

FIRESCOPE
PROGRAM REPORT
(1972-1982)

FIRESCOPE PROGRAM REPORT
TEN YEARS OF RESEARCH, DEVELOPMENT AND IMPLEMENTATION
(1972-1982)

EXECUTIVE SUMMARY

In 1971, Congress directed the Forest Service to develop a system to improve southern California fire services coordination on multijurisdictional fires and other emergencies. This followed the tragic 1970 fires, which resulted in considerable loss of lives, property, and natural resources. The effort became known as FIRESCOPE: "Firefighting Resources of Southern California Organized for Potential Emergencies." State and local fire services joined with the Forest Service to design, develop, and implement the program.

This report covers the ten-year span (1972-82) of the work that followed. The report is structured to:

- Summarize the "Research Design Intent" of each of the Program's major components and supporting technologies,
- describe the development and implementation efforts on each element, and,
- provide an analysis of progress and improvement that exists today, compared to 1970.

Funding history and the costs required to complete the Program are included. These show:

- 1972-77:	Federal research	\$4.7 million
	Member agencies support	1.0 million
- 1978-82:	Federal development	7.8 million
	Member agencies support	9.0 million
- future:	Program completion	8.1 million

During the ten years, two economic studies were conducted. Both showed the potential for the completed program to save at least 10% annually in direct costs and losses into the future. In 1980, with the program less than half implemented, analysis of performance on a series of fires showed significant improvement in coordination, resource utilization and effectiveness. Additional estimates of program value can be seen in the fact that many of its components are being adopted on a statewide and national basis. All evidence leads to the conclusion that the program was extremely cost-effective, and that even greater savings can be expected if the development and implementation work is completed.

Other important conclusions of the report are:

1. Development and implementation work is only 60% completed. Most of the advances have been made in the areas of organization and procedures. The "high technology" components (local terrain wind models and sophisticated fire behavior prediction) are not done.
2. The commitment and participation of the member agencies has been a key factor in the success of the program. The multiagency Decision Process provided a vehicle for all members to input to development actions and gained "ownership" and support to implementation. The Decision Process needs to continue so that implemented components can be managed, and any future development can be guided in the same, successful, multiagency manner.
3. The FIRESCOPE Program involved agencies from all four levels of government. Program design included two major components and six supporting technologies, all interconnected in some manner. Funding came in annual increments and the amounts provided bore little relationship to overall plans or development needs. Member agencies' actual implementation progress (and problems) were varied. These factors made it necessary for the four people in the Program Office to spend most of their time and effort on two basic tasks: planning (and re-planning) and facilitating communications between members. Since there is little reason to believe that future development efforts will be less complex, or funded in a more consistent manner, such future efforts must include some form of planning and facilitating group.
4. The two major components of FIRESCOPE (the Incident Command System and the Multi Agency Coordination System) were originally intended to meet fire emergency needs. As they were developed, however, they were tailored to meet "fire service needs", i.e. those types of incidents that fire agencies must respond to. This came to be termed "all-hazard" or "all-risk" and includes a wide spectrum of emergencies (plane crashes, hazardous materials accidents, earthquake, etc.). This "all-hazards" capability has been initially structured into the present systems, and has been introduced into the National Interagency Incident Management System (NIIMS). Any further development should ensure that all-hazard procedures are further defined and included in the systems documentation. Efforts should be made to extend these proven systems to other public safety services as the foundation of a uniform and comprehensive emergency management system.
5. The entire system of interagency communications presently depends upon telephone services or microwave. Parts of the radio communications are also accessed through microwave. There is only one computer, without an emergency back-up unit.

All forms of existing interagency communications and data processing are extremely vulnerable to failure from earthquake. Resolving these weaknesses should be a high priority.

6. Software development for the Fire Information Management System (FIMS) was slow and inefficient. There was little commonality between the member agency practitioners and the professional software designers. As a result, operational programs (FIREMOD, Resource Status, Incident Reports) were slow to produce, and were usually re-programmed at least once before they met user requirements. As a rule, the users could not describe fully what they wanted until they were shown a prototype, which then enabled them to say what they didn't want. These situations created tension and frustration with both users and programmers. Future software development efforts can avoid this kind of problem if all parties take the time and energy to prepare thorough specifications and requirements before program design begins.

A number of other conclusions and recommendations are documented in appropriate sections of the report.

If another 1970 fire situation occurs in the near future, evaluations could be expected to show:

* Great improvement in:

- Incident management procedures through use of the Incident Command System.
- Incident information reporting through use of Incident Reports and the Fire Information Management System.
- Regional multiagency priority setting and resource allocation through use of the Multi Agency Coordination System.
- Initial and extended attack communications between agencies through use of mobile synthesizer radios.

* Some improvement in:

- "On-incident" communications capabilities.
- Regional knowledge of remaining resource commitments and availability of resources
- Availability and use of common maps
- Timeliness and useability of Infrared intelligence to support incident planning
- Agency ability to order proper resources in terms of type,

kind, and capability (Strike Teams and Task Forces)

* Limited improvement in:

- "Off-incident" communications
- Fire behavior prediction modelling
- Localized, specific fire weather forecasts to incidents and agencies

* No improvement in:

- Capability to examine either individual incident, or regional, multiple incident suppression alternatives.
- Legal and fiscal agreements that could further enhance coordination and reciprocity.

Taken as a whole, the report documents a "first-of-its-kind", massive and unique effort that achieved much better results than were originally expected. Many of those results are still imperfect, and a significant amount of work remains undone. However, a solid foundation exists for future improvements, and this report should be very helpful to those who may someday continue the work.

