U.S. Department of Energy

Type B Accident Investigation

Exertional Heat Illnesses During SPOTC 2006 at the National Training Center Albuquerque, New Mexico

July 2006

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RELEASE AUTHORIZATION

On June 20, 2006, I appointed a Type B Accident Investigation Board (the Board) to investigate the June 15, 2006 heat-related illnesses that occurred during the 2006 Security Protection Officer Training Competition at the DOE National Training Center. The Board's responsibilities have been completed with respect with to this investigation. The analysis and the identification of the direct cause, the root cause, and the contributing causes, and the Judgments of Need resulting from this investigation were performed in accordance with DOE Order 22.1A, *Accident Investigations*.

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

Jo Ann Milam
Director, National Training Center
U.S. Department of Energy

13 July 2006
Date

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ACRONYMS

AAR	After Action Report
ACGIH	American Conference of Governmental Industrial Hygienists
Board	Type B Accident Investigation Board
CRO	Chief Range Officer
°F	Degrees Fahrenheit
DOE	U.S. Department of Energy
EHI	Exertional Heat Illness
EMT-P	Emergency Medical Technician-Paramedic
ES&H	Environment, Safety and Health
JON	Judgment of Need
KAFB	Kirtland Air Force Base
LFR	Live Fire Range
LOI	Line of Inquiry
NIOSH	National Institute for Occupational Safety and Health
NTC	National Training Center
P1	First injured Pantex Plant employee
P2	Second injured Pantex Plant employee
Pantex	Pantex Plant
PPE	Personal Protective Equipment
RH	Relative Humidity
RO	Range Officer
S&SCTA	Safeguards and Security Central Training Academy
S1	Injured Savannah River Site employee
SME	Subject Matter Expert
SNL	Sandia National Laboratories
SOP	Standard Operating Procedure
SPO	Security Police Officer
SPOTC	Security Protection Officer Training Competition
SQA	WSI-NTC Safety and Quality Assurance Department
SRS	Savannah River Site
TLV	Threshold Limit Value
WSI-NTC	Wackenhut Services, Incorporated – National Training Center

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REFERENCES

10 CFR 1046, *Physical Protection of Security Interests*
DOE Order 225.1A, *Accident Investigations*
DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*
NTC SOP 500, *Quality Assurance Plan*
NTC SOP 502, *ES&H Management Plan*
NTC SOP 523, *Paramedic Program*
NTC SOP 531, *Risk Analysis*
NTC SOP 552 , *Inclement Weather Training Restrictions*
WSI Integrated Safety Management Manual
SPOTC 2006 Program Guide
SPOTC 2005 After Action Review
ACGIH Publication, *Threshold Limit Values for Chemical Substances and Physical Agents*
DoD Publication, *Medical Aspects of Harsh Environments*, Volume 1, Chapter 7, "Clinical Diagnosis, Management, and Surveillance of Exertional Heat Illness."
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PROLOGUE

This Report addresses three injuries that occurred on June 15, 2006 during the annual Security Protective Officer Training Competition (SPOTC) at the National Training Center (NTC). One individual required hospitalization for more than a week, much of the time in intensive care. Two other individuals were examined at the hospital and released.

Some of the issues raised in the Report have implications that go beyond SPOTC and NTC. Accordingly, readers may want to pay particular attention to three issues addressed in the report that have implications for training and safety activities throughout the DOE complex:

- The conclusion that Exertional Heat Illness has not been specifically recognized by DOE, nor has information about its potential safety concerns been disseminated throughout DOE.

- The need to assure that expertise in exercise physiology is consulted in the planning and implementation of training that involves rigorous physical demands.

- The need to assure that the design of training regimens appropriately balances physical rigor with safety of the participants.

All of us recognize that it is not possible to conduct some of our security training without a few minor scrapes, sprains, cuts and bruises. However, it is entirely possible to prevent the kinds of injuries that occurred during SPOTC 2006. NTC is committed to doing just that.

Training for ProForce, Special Response Teams, Opposition Forces, and the Elite Force necessarily involves exceptional physical demands. It is likely that those demands will increase as the threats we face continue to evolve. Even as the demands increase, however, safety must be our highest priority.

I have encouraged the Director of SSA in partnership with the Acting Assistant Secretary for EH to provide guidance as expeditiously as possible on “exertional heat illness” as it relates to all performance-based training and exercises conducted throughout DOE.

NTC will share this Report through its Training Advisory Committees, the Training Managers Working Group and the Lessons Learned and ORPS systems. In addition, NTC will share its corrective action plan with all of the sites that participated in SPOTC 2006 and with any other sites that would like a copy.

If you have any questions or comments, please contact either of the following:

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You may also contact any members of the Investigation Board.

Respectfully submitted,

Jo Ann Milam
Acting Director
National Training Center

EXECUTIVE SUMMARY

The Accident

On June 15, 2006, during the course of competing in the Department of Energy's Security Protection Officer Training Competition (SPOTC) Super Team Event at the National Training Center's Live Fire Range on Kirtland Air Force Base, New Mexico, three Security Police Officers suffered from Exertional Heat Illnesses. A competitor (S1) from the Savannah River Site was the most seriously ill. S1 was diagnosed with rhabdomyolysis, requiring hospitalization and surgical intervention to correct compartment syndrome. Two competitors (P1, P2) from the Pantex Plant exhibited symptoms of heat exhaustion, suffered much milder consequences, and were treated and released the same day.

Twelve teams (60 competitors) completed the Super Team Event prior to the SRS Team without any competitors requiring treatment for heat illness. Competition officials believed S1's illness to be an isolated occurrence. They supported the Chief Range Officer's decision to continue with the Super Team Event. After SRS three teams completed the event without incident. Pantex was the last team to attempt the event. Pantex and SRS had been in close competition for first place for years. The Board considered that it was no coincidence that all three heat illness cases came from these two teams. To the recollection of 2005 and 2006 SPOTC organizers, in more than 20 years of SPOTC no occurrence of Exertional Heat Illness had been reported.

On June 20, 2006, the Director of the National Training Center appointed a Type B Accident Investigation Board (the Board) to investigate the accident in accordance with DOE Order 225.1A, *Accident Investigations*. Although the accident investigation encompassed the cases of all three competitors who became ill, the Board focused primarily on the illness suffered by S1, which was by far the most serious illness.

Conclusion

The direct cause of the illness was metabolic reaction to the exertion required to quickly carry a 158 pound articulated dummy up four flights of stairs (approximately 36 foot vertical distance), resulting in Exertional Heat Illness. Planning activities associated with the design and validation of the Super Team Event did not recognize or evaluate the potential for Exertional Heal Illness among young, physically fit individuals participating in strenuous activities. Had this potential been recognized during the planning, preparation, and conduct of the event, a number of actions could have been taken that would have minimized the likelihood of this accident.

The conditions that can precipitate Exertional Heat Illness, as opposed to the more commonly understood and very different conditions that may result in classical heat illness, have not been specifically recognized by the Department of Energy or disseminated throughout the complex as a matter of potential safety concern. In the case of the 2006 SPOTC, this lack of recognition had consequences throughout the Super Team Event planning and execution. For example, the process used to develop, analyze, evaluate, and validate the tasks included in the Super Team Event did not include a sports medicine physician, an exercise physiologist, or other specialist who may

have recognized the potential for Exertional Heat Illness. While each task in the Super Team Event was performed individually by National Training Center Staff to ensure they were physically achievable, the collection of tasks comprising the event were not performed in the rapid sequence that would be required of competitors. Consequently, the total impact of the physical demands of the event was not demonstrated or validated.

The highly intense level of individual motivation and competition associated with SPOTC, and especially with the Super Team Event, typically manifests in competitors' determination to push themselves as hard and as far as they can to win. This intense competition is encouraged by SPOTC rules and scoring protocols. Therefore, it falls to event officials to establish effective controls for necessary intervention to protect competitors. However, SPOTC program documentation did not clearly define criteria sufficient for assessing competitors' physical conditions or identifying conditions or situations where intervention would be appropriate to protect competitors. Similarly, the safety briefing for the Super Team event did not provide sufficient information about the potential hazards associated with the event to enable team leaders to make fully informed decisions on how to safely manage each stage of the event.

Although the emergency medical response capabilities available at SPOTC were well-planned and executed, and reduced the severity of the consequences of this accident, they could not fully compensate for the lack of consideration of the potential for Exertional Heat Illness during the event planning and conduct processes. The Board's conclusions and judgments of need are provided below.

Conclusions	Judgments of Need
Despite the significant physical demands of SPOTC competitions, there was no involvement by fully qualified specialists (e.g., sports medicine physician or exercise physiologist) in SPOTC competition event design, analysis, and evaluation. Stage planning for the SPOTC Super Team Event did not adequately consider the potential for Exertional Heat Illness (EHI). EHI hazards were not recognized and were not analyzed for the Super Team Event. The ACGIH TLV for heat strain and stress is not incorporated into NTC SOP 552, Inclement Weather Training Restrictions, resulting in development and implementation of less comprehensive control measures. Because NTC SOP 552 does not address EHI, SPOTC staff was not trained to anticipate its occurrence. Appropriate controls were not established because EHI hazards were neither recognized nor analyzed.	**JON 1**: NTC needs to improve SPOTC planning to ensure that appropriate expertise is included to fully evaluate hazards and to control event conditions that could lead to heat illnesses such as EHI. **JON 2**: NTC needs to integrate ACGIH TLV for heat strain and stress into SPOTC-specific documents to ensure that the controls appropriate for managing EHI are effectively implemented. **JON 3**: DOE should use processes such as the Lessons Learned Program and Operating Experience Summary to disseminate the hazards of strenuous activities that could lead to EHI.

Conclusions	Judgments of Need
SPOTC program documents did not clearly define criteria for identifying competitors' physical conditions or situations that would require intervention to protect competitors in the midst of an event. The Super Team Event safety briefing did not provide sufficient information about the EHI hazards to influence team leaders' consideration during their tactical decision-making process. Stop work responsibility and authority was not consistently and effectively implemented. Factors that contributed to ineffective stop work authority included a lack of clear assignment and understanding of roles and responsibilities, a lack of actionable criteria tailored to the competition environment, weakness in training of individuals to recognize their physical limitations, and competition rules that have the potential to allow motivated competitors to push themselves to exhaustion and injury. The SPOTC Rule Book, the scoring approach, NTC staff's experiences, and processes used for planning and execution of the Super Team Event were not sufficiently comprehensive to establish an appropriate balance between the competitive fever of highly motivated competitors and their personal safety.	**JON 4**: NTC needs to ensure that: • SPOTC program documents define criteria for identifying competitors' physical conditions or situations that would require intervention to protect competitors in the midst of an event. • Safety briefings provide sufficient information about EHI hazards to influence team leaders' consideration during their tactical decision-making process. • Stop work responsibility and authority are consistently and effectively implemented. • Future physical activities demanding extremely high physical exertions including SPOTC should include appropriate expertise (e.g. sports physician or exercise physiologist). • SPOTC planning and design, including rules and scoring, balance intense competition with competitors' safety.
NTC has established an adequate framework for ISM management systems and processes for SPOTC.	None
The emergency medical services were well planned and executed, and were effective in minimizing the severity of the injuries. The practice of conducting emergency drills prior to SPOTC contributed to the effective and timely response of emergency medical services.	None
WSI-NTC demonstrated investigative readiness that meets the intent of the DOE Order 225.1A Contractor Requirements Document.	None

1.0 BACKGROUND

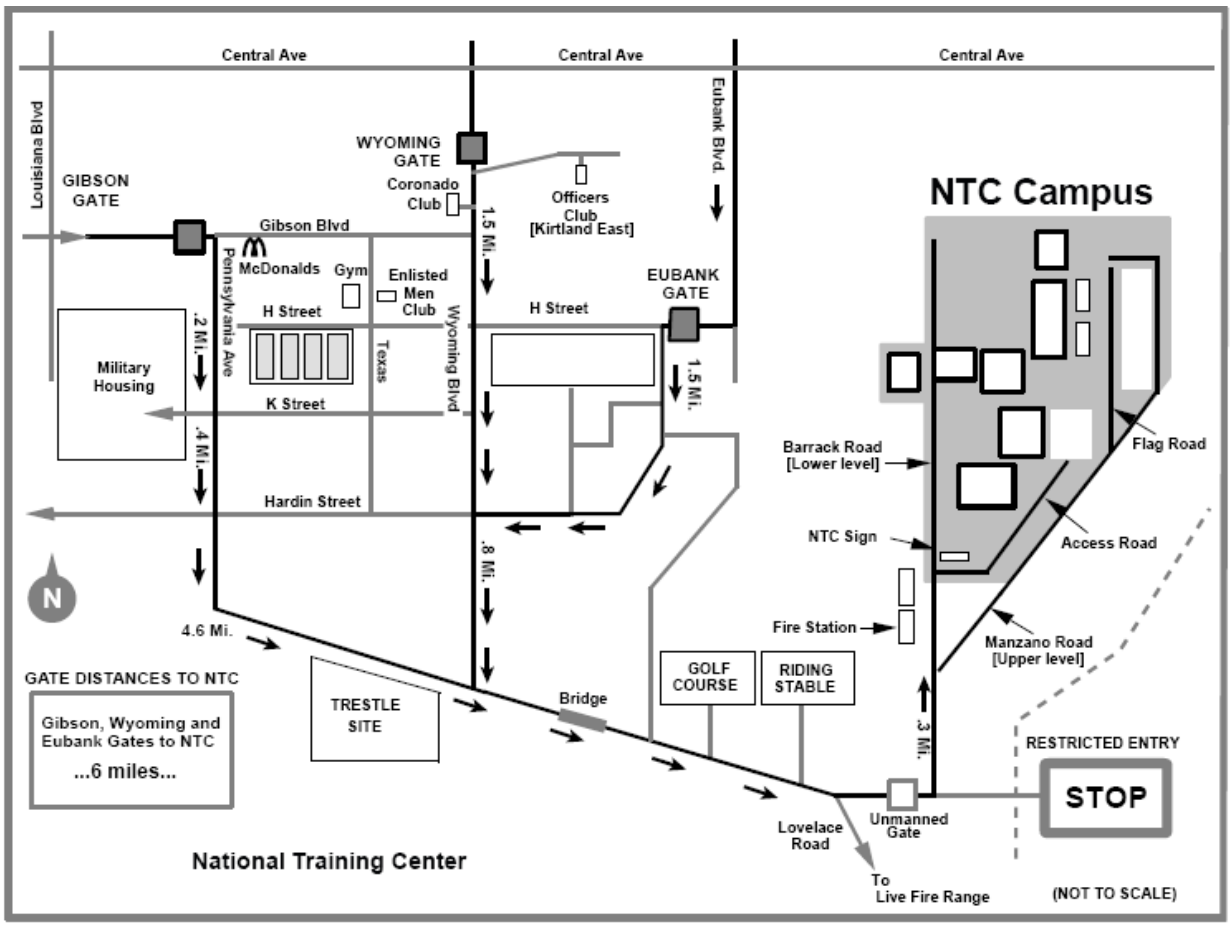
The illnesses that precipitated this investigation were experienced by Security Police Officers (SPO) from the Savannah River Site (SRS) and the Pantex Plant (Pantex) while participating in the Department of Energy's (DOE) 2006 Security Protection Officer Training Competition (SPOTC), an event planned and hosted by the DOE National Training Center (NTC). These illnesses were diagnosed as Exertional Heat Illness (EHI). The SPO from SRS sustained the most serious illness, resulting in eight days of hospitalization and requiring surgical intervention to correct compartment syndrome. The primary organizations involved in planning and conducting this event include the NTC, its Safeguards and Security Central Training Academy (S&SCTA), and the NTC support contractor, Wackenhut Services, Incorporated – NTC (WSI-NTC). This section provides brief descriptions of these organizations, SPOTC and its context, the scope of this investigation, and the methodologies employed by the Type B Accident Investigation Board (Board).

