REPORT OF
THE FIRE SAFETY REVIEW TEAM

MARCH 1967

A PLAN TO FURTHER REDUCE
THE CHANCES OF MEN BEING BURNED WHILE FIGHTING FIRES

U. S. DEPARTMENT OF AGRICULTURE-FOREST SERVICE-WASHINGTON, D. C.

P R E F A C E

This report summarizes the work of the Fire Safety Review Team whose objective was to recommend a program to prevent men from being burned while fighting forest, grass and brush fires. Each of the team's recommendations was studied by me and key members of the Washington Office Staff. Then the team's report was expanded to include Washington Office comments and guidance for an action program.

Edward P. Cliff, Chief

FORM 6200-8 (1/64)
UNITED STATES GOVERNMENT

Memorandum

Department of Agriculture—Forest Service
Washington, D. C. 20250

TO : Chief, Forest Service

File No. 6170

FROM : Fire Safety Review Team

Date: February 3, 1967

SUBJECT: Fire Control - Fire Suppression Safety

Your reference:

Report of Fire Safety Review Team to Recommend Action Program to Prevent Men from being Burned while Fighting Forest, Grass, and Brush Fires.

Our report and recommended action program is attached. We believe that much progress in fire safety has been made in the last ten years and that, in general, the program is heading in the right direction.

In flashy brush types, as in Southern California and in other areas with similar topography, fuel volume, and rate of spread, downhill line operations without positive knowledge that the toe of the fire is secured are not an acceptable practice. Also, a "chimney" or similar topographic feature, even if devoid of fuel by prior burning or otherwise, is not a safe place if there is fuel below that may catch fire. Fire below a "chimney" can be expected to explosively flash up slope. We believe that activating our recommendations in regard to these and other items will further reduce the chances that men will be burned while fighting forest, grass, and brush fires.

/s/ Robert Bjornsen
Robert Bjornsen

/s/ Jay Peterson
Jay Peterson

/s/ Tony Skufca
Tony Skufca

/s/ Mike Hardy
Mike Hardy

/s/ A. E. Spaulding
A. E. Spaulding, Chairman

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INTRODUCTION

This report is submitted in response to the Chief's 5100 memo of November 30, 1966 (Appendix 1). By that memo, the Chief appointed a Fire Safety Review Team and transmitted the report on "The Loop Fire Disaster" in which twelve men lost their lives and others were seriously burned.

OBJECTIVES

Overall objective set by the Chief for the Fire Safety Review Team:

> "There is no way we can return the men lost in the recent tragedy. We must now provide for those others who depend upon our programs to give them the skills needed for their safe conduct."

Deputy Chief Nelson's 5100 memo of December 15, 1966 (Appendix 2) gave the Fire Safety Review Team these definite assignments:

1. Your team activities should be related to the program developed by the Fire Task Force of 1957 and the fire safety progress made since then.

2. The recommendations made by the Loop Fire Analysis Group are guides for your work. These recommendations are broad and you must analyze them and specify what needs to be done to extend these benefits to firefighters throughout the Service.

3. You should not limit your activities to implementing the Analysis Group's recommendations. In addition, you should weigh the benefits of all pertinent safety measures you identify.

4. The end product of your Fire Safety Team's efforts should be a recommended action program to prevent men from being burned while fighting forest, grass, and brush fires.

PROCEDURE

We reviewed pertinent available material on:

1. Casualty causing fires of the past ten years.

2. The work of the 1957 Fire Task Force in analyzing casualty causing fires of the previous twenty years and the resulting action program.

3. Fire Safety progress made since 1957.

Ideas from these several sources were catalogued, combined, and fully discussed by the Fire Safety Team.

REVIEW OF FIRE FATALITIES

In reviewing the records for the past 30 years on the casualty-causing fires, there have been 27 tragedy fires on the National Forests in which 109 men lost their lives by burning. Thirteen of these fires, with a loss of 42 lives by burning, have occurred in the past eleven years. Usually the factors involved in these fires were unexpected fire behavior coupled with flashy fuels and critical fire danger. Downhill line operations were involved in the Loop, Inaja, and Silver Creek fires. On the Loop and Inaja fires "chimneys" further complicated the situation. Most of our recommendations are pertinent to these subjects.

For a list of tragedy fires of the last 30 years, see Appendix 3. For an analysis of principal factors common to major tragedy fires in the last 60 years, see Appendix 4.

The greatest opportunity to prevent these tragedies lies in the management and organizing on the job to insure and require the use of what we already know and what we already have.

DOWNHILL LINE OPERATIONS AND "CHIMNEYS"

The Loop Fire Analysis Group recommended a physical checklist for downhill line operations whereby such an operation would be done only when all critical factors are aligned favorably and checked off on the list. Further, that this checklist include complete factual knowledge that the toe of fire edge will be held in a safe condition.

Men lost their lives by burning while constructing fireline downhill on the Inaja, Silver Creek and Loop fires.

At the present time there are no written instructions for correct procedure and what factors to be considered on how to locate and construct a fireline downhill. Downhill line construction is an acceptable practice in many forest areas and has not created an unusual safety hazard except in the flashy brush types.

