

TYPE B ACCIDENT INVESTIGATION  
OF THE  
MARCH 20, 2003  
BUILDING 752 STAIR INSTALLATION  
ACCIDENT  
AT THE  
SANDIA NATIONAL LABORATORIES,  
NEW MEXICO



**April 2003**

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## RELEASE AUTHORIZATION

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On March 27, 2003, I appointed a Type B Accident Investigation Board to investigate the March 20, 2003 accident that occurred while erecting steel during construction of Building 752 at the Sandia National Laboratories, New Mexico. The responsibilities of the Board have been satisfied with respect to this investigation. The analysis, identification of contributing and root causes, and judgments of need reached during the investigation were performed in conformance with Department of Energy Order 225.1A, *Accident Investigations*.

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

  
Karen L. Boardman 4.25.03  
Sandia Site Office Manager

## DISCLAIMER

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This report is an independent product of the Type B Accident Investigation Board appointed by Karen L. Boardman, Manager, Sandia Site Office (SSO), National Nuclear Security Administration (NNSA).

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

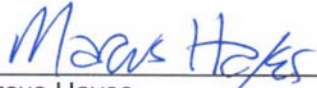
The discussion of facts, as determined by the Board, and the views expressed in the report are not necessarily those of the Department of Energy or the National Nuclear Security Administration and do not assume and are not intended to establish the existence of any legal causation, liability, or duty 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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# BOARD SIGNATURES

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Marcus Hayes  
Accident Investigation Chairperson  
NNSA Service Center

April 11, 2003  
Date



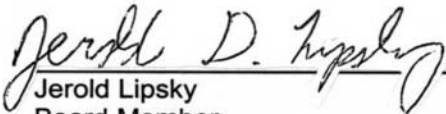
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Isaac M. Valdez  
Board Member  
NNSA Service Center

April 11, 2003  
Date



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Ralph A. Fevig  
Board Member  
Sandia Site Office

April 11, 2003  
Date



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Jerold Lipsky  
Board Member  
Los Alamos Site Office

April 11, 2003  
Date

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# TERMS, ABBREVIATIONS, AND INITIALISMS

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CSO – construction safety officer

ES&H – environment, safety, and health

FMOC – Facilities Management and Operations Center

FMOC SE - Facilities Management and Operations Center safety engineer

General Contractor – Summit Construction, Inc.

Sandia PM – Sandia Project Manager

SCO – Sandia Construction Observer

SCR – Sandia Contracting Representative

SDR – Sandia Delegated Representative

SSO – Sandia Site Office (NNSA)

SSO FR - Sandia Site Office Facilities Representative

SSO PM - Sandia Site Office Project Manager

Summit - Summit Construction, Inc.

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# EXECUTIVE SUMMARY

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## ***Background***

On Thursday, March 20, 2003, at 7:30 a.m., two subcontractor employees sustained injuries as the result of a steel stair component and temporary hoisting beam falling during installation of the north stairwell of Building 752 being constructed in Technical Area I at the Sandia National Laboratories, New Mexico (Sandia).

Because one of the injured contractor workers was hospitalized for more than five calendar days, the Manager of the Sandia Site Office (SSO) appointed a Type B Accident Investigation Board on March 27, 2003. The Board was convened to analyze causal factors, identify root causes, and determine judgments of need related to the accident to preclude similar accidents in the future. The Board arrived onsite and began the investigation on Monday, March 31, 2003, and completed the investigation on April 18, 2003.

## ***Site Description***

Building 752 was being constructed in Technical Area I of the Sandia National Laboratories in Albuquerque, New Mexico (SNL/NM). SNL/NM is a multifunctional facility whose headquarters and main laboratories are located within the boundaries of Kirtland Air Force Base, on the southeast edge of Albuquerque, New Mexico. Operations are conducted in six locations. The accident under investigation occurred in TA-I that is the largest of the SNL/NM areas. TA-I is dedicated to administration, site support, technical support, basic research, component development, energy programs, microelectronics, defense programs, exploratory systems, technology transfer, and business outreach.

Sandia is a government-owned/contractor operated facility. Lockheed Martin manages Sandia for the U.S. Department of Energy's National Nuclear Security Administration. Through science and technology, people, infrastructure, and partnerships, Sandia's mission is to meet national needs in the key areas of nuclear weapons, nonproliferation and materials control, energy and critical infrastructure, and emerging threats.

## ***Results and Analysis***

The direct cause of the accident was the temporary hoisting beam falling from its rooftop supporting structural beams into the stairwell opening, striking a worker, and dropping the stair-section load injuring another worker.

The root cause of the accident was that installation of the temporary hoisting beam and the movement of the load during the lift were not performed in accordance with the requirements of 29 CFR 1926. In addition to the direct and root causes, there were several contributing causes.

## ***Conclusion***

The Board concluded that the accident was preventable.

Conclusions	Judgments of Need
Std. Spec. 01065 did not clearly communicate to Summit Sandia's expectations for the conduct or content of safety meetings.	<p>Sandia needs to ensure that subcontractors more fully implement the provisions in Std. Spec 01065 in the following areas:</p> <ul style="list-style-type: none"> <li>• Task-specific hazards analysis.</li> <li>• Effective safety meetings that communicate activity-specific hazards analysis and controls to workers</li> <li>• Jobsite safety inspections focused on compliance with 29 CFR 1926 and at frequencies specified in DOE O 440.1A.</li> <li>• Verification (frequency, scope, documentation) of safety practices at this and similar construction work sites.</li> </ul>
If the ironworker crew discussion on the morning of the accident included possible hazards that might be encountered on the upcoming activity, it did not identify effective controls (e.g., securing the temporary hoisting beam).	
Sandia did not fully define and communicate its expectations regarding task-specific hazards analysis to subcontractors.	
The level of hazards identification required by Std. Spec. 01065 allowed Summit flexibility to analyze hazards consistent with the complexity of the job.	
Sandia Standard Specification 01065 required weekly inspections by the subcontractor, not daily inspections as required in the Contractor Requirements Document of DOE O 440.1A. Sandia did not ensure Summit's compliance with the weekly construction inspections requirement of Specification 01065.	

Conclusions	Judgments of Need
Roles and responsibilities in Specification 01065 had not been clearly communicated to those engaged in project management.	Sandia needs to ensure that the construction safety and project management more clearly understand and implement the provisions in Std. Spec 01065 in the following areas: <ul style="list-style-type: none"> <li>• Subcontractors perform task-specific hazards analysis.</li> <li>• Subcontractors conduct effective safety meetings that communicate activity-specific hazards analysis and controls to workers.</li> <li>• Subcontractors perform jobsite safety inspections focused on compliance with 29 CFR 1926 and at frequencies specified in DOE O 440.1A.</li> </ul>
Sandia inspections were documented, but the content did not include safety-specific details.	
Sandia had not clearly communicated construction safety oversight roles and responsibilities to staff members.	
SSO performed and documented infrequent inspections that did not include safety-specific details.	SSO needs to establish clear roles and responsibilities concerning construction safety management in the areas of: <ul style="list-style-type: none"> <li>• Task-specific hazards analysis.</li> <li>• Effective safety meetings that communicate activity-specific hazards analysis and controls to workers.</li> <li>• Jobsite safety inspections focused on compliance with 29 CFR 1926 and at frequencies specified in DOE O 440.1A.</li> <li>• Verification (frequency, scope, documentation) of safety practices at this and similar construction work sites.</li> </ul>
SSO had not clearly communicated construction safety oversight roles and responsibilities to staff members.	
Sandia could have exhibited a higher level of investigative readiness, particularly in the areas of evidence preservation and timely acquisition of witness statements. These deficiencies did not affect the ultimate outcome of this investigation. In other accidents, evidence preservation may be of paramount importance	Sandia needs to enhance its accident scene preservation practices to be consistent guidance provided by DOE G 225.1-1.

