Appendix 6 — The Investigation

Team Formation

The following chronology shows how members of the South Canyon Fire Accident Investigation Team and cooperating investigators were notified of their selection to serve in the investigation.

July 6

6:45 p.m.	Dick Mangan, Ted Putnam, and Jim Kautz received a resource order from the Northern Region Coordination Center to investigate the fatalities.
10:00 p.m.	Mark Reimers was notified by J. Lamar Beasley, Acting Chief of the Forest Service, that he would be the Chief's representative on the Investigation Team.
11:00 p.m.	Mike Clarkson and Roy Johnson were notified by Al Dunton, BLM Chief of Fire and Aviation, that they would serve on the Investigation Team.

July 7

6:30 a.m.	Les Rosenkrance was notified by Al Dunton, BLM Chief of Fire and Aviation that he would be the Director's representative on the team. At 7:00 a.m. BLM Deputy Director Denise Meredith confirmed his selection via telephone.
7:30 a.m.	Sue Husari was notified by Dave Aldrich of the Forest Service Washington Office.
8:00 a.m.	Paul Werth was notified by NIFC BLM.
9:00 a.m.	John Graber was notified by the Forest Service Washington Office.
10:30 a.m.	Jim Webb was notified by the Forest Service Washington Office.

The team first met on July 7 at 10:00 p.m. Rosenkrance, Reimers, Johnson, Clarkson, Husari, Werth, and Webb attended. At 11:00 p.m. BLM Director Mike Dombeck and Forest Service Chief Jack Ward Thomas arrived at the meeting, and the charter for the joint Bureau of Land Management/Forest Service Interagency Investigation Team was discussed. Les Rosenkrance was designated team leader.

Observers

July 7

early morning	Bill Baden arrived at the headquarters of the National Fire Protection Association (NFPA) and was requested to call National Interagency Fire Center (NIFC) by his supervisor and offer his assistance on the investigating team. Steve Robinson, NIFC Assistant Director, responded that NFPA's assistance would be greatly appreciated. Bill Baden and

Mike Isner, NFPA fire investigators, joined the team in a support role.

mid-morning — Bobby Glover, Area Manager for the Occupational Safety and Health Administration (OSHA) was notified by Caroline Sullivan, Department of Agriculture, and Ronald Wilson, USDA Forest Service, that several fire fighters had died on the South Canyon fire. Later that morning Glover dispatched Paul Bakewell, Stephen J.Yellstrom, and Pete Dailey as compliance officers for the investigation. The OSHA representatives participated with the team as observers but reported that they would be required to conduct a separate investigation and prepare a separate report.

Investigation Sequence

The following chronology presents the main events in the investigation of the South Canyon fire.

July 6 and 7 — Team notification and travel

July 7

4:00 a.m. — Johnson arrives in Grand Junction to establish investigation facilities, obtain support, and get information to brief the team.

11:00 a.m. — Putnam, Mangan, Kautz, Isner, Martinez, and McShane arrive at fatality site.

8:00 p.m. — Team's first meeting is attended by Rosenkrance, Reimers, Johnson, Clarkson, Werth, Webb, and Husari. Organizational assignments are made and agreed upon.

11:00 p.m. — Team presents functional charter to Mike Dombeck and Jack Ward Thomas for their approval. Dombeck and Thomas agree that this investigation will be a joint effort between the USDA Forest Service and the Bureau of Land Management. Rosenkrance is designated team leader.

July 8

9:00 a.m. — Team holds organizational meeting to determine who will be interviewed and in what priority. Putnam, Mangan, Kautz, Isner, Martinez, and McShane continue their investigation at fatality site. Team receives a signed copy of its charter. First press conference is held in Grand Junction.

4:00 p.m. — Public affairs, clerical, and recorder support are ordered.

July 9

7:30 a.m. — Team meets to request more equipment and to follow up on assignments. Clarkson and Webb visit fire site with smokejumpers, while Johnson, Husari, and Werth visit site with ground crews. Rosenkrance, Reimers, Mangan, Chief Thomas, and Assistant Secretary of Agriculture Lyons attend

press conference in Glenwood Springs with Secretary of Agriculture Espy. After press conference Rosenkrance and Reimers fly over fire site. Putnam, Isner, and Martinez continue investigation at the fatality site.

July 10

7:30 a.m. Team meets to discuss progress. Putnam, Isner, and Martinez continue work at fatality site.

7:30 p.m. Team interviews continue all day. Progress on gathering information is going well.

July 11

7:30 a.m. Team meets to discuss progress. Putnam, Isner, and Martinez continue their investigation at fatality site. Interviews to continue all day. A proposed interagency alert is sent to NIFC to be issued.

7:30 p.m. Team discusses interviews.

July 12

7:30 a.m. Entire team travels to Glenwood Springs to visit fireline, escape routes, fatality sites, deployment areas, safety zones, blowup area, and Helispots 1 and 2. Putnam, Isner, and Martinez complete site analysis and join team in Grand Junction.

July 13

7:30 a.m. Team meeting. Interviews and analysis continue all day.

7:30 p.m. Team meeting.

July 14

7:30 a.m. Team agrees to meet formally only once a day. Interviews and analysis continue.

July 15

7:30 a.m. Team meets to assess programs and clarify assignments. Team also develops report format and tentative deadlines. Second interagency alert is sent to NIFC.

July 16

7:30 a.m. Team discusses sequence of fire events. A draft of sequence is due for team review by noon on July 16. Mangan and Baden are scheduled to conduct more interviews in Prineville, OR, on July 18. A partial draft of the Findings section of the report is due at 7:30 a.m. on July 17.

July 17

7:30 a.m. Team meets and reviews Findings.

4:30 p.m. Mangan and Baden leave for Prineville.

July 18

7:30 a.m. Team meets to assess program and review work assignments. Interviews continue.

July 19

7:30 a.m. Team reviews sequence of events and continues to work on report sections.

July 20

7:30 a.m. Photos are reviewed and logged. Final interviews are completed. Team continues to draft and review report. Mangan and Baden return from Prineville.

July 21

7:30 a.m. Team meets to discuss remaining tasks and establish draft report timeframes.

July 22

7:30 a.m. Final team meeting in Grand Junction. Investigation files to be temporarily housed at BLM Arizona State Office in Phoenix.

July 27

8:00 a.m. Rosenkrance, Johnson, and Clarkson meet with some support team members in Phoenix to work on Incident Overview.

July 28

8:00 a.m. Meeting continues in Phoenix.

August 9

8:00 a.m. Team meets in Phoenix to complete investigation report and transmittal letter.

August 10

7:00 a.m Team meeting in Phoenix continues.

August 11

7:30 a.m. Team meeting in Phoenix concludes.

August 17

10:30 a.m. Rosenkrance and Reimers present the team's reports to the Director of BLM and Chief of the Forest Service in Washington, D.C.

Team Members

The following list gives the names and titles of the members of the South Canyon Fire Accident Investigation Team, observers on the investigation, and the Principal Support Team.

South Canyon Fire Accident Investigation Team

Les Rosenkrance
Arizona State Director
Bureau of Land Management
Phoenix, AZ

Mark A. Reimers
Deputy Chief—Programs and Legislation
USDA Forest Service
Washington, D.C.

