers?	How Did Each Barrier Perform?	Why Did the Barrier Fail?	How Did the Barrier Affect the Accident?
Choice of elevated working platform	Work planning resulted in a decision to use Tele-Towers® over a "JLG" or scissors lift to accomplish the work activity.	Planners/workers did not consider specific work actions / movements that resulted in workers reaching outside the boundaries of the scaffolding (extended reach) and accessing scaffolds.	Injured worker would not have had to access scaffold via ladder. B13
Worker compliance to 8Q-16, Ladder & Scaffold Safety procedure requirements re: Tele-Tower®	Failed	Management system did not assure workers trained to the updated (2007) requirements for Tele-Tower® scaffolds.	Unsure (workers were not provided consistent information for access to and egress from Tele-Tower® ladders) B14

Appendix C: 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. Change can be planned, anticipated, and desired, or it can be unintentional and unwanted. Change analysis examines the planned or unplanned disturbances or deviations that caused the undesired results or outcomes related to the accident. This process analyzes the difference between what is normal (or “ideal”) and what actually occurred. The results of the change analysis are used to support the development of causal factors.

Table C-11: Change Analysis

CHANGE ANALYSIS WORKSHEET			
Accident Situation	Accident Free, Prior or Ideal Situation	Difference	Evaluation of the Effect on the Accident
Workers were removing large (greater than 2'x2') pieces of sheet rock	Workers removed smaller (2'x2' or less) pieces of sheet rock.	Larger pieces are heavier, more difficult to manage and resulted in workers demonstrating "at risk" behavior.	No effect on accident.
Sheet rock was being dropped to the floor	Sheet rock was being handed down and handed to the floor	The change in "pass-down" process resulted in "at risk" behavior.	No effect on the accident.
The foot wear worn by the IW was worn, and had a piece missing from the heel.	Sturdy (construction quality), well maintained footwear is worn to assure protection during construction activities and reduce possibility of slipping.	Sturdy (construction quality) footwear reduces the possibility of foot injury and injury due to slipping.	Reduced possibility of loss of footing while climbing ladders and transitioning from horizontal to vertical surfaces. C1
Injured worker setup and used a scaffold without having it inspected by a scaffold competent person.	Scaffold was setup and inspected by a scaffold competent person and the scaffold deficiencies would be corrected prior to use.	Scaffold had deficiencies that were not identified or corrected prior to use (structural deficiencies and overhead obstruction).	Uncorrected deficiencies and unmitigated overhead obstructions provided an increased potential for fall. C2

CHANGE ANALYSIS WORKSHEET			
Accident Situation	Accident Free, Prior or Ideal Situation	Difference	Evaluation of the Effect on the Accident
Hand and power tools were on the Tele-Tower® walking surfaces while working (chisel and potentially a screw driver on TTA)	The walking surfaces were clear of obstructions.	Leaving the hand tools and power tools on the Tele-Tower® walking surface demonstrated at risk behavior that resulted in potential for tripping/slipping hazards.	Tripping/slipping hazards were present on the Tele-Tower® "A" walking surface. C3
No SRNS safety professional oversight was conducted at the job site to assess work performance.	SRNS safety professional oversight is present to observe, assess and correct work in progress (ideal).	Safety professional were not present to champion the safe performance of work while work was in progress	Lost opportunity to identify and correct at risk behavior and work activity deviations. C4
No DOE oversight was conducted at the job site on the day of the accident.	DOE oversight is present to observe, assess and correct work in progress (ideal).	DOE oversight was not present to champion the safe performance of work while work was in progress on that day.	Lost opportunity to identify and correct at risk behavior and work activity deviations. C5
Workers were taking risks during the performance of work.	Workers work within the controls established in the Safe Work Permit and work instructions.	Workers performing work within established controls reduce risk to injury.	Not complying with the hazard controls established in the Safe Work Permit and work instructions placed the IW at a greater risk to injury. C6
Superintendent (IW) was on the Tele-Tower®.	Superintendent was on the ground observing and directing the work activities	The Superintendent was not on the Tele-Tower®.	The accident would not have happened. C7
Supervision at the job site were not performing (not trained - expectations not conveyed) supervisory duties	Supervision at the job site were trained and knowledgeable in conducting pre-job briefings for workers, making safety observations and correcting at risk behavior at the job site.	Supervision was unsuccessful in maintaining a safe work environment.	The supervision at the job site encouraged and demonstrated at risk behaviors. C8

