Report No. DOE/EH-0483

Type A
Accident Investigation Board Report
on the April 3, 1995,
Security Rappel Tower Fatality
at the
Department of Energy
Savannah River Site

Volume 1: Summary Report

August 1995

Office of Environment, Safety and Health
U.S. Department of Energy

On April 3, 1995, I established a Type A Accident Investigation Board to investigate the fatal rappelling accident at the Savannah River Site Advanced Tactical Training Academy. The Board's responsibilities have been completed with respect to the investigation. The analysis, identification of root and contributing causes, and judgments of need reached during the investigation were performed in accordance with DOE 5484.1, "Environmental Protection, Safety, and Health Protection Information Reporting Requirements." I accept the findings of the Board and authorize the release of this report for general distribution.

Tara O'Toole, M.D., M.P.H.
Assistant Secretary
Environment, Safety and Health

EXECUTIVE SUMMARY

The objectives of this investigation are twofold: to determine the cause and surrounding circumstances of this accident and to prevent the occurrence of similar accidents.

The accident under investigation occurred on April 3, 1995, at approximately 10:46 a.m. As a result of the accident, a Wackenhut Services, Incorporated–Savannah River Site (WSI–SRS) Special Response Team (SRT) member received fatal injuries from a 27-foot fall from the top of the Savannah River Site (SRS) Advanced Tactical Training Academy Security Rappel Tower. The accident took place during a rappel training exercise undertaken in preparation for an offsite Special Weapons and Tactics (SWAT) competition. A "buddy rappel," in which a rappeller carries a "buddy" on his back, was in progress, and a single rope was being used to descend from the top of the tower. The accident occurred when the rope separated during the rappel, and the Rappeller fell on top of the Buddy.

The Department of Energy (DOE) Accident Investigation Board (Board) assembled for this investigation was appointed by the Assistant Secretary, Environment, Safety and Health. The Board included both subject-matter and accident-investigation experts. Appendix A contains copies of the appointment letters. To determine the direct, probable, and root causes of the accident, and to identify judgments of need for correcting the deficiencies that led to the accident, the Board determined the most likely accident scenario and analyzed management structures, policies, procedures, and related practices at SRS.

The Board determined that the direct cause of the accident was the separation of the rope.

The Board determined that the direct cause of the accident was the separation of the rope, which was caused by the rope coming in contact with the small-radius, sharp-edged, lock-pin housing of the newly installed safety gate combined with the dynamic load of the Rappeller and the Buddy on the rope. Rope will separate under loads much smaller than those of its design strength when stretched under tension during an activity such as rappelling and over a small-radius diameter object like the gate lock-pin housing.

Savannah River Site management did not ensure that Special Response Team training requirements approved for the protective force mission were in accordance with the Site Safeguards and Security Plan.

The Board examined both the WSI–SRS mission and its protective requirements and found there was confusion about the necessity of the SRT's use of rappelling. The Site Safeguards and Security Plan (SSSP) did not include rappelling as a required SRT operational or tactical response technique. The Board found that Savannah River Operations Office (SR) management did not ensure that the SRT training requirements approved for the WSI–SRS mission were SSSP driven.

The Board also found that the DOE Headquarters Office of Nonproliferation and National Security (NN) exercised program management of the protective force and training programs in accordance with prevailing DOE orders. However, the Board determined that WSI-SRS viewed NN and their Central Training Academy rappel-training lesson plans as Department policy and, therefore, viewed the rappelling lesson plans as NN sanctioning rappelling, irrespective of site security requirements. In addition, the Board found that WSI-SRS and DOE policy regarding rappelling was inadequate to prohibit the use of the unacceptable buddy rappel technique.

DOE rappel policy was inadequate to prohibit the use of the unacceptable buddy rappel technique.

Two probable causes support these findings: SR did not make a comparison between the WSI-SRS mission and its training requirements; and the DOE Headquarters responsible program office, the Office of Environmental Management (EM), along with NN, which have security management responsibilities, did not ensure that SR clearly understood DOE's rapelling requirements and their appropriate application and effective implementation. In addition, EM was focused on security planning, not on safety and conduct of operations.

Several training-related factors combined to contribute to the accident.

Several training-related factors combined to contribute to the accident. The most important of these are: the SRT last conducted buddy rappelling in 1989; NN and WSI–SRS management reviews identified a need for Rappel Instructor/Master refresher training, but a training program was not developed; information concerning the impact of recently installed rails and gates at the Security Rappel Tower was lacking; and there were no buddy-rappel lesson plans. These factors led the Board to determine that WSI–SRS did not develop a training program that included all the necessary steps to conduct buddy rappelling safely and effectively.

The Board found that there was neither DOE nor WSI–SRS safety or training management of SRT competition preparation activities and that SR reviews of the WSI–SRS training program were not effective. The WSI–SRS safety program was primarily focused on facilities, not on operations and training, and WSI–SRS procedures did not assign safety responsibilities in a manner that ensured a progression of safety responsibility beyond the Rappel Master.

The Board determined that management controls were not provided because the operations office and the protective force perceived that competition preparations were outside normal operations and training requirements.

The Board determined that management controls were not provided because SR and WSI–SRS perceived that the competition preparations were outside normal operations and training requirements. WSI–SRS safety management controls were not accomplished at each organizational level because the procedures, position descriptions, and job task analyses for WSI–SRS managers and personnel involved in rappelling did not contain sufficient detail on safety responsibilities. In addition, DOE management controls were weak in that no line management reviews of rappelling operations had been conducted, no oversight by the DOE Headquarters Office of Environment, Safety and Health (EH) had been conducted, and there was no assurance that DOE rappelling training adequately covered the fundamental safety principles related to rappelling.

The Board also examined the injury and illness data for protective force operations and found that these operations are among the most hazardous in the Department. This finding indicates that greater emphasis needs to be placed on operational safety of SRT activities.

Based on the analyses and findings in this report, the Board identified the judgments of need listed below:

- WSI-SRS needs to upgrade management of SRT operations and training.

- WSRC needs to upgrade emergency response and occupational safety and health compliance.

- SR needs to improve management of protective force operations and determine the need for rappelling.

- EH needs to provide assistance and expand safety oversight of protective force operations.

- EM needs to place greater emphasis on safety and conduct of operations in protective force operations.

- NN needs to develop better DOE controls for protective force rappelling and competition participation safety and also needs to upgrade the training approval program.

In addition to the judgments of need above, the Board has two broad recommendations for consideration based upon the results of this accident investigation and a review of other DOE security program safety issues. DOE should:

- Conduct a review of the adequacy of safety programs used in security training and develop recommendations for improvement.

- Reassess DOE's security requirements against DOE's programmatic needs and put in place a mechanism for continuous evaluation of such needs.

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Volume 1: Summary Report

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1. INTRODUCTION AND BACKGROUND

This is Volume 1 of a two-volume Type A Accident Investigation Board report on the April 3, 1995, Advanced Tactical Training Academy Security Rappel Tower fatality at the Department of Energy (DOE) Savannah River Site (SRS). This volume includes the Executive Summary, a description of the accident, an analysis of the pertinent facts, and the Board's conclusions and judgments of need. This volume also contains photographs of the accident scene; causal analysis diagrams; and Appendices A through H, which contain supporting documentation.

Volume 1 is designed to be a stand-alone document that provides the reader with a summary of the facts, analyses, and conclusions related to the accident. Volume 2 is also a stand-alone document and was designed to provide more-detailed information about the facts surrounding the accident, an expanded analysis of the facts, and the Board's conclusions and judgments of need. Volume 2 contains additional photographs, drawings, diagrams, and appendices.

SRS is a large industrial complex covering more than 300 square miles. The site borders the Savannah River and encompasses parts of three counties in western South Carolina. The Advanced Tactical Training Academy is in the northeast quadrant of the site, near the Barnwell-Aiken County line, as shown in Figure 1-1. The Advanced Tactical Training Academy consists of a pistol range, a 400-meter, known-distance range, a Security Rappel tower, a live-fire shoot house, and a stress course. The Security Rappel Tower is shown in Figure 1-2.

Figure 1-1. Savannah River Site Map

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2. BOARD'S INVESTIGATION STRATEGY

The Board's investigation approach was twofold. First, the Board determined the accident scenario by examining the Security Rappel Tower and the rappelling equipment and by reviewing the actions taken by the Rappeller, the Buddy, and other Special Response Team (SRT) personnel present during the training exercise.

Programmatic breakdowns that could have contributed to the fatal accident were investigated.

The Board then analyzed management structures, policies, procedures, and related practices in effect at DOE Headquarters, the Department's Savannah River Operations Office (SR), Wackenhut Services Incorporated–Savannah River Site (WSI–SRS), and Westinghouse Savannah River Company (WSRC) that led to the SRT's use of rappelling at SRS. This line of investigation was pursued to determine if there had been programmatic breakdowns that could have contributed to the fatal accident.

The Board used various accident analysis techniques, including Management Oversight and Risk Tree (MORT) analysis, event and causal factors charting, analytical trees, barrier analysis, and change analysis. The Board conducted extensive interviews and document reviews and performed engineering and root cause analyses to identify the operational, facility, equipment, and management deficiencies that contributed to the accident.

Based on these analyses, the Board determined the direct, probable, and root causes of the accident. Root causes are those deficiencies that, if corrected, might have prevented this accident. In addition, the Board developed judgments of need for correcting the identified deficiencies. These can be used to prevent similar accidents throughout the Department.

2.1 Expertise Used During Investigation

The Accident Investigation Board and advisors assembled to conduct this investigation included individuals with experience and training in DOE accident investigation and analysis, occupational safety, training, rappelling, security operations, management systems, SRT operations, systems analysis, and engineering testing and analysis. Appendix B contains qualifications of the Board, advisors, and consultants. The Board was assisted by representatives of WSI–SRS, the United Plant Guard Workers of America, an SR advisor, WSRC personnel, and several technical consultants.

Rappelling is a tactic used by DOE protective forces and SRT personnel to gain access to facilities to thwart the theft, diversion, or sabotage of special nuclear material. DOE fire and rescue personnel also train in rappelling and use it during some of their missions and operations. Rappel training is conducted at the DOE Central Training Academy and at various Department field sites, including the SRS Advanced Tactical Training Academy.

2.2 Rappelling Defined

Rappelling is a tactic used by DOE protective forces and SRT personnel to gain access to facilities to thwart the theft, diversion, or sabotage of special nuclear material.

Rappelling is the science of sliding down a rope in a safe, controlled manner, during which the rappeller has to support only a fraction of his or her total weight with the hands. Rappelling techniques have evolved from crude body rappels, in which a rope was wrapped around one or more parts of the body, to the mechanical descenders currently in use.

Mechanical descenders were used during both the single-person and the buddy-method rappel training exercises discussed in this report. The specific descender used during the buddy rappel was a "Figure 8" descender. Figure 2-1 illustrates this descender as it was observed after being unhooked from the Rappeller.

2.3 Rappelling Safety

The Board identified the basic safety principles that should be used in rappelling. These principles are listed below.

- Using a safety factor that requires rappel ropes to have a strength of at least 15 times greater than the rappeller's weight;
- Using double ropes to provide a second rope should one fail during the rappel;
- Examining the rappel rope path and carefully padding or avoiding sharp or small-radius objects;
- Using a bottom belayer who is able to slow or stop out of control descents;
- Using a top belayer who provides an additional (safety) rope;
- Inspecting the rope and equipment regularly and discarding anything that is questionable;
- Testing rope anchorages prior to the rappel by using more weight than required by the rappel;
- Using ropes manufactured specifically for rappelling; and
- Training in and practicing rapelling regularly.

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3. ACCIDENT INVESTIGATION ACTIVITIES AND ANALYSIS

3.1 Accident Description

On April 3, 1995, at approximately 10:46 a.m., a WSI–SRS employee received fatal injuries as the result of a fall during a rappel training exercise at the SRS Advanced Tactical Training Academy Security Rappel Tower. The training was being conducted from the top of the 40-foot-high tower, which is shown in Figure 3-1.

Training in progress at the time was a buddy rappel (i.e., two men on a single rope). This exercise was being conducted to prepare for a South Carolina State Special Weapons and Tactics (SWAT) competition in Spartanburg, South Carolina.

Training in progress at the time was a "buddy rappel" (i.e., two men on a single rope). This exercise was being conducted to prepare for a South Carolina State Special Weapons and Tactics (SWAT) competition in Spartanburg, South Carolina.

Initial training exercises consisted of building entry and clearing techniques on each level of the Security Rappel Tower, concluding with each competition-team member executing a single rappel from the top of the 40-foot tower. The recently installed safety gates were open, with the rope bearing on the edge of the top deck, during regular rappel exercises. Following these exercises, the team practiced the buddy rappel technique over the top of the closed safety gates. The Rappel Master, Team Coach, Rappeller, Buddy, and another team member climbed to the top of the Security Rappel Tower to prepare for the exercise.