Roy A. Johnson
Fire Management Specialist
Bureau of Land Management
National Interagency Fire Center
Division of Fire and Aviation Policy and Management
Boise, ID

Jim Webb
Forest Supervisor
USDA Forest Service
Monte Vista, CO

John H. Graber
Safety and Health Manager-Union Rep. (NFFE)
USDA Forest Service
Milwaukee, WI

Mike Clarkson
Bureau of Land Management
National Interagency Fire Center
Division of Fire and Aviation Policy and Management
Chief, Branch of Smokejumper Management
Boise, ID

Paul Werth
Fire Weather Meteorologist
National Weather Service
Boise, ID

Sue Husari
Assistant Director for Fuels
Fire and Aviation Management
USDA Forest Service
San Francisco, CA

Dick Mangan
Fire and Aviation Program Leader
USDA Forest Service
Technology and Development Center
Missoula, MT

Ted Putnam
Equipment Specialist
USDA Forest Service
Technology and Development Center
Missoula, MT

Observers

Paul Bakewell
Assistant Area Director for Safety
Occupational Safety and Health Administration
Denver, CO

Peter Dailey
Safety Compliance Officer
Occupational Safety and Health Administration
Denver, CO

Stephen J. Yellstrom
Industrial Hygienist
Occupational Safety and Health Administration
Denver, CO

Principal Support Team

George Jackson
Equipment Specialist
USDA Forest Service
Technology and Development Center
Missoula, MT

Al Martinez
Regional Safety and Health Manager
USDA Forest Service, Region 2
Golden, CO

Dave Goens
Fire Weather Forecaster
National Weather Service
Salt Lake City, UT

Jim Kautz
Audio Visual Production Specialist
USDA Forest Service
Technology and Development Center
Missoula, MT

Elena Miller
Information Receptionist
USDA Forest Service, Boise National Forest
Lowman Ranger District
Lowman, ID

LuAnn Waida
Agreements Specialist
USDA Forest Service, Region 2
Lakewood, CO

Bill Baden
Senior Fire Service Specialist
National Fire Protection Association
Quincy, MA

Mike Isner
Fire Investigator
National Fire Protection Association
Quincy, MA

Beth Roetzer
Visual Information Specialist
Bureau of Land Management
Arizona State Office
Phoenix, AZ

Joanie Losacco
Deputy State Director, External Affairs
Bureau of Land Management
Arizona State Office
Phoenix, AZ

Lucy Ontiveros
Staff Assistant
Bureau of Land Management
Arizona State Office
Phoenix, AZ

June Clay
Staff Assistant
Bureau of Land Management
National Training Center
Phoenix, AZ

George Nelson
National Training Coordinator
Bureau of Land Management
National Training Center
Phoenix, AZ

Ken McGinty
Writer-Editor
Bureau of Land Management
National Training Center
Phoenix, AZ

Daniel James Jiron
Public Affairs Officer
USDA Forest Service
Pueblo, CO

Rem Hawes
Public Affairs
Bureau of Land Management
Arizona State Office
Phoenix, AZ

Ken Smith
Public Affairs
Bureau of Land Management
Canon City District
Canon City, CO

Trey Holt
Garfield County Coroner
Glenwood Springs, CO

Terry McShane
Carbondale Fire Department
Carbondale, CO

Other Contributors To The Investigation

The Investigation Team wishes to acknowledge and thank the following people for contributing to this investigation their photographs and video-tapes of the fire.

Photographs

Sabinio Archuleta
Missoula, MT

Bill Baker
Prineville, OR

Gary Benavidez
Missoula, MT

Debbie Dinelli
Glenwood Springs, CO

Sarah Doehring
Missoula, MT

Bruce Meland
Bend, OR

Tony Petrelli
Missoula, MT

Jo Temple
Glenwood Springs, CO

Video Tape

Allen Bell
Glenwood Springs, CO

Appendix 7 — Firefighters Assigned To The South Canyon Fire On July 6, 1994

Smokejumpers Jumped 7-5-84, Aircraft 490as

1.	Don Mackey	Jumper in Charge
2.	Sarah Doehring	Crew Member
3.	Keith Woods	Crew Member
4.	Quentin Rhoades	Crew Member
5.	Sonny Soto	Crew Member
6.	Sabinio Archuleta	Crew Member
7.	Eric Shelton	Crew Member
8.	Kevin Erickson	Crew Member

Smokejumpers Jumped 7-6-94, aircraft 117BH

1.	Eric Hipke	Crew Member
2.	Bill Thomas	Crew Member
3.	Tony Petrelli	Crew Member
4.	Dale Longanecker	Jumper in Charge
5.	Michael Cooper	Crew Member
6.	Mike Feliciano	Crew Member
7.	Roger Roth	Crew Member
8.	James Thrash	Crew Member

Prineville Interagency Hot Shot Crew

1.	Tom Shepard	Superintendent
2.	Jon Kelso	Squad Leader
3.	Kathi Beck	Crew Member
4.	Scott Blecha	Crew Member
5.	Levi Brinkley	Crew Member
6.	Bonnie Holtby	Crew Member
7.	Rob Johnson	Crew Member
8.	Tami Bickett	Squad Leader
9.	Doug Dunbar	Crew Member
10.	Terri Hagen	Crew Member
11.	Tom Rambo	Crew Member
12.	Alex Robertson	Crew Member
13.	Kip Gray	Crew Member
14.	Mike Simmons	Squad Leader
15.	Bill Baker	Crew Member
16.	Brian Lee	Crew Member
17.	Tony Johnson	Crew Member
18.	Louie Navarro	Crew Member
19.	Kim Valentine	Crew Member
20.	Brian Scholz	Crew Member

Firefighters Dispatched From Grand Junction Dispatch

1. Butch Blanco	Incident Commander		BLM
2. Derek Brixey	Crew Member		BLM
3. Brad Haugh	Crew Member		BLM
4. Todd Abbott	Crew Member		BLM
5 Eric Christianson	Crew Member		BLM
6. Loren Paulson	Crew Member		FS
7. Brian Rush	Crew Member		FS
8. Jim Byers	Crew Member		BLM
9. Mike Hayes	Crew Member		BLM
10. Neil Shunk	Crew Member		BLM
11. Michelle Ryerson	Squad Leader		BLM

Helitack Crew

12. Rich Tyler	Helicopter Mgr.	H-2	BLM
13. Robert Browning	Crew Member	H-2	FS

Firefighters Stationed At South Canyton Estates Helibase

14. Bruce Dissell	Crew Member	BLM
15. Steve Little	Crew Member	FS
16. Pat Medina	Crew Member	FS
17. Brian Cardoza	Crew Member	BLM

Interstate 70 - Guard

18. Janie Jarrett	Crew Member	BLM

Appendix 8 — Firefighter Qualifications

Name	*Qualifications
BLM/FS Firefighters	
Butch Blanco	ICT3, STCR, CRWB, ENGB
Brad Haugh	FFT2, ENOP
Loren Paulson	FFT2, FALC, SQDB
Brian Rush	FFT2, SQDB
Jim Byers	ICT4, STDZ, STCR, CRWB
Mike Hayes	FFT2
Neil Shunk	FFT2
Michelle Ryerson	FFT2
Rich Tyler	FFT1, SQDB, EMTB
Robert Browning	FFT2, ENOP, ENGB, HECM
Bruce Dissell	ENGB, HESM
Steve Little	FFT2, HECM, ENOP
Pat Medina	FFT2, HECM, HESM
Brian Cardoza	FFT2, CRWB
Janie Jarrett	FFT2
Smokejumpers	
Don Mackey	CRWB, FALC
Sarah Doehring	SQDB
Keith Woods	SQDB
Quentin Rhoades	SQDB, FALC
Sonny Soto	SQDB
Sabinio Archuleta	STCR, HESM, HEB1, HEM1
Eric Shelton	ICT4, SQDB, FALC
Kevin Erickson	CRWB, FALC, SMJ
Eric Hipke	FFT2, SMJ
Bill Thomas	DIVS, EMT1
Tony Petrelli	CRWB, FALC
Dale Longanecker	STCR, TFLD, FALC, FELB
Michael Cooper	ICT4, CRWB, FALB, SMJ
Mike Feliciano	FFT1, FALB, SMJ
Roger Roth	FFT1, FALB, SMJ
James Thrash	ICT4, CRWB, FALB, SMJ

*See the following listing of ICS positions.

