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FIRESCOPE:

a new concept in multiagency fire suppression coordination

Richard A. Chase

The Author

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PREFACE

For a 2-week period in fall 1970, a continuing siege of major wildfires over the chaparral region of southern California severely taxed the capabilities of the region's fire protection agencies and caused major damage to structures and wildland resources. As a result, in 1971, Congress directed its attention to the southern California fire problem. During the second session of the 92d Congress, a subcommittee of the House of Representatives, Committee on Appropriations, recommended an appropriation of "$900,000 to strengthen fire command and control systems research at Riverside, California, and Fort Collins, Colorado." The House subcommittee further recommended: "At Riverside, research will concentrate on developing advanced airborne fire intelligence methods for detecting and mapping fires, including real time telemetry of information and display at fire command control centers..."

With the subsequent appropriation of funds, a research, development and application (RD&A) program was established at the Pacific Southwest Forest and Range Experiment Station's Forest Fire Laboratory, Riverside, California. In response to the Congressional directive, research was to identify the most productive study areas and approaches for the RD&A program. Analysis of the problem was carried out jointly by Forest Service researchers and principal southern California fire agencies. This analysis quickly showed that the solution must involve a major systems design that would necessarily address not only advanced airborne fire intelligence methods, but fire information systems generally and their effective utilization in planning and coordinating action on both single- and multiple-agency fires or similar emergencies. The program charter was prepared accordingly and formally approved in March 1973.

The intent of the total program was to design and provide the procurement, testing, and implementation of an operational fire suppression coordination system, assuming that implementation funding would become available in an orderly and timely manner as the program proceeded. Such funding, however, did not materialize within the 5-year R&D phase of the program. The research product was therefore redefined in June 1976 as a series of performance specifications for recommended subsystems, and implementation was delayed. The specification reports, which form the basis of the system descriptions herein, are listed in the footnotes. These reports were prepared by the Station and contractors.

In October 1975, in preparation for the implementation phase, leadership responsibility began to shift from the Pacific Southwest Station to State and Private Forestry, California (now Pacific Southwest) Region of the Forest Service. Research and development work required to complete the design and support implementation was assigned to a research work unit.

The major product of this complex team effort involveing Forest Service researchers and land managers, cooperating fire agencies, and contractors was FIRESCOPE (*FI*refighting *RE*sources of *S*outhern *C*alifornia *O*rganized for *P*otential *E*mergencies—a new concept and system in multiagency fire suppression coordination).

The principal researchers and their contributions:

- Stanley N. Hirsch, program manager (1972-1975)—general program management.
- Richard A. Chase, assistant program manager (1972-1975); Research Work Unit Leader (1975-1978) —program coordination, overall system concept design and development.
- Randall J. Van Gelder, operations research analyst—information management system design and development.
- John W. Warren, electronic engineer, communication system, infrared telemetry, weather telemetry design.
- Kelly Mason, electronic engineer, communication system, mobile communication unit, and weather telemetry network design.
- Romain M. Mees, operations research analyst—information services development.

Research Work Units that furnished technical support:

- Forest Fire Meteorology (PSW-2108), Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.
- Management of Chaparral and Related Ecosystems (PSW-1652), Pacific Southwest Station, Riverside, Calif.
- Fire Fundamentals (INT-2103), Intermountain Forest and Range Experiment Station, Missoula, Mont.

Program support and technical advice was provided by personnel from these agencies:

- California Department of Forestry
- California Office of Emergency Services
- Los Angeles City Fire Department
- Los Angeles County Fire Department
- Santa Barbara County Fire Department
- California Region, Forest Service, U.S. Department of Agriculture
- Ventura County Fire Department

Principal contractors to the program were:

- The Aerospace Corporation, El Segundo, Calif.
- Mission Research Corporation, Santa Barbara, Calif.
- System Development Corporation, Santa Monica, Calif.
- Stanford Research Institute, Palo Alto, Calif.
- University of California, Berkeley, Calif.

The recommendations, criteria, and descriptions outlined in this report resulted from an iterative process involving cooperators, researchers, land managers, and contractors. In addition, the implementation program now underway and directed by Robert L. Irwin, State and Private Forestry, Pacific Southwest Region, Forest Service, was begun 18 months before the research effort was terminated. Therefore, some of the final design recommendations included changes related to evaluation, testing, and modification in the implementation program. This iterative process also resulted in the rejection of part or all of the contractor reports. These reports, which have been made available to cooperators, may become valuable reference documents, however, for any future work designed to improve and strengthen FIRESCOPE.

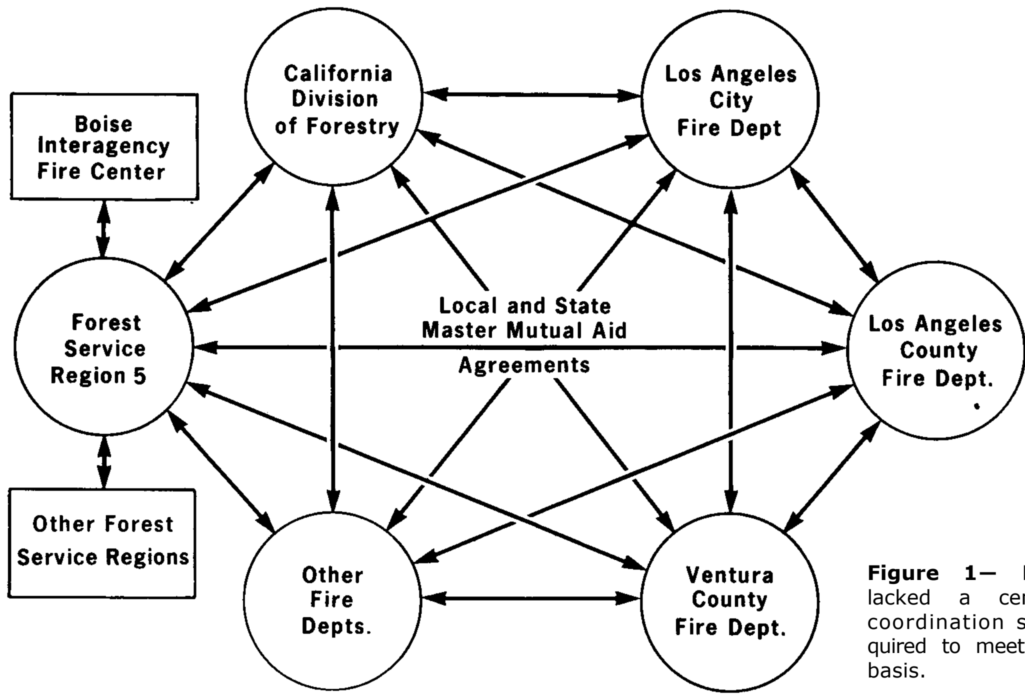

Figure 1— Pre-FIRESCOPE coordination lacked a centralized information and coordination source. Agencies were required to meet this need on an individual basis.

During the 13-day period from September 22 to October 4, 1970, 17 major wildland fires driven by hot, dry winds burned one-half million acres in southern California, severely damaging valuable watershed and other resources, destroying nearly 700 structures, and taking 16 lives (Phillips 1971).

Cooperation between Federal, State, County, and local fire services in this full-scale emergency was sound. All agencies recognized, however, that a number of problems significantly hampered the effectiveness of this cooperation (Task Force on California's Wildland Fire Problem 1972). Most apparent was the lack of a centralized information source from which to obtain accurate, up-to-the-minute facts about the fast-changing fire situation regionwide and an inability to carry out centralized planning. This fact made it difficult—sometimes impossible—to establish rational priorities in allocating scarce fire suppression resources and coordinating individual agency requests for aid (*fig. 1*). Considerable difficulty was encountered in establishing and maintaining communications between the various agency units on the firelines because of the high volume of radio traffic and the many radio frequencies involved. Confusion also existed between agencies because of nonuniformity in terminology, wildland fire suppression organization structure, and procedures (Chase 1977a).

As a result, the major agencies involved in wildland fire protection in southern California agreed to cooperate in a research and development program that would address the problems of the 1970 situation. The participating agencies included the Forest Service of the U.S. Department of Agriculture, California Department of Forestry, California Office of Emergency Services, and the fire departments of Los Angeles City and the Counties of Los Angeles, Santa Barbara, and Ventura. The program was initiated in 1972 under the direction of the Pacific Southwest Forest and Range Experiment Station, with subsequent design participation by the seven "partner" protection agencies. Thus marked the inception of *FIRESCOPE—FI*refighting *RE*sources of *S*outhern *C*alifornia *O*rganized for *P*otential *E*mergencies.

DESIGN PROCESS

FIRESCOPE probably represents the first practical application of systems design to a major, complex wildland fire management operational problem. The systems approach to fire management requires that the fire problem and potential solutions be addressed as a single entity—the sum of all subsystems and their interrelationships (Maloney and Potter 1974, Simard 1977). The design aims to maximize effectiveness of the total system, rather than its individual components. This point is important if subsequent attempts are made to implement only selected parts of the design, for expected operating benefits may not fully materialize.

