Office of Environment, Safety and Health

Type A Accident Investigation

Subcontractor Fatality at the Pond B Dam Upgrade Project

on July 26, 2004

at the

Savannah River Site

Aiken, South Carolina

September 2004

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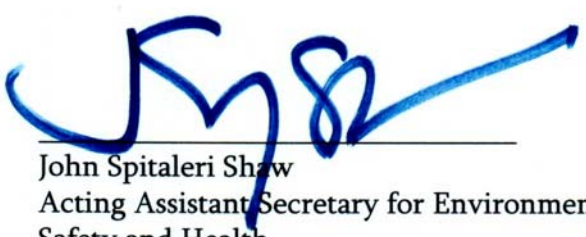
Figures and Tables

Release Authorization

On July 28, 2004, I appointed a Type A Accident Investigation Board (Board) to investigate the July 26, 2004, subcontractor fatality that occurred at the Savannah River Site Pond B Dam. The Board's responsibilities have been completed with respect to this investigation. The analyses and the identification of the contributing causes, the root cause, and the Judgments of Need resulting from this investigation were performed in accordance with DOE Order 225.1A, *Accident Investigations*.

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



John Spitaleri Shaw
Acting Assistant Secretary for Environment,
Safety and Health
U.S. Department of Energy

Date

This report is an independent product of the Type A Accident Investigation Board appointed by John Spitaleri Shaw, Acting Assistant Secretary, Environment, Safety and Health, U.S. Department of Energy.

The Board was appointed to perform a Type A 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 the report do not assume, and are not intended to establish, the existence of any duty at law on the part of the U.S. Government, its employees or agents, contractors, their employees or agents, or subcontractors at any tier, or any other party.

This report neither determines nor implies liability.

ACRONYMS

AHA	Automated Hazard Analysis
Board	Type A Accident Investigation Board
BNFL	British Nuclear Fuels, Limited
BSRI	Bechtel Savannah River, Incorporated
CFR	Code of Federal Regulations
DAR	Daily Activity Report
DEAR	Department of Energy Acquisition Regulation
DOE	Department of Energy
EMS	Emergency Management Services
EMR	Experience Modification Rate
ES&H	Environment, Safety and Health
ES&HP	Environment, Safety and Health Provisions
FEB	Facility Evaluation Board
FERC	Federal Energy Regulatory Commission
FRAP	Functions, Responsibilities, and Authorities Procedure
FSSBU	Field Support Services Business Unit
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
MCG	Medical College of Georgia
METRAC	Metropolitan Tractor Company
OA	Office of Independent Oversight and Performance Assurance
OBU	Operations Business Unit
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration
OSS	Office of Site Services
PVC	Polyvinyl chloride
RFP	Request for Proposal
SR	Savannah River Operations Office
SRS	Savannah River Site
SRSOC	Savannah River Site Operations Center
STARRT	Safety Task Assignment Risk Reduction Talk
STR	Subcontract Technical Representative
TRC	Total Recordable Case
TSP	Task-Specific Plan
WPP	Worker Protection Plan
WSI/SRS	Wackenhut Services, Incorporated/Savannah River
WSRC	Westinghouse Savannah River Company, LLC

Executive Summary

The Accident

On July 26, 2004, at approximately 3:15 p.m., a truck driver (driver) was critically injured at the Savannah River Site, while loading a rented excavator onto a lowboy trailer for return to the rental company. The accident occurred when a teamster from GradeSouth, Inc., a construction sub-tier contractor, and a truck driver from Guthrie Grading and Hauling attempted to reposition an outrigger plank on the lowboy trailer. The plank had become dislodged when the excavator was being positioned on the trailer. The teamster used the excavator's boom to lift one of the excavator tracks off the trailer so that the driver could reposition the plank under the track. The excavator dropped (moved) while the driver was repositioning the plank, and the driver suffered critical and subsequently fatal injuries. The direct cause of the fatality was crushing injuries resulting from movement of the excavator during loading operations.

On July 28, 2004, the Acting Assistant Secretary for Environment, Safety and Health appointed a Type A Accident Investigation Board (Board) to analyze causal factors, identify root causes, and determine Judgments of Need to preclude similar accidents in the future. The Chairman and some Members of the Board arrived at the Savannah River Site July 28, 2004, and the full Board convened onsite on August 2, 2004. The Board completed the investigation on September 1, 2004.

Background

The Savannah River Site is located approximately 25 miles southeast of Augusta, Georgia and 22 miles south of Aiken, South Carolina. With the exception of facilities operated for the National Nuclear Security Administration, many of the original production facilities within the site are being decommissioned, and major waste treatment and management activities associated with that effort are conducted under the cognizance of the U.S. Department of Energy's (DOE) Office of Environmental Management. Local DOE management is provided by the DOE-Savannah River Operations Office (DOE-SR).

In December 2003, Bechtel Savannah River, Inc. (BSRI) awarded a construction subcontract to GradeSouth, Inc., to make necessary repairs to the Savannah River Site's Pond B Dam to bring the dam into compliance with guidelines issued by the Federal Energy Regulatory Commission. Part of the work GradeSouth performed required the use of a rented excavator. The deceased driver was an employee of Guthrie Grading and Hauling, which had been hired to return the excavator to the rental company, Metropolitan Tractor. The driver's fatal injuries occurred at the Pond B Dam Upgrade Project during the final phases of the project.

Results and Analysis

The Board conducted numerous interviews, reviewed relevant documents, and had elements of the excavator's performance evaluated (tested). Results from these efforts were used to perform a causal factors analysis in accordance with the DOE Workbook, *Conducting Accident Investigations*. Causal factors are events or conditions that produced or contributed to the occurrence of the accident and consist of root, direct, and contributing causes.

The root cause of the accident is the fundamental cause that, if corrected, would

prevent reoccurrence of this and similar accidents. The direct cause is the immediate event or condition that caused the incident. Contributing causes are events or conditions that, collectively with the other causes, increase the likelihood of the accident but individually did not cause the accident.

The Board concluded that the following are the root causes of the accident that should be corrected to prevent similar events from occurring.

- DOE, WSRC and BSRI were inattentive to programmatic deficiencies in the communication and implementation of safety requirements for subcontracted construction work at the Pond B Dam Project.
- The subcontractors' unstructured approach to work did not ensure that safety and health requirements were translated into work controls, did not take those actions necessary to enforce compliance with fundamental safety requirements during the work, nor did they define their safety and health expectations for the activity prior to work.
- WSRC failed to fully address the causal factors for previous operational occurrences through the corrective action processes at the site.

The Board further determined that the direct causes of the accident resulting in the excavator falling onto the driver are as follows:

- The driver was working under or near the excavator.
- The GradeSouth teamster was not qualified to operate the excavator.
- GradeSouth failed to exercise control over its employee and vendor.
- Stop-work authority was not effectively utilized.

The Board also identified contributing causes and conclusions related to this accident. Based on those conclusions, the Board determined the appropriate Judgments of Need in responding to this accident. Judgments of Need are managerial controls and safety measures necessary to prevent or minimize the probability or severity of a recurrence. They are also directed at guiding managers in developing corrective measures. Table ES-1 summarizes the Board's conclusions and Judgments of Need.

Summary

The Accident Investigation Board concluded that this accident was preventable. The Board identified weaknesses in the site's implementation of integrated safety management policy through work practices as it relates to the subcontractor and vendors performing work at the Pond B Dam Upgrade Project. WSRC did not ensure that the subcontractor met basic requirements imposed by the Department, the site, and the Occupational Safety and Health Administration. Although internal and external oversight activities and a series of operational occurrences identified construction safety-related issues and concerns with similar systemic causes, a lack of rigorous causal analysis prevented identification of lessons-learned and systemic weaknesses and implementation of effective corrective actions.

The DOE-SR and WSRC need to intensify their efforts and commitment to ensure that all the elements associated with ISM are promptly and effectively addressed for all construction subcontractors and sub-tier contractors and vendors to prevent additional accidents.

Table ES-1. Causal Factors and Judgments of Need

Conclusions	Judgments of Need
The driver placed himself in an unsafe position under a suspended load in order to adjust the plank. The teamster was not qualified to operate the excavator. There were a number of opportunities to utilize stop work and it was not exercised. Grade South failed to ensure that the heavy equipment operations were conducted by qualified operators. In the configuration that the teamster was using to lift the excavator track, the leak in the hydraulic line to the arm cylinder contributed to the accident.	WSRC needs to make sure that construction subcontractors' and vendors' worker protection program flows down the site requirements and integrated safety management systems and principles to the worker and with emphasis on the importance and need for workers' stop work authority, qualified and competent workers, and safe operation of construction equipment.
GradeSouth failed to provide control and oversight of their activities at the Pond B Dam Upgrade Project BSRI failed to provide sufficiently detailed guidance for developing a task-level hazards analysis, and safety oversight failed to identify the weaknesses of the hazards analysis. Both hazards analyses — the TSP and AHA — for the Pond B Dam Upgrade Project failed to adequately address the full scope of work (i.e., demobilization) or identify hazards at a task or activity level, including the loading and unloading of heavy equipment.	WSRC needs to make sure that hazards are identified and that controls are developed and implemented at the task level for all subcontractors on site.
GradeSouth failed to provide control and oversight of their activities at the Pond B Dam Upgrade Project WSRC and BSRI oversight activities were not effective in ensuring that subcontractor safety issues were adequately identified and resolved.	WSRC and BSRI need to make sure that subcontractor safety issues are adequately identified and resolved.
WSRC failed to fully address the causal factors for previous operational occurrences reported through the corrective action processes in place at the site. Effective recurrence controls for identified deficiencies were not established.	WSRC, BSRI, DOE-SR needs to improve their lessons learned program to evaluate precursor activities and implement effective corrective actions.
BSRI imposed additional, and sometimes conflicting, requirements on GradeSouth over and above those in the contract.	BSRI needs to review their subcontracting controls to ensure that all applicable ES&H requirements are contained in the contract.
The current DOE-SR FRAP does not clearly define roles and responsibilities for activities related to ES&H oversight of construction projects. DOE-SR provided no direct oversight of subcontractor construction activities on the Pond B Dam Upgrade Project.	DOE-SR needs to provide oversight of the WSRC and BSRI construction subcontractors and ensure the roles and responsibilities for oversight of WSRC and BSRI construction subcontracting are established in the DOE-SR FRAP.
Emergency Management Response was hampered by the lack of an accurate description of the incident due to poor communications. GradeSouth failed to meet the requirements established by WSRC for the Remote Worker Notification program.	WSRC needs to make sure that the Remote Worker Notification program is effectively implemented by all affected organizations to ensure that workers have direct access to a reliable means of communication with SRSOC. This includes ensuring all personnel on site that may be potentially remote workers are aware of the requirements of the program and understand when and how to effectively communicate emergency response with SRSOC.

Table ES-1. Causal Factors and Judgments of Need (continued)

Conclusions	Judgments of Need
The EMS responders did not precisely follow the approved SRS Medical Protocols for trauma transport. MEDEVAC could have decreased transport time to the Medical College of Georgia by thirty minutes or more.	WSRC needs to conduct a comprehensive review with all medical responders to ensure they are able to implement the requirements and guidance in the protocol. The technical capabilities and limitations of the WSI MEDEVAC helicopter needs to be clarified for all applicable emergency response personnel including physicians, emergency medical technicians, emergency dispatchers and emergency response supervisory personnel.
The Board concludes that the actions taken by DOE-SR, WSRC, and WSI/SRS were effective in preserving the accident scene.	
The Board concludes that WSRC/BSRI line management roles and responsibilities for ensuring safe execution of the project were established.	
The Board concludes that the line management roles and responsibilities for the GradeSouth personnel were clearly documented and understood.	
The Board concludes that the subcontract for the Pond B Dam Upgrade Project was adequate in that ISM and worker protection requirements were included.	

1.0 Introduction

1.1 Background

On July 26, 2004, at the Savannah River Site (SRS) Pond B Dam, a truck driver suffered fatal injuries when he was crushed by an excavator. On July 28, 2004, John Spitaleri Shaw, Acting Assistant Secretary for Environment, Safety and Health, U.S. Department of Energy (DOE), appointed a Type A Accident Investigation Board (Board) to investigate the accident in accordance with DOE Order 225.1A, *Accident Investigations* (see Appendix A for appointment memorandum).

1.2 Facility Description

1.2.1 Savannah River Site

Savannah River Site covers 310 square miles, encompassing parts of Aiken, Barnwell, and Allendale Counties in South Carolina, bordering the Savannah River. The site is located approximately 25 miles southeast of Augusta, Georgia, and 22 miles south of Aiken, South Carolina. Many of the original production facilities within the site are being decommissioned. Major waste treatment and management activities associated with that effort are conducted under the cognizance of the DOE Office of Environmental Management (EM), with local DOE management provided by the Savannah River Operations Office (DOE-SR). Also located within the site are operating facilities associated with tritium processing and handling under the cognizance of the National Nuclear Security Administration.

The site is operated by an integrated team led by Westinghouse Savannah River Company, LLC (WSRC), which is responsible for the site's nuclear facility operations, environment, safety, and health (ES&H), and quality assurance; all site administrative functions; and the Savannah River National Laboratory. Major subcontractors to WSRC include Bechtel Savannah River, Incorporated (BSRI), which is responsible for environmental restoration, project management, and engineering and construction activities; British Nuclear Fuels, Limited Savannah River Corporation, which is responsible for the site's solid waste program; CH2 Savannah River Company, which is responsible for decommissioning and demolition; and Polestar Savannah River Company, which provides the services of the Chief Closure Officer. Security, protective services and special response capability are provided by Wackenhut Services, Incorporated/ Savannah River Site (WSI/SRS).

1.2.2 Pond B Dam

Figure 1-1 shows an aerial view of Pond B. The Pond B Dam, the scene of this accident, was constructed in 1960 as a simple earthen dam with a sandy-toe drain system that was typical of that period. The dam is operated and maintained using the Federal Energy Regulatory Commission (FERC) guidelines as set forth under Title 18 Code of Federal Regulations (CFR) Part 12, *Safety of Water Power Projects and Project Works*. WSRC and FERC inspections confirmed that the pre-repair state of the Pond B structure did not comply with FERC guidelines and required repair. A fixed-price construction contract was awarded to and executed by GradeSouth, Inc., a sister company to Beam's Contracting. The scope of the Pond B Upgrade Project included the installation of a filter and drainage system consisting of coarse gradation sand, fine gradation sand, and a compacted-earth fill berm; installation of a rock riprap collection ditch; installation and removal of a temporary sediment basin; and installation of four piezometers. At the time of the accident, GradeSouth was completing punchlist activities

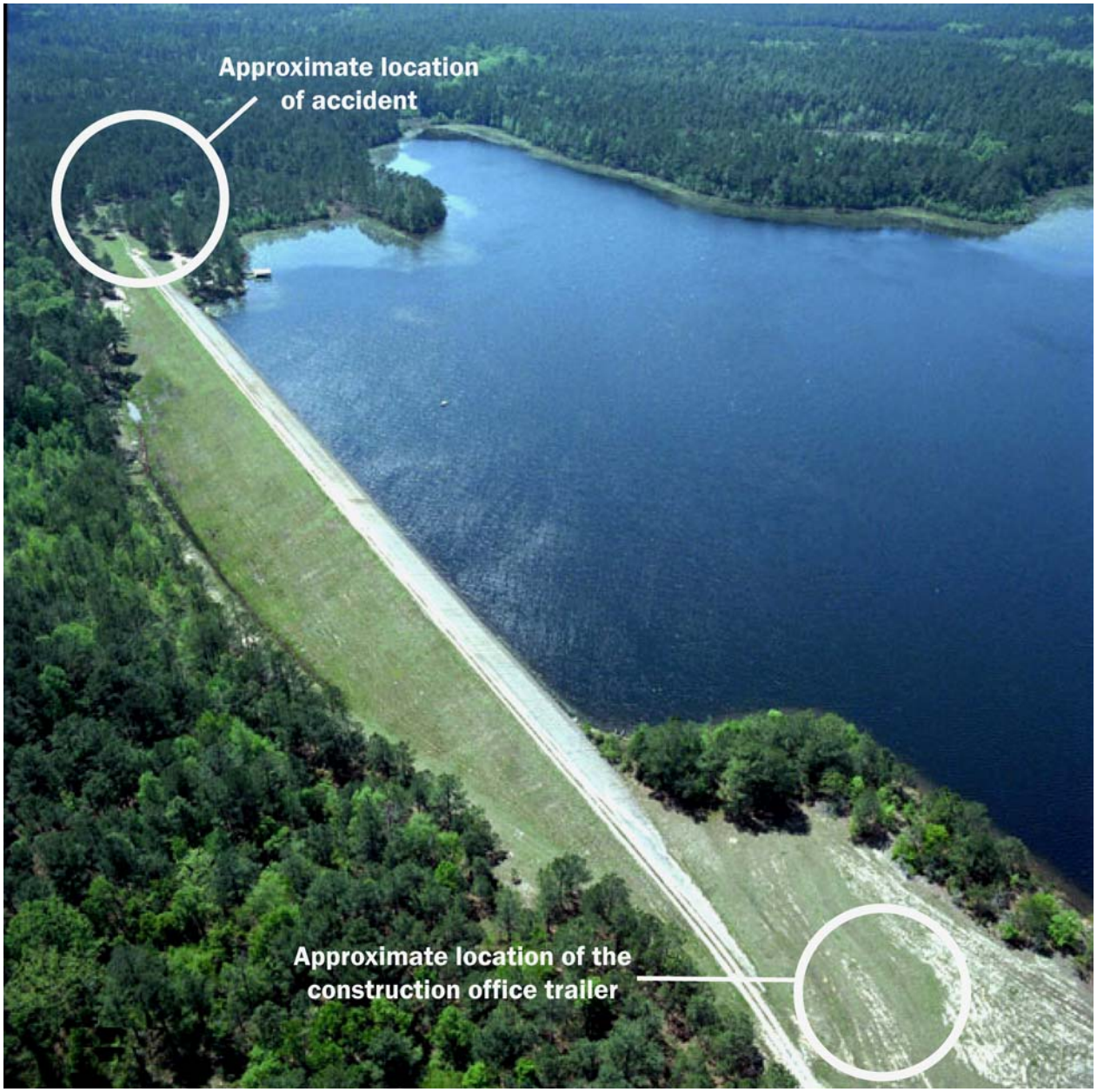


Figure 1-1. South end of Pond B Dam

after receiving a Certificate of Mechanical Completion from BSRI on June 23, 2004. These activities included excavation and earth-moving work.

