Type B Investigation Board Report
Worker Fall from Shoring/Scaffolding Structure
at the
Savannah River Site
Tritium Extraction Facility -
Construction Site
April 2, 2002

SAVANNAH RIVER SITE OFFICE

MAY 2002

May 13, 2002

On April 11, 2002, I established a Type B Accident Investigation Board to investigate the accident at the Savannah River Site, managed and operated by Westinghouse Savannah River Company, Aiken, South Carolina.

The Board's responsibilities have been completed with respect to this investigation. The analysis process; identification of direct, contributing and root causes; and development of judgments of need during the investigation were done in accordance with DOE Order 225.1A, *Accident Investigations.*

I accept the findings of the Board and authorize the release of this report for general distribution.

Maureen A. Hunemuller, Manager
National Nuclear Security Administration
Savannah River Site Office

This report is a product of an accident investigation board appointed by Maureen A. Hunemuller, Manager, National Nuclear Security Administration, Savannah River Site Office.

The Board was appointed to perform a Type B Investigation of this accident and to prepare an investigation report in accordance with DOE Order 225.1A, *Accident Investigations*.

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

This report neither determines nor implies liability.

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ACRONYMS

BBS	Behavior Based Safety
BCSP	Bell's Certified Safety Professional
Bell	Bell Technologies, Inc.
BNFL	British Nuclear Fuels, Limited
BSRI	Bechtel Savannah River Incorporated
C1	Injured carpenter
C2	Second carpenter on erection crew
C3	Third carpenter – competent person
DOE	Department of Energy
EMT	Emergency Medical Technician
ES&H	Environment, Safety & Health
F1	Erection crew foreman
ISMS	Integrated Safety Management System
JHA	Job Hazards Analyses
MCG	Medical College of Georgia
NNSA	National Nuclear Security Administration
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
RHB	Remote Handling Building
SME	Subject Matter Expert
SROO	Savannah River Operations Office
SRS	Savannah River Site
SRSO	Savannah River Site Office
STR	Subcontractor Technical Representative
TEF	Tritium Extraction Facility
TPB	Tritium Processing Building
TPBARS	Tritium Producing Burnable Absorber Rods
WPP	Worker Protection Plan
WSRC	Westinghouse Savannah River Company

EXECUTIVE SUMMARY

INTRODUCTION

On April 2, 2002, a carpenter helping to erect shoring/scaffolding fell about 52" and struck his head. He sustained head injuries requiring hospitalization that exceeded the threshold for a Type B investigation in accordance with Department of Energy (DOE) Order 225.1A, *Accident Investigation.* The accident occurred at the DOE's Savannah River Site (SRS) at the Tritium Extraction Facility (TEF) construction site.

The Manager of the DOE National Nuclear Security Administration (NNSA) Savannah River Site Office (SRSO) established an accident investigation board (the Board) on April 11, 2002. The Board was chartered to investigate the accident using processes and analytical techniques standardized in DOE Order 225.1A. The Board inspected and photographed the accident scene, reviewed events surrounding the accident, and conducted interviews and document reviews to determine the factors that contributed to the accident. The DOE Integrated Safety Management System (ISMS) core functions provided a basis for evaluating relevant safety management practices.

The SRSO manages the NNSA Defense Programs activities at the SRS. The site is operated by an integrated team led by Westinghouse Savannah River Company (WSRC). The team includes Bechtel Savannah River Incorporated (BSRI), which is responsible for construction project management. Bell Technologies, Inc. (Bell) is a BSRI subcontractor for the civil/structural portion of building the TEF.

ACCIDENT DESCRIPTION

The accident occurred at approximately 3:35 p.m. on Tuesday, April 2, 2002. A carpenter had started to climb the end frame of a shoring/scaffolding tower assembly located in the northwest corner of the Furnace Room, in the Remote Handling Building (RHB) at the TEF construction site. The carpenter was climbing to the second step of the frame when he apparently lost his grip, fell backwards off the frame and struck his head on the concrete wall 88" behind him. He immediately collapsed to the floor with a severe head injury and a broken ankle. Emergency medical services providers rescued the carpenter and transported him by helicopter to the trauma unit at the Medical College of Georgia (MCG).

CONCLUSIONS AND JUDGMENTS OF NEED

Using DOE standard investigation processes and analytical techniques, the Board concluded that:

> The direct cause of the fall was the carpenter's loss of his grip on the shoring/scaffolding structure he was climbing. The Board examined a variety of factors that could have contributed to this situation such as the presence of water at the site, inadequate Personal Protective Equipment (PPE), characteristics of the structure, inadequate instructions or training and the carpenter's medical condition. The Board also reviewed

processes, such as identification of requirements for the work, hazards analysis, and oversight of the work.

The Board concluded that the carpenter and his co-workers were experienced in the work to be performed, were familiar with the hazards involved, and were using the appropriate PPE. The appropriate standards and instructions for the work were used. The job to be performed was routine, as was their approach to the job. Bell had an adequate emphasis on safety and provided a qualified safety staff who were involved on a daily basis with the work. Oversight by the BSRI and DOE was commensurate with the hazards involved and the terms of the contract. No conclusive contributing factors were found, that if modified or eliminated by practical means would have prevented this accident.

Improvements can always be made to reduce the risk to workers and some possibilities were noted in this report, but none of these were judged to be of such potential benefit that warranted Judgments of Need. The practicality of protecting workers from falls at low heights (about 52” in this case), particularly on a construction site, must be considered. Further, the emphasis for this contract was to have the subcontractor conduct the work as much as possible in accordance with relevant commercial standards and practices, and to impose few additional requirements by the DOE/NNSA. The Board agreed with this approach.

During the course of this investigation, the Board noted some areas for improvement. These areas were determined not to have a causal relationship to this accident, but might play a role in potential future events. These matters were noted in the report and were referred to the Appointing Official for consideration.

1.0 INTRODUCTION

1.1 Background

On April 2, 2002, a carpenter fell from a shoring/scaffolding structure that he and two co-workers were erecting for the Tritium Extraction Facility (TEF) construction project at the Department of Energy's (DOE) Savannah River Site (SRS). The carpenter was climbing the first few rungs of the structure, located in a below-grade portion of the facility under construction. The carpenter sustained a blow to the head and a broken ankle.

The Manager of the National Nuclear Security Administration (NNSA) Savannah River Site Office (SRSO) appointed a Type B Accident Investigation Board (the Board) on April 11, 2002. The Board was chartered to review the accident and to determine the causes of the accident in accordance with DOE Order 225.1A, *Accident Investigations*.

1.2 Facility Description

1.2.1 Savannah River Site

The SRS covers 310 square miles encompassing parts of Aiken, Barnwell and Allendale counties in South Carolina, bordering the Savannah River. The SRS is located approximately 25 miles southeast of Augusta, Georgia; 22 miles south of Aiken, South Carolina; and 100 miles from the Atlantic Coast. Most of the industrial complex within the site is being decommissioned. Major waste treatment and management activities are associated with that effort and are conducted under the purview of the DOE Environmental Management Program, with local DOE management provided by the Savannah River Operations Office (SROO). Also located within the site are operating facilities associated with tritium processing and handling under the cognizance of the DOE NNSA, and locally managed by SRSO.