CHANGE ANALYSIS WORKSHEET			
Accident Situation	Accident Free, Prior or Ideal Situation	Difference	Evaluation of the Effect on the Accident
Tele-Towers® were used by the work crews during sheet rock removal.	Work crews use a scissor lift or "JLG" to during sheet rock removal.	Workers would not have to reach outside the work platform or climb to access working platforms and would be at lower risk to falling.	Fall potential when climbing access ladders or while removing sheet rock is reduced. C9
Overhead obstructions were present near the edge of the Tele-Tower® access ladder.	The Tele-Tower® access ladder is free of overhead obstructions.	The Tele-Tower® access ladder and walking surfaces would be clear of overhead obstructions.	The potential for contact with an overhead obstruction would be eliminated. C10
All safety chains were down on Tele-Tower® "A" following the accident.	All safety chains are latched while on the Tele-Tower® working platform.	Safety chains performed their intended purpose to prevent accidental falls from the Tele-Tower®.	Unknown - If not intending to climb down the ladder, the IW may have unexpectedly stepped off the working platform. C11

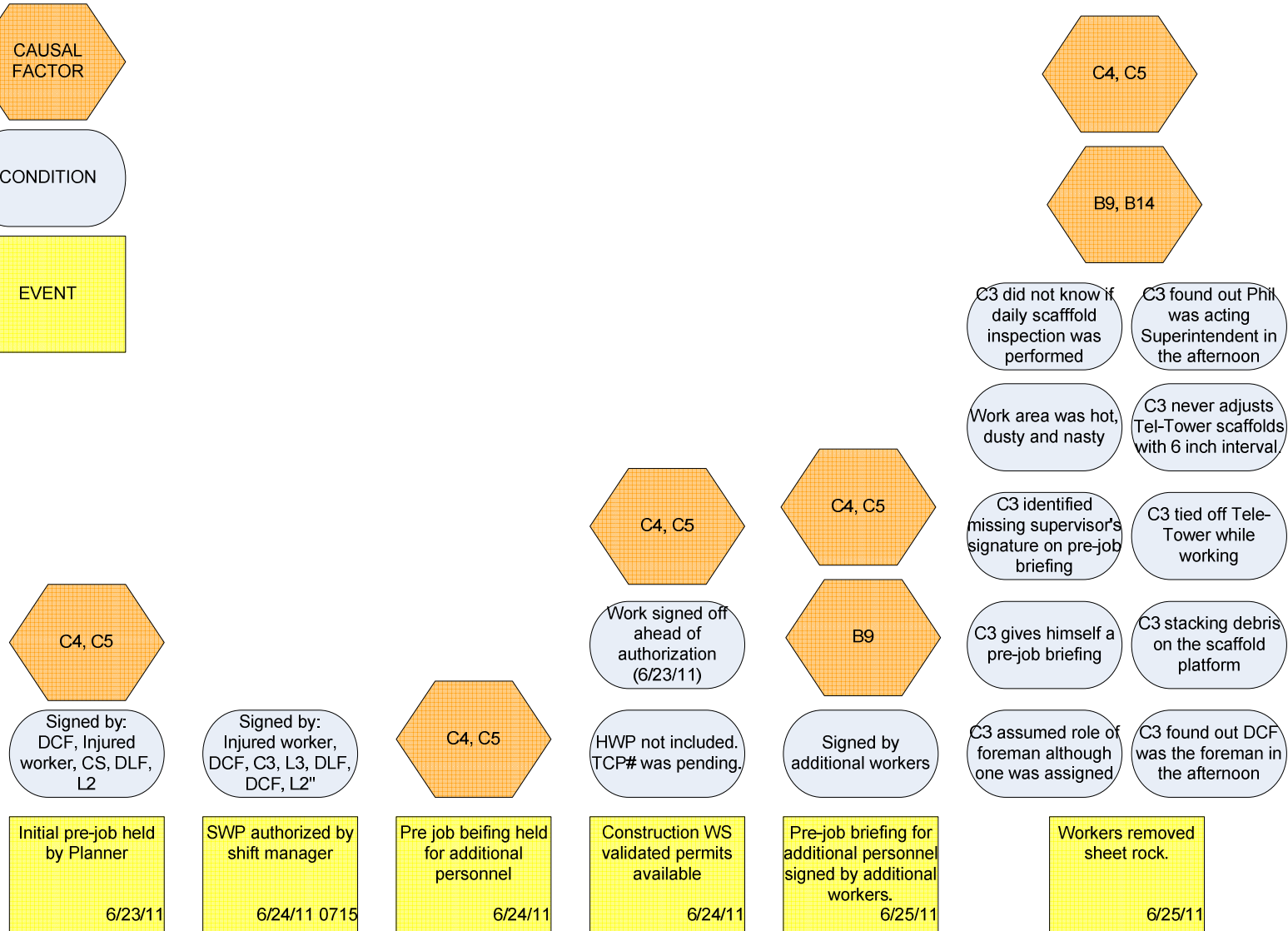
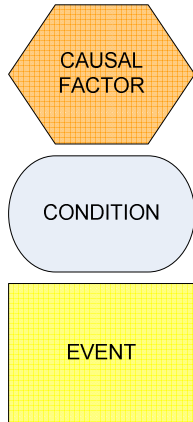
Appendix D: Events and Causal Factor Analysis