1.1 National Training Center

The DOE Headquarters Office of Security and Safety Performance Assurance is the NTC's parent organization. Founded in 1984 and formerly known as the Nonproliferation and National Security Institute, NTC's primary mission is to promote the development, maintenance, and enhancement of a qualified and professional workforce possessing the competencies necessary to accomplish DOE missions. It does this through the development and delivery of relevant, effective training and professional development programs in various technical disciplines, especially those related to Safeguards and Security and Safety. The NTC Director is a DOE Federal employee who is supported by a Federal staff which manages and oversees the support contractor's administration and operation of NTC facilities, training programs, and support activities.

Located at facilities on Kirtland Air Force Base (KAFB) in Albuquerque, New Mexico (see Figure 1-1), NTC provides security training and services – primarily focused on nuclear safeguards and security, safety, infrastructure protection, and antiterrorism to more than 100 separate government customers. Among the NTC's organizational guiding principles is a commitment to plan and execute training activities through the practice of Integrated Safeguards and Security Management to safeguard its personnel. In addition, all work at the NTC is to be conducted in accordance with the Integrated Safety Management System. Functionally, NTC training and education programs are planned and implemented by four subordinate training academies and two programs, each of which deals with specific professional disciplines.

Figure 1-1: NTC Location on Kirtland Air Force Base



1.2 Safeguards and Security Central Training Academy

The S&SCTA is the NTC element responsible for providing security-related training to DOE and DOE contractor personnel who are involved in protecting DOE's vital national security assets. The S&SCTA provides an extensive training curriculum in the six major safeguards and security topical areas, including the Protective Force area (the area associated with the accidents under investigation) which has as its primary target audience armed, uniformed security personnel responsible for both offensive and defensive security measures at DOE facilities. S&SCTA provides training at the main NTC campus, at the NTC Live Fire Range, through mobile training teams, and via e-learning courses. The S&SCTA is headed by the DOE Director of the Office of Security Training Operations. The training and facilities support staffs are provided by WSI-NTC (and its subcontractors), whose Protective Force Department had primary responsibility for planning and conducting the 2006 SPOTC.

1.3 Wackenhut Services, Incorporated – NTC

Wackenhut Services, Incorporated – NTC has been the primary support contractor for the NTC since its inception. WSI-NTC is responsible for development and delivery of instructional programs and for facility operation and maintenance, and is organized accordingly. It has a total of 184 employees supporting the NTC (107 full time; 77 part time), including 79 employees (24 full time; 55 part time) staffing the Protective Force Department, which had primary responsibility for planning and conducting the 2006 SPOTC. Environment, safety and health support is provided by a WSI-NTC subcontractor, Battelle/NTC.

1.4 Live Fire Range

The S&SCTA's Live Fire Range (LFR), the venue for the 2006 SPOTC, is located in KAFB's Coyote Canyon area, in the foothills of the Manzano Mountains approximately 6.3 miles from the NTC main campus and at an altitude of approximately 6000 feet above sea level (see Figure 1-2). The LFR is staffed and operated by WSI-NTC's Protective Force Department, and includes the presence of at least one paramedic during live fire operations. Range facilities are layed out linearly along a single access road and consist of seven live fire ranges, which includes a live-fire shoot house; range control towers; a Tactical Training Tower; an armory building; weapons cleaning buildings; classroom buildings; a maintenance building; ammunition storage bunkers; and an administrative building containing staff offices, classrooms, a medical treatment room referred to as the Aid Station, and lounge facilities (see Figure 1-3). Vehicle access to the LFR requires leaving the hard surface Lovelace Road and traveling 4.5 miles on unpaved Coyote Springs Road to the range entrance; the roadway within the range is also unpaved.

Figure 1-2: Map to Live Fire Range

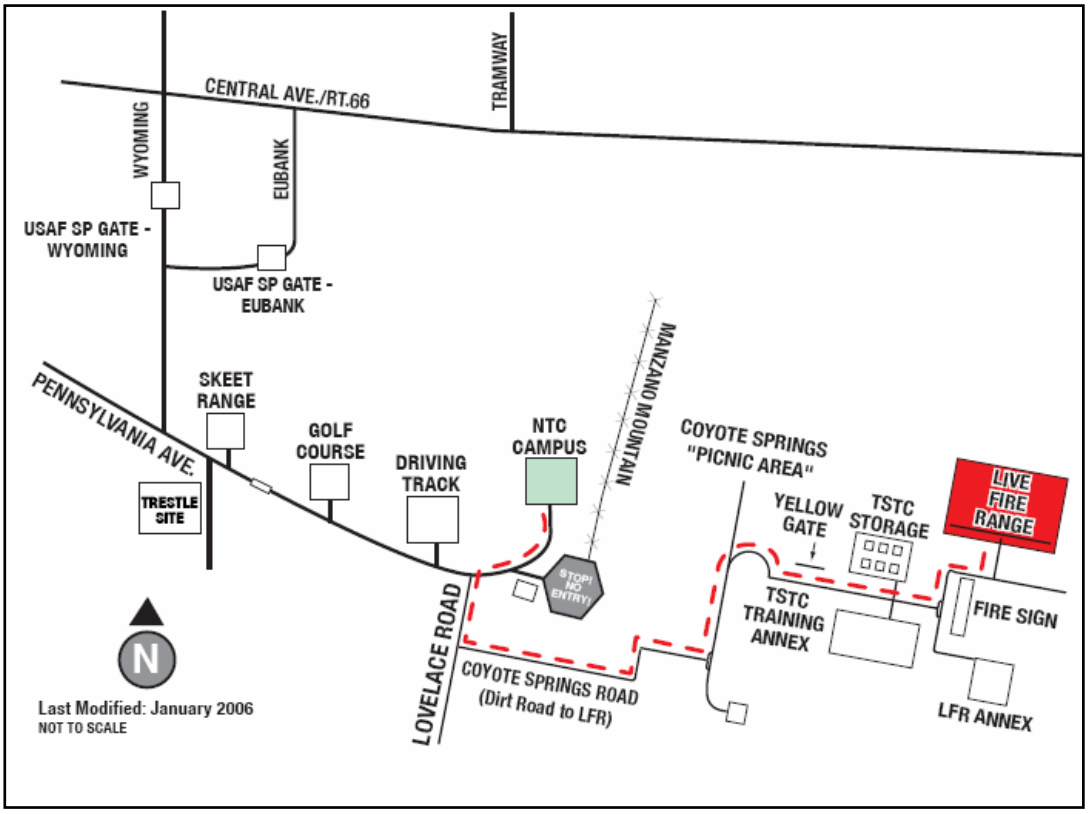


Figure 1-3: Aerial Photo of Live Fire Range

1.5 Security Protection Officer Training Competition

The DOE SPOTC is an annual tactical skills-oriented firearms competition between teams representing protective forces at DOE facilities, and that also includes teams from domestic and foreign law enforcement, military, and security organizations that participate in the same events but compete in a category separate from the DOE teams. The competition includes both individual and team events emphasizing marksmanship, tactical skills, physical fitness and endurance, and small unit leadership. Awards are presented to winners in a variety of individual and team categories. Within DOE, SPOTC is a major, high-profile, highly competitive event, and some participating protective forces and their sites place much emphasis on a good showing at the competition. The 2006 SPOTC was sponsored by the DOE Office of Security and Safety Performance Assurance, was hosted by the NTC, and was held at the S&SCTA's LFR. The NTC's DOE and contractor staffs, with primary responsibility for conducting and evaluating the competition, were augmented by volunteers from various sources who assisted in meeting the event's many administrative, operational, and logistical needs. Competitors included teams from eight DOE facilities/organizations and (by invitation) nine law enforcement and military tactical units from the United States, Canada, and the United Kingdom.

SPOTC is designed to place competitors in a stressful and physically challenging environment that will allow identification of the individuals and teams most successful at completing events simulating real world tactical environments. The nature of this competition is understood by competitors to be physically challenging and very demanding, and the competitors typically come motivated to win. SPOTC operates in the safety realm where individuals must make real time decisions that inherently affect team safety. The team safety and range safety aspects are more readily accommodated in range procedures, event planning, medical response, and other aspects of running a safe SPOTC.

1.6 Investigation Scope and Methodology

The Board was appointed on June 20, 2006 by the NTC Director. The scope of the Board's authority was to investigate the circumstances surrounding heat-related illnesses experienced by three SPOTC competitors on June 15, 2006 and to: identify all relevant facts; analyze the facts to determine the causes of the illnesses; develop conclusions; and determine Judgments of Need (JON) that, once implemented, should minimize the likelihood of recurrence of such illnesses. Additionally, the Board was to address the roles of the DOE and contractor organizations and management systems as they may have contributed to the accident, and to examine the actions taken by NTC in response to the accident. See Figure 1-4 for an explanation of accident investigation terminology.

Figure 1- 4: Accident Investigation Terminology

Accident Investigation Terminology

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

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

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

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

The investigation was performed in accordance with DOE Order 225.1A, *Accident Investigations*, using the following methodology:

- The accident scene was inspected, physical evidence was collected, and photographs/videos of the Super Team Event accident/competition scene were obtained.
- Facts relevant to the incident were gathered through interviews, document reviews, and examination of photographic/videotaped evidence.
- The facts were analyzed to identify the causal factors using event and causal factors analysis, barrier analysis, change analysis, and root cause analysis.

Conclusions and JONs were developed to guide the identification of corrective actions that, if implemented, should prevent the recurrence or minimize the consequences of similar accidents.

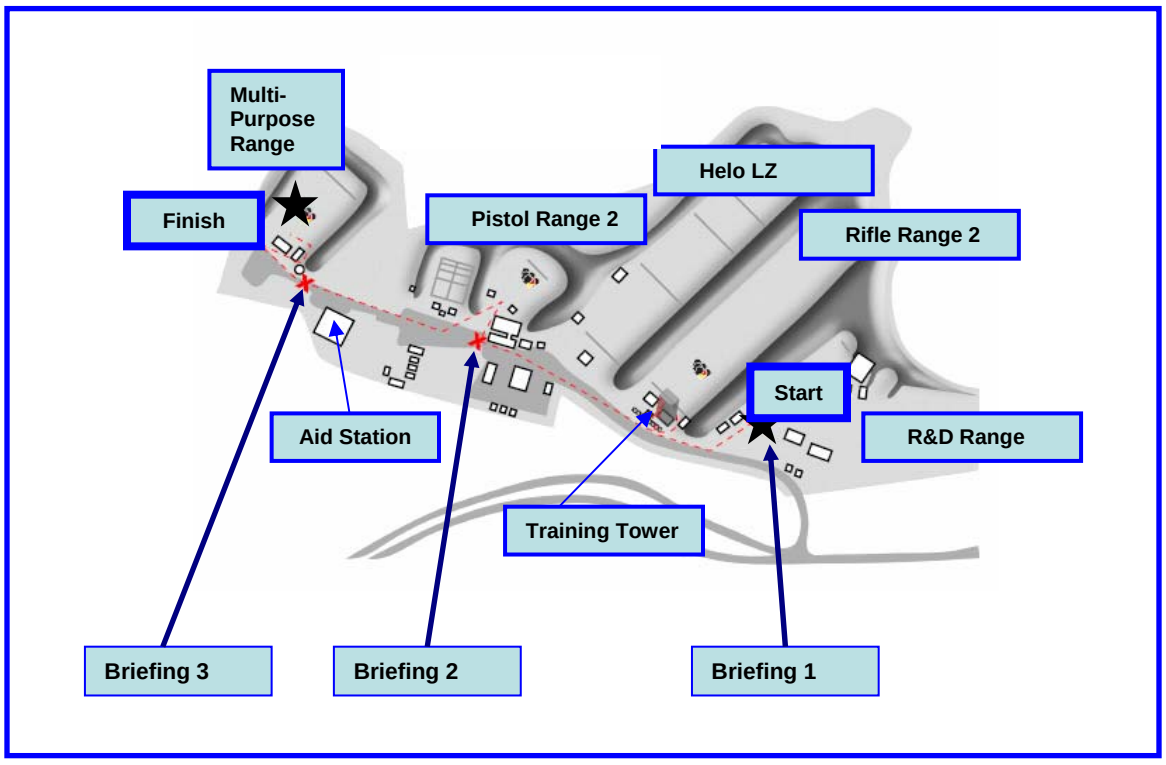
2.0 ACCIDENT DESCRIPTION AND CHRONOLOGY OF EVENTS

2.1 Accident Description

On June 15, 2006 a team of SPOs from SRS competed in the Super Team Event, the final event of four days of individual and team events associated with the 2006 SPOTC. The Super Team Event was a timed event consisting of three stages requiring a significant level of physical exertion and, during the 9 ½ minutes it took the SRS team to complete the event, one of the SRS participant (S1) exceeded his physical capacity and experienced a heat related illness (i.e. Exertional Heat Illness) requiring hospitalization and surgery to correct compartment syndrome.

The Super Team Event was a live-fire event designed to test marksmanship skills under levels of physical and mental stress intended to simulate those that would be experienced under a tactical engagement with an adversary. Event requirements involved timed movement between four live fire ranges (see Figure 2-1) incorporating a series of running, lifting, jumping, and climbing demands intended to induce stress, interspersed with marksmanship activities requiring concentration and precise physical control of rifles and handguns.

Figure 2-1: Super Team Event Diagram



Seventeen teams competed in the event, with Team 1 starting at about 0715. SRS, as Team 13, started at 1100. The last competitors, Team 17 from Pantex, started at 1300. Arrival time at the site was at each team's discretion, but each team was required to arrive and report no later than 20 minutes prior to their scheduled start time. Both the SRS and Pantex teams arrived at the LFR approximately 1 ½ hours prior to their scheduled start times. Participants were clothed in long or short sleeved T shirts, long pants, boots, hats, and elbow and knee pads, and carried approximately 15 pounds of equipment that included rifles, pistols, ammunition, and duty respirators.