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APPENDIX A - USDA Forest Service General Technical Report PSW 40
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FIRESCOPE PROGRAM REPORT:
TEN YEARS OF RESEARCH, DEVELOPMENT, AND IMPLEMENTATION
(1972-1982)

1 INTRODUCTION

FIRESCOPE (Firefighting Resources of Southern California Organized for Potential Emergencies) began as a result of the disastrous fire season of 1970. In the fall of that year, in a critical 13-day period, over 500,000 acres burned, 772 structures were destroyed, and 16 lives were lost. The fire suppression and interagency coordination workloads caused by this conflagration period severely taxed the fire agencies involved. It was clearly evident that improvements were necessary if future events of similar magnitude were to be managed effectively.

In 1971 Congress directed the United States Forest Service to develop a system that would improve the coordination of local, state, and federal fire agencies in southern California on multi-jurisdictional fires and other emergencies. In 1972, the California Department of Forestry and Office of Emergency Services; Los Angeles, Ventura, and Santa Barbara County fire departments; and the Los Angeles City Fire Department joined with the Forest Service in the joint development of the systems that are FIRESCOPE.

It has now been ten years since this very complex intergovernmental program was started. Much has been accomplished, yet much remains to be done. In 1982 Congress signaled the end of Federal funding for further development. So, on this 10th anniversary, it is appropriate to record the effort, describe and analyze the technologies being implemented, enumerate those areas of development not yet completed, and discuss the lessons learned during the life of the Program.

From both a funding and overall development standpoint, the Program was divided into two distinct phases. The first phase, from 1972 through 1977 emphasized research and design activities. The technical results of that phase have been thoroughly documented elsewhere, and will only be summarized in this report. (12) The second phase, which was devoted to development and implementation of design elements, began in fiscal year 1978 and continued through fiscal 1982. This report will concentrate most heavily on the second phase accomplishments.

Over the five years encompassing the second phase, only about 60% of the Program's components were completed. Another three years of development and implementation activity will be necessary for total Program completion.

2 PROGRAM ADMINISTRATION

2.1 Program Office Management

The FIRESCOPE Program was managed by two branches of the Forest Service. The first phase (1972-1977), was administered by Forest Service Research, and the program development and implementation phase (1978-1982), was administered by State and Private Forestry.

A Forest Service Program Manager was established at the Pacific Southwest Forest and Range Experiment Station's Fire Laboratory in Riverside at the beginning of the program. A change in managers was made in 1975. The Program Office staff, which built up over time, consisted of:

- * Program Manager
- * Assistant Program Manager
- * Program Planner
- * Administrative Assistant
- * Computer Systems Specialist, Communications Specialist and Mapping Specialist were also assigned to the project from the U.S. Forest Service Pacific Southwest Region, but not fully funded by FIRESCOPE.

2.2 FIRESCOPE Decision Process

Throughout both phases of the program, the participating state and local fire services had a significant role in guiding the program development. In the early phase of the program (1973-1974), the organizational structure consisted of: (3)

- * Policy panel - all Forest Service (set policy - act as Senior Advisory Group).
- * Technical Team - Inter-agency group made up of Chiefs or Chief Deputy personnel from principal member agencies.
- * Task Force - Designated representative from member agencies to work on specific aspects of design and development.

By 1975, there were several major design efforts underway. These efforts were producing interim research products which would have

a major impact on the eventual design of the systems and technologies. The size of the challenge and the character of these interim products made it evident that significant inter-agency coordination would be required by the member agencies to effect a smooth transition from the research design to an operational system. The change in program management brought an expanded decision organization, and for the first time a process for decision making was established. There were two major objectives for the expanded process. First, it was clear that whatever the Program developed there would be a need to manage and maintain those products into the future, long after the Forest Service Program Office was disbanded. Therefore, the process had to be strong enough and effective enough to become a member agency "institution" in its own right, capable of on-going operation and maintenance functions. Second, it had to be a process that was capable of integrating FIRESCOPE decisions and products into the normal, day-to-day operations of each member agency, as well as other fire services who were expected to join the effort in the following years. It was designed to become a "quasi organization" that would make decisions and solve problems in the same procedural manner as a true formal organization. (19)

One of the steps taken to achieve the first objective was the establishment of the Operations Coordination Center Support and Service Manager (OCC/SSM) by the Office of Emergency Services. This position was filled in 1978. From that time forward, products accepted as ready for implementation by the agencies were "handed-off" to the OCC/SSM for operation and maintenance. (In 1982, the executive management responsibilities of the Decision Process were passed entirely to the OCC/SSM.) The organizational structure for this Decision Process has evolved over time and now consists of:

- * Board of Directors - Heads of major departments/agencies involved in the program.
- * Operations Team - Assistant or Deputy level, or the persons charged with departmental implementation of developed programs.
- * Task Force - Similar to the previous structure - representatives of member agencies charged with responsibility for developing the design.
- * Specialist Groups - Groups of personnel with specific expertise formed to do detailed development work. Specialist groups have been formed for areas of Communications, Training, Information, Mapping and Data Base.

The Process has been the instrument by which all major decisions affecting the program's development and implementation have been made.

The Decision Process itself is often referred to as a FIRESCOPE technology development. It, more than any other single thing, has provided the means for ensuring that the program would move forward. A number of revisions were made over time as it became more evident to the member agencies and program management that the Process was essential for program continuation. The revisions reflect both the growth of confidence in the Process as well as the need to incorporate new ideas and procedures. (21)

3 PROGRAM DESCRIPTION AND ANALYSIS

3.1 Introduction

Immediately after the 1970 disaster, (1) Forest Service Research, the involved agencies, and several independent contractors began intensive examinations of the response efforts. Post-incident evaluations pointed out the inability of individual agencies to cope with such a severe situation. It also pointed out that even with sufficient fire suppression resources,* an improved regional coordination capability must be put into place to maximize the effectiveness of the agencies. (5)

Three major areas requiring improvements were identified as a result of the 1970 fire analysis:

- a. At the Incident: Major wildland fire incidents recognize no jurisdictional boundaries. Yet, a multi-jurisdictional incident demands a high degree of coordination and cooperation on the part of the agencies involved. If coordinated resource use and planning are not accomplished at the scene, the result can be (and was in 1970) inefficient use of resources. Separate and uncoordinated planning can also result in a higher safety risk to personnel. The Incident Command System (ICS) was the agencies' answer to this problem.
- b. Intra-Area Response Coordination: With a large number of incidents occurring within a given time frame, all competing for resources and with different priorities, the function of inter-agency resources coordination becomes all-important. 1970 proved conclusively to the agency analysts that improved inter-agency resources handling measures needed to be developed. The Multi-Agency Coordination System (MACS) is the result of the agencies' intent to improve the resources coordination function.
- c. Support Technology: From the 1970 fire analysis several areas were identified in which major technological improvements could be made to increase the overall operating performance of both the personnel responsible for the management of incidents and for those involved in regional resource coordination. These included:

*The term "resources" as used throughout this report refers to the combination of personnel and equipment which constitute fire service emergency response forces.

1. Improved infrared scanning systems.
2. Improved meteorological monitoring and forecasting.
3. Improvement in radio and telephone communication systems.
4. Improvement in fire behavior modeling.
5. Improvement to information processing at the incident, between incidents and agency facilities and on an agency-to-agency basis.
6. Development of a common mapping system that would support all of the above and provide a basis for a physical data base retrieval system.

Combined with these was the need to improve levels of training in the new technologies -- especially on an inter-agency basis.

Actual work on the FIRESCOPE Program began in October of 1972 with the establishment of a Program Office in Riverside, California, the beginning of work in examining the tactical field operations by an inter-agency working group (January, 1973) and the beginnings of an analysis of the policy and command operations structure (June, 1973).

3.2 Original FIRESCOPE Program

In 1973, the FIRESCOPE Program was set up in three parts. (3)

Part 1 Command System Policy and Operations which was made up of:
(a) Policy, (b) Command Operations, (c) Tactical Field Control Operations.

Part 2 Command System Development (technology applications).

Part 3 Command System Fabrication and Installation (implementation).

The first efforts (Part 1-C) began as an extension of a separate effort already established by the Riverside Fire Laboratory (with support financing from the National Bureau of Standards) to examine the requirements for a field communication vehicle. This project, now placed under the FIRESCOPE Program, was expanded to examine the requirements, and develop a capability to better utilize multi-agency resources in tactical suppression at a major incident. An inter-agency working group (Task Force) was established and began work in January of 1973, assisted by a contractor (Public Safety Systems, Inc.). This effort was the beginning of the Incident Command System (ICS).

The Policy and Command Operations Program (Parts 1-A and 1-B)

began in June. This activity was initially done largely under contract. The objective was to determine the major functions and requirements for an integrated approach to regional resource response coordination. A joint team from Mission Research Corporation (MRC) and System Development Corporation (SDC) was formed to begin work on this project under contract. This project marked the beginning of the Multi-Agency Coordination System (MACS).

Command System Development (Part 2) began with a grant to the Aerospace Corporation to support the overall program development, evaluate pertinent technology, develop specifications for subsequent hardware procurement, and to examine and improve fire behavior/spread techniques.

From these beginnings in 1973, the program was moved forward. Several important baseline technical publications were developed by December of 1974 from the Part 1 (A B and C) projects. These were:

- a. A Discussion of FIRESCOPE System Functions and Enabling Policies, (December, 1973). This document outlines through a set of assumptions the major conditions (requirements) under which FIRESCOPE components would operate. (22) (Part 1-A).
- b. A Conceptual Definition of a Wildland Fire Management Regional Coordination System, (June, 1974). A report covering the first year's design effort. This report described a relatively sophisticated, but state of the art regional Multi-Agency Coordination System, including a fairly detailed description of an Operations Coordination Center. (23) (Part 1-B).
- c. Field Command Operations, (June, 1974). This two-volume report was the predecessor of current Incident Command System Positional Manuals. It activity documented the results of the initial efforts of the inter-agency Task Force to cooperatively develop a field incident management system. Although now substantially improved and expanded, the basic organizational structure for the Incident Command System has remained essentially intact through the development process. (34) (Part 1-C).

These first efforts formed the basis for future FIRESCOPE design and development activity. From them evolved two major systems designs and a number of supporting technologies.

a. The major systems design were:

1. The Multi-Agency Coordination System (MACS)
2. The Incident Command System (ICS)

b. Identified supporting technologies were:

1. Communications (incident radio/telephone incident to agency).
2. Mapping (incident planning, agency response and dispatch maps).
3. Automated Data Processing (includes hardware, data bases and software programs developed in support of ICS or MACS).
4. Training (primarily in support of ICS).
5. Infrared (in support of both improved incident applications and MACS needs).
6. Meteorological (fixed station networks and portable/ mobile equipment for incident use).

The balance of this section will consider each of the major system designs and supporting technologies. For each, the Research Design intent will be briefly summarized, the development of the system or technology will be described, and a brief analysis will be made of each of the major program elements.

3.3 Multi-Agency Coordination System (MACS)

3.3.1 Research Design Intent

The design intent for MACS was to develop an improved capability to perform regional information management and resources coordination for the Southern California fire agencies.

Basically, the improved capability would provide:

- * "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, labor and equipment assigned, for major incidents) 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 and best allocations 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." (12)

The means by which these improvements would be implemented was through the use of a central Operations Coordination Center (OCC) facility; improved regional inter-agency communications systems; and improvements to inter-agency procedures governing the exchange of information and the coordination of resources.