The intent of the research design effort was to "make a quantum jump in the capability of southern California wildland fire protection agencies to effectively coordinate interagency action and to allocate suppression resources in dynamic, multiple-fire situations."[1] The following criteria directed the aim of the system design:

- Identify state-of-the-art technology acceptable for 1980 implementation.
- Achieve design consensus between partner agencies while remaining responsive to individual organizational, political, legal, and financial needs and constraints.
- Assert cost effectiveness.
- Complement daily operational and equipment needs of each partner agency to the fullest extent possible.
- Encourage investments that favored initial capital outlay and minimized subsequent operation and maintenance costs. Such investment strategy was based on the observed problem of agencies to secure .increased annual operating funds versus the one-time capital investment. (This issue became even more critical with the 1978 passage of California's Proposition 13, which significantly affected local operating budgets.)
- Implement system components in prototype, whenever possible, as soon as the design was completed to enable research evaluation and appropriate operational testing.

Generally, these goals were successfully met and the design presented here was responsive to them. Unfortunately, however, partner input and consensus remained an elusive goal during the life of the program. Expectations were not met relating to (1) the role of individual agencies in defining system performance standards and requirements and (2) anticipated differences resolving in a consensus position. The design therefore represents research's best judgment of a system that most closely approximates the program purpose while remaining responsive to collective agency needs. Such sensitivity coupled with a critical, systematic analysis and rational solutions advance the design toward eventual acceptance and implementation. The system is *not* presented as fully endorsed in all of its components by all parties involved. All participating agencies have, however, formally agreed to the basic concepts fundamental to the general system design.[2]

The level of design development was greatly affected by two factors: lack of agency consensus on a number of important operational details—such as the communication system configuration and data processing system standards—and concurrent uncertainty over the amount and timing of system procurement and operational funding. Based on these contingencies, reasons of efficiency determined that some subsystems not be developed beyond performance specifications. Procurement specifications were implemented, however, for those subsystems that required development of prototype hardware or software for research design evaluation. Principal research documents therefore represent various levels of design completion, but all minimally contain system performance specifications.

Preliminary assessment of estimated protection costs plus wildfire losses associated with the implementation of the recommended system design showed potential savings in excess of 15 percent of the current annual average.[3]

OPERATIONAL CONCEPTS

The basic operational concept of the FIRESCOPE system calls for timely commitment of adequate multiagency resources, operating under common procedures and organizational structure, to all incidents which exceed, or threaten to exceed, the capability of any single fire protection agency.[4] Though primarily oriented toward suburban-

[1] Forest Service, U.S. Department of Agriculture. 1973. FIRESCOPE RD&A program charter, March 26, 1973. (Unpublished document on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

[2] Forest Service, U.S. Department of Agriculture. 1974. FIRESCOPE multiagency coordination system development agreement. June 26, 1974. (Unpublished document on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

[3] Stanford Research Institute. 1974. An economic evaluation of multi-agency communication and coordination systems for southern California. (Unpublished report on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

[4] Mission Research Corporation and System Development Corporation. 1974. A conceptual definition of a wildland fire management regional coordination system. (Unpublished report on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

wildland interface fire problems, the system also has the capability to provide appropriate support to agencies responsible for other types of incidents, such as urban fires or rescues.[5]

The FIRESCOPE concept consists of the interrelationship of two independent systems: the Incident Command System (ICS), to provide more effective onsite utilization and management of resources; and the Multiagency Coordination System (MACS), to facilitate efficient allocation of resources from all involved Federal, State, and local agencies to incidents on a regional basis (principally the seven-county area in southern California between the ocean and the desert) (*fig. 2*).

Incident Command System

At the incident level, the Incident Command System (ICS) provides:

- Uniform terminology, procedures, and incident organization structure required to ensure effective coordinated action when two or more agencies are involved in a combined effort.
- Improved communications, particularly between units of different agencies.
- Modern data collection, transmission, and processing systems to provide timely and accurate weather, fire perimeter, suppression and rescue resource status, and similar information needed for incident planning and management.

The Incident Command System can accommodate a variety of incident types, sizes, and operational environments. Particular functions and organizational elements are activated only at the time and to the extent dictated by operational requirements of each specific incident. Coordination of such an effort presumes that all agencies adopt uniform terminology (and procedures, to the extent compatible with operational requirements of individual agencies) for day-to-day use, as well as minimal uniform training and qualification standards for personnel potentially assigned to multiagency incidents.

Jurisdictional command responsibility and authority are not compromised. Unless there is express agreement to the contrary, each agency retains its legal responsibility within its jurisdiction and is assumed to maintain full command authority within that jurisdiction at all times.

Equipment and personnel from assisting agencies are generally grouped under the command of their own supervisory personnel who receive direction from the responsible agency through command channels.

[5] Mission Research Corporation and System Development Corporation. 1973. A discussion of FIRESCOPE system functions and enabling policies. (Unpublished report on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

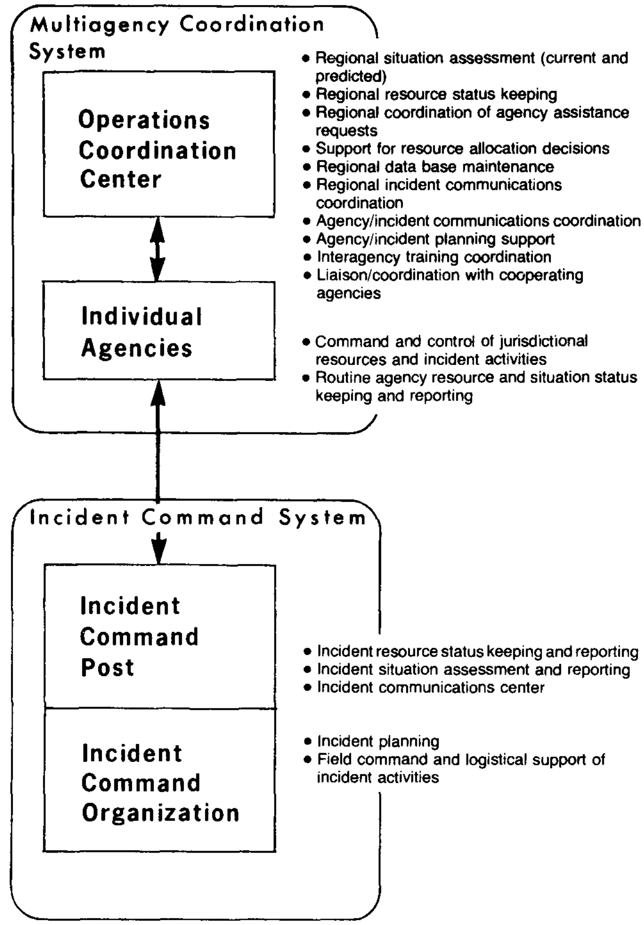

Figure 2—FIRESCOPE interrelates two independent systems, the Multiagency Coordination System (MACS) and the Incident Command System (ICS).

On multijurisdiction incidents, unless otherwise agreed, each agency exercises full command authority within its jurisdiction through its own Incident Commander and appropriate subordinate command positions. Where such is the case, overall command, logistics, and planning functions between jurisdictions are coordinated through the multiagency Incident Command Post (ICP). The joint ICP is staffed with appropriate operational personnel from each agency, as necessary, to plan and execute fully coordinated operations for the entire incident area.

The major elements of the ICS, namely, common terminology, uniform organizational structure, and uniform procedures for incident operations, have been tested and adopted by all partner agencies, and are currently being implemented in the FIRESCOPE area.

Multiagency Coordination System

The Multiagency Coordination System (MACS) is designed to perform regional information management, situation assessment, resource coordination, and other services as appropriate, to support existing Federal, State, and local fire protection agencies in southern California. MACS specifies the procedures, hardware, and personnel required to integrate the command-dispatch functions of the individual organizations to increase significantly both opportunities and capabilities for coordination of emergency operations, with emphasis on multiple-incident situations.[5]

MACS does not have independent operational authority. Rather, it is a formally defined extension of the command, dispatch, and support functions of the individual user agencies. MACS is a user-managed, service-oriented system designed to enhance agency operations. Individual agency authority and responsibility is not compromised or usurped.

Specifically, the Multiagency Coordination System provides

- Comprehensive and current geographic data base which includes site-specific information on cultural features, fuels, topography, risk, and values in a uniform format for all jurisdictions.
- Centralized collection, processing, and display of current information on local weather, status of agency resources, and fire activity (including perimeter, control status, and labor and equipment assigned, for major fires) for the FIRESCOPE area.
- Improved support of individual incidents through capability to predict, and assess probable consequences of, local weather, fire behavior and spread potential, and resource effectiveness.
- Dynamic centralized evaluation of major and multiple-incident situations, with the capability to coordinate agency requests for assistance and to determine the best allocation and assignment of resources to meet individual incident needs.
- Administration of ICS and MACS programs, including document control; training coordination; and data base, software and equipment maintenance.

Operations Coordination Center

The MACS functions are funneled principally through the central Operations Coordination Center (OCC), providing an improved, integrated communication system with existing agency dispatch centers and individual Incident Command Posts. The OCC is the central information and resource coordination point for MACS, maintaining applicable geographic and environmental data bases and resource activity information for the FIRESCOPE region. All agency requests for assistance (except those for local aid under established automatic or mutual aid agreements) are coordinated through the OCC (*fig. 3*). As this focal point for current regional information from all agencies, the Center can provide situation summaries to cooperating agencies, news media and other information users. But most importantly, the OCC provides the logical site from which top command personnel from involved agencies can coordinate and direct integrated operations in a major emergency. The Operations. Coordination Center is intended to operate full time, with a permanent support staff, including daily and seasonal staffing and readiness levels appropriate for expected system workload and related response-time requirements.