# INTRODUCTION

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## ***Background***

Because one of the injured subcontractor workers was hospitalized for longer than the five calendar days threshold, the Manager of the Sandia Site Office appointed a Type B Accident Investigation Board (Board) on March 27, 2003. The Board was formally established to investigate a non-fatal accident that occurred on March 20, 2003, at the Sandia National Laboratories, Building 752-construction site. Building 752 was being constructed as a design/build contract and is the third facility to be constructed under the contract originally let for Buildings 750 and 751.

In this accident, an ironworker foreman standing on the second floor sustained a crushing injury to his right foot. A journeyman ironworker stationed on the ground floor received a laceration to his left shin that required six sutures to close. An apprentice ironworker on the ground floor was knocked down, but was not injured.

## ***Facility Description***

Sandia is a government-owned/contractor operated facility. Lockheed Martin manages Sandia for the U.S. Department of Energy's National Nuclear Security Administration. Sandia National Laboratories is a multifunctional facility whose headquarters and main laboratories are located within the boundaries of Kirtland Air Force Base, on the southeast edge of Albuquerque, New Mexico. Operations are conducted in six locations. The accident under investigation occurred in Technical Area I, the largest of the SNL/NM areas. Technical Area I is dedicated to administration, site support, technical support, basic research, component development, energy programs, microelectronics, defense programs, exploratory systems, technology transfer, and business outreach.

Through science and technology, people, infrastructure, and partnerships, Sandia's mission is to meet national needs in the key areas of nuclear weapons, nonproliferation and materials control, energy and critical infrastructure, and emerging threats.

## ***Scope, Purpose, and Methodology***

The Board conducted its investigation in accordance with DOE O 225.1A, *Accident Investigations*, 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 factors charting, along with barrier analysis and change analysis techniques, were used to analyze the facts and identify causes of the accident.
- Based on analysis of the information gathered, judgments of need for corrective actions to prevent recurrence were developed.

In conducting the investigation, the Board employed various analytical tools, among them barrier analysis, change analysis, and root cause analysis. The Board inspected and photographed the accident site, and analyzed events before and after the accident occurred.

The Board conducted interviews with witnesses, individuals who responded to the emergency call, and others who had relevant knowledge of the accident, to determine the causal factors that led to the event. Summit Construction (general contractor) and Structural Services (subcontractor) management systems were evaluated against Sandia's Integrated Safety Management System (ISMS) standard.

The Board began its investigation on March 31, 2003, completed its investigation on April 18, 2003, and presented its final report to the Manager, Sandia Site Office (SSO) on April 21, 2003.

## **THE ACCIDENT**

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### ***Description of the Accident***

The accident took place at approximately 7:30 a.m. on March 20, 2003. A work crew of three ironworkers was hoisting a steel stair section onto the supporting structural beams of the open north stairwell of Building 752 in preparation for fixing it in place.



(See Figure 1) After the stair section had been hoisted to the necessary height and while it was being positioned, the temporary hoisting beam that had been supporting the hoisting equipment and the stair section slipped from its position on the angle iron framing the rooftop stairwell opening. The temporary hoisting beam fell to the second floor where it struck the foreman's hardhat and then his foot before it continued to the ground level where it imbedded itself into a small mound of loose earth and came to rest without causing further damage (see photo at left).

The foreman's right foot sustained a crushing injury that required a seven-day hospital stay and three surgeries to treat. When the temporary hoisting beam ceased to provide support for the hoisting equipment and the stair section, the stair section fell and bounced off the supporting structure, tipped to the south, and fell onto the ground. As it came to rest, a support brace that was attached to the stair section struck the journeyman ironworker on the left shin, causing a laceration that needed six sutures to close. The apprentice ironworker who was knocked to the ground received no injury. The foreman descended the south stairs and continued across the ground floor to the accident scene.

### ***Emergency Response and Medical Treatment***

The apprentice walked to the cafeteria across the street from the construction site where Sandia paramedics were eating breakfast. The paramedics went to the accident scene at about 7:35 a.m. where they found two injured workers – the foreman and the journeyman. The foreman was found on the ground floor surrounded by other construction crewmembers. He was in obvious pain, but was conscious and alert.

Paramedics removed the foreman's right non-steel-toe work boot and sock and found that he had received a large gash to the metatarsal region of his right foot caused by the falling temporary hoisting beam. The injury extended to the big toe and the bottom of his right foot. The paramedics noted blood on the sock, but blood loss was minimal. No other injuries or medical conditions were noted. Paramedics medicated him, stabilized the injury with splint and bandage, and transported the injured foreman to the Sandia Medical Facility for evaluation. He was later transported by Sandia ambulance to the University of New Mexico Hospital (UNMH) where he was admitted for treatment.

At UNMH, the injuries were identified as "Grade II open fractures to the great toe, metatarsal fractures of the second and third toes and laceration of lateral neurovascular bundle to great toe distal phalanx." X-rays confirmed a partial amputation of his great toe at the base of the distal phalanx, fractured first metatarsal shaft, fracture of the second and third metatarsal shaft. He was hospitalized from March 20 to 27, 2003, during which time, he received three surgeries (without complication) for repeated irrigation and debridement of his right foot. He was released in good condition with medications and the injury was protected by a non-weight bearing short leg cast.

Paramedics treated the journeyman for a laceration to his left shin that he received when a part of the stair section hit him as it fell. Consistent with Summit's safety plan, the apprentice transported the injured journeyman to the Concentra Medical Center (an offsite medical facility) where he received six sutures to close the laceration. The journeyman was released about 9:29 a.m. on the same day and returned to work with the restriction not to climb stairs or ladders.

## **SEQUENCE OF EVENTS**

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April 9, 2001. Sandia Corporation awarded Contract Number 17875, Building 750 to Summit Construction, Inc. This contract contained the options for construction of buildings 751 and 752.

December 11, 2002. The second contract option, for constructing Building 752, was signed and notice to proceed was issued.

March 19, 2003, 11:00 a.m. Construction site was shut down because of inclement weather.

### **Thursday, March 20, 2003 (all times are approximate and based on witness interviews)**

#### A.M.

7:00. A three-man crew reported to work to install the second section of stairs into the north stairwell. The first section of the stairs had been fixed in place prior to this activity. The temperature was 36°F and the relative humidity was 96%. Walking and working surfaces were wet from the previous day's rainfall.

7:30. The crew raised the stair section to the required height and was positioning the section into its final location on the landing support structure that was already in place. The temporary hoisting beam that was spanning the rooftop opening of the stairwell to provide support for the hoisting equipment, fell into the opening and struck the foreman, who was on the second floor, on his hardhat then his right foot. The stair section that was being lifted fell, striking the journeyman on the left shin causing a laceration.



7:35. The apprentice walked to the cafeteria across the street where Sandia paramedics were eating breakfast. The paramedics responded to the accident scene. The Sandia Incident Commander (IC) was notified of the accident.

7:38. Sandia paramedics began treatment and evaluation of the injured foreman. The IC and Facilities Management and Operations Center (FMOC) safety engineer (FMOC SE) arrived at the site.

7:40. The IC and FMOC SE secured the area and identified the injured journeyman. All steel erection activities at the work site were suspended.

7:41. The Summit Construction Superintendent contacted Sandia Delegated Representative (SDR).

7:42. The SDR, FMOC SE, and mechanical and electrical construction observers began gathering information, conducted initial assessments, and interviewed the Summit Construction, Inc. Superintendent.

7:45. Having received a call from the foreman, the Structural Services Site Superintendent arrived at the site, tagged out the chain fall, and removed the chain fall from the scene and took it to Structural Services's facility.

7:48. The foreman was transported by paramedics to the Sandia Medical Facility for initial medical attention. The journeyman transported in the apprentice's personal vehicle to Concentra Medical Center (an offsite medical facility) for treatment.

8:10. The SDR contacted the Sandia Construction Inspection and Acceptance Department Manager and the Technical Services Program Level II Manager.