The weather at the LFR on June 15 was slightly overcast and cooler than the previous three days of the competition, with temperatures ranging between 86 and 90 degrees Fahrenheit (°F) during the period of competition. Winds were mild in the morning, increasing to strong gusts in the afternoon. Relative humidity (RH) varied during the day from about 4% to 21%. The altitudes of the live fire range facilities vary from 6000 to 6200 feet above sea level.

The event began at the R&D Range with a general team safety briefing followed by a 2-minute maximum stage briefing at which the SRS Team Leader was provided a Stage Briefing Card explaining the mission requirements for the stage and was given up to two minutes to decide how to accomplish the stage mission, brief the team on the stage mission requirements, and make team assignments for Stage 1. Each of the three stages began with a similar two minute allowance for team decision making and briefing. The Stage 1 mission required the team to move to Rifle Range 2, climb over a five-foot high chain link fence, engage targets with rifles, and carry a 158 pound human-like articulated dummy from the base of the Tactical Training Tower located at Rifle Range 2 up four flights of metal stairs to the fifth floor of the tower – a vertical distance of approximately 36 feet.

As this was a timed event, the quickest way to complete this task was to divide the shooting and dummy carrying tasks among team members. S1 and a teammate were designated by the team leader to carry the dummy. The team ran approximately 175 yards from the R&D range to Rifle Range 2, climbed the fence to enter the range, and immediately began their assigned tasks. S1 carried the dummy by himself as fast as he could up four flights of stairs. The teammate accompanying S1 provided limited assistance in supporting the dummy's weight, reportedly due to the awkwardness and speed impediment associated with two persons trying to manipulate the dummy. The stairs were not wide enough to accommodate two competitors abreast with the dummy between them.

After completing Stage 1, the team ran approximately 408 yards to the Stage 2 briefing area near the entrance to Pistol Range 2. At the Stage 2 briefing area, participants received the Stage 2 mission brief, donned their duty respirators, and then moved onto Pistol Range 2 and engaged targets with rifles.

After completing Stage 2, the team ran, still wearing their duty respirators, about 337 yards to the Stage 3 briefing area located approximately 50 yards downhill from the entrance to the Multi Purpose Range. S1 lagged behind during this movement, causing the Chief Range Officer (CRO) and the SRS Team Captain, who were following the team, to question S1's physical condition and whether paramedic support was needed. They decided to let S1 continue. The CRO alerted the paramedics by radio to be ready should S1's physical condition, assumed to be very tired muscles, deteriorate. When the SRS Team arrived at the Stage 3 briefing area, members removed their respirators (other team members removed S1's respirator for him), received the Stage 3 mission brief, and began the approximately 77 yard uphill run to the Multi Purpose Range firing line.

Shortly after leaving the Stage 3 briefing area, S1 began staggering up the hill. His teammates joined him to provide verbal motivation and a shoulder to lean on. By the time they reached the top of the hill, S1 had both arms around two teammates' shoulders, but continued moving his own legs. As this group arrived within about 10 yards of the Stage 3 firing line, S1 dropped to his knees, was no longer able to contribute to his own forward motion, and was carried by two teammates, with his feet dragging, to the firing line. S1 was lowered to his knees at the firing position and appeared to be unconscious and unresponsive. Within seconds, the CRO called for a paramedic who checked S1, put him into a transport vehicle, and drove him down the hill to the nearby LFR Aid Station. At that point, the CRO temporarily stopped all SPOTC competition and live-fire range activities while S1 was being treated and evacuated.

The Sandia National Laboratory (SNL) ambulance, on call for emergencies at the LFR, was summoned and dispatched to the range. Within minutes a private Albuquerque Ambulance Service ambulance was also dispatched and, as per established protocol, was escorted by an SNL Security vehicle from the KAFB Wyoming gate to the LFR. At the Aid Station the paramedics monitored S1's vital signs and treated him for heat related illness symptoms, including cramped calf muscles. Treatment included intravenous administration of saline and electrolytes, measures to lower S1's body temperature, and stretching of cramped leg muscles. When considered stable, S1 was placed into the SNL ambulance. At that point the Albuquerque Ambulance Service vehicle arrived and S1 was transferred to the Albuquerque Ambulance Service vehicle and transported to Kaseman Presbyterian Hospital in Albuquerque. The SNL ambulance did not transport S1 due to other scheduled commitments. S1 was treated at the Kaseman Presbyterian Hospital emergency room and was subsequently transferred and admitted to Presbyterian Hospital, where he later received surgical treatment to relieve compartment syndrome pressure on seized calf muscles. On June 23 S1 was released from the hospital and returned to his home site in South Carolina.

After S1 was evacuated and the range was reopened, the competition continued. Pantex, the final team scheduled to compete, started the Super Team Event at 1300. Pantex had originally been scheduled to start at 1115. The Pantex Team completed Stage 1 and similar to the SRS Team, had one participant (P1) carry the dummy up the stairs. P1 lagged behind the rest of the team in the movement from Stage 2 to Stage 3. During the movement from Stage 2 to Stage 3, P1 went to his knees. When this occurred the CRO immediately called for the paramedics (one of which was within feet of P1) and stopped the event. Shortly thereafter a second Pantex Team member (P2) requested paramedic support for heat and overexertion conditions. Both P1 and P2

were treated at the nearby Aid Station and were subsequently transported to a local hospital emergency room, one by ambulance and one by helicopter. LFR protocol requires a helicopter to be summoned if simultaneous multiple casualties require evacuation. Both P1 and P2 were treated and released at the emergency room. Figure 2-3 provides, in tabular form, a chronology of significant events related to the injuries sustained by S1, P1, and P2.

Figure 2-3 – Chronology of Events

DATE	TIME(MDT)	EVENT
Prior to June 11		Sites select SPOTC teams and train to expected individual and team events.
June 7 and 8 Wed, Thurs		SRS Team arrives in NM and conducts warm-up runs.
June 11 Sunday	1430	Team leader briefing by SPOTC staff explains competition and safety.
	1930	Teams provided welcome, event overview, and safety briefing.
June 12 Monday	0800-1700	Individual stages 1-6 combine marksmanship and physical activity. SRS participants complete stages 1, 2, 4, and 6.
June 13 Tuesday	0800-1200	Individual stages 1-6 completed. SRS individuals complete stages 3 and 5.
	1430-1530	SRS Team Physical Challenge (running and other physical events).
June 14 Wednesday	0720-1500	Teams complete team stages 1, 2, 3 and 4.
	>1700	SRS and Pantex teams depart LFR.
June 15 Thursday	0715	Super Team Event begins with teams scheduled at 15 minute intervals.
	0845	SRS Team arrives at Live Fire Range.
	0900	Pantex Team arrives at Live Fire Range.
	1015	SRS scheduled for Super Team Event (13 of 17). Event delayed.
		SRS Super Team safety brief at R&D Range ~20 min prior to event.
	~1100	SRS Team begins Super Team event
	~1100	SRS Team receives 2-minute (maximum) brief for Stage 1 event given at R&D Range. Team leader assigns tasks.
		SRS Team moves to Stage 1 at Rifle Range 2.
		S1 carries dummy to 5th floor. SRS teammate provides limited assistance. Other teammates engage targets.
		SRS Team moves from Stage 1 at Rifle Range 2 to Stage 2 at Pistol Range 2.
		SRS Team receive 2-minute brief for Stage 2, don respirators, runs to Pistol Range 2 to engage targets.
		SRS Team moves wearing respirators to Stage 3 briefing areas near Multi Purpose Range. S1 lags behind during movement.
		CRO warns paramedic of situation and orders paramedic to Multi Purpose Range.
		SRS Team removes respirators and receives 2-minute Stage 3 mission brief.

DATE	TIME(MDT)	EVENT
		SRS Team begins move uphill toward Multi Purpose Range firing line.
		S1 moves with significant assistance uphill just inside gate to Multi Purpose Range.
		S1 goes to knees and is unable to assist in his own movement. Teammates carry S1 with feet dragging about 30 feet to firing line. S1 on knees at firing line.
		CRO signals nearby paramedic to respond at firing line.
		Paramedics transport S1 in 4-wheeler to nearby LFR Aid Station.
	1110	SRS Team Manager signs and dates score card.
	1113	Protective Force Training Department Manager calls for SNL ambulance.
	1118	SNL dispatches ambulance. Albuquerque Ambulance also dispatched.
	~1120	CRO orders Range Pause (stop competition activities).
	1131	SNL ambulance arrives.
	1135	S1 into SNL ambulance – SNL paramedics evaluate S1's condition
		Albuquerque Ambulance arrives at LFR.
	1144	S1 transferred to Albuquerque Ambulance – Paramedics evaluate S1's condition.
	1201	Albuquerque Ambulance transports S1 to emergency room.
	~1205	Resume range operations.
		Canadian Civil Nuclear Constabulary runs Super Team Event
		SNL/NM Team runs Super Team Event
		Pueblo Colorado PD runs Super Team Event
	~1300	Pantex Team begins Super team event.
		2-minute brief of Stage 1 event given at R&D Range. Team leader makes assignments.
		Pantex Team moves to Rifle Range 2 for Stage 1.
		P1 carries dummy to 5th floor of tower. Teammate provides limited assistance. Other teammates engage targets.
		Pantex Team moves to Stage 2 at Pistol Range 2.
		Pantex Team receives 2-minute brief, dons respirators, and completes Stage 2.
		Pantex Team moves wearing respirators to Stage 3 at Multi Purpose Range. P1 lags behind then goes to knees during movement.
	1319	CRO calls in paramedics for P1. Super Team Event terminated.
	1319	P2 suffers heat exhaustion and seeks paramedic first aid.
	1343	Helicopter ambulance transports P1 to hospital.
	1354	Albuquerque Ambulance transports P2 to hospital.

DATE	TIME(MDT)	EVENT
	>1500 hrs	P1 and P2 treated and released at ER.
		S1 transferred and admitted to Presbyterian Hospital for treatment.
June 23 Friday		S1 released from hospital.

Twelve teams (60 competitors) completed the Super Team Event prior to the SRS Team without any competitors requiring treatment for heat illness. Competition officials believed S1's illness to be an isolated occurrence. They supported the Chief Range Officer's decision to continue with the Super Team Event. After SRS three teams completed the event without incident. Pantex was the last team to attempt the event. Pantex and SRS had been in close competition for first place for years. The Board considered that it was no coincidence that all three heat illness cases came from these two teams. To the recollection of 2005 and 2006 SPOTC organizers, in more than 20 years of SPOTC no occurrence of Exertional Heat Illness had been reported.

2.2 Emergency Response and Investigative Readiness

Staffing of the LFR during SPOTC events included two paramedics from the pool of part-time WSI-NTC employees who routinely provide emergency medical services at the LFR. While LFR procedures call for one paramedic during live fire operations, two were employed during SPOTC events. The paramedics are certified at the Bernalillo County protocol at the EMT-P level. The permanent Aid Station at the LFR is equipped with trauma kits and advanced cardiac life support equipment similar to that found in an ambulance. Additionally, during SPOTC events the paramedics had at their disposal an all terrain vehicle-type motorized cart and a full size van. A helicopter landing zone had been established on a portion of one of the unused rifle ranges to accommodate medical helicopter operations if needed during SPOTC events. Range Officers (RO) and other event officials had immediate and continuous communications capability with the paramedics via radio and with the SNL emergency dispatcher via radio and telephone. The paramedics were immediately available to provide medical assistance during SPOTC events.

By agreement and as reflected in NTC SOP 523, *Paramedic Program*, SNL provided ambulance response to medical emergencies at the LFR. Albuquerque Ambulance Service responds to the LFR and transports casualties to off-base medical facilities. If the nature of the medical emergency dictates, a helicopter ambulance responds and transports casualties to off-base medical facilities. During the course of the June 15th events, all three of these resources were summoned and responded.

Upon evacuation of the three heat-related casualties (S1, P1, and P2) to local emergency rooms, the NTC Environment, Safety and Health Manager began an investigation into the circumstances surrounding the injuries and generating an Occurrence Reporting and Processing System (ORPS) report. When it became evident that S1's hospitalization would extend beyond the five day threshold for a Type B accident investigation, information that had been collected to that point was held and turned over to the Board upon its appointment and arrival at NTC.

The Board concludes that WSI-NTC demonstrated investigative readiness that meets the intent of DOE Order 225.1A's Contractor Requirements Document.

2.3 Description of Injuries

The DOE physician acting as a consultant to the Board examined the available medical evidence in relation to S1's injury. Based on this information and discussions with the attending physician, he concluded that the clinical diagnosis of the injury sustained by S1 was rhabdomyolysis. Rhabdomyolysis is a serious illness that results in the breakdown of skeletal muscle fibers with leakage of muscle cell content into the blood stream, and requires timely medical treatment. Major common causes of rhabdomyolysis identified in medical literature include muscle overexertion and muscle compression, a situation that was clearly present in the events leading to S1's illness. Heat dissipation impairment or exercising in humid, warm weather also increases the risk of rhabdomyolysis.

In addition to rhabdomyolysis and possibly as a result of this illness, S1 also suffered from compartment syndrome in his calf muscles after competition and when he arrived at the hospital. compartment syndrome is a painful condition where nerves and blood vessels in a muscle group that are covered by tough membrane-fascia can no longer readily expand, causing pressure within the muscles that builds to dangerous levels capable of damaging blood vessels, nerves, and muscle cells. Within the muscle compartment, swelling and/or bleeding creates pressure on capillaries and nerves. When the pressure in the compartment exceeds the blood pressure within the capillaries, the capillaries collapse. This disrupts the blood flow to muscle and nerve cells. Without a steady supply of oxygen and nutrients, nerve and muscle cells begin to die within hours. Unless the pressure is relieved quickly, this can cause permanent disability or death.

The compartment syndrome suffered by S1 was judged by the attending physicians at Presbyterian Hospital to be serious enough to require surgical intervention to relieve the pressure. As a result of the surgery and the required recovery time, S1's stay in the hospital went beyond five days and exceeded the threshold for a Type B Accident Investigation event.

P1 and P2 also became ill during the Super Team Event. These individuals were diagnosed by paramedics to have heat exhaustion. They were treated with hydration and cooling at the LFR by the paramedics, then treated and released the same day by the hospital emergency room.