The SRS is operated by an integrated team led by Westinghouse Savannah River Company (WSRC), which is responsible for the site's nuclear facility operations, environment, safety, health and quality assurance, all of the site's administrative functions, and the Savannah River Technology Center. The team also includes Bechtel Savannah River Incorporated (BSRI), which is responsible for environmental restoration, project management, and engineering and construction activities; BWXT Savannah River Company, which is responsible for facility decontamination and decommissioning; and British Nuclear Fuels, Limited (BNFL) Savannah River Corporation, which is responsible for the site's solid waste program.

1.2.2 Tritium Extraction Facility

At the time of the accident the TEF was under construction in the SRS H-Area, located near the center of the complex, and co-located with the other tritium facilities in this area. This facility will be used to extract tritium-containing gases from Tritium Producing Burnable Absorber Rods (TPBARs) after they have been irradiated in Tennessee Valley Authority's Watts Bar and Sequoyah reactors. The gases will be delivered to one of the other tritium facilities in H-area for purification and eventual use in meeting nuclear weapons stockpile requirements.

BSRI, consistent with the division of duties among the integrated team of contractors, was the prime DOE contractor with Bell Technologies, Inc. (Bell) as the civil/structural construction subcontractor. The project was being managed by the NNSA Headquarters Office of Tritium Production. Local NNSA management was being provided by SRSO with matrix support from SROO.

Facility construction began in Fiscal Year 2001 with the first concrete placement completed in May 2001. At the time of this investigation, the facility shell construction was about 60% complete. Bell's contract was for the civil/structural portion of the project, which included the Remote Handling Building (RHB) and the Tritium Processing Building. Upon Bell's completion of the building shells, WSRC intended to complete equipment installations using on-site workers supported by subcontractors with specialized scopes of work.

The RHB will be a shielded concrete structure approximately 70' wide by 200' long and approximately 90' tall, with about 30' underground. The RHB will include a truck receiving area, cask decontamination area, TPBAR and waste preparation area, furnaces, hot maintenance areas, and associated extraction pumps and tanks. The RHB will also include overhead cranes and remote handling equipment. The underground portion of this facility will house, in part, furnaces to heat the TPBARs under a vacuum to drive off the tritium-containing gases. The shoring/scaffolding structure where the carpenter fell was located in the Furnace Room. (See Figure 1)

Figure 1 - TEF Construction Site

1.3 Purpose, Scope, and Methodology

The SRSO Manager appointed the Board on April 11, 2002. On-site Board members began the investigation on April 15, 2002, and the rest of the Board arrived on April 16, 2002.

The scope of the Board's investigation included all activities required to determine the relevant facts and to review and analyze the facts and circumstances surrounding the accident. Using these facts, the Board attempted to determine the direct, root, and contributing causes; developed conclusions; and attempted to determine judgments of need that, when implemented, should reduce the probability of similar recurrences.

During the investigation, the Board inspected and photographed the accident scene; reviewed documentation presented by SRSO, SROO, WSRC, BSRI, and Bell; reviewed critical events leading to the accident; and reviewed emergency response activities. In addition, the Board conducted interviews with appropriate individuals, conducted analyses of physical evidence, and performed causal analysis. The Board evaluated the adequacy of Bell's safety management systems and work control practices relevant to the accident and identified judgments of need, as appropriate.

2.0 FACTS, ANALYSIS, and CONCLUSIONS

2.1 Activities Prior to the Accident

Two carpenters (C1 and C2) had been working in the Furnace Room for about one week prior to the accident erecting shoring/scaffolding to support form work for concrete placement for the floor above the Furnace Room. Erection was proceeding in accordance with the Safeway Formwork Systems Shoring Plan drawing numbers S11 and S14 and instructions. The shoring had been erected to an approximate height of about 20'. The shoring system in this area would eventually reach over 60'. The shoring construction consisted of connecting 4' x 5' and 4' x 6' sections (known as bucks) with cross bracing, forming tower assemblies that would be tied together to construct the specified array. The shoring when completed supported aluminum beams, which in turn supported flat forms for a concrete roof placement. Adjustable screw jacks with base plates were at the bottom and adjustable screw jacks with flat plates or "U" heads at the top of the array adjusted the structure to the precise height needed. (See Figure 2) The primary purpose of the structure was to support the construction of the floor above, but Bell also intended to occasionally use the structure as a scaffold for other work. The Safeway Formworks plan only identified the structure as shoring.

HI-LOAD SHORING
TYPICAL HI-LOAD TOWER

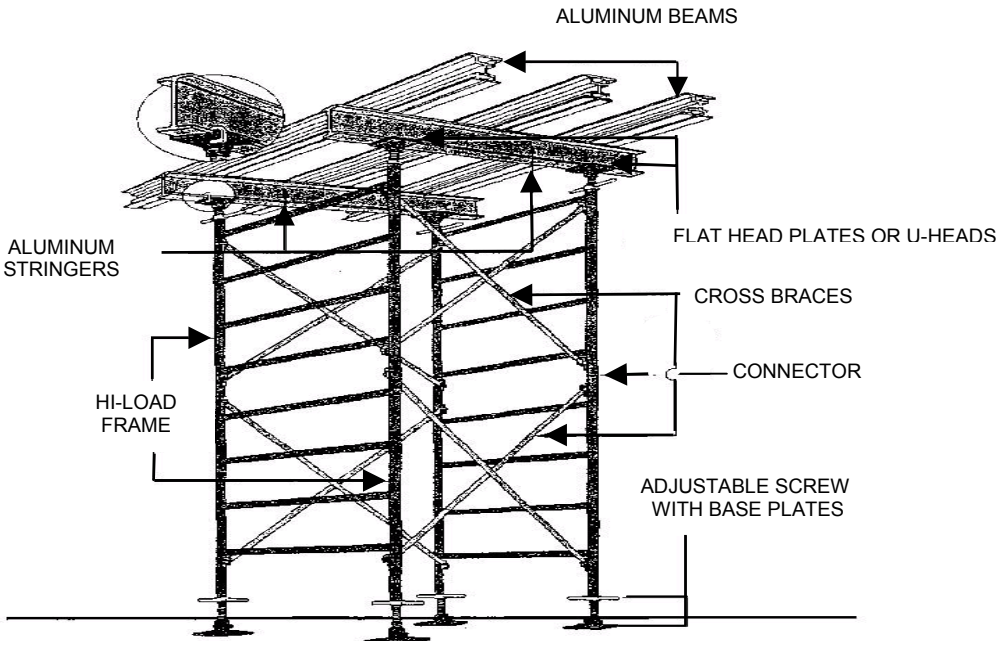

Figure 2 - Shoring Drawing

A third carpenter (C3) joined C1 and C2 in the Furnace Room the day of the accident and they had been erecting shoring all day. The carpenters had just returned from their afternoon break and were continuing with erection/bracing activities as called for in the shoring plan. The crew was connecting the towers to one another with lengths of pipe at about the 20' height. C1 and C3 were to climb the towers and pull up materials handed up by C2 at floor level and install the bracing.

Work had not taken place in the Furnace Room the previous day because there had been 2-3" of standing rain water throughout the entire Furnace Room. The rainwater had been pumped out the day before and although most of the floor was dry, approximately ¼" of water stood around the base of the structure in the area where the accident occurred. Water was a common problem at the site due to rainfall and the need to spray water on the concrete during the curing process to keep it cool. Bell's Certified Safety Professional (BCSP) and other crew members routinely came out to the site before the first shift and on weekends to inspect the worksite and pump water after it had rained.