1.3 Scope, Conduct, and Methodology

The Board began its activities on July 29, 2004, and completed its investigation on September 1, 2004. The scope of the Board's investigation was to identify and analyze all relevant facts to determine the direct, contributing, and root causes of the event; to develop conclusions; and to determine Judgments of Need that, when

implemented, should prevent recurrence. See Figure 1-2 for an explanation of accident investigation terminology.

The Board conducted its investigation in accordance with DOE Order 225.1A, *Accident Investigations*, using the following methodology:

- The Board gathered relevant facts through interviews and by reviewing documents and evidence.
- The Board inspected the accident scene, tested equipment, conducted an engineering analysis, and reviewed photographs of the scene.
- The Board identified causal factors using event and causal factor analysis, barrier analysis, and change analysis.
- Using these causal factors, the Board developed Judgments of Need for corrective actions to prevent recurrence.

A **causal factor** is an event or condition in the accident sequence that contributes to the unwanted result. There are three types of causal factors: **direct cause**, which is the immediate event or condition that caused the accident; **root cause**, which is the causal factor that, if corrected, would prevent recurrence of the accident; and the **contributing causes**, which are the causal factors that collectively, with the other causes, increase the likelihood of an accident but that did not cause the accident.

Event and causal factors analysis includes charting, which depicts the logical sequence of events and conditions (causal factors that allowed the accident to occur) and the use of deductive reasoning to determine the events or conditions that contributed to the accident.

Barrier analysis reviews the hazards, the targets (people or objects) of the hazards, and the controls or barriers that management systems put in place to separate the hazards from the targets. Barriers may be physical or administrative.

Change analysis is a systematic approach that examines planned or unplanned changes in a system that caused the undesirable results related to the accident.

Figure 1-2. Accident investigation terminology

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2.0 The Accident

2.1 Background and Accident Description

2.1.1 Accident Overview

On the afternoon of July 26, 2004, a GradeSouth teamster employee and a truck driver from Guthrie Grading and Hauling, Inc. (Guthrie) were loading a John Deere Model 790E-LC excavator onto a lowboy trailer. The accident occurred at approximately 3:15 p.m. as the teamster and driver attempted to reposition an outrigger plank on the lowboy trailer that became dislodged while the excavator was being positioned on the lowboy. The teamster used the excavator's boom to lift one of the excavator tracks off the lowboy trailer so that the driver could reposition the plank under the track. As the driver was repositioning the plank, the excavator dropped (moved), critically injuring the driver. Figure 2-1 shows the position of the excavator and lowboy immediately following the accident.

2.1.2 Background

On August 15, 2003, BSRI sent a Request for Proposal (RFP) for the Pond B Dam Upgrade Project to four construction contractors. The scope of work included soil excavating and trenching, earth filling, installing polyvinyl chloride (PVC) drainage pipes, and setting precast reinforced-concrete manholes and weir boxes. It also included drilling monitoring wells and setting piezometers and monitoring well components. This work involved operating

Figure 2-1. The accident scene

heavy earthmoving equipment and drilling rigs and performing rigging activities at a remote onsite location.

Of the four contractors, GradeSouth was the only prospective bidder to respond to the RFP. The company had previously worked at SRS with demonstrated safety performance for three years, based on the Minimum Performance Eligibility Factors of the RFP. These factors included an Experience Modification Rate (EMR) of 1.0 or less and a Total Recordable Case (TRC) rate of 7.9 or less. In December 2003, GradeSouth was awarded a fixed-price construction contract to execute the work at the Pond B Dam and started mobilization activities. BSRI issued a Notice to Proceed on January 7, 2004. After completion of a pre-job briefing, GradeSouth started construction work the week of January 19, 2004.

During the execution of the project, two incidents occurred. On February 19, 2004, a GradeSouth employee bent a drill auger when he rotated the equipment boom while the auger was still in the hole. The operator believes he may have blacked out due to a medical condition that was not previously disclosed to GradeSouth. On April 23, 2004, BSRI issued a safety citation to GradeSouth for an incident in which a GradeSouth driver overturned a dump truck equipped with a 1,000-gallon, skid-mounted water tank while backing onto an adjacent slope to make a turn. The dump truck and water tank were being used to wet down a road for dust control, and the tank had not been secured to prevent lateral shifting within the body of the dump truck.

On June 23, 2004, BSRI issued a Certification of Mechanical Completion, with a punchlist of items to be completed, to GradeSouth for the Pond B Dam Upgrade Project. As one of the punchlist items, GradeSouth had to rework the sediment pond and needed a long-boom excavator to reach across the pond while on level ground. GradeSouth's vendor, Metropolitan Tractor Company (METRAC), delivered the excavator to the project site on July 15. A qualified operating engineer from GradeSouth unloaded the excavator. The METRAC driver informed the operating engineer that the excavator had a hydraulic leak. GradeSouth repaired the leak by tightening hydraulic line fittings. On July 19, while using the excavator to load a dump truck, the operating engineer noticed that it was losing hydraulic pressure and that the boom gradually lowered into the truck bed. After adding about 5 gallons of hydraulic fluid, the operating engineer completed the fieldwork that required the long-boom excavator. The following day, a GradeSouth mechanic made repairs that included replacing an O-ring on a hydraulic line to the operating cylinder for the arm and tested the excavator to confirm that there was no detectable leak. The excavator was parked. GradeSouth notified METRAC of the repairs and requested that the equipment be transported off site. METRAC then contacted Guthrie and requested that the excavator be transported to their Augusta office.

2.1.3 Accident Description

At approximately 2:00 p.m. on July 26, 2004, a GradeSouth teamster was assigned to meet a Guthrie truck driver at the New Ellenton security gate and escort him on site to retrieve the excavator. The teamster used a GradeSouth company vehicle to travel to the gate. Records indicate that the truck driver signed in at the New Ellenton security gate at 2:35 p.m. The teamster led the truck driver to the Pond B Dam Project area and parked the company vehicle near the excavator. The truck driver positioned the lowboy trailer he had brought for loading the excavator and disconnected the trailer from its gooseneck trailer hitch, which remained attached to the truck cab.

The lowboy trailer, shown in Figure 2-2, is 8 feet, 6 inches wide. Outriggers are available for the trailer to extend it an additional 1 foot on each side, resulting in a total width of 10 feet, 6

inches. The trailer body supports the weight of the excavator, and the outriggers support the tracks, which sag if not supported. The excavator is 11 feet, 1 inch wide, which means the excavator track will hang over the outriggers about 3 to 4 inches when the excavator is centered on the lowboy.

The driver positioned the outrigger and plank on the driver's side of the lowboy, and the teamster assisted the driver in positioning the outrigger and plank on the passenger side (post-accident visual examination indicated that outriggers were missing on the lowboy – three on the passenger side and two on the driver's side). The outrigger plank on the driver's side spanned six outrigger positions, including one of the missing positions. The teamster drove the excavator onto the lowboy trailer from the front end of the trailer. He stated that he loaded the excavator as a courtesy to the driver. The GradeSouth employee is a teamster, not an operating engineer.

The excavator was initially positioned as far back on the lowboy as it would go. The teamster stated that the truck driver asked him to move the excavator toward the front of the trailer and signaled the teamster by hand when the excavator was positioned where he wanted it. The teamster also stated that the truck driver told him that the plank on the outrigger on the driver's side of the lowboy was cocked and that the driver asked him to use the boom to lift the track on that side of the excavator so that he could reposition the plank correctly on the outrigger. Post-accident statements by the teamster indicate that neither he nor the truck driver considered stopping work or backing the excavator off the trailer and starting over when the plank became cocked.

The teamster raised the excavator boom and swung it about 90 degrees to the right so that it was nearly perpendicular to the excavator tracks. He positioned the boom and the arm to place the bucket on the ground about 10 to12 feet from the trailer. In this position, the arm is at an approximate 45-degree angle to the ground. John Deere recommends that the arm should be at a 90- to 110-degree angle to the boom, allowing the track to be elevated by applying downward force on the boom only, rather than operating in "two-stick" control

Figure 2-2. Lowboy after removing excavator

(illustrated in Figures 2-3 and 2-4). The teamster then used the excavator controls to push down on the boom and out on the arm to raise the track (i.e. "two-stick" control). He stated that the truck driver verbally directed him at least twice to raise the track higher. During this activity, the driver was in the teamster's line of sight. The driver then squatted down near the excavator and trailer, and he then disappeared from the teamster's line of sight.

The teamster stated that shortly afterwards he felt the excavator budge, like it dropped. He then focused his attention on the excavator bucket and the ground and a short time later saw the excavator drop again. He believed he could feel the bucket bleeding down and, from where the pressure had been applied to raise the track, it was releasing the pressure, allowing the track to come back down. He then began calling to the driver to get out, that the excavator was coming down. The teamster stated that the truck driver told him to hold on a minute and not do anything. The teamster said that he took his hands completely off the controls so he wouldn't accidentally bump the bucket, but the bucket was continuing to slide in. He reported that he did not have a sensation that the excavator was sliding but that the bucket was sliding.

When the teamster heard the truck driver scream out in pain, he applied pressure and boomed back up in order to keep the tracks off the driver or the bucket from getting to the driver. He did this by pushing down on the boom and out on the arm. The teamster asked the driver if he was okay and was told that he needed some help.

The teamster stated that he locked down the hydraulic controls on the excavator, ran off the back of the trailer without looking at the injured driver, got into the company vehicle, and drove across the dam (0.4 miles) to the GradeSouth construction office trailer to get help. He met his foreman, general superintendent, and another GradeSouth employee and told them the driver was pinned. The four of them returned to the scene of the accident in two vehicles; the foreman and superintendent in one and the teamster and employee in the other. When they arrived at the accident scene, they found the driver lying on his stomach,

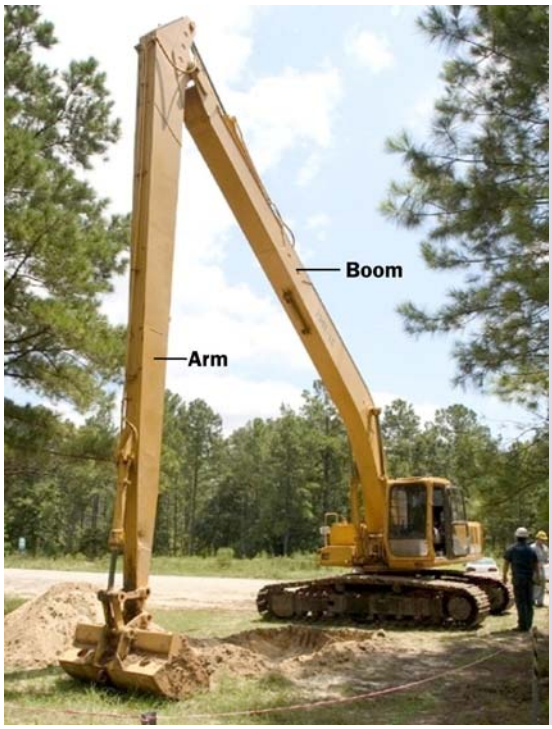


Figure 2-3. (left) The recommended arm configuration for lifting tracks

Figure 2-4. (below) Approximate arm configuration the teamster used.

somewhat parallel to the track of the excavator, with his feet near the edge of the track. The foreman determined that an ambulance was required, and the superintendent used his company-issued cell phone to call the GradeSouth onsite office in H-Area, informing them of the accident and requesting an ambulance. The GradeSouth onsite office then notified the SRS Emergency Duty Officer that an accident had occurred at the Pond B Dam and that medical assistance was required.

The GradeSouth employees wedged lumber from the lowboy under the track to prevent it from dropping further. Table 2-1 below provides an event chronology.

The Board concludes that there were a number of opportunities to utilize stop work and it was not exercised.

Table 2-1. Event chronology

Date	Event
8/15/2003	BSRI issued the RFP.
9/8/2003	BSRI issued Addendum 1 to the RFP.
12/3/2003	BSRI awarded the subcontract to GradeSouth.
1/7/2004	BSRI gave GradeSouth the Notice to Proceed.
6/23/2004	BSRI issued the Certificate of Mechanical Completion, with punchlist.
7/15/2004	GradeSouth received the excavator from METRAC.
7/21/2004	GradeSouth requested METRAC to pick up the excavator.
7/26/2004 2:35 p.m.	The Guthrie driver entered the site to pick up the excavator .
	GradeSouth teamster escorted the driver to the Pond B Dam Project area.
	The driver positioned the lowboy for loading.
	The teamster rotated the boom and raised the excavator.
	The driver asked the teamster to raise the excavator higher using the boom.
	The driver repositioned the outrigger plank.
~3:15 pm	The excavator fell on the driver.
	The teamster drove to the other side of the Pond B Dam to get help at the construction office trailer.
	GradeSouth employees drove back to the accident site and found the driver lying on his stomach somewhat parallel to the excavator track, but not under it.
3:27 pm	The supervisor called the GradeSouth H-Area Office by cell telephone.
	A GradeSouth employee in H-Area called the Savannah River Site Operations Center (SRSOC) using the site telephone and requesting an ambulance.
3:28 pm	GradeSouth H-Area Office employee made a follow-up call to the SRSOC.
3:28 pm	The SRSOC dispatched Squad 3/Medic 3.
3:40 pm	Unit 91 arrived as first responder Emergency Medical Services and provided a critical assessment of the driver.
3:40 pm	Squad 3/Medic 3 arrived at the scene.
3:55 pm	Medic 3 departed the scene for the Medical College of Georgia Trauma Center.
	Medic 3 picked up an additional paramedic while en route.
4:40 pm	Medic 3 arrived at the Medical College of Georgia.
6:18 pm	The Medical College of Georgia reported this as the time of death.

2.2 Emergency Response and Medical Treatment

Although GradeSouth reported that they had BSRI remote worker radios in the work trailer at the worksite, and the teamster told them that the driver had been pinned, the initial call for medical assistance was not made until the GradeSouth foreman and superintendent drove to the accident scene and determined that an ambulance was required. The GradeSouth superintendent used his company-issued cell phone to call the GradeSouth office in H-Area at SRS, informing them of the accident and requesting an ambulance. At 3:27 p.m., the GradeSouth employee located in H-Area called the Savannah River Site Operations Center (SRSOC) and reported that they had a man down that was non-responsive and that an ambulance was needed. The employee reported that the man (driver) was at the Pond B Dam Upgrade Project. In a follow-up phone call from H-Area to SRSOC at 3:28 p.m., the employee reported that the man was non-responsive, and they were not sure if he fell off something. SRSOC had no direct communication with the employees at the accident scene to obtain information for the first responders.

At 3:28 p.m., SRSOC dispatched fire department personnel, emergency medical technicians, and a paramedic from Savannah River Fire Department Station 3 to the accident scene. At 3:32 p.m., while en route to the accident scene, these first responders radioed SRSOC to request additional information on the driver's condition. The dispatcher responded that all that was known indicated that he was conscious, but incoherent. The first responders, along with SRS law enforcement personnel, arrived at the Pond B Dam at 3:40 p.m. Personnel arriving at the accident scene found the driver conscious, lying face down, responding to questions, and complaining of leg pain. The first responders stated that no one at the scene provided them with an accurate description of the accident when they first arrived.