MACS is designed to provide a capability to anticipate fire suppression requirements for an incident. Information collection and analysis by MACS, coupled with assessment and forecasting capabilities, will enable improved agency assessment of critical needs and evaluation of probable alternative responses, particularly during multiple-incident situations. Such advance information will permit more effective planning, and decrease the chances that unexpected events will disrupt operations.

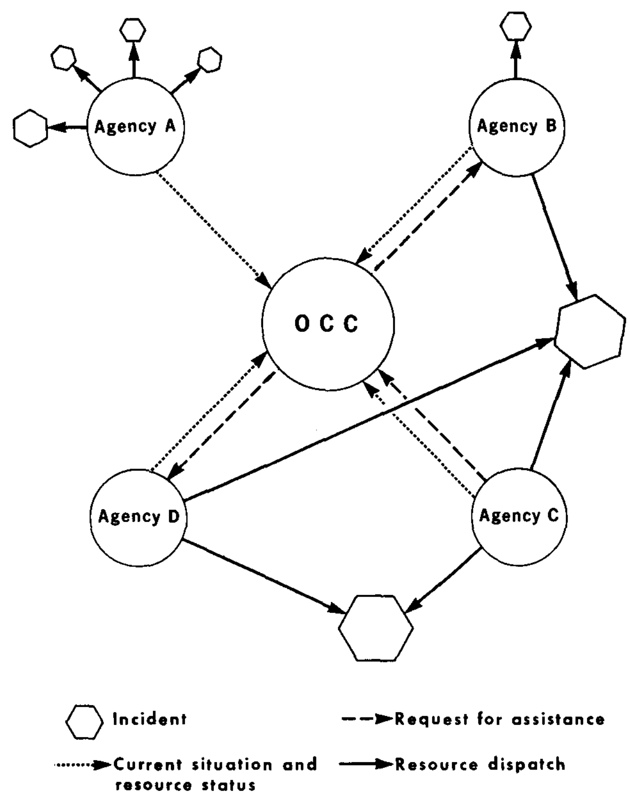

Figure 3— Multiagency Coordination System (MACS) operation. MACS activity is centralized at the Operation Coordination Center, designed to maintain current information from all jurisdictions and to assist in coordinating requests for information.

MAJOR FUNCTIONS OF FIRESCOPE

FIRESCOPE functions may be grouped into four general categories, based on system performance requirements and operational characteristics:

- Incident Command
- General Intelligence
- Planning and Support
- Communications

The Incident Command function addresses the management of onsite operations responding to a specific emergency or incident. The purpose is to facilitate effective and efficient use of resources assigned to that incident within the scope of suppression and rescue responsibilities of the fire services.

General Intelligence, Planning and Support, and Communications directly support the Incident Command System. At the regional level, they also provide the capability for MACS to carry out both dynamic preemergency planning and coordination of emergency responses between agencies and incidents.

Incident Command

The Incident Command provides the common organizational procedures and terminology required for agency personnel to efficiently plan and coordinate activities at a major fire or other incident involving two or more fire protection agencies. The Incident Command defines information collection, processing, and transfer requirements for system operation and identifies related hardware needs.

Incident Command System effectiveness hinges on the integration of system terminology and concepts, to the fullest extent possible, into the daily operations of each agency, including use on small, single-agency incidents. Agencywide adoption of the system is therefore central to program success. Lacking such system integration, personnel would be required to learn two emergency operating systems—one for the agency, another for ICS. These dual operating procedures would pose a high poten-

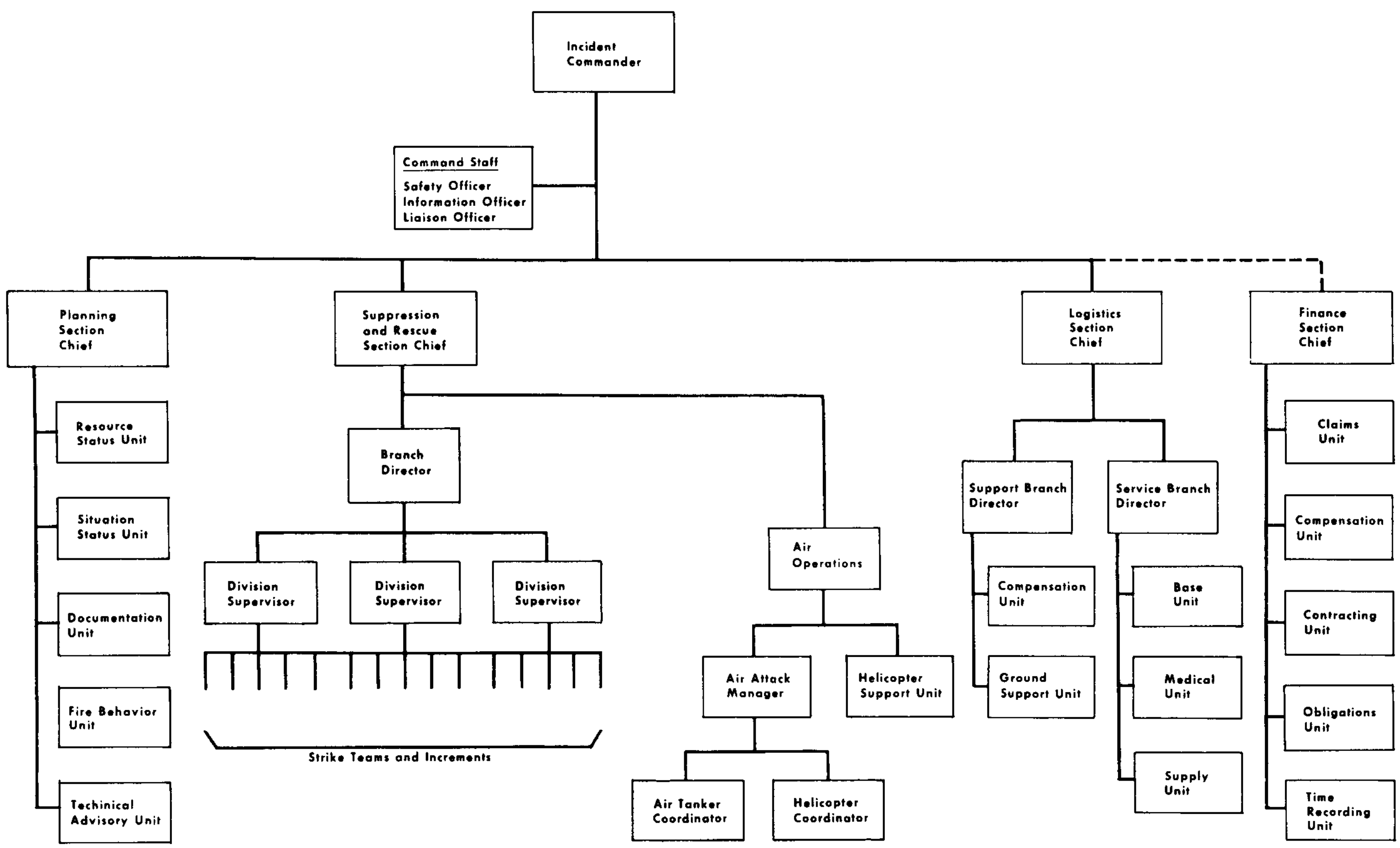

Figure 4—FIRESCOPE Incident Command System (ICS) organization structure.

tial for confusion as an incident progressed from single- to multiple-agency status.[6]

The Incident Command System is an organizational and operational concept differing from that presently existing in any participating organization. Principal differences tend to be in the method of organization, the planning procedures, and the management information systems that support these procedures.

Organizational Structure

The Incident Command System typically consists of five system functions (*fig. 4*):

- Incident Command—overall system management and command
- Planning Section—operational planning
- Suppression and Rescue Section—management and supervision of tactical field operations
- Logistics Section—logistical support of incident operations
- Financial Section—fiscal accounting support for operations

The ICS organization is activated at the moment of incident response, with system positions and associated functions activated and deactivated based upon the needs of the incident command in relation to incident progress. Several functions may be performed by one individual in less complex situations. On a small fire, for example, the Incident Commander might perform all the responsibilities of the Suppression and Rescue Section, including Division Supervisor, and perhaps extend Incident Commander authority to the Planning Section, as well. Conversely, under heavy or complex jobs, responsibilities for a single position or function may be divided between two or more individuals.

The key element of the system is that only one ICS organization exists per incident, regardless of the number of agencies or jurisdictions involved. In multijurisdiction incidents, jurisdictional integrity may be ensured by jointly filling positions, where appropriate, with personnel from each participating agency, and carrying out the particular function on a coordinated basis.

System Responsibilities

Incident Command is headed by the Incident Commander who is responsible for overall operations management, including activation of the ICS organization in accordance with specific incident needs. The Incident Commander is supported by a Command Staff and assisted in the preparation of strategic plans by the General Staff, which is comprised of the Section Chiefs.

The Planning Section is responsible for collecting, analyzing, and reporting information relating to resources assigned to the incident. Such information includes incident history, current situation, prediction of probable course of incident events, and the preparation of alternative plans for future operations.

The Suppression and Rescue Section is responsible for management, direction, and execution of all field operations related to the incident. The basic tactical unit is the Strike Team, a formally defined aggregation of field resources, for example, five engines managed as a unit, although each resource element may be assigned to a special task. Strike Teams are organized by geographical or functional assignment into divisions, and, as the magnitude of the incident increases, into branches under the Section Chief.