3.0 INTEGRATED SAFETY MANAGEMENT SYSTEM EVALUATION

3.1 Background – Event Control Procedures for SPOTC

The Board reviewed a number of NTC procedures and relevant documents to determine whether a management system framework that meets the requirements of ISM policy has been established and documented. NTC has developed a number of standard operating procedures that are in effect for all range activities, including SPOTC. Selected procedures relevant to this accident investigation include:

- SOP 531, *Risk Analysis*. The procedure establishes requirements for the hazards review of training, maintenance, and construction activities performed at the NTC.
- SOP 552, *Inclement Weather Training Restrictions*. This procedure establishes the inclement weather restrictions for potentially hazardous weather conditions including environmental heat illness.
- SOP 502, *ES&H Management Plan*. This plan describes the requirements and responsibilities of the NTC ES&H Program and associated management systems.
- SOP 504, *NTC Emergency Management Plan*. This procedure establishes the emergency management and preparedness site plan for the NTC.
- SOP 500, *Quality Assurance Plan*. This plan describes the mission, objectives, responsibilities, and assessment criteria for the NTC quality management program.
- SOP 523, *Paramedic Program*. This procedure provides guidance to the paramedics at the DOE NTC in administering patient care. The SOP covers medical protocols and medical supply inventories.
- SOP 544, *Live Fire Range Operations*. This procedure establishes the roles and responsibilities and requirements for the safe operations of the NTC LFR.

In addition to these standard operating procedures, there are several documents that are specifically applicable to SPOTC, including:

- *SPOTC Protocol Plan*. This document describes the events and actions to be completed in preparation for and during the conduct of SPOTC. Described in the protocol plan are key ES&H actions and assignments in preparation for the safe conduct of SPOTC.
- *SPOTC Program Guide*. This document is provided to all participants in advance of SPOTC and covers general site information and administrative and competition requirements.
- *SPOTC Rulebook*. This document describes the competition rules and scoring, and generic roles, responsibilities and authorities for range management and competitors.

The Board concludes that NTC has established an adequate framework for ISM management systems and processes for SPOTC.

The Board performed an evaluation of the effectiveness of ISM implementation for SPOTC within the context of the five Core Functions of ISM and the applicable

Guiding Principle on balanced priorities. The results are presented below.

3.2 Core Function 1 - Define the Scope of Work

For over twenty years SPOTC has been a major and visible annual event for DOE protective forces. The event is rigorously designed to showcase NTC's strong involvement in security force training and to provide a unique forum where security forces have the opportunity to benchmark their capabilities against the "best in class" security forces from other high quality organizations. The event traditionally attracts considerable federal and contractor upper management attention and involves a large number of dedicated and experienced NTC staff in its planning and execution.

3.2.1 Institutional Planning

The overall institutional planning and preparation for the 2006 SPOTC was no exception to the prior years; the planning for the event was generally rigorous and comprehensive. In addition, NTC staff and contractors involved in planning the 2006 SPOTC were highly experienced and devoted considerable effort to this task. A major element of the SPOTC planning process at NTC is the development of an After Action Report (AAR) for each year's event, which becomes the planning protocol document for the next year's competition. This report typically summarizes the lessons learned from each year's event and applies these lessons to the organization and planning of the next SPOTC. The SPOTC 2005 AAR identified requirements for increased participation by the Safety and Quality Assurance (SQA) organization and a number of environment, safety and health (ES&H) actions for incorporation into 2006 SPOTC. Selected actions from SPOTC 2005 and their completion dates are noted below:

(1) Verification of each competitive stage. Feb-May 2006
(2) Observation of test fire for all stages. Mar-May 2006
(3) Establishment of helipad location as an emergency management measure. Mar 2006
(4) Development of bad weather evacuation plan. Apr 2006
(5) Assurance that required communications capabilities were available. May 2006
(6) Review and approve of all range plans for safety issues. May 2006
(7) Updating the LFR risk analysis. Apr 2006
(8) Control access routes to dangerous areas the week before the event.
(9) Test medical evacuation plan two weeks prior to the event.

Overall, there was significant involvement by the SQA organization in preparation for the 2006 SPOTC leading to the completion of a number of key support activities before the event.

3.2.2 Individual Stage Planning

Following the established protocol, an event briefing was presented to each participating team before the start of the SPOTC 2006 Super Team Event. The event briefings covered a number of hazards including dehydration and use of personal protective equipment (PPE). The SPOTC Super Team Event took place during the last day of competition and was a "blind event." In other words, in this event the competitors had no prior knowledge of the specific activities comprising the various stages of the event and had no prior knowledge of what needed to be accomplished to successfully complete the timed event. This event was designed to test team leaders'

abilities in real-time tactical decision making. The event was designed to test the teams' physical and technical skills as well as the team leaders' tactical decision making and management abilities.

At each of three stages in this event the team leaders were given a Stage Briefing Card describing tasks the team needed to accomplish to complete the stage. At the beginning of each stage the team leader would read the card or explain the tasks to the entire team and would make assignments to various team members. One task included in the first stage of the SPOTC 2006 Super Team Event involved carrying a 158 pound articulated dummy up four flights of stairs simulating carrying an injured comrade to a safe location. The briefing card instruction did not require this task to be accomplished by one individual. However, achieving a fast competition time would encourage highly motivated competitors to accomplish this task using one individual. Considering the height of the tower ascent (36 feet) and the number of stairs (56 steps), this was the most physically demanding task within the competition. Two of the three individuals that become ill during this event had single-handedly carried the dummy up the tower.

In the planning phase SPOTC organizers had validated the feasibility of each individual stage within the Super Team Event. Three NTC instructors individually carried the 158 pound dummy up the tower to confirm that the task could be performed. However, they had not then proceeded directly to complete the remaining stages of the event to evaluate the cumulative effects of the all stages of the event. In addition, planners did not have the appropriate expertise to recognize conditions that increase the risk of EHI. Figure 3-1 provides a brief discussion of EHI.

The Board's rough estimates of the metabolic rates for the SPOTC Super Team Event, which equates to very heavy work rate, suggests body heat storage and accumulation well in excess of recommended criteria in the National Institute of Occupational Safety and Health (NIOSH) Document "Occupational Exposure to Hot Environments, Revised Criteria 1986 (Table VIII-1 adapted from ISO DP 9733 Thermal Environments – Analytical Determination of Thermal Stress, 1982). The burden on S1and P1 may have been further increased by the fact that the competition was held at an altitude significantly higher than of their duty stations, and consequently resulted in reduced physiological efficiency in response to very heavy work rate.

The Board concludes that stage planning for the SPOTC Super Team Event did not adequately consider the potential for Exertional Heat Illness (EHI).

The Board concludes that despite the significant physical demands of SPOTC competitions, there was no involvement by fully qualified specialists (e.g., sports medicine physician or exercise physiologist) in SPOTC competition design, analysis, and evaluation.

Figure 3-1

Exertional Heat Illness

Exertional Heat Illness (EHI) has been recognized as a substantial problem in military operations and training. It is a fairly common illness in healthy young adults undergoing strenuous physical training in warm and humid weather. EHI arises from sustained or heavy exertion, usually in hot a environment. Typically, onset is abrupt, occurring during or shortly after exertion, with orthostatic manifestations (faintness, staggering, or visual disturbance) leading to events such as collapse, confusion, and delirium. EHI is significantly different from the classic heat illness that is typically associated with extended exposure to a hot environment and that primarily impacts older people or those with weak cardiovascular reserve.

The most severe cases of EHI, similar to those in classical heat illness, are categorized as exertional heatstroke, exertional heat injury, and exertional heat exhaustion. Exertional heatstroke is characterized by early, severe, non-focal encephalopathy (neurological disturbance) with hyperthermia (increase in core temperature). Exertional heat injury is a progressive multi-system disorder, with hyperthermia accompanied by organ damage or severe dysfunction, e.g. metabolic acidosis, acute renal failure, or muscle necrosis. The external heat exhaustion is a reversible, non-life-threatening multi-system disorder reflecting the inability of the circulatory system to meet the demands of thermoregulatory, muscular, cutaneous, and visceral blood flow.

Exertional heat illness requires urgent diagnosis and treatment. Although severe cases of EHI constitute clear medical emergencies, patients with EHI at milder levels also require urgent and aggressive management to avoid progression. Specifically and as recommended in reference noted below, (1) in controlled settings, emergency medical care for EHI should be arranged in advance, (2) if transportation to an emergency department requires more than 5 to 10 minutes, provisions should be made for administering intravenous fluids en route, and (3) management of military training centers should require that at least one medic is present on site while strenuous training is conducted, and when emergency vehicles leave the training site strenuous activities should be stopped until medical support and transport are again available.

Medical Aspects of Harsh Environments
Textbooks of Military Medicine
Published by the Office of the Surgeon General, Department of the Army, USA

3.3 Core Function 2: Analyze the Hazards

The Board reviewed the NTC Standard Operating Procedure (SOP) 531, *Risk Analysis,* dated January 1, 2006. Section 8.1 of SOP 531 states that a risk analysis must be completed on any new activity before that activity may begin. Section 8.3 also requires that the risk analysis be signed by the preparer and the subject matter expert (SME); reviewed by the Department and Academy Manager(s), SQA Department, and Range Master; and approved by DOE and the Director of Training or Support Operations. A risk analysis report was prepared and formally approved for the 2006 SPOTC.

In accordance with SOP 531, the risk analysis must list all potential hazards associated with the proposed activities to eliminate, control, or mitigate identified hazards to an acceptable level. The 2006 SPOTC Risk Analysis Report, dated June 8, 2006, identified hazards for the competition events, including weather/environmental conditions such as hot weather (i.e., heat stress, heat stroke, heat cramps) and high altitude conditions, physical hazards, personnel protective equipment hazards, and firearms. The hazards analysis report included an evaluation of general hazards present at the LFR and for competition events, as well as specific activity-level hazards for each of the individual and team events, including the Super Team Event.

The hazards analysis for the 2006 SPOTC Super Team Event identified injury to competitors as a possible consequence of carrying a 158-pound dummy to the top of the Tactical Training Tower. The risk analysis report also identified as a hazard breathing difficulties due to the use of respirators in the second stage of the Super Team Event. Hazards due to environmental heat, altitude, physical conditions, and physical demands of the individual and team events were identified in relation to environmental heat illness in various parts of the risk analysis report, it was not evident in the risk analysis report that specific evaluation of the cumulative effects of all hazards, including exertional heat illness during the course of each event. In testimony to the Board, RO staff stated that they considered the cumulative risk of day-after-day competition in both individual and team events on an individual competitor and tried to address this primarily through safety briefings stressing the importance of hydration and the effects of heat and strenuous activity on the human body.

A detailed hazards analysis of heat generation, accumulation, and balance was not performed. In addition, the impact of altitude on nonacclimated individuals that may be significant was not examined. S1 stated during an interview with Board members that he noticed a difference in his performance during the physical fitness test individual event (held two days prior to the Super Team Event), and his body wasn't acclimated to the altitude. In addition, S1 also stated this was the first time that he had competed at such an altitude.

Involvement by medical support personnel including paramedics and the SNL Medical Department was limited to ensuring that adequate emergency response resources were made available to support the competition. They were not involved with analyzing hazards (i.e., EHI) associated with the Super Team Event.

The Board concludes that EHI hazards were not recognized and were not analyzed for the Super Team Event.

3.4 Core Function 3 – Develop and Implement Hazards Controls

The Risk Analysis Report described in the previous section identifies and describes a large number of hazards and associated controls for safe execution of SPOTC 2006.

In the General Hazards section, the report identifies hazards due to hot weather and high altitude. In relation to weather, the risk analysis report states, that "Range Officers (ROs) will consult SOP 552, Appendix B, National Weather Service Heat Index/Heat Disorder Chart, for guidance." The Board confirmed that the NTC staff was monitoring the environmental conditions during the SPOTC Super Team Event and that those conditions did not justify any further advisory that would impact the

course of the competition. Another control referred to by the risk analysis report relies on ROs' training to recognize the early symptoms of heat illness. Interviews by the Board indicate that the symptoms referred to in the Risk Analysis Report are medical rather than physiological symptoms, which are masked by competition stress. Medical symptoms of heat illness are lagging indicators. As a result, this control does not constitute an effective measure to prevent injury. Controls based on requirements of the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) for Heat Stress and Heat Strain, referenced within DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*, would have been a more effective approach.

The ACGIH TLV screening criteria are designed to apply for one hour duration. Therefore, screening criteria are not directly applicable when facing short duration tasks (such as the 8-12 minute SPOTC Super Team Event) where very heavy work rates may far exceed heat removal rates, regardless of environmental conditions. In this case, the ACGIH TLV recommends a detailed heat balance analysis and/or physiological monitoring should be used.

Figure 3-2

What Are the WBGT, the ACGIH TLV, and the National Weather Service Heat Index?

WBGT is the Wet Bulb Globe Temperature. As stated in the ACGIH TLV "It offers a useful, first order index of the environmental contribution to heat stress. It is influenced by air temperature, radiant heat, and humidity." The ACGIH TLV is the American Conference of Governmental Industrial Hygienists Threshold Limit Value. The TLV "represents conditions under which it is believed that nearly all adequately hydrated, unmedicated, healthy workers may be repeatedly exposed without adverse health effects. The guidance is not a fine line between safe and dangerous levels." Implied is that a balance is achieved between heat generation, body storage and accumulation of heat, and heat removal (i.e. a balance between metabolic rates and heat removal rates via convection, radiation, and evaporation mechanisms) such that workers do not experience a core body temperature above 100.4°F. In the case of the TLV, the screening criteria table factors in work rate, acclimatization, clothing, work/rest periods, and WBGT at 1 hr intervals. Where physiological strain or condition are beyond that which served as the basis for the TLV, it is recommended that a more detailed analysis and/or physiological monitoring be performed to ensure the safety of the individual.

Note: The WBGT at KAFB on June 15th between 11:00am and 3:00pm ranged from 69.4°F to 72.4°F, in part due to the low relative humidity. These values fall short of the lowest listed thresholds in the ACGIH tables and would be characterized as mild or benign conditions.

The National Weather Service Heat Index Chart is a chart, with dry bulb temperature and relative humidity as the variables, which assigns risk and likelihood of heat disorders with prolonged exposure or strenuous activity. Its target audience is the population at large, including the elderly, the young, and the less fit. The Heat Index (or apparent temperature) is the result of extensive biometeorological studies, and the values are derived from a collection of equations that comprise a model.

Note: The relative humidity at KAFB on June 15th between 11:00am and 3:00pm was less than 8%. These values fall short of the lowest threshold (40% RH) listed on the Heat Index Chart.

The Board concludes that the ACGIH TLV for heat strain and stress is not incorporated into NTC SOP 552, Inclement Weather Training Restrictions, resulting in development and implementation of less comprehensive control measures.

The Board concludes that because NTC SOP 552 does not address EHI, SPOTC staff was not trained to anticipate its occurrence.