The first responders noted that the driver's feet were near the track and that his body was positioned at approximately the same angle as the lumber (Figure 2-5) that was placed under the track by GradeSouth personnel to prevent the tracks from falling onto the driver. They also noted that the driver's pants were torn and that his right leg and pelvis were injured. The driver could not provide the first responders with an accurate description of the accident. During the first responders' initial assessment, the driver's blood pressure decreased and heart and respiratory rates increased. The driver was given oxygen by non-rebreather mask and placed on a Reeves Sleeve for transport.

Testimony from emergency responders indicates that consideration was given to using the WSI helicopter for MEDEVAC transport. Several of the first responders stated that if they had known that the driver had been crushed by the excavator, they would have put the helicopter on standby. One of the first responders (a paramedic) stated that they would not have been able to effectively secure, treat, and transport the driver using the MEDEVAC. The Board's inspection of the MEDEVAC helicopter and interviews with the pilots indicated that there is room for the patient to be securely strapped in the helicopter, along with two attending medical personnel and their equipment. The approved SRS Medical Protocols dated September 25, 2001, indicate that the driver exhibited at least three of the anatomic and physiologic criteria that may warrant a MEDEVAC transport. The Medical Protocols also indicate that ground travel to the Medical College of Georgia is approximately 50 minutes and air travel is 7 to 8 minutes.

The ambulance departed the accident scene at 3:55 p.m. for the nearest Level I Trauma Center at the Medical College of Georgia in Augusta. A paramedic and an emergency medical

Figure 2-5. The scene immediately following the accident

technician both attended the injured truck driver in the back of the ambulance. The ambulance driver declared a Code 3 (lights and siren) and Signal 24 (multiple trauma and shock) and radioed the hospital to report that they were transporting the driver. The emergency medical technician and paramedic had difficulty controlling the injured driver, who was, at times, combative and uncooperative. The ambulance driver radioed Savannah River Fire Department Station 1 to request that a second paramedic meet the ambulance en route to help in controlling the injured driver and assisting the paramedic and technician. Subsequently, the second paramedic assisted in giving the driver oxygen and intravenous fluids. During transport, the paramedics noted that the driver stopped breathing for several seconds and administered oxygen using a bag valve mask. The injured driver quickly resumed breathing spontaneously.

The ambulance arrived at the hospital's emergency department at 4:40 p.m. The driver was taken to the trauma room, where the hospital's trauma team managed his injuries. The team's physical examination revealed bruises and abrasions on the driver's left thigh and an open fracture of the right femur. The driver could not move his lower extremities and had no sensation in either leg up to the level of the umbilicus. X-rays showed an extensively comminuted intertrochanteric fracture of the right femur, multiple pelvic fractures (right and left superior and inferior pubic rami, right sacrum with widening of the right sacroiliac joint) and fracture of the right transverse process of vertebra L5. Orthopedic Surgery personnel wrapped the driver's pelvic area in a bed sheet to stabilize the pelvis and applied a traction device to the right leg to reduce the femur fracture. The driver displayed respiratory distress and was placed on mechanical ventilation. He was then transported to the

angiography suite to determine the extent of suspected vascular injuries and to embolize affected blood vessels, as needed. As the patient was transferred to the angiography table, he experienced a cardiopulmonary arrest and could not be resuscitated. The time of death was recorded as 6:18 p.m.

Forensic pathologists performed an autopsy on July 27, 2004, at 10:00 a.m. The probable cause and mechanism of death were determined to be hypovolemic shock due to fracture of the pelvis and right femur and blunt trauma to the pelvis and legs from being crushed by an excavator. Significant findings on examination included:

1. Much contusion of the medial aspects of both right and left thighs.
2. Fracture of the right mid-femur.
3. A quarter-inch puncture wound on the upper right lateral thigh.
4. An irregular abrasion over the mid lateral left thigh extending to the back of the thigh.
5. Contusions over the right and left buttock areas.
6. Examination of the internal organs revealed bilateral fractures of the pelvis with separation of the symphysis pubis. Much hemorrhage was present in the pelvis. The right femur, tibia, and fibula were also fractured.

The forensic pathologist reported that there was no evidence of injury to the major blood vessels in proximity to the pelvic or femoral fracture. The South Carolina Law Enforcement Division Forensic Services Laboratory analysis of blood and ocular fluid was negative for volatiles, including ethanol, amphetamine/metamphetamine, barbiturates, benzodiazepines, cocaine, and opiates. Five postmortem digital photographs were provided to the Board's physician advisor.

The Board concludes that the emergency medical response was hampered by the lack of an accurate description of the incident due to poor communications.

The Board also concludes that the emergency medical services (EMS) responders did not precisely follow the approved SRS Medical Protocols for trauma transport. MEDEVAC could have decreased transport time to the Medical College of Georgia by 30 minutes or more.

In addition, the Board concludes that GradeSouth failed to meet the requirements established by WSRC for the Remote Worker Notification Program.

2.3 Investigative Readiness and Accident Scene Preservation

Initial investigative activities related to this accident began after the injured driver was transported to off-site medical facilities and were managed by a law enforcement officer employed by WSI/SRS. Law enforcement personnel and investigators dispatched to the scene ensured that first-person written statements were collected from personnel involved directly or indirectly with the accident or the subsequent response. The investigators also conducted a preliminary interview with the GradeSouth teamster who was operating the excavator during the accident, and the results of that interview were documented. The investigators performed preliminary inspections of the excavator, the lowboy trailer, and the tractor. Digital pictures of the accident scene and environs were collected and maintained. Fire department and emergency medical personnel also conducted a critical incident critique of the accident and their response.

WSI/SRS was notified by the Barnwell County Coroner on July 26, 2004, that the driver was deceased as a result of the injuries received from

the accident. The accident scene was secured at 5:52 p.m., and at 8:21 p.m., a WSI/SRS Security Officer was posted at the scene. The DOE-SR Safety and Radiation Protection Division Director was notified of the fatality by the SRSOC at 8:36 p.m. The DOE-SR notified WSI/SRS at 9:25 p.m. to restrict access to the scene pending a DOE Type A Accident Investigation. The accident scene was controlled as a crime scene by WSI/SRS, and access controls were established at the opposite (east) end of the Pond B Dam, approximately 0.4 miles from the accident scene. The only access to the accident scene was the road across the dam. Crime scene tape was erected around the excavator and trailer to demarcate the scene control boundaries. All personnel allowed entry to the accident scene were logged into the area by WSI/SRS at the access control point at the east end of the Pond B Dam.

On July 27, 2004, at approximately 12:00 p.m., DOE-SR representatives from the Safety and Radiation Protection Division visited the site of the accident, and coordinated the activities to preserve the scene from heavy rains forecast for that evening. A large protective enclosure was installed over the accident scene as much as practical to preserve the scene. Also, sandbags were placed to prevent loss or alteration of evidence. Small diversion trenches were installed to channel water away from the accident site. Additional protective covering was installed on July 29, 2004, to fully enclose the accident scene. Access to the site was controlled by WSI/SRS, with access permission granted initially by DOE-SR and subsequently by the Type A Accident Investigation Board Chairperson.

The Accident Investigation Board assumed control of the accident site on August 3, 2004. WSI/SRS officers maintained direct control of the accident scene, with the Board approving all entries. On August 6, 2004, the Board allowed WSRC to remove the excavator from the lowboy trailer so that operability tests could be performed on the excavator. The testing was performed under the oversight of the Board and was witnessed by representatives of several companies. The Board inspected the lowboy trailer, tractor, and the surrounding area for any additional evidence, then released the lowboy trailer and tractor to WSRC, which subsequently allowed Guthrie to remove it from the accident site. On August 11, 2004, the Board returned control of the accident site to WSRC, with the exception of the excavator. On August 16, 2004, the Board determined that no additional analysis of the excavator was required and released it to WSRC.

The Board concludes that the actions taken by DOE-SR, WSRC, and WSI/SRS were effective in preserving the accident scene.

2.4 Accident Reconstruction and Analysis

The Board's inspection of the accident scene determined that the excavator was initially driven all the way to the back end of the lowboy trailer with the boom facing the rear of the trailer. Asphalt and mud on the back end of the trailer indicated that the excavator was centered on the trailer at the back end. The excavator was then moved forward on the trailer. Again, deposited material from the tracks indicated that the excavator was centered on the trailer. The teamster stated that he was asked to swing the boom around and lift up one track so that the outrigger plank on the driver's (accident) side could be repositioned. The teamster raised the boom and swung it to the right, placing it at approximately a right angle to the track. He stated that he positioned the bucket 10 to 12 feet from the track and used the boom and arm controls to raise the track. This is not the configuration recommended by the manufacturer, John Deere, to raise the track. In post-accident interviews, the teamster stated that he didn't think he could raise the excavator track with the angle between the boom and arm

at 90 to 110 degrees (as recommended by John Deere) because of the long boom. He noted that a regular excavator could be raised in that manner but with a long-stick excavator, there is a chance of bending the piece of equipment or not picking it up at all. The Board believes the teamster's assumption was incorrect.

The Board conducted engineering analysis and calculations, and simulated the accident conditions in the field to assist in analyzing the accident. Engineering analysis indicate that initially, the excavator configuration was stable with about 16,000 pounds of force on the bucket and 35,000 pounds of force on the stationary track. The Board determined that, while the track was elevated, a leak on the hydraulic line to the arm cylinder (caused by a loose fitting) relieved hydraulic pressure from the arm cylinder. The gradual loss of pressure in the cylinder resulted in a redistribution of loads within the excavator structure, which caused a buildup of lateral loads at the excavator support points (the stationary track and the bucket). After the lateral loads built up to a level that exceeded the frictional holding capability at the excavator supports (between either the stationary track and trailer or the bucket and ground), slippage occurred, until sufficient pressure was built up in the cylinder to re-support the load. This action occurred repeatedly, causing either the bucket or the track to slip, until the suspended track was again resting on the trailer bed.

The simulation of the accident conditions using the excavator involved in the accident, with the existing hydraulic leak present, confirmed the Board's engineering analysis. Both bucket slippage and track slippage were noted with a similar pre-accident excavator configuration. The simulation was re-performed after repair of the hydraulic leak by tightening the loose fitting. No bucket slippage or track slippage was noted. However, the raised track did lower slowly over the next 20 minutes, probably from slow internal leakage around the cylinder piston seals. Based on these simulations and supporting engineering evaluation input, the Board determined that, as the excavator bucket and track slipped, the excavator fell onto and critically injured the Guthrie driver.

The Board also attempted to determine the driver's actions when he was out of sight of the teamster while attempting to reposition the outrigger plank. The outrigger plank was approximately 18 inches off the ground and under the excavator track. The track extended about 3 to 4 inches beyond (over) the plank width. The plank was 11 feet long and, based on 3.7 pounds per foot for dried oak, weighed approximately 40 pounds. Considering the physical stature of the driver and the manipulations required to adjust the plank, the Board determined that he was lying on his side on the ground under or near the raised (suspended) track, contrary to Occupational Safety and Health Administration (OSHA) 29 CFR 1926.600(a)(3)(i). The medical reports identified multiple fractures of the pelvis, fractures to the right femur, fibula, and tibia, and abrasions that support this conjecture. The Board also determined that after the teamster heard the driver scream out in pain and raised the track up again, the driver managed to move out from under the track to the position he was in when the teamster and the other GradeSouth employees returned. Medical personnel at the accident scene reported that the driver had a layer of dirt on him and that his pants were pulled down slightly, which is consistent with crawling on his elbows.

The Board concludes the following:

- *The driver placed himself in an unsafe position under a suspended load in order to adjust the plank.*
- *The teamster was not qualified to operate the excavator.*
- *In the configuration that the teamster was using to lift the excavator track, the leak in the hydraulic line to the arm cylinder contributed to the accident.*

3.0 Accident Facts and Analysis

This section addresses the facts related to the accident, along with the results of the Board's analysis. When analyzing the facts, the Board considered the core functions and guiding principles of Integrated Safety Management, which comprise the fundamental DOE safety and health policies that should be incorporated in all phases of the work, from work planning through execution and feedback.

3.1 Line Management Roles and Responsibilities

Line management is directly responsible for the safety and protection of the public, workers, and the environment. In order to be effective, the Department and its contractors must establish and maintain clear lines of authority and responsibility for ensuring safety. These responsibilities apply to activities conducted by DOE, WSRC, BSRI, and GradeSouth for the Pond B Dam Upgrade Project.

3.1.1 DOE Roles and Responsibilities

Figure 3-1 illustrates the relevant portions of the DOE organization from the Program Secretarial Office (EM-1) to the Pond B Dam Upgrade Project. DOE-SR describes its organizational roles and responsibilities in the *Functions, Responsibilities, and Authorities Procedure (FRAP)*, which was updated in April 2004. The DOE-SR FRAP states that the DOE-SR Manager has overall responsibility for ensuring the development and maintenance of

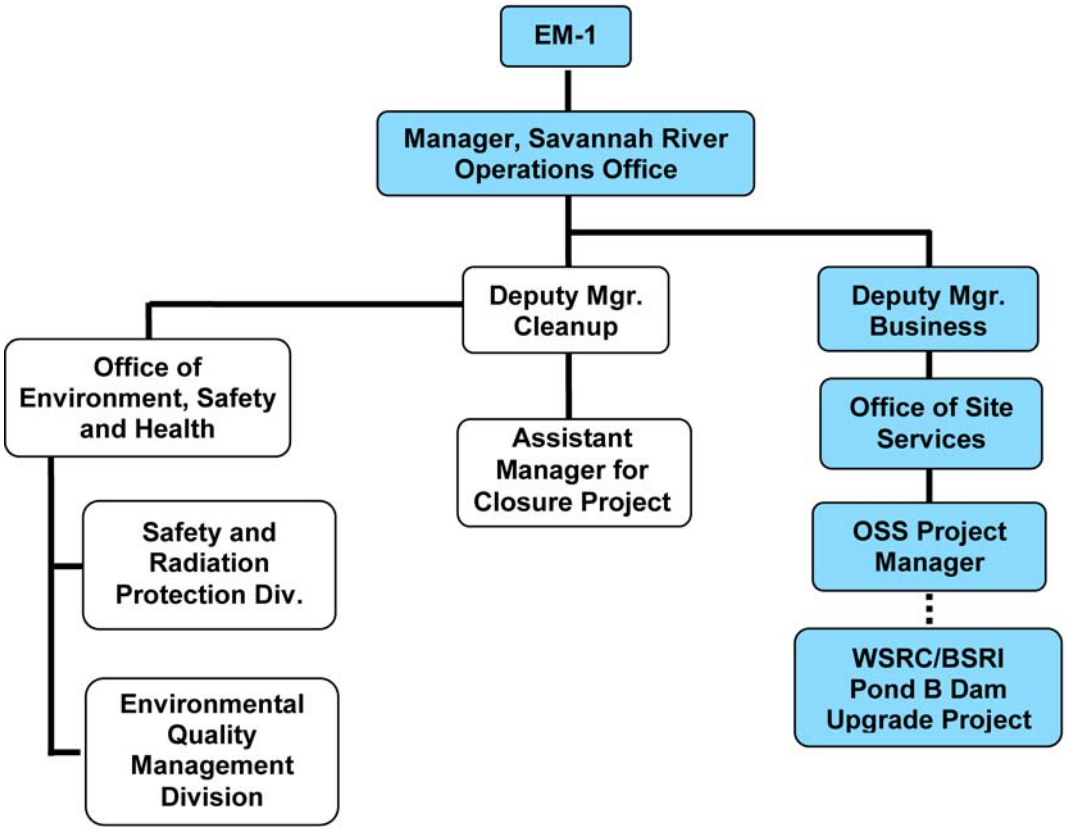


Figure 3-1. Relevant DOE organizational chart

safety management systems so that work is carried out in a manner that assures the safety and health of the public and workers.

The DOE-SR Office of Site Services (OSS) manages the programmatic and technical activities associated with logistics, support services, and non-nuclear infrastructure at SRS; consequently it is the line management office for the Pond B Dam Upgrade Project. The OSS project managers and field representatives manage the field activities of DOE-SR and its contractor, WSRC, by performing periodic surveillances, assessments, and walkthroughs. The OSS line management responsibility applies only to WSRC. OSS does not provide oversight of subcontractors, such as BSRI, or lower-tier subcontractors, such as GradeSouth. Moreover, the DOE-SR FRAP does not address oversight of work being carried out by subcontractors to WSRC.

The DOE-SR Office of Environment, Safety and Health and the Assistant Manager for Closure Projects (Figure 3-1) provide subject matter experts and technical support to construction project line management when requested.

The Board concludes that the current DOE-SR FRAP does not clearly define roles and responsibilities for activities related to ES&H oversight of WSRC subcontractors.

3.1.2 WSRC/BSRI Roles and Responsibilities

Figure 3-1 presents the WSRC line management organization responsible for the execution of work at Pond B Dam. WSRC subcontracts with BSRI for construction activities, and the subcontract is implemented using jointly developed policies and procedures for safety and project management. The BSRI organization, as a unit, reports to the WSRC President. WSRC uses a matrix management organization to establish a project team to execute construction projects. A project team is formed by assigning personnel from appropriate functional organizations to plan and execute the work and to bring the tools necessary to complete their assigned activities. The team for the Pond B Dam Upgrade Project consisted of a project manager, assistant project construction manager, safety engineer, subcontract technical representative (STR), subcontract specialist, and personnel from other disciplines as necessary for project completion. These staff personnel have line management responsibility for safety and take day-to-day direction from the WSRC project manager.