A physical checklist was prepared for downhill line operations by the Fire Safety Review Team and found that it was not practicable on most situations. A checklist of this type would weaken our present Ten Standard Firefighting Orders.

Recommendations:

Instructions for correct procedure on how to locate and construct fireline downhill should be included in Fireman's Handbook, Chapter 50. These instructions should also be included in the Sector, Crew Boss and Line Scout training outlines and other appropriate places to get the message to field employees.

To construct fireline in the flashy brush types downhill, requirements that are a must are:

a. Be sure the toe of the fire is anchored and communications established with crew at toe of fire.

b. Establish an anchor point (safety zone) before starting down.

c. Fireline can be built on fire edge or burned out as you go, and always have access far enough into burned portion of fire for safety (have one foot in the burn).

d. No "chimney," "chute," or "flue" on or adjacent to the proposed line exists with unburned fuel below.

e. When the control line cannot be built directly on the fire edge, its location should be far enough from the fire edge to provide adequate time for line to be constructed and fired out, and also allow enough margin for safety. Make certain that qualified firemen make this decision only after scouting in advance.

WASHINGTON OFFICE COMMENTS:

We agree with the Review Team's findings that a physical checklist to be carried by firefighters is not needed. But a checklist would be valuable to serve as a basis for training and to remind fire overhead of factors to consider when planning downhill line building strategy. The team's recommendations on this point are, therefore, modified to include preparation of a checklist to be inserted in the Fireman's Handbook, appropriate training materials and regional fireline notebooks.

Instructions and training should specify the responsibilities of the crew at the bottom of the slope as well as those of the crew coming down and other overhead.

Requirements a, b, d and e are approved. To Requirement c should be added: "When line is built downhill away from the fire edge, it is desirable to finish autonomous sections of line before burning them out."

ACTION GUIDES:

	Task	Responsibility	Target Date
1.	Prepare checklist and revise FSM	Director, Division of Fire Control	3/31/67
2.	Revise regional fireline notebooks and other pertinent regional and area instructional materials	Regional Foresters and Area Directors	5/19/67
3.	Revise pertinent regional and area training materials	Regional Foresters and Area Directors	5/31/67
4.	Revise training materials used at National fire training meetings and common Servicewide materials controlled from the Washington Office	Director, Division of Fire Control	12/29/67

COMMUNICATIONS

The 1957 Task Force concluded that communication was not adequate on most tragedy fires. They recommended increased attention to communication, including exploring the use of transistor-type receivers and encouraging the practice that receivers on all radios used on a fireline be "on" at all times. Much progress has been made since that time in development, procurement and use of equipment such as forest net, fire net and air net. Standards for radio communication between line overhead have not been established. It has become common practice to equip line overhead down through the Sector Boss with the fire tactical net -- either the forest net or fire net, whichever is appropriate and available. On the Loop Fire, all Interregional Crew Bosses, with the exception of the El Cariso Crew Boss, were equipped with fire tactical net radios. We believe it is desirable that the Crew Boss be equipped with radios to communicate with adjacent Crew Bosses and his superior. The fire tactical net may be used for this purpose on small fires or the early stages of large fires. However, when the volume of traffic will overload the tactical fire net, an intrasector net should be made available and used.

In addition, helicopter support of ground forces engaged in line construction or line holding should be directed by localized ground forces -- preferably the Crew Boss with the Sector Boss as second preference. We visualize that the Line Boss would establish priorities for helicopter support and the Helicopter Pilot would report to the appropriate Sector for localized direction from the Crew Boss or Sector Boss. Service-wide standards now require that each aircraft used in firefighting will be equipped with an air net radio as well as FAA required frequencies. Local aircraft may also be on the forest net. The Air Attack Boss or Helicopter Boss is equipped with air net radios and directs the Helicopter Pilot. In current normal operations on project fires, in many cases there is no direct communication between the Helicopter Attack Pilot and localized ground forces.

On many sectors of brush fires in California, the only practical means of tactical line scouting is by helicopter. Strategic line scouting by helicopter has reached a high degree of effectiveness and is of great value to the Fire Boss, Plans Chief and Line Boss. Detailed tactical line scouting to provide the Sector Boss and Crew Boss with detailed local information needs improvement. Communication between the strategic Line Scout, whether he be in a helicopter or on the ground, is needed with the Sector Boss and/or Crew Boss.

When two crews are working toward each other with radios on different frequencies, an extra radio from one crew should be provided the other.

The equipment and organization know-how required to provide an adequate communications capability is available. We need to agree on standards

who needs to communicate with whom -- then our radio engineers can provide alternate suggested systems. After agreement is reached on standards and system, the necessary equipment can be purchased and we should organize to insure its proper use.

Recommendations:

1. The Chief should establish Service-wide standards for communication on fires. The team believes that these standards should provide for:

   a. Short-range lightweight radio units for intrasector operations on a secondary net. These sets should be two-channel with the air net as the second channel to be used for localized direction of helicopter and possibly other air support, and for Crew Boss or Sector Boss to receive detailed scouting information from tactical line scout in helicopter. NOTE: If the latter is approved, organization standards for air support need revision.

   b. Fire tactical net (forest net or fire net) for line overhead down through Sector Bosses.

   c. Air net as now used.

   d. When two crews are working toward one another, communication must always be provided between them. If radios are not available for this, then special arrangements must be made, such as prearranged audio or visual signals.