The Buddy replied, "Then we'll go over the gate."

The Rappeller asked, "Do we go over or under the gate?" The Team Coach said, "At Spartanburg, they go over the rail." The Buddy replied, "Then we'll go over the gate." The Rappel Master then closed and locked the gates. The rope was routed over the top rail of the gate and down to the ground. The position of the rappel rope prior to the buddy rappel is illustrated in Figure 3-2.

The Buddy attached his seat harness to the back of the Rappeller and prepared for the descent. The Rappeller said "On rappel," indicating a readiness to descend, and the Belayer on the ground responded "On belay," indicating a readiness to slow or stop the Rappeller's descent, if required.

The Rappeller and the Buddy climbed over the gate and stood on the edge of the top of the tower. As they started their descent, the Rappeller experienced difficulty in establishing his body in the "L" position because of his and the Buddy's combined weight of 484 pounds. As the Rappeller maneuvered his feet, the rope moved laterally and slipped approximately 8 inches down into the area between the gates where the gates were pinned together. This slippage enabled

Figure 3-2. Security Rappel Tower and Rappel Ropes

the rope to come in contact with the small-radius edge of the gate lock-pin housing.

The Rappeller landed on top of the Buddy, causing severe chest compression to the Buddy.

When the Rappeller and the Buddy were approximately 10 feet down the wall of the tower, the Belayer perceived that the Rappeller was descending too fast and was not in full control of the descent. His response was to apply tension to the rope to slow or stop the descent. At about the same time, the rope separated where it had been in contact with the small-radius edge of the gate lock-pin housing. The sound of the rope separating was described as a "crack" similar to a small-caliber rifle shot. At about 10:46 a.m., the Rappeller and the Buddy fell approximately 27 feet to the sawdust on the ground level. The Rappeller landed on top of the Buddy, causing severe chest compression to the Buddy.

3.2 Post-Accident Medical Response

Emergency medical response was conducted by qualified Emergency Medical Technicians (EMT). Emergency medical response was provided by SRT EMTs, who were already at the scene of the accident, and by the WSRC Fire Department. All of these EMTs were qualified by the State of South Carolina. At the time of the accident, WSI–SRS sent requests by radio for SR helicopter assistance and by telephone to the SRS Operations Center for ambulance assistance. The Board examined each of these responses separately, in addition to reviewing related emergency-response actions.

3.3 SRT Medical Response

The Buddy was transported by the Savannah River helicopter to University Hospital Emergency Room in Augusta, Georgia, where he was pronounced dead at 11:37 a.m.

The first, immediate medical response was from an SRT competition-team member who was a qualified EMT. The Rappeller and the Buddy were unhooked, and the Rappeller was rolled off the Buddy. The Rappeller complained of pain in his back and neck. The Buddy was nonresponsive, was not breathing, and his eyes were only partially open. Rescue breathing was administered. At first, a weak radial pulse was detected. Rescue breathing was continued, and, after several applications of the technique, no pulse was detected. At this point, cardiovascular pulmonary resuscitation was initiated.

The SR helicopter arrived at about 10:54 a.m. and departed the accident scene at about 11:00 a.m. with the Buddy. He was transported by the SR helicopter to University Hospital Emergency Room in Augusta, Georgia, where he was pronounced dead at 11:37 a.m.

3.4 EMT Medical Response

The two WSRC Fire Department ambulances, Medic 1 and Medic 2, were dispatched at 10:49 a.m. En route, the crews discussed the quickest route to the accident to ensure

they did not lose time and to ensure that Medic 1, the following ambulance, did not become disoriented in the dust-cloud created by Medic 2. Both crews discussed treatment requirements while en route. The crews arrived at the accident site within a minute of each other.

Medic 1 and Medic 2 arrived at the accident scene at approximately 11:04 a.m., which was about 4 minutes after the SR helicopter had departed with the Buddy. Although the primary emergency response was focused on the Buddy, the Rappeller, who reported numbness in his arms and legs, also received first-aid.

Medic 2, with the Rappeller on board, departed for the Medical College of Georgia Trauma Unit at 11:14 a.m and arrived there at 12:07 p.m. The Rappeller was treated and released the same day, with no apparent long-term effects.

3.5 Related Emergency Response Activities

Information obtained from tape recordings made by the SRS Operations Center during the accident time period indicated that conversations between WSI–SRS and individuals calling about the accident were transmitted over an open telephone line.

Interviews indicated that EMT emergency response kits were not standardized at SRS. The WSRC Medical Director recommended the contents to be included in WSRC's EMT kits and had oversight responsibility for them. The WSI–SRS kits were not necessarily standardized with those of WSRC, and there was no oversight of their contents.

The WSI–SRS EMTs provided a quicker response and transportation by helicopter than did the WSRC EMTs by ambulance due to the presence of WSI–SRS EMTs at the accident site. The WSI–SRT EMTs immediately called for the SR helicopter, which took only a few minutes to arrive and depart the accident scene carrying the Buddy.

3.6 Accident and Operations Analysis

A summary of the accident analysis, including discussions of the Security Rappel Tower, safety railings, rappel rope, rope testing, and analytical techniques, is provided in Appendix H. Operations analyses, including mission and policy, operations and training, occupational safety, management systems, and the direct cause of the accident, are summarized in Appendix I. The analysis described in the appendix was used to develop the conclusions discussed in the following section.

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4. CONCLUSIONS

4.1 Mission and Policy

Findings

The Site Safeguards and Security Plan did not include rappelling as a required capability.

- The SRS Site Safeguards and Security Plan (SSSP) was developed to provide formal DOE documentation of the protection strategy for vital SRS facilities. The SSSP did not include rappelling as an SRT operational or tactical response technique for achieving interdiction, interruption, neutralization, or recapture missions.

- SR did not ensure that SRT training requirements approved for the WSI–SRS mission were driven by the SSSP.

- Both SR and WSI–SRS senior management viewed Central Training Academy lesson plans as Department policy; however, NN stated that the plans were training criteria.

Probable Causes

- SR did not make a comparison between the WSI–SRS mission and its training requirements.

4.2 Operations and Training

Findings

- SR required WSI–SRS, by contract, to maintain an SRT that was "highly qualified and trained in aerial/building rappel techniques"; however, there was an absence of documentation to indicate how this capability was to be used.

- SR did not update the WSI–SRS contract to reflect changes in the design-basis threat policy and the evolving site mission. WSI–SRS participation in competitions was not a contract requirement, but SR authorized WSI–SRS participation as being within the perceived contractual scope of work. Success in offsite SWAT competitions was an assessment factor when SR determined award fees for WSI–SRS performance.

- SWAT competition rules were not clearly understood prior to the competition preparations for training. Competition team training did not include:

  - use of the unapproved buddy rappel technique;

  - a top belay safety line;

  - formal rappel safety briefing; or

- formal assignment of responsibility to any one person; instead, these responsibilities were split informally among several SRT personnel.

Rappel Master/Instructor training on the safety risks and dynamics of rappelling was incomplete.

- There has been no WSI–SRS training in buddy rappelling since 1989, and no refresher training had been developed for the WSI–SRS Rappel Masters.

- The WSI-SRS rappelling lesson plan and standard procedure (1-5600, *Rappelling*, Revision 2) did not include references to the Security Rappel Tower gates in tower rappel training.

- Management of the WSI-SRS training program was inadequate to ensure that appropriate lesson plans were developed and that risk analyses were conducted for each type of rappel activity.

- Rappel Instructor/Master training on the safety risks and dynamics of rappelling was incomplete.

Probable Causes

- There was a lack of attention to detail by SR contract performance monitoring personnel, as they did not ensure that the statement of work for WSI-SRS was maintained accurately and reflected current mission requirements. In addition, SR did not clarify the specific correlation between WSI-SRS competition success and subsequent award fee determinations.

- WSI-SRS did not include buddy rappelling as a necessary technique, did not update either the rappelling lesson plans or the rappel procedures, and did not recognize the need to train personnel in the dynamics of rappelling.

WSI-SRS SRT personnel were unprepared to recognize all the potential dynamics of rappelling, unaware of the functions and limitations of the Security Rappel Tower rails and gates, and unprepared to conduct the buddy rappel because the WSI–SRS Training Division had not developed and validated a program for safe conduct of buddy rappel training.

4.3 Occupational Safety

Findings

- Neither WSRC nor WSI–SRS identified fall protection on the Security Rappel Tower as an Occupational Safety and Health Administration (OSHA) requirement. In addition, it appears that neither WSRC nor WSI–SRS was properly staffed with individuals qualified to conduct OSHA inspections. The gates on the Security Rappel Tower, as designed, were unsafe for the training purposes of the tower.

The SRT occupation is one of the riskiest and most hazardous occupations in the United States.

- The SRT occupation is one of the riskiest and most hazardous occupations in the United States, as indicated by injury an illness data.

Probable Causes

- Job safety analyses were not performed by WSI–SRS and other site security contractors to identify safety improvements that could be made in SRT activities. There was neither communication nor concurrence between WSRC and WSI–SRS on the design, fabrication, and installation of the Security Rappel Tower gates. Both the number of WSRC personnel conducting OSHA inspections at SRS and the qualifications of these personnel were inadequate.

4.4 Management Systems

The Department's rappel policy was not adequate to prohibit the use of the unacceptable buddy rappel technique.

Findings

- The Department's rappel policy was not adequate to prohibit the use of the unacceptable buddy rappel technique. SR line management of the WSI–SRS training program was not comprehensive. NN certification of WSI–SRS training did not identify shortcomings in Rappel Master knowledge.

- The Office of Environmental Management's (EM) line management did not focus on security planning and safety issues or on conduct of operations.

- The Office of Environment, Safety and Health (EH) Site Residents' safety oversight of WSI–SRS historically did not include operations and training activities. The EH safeguards and security oversight inspection program did not formally include safety until fiscal year 1995. Analyses of accident and illness statistics have not been comprehensive, and EH safety program management has not provided routine support to the Department's Safety and Security Program.

- SR line management of the WSI–SRS training program was not effective.

- The WSI–SRS safety program was primarily focused on facilities, not on operations and training.

- WSI–SRS supervisors did not meet their responsibility for ensuring that established procedures were followed, that lesson plans and safety analyses were developed for rappelling activities, and that the impact of changes to training facilities was communicated to WSI–SRS personnel.

- Neither SR nor WSI–SRS provided safety or training management of SRT competition activities. The WSI–SRS procedure for rappelling did not assign safety responsibilities beyond the Rappel Master, and the WSI–SRS safety program focused primarily on facilities, not on operations and training.

Probable Causes

- EM line management was focused only on security planning, not on safety and conduct of operations.
- EH safety program management and safety oversight of security operations had a low priority.
- NN certification activities of WSI–SRS training were too narrowly focused.

SR and WSI–SRS line management control was not provided for SRT competition preparations because they were perceived to be outside normal operational and training activities.

- SR and WSI–SRS line management control was not provided for SRT competition preparations because they were perceived to be outside normal operational and training activities.
- SR line management control of security training had a low priority.
- WSI–SRS safety management was ineffective because of a lack of sufficient details regarding safety management responsibilities.
- Ineffective communications and the failure of supervisors to meet their responsibilities led to unsuccessful line management within WSI–SRS.
- The WSI–SRS safety program did not focus on operations and training.

4.5 Accident Analysis Summary

Direct Cause

On the basis of its review, the Board concluded that the direct cause of the fatal rapelling accident was the separation of the rappel rope, which was caused by the combination of the rope coming in contact with the small-radius edge of the gate lock-pin housing and the dynamic loading of the Rappeller and the Buddy on the rope.

The Board concluded that the following major findings indicated a breakdown of several management systems that could have prevented the accident.

- Lack of procedures or protocol for nonroutine buddy rappel training activity;
- No risk analysis for performing unusual training on the recently modified tower;
- Recognition of unsafe conditions during rappelling not ensured by basic principles of rappelling safety in the core training program;
- Poor communications between management and competition training team;
- Poor command and control of rappelling operation by leadership;
- Lack of safety management controls by DOE and WSI–SRS;

- Unclear assignment of safety responsibility in contractor organizations;
- Lack of full utilization of lessons learned from prior rappelling accidents; and
- Lack of firm mission requirements for rappelling and no reevaluation of changing needs.

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5. JUDGMENTS OF NEED

The integration of the Board's analyses and findings resulted in the identification of the following major management system needs for DOE, WSI–SRS, and WSRC.

WSI-SRS Actions

- WSI–SRS needs to expand the focus of its safety program, more effectively use lessons learned, and establish safety responsibilities at each level of the organization.

- WSI-SRS needs to ensure that its Conduct of Operations Program more effectively meets stated program goals, including facility safety analysis, management oversight, and procedural compliance.