8:13. The foreman was transported by Sandia ambulance to the University of New Mexico Hospital (UNMH) and admitted for treatment of the injury to his right foot.

8:15. The Technical Services Level II Manager notified the Center Director and the Division 10000 Vice President's office.

8:30. The Sandia Project Manager arrived at the site and initiated stand down of all construction activities at Building 752.

8:50. The FMOC Environment, Safety, and Health Coordinator left voice-mail for the SSO Facility Representative (FR) to notify him of the accident.

9:00. The SDR stopped all work activities at the Building 752 site. A safety meeting was held to review the accident held with entire workforce on the site. The SDR, FMOC SE, and construction observers participated.

9:29. The journeyman was released to return to work.

9:30. The contractors' supervisors conducted separate safety meetings, including a review of pre-task planning and trade-specific materials, equipment, and personal protective equipment.

11:00. Work activities, except steel erection, resumed at the Building 752 site. SSO SE notified SSO FR. SSO FR notified SSO Project Manager.

11:30. SSO Project Manager and SSO FR arrived at the accident scene.

## P.M.

12:00 to 2:00. The SDR, construction observers, and general contractors conducted safety meetings at the other five FMOC steel erection construction sites.

3:00. The FMOC SE revisited the accident scene to gather additional information.

3:30. The FMOC SE provided tour of the accident scene for the SSO FR, SSO Project Manager, SSO SE, and Sandia Project Manager. They discussed accident scene preservation and investigation activities.

5:15. The SSO Project Manager and SSO FR briefed the SSO Manager and assistant managers.

### **Friday, March 21, 2003 (all times are approximate and based on witness interviews)**

10:30 a.m. The FMOC SE and Sandia safety subject matter expert visited the scene. Additional photographs were taken. The Summit site superintendent, journeyman, and apprentice who were involved in the previous day's activities provided statements.

12:50 p.m. The Construction Inspection and Acceptance Department Manager sent an e-mail alert to all construction contractors describing the accident.

### **Monday, March 24, 2003 (all times are approximate and based on witness interviews)**

10:00 a.m. to 2:00 p.m. The FMOC SE performed walk downs of all FMOC projects involving steel erection. The Joint Computational Engineering Laboratory (JCEL) site was identified as the only site having steel erection activities this day. A safety meeting was held with JCEL steel erection crew, FMOC SE, and the JCEL contractor's safety director.

### **Tuesday, March 25, 2003**

The injured foreman has been hospitalized for five days, crossing the DOE O 225.1A threshold for a Type B Accident Investigation.

### **Wednesday, March 26, 2003**

The SSO Manager appointed a Type B Accident Investigation Board and verbally notified FMOC.

### **Thursday, March 27, 2003**

The foreman was released from the hospital.

## **INVESTIGATIVE READINESS AND ACCIDENT SCENE PRESERVATION**

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The DOE O 225.1A, *Accident Investigations*, Contractor Requirements Document mandates that contractors develop provisions for supporting Type A and B accident investigations and that contractor staff establish and maintain a site readiness capability to preserve an accident scene.

Sandia's Corporate Process Requirement (CPR) 400.1.1, *Environment, Safety and Health (ES&H) Manual*, contains the requirement to preserve the site of property damage in

Section 2D, "Perform Work, Unplanned Conditions or Events and Emergency Response," which states that in the event of an accident, managers shall instruct personnel to preserve, to the extent feasible, the accident scene and to document the event by:

- Noting the time, location, ambient conditions, and property involved.
- Identifying persons involved and/or witnesses and taking initial statements.
- Roping off the area, placing barricades or guards, and otherwise limiting access to the scene.
- Taking equipment involved out of use (if not essential to other operations).
- Taking photographs or making diagrams of the accident.
- Making copies of equipment and personnel logs and other pertinent records.
- Assigning ownership or custody of evidence.

During the investigation, the following facts were noted regarding investigative readiness and accident scene and evidence preservation:

- The IC and FMOC SE initially secured the accident scene at approximately 7:40 a.m. on the day of the accident.
- The SDR, FMOC SE, and mechanical and electrical construction observers began gathering information and conducted an initial assessment at approximately 7:42 a.m.
- A ladder, extension cord, and welding helmet shown in the initial pictures were removed prior to the arrival of the SSO Type B Accident Investigation Board.
- The chain fall was removed from the construction site shortly after the accident. The wire rope slings were removed from the immediate scene of the accident.
- All of the hoisting and rigging equipment, except one shackle, was returned to the construction site when requested during the week following the accident. The Board believed that at least one of the wire rope slings, presented as evidence, might not be the same sling that appeared in post-accident photographs (Sandia wire rope inspector concurred).
- A damaged 2"x4" temporary guardrail around the second floor stairwell opening was repaired to provide fall protection.
- Initial written statements were not taken from the journeyman and the apprentice until the day after the accident.

The Board concluded that Sandia could have exhibited a higher level of investigative readiness, particularly in the areas of evidence preservation and timely acquisition of witness statements. These deficiencies did not affect the ultimate outcome of this investigation. In other accidents, evidence preservation may be of paramount importance.

# ISMS ANALYSIS

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Integrated Safety Management is a management system (ISMS) in place throughout the DOE complex. In the context of this accident, ISMS is implemented on two levels:

- DOE and Sandia
- Sandia and Summit Construction

A provision of the Prime Contract between DOE and Sandia requires the implementation of ISMS at Sandia. ISMS contains five core functions:

- Define the Scope of Work – bound the activity by requirements and expectations.
- Hazards Analysis – identify actual and potential hazards associated with the activity.
- Develop and Implement Controls – put in place engineering and administrative controls to minimize the probability of the identified hazards resulting in an unplanned event.
- Perform Work Within Controls – perform work within the defined boundaries and controls to ensure to the extent possible, an accident-free activity.
- Feedback and Improvement – acquire information about the performance of the activity and the effectiveness of hazard controls to improve the performance of similar activities or communicate lessons learned.

Through ISMS, requirements and expectations are identified and communicated. This mechanism provides the venue for communication that should preclude misunderstanding and miscommunication between the agencies and personnel at all levels of management and work performance. The Department of Energy Acquisition Regulation (DEAR) Clause 970.5204-78(d) allows Sandia to take a graded approach in flowing down ISMS implementation to subcontractors.

Flow down of ISMS from Sandia to Summit is a provision of Sandia Standard Specification 01065 that is included in all construction contracts. Specification 01065 allowed Summit Construction to adopt Sandia's ISMS or to develop its own safety management system plan.

There is a generic statement in Specification 01065 to comply with applicable environmental, safety, and health laws; rules and regulations, as amended, of the federal, state, and local governments; DOE directives; and Sandia requirements. Without a tailoring process to specify which DOE directives are applicable to a given construction project, such a broadly stated expectation would be difficult and costly for subcontractors to implement. To illustrate this point, DOE-STD-1090-2001, *Hoisting and Rigging Manual*, describes accepted practices beyond those of OSHA and ASME standards. Use of the *Hoisting and Rigging Manual* was not mandated by Sandia for this activity or even known to the subcontractor.

The Board determined that a more rigorous implementation of the ISMS core functions would not have directly prevented this accident.

The Board concluded that:

- SSO and Sandia have differing expectations as to the level of implementation of ISMS by subcontractors.
- If SSO and Sandia expect Sandia subcontractors to fully adhere to the requirement of ISMS:
  - Subcontractors need more information about ISMS and SSO and Sandia expectations.
  - SSO and Sandia oversight visits and inspections must be enhanced to ensure compliance with contract provisions, including ISMS.

### ***Define the Scope of Work***

Building 752 was being constructed under a design/build contract and was the third facility to be constructed under the contract originally let for Building 750 and used for Building 751. Design/build contracts are intended to accelerate construction projects by placing greater reliance on the general contractor.