2. If 1(a) is approved, the team suggests that three of these two-channel sets be assigned each Interregional Crew at their home base. On the fire one of these sets would remain with the Crew Boss and the other two would be available for use by the Sector Boss, local Line Scout or for the crew constructing line toward them.

WASHINGTON OFFICE COMMENTS:

The recommendations are approved, but 1(a) is modified to provide multi-channel radios in helicopters, one of these channels to be on the universal intrasector frequency. As recommended, key personnel in the sector would be equipped with two-channel radios. One of these channels would be the universal intrasector fire frequency, the other the regional or zone fire cache frequency. In this way, sector personnel can talk to helicopter pilots without chance of overloading the air net. Equipping Interregional Fire Crews with compact two-channel radios is a good way to begin but our objective should be to have this intrasector communication available on all large fires as soon as possible.

ACTION GUIDES:

	Task	Responsibility	Target Date
1.	Prepare Service-wide standards for communications on fires	Director, Division of Fire Control	6/2/67
2.	Prepare guidelines for developing and field testing the universal intrasector fire radio net	Director, Division of Fire Control	3/31/67
3.	Assign frequency for the nonair channel of the intrasector net	Director, Division of Administrative Management	3/31/67
4.	Determine specifications and source of supply for the two-channel intrasector radios	Director, Division of Administrative Management	3/31/67
5.	Purchase 3 intrasector net radios for each Interregional crew and train the crew in their use	Regional Foresters of regions where the crews are based	7/14/67
6.	On a southern California Forest, study and report the number of intrasector net radios needed for optimum performance	Regional Forester, R-5	12/29/67
7.	Revise the organization instructions for air support as necessary to incorporate and fully use the expanded air-ground communications provided by the two-channel intrasector net	Director, Division of Fire Control	5/1/67
8.	Using R-5's study as a guide, analyze the needs of each region and prepare plan to meet needs in five years.	Regional Foresters	Plan by 5/28/68

IMPROVE SCOUTING AT ALL CRITICAL POINTS

The Loop Fire Analysis Group recommended improving intelligence by helicopter or on-the-ground scouting, or both, at all critical points in the fire area, and particularly where two crews are working toward each other. The Fire Task Force of 1957 reported that scouting was not done, not thorough and too dependent on air scouting.

It is imperative that adequate scouting be accomplished in heavy timber, broken up topography, ledges, chimneys, or other critical situations; i.e., "Know what your fire is doing at all times, observe personally, use scouts."

Great strides have been made the past ten years in the use of helicopters and the infrared fire mapping for strategic scouting. The Fire Boss, Plans Chief and Line Boss have used these tools to good advantage and have had adequate information in planning the overall fire strategy. The use of the helicopter has decreased the use of Line Scouts and consequently the Sector and Crew Boss have less knowledge of their zone of responsibility. On many sectors of brush fires in California, the only practical means of tactical line scouting is by helicopter. The detailed tactical line scouting by helicopter or on-the-ground scouting to provide the Sector Boss and Crew Boss with detailed local information needs improvement.

The Forest Service Manual describes the fire-job for a line scout and under what conditions it should be used. The fire organization chart for two division fires and larger does not list this position in the line organization.

Under actual practice, usually the line scout duties and responsibilities are not assigned and become the responsibility of the Sector or Crew Boss. On critical sectors the Sector or Crew Boss cannot do the advance scouting for his unit without detriment to his other responsibilities. A position on the fire organization chart may be a reminder that this position needs to be filled on critical sectors.

Recommendations:

1. Better utilization of helicopters for tactical scouting purposes with direct communications with local line organization (Sector and Crew Boss).

2. Include the line scout position in the line organization chart for two division fires and larger. This may be a reminder that adequate scouting is needed in sectors with heavy timber, broken up topography, ledges, chimneys, or other critical situations.

WASHINGTON OFFICE COMMENTS:

The recommendations are approved. On a large fire, keen competition generates for available helicopter time from retardant dropping, personnel transport, strategic scouting, tactical scouting, equipment and supply transport. We must do a timely and thorough job of on-the-ground scouting to provide information to Sector and Crew Bosses. When the helicopter is the best way to do this, it should be made available to get the job done.

ACTION GUIDES:

	Task	Responsibility	Target Date
1.	Revise Fireman's Handbook, FSM and related materials to include line scouts for two division and larger fires	Director, Division of Fire Control	3/31/67
2.	Revise regional fireline notebooks and other pertinent regional and aerial instructional materials	Regional Foresters and Area Directors	5/19/67
3.	Revise training materials as necessary to emphasize sector level line scouting	Regional Foresters and Area Directors	5/31/67

ORGANIZATION

The 1957 Task Force recommended adherence in all regions to the Service-wide principles of organization for fire suppression set forth in the Directives System. Good progress has been made on this recommendation. These principles are periodically reviewed and needed revisions made. Several of our recommendations, if approved, will require minor revisions or additions.