The Logistics Section provides those facilities, services, and materials necessary to support suppression and rescue operations. Support functions include planning and staffing incident personnel requirements, communications, fueling, maintenance and repair of ground equipment, and managing the unassigned labor and equipment pool. Service responsibilities include required meals, sleeping accommodations, and medical services; and ordering and distributing supplies and equipment.

The Finance Section is maintained by those agencies requiring onsite fiscal services to support incident operations.

Procedures and Terminology

Detailed descriptions of responsibilities and procedures for each ICS organizational element are documented in the FIRESCOPE ICS manuals. A glossary of standard terms and resource definitions adopted for common usage by participating agencies is also provided in those manuals.

Supporting System Requirements

Effective operation of the Incident Command System is dependent upon the availability of a number of support systems and related equipment. These systems include the general intelligence functions of resource and situation status, the planning support capability provided by programs to predict fire spread and behavior, and effecttiveness assessment of alternative strategies and tactics. In addition, positive communications are required not only between elements of the ICS organization at the incident, but between the Incident Command Post, the OCC, and the participating agencies (fig. 5).

Detailed performance requirements and characteristics for the support systems are presented below. Basic equipment for their application at the incident level includes:

- Mobile communications unit equipped with ICP radio communications on both FIRESCOPE-dedicated and participating agency frequencies; cached portable radios on FIRESCOPE frequencies for incident-wide

[6] Mission Research Corporation. 1974. FIRESCOPE field command operations system: conceptual design description. (Unpublished report on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

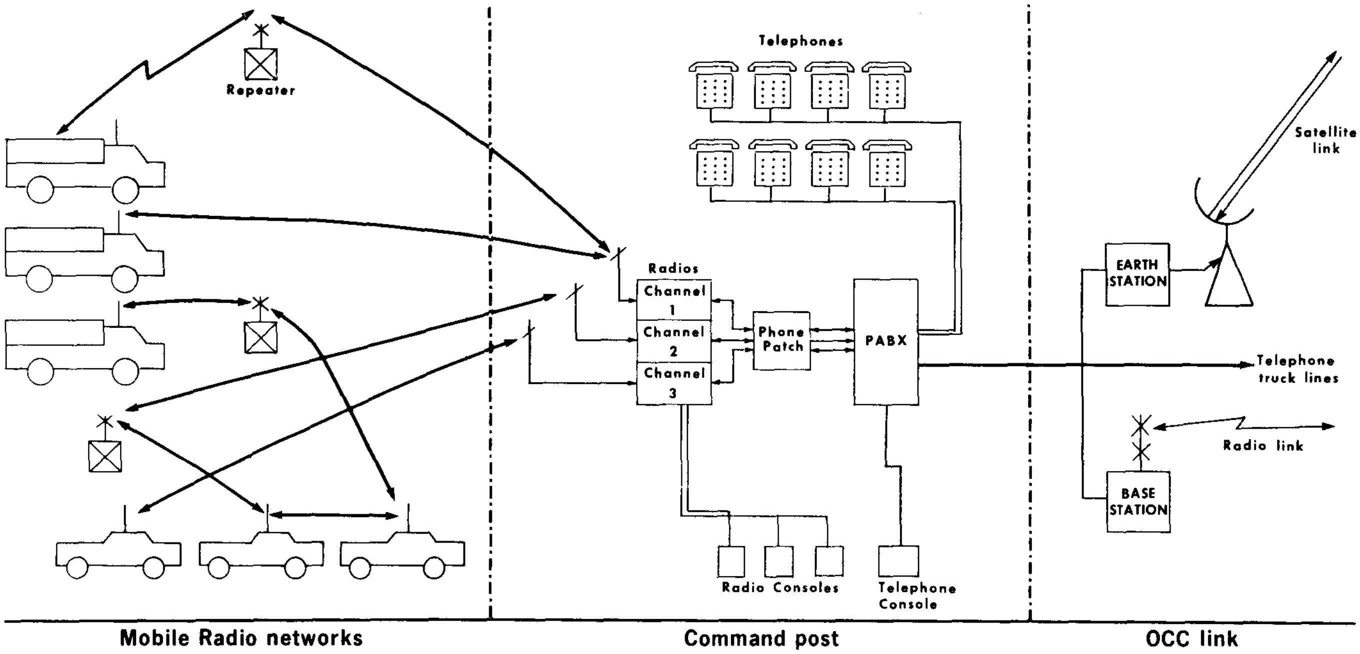

Figure 5—Effectiveness of the Incident Command System is based on a positive communication system linking all elements.

command, logistics, status, and coordination communications; and ICP telephone system.

- Mobile base unit and related equipment to establish a microwave, satellite, or other positive communications link between the ICP, the OCC, and agency headquarters.
- Mobile ground station for receiving IR imagery telemetered from aircraft.
- Mobile unit facilities to house command, logistics, and planning, including situation status and resource status functions.

General Intelligence

FIRESCOPE system general intelligence processes current information related to three specific areas:

- Suppression resource status
- Situation assessment
- Geographic data bases

This information supports not only daily operational decisions at the incident and OCC-agency command levels, but also agency needs related to short-range and long-range planning and training. General intelligence ranges in timeliness from static topographic data stored at the OCC for the entire area to dynamic status maintained at the ICP of specific resources assigned to an incident.

Suppression Resource Status

The suppression resource status (RESTAT) maintains current information on the location, availability, and general capabilities of fire suppression or other emergency forces. The detail and timeliness of status information maintained at the incident, the OCC, and agency dispatch offices will differ, depending on differing information requirements.

At the individual incident, status-keeping is carried out by the Resources Status Unit, a part of the Planning Section. The unit maintains information on all resources allocated to the incident, both by resource item and by incident summary. The information for individual resource elements includes

- Identifier (agency and unit number)
- Type
- Current status (active, available, or out-of-service)
- Current location (division or unit assignment, name of camp staging area, or if en route, the estimated time of arrival)
- Pertinent performance factors

Both a manual and an automated system have been proposed for maintaining status information. The manual system consists of compact racks clearly displaying cards which are color-keyed by resource type, status, location, or assignment for each element, and upon which identifier and other data are entered (Chase 1977b). The automated system requires the availability of a mini- or microprocessor and related peripheral equipment. Such a system could be transported to the ICP in a mobile unit, or—if a suitable positive data communication link can be assured—located at the OCC and accessed via terminals at the incident.

The manual system is technically less complex than the automated system and therefore involves less cost and risk to establish; however, physical constraints on data entry and retrieval (relating to speed and location) limit the utility of the manual system under heavy-load conditions when efficient performance is most important. The manual system should therefore not substitute for the automated system, but realize its potential on small- to medium-sized incidents and as backup to the computerized system.

RESTAT at the regional level relies on the agencies to maintain status of their respective resources, at least during routine activities. In general, the OCC is concerned with remaining apprised of *levels* of activity within each agency and thus being aware of resource availability should a major incident occur. Exceptions are scarce specialized resources, such as fire retardant air tankers, helicopters, and key crews, which are available to other agencies for emergency aid use. Status of these individual units is routinely maintained at the OCC. During major emergencies, the OCC will maintain closer track of uncommitted resources of all types, as appropriate, as resource commitment by agencies becomes heavy. For this purpose, the OCC maintains a current record of all resources assigned by individual agencies to each major incident.

Information collection, transfer, processing, storage, and display for RESTAT within MACS can be manual, automated, or a combination thereof.

A fully automated system involves the integration of individual agency-dedicated miniprocessor resource status systems. Summary or specific status information required for centralized coordination can be transferred automatically to the OCC system for processing and display. The status information is then available for further summary and transfer to other interagency coordination centers within the State or Nation.

In a less sophisticated automated system, data would be entered into the OCC system through terminals at agency dispatch offices, or at the OCC from agency dispatch office telephone reports. Both options impose a reporting workload on agency dispatch personnel above that required for the fully automated system.

The OCC manual system implies an essentially larger version of the card and rack system proposed for the ICP. Both the card and rack system and the centralized data entry terminal system would require a reliable communications link between agency dispatch offices, ICP's and the OCC.

Situation Assessment

Situation assessment consists of data storage and display required to assess the existence of, or potential for, incidents within the jurisdiction of participating fire services. Assessment data include the number, size, and locations of incidents; damages sustained and values threatened; progress of work on individual incidents; access, terrain, and vegetation; and current and expected weather. Efficient transfer of situation assessment information between the incident, agency headquarters, and regional coordination (OCC) levels is essential for system operation.

At the incident, the Situation Status Unit provides the data specifically required for strategic and tactical planning, including a chronological record of events. In addition, the Situation Status Unit provides general incident information to the OCC as a basis for interagency regional resource allocation and coordination decisions and for public information purposes.

Data to support situation assessment are obtained from a variety of sources. Basic geographic data are available in map or digital form from the geographical data base maintained at the OCC. Up-to-date regional fire activity information, including specific locations of problem fires, will be provided to the OCC by individual agency dispatch offices via a dedicated communications system.

Fire perimeter and related intelligence on large fires are obtained at the incident by a combination of visual ground and aerial scouting, and aerial infrared remote sensing, with telemetry of the latter data in near real-time to the ICP and OCC (Warren 1975). Forward-looking infrared (FLIR) and similar heat-sensitive, camera-TV type display systems may be employed to acquire tactical intelligence on portions of a fire (or other incident) obscured by smoke or darkness; but the principal FIRESCOPE system is an IR line-scan operating at an altitude of 5,000 to 20,000 feet to produce the mapping imagery required for system operations. Telemetry of this thermal map to portable ground stations at the ICP and a fixed receiver at the OCC will provide both stations with a printout of the current fire perimeter, burning intensity, and related data required for tactical and strategic planning. Information from this source is also essential for updating previous computer fire model perimeter predictions, as well as improving current accuracy. If a portable ground station is not available at the incident, imagery or a map representation can be transmitted from the OCC via telecopier.