3.3.2 Program Description

A major design effort in 1973-74 described the MACS and its OCC. (23) That design envisioned that "a central coordination capability will be established which tentatively will be operated by the State Office of Emergency Services on behalf of the participating agencies and which will have the responsibility for the coordination of resource allocations and other services to incidents." An enabling policy statement was formulated and

recommended. (24)

The Program Office set up a prototype regional information gathering center and looked firsthand at the problems of acquiring and processing information. The first Operations Coordination Center (OCC) was established in the summer of 1974 at the Riverside County Communications Center and manned that first year primarily by Task Force members with support from other agency personnel. The experiment clearly pointed out many of the difficulties in obtaining timely information on both the status of incidents and of resources. (25) The Task Force recommended the continuation of the experimental OCC, and in 1975 the OCC was established in a vacant Los Angeles County Fire Station in El Monte.

Also in 1975, the California Department of Forestry (CDF) and Forest Service (USFS) elected to operate their respective Region 6 and South Zone dispatch and coordination functions in a collocated center in Riverside. (26) This activity, coupled with the El Monte OCC operation, pointed out that if the OCC was collocated with the CDF/USFS joint center, it would eliminate overlap in information collection, display and processing. Although the purposes of the two centers were distinctly different, much of the information they needed and used was very similar.

From an analysis of that year's operation, it was decided that the FIRESCOPE MACS/OCC function should be collocated with the Riverside USFS/CDF facility. (27) Accordingly, in 1976, the combined activities were moved into a facility at the CDF Regional Headquarters in Riverside. From 1976 to present, the OCC and CDF/USFS activities have been at the same facility.

In 1976, the Decision Process began to formalize the method of collecting information on regional incidents and resource status through the issuance of procedures to member agencies. Also, the regional resource coordination function at the OCC was being developed through the establishment of written procedures, and the development of a set of operational modes (Modes 1-4). Under Mode 4 conditions, the member agencies were to send representatives to the OCC. (The Operational Mode concept was an outgrowth of the results of the 1975 El Monte OCC activity.) (27)

By the end of 1976, it was evident that there was ample information available from the experimental OCC applications to do a major design study. During 1977, System Development Corporation (SDC) prepared a Detailed Design Requirements Study which described functional specifications, personnel and facility considerations and a proposed MACS/OCC organization. (31)

In 1978, the first year of the development and implementation phase, the FIRESCOPE Board of Directors (BOD) approved the concept of having a regional GHQ (General Headquarters) facility

and a centralized regional resources coordination responsibility (OCC). This decision and the SDC study resulted in the beginning of a major effort to develop the MACS/OCC operating procedures. In 1978, the Office of Emergency Services hired a Support and Service Manager to oversee the OCC functions.

In 1979, there were a series of major fire incidents. During the time of peak fire activity, MACS Procedures* were utilized, and for the first time a regional GHQ was established under Mode 4 conditions. Much was learned from that activity about what was needed to bring about improved regional resources coordination as well as improving the operations of the OCC and GHQ. (62) Most of all, the 1979 OCC operation proved that the concept was workable.

After the analysis of the 1979 fire situation, a set of MACS Goals was developed which would become the focus of future systems and procedures development.

During 1980, considerable effort was expended on developing ways in which the goals could be achieved. A final set of MACS Goals was approved in May of 1981, (32) and the Task Force was charged with developing systems and procedures to accomplish the goals.

The Research Design had indicated a need to increase information processing by applying automatic data processing. A recommended computer configuration was a part of the design. In 1978, the BOD approved the Program Office Plan for acquiring a computer system. The system was delivered in 1979, and made operational early in 1980. (64)

With the advent of the computer installation in 1980, the Fire Information Management System (FIMS) began to function in tying the OCC and 23 other agency coordination points (36 by 1982) into a network. MACS/OCC Procedures which were previously used in a manual mode were rewritten to include the use of the FIMS as a primary means of communication of incident status information and agency resource status and commitments.

*MACS/OCC Procedures are documented as MACS 410-1 and are reviewed annually.

Major MACS/OCC accomplishments are listed below:

- 1978 * BOD approves MACS concept in principle.
- * OCC re-established for fifth year.
- * MACS Intercom Net approved (recommended in 1976 analysis).
- * BOD approved computer system plan.

- 1979 * OCC operated successfully in Mode 4 condition.
- * Analysis of major incidents point out many shortfalls - sets major work program for Task Force/Operations Team.
- * MACS Intercom Network established and put into limited operation.
- * MACS computer system installed.

- 1980 * OCC facility changes made as a result of previous analysis.
- * Introduction of Fire Information Management System (FIMS).

- 1981 * BOD approves MACS Goal Statements.
- * Operations Teams approves regional resource designation system.

- 1982 * First major exercise of MACS/OCC functions.
- * Interim expansion of OCC facilities completed.
- * Decision Process places OES in leadership role for ongoing MACS Operations and Maintenance functions.

3.3.3 Program Analysis

In 1978, the "Research Design" for the Multi Agency Coordination System consisted of only a conceptual statement of intent. The concept called for a drastic departure from existing practices and a complete centralization of resource allocation authority at the OCC. This concept was not acceptable to the member agencies.

There were several alternative concepts proposed, and each in its own way also proved unacceptable. Reaching any kind of compromise that would lead to a single coordination process proved impossible. Thus, the MACS resource allocation procedures of 1982 are a conglomerate of the three systems that existed in 1970. These are the Forest Service's decentralized process, with it's national interties, the CDF's somewhat centralized statewide dispatching network, and the urban agencies' Statewide Fire and Master Mutual Aid Agreement, coordinated by OES. The inherent differences in these systems stem from legal, fiscal, and traditional use (agency "mission") characteristics of the users. These characteristics have not changed, even with FIREScope. Therefore, the MACS procedures that exist today are a melding of the three systems, supported by some improved interfacing procedures.