The Interregional Crews in California, locally known as "Hot Shot" Crews, have diverged from the principles of organization by carrying their headquarters' camp titles of Superintendent, Assistant Superintendent and Foreman out on the fireline.

Clarification is needed in portions of the directives system and regional guidelines as to who the Fire Boss on a project fire works for and to whom he is to report. FSM 5130 lacks clarity as to Forest Supervisors' responsibilities. This section implies that the Fire Boss is supreme commander and can be construed that he is not accountable to anyone. The list of duties for the Fire Boss does not mention to whom he is responsible. The organization chart (Exhibit 1) shows the Forest Supervisor as being subordinate to the Fire Boss. To FSM 5130 should be added the duties of the Fire Boss's boss. The implication of some of the above is that the Forest Supervisor is not in control even though the zero code of 5100 clearly delegates full responsibility to the Forest Supervisor.

Recommendations:

1. The Chief should revise the principles of organization where needed to be compatible with those findings and recommendations of this report that are approved by him.

2. Regional Fireline Notebooks and like material should be revised to conform with results of 1. above.

3. Region 5 should comply with standard nomenclature.

WASHINGTON OFFICE COMMENTS:

The recommendations are approved.

ACTION GUIDES:

	Task	Responsibility	Target Date
1.	Revise FSM to clarify fire suppression roles of the Fire Boss and Forest Supervisor	Director, Division of Fire Control	6/30/67
2.	Revise the principles of organization as needed to accommodate the approved recommendations of this report	Director, Division of Fire Control	5/19/67
3.	Revise regional fireline notebooks and similar material as needed to implement new instructions	Regional Foresters and Area Directors	5/19/67
4.	Change the titles of overhead on California Interregional and other organized fire crews to comply with the principles of fire suppression organization	Regional Forester, R-5	4/14/67

PROTECTIVE SHELTERS

The Loop Fire Analysis Group Recommended:

> "Continue development of improved fire protective shelters and make them standard equipment for all fire suppression men and crews who are ordinarily assigned to fight fires in fast-burning fuels."

Missoula Equipment Development Center (MEDC) has developed, tested, and prepared specifications for a fire protective shelter. These shelters were available for purchase @ $13 each by field units prior to the 1966 fire season.

The present pup-tent style shelter offers the following advantages over the tepee-style shelter previously used:

1. Stronger.

2. Lower profile reducing probability of direct flame contact and providing better conductive cooling.

3. Improved hold-down system for use in high winds.

4. Double-wall construction minimizing problem of smoking adhesive and offering dead air space insulation.

Shelter tests using human subjects have conclusively shown that it will provide protection within its design limitations. In addition, in a recent test at MEDC, an experienced firefighter, unfamiliar with use of the shelter, took 32.5 seconds to unstrap it from his waist and completely settle himself inside the shelter. With three trials the test subject was able to reduce the time to 23 seconds.

Recommendations:

1. Require that protective shelters be carried as standard equipment by all Interregional Crews.

2. Regional Foresters will establish standards for use of shelters by other suppression forces.

3. Require that all suppression forces issued shelters actually strap pouched shelter to waist while on the line (dozer operators may carry shelter in containers on tractor).

4. Continue development of shelters to improve protection, reduce weight and lower costs.

5. Prepare and issue a training film on fire protective shelters.

WASHINGTON OFFICE COMMENTS:

Interregional Crews should be equipped with protective shelters but we would limit mandatory requirement for carrying them to conditions of hazard where fires could spread rapidly. They should always be carried by all personnel when working to control fires in fuels with extreme or flash rates of spread. Recommendation 2 is approved. Recommendation 3 will be expanded with guidelines for carrying shelters by personnel engaged in all types of control line activities. Recommendations 4 and 5 are approved. Use of protective shelters and protective clothing should be covered in the same training film. Since an effective shelter is now available, their use should not be delayed while awaiting further developments.

ACTION GUIDES:

	Task	Responsibility	Target Date
1.	Revise FSM and similar instructional materials to include Service-wide standards and guidelines for use and stocking of protective shelters	Director, Division of Fire Control	3/31/67
2.	Within the framework of 1 above, establish regional standards for use of protective shelters	Regional Foresters	5/19/67
3.	Prepare protective shelter and clothing training film	Director, Division of Fire Control	6/15/67
4.	Establish the use of protective shelter equipment in appropriate training courses	Regional Foresters and Area Directors	6/30/67

FIRE PROTECTIVE CLOTHING

The Loop Fire Analysis Group recommended:

> "Increase efforts on the development of lightweight flame-resistant suits, including face masks and gloves. When satisfactory items have been developed, make their use mandatory by trained men and fire suppression crews ordinarily assigned to work in fast-burning fuels."