The design/build contract between Sandia and Summit Construction was awarded under "Best Value Procurement" that allowed awarding of a contract based on factors other than the traditional low-bid concept. The six criteria that contractor were evaluated on were:

- Proposed schedule.
- Design concept and scope.
- Contractor past performance and related experience. (Within these criteria, related experience was weighted higher than past performance.)
- Project personnel and resources. (Within criteria, project management and key personnel were weighted higher than resources.)
- Quality of construction products and sustainability.
- ES&H compliance and construction safety program.

The Board concluded that the scope of work for the construction of Building 752 was adequately defined.

### ***Hazards Analysis***

Sandia broadly communicated hazards and controls that are commonly associated with construction activities to its subcontractors through Specification 01065. Table 1 of 01065 mentioned hazards analysis, but did not clearly establish expectations regarding task-specific hazards analysis.

The Summit site superintendent stated that hazards discussions were included in his weekly meetings with construction personnel. Attendance records do not include the names of the

Structural Service ironworkers who were involved in this accident. Further, the Summit site superintendent stated that no task-specific hazards analyses were conducted immediately prior to the performance of construction activities.

One of the ironworkers said that the Structural Services crew held a discussion on the morning of the accident that may have included possible hazards that might be encountered on the upcoming activity. The Board concluded that if this discussion identified hazards, it did not identify effective controls (e.g., securing the temporary hoisting beam).

The Board was not provided evidence of additional hazards analysis, but concluded that the level of hazards identification required by Specification 01065 allowed Summit flexibility to analyze hazards consistent with the complexity of the job.

The Board concluded that Sandia did not fully define and communicate its expectations regarding task-specific hazards analysis to subcontractors.

### ***Develop and Implement Controls***

The Board examined the flow down of safety and health requirements and directives (controls) to evaluate the extent to which DOE's construction safety expectations had been clearly defined and communicated to all levels of Sandia and SSO organizations.

Interviews with SSO managers revealed varying levels of understanding of the DOE requirements to be flowed down to Sandia and its subcontractors. For example, some SSO managers believed that, because DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*, is listed in Appendix J of the Sandia Prime Contract, all DOE guides, manuals, and standards associated with worker protection were incorporated and required by reference. Other SSO managers stated that unless DOE guides, manuals, and standards are specifically listed in Appendix J, SSO does not expect Sandia to comply with them. DOE O 440.1A contains the following wording:

“Consult the DOE Directives Checklist for current Implementation Guides and Safety Manuals associated with this Order.”

The Board determined that DOE instructions to “consult” a directive checklist did not clearly communicate to SSO or Sandia whether DOE guides, manuals, and standards should be automatically incorporated by reference into Appendix J of the DOE/Sandia Prime Contract.

The contract for the construction of Building 752 defined and documented the mechanisms needed for managing the project and making changes during the project's entire life cycle. The building construction contract required compliance with Sandia Standard Specification, Section 01065, *Environment, Safety, and Health for Construction and Maintenance Service Contracts*. Specification 01065 incorporates 29 CFR 1926, Occupational Safety and Health Administration (OSHA) general construction standards, implementation of ISMS, and compliance with federal, state, and local laws and regulations.

The Board concluded that the set of controls identified in Specification 01065 met the intent of the DEAR Clause.

## **Communication of Hazards and Controls to Workers**

The Board reviewed minutes of Summit-conducted toolbox safety meetings. In January, the meetings were conducted weekly. After January, meetings were conducted on February 7, February 19, and March 14. Summit used Associated General Contractors (AGC) Toolbox Safety Talk fliers to document this training. The topics of meetings included the use of safety glasses, hand tools, hand traps, eye protection, teamwork, and Limited Access Zones for masonry work. In addition to documenting generic safety topics, the Summit site superintendent could have been more proactive in providing specific training on upcoming activities. For example, a March 14 meeting topic was fall protection because personnel would be working on elevated surfaces the following week. This was the only time that an upcoming task was addressed directly.

None of the ironworkers involved in this accident appeared on the meeting attendance lists.

DOE G 440.1-2, *Construction Safety Management Guide For Use With DOE Order 440.1* states that DOE O 440.1A does not specify curricula or duration of required employee worker safety and health training, but emphasizes the need to formally communicate information concerning foreseeable project hazards and required protective measures.

Based on meeting records, the Board determined that Summit's safety meetings were not conducted weekly as stated by the Summit site superintendent in his interview. The meetings that were conducted did not include all workers or address activity-specific hazards.

The Board concluded that Specification 01065 did not clearly communicate to Summit Sandia's expectations for the conduct or content of safety meetings.

Sandia did require that each construction worker receive ten hours of OSHA training prior to working on Sandia's construction sites. Each of the ironworkers involved in the accident received this training from New Mexico Ironworkers Local 495. The training covered fall protection, electrical safety, material handling, ladder safety, tool safety, and other safety-related topics. The Board also reviewed additional training available from Local 495. Each of the ironworkers was also provided general OSHA information and hazard communications training. Two of the three ironworkers received fall protection-specific training in accordance with 29 CFR 1926, Subpart R. The apprentice was in the progress of receiving sixteen hours of hoisting and rigging training.

The Board concluded that no deficiencies in the ironworkers' training contributed to the accident.

## **Perform Work Within Controls**

### **Slings and Temporary Hoisting Beam Placement**

At the time of the accident, a three-man ironworker crew was installing a metal stairway along the north side of the building. A Summit-owned mobile crane was being used on another construction project at Sandia and was not available until 11:00 a.m. the morning of the accident. The ironworkers decided to use a chain fall with associated slings (see Figure 3) to lift the second stair section. To rig the 728 lb. stair section, the journeyman and an apprentice placed a 4"X4"X13'9" tubular steel beam (approximately 170 lbs.) across the 10' wide rooftop stairway opening. According to the ironworkers the beam was centered across the opening, so about 23" extended beyond each side of the opening frame (see Figure 2). The temporary hoisting beam rested on 1/4" metal edges of the opening frame and there was approximately

1.7% slope from the north edge to the south edge of the opening. Tack welds, clamps, or other securing devices were not used to affix the temporary hoisting beam.

From the temporary hoisting beam, two wire rope slings were attached in series (see Figure 3) by a shackle. The top sling was placed in a choker configuration around the temporary hoisting beam. The 1-ton chain fall suspension hook was placed into the eyelet of the bottom wire rope sling. A four-inch synthetic sling was placed in a choker configuration around the stairway section and attached with a shackle to the lifting hook of the chain fall.



The Board observed that the chain fall did not have a cover (see photo at left) identifying the load rating or manufacturer's name. The hooks were stamped or marked "1T," suggesting a one ton capacity. For the Board, Sandia successfully load-tested the chain fall at one ton. The Board noted that the safety latch on the load hook was damaged and the load block hook was spread 15%, which is in excess of the rejection criterion. Gaps in the material of the throat of the hook suggest that the hook was poorly cast, presenting an opportunity for failure. The dry-type

brake disks were coated with grease, but apparently had no affect in this case. Although the Board determined that the deficiencies found with the chain fall did not contribute to the accident, the chain fall should have been removed from service prior to this lift.

The Board also inspected the slings used in the accident. The top sling had three kinks present after the accident. This was a result of this sling being wrapped around the relatively small cross section of the temporary support beam

### **Positions and Actions of the Workers**

The ironworkers had previously installed the south, interior stairway using the same equipment. However, a column near the north stairs interfered with the ironworker's ability to place the second stair section. The ironworkers anticipated that the lift of the section would be plumb and all they had to do was lift it and move it into place. While the apprentice operated the chain fall, the foreman and journeyman positioned themselves to place the stair section. However, an attached landing structural frame member on the stair section caught on a column near the stairway opening. The ironworkers attempted to manually maneuver the lifted stair section around the column. The foreman noticed that the load was not moving because a second floor 2"x4" temporary guardrail brace interfered with the wire rope sling.