Because the heat generation, accumulation, and balance for the most strenuous task of carrying of a 158 pound dummy up four flights of stairs and its implication in relationship to EHI was not recognized, the only control identified in the Risk Analysis Report was the physical fitness and ability of the competitors "to undergo the rigors of competition events." S1 had been subjected to appropriate medical examination at SRS as required by 10 CFR 1046 fitness standards and was found to be medically qualified for the competition. SPOTC exposes competitors to physical demands far exceeding the minimal requirements addressed in 10 CFR 1046.

The Board concludes that appropriate controls were not established because EHI

hazards were not adequately recognized or analyzed.

The Risk Analysis Report also identified the presence of paramedics and emergency response and the use of stop work authority by ROs, SQA staff, and observers to prevent unsafe acts as generic controls that apply to all stages of the competition. The two paramedics required by the planned emergency medical services support to SPOTC were on duty and present for all individual and team events and they were actively outside monitoring competitors and environmental conditions during the course of SPOTC. The WSI-NTC safety staff were also overseeing SPOTC events.

Stop work authority is generally defined in NTC SOP 502, *"ES&H Management Plan,"* dated May 10, 2004, and in the NTC *"WSI Integrated Safety Management Manual,"* dated November 2004. The Board could not find clear documented criteria for how stop work authority was to be applied to SPOTC or what conditions would warrant stopping the competition. Interviews with RO and paramedic staff indicated that there were unwritten and inconsistent practices being followed regarding when to intervene if a competitor was in physical distress. These were difficult to apply in a team competition environment, as further discussed in the next section.

The Board concludes that SPOTC program documents did not clearly define criteria for identifying competitors' physical conditions or situations that would require intervention to protect competitors in the midst of an event.

3.5 Core Function 4 - Perform Work within Controls

A general safety briefing was presented to all participants during the Sunday night meeting at the beginning of the competition. The briefing covered the four general and fourteen specific firearms safety rules, as well as a number of other important safety topics such as how to avoid dehydration. The briefing also referenced all pertinent parts of the risk analysis report and laid out the requirement for separate safety briefings for each specific course of fire before the start of each event.

The event description for the SPOTC 2006 Super Team Event indicates that the initial briefing covered general firearms rules, stated that required PPE was to be worn at all times, and that lost safety equipment had to be recovered or competitors would not be allowed to continue. The need for hydration was also emphasized. No other safety element (e.g., impact of altitude, and/or exhaustion, and muscle cramp) was addressed by this briefing, even though the risk analysis report states that "pre-event briefing advises competitors of event sequence, potential hazards, and requirements for safe completion of the course."

Interviews with participants in the Super Team Event indicate that, in general, they had been appropriately hydrated and that water and sports drinks were available to them at every station and every range during this event. The NTC staff was engaged in monitoring the heat index during this event but conditions did not warrant change to the event based on this information.
The Board examined how the hazards associated with each stage of the Super Team Event documented in the risk analysis report were communicated to and used by the team leaders when they were assigning tasks to their team members. There was no reference in the Sunday night briefing to hazards and controls for the most physically demanding task in the SPOTC 2006 Super Team Event (namely carrying 158 pound

dummy up four floors in the Tactical Training Tower) as identified in the risk analysis report. The Team Leader Briefing Card for that stage allows for this task to be performed by more than one team member, but leaves the decision to the team leader. S1 and one of the Pantex team members (P1) who later collapsed and needed medical assistance performed the task of carrying the dummy during this event.

The Board concludes that the Super Team Event safety briefing did not provide sufficient information about the EHI hazards for team leaders' consideration during their tactical decision-making process.

Testimony given to the Board indicated that several individuals, including the CRO, noticed that at the start of Stage 3, S1 could not proceed unassisted and had to be supported by his team mates. The CRO and the SRS Team Coach discussed S1's condition and decided to allow the team to continue. Review of event video shows S1 being dragged to the Stage 3 shooting box, indicating he could not move under his own power. According to the SRS Team Leader, the Stage 3 RO stated that the team would be disqualified if all members did not reach the firing line. This was not addressed in competition rules. None of the officials or other individuals who (according to the risk analysis report) had the responsibility and authority to stop the competition stepped forward to do so. After S1 collapsed, the SRS team quickly completed the final stage of the event and the competition was paused. Interviews with the paramedics who were called in to treat S1 indicated that they do not believe that they had been given appropriate guidance on stopping competition when they believed this to be appropriate.

Factors that contributed to ineffective stop work authority included a lack of clear assignment and understanding of roles and responsibilities, a lack of actionable criteria tailored to the competition environment, weakness in training of individuals to recognize their physical limitation, and inflexible competition rules that have the potential to push motivated individuals to exhaustion and injury.

The Board concludes that stop work responsibility and authority was not consistently and effectively implemented.

The Board also examined the emergency medical services. As previously mentioned in Section 2.2 and other sections of the report, the LFR SOP requires a minimum of one paramedic on duty during live fire range operations. Per the SPOTC Protocol Plan, two paramedics to support SPOTC were on duty for all events, and were actively outside monitoring competitors during the course of the competition. Testimony provided to the Board indicates ROs and other officials were in constant radio contact with the paramedics. Paramedics were immediately available and responded in a timely manner in treating all three heat illnesses. In addition, all three responding emergency medical transportation resources arrived in a timely manner. Annual emergency drills, which are specifically conducted just prior to SPOTC, tested all emergency communications and readiness of emergency response resources.

The Board concludes that the emergency medical services were well planned and executed, and were effective in minimizing the severity of the injuries.

The Board concludes that the practice of conducting emergency drills prior to SPOTC contributed to the effective and timely response of emergency medical services.

3.6 Feedback and Continuous Improvement

The SPOTC After Action Report is the feedback and improvement mechanism used by NTC to capture lessons learned and make improvements from competition to competition. This report was appropriately used in the development of SPOTC 2006 as described in Section 3.2. The Board also examined the NTC SOP 500, *Quality Assurance Plan*. Activity-specific periodic Quality Assurance reviews were not performed on long established activities such as Basic Security Police Officer Training, Firearms Instructor Certification, Security Police Officer III, and SPOTC so long as programmatic QA reviews did not identify latent system defects.

The SPOTC organization implemented lessons learned from the 2005 AAR to include increased availability of water and sports drinks throughout the LFR, conducting pre-event drills for emergency response, and increasing paramedic support. This indicates a working feedback and improvement process. SPOTC 2005 [and to the Boards knowledge previous SPOTC competitions] events and conditions were such that no individual experienced rhabdomyolysis; thus, EHI was not recognized as a hazard for SPOTC competitions.

3.7 Guiding Principle 4: Balance Priorities

As mentioned earlier, SPOTC is one of the premier forums for security forces to benchmark their capabilities to the "best in class" within a realistic environment. As a result, the event is extremely competitive and highly motivated participants and teams are readily willing to push themselves beyond what may be physically and safely achievable. Considering the risks inherent in such an environment the Board examined to what extent the planning and execution of SPOTC included consideration of the necessary balance between competitive fever and individual safety of the participants. NTC's prior experience with the organization and execution of SPOTC, the SPOTC Rule Book, and the scoring process ensure an appropriate balance in relation to firearms safety. This statement however, is not applicable in relation to other safety concerns associated with EHI resulting from severe physical exertion.

The Board concludes that the SPOTC Rule Book, the scoring approach, NTC staff's experiences, and processes used for planning and execution of the SPOTC event are not sufficiently comprehensive to establish an appropriate balance between the competitive fever of highly motivated competitors and their personal safety.

4.0 CAUSAL FACTORS

4.1 Direct Cause

The direct cause of the accident was metabolic reaction to the exertion required to quickly carry the 158 pound articulated dummy up four flights of stairs, resulting in Exertional Heat Illness in the three competitors.

4.2 Root Cause

SPOTC planning activities did not recognize or evaluate the potential for Exertional Heat Illness during the design, analysis, or validation of the Super Team Event.

4.3 Contributing Causes

1. SPOTC program documentation did not clearly define criteria for identifying competitors' physical conditions or situations that would require intervention to protect competitors.
2. EHI is a fairly common illness in healthy young adults undergoing strenuous physical training in warm and humid weather.
3. The level of competitive motivation associated with SPOTC at all organizational levels, including DOE, NTC, contractors, and all competitors blurred the distinction between winning and ensuring competitors' safety.
4. The safety briefing for the Super Team Event did not provide sufficient information about the hazards associated with the event to enable team leaders to make fully informed decisions on how to safely manage each stage of the event.
5. SPOTC rules and scoring protocols encourage intense competition without balancing that intensity with competitor safety.

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5.0 CONCLUSIONS AND JUDGMENTS OF NEED

JONs are the managerial controls and safety measures determined by the Board to be necessary to prevent or minimize the probability or severity of a recurrence. These JONs are linked directly to the causal factors, which are derived from the facts and analyses and form the bases for corrective action plans which are the responsibility of line management. The following table, Figure 5-1, contains the Board's conclusions and JONs.

Figure 5-1 – Conclusions and Judgments of Need

Conclusions	Judgments of Need
Despite the significant physical demands of SPOTC competitions, there was no involvement by fully qualified specialists (e.g., sports medicine physician or exercise physiologist) in SPOTC competition event design, analysis, and evaluation. Stage planning for the SPOTC Super Team Event did not adequately consider the potential for Exertional Heat Illness (EHI). EHI hazards were not recognized and were not analyzed for the Super Team Event. The ACGIH TLV for heat strain and stress is not incorporated into NTC SOP 552, Inclement Weather Training Restrictions, resulting in development and implementation of less comprehensive control measures. Because NTC SOP 552 does not address EHI, SPOTC staff was not trained to anticipate its occurrence. Appropriate controls were not established because EHI hazards were neither recognized nor analyzed.	**JON 1**: NTC needs to improve SPOTC planning to ensure that appropriate expertise is included to fully evaluate hazards and to control event conditions that could lead to heat illnesses such as EHI. **JON 2**: NTC needs to integrate ACGIH TLV for heat strain and stress into SPOTC-specific documents to ensure that the controls appropriate for managing EHI are effectively implemented. **JON 3**: DOE should use processes such as using the Lessons Learned Program and Operating Experience Summary to disseminate across the complex the hazards of strenuous activities that could lead to EHI.
SPOTC program documents did not clearly define criteria for identifying competitors' physical conditions or situations that would require intervention to protect competitors in the midst of an event. The Super Team Event safety briefing did not provide sufficient information about the EHI hazards to influence team leaders'	**JON 4**: NTC needs to ensure that: • SPOTC program documents define criteria for identifying competitors' physical conditions or situations that would require intervention to protect competitors in the midst of an event. • Safety briefings provide sufficient

Conclusions	Judgments of Need
consideration during their tactical decision-making process. Stop work responsibility and authority was not consistently and effectively implemented. Factors that contributed to ineffective stop work authority included a lack of clear assignment and understanding of roles and responsibilities, a lack of actionable criteria tailored to the competition environment, weakness in training of individuals to recognize their physical limitations, and competition rules that have the potential to allow motivated competitors to push themselves to exhaustion and injury. The SPOTC Rule Book, the scoring approach, NTC staff's experiences, and processes used for planning and execution of the Super Team Event were not sufficiently comprehensive to establish an appropriate balance between the competitive fever of highly motivated competitors and their personal safety.	information about EHI hazards to influence team leaders' consideration during their tactical decision-making process. • Stop work responsibility and authority are consistently and effectively implemented. • Future physical activities demanding extremely high physical exertions including SPOTC should include appropriate expertise (e.g., sports physician or exercise physiologist). • SPOTC planning and design, including rules and scoring, balance intense competition with competitors' safety.
NTC has established an adequate framework for ISM management systems and processes for SPOTC.	None
The emergency medical services were well planned and executed, and were effective in minimizing the severity of the injuries. The practice of conducting emergency drills prior to SPOTC contributed to the effective and timely response of emergency medical services.	None
WSI-NTC demonstrated investigative readiness that meets the intent of the DOE Order 225.1A Contractor Requirements Document.	None

6.0 BOARD SIGNATURES

Marcus Hayes, CSM
DOE Board Chairperson
U.S. Department of Energy
National Nuclear Security Administration
Albuquerque Service Center

William Schleyer
DOE Board Member – Trained Accident Investigator
U.S. Department of Energy
National Nuclear Security Administration
Albuquerque Service Center

Joe Eizaguirre
DOE Board Member
U.S. Department of Energy
National Nuclear Security Administration
Sandia Site Office

Robert Freeman
DOE Board Member
U.S. Department of Energy
HQS/GTN

Ali Ghovanlou
DOE Board Member
U.S. Department of Energy
HQS/GTN

Glenn Morton
DOE Board Member
U.S. Department of Energy
Savannah River Operations Office

LIST OF BOARD MEMBERS, ADVISORS, AND STAFF

Board Members

Chairperson Marcus Hayes, CSM, Occupational Health and Safety Manager, NNSA Albuquerque Service Center

Member William Schleyer, CSP, Occupational Safety Team Leader, NNSA Albuquerque Service Center

Member Joe Eizaguirre, CIH, CSP, Industrial Hygienist, NNSA Sandia Site Office

Member Robert Freeman, Nuclear Engineer, DOE Headquarters (SP-44)

Member Ali Ghovanlou, Senior Oversight Engineer, DOE Headquarters (SP-44)

Member Glenn Morton, PE, Fire Protection Engineer, Savannah River Operations Office

Advisors

Medical Advisor Steven J. Yevich, MD, Medical Officer, DOE Headquarters (EH-5)

Advisor Edward A. Behling, ACSM/HFI, NSCA/CSCS, CPT, Exercise Physiologist, Office of Secure Transportation Western Command

Administrative Support

Iriz Yazno, Administrative Analyst, NNSA Service Center
CE2 Corporation

Kenneth M. Jurjevich, Paragon Technical Services, Inc.

Court Reporter Melissa Correa, RPR, CCR, Bean & Associates

APPENDIX A – APPOINTMENT OF TYPE B ACCIDENT INVESTIGATION BOARD

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Department of Energy
National Training Center
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

JUN 2 0 2006

MEMORANDUM FOR MARCUS L. HAYES
SAFETY AND OCCUPATIONAL HEALTH
MANAGER
NNSA SERVICE CENTER

FROM: JO ANN MILAM
DIRECTOR
NATIONAL TRAINING CENTER

SUBJECT: National Training Center Type B Accident Board Investigation

I hereby establish a Type B Accident Investigation Board to investigate the heat related injuries which occurred at the National Training Center on June 15, 2006. I have determined it meets the requirements established for a Type B accident investigation in DOE O 225.1 A, ACCIDENT INVESTIGATIONS, dated September 29, 1997.