Substantial effort has already been made by the Missoula Equipment Development Center (MEDC) in development and testing of lightweight flame-resistant shirts and trousers, including face masks. Little, if any, work has been done on flame-resistant gloves. Following is a resume of what is currently available or under development and test in the protective clothing and face mask area:

1. Cotton Fabric: The Forest Service is operationally using a fire-retardant treated cotton work shirt. These shirts are currently stocked by GSA and cost approximately $5. Fire-retardant cotton shirts have not been entirely satisfactory because the retardant treatment bleaches out after 15-20 launderings, also the treatment weakens the fabric considerably, leaving the shirts with a very short service life in comparison to untreated cotton work shirts.

   During the past 6 years, MEDC has not been able to find any fire-retardant, treated cotton work trousers that will withstand the rigors of firefighting.

2. Nomex Fabric: This is a synthetic fiber in a variation of the nylon polymer. It does not support combustion and decomposes into a friable char at high temperatures. About 300 shirts and trousers are being tested. To date, Nomex is the most promising material for firefighter's clothing. Its main drawback is its high cost (shirts - $18.75, trousers - $25). This disadvantage is offset by the fabric's extreme durability, e.g., tests have shown that it will outwear cotton 5 to 1 and does not lose retardancy with repeated launderings.

3. Face Heat Shields: This item is manufactured by the Bullard Company and is available for operational use. Although field evaluations in Region 1 were mostly favorable, no further development work has been undertaken because low-volume sales of this item reflects a lack of field interest in face protection.

Except for minor refinements, there now exists a satisfactory lightweight flame-resistant material (Nomex) for use in manufacture of fire-resistant clothing. There is also a satisfactory face mask available for firefighters.

The crux of the problem surrounding these safety items is not optimum design and development of more equipment, it is getting better field utilization of existing equipment.

Recommendations:

1. As a minimum, encourage all suppression forces to wear long-sleeved shirts and loose fitting trousers, and that each man has a jacket as part of his fire gear. So inform all firefighters of the benefit of wearing extra clothing, gloves and face masks for burn injury protection. 1/

2. Require mandatory use of fire-resistant shirts by Interregional Fire Suppression Crews, that fire-resistant trousers also be required as mandatory when suitable models are available. Regional Foresters will establish standards for other suppression forces.

3. Continue with a development and test program for different configurations of fire protective clothing, e.g., coveralls and/or looser fitting garments to fit over conventional clothing for added insulation and flame protection.

4. Develop a suitable fire-resistant glove for hand protection.

5. Improve the present face masks to allow for better visibility and more protection with a minimum of discomfort to the firefighter.

6. Provide for wide circulation of a film showing the benefits of fire protective clothing and related equipment.

1/ Evidence from the Blackwater and Loop fires conclusively shows that ample, loose fitting clothing can substantially reduce burn injuries to firefighters.

WASHINGTON OFFICE COMMENTS:

The recommendations are approved and Recommendation 1 expanded to require as a minimum long sleeved shirts and loose fitting trousers for all regularly hired firefighting personnel. Development of durable, economical protective trousers is especially important. The recommended training film will include both protective clothing and protective shelters.

Objectives of the development program will be to fully exploit present day possibilities and have the best equipment possible by June 30, 1968. Before long, we expect protective shirts and trousers to be as standard as hard hats.

ACTION GUIDES:

	Task	Responsibility	Target Date
1.	Revise FSM and related instructions to include Servicewide standards for use of protective clothing	Director, Division of Fire Control	3/31/67
2.	Using the guidance of 1 above, establish regional standards for use of protective clothing	Regional Foresters	5/19/67
3.	Pace the development program to have durable, effective and economical trousers and face masks as soon as possible	Director, Division of Fire Control	Trousers and masks to be available 6/30/68
4.	Expand the development program to include protective gloves and testing of different configurations of protective clothing	Director, Division of Fire Control	FY 1968
5.	Establish the use of protective clothing in appropriate training courses	Regional Foresters and Area Directors	6/30/67

PRE-ATTACK PLANNING AND CONSTRUCTION

The Loop Fire Analysis Group recommended that we "reexamine the full array of presuppression activities in flash fuel areas and establish the benefits plus or minus of accelerating the fuelbreak system in relation to safety and its place in the balance of all presuppression activities."

In many of the critical fire areas funds have been made avai' le for preattack projects. Good progress has been made especially ' the flashy fuel types. Standards have been developed and guide ' es have been published in a Pre-Attack Handbook.

Pre-Attack is a planned systematic procedure for the gathe' ', evaluating and recording of intelligence, as well as the co' ruction of certain fire control facilities, to insure the rapid and fficient suppression of fire on any given area.

To the present time, the most intensive pre-attack planning has been done in Southern California forests where fire control is the primary job. Timber, recreation, grazing, and other resources have functional management plans. Pre-attack planning should be integrated with these resource management plans. When the resource management plan is activated the end result should enhance the pre-attack plan.

Grazing revegetation projects, wildlife habitat browseways, timber sale block, etc., all can be coordinated with fire control needs.

Recommendation:

Continue and expand coordination of fire control and resource plans to facilitate progress in pre-attack planning and construction.