- WSI-SRS needs to ensure that the fundamental principles of rappelling are included in training by more effectively utilizing the CTA-trained Rappel Instructors, and needs to verify that all training is supported by up-to-date, approved lesson plans.

- WSI-SRS needs to ensure that management and supervisory responsibilities for SRT training and operations are understood and implemented.

WSRC Actions

- WSRC, in conjunction with WSI-SRS, needs to upgrade emergency response procedures on telephone discipline, standardization of emergency medical technician kits, and the use of SR helicopters in responding to medical emergencies.

- WSRC, in conjunction with WSI-SRS, needs to ensure that all noncompliances with OSHA requirements are identified and that they are coordinated with WSI–SRS for facilities which they occupy.

- WSRC, in conjunction with WSI-SRS, needs to conduct a review of the Security Rappel Tower safety railings to establish a design that meets both the OSHA fall-protection and WSI-SRS training requirements.

SR Actions

- SR needs to improve implementation of the protective forces safety program, conduct of operations, and line management to include a full range of safety surveillance activities in addition to those conducted in support of the award fee process.

- SR, in conjunction with WSI-SRS, needs to review the requirement for rappelling at SRS to determine its further use as an SRT technique.

- SR needs to justify that competitions are within the scope of WSI-SRS contract, satisfy the mission, and are desirable conducted safely.

EM Actions

- EM needs to place greater emphasis on occupational safety and conduct of operations in security and SRT operations at its sites by sponsoring job safety analysis and using other safety management tools to reduce occupational injury rates.

EH Actions

- EH needs to ensure that its safety program management, oversight, and assistance programs include protective force operations and training programs, including a more comprehensive analysis of injury and illness statistics to identify areas that need improvement.

- EH needs to expand the scope of oversight to include occupational safety in safeguards and security activities, specifically in the area of protective force operations and training programs.

NN Actions

- NN, in collaboration with the program offices, needs to develop and disseminate program guidance on Rappel Instructor/Master recertification, dynamics of rappelling training criteria, and participation in high-risk competitions and similar events.

- NN, in collaboration with the program offices, needs to provide management control mechanisms to reconcile protective force rappel training requirements with documented site mission requirements (i.e., the SSSP).

BOARD MEMBER SIGNATURES

The investigation of the Security Rappel Training Tower Fatality at the Department of Energy's Savannah River Site was conducted, and the report prepared, by the following Accident Investigation Board members:

_____ Date August 11, 1995

Robert W. Barber, DOE Chairperson
Office of Field Support
DOE Accident Investigator
U.S. Department of Energy

_____ Date August 11, 1995

John Teske, Board Member
Office of ES&H Residents
DOE Accident Investigator
U.S. Department of Energy

_____ Date August 11, 1995

Mike Stalcup, Board Member
Office of Security Evaluations
U.S. Department of Energy

_____ Date August 11, 1995

Dennis Vernon, Board Member
Office of Security Evaluations
U.S. Department of Energy

_____ Date August 11, 1995

James S. Campbell, Board Member
DOE Accident Investigator
Oak Ridge Operations Office
Engineering Services Division
U.S. Department of Energy

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BOARD MEMBERS, ADVISORS, AND STAFF

Board Chairperson	Robert W. Barber, DOE, EH-53
Member	John Teske, DOE, EH-24
Member	Michael Stalcup, DOE, EH-21
Member	Dennis Vernon, DOE, EH-21
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Advisor	Theodore O. Macklin, Jr., Consultant
Advisor	John D. Simpkins, Consultant
Advisor	Elliott P. Sydnor, Consultant
Advisor	Fredrick J. Borchardt, Central Training Academy
Advisor	David Freshwater, Consultant
Advisor	Raymond Rogers, DOE, EH-51
Advisor	Prakash B. Kunjeer, DOE, EH-22
Board/Site Liaison	Gary Vest, DOE, SR
Legal Counsel	Lucy M. Knowles, DOE, SR
Medical Advisor	James O. Hightower, MD, WSRC
Union Representatives	Moses Cummings, WSI Herbert L. Colman, WSI Martin Hewitt, WSI Gregory Dawson, WSI
MORT Analysis	Rebecca M. McManus, WSRC
MORT Analysis	Dennis R. Hickman, WSRC
Board Administrator	Marilyn Reames, DOE, SR
Report Coordinator	Jan Hill, BSRC-PNL
Report Manager	Tom Martin, Halliburton-NUS
Technical Editors	Catherine E. Brown, TAPS (Volume 1) John Shipman, Halliburton-NUS (Volume 2)
Administrative Support	Donald L. Catlett, WCS Regina Speir, Halliburton-NUS
Stenographers	Aiken Reporting Service, Inc. Alice D. Boni, Court Recorder Sharon G. Owens, Court Recorder Kimberly R. Lawless, Court Recorder

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ACRONYMS

DOE	U.S. Department of Energy
EH	Office of Environment, Safety and Health
EM	Office of Environmental Management
ES&H	Environment, Safety, and Health
EMT	Emergency Medical Technician
MORT	Management Oversight and Risk Tree
NN	Office of Nonproliferation and National Security
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
SR	Savannah River Operations Office
SRS	Savannah River Site
SRT	Special Response Team
SSSP	Site Safeguards and Security Plan
SWAT	Special Weapons and Tactics
WSI	Wackenhut Services, Incorporated
WSRC	Westinghouse Savannah River Company

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APPENDIX B

BOARD MEMBERS AND ADVISORS QUALIFICATIONS

NAME:
Robert W. Barber

AREA OF RESP.: DOE Accident Investigation Board Chairman

ASSOCIATION: U.S. Department of Energy, Office of Risk Analysis and Technology

EXPERIENCE: 36 years

- **U.S. Department of Energy**

  - Over 36 years experience in safety activities including radioisotope licensing, management of large complex nuclear safety projects, extensive appraisal and investigation leadership roles ranging from nuclear safety to worker occupational safety. Led a number of complex engineering design reviews of the safety of nuclear facilities including systems analysis and the effects of steam and water transients in hydraulics systems. Managed DOE's support for the Nuclear Regulatory Commission's reactor safety program which included development and testing of computer codes to predict transient effects in water steam systems. Developed DOE's Technical Safety Appraisal Program which included Assessments of operating practice at DOE's facilities. Recent positions include:

  - Director, DOE Office of Field Support. Responsible for field support and assistance to DOE's worker safety and health, chemical safety, site cleanup, aircraft operations, high explosives and counterfeit parts programs.

  - Director, DOE Office of Risk Analysis and Technology. Responsible for nonnuclear risk analysis, natural phenomena, hazardous materials transportation, and aircraft safety oversight, and policy.

  - Director, DOE Office of Integration. Responsible for analysis and oversight of operational safety issues, safety compliance, safety and health accident/incident analysis, and safety and health training.

  - Director, DOE Office of Nuclear Safety. Responsible for oversight, policy, and assistance in nuclear safety, health physics, and emergency preparedness.

EDUCATION: B.S., Chemistry, Tufts University
B.S., Chemical Engineering, Tufts University

Other: Graduate, Oak Ridge School of Reactor Technology
Charter Member of Federal Senior Executive Service
Graduate, Federal Executive Institute

NAME: James S. Campbell

AREA OF RESP.: DOE Accident Investigation Board Member

ASSOCIATION: U.S. Department of Energy, Oak Ridge Operations, Construction and Engineering

EXPERIENCE: 28 years

- **Construction and Engineering**

  - DOE Certified Accident Investigator. Participated as a board member in four Type A investigations, one Type B investigation and two Type C investigations.
  - Manager. Design and construction of line-item construction projects. Provided oversight of facilities-related programs including site planning and value engineering.

- **U.S. Army Missile Command**

  - Operations and Maintenance of Mechanical Utilities systems.

  - Design and construction of mechanical facilities systems.

- **Private Industry**

  - Designed mechanical systems for construction in paper and chemical industries.

EDUCATION: B.S., Mechanical Engineering, Auburn University
B.S., Forestry, Auburn University
Graduate Studies in Systems Engineering, University of Alabama, Huntsville

NAME: David E. Freshwater

AREA OF RESP.: DOE Accident Investigation Board Advisor

ASSOCIATION: Science Applications International Corporation, Washington, DC (Consultant)

EXPERIENCE: 16 years

- **Science Applications International Corporation, 5 years**

  - Assisted development of DOE Orders and guidance updating the Emergency Management System.

  - Participated in the pilot Technical Assistance Appraisal of the Emergency Management Program at the Idaho National Engineering Laboratory.

  - Participated in 8 Technical Safety Appraisals at Defense Programs facilities.

  - Participated in the DOE Headquarters ORR for Cold Chemical Runs at the SRS DWPF.

  - Participated in the evaluation and control of 17 emergency readiness exercises.

  - Member of the Environmental Protection and Waste Management Technical Review Group for Safety Analysis Reports.

  - Updated the Environmental Protection Agency's plans and procedures for response to a radiological emergency.

- **United States Army, 11 years**

  - Assisted in the development and publication of plans ranging from interregional, superpower conflict to the emergency evacuation of U.S. citizens from a specific country or area.

  - Improved security plans for ten installations against both terrorist and civil disturbance/demonstration threats.

  - Developed emergency evacuation plans for U.S. citizens within a large area of West Germany.

  - Organized and trained the security and medical teams responsible for responding to nuclear accidents/incidents within a wide area of West Germany.

EDUCATION: B.S., Engineering, U.S. Military Academy, New York, 1979
M.S., Technology Management (Pending thesis), Southern College of Technology, Georgia

OTHER: Certified Emergency Manager, National Coordinating Council on Emergency Management, 1994
Engineer-in-Training, Pennsylvania, 1979

NAME: Dennis R. Hickman

AREA OF RESP.: MORT Analysis

ASSOCIATION: Westinghouse Savannah River Company

EXPERIENCE: 12 years

- **Westinghouse Savannah River Company (WSRC)**

  - Security Systems Analysis, Safeguards & Security Systems Department. Conduct and trending analysis on security systems performance. Review policies and procedures impacting security systems Conduct of Operations. Conduct performance tests on new or modified systems.

  - Chairman Security Systems Performance Review Board, Safeguards & Security Systems Department. An established forum to discuss, document, and abate issues impacting security systems Conduct of Operations.

- **Wackenhut Services Incorporated Savannah River Site (WSI-SRS)**

  - Electronic Safeguards & Security System (E3S) Task Force Leader, Planning Division. Development and implementation of plans for integrating the protective force to the E3S.

  - Manager, Zone Operations Division. Protection of assets and personnel against the postulated DOE threat.

- **United States Marines Corps (USMC)**

  - Military Police, NonCommissioned Officer (NCO).

EDUCATION: ABA Business Administration; Phillips College

OTHER: Root Cause Analysis Training (1992)
Certified Protection Profession (CPP) American Society for Industrial Security (ASIS) 1993

NAME:

Janice E. Hill

AREA OF RESP.: DOE Accident Investigation Report Coordinator

EXPERIENCE: 16 years

- **Battelle Seattle Research Center**

  - Researcher. Supports and assists DOE-HQ with Type A Accident Investigation processes and procedures, and provides support for onsite assessments and reviews. Provided onsite administrative support for the Type A Investigation of the Arc Blast at Building 9725 Resulting in an Injury at Oak Ridge, the DOE-HQ Order Compliance Review at the Los Alamos TA-55 facility, and the EH Oversight Assessment of the Operational Readiness Review of the Rocky Flats Building 707.

- **EG&G Idaho, Inc.**

  - Program Administrator. Provided onsite administrative support for the DOE-HQ Type A Accident Investigation of the Hanford Pit Fatality, the DOE-HQ Spent Fuel Initiative, the Chemical Safety Oversight Review at Los Alamos National Laboratory, and the Special Review of OSHA Programs for the Hanford High-Level Waste Tanks. Maintained rosters of consultants and laboratory personnel in all technical disciplines, and staffed assessment and review teams.

  - Report Coordinator. Provided onsite support to the Safety and Health Subteam on the Tiger Team Assessments at Paducah Gaseous Diffusion Plant, the Solar Energy Research Institute, the Los Alamos National Laboratory, the Naval Petroleum Reserves, and the Strategic Petroleum Reserves.

EDUCATION: Coursework in music education through the University of Arkansas at Little Rock and completed coursework in computers and speedwriting through the Eastern Idaho Technical College. Completed numerous professional workshops, general management, and administrative skill courses.

OTHER: Certified Trainer, Crosby Quality Education System

NAME: Theodore O. Macklin, Jr.

AREA OF RESP.: DOE Accident Investigation Board Advisor

ASSOCIATION: Office of Environmental Management Program Office Safeguards and Security Advisor

EXPERIENCE: 19 years

- **U.S. Department of Energy**

  - Support Environmental Management's Office of Facility Management and Transition (EM-60), Rocky Flats Program Office (EM-64), and Office of Safeguards and Security (EM-15).