Prineville Interagency Hotshot Crew

Tom Shepard	DIVS, STEN, FALC
John Kelso	FFT1, SQDB
Kathi Beck	FFT1, SQDB
Scott Blecha	FFT2
Levi Brinkley	FFT2
Bonnie Holtby	FFT2
Rob Johnson	FFT2
Tami Bickett	FFT2
Doug Dunbar	FFT2
Terri Hagen	FFT2
Tom Rambo	FFT2
Alex Robertson	FFT2
Kip Gray	FFT2
Mike Simmons	CRWB, ENGB, FFT1, FALB
Bill Baker	FFT2
Brian Lee	FFT2
Tony Johnson	FFT2
Louie Navarro	FFT2
Kim Valentine	FFT2
Brian Scholz	CRWB, SQDB, FFT1

List of ICS Positions

ICS Positions and Mnemonics

Area Commander (ACDR)
Area Command Logistics Chief (ACLC)
Area Command Planning Chief (ACPC)
Agency Representative (AREP)
Air Operations Branch Director (AOBD)
Air Support Group Supervisor (ASGS)
Air Tactical Group Supervisor (ATGS)
Air Tanker/Fixed Wing Coordinator (ATCO)
Base/Camp Manager (BCMG)
Claims Specialist (CLMS)
Commissary Manager (CMSY)
Communications Unit Leader (COML)
Compensation/Claims Unit Leader (COMP)
Compensation-for-Injury Manager (INJR)
Cost Unit Leader (COST)
Demobilization Unit Leader (DMOB)
Display Processor (DPRO)
Division/Group Supervisor (DIVS)
Documentation Unit Leader (DOCL)
Equipment Manager (EQPM)
Equipment Time Recorder (EQTR)
Facilities Unit Leader (FACL)

Field Observer (FOBS)
Finance/Administration Section Chief Type 1 (FSC1)
Finance/Administration Section Chief Type 2 (FSC2)
Food Unit Leader (FDUL)
Ground Support Unit Leader (GSUL)
Helibase Manager 1-3 (HEB2)
Helibase Manager 4+ (HEB1)
Helicopter Coordinator (HLCO)
Helicopter Crewmember (HECM)
Helicopter Manager (HEMG)
Incident Commander Type 1 (ICT1)
Incident Commander Type 2 (ICT2)
Incident Commander Type 3 (ICT3)
Incident Commander Type 4 (ICT4)
Incident Communications Manager (INCM)
Interagency Resource Representative (IARR)
Information Officer Type 1 (IOF1)
Information Officer Type 2 (IOF2)
Information Officer Type 3 (IOF3)
Liaison Officer (LOFR)
Logistics Section Chief Type 1 (LSC1)
Logistics Section Chief Type 2 (LSC2)
Medical Unit Leader (MEDL)
Operations Branch Director (OPBD)
Operations Section Chief Type 1 (OSC1)
Operations Section Chief Type 2 (OSC2)
Ordering Manager (ORDM)
Personnel Time Recorder (PTRC)
Planning Section Chief Type 1 (PSC1)
Planning Section Chief Type 2 (PSC2)
Procurement Unit Leader (PROC)
Receiving/Distribution Manager (RCDM)
Resource Unit Leader (RESL)
Safety Officer (SOF1)
Safety Officer (SOF2)
Security Manager (SECM)
Service Branch Director (SVBD)
Situation Unit Leader (SITL)
Strike Team Leader Dozer (STDZ)
Strike Team Leader Crew (STCR)
Strike Team Leader Engine (STEN)
Strike Team Leader Tractor/Plow (STPL)
Staging Area Manager (STAM)
Status/Check-in Recorder (SCKN)
Supply Unit Leader (SPUL)
Support Branch Director (SUBD)
Task Force Leader (TFLD)
Time Unit Leader (TIME)

Skill Positions and Mnemonics

Wildfire Skill Positions
Advanced Firefighter/Squad Boss (FFT1)
Crew Representative (CREP)
Crew Boss (Single Resource) (CRWB)
Dozer Boss (Single Resource) (DOZB)
Engine Boss (Single Resource) (ENGB)
Felling Boss (Single Resource) (FELB)
Firing Boss (Single Resource (FIRB)
Fire Behavior Analyst (FBAN)
Firefighter (FFT2)
Infrared Interpreter (IRIN)
Tractor/Plow Boss (Single Resource) (TRPB)
Training Specialist (TNSP)

Expanded Dispatch Skill Positions
Coordinator (CORD)
Dispatcher Recorder (EDRC)
Supervisory Dispatcher (EDSP)
Support Dispatcher (EDSD)

Appendix 9 — Investigation Team Charter

U.S. Department of the Interior
Bureau of Land Management
Washington, D.C. 20240

U.S. Department of Agriculture
Forest Service
Washington, D.C. 20090

SOUTH CANYON FIRE

Accident Investigation

July 12, 1994

This letter supersedes our direction of July 7, 1994. The designated Interagency Accident Investigation (Review) Team of Les Rosenkrance, BLM (Leader); Mark Reimers, USFS; Roy Johnson, BLM; Jim Webb, USFS; John Graber, USFS; Mike Clarkson, BLM; Dave Goens, NWS; Paul Werth, NWS; Sue Husari, USFS; and other representatives are delegated the authority to conduct a joint investigation of the injuries and fatalities that occurred on the South Canyon Fire. The Investigation Team shall serve as a board of investigation under Department of the Interior Department Manual 485, Chapter 7. The team shall:

1. Identify factual data associated with the circumstances relating to the incident.

2. Accurately and objectively record the findings.

3. Analyze the findings to identify the significant factors involved and their relationships.

4. As appropriate, recommend actions that should be implemented immediately to prevent similar future occurrences.

5. Develop and submit a factual report and an investigative report to the Director of the Bureau of Land Management and the Chief, U.S. Forest Service within 45 days of the accident.

A separate Management Review Team will be appointed jointly by the Agency heads to review the accident reports and to develop proposed corrective actions that should be implemented by the agencies to reduce future accidents of this nature.

This action will take place immediately.

MIKE DOMBECK
Director, Bureau of Land Management

JACK WARD THOMAS
Chief, U.S. Forest Service

Appendix 10 — Interagency Alerts 1 And 2

INTERAGENCY ALERT - SOUTH CANYON FIRE

WILDLAND FIRE SUPERVISORS: SHARE THIS INFORMATION WITH ALL EMPLOYEES AND DISCUSS CRITICAL ITEMS AS TO WHAT EFFECT THEY HAVE IN YOUR GEOGRAPHIC AREA.

The 1994 fire season is only half over and there have been at least seven separate entrapments on wildland fire incidents. Prior to the South Canyon fire, firefighters involved in entrapments have experienced relatively minor injuries.

The South Canyon fire tragedy has resulted in the deaths of 14 wildland firefighters. Nine Hot Shot Crew members, three Smokejumpers and two Helitack Crew members were killed on the incident.

CRITICAL FACTORS

FUELS AND WEATHER

1. Extreme weather conditions consisting of high temperatures and low relative humidities.
2. Low dead fuel moisture, and extremely low live fuel moisture.
3. Strong wind events. Pay attention to "RED FLAG WARNINGS".

FIRE BEHAVIOR IS SO EXTREME THAT THE TIME FRAMES FOR DECISION MAKING ARE VERY SHORT.

STRATEGY AND TACTICS: Remember the basics, establish a secure anchor, and flank your fire from your anchor. FRONTAL ATTACK IN THESE CONDITIONS IS TOO RISKY!

If you can't clearly see the fire edge, assign a lookout who can see all areas of the fire with potential.

Communications are critical. You must be able to talk with your crew and adjacent crews. Each crew must have access to operational and fire weather information.

Designating your fire lines as an escape route is not enough. Factor your travel time in escape situations. Steep slopes and loose soil on many fire lines slows your escape. Ensure your escape route will get you out of potential trouble in time.

The safety zone you select must offer protection from direct flames and high levels of radiant heat. Be sure it is big enough for everyone who intends to use it. Medium size heliports are often not adequate.

Consider the potential for reburn in areas that appear black and safe. If an area doesn't have a good safety zone, either build one or don't go in.

REVIEW AND IMPLEMENT

10 FIRE ORDERS

18 SITUATIONS THAT SHOUT "WATCH OUT"

L.C.E.S.: Lookout, Communications, Escape route, Safety zones

WORK/REST and LENGTH OF ASSIGNMENT GUIDES

PERSONNEL NUTRITION AND WEATHER REQUIREMENTS

NO WILDLAND FIRE, EVEN THOSE THAT THREATEN STRUCTURES OR IMPROVEMENTS, IS WORTH RISKING DEATH OR INJURY.

INTERAGENCY ALERT- SOUTH CANYON FIRE

The interagency team investigating the South Canyon fire tragedy will release a report to the Chief of the Forest Service and the Director of the Bureau of Land Management in August. The primary purpose of this Alert is to provide information that will help other firefighters avoid similar situations. In light of this, the interagency team strongly recommends that each fire manager review the four major common denominators of fire behavior on tragedy fires:

1. Most incidents happen on smaller fires or on isolated sections of larger fires.

   The South Canyon fire was initially a small, relatively inactive fire.