The foreman went to the second floor and attempted to move the load around the brace by hand. He then removed the brace and pulled on the wire rope sling to get the load around the column. At the same time, the journeyman and apprentice on the first floor were also moving the load. The Board concluded that the unsecured temporary hoisting beam slid off its rooftop supports, fell into the stairway opening, and struck the foreman standing on second floor. The temporary hoisting beam then fell to the first floor without causing further injury.



A journeyman ironworker on the first floor was struck by the falling stairway section causing a laceration to his left shin. The apprentice on the first floor was knocked to the ground, but sustained no injuries.

According to the chain fall manufacturers' instructions, operators should avoid swinging the load or load hook and the hoist suspension hook should be securely attached to a suitable (i.e. fixed) support.

Specification 01065 states that workers can suspend inappropriate or unsafe work activities when those activities present clear and imminent danger. Although stop work authority was not specifically stated in the Summit Safety Plan, during interviews, the workers expressed an awareness of this authority, but none of them felt that they were at sufficient risk to invoke it.

The Board concluded that this accident would have been avoided had the ironworkers been erecting the stairway in accordance with the requirements of 29 CFR 1926.

### **Personal Protective Equipment (PPE)**

The Board recognized that there is no definitive OSHA requirement for wearing steel-toed safety shoes and was aware of the reluctance of some persons, especially ironworkers, to wear steel toed safety shoes. The Board found OSHA interpretations of 29 CFR 1926 that place the responsibility for determining appropriate PPE, such as foot protection, on the employer. The Board considered that the energy of the falling temporary hoisting beam and the position of the impact on the foreman's foot would have rendered steel-toed safety shoes ineffective protection.

## ***Feedback and Improvement***

### **Occurrence Reporting and Processing System (ORPS)**

Review of SNL ORPS reports for the period January 1, 2000 to March 3, 2003 revealed that there were two construction-related occurrences, both specific to crane use and not applicable to this accident.

### **Summit Construction Oversight**

Summit did not maintain records of construction safety inspections in accordance with Sandia Standard Specification 01065. During the Board's interview with Summit's general superintendent/company safety officer, he stated that Summit employs a safety inspection consultant on construction projects other than those for Sandia, but relies on Sandia's construction inspectors for onsite projects.

The Board concluded that Sandia did not ensure Summit's compliance with the weekly construction inspections requirement of Specification 01065.

### **Sandia Construction Oversight**

Review of Sandia's inspectors' logs for this job indicated that Sandia construction inspectors were present on the site daily. Although inspector' notes document operations, their notes contain limited discussion of the state of site safety. The construction observers and the Summit site superintendent stated that safety issues were brought informally to the attention of workers and foremen.

The Board reviewed the 1998 verification report of ISMS implementation at Sandia. The report stated that construction inspectors were using inspection forms to document their activity in

1998. This no-fault information was provided to the construction contractor and provided useful trending information for Sandia. At the time of the accident, the inspection form had been replaced by a Safety Deficiency Notice that was issued only when a significant deficiency was noted. No deficiencies had been issued to Summit and its subcontractors on this project prior to the accident. The Board believed that the negative and potentially punitive connotation of the Safety Deficiency Notice made it more difficult for construction safety observers to document safety and health deficiencies and still maintain an effective working relationship with the subcontractors.

Specification 01065 authorized the Sandia Construction Observer (SCO) to act as the official representative of Sandia for the specific purpose of accepting work in accordance with plans and specifications, coordination of access, scheduling of utility outages, crane inspections, ES&H observations, and securing of permits.

Specification 01065 authorized the Sandia Construction Safety Officer (CSO) to act as the official representative of Sandia for the specific purpose of review and observation of construction subcontractors' safety plans and performance.

Project personnel interviews indicated some confusion over whether primary construction oversight responsibility belonged to the CSO or the SCOs. Some people believe that the CSO acted as an as-needed consultant to project management and SCOs. Others believed that the CSO was primarily responsible for routine construction safety oversight.

The Board concluded that roles and responsibilities in Specification 01065 have not been clearly communicated to those engaged in construction project management. FMOC provided cost project information for facilities construction. FMOC reported that in FY02, facilities construction costs were \$72M and were projected to increase to nearly \$132M in FY04. With this magnitude of increase, it is paramount that expectations are fully understood by all construction-involved personnel to minimize wasted resources and maximize application of resources to the projects. Additionally, the Board agreed with the DOE Office of Oversight and Performance Assurance (OA) audit observation that manpower resources may not be sufficient to cover the future workload.

The Sandia-conducted, weekly progress meeting of March 3 included a discussion of fall protection deficiencies. These meetings were attended by project supervision and typically focused on project management issues, not worker safety.

FMOC conducted a management surveillance of this construction site on March 10, 2003. The Sandia Center 10800 Director was present during this surveillance. One corrective action was identified and corrected during this surveillance. Numerous observations were noted focusing on safety, but no additional corrective actions were identified.

### **CSO Feedback Activities**

On February 27, 2003, Sandia's CSO participated in Summit's safety meeting that reviewed 29 CFR 1926, Subpart R, *Steel Erection*. This review was conducted because of recent changes to the standard. The subject matter expert also provided information to SCOs on fall protection observations and questions regarding the associated section of Subpart R. This information was to assist SCOs in their oversight. Later, this information was provided to Summit. On a quarterly basis, Sandia provided quarterly construction safety seminars for its construction subcontractors. Past topics included penetration permits, waste management issues, and discussions and trending of recent occurrences.

## SSO Oversight

At the time of the accident, SSO was updating the procedures pertaining to programmatic oversight. There was no clear description of SSO roles and responsibilities for providing safety oversight of construction activities. Position descriptions of Realty Specialist (former title) and Project Manager (new title) were reviewed and compared. Both of these descriptions are, or were, applicable to the SSO Project Manager for this construction project. Affected SSO personnel received the new position description at the end of March, after the accident. The position description that was in place at the time of the accident provided limited direction on the conduct of safety oversight of construction projects. The new position description was clear on responsibilities for safety oversight of construction projects. SSO was also developing a plan to implement the requirements of the new position description.

SSO should verify that the safety requirements in the Project Manager's position description are properly implemented and documented. The Board found no records of safety inspections conducted by SSO personnel at construction sites prior to the accident, except for the Balance-of-Plant Facility Representative who solicited occasional SSO subject matter expert assistance.

The Board concluded that Sandia inspections were documented, but the content did not include safety-specific details and that SSO performed and documented infrequent inspections that did not include safety-specific details.

The Board concluded that SSO and Sandia had not clearly communicated construction safety oversight roles and responsibilities to their staffs.

**Note:** The Office of Audits and Assessments noted the issue of the delegation of responsibility during their January 2003 assessment of SSO and Sandia.

The Board concluded that Sandia Standard Specification 01065 did not meet the requirements established in the part of Contractor Requirements Document of DOE O 440.1A that addresses the feedback mechanism of construction safety inspections.

## CAUSAL ANALYSES

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### ***Barrier Analysis***

**Barrier analysis** reviews 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, such as equipment design or protective clothing, or elements of management, such as training and supervision. The Board's barrier analysis verified the information presented in the Events and Causal Factors Analysis and the Change Analysis and confirmed the Board's conclusions. The barrier analysis is not included in this report because it did not add significant information beyond that already presented.

### ***Change Analysis***

**Change analysis** is a systematic approach that examines planned or unplanned changes in a system that caused undesirable results related to the accident. The Board performed a change analysis to determine the changes or differences that may have been causal factors in this accident. An analysis of the changes and differences was performed to determine if they could be, directly or indirectly, factors in the accident.