The BCSP stated that at some point after the carpenters had begun erecting the shoring/scaffolding, the WSRC Fire Department had toured the TEF construction site. One purpose of the tour was to evaluate possible challenges to the timely rescue of injured workers. The Fire Department personnel commented specifically on difficulties posed by rescues from the Furnace Room. The depth of the room, the close quarters imposed by the shoring/scaffolding system, and the height of the surrounding rebar all complicated potential rescues from the Furnace Room. (See Figure 3) Response and evacuation drills had also been

conducted, although rescue as required by this accident had not been practiced or specifically planned.

Figure 3 – Accident site (single person stairway out of view in foreground)

2.2 Accident Description & Chronology of Events

C1 started to climb the bucks comprising the end frame of a tower assembly at approximately 3:35 p.m. on Tuesday, April 2, 2002. The tower assembly was located in the northwest corner of the RHB Furnace Room. C1 was ascending to the second rung of the shoring (approximately 52" off the floor) when he apparently lost his grip, fell backwards off the shoring and struck his head on the concrete wall located 88" behind him. His head reportedly struck the wall approximately 1' to 2' above the floor. C1 immediately collapsed to the floor and was seen laying on his right side. C2 and C3 ran to his aid. C3 tried to keep C1 from moving as he began to thrash around while C2 summoned assistance.

C2 stated that his back was to C1 and that he did not see the accident and did not hear C1 cry out, but heard the impact of the fall. C3 also stated that he did not hear C1 cry out and that he saw C1's fall in his peripheral vision. C3's impressions of C1's body position at the time he started to fall backwards was that he had one foot on the first rung and the other foot on the second rung of the end frame. He also had the impression that C1 continued his fall backwards until his head impacted the wall behind him before his body hit the floor.

C1 was wearing his hard hat, gloves, boots, fall protection harness, and tool belt. C3 estimated the tool belt and harness weighed about 25 - 30 pounds.

2.3 Emergency Response

WSRC Emergency Medical Technicians (EMTs) were dispatched at 3:39 p.m. The first responder arrived at the accident scene about 3:45 p.m. The responder made a preliminary assessment and communicated by radio to the enroute EMTs who arrived about 3:48 p.m. The EMTs examined C1 and noted a softball-sized swelling on the rear of his head and unequal pupils. C1 was semi-conscious and slightly combative. EMTs placed a cervical collar around C1's neck and provided emergency medical care. With assistance from his co-workers, the EMTs rolled C1 onto a spine board and secured him.

The tight maze of scaffolding, shoring, rebar and walls required that a crane be used to lower a Stokes rescue basket into the Furnace Room and to lift out C1. (See Figure 4) One of the EMTs put on a rescue harness and safety line and attached himself and the basket to the crane hook. The EMT rode up with C1 to help steady the rescue basket during C1's extraction.

Figure 4 - Crane lifting injured carpenter and EMT out of construction site

While the extraction progressed, emergency responders cleared a landing zone and a Wackenhut Services, Inc. helicopter landed approximately 1/8 mile from the accident scene. The crane operator set the basket down near an ambulance that transported C1 to the helicopter. (See Figure 5) The helicopter transported C1 to the Medical College of Georgia (MCG) Trauma Center.

The helicopter arrived at MCG less than an hour from the time the Fire Department received the initial call. C1 was admitted to the hospital and underwent two surgical procedures to relieve pressure on the brain. Medical images and X-rays indicated C1 had suffered a fractured skull and a broken right ankle.

Figure 5 - Injured being transferred to ambulance to be taken to helicopter for evacuation to MCG Trauma Center

2.3.1 Analysis

The response to C1's fall and extraction from the site was difficult because of his location in the building. Prompt EMT response, the immediate availability of a crane and helicopter, the fact that response personnel were familiar with the challenges of the construction site, and that an emergency response evacuation had been conducted not long before the accident, all contributed to a very effective and timely emergency response action.

2.3.2 Conclusion

The Board concluded that, despite significant challenges, the emergency response, extraction, and transport to the trauma center effectively minimized any exacerbation of C1's condition. The coordination among the various organizations and individuals involved was timely and effective.

2.4 Investigative Readiness

After C1 was transported to MCG, BSRI and Bell secured the accident scene, took photographs and initial statements, and preserved evidence. The Board was provided photographic evidence, initial statements, and C1's Personal Protective Equipment (PPE). The accident scene remained undisturbed until the Board chairperson arrived on April 16, 2002. Evidence at the scene was limited to the shoring structure and about ¼" of water remaining on the floor from another rainfall event.

2.4.1 Analysis

The evidence provided to the Board and the control of the accident scene was adequate to support the Type B investigation.

2.4.2 Conclusion

SRSO, BSRI, and Bell demonstrated adequate investigative readiness.

2.5 Medical Information

C1 was 5' 10" tall and weighed about 200 lbs. Co-workers described him as physically fit and very strong. The Board requested information regarding C1's medical history and additional information obtained over the course of his treatment. Requests to Bell's insurance provider yielded the most information. The Board also forwarded a questionnaire to C1's attorney and sought assistance in obtaining information from the MCG attending physician. The physician expressed reluctance to answer the Board's questions without a release signed by C1. At the time the Board adjourned, C1 had not recovered sufficiently from his injuries to sign a release.

The available medical history for C1 did not suggest any preexisting condition that might have contributed to the fall. Blood tests done upon admission to MCG were negative for alcohol and controlled substances. Medical images taken during C1's treatment provided no indication that a stroke may have contributed to the fall. The description of the ankle break provided to the Board suggested that it was a severe injury that would require surgery and subsequent physical therapy. The attending physician believed C1's broken right ankle did not contribute to the fall, but was a result of the fall.

2.5.1 Analysis

The Board attempted to obtain information regarding possible medical conditions that could have led to C1's fall from the shoring/scaffolding. Potential conditions the Board inquired about included cardiac events, neurological conditions, diabetes, interactions between prescription drugs and over-the-counter drugs. The Board determined that the information provided was sufficient to rule out obvious medical causes of the accident. The Board believed that, had C1 lost consciousness for any reason immediately prior to the fall, the resulting loss of muscle tension would not have led to C1's reported body position during the fall as well as after the fall (i.e., at the base of the wall behind him as opposed to at the base of the shoring/scaffolding).

The Board believed that C1's head hit the wall first and that the broken right ankle may have been caused when his body landed on the leg. Although C1 could have landed on his feet, broken his ankle, and then fallen back into the wall (C1 is 70" tall and the distance to the wall is 88), the Board based its belief on the severity of C1's head injury and on C3's statement that C1's head struck the wall before he fell to the floor. Falling to his feet first would most likely have reduced the force of the fall. Although the fall probably occurred as C1 was raising himself to the second rung and his right foot was no higher than 52", a severe injury could result if his full weight (200 lbs + 25 to 30 lbs of tools) was behind the blow to his head. Similarly, the severity of the head injury together with C3's impression of C1's body position and impact point on the wall, does not suggest that C1's feet slipped before his hands. The Board believed that if C1's feet had slipped and then he broke his ankle, his fall would have positioned him closer to the scaffolding and he would have been less likely to strike his head with sufficient force to produce the head injury sustained.