WASHINGTON OFFICE COMMENTS:

Though the recommendation is not fully responsive to the problem, it it approved. Both the following action guides and those on page 21 deal with this problem. For safety reasons, priority should be given to areas where fast fuels are common but this program has strong potential for more permanently reducing the threat from large wildfires on almost all forest, brush and range lands. Since the preattack plan would serve as the device for coordinating Fire Control needs with resource activities, we should speed up preattack planning and expand its scope Service-wide.

ACTION GUIDES:

	Task	Responsibility	Target Date
1.	Prepare and issue nationwide instructions for preattack planning	Director, Division of Fire Control	6/30/67
2.	Review and as necessary strengthen multiple use coordination instructions to join resource activities and fire control in a common endeavor to break up dangerous bodies of fuel	Director, Division of Fire Control working with resource divisions	12/29/67
3.	On a nationwide basis, identify geographical areas where preattack planning is needed most	Director, Division of Fire Control working with regions	6/30/67
4.	In FY 1968 begin to expand preattack planning to new areas	Regional Foresters where high priority areas are located	

FUELBREAK SYSTEM

Progress has been made in developing the fuelbreak system since 1957. Test plots have been established and standards have been developed. Special funds have been made available for fuel treatment on priority areas.

Fuelbreak systems, involving the clearing of vegetative fuels in strategic places, offer some potential to improve the ability to confront and stop large or small fires. The fuelbreaks usually will not work unless suppression forces are used to man them in advance of a fire.

Fuelbreaks greatly enhance the safety of the firefighters and provide for greater access to the wildland areas, facilitate faster first attack on fires and reduce the intensity of fire originating in the modified areas.

The cost of fuelbreaks differs widely in different areas because the widths vary greatly with topography and cover type. An estimated average cost per acre is $50.

Fuelbreaks would be a supplement to our present organization so priorities would need to be established as to where the available monies would be used.

A balanced program of pre-attack coupled with a fuelbreak system would be of great benefit to fire suppression activities.

Recommendations:

Make a cost-benefit analysis of fuel modification in critical fire areas to determine feasibility of expanding the fuel break program.

WASHINGTON OFFICE COMMENTS:

The recommendation is approved in principle. Before going ahead with it, a thorough evaluation of pertinent studies already available will be made. After that, the objectives of the analysis can be more clearly specified.

The Duckwall project and fuel modification work done in various regions has shown fuel modification to be a sound measure for breaking up continuous bodies of dangerous fuels, thereby improving the chances of preventing large, damaging fires. We know this work is effective. What we don't know is how much or what kind of it should be done to achieve optimum benefits. The analysis should, therefore, be aimed at solving this problem.

While the analysis is being made, fuel modification work should continue in areas where its need is clearly indicated by pre-attack planning.

ACTION GUIDES:

	Task	Responsibility	Target Date
1.	Review past studies related to fuel modification and specify objectives for the analysis	Director, Division of Fire Control	6/30/67
2.	Make the analysis	To be determined	12/29/67
3.	From the results of the analysis, prepare operational guidelines	Director, Division of Fire Control	6/30/68

FIRE BEHAVIOR AND FIRE RESEARCH

Qualified men trained in fire behavior principles and with many years of fighting fires in Southern California brush complexes did not anticipate the fire spread that resulted in the tragedy on the Loop Fire. One of our greatest urgencies is to understand and identify the localized hazardous combinations of air flow, topography and fuel.

The fire behavior officer acts as liaison between the fire weather forecaster and the Fire Boss, interpreting the weather information in terms of how the fire may behave under the existing and predicted fuels and topographic situation. This can be quite specific in small fires but of necessity becomes more general as the fire perimeter encompasses more variations in fuels and topography.

This is the time when the overhead person on the ground must further interpret the fire behavior officer's information to the specific and immediate situation confronting him. If he is an old hand at it, he can generally integrate almost automatically the behavior situation with the required suppression procedures. But even an old hand can miss a clue occasionally if he isn't refreshed from time to time. Thus, it becomes imperative for men at the Sector Boss and Crew Boss level to be given trainingin specific elements of fire behavior with which he is most likely to be confronted.

Two levels of training are used, one for the fire behavior officer and other top overhead, and another for the Sector Boss-Crew Boss. In these, considerable review and study is required. Only careful development of course material brings out salient points that must be evaluated quickly on the fire line and the proper situation solutions reached.

See Appendix 5 for Progress in Fire Behavior Knowledge Since 1957.

Recommendations:

1. Continue an aggressive fire behavior training program and increase emphasis at regional and forest level on information required for Crew Boss and Sector Boss personnel.

2. Develop and make available low cost, hand or back-packed fire weather instrumentation, especially for use in off-the-road situations.

3. Give special emphasis on causes of blowup or erratic fire behavior situations in the fire research program.

WASHINGTON OFFICE COMMENTS:

Recommendation 1 is approved. Given up-to-date equipment and support, we know our most powerful fireline safety weapon to be intelligent, well trained men making decisions on the fireline. The quickest answer to Recommendation 2 is to get more use made of the belt weather kits and other portable weather equipment now available. Fire behavior on recent tragedy fires has usually been quite apparent to trained observers. We believe research on causes of blowups or erratic fire behavior should continue at about its present pace. We feel that accelerated research leading to a useful system for fuel evaluation would make a stronger and more immediate contribution to fire safety. More safety pay off can be gained from research aimed more specifically at helping firemen interpret the various situations confronting them. We, therefore, do not approve Recommendation 3.