<b>Prior, Ideal, or Occurrence Free Situation</b>	<b>Occurrence situation</b>	<b>Difference</b>	<b>Evaluation of Effect</b>
Temporary hoisting beam welded or clamped into place on the supporting structural beam.	Temporary hoisting beam was not fixed.	Temporary hoisting beam was free to move when the load shifted allowing the hoist, rigging, hoisting beam, and stair section to fall.	The temporary hoisting beam and stair section fell striking two workers.
The temporary hoisting beam is placed on dry, sufficiently wide bearing surfaces.	Surfaces were narrow and wet.	Climate and physical factors may have contributed to the slipping of the temporary hoisting beam on its supporting structural surfaces.	These conditions contributed to initiating the chain of events.
The lift is conducted using a crane or other means to avoid the obstructing column.	A chain fall was used that did not provide a means to move the load around the obstructing column.	Ironworkers' created excessive movements when manually moving the load past the obstructing column causing the temporary hoisting beam to fall into the stairwell opening.	The falling temporary hoisting beam struck foreman and the stair section struck the journeyman.
Chain fall manufacturer's operator manuals followed.	No manuals available.	There were no recommended procedures for installation of the chain fall.	Foreman could not have been certain that the chain fall was rigged in accordance with manufacturer's instructions.
Chain fall is inspected and in good working condition.	Chain fall had deficiencies while in use.  There was no record of the required annual chain fall inspection.	Defective chain fall was used during the activity.	Chain fall condition did not contribute to the accident, but presented an unsafe condition.

<b>Prior, Ideal, or Occurrence Free Situation</b>	<b>Occurrence situation</b>	<b>Difference</b>	<b>Evaluation of Effect</b>
There is visual communications between foreman and other ironworkers during hoisting activity.	Foreman was on second floor while others were on the ground level out of his sight.	The three workers were pulling without a coordinated effort.	Excessive movements shifted hoisting beam off its supporting structural beams.
The contractor implements hoisting and rigging requirements.	Contractor did not follow all of the requirements of 29 CFR 1926 (e.g., equipment inspections, equipment use).	All requirements not followed for hoisting and rigging practices (e.g., tugging on load lines, offset lift).	Practices did not prevent the fall of the hoisting beam and stair section that struck the workers.
Task analysis is performed to identify all potential hazards associated with the hoisting activity.	Informal task-specific hazards analysis performed.	Potential hoisting, rigging, and load hazards were not identified.	Unidentified hazards resulted in the hoisting beam and stair section falling and injuring the workers.
ISMS management system core functions and guiding principle are implemented at subcontractor level.	Std. Spec. 01065 required that ISMS be implemented on the construction site, but expectations were vague.	SSO and Sandia have differing expectation of the level of ISMS implementation by subcontractors.	Subcontractor hazard identification and performance of work failed to identify all hazards and controls appropriate to this task.
General contractor performs safety inspections per Std. Spec 01065.	Inspections may have been performed, but were not documented.  (Informal walk arounds do not meet the intent of Std. Spec. 01065.)	Data is not available to identify trends or the evolution of unsafe work practices.  Some unsafe practices may not have been detected or corrected.	Unsafe practices evolved on the work site.

Prior, Ideal, or Occurrence Free Situation	Occurrence situation	Difference	Evaluation of Effect
Sandia and SSO perform and document comprehensive construction safety management oversight.	Sandia inspections are documented, but the content does not include safety-specific details.  SSO performed infrequent inspections. Those that are performed and documented do not include safety-specific details.	Data is not available to identify trends or the evolution of unsafe work practices.  Some unsafe practices may not have been detected or corrected.	Unsafe practices evolved on the work site.
South stairs were installed without accident using similar equipment and practices.	North stairs installation resulted in an accident.	The south stairs did not have an obstructing structural column.	Obstructing column contributed to the accident.

## ***Events and Causal Factors Analysis***

Events and causal factors (ECF) analysis charts the logical sequence of events and conditions (causal factors) that allowed the event to occur, and employs deductive reasoning to determine events and conditions that contributed to the accident (see Attachment 3).

### ***Causal Factors Analysis***

A **causal factor** is an event or condition in the accident sequence that produces or contributes to the occurrence of the accident. There are three types of causal factors:

1. *Direct cause*, the immediate event(s) or condition(s) that caused the accident.
2. *Root cause(s)*, the causal factor(s) that, if corrected, would prevent recurrence of the same accident or similar accidents.
3. *Contributing causes*, factors that collectively with other causes increase the likelihood of an accident, but that individually did not cause the accident.

The **direct cause** of the accident was the temporary hoisting beam falling from its rooftop supporting structural beams into the stairwell opening, striking a worker, and dropping the stair-section load injuring another worker.

The **root cause** of the accident was that installation of the temporary hoisting beam and the movement of the load during the lift were not performed in accordance with the requirements of 29 CFR 1926.

### **Contributing causes of the accident were:**

- Sandia did not clearly communicate their expectations to Summit for the conduct and content of safety meetings.
- Sandia Standard Specification 01065 required weekly inspections by the subcontractor, not daily inspections as required in the Contractor Requirements Document of DOE O 440.1A. Sandia did not ensure Summit's compliance with the weekly construction inspections requirement of Specification 01065.
- Sandia did not fully define and communicate its expectations regarding task-specific hazards analysis to subcontractors.
- Roles and responsibilities in Specification 01065 were not clearly communicated to those engaged in project management.
- Sandia inspections were documented, but the content did not include safety-specific details.
- Sandia had not clearly communicated construction safety oversight roles and responsibilities to their staffs.
- SSO performed and documented infrequent inspections that did not include safety-specific details.
- SSO had not clearly communicated construction safety oversight roles and responsibilities to their staffs.

## **CONCLUSIONS AND JUDGMENTS OF NEED**

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This section identifies the conclusions and judgments of need that were determined by the Board as a result of using accident analysis methods. Conclusions of the Board are factors that were considered significant and are based upon 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 of a recurrence of this type of accident or to mitigate the severity of a similar accident. Judgments of need flow from the conclusions and causal factors and are provided to guide managers when developing their corrective actions. The following table lists the causal factors and the corresponding judgments of need identified by the Board.

Conclusions	Judgments of Need
Std. Spec. 01065 did not clearly communicate to Summit Sandia's expectations for the conduct or content of safety meetings.	<p>Sandia needs to ensure that subcontractors more fully implement the provisions in Std. Spec 01065 in the following areas:</p> <ul style="list-style-type: none"> <li>• Task-specific hazards analysis.</li> <li>• Effective safety meetings that communicate activity-specific hazards analysis and controls to workers</li> <li>• Jobsite safety inspections focused on compliance with 29 CFR 1926 and at frequencies specified in DOE O 440.1A.</li> <li>• Verification (frequency, scope, documentation) of safety practices at this and similar construction work sites.</li> </ul>
If the ironworker crew discussion on the morning of the accident included possible hazards that might be encountered on the upcoming activity, it did not identify effective controls (e.g., securing the temporary hoisting beam).	
Sandia did not fully define and communicate its expectations regarding task-specific hazards analysis to subcontractors.	
The level of hazards identification required by Std. Spec. 01065 allowed Summit flexibility to analyze hazards consistent with the complexity of the job.	
Sandia Standard Specification 01065 required weekly inspections by the subcontractor, not daily inspections as required in the Contractor Requirements Document of DOE O 440.1A. Sandia did not ensure Summit's compliance with the weekly construction inspections requirement of Specification 01065.	
Roles and responsibilities in Specification 01065 had not been clearly communicated to those engaged in project management.	<p>Sandia needs to ensure that the construction safety and project management more clearly understand and implement the provisions in Std. Spec 01065 in the following areas:</p> <ul style="list-style-type: none"> <li>• Subcontractors perform task-specific hazards analysis.</li> <li>• Subcontractors conduct effective safety meetings that communicate activity-specific hazards analysis and controls to workers.</li> <li>• Subcontractors perform jobsite safety inspections focused on compliance with 29 CFR 1926 and at frequencies specified in DOE O 440.1A.</li> </ul>
Sandia inspections were documented, but the content did not include safety-specific details.	
Sandia had not clearly communicated construction safety oversight roles and responsibilities to staff members.	