The project manager is required to develop a Construction Execution Plan and delineate staff assignments and responsibilities. The Construction Execution Plan for the Pond B Dam Upgrade Project gives overall responsibility for planning, organizing, controlling, and directing the project effort to the Project Manager, with the assistant project construction manager responsible for performance of the construction team. It delineates staff assignments and responsibilities accordingly.

The Board concludes that WSRC/BSRI line management roles and responsibilities for ensuring safe execution of the project were established.

3.1.3 GradeSouth Roles and Responsibilities

The GradeSouth Worker Protection Plan (WPP) contains line management roles and responsibilities for corporate positions, including senior managers, supervisors, and employees. Figure 3-2 also depicts the specific GradeSouth line management organization for the Pond B Dam Upgrade. The Secretary/Treasurer, as the senior manager for the project, is responsible for application of the company's safety program. As stated in the GradeSouth WPP, the senior manager establishes field personnel safety goals and objectives, and delegates the responsibility for accident

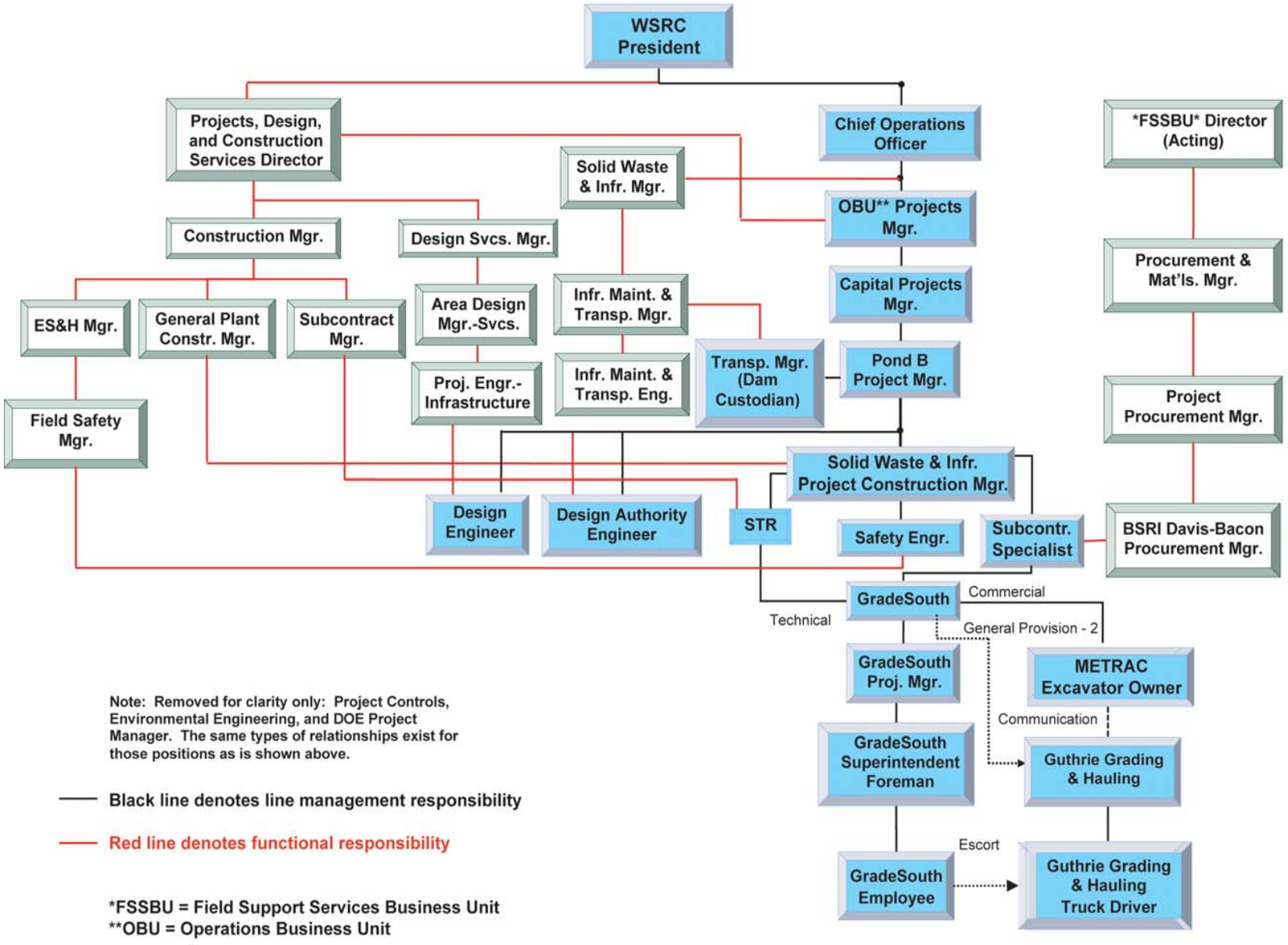


Figure 3-2. WSRC, BSRI, subcontractor, and vendor line management and functional relationships

prevention to the supervisors, holding them accountable for positive action within their area.

The GradeSouth onsite Project Manager, as supervisor for the Pond B Dam Upgrade Project, is responsible for completing the work within schedule and budget. The Project Manager is responsible for safety, obtaining equipment needed for the job, and for employee training. The Superintendent and his direct reporting Foreman are also considered supervisors. The Superintendent has responsibilities for multiple projects onsite, and the Foreman is responsible for a single job; in this case, the Pond B Dam Upgrade Project.

As stated in the WPP, these supervisors are required to have a thorough knowledge of the hazards involved in every operation within their craft and a knowledge of controls for those hazards. They must also insist on proper use of machinery, equipment, and tools to avoid accidents, complete a job safety analysis for operations that are likely to produce accidents, and perform daily inspections of their accountable areas. The WPP states that GradeSouth employees are to incorporate safety in every job procedure, know and obey safe practices, and report unsafe conditions to a supervisor.

The Board concludes that the line management roles and responsibilities for the GradeSouth personnel were clearly documented and understood.

3.2 Procurement and Contractual Requirements

The procurement process for the Pond B Dam Upgrade Project began with the approval of a purchase requisition in July 2003. Also that month, the requisition preparer completed the *Subcontract Safety Checklist,* found in procedure WSRC Manual 8Q, Procedure 15 (WSRC 8Q-15), *Subcontracted Services Workplace Safety and Health, using* the anticipated scope of work to be performed at the Pond B Dam. Completion of the checklist permitted BSRI to categorize the work, establish whether the work was hazardous or non-hazardous, and determine worker protection plan requirements for the subcontractor awarded the contract. The Pond B Dam Upgrade Project was classified as Category C work. It was deemed hazardous work due to the operation of forklifts or other heavy equipment, rigging, soil excavation or trenching, and construction. Non-hazardous activities included material and supply delivery services.

WSRC/BSRI categorizes subcontracted work to determine the level of ES&H compliance required and the amount of safety oversight WSRC/BSRI will provide (see Figure 3-3). The level of oversight and type of safety documentation required can vary based on scope, hazards, proximity of the job to site personnel, and subcontractor's knowledge, compliance and commitment to employee safety. The categories are delineated in WSRC 8Q-15 and are based on the *SRS Workplace Safety and Health Policy*, dated August 21, 1998. This policy was developed jointly by DOE-SR and WSRC.

The RFP for the Pond B Dam Upgrade Project was issued in August 2003, shortly after the purchase requisition was approved, as a fixed-price construction bid. Several general ES&H and key ISM requirements were incorporated in the RFP. They include:

- Subcontractor must maintain complete control over its employees and all of its lower-tier suppliers and subcontractors. (BSRI procurement personnel consider vendors, such as Guthrie, as lower-tier suppliers.)
- Documentation in the subcontract will describe how the subcontractor will implement ISM core functions.

– In performing work, implement the General Provisions of the contract.
– Before performing work, evaluate the hazards and establish an agreed-upon set of standards; tailor controls to the work.

Category A
Subcontract work that requires subcontractor and site personnel to jointly perform manual work in the same job or project. This category of work requires compliance with applicable WSRC procedures and a subcontractor safety and health policy. For hazardous Category A work, the minimum safety interface is monthly.

Category B
Subcontract work that does not require the subcontractor and site personnel to jointly perform manual work, and the work is located in close proximity and may or may not result in risk to site personnel safety. Hazardous Category B work requires compliance with the subcontractor's corporate WPP, which is aligned with OSHA, to include a task-specific plan and a minimum of weekly interface with WSRC safety oversight.

Category C
Subcontract work that does not require the subcontractor and site personnel to jointly perform manual work. The work is isolated, and the work does not reasonably result in risk to site personnel safety. This category of work requires the subcontractor to comply with its corporate WPP, which is aligned with OSHA. WSRC oversight, at a minimum, consists of incident review, consultation, or as requested by the funding division.

Figure 3-3. WSRC categories of subcontracted work

– The subcontractor will comply with OSHA and all other applicable federal, state and local regulatory requirements. (However, BSRI personnel stated that they had no jurisdiction over vendors or suppliers to subcontractors for flow-down of ISM requirements.)
– BSRI will provide to subcontractor employees copies of the *Subcontractor Safety Handbook*, which complies with DOE Order 440.1A, *Worker Protection Management*.
– The subcontractor will submit a WPP that implements OSHA requirements.

Four companies were invited to bid on the project and were required to meet the following minimum performance eligibility factors for ES&H: 1) a three-year average experience modification rate (EMR) of 1.0 or less, and 2) a three-year average total recordable case (TRC) rate of 7.9 or less.

During an August 2003 pre-proposal conference for the Pond B Dam Project, BSRI distributed the SRS Davis-Bacon Construction Subcontractor Safety and Health Information Handout, which provided information on 36 items related to safety. Of these, Item 3 required subcontractors to submit a task-specific plan (TSP), a supplement to the WPP, that included a breakdown of tasks, hazards, and controls. However, the RFP contained no requirements to develop a TSP. BSRI also distributed at the pre-proposal conference, guidance for developing a TSP and the checklist that would be used to evaluate the WPP. Additionally, to clarify questions from the pre-proposal conference, Addendum 1 to the RFP was issued and stipulated that a BSRI field radio was required to be with the subcontractor every day work was performed at the job site.

GradeSouth was the only company to submit a proposal for the Pond B Dam Project. The contract for the Project was awarded to

GradeSouth in December 2003, after final negotiations. The subcontractor received a Notice to Proceed on January 7, 2004, and began construction work during the week of January 19, 2004.

The Board concludes that the subcontract for the Pond B Dam Upgrade Project was adequate in that ISM and worker protection requirements were included.

3.3 Work Planning and Controls

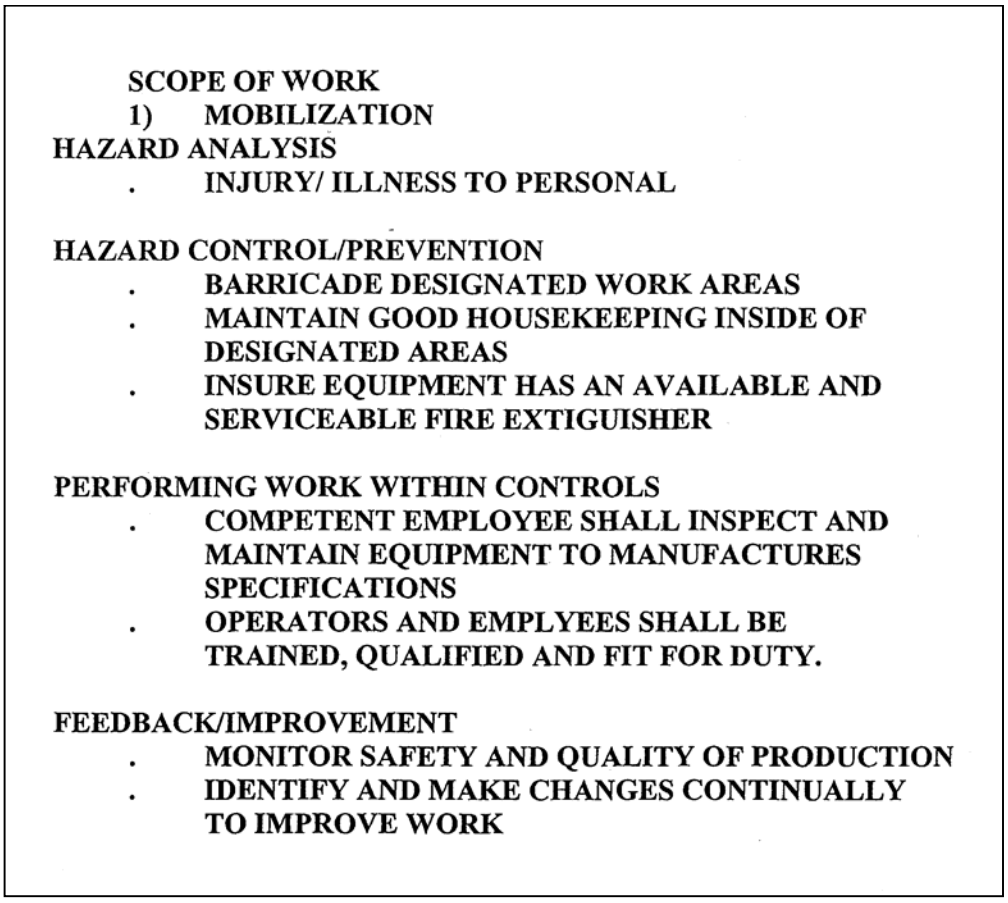
Work planning and execution at SRS is, in part, governed by Department of Energy Acquisition Regulation (DEAR) 970.5223-1, *Integration of Environment, Safety and Health into Work Planning and Execution,* in the WSRC contract through Section H.16. This DEAR clause requires that the contractor exercise a degree of care commensurate with the work and the associated hazards; and that ES&H be an integral and visible part of work planning and execution.

The RFP and the ensuing subcontract for the Pond B Dam Upgrade Project contained flowdown requirements related to ISM, and specifically required that subcontractors and their lower-tier subcontractors implement the listed guiding principles and core functions of ISMS when performing work. The RFP also stipulated that:

- Subcontractors possess and maintain a corporate-level WPP that implements the OSHA requirements.
- BSRI will provide guidance on preparation, content, review, and acceptance of the WPP.
- The WPP shall provide employee guidance on task hazards, engineering controls, precautions, and requirements on personal protective equipment.
- Documentation in the subcontract will describe how subcontractor will implement the five core functions of ISM.
- Subcontractor shall comply with OSHA and shall implement site-specific ES&H requirements when specified in the contract.
- Subcontractors perform daily documented safety inspections and observations of working craftsmen.
- Subcontractors complete Equipment Declaration Forms prior to equipment being used on site.

At the pre-proposal conference in August 2003, BSRI issued a checklist for subcontractors to use to develop a WPP. This checklist required a TSP (task-level hazards analysis and controls) for only Category B work, consistent with WSRC Manual 8Q, Procedure 15. However, BSRI notified potential bidders at the pre-proposal conference that a TSP would be required for the Pond B Dam Upgrade Project, and guidance for developing a TSP was distributed. The guidance provided did not contain sufficient details to prepare a hazards analysis at the task level as required by the RFP.

GradeSouth submitted its corporate Safety Program Policies and Procedures as evidence of their WPP. The WPP is the document that GradeSouth uses to establish and communicate safe work practices to workers. While their corporate document addresses many of the OSHA requirements of 29 CFR 1926, it fails to meet minimum requirements of the contract. For example, the WPP does not address employee guidance on task hazards relevant to the full scope of work nor designate a safety and health professional. Additionally, the WPP does not emphasize stop work authority, but states that the employee's responsibilities are to caution fellow workers when they perform unsafe acts and to refrain from taking chances.



SCOPE OF WORK
1) MOBILIZATION
HAZARD ANALYSIS
. INJURY/ ILLNESS TO PERSONAL

HAZARD CONTROL/PREVENTION
. BARRICADE DESIGNATED WORK AREAS
. MAINTAIN GOOD HOUSEKEEPING INSIDE OF DESIGNATED AREAS
. INSURE EQUIPMENT HAS AN AVAILABLE AND SERVICEABLE FIRE EXTIGUISHER

PERFORMING WORK WITHIN CONTROLS
. COMPETENT EMPLOYEE SHALL INSPECT AND MAINTAIN EQUIPMENT TO MANUFACTURES SPECIFICATIONS
. OPERATORS AND EMPLYEES SHALL BE TRAINED, QUALIFIED AND FIT FOR DUTY.