2.5.2 Conclusion

The Board concluded that, based on available evidence, C1's prior medical condition did not contribute to the accident. A climbing scenario involving force being applied by the leg to raise the body to the next rung as the hand(s) came loose was consistent with a picture of C1's body arcing backwards into the wall. Factors that might have caused C1 to lose his grip on the shoring/scaffolding are discussed in the following sections.

Figure 6 - Actual Accident Scene

Figure 7 - Re-enactment of C1's position on shoring at time of fall

2.6 Shoring/Scaffolding

Bell contracted with Safeway Formwork Systems to provide the shoring design. Safeway provided Bell with shoring erection plan drawings and instructions on erecting a shoring system structurally capable of supporting the concrete forms and concrete that would become the RHB grade level floor. Safeway also provided Waco-manufactured shoring components including the bucks, screw jacks, and cross bracing. Shoring erection was Bell's responsibility, but Safeway provided on-going periodic inspection to assist Bell in proper erection. In this contractual relationship, Safeway was responsible for providing the design of the shoring between the bottom screw jacks and the top screw jacks. Bell was responsible for erecting the shoring in accordance with Safeway's plan and for adjusting the top and bottom screw jacks to properly align the concrete forms.

The Board reviewed Safeway's design drawings that identified the structure as shoring. Personnel interviewed consistently stated that the structure was shoring, not scaffolding, but the Board found that the structure was intended to also function as a scaffold. The Board observed later in the investigation that work platforms had been added so that carpenters could construct forms for concrete placement for walls.

Shoring and scaffolding appear similar, but differ in function. Shoring typically supports concrete forms and concrete until the concrete has cured to the design specifications. Generally, the only workers climbing shoring are the erectors and dismantlers. Scaffolding is intended to support work platforms that are walking/working surfaces for a variety of craftspeople. Scaffolding erectors climb the scaffolding to erect it and construct "means of

access" to the work platforms. Other craftspeople working on the scaffolding use these means of access to get onto the work platforms. These craftspeople may climb the scaffold end frames only if the end frames are specifically designed for that purpose.

Since the structure was to function as both a shoring system and a scaffold, Occupational Safety and Health Administration (OSHA) standards for both applications would apply. Considering this situation, and the Board's interest in contributing factors for C1 to lose his grip, aspects of the OSHA standards pertinent to a determination of the structure's stability, means of access, and suitability of the climbing surface were examined.

Stability

The shoring design must be prepared by a qualified designer and the final erected arrangement must be inspected by an engineer qualified in structural design. The design and final erection are generally intended to support heavier loads than scaffolding, but the loads are typically more predictable than scaffolding loads. The scaffolding standard specifies a safety factor for the structure itself. The standard further requires that a competent person* determine that the scaffolding has been constructed in accordance with OSHA standards. A competent person must supervise the assembly of the scaffolding.

The Board interviewed the Safeway designer to obtain his opinion regarding the use of the shoring system he designed for scaffolding purposes. The designer stated that the shoring system erected in the Furnace Room exceeded the structural requirements for scaffolding. He further stated that, if Bell elected to use the shoring system as scaffolding, Bell's competent person would be responsible for ensuring the scaffolding requirements were met.

The Board examined the shoring/scaffolding system on April 16, 2002. Even though the towers were in the process of being tied together and to the wall, the structure was stable enough to support safe climbing.

Means of Access

The shoring standard is silent on the topic of access to the structure. The scaffolding standard requires that a competent person determine a proper means of access and also states that, during erection, the end frames may be climbed. The Board's examination of the shoring/scaffolding structure found that the distance between the Furnace Room floor and the first rung on each tower varied depending on needed adjustments to the screw jacks. The height to the first rung of the tower in question was found to be 34½". The distance between individual rungs in the end frames was 18". The scaffolding standard specifies a maximum of 24" to the first access point for workers using a work platform, but does not specify a maximum height for erectors. During a re-enactment of C1's climb of the end frame of the tower, the worker stepped onto a jacking nut to get a boost to the first rung.

Climbing a shoring/scaffolding structure of this type during erection and dismantling is specifically provided for in the standard, and according to interviewees was routine for this work.

* Competent person means one who is capable of performing the task in accordance with OSHA requirements and who is capable of identifying existing and predictable hazards in the surroundings or working conditions, which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

The general installation instructions provided by Safeway were from the Scaffolding Shoring Forming Institute and did not speak to this subject. The Board consulted an OSHA compliance officer who confirmed that climbing end frames is a common accepted practice.

Climbing Surface

Neither the shoring nor the scaffolding standards speak to the characteristics of the climbing surface. Most of the bucks used in this shoring system had a smooth painted surface. This type of surface was reported to be typical for shoring components. Several of the interviewees stated that the surface was slick when it was wet.

2.6.1 Analysis

The structure was found to be stable for climbing at C1's position at the time of the accident, regardless of confusion generated by the designation of shoring versus scaffolding. The design of the structure was a rectangular array grounded on a level concrete slab, straight up to the floor level above, and assembly was uncomplicated. There were no special assembly or safety instructions, only general instructions for all applications. Although the construction of the structure was not under the supervision of a competent person from the beginning, this fact was not relevant to the accident. At the Board's request, Bell's competent person evaluated the shoring/scaffolding structure and confirmed the Safeway designer's opinion that the shoring met or exceeded the scaffolding requirements for structural stability.

Other means could have been employed to access the system at varying heights, although it would have been less efficient than climbing. Ladders for instance, would have required constant repositioning and would have possibly introduced other potential hazards as the worker transitioned between the ladder and the shoring/scaffolding. Some climbing throughout the system would have been necessary, even if other means of access were provided for the full height of the structure, since towers had to be tied together.

There is no particular requirement in the standards for the climbing surface used by erectors of shoring or scaffolding. Undoubtedly, a roughened abrasive surface would provide less opportunity for slipping of the hands or feet. The coating on the bucks was to reduce the tendency towards rusting and to reduce sticking of foreign material, not to aid climbing.

2.6.2 Conclusion

Structural stability was not a factor in C1 losing his grip on the structure. The shoring/scaffolding structure was not being used in an unusual application and did not require special safety instructions. The access point to the structure when used as a scaffold was not at the place where C1 started climbing. The 24" requirement was not applicable. Regardless of how C1 got to the first rung, he was climbing from the first to the second when he fell. While it is possible that his means of access may have in some way left him in an unsettled position, the Board believed that at least one foot was at the height of the second rung and he may have been reaching for the fifth rung when he lost his grip. Point of access to this structure did not appear to be a factor in this accident.

If C1 had not been climbing the end frame, he may have been less likely to fall. Other, less efficient means of access could have been used for some part of the work, but space constraints severely limited ground based aids at the point where the accident occurred. Other means of access also have their limitations, particularly at transition points. Climbing was typical for the type of job in question, and could not be completely eliminated in a practical sense since the towers had to be tied together.