  - Office of Defense Programs Rocky Flats Program Office (DP-6.1) Safeguards and Security Advisor.

  - Site Security Survey and Exercise Advisor-Protective Force - Rocky Flats Environmental Technology Site; Oak Ridge Y-12, K-25, Paducah Gaseous Diffusion Plant; Lawrence Livermore National Laboratory.

- **U.S. Department of Defense**

  - Team Leader, US Navy "Red Cell" Anti-Terrorist Program.

  - U.S. Navy Special Warfare (SEAL) Officer, SEAL Teams 2 and 6.

  - U.S. Navy Surface Warfare Officer, USS Bowen (FF-1079), Nuclear Weapons Security Officer.

- **Private Industry**

  - General Partner, Security Assistance and Special Operations (SASO). Security planning and exercise development for Fortune 500 companies.

  - Consultant, Brown & Root International Construction Corporation. Planned mine clearing and oil fire operations in the U.S. Sector - Post Gulf War Kuwait.

EDUCATION: MBA, Georgetown University (cand.)
BA, Holy Cross

OTHER: Advisor, President Bush's Commission on Aviation Security and Terrorism, 1990: The Downing of Pan Am Flight 103.

NAME: Rebecca M. McManus

AREA OF RESP.: Accident Investigation MORT System Analyst

ASSOCIATION: Westinghouse Savannah River Company

EXPERIENCE: 23 years

- **Westinghouse Savannah River Company (WSRC)**

  - Team Leader, Safeguards, Security and Emergency Services Division. Development of Security Self Assessment Program including Trends Analysis, Root Cause Analysis, Performance Indicators, tracking Corrective Actions and Issues Management controls.

  - Sector Manager, SS&ES. Management of Protection Program Operations for three Class A facilities containing Category I-IV Special Nuclear Material and classified information up to and including secret/restricted data.

- **E.I. du Pont de Nemours, Inc., Savannah River Plant**

  - Research and Development Supervisor, Management of Laboratory Services Control Room Operations and Facility Custodian.

  - Safety Engineer, Development, compliance, and implementation of safety rules, regulations and OSHA requirements. Conducted Unusual Accident/Incident investigations resulting from unexpected loss of equipment and/or injuries to personnel.

  - Construction Liaison Foreman, Planned and implemented processes to complete Construction/Contractor activities to minimize disruption of production operations.

- **August Kohn and Company, Inc., Mortgage Bankers**

  - Corporate Accountant, Recorded transactions into account ledgers for corporate offices and management.

  - Foreclosure Clerk, Processed foreclosure claims with attorneys for FHA, VA, and Conventional home mortgage loans.

EDUCATION: Associate Degree in Business, Palmer College

OTHER:
Safety Fundamentals, 1985
MORT Accident Investigation, DOE/EG&G, 1986
Managing Safety, 1987
Security Inspection Procedures I, DOE/CTA,1991
Vulnerability Assessment Fundamentals, DOE/CTA, 1992
Sensor System I, DOE/CTA, 1992
Physical Protection Systems, 1993
Root Cause Analysis Workshop, 1994
Performance Based Assessments, 1994
Site Safeguards and Security Planning Workshop, DOE-HQ, 1995

NAME: Barbara M. Reames

AREA OF RESP: DOE Accident Investigation Board Administrator

ASSOCIATION: Manager's Office, U.S. Department of Energy (DOE) Savannah River Operations Office (SR), Aiken, SC

EXPERIENCE: 35 Years

- **U.S. Department of Energy (DOE)**
  - Detailed, Secretary, Manager's Office, SR, Aiken, SC.
  - Division Secretary, Environmental and Laboratory Programs Division, SR.
  - Served as Secretary in Personnel Office, Office of External Affairs, production Division, Safety Division, SR.
  - Detailed Twice, Secretary, DP-6 and DP-60, DOE Headquarters, Forrestal Building, Washington, DC.
  - Detailed, Rocky Flats Resumption Team, Secretary to Assistant Manager for Environment, Safety and Health, DOE Rocky Flats, CO.
- **Richmond County Sheriff's Department, Augusta, GA**
  - Deputy Sheriff/Deputy Jailer Office Manager/Administrative Assistant to Sheriff.
- **Augusta Police Department, Augusta, GA**
  - Office Manager/Executive Secretary to Chief of Police.
  - Collateral Duty as Secretary to Board of Civil Service Commission, Governing Body of Augusta Police and Fire Departments.
- **Johnson Motor Company, Augusta, GA**
  - Office Manager and Head Bookkeeper, Large Auto Dealership.

EDUCATION: Graduate, Academy of Richmond County, Augusta, GA

Courses, University of GA Extension, Augusta, GA

OTHER: Many Courses Secretarial, Administrative, Computer/Systems Administrator, Interpersonal
Federal Women's Program Council Member, SR, Aiken, SC
Federally Employed Women's National Board of Directors,
S.E. Regional Representative, Washington, DC

NAME: Raymond R. Rogers, C.S.E

AREA OF RESP.: DOE Accident Investigation Board Advisor

ASSOCIATION: Office of Occupational Safety and Health Policy, EH-51, Department of Energy, Headquarters

EXPERIENCE: 35 years

- **U.S. Department of Energy**
  - Occupational Safety and Health Manager.
  - Senior Occupational Safety and Health Expert for DOE-wide Worker and Facility Safety.
  - Manager of the DOE Interpretations Guide to OSH Standards.
  - Manager of the DOE 800 Response Line.
  - Team Member, EM-60 Rocky Flats Pre-Turnover Review.
  - Team Member, ES&H Progress Assessment, Idaho National Engineering Laboratory.
- **U.S. Department of Labor, Occupational Safety and Health Administration**
  - Occupational Safety and Health Supervisor/Area Director: Responsible for managing eight professionals in the areas of industrial hygiene, industrial and construction safety within the designated boundaries of the area office.
  - Senior Safety and Health Compliance Officer: Directly responsible for inspecting a wide variety of complex and high risk industrial activities in diverse workplaces.
- **U.S. Air Force**
  - Construction and Utilities Superintendent: Responsible for managing civilian and military professional in areas of contract management for heavy construction and the installation of utility systems at military facilities throughout the United States and overseas.

EDUCATION:

OTHER: Certified Safety Executive, WSO

Certified Civil Engineering Technician

NAME: John D. Simpkins

AREA OF RESP: DOE Accident Investigation Board Adviser

ASSOCIATION: Battelle, Columbus Operations

EXPERIENCE: 25 years

- **Battelle, Human Systems and Performance**

  - Twelve years designing, developing and evaluating professional development, training and performance improvement programs for governments and industry.

  - DOE, Security Evaluations. Participated in numerous inspections and evaluations of protective force training programs at DOE facilities.

  - State of Ohio, Dept of Education. Conducted multi-year statewide studies of the impact of special instructional programs in Ohio schools.

  - US Air Force, Tinker Air Force Base. Managed an ergonomic hazard identification/assessment project for nearly 300 different job types.

  - DOD, OASD-Health Affairs. Developed training requirements to support the operation of new computer technologies in DOD Health Care facilities.

  - DOE/Oak Ridge/IWES. Completed a human factors hazard analysis and training needs for a prototype PCB incinerator operations and maintenance.

- **Prior to Battelle**

  - Vanderbilt University Medical Center. Planning and development of training of technology applications and use for health care professionals.

  - Ten years teaching and curriculum development at major state universities.

EDUCATION: Ph.D. Communication Systems, Ohio University

OTHER: Post Doctoral Program: Information Science and Systems, School of Medicine, University of Missouri-Columbia
Inspection Process Training, DOE Security Evaluation

NAME: Mark A. Smith

AREA OF RESP.: DOE Accident Investigation Board Advisor

ASSOCIATION: Department of Energy, Savannah River Operations Office

EXPERIENCE: 12 years

- **U.S. Department of Energy, Savannah River Operations Office, Aiken, SC**

  - Nuclear Engineer, Operational Programs Division, Office of Environment, Safety, Health and Quality Programs. Responsible for oversight of laboratory operations involving safety, maintenance, engineering, projects, operational readiness reviews, and conduct of operations. Savannah River Site Operations Assessment Program Manager.

  - Nuclear Engineer, Nuclear Safety Branch, Safety Division, Office of Environment, Safety, Health and Quality Programs. Responsible for technical oversight, review and approval of safety analysis reports, technical safety requirements, unreviewed safety questions, operational readiness reviews, authorization basis documents, nuclear criticality safety analyses, and associated programs.

- **U.S. Department of Defense, Department of the Navy, Charleston Naval Shipyard, Charleston, S.C.**

  - Nuclear Engineer, Fluid Systems and Mechanical Engineering Division, Nuclear Engineering Department. Duties included preparation of technical repair and maintenance procedures and engineering oversight of work operations for Naval Nuclear reactor plant fluid and mechanical systems. Developed extensive program for performing primary side steam generator eddy current inspections and repair.

  - Nuclear Engineer, Test Engineering Division, Nuclear Engineering Department. Duties included preparation of test procedures and the conduct of post-maintenance testing for Naval Nuclear reactor plant systems.

EDUCATION: B.S., Mechanical Engineering, Clemson University

OTHER: Board Member on Type A Accident Investigation of Chlorine Release at Argonne National Laboratory - West on April 15, 1994

Board Member on Type B Accident Investigation of H-Canyon Condensate-Induced Water Hammer Accident at Savannah River Site on June 16, 1994

NAME: David R. Spence (DOE Senior Executive Service - Retired)

AREA OF RESP.: DOE Accident Investigation Board Advisor

ASSOCIATION: Lockheed Idaho Technologies Company (Consultant)

EXPERIENCE: 34 Years

- **RI-Tech. Inc, Aiken**
  - Advisor, DOE Fernald Uranium Nitrate Hexahydrate, Operational Readiness Review.
- **Halliburton-NUS Aiken, SC**
  - Member, Type-B Accident Investigation Board, Condensation Induced Water Hammer Accident.
- **Technical and Professional Services, Fayetteville, TN**
  - Advisor, Type-A Accident Investigation Board, Idaho National Engineering Laboratory Chlorine Release.
  - Member, Oak Ridge Field Verification Team, Chemical Safety Vulnerability Review.
- **U.S. Department of Energy, Savannah River Operations Office, Aiken, SC**
  - Assistant Manager, Engineering and Projects.
  - Member, Type-A Accident Investigation Board, Hanford Steam Fatality.
- **U.S. Department of Energy, Strategic Petroleum Reserve, New Orleans, LA**
  - Assistant Manager, Operations and Maintenance/Engineering and Construction.
  - Tiger Team Leader, Sandia National Laboratories.
  - Manager, Isotope Program, Oak Ridge, TN.
- **U.S. Department of Energy, Oak Ridge, TN**
  - Deputy Manager, Centrifuge Machine Office, Gas Centrifuge Enrichment Plant Project.
  - Director, Product Assurance and Acceptance Division.
  - Member, Baseline Assessment Team, Strategic Petroleum Reserve.

- **Northrop Space Laboratories, Huntsville, AL**

  - Director, System Analysis Division.

  - Director, Operations Analysis, Space System Branch.

- **National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, TX**

  - Aerospace Engineer, Space Science Payload System Integration.

- **The U.S Air Force, Tinker Air Force Base, Oklahoma City, OK**

  - Structures Engineer, Aircraft Accident Investigation.

EDUCATION: B.S., Mechanical Engineering, University of Oklahoma
Graduate Studies in Aerospace Engineering

OTHER: DOE Exceptional Service Award (1994)
DOE Accident Investigation Chairman Workshop (1993)
Fundamentals of DOE Operations (1990)
Japanese Methods for Productivity and Quality (Deming-1982)

NAME: Michael L. Stalcup

AREA OF RESP.: DOE Accident Investigation Board Member

ASSOCIATION: U.S. Department of Energy

EXPERIENCE: 24 years

- **U.S. Department of Energy**

  - Protection Program Management and Information Security Inspector, Office of Security Evaluations. Plans and conducts safeguards and security oversight activities of DOE facilities.

- **U.S. Army**

  - Senior Intelligence Analyst, U.S. Forces Korea. Collection and analysis of data, and reporting of results to senior U.S. and Korean government officials.

  - Executive Officer, Military Intelligence Battalion, U.S. Forces Korea. Developed and implemented internal oversight program.

  - Intelligence Analyst, Defence Intelligence Agency. Coordinated intelligence support for the Joints Chiefs of Staff.

  - Company Commander, U.S. Forces Europe. Responsible for the development and execution of operational plans, training program, and safety program.

  - Safety Officer, Air Defense Unit, U.S. Forces Europe. Developed and implemented safety program for geographically dispersed unit.