After an evaluation of MACS performance during the 1979 fires, a basic agreement was reached and the Board of Directors established seven broad goals to guide future MACS development. Since that agreement, only a limited amount of work has been done to transform the goals into specific procedural steps that can be used by all agencies during major emergencies. However, the goals, and some evolving procedures did guide real-life actions during the 1980 fires, and 1981's "Top-Hat" MACS/OCC exercise.

Thus, although the MACS "design" was one that evolved over time, and still has weaknesses, it represents a significant accomplishment in multiagency communication and coordination. Establishment of the OCC (now in its ninth year) has contributed to increased multiagency effectiveness. During emergencies, the consolidation of incident reports increases regional situation knowledge; the capability to monitor resource commitments and requirements enables objective priority-setting. The use of four Modes of Operation enables the agencies to staff and respond to MACS procedures according to the level of emergency in progress across the region. GHQ operation calls for "face-to-face" coordination in Mode 4, and brings agency representatives physically into the OCC, thus greatly increasing accurate information exchange.

The OCC, FIMS, and existing MACS procedures have improved the potential for availability of better situation and resource information for decision makers during regional emergencies. Continued operation and evaluation should bring more improvements, and point the way toward more evolutionary modifications.

If a 1970, (or 1980) situation were to reoccur in 1983, the agencies could expect:

- Better regional situation intelligence
- Improved multiagency resource status information
- Increased interagency information exchange
- Enhanced capabilities to identify problem incidents and set regional priorities for allocation of scarce resources.

It should be noted that these improvements are supported by a minimum level of hardware and other technologies. Until further development of data bases, meteorological systems, and sophisticated modeling can be achieved, MACS will essentially be "stuck" at its present level of performance. The full range (and effectiveness) of the Board's goals will not be realized until such development takes place. (See Sections 3.5 through 3.10, and Figure 6-1 for status of unfinished work).

3.4 Incident Command System (ICS)

3.4.1 Research Design Intent

The design intent for the ICS was to field a system which would provide uniform terminology, procedures and incident organization structure required to ensure effective coordinated action when two or more agencies are involved in a combined effort. (12)

3.4.2 Program Description and Development

The ICS evolved out of the early Task Force and contractor work in 1973-74 on the Part 1-C Program (Field Command Operations). (34) By 1975, significant progress had been made in documenting the organization, basic procedures and checklists associated with the operation of the ICS. A series of small test exercises was developed and conducted at Systems Development Corporation to examine the general adequacy of these procedures using agency personnel operating in simulated incident conditions.

The enthusiasm toward the new system began to be felt within the agencies, and it was not long before the agencies decided to test the ICS on actual wildland fire incidents.

The major problems they encountered in doing this were:

- a. Lack of Training: Only a relatively few personnel (mostly Task Force members) had a comprehensive grasp of the ICS organization and procedures.
- b. Lack of Adequate Incident Communications Systems: The Research Design recommended improved radio and telephone communications systems to support the ICS. Those systems were not available at the time that the ICS testing began.

None the less, a decision was reached to establish a limited test area (Core Area) within the FIRESCOPE region and if all conditions were favorable, it would be possible, with the approval of the jurisdictional and adjacent agencies to use the ICS on an actual incident.

Even without trained personnel and adequate communications, it became evident in the fall of 1976 that the new system had considerable merit. As a result of the limited field testing, the Task Force spent the next year in making substantial improvements to the operating procedures and checklists.

The ICS organization and terminology as developed during the 1973-77 Research Design have basically stayed the same. The use of Core Area testing for the ICS contributed substantially to ICS

development by:

- a. Reducing the initial personnel training requirement.
- b. Providing the vehicle to focus on adequacy of procedures at ICS units and sections.
- c. Having good control over the kinds of situations to manage as ICS test incidents.

The original ICS Procedures (first documented in 1974) have undergone steady updating and expansion as a result of the testing program. (34) As a result, the ICS now represents a system which has had the benefit of being field tested in the process of its evolution.

In 1980, with the demonstrated success of the ICS in Southern California clearly evident, the National Wildfire Coordinating Group (NWCG) undertook a study to determine the feasibility of making the ICS applicable for nationwide use. The results of the work (67) in 1980 and 1981 have led to the development of the National Inter-Agency Incident Management System (NIIMS). The ICS is the incident management component of NIIMS.

A chronology of major ICS accomplishments is shown below:

- 1976 * Agencies formally agree on common terminology and procedures.
- * Limited field testing begins within Core Area.
- 1978 * Parts of the system successfully used on several wildland fire incidents, and applied to urban firefighting.
- * ICS formally adopted by Los Angeles City Fire Department.
- * Documentation of ICS positions completed.
- * Development of 20 Training Lesson Plans.
- * BOD commits to the implementation of the ICS.
- 1980 * Expansion of ICS positional checklists, procedures and forms.
- * National Wildfire Coordinating Group (NWCG) performs analysis of ICS for possible national application.
- * ICS formally adopted by the California Department of Forestry (CDF), the Office of Emergency Services (OES), partner agencies, and endorsed by the State Board of Fire Services.
- 1981 * ICS in wide use throughout Southern California by major fire agencies. Use on non-fire incidents increasing.
- * NWCG accepts recommendation for developing the ICS for national application.
- * Forest Service approves Region 5 ICS implementation by 1983, and servicewide use by 1985.
- 1982 * All ICS documentation revised to National Interagency

Incident Management System (NIIMS) terminology and organization.

3.4.3 Program Analysis

The development and implementation of the ICS represents the most visible and significant improvement brought about by the FIRESCOPE Program. There are several reasons for this:

- a. The ICS was viewed by all of the member agencies as meeting a real need for a common emergency management system.
- b. Agencies committed themselves strongly to the design and the development process.
- c. There was a real desire on the part of the member agencies to use the system, improve upon the design, and continue to use it.