Conclusions	Judgments of Need
SSO performed and documented infrequent inspections that did not include safety-specific details.	SSO needs to establish clear roles and responsibilities concerning construction safety management in the areas of: <ul style="list-style-type: none"> <li>• Task-specific hazards analysis.</li> <li>• Effective safety meetings that communicate activity-specific hazards analysis and controls to workers.</li> <li>• Jobsite safety inspections focused on compliance with 29 CFR 1926 and at frequencies specified in DOE O 440.1A.</li> <li>• Verification (frequency, scope, documentation) of safety practices at this and similar construction work sites.</li> </ul>
SSO had not clearly communicated construction safety oversight roles and responsibilities to staff members.	
Sandia could have exhibited a higher level of investigative readiness, particularly in the areas of evidence preservation and timely acquisition of witness statements. These deficiencies did not affect the ultimate outcome of this investigation. In other accidents, evidence preservation may be of paramount importance	Sandia needs to enhance its accident scene preservation practices to be consistent guidance provided by DOE G 225.1-1.

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## **APPENDIX A – APPOINTMENT MEMO**

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United States Government

Department of Energy

# memorandum

National Nuclear Security Administration  
Sandia Site Office

DATE: MAR 27 2003  
REPLY TO: SSO  
SUBJECT: Establishment of a Type B Accident Investigation Board  
TO: Dr. C. Paul Robinson, President, Sandia National Laboratories, MS 0101

I hereby establish a Type B Accident Investigation Board to investigate the accident which occurred at the SNL/NM Building 752 construction site on March 20, 2003. I have determined it meets the requirements established for a Type B accident investigation in DOE O 225.1A, Accident Investigations, dated September 29, 1997.

I appoint Marcus Hayes of the NNSA/Service Center's Environment, Safety, and Health Division (NNSA/SC/ESHD) as the accident board chairperson. The Board will include:

Board Member, Jerry Lipsky, Los Alamos Site Office (LASO)  
Board Member, Issac Valdez, NNSA Office of Secure Transportation (OST)  
Board Member, Ralph Fevig, Sandia Site Office/Oversight & Assessment (SSO/OA)  
Administrative Support, Arminda Roberts, NNSA/SC Independent Safety Review Division (ISR)  
Technical Writer, Dan Nestor, Sandia National Laboratories/NM (SNL)

You may assign a member of your staff who is independent of the affected organizations to serve as an observer to this process. The Board will be assisted by advisors and consultants and by other support personnel as determined by the chairperson.

The scope of the Board's investigation will include but is not limited to:

- identifying all relevant facts; analyzing the facts to determine the 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 O 225.1A and will specifically address the role of SSO and SNL organizations and management systems as they may have contributed to the accident. The application of lessons learned from similar accidents within the Department will be reviewed also.

The Board will provide my office with daily reports on the status of the investigation, but will not include any conclusions until an analysis of all the causal factors has been completed. Draft copies of the factual portion of the investigation report will be submitted to SSO and SNL for a factual accuracy review prior to report finalization.

MAR 27 2003

The report should be provided to me for acceptance within 30 calendar days from the date of this memorandum. Discussions of the investigation and copies of the draft report will be controlled until I authorize release of the final report.

Should you have any questions on the establishment of this Board, please call me at 845-6036.



Karen L. Boardman  
Manager

cc:

B. Cook, EH-1  
D. Stadler, EH-2  
C. Lagdon, EH-21  
D. Vernon, EH-21  
J. Mangeno, NA-1  
R. Crowe, NZ  
D. Blanton, SNL, MS 0186  
M. Hayes, NNSA/SC/ESHD  
R. Fevig, SSO/OA  
J. Lipsky, LASO  
I. Valdez, NNSA OST  
A. Roberts, NNSA/SC/ISR  
C. Soden, NNSA/SC/ESHD  
A. Trujillo, SSO/OA  
F. Bell, LASO  
R. Baca, NNSA OST  
J. Nevarez, NNSA/SC/ISR  
A. Montoya, SNL, MS 1090

## **APPENDIX B – FIGURES 1-3**

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Figure 1 – Composite Isometric, Structural Framing With Rigging Elements

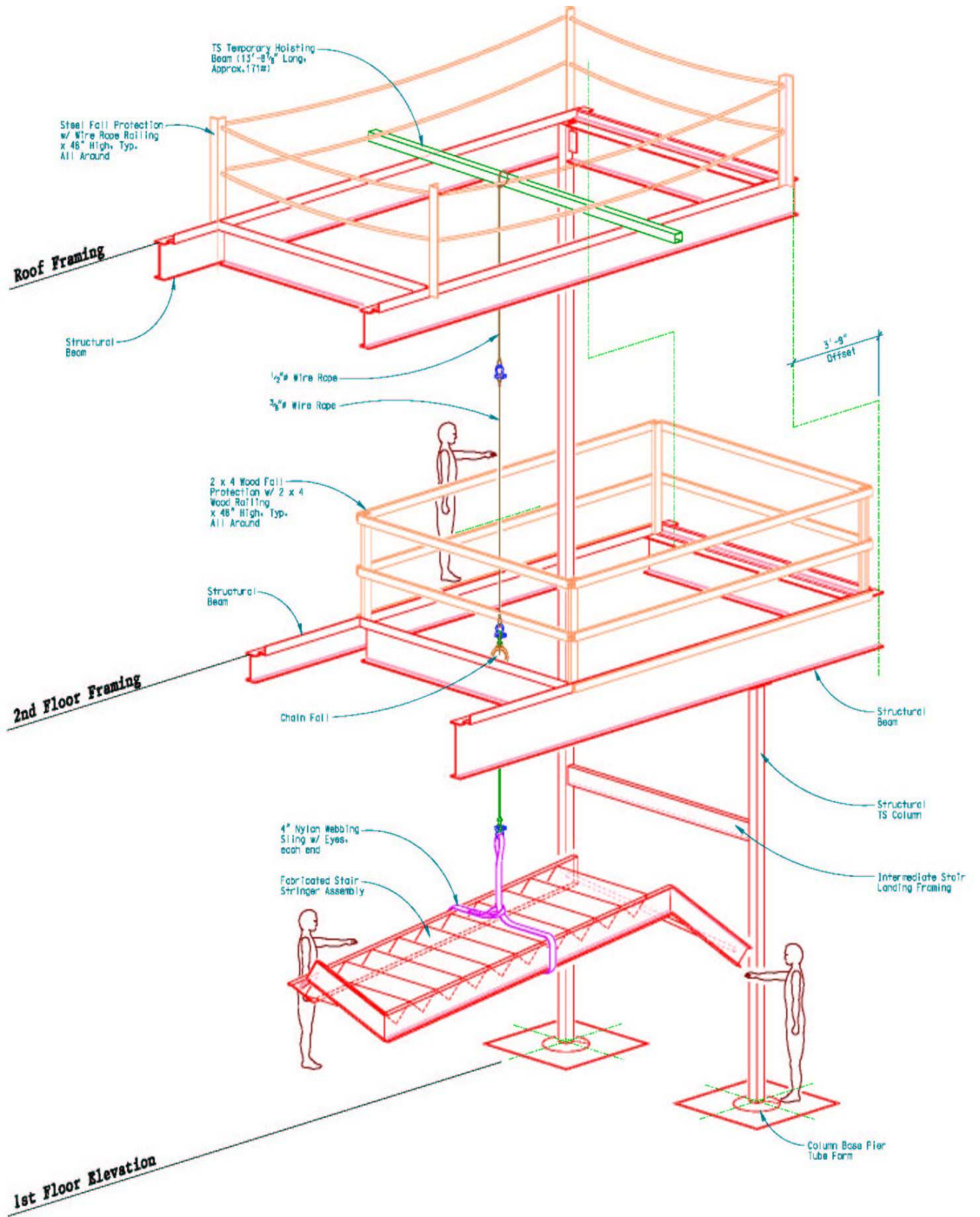


Figure2 – Temporary Hoisting Beam  
(At Roof Elevation)