I appoint you as the accident board chairperson. The board members will be:

Joe Eizaguirre, Sandia Site Office
Robert Freeman, Security and Safety Assurance, SP-44
Ali Ghovanlou, Security and Safety Assurance, SP-44
Dennis Godbee, Savannah River Operations Office
Johnnie Nevarez, NNSA Service Center

Trained Investigator:

William Schleyer, NNSA Service Center

The board will be assisted by advisors and consultants and by other support personnel as determined by the chairperson.

The scope of the board's investigation will include but is not limited to identifying all relevant facts; analyzing the facts to determine the causes of the injury; developing conclusions; and determining the judgments of need that should prevent the recurrence of the accident, once implemented. The investigation will be conducted in accordance with DOE O 225.1A and will specifically address the role of DOE and contractor organizations and management systems as they may have contributed to the accident.

The scope will also include actions taken by the National Training Center in response to the incident and the application of lessons learned from similar accidents within the Department.

The board will provide my office with periodic reports on the status of the investigation but will not include any conclusions until the analysis of all the causal factors has been completed. Draft copies of the factual portion of the investigation report will be submitted to the National Training Center and Wackenhut Services Incorporated for a factual accuracy review prior to report finalization.

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

cc: Glenn Podonsky, SP-1
Michael Kilpatrick, SP-1
Joe Eizaguirre, SSO
Kim Davis, SSO
Robert Freeman, SP-44
Ali Ghovanlou, SP-44
Marvin Mielke, SP-44
Dennis Godbee, SR
Jeffrey Allison, SR
Michael Garcia, NZ
Ray Corey, NZ
William Schleyer, NZ

Department of Energy
National Training Center
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

JUN 2 8 2006

MEMORANDUM FOR MARCUS L. HAYES
SAFETY AND OCCUPANTIONAL HEALTH
MANAGER
NNSA SERVICE CENTER

FROM: JO ANN MILAM, DIRECTOR
NATIONAL TRAINING CENTER
OFFICE OF SECURITY AND SAFETY
PERFORMANCE ASSURANCE

SUBJECT: National Training Center Type B Accident Investigation
Amendment #1 to June 20, 2006 charter memorandum

This memorandum amends the June 20, 2006 charter memorandum issued to you regarding the Type B investigation of heat-related injuries that occurred on June 15, 2006. The purposes of this memorandum are:

1. To clarify the scope of the Type B investigation.
2. To record my decision that a conflict of interest involving Mr. Schleyer does not exist.
3. To add a member to the investigation board and to delete a previously named member.

1. Scope

A. Your investigation should examine the heat-related injuries in the context of the overall Security Protective Officer Training Competition (SPOTC) and should not be limited to only the day or the particular events during which the heat-related injuries occurred. Your investigation should not extend beyond the SPOTC competition to overall federal, state, local or departmental laws, rules, regulations or policies that may address over-arching topics that could have some relevance to NTC operations but are not of immediate and specific relevance to the SPOTC competition or the incidents in question.

B. Should you and the investigation board identify subjects beyond the scope as described above that you believe for any reason should be addressed by NTC, SSA, and/or DOE, please identify these along with any

recommendations the board wishes to make in a cover or transmittal memorandum to the final report.

C. If the scope describe in "A" above is unclear or if you and/or members of the board believe it should be amended to facilitate or otherwise support the board's investigation, please let me know immediately.

2. Conflict-of-Interest
   A. You notified me that in your regular jobs at the NNSA Service Center, Mr. Schleyer is your Team Leader.
   B. Mr. Schleyer has the requisite training to assist the Investigation Board as a trained investigator.
   C. I have determined that no conflict-of-interest exists as a result of the working relationship between you and Mr. Schleyer in your regular jobs.

3. Board Membership
   A. Dennis Godbee, who was named in the original charter memorandum, will not be available to serve on the Investigation Board and, accordingly, is removed as a member of the Board.
   B. Glenn Morton, Savannah River Site Office, is designated as a member of the Investigation Board.

Please let me know if you have any questions or comments.

cc:
Glenn Podonsky, SP-1
Mike Kilpatrick, SP-1
Pat Worthington, SP-44
Jeffrey Allison, SR
Dennis Godbee, SR
Glenn Morton, SR

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APPENDIX B – BARRIER ANALYSIS

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APPENDIX B
BARRIER ANALYSIS

Barrier analysis is based on the premise that hazards are associated with all tasks. For an accident to occur, there must be a hazard that comes into contact with a target because the barriers or controls were not in place, not used, or failed. A hazard is the potential for unwanted energy flow to result in an accident or other adverse consequence. A target is a person or object that a hazard may damage, injure, or fatally harm. A barrier is any means used to control, prevent, or impede the hazard from reaching the target, thereby reducing the severity of the resultant accident or the adverse consequence. The results of the barrier analysis are used to support the development of the causal factors. The results of the barrier analysis are provided below.

BARRIER	HOW DID IT PERFORM	HOW DID BARRIER PERFORMANCE CONTRIBUTE TO ACCIDENT
Individual's Physical/Medical Fitness	S1, P1, P2 did not pace themselves appropriately. Inadequate information was available to competitors regarding length and physical demands of the Super Team event.	Competitors did not have enough information about the event to pace themselves.
Stop work authority.	Roles and responsibilities not formally defined. Criteria for stopping and resuming competitive events not defined, communicated for SPOTC officials, competitors, and other participants.	Allowed continued participation by S1. Delayed stop work and may have increased severity of illness. Resumption exposed remaining competitors to EHI risk.
Validation of events prior to competition.	Single stage validation was performed. Accumulative stress for the entire event not evaluated. Additional required expertise not involved.	Did not identify the potential for EHI. Competitor fitness to compete assumed by SPOTC organizers.
Emergency Medical Services.	Well planned and executed.	Succeeded in minimizing the severity of the outcome.
General Safety briefing.	Comprehensive communication of SPOTC-specific general hazards. Communicated need for hydration, firearms safety, PPE, effects of altitude.	Effective in heightening hazard awareness.

BARRIER	HOW DID IT PERFORM	HOW DID BARRIER PERFORMANCE CONTRIBUTE TO ACCIDENT
Super Team Event safety briefing.	Not comprehensive because did not communicate the magnitude of EHI hazard associated with event.	Did not inform participants of EHI hazards, methods of recognition, and protection.
Range Officer recognizing symptoms of heat injury and stops the activity.	Training and experience appropriate for recognizing medical symptoms, a lagging indicator for heat illness.	ROs were not trained to recognize physiological symptoms (leading indicators), which are masked by anticipated fatigue of competitors.
Competitors recognizing symptoms of heat injury and stops the activity.	Training and experience appropriate for recognizing medical symptoms, a lagging indicator for heat illness.	Competitors were not trained to recognize physiological symptoms.(leading indicators), which are masked by anticipated fatigue of competitors
SOP 552 – Inclement Weather Training Restrictions.	Not sufficiently rigorous. Does not invoke DOE-required ACGIH-TLV.	Prevailing weather conditions did not influence outcome. However, rigorous application may have led to more detailed analysis and precautions for the stair climb task.
Rest breaks between events/hydration.	Rest breaks well-planned. Water/sports drinks readily available.	Prevented environmental heat illnesses, but not equally effective for preventing EHI.
Emergency drills prior to SPOTC.	Contributed to effective medical response.	Minimized the severity of the outcome.
Competition Rules and Scoring that balance intensity of competitive effort with individual safety.	Scoring encourages excessive physical exertion. Also encourages continued participation despite injury/illness.	Did not ensure a balance and impeded effective implementation of stop work authority.