The ICS, as it is today is perhaps the only truly inter-governmental emergency management organization in existence. While its focus (documented version) is on wildland fire management, its concepts and system construction is such that it has wide adaptability and has been used on other kinds of incidents (e.g., high-rise structures, floods, etc.).

There are three areas remaining which require more development effort. Upon their completion, the ICS will reflect an even greater strength and capability than it now does. The areas are:

- a. Personnel Training There is a continuing need to train personnel of all the member agencies (particularly smaller departments) in the organization, terminology and procedures of the ICS. Accompanying this training must be some form of acceptable inter-agency certification system which will allow a much more rapid deployment of the ICS (through the immediate use of other agency personnel) and thus show improved cost effectiveness.
- b. Communications The ICS was designed to have a much improved internal communications capability than found in previous organizations. This capability calls for the establishment of functional communications networks which will reduce the amount of radio monitoring; reduce the traffic loads; and effectively cluster like kinds of transmissions onto functional networks (e.g., command, support, tactical, etc.). While significant progress has been made (See 3.5, Communications) much is yet to be done.
- c. Facilities An important part of the ICS original design was to predesignate Incident Command Posts and work to preplan and improve their operating capability. In some cases, this

means predesignation and equipping of fixed facilities and in other cases, the providing of support facilities (i.e., trailers) to more remote ICPs for use in Command, Planning and Logistical activities at the incident. Again, some progress has been made by some of the agencies, but as yet there has been no significant improvement as envisioned in the Research Design. (See Program Development Section for additional data on this need.)

Even with the shortfalls identified above, the ICS remains as a real tribute to the dedication and intent of the agencies to create a better and more efficient on-the-scene incident management system. Given a 1970 reoccurrence, there is no question that a "quantum Jump" has been made in the agencies' ability to better manage major multi-agency incidents.

The potential for ICS use in an all-hazards multiple service application has been recognized and future development efforts will encompass this approach.

3.5 Communications

3.5.1 Research Design Intent

The design intent was to provide improved communications capability at three levels: on-incident, between incidents and agencies (including the OCC), and between agencies. The design goals were: (12)

- * 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 commercially 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.

3.5.2 Program Description and Development

Considerable effort was put into the research phase to design communications systems to serve both incidents and the OCC. (38, 39, 40) With the exception of the design and implementation of an inter-agency microwave intercom circuit installed in 1979, nearly all of the emphasis in communications development has been in support of the ICS. Three principal ICS related communications activities were as follows:

- a. The development of an improved inter-agency radio system which would allow for improved initial attack communications between agencies, and a better capability to develop common networks on major incidents.
- b. The development of improved command post communications. This took the form of designing improved communications vehicles, upgrading and improving the capability of agency owned vehicles to function within the ICS, and developing an improved incident based telephone system.
- c. Developing an off-incident communications capability.

A major problem facing the Communications Specialist Group as it began operation in 1978 was to analyze and evaluate the differing communication design studies done under the Research Design

effort.

While all designs were in general agreement regarding the basic communication requirements at the incident (loading and numbers of nets), there were competing proposals on how to achieve the desired results. The Specialist Group reached agreement in 1979 on a set of recommendations toward the development and implementation of an incident radio communications system. (44) Essentially, that system entails the use of agency-pooled radio frequencies within the 150-174 MHz band, multi-channel synthesizer mobile radios, an inter-agency frequency pool and management plan, and the development of cached portable radios and repeaters.

As of this time, a considerable amount of equipment has been purchased by the FIRESCOPE Program (69) and placed into operation. Included are:

- * 72 120-channel synthesized radios
- * 18 remote control consoles
- * 18 portamobile radios
- * 5 mobile telephone switchboards

In addition, a comprehensive frequency management agreement has been reached as well as a basic radio frequency assignment plan for allocation of frequencies within blocks on the synthesizer radios.*

A 1977 analysis of a mobile communications unit (COMSTAT 6) led to a number of recommendations both pertaining to the upgrading of this unit as well as establishing guidelines for future communication unit development. (41) The Specialist Group has also spent considerable time in analyzing the needs for mobile communications vehicles and considered several designs for such vehicles. A complete redesign has been made to the COMSTAT 6 mobile communications vehicle. Also, a standardized equipment list for upgrading agency owned vehicles has been developed, and several of the agencies are now making those modifications with the support of the FIRESCOPE Program.

Major accomplishments in the field of communications development have included:

- 1978 * Communications Specialist Group formed.
- 1979 * Final set of communications recommendations developed and approved.

*Radio Frequency Communications Planning Guide has also been incorporated into the Incident Command System Publications (ICS 223-5).

1980

&

1981 * Program purchases radio equipment to begin the implementation of communication recommendations.

1981 * Frequency management agreement signed by all agencies.

1982 * Redesign of COMSTAT 6 vehicle completed.

* Several agencies complete redesign of communication vehicles.

3.5.3 Program Analysis

For purposes of analysis, communications is looked at as three different subsystems:

- a. Incident based (radio and telephone systems used on an inter-incident basis).
- b. Incident to agency and outside locations.
- c. Agency to agency.

Incident Based: In the research Design, a comprehensive analysis was made of the probable traffic loading on incident radio systems using the ICS organization and procedures. (39) From this analysis, the numbers of radio channels were determined. Several different studies were made on how best to achieve the required capability in mobile and cached radio systems. (38, 40, 42, 43)

To date, little (other than planning) has been done to obtain the required radio cache capability, and radio caches from the National Fire Radio Cache (NFRC) are still utilized on the major ICS incidents. These caches partially meet the need although deployment is not as rapid as could be desired, and the pre-packaging does not match the ICS organizational structure. The radio cache component for the ICS remains to be completed.

The use of the mobile synthesizers and NFRC radio caches in multi-agency incidents has, however, improved the internal operating capability of the ICS and has demonstrated the desirability of using this approach.