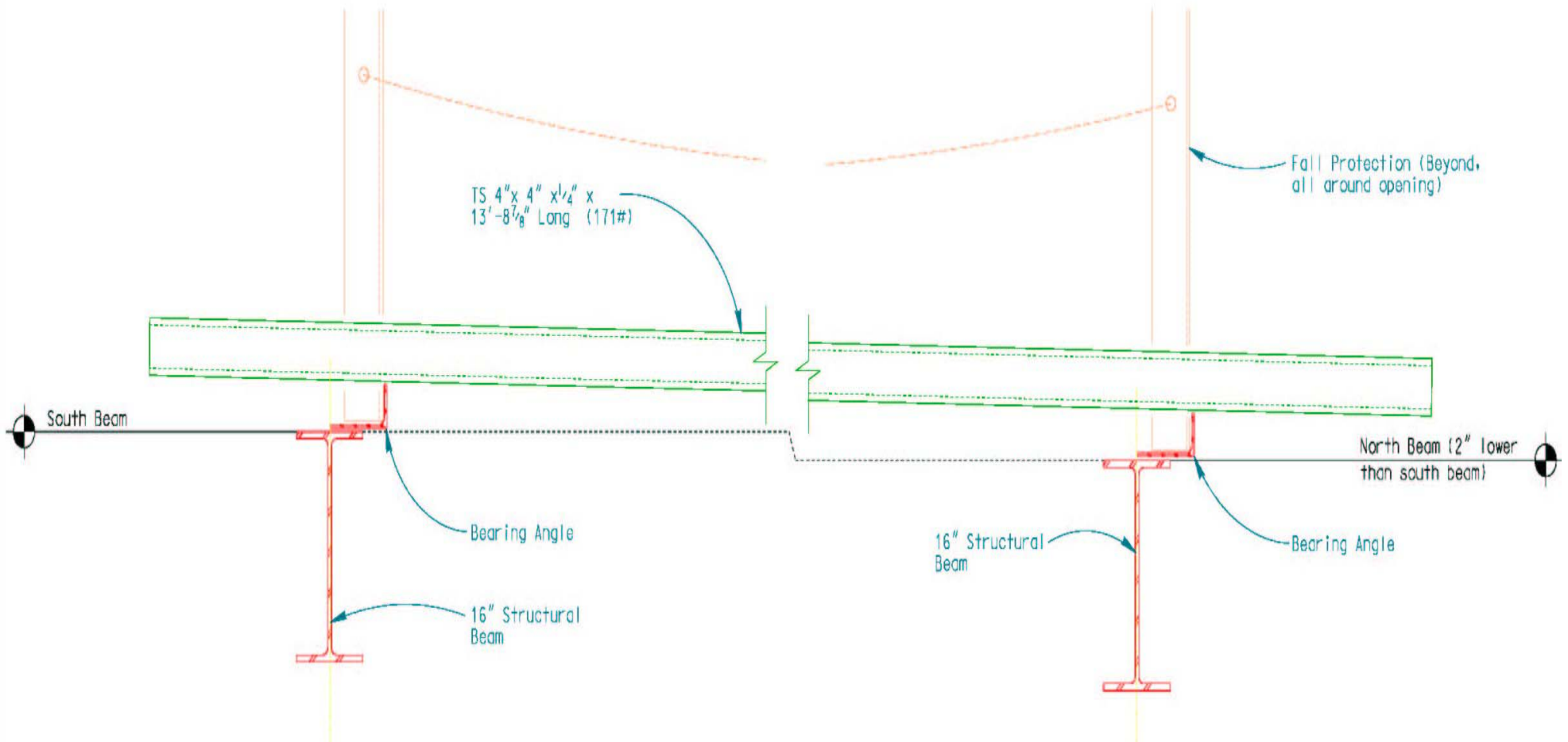
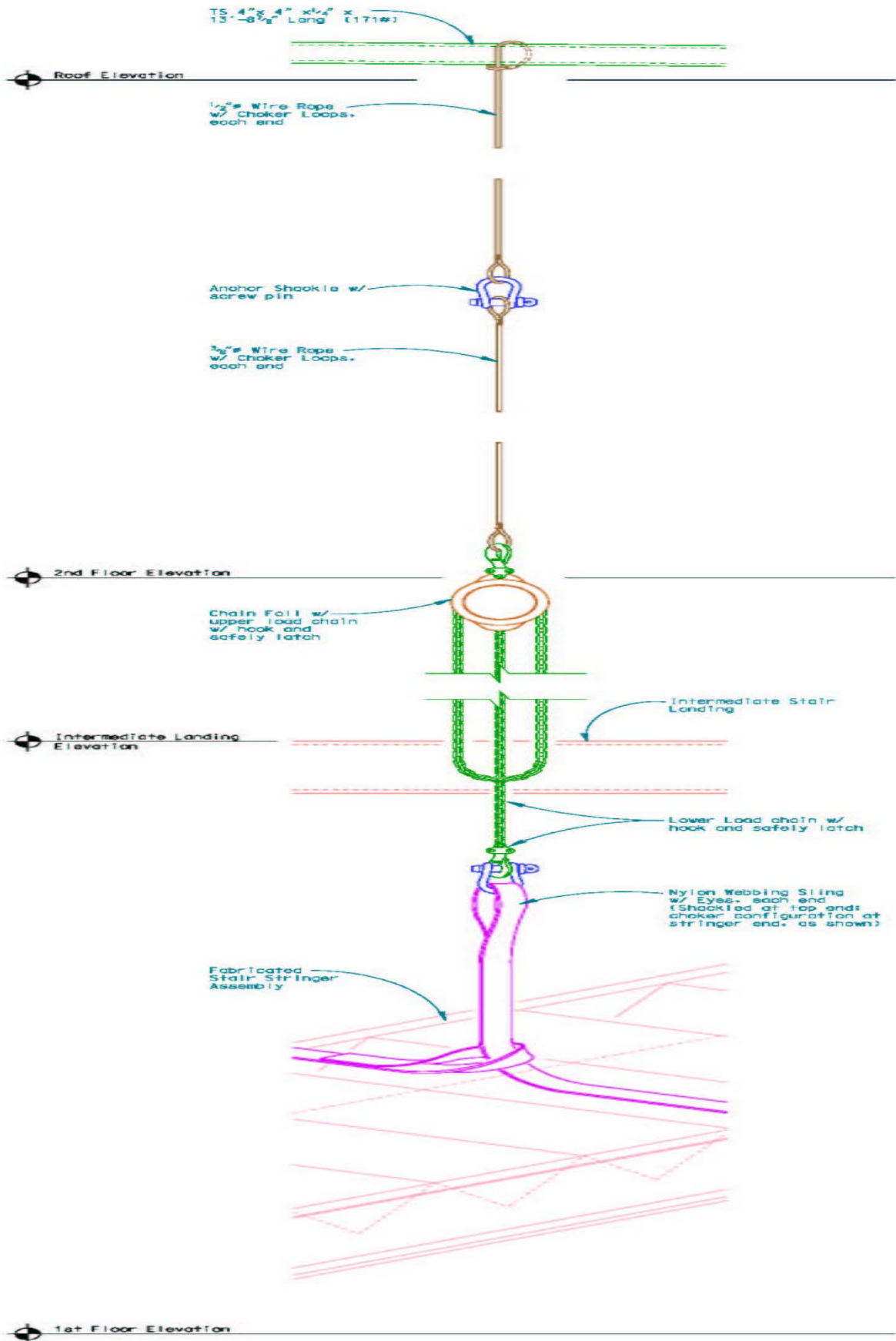


Figure 3 – Rigging Sequence



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## **APPENDIX C - EVENTS AND CAUSAL FACTORS (ECF) ANALYSIS**

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# LEGEND



Event



Condition



Accident



Causal Factor