Regional meteorological data is required for centralized assessment of current and expected burning conditions, flooding potential, and other weather-related emergencies. Such data is also necessary input to the computerized fire perimeter and intensity prediction models. Data collection for the variety of operational and planning purposes involved is through an extensive fixed regional network and portable networks displayed at individual incidents.

The recommended regional network consists of approximately 30 unattended stations measuring average windspeed and direction, current temperature and humidity, and precipitation. Ten of these key locations would report data on an as-needed basis. The remaining stations would be self-timed and transmit data at 3-hour intervals. Both types of stations would utilize the National Environmental Satellite Service (NESS) and Geostationary Operational Environmental Satellite (GOES) to relay data to the

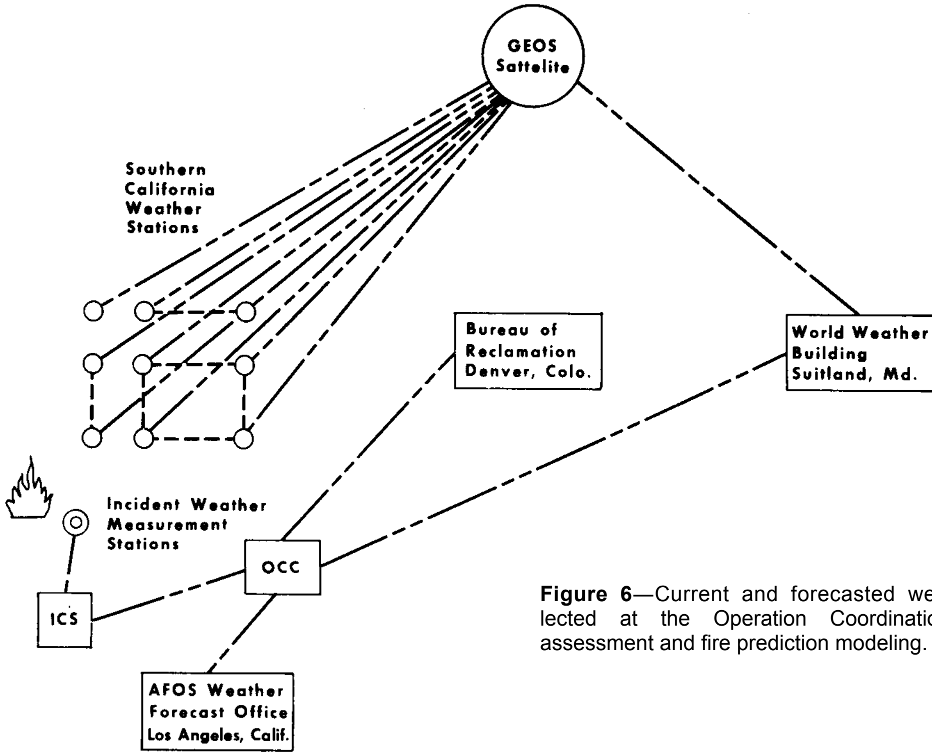

Figure 6—Current and forecasted weather information is collected at the Operation Coordination Center for situation assessment and fire prediction modeling.

National Weather Service computer in Suitland, Maryland. The data would then be automatically transmitted by phone line to an OCC minicomputer for processing, storage, and display. Additional observations and forecast information will be obtained from the National Weather-Service AFOS (Automation of Field Operations and Service) network and from computerized forecast data provided by the Bureau of Reclamation in Denver, Color (*fig 6*).

To supplement the fixed network, portable systems consisting of up to six remote stations can be deployed in the vicinity of major incidents. These stations are designed to radio transmit data upon command from a base station located at the ICP, where the data would be recorded for local use and relay to the OCC.

Geographic Data Base

Geographic data are provided in map or digital form. Map-type data are presented uniformly for all agencies on USGS quadrangle orthophotos and overlays at scales of 1:24000 for the entire FIRESCOPE area and 1:6000 for the higher value front country, wildland-urban interface areas. Information displayed includes topography (contours and drainages enhanced), vegetative cover with fuel classification (type and age), political boundaries, geographic names, and cultural features such as roads, structures, powerlines, fuel and firebreaks. These orthophotos and overlays would be used at incidents, agency headquarters, and the OCC.

Digital representation of the above data is stored at the OCC and accessed through the Center's ADP system. Data stored in digital form, and principally required by the various programs within the FIRESCOPE information management model, include elevations at approximately 1-acre (205-foot) resolution, transportation network, resource, fuel type and age to a 4-acre resolution, and location of appropriate fire control facilities.

Planning and Support

MACS planning and support functions are principally located at the OCC because of MACS dependence on the Center's information collection, processing, storage, and display capabilities. MACS planning and support functions are designed to provide assistance to individual agencies in the following areas:

- Wildland fire initial attack effectiveness assessment
- Coordination of agency requests for assistance and allocation of resources in multiple-incident situations
- Pre-incident planning
- Communications coordination
- System training and documentation coordination
- Centralized cost accounting of interagency resource use under mutual aid agreements
- Regional, State, and National situation assessment.

MACS also provides direct incident support through local weather forecasts, fire behavior and spread predictions, evaluation of strategic and tactical alternatives, and coordination and deployment of communications and intelligence systems, such as IR mapping.[7]

The capability for most of these functions is provided by the FIRESCOPE Information Management System (FIMS). This system organizes several data collection and computer model functions to perform a variety of analytical and predictive tasks (*fig. 7*) (Van Gelder 1978).[8,9]

Operational Considerations

The planning and support function is designed to respond to specific requests to the OCC from agencies or individual incidents. Though principally oriented toward wildland fire emergencies, the system has the capability to provide assistance in urban fire and major nonfire disasters.

To provide the maximum efficiency, the system design integrates regional coordinating dispatch functions of the major wildland agencies (that is, the Forest Service and California Department of Forestry) with MACS planning and support at the OCC. In addition, the system design calls for the California Office of Emergency Services, and other agencies when needed, to place coordinator personnel at the OCC specifically to carry out the MACS planning and support functions during major incidents. In this manner, system activities which involve operational knowledge and decisions are performed by qualified agency operational personnel.

In recognition of its emergency capabilities and responsibilities, MACS should be maintained at full-time operational preparedness at a level appropriate to expected workload and response time required for any emergency situation.

Initial Attack Assessment

The FIMS Initial Attack Assessment module provides rapid assessment of early wildland fire behavior and the degree to which dispatched attack forces will be able to contain and control that fire.[10] The computer program will be stored on OCC data processing hardware and may be accessed by individual major agencies via their dispatch office. Estimated turnaround from data entry to program output is less than 5 minutes. Within that time, dispatch and command personnel will be provided with an estimate of the fire's potential and a probability-over-time factor within which dispatched attack forces will be able to achieve containment and control. Unacceptably low estimates of success probability can be countered by dispatching reinforcements even before the initial forces arrive at the incident (*fig. 8*).

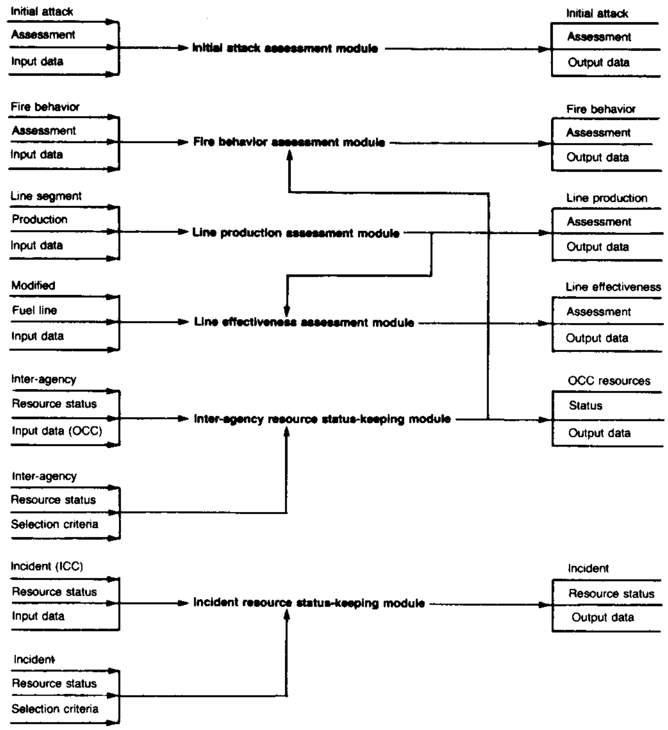

Figure 7—FIRESCOPE Information Management System (FIMS) organizes data processing and modeling functions to provide information required for system operation.

Interagency Resource Use Coordination

MACS interagency resource coordination at the OCC provides the means for expedient and efficient assistance on a regional basis. The OCC provides a single source through which all needed resources and services (exclusive of those secured through mutual or automatic aid agreements) can be requested. This centralized coordination is made possible because the OCC remains apprised of current and anticipated activity throughout the FIRESCOPE region, including existing and potential levels of resource commitment by each agency. With such information, the OCC can quickly determine the closest available resources requested and thereby coordinate the necessary allocations, as appropriate, according to established authorizing local, State, or Federal procedures and legal agreements.