The smooth surface of the bucks, particularly if wet, must be considered a factor in C1 losing his grip. The Board believed that an abrasive surface applied to the bucks could have reduced the likelihood of C1 losing his grip. However, climbing untethered could occur at many places on the structure. Even though Bell required fall protection in all cases above 6', including climbing, the Board questioned the feasibility of using the equipment in every instance as the carpenters climbed throughout the system. Therefore, all bucks in the structure would have to be treated to make this remedy completely effective. Procurement of special purpose shoring components just for DOE was not viewed as a practical avenue to pursue.

2.7 Training/Qualification

Training

The shoring standard requires that workers erecting and dismantling shoring have general training and experience in order to be knowledgeable of the hazards associated with such work. The scaffolding standard is more prescriptive regarding training and qualification for erectors and dismantlers because the nature of the work changes as platforms are used for a variety of tasks, and other craftspeople use the platforms. The scaffolding standard establishes specific training for erectors and dismantlers. The standard also requires certain duties of a competent person, a position with specialized requirements. The shoring and scaffolding standards both require training in fall protection.

In response to the Board's request for C1's, C2's, and C3's training records, Bell provided records indicating that the carpenters had received Bell-provided hazard communication and fall protection training. During interviews, C2 stated that he had never received formal scaffolding training prior to reporting to work on the TEF project. The foreman (F1) for the job in question stated that he had received scaffolding training from a different contractor on a previous project. Records were not available for C1 concerning scaffolding training. Training records for C3 documented that, in addition to the Bell-provided fall protection training, he had received training required for a competent person. He received this training through his union prior to reporting to work on the TEF project. C1, C2, and C3 were all journeyman carpenters, and interviews indicated that they, as well as F1, were knowledgeable and had many years experience in erecting shoring and scaffolding.

2.7.1 Analysis

The Board reviewed OSHA interpretations to understand how OSHA expects employers to determine whether new workers or temporary labor workers have received required training. Although none of the interpretations dealt specifically with the scaffolding and fall protection standards, several interpretations revealed a pattern in OSHA's responses. One interpretation pointed out that OSHA standards do not specify who must maintain training and certification

records. However, the employer is ultimately responsible for ensuring the availability of these records.

Third-party trainers who agree to maintain the records would also need to ensure their immediate availability to the employer. Another interpretation stated employers employing new operators or temporary labor operators who claim prior training would be required to evaluate the applicability and adequacy of prior training to determine if all required training topics have been covered.

The BCSP stated that Bell relied on the unions to send them craftspeople that have already received appropriate OSHA-required training. The carpenters' union steward explained that South Carolina is a right-to-work state. The unions maintain lists of craftspeople that are available to work. When a contractor requests carpenters from the union, the contractor bears the responsibility of asking for "carpenters with scaffold erection and fall protection training." By the right-to-work law, the union's business agent must offer the carpenter at the top of the availability list the work. As the steward explained, the business agent can ask whether the carpenter has the training the contractor requested, but it is up to the contractor to verify the carpenter is trained in compliance with the applicable OSHA standards.

In evaluating whether lack of training, following generally accepted practices or specific procedures contributed to the accident, the Board considered the following: C1 had not climbed high enough for the fall protection standard to apply and C1 was wearing appropriate fall protection equipment. No special instructions or safety cautions were necessary for the shoring/scaffolding system they were working on. The training required for scaffold workers is oriented towards providing a safe structure for work platforms, and did not have special cautions for erectors other than the need for fall protection. The only other aspect of the standards which were relevant to C1's situation at the time of the accident, was the general requirement that workers be knowledgeable of the hazards associated with such work. The carpenters were judged to be qualified for the task and had many years experience.

2.7.2 Conclusion

The Board concluded that deviation from OSHA training standards and record keeping practices did not contribute to the accident. The job was a routine application of a shoring/scaffolding system and the Board believed that OSHA standards and Bell requirements were sufficiently protective for this type of work. Additional training or verification of existing training would not have made the carpenters more knowledgeable of the hazards of this job nor provided unique insight on techniques for climbing at the height C1 was positioned.

While the Board believed that training and experience were not factors in this particular event, the Board communicated to the Appointing Official a concern that Bell was not consistently fulfilling the employer's responsibility to verify that craftspeople have received OSHA-required training. Both the OSHA standard and the Bell Worker Protection Plan (WPP) assigned important, safety significant responsibilities to the competent person, but Bell provided no evidence that efforts had been made to verify that C3's competent person training fulfilled OSHA's expectations. Training requirements similar to those in the scaffolding and fall protection standards apply to workers such as powered industrial truck operators, crane

operators, and electricians. Lack of appropriate training could be a factor in a variety of potential future accident scenarios.

2.8 Personal Protective Equipment

C1's PPE when the incident occurred was typical for this work. The PPE included hard hat, safety glasses, sturdy work boots with slip resistant soles, a fall protection harness with lanyard and positioning belt (chain), rough leather outer surface gloves, and normal construction work clothes. C3 stated that he believed C1's gloves were wet as well as his boots at the time of the accident.

C1 was wearing a standard MSA ANSI Z89.1 construction hard hat with integral adjustable insert. C1's hard hat fell off when his head struck the wall.

For fall protection, C1 was wearing a Miller full-body harness with a work belt integral to the harness. A 2½" diameter D-ring was located at the center back at shoulder level. The work belt was equipped with dual-hip 2½" diameter D-rings. The body harness had a body-positioning chain attachment lanyard with a double-lock hook and a rebar hook grabber at the ends. The total length of chain attachment with rebar hook grabber was 25" hook-to-hook. The harness also had a 6' safety lanyard equipped with a 42" decelerating device and a similar rebar hook grabber at one end.

The uppers of C1's boots were made of thick leather for protection from scuffing and abrasions. For traction, the soles incorporated an improved slip resistant plastic insert at the ball of the foot and the center of the heel. The arch contained a label insert of the same plastic material. The outer edge of the sole was of durable material with radial configured tread seams. The soles were also oil-resistant as indicated on the arch of the sole. (See Figures 8 and 9) The boots showed some minor signs of wear but were still in very good condition.

Figure 9 - C1's boot showing oil resistant sole in good condition

Bell had provided gloves appropriate for general protection of the hands while handling steel shoring sections, as well as for climbing. C1's gloves were made of heavy leather with a rough outer surface for gripping. Generally, the gloves were in good condition although each had 3-4 small holes (less than the size of a dime) in the palm. There were no holes from the base of the fingers to the tips. The outer rough side of the leather was still well defined showing no significant signs of wear. (See Figure 10)

Figure 10 - C1's Gloves

2.8.1 Analysis

C1's work gloves may have been wet. Residual moisture on the shoring components and bracing materials was likely and C3, in an interview, reported that C1's gloves were wet. Even wet, however, these gloves were well suited for climbing and handling of shoring equipment and may actually have allowed for a better grip than dry stiff gloves. C3 stated that he sometimes removed his gloves prior to climbing scaffold or shoring, because he got a better grip on the painted steel with his bare hands. He then put his gloves back on to handle ropes and other materials. Bare hands might not always be the better choice either, particularly when it is wet and cold.

Sturdy work boots with slip resistant soles were a good choice for the potentially slippery conditions that would likely be encountered for the combination of a general construction worksite, which may become wet and/or muddy, and for climbing on shoring or scaffolding. C1's footwear could also have been wet, and even though the boots were suitable for this use, traction could have been diminished.