FEEDBACK/IMPROVEMENT
. MONITOR SAFETY AND QUALITY OF PRODUCTION
. IDENTIFY AND MAKE CHANGES CONTINUALLY TO IMPROVE WORK

Figure 3-4. Reproduction of GradeSouth's hazard analysis for mobilization

GradeSouth submitted a TSP that identified potential hazards, hazards controls, and feedback mechanisms for six major work areas: 1) mobilization; 2) pollution control and erosion control, 3) dewatering (well points), 4) grading, excavating and earth filling, 5) installing PVC drainage pipes and manholes, and 6) seeding and mulching.

However, the TSP does not evaluate hazards at a task level as required by the BSRI guidelines. For example, the hazards analysis for mobilization (shown in Figure 3-4) uses a generic approach instead of a task-specific approach to hazards analysis. It does not consider loading and unloading of heavy equipment or transporting wide loads on site. It does, however, require that operators and employees be trained, qualified, and fit for duty. The TSP does not include demobilization as part of the work scope to be analyzed for hazards. A generic approach to hazards analysis was also used for other major work areas, instead of a task level hazard evaluation.

On January 5, 2004, the BSRI safety engineer documented that the GradeSouth WPP and TSP met the requirements of the contract, and a Notice to Proceed was issued on January 7, 2004.

Although not required by WSRC procedures, on January 13, 2004, the BSRI STR completed an automated hazard analysis (AHA) for the Pond B Dam Upgrade because there were no other tools in place to effectively prepare for and document the pre-job briefing or to identify task-specific hazards. (The AHA is an internal WSRC tool to identify and analyze hazards and

replaced the job hazard analysis process. The STR used the AHA to brief GradeSouth employees at a pre-job briefing, and BSRI and GradeSouth safety and management personnel signed the AHA. Although the AHA analyzes some hazards at the task level for the Pond B Dam Project, it does not consider the full scope of work, including mobilization and demobilization activities or loading and unloading heavy equipment. It also does not incorporate the transportation of wide loads on site and the operation of heavy equipment on sloping ground as hazardous tasks.

The AHA does, however, identify a number of other hazards and controls that are not considered in the GradeSouth WPP and TSP. For example, it considers the remote location of the job site as a hazard and reinforces the need to notify the SRSOC using BSRI-issued remote radios prior to and after working each shift per Procedure MRP 4.03. It also requires a qualified first-aid person at the work site when performing any work. The AHA invokes several site procedures as additional requirements, including:

- OSR 18-125, *Excavation/Trenching Checklist;*
- 8Q, Procedure 34, *Excavations and Trenches;*
- 8Q Procedure 9, *Barricades*, and TM-90-7, *SRS Hoisting and Rigging Manual;*
- 8Q, Procedure 12, *General Site Safety Requirements;*
- MRP 4.03, *Savannah River Site Remote Worker Notification*; and
- 8Q, Procedure 117, *Hand and Portable Power Tools.*

As a result, the subcontractor had two separate hazard analyses — a TSP and an AHA — both of which failed to consider the full scope of work or analyze hazards at a task level. These documents identified different hazards and controls. The Board noted that there is a lack of clarity in how the various documents — the WPP, TSP and AHA — interface with one another. Each contains important controls that the subcontractor needs to execute ISM and mitigate hazards; however, these controls are not consolidated in the subcontractor's WPP or TSP, which are used to perform work. The WSRC procedures and guidance documents do not clarify the hierarchy of the various safety documentation involved in this project and contain conflicting requirements for completing and developing the safety document. This contributed to the ineffectiveness of the BSRI work planning and execution process, as required for Davis-Bacon Category C construction subcontractors.

The Board concludes the following:

- *BSRI imposed additional, and sometimes conflicting, requirements on GradeSouth that were over and above those in the contract.*
- *BSRI failed to provide sufficiently detailed guidance for developing a task-level hazards analysis, and safety oversight failed to identify the weaknesses of the hazards analysis.*
- *Both hazards analyses — the TSP and AHA — for the Pond B Dam Upgrade Project did not adequately address the full scope of work (i.e., demobilization) or identify hazards at a task or activity level, including the loading and unloading of heavy equipment.*

3.4 Safety Oversight

3.4.1 GradeSouth Oversight

GradeSouth's contract requires that a safety and health professional be designated in the WPP, along with his or her associated qualifications and duties. It also requires that the safety representative conduct, at a minimum, documented 30-minute daily safety inspections at the job site and 30-minute observations of working craftsmen. The WPP does not delineate who has responsibility for oversight

and for executing the requirements and terms of the contract, and it fails to designate the safety and health professional. The Board determined that a safety and health professional was assigned to the job. However, the Board found no 30-minute daily safety inspection reports or 30-minute observations of work. Daily Activity Reports (DARs) were submitted to the STR; however, entries under "Safety" were noted either as "Weekly" or "N/A."

In addition to the daily safety oversight activities to be accomplished, the contract requires GradeSouth to ensure that all major equipment is inspected, operated, and maintained by competent personnel and to complete a Major Equipment Declaration Form prior to using equipment onsite. An Equipment Declaration Form was not submitted for the excavator involved in this accident prior to its use.

The Board concludes that GradeSouth failed to provide control and oversight of its activities at the Pond B Dam Upgrade Project.

3.4.2 WSRC/BSRI Oversight

WSRC provides independent oversight of subcontractor safety through periodic project reviews and evaluations conducted by the Facility Evaluation Board (FEB). In April 2001, the WSRC FEB completed a Focused Integrated Safety Management Evaluation of Subcontractor Safety at the request of the WSRC President. The evaluation identified the following two relevant core issues:

- The mechanism for the identification of WSRC requirements tailored to a specific task for categories of work A, B, and C was not clearly and uniformly understood by all stakeholders, STRs, and subject matter experts from the initial development phases of the subcontract to field implementation.
- Conflicting requirements were found in the following WSRC manuals: 11B, 7B, 3E, 8Q. As a result, additional requirements over and above the contractual requirements were being imposed.

A corrective action plan was submitted in August 2001.

In March 2004, the WSRC FEB Project Review Team conducted a performance-based evaluation of the Pond B Upgrade Project. The evaluation identified the assessment area of Environmental, Safety, Health and Quality Assurance as "Below Average." The report notes "improvements were needed in the control and conduct of activities within the prescribed contract and permit conditions." The report further notes that "Safety walk-downs performed at the site were not sufficiently thorough to identify and correct unsafe conditions." A corrective action plan was submitted in August 2004.

BSRI routine oversight of subcontractor safety is provided through the safety engineers/representatives and STRs as part of the project team's line management organization. The safety engineers are responsible for providing primary occupational safety and health support and field oversight of subcontractors, reviewing and accepting the subcontractor's WPP, and coordinating stop-work actions. The STRs performed their safety oversight through daily walkthroughs of the project to identify and document safety concerns in Daily Activity Reports. This level of oversight is greater than required in WSRC Manual 8Q, Procedure 15 for Category C work, where the STR is only required to provide oversight for incident reviews.

The Board concludes that WSRC and BSRI's oversight activities were not effective in ensuring that subcontractor safety issues were adequately identified and resolved.

3.4.3 DOE Oversight

DOE line management for the Pond B Dam Upgrade Project is provided by the OSS, which reports to the Deputy Manager for Business. This organization carries out oversight responsibilities through the field representatives, who manage the prime contractors' activities through periodic surveillances, assessments, and walkthroughs. There were no surveillances or assessments completed by a field representative for the Pond B Dam Upgrade Project.

DOE-SR is responsible for ensuring protection of the environment, workers, and public from hazards posed by DOE facilities, operations, and cleanup activities. Within the DOE-SR Office of Environment, Safety and Health, the Safety and Radiation Protection Division provides direct oversight of prime contractors' safety and health programs through scheduled and reactive assessments as well as trending of safety data. No assessments of subcontractors' safety and health programs, including BSRI's, have been performed by this Office. However, an assessment of the prime contractor's oversight of subcontract work in high-level waste was performed in 2003 by an employee of the line management organization for high-level waste. That assessment concluded that the subcontractor management program provided sufficient guidance and oversight to ensure proper implementation of subcontract requirements and flowdown of contract requirements. Two weaknesses were noted in the implementation of the WSRC Manual 8Q, Procedure 15 requirements, specifically in the use of Equipment Declaration Forms and documented TSPs aligned with modified tasks.

The Board concludes that DOE-SR provided no direct oversight of subcontractor construction activities on the Pond B Dam Upgrade Project.

3.5 Feedback and Improvement

Feedback and improvement processes should be designed and utilized to provide information on the adequacy of work controls, to identify and implement opportunities for improving the definition and planning of work, and to utilize line and independent oversight processes to provide information on the status of safety. Line management is directly responsible for establishing and implementing feedback and improvement programs and processes to facilitate a culture that promotes ongoing examination and learning, while connecting the practical experiences of work that has been conducted to the planning for future work. The feedback and improvement function is intended to identify and correct processes or deviations that lead to unsafe or undesired work outcomes, confirm that the desired work outcomes were obtained safely, and provide managers and workers with information to improve the quality and safety of subsequent, similar work.

In evaluating how DOE, WSRC, and BSRI had analyzed performance information as part of lessons-learned, feedback, and improvement, the Board reviewed previous accident investigation reports, the feedback provided by DOE and WSRC assessments, GradeSouth incident reports that were generated during the project, and site Occurrence Reporting and Processing System (ORPS) reports.

3.5.1 Daily Safety Meetings

Information collected during this investigation suggests that the STR for the Pond B Dam Upgrade Project routinely provided GradeSouth supervision with information to be shared with craft personnel during daily tailgate safety and plan-of-the-day meetings on the project. Copies of safety topics collected and cataloged at GradeSouth's work trailer at the job site indicated that a wide variety of topics were

discussed, including heavy equipment safety, heat and cold stress, and biological hazards.

3.5.2 Feedback from DOE, WSRC, and BSRI Assessements

As discussed in Section 3.4.2 of this report, the WSRC Facility Evaluation Board completed a Focused Integrated Safety Management Evaluation of Subcontractor Safety, in April 2001. This review identified two core issues: 1) the mechanism for the identifying WSRC requirements tailored to a specific task for A, B and C categories of work was not clearly and uniformly understood by all stakeholders, and 2) conflicting requirements were identified in a number of WSRC manuals, resulting in additional requirements over and above contractual requirements being imposed.

In April 2002, a Type B accident investigation was conducted following a worker's fall from a shoring/scaffolding structure at the SRS Tritium Extraction Facility construction site. While the Type B Investigation Board did not identify Judgments of Need associated with this accident, Areas for Improvement were referred to the Appointing Official. In the referral, the Board stated: "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." Two of the referred areas for improvement were applicable to the accident at the Pond B Dam Upgrade Project, and are presented below:

"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,"

and"Since there could be circumstances in the future where an inadequate JHA [Job Hazard Analysis] 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."

While Judgments of Need were not identified for the April 2002 accident investigation, that report clearly indicated "areas for improvement" requiring consideration by DOE and WSRC related to possible future accident scenarios. Those areas for improvement were forwarded to DOE for consideration; the Board found no evidence that DOE or WSRC took specific actions to address the identified construction safety deficiencies.

In January 2004, WSRC completed a Phase I and II reverification of the WSRC integrated safety management program. The report concluded that ISMS was implemented at SRS but identified opportunities for improvement related to the AHA process contained in WSRC Manual 8Q, Procedure 120. The WSRC report noted that the level of detail provided in AHAs varied and indicated that additional training and mentoring was necessary to ensure further improvement in the AHA process.

During January and February 2004, DOE Headquarters Office of Independent Oversight and Performance Assurance (OA) conducted an inspection of environment, safety and health management and emergency management at SRS. OA's Summary Report stated, in part, that safety controls were not always effectively communicated to the workers and effectively implemented by the workforce, and that WSRC had not established adequate mechanisms to ensure that controls identified in the AHA were implemented and effectively integrated into work activities. The report also noted that construction and subcontractor personnel were

not always rigorously and consistently implementing construction safety requirements, resulting in potentially unsafe conditions and practices.

While a corrective action plan was developed and submitted for the OA ES&H inspection six months after the inspection was completed, there was no evidence to indicate that DOE, WSRC, or BSRI took compensatory action to assess or evaluate the construction safety issues that were identified by the OA team.

In February 2004, during drilling of well points at the Pond B Dam, a GradeSouth operator blacked out and rotated the equipment boom while the auger was still in the hole, resulting in minor damage to the auger. An investigation was conducted by BSRI personnel; however, no causal factors and corrective actions were identified.

In March 2004, the WSRC Facility Evaluation Board Project Review Team conducted a performance-based evaluation of the Pond B Dam Upgrade Project and identified the assessment area of environment, safety and health as "Below Average." The report noted that improvements were needed in the control and conduct of activities within the prescribed contract and permit conditions, and that safety walkdowns performed at the site were not sufficiently thorough to identify and correct unsafe conditions.

In April 2004, during dust control activities, a dump truck rolled onto its side when the operator was backing the vehicle, and one of the rear tires backed onto a slight incline. The water tank shifted, causing the truck to roll onto its side. An occurrence report was generated, and the subsequent investigation indicated weaknesses in two ISM Core Functions: analyzing the hazards and developing and implementing hazard controls. Corrective actions were developed to address the incident, but did not include supplier/vendor-owned equipment.

DOE, WSRC, and BSRI managers were provided with information from a variety of sources over a number of years to indicate there were programmatic deficiencies in the communication and implementation of safety requirements for subcontracted construction work across the Savannah River Site.

The Board concludes that effective recurrence controls for identified deficiencies were not established.

3.5.3 Operational Occurrences

The Board also reviewed recent construction related occurrences in ORPS at SRS to determine whether precursor events had occurred before the accident on July 26, 2004. As a result of this review, the Board identified similar underlying causes for the incidents, which are summarized in Appendix B. Many of the corrective actions were to stand down, change, or clarify procedures and to retrain the workers. The Board determined there were a number of common causes for these occurrences, as well as the ineffective corrective action processes:

- Workers failed to recognize hazardous conditions in their assigned work areas;
- Workers were unaware of other personnel in the work surroundings;
- Although job conditions changed, stop-work authority was not utilized, nor was the efficacy of reanalyzing the hazards or controls considered;
- There was an over-reliance on the skill of the craft assigned to accomplish the task; and
- There was inattention to detail by operators, or operators were less experienced and/or untrained in the work they were assigned to accomplish.

The Board concludes that WSRC failed to fully address the causal factors for the occurrences through the corrective action processes in place at the site.

3.6 Personnel Training and Qualifications

3.6.1 Equipment Operators

Subpart C, *General Safety and Health Provisions,* to the OSHA Safety and Health Regulations for Construction, 29 CFR 1926.20(b)(4) states: "The employer shall permit only those employees qualified by training or experience to operate equipment and machinery." The SRS Davis-Bacon Construction Subcontractor Safety and Health Information Handout (part of the pre-bid package for the Pond B Dam Upgrade Project) states: "Heavy equipment operators shall be qualified and knowledgeable with the equipment being operated according to the manufacturer's guidelines and warnings found in the operating manual." The Mobilization section of the TSP submitted by GradeSouth for the Pond B Dam Upgrade Project states: "Operators and employees shall be trained, qualified and fit for duty." GradeSouth does not have a formal or documented process for verifying that employees are trained and qualified. These decisions are made by supervision based on the firsthand knowledge of the individual's ability and/or a review of previous training, experience, or possession of the journeyman card in the applicable craft area.

At a union construction site such as the Pond B Dam Upgrade Project, operating engineers are the craft that are trained and qualified to operate heavy equipment. A review of the Local 470 operating engineer training program indicates that it provides both classroom and hands-on training related to heavy equipment operation, including excavator operation. When METRAC delivered the excavator to the job site, it was offloaded by one of the GradeSouth operating engineers, not the METRAC truck driver. The operating engineer operated the equipment to perform the required work at the job site. He has been an operating engineer since 1977 and has significant experience with heavy equipment operation.

The individual that loaded the excavator on the lowboy trailer the day of the accident is a teamster and not an operating engineer. Teamsters do not receive formal training in heavy equipment operation. Although he had previous experience operating similar equipment at another jobsite for GradeSouth, he did not have any experience operating the long-boom excavator that was involved in the accident. There was an operating engineer at Pond B at the time the excavator was being loaded, but he was operating another piece of equipment at the job site. The foreman for the Pond B Dam Upgrade Project at the time of the accident stated that he assigned the teamster to meet and escort the Guthrie driver to the job site but that they did not specifically assign him to load the equipment.

The Board concludes that GradeSouth failed to ensure that heavy equipment operations were conducted by qualified operators.

3.6.2 Safety Personnel and Subcontract Technical Representatives

BSRI Construction Management Procedure CMP 04-01.01 establishes the qualification requirements for STRs. The procedure requires candidates to have a minimum of six education and experience credits before consideration as a potential STR. Guidance is included in the procedure for determining the applicability of education and experience and how that equates to credits or partial credits. Potential STR candidates must also complete a structured and documented interview with the Construction Subcontracts Manager (CSM) or designee to challenge the candidate's technical and administrative procedure knowledge level. The CSM also reviews the candidate's previous training and required reading requirements and determines if it was adequate. When all of these

requirements are complete, the CSM approves a letter of qualification for the candidate.