  - Intelligence Training Officer, First U.S. Army. Coordinated training activities for Reserve and National Guard Military Intelligence Units.

  - Security Officer, Air Defense Unit, U.S. Forces Korea. Planned and implemented security oversight program for nuclear capable unit.

EDUCATION: B.A. Degree History; University of Wyoming

OTHER: U.S. Army Command and General Staff College (1981)

NAME: Elliott P. Sydnor, Jr. - Colonel, U.S. Army (Ret.)

AREA OF RESP.: DOE Accident Investigation Board Advisor

ASSOCIATION: Inspection & Evaluation Team Member, DOE Directorate of Security Evaluation

EXPERIENCE: 45 years

- **U.S. Army**
  - Special Operations & Tactics.
  - Commandant, U.S. Army Ranger School.
  - Instructor, Airborne Dept., U.S. Army Infantry School.
  - Instructor, Company Tactics, U.S. Army Infantry School.
  - Commander, 1st Special Forces Group (ABN).
  - Lecturer, U.S. Air Force, Special Operations School.
  - U.S. Army Ranger Hall of Fame - 1992.
- **Department of Energy**
  - Inspection & Evaluation Team - Protective Force Area.
- **Private Industry**
  - Operations & Training - WATCO.
  - SRT Lesson Plan Writer - WATCO.

EDUCATION: B.S., Physical Education, Western Kentucky University
M.S., Personnel Management, George Washington University, Washington, D.C.

NAME: John W. Teske

AREA OF RESP.: DOE Accident Investigation Board Member

ASSOCIATION: U.S. Department of Energy, Office of EH Residents

EXPERIENCE: 30 Years Occupational Safety and Health

- **Occupational Safety and Health Program Management**
  - U.S. Department of Agriculture.
  - Versar Incorporated.
  - U.S. Fish and Wildlife Service.
  - University of Minnesota.
- **Occupational Safety and Health Compliance and Oversight**
  - U.S. Department of Energy.
  - Occupational Safety and Health Administration.
  - Mining Safety and Health Administration.
- **Accident Investigation Experience**
  - Program Manager DOE Accident Investigation Program.
  - Type A Investigation 1994, Argonne National Laboratory-West Site.
  - Numerous investigations during career.

EDUCATION: B.S. Civil Engineering and Graduate Occupational Safety and Health Studies, University of Minnesota; Master of Business Administration, George Mason University

OTHER: Certified in Comprehensive Practice of Industrial Hygiene; Registered Professional Engineer, California; Certified Safety Professional.
Served on a number of professional association assignments; and instructor or faculty member at Federal training centers, colleges, and universities.

NAME: Dennis L. Vernon

AREA OF RESP.: DOE Accident Investigation Board Member

EXPERIENCE: 24 years

- **U.S. Department of Energy**

  - Security Specialist, Office of Security Evaluations. Serves as a member of the Inspection and Evaluation Team that assesses the adequacy and effectiveness of Department's safeguards and security programs across the Department, including the Protective Force Program.

  - Chief, Inspections and Technical Assessments Branch, Safeguards and Security Division, Savannah River Operations Office (SR). Survey the security posture of facilities and security programs under SR cognizance.

  - Technical Security Specialist, Security Operations Branch, Safeguards and Security Division, SR.

  - Physical Security Specialist, Security Operations Branch, Safeguards and Security Divisions, SR.

- **United Nuclear Corporation**

  - Security Supervisor. Naval Products Division. Responsible for line management of protective force training and operations including response force contingency plans to meet U.S. Nuclear Regulatory Commission and DOE requirements; served as a site Emergency Director.

- **U.S. Department of Treasury**

  - Federal Officer, Executive Protective Service, U.S. Secret Service. Served in the White House and Foreign Missions Divisions; participated on various executive protection details.

EDUCATION: B.S., Administration of Justice, The American University
A.A.S., Police Science, Northern Virginia Community College

OTHER: Certified Protection Professional (1982)

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APPENDIX D

DOCUMENTS REVIEWED

DOE Orders

1. DOE 4330.4A, Maintenance Management Program
2. DOE 5480.4, Environmental, Safety and Health Protection
3. DOE 5482.1, Environmental, Safety, and Health Appraisal Program
4. DOE 5484.19, Conduct of Operations Requirements for DOE Facilities
5. DOE 5484.4, Environmental Protection, Safety and Health Protection
6. DOE 5500.1B, Emergency Management System
7. DOE 5500.3B, Planning and Preparedness for Operational Emergencies
8. DOE 5630.15, Safeguards and Security Training
9. DOE 5632.7A, Protective Force Program
10. DOE 5634.1B, Facility Approvals, Security Surveys, and Nuclear Material Survey

DOE Savannah River Office

11. Savannah River Operations Office Management and Operating Contract for Paramilitary Security Services, Contract Number DE-AC09-93-SR18292, Effective Date September 30, 1993
12. Unannounced Occupational Safety and Health Administration (OSHA) Compliance Inspection No. 94-SD-ISB-0022, June 3, 1994
13. DOE Letter, L. Brown (SR)\L. Brede (WSI), Dated December 20, 1994, Subject: "Authorization to Carry Weapons Off-Site During Calendar Year 1995"
14. WSI-SRS Monthly Maintenance Report, March 20, 1995
15. Maintenance Request, May 13, 1994
16. SRM 1100.6.X.X.1, Organizations, Functions, and Delegations
17. Performance Evaluation Plan for Wackenhut Services, Incorporated, Contract No. DE-AC09-93SR-18292
18. Savannah River Operations Office Contract Plus Award Fee Determinations for Wackenhut Services, Incorporated

19. SRIP 5480.19.1C, Facility Representative Program

20. SRIP 5700.6.12A, SR Technical Assessment Program

21. SR OSS 5482.1.1A, Performing Safeguards and Security Appraisals

22. SR DII 5632.7B, Protective Force Program

Wackenhut Services, Incorporated - Savannah River Site Documents

23. Transmittal of Requested Information - ATTA Range Accident (SRT Statements), April 6, 1995

24. Memorandums of Understanding, Westinghouse Savannah River Company and Wackenhut Services, Incorporated, July 1994

25. WSI-SRS Memorandum: C. Futch/R. Evitts, Dated May 21, 1991, Subject: "Approval to Use Single Rope Rappel for 1991 National SWAT Competition"

26. Security Police Officer III Training Lesson Plan

27. Live Fire Obstacle Course Lesson Plan #93.30.06

28. Tactical Proficiency Evaluation Lesson Plan #93.30.19

29. Helicopter Rappelling Lesson Plan #93.30.28

30. Purchase Order 29291, 11/01/94, Mountain Climbing Rope, 120' Coil

31. WSI-SRS Standard Procedures

    a. 1-01, "Functions and Responsibilities Directive (FARD)"

    b. 1-1002, "Maintenance Management Responsibilities"

    c. 1-3100, "General Safety Procedures"

    d. 1-3105, "Inspection Programs"

    e. 1-3112, "Line Control Safety and Health Program"

    f. 1-3144, "Accident/Injury Review and Investigation"

    g. 1-3151, "Guidelines For ES&H Representatives Program"

    h. 1-3157, "Job Safety Analysis"

    i. 1-3301, "Self-Inspection Program (SIP)"

    j. 1-3304, "Management/Safety Oversight Walkdown"

k. 1-3307, "Environment, Safety & Health and Quality Department Audit, Appraisal and Surveillance Program"

l. 1-3309, "Quality Assurance Surveillances"

m. 1-5600, "Rappelling," Rev. 2

n. 1-6902, "SATA and ATTA Preaccident Plan"

o. 1-6904, "SATA and ATTA Range Operations and Safety Procedure"

p. 1-6912, "Occupational Safety and Health (OSH) Inspections of SATA and ATTA"

q. 1-8100, "Facility/Equipment Repairs"

r. 1-8102, "Operational Readiness Review (ORR) Procedure"

s. 2-301, "Standardized Muster Checklist"

t. 2-305, "On The Job Training Program"

u. 2-321, "Tactical Proficiency Evaluation"

v. 3-5601, "SRT Static Display and/Training Demonstration"

w. 3-5617, "WSI-SRT National SWAT Competition Selection Process"

x. 3-6006, "Incorporation of Lessons Learned Into Training Program"

y. 3-6601, "Rappel Training for SRT"

z. 3-6900, "Range Safety Officer Responsibilities"

Westinghouse Savannah River Corporation Documents

32. WSRC 2Q2 Manual

33. Memorandums of Understanding, Westinghouse Savannah River Company and Wackenhut Services, Incorporated, July 1994

34. Facility Evaluation Board Report - B-Area Facilities (U), ESH-FEB-95-0515, March 8, 1995

35. Procurement SSD-CWE-943148, August 18, 1994 (Rappel Tower Safety Rails and Repair)

36. An Evaluation of Rappelling Rope Capacity and Loading, WSRC-TR-95-1094

Occupational Safety and Health Administration Documents

37. Code of Federal Regulations 29 CFR 1910.23, Guarding Wall and Floor Openings and Holes

38. Code of Federal Regulations 29 CFR 1926.500, Guardrails, Handrails and Covers

Central Training Academy Document

39. CTA Rappel Instructor Course and Lessons Plan

Other Documents

40. Martin, Tom, Rappelling, Edition II, Search, Mt.Sterling, KY, 1988

41. Military Mountaineering, Training Circular 90-6-1, Dated April 1989, Published by the U.S. Department of the Army, Washington, D.C.

42. Ranger Handbook, Study Text 21-75-2, Dated October 1980, Published by the U.S. Department of the Army Infantry School

43. Special Tactical Training for the Response Force, Tactical Training Manual 1-III, DOE/DP/30319-3, Dated 1985, Prepared by Criterion Referenced Consultants, Incorporated, Under Contract Number DE-AC01-83DP30319 and Published by the U.S. Department of Energy, Office of Safeguards and Security

44. Guide for Implementation of Safeguards and Security Directives, Chapter III, Dated March 10, 1995, Published by the U.S. Department of Energy, Office of Safeguards and Security on March 17, 1995

45. 2nd Annual SWAT Competition Announcement, Spartanburg County Detention Facility, Spartanburg, SC, April 13 - 15, 1995.

46. DOE Emergency Management Guide, June 26, 1992

APPENDIX E

INDIVIDUALS INTERVIEWED

Name	Position	Organization
Borchardt, Fredrick J.	Senior Tactical Instructor	DOE Central Training Academy, Albuquerque
Bowling, Larry	Range Manager	Wackenhut Services, Inc.
Brede, Jr., Lawrence	Sr. Vice President and General Manager	Wackenhut Services, Inc.
Brooks, Lee G.	Director	Wackenhut Services, Inc., Training Division
Brown, George	President	Brown Welding Company
Brown, James	Director	Wackenhut Services, Inc., Environment, Safety, and Health
Brown, Sr., Larry	Deputy Director	DOE-SR, Security Management Division
Burge, Robert A.	Industrial Security Specialist	DOE-SR, Office Safeguards and Security
Carney, Ritchie	Manager	DOE Headquarters, Office of Safeguards and Security
Cooksey, Tommy	Sergeant	Wackenhut Services, Inc., Special Response Team (SRT) Training Division
Crouch, William S.	Emergency Medical Technician	Wackenhut Services, Inc., SRT
Davis, Robert L.	Range Safety Officer and Firearms and Instructor	Wackenhut Services, Inc., Training Division
Dawson, Greg	Safety Chairman	Wackenhut Services, Inc.
Drury, David	Industrial Safety Engineer	DOE-SR, Office of Safety
Evitts, Rex	Commander	Wackenhut Services, Inc., SRT
Frischmann, William M.	Lieutenant	Wackenhut Services, Inc., SRT
Gann, William	SPO-3	Wackenhut Services, Inc., SRT
Godbee, Dennis	Senior EH Resident	DOE Headquarters (EH-24)
Greene, Jeffrey Guy	Special OPS Training Instructor	Wackenhut Services, Inc.