APPENDIX C – EVENTS AND CAUSAL FACTORS CHART

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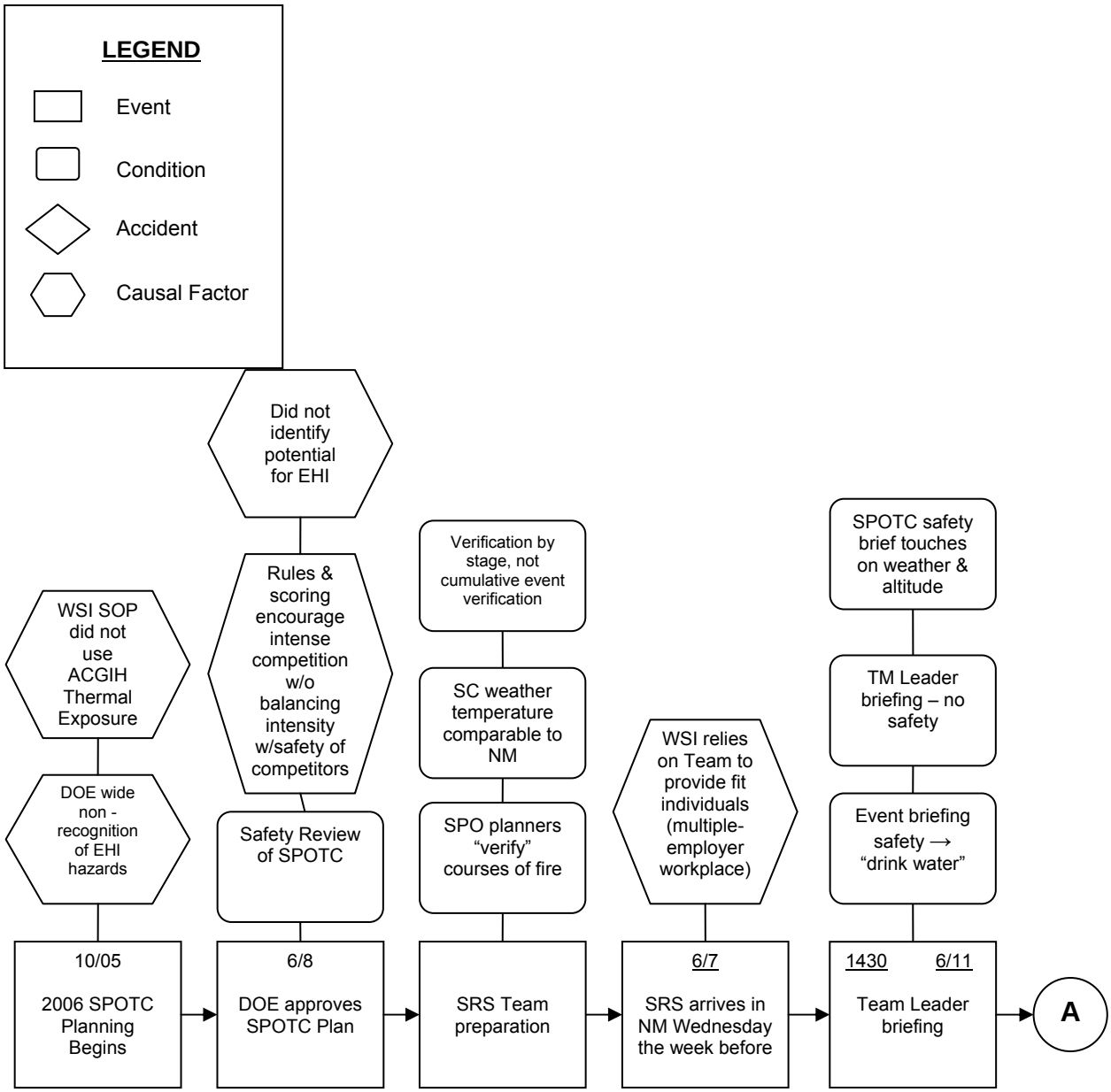
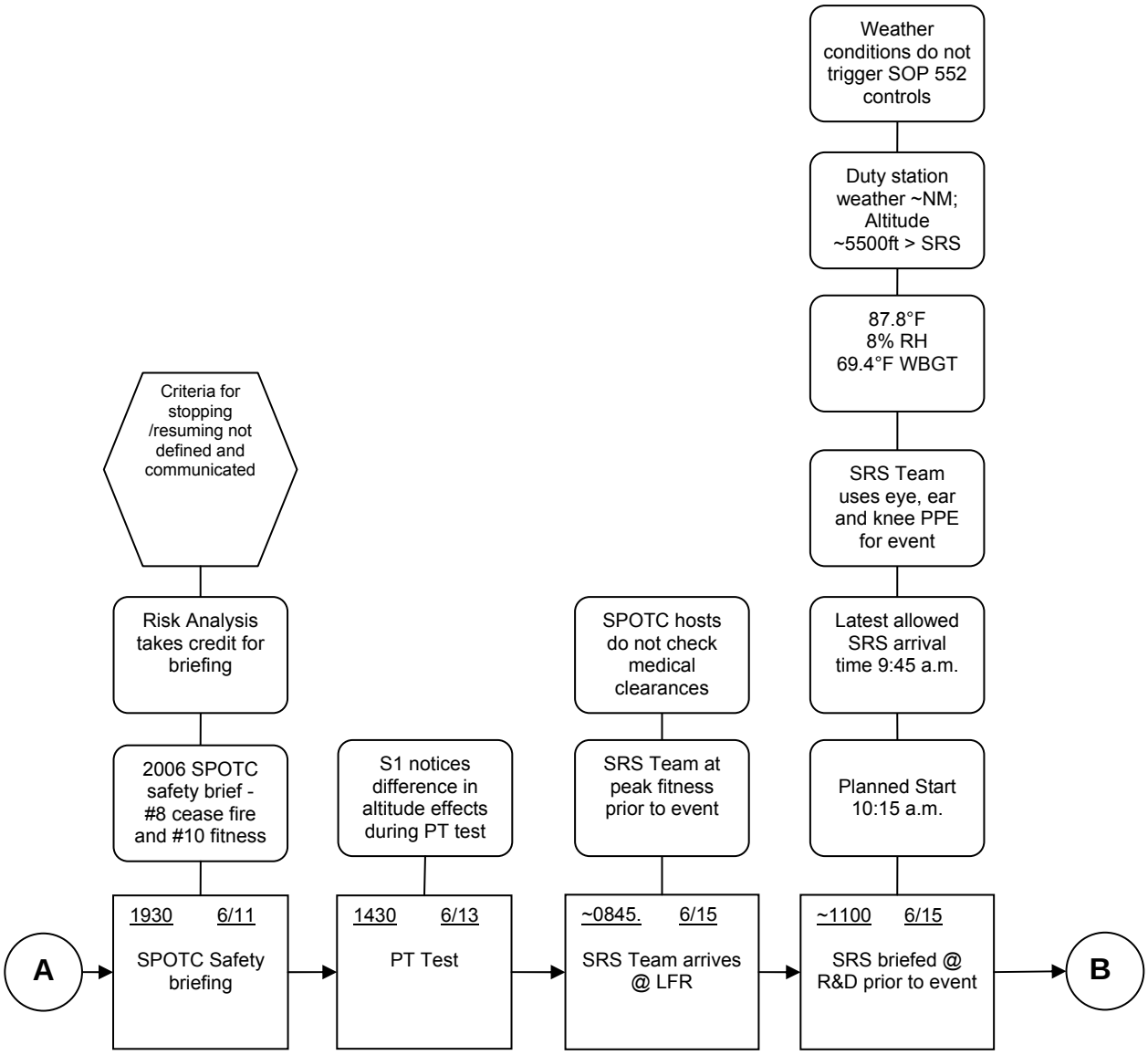
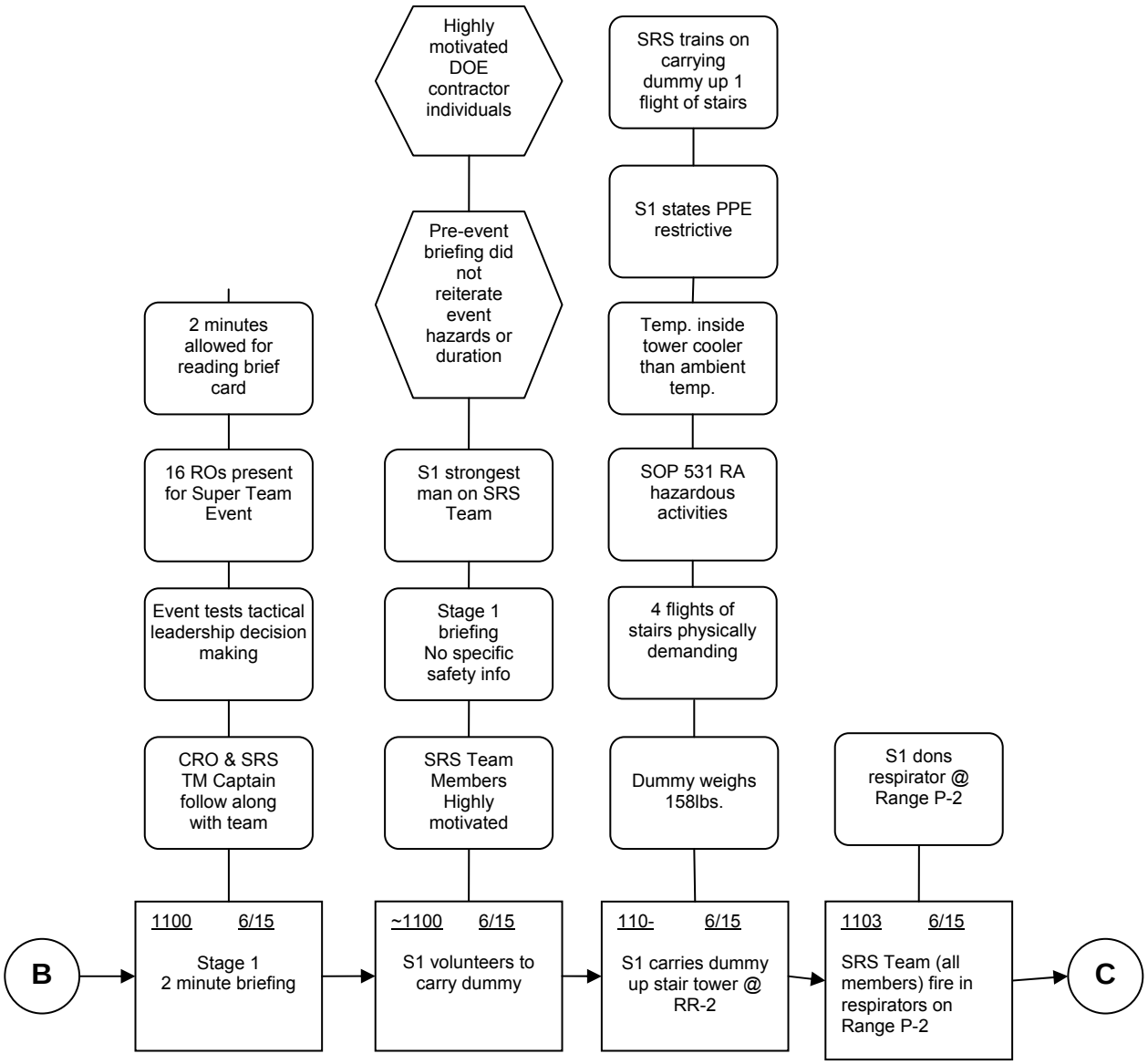
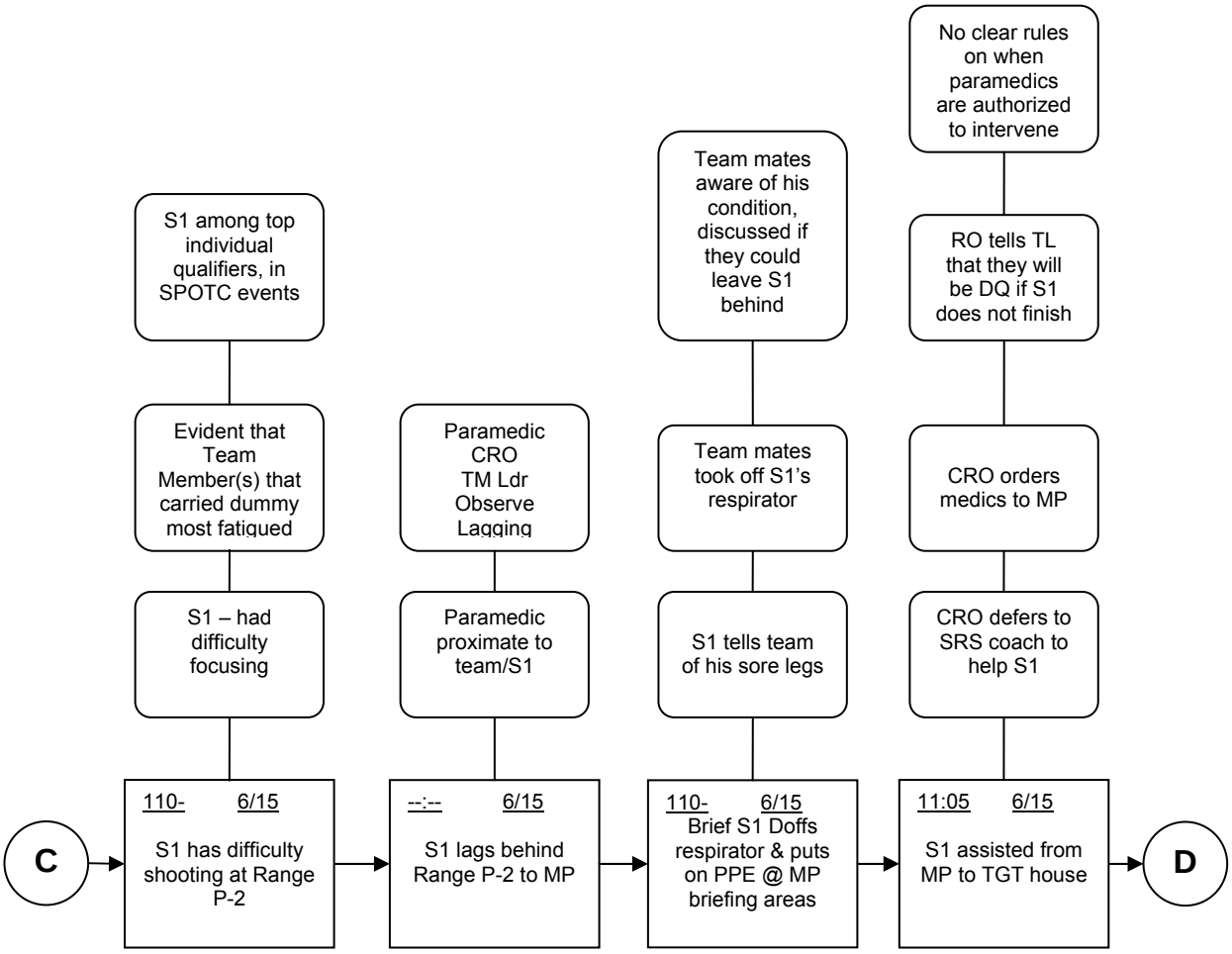
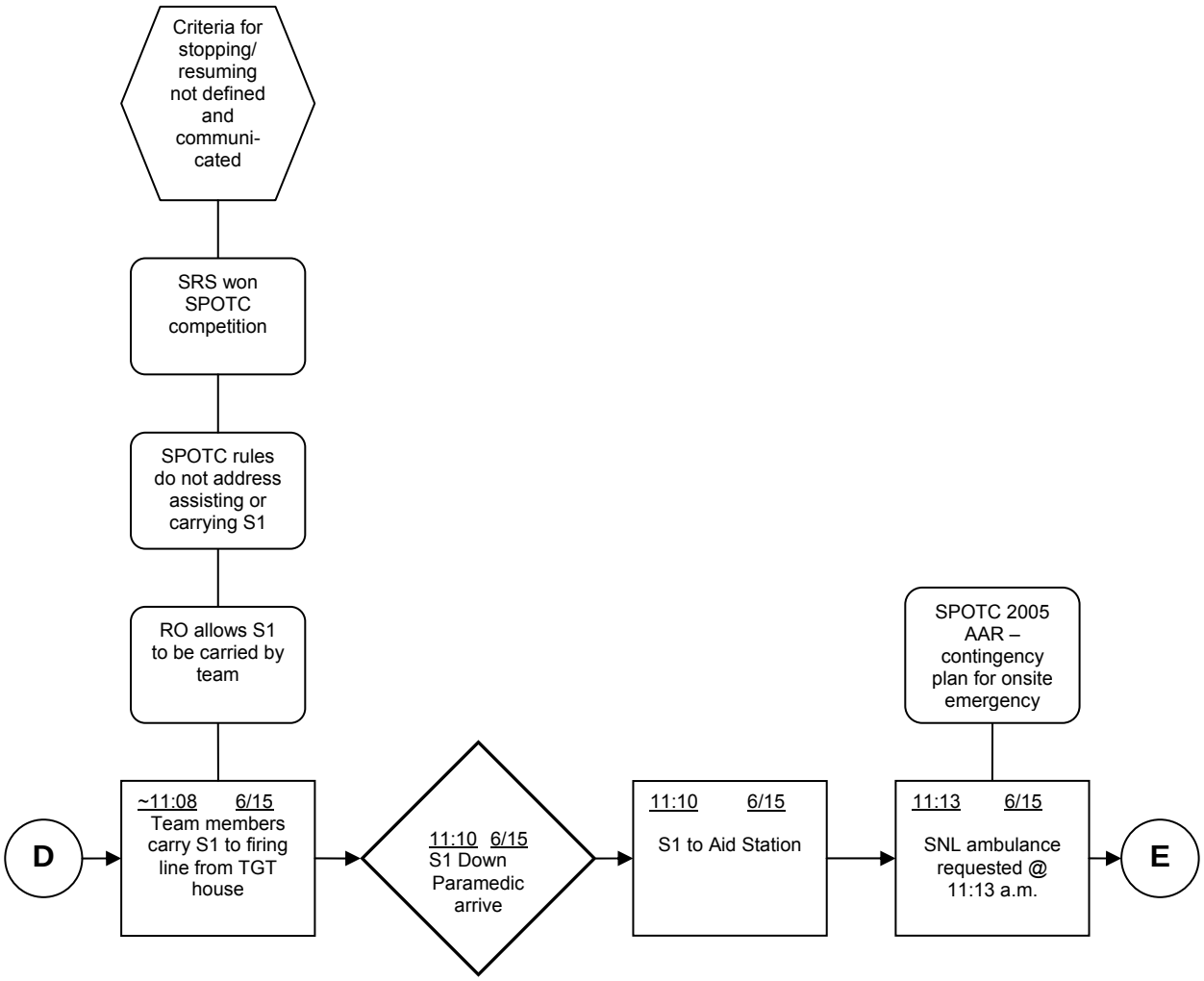
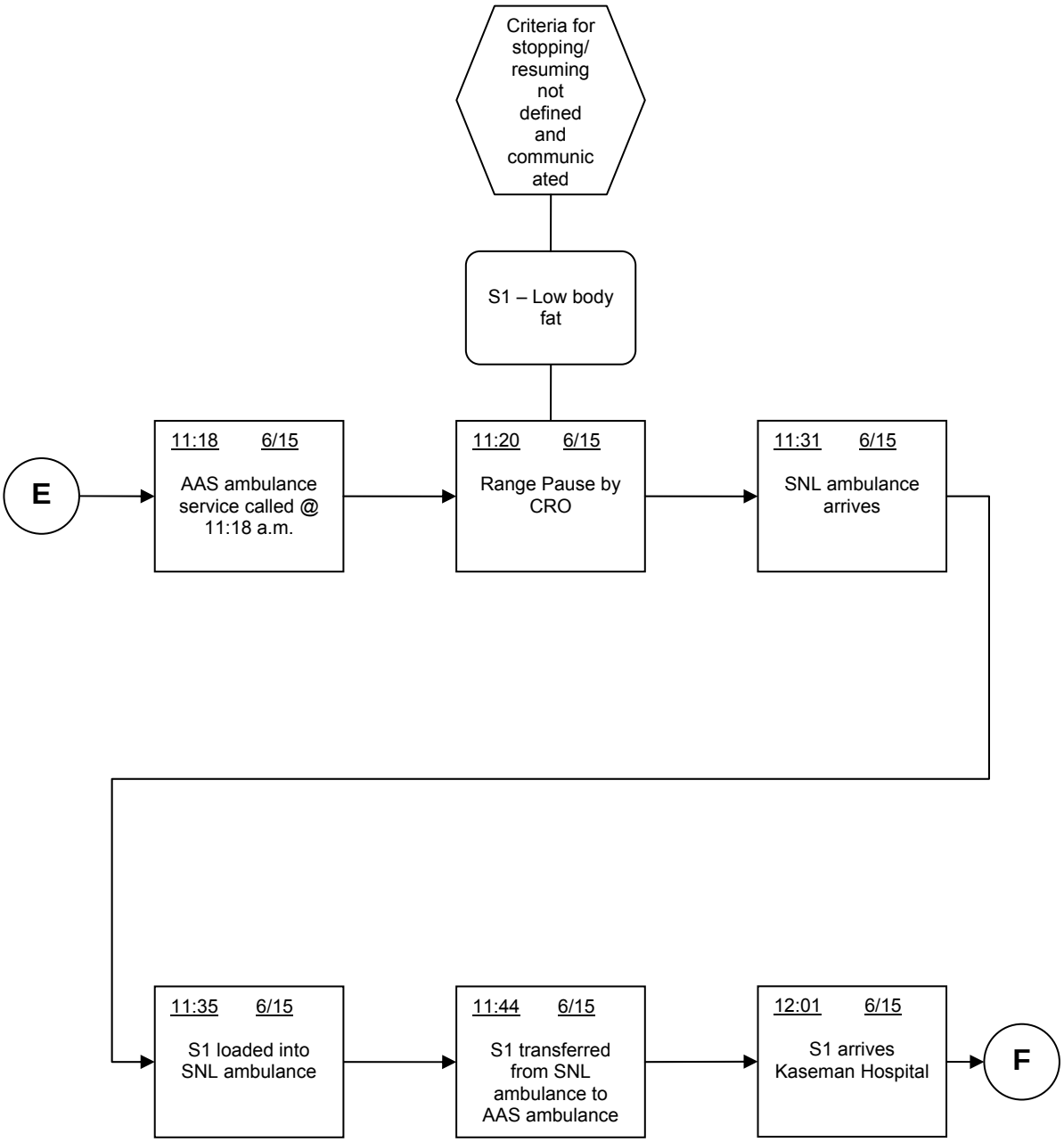