2. Flare-ups generally occur in deceptively light fuels, such as grass, herbs and light brush.

   The fuels on the South Canyon fire were either pinyon-juniper with a grass understory or oak brush. These fuels are light and reacted quickly to an increase in wind speed. Very rapid intense spread occured in underburned oakbrush.

   This is an active fire season. It is essential that firefighters dispatched to fires in areas of the country far from their homes be provided with information about the burning characteristics of fuels in the local area.

3. Most fires are innocent in appearance before unexpected shifts in wind direction and or speed result in "flare ups". In some cases, tragedies occur in the mop-up stage.

   The South Canyon was relatively inactive until the wind speed increased. At this time it became active quickly and reached "blow-up" intensity very rapidly. The South Canyon fire moved up-slope in some areas as rapidly as 18.5 miles per hour.

4. Fires respond to large and small scale topographic conditions, running uphill suprisingly fast in chimneys, gullies, and on steep slopes.

   The South Canyon fire moved rapidly upslope. The most extreme fire behavior occurred where wind was channeled by saddles, gullies and other topographic features.

The South Canyon Fire at the time of the "blow-up" affected 50 firefighters in several separate locations. All were in very hazardous situations. Those firefighters who died were directly in the path of the flames. Other fire fighters were able to use escape routes and reach safety. Eight fire fighters deployed fire shelters within the fire area and survived their entrapment.

CONTINUE TO STRESS

10 STANDARD FIRE FIGHTING ORDERS
AND
18 SITUATIONS THAT SHOUT "WATCH OUT"

Appendix 11 — Fire Suppression Work-Rest Guidelines

United States Department of Agriculture | Forest Service | Washington Office | 14th & Independence SW
P.O. Box 96090
Washington, DC 20090-6090

Reply to: 5100/6700 Date: May 24, 1993

Subject: Fire Suppressions Activity Work-Rest Guidelines

To: Regional Foresters and Area Director

Enclosed are the Work-Rest Guidelines to be used for fire suppression activities. Fire suppression is an emergency activity, but Forest Service policy sets the first priority for the safety of the individuals involved. It is imperative that Forest Service and other applicable standards are not violated or compromised. The guidelines are consistent with existing standards, and they generally provide a margin of safety for extended operations and physically and mentally demanding situations. Used in conjunction with the other applicable standards, they provide line officers and supervisors with room for making decisions based on the specific situations that provide for safety.

Please see that these guidelines are given broad distribution to all employees who may be involved with fire suppression activities.

/s/ John W. Chambers (for)

RICHARD ADAMS, Acting Director
Fire and Aviation Management

Enclosure

cc: Dick Stauber
Ron Wilson
Bill Bradshaw
Fire Operations
Engineering

I concur: D.Aldrich 05/17/93I concur: N.Steward 05/17/93I concur: R.Joens 05/17/93I concur: Z.Humes 05/19/93

FS:SPF:F&AM:D.ALDRICH:nms:!Correspondence Operation:05-17-93:202-205-1489

FIRE SUPPRESSION WORK-REST GUIDELINES
MAY 1993

Work-rest management of crews, overhead and support personnel to assure safe, productive fire suppression activities is a basic responsibility of fire management personnel. Utilize the following guidelines in decision making to assure adequate rest for fire suppression personnel:

1. Plan for and ensure a 2 to 1 work-rest ratio. Provide 1 hour of sleep/rest for every 2 hours of work/travel.

2. Plan for a minimum fire assignment length of 14 days within the "Lower 48", and 21 days going to or coming from Alaska. Maximum length assignment will not exceed 21 days, unless justified in writing by the Incident Commander and approval for further involvement is received from the firefighters home unit. The maximum assignment for certain State crews is limited through agreements to 14 days plus travel time.

3. Provide a minimum of 1 full day's rest in every 14 day assignment, and 2 full days' rest in every 21 day assignment to continuous suppression activity. If AD crews are released at the end of a 14 day assignment, rest and recuperation (R&R) will not normally be provided.

4. Provide personnel a minimum of 24 hours of rest for sleep and personal services following extended fire suppression assignment before mobilizing to another fire.

5. When dispatched or assigned to emergency situations the following driver restrictions applies to the first day:

> Personnel having driving responsibilities will not exceed a shift length of 15 hours of which no more than 10 hours may be actual driving time. All work shifts must be followed by a minimum of 8 consecutive hours in non-duty status.

6. Driving associated with an emergency situation after the initial 24 hour period should be in compliance with the Forest Service Health and Safety Code Handbook (FSH 6709.11).

7. When days off are planned, arrange for R&R facilities that provide for the following:

a. Eight (8) hours of uninterrupted sleep.
b. Facilities for showering and washing clothes.
c. Commissary or other sources of essential items.
d. Access to a public telephone for personal calls.
e. Recreational opportunities such as television and video movies may be provided where practical.

8. Rest and recuperation sites that provide the above needs at the least cost to the government should be selected.

9. Performance evaluations and ratings of overhead, crews and support personnel should evaluate performance of work-rest responsibilities ad defined by these guidelines.

Appendix 12 — Fire Entrapment Investigation and Review Guidelines

NATIONAL WILDFIRE COORDINATING GROUP

Memorandum July 27, 1993

To: NWCG Members

From: Chair, NWCG

Subject: Fire Entrapment Investigation and Review Guidelines

At the January, 1993 meeting, NWCG approved the Fire Entrapment Investigation and Review Guidelines prepared by the Safety and Health Working Team, subject to some editorial changes. Those changes have been completed as attached. The intent of the Guidelines is to obtain standardized data to assist in identifying trends and determining preventative measures for the benefit of all. They are not intended to replace agency protocol or to compromise any agency prerogatives.

NWCG recommends that each member review existing direction regarding investigation procedures and subsequent sharing of information resulting from investigation of fire entrapments, then incorporate the guidelines below to the extent possible.

These Guidelines recommend:

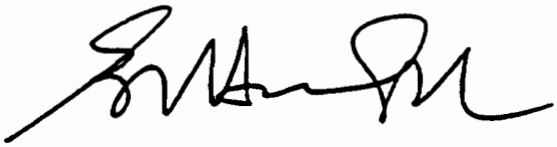
- A standard interagency investigation process, procedures and composition.
- Interagency participation on investigation teams.
- Identified channels to communicate findings and mitigation measures.

These guidelines recommend the establishment of Entrapment Investigation Teams. Because of the short time frames to organize such Teams, potential members should be pre-determined by the various Geographic Coordination Groups and reflect interagency composition so far as practicable.

The guidelines also indicate that the Safety and Health Working Team will review each entrapment report and distribute a "sanitized" summary of applicable findings and recommendations to NWCG and the National Fire Protection Association within thirty days of receipt of the investigation report from the appropriate agency administrator, via the "SafetyGram".

Portions of these guidelines, specifically the "Management and Command Responsibilities" and the "Entrapment Investigation Element Matrix", will be added to Chapter 4 (Firefighter Safety) of the NWCG 410-1 "Fireline Handbook" upon its next revision.

NWCG feels that these guidelines will be a viable and useful tool for all participating members.



Elmer Hurd

Enc.

FIRE ENTRAPMENT INVESTIGATION AND REVIEW GUIDELINES

PROBLEM STATEMENT:

Since 1976, over 300 shelter deployments and 30 entrapment fatalities have been documented in wildfire suppression operations. In reviewing available injury and fatality investigation reports, it is clear that there are common circumstances that are causal factors throughout the entire wildland fire management community chain of command.

NWCG recognizes that some agencies do an outstanding job of investigating entrapments, implementing corrective recommendations, and distributing findings. However, in some cases, improvements could be made by implementing and following clear investigation criteria, using consistent entrapment review elements, and by wide distribution of findings and recommendations.

These key improvements would noticeably further the prevention of these tragedies and near-miss incidents; without correction of these deficiencies, fire behavior-related injuries and fatalities will continue to occur.

STATEMENT OF PURPOSE:

NWCG hereby recommends guidelines for investigation and review of fire entrapment situations. These guidelines are not intended to replace agency-specific investigation protocol.