In multiple-incident situations when resource demands begin to exceed availability, at least in the short run, the

[7] System Development Corporation. 1977. FIRESCOPE Operations Coordination Center detailed design requirements. (Unpublished contractor report on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

[8] Mission Research Corporation. 1975. A simulation for wildland fire management planning support. Vols. l-IV. (Unpublished report 7512-6-1075 on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

[9] Mission Research Corporation. 1976. Wildland fire modeling for planning support. Vols. l-IV. (Unpublished report 7611-3-876 on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

[10] Mission Research Corporation. 1976. Users guide:. experimental initial attack evaluation model. (Unpublished contractor report 7611-1-376 on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

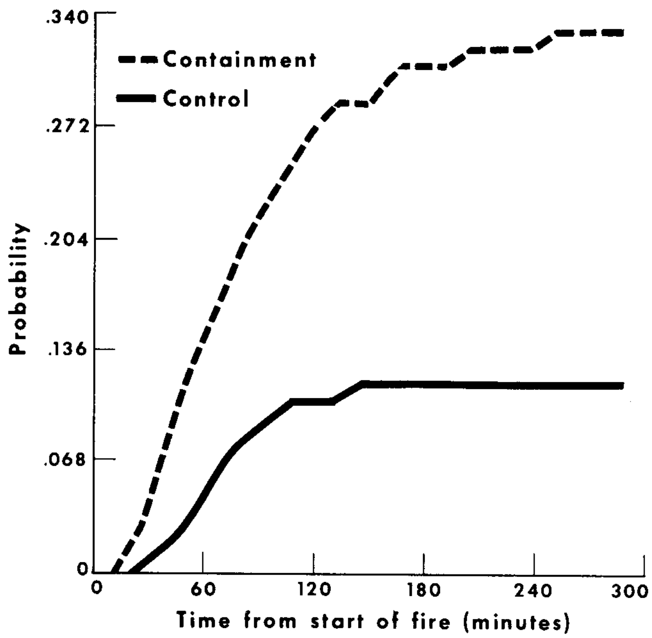

Figure 8—Sample computer output of the Initial Attack Assessment Model. Both predicted fire growth and probable success of the dispatched forces are shown.

OCC can assist agency decisionmakers in setting resource allocation priorities. In fact, in any major multiple-incident emergency, it is assumed that top command personnel from the major agencies involved will assemble at the OCC facility to personally coordinate resource allocation and other interagency activities. The OCC provides support for such decisions through FIRESCOPE Information Management System. FIMS furnishes current, regionwide resource status and situation assessment information for all types of incidents, including wildfire forecasting. FIMS forecasting modules permit assessment of potential behavior, spread, and damage of large fires; anticipates resource needs 2 to 6 hours in advance, and evaluates probable effectiveness of resource allocation and strategy alternatives.

The OCC also provides centralized liaison with cooperating nonfire agencies during major situations. The OCC can assist these agencies in coordinating diverse service requests because the Center retains current activity status on a regionwide basis and is capable of making at least limited forecasts of probable future requirements.

Pre-incident Planning

Agencies can use the OCC fire modeling and data base capability for a variety of purposes: to develop and implement variable staffing plans (such as on a daily, weekly, risk, or hazard basis) for existing initial attack situations; to plan the most effective initial attack force locations and associated preplanned dispatch assignments, particularly where opportunities for multiagency resource involvement exist; and to prepare general contingency plans for major incidents on a multiagency basis. Contingency planning considers the most likely occurrence locations for major incidents and generates models to effectively deal with probable resource and service requirements. Contingency planning is also considerably valuable in individual and multiple-agency training.

Communications Coordination

An important OCC function is the coordination of system-furnished communication cache equipment and agency- and system-assigned frequencies on a noninterfering basis among major multiagency incidents, because radio frequencies available for interagency communication are limited. The OCC coordination staff will assist agencies in setting priorities, where appropriate, and will be responsible for assigning frequencies and equipment along interagency guidelines to provide essential services to the maximum number of simultaneous incidents.

Training and Documentation Coordination

Standardized experience, training, and course material are required of all participating agencies to ensure the success of the multiagency system.[11] The OCC training coordinator will coordinate the development of these requirements and assist agencies in preparing individual, but uniformly responsive, training programs. Integral to this program is the coordination of interagency training sessions and records of individual qualifications for position assignments on multiagency incidents.

A major responsibility of the training program is to issue and maintain all FIRESCOPE system documents, including operational procedures and position descriptions.

Cost Accounting Services

The OCC will maintain accounting records of all interagency resource assistance which it coordinates. The OCC will also provide a basis for reimbursement control under documented aid agreements between participating agencies.

Communications

The FIRESCOPE Communication System is comprised of three subsystems:[12]

- Incident Command System serving ground operations

[11] System Development Corporation. 1977. FIRESCOPE Incident Command System documentation and training support. (Unpublished final report TM-5961 on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

[12] Institute for Telecommunication Sciences and U.S. Department of Commerce Office of Telecommunications. 1977. Incident communications design for FIRESCOPE. (Unpublished report on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

- Interface linking the Incident Command System with the OCC and agency headquarters
- Interface linking the OCC with agency headquarters and other data sources.

The system design provides a positive information-data transfer link (in proportion to volume and urgency of expected traffic) between appropriate system-subsystem components. Several criteria were established as design goals:

- The system would complement agencies' existing systems and operating processes.
- Existing agency communications equipment would be utilized, except where available advanced technology made addition or replacement a clearly desirable alternative for operational purposes.
- System technology would be proven and comercially available at competitive costs for 1981 implementation.
- Telephone communications would be preferred whenever practical; radio would be used primarily for local communications where telephone is not feasible, such as for portable-mobile communication applications.

Incident Communications

The principal ICS communication subsystem components, which provide all intra-incident communications, are command, planning, and logistics at the Incident Command Post, and air and ground units in the field operations (*fig. 9*).

Incident communications will consist of a combination of agency-furnished equipment on agency operational frequencies and FIRESCOPE system equipment on system-dedicated channels.

Since communications requirements vary according to incident type, size, and location, the design proposes a flexible, modular approach to meet incident needs, rather than rigidly specifying equipment and frequencies. In conjunction with incident and agency communications personnel, the OCC would be responsible for planning and coordinating the assignment of FIRESCOPE system hardware and frequencies to each incident beyond the initial response stage. Such system coordination would preclude, or minimize, interference between incidents in multiple-incident situations and maximize system efficiency as the number of simultaneous incidents increased.

The incident communications center is a mobile unit which allows onsite incident radio and telephone commu-

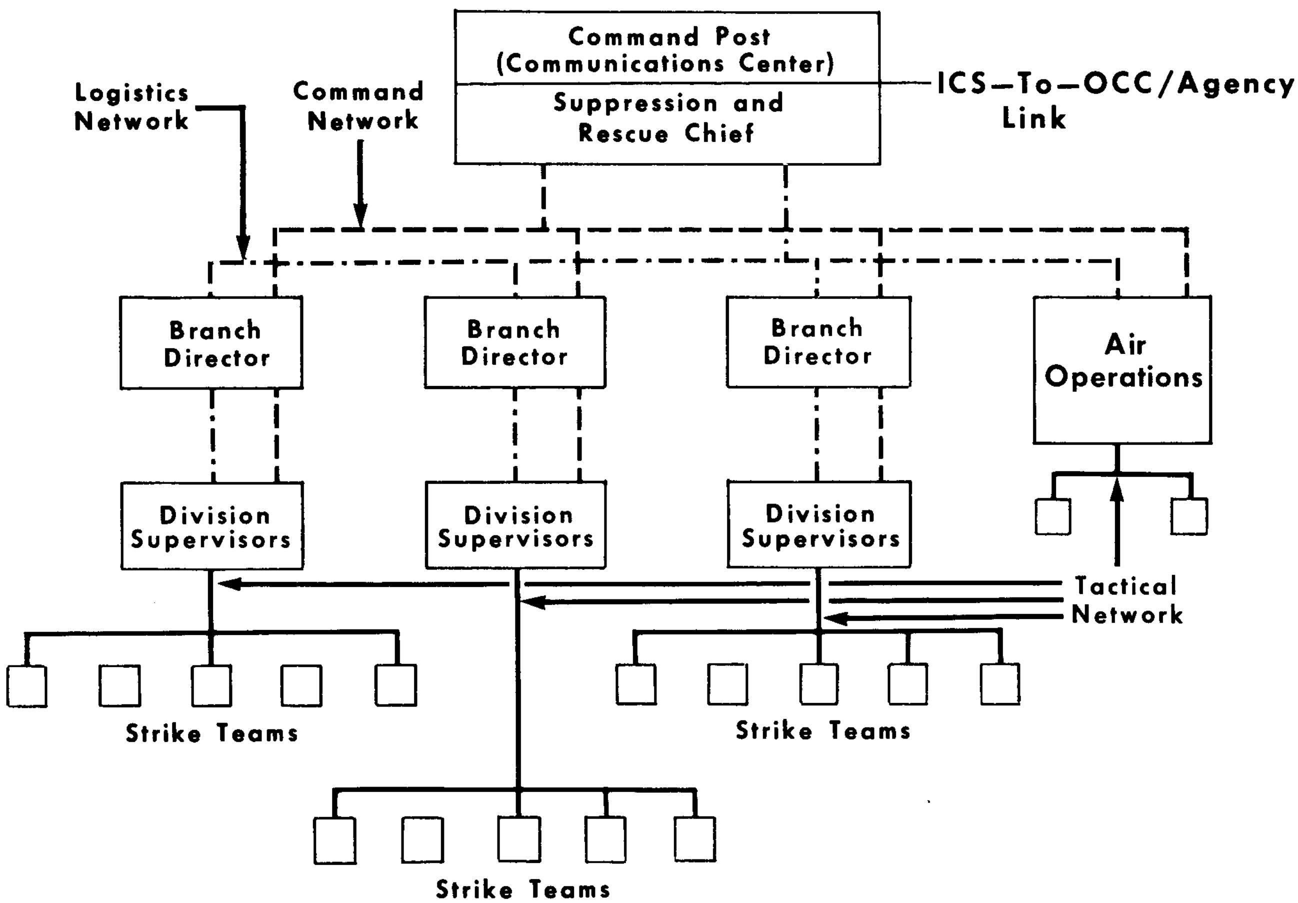

Figure 9—FIRESCOPE incident communication networks.