The fall protection harness was not in use. Since C1 fell from about 52", he was still below the 6' level so tie-off was not required. OSHA's standards for fall protection have considered the efficacy of tie off when climbing. Tie off has not clearly been found to be beneficial in a climbing situation, and standards require it only in specialized circumstances. Bell's requirements for fall protection were more restrictive than that required by OSHA since they required a chain or lanyard attachment to the structure above 6' even when climbing. There are other methods of fall protection which can be employed that will also protect at low heights. A harness attached to an overhead guy wire is one method that, much like an automobile seatbelt, allows movement unless there is a sudden acceleration of the tether. Fall protection of this type however, would require constant repositioning of the anchor points as workers moved throughout the room.

C1's hard hat may have come off during the fall just before striking his head or at the time his head hit the wall. C3 said that the hard hat was pushed off when C1 first hit his head. Hard hats are primarily intended to protect the worker's head from falling objects, and are not generally provided with chin straps. The hard hat was in serviceable condition, but was not expected to provide protection in this situation.

2.8.2 Conclusion

The Board found no conclusive evidence that the condition of C1's PPE or his use of the PPE contributed to this accident. C1 did lose his grip for some reason and the Board could not rule out that moisture on the shoring and/or gloves played a part. Foot slippage may also have played a part, although as discussed previously, the Board believed the most likely fall scenario to be one where foot traction was good and C1's leg was providing considerable force to lift him as his hands came loose. The Board believed that use of gloves should be discretionary for climbing in order to best adapt to conditions at the time. The Board did not believe it would have been reasonable for Bell to pursue a strategy of providing fall protection for work at the height C1 was positioned. A fall from this height could occur at many places on the construction site.

2.9 Management Systems

2.9.1 Define Scope of Work

WSRC (and therefore BSRI) had a documented process for determining what environment, safety and health (ES&H) requirements were appropriate for subcontracted work, within the context of their ISMS and the flowdown of integrated safety management into the contracts for different categories of subcontracted work. This process established whether, and to what extent, it was necessary that the subcontractor follow WSRC procedures by considering the degree to which the subcontractor work could be isolated from WSRC work, and whether the subcontracted work could present hazards to WSRC personnel and operations. Subcontracts were binned into A, B, and C categories by degree of isolation: A was totally integrated with WSRC operations, C was totally isolated. The hazards associated with the work were also considered. Standard clauses expressing safety management system principles and expectations were aligned with these categories. The minimum level of oversight by WSRC was also aligned with the established category and the hazards posed to WSRC by the work.

The TEF construction project where the accident occurred was categorized as a "B" subcontract. This meant that the contractor was performing work that, to a large extent, could be isolated from WSRC work and Bell was required to follow WSRC procedures only for certain types of work that were deemed to pose a potential hazard to WSRC. The special procedures in this case were these three: 18Q Procedure 2 Rev. 4 *Safe Electrical Practices and Procedures,* 8Q Procedure 32 Rev. 9 *Hazardous Energy Control (Lockout/Tagout)*, and 8Q Procedure 35 Rev 4. *Work Clearance and Authorization.* The first two procedures were placed into the contract because of the concern over interfaces with site electrical systems and the last procedure established the requirement to perform Job Hazard Analyses (JHA) and establish appropriate controls for certain types of work. There were particular concerns in this case over the use of cranes and proximity to WSRC structures. Although the subcontractor was provided the WSRC "Subcontractor Safety Handbook," this handbook did not provide detailed requirements and was only intended to promote safe work. Another notable contract requirement was for Bell to implement a Behavior Based Safety (BBS) process.

Work packages were put together by Bell for some jobs where detailed planning, special instructions or cautions were necessary. The shoring/scaffolding job in question did not have a special work package prepared for it. Instructions for the job in documents provided by the designer were believed by Bell to be sufficient.

2.9.1.1 Analysis

The safety management system contract language for the Bell contract required that an ISMS description addressing a listed set of principles be prepared for BSRI review and that a WPP should also be prepared for review by BSRI which met certain criteria outlined in the contract. Bell had the option of submitting the WPP as part of their ISMS description. As documents were prepared and discussed, BSRI determined that the Bell WPP met the intent for an ISMS description and accepted the WPP on 12/20/00. The WPP incorporated the above special procedure requirements, implements relevant OSHA requirements, certain site environmental protection and reporting requirements, and Bell corporate policies for this type of work. It was

also noted that Bell's safety performance, as expressed in terms of their Experience Modifier of .75, was better than most in the construction industry.

Individuals interviewed during this investigation concerning instructions for the shoring/scaffolding job all believed that instructions were sufficient to correctly and safely perform the task. The job was uniformly perceived as routine and uncomplicated.

2.9.1.2 Conclusion

The Board had no issues identified with flow down of requirements to the subcontractor. The WSRC process was designed to give the subcontractor the greatest freedom possible in performing work consistent with potential impacts to WSRC from abnormal events. This process provided a good structure for streamlining the identification of requirements and including them in the contract only with adequate justification.

The Board believed that instructions for the job were sufficient.

2.9.2 Analyze Hazards

The terms of Bell's contract required that JHAs be performed and that controls be established to mitigate the hazards. A set of 33 JHAs was submitted as part of Bell's WPP. These JHAs described some very specific tasks, but many appeared to be designed to cover categories of activities and routine hazards on the construction job. "Install Reinforcement Steel" for example, identified falls as a hazard and recommended fall protection controls. The contract required that additional JHAs be performed as necessary. No specific analysis was performed for the shoring work in question. General site safety rules, and JHAs for similar types of work where falls could be a hazard (e.g. excavation shoring erection), identified the PPE for the work. The presence of water was not identified as a hazard in any JHAs addressing slips or falls.

2.9.2.1 Analysis

Although none of the JHAs for the construction job mentioned water as a hazard, with accompanying controls, a great deal of effort was expended to control water at the site. Bell clearly recognized water accumulation as a common construction site problem. The carpenters did not erect shoring in the Furnace Room the day prior to the accident because of excessive water. The carpenters entered the room the day of the accident only after pumping had reduced the amount of water to levels acceptable to the BCSP, F1 and the work crew. C2 and C3 both indicated that there was nothing unusual about the circumstances or situation and that they had no hesitation about climbing the shoring/scaffolding under existing conditions. Interviews indicated that water was recognized as a hazard for slips and falls, and there were some indications that the subject was discussed during site safety meetings.

2.9.2.2 Conclusion

Bell could have improved the rigor of their JHAs and definition of their selection process for analysis of jobs. The Board did not believe, however, that a specific JHA for this job identifying water as a hazard would have caused changes in Bell's water control strategy prior to the accident. They exhibited reasonable and prudent precautions to reduce water in the open

construction site. The Board also did not believe that improvements in the analysis would have translated into heightened awareness, by the foreman and carpenters of the hazards of climbing, whether wet or dry. All exhibited the awareness of the ubiquitous hazards of slips, trips, and falls from low levels, and the carpenters were equipped with fall protection equipment for work at greater heights. Other control strategies as discussed in previous sections of this report could have been identified to reduce the risk of a fall still further, but the Board was of the opinion that they would not have been selected prior to the accident and were unwarranted after the event. It was not practical, beyond precautions already taken, to try and control falls from such low heights on a construction site. Since there could be circumstances in the future where an inadequate JHA process could fail to identify a less obvious hazard or where a unique control strategy could be beneficial, these observations about Bell's JHA process were referred to the appointing official for appropriate follow up with BSRI and Bell.