An events and causal factors analysis was performed in accordance with the DOE Workbook *Conducting Accident Investigations*. The events and causal factors analysis requires deductive reasoning to determine those events and/or conditions that contributed to the accident. Causal factors are the events or conditions that produced or contributed to the accident, and they consist of direct, contributing, and root causes. The direct cause is the immediate event(s) or condition(s) that caused the accident. The contributing causes are the events or conditions that, collectively with the other causes, increased the likelihood of the accident, but which did not solely cause the accident. Root causes are the events or conditions that, if corrected, would prevent recurrence of this and similar accidents. The causal factors are identified in Figure D-1: Events and Causal Factors Analysis on pages D-1 through D-8.

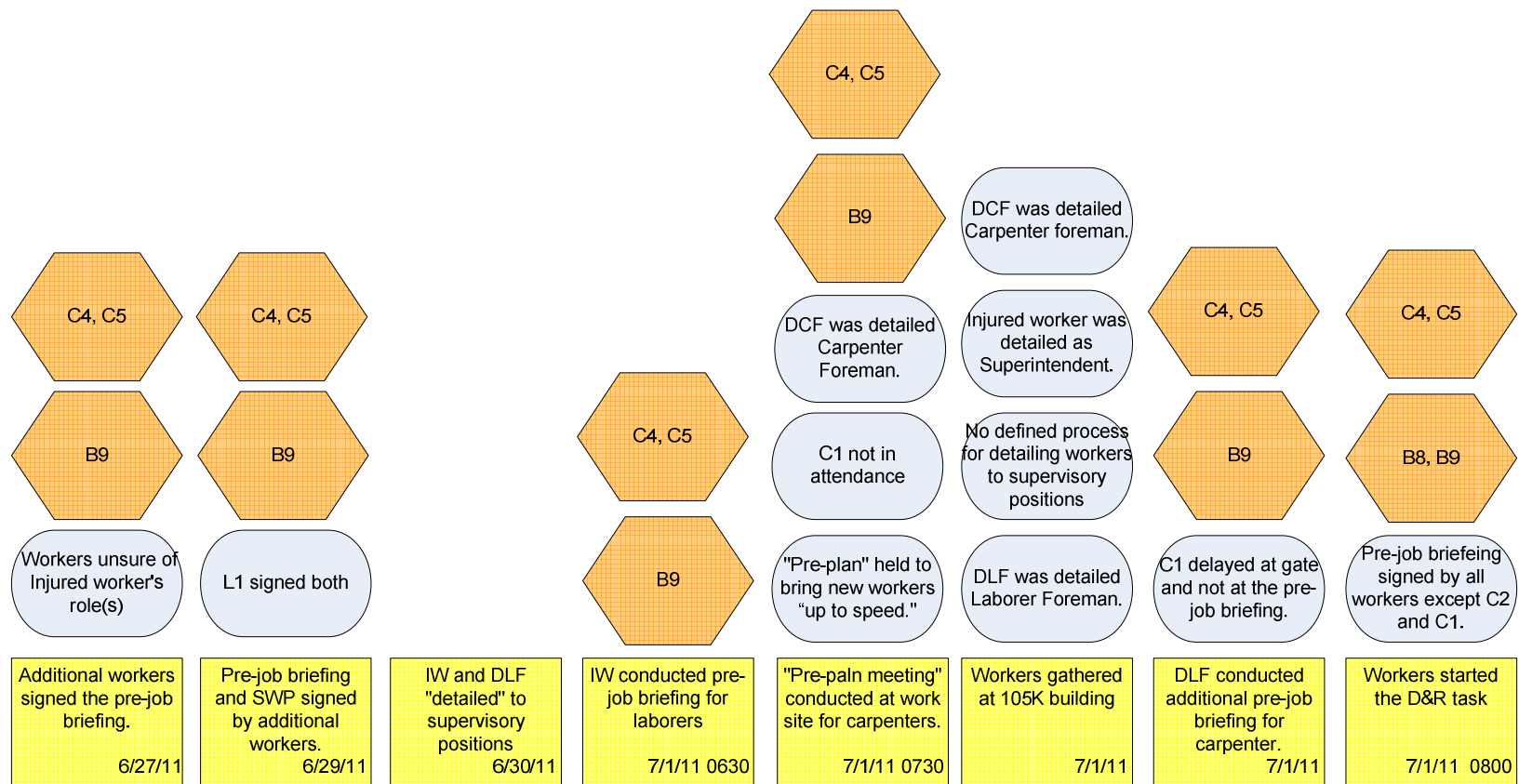
Figure D-1: Events and Causal Factors Analysis