Name	Position	Organization
Hall, Kevin	Acting Eastern Regional Manager	DOE Headquarters (EH)
Harrison, Don W.	Deputy Manager	Central Service of Works Engineering
Hendricks, William D.	Manager	Wackenhut Services, Inc., Special Operations Training
Hudson, Todd	SPO-3	Wackenhut Services, Inc., SRT
Luther, Archie	SPO-3	Wackenhut Services, Inc., SRT
McCoy, III, Frank R.	Assistant Manager	DOE-SR, Environment, Safety, Health and Quality
Mitchell, Ronald W.	SPO-3	Wackenhut Services, Inc., SRT
Moore, Bobby	SPO-3	Wackenhut Services, Inc., SRT
Ogletree, Larry	Director	DOE-SR, Office of Safeguards and Security
O'Neil, Larry	Senior Instructor	Wackenhut Services, Inc., Special Operations Training Division
Pollock, Angie	Section Secretary	Wackenhut Services, Inc., SRT
Powers, Larry	Director	Spartanburg Co. Detention Facility
Reynolds, Thomas E.	Deputy Director	DOE-SR, Office of Procurement and Contractor of Human Resources
Rosier, H. Therese	Manager	Westinghouse Savannah River Company, B-Area Administrative Facilities Management Department
Shelt, T. Steven	Team Leader	DOE-SR, Office of Safeguards and Security, Security Management Division
Smith, Walter	SPO-3	Wackenhut Services, Inc., SRT
Spears, J. Terrel	Deputy Director	DOE-SR, Quality Programs Division
Tussey, Ernest H.	Director	Wackenhut Services, Inc., Special Operations Division
Underwood, Mack	Chief Investigator	Wackenhut Services, Inc.
Vest, Gary	Industrial Security Specialist	DOE-SR, Office of Safeguards and Security

Name	Position	Organization
Panel Discussion:		
Mark Barnwell	SRT Members	Wackenhut Services, Inc.
Kevin "Spike" Gregory		
Jeffrey "Bones" Hammonds		
James Reid		
Jack Sellnet		
Billy Thornton		
Jerry Zaun		
EMT Group Interview:		
James O. Hightower, M.D.	Manager	Westinghouse Savannah River Corporation, Medical Dept.
Chris Alverson	Fire Captain	SR Fire Department
Johny L. Simmons	Shift Lieutenant	SR Fire Department
Michael "Kevin" Faircloth	Fire Fighter, EMS Driver	SR Fire Department
William Robinson, Jr.	Station Lieutenant	SR Fire Department
Greg Brooks	Registered Paramedic	SR Fire Department
SRT Group 1		
Chris Allen	SRT Members	Wackenhut Services, Inc.
Garland M. Slater, Jr.		
Dereck Gillespie		
Jeffrey Stroda		
Britt Burbury		
David Sewis		
Walter Smith		
Clay Still		
Wesley Earhart		
Harold Carter		
Bennie Efird		
Ron Mitchell		
Jerry Brown		
Levin Gregory		
Billy Thornton		
Doug Oglesby		
Greg Dawson		

Name	Position	Organization
SRT Group 2		
Clay Bryant	SRT Members	Wackenhut Services, Inc.
Mark Moon		
Archie Luther		
Frank Seaman		
Travis Fulmer		
Greg Rowland		
Karl Summers		
Eric Frails		
Rock Slaughter		
Stan Crouch		
Charles Ashe		
Patrick Murphy		
Shirley Frye		
Jeff Langley		

APPENDIX H

ACCIDENT ANALYSIS

Security Rappel Tower

The Board arrived at the Savannah River Site (SRS) on April 4, 1995, and took responsibility for the Security Rappel Tower and the equipment associated with the accident. Wackenhut Services Incorporated–Savannah River Site (WSI–SRS) had posted a 24-hour guard at the entrance to the Advanced Tactical Training Academy-Rappel Tower shortly after the accident. Because rain and wind were predicted, WSI–SRS had also erected a tent and covered the Rappel Tower gates with clear-plastic sheeting to preserve the scene of the accident, as shown in Figure H-1.

The Board concurred with the actions taken and agreed that WSI–SRS should continue to maintain security at the Security Rappel Tower until it was returned to them for training operations.

Based on a review of meteorological conditions at the time of the accident, the Board determined that weather was not a factor in the accident. On the day of the accident, the sky was clear, the temperature did not exceed 70 degrees Fahrenheit, and the wind was from the north at 9 miles per hour.

The gate lock-pin housing that was in contact with the rope at the time of the separation is shown in Figure H-4. Rope fibers can be seen next to the edge where the rope abraded prior to the separation.

The Security Rappel Tower was examined by the Board, as was all of the accident-related equipment, both on the tower and at the base of the tower.

The Security Rappel Tower was examined by the Board, as was all of the accident-related equipment, both on the tower and at the base of the tower.

When the accident occurred, the elasticity of the rope caused it to recoil from the gate at the top of the Security Rappel Tower. The rope and the area in which it came to rest following the accident are shown in Figure H-2. The gate had been opened after the accident, before this photograph was taken.

A closeup view of the rope separation at the top of the tower is shown in Figure H-3. The gate lock-pin housing that was in contact with the rope at the time of the separation is shown in Figure H-4. Rope fibers can be seen next to the edge where the rope abraded prior to the separation.

The impact area of Rappeller and the Buddy, at the base of the Security Rappel Tower, is shown in Figure H-5, as seen from the top of the tower. Another view of the impact area is shown from ground level in Figure H-6. The rope used for single-person rappels was still in place on the tower at the time this photograph was taken. Another view of the impact area and the rope in use at the time of the accident is shown in Figure H-7. A closeup of the separated rope, as it came to rest after the accident, is shown in Figure H-8.

On April 7 and 10, 1995, respectively, the Assistant Secretaries for Environmental Management (EM) and Defense Programs signed memoranda suspending all rappelling operations conducted for such purposes as training, initial qualification, requalification, certification, and competition at all EM sites. (See Appendix Q

in Volume II of this report.) This suspension did not prohibit currently qualified individuals from rappelling during emergency lifesaving operations. The Board concluded its examination of the Security Rappel Tower and returned it to WSI–SRS for normal range operations, with the exception of rappelling, on April 17, 1995.

Security Rappel Tower Safety Railings

The Security Rappel Tower is approximately 40 feet high, and three levels are used for training purposes. The tower was constructed in 1983. Originally, the Security Rappel Tower had barrier chains installed at each level as fall protection. However, during a Savannah River Operations Office (SR) Safety Division occupational safety and health (OSH) inspection of the tower, the chains were judged to be inadequate to meet Occupational Safety and Health Administration (OSHA) fall-protection requirements. Correction of this deficiency was a factor in the rappelling accident.

Addressing the OSHA requirement for better fall protection in lieu of barrier chains led to the installation of new safety railings on the Security Rappel Tower.

Addressing the OSHA requirement for better fall protection in lieu of barrier chains led to the installation of new safety railings on the Security Rappel Tower. These railings were designed as gates that could be opened for training exercises. The fatal buddy rappel was conducted over these gates although they were not designed for that purpose.

The Rappel Rope

Most rappel ropes are constructed using twisted, braided, or plaited nylon-yarn fibers. This process is illustrated in Figure H-9. The rope being used for the rappel training exercise at the time of the accident was a 7/16-inch diameter, "Military Green Line," twisted-nylon, mountaineering-operations rope that measured 93 feet, 4 inches in length. The rope was 120 feet long when purchased and had apparently been shortened by 26 feet, 8 inches. The shortening had no bearing on the accident, as the Board found the length of the rope was not a relevant factor.

The rope was purchased from the Defense Industrial Supply Center under Federal Stock Number 4020-00-931-8793. This is consistent with Revision 2 to WSI–SRS Standard Procedure 1-5600, *Rappelling*, which defines the requirements for rappel rope.

The maximum recommended load for the rope that was involved in the accident is 315 pounds (0.07 x 4,500). The actual weight of the Rappeller and the Buddy plus their gear was estimated to be 484 pounds.

When a rope is used for rappelling, a working load of 7 percent or less (a safety factor of 15:1) is recommended. The working load is defined as the percent of the tensile strength of the rope that should be used for rappelling. The maximum recommended load for the rope that was involved in the accident was 315 pounds (0.07 x 4,500). The actual weight of the Rappeller and the Buddy, plus their gear, was estimated to be 484 pounds.

Figure H-2. Top of Security Rappel Tower

Figure H-3. Closeup of Rappel Rope

Figure H-5. Impact Area as Seen from Top of Rappel Tower

Figure H-6. Impact Area as Seen from Ground Level

Rope Testing

The acceptable minimum tensile strength of the rope, as stated in the WSI–SRS rappel procedure, was 3,840 pounds. This was determined to be inconsistent with the tensile strength of 4,500 pounds specified for the rope purchased under the Federal Stock Number referenced above. The origin of the 3,840-pound tensile strength was found to be taken from a Department of the Army Training Circular, C1, TC 90-6-1, dated 30 September 1976, entitled, *Military Mountaineering*. This reference states: "Nylon rope is most commonly used in climbing. The rope is 1.1cm (11mm) in diameter and is issued in 36-1/2 meter lengths. The actual separating strength when dry averages 3,840 pounds (±5 percent). The separating strength is reduced by 18 percent when the rope is wet."

Sections of the rope involved in the accident and a new "reference" rope, which was taken from inventory, were subjected to tensile testing by Westinghouse Savannah River Company to determine if the rope met the original specification tensile requirement of 4,500 pounds. Tests were also conducted to simulate the small-radius edge of the safety gate lock-pin housing that caused the rope to separate. In addition, static and dynamic analyses were conducted to determine the actual loads on the rappel rope at various positions of the Rappeller during the descent. Forces in the Rappeller's legs that were required to maintain the combined center of mass at various distances from the Security Rappel Tower wall were also calculated.

The average separating strength of the reference rope taken from inventory was 5,600 pounds. The average separating strength of the rope involved in the accident was 5,370 pounds. Both ropes exceeded the tensile strength requirement of 4,500 pounds found in the rope specification.

The average separating strength of the rope involved in the accident, when subjected to the same conditions, was 783 pounds.

The average separating strength of the reference rope over a small- radius edge simulating the safety lock-pin housing was 767 pounds. The average separating strength of the rope involved in the accident, when subjected to the same conditions, was 783 pounds.

The static rope tension force present during the rappel was the combined weight of the Rappeller and the Buddy (i.e., 484 pounds). The dynamic shock load on the accident rope, due to its sliding from the top rail of the gate to the pin housing, which is a 7.25-inch vertical drop, was calculated to be between 780 pounds and 1,150 pounds, depending on the stiffness of the rope and the position of the Rappeller relative to the tower wall. Assuming an average value of 965 pounds, the dynamic load on the rope exceeded the load capacity of the rope when in contact with the small radius of the lock-pin housing, resulting in separation of the rope.

Analytical Techniques

The Board used several analytical techniques to examine the events that contributed to the fatal accident.

The Board used several analytical techniques to examine the events that contributed to the fatal accident, including change analysis, barrier analysis, fault tree analysis, and events and causal factor analysis.

The significant departures from normal operating conditions that preceded the accident are discussed in Volume 2 of this report under the section entitled Change Analysis. The performance of barriers and controls that could have prevented the accident are also discussed in Volume 2 of this report under the section entitled Barrier Analysis.

The fault tree analysis was developed using a MORT logic diagram. The MORT logic diagram is a model of the generic events, basic events, and conditions that represent failures in the management control system. See Section 3 of Volume 2 for five fault tree analyses of this accident.

Causal Factor Analysis

Causal factors are classified as either probable or root causes.

The causal factor analysis presented in Table H-1 uses techniques from MORT-based root cause analysis and the Institute of Nuclear Power Operation's Good Practice OE-907, *Root Cause Analysis*. Causal factors are classified as either probable or root causes. This classification is used to differentiate (1) causes that, if corrected, would not by themselves prevent the accident but are important enough to be recognized as needing corrective action to improve the quality of the process; and (2) fundamental causes and associated corrective actions that, if corrected, will prevent recurrence of an event or adverse action.

The Board performed an analysis of oversight issues to determine those barriers whose failure could have been prevented by the exercise of DOE's oversight responsibility. Table H-2 presents the results of this work. Table H-3 summarizes the change analysis.

The static rope tension force present during the rappel was the combined weight of the Rappeller and the Buddy (i.e., 484 pounds). The dynamic shock load on the accident rope, due to its sliding from the top rail of the gate to the pin housing, which is a 7.25-inch vertical drop, was calculated to be between 780 pounds and 1,150 pounds, depending on the stiffness of the rope and the position of the Rappeller relative to the tower wall. Assuming an average value of 965 pounds, the dynamic load on the rope exceeded the load capacity of the rope when in contact with the small radius of the lock-pin housing, resulting in separation of the rope.