nications with all assigned units, the OCC, or agency headquarters.[13] The equipment modules which would be transported to the incident unit include:

- Base station radio equipment covering all participating agency- and FIRESCOPE-assigned frequencies
- Telephone equipment to establish an ICP telephone system, including links with the base radio system and external telephone company (or satellite-earth terminal) lines
- Cached portable multichannel radios and portable repeaters on FIRESCOPE system frequencies
- Portable remote weather telemetry system
- Data terminals and ADP hardware
- Remotable console positions for message center and message switching functions.

Planned FIRESCOPE ICS radio communications with and between field units utilize existing agency radios and frequencies for tactical communications within and between an agency's Strike Teams, between the Strike Team and its Division Supervisor, and between air and air-and-ground units. These existing tactical ground and air networks satisfactorily provide the intra-agency communications typically required for all suppression and rescue operations. The standard agency communication procedures will thus continue in the FIRESCOPE system operation with little or no effect.

Command, logistics, and interagency coordination communications at the division level and above (between field positions, including base camps and staging areas, as well as supervisory personnel, and field positions and the OCC) will be on two FIRESCOPE-frequency networks assigned to the incident by the OCC. Portable radios would be provided from the ICP communication unit cache. The command and logistics networks are essentially parallel. The command network coordinates situation and resource information, as well as strategic and tactical orders. The logistics network serves support and service functions. A minimum of eight dedicated channel-pairs should be available to these networks to minimize possible interference in multiple-fire situations. Twelve channel-pairs are recommended.

Incident-OCC Communications

Communications between the ICP and the OCC or agency headquarters will use commercial telephone whenever available with sufficient capacity and reliability.

Where suitable telephone service is lacking, a communication satellite link is proposed. The satellite would be accessed at the incident through a portable ground terminal at the ICP. A fixed terminal would be provided at the OCC and communications with agency headquarters (or other points) would be via OCC commercial telephone link (Warren 1977).

[13] Forest Service, U.S. Department of Agriculture. 1978. FIRESCOPE Incident Command Post communication system design. (Unpublished report, Research Work Unit 2110, on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

OCC-Agency Communications

Communications between agency headquarters and the OCC will be via a combination of leased and commercial telephone line service and a State microwave intercommunication network. A minimum of one dedicated line between each major agency and the OCC will be required for data transmission; additional incidental voice communication requirements can be satisfied by phone and State microwave intercommunications.

An emergency backup will be maintained at the OCC to ensure radio communication with each agency headquarters, as well as monitoring of agency dispatch and tactical operations channels when necessary.

MAJOR HARDWARE, FACILITIES, AND STAFFING REQUIREMENTS

FIRESCOPE is an integration of participating agency personnel and equipment; collectively managed hardware, software, facilities, procedures; and system personnel required to perform specialized system tasks. The capacity of the system to respond to coordination and support demands by individual agencies is proportional to the extent of these collectively managed resources. System integrity must therefore consider not only the probable number, type, size, and timing of demands, but also the performance requirements and associated limits of acceptable response degradation as design capacity is exceeded by simultaneous job requests.

The design recommendations for system-provided equipment, facilities, and staffing are predicated on a system capacity that meets the requirements of a situation characterized by five simultaneous and similar, major, multiagency fires or incidents. Consideration must, however, account for variations in individual incident size, scope, and complexity, and the resulting demands on system support. Thus, the system design capacity could in reality be overwhelmed by two or three simultaneous catastrophic incidents, or it could adequately meet the needs of 12 large incidents in a relatively uncomplex situation. In actuality, the amount of system-provided hardware and support staff is ultimately a funding decision, based on expected workload and some rational standard for minimum acceptable system performance. As system capacity is reached, an operational decision will be required to choose between servicing additional support requests at the expense of downgrading service to ongoing incidents, or cuing in new requests and responding to them only as the needed system function again becomes fully available.

Incident Command System

Facilities and Equipment

The centralized Incident Command functions are carried out at the Incident Command Post (ICP), normally located at the incident base. Standard facilities and support equipment are provided by communications trailers and support trailers available for assignment to major incidents, since base locations are largely unpredictable and available facilities at any given site are subject to considerable variation. The communications trailers provide ICS base personnel with appropriate work space and transport appropriate specialized equipment to the incident. These units could be maintained and operated by individual agencies or be designated FIRESCOPE units and held for assignment to multiagency incidents. In either case, a 40- by 8-foot semitrailer is recommended. Oncall contract tractors would be used to move the units if agency equipment were unavailable.

The support trailer would provide suitable work space, equipment, and supplies for the principal command and planning staff. The support trailer would house RESTAT, SITSTAT, as well as the incident minicomputer and related peripheral equipment.

The communications trailer will provide console positions for four radio operators and a telephone operator and would be equipped to carry out the RESTAT function in the manual mode in the absence of other facilities.[13]
The installed communications equipment will include:

- Five base station synthesizing transceivers (three to cover FIRESCOPE-assigned channels, and two to cover agency-operated frequencies)
- One base station for the portable remote weather telemetry network[14]
- One telephone PABX (30 internal, 8 external line capacity), with radio-phone patch capability, for base internal communications and as a base link with the outside
- Appropriate support generating and air conditioning. The unit will also carry for distribution:
- A cache of 40 portable, 6-channel transceivers on FIRESCOPE frequencies
- Thirty telephones for base communications
- Two remote consoles to provide direct radio communication at the support trailer or other ICP facility
- A portable 6-station remote weather telemetry system
- Two programmable transportable radio repeaters covering FIRESCOPE channels.

The communication link between an individual incident and the OCC or individual agency headquarters will be direct commercial telephone service, whenever possible. For situations where this service is unreliable or unavailable, the FIRESCOPE system design recommends three portable satellite communication ground stations for assignment to incidents by the OCC (Warren 1977).

The FIRESCOPE system will have five mobile ground receiving units available for OCC assignment to provide direct reception of IR line-scan mapping imagery at the incident.[15]

Personnel

All ICS positions will be filled by qualified regular personnel from the fire protection agencies. Assignment will be made by the agencies involved in the particular incident, or through the OCC upon agency request.

Multiagency Coordination System

Facilities and Equipment

The Muiltiagency Coordination System operates out of a 7000-square-foot facility that serves as the FIRESCOPE Operations Coordination Center. The California Department of Forestry and the U.S. Forest Service use these same facilities for regional coordinating dispatch operations. Though integrally associated with these two wildland protection partners, FIRESCOPE OCC acts independently under joint management of the FIRESCOPE Board of Directors. Comprised of representatives of the actively participating and financially supporting agencies, the Board of Directors sets general policy guidance for the OCC.

The Operations Coordination Center consists of the following principal hardware components:

- Data processing system consisting of three integrated miniprocessors and related data entry, storage, and display devices. Three central processing units (CPU's) perform three simultaneous functions, including a redundancy feature that lets the system remain operable in a hardware failure[16]

[14] Forest Service, U.S. Department of Agriculture. 1977. FIRESCOPE portable remote meteorological system design. (Unpublished report, Research Work Unit 2110, on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

[15] Forest Service, U.S. Department of Agriculture. 1977. FIRESCOPE infrared telemetry system design. (Unpublished report, Research Work Unit 2110, on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

[16] Mission Research Corporation. 1977. FIRESCOPE information management system performance specification and implementation plan. (Unpublished report on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

- Weather information processing terminal connected to the NWS AFOS network
- Internal PABX system to provide, preferably, 30 internal and 8 external communication links
- Drop connection with the State microwave intercom network
- Ground unit for receiving telemetered IR line-scan imagery
- Satellite communication ground station.

A miniprocessor and data communication link with the OCC will be installed at the dispatch offices of participating agencies to perform information storage and transfer functions of RESTAT and SITSTAT

An automatic weather data collection and telemetry network consisting of approximately 30 remote stations will be installed to cover the FIRESCOPE area.[17]

Software

The following FIRESCOPE Information Management System (FIMS) modules are recommended for implementtation on OCC data processing equipment:[16]

- Initial Attack Assessment module to estimate small fire behavior and initial attack force effectiveness from generalized location, fuel, weather and slope information, and specific initial force units dispatched.
- Fire Behavior Assessment module to calculate expected fire perimeter locations for specified times based on point of origin and site-specific fuel, weather, and topography data
- Line Production Assessment module to estimate control line production for specified line segments by typical fire suppression resources used in southern California, including the effects of local fuel on construction difficulty and line width parameters, topography and weather, as well as personnel fatigue factors
- Line Effectiveness Assessment module to estimate probable effectiveness of specified proposed control line segments, considering fire behavior, line production, completion time, and stability
- Resource Status Keeping module to maintain files of interagency resources and the status of all resources assigned to major incidents
- Meteorological Computation and Forecast module to process local weather observations from the regional network or other sources, and numerical and forecast information, thereby enabling local interpolation of current conditions and forecasting of expected meteorological values for the Fire Behavior module.