The intended purpose for developing these guidelines is to provide standardized data to assist in identifying and analyzing trends. From those trend analyses, preventative recommendations may be made.

These investigation and review guidelines will:

a. Outline investigation elements, and

b. Clarify management and command responsibilities.

Through the NWCG Safety and Health Working Team, the review process will:

c. Provide an effective distribution mechanism of findings, and

d. Develop a framework for implementation of recommendations.

DEFINITIONS:

Agency Administrator:
That lead employee having responsibility for management of land and/or resources on an organizational unit, and having accountability for overall results of management actions.

Entrapment:
A situation where personnel are unexpectedly caught in a fire behavior-related, life-threatening position where planned escape routes or safety zones are absent, inadequate, or have been compromised. An entrapment may or may not include deployment of a fire shelter for its intended purpose. These situations may or may not result in injury. They include "near misses".

ENTRAPMENT INVESTIGATION ELEMENTS:
The following elements most commonly contribute to entrapment situations. As a minimum, each of these elements should be addressed in an entrapment investigation and subsequent report, even if the investigation indicates that the element did not contribute to the entrapment. Exhibit I, "Entrapment Investigation Element Matrix", may be utilized to expedite the process.

I. FIRE BEHAVIOR
   Fuels
   Weather
   Topography
   Predicted vs. Observed

II. ENVIRONMENTAL FACTORS
   Smoke
   Temperature
   Visibility
   Slope
   Other

III. INCIDENT MANAGEMENT
   Incident Objectives
   Strategy
   Tactics
   Safety Briefings/Major Concerns Addressed
   Instructions Given

IV. CONTROL MECHANISMS
Span of Control
Communications
Ongoing Evaluations
"10 Standard Fire Orders/18 Watchout Situations"

V. INVOLVED PERSONNEL PROFILES
Training/Qualifications
Operational Period Length/Fatigue
Attitudes
Leadership
Experience Levels

VI. EQUIPMENT
Availability
Performance/Non-performance
Clothing and Equipment
Used for Intended Purpose?
Etc.

MANAGEMENT AND COMMAND RESPONSIBILITIES:

Incident Commander Responsibilities (in addition to those identified in ICS 410-1, "Fireline Handbook"):

Upon notification of an entrapment the Incident Commander should consider:

1. Removing involved personnel from the fireline, ensuring appropriate medical attention as necessary. When hospitalization or fatalities occur, relevant facilities and organizations should be advised to preserve all involved personnel's protective clothing and equipment.

2. Ensuring that the entrapment or deployment scene is secured and that all pertinent evidentiary items are secured (in place if possible), particularly fire shelters and personal protective equipment as required by the Occupational Safety and Health Act.

3. Immediately notifying the Agency Administrator and providing details on the incident status summary (ICS-209).

4. Initiating a preliminary investigation of the entrapment or deployment to determine the facts of the entrapment, insofar as possible. The initial investigation will be completed within 24 hours of the entrapment.

5. Relieving involved supervisors from fireline duty until the preliminary investigation has been completed.

6. Ensuring that personnel and supervisors are readily available for interviews by the Entrapment Investigation Team (EIT, below defined). "Available" means present at the incident base or nearby R&R center.

7. As soon as possible, providing the results of the Incident Commander's preliminary investigation to the Entrapment Investigation Team. Ensure preparation of a roster of individuals involved in the entrapment. The roster must minimally contain their names, employing agency, genders, ages, addresses, incident position titles, and appropriate employee identification numbers.

Agency Administrator Responsibilities:
Upon notification of an entrapment or deployment, the Agency Administrator should assure that the following activities take place within 24 hours of notification:

1. Convene an Entrapment Investigation Team (EIT) to investigate the entrapment. It is recommended that the EIT be interagency in nature and should include personnel with the following skill areas:

   a. Incident Commander or Operations Section Chief (Type I).

   b. Fire behavior analysis, qualified in the specific fuel type.

   c. Safety officer, with investigative expertise.

   d. Wildfire operations, with expertise at the peer level of the person(s) directly involved.

   e. Agency representative of involved person(s).

   f. Employee representation (union, peer at operations level)

   g. Fire weather meteorology.

   h. Personal protective equipment specialist, from a lab such as the USDA-Forest Service's Missoula Technology and Development Center.

2. Instruct the EIT to arrive on scene within 24 hours.

3. Advise the Incident Management Team of the EIT's time of arrival and team composition.

4. As required by the Occupational Safety and Health Act of 1970, advise the nearest office of the Occupational Safety and Health Administration (federal or state as applicable) if the entrapment involves a fatality or the hospitalization of 5 or more personnel. Advise OSHA office that a formal investigation is being conducted by a designated Entrapment Investigation Team.

5. Arrange for a critical incident stress debriefing team for the personnel involved in the entrapment.

6. Notify the home unit agency administrator of all individuals involved in the entrapment/deployment.

7. Submit a copy of the EIT's final report to the NWCG Safety and Health Working Team within 60 days of receipt from the EIT.

Entrapment Investigation Team Responsibilities:

1. The EIT will conduct the investigation, identify causal factors and list findings for the entrapment situation. Recommendations for corrective actions should be included in the letter of transmittal.

2. The EIT will brief the Agency Administrator and the Incident Commander of their preliminary findings prior to leaving the incident.

3. Within 30 days of the EIT's dispatch, the EIT's final report and recommendations for corrective actions will be submitted to the Agency Administrator.

NWCG Safety and Health Working Team (SHWT) Responsibilities:

1. Within 30 days of receipt of each entrapment report, the SHWT will distribute a summary of the applicable findings to NWCG agencies and the National Fire Protection Association, per the NWCG "Safety Gram". This summary will not include any incriminating agency references or information identified as sensitive by the agency.

2. The SHWT will periodically review all entrapment reports, determine trends, and incorporate findings to develop specific prevention recommendations for implementation by NWCG agencies.

ENTRAPMENT INVESTIGATION ELEMENT MATRIX

	Did Not Contribute	*Influenced	*Significant Contribution
FIRE BEHAVIOR			
Fuels			
Weather			
Topography			
Predicted vs. Observed			
ENVIRONMENTAL FACTORS			
Smoke			
Temperature			
Visibility			
Slope			
Other			
INCIDENT MANAGEMENT			
Incident Objectives			
Strategy			
Tactics			
Safety Briefings/Major Concerns Addressed			
Instructions Given			
CONTROL MECHANISMS			
Span of Control			
Communications			
Ongoing Evaluations			
"10 Standard Fire Orders/18 Watch-out Situations"			
INVOLVED PERSONNEL PROFILES			
Training/Quals./Physical Fitness			
Operational Period Length/Fatique			
Attitudes			
Leadership			
Experience Levels			
EQUIPMENT			
Availability			
Performance/Non-Performance			
Clothing and Equipment			
Used for Intended Purpose?			

Element items must be supported with written documentation.

ENTRAPMENT INVESTIGATION ELEMENT MATRIX

	Did Not Contribute	• Influenced	• Significant Contribution
I. FIRE BEHAVIOR			
Fuels			
Weather			
Topography			
Predicted vs. Observed			
II. ENVIRONMENTAL FACTORS			
Smoke			
Heat			
Other			
III. INCIDENT MANAGEMENT			
Incident Objectives			
Strategy			
Tactics			
Safety Briefings/Major Concerns Addressed			
IV. CONTROL MECHANISMS			
Span of Control			
Communications			
Ongoing Evaluations			
"10 Standard Fire Orders/18 Watch-out Situations."			
V. INVOLVED PERSONNEL PROFILES			
Training/Qualifications/Physical Fitness			
Operational Period Length/Fatigue			
Attitudes			
Leadership			
Experience Levels			
VI. EQUIPMENT			
Availability			
Performance			

* Element items must be supported with written documentation.

(Exhibit 1)

Glossary

Aerial Fuels: All live and dead vegetation in the forest canopy or above surface fuels, including tree branches and crowns, snags, moss, and high brush.

Air Tanker: A fixed-wing aircraft equipped to drop fire retardants or suppressants.

Anchor Point: An advantageous location, usually a barrier to fire spread, from which to start building a fireline. An anchor point is used to reduce the chance of firefighters being flanked by fire.