Table H-1. Causal Factor Analysis

Root Causes	Discussion
Management	Management did not specifically assign responsibility for hazard evaluation and identification to SRT supervision. As a result, management was not in control of the SWAT competition training process. Management did not provide for organizational communication between WSRC and WSI-SRS on the need for a safety review and risk analysis on the safety railings. The management control system was less than adequate.
Training	The SWAT competition training program was informal, was not based on approved lesson plans, and improperly exposed personnel to hazardous rappelling activities. The training did not use a graded approach with progression to the hazardous rappelling activities. There was no provision for risk-free failures in the training activities.
Policy Implementation	Policy and mission requirements conflict with policy implementation in the SR/WSI-SRS contract. This resulted in the WSI-SRS interpretation of rappelling as a mission requirement from the contract. Safety policy implementation was insufficient in that supervision was not specifically responsible for evaluation and identification of hazards and risks encountered in the performance of SRT training duties. Safety responsibilities are not identified in position descriptions. Safety policies did not control the training process in the SWAT competition training.
Risk Assessment and Hazard Analysis	A risk analysis was not performed during design on the new safety railings on the Rappel Tower. The hazards to rappelling activities were not identified and evaluated, and barriers and controls were not in place to protect team members.
Conduct of Operations	Conduct of operations as implemented by WSI-SRS was deficient because: • The safety and risks associated with the Rappel Tower were not assessed. • Supervision was not required to inspect the Rappel Tower. • A design safety risk assessment was not performed on safety modifications to the Rappel Tower to ensure the modifications did not present additional risk to rappelling operation. • Management oversight of the Rappel Tower was not adequate to ensure the training workplace was free from hazards that affect employees. • Lesson plans were not in place for SWAT competition training, particularly the hazardous activities - Buddy Rappel and single-rope rappel. • Policies and procedures did not ensure that the trainee personnel were effectively utilized and aware of all rappelling limits and hazards. • There was not a barrier in place to prevent use of the safety railings beyond the operational capabilities. • Acceptance criteria were not documented for returning the Rappel Tower to safe operation following the modifications. • There was no provision in required reading for notifying personnel of the tower modifications. • There was no ES&H safety walkdown of the tower modifications following safety rail installation or prior to rappelling.
DOE Oversight	Oversight did not reveal deficient conditions in WSI-SRS conduct of operations training and safety in rappelling operations.

Table H-1. Causal Factor Analysis (continued)

Probable Causes	Discussion
Procedures	Procedures in effect at the time of the rappelling accident did not provide progression of safety responsibility, rope awareness and improperly granted an exception to rappelling on two ropes without an annual safety review.
Safety	The WSI-SRS ES&H organization did not conduct a safety inspection following the installation of the new safety railings on the Rappel Tower and did not evaluate the risks involved in the rappelling activities. WSRC did not provide a safety review of the safety rail design and did not perform a safety analysis of the interface between the safety rails and rappelling operations.
Supervision	Although supervisors are assigned responsibility for safety in procedures, the flowdown of this assigned responsibility is not contained in position descriptions of supervisors in the SRT ranks. This caused the safety railings modification not to be inspected by supervisors present at the accident scene. The rappelling procedure does not assign supervision responsibility for inspection of Rappel Tower modifications.
Design	Failure to conduct a safety review of the safety railings during design resulted in a lack of identification and evaluation of risks to tower fall protection during rappel activities. Barriers were not designed and installed on the safety railings prior to the start of the SWAT competition training. This was caused by a lack of a risk analysis and identification of the safety precedence sequence for the barriers.
Communications	The intent to train on the hazardous Buddy Rappel was not properly communicated to higher supervision nor was it properly discussed by supervision prior to the training. Information pertaining to the safety railings on the Rappel Tower was not adequately communicated to SRT personnel.
Equipment	New safety railings were installed on the Rappel Tower without an adequate safety review to identify the interface between rappelling operations, safety, and procedural requirements for inspections. Safety railings were used for rappelling, an activity for which they were not intended. The new safety railings were not inspected by WSI-SRS ES&H Division and SRT supervision.
Operational Readiness	The safety railings were not ready to be placed into service, and there was not a requirement for an operational readiness review. An operational readiness review with the user, designer, and Safety Division representative could have revealed the interface between rappelling operations and the hazardous safety railings.

Table H-2. Performance of Barriers

Barrier	Purpose	Performance
WSI-SRS Standard Procedure 1-5600, "Rappelling," Rev. 2	To standardize procedures for all rappel operations and outline responsibilities for their safe conduct.	Barrier failed because procedure was not followed.
SPO III Core Curriculum Risk Analysis	To determine the risk involved in conducting SPO III core curriculum training.	Barrier failed because the risk analysis does not address the types of rappel and does not address the hazards involved in Buddy Rappel.
ATTA Safety Analysis Report	To determine the risk involved in operating the ATTA range facilities.	Barrier failed because: • Risk analysis does not cover the Rappel Tower and the two hazards associated with the fall protection. • Risk analysis was not amended to address fall protection modifications (new handrails).
Training for Rappel Master	To provide Rappel Master with guidance to safely exercise overall control and coordination of rappelling activities. The emphasis is on providing safe and effective rappel operations.	Barrier failed because: • Provisions were not made for refresher training for onsite Rappel Masters. • Hazardous Buddy Rappel was not addressed as a training exercise to be continued or discontinued. • Training does not specifically address safety responsibilities of Rappel Master or CTA Training Instructor. • CTA-trained Rappel Instructors were not providing refresher training to SRS-certified Rappel Masters.
Communications	To provide SRT members with information required to conduct rappelling activities safely and efficiently.	Barriers failed. Team Coach did not determine that two men on a rope resulted in disqualification at the SWAT competition. Lack of this information resulted in SRT members initiating training for Buddy Rappel.
Final Acceptance Inspection of Safety Rails	To determine that acceptance criteria for safety rail installation are satisfied including safety inspection.	Barriers failed because safety inspection did not reveal presence of small radius edge on safety rail gate pin-housing.
Two-Rope Rappelling	To provide a safe rope if the main rappel rope separates.	Barrier failed because single-rope rappelling was being used to simulate SWAT competition conditions.

Table H-2. Performance of Barriers (continued)

Barrier	Purpose	Performance
Management Policy	To provide guidance and requirements for the development of the containment protection strategy and the associated risk acceptance for vital SRS facilities.	Barrier failed because SR and WSI-SRS did not properly implement policy requirements of DOE 5632.7A. This resulted in a contractual requirement for rappelling in the SR/WSI-SRS contract.
Knots and Anchors	Anchors are devices of sufficient strength to support loads on rope. Knots are used to fasten rappel ropes to anchors.	Did not fail.
Scuff Pads or Protective Mats	Protect ropes from damage by sharp objects.	Barrier failed because scuff pads were not used to cover safety rails or lock-pin housing.
Rappel Master Duties	Duties provide for ensuring safety of all personnel utilizing the Rappel Tower or helicopter rappel lanes.	Barrier failed because: • Rappel Master did not stop unsafe act of placing rope on top of safety rails. • Rappel Master inspection of handrail did not reveal small radius edge on lock-pin housing. • Rappel Master did not ensure safe and orderly progression of training.
Dynamic Line Around Rappeller's Waist	Provide safety rope to support Buddy during Buddy Rappel.	Did not fail.
Rope Awareness	Provide awareness of rope pathway to avoid placing rope in a hazardous location.	Barrier failed because personnel involved with Buddy Rappel did not maintain proper awareness of rope position relative to small radius edge of lock-pin housing.
Top Belay	Provides slowing or stopping action of Rappeller from tower top.	Barrier was not used because of simulation of ground belay from SWAT competition.
Ground Belay	Provides slowing or stopping action of Rappeller from ground.	Barrier did not fail. Ground belay slowed and stopped rappellers; however, rope separated upon contact with small radius of lock-pin housing.
Rope	7/16-inch diameter nylon, 4,500-pound tensile strength provides support to Rappeller during rappelling activities.	Barrier failed. Rappel rope separated upon contact with small radius edge of lock-pin housing.

Table H-2. Performance of Barriers (continued)

Barrier	Purpose	Performance
Warning Signs	Identification of safety rails as fall protection and forbids use in rappelling.	Warning signs were not present because design was not coordinated with Safety or WSI-SRS user.
Human Performance (Good Judgment, Training, and Qualifications)	Assists in interpretation of requirements to ensure safe execution, enhances ability to perform job, and guides on-the-job behavior.	Barrier failed. Task was undertaken for which lack of training did not provide qualifications; poor judgment in undertaking this task led to task performance errors.
WSI-SRS Procedure 1-811, "Facility/Equipment Repairs"	Establishes a procedure for the management of WSRC work requests for WSI-SRS facilities where there is a potential to degrade security or safety and health of employees.	Barrier failed because procedure did not require a safety review, risk analysis, and hazard identification of the Rappel Tower fall protection (handrails) modifications.
Conduct of Operation	To develop directives, plans, and procedures that, when implemented, will result in the improvement of quality and uniformity of operations.	The procedures and directives developed by WSI-SRS for the conduct of operations were not implemented in rappelling operations at the ATTA range.

Table H-3. Change Analysis

Change or Difference		Analysis	
Planned/Normal	Present	Difference	Analysis
Safety rail gates open	Safety rail gates closed	With gates open, the rappel is performed from the scuff pad on the tower floor. With gates closed, the rappel was done with rope on top of the safety rail.	The decision was made to Buddy Rappel with the rope on top of the safety rail and with the gates closed.
Scuff pads on edge of tower floor	Scuff pads were not used on top of safety rails	Rope contacted small radius edge of lock-pin housing.	The rappel rope received no protection from the small radius edge of the lock-pin housing.
Top belay	Ground belay	Only the ground belay was available as fall protection for the rappellers.	This condition resulted from the decision to conduct training simulating SWAT competition conditions.
Single Rappeller on rope	Buddy Rappel	Buddy Rappel increased static load on rope to 484 pounds. Rope actually separated on small radius edge with a dynamic load of 965 pounds.	Caused by team's desire to streamline rappelling activities for SWAT competition.
Two-rope rappel	Single-rope rappel	Single-rope rappel offers much less load support for Rappeller.	Two-rope rappelling is required at WSI-SRS for all rappelling activities except SWAT competition training. This exception is too broad and training requirements should be reviewed by Safety each year.
Chain and post fall protection	Safety rail/gates fall protection	Safety rail/gates fall protection present two hazards to tower users.	Created a climb over obstacle and potential for a rope pathway hazard.
Rope awareness and pathway	Lack of rope awareness and pathway	Rappeller unaware of rope pathway, fall line, and hazards.	Lack of awareness of rope pathway contributed to rope contacting small radius of lock-pin housing.
Rappel Master training discontinued	SRT not proficient in performing hazardous task (Buddy Rappel).	Management has not addressed the requirement for the Buddy Rappel as a useful rappel.	Buddy Rappel use is continued without regard to its hazard potential.

Table H-3. Change Analysis (continued)

Change or Difference		Analysis	
Planned/Normal	Present	Difference	Analysis
Risk Analysis - SPO III Core Curriculum 6/17/94	Risk analysis does not reflect new safety rails	The hazards involved in rappelling with the rope on top of the safety rail.	A risk analysis performed on the new fall protection should reveal the hazard to the rope caused by the small radius edge of the lock-pin housing.
Lesson plans for training	Lesson plans not required for SWAT competition training	Training is informal, not reviewed by Safety, and not approved by management.	SWAT competition training is informal, planning is insufficient, and hazardous activities are included.
Rappel practices well established in Procedure 1-5600 and SRT training procedures.	SWAT competition rappel practices not known by SRT members.	SRT members begin training using rappel practices that are illegal under competition rules.	The use of the hazardous buddy rappel was introduced into training because competition rules were not known by SRT members.
Rappel Procedure 3-6601 requires a visual inspection of the tower prior to each iteration of rappelling.	Inspection of safety rails not performed - procedures not followed.	Safety rails were not inspected for rope pathway hazards - small radius edge.	Lack of inspection led to hazardous rope pathway during SWAT competition training.
Procedure 1-3146 requires inspection of stationary rappel by appropriate safety personnel prior to each rappel training class.	Procedures not followed.	Safety rail fall protection not integrated with rappelling operation hazards.	Lack of inspection resulted in safety rail being used as a rappelling device and exposure of rope to pathway hazard.
Rappel rope placed on tower floor for rappelling from tower.	Rappel rope placed over top of safety rail.	Rope placement change to a more hazardous pathway.	Rope pathway change was made to simulate training under SWAT competition conditions.

APPENDIX I

OPERATIONS ANALYSIS

Mission and Policy

SRT operational and tactical response plans, which are required to be integrated within the SSSP, did not identify an aerial/building rappelling mission for the SRS SRT.

DOE 5632.7A, *Protective Force Program*, does not contain a prescriptive requirement for the Special Response Team (SRT) to have a rappelling capability; however, rappelling may be justified by site-specific conditions. The Site Safeguards and Security Plan (SSSP) documents the containment protection strategy and the associated risk acceptance for vital Savannah River Site (SRS) facilities, as approved by the Department. SRT operational and tactical response plans, which are required to be integrated within the SSSP, did not identify an aerial/building rappelling mission for the SRT.

The Office of Nonproliferation and National Security (NN) advised the Board that Department of Energy (DOE) sites are required to follow Central Training Academy lesson plans. Rappel training is required for the SRT Qualifications Course, unless an "exception" has been granted by NN. Since NN requires an exception for a capability (rappelling) that is not required by DOE 5632.7A, it fosters the belief that Central Training Academy lesson plans are Department policy and, therefore, implementation is required.