2.9.3 Feedback and Improvement (Oversight)

From the standpoint of ES&H oversight, for a "B" contract involving hazardous work, weekly interaction as a minimum was required between BSRI and Bell. There were no other requirements for content or criteria for these interactions or for organizations other than BSRI. The nature and frequency of interactions of various organizations involved in this project are outlined below.

Bell Technologies, Inc.

Bell's Construction Superintendent was the management official responsible for safety on the construction project and for assuring that the requirements of the WPP were carried out. These responsibilities were primarily met through the work of the Bell safety staff.

Bell assigned a certified safety professional to be continuously on-site for this project. By reviewing the BCSP's resume, the Board determined that individual was well qualified and professionally certified to provide safety and health management services. During interviews, the BCSP exhibited the knowledge expected of a safety professional. Review of the BCSP's and her assistants' daily workplace inspection records indicated that the inspections were effectively identifying hazards and actions taken to mitigate/abate the hazards. One of the two other safety specialists was assigned to the job to cover a second shift, and one was assigned to deal with the numerous logistical duties created by increased security after September 11, 2001.

Daily inspections of the site were conducted by the BCSP. The Safety/Housekeeping Inspection Checklist standard form (Attachment "C" of Exhibit F of the contract) was used to record these inspections. Review of a sampling of these forms found the content to be substantive with numerous comments rather than only a list of checked boxes. The Site Worker Observation Data Sheet (Attachment "D" of Exhibit F of the contract) was attached to many of these daily inspection reports. A craftsperson was selected by the BCSP to make observations of work at the site as part of their BBS process. These worker observations, together with a safe practice awards system, were the primary aspects of the Bell BBS process.

Weekly inspections of the site were conducted by the BCSP and members of other organizations responsible for construction and safety oversight often attended. All issues and findings were written on the checklist and signed by all the members on the walkdown. A copy went to Bell and into the project file. Additionally, a synopsis was listed in the BSRI Subcontractor Technical Representative's (STR)'s Daily Activity Report with a note to see the checklist on file for detail. At the next weekly progress meeting chaired by the assigned STR, the first agenda item was to cover the past week's safety walkdown in front of Bell's and the rest of the Project Team. "Toolbox Safety Talks" had been held daily in the past, and topics and attendance had been recorded. A change was made to the frequency of these talks. Bell management believed that these all-hands talks would be more effective if scheduled only when a topic of wide application would be discussed. A new practice of daily "safety huddles" at the job site for individual crews with their foremen was instituted after the accident to emphasize specific safety cautions and issues for the crews' work each day.

Bell's insurance carrier, The Travelers, also inspected the site on about a monthly basis. An inspection was performed the day of the accident, but the location in question was reportedly not visited. The BCSP usually accompanied the inspector and findings, as well as any injuries that had occurred since the last inspection, were discussed. Reports were issued to Bell and provided to BSRI after the inspection.

BSRI

BSRI oversight activities were performed by and coordinated with the STRs. The six STRs assigned to this project were responsible for the daily interface with Bell in assuring that the job was performed in accordance with contract provisions. The STRs were responsible for bringing in special ES&H expertise whenever there were issues of concern and were responsible for issuing a Safety Citation (Attachment "B" of Exhibit F of the contract) when warranted. Three safety citations had been issued to Bell. A minimum of a half-day safety standdown of workers was required when these safety citations were issued. Bell conducted a safety standdown after receiving a third citation from an event unrelated to this fall incident.

A representative of the Construction Safety Management organization attended the weekly site safety inspections, and performed other reviews when work of particular interest was being conducted or if requested by the STR (e.g. special crane lifts). The Board reviewed the STR daily and weekly safety walkdown reports. The daily reports did not usually address safety items. The weekly safety walkdown reports were quite substantive despite the fact that these forms were simply a checklist of topics with a comment section.

DOE/NNSA Project Team

The project team was locally managed by members of the NNSA SRSO, with matrix support from SROO. ES&H Subject Matter Expertise (SME) was provided from SROO, and SRSO provided daily construction oversight by an individual dedicated to the project. This person, while not possessing the expertise of the safety SMEs, had sufficient training and experience to recognize many potential hazards and non-standard practices. A member of the SROO Safety Division, as part of their matrix support function, often attended the weekly Bell safety inspections, and issued reports of observations from periodic site inspections to their management and to SRSO. Members of the team from the SROO Engineering and Analysis

Division also provided observations on safety related matters in their periodic reports of site visits.

2.9.3.1 Analysis

Bell provided a knowledgeable safety staff that was intimately involved in daily operations. The staff promoted open communications for workers to bring forward safety concerns, and had formal processes for documenting inspections and correcting deficiencies. Oversight by BSRI was commensurate with the nature of the work and the terms of the contract. The continuous presence of the STRs, and the knowledge of construction safety practices shown by the STR interviewed, provided assurance that serious deficiencies would be noticed and that SMEs would be consulted when necessary. SRSO also provided an individual on a daily basis with similar knowledge and experience.

The effort by Bell to implement a BBS had been unusual in that Bell administered the process with a safety professional and a randomly selected worker that weekly traverse the construction site recording safe behavior. Bell used this system with a periodic incentive reward to improve behavioral performance and build upon a safety culture. Since this differed considerably from a classical BBS program, it was unlikely that any major outcomes would be realized in the traditional sense. Traditional programs have an immediate feedback feature for the observed worker(s)' safe behavior.

2.9.3.2 Conclusion

A more frequent involvement by BSRI and DOE SMEs during weekly inspections would be desirable. Overall, oversight of this job by all parties was judged to be commensurate with the hazards involved, and the terms of the contract. These points are not implicated in C1's accident.

3.0 CAUSAL FACTORS

The Board determined that the direct cause of the fall was the carpenter's loss of his grip on the shoring/scaffolding. The Board further determined that, although water present at the accident scene may have contributed to the carpenter's loss of grip, Bell had demonstrated reasonable and prudent efforts to mitigate hazards common to construction activities that are associated with water.

A Change Analysis was used to systematically identify direct and contributing causes as illustrated in the following table.

3.1 Change Analysis

Change Analysis Worksheet

Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
Water on floor may have increased likelihood of a slip.	Workplace is maintained free of slipping and tripping hazards.	Water on floor despite Bell's efforts to minimize it.	Water is commonplace hazard on construction sites and probably did not contribute to accident.
Employer provided PPE was appropriate to task and was maintained in reliable condition.	C1's footwear, fall protection harness and lanyards were in reliable condition. C1's gloves were worn, but in serviceable condition.	None	C1's boots were in almost new condition. Eyewitness account suggested that C1's foot did not slip off shoring. At time of fall, C1 was not above the 6' elevation at which fall protection was required. C1's PPE did not contribute to accident.
Training records for C1, C2 and C3 documented appropriate OSHA-required training for scaffolding and fall protection. C3's records also documented appropriate competent person training.	Employer trained workers to recognize hazards associated with shoring erection and methods of protecting themselves.	None	Carpenters had received appropriate training, so no deficiencies contributed to accident.
Workers erected shoring in accordance with supplier's drawings in a manner that ensured reliable, stable structure capable of supporting design loads.	Shoring system was being erected in accordance with supplier's instructions.	None	At the point from which C1 fell, the shoring structure was stable and did not contribute to the accident.

Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
C1 was described as a very robust individual just returning from a rest break. Tests indicated C1 was not under influence of alcohol or drugs.	Worker was fit for duty.	None	C1 was fit for duty and his physical condition did not contribute to accident.
Inspection records from Bell, BSRI, and DOE documented constant, effective workplace inspections that identified significant situations and appropriate corrective actions.	Oversight effectively identified deviations from expected safety and health performance expectations.	None	The accident scene contained no deviations from OSHA standards, company policies and procedures, or DOE directives. Oversight was not deficient and likely would not have prevented accident.
Bell employees were acting in accordance with the terms of the contract with WSRC.	Terms of contract ensured flowdown of safety and health standards to work activities.	None	Bell had provided a WWP fulfilling the ES&HP-2 alternative provided in contract with WSRC. Carpenters were erecting shoring using practices described in the WPP.

4.0 CONCLUSIONS AND JUDGMENTS OF NEED

The Board concluded that the direct cause of the fall was C1's loss of his grip on the shoring/scaffolding structure he was climbing. The Board examined a variety of factors that could have contributed to this situation such as the presence of water at the site, inadequate PPE, characteristics of the structure, inadequate instructions or training and C1's medical condition. The Board also reviewed processes such as identification of requirements for the work, hazards analysis, and oversight of the work.

The Board concluded that C1 and his co-workers were experienced in the work to be performed, were familiar with the hazards involved, and were using the appropriate PPE. The appropriate standards and instructions for the work were used. The job to be performed was routine, as was their approach to the job. Bell had an adequate emphasis on safety and provided a qualified safety staff who were involved on a daily basis with the work. Oversight by the BSRI and DOE was commensurate with the hazards involved and the terms of the contract. No conclusive contributing factors were found, that if modified or eliminated by practical means would have prevented this accident.

Improvements can always be made to reduce the risk to workers and some possibilities were noted in this report, but none of these were judged to be of such potential benefit that warranted Judgments of Need. The practicality of protecting workers from falls at low heights (about 52" in this case), particularly on a construction site, must be considered. Further, the emphasis for this contract was to have the subcontractor conduct the work as much as possible in accordance with relevant commercial standards and practices, and to impose few additional requirements by the DOE/NNSA. The Board agreed with this approach.

During the course of this investigation, the Board noted some areas for improvement. These areas were determined not to have a causal relationship to this accident, but might play a role in potential future events. These matters were noted in the report in sections 2.7.2, 2.9.2.2, and 2.9.3.2 and were referred to the Appointing Official for consideration.

5.0 BOARD SIGNATURES

Constance Soden
Accident Investigation Board Chairperson
U. S. Department of Energy
Albuquerque Operations Office

Date 5-10-02

Marcus Hayes
Board Member
U. S. Department of Energy
Albuquerque Operations Office

Date 5/10/02

August Maniez, Jr.
Board Member
U. S. Department of Energy
Savannah River Operations Office

Date 5/10/02

Jeffrey Klapper
Board Member
Accident Investigator
National Nuclear Security Administration
Savannah River Site Office

Date 5/10/02

6.0 BOARD MEMBERS, ADVISORS AND STAFF

Chairperson	Constance Soden, DOE/NNSA, Albuquerque Operations Office
Member	Marcus Hayes, DOE/NNSA, Albuquerque Operations Office
Member	August Maniez, DOE Savannah River Operations Office
Member	Jeffrey Klapper, DOE/NNSA, Savannah River Site Office
Advisor	Robert Goehle, DOE/NNSA, Savannah River Site Office
Administrative Support	Carol Emerson, DOE/NNSA, Savannah River Site Office
Administrative Support	Christina Vialpando, DOE/NNSA, Albuquerque Operations Office

Appendix

DOE F 1325.8

United States Government **National Nuclear Security Administration**
Savannah River Site Office (SRSO)

Memorandum

DATE: APR 11 2002

REPLY TO ATTN OF: TRIT (Richardson, 8-1195)

SUBJECT: Type B Accident Investigation – Construction Injury at the Tritium Extraction Facility

TO: Constance L. Soden, and Marcus L. Hayes, Albuquerque Operations Office (AL)
Jeffery A. Klapper, Savannah River Site Office (SRSO)
August Maniez, Jr., Savannah River Operations Office (SR)

I hereby establish a Type B Accident Investigation Board to investigate the employee injury from a fall that occurred at the Savannah River Site's Tritium Extraction Facility construction site on April 2, 2002. I have determined this incident meets the requirements established for a Type B accident investigation per Department of Energy (DOE) Order 225.1A, "Accident Investigations," dated November 26, 1997.

The individuals appointed to the Board are:

- Chairperson - Constance L. Soden, Director, Environment, Health, and Safety Division, AL,
- Accident Investigator - Marcus L. Hayes, Industrial Safety Specialist, AL,
- Accident Investigator - Jeffery A. Klapper, Tritium Facility Representative, SRSO, and
- Board Member - August Maniez, Jr., Safety Engineer, SR.

Other advisors, consultants and support personnel as determined by the chairperson will be made available. Carol Emerson, Program Analyst, SRSO will provide logistical support and assistance to the team.

The scope of the Board's investigation will include, but is not limited to, identifying all relevant facts; analyzing the facts to determine the direct, contributing, and root causes of the accident; developing conclusions; and determining the judgments of need that, when implemented, should prevent the recurrence of the accident. The investigation will be conducted in accordance with DOE Order 225.1A and will specifically address the role of DOE, contractor organizations, and management systems as they may have contributed to the accident. The scope will also include any deficiencies related to Integrated Safety Management System implementation and the application of lessons learned from similar accidents within DOE.

The Board will provide my office with periodic reports on the status of the investigation, as well as a draft copy of the factual portion of the investigation for a factual accuracy review prior to report finalization. Conclusions will be determined after an analysis of all of the causal factors has been completed.

Distribution - 2 - APR 11 2002

Four copies of the complete draft report should be provided to me no later than May 10, 2002, for review prior to its preparation in final form. Any delay to this date should be justified and forwarded to my office. Discussions of the investigation and copies of the draft report will be controlled until I authorize release of the final report.

By copy of this memorandum, I am advising the supervisors of each of the Board Members that this assignment is full-time until the investigation and report are completed. The advisors to the Board shall assist the Board in the investigation on a priority basis and provide input to the Chairperson, as requested. Board Members and Advisors are requested to attend an opening meeting to be held at SRSO, at 8:00 a.m. on April 16, 2002, in Building 246-H, Room 106.

Maureen A. Hunemuller, Manager
National Nuclear Security Administration
Savannah River Site Office

TRIT:WAR:mp

RB-02-0112

cc: Greg Rudy, Manager SR
Beverly Cook, EH-1
Dr. Everet Beckner, NA-1
David Beck, NA-12
Tony Tavares, NA-12
Stephen Sohinki, NA-125
Ralph Erickson, NA-50
Silas Stadler, EH-2, HQ/GTN
Dennis Vernon, EH-21, HQ/GTN
Larry Kirkman, OSAF, AL
Roger Rollins, SR
Tom Burns, DNFSB
Robert Pedde, WSRC
Charles Spencer, WSRC