ACTION GUIDES:

	Task	Responsibility	Target Date
1.	Review the effectiveness of past fire behavior training to determine if it is meeting objectives	Director, Division of Fire Control	9/30/67
2.	Examine and as necessary update fire behavior training materials at all levels	Regional Foresters and Area Directors	12/28/67
3.	Establish guidelines for using available portable fire weather equipment on fires	Director, Division of Fire Control	5/19/67
4.	Accelerate research on forest fuels appraisal systems with the objective of producing useful field guidelines at the earliest possible date	Chief, Branch of Forest Fire Research	7/1/67

APPENDIX

1. Chief Cliff's memorandum transmitting the Loop Fire Analysis Group's Report and assigning the Fire Safety Review Team
2. Deputy Chief Nelson's memorandum establishing objectives for the Fire Safety Review Team
3. List of tragedy fires for the past 30 years
4. Factors common to major tragedy fires
5. Progress in fire behavior knowledge since 1957

Appendix I

FORM 6200-8 (1/64)
UNITED STATES GOVERNMENT

Memorandum

Department of Agriculture---Forest Service
Washington, D. C. 20250

TO : Regional Foresters

File No. 5100

FROM : Edward P. Cliff, Chief

Date: November 30, 1966

SUBJECT: Fire Control (Loop Fire - Angles National Forest)

Your reference:

We are sending you two copies of the report of the Fire Analysis Group which studied the tragedy on the recent Loop Fire in Southern California. This report will be of great interest to yourfire control people and to other personnel.

All of us in the Forest Service are deeply affected by this tragedy. It occurred with an elite crew, tops in handling severe fire situations, which amplifies the blow to families, friends and the Service alike.

We are also including a supply of a brief which can be given wider distribution than the report. We do not have sufficient copies of the report to make wide distribution, but we do have a few additional copies. These can be given to those with a special interest in studying the accident more completely.

The report and especially the recommendations will form the basis for strengthening our fire control program, particularly, in several safety items. I have appointed the task force as recommended in the report and directed them to complete their work early this winter. This will enable us to use their recommendations in our training and other preparatory programs for the coming fire season.

The following will serve on this task force:

FIRE SAFETY REVIEW TEAM	DETAIL PERIOD
Al Spalding, R-6, Deputy Regional Forester	Jan. 23 - Feb. 3
Robert Bjornson, R-1, Missoula Equipment Development Center	Jan. 30 - Feb. 3
Jay Peterson, R-5, RO, Division of Fire Control	Jan. 16 - Feb. 3
Tony Skufca, R-2, Supervisor, San Isabel Nat'l. Forest	Jan. 30 - Feb. 3
Mike Hardy, Intermountain Station, Fire Research	Jan. 30 - Feb. 3

Special instructions for this group will be sent to the concerned Regions. We expect them to meet in Washington and to have their report available for our use before the end of February.

EDWARD P. CLIFF

2°

NFS-9 - 2 SE
NE

cc: Directors - 1 copy of report, 10 of brief
Area Directors - 1 copy of report, 10 of brief
W. O. - Fire Research - 2 copies of report, 10 of brief
W. O. - Cooperative Fire Control-2 copies of report, 10 of brief

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MSLowden/MMNelson:sm
11/30/66

Lowden initialed 1st draft

10 copies of report

Mailed - 4 copies of Brief to all RF's except R-5 - sent R-5-10
NF copies of Report & 20 of Resume
NR & CFFR - 2 copies of rept & 2 copies of brief
Area Dir - 1 copy of rept & 5 of Brief
NFS - 1 copy of Rept & 2 of Brief

appendix 2

FORM 6200-6 (1/64)
UNITED STATES GOVERNMENT

Memorandum

Department of Agriculture---Forest Service
Washington, D. C. 20250

TO : Alfred E. Spaulding, Deputy Regional Forester, R-6

File No. 5100

FROM : M. M. Nelson, Deputy Chief

Date: DEC 15 1966

SUBJECT: Fire Control - Fire Suppression Safety

Your reference:

The Chief has appointed you to serve as chairman of the Fire Safety Review Team. In this capacity, you will be directing the team to meet the objective set by the Chief when he approved the Loop Fire Analysis Report:

> "There is no way we can return the men lost in the recent tragedy. We must now provide for those others who depend upon our programs to give them the skills needed for their safe conduct."

Your team activities should be related to the program developed by the fire task force of 1957 and the fire safety progress made since then. The recommendations made by the Loop Fire Analysis Group are guides for your work. These recommendations are broad and you must analyze them and specify what needs to be done to extend these benefits to firefighters throughout the Service. You should not limit your activities to implementing the analysis group's recommendations. In addition, you should weigh the benefits of all pertinent safety measures you identify. The end product of your Fire Safety Team's efforts should be a recommended action program to prevent men from being burned while fighting forest, grass and brush fires.