Operations and Training

Interviews with Savannah River Operations Office (SR) and Wackenhut Services, Incorporated-Savannah River Site (WSI–SRS) management provided several explanations as to why SRT rappel operation requirements were contained in the WSI–SRS contract. One of the explanations was that because the Central Training Academy teaches a formal rappelling course, it was perceived as a Department policy requirement by SR and WSI–SRS senior security management and, therefore, required by contract.

Site-specific needs did not support the rappelling operations identified in the contract, regardless of how the status of Central Training Academy lesson plans was perceived.

The Board examined SR and WSI-SRS explanations and found them unsupported by site-specific needs as defined by the SSSP. Although some explanations had merit, based on NN interviews and DOE 5632.7A requirements, site-specific needs did not support the rappelling operations identified in the contract, regardless of how the status of Central Training Academy lesson plans was perceived. The need for the current SRT rappelling contractual requirement, first contained in the 1988 WSI–SRS contract, was not reassessed by SR management, despite changes to the DOE Design Basis Threat Policy, SRS mission requirements, and SSSP protection strategy.

The relevance of the buddy rappel technique to DOE or SRT operations is obscure. The Special Weapons and Tactics (SWAT) competition team viewed the buddy rappel technique strictly as a method of increasing their chances of winning the competition by descending two rappellers at one time to reduce the overall event completion time.

The competition team knew there would be a timed rappelling event at the Spartanburg SWAT competition and concluded that the buddy rappel might be a solution to reducing the event task time.

The competition team knew there would be a timed rappelling event at the Spartanburg SWAT competition and concluded that the buddy rappel might be a solution to reducing the event task time. Both WSI–SRS SRT management and WSI–SRS training management were presented with several opportunities to explicitly direct the exclusion of the buddy rappel technique from the competition training, but they did not.

The presence of a multi-faceted command and control structure at the Advanced Tactical Training Academy facility on the morning of the accident resulted in competition event training responsibilities being informally split among several SRT personnel. This fragmentation of command and control authority precluded any opportunity for a focused, carefully directed training and safety regimen overseen by a single leader. The absence of written SWAT competition training procedures that incorporated lessons learned from previous SRT competitions resulted in the team relying on experience and memory to drive their training and safety practices.

None of the members of the competition team were fully qualified to perform a buddy rappel.

A combination of several training-related factors were important contributors to the accident. The experience and training of the SRT appear to have been sufficient to meet the SRS requirements for performing normal duties. However, the competition team's buddy rappel training was discontinued in 1989, and the WSI–SRS Rappel Masters have not had the benefit of either refresher training or Central Training Academy instruction since that time. Therefore, none of the members of the competition team were fully qualified to perform a buddy rappel. There was no formal training program for the competition, and lesson plans had not been developed for buddy-rappel training. If lesson plans had been developed for the buddy rappel, SRT management would have had the opportunity to review the instructions during the training approval process and to determine the validity of the buddy rappel for SRS.

Revision 2 of WSI–SRS Standard Procedure 1-5600, *Rappelling*, did not contain changes concerning the use of the safety rails and gates that affected rappelling procedures. Updated procedures regarding the purpose and function of the Security Rappel Tower rails as related to rappelling could have deterred their use. Further, the current approach to safety training, which is a standard element of all rappel training, did not prepare otherwise skilled rappellers to consider, prepare for, and control all of the dynamics of buddy rapelling. Such dynamics include assessing how changes in the position of the rope impact safe rappel operations, recognizing that changes to the rappel facility impact rappel operations, and analyzing how changes to rappel techniques impact rappel operations.

There appears to have been a disparity between the intent of the Office of Nonproliferation and National Security concerning the application of Central Training Academy lesson plans and how the plans were perceived by SR and WSI-SRS officials.

Finally, the Board determined that NN had not effectively identified the appropriate application of Central Training Academy lesson plans pertaining to rappel requirements, nor had NN disseminated this information in DOE Orders to ensure clear understanding of the requirements and the process to receive relief from these requirements. Interviews with senior security management for NN, SR, and WSI–SRS established that there were differing views on the application of Central Training Academy lesson plans. These differing views led to WSI-SRS not ensuring that a rappel instructor trained by the Central Training Academy was present during rappel operations. There appears to have been a disparity between the intent of NN concerning the application of Central Training Academy lesson plans and how the plans were perceived by SR and WSI-SRS officials.

Conducting competition preparations without recent successful training on buddy rappelling, combined with a lack of Rappel Instructor/Master refresher training and enhanced safety training; the lack of information concerning the impact of the rails and gates on training at the Security Rappel Tower; and the lack of approved buddy-rappel lessons plans, were significant training-related contributors to the April 3, 1995, accident.

The current program direction for the protective force training program is not sufficient to ensure that either Central Training Academy training or the Rappel Instructors/Masters trained at the Central Training Academy will incorporate the necessary principles and facts about the operational safety and dynamics of rappelling that contributed to the April 3, 1995, accident into future training. The training program in effect at the time of the accident did not include such basic rapelling information as rope watching, load-bearing capacity under static and dynamic conditions, and the relationship between rope capacity and exposed-edge radius. The application of Central Training Academy lesson plans must be clarified and emphasized to ensure adherence to all Central Training Academy training requirements and to ensure the development of a clear process for obtaining relief from those training requirements that are not driven by site-specific protection program requirements.

Occupational Safety

Installation of new safety railings on the Security Rappel Tower to satisfy Occupational Safety and Health Administration (OSHA) fall-protection requirements was a factor in the accident. OSHA requires that this type of railing be designed to withstand a 200-pound force applied in any direction to the rail. The safety railings on the Security Rappel Tower were designed as gates to be opened for training exercises. After inspection of the tower by the SR Safety Division, the chains across openings were judged to be inadequate to meet the OSHA fall-protection requirements.

Neither WSRC nor WSI–SRS identified the need for fall protection on the Security Rappel Tower to meet the OSHA requirements.

Neither Westinghouse Savannah River Company (WSRC) nor WSI–SRS identified the need for fall protection on the Security Rappel Tower to meet the OSHA requirements. However, the SR Safety Division identified the need when conducting an inspection for an Occupational Safety and Health Program performance review of WSRC and WSI–SRS. After receiving a request from WSI–SRS, WSRC initiated actions to install the safety railings and exercised complete control of their design, fabrication, installation, and final inspection. Although, WSI–SRS was aware of the installation of safety railings on the Security Rappel Tower, the Board could find no evidence that they had participated in the design process.

WSI–SRS did not conduct a formal change analysis concerning the impact of the new gates on training activities.

The WSI–SRS Range Manager took the Security Rappel Tower out of service on March 6, 1995, for the installation of the safety railings and placed it back in service on March 29, 1995, at the completion of the job. Before placing the Security Rappel Tower back in service, the WSRC Area Safety Engineer inspected the handrail and gate installation and found it to be satisfactory for safe use as fall protection from the tower. This was just before the April 3, 1995, fatal rappel training accident. WSI–SRS did not conduct a formal change analysis concerning the impact of the new gates on training activities.

The Board examined the occupational injury and illness experience of WSI–SRS and other DOE security contractors to identify significant trends.

The Board examined the occupational injury and illness experience of WSI–SRS and other DOE security contractors to identify significant trends. In 1994, DOE had 31 security contractors with approximately 7,005 full-time employees. Table I-1 lists the 1992 to 1994 injury and illness rates for 8 of these contractors, with a total of 4,651 employees.

Table I-2 lists the total recordable and lost workday case rate of the SRT force versus the rate for all WSI–SRS and all Department protective forces. The WSI–SRS and SRT data in this table were obtained from WSI–SRS rather than from the Department's Computerized Accident/Incident Reporting System (CAIRS) database. The differences between Table I-1 and Table I-2 are due to the WSI–SRS information being more accurate and more current than that available from the CAIRS database. Table I-3 lists injury and illness rates for nine major sectors of DOE.

Management Systems

Some aspects of the management systems at SRS have been implemented effectively; however, there were shortcomings in the implementation of line management, program management, and independent oversight. Line management of WSI-SRS was not effective and did not include all operations. The focus of EM and SR line management of activities of WSI-SRS was on security planning and normal training and operations, respectively. Line management of WSI-SRS competition preparation was non-existent. This represents the most significant management systems failure. There were other failures within WSI-SRS. WSI–SRS oral and written communications did not prohibit the use of the unacceptable and unauthorized buddy rappel technique, nor did they ensure that personnel conducting operations on the Security Rappel Tower were informed of changes and their impact on operations. Breakdowns in the supervision and communication processes within WSI–SRS resulted not only in the buddy rappel technique being accepted for use, but also allowed the technique to be introduced as a training activity even though it was not authorized for the competition.

Line management of WSI-SRS was not effective and did not include all operations.

A number of shortcomings in program management systems contributed to WSI–SRS's use of an unacceptable rappel technique. These shortcomings include the lack of clear Department policy with regard to the appropriateness of the buddy rappel, not identifying shortcomings in the Rappel master qualifications during program management reviews, and the lack of understanding concerning the Central Training Academy's lesson plans.

DOE safety organizations did not provide managers with significant accident and illness data for SRTs across the DOE complex. Independent safety oversight by the Office of Environment, Safety and Health did not provide coverage for protective force operations and training.

Table I-1. DOE and Contractor Injury and Illness Rates for Select Security Contractors 1992 Through 1994

Contractor	1994 Equiv. Full-Time Employees	1994			1993			1992		
		TRC Rates	LWC Rates	LWD Rates	TRC Rates	LWC Rates	LWD Rates	TRC Rates	LWC Rates	LWD Rates
Wackenhut Services, Inc.-SRS	1,134	3.8	3.4	106.0	4.7	3.7	82.5	2.4	1.9	33.9
Wackenhut Services, Inc.-Rocky Flats	755	4.7	3.3	68.0	6.1	4.6	131.0	5.0	3.6	80.8
M&G-Amarillo-Security Forces	526	8.2	4.2	72.9	8.2	3.8	85.9	5.9	2.6	21.3
Albuquerque Transportation Division	523	9.9	8.3	270.6	6.0	5.6	228.0	12.9	6.8	335.3
Martin Marietta Y-12 Security Force	454	7.4	3.9	233.1	12.8	5.1	195.2	17.8	8.8	309.5
Westinghouse Hanford Security	444	4.5	2.6	102.2	3.2	2.1	63.2	4.7	2.0	73.9
Lockheed Idaho Tech. Co. - Security	424	2.2	1.2	11.9	1.7	1.5	19.5	5.2	3.5	53.6
Protection Technologies Los Alamos	391	15.9	13.7	115.1	11.3	11.1	229.5	14.2	11.1	252.0
Subtotal	4,651									
Total All Security Contractors	7,005	6.0	4.1	92.5	6.6	4.2	102.9	7.6	4.4	121.6
Total DOE and Contractor	184,073	3.5	1.6	33.1	3.7	1.6	42.3	3.8	1.8	52.0

TRC = Total Recordable Case Rate
= Total Injuries and Illnesses x 200,000/Employee Hours Worked
LWC = Lost Work Day Case Rate
= Number of Lost Work Day Cases x 200,000/Employee Hours Worked
LWD = Lost Work Day Rate
= Total Days Lost x 200,000/Employee hours Worked
Source: DOE CAIRS

Table I-2. Injury and Illness Rates for Wackenhut Services, Inc., Savannah River Site and WSI-SRS Special Response Teams 1992 Through 1994

	1994		1993		1992	
	TRC	LWD	TRC	LWD	TRC	LWD
WSI-SRS*	3.71	107	4.9	92	3.06	59
WSI-SRS SRT*	8.78	102	26.4	912	14.5	51
All DOE Security**	6.0	93	6.6	103	7.6	122

TRC = Total Recordable Case Rate
= Total Injuries and Illnesses X 200,000/ Employee Hours Worked
LWD = Lost Work Day Rate
= Total Days Lost X 200,000/ Employee Hours Worked
Source:
*WSI-SRS Data
**DOE CAIRS Data

There were also numerous shortcomings in the conduct of operations program that led to training in rapelling being initiated on the Security Rappel Tower prior to full testing and without informing the SRT of the purpose and limitations of the newly installed gates. There are established procedures that are used for the analysis and testing of modifications to facilities prior to reinitiation of operations. Line management was complacent about ensuring that testing and change analysis requirements were completed prior to resuming operations at the Security Rappel Tower. Also, procedures were too broad in the assignment of safety responsibility during rappel training, even for authorized rappel techniques. In addition, lessons learned from previous accidents were not effectively utilized in all elements of WSI–SRS programs or operations.

There were also numerous shortcomings in the conduct of operations program that led to training in rapelling being initiated on the Security Rappel Tower prior to full testing and without informing the SRT of the purpose and limitations of the newly installed gates.

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