Incident to Agency and Outside Locations: The Research Design called for the development of a 12-channel communications capability for off-incident communications. This was to be accomplished through the use of a 1 or 2 relay mobile microwave into telephone company facilities. That system has not yet been procured.

At least part of the delay resulted from the hope that a satellite communications system (which would be significantly more effective and versatile) would be possible to achieve at some future date.

The lack of off-incident communications on major incidents hampers the effectiveness of incident operations as well as those of MACS. The incident is not capable of rapidly processing orders or providing situation information. Also, the lack of off-incident communications capability restricts the full use of any improved fire modeling or planning, information exchange.

Agency to Agency: The need for improved agency to agency communications systems was not a part of the original communications research. A recommendation which came out of the 1976 OCC evaluation (29) was to install a microwave intercom network between a number of the member agencies not already serviced by an existing CDF intercom system. The intention behind the intercom network was to provide a rapid means for agencies to communicate with one another for passing information, resource requests, resource coordination, etc. Agency acceptance of the intercom has been spotty for a variety of reasons ranging from having the control in different locations in different agencies, noise levels, having to make modifications to existing procedure for passing information requests, and lack of full understanding to purpose and need.

Since 1980, there has been an increased need by the agencies to have the FIRESCOPE developed technologies applicable to an all-risk environment (e.g., high winds, earthquake, flood, nuclear accident/attack.). Existing inter-agency communications systems (telephone/microwave) are highly vulnerable to the effects of some of the hazards of this all-risk environment. In recognition of this the Program Office has included a recommendation within the Development Plan for the design and procurement of a back-up radio or satellite inter-agency communications system which would have the capability for both data and voice transmission.

It is clear that there has been marked improvement in communications since 1970. The intercom, the Incident Communications Planning Guide, introduction of mobile synthesized radios, agreement on frequency pooling and management, and a strong Communications Specialist Group all have contributed to an overall better communications capability. Even at the incident with the use of existing cache radios, there is a better allocation of frequencies and distribution of traffic loads when proper planning is conducted. Needed yet are improved radio caches, systems for off-incident communications and a back-up all-hazards capability to communicate between agencies.

3.6 Mapping

3.6.1 Research Design Intent

The design intent for the mapping program was to provide a common standard map and locator system for all agencies to use. (12)

3.6.2 Program Description and Development

In the first six months of 1974, a comprehensive study of mapping and geo-coding was accomplished as a part of the research design. (45) This study produced the first set of requirements associated with the mapping program. The study recommended an orthophoto based mapping system be developed to meet FIRESCOPE Program requirements.

In 1977, a Mapping Coordinator position was established within the USFS, and a Mapping Specialist Group was formed in 1978. The Mapping Coordinator was responsible for overseeing the development of a comprehensive mapping program that would meet the following objectives:

- a. Provide a common standardized mapping system.
- b. Coordinate and consolidate Southern California mapping to reduce the number of processes to save time and money as well as increase efficiency.
- c. Interface with fire intelligence systems to increase efficiency and meet MACS Goals.

The mapping effort was a major activity as approximately 16-million acres of area were involved.* Since the inception of the program, it was recognized that there was a need to have a common inter-agency mapping and grid system.

With the establishment of the mapping group and a cooperative USFS/US Geological Survey project, the stage was set to build a common mapping system. That process has taken considerable time, yet is estimated to save millions of dollars now spent in redundant work efforts within the member agencies. (46)

The mapping program has used a map development process which starts with a set of 1:40000 aerial photographs for each of the quadrangles within the FIRESCOPE Area. From these, a high resolution ortho-image is made at the 1:24000 scale (corresponding to the standard topographic maps now in common use). Operational layers or overlays are produced and composited

*The FIRESCOPE Area is covered by 386 7-1/2-minute quadrangles.

with the base maps or orthophotos to produce an orthophoto map. 1:24000, 1:12000 and 1:6000 scale orthophotos and maps can then be generated which results in a "family of maps." Agency response books can also be produced which provide all maps within a given area (e.g., a county). The Mapping Specialist Group has determined and agreed upon standard fire related symbology for use on the maps. The Geographic Locator System (GEOLOC) is overprinted on all maps and is a common inter-agency standard reference system.

A nationally applicable Geographic Locator Grid System (GEOLOC) has been developed and adopted, and is being used on all FIRESCOPE produced mapping products. (47) That grid system has also been included within a computerized data base, where it has wide application for data storage and retrieval in a variety of all-hazard situations.

The major accomplishments in the mapping program are:

- 1977-1978 * Establishment of Mapping Coordinator position and formation of the Mapping Specialist Group.
- * Establishment of an inter-agency agreement on common symbology for maps.
- * Development of the Geographic Locator System (GEOLOC).
- * Completion of all orthophotography for FIRESCOPE Area.
- 1979 * Multiagency mapping process developed and agreed to.
- 1982 * Distribution of mapping products to member agencies. (Not completed as of 10/82)

3.6.3 Program Analysis

The mapping program has been a large and relatively complex development effort. As originally conceived in 1974 (45), the development of the orthophoto mapping system and geographic reference capability has moved steadily forward under a highly cooperative inter-agency approach and the effective inter-governmental USFS/USGS program.

The addition to the design plan of providing agency response books, which makes the mapping program applicable for day-to-day use, has done a great deal to create agency acceptance.

The ability to use the geographic reference system (GEOLOC) both for agency dispatch purposes as well as the basis for many FIMS data retrieval and computational needs contributes to making this a good example of a well-designed and planned component of the overall system structure.

Delivery of the basic mapping products is now taking place. With these in the hands of the agencies, and a period of time for familiarization and training in their use, a major improvement

familiarization and training in their use, a major improvement should be seen by having a common standard inter-agency system. The all-agency adoption of the GEOLOC System will also contribute substantially to increased effectiveness of inter-agency coordination by providing a single, uniform dispatching reference system.