Yours is an important and far-reaching undertaking. To organize the team's activities, you should work with the Division of Fire Control and directly with each team member as necessary. Team members were assigned in Chief Cliff's memorandum of November 30, copy attached. It is our objective to have your recommended action program available to all regions prior to the 1967 western fire season.

For your advance preparation, the following materials are enclosed:

1. Copy of 1957 Task Force Report, 7/25/57.

2. Copy of Chief's advance information memorandum of 6/28/57.

3. Copy of Chief's memorandum of 8/16/57 transmitting Task Force Report.

4. Copy of pertinent section of Forest Service Training and Development Handbook (FSH 6141.16) which outlines desirable minimum fire training.

5. Copy of Chief's memorandum of transmittal and the Loop Fire Disaster Report.

APPENDIX 3

List of Tragedy Fires of the Last 30 Years:

Name of Fire	Date	Region	Forest	No. Fatalities by Burning
Loop	1966	5	Angeles	12
Coyote	1964	5	Los Padres	1
Timberlodge	1962	5	Sierra	4
Silver Creek	1961	1	Nezperce	2
Sierra	1961	5	Angeles	1
Cummings Creek	1960	6	Umatilla	1
Dry	1959	5	Sequoia	1
Stable	1959	5	San Bernardino	1
Decker	1959	5	Cleveland	5
Gun	1958	5	Angeles	1
Albert Ranch	1958	5	Angeles	1
Inaja	1956	5	Cleveland	11
East Highlands	1956	5	San Bernardino	1
Sagebrush	1955	6	Malheur	1
Johnson	1955	3	Prescott	1
Tunnel No. 6	1954	5	Tahoe	3
Rattlesnake	1953	5	Mendocino	15
Mann Gulch	1949	1	Helena	13
Hells Canyon	1949	4	Payette	1
Walton Spur	1949	5	Stanislaus	1
Barrett Dam	1948	5	Cleveland	1
Bryant Canyon	1947	5	Cleveland	2
Hot Springs	1944	4	Payette	1
Hauser Creek	1943	5	Cleveland	11
Silver Plume	1940	3	Lincoln	1
Blackwater	1937	2	Shoshone	15
Welcome Lake	1937	9	Huron	1

APPENDIX 4.

Analysis of Principal Factors Common to the Major Tragedy Fires in Last 60 Years

Major Factor	Fire							
	Inaja	Rattle-snake	Mann Gulch	Hauser Creek	Black-water	Timber Lodge	Decker	Loop
	R-5	R-5	R-1	R-5	R-2	R-5	R-5	R-5
1. Fire Behavior	C	C	C	C	C	C	C	C
2. Instructions	C	C	C	C	C	C	C	C
3. Foremanship	NC	C	C	C	NC	C	C	C
4. Line Supervision	C	C	NC	C	NC	C	C	C
5. Communication	C	C	C	C	C	NC	NC	C
6. Strategy & Tactics	C	NC	C	C	C	C	C	C
7. Scouting	C	NC	-	C	C	NC	NC	C
8. Escape Plan	C	C	C	C	C	C	C	C
9. Lookouts	C	C	-	C	NC	C	C	C
10. Organization	C	NC	C	C	C	C	C	C
11. Post Actions	NC	NC	C	C	NC	C	C	C
12. Downhill Line Construction	C	NC	NC	NC	NC	-	-	C
13. "Chimney" Involved	C	NC	NC	NC	NC	-	-	C

C - Critical
NC - Not Critical
- Not Pertinent

APPENDIX 5

PROGRESS IN FIRE BEHAVIOR KNOWLEDGE SINCE 1957

		(1) Available	(2) In Progress
1.	Fire Danger Rating. Severity index and buildup index factors have been developed for the national system. This system is in use throughout the United States except in California.	X	X
2.	"Winds Over Wildlands," a publication using some of the information that will ultimately be expanded into the Fire Weather Handbook.	X	
3.	Fire weather and fire climate surveys, accomplished mostly in California.	X	
4.	Investigations into the ramifications of Santa Ana winds.	X	
5.	Winds in relation to topography in synoptic weather situations.		X
6.	Fire chemistry project at Berkeley.		X
7.	Atmospheric behavior in forested areas at interface of Atlantic Marine and Continental Air masses.		X
8.	Major synoptic weather types associated with critical fire weather in all regions of the United States.	X	
9.	Fire whirl publications.	X	
10.	Mechanisms of fire spread as influenced by weather and fuels. (Research into the effect of topography will be coming later.)	X	
11.	Fuel flammability description for western and northern fuels.		X
12.	Ignition of forest fuels.		X
13.	Fuels classification.		X
14.	Study of mountain thunderstorm.	X	

		(1) Available	(2) In Progress
15.	Fuels classification on an area-wide basis.		X
16.	Fuel flammability description for southern and eastern fuels.		X
17.	Mass fire studies.	X	X
18.	Fire case histories.	X	X
19.	Basic knowledge of forest fire energy systems.		X
20.	National Fire Behavior Officer's Training Schools.	X	X
21.	Fire Weather Handbook		X
22.	Fire Science Research projects.		X