Events and Causal Factors Analysis

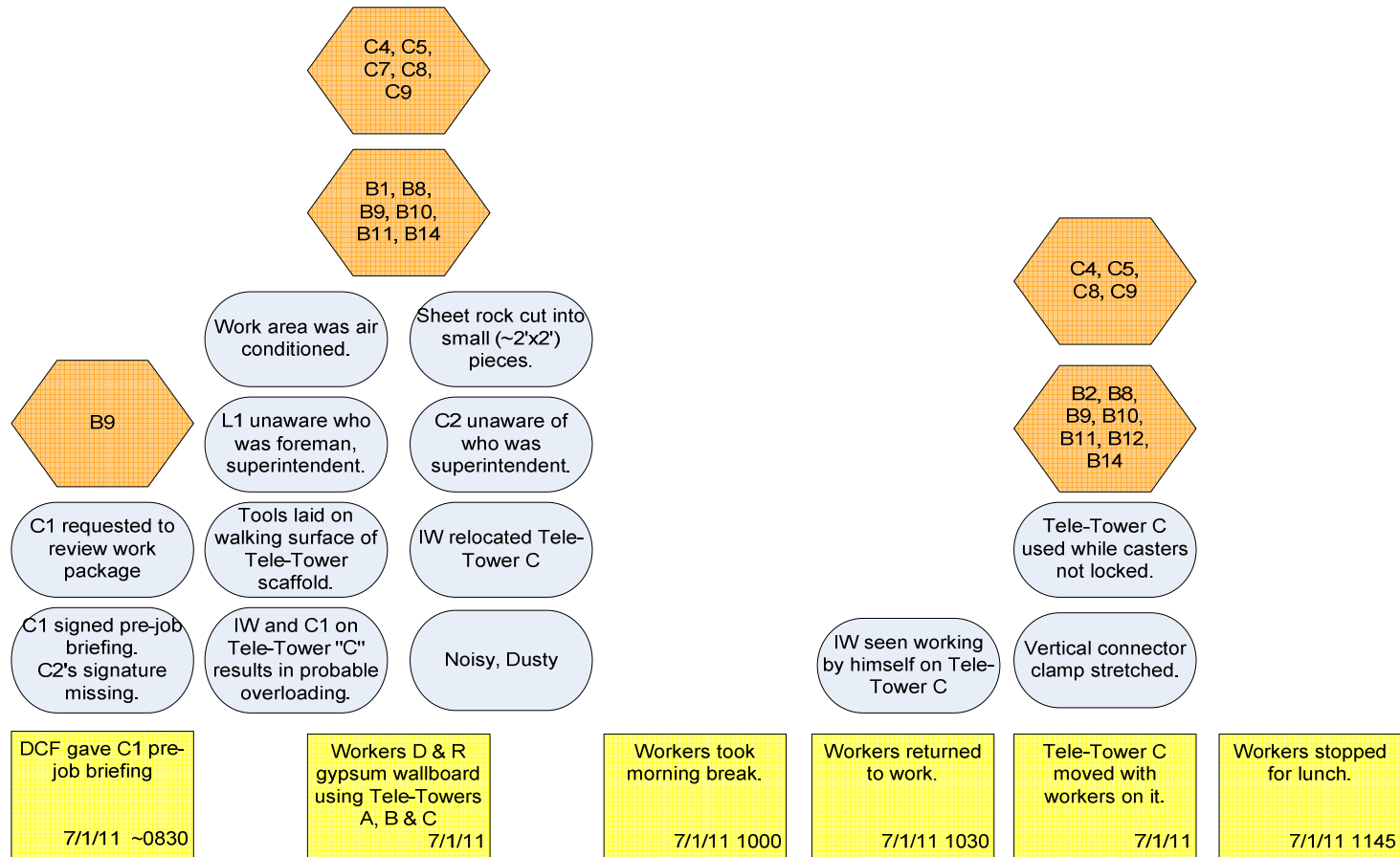
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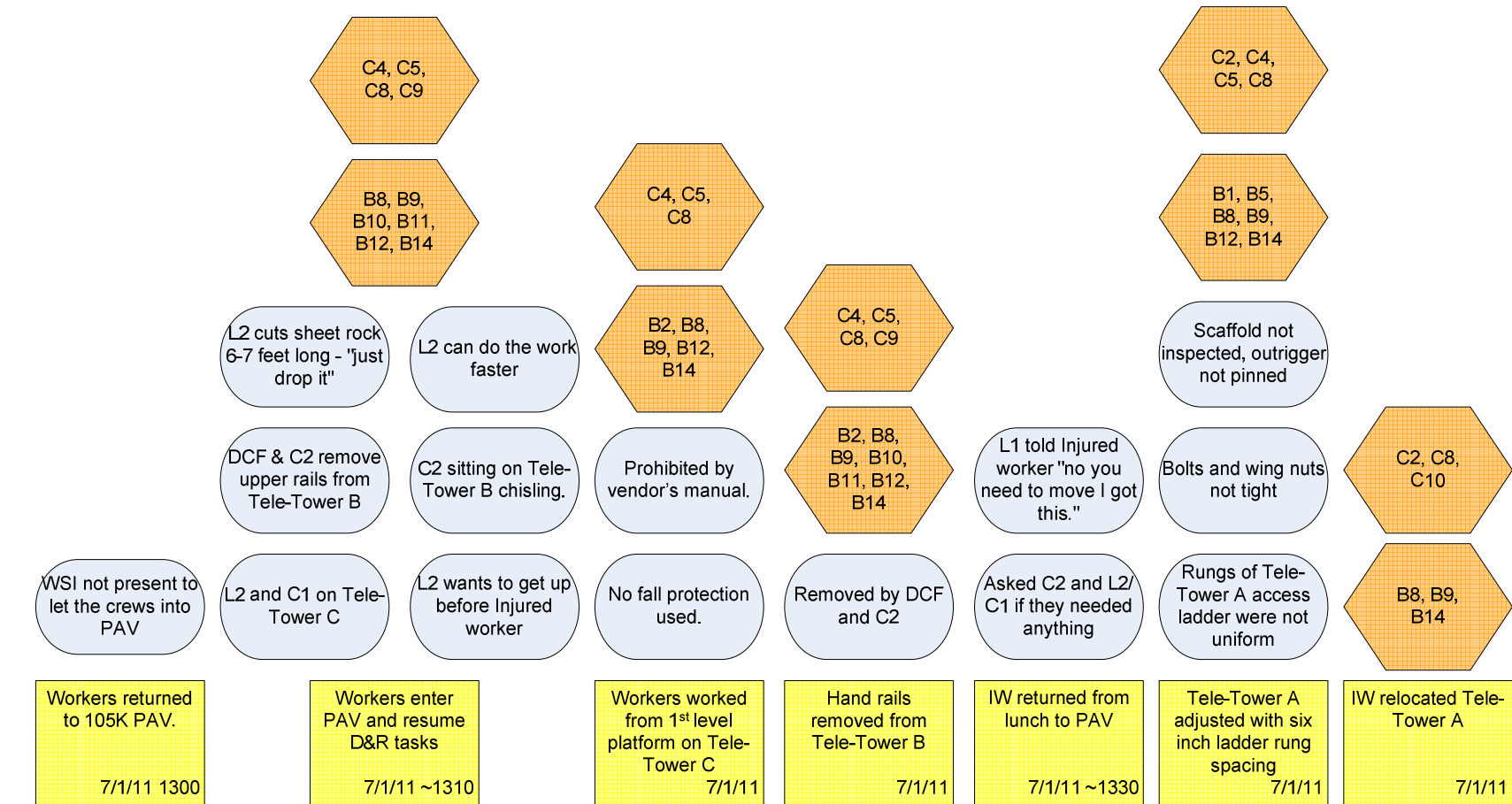
Events and Causal Factors Analysis



Events and Causal Factors Analysis



Events and Causal Factors Analysis



Events and Causal Factors Analysis