Aramid: The generic name for a high-strength, flame-resistant, synthetic fabric used in the shirts and jeans of firefighters. Nomex, a brand name for aramid fabric, is the term commonly used by firefighters.

Aspect: Direction toward which a slope faces.

Backing Fire: Fire spreading against the wind or downslope. A fire spreading on level ground without wind is a backing fire.

Behave: A system of interactive computer programs for modelling fuel and fire behavior. BEHAVE consists of two systems: BURN and FUEL.

Blowup: A sudden increase in fire intensity or rate of spread strong enough to prevent direct control or to upset control plans. Blowups are often accompanied by violent convection and may have other characteristics of a fire storm. See FLAREUP.

Bucket Drops: The dropping of fire retardants or suppressants from specially designed buckets carried by helicopter like sling loads.

Bumpup Method: A progressive method of building a fireline on a wildfire without changing relative positions in the line. Work is begun with a suitable space between workers. Whenever one worker overtakes another, all workers ahead move one space forward and resume work on the uncompleted part of the line. The last worker does not move ahead until completing his or her space.

Burning Index: A relative number related to the contribution that fire behavior makes to the amount of effort needed to contain a fire in a specified fuel type. Doubling the burning index indicates that twice the effort will be required to contain a fire in that fuel type as was previously required, providing all other parameters are held constant.

Burning Out: A type of suppression fire used to widen control lines during line construction or to eliminate unburned fuels inside the control lines after containment.

Chain: A unit of linear measurement equal to 66 feet.

Cold Front: The leading edge of a relatively cold air mass that displaces warmer air. The heavier cold air may cause some of the warm air to be lifted. If the lifted air contains enough moisture, the result may be cloudiness, precipitation, and thunderstorms. If both air masses are dry, no clouds may form. Following the passage of a cold front in the Northern Hemisphere, westerly or northwesterly winds of 15 to 30 or more miles per hour often continue for 12 to 24 hours.

Contain (Confine) A Fire: To take fire suppression action as needed, which can reasonably be expected to keep the fire within established boundaries under prevailing conditions.

Control A Fire: To complete a control line around a fire, any spot fires therefrom, and any interior islands to be saved; burn out any unburned area next to the fire side of the control lines; and cool down all hotspots that immediately threaten the control line until the lines can reasonably be expected to hold under foreseeable conditions.

Control Line: All built or natural fire barriers and treated fire edge used to control a fire.

Crew: An organized group of firefighters under the leadership of a crew leader or other designated official.

Crowning: The movement of fire through the crowns of trees or shrubs more or less independently of the surface fire.

Deployment: See FIRE SHELTER DEPLOYMENT.

Direct Attack: Any treatment of burning fuel, such as by wetting, smothering, or chemically quenching the fire or by physically separating burning from unburned fuel.

Dispatch Center: A facility from which resources are directly assigned to an incident.

Dead Fuels: Fuels with no living tissue in which moisture content is governed almost entirely by atmospheric moisture (relative humidity and precipitation, dry-bulb temperature, and solar radiation).

Energy Release Component (ERC): The computed total heat released per unit area (British thermal units per square foot) within the fire front at the head of a moving fire.

Engine Crew: Firefighters assigned to an engine. The Fireline Handbook defines the minimum crew makeup by engine type.

Entrapment: A situation in which a fire traps people in a life-threatening position with no, inadequate, or compromised evacuation routes or safety zones. An entrapment may or may not involve deploying fire shelters.

Equilibrium Moisture Content: Moisture content that a fuel particle will attain if exposed for an infinite period in an environment of specified constant temperature and humidity. When a fuel particle reaches equilibrium moisture content, net exchange of moisture between it and it environment is zero.

Extended Attack Incident: A wildland fire that has not been contained or controlled by initial attack forces and for which more firefighting resources are arriving, enroute, or being ordered by the initial attack incident commander.

Extreme Fire Behavior: A level of fire behavior that ordinarily precludes methods of direct control.

Fingers Of A Fire: Long narrow tongues of a fire projecting from the main body of a fire.

Fire Behavior: How a fire reacts to the variables of fuel, weather, and topography.

Fire Behavior Specialist: A person responsible to the Planning Section Chief for establishing a weather data collection system and for developing fire behavior predictions based on fire history, fuel, weather, and topography.

Firefighting Resources: All people and major items of equipment that can or potentially could be assigned to fires.

Fire Front: The part of a fire within which continuous flaming combustion is taking place. Unless otherwise specified, the fire front is assumed to be the leading edge of the fire perimeter. In ground fires, the fire front may be mainly smoldering combustion.

Fire Intensity: A general term relating to the heat energy released by a fire.

Fireline: A linear fire barrier that is scraped or dug to mineral soil.

Fire Load: The number and size of fires historically experienced on a specified unit over a specified period (usually 1 day) at a specified index of fire danger.

Fire Perimeter: The entire outer edge or boundary of a fire.

Fire Shelter: A personal protection item carried by fire fighters that, when deployed, unfolds to form a tent-like shelter of heat reflective materials.

Fire Shelter Deployment: The removing of a fire shelter from its case and using it properly for protection against fire.

Fire Weather: Weather conditions that influence fire ignition, behavior, and suppression.

Flame Depth: The depth of the fire front.

Flame Front: See FIRE FRONT.

Flame Length: The distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface), an indicator of fire intensity.

Flareup: Any sudden acceleration of fire spread or intensification of a fire. Unlike a blowup, a flareup lasts a relatively short time and does not radically change control plans. See BLOWUP.

Fuel Moisture (Fuel Moisture Content): Water content of a fuel expressed as a percentage of its ovendry weight.

Fuel Type: An identifiable association of fuel elements of distinctive plant species, form, size, arrangement, or other characteristics that will cause a predictable rate of fire spread or difficulty of control under specified weather conditions.

Fusee: A colored flare designed as a railway warning device and widely used to ignite suppression and prescription fires.

Ground Fuel: All combustible materials below the surface litter (duff, tree roots, punky wood, organic soil, sawdust) that normally support glowing combustion without flame.

Handline: A fireline built with hand tools.

Head Of A Fire: The side of the fire having the fastest rate of spread.

Helibase: The main location within the general incident area for parking, fueling, maintaining, and loading helicopters. The helibase is usually located at or near the incident base.

Helispot: A temporary landing spot for helicopters.

Helitack Crew: A group of firefighters trained in the technical and logistical use of helicopters for fire suppression.

Hotshot Crew: A highly trained firefighting crew used mainly in building firelines by hand.

Hotspot: A particularly active part of a fire.

Hotspotting: Reducing or stopping the spread of fire at points of particularly rapid rate of spread or special threat, generally the first step in prompt control, with emphasis on first priorities.

Incident: A human-caused or natural occurrence, such as a wildfire, that requires emergency service action to prevent or reduce the loss of life or damage to property or natural resources.

Incident Commander (IC): The person responsible for managing all incident operations.

Initial Attack (Action): The first suppression action on a fire.

Lead Plane: Aircraft with pilot used to make dry runs over the target area to check wing and smoke conditions and topography and to lead air tankers to targets and supervise their drops.

Light (Fine) Fuels: Fast-drying fuels, generally with a comparatively high surface area-to-volume ratio, which are less than 1/4-inch in diameter and have a timelag of 1 hour or less. These fuels readily ignite and are rapidly consumed by fire when dry.

Line Scout: A firefighter who determines the location of a fireline.

Litter: Top layer of the forest, scrubland, or grassland floor, directly above the fermentation layer, composed of loose debris of dead sticks, branches, twigs, and recently fallen leaves or needles, little altered in structure by decomposition.

National Fire Danger Rating System (NFDRS): A multiple index scheme designed to give fire suppression people and land managers a systematic means of assessing aspects of fire danger on a day-to-day basis.

Nomex: See ARAMID.

Overhead: People assigned supervisory positions, including incident commanders, command staff, general staff, directors, supervisors, and unit leaders.

Perimeter: See FIRE PERIMETER.

Radiant Burn: A burn received from a radiant heat source.

Radiant Heat Flux: The amount of heat flowing through a given area in a given time,usually expressed as calories/square centimeter/second.

Rate Of Spread: The relative activity of a fire in extending its horizontal dimensions, expressed as the rate of increase of the perimeter, rate of increase in area, or rate of advance of its head, depending on the intended use of the information. Rate of spread is generally expressed in chains or acres per hour for a specific period in the fire's history.