There were three STRs assigned to the Pond B Dam Upgrade Project over the duration of the project. A review of the training and qualification records of the three STRs indicates that they each had over 20 years of relevant experience and that they met the STR qualification requirements stated in CMP 04-01.01.

A review of the training and qualification records for the two people assigned as safety engineers to the Pond B Dam Upgrade Project indicates that they both possess adequate training and experience for that position.

3.6.3 Truck Driver

The driver of the Guthrie tractor and lowboy trailer did have a commercial driver's license that covered driving a tractor and trailer of the size involved in the accident. Guthrie management personnel stated that driving the lowboy was his primary responsibility and that he was not trained or utilized by them as an equipment operator. They also stated that although he may have loaded smaller equipment on trailers in the past (e.g., backhoes and small dozers), he was not qualified and never loaded a piece of equipment the size of the excavator on the lowboy trailer.

3.7 Change and Barrier Analyses

Change analysis examines changes planned or unplanned that cause undesirable results related to the accident. This process analyzes the difference between what is normal, or expected, and what actually occurred before the accident. The results of the change analysis conducted for the accident at Pond B Dam were integrated into the events and causal factors chart to support the development of causal factors. Appendix D contains the change analysis.

A barrier analysis was also conducted to identify barriers associated with the accident. This analysis addressed physical systems and management systems in place to isolate and avoid the hazards. The results of the barrier analysis validated the results in the change analysis. The results of the barrier analysis is not included in the report.

3.8 Causal Factors Analysis

The Board performed a causal factors analysis in accordance with the DOE Workbook, *Conducting Accident Investigations*. Causal factors are events or conditions that produced or contributed to the occurrence of the accident and consist of direct, root, and contributing causes.

A direct cause is the immediate event or condition that caused the incident. The Board concludes that a direct cause of the accident was the excavator falling onto the driver.

The root causes of the accident are the fundamental causes that, if corrected, would prevent reoccurrence of this and similar accidents. The Board has also identified contributing causes. Contributing causes are events or conditions that, collectively with the other causes, increase the likelihood of the accident but individually did not cause the accident. The causal factors are identified in Table 3-1.

Table 3-1. Causal Factors Analysis

Root Cause	Discussion
DOE, WSRC, and BSRI were inattentive to programmatic deficiencies in the communication and implementation of safety requirements for subcontracted construction work at the Pond B Dam Upgrade Project.	WSRC and BSRI oversight activities were not effective in ensuring that subcontractor safety issues were adequately identified and resolved. DOE-SR provided no direct oversight of subcontractor construction activities on the Pond B Dam Upgrade Project. GradeSouth failed to provide control and oversight of their activities at the Pond B Dam Upgrade Project.
Subcontractors' unstructured approach to work did not ensure that safety and health requirements were translated into work controls, did not take those actions necessary to enforce compliance with fundamental safety requirements during the work, nor did they define their safety and health expectations for the activity prior to work.	Grade South failed to exercise control over its employee and supplier BSRI failed to provide sufficiently detailed guidance for developing a task-level hazards analysis, and safety oversight failed to identify the weaknesses of the hazards analysis. Both hazards analyses — the TSP and AHA — for the Pond B Dam Upgrade Project failed to adequately address the full scope of work (i.e., demobilization) or identify hazards at a task or activity level, including the loading and unloading of heavy equipment. BSRI imposed additional and sometimes conflicting requirements on GradeSouth over and above those in the contract. GradeSouth failed to meet the requirements established by WSRC for the Remote Worker Notification program
WSRC failed to fully address the causal factors for the occurrences through the corrective action processes at the site.	WSRC failed to fully address the causal factors for operational occurrences reported through ORPS. Effective recurrence controls for identified deficiencies were not established.

Direct Cause	Discussion
The Driver was working under or near the excavator	This is a violation of 29 CFR 1926.600(a)(3)(i)
The GradeSouth Teamster was not qualified to operate the excavator	This is in violation of 29 CFR 1926.20(b)(4). The teamster placed the boom and arm in a configuration not recommended by the manufacturer.
GradeSouth failed to exercise control over its employee and Vendor	Grade South did not assign qualified operating engineer to load the excavator. Also, GradeSouth had the responsibility for the safety and health of its subcontractors and suppliers.
Stop work authority was not effectively utilized.	It is an important part of DOE O 440.1A that all subcontractor workers have the right to stop work.

Table 3-1. Causal Factors Analysis (continued)

Contributing Cause	Discussion
There was a hydraulic leak in the line to the arm cylinder.	Hydraulic leaks were identified when the equipment was received and while the equipment was operating. Repairs were made so that the unit could be transported from the site.
GradeSouth failed to implement controls and safety requirements contained in the contract documents	GradeSouth did not complete the Equipment Declaration Form for the excavator; complete daily safety inspections or daily 30-minute observations as required by the contract; communicate with SRSOC daily via the remote BSRI-issued radios; or have a qualified operating engineer load the excavator onto the trailer.
BSRI contract requirements were not incorporated into the GradeSouth Worker Protection program	The WPP did not include all of the safety and health requirements found in Appendix F of the contract and the safety checklist. • There was no designated safety representative. • There was no strong stop work policy.
WSRC & BSRI failed to ensure that GradeSouth understood and implemented the ISMS as required by the contract	BSRI did not provide sufficiently detailed guidance for developing a task-level hazards analysis, and safety oversight failed to identify the weaknesses of the hazards analysis. Both hazards analyses — the TSP and AHA — for the Pond B Dam Upgrade Project did not adequately address the full scope of work (i.e., demobilization) or identify hazards at a task or activity level, including the loading and unloading of heavy equipment.
WSRC and BSRI's oversight activities were not effective in ensuring that subcontractor safety issues were adequately identified and resolved.	The STRs were conducting daily visits to the GradeSouth project. The daily activity reports did not identify any significant issues.
BSRI construction safety management documents were confusing and added additional requirements outside the contract.	Although not required by some documents a AHA and TSP were conducted and each document addressed different hazards and controls.
WSRC, BSRI and DOE-SR did not have an effective lessons learned program to evaluate precursor activities and implement effective corrective actions.	Previous internal and external assessments, ORPS reports, and incident investigations identified issues associated with subcontractor performance and oversight of subcontractors.
DOE-SR roles and responsibilities were not clearly defined in the FRAP for ES&H oversight of WSRC subcontractors.	The DOE-SR recently updated the FRAP but the FRAP did not address oversight of work being carried out by WSRC subcontractors.
Emergency Response was hampered by the lack of accurate description of the accident.	The driver and Grade South employees did not provide an accurate description of the accident.
The EMS responders did not precisely follow the approved SRS Medical Protocols.	Despite clinical indicators of multiple trauma, shock, and possible neurological injury, they decided to transport the driver by ground ambulance versus a medical helicopter.

4.0 Judgments of Need

Conclusions are synopsis of those facts and analytical results that the Board considers especially significant. Judgments of Need are managerial controls and safety measures necessary to prevent or minimize the probability or severity of a recurrence. They flow from the conclusions and are directed at guiding managers to developing corrective measures. Table 4-1 summarizes the Board's conclusions and Judgments of Need.

Table 4-1. Conclusions and Judgments of Need

Conclusions	Judgments of Need
The driver placed himself in an unsafe position under a suspended load in order to adjust the plank. The teamster was not qualified to operate the excavator. There were a number of opportunities to utilize stop work and it was not exercised. Grade South failed to ensure that the heavy equipment operations were conducted by qualified operators. In the configuration that the teamster was using to lift the excavator track, the leak in the hydraulic line to the arm cylinder contributed to the accident.	WSRC needs to make sure that construction subcontractors' and vendors' worker protection program flows down the site requirements and integrated safety management systems and principles to the worker and with emphasis on the importance and need for workers' stop work authority, qualified and competent workers, and safe operation of construction equipment.
GradeSouth failed to provide control and oversight of their activities at the Pond B Dam Upgrade Project BSRI failed to provide sufficiently detailed guidance for developing a task-level hazards analysis, and safety oversight failed to identify the weaknesses of the hazards analysis. Both hazards analyses — the TSP and AHA — for the Pond B Dam Upgrade Project failed to adequately address the full scope of work (i.e., demobilization) or identify hazards at a task or activity level, including the loading and unloading of heavy equipment.	WSRC needs to make sure that hazards are identified and that controls are developed and implemented at the task level for all subcontractors on site.
GradeSouth failed to provide control and oversight of their activities at the Pond B Dam Upgrade Project WSRC and BSRI oversight activities were not effective in ensuring that subcontractor safety issues were adequately identified and resolved.	WSRC and BSRI need to make sure that subcontractor safety issues are adequately identified and resolved.
WSRC failed to fully address the causal factors for operational occurrences reported through the corrective action processes in place at the site. Effective recurrence controls for identified deficiencies were not established.	WSRC, BSRI, DOE-SR needs to improve their lessons learned program to evaluate precursor activities and implement effective corrective actions.

Table 4-1. Conclusions and Judgments of Need (continued)

Conclusions	Judgments of Need
BSRI imposed additional, and sometimes conflicting, requirements on GradeSouth over and above those in the contract.	BSRI needs to review their subcontracting controls to ensure that all applicable ES&H requirements are contained in the contract.
The current DOE-SR FRAP does not clearly define roles and responsibilities for activities related to ES&H oversight of construction projects. DOE-SR provided no direct oversight of subcontractor construction activities on the Pond B Dam Upgrade Project.	DOE-SR needs to provide oversight of the WSRC and BSRI construction subcontractors and ensure the roles and responsibilities for oversight of WSRC and BSRI construction subcontracting are established in the DOE-SR FRAP.
Emergency Management Response was hampered by the lack of an accurate description of the incident due to poor communications. GradeSouth failed to meet the requirements established by WSRC for the Remote Worker Notification program.	WSRC needs to make sure that the Remote Worker Notification program is effectively implemented by all affected organizations to ensure that workers have direct access to a reliable means of communication with SRSOC. This includes ensuring all personnel on site that may be potentially remote workers are aware of the requirements of the program and understand when and how to effectively communicate emergency response with SRSOC.
The EMS responders did not precisely follow the approved SRS Medical Protocols for trauma transport. MEDEVAC could have decreased transport time to the Medical College of Georgia by thirty minutes or more.	WSRC needs to conduct a comprehensive review with all medical responders to ensure they are able to implement the requirements and guidance in the protocol. The technical capabilities and limitations of the WSI MEDEVAC helicopter needs to be clarified for all applicable emergency response personnel including physicians, emergency medical technicians, emergency dispatchers and emergency response supervisory personnel.
The Board concludes that the actions taken by DOE-SR, WSRC, and WSI/SRS were effective in preserving the accident scene.	
The Board concludes that WSRC/BSRI line management roles and responsibilities for ensuring safe execution of the project were established.	
The Board concludes that the line management roles and responsibilities for the GradeSouth personnel were clearly documented and understood.	
The Board concludes that the subcontract for the Pond B Dam Upgrade Project was adequate in that ISM and worker protection requirements were included.	

5.0 Board Signatures

Raymond J. Hardwick, Jr.
DOE Accident Investigation Board Chairperson
U.S. Department of Energy
Office of Facility Safety

Patrice M. Bubar
DOE Accident Investigation Board Member
U.S. Department of Energy
Office of Environmental Management

Ralph A. Fevig
DOE Accident Investigation Board Member
U.S. Department of Energy
Sandia Site Office

Michael J. Thomas
DOE Accident Investigation Board Member
U.S. Department of Energy
Office of River Protection

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6.0 Board Members, Advisors, and Staff

Board Members

Chairperson	Raymond J. Hardwick, Jr., DOE Office of Environment, Safety and Health
Member	Patrice M. Bubar, DOE Office of Environmental Management
Member	Ralph A. Fevig, DOE Sandia Site Office
Member	Michael J. Thomas, DOE Office of River Protection

Advisors

Advisor	William T. Cooper, Jr., DOE Office of Environment, Safety and Health
Advisor	Michael Montopoli, M.D., Occupational Health, DOE EH
Advisor	Amy B. Poston, DOE SRS
Advisor	Mark A. Smith, DOE SRS

Consultants

Consultant	Tom Bolton, BSRI
Consultant	Pat Casey, MAS Consultants, Inc.
Consultant	H.E. Flanders, P.E., WSRC
Consultant	Margie Lewis, Parallax, Inc.
Consultant	R.R. Rothermel, WSRC
Consultant	Mike Schoener, MAS Consultants, Inc.

Technical and Administrative Support

Coordinator/Technical Editor	Elaine Merchant, Parallax, Inc.
Coordinator	Karen Brown, Parallax, Inc.
Court Reporters	Cathy T. Pirtle, Culpepper Reporting, Inc. Pamela N. Pope, Culpepper Reporting, Inc.

Appendix A — Appointment of Type A Accident Investigation Board

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Department of Energy
Washington, DC 20585

July 28, 2004

MEMORANDUM TO: Jeffrey M. Allison, Manager Savannah River Operations Office

FROM: John Shaw, Acting Assistant Secretary
Office of Environment, Safety & Health

SUBJECT: Investigation of the July 27, 2004, Worker fatality at Savannah River

Based on your recommendation a Type A Accident Investigation Board is hereby established to investigate the July 26, 2004, worker fatality at Savannah River Operations Office Worksite near Pond B Dam.

The Office of Environment, Safety, and Health (EH) will lead the Accident Investigation. I have appointed Raymond Hardwick, Deputy Assistant Secretary for Facility Safety (EH-2) as the Accident Investigation Board Chairperson. The Board will be composed of members, advisors and other personnel as deemed necessary by the Board Chairperson.

The scope of the Board's investigation will include, but is not limited to, analyzing causal factors, identifying root causes resulting in the accident, and determining Judgment of Need to prevent recurrence. The investigation will be conducted in accordance with DOE Order 225.1A, Accident Investigation. The Board will also focus on management roles responsibilities and application of lessons learned from similar accidents on site or within the Department.

The Board will provide my office with periodic reports on the status of the investigation. These periodic reports should not include any findings or arrive at any premature conclusions until an analysis of all the causal factors have been completed. Discussions of the investigation and copies of the draft report will be controlled until I accept and authorize release of the final report.

The report should be provided to my office 30 calendar days from the date of this memorandum.

cc:
P. M. Golan, Acting EM-1
R. Hardwick, EH-2

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Department of Energy
Washington, DC 20585

August 3, 2004

MEMORANDUM TO: John S. Shaw, Acting Assistant Secretary
Office of Environment, Safety and Health

FROM: Raymond J. Hardwick, Jr., Deputy Assistant Secretary For Facility Safety

SUBJECT: Type A Accident Investigation at the Savannah River Site

As the appointed Chair of the Type A Accident Investigation Board for the investigation of the fatality at the Savannah River Site I have assumed responsibility for the investigation effective immediately. I have commenced the investigation in accordance with the requirements of DOE Order 225.1, *Accident Investigations*. In addition to myself as Chair, the other Board members are:

- Patrice Bubar, Deputy Assistant Secretary for Integrated Safety Management and Operations Oversight, Office of Environmental Management
- Michael Thomas, Operation and Commissioning Team Lead, Office of River Protection
- Ralph Fevig, Industrial Safety Program Manager, Sandia Site Office

Dr. Michael Montopoli will serve as a medical advisor to the Board. The Board will be assisted by other advisors, consultants and support personnel as I deem necessary.