LEGEND
Event
Condition
Accident
Causal Factor
Did not identify potential for EHI
WSI SOP did not use ACGIH Thermal Exposure
Rules & scoring encourage intense competition w/o balancing intensity w/safety of competitors
Verification by stage, not cumulative event verification
SPOTC safety brief touches on weather & altitude
DOE wide non - recognition of EHI hazards
Safety Review of SPOTC
SC weather temperature comparable to NM
WSI relies on Team to provide fit individuals (multiple-employer workplace)
TM Leader briefing – no safety
Event briefing safety → "drink water"
SPO planners "verify" courses of fire
10/05
2006 SPOTC Planning Begins
6/8
DOE approves SPOTC Plan
SRS Team preparation
6/7
SRS arrives in NM Wednesday the week before
1430 6/11
Team Leader briefing
A


Weather conditions do not trigger SOP 552 controls
Duty station weather ~NM; Altitude ~5500ft > SRS
87.8°F
8% RH
69.4°F WBGT
SRS Team uses eye, ear and knee PPE for event
Latest allowed SRS arrival time 9:45 a.m.
Planned Start 10:15 a.m.
~1100 6/15
SRS briefed @ R&D prior to event
B
SPOTC hosts do not check medical clearances
SRS Team at peak fitness prior to event
~0845. 6/15
SRS Team arrives @ LFR
S1 notices difference in altitude effects during PT test
1430 6/13
PT Test
Criteria for stopping /resuming not defined and communicated
Risk Analysis takes credit for briefing
2006 SPOTC safety brief - #8 cease fire and #10 fitness
1930 6/11
SPOTC Safety briefing
A

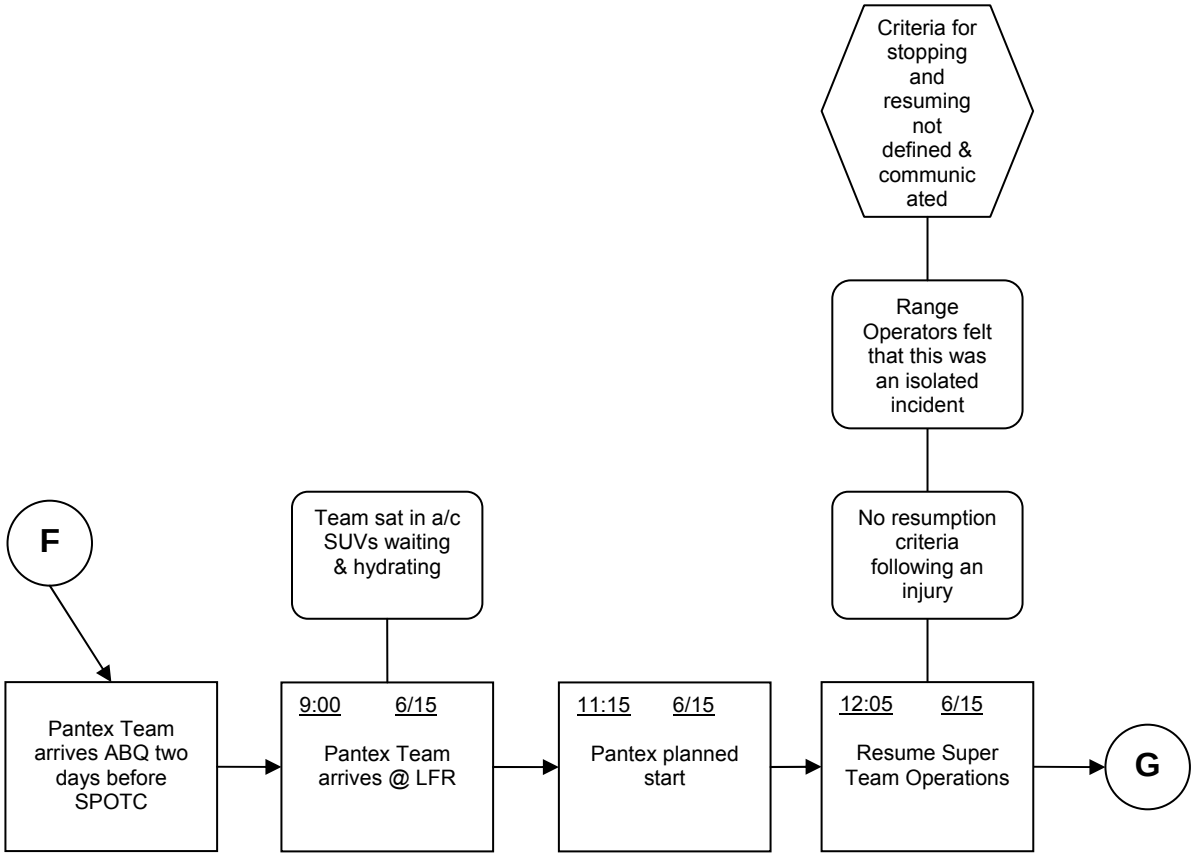

B
1100 6/15
Stage 1
2 minute briefing
2 minutes allowed for reading brief card
16 ROs present for Super Team Event
Event tests tactical leadership decision making
CRO & SRS TM Captain follow along with team
~1100 6/15
S1 volunteers to carry dummy
Highly motivated DOE contractor individuals
Pre-event briefing did not reiterate event hazards or duration
S1 strongest man on SRS Team
Stage 1 briefing No specific safety info
SRS Team Members Highly motivated
110- 6/15
S1 carries dummy up stair tower @ RR-2
SRS trains on carrying dummy up 1 flight of stairs
S1 states PPE restrictive
Temp. inside tower cooler than ambient temp.
SOP 531 RA hazardous activities
4 flights of stairs physically demanding
Dummy weighs 158lbs.
1103 6/15
SRS Team (all members) fire in respirators on Range P-2
S1 dons respirator @ Range P-2
C

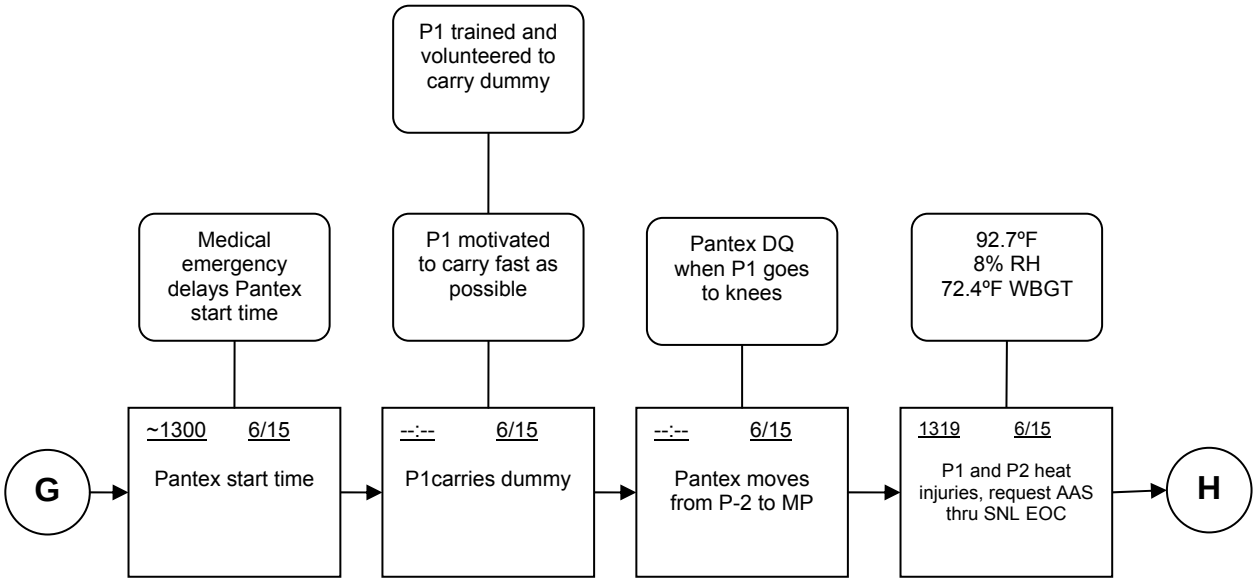

C
110- 6/15
S1 has difficulty shooting at Range P-2
S1 among top individual qualifiers, in SPOTC events
Evident that Team Member(s) that carried dummy most fatigued
S1 – had difficulty focusing
--:-- 6/15
S1 lags behind Range P-2 to MP
Paramedic CRO TM Ldr Observe Lagging
Paramedic proximate to team/S1
110- 6/15
Brief S1 Doffs respirator & puts on PPE @ MP briefing areas
Team mates aware of his condition, discussed if they could leave S1 behind
Team mates took off S1's respirator
S1 tells team of his sore legs
11:05 6/15
S1 assisted from MP to TGT house
No clear rules on when paramedics are authorized to intervene
RO tells TL that they will be DQ if S1 does not finish
CRO orders medics to MP
CRO defers to SRS coach to help S1
D

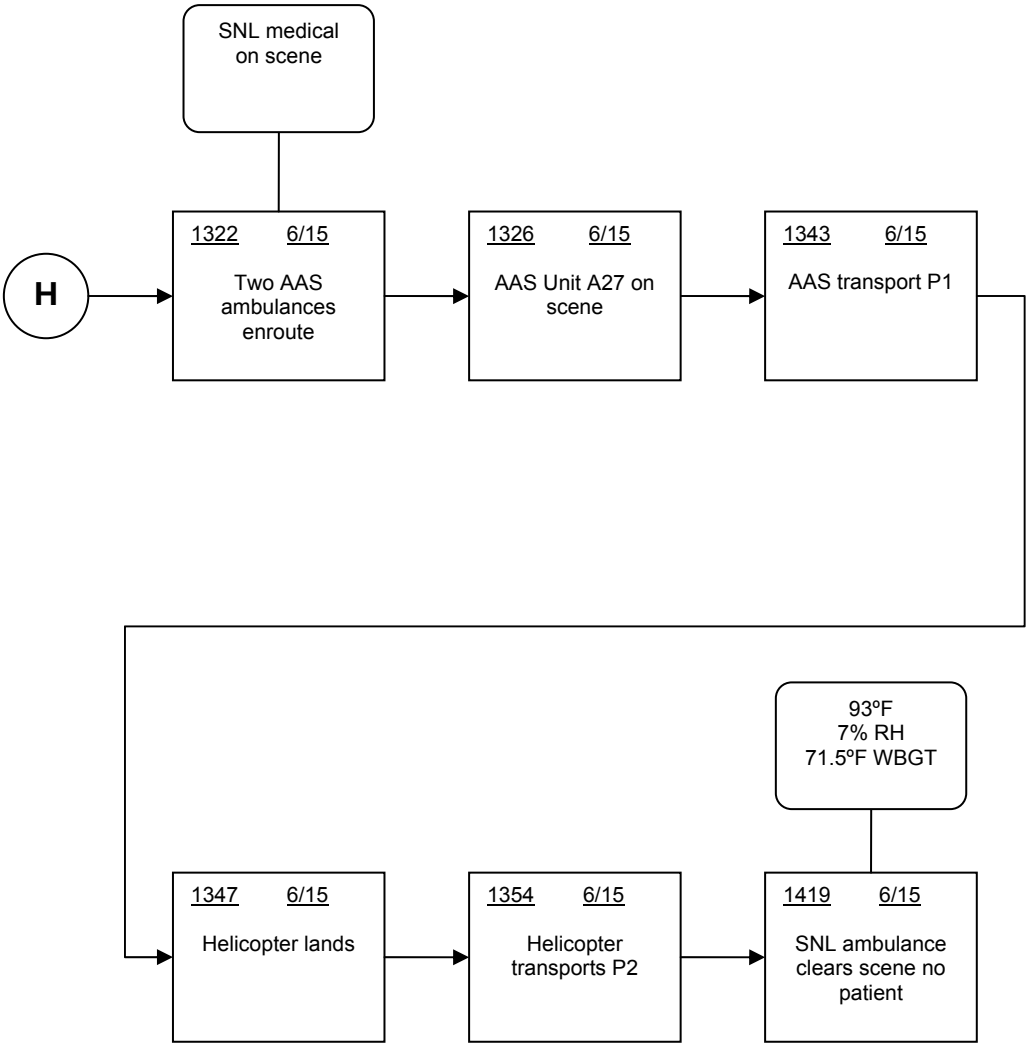

Criteria for stopping/ resuming not defined and communi-cated
SRS won SPOTC competition
SPOTC rules do not address assisting or carrying S1
RO allows S1 to be carried by team
SPOTC 2005 AAR – contingency plan for onsite emergency
D
~11:08 6/15
Team members carry S1 to firing line from TGT house
11:10 6/15
S1 Down
Paramedic arrive
11:10 6/15
S1 to Aid Station
11:13 6/15
SNL ambulance requested @ 11:13 a.m.
E


Criteria for stopping/ resuming not defined and communic ated
S1 – Low body fat
E
11:18 6/15
AAS ambulance service called @ 11:18 a.m.
11:20 6/15
Range Pause by CRO
11:31 6/15
SNL ambulance arrives
11:35 6/15
S1 loaded into SNL ambulance
11:44 6/15
S1 transferred from SNL ambulance to AAS ambulance
12:01 6/15
S1 arrives Kaseman Hospital
F

Start of Pantex Injury




P1 trained and volunteered to carry dummy
Medical emergency delays Pantex start time
P1 motivated to carry fast as possible
Pantex DQ when P1 goes to knees
92.7ºF
8% RH
72.4ºF WBGT
G
~1300 6/15
Pantex start time
--:-- 6/15
P1carries dummy
--:-- 6/15
Pantex moves from P-2 to MP
1319 6/15
P1 and P2 heat injuries, request AAS thru SNL EOC
H


SNL medical on scene
H
1322 6/15
Two AAS ambulances enroute
1326 6/15
AAS Unit A27 on scene
1343 6/15
AAS transport P1
93ºF
7% RH
71.5ºF WBGT
1347 6/15
Helicopter lands
1354 6/15
Helicopter transports P2
1419 6/15
SNL ambulance clears scene no patient

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