RAWS: See REMOTE AUTOMATIC WEATHER STATION.

Relative Humidity (Rh): Percentage of the actual vapor pressure of the air to the saturation vapor pressure; the ratio, expressed as a percentage, of the amount of water vapor in the air compared to the amount the air can hold under the same conditions.

Remote Automatic Weather Station (RAWS): An apparatus that automatically acquires, processes, and stores local weather data for later transmission to the GOES Satellite, from which the data is retransmitted to an earth receiving station for use in the National Fire Danger Rating System.

Reburn: The burning of an area that has been previously burned but that contains flammable fuel that ignites when burning conditions are more favorable; an area that has reburned.

Red Flag Warning: A term used by fire weather forecasters to call attention to weather conditions of limited duration that may result in extreme burning conditions.

Red Flag Watch: A term used by fire weather forecasters to notify using agencies, usually 24 to 72 hours ahead of the event, that current and developing meteorological conditions may evolve into dangerous fire weather.

Resource Order: An order placed for firefighting resources.

Resources: See FIREFIGHTING RESOURCES.

Retardant: A chemical having a retarding action on fire.

Run (Of A Fire): The rapid advance of the head of a fire with a marked change in fireline intensity and rate of spread from that noted before and after the advance.

Safety Zone (Area Or Island): An area used for escape should the fireline be outflanked or a spot fire cause fuels outside the fireline to make the fireline unsafe.

Scratchline: An unfinished preliminary fireline hastily established or built as an emergency measure to check the spread of fire.

Sizeup (Or To Size Up): The evaluation of (or to evaluate) a fire to determine a course of action for fire suppression.

Slopover (Breakover): A fire edge that crosses a control line or the resultant fire.

Smokejumper: A firefighter who travels to fires by aircraft and parachute.

Spot Fire: Fire set outside the perimeter of the main fire by flying sparks or embers.

Spotter: In smokejumping, the person responsible for selecting drop targets and supervising all aspects of dropping smokejumpers.

Spotting: Behavior of a fire producing sparks or embers that are carried by the wind and start new fires beyond the zone of direct ignition by the main fire.

Spot Weather Forecast: A special forecast issued to fit the time, topography, and weather of each specific fire. These forecasts are issued upon request of the user agency and are more detailed, timely, and specific than zone forecasts.

Strategy: The science and art of command as applied to the overall planning and conduct of an incident.

Suppressant: An agent, such as water or foam, used to extinguish the flaming and glowing phases of combustion when directly applied to burning fuels.

Suppression: All the work of extinguishing or confining a fire, beginning with its discovery.

Surface Fuels: Loose surface litter on the soil surface, normally consisting of fallen leaves or needles, twigs, bark, cones, and small branches that have not yet decayed enough to lose their identity; also grasses, forbs, low and medium shrubs, tree seedlings, heavier branchwood, downed logs, and stumps interspersed with or partially replacing the litter.

Tactics: Deploying and directing resources on an incident to meet objectives determined by strategy.

Timelag: Time needed under specified conditions for a fuel particle to lose about 63 percent of the difference between its initial moisture content and its equilibrium moisture content. If conditions remain unchanged, a fuel will reach 95 percent of its equilibrium moisture content after 4 timelag periods.

Torching: The ignition and later flareup of a tree or small group of trees, usually from bottom to top.

Type: The capability of a firefighting resource in comparison to another type. Type I usually means a greater capability due to power, size, or capacity.

Underburn: A fire that consumes surface fuels but not trees or shrubs. See SURFACE FUELS.

Vectors: Directions of fire spread as related to rate of spread calculations (in degrees from upslope).

Western Slope Fire Coordination Center: An interagency organization serving western Colorado and eastern Utah that coordinates the acquisition of firefighting resources; helps establish priorities for these resources; receives and disseminates fire information; calls for and pre-positions smokejumpers; and manages a 500-person fire cache, an air tanker base, a helicopter and a helitack crew.

Wildland Fire (Wildfire): Any fire occurring on land that is essentially undeveloped except for roads, railroads, powerlines and similar transportation facilities.

Wind Vectors: Wind directions used to calculate fire behavior.

U.S. Department of the Interior
Bureau of Land Management
Washington, D.C. 20240

U.S. Department of Agriculture
Forest Service
Washington, D.C. 20090

Memorandum

AUG 19 1994

To: Claudia P. Schechter
Designated Agency Safety and Health Official,
Department of the Interior

Wardell Townsend
Designated Agency Safety and Health Official,
Department of Agriculture

From: Acting Director, Bureau of Land Management
Chief, Forest Service

Subject: Joint Report of Investigation of South Canyon Fire

In accordance with the safety investigation procedures of our respective Departments, we hereby transmit to you the attached Report of the South Canyon Fire Accident Investigation Team and the Team's Letter of Transmittal/Investigative Report. We have established an Interagency Management Review Team to serve as a steering group to review the findings and conclusions of the Investigation Team, review and refine the Team's recommendations, and propose a plan for corrective action. A copy of the corrective action plan will be submitted to you upon its completion. In the meantime, we have adopted the Team's recommendations as interim measures.

We have decided to release both parts of the Investigation Team's Report publicly for two reasons. First, after reviewing the findings and conclusions in the Report, we have adopted the Team's recommendations as interim measures, subject to further refinement by the Interagency Management Review Team. Second, the intention of both the Bureau of Land Management and the Forest Service from the outset was to release the Report in its entirety to the public, and the investigation was conducted with that intention in mind.

You will find that some information has been deleted from several of the witness statements included in the report. We have removed personal privacy information (home addresses and telephone, social security and driver's license numbers, and dates of birth) provided by several witnesses on their statement forms. Any deletions from the body of the statements reflect the witnesses' own corrections.

Mike Dombeck
Director,
Bureau of Land Management

Jack Ward Thomas
Chief,
Forest Service

Letter of Transmittal/ Investigative Report South Canyon Fire

Summary

On July 2, 1994, during a year of drought and at a time of low humidity and record high temperatures, lightning ignited a fire 7 miles west of Glenwood Springs, Colorado. The fire was reported to the Bureau of Land Management on July 3 as being in South Canyon, but later reports placed it near the base of Storm King Mountain. The fire began on a ridge, which was paralleled by two canyons or deep drainages, called the east and the west drainages. In its early stages the fire burned in the pinyon-juniper fuel type and was thought to have little potential for spread.

Dry lightning storms had started 40 new fires in BLM's Grand Junction District in the 2 days before the South Canyon fire started, requiring the District to set priorities for initial attack. Highest priority was given to fires threatening life, residences, structures, and utilities, and to fires with the greatest potential for spread. All initial attack firefighting resources on the Grand Junction District were committed to the highest priority fires. In response to a request from the Grand Junction District, the Garfield County Sheriff's Office and White River National Forest monitored the South Canyon fire.

Over the next 2 days the South Canyon fire increased in size, the public expressed more concern about it, and some initial attack resources were assigned. On the afternoon of July 4 the District sent two engines. Arriving at 6:30 p.m. at the base of the ridge near Interstate 70, the crew sized up the fire but decided to wait until morning to hike to the fire and begin firefighting efforts.

The next morning, a seven person BLM/Forest Service crew hiked 2 and 1/2 hours to the fire, cleared a helicopter landing area (Helispot 1) and started building a fireline on its southwest side. During the day an air tanker dropped retardant on the fire. In the evening the crew left the fire to repair their chainsaws. Shortly thereafter, eight smokejumpers parachuted to the fire and received instructions from the Incident Commander to continue constructing fireline. The fire had crossed the original fireline so they began a second fireline from Helispot 1 downhill on the east side of the ridge. After midnight they abandoned this work due to the darkness and the hazards of rolling rocks.

On the morning of July 6 the crew returned to the fire and worked with the smokejumpers to clear a second helicopter landing area (Helispot 2).

Later that morning eight additional smokejumpers parachuted to the fire. They were assigned to build the fireline on the west flank. Later, 10 Prineville Interagency Hotshot Crew members arrived, and 9 joined the smokejumpers in line construction. The remaining members of the hotshot crew upon arrival were sent to help reinforce the fireline on the ridgetop.