In accordance with DOE Order 225.1 the Board will identify the relevant facts; analyze the facts to determine the cause of the accident; develop conclusions; and determine Judgments of Need to prevent similar accidents in the future. I anticipate having the investigation and subsequent report complete in 30 days. I will provide you with periodic reports on the status of the investigation.

cc: Accident Investigation Team
Paul Golan, EM-1 (acting)
Ines Triay, EM-3
Jeff Allison, SR
Bob Pedde, WSRC

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Appendix B — Analysis of Previous Savannah River Near-Miss and Industrial Operations Occurrences

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Table B-1. Appendix B — Analysis of Previous Savannah River Near-Miss and Industrial Operations Occurrences

Accident	LLW Containers Dislodged from Disposal Array	Forklift Damage to Fire Suppression System	Recovery Chiller Lockout Point Compromised	Near-Miss: Hand Held Shear Failure	Near-Miss: Employee Hit by Trackhoe Bucket	Near-Miss: Auger Disengaged from Equipment	Near-Miss: to Steam Burns	Near-Miss: Crane Contacts Power Line	Near-Miss: Improper Removal of Ductwork	Subcontractor Water Hauling
Date	**1/20/03 1/28/03**	**3/3/03**	**3/13/03**	**4/8/03**	**5/9/03**	**8/26/03**	**11/20/03**	**2/10/04**	**4/14/04**	**4/23/04 4/26/04**
Hazard Analysis and Control	Informal/ Inadequate	Informal/ inadequate	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate
Procedures and Procedure Adherence	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate
"Skill of the Craft"	Over reliance	Over reliance	Over reliance	Over reliance	Over reliance	Over reliance	Over reliance	N/A	Over reliance	N/A
Training and Competencies	Most experienced personnel not used	N/A	Inadequate	Inadequate	Inadequate	N/A	Inadequate	N/A	Inadequate	Inadequate
Pre-Job Briefing	Inadequate	N/A	Completed day of occurrence	Incomplete/ Inadequate	N/A	N/A	Inadequate	Pre-job walkdown not performed	N/A	N/A
Lessons-Learned/Corrective Actions	Inadequate response to previous event	N/A	Inadequate response to previous lift attempt	Inadequate response to previous events	N/A	N/A	N/A	N/A	N/A	N/A
Hazard Control Communication	Inadequate	Inadequate	Inadequate	Inadequate	Inadequate	N/A	Inadequate	Inadequate	Inadequate	Inadequate
Management/Supervisory involvement/Control or Oversight	Inadequate management of work planning/ control	Inadequate management of work planning/ control	Work planning did not identify special circumstances or conditions	Work planning did not identify special circumstances or conditions	Inadequate management of work planning/ control	Inadequate management of work planning/ control	Work planning did not identify special circumstances or conditions	Inadequate management of work planning/ control	Inadequate management of work planning/ control	Inadequate management of work planning/ control
Requirements Implementation	Appropriate requirements not incorporated	Spotter requirement not implemented	Management policy guidance or expectations not well-defined, understood or enforced	Appropriate requirements not incorporated	Appropriate requirements not incorporated	Appropriate requirements not incorporated	Appropriate requirements not incorporated	Appropriate requirements not incorporated	Appropriate requirements not implemented	Appropriate requirements not implemented

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Appendix C — Change Analysis

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Table C-1. Change Analysis

Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
Driver working under the elevated tracks to adjust outrigger plank (suspended load)	Back equipment off the trailer to reposition the plank	Driver is exposed to serious hazard should equipment fail or fall	The driver working under the elevated load was a causal factor of the accident. Should the equipment fail, or the ground give away, the worker would be caught between the equipment and the ground, causing serious injury. Title 29 CFR 1926 states, "Heavy equipment which are suspended or held aloft shall be substantially blocked or cribbed before employees are permitted to work under or between them."
The teamster used the excavator boom to lift the tracks so the driver could reposition the outrigger plank	Back equipment off the trailer to reposition the plank, or block or crib the tracks prior to allowing the drive access into the danger zone	Lifting the excavator track to allow the driver access to the outrigger plank placed the driver in an imminent danger situation	The improper use of the excavator to-lift itself to allow personnel access under the tracks without blocking or cribbing places personnel in an imminent danger situation
Outriggers and planks in poor condition	Outriggers and planks in good condition	Broken outriggers on the trailer could cause the plank to move out of position when loading the excavator	If the outriggers were in good condition the plank may not have moved when the excavator was loaded on the trailer.
Acceptance of defective equipment	Equipment Declaration Form completed and equipment verified to be operable in accordance with applicable requirements	Properly serviced and maintained equipment is needed to conduct a task safely	There is an equipment declaration policy established by the site to ensure that equipment is functioning safely. Title 29 CFR 1926.20 states that the use of any equipment or machinery which is not in compliance with any applicable requirement of this part is prohibited. However, BSRI did not ensure that the subcontractor and vendors submitted this declaration. The excavator and the lowboy trailer each had notable deficiencies. The excavator initially had experienced hydraulic leaks and the trailer had missing and/or damaged outriggers.
The Teamster loads the excavator onto the trailer	A qualified operating engineer loads the excavator onto the lowboy trailer	A fully trained operating engineer will be knowledgeable of the safe operations of the equipment, as well as loading and unloading the excavator	Neither the driver nor the teamster were qualified to operate the excavator. Although the teamster had some equipment operating experience, he was a not a qualified operating engineer and had no prior experience operating this excavator. A qualified operating engineer would be competent to load and operate the equipment.

Table C-1. Change Analysis (continued)

Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
The teamster was allowed to load the excavator	A qualified operating engineer is assigned to load the excavator	Supervision assures that only qualified personnel are assigned to operate equipment.	Although the foreman did not specifically assign the teamster to load the excavator, supervision had permitted him to operate equipment on other GradeSouth jobs and therefore he had implied authorization to perform this task. A qualified operating engineer would be competent to load and operate the equipment.
Stop work not used	Stop work used	Using the stop work authority will lessen the potential of unsafe acts and unsafe conditions in the course of doing work.	It is an important part of DOE O 440.1A that all subcontractor workers have the right to stop work. If the teamster and driver had stopped work when the plank went out of position and backed the excavator off the trailer, the hazard would have been removed. The WPP does not strongly emphasize stop work authority. In the WPP, the employee's responsibilities are to caution fellow workers when they perform unsafe acts and to refrain from taking chances.
Site accident investigation does not determine root cause	Site accident investigation determines root cause	Determining the root causes will assist in avoiding similar types of incidents.	Although two prior accidents occurred at the Pond B Dam, the site's investigations failed to go beyond the finding of worker error. With the site's emphasis on a behavior- based safety approach to safety performance, management should attempt to determine the root cause of worker error by evaluating management systems.
WPP does not meet requirements of the "Subcontractor Safety Checklist," the AHA, contract specifications, and DOE O 440.1A.	WPP meets, meets the "Subcontractor Safety Checklist," AHA, contract specifications, and DOE O 440.1A.	Having the requirements incorporated into the WWP would ensure workers have access to information regarding the hazards and controls associated with the job.	GradeSouth employees were not aware of some of the safety and health requirements that could have impacted the safety of others tasks, specifically the need to report their work in remote locations on a daily basis and the need to declare the equipment to ensure safety and operability. Appendix F requires GradeSouth to conduct daily inspections using "the Safety/Housekeeping Inspection Sheets' or a pre-approved equivalent and to make daily observations using the "Safe Worker Observation Data Sheet." GradeSouth only used the equivalent of the "Daily Activity Report" form. Entries under "Safety" were noted either as weekly or N/A. Comparing the WPP and the requirements of the subcontract, the WPP does not designate the safety representative, or contain a stop work policy as defined in DOE O440.1A

Table C-1. Change Analysis (continued)

Accident Situation	Prior, Ideal, or Accident-Free Situation	Difference	Evaluation of Effect
A task-specific hazard analysis not completed	A task-specific hazard analysis is completed	The hazards would have been identified, analyzed and the appropriate controls put in place.	WSRC and GradeSouth did not enforce the requirement to perform a hazard analysis, nor did GradeSouth implement hazard analysis requirements for the excavator loading operation.
GradeSouth did not implement the remote worker program	GradeSouth implemented the remote worker program	Implementation of the remote worker program would have ensured direct communication with SRSOC.	The Grade South Superintendent traveled to the accident scene after being notified of the accident by the teamster. Since the BSRI radios were left at the trailer, approximately 0.4 miles away, and the emergency telephone number for cell phones was not used, communications related to the accident were not made directly with SRSOC. Instead, a cell telephone call was made to the GradeSouth Site Manager, who then called the SRSOC. This caused some delay in the emergency response and the first responders did not have an factual description of the accident.
Corrective actions resulting from assessments and inspections of subcontractor construction projects are not effectively implemented in a timely manner.	Corrective actions are effectively implemented in a timely manner.	Effective corrective actions implemented in a timely manner will prevent recurrence.	Although numerous evaluations and self-assessments were conducted, some actions are still awaiting implementation because of extended completion dates. Other corrective actions were not effective in preventing recurrence of similar issues.
Lessons learned from other construction projects at SRS not utilized	Lessons learned utilized	Lessons learned from Tritium Extraction Facility Type B Accident Investigation and other data sources are implemented to prevent recurrence.	WSRC processes were ineffective in ensuring that lessons learned were understood and applied on the Pond B Dam upgrade project.
Oversight by WSRC did not evaluate GradeSouth's performance in meeting the subcontract requirements associated with ES&H.	WSRC oversight ensures GradeSouth's compliance with subcontract ES&H requirements	WSRC failed to identify ES&H performance deficiencies.	Although oversight activities were scheduled and conducted, there were a number of opportunities missed to identify ES&H deficiencies on the Pond B Dam Upgrade project and implement corrective actions.
DOE oversight of Pond B Dam Upgrade Project was not in place.	DOE oversight in place.	No programmatic assessment of construction safety management at the Pond B Dam Upgrade Project was conducted by OSS or OESH.	With DOE oversight, deficiencies with the construction safety management at the Pond B Dam Upgrade Project could be identified and corrected.

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Appendix D — Events and Causal Factors Analysis

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Figure D-1. Events and Causal Factors Chart

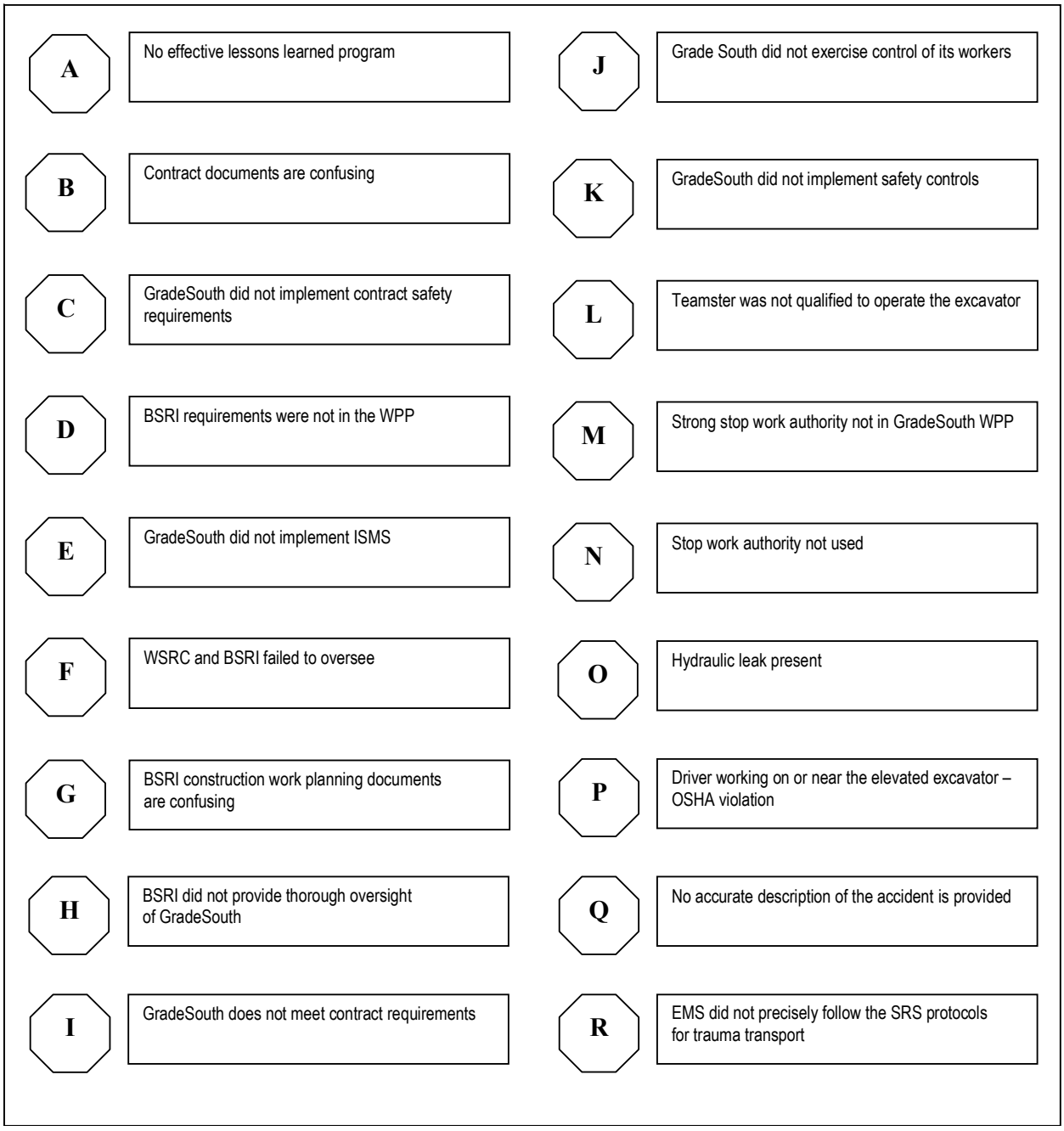
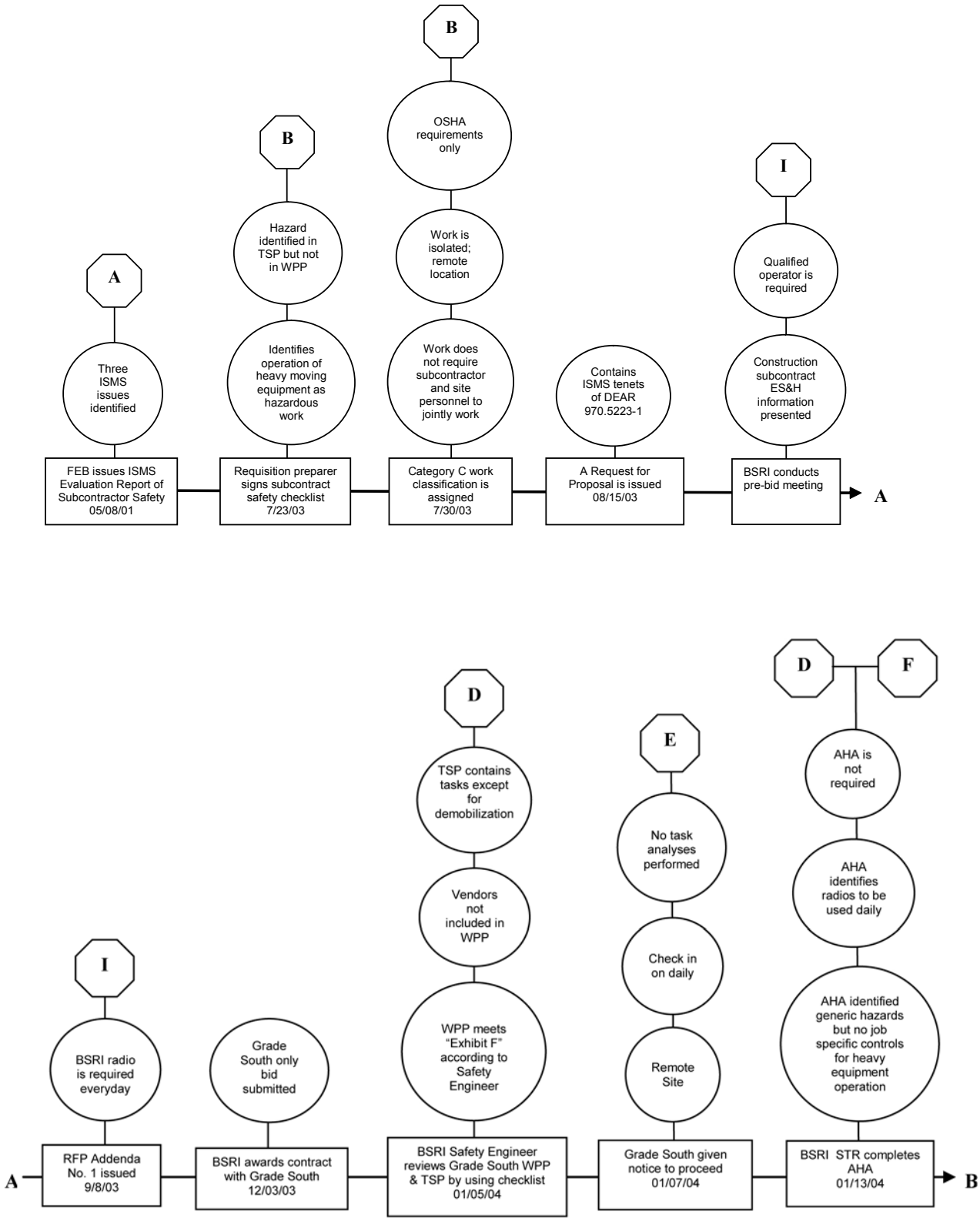