[17] Forest Service, U.S. Department of Agriculture. 1977. FIRESCOPE meteorological station network design. (Unpublished report, Research Work Unit 2110, on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

The following data bases will be maintained:

- Vegetation, to include fuel type and age[18]
- Topography
- Transportation network
- Meteorology
- Fire and other emergency resources and facilities

Personnel

The administration and performance of FIRESCOPE OCC service and support functions will require approximately a 14-member staff (*table 1*). Approximately half of these positions should be filled by FIRESCOPE system employees; the remaining positions should be filled by agency personnel assigned to the OCC for a tour of duty, with assignments rotated periodically among the agencies.[7]

System employees (versus agency employees) could be hired through a single agency, such as State Office of Emergency Services. The positions relate specifically to MACS management.

Field maintenance of communication and weather station equipment will require additional technical support that could be shared by agency personnel.

As OCC workload increases during emergency situations, operational personnel from individual agencies involved in incidents would be temporarily assigned to the OCC to assist resource coordination and incident support functions.

Locating local NWS personnel at the OCC is strongly recommended because of the meteorological interpretation necessary for modeling and situation assessment. Alternatively, a FIRESCOPE system staff meteorologist will be required in addition to the other proposed positions.

NATIONAL APPLICATION OPPORTUNITIES

FIRESCOPE is a system oriented toward specific southern California problems and capabilities. With few exceptions, the conditions addressed by the system are not paralleled elsewhere in the United States. It follows, therefore, that implementation of the total system would not be operationally or economically justified outside of the seven-county FIRESCOPE region.

Considerable technology has been developed which does, however, have national implications and which can

[18] Forest Service, U.S. Department of Agriculture. 1977. FIRESCOPE fuels data base report. (Unpublished report, Research Work Unit 1652, on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

Table 1 — *Operation Coordination Center positions. Support personnel perform system administrative functions. Service personnel provide operational interface with individual agencies.*

Position	Function	Personnel required	Salary range (1977 dollars)	How staffed	When staffed
		Support area			
Supervisor	Administration	1	28-31 K	Hire	Full time
Supervisor	Data processing	1	23-26K	Hire	Full time
Technician	Data processing	1	15-16K	Hire	Full time
Technician	Maintenance	2	16-18K	Hire	Full time
Supervisor	Document control	1	19-22K	Hire	Full time
Supervisor	Cost accounting	½	11-13K	Hire	As needed
Secretary	Administration	1	12-13K	Hire	Full time
		Service area			
Supervisor	Administration	1	28-31K	Agency	As needed
Coordinator	Training	1	23-26K	Agency	As needed
Coordinator	Resources	1	23-26K	Agency	As needed
Analyst	Resources	2	16-18K	Agency	As needed
Clerk-typist	Administration	2	11-12K	Agency	As needed

provide significant contributions to fire management in other areas of the country. The chief contributions of the FIRESCOPE program on a national level are:

- *Infrared Telemetry.* The prototype infrared line-scan mapping telemetry system developed for use in the FIRESCOPE region provides timeliness of delivery of the imagery. Before existing hardware can be used elsewhere, however, approval from the Interdepartment Radio Advisory Committee (IRAC is required for additional telemetry channels, since the one presently used is limited to a specific geographical area.
- *Automatic Weather Telemetry Network.* The FIRESCOPE- recommended stations provide more versatility in quality and potential uses of collected weather data than single-purpose stations currently under consideration for National Fire Danger Rating, with only minor, if any, increase in costs.
- *Incident Command System.* The concepts of uniform terminology, emergency organization structure, and cooperating agency procedures initially were not thought to be radical innovations. Program development to date, however, indicates that this may be one of the more significant contributions of FIRESCOPE, with correspondingly minor implementation cost. The Incident Command System as well as improvements in present wildland organization and operating procedures deserves further study for expanded application.
- *Multiagency Coordination.* Development of the FIRESCOPE system involved a detailed, systematic analysis of one of the more complex coordination situations confronting any fire protection agency in the country. The experience gained should therefore be utilized to develop sound solutions to both single-and multiagency coordination problems elsewhere. The FIRESCOPE Operations Coordination Center, unique in its particular role in southern California, can provide a model for other local coordination centers, for example, in the study of Boise Interagency Fire Center operations. A systematic analysis of operational problems and requirements of candidate locations would, of course, be required prior to any application of specific technology.
- *Fire Information Management Systems*. Developments in information management perhaps offer the most potential for extending FIRESCOPE technology to other areas of the country. Unfortunately, fire management functions have tended to lag behind other resource management activities in the area, yet many opportunities exist to increase effectiveness and efficiency of data collection, processing, storage, retrieval, and display to meet a variety of fire-oriented needs.

One example of technological spinoff is FIRECASTING, a computerized method for forecasting fire spread and behavior based on specified fuel, weather, and site parameters. Developed as an *interactive* computer program, FIRECASTING enables the field user to apply standard fuel models or create one to meet specific local conditions. This program thus provides a major tool for preparing fire use prescriptions and planning prescribed fire operations.[19]

Similar contributions can be expected from operational fire suppression information system improvements at

[19] Van Gelder, Randall J. 1978. FIRECASTING operator's guide. Pacific Southwest Forest and Range Exp. Stn., Berkeley, Calif. (Unpublished manuscript on file at Forest Fire Laboratory, Pacific Southwest Forest and Range Experiment Station, Riverside, Calif.)

local, regional, and national levels. The benefits of uniform data bases and integrated resource and situation status-keeping systems have been demonstrated by the FIRESCOPE program and are equally applicable to other multijurisdictional situations.

SUMMARY

The FIRESCOPE system was designed to provide an effective and efficient solution to operational coordination requirements and problems of the major fire protection agencies serving the southern California urban-wildland complex. These agencies are responsible for providing a variety of emergency services over an area of more than 20,000 square miles containing 12 million people, high value improvements, and broad expanses of some of the most flammable vegetation found in the world.

Major wildland fires are a common annual occurrence in this Mediterranean-like climate which typically gives the area 4 to 6 months of almost total drought. In addition, the region is threatened with infrequent, but potentially disastrous, urban emergencies precipitated by flooding, earthquake, and fire. Any major incident requires and receives fast, close cooperation from fire services in the area. The FIRESCOPE Program is directed towards improving the effectiveness of this excellent cooperative working arrangement.

LITERATURE CITED

Chase, Richard A.
1977a. **FIRESCOPE: a regional solution to multiagency coordination problems.** Int. Fire Chief 43(9):18-21.
Chase, Richard A.
1977b. **T-cards provide versatile resource status system.** Fire Manage. Notes 38(3):12-13.
FIRESCOPE Program.
1978. **Incident command system position description and procedure manuals.** FIRESCOPE Program Office, Riverside, Calif. March 1978. 424 p.
Maloney, J. E., and M. O. Potter.
1974. **The fire management system: the fire management centre: preliminary results and design concepts.** Forest Fire Res, Inst., Ottawa, Ontario. 46 p.
Phillips, Clinton B.
1971. **California aflame! September 22-October 4, 1970.** State of Calif. Dep. of Conserv., Div. For., Sacramento, Calif. 73 p.
Simard, A. J.
1977. **Wildland fire management, a systems approach.** Canadian Forestry Serv. Dep. of Fisheries and Environment Tech. Rep. 17, Ottawa, Ontario. 25 p.
Task Force on California's Wildland Fire Problem.
1972. **Recommendations to solve California's wildland fire problem.** State of Calif. Dep. of Conserv., Div. For., Sacramento, Calif. 63 p.
Van Gelder, Randall J.
1978. **FIREMANS: a fire management system simulation for operational fire planning support.** Proc. Int. Union of For. Res. Organ., Wageningen, The Netherlands.
Warren, John R.
1975. **Telemetering infrared imagery from aircraft to fire camp.** Fire Manage. Notes 36(4):8-10.
Warren, John R.
1977. **Remote-site communications via satellite.** Fire Manage. Notes 38(2):3-4, 19.

Chase, Richard A.
1980. **FIRESCOPE: a new concept in multiagency fire suppression coordination.** Gen. Tech. Rep. PSW-40, 17 p., illus. Pacific Southwest Forest and Range Exp. Stn., Forest Serv., U.S. Dep. Agric., Berkeley, Calif.

FIRESCOPE is a system developed to improve the capability of firefighting agencies in southern California in allocating and managing fire suppression resources. The system provides an effective and efficient solution to operational coordination requirements and problems of the major fire protection agencies serving the southern California urban-wildland complex. Major wildland fires are a common annual occurrence in this Mediterranean-like climate which typically gives the area 4 to 6 months of almost total drought. In addition, the region is threatened with infrequent, but potentially disastrous, urban emergencies precipitated by flooding, earthquake, and fire. The FIRESCOPE program is directed towards improving the effectiveness of the close working arrangement of fire services in the area in response to any major incident.

Retrieval Terms: FIRESCOPE, fire management systems, agency coordination