At 3:20 p.m. a dry cold front moved into the fire area. As winds and fire activity increased, the fire made several rapid runs with 100-foot flame lengths within the existing burn. At 4:00 p.m. the fire crossed the bottom of the west drainage. It spread up the drainage on the west side. It soon spotted back across the drainage to the east side beneath the firefighters and moved onto steep slopes and into dense, highly flammable Gambel oak. Within seconds a wall of flame raced up the hill toward the firefighters on the west flank fireline. Failing to outrun the flames, 12 firefighters perished. Two helitack crew members on the top of the ridge also died when they tried to outrun the fire to the northwest. The remaining 35 firefighters survived by escaping out the east drainage or seeking a safety area and deploying their fire shelters.

Findings and Recommendations

The South Canyon fire at the time of the blowup affected 49 firefighters in several separate locations. All were in very hazardous situations. Firefighters who died were directly in the path of the flames. Other firefighters used escape routes to reach safety. Eight firefighters deployed fire shelters within the fire area and survived their entrapment.

Twelve Fatalities on Southwest Flank Line

The twelve fatalities resulted from a combination of factors. The crew was building a direct attack fireline downhill in Gambel oak. Surface fuels had been burned, but aerial fuels were still present and unburned. The investigation found that many of the 18 Watch Out Situations and the 10 Standard Fire Orders were either compromised, not recognized, or proper action was not taken.

Critical changes in weather and fire behavior were not recognized and not acted on soon enough for firefighters to escape. Firefighters did not receive or request spot weather forecasts from the Grand Junction District Dispatch.

Even though some of the firefighters expressed concern that they were at risk building the fireline downhill, they had enough confidence that they could stop the fire near the bottom of the canyon. Some firefighters knew a cold front was approaching and thought that they could line the west flank before the cold front arrived. Unfortunately, the cold front arrived before the fireline was completed.

Two Helitack Fatalities

The two helitack members were managing helicopter operations at Helispot 2. The escape route to the designated safety zone at Helispot 1 was blocked by the rapidly moving fire. Therefore, crews were directed off the ridge into the east drainage. The two helitack members ran north up the ridgeline to escape the fire. In this attempt, they were overcome by the fire.

A. Weather, Fire Danger, and Fire Behavior

Critical fire behavior and fire weather indicators of blowup conditions were not recognized by either fire managers or firefighters. Fire weather forecasts were not effectively communicated to the firefighters on the fire, and no system was in place to alert people on the fire of significant weather changes. Although a fire weather meteorologist at the Western Slope Fire Coordination Center was available to give forecasts and briefings for specific wildfires, he was not used on the South Canyon fire. Within the firefighting organization there was also considerable confusion about the difference between what is meant by a red flag watch and a red flag warning.

Recommendations:

1. A national interagency review should be conducted of the National Weather Service's Red Flag Program, with emphasis on the number of watches and warnings issued. Distinguish clearly between red flags for cold fronts and high winds and red flags for lightning.

2. A fire behavior analyst should be available or requested whenever a fire weather meteorologist is requested for a fire coordination center. A fire behavior analyst can relate the weather forecast to how fires burn in terms of rate of spread, flame length and fireline intensity. These are terms that firefighters understand. An alternative is establishing regional centers for consolidating and interpreting fire behavior and weather information during periods of high fire activity.

3. Fire weather forecasts must be communicated to firefighters on initial attack and extended attack incidents.

4. Spot weather forecasts should be requested for fires that have potential for extreme fire behavior or exceed initial attack or are located in areas for which red flag warnings have been issued.

5. NOAA Weather Radio forecasts should not be substituted for fire weather forecasts. NOAA Weather Radio does not broadcast fire weather forecasts, but forecasts directed to the general public.

6. A national interagency strategy and implementation plan should be developed to improve technical transfer of fire danger and fire behavior technology.

7. The National Weather Service fire weather program is a critical part of the Interagency Fire Management Program. It is essential that it be maintained at present levels to ensure firefighter safety.

8. An organized live fuel moisture sampling network should be established for Gambel oak. Strategy and tactics should be adjusted on the basis of this information.

Note: The Gambel oak fuel type has been directly responsible for 17 firefighter fatalities since 1976 on the BLM Grand Junction District.

B. Leadership, Attitudes, and Training

A common response to situations of this nature is to recommend additional training. Although there are several specific training needs related to fire shelters, we believe that training is not the core issue. Rather it is one of implementing the training all firefighters receive.

Attitudes and leadership set the tone for execution of the training received. There is a dire need to create a passion for compliance with the basics of safe fire suppression. This will occur only if leadership sets and demonstrates a clear commitment to safety.

Recommendations:

1. Attitudes and leadership are universal factors that influence safe fire suppression. The Interagency Management Review Team should explore actions that will strengthen sensitivity to basic safety standards so they permeate every fiber of our strategy, tactics, and basic fire operations.

2. The Interagency Management Review Team needs to evaluate current training to assure emphasis is placed on the basics of fire behavior, firefighting strategies and tactics, the 10 Standard Fire Orders, and the 18 Watch Out Situations.

3. The South Canyon fire incident should be used in the development of a training exercise for use by agency administrators, fire managers, dispatchers, and firefighters. The training exercise should be developed by field level firefighters.

4. The Investigation Team recommends that the National Wildfire Coordinating Group develop mandatory fire shelter training courses and implement them prior to the 1995 fire season. The main course should be required every 2-4 years with yearly refresher training. Courses should emphasize timed practice deployments, proper deployment practices, deployment in high winds, and site selection.

5. The Interagency Management Review Team should charter a group to develop guidelines for adequate deployment sites and safety zones in different heat and flame scenarios to show the value and the limitations of the fire shelters. Followup training should include recognition of survivable shelter deployment sites and safety zones.

6. Fire behavior and fire weather concepts should be reviewed in training each year for all fire managers.

7. "Standards for Survival" and "Look Up, Look Down, Look Around" training materials were developed in response to previous entrapment investigations. The Team recommends that all firefighters be required to take these subjects and review them every 2 years to maintain firefighting qualifications.

8. Fire shelter training materials should be revised to stress discarding packs and equipment when escape is questionable and that it is no longer acceptable to take packs and equipment into fire shelters.

C. Management Support and Dispatch Coordination

The Investigation Team concentrated on the direct causes of the fatalities on the South Canyon fire. We identified a number of findings related to management support and dispatch coordination. We also identified incident management, control mechanisms, and support structure as contributory causes.

Recommendations - Management Review

1. We recommend a management review of the Fire and Aviation Programs for the BLM State of Colorado to address policy direction; accountability mechanisms; training and qualifications of personnel; and staffing, including budget, workload, and FTE controls.

2. The review should also address the implementation of National Wildfire Coordinating Group's work, rest, and rotation guidelines.

D. Mobilization Planning for Above Average Fire Seasons

Droughts are part of the climatological pattern, particularly in the western United States. Colorado's West Slope was in extreme drought as determined by the Palmer Drought Index. Glenwood Springs has had 8 straight months of belownormal precipitation. Precipitation since October 1993 had been 58 percent of normal.

The Grand Junction District was experiencing a severe fire season. Fire danger indices in early July were at maximum recorded levels in 21 years. As of early July the number of fires were twice the annual average. Type I and Type II incident management teams had responded to five times the number of fires that they would respond to in a normal year.

Recommendations:

1. As part of the management review, special attention should be given to analysis of how all federal, state, and local firefighting organizations plan and conduct fire operations to respond to wide variations in fire severity from season to season.

2. Procedures should be established to monitor the level of drought at representative fire weather stations. Present fire danger levels should be compared to historic averages and worst case conditions, and the selection of appropriate suppression response should be adjusted on the basis of this information.

Conclusion

Firefighters and fire managers are engaged in a complex business with inherent risks , which requires skill, good judgment, and the ability to make difficult decisions. The South Canyon fire tragedy resulted from a series of judgments, decisions, events, and actions with serious cumulative impacts.

No one person or unit recognized the interaction of all factors on the incident that resulted in the entrapments. Firefighting safety fundamentals were compromised during a period of extreme weather and fire behavior in a highly flammable fuel type. This situation, compounded by failure to provide critical fire weather and fire behavior information to the firefighters, was the primary cause of the injuries and fatalities.

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