Figure D-1. Events and Causal Factors Chart



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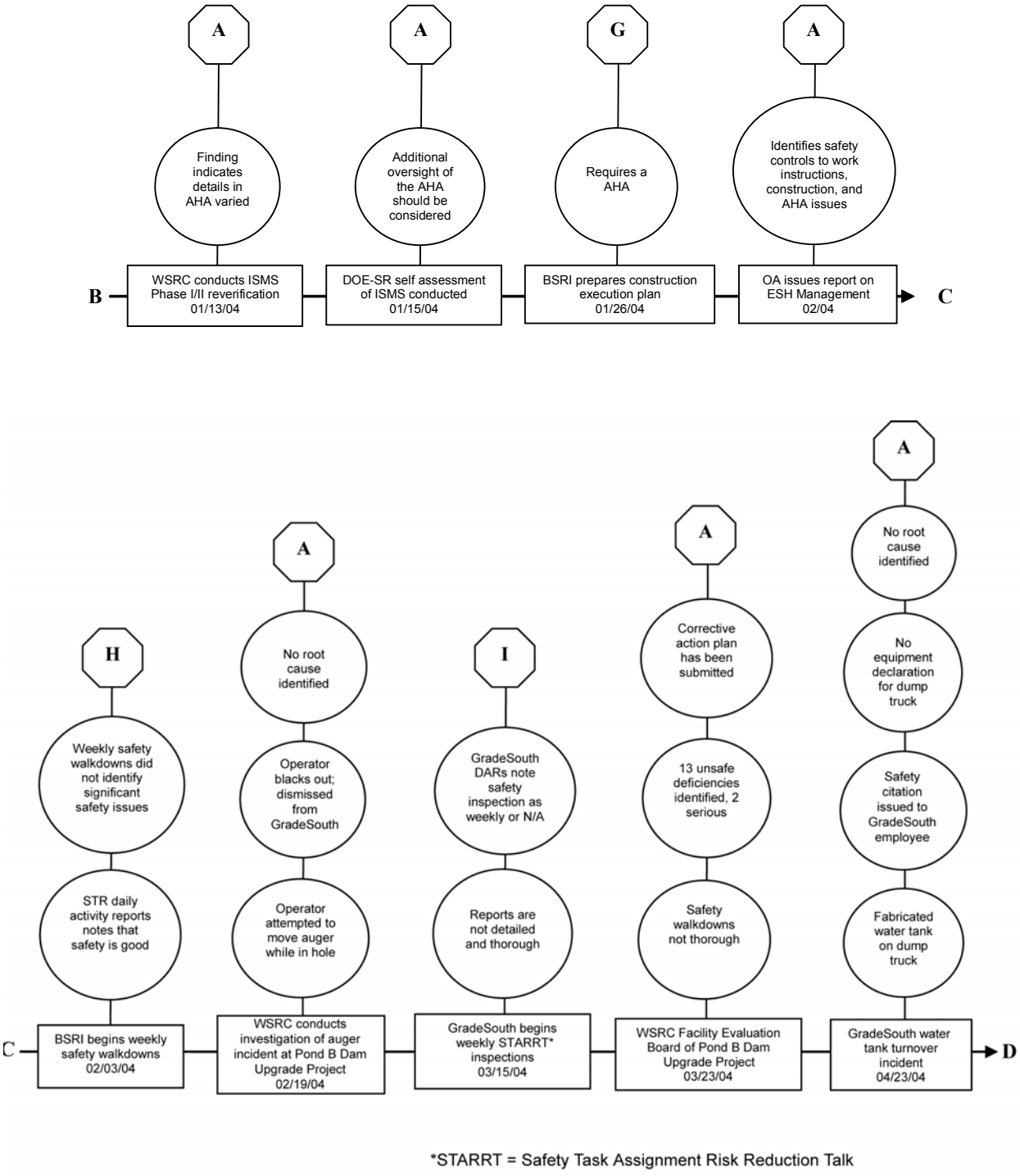
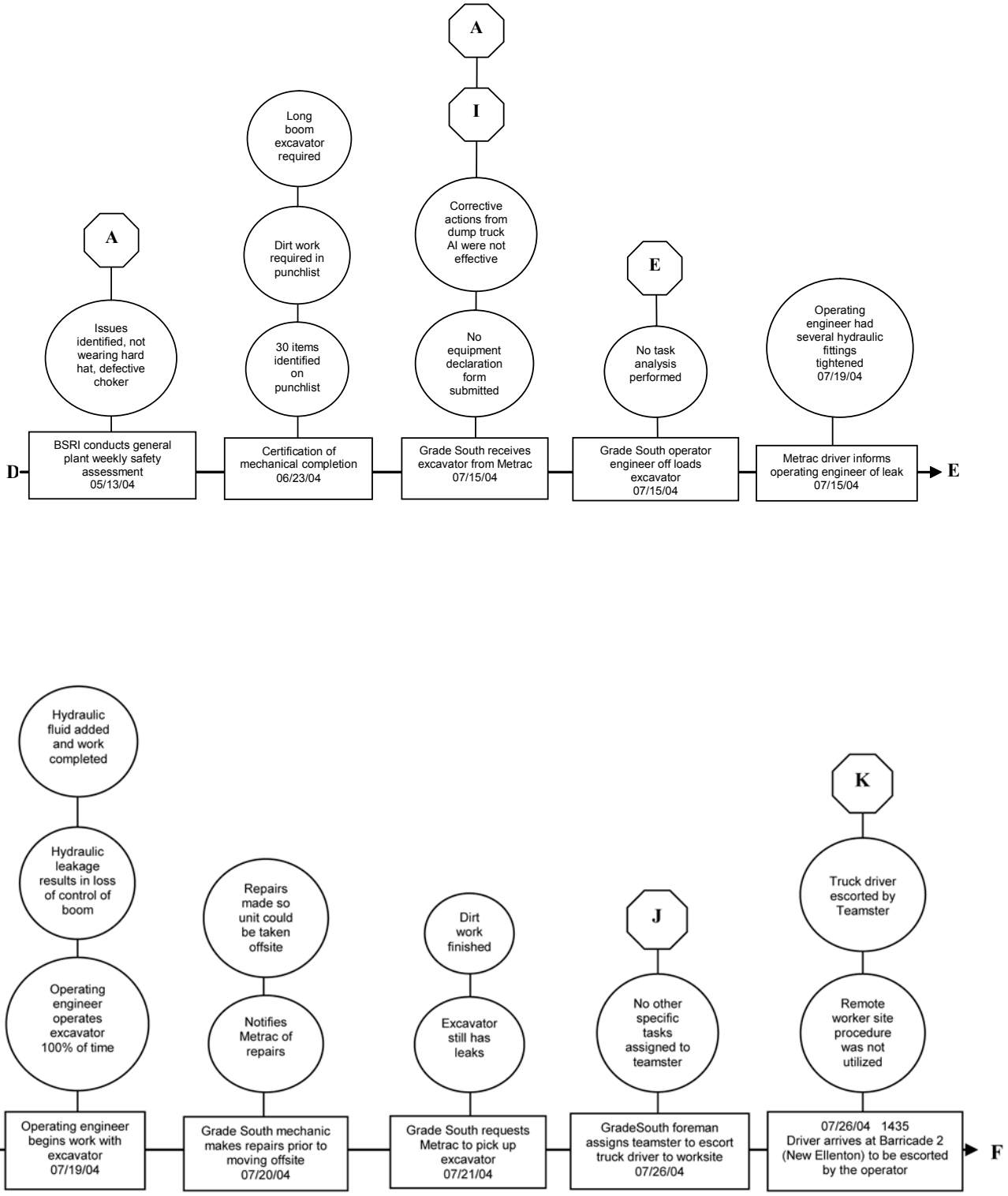


*STARRT = Safety Task Assignment Risk Reduction Talk

Figure D-1. Events and Causal Factors Chart



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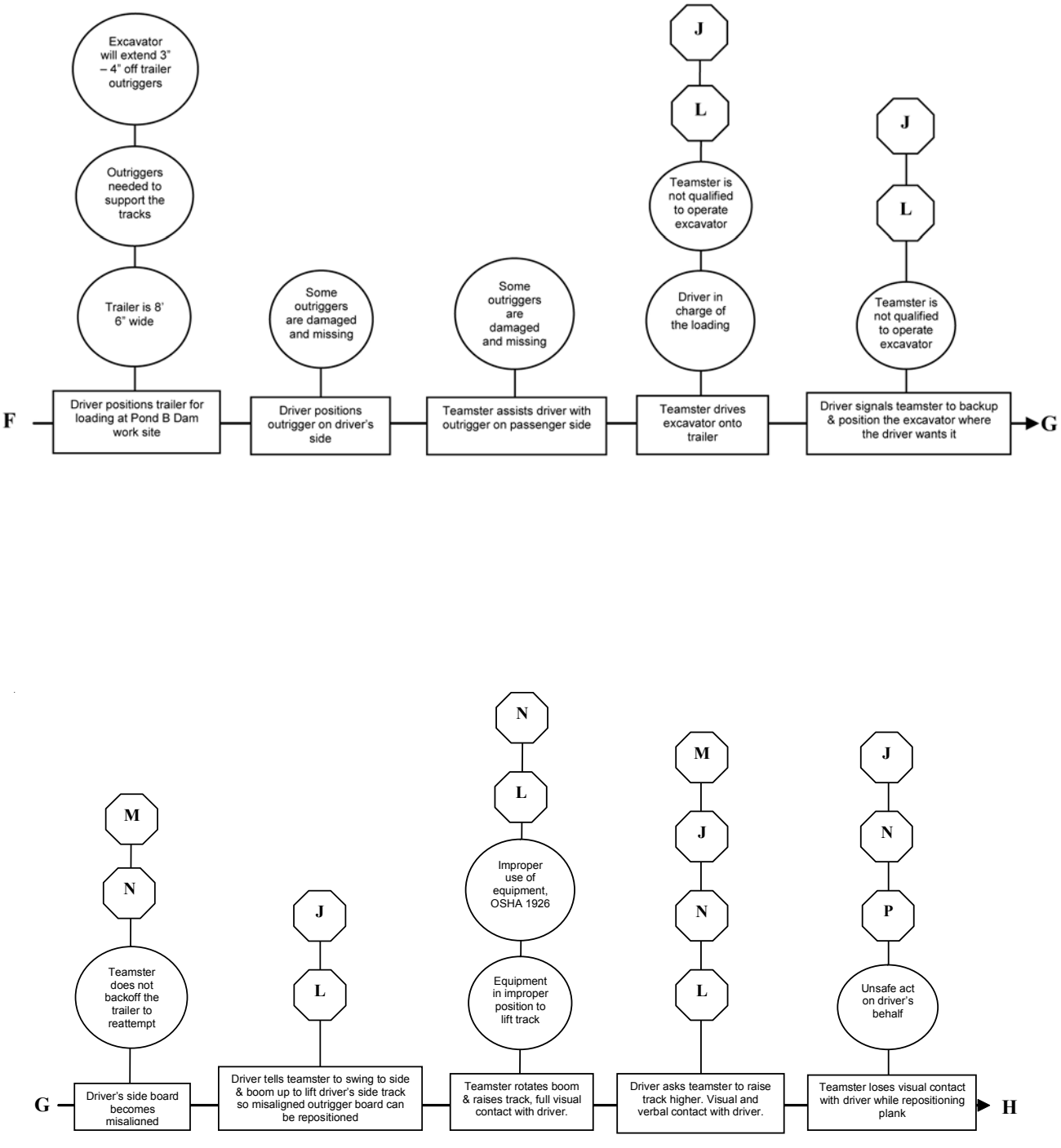

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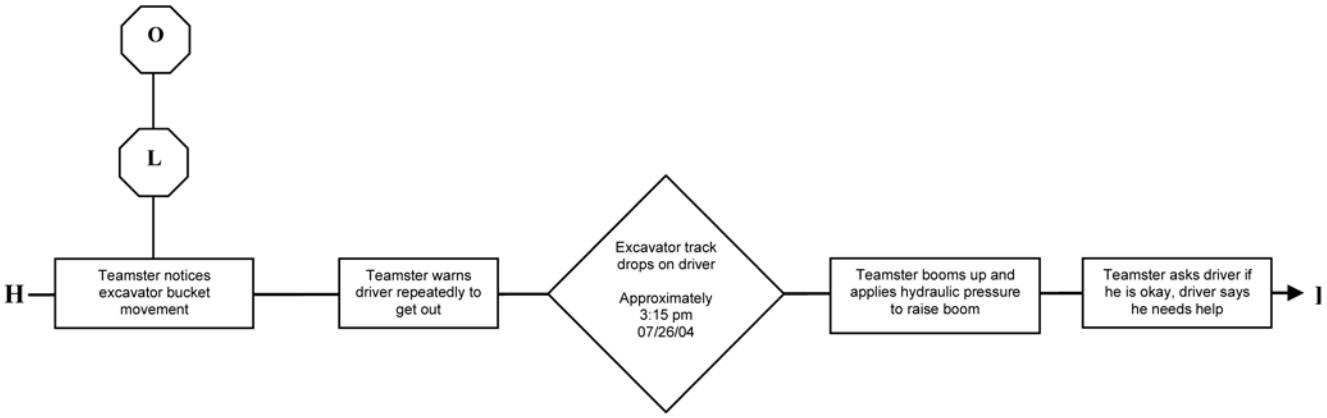

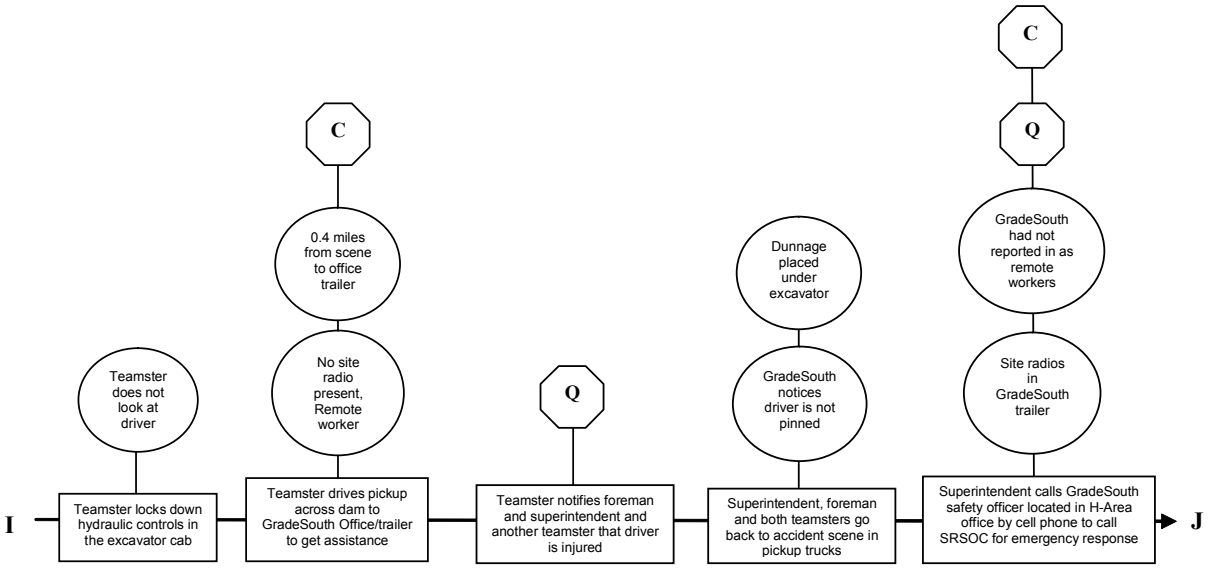

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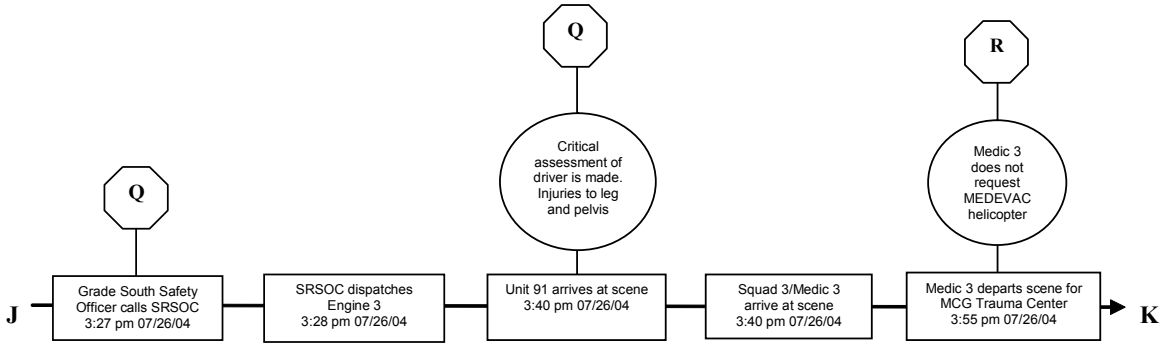

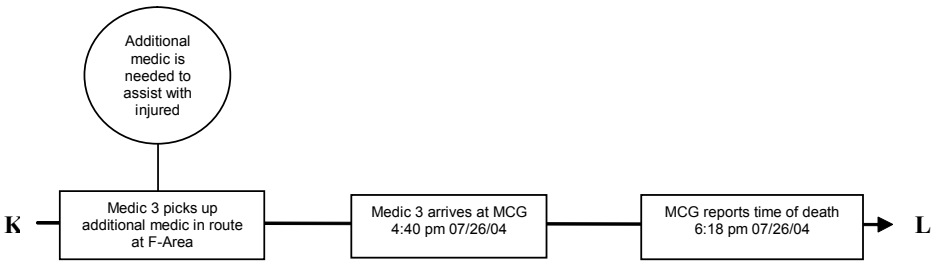

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