Like the ICS, the mapping program success must be at least partially attributed to the committed involvement of the member agencies and the energy of the staff personnel assigned. Also, like the ICS, the mapping program is one of the most effective and usable products of the FIRESCOPE Program. It is also a product which has national potential for a variety of fire and other public safety applications. However, since the Program Office was unable to complete full delivery of all basic mapping products, it remains with the Decision Process and involved agencies to complete the project for southern California. If this is not done, then only patchwork utilization of the mapping will exist, and the BOD intent will not be accomplished.

3.7 Automated Data Processing

3.7.1 Research Design Intent

The Research Design considered computer systems, software and data bases separately. These elements were combined into a single Automated Data Processing category in 1978, primarily to ensure necessary interface and for program management and budgeting purposes.

The Research Design called for a data processing system consisting of three integrated miniprocessors and related data entry, storage and display devices. The software system consisted of six modules; four of which dealt with fire behavior and suppression effectiveness modeling, one for resources status keeping, and one for meteorological purposes. A geographic data base which included vegetative fuels, topographical and cultural data would be stored in digital form and used as required by the various software modules. (53)

3.7.2 Program Description and Development

The three integrated miniprocessors called for in the Research Design were to provide simultaneous independent processing for the various modules as well as providing redundancy in the event of a computer failure.

In 1978, the FIRESCOPE Board of Directors approved the data processing plan and the Program Office began the process of computer acquisition. Bids were let for the first of the minicomputers, and in 1979, a Prime 550 computer was purchased and installed. At approximately the same time, the Program Office took advantage of the opportunity to procure a Data General Eclipse minicomputer along with the associated peripheral equipment that goes into making an Automation of Field Operations and Service System (AFOS). (AFOS is the computer system utilized in Department of Commerce National Weather Services Offices.) Program management felt that the AFOS system would be needed to operate the meteorological module, and that this system would eventually be interfaced with the Prime 550 computer. The computer and the AFOS system were installed at the Operations Coordination Center in Riverside. The third minicomputer called for in the Research Design has not been procured.

A total of 41 CRT terminals and seven portable terminals have been purchased and distributed for use with the Prime computer. Twenty-six (32 by 1982) of these terminals were installed in the dispatch centers at Operational Area and Regional Coordination Centers within the eleven-county FIRESCOPE region as well as in USFS South Zone National Forests and GDF Region 6 Ranger Units. Five portable terminals were acquired to be used specifically at

Incident Command Posts. Terminals were also installed at agency headquarters in San Francisco and Sacramento. USFS North Zone (Redding, Calif.) and the Boise Interagency Fire Center also obtained terminals.

Initially, there was little specialized software available for use on the Prime computer. An electronic mail feature, part of the Operating System, enabled agencies to rapidly transmit information back and forth. Summary weather forecast information from the National Weather System was put on the system twice daily. The basic fire model (FIREMOD) was put on the system and improved. Under a GSA contract, a team of analysts and programmers began developing operational software programs in 1981. One of the first of these, the Incident 209 (Situation Status Summary), was developed around the manual ICS 209 Form prepared by the Situation Unit at the incident.* This program was placed into operation in 1981, and has been very successful in providing users with information about incidents occurring within the area. Other software programs involving resource status, order processing, and those involved in certain fire modeling activities are now in the development stage. (See Section 5 for detailed list of programs.)

Associated with the computer acquisition and development of software has been the development of various data bases which would provide much of the information necessary for any ADP operations. A comprehensive Resources Inventory form was developed in 1979, and information on some 50 kinds of resources was collected and stored within the computer from all Southern California fire agencies. Several of the most used and high priority resources within the data base have been used in conjunction with the resources status software development program. Other data bases have included the cultural features data obtained from the mapping program, the GEOLOC grid system, elevation and slope aspect data needed in fire modeling, and vegetative fuels data.

The major accomplishments in the ADP area include:

- 1978 * Board of Directors decision to proceed with the acquisition of a dedicated computer system.
- 1979 * Prime 550 minicomputer purchased and installed.
- 1980 * Prime 550 system operational, AFOS equipment procured.
 - * BOD approves the hardware/software design for the Fire Information Management System (FIMS)
- 1981 * GSA contract approved for program support.
 - * Incident 209 program becomes operational.
 - * Successful test of vegetative fuels data acquisition.

*An example of this form may be found in ICS 230-2, the ICS Forms Manual.

1982 * Decision reached on transferring FIMS Operation and Maintenance to OES.

3.7.3 Program Analysis

This analysis covers the hardware elements, software programs and data bases. The Fire Information Management System (FIMS) is the combination of these three elements plus the personnel and procedures necessary to make an operable system.

3.7.3.1 Hardware Systems

The Research Design called for an additional redundant backup for the Prime 550. That system has not been obtained and is still included within the Program Development Plan. This hardware system, including terminals, has been a highly reliable system with a minimum of down time and thus far, has been adequate to meet existing needs (without redundancy). More versatile Coordination Point terminals and improved terminals for use at incidents are included within the Program Development Plan, as well as the back-up computer system. No hardware interface has as yet been made between the Prime and AFOS equipment.

3.7.3.2 Software Program

Software development progress has been mixed. Major achievements are in the field of incident situation processing (The Incident 209 program) and the development of the GEOLOC and aircraft software management programs. An order processing software program is currently under development. Other parts of the Prime Operating System software such as the electronic mail and word processing capabilities have been extensively utilized and have proven their value.

Two difficulties in developing the ADP software have been:

- a. Lack of "user" requirements definition.
- b. Lack of communication between user and software development team.

3.7.3.3 Data Bases

Data base development, like the software program development, is a mixed array. Nine major data bases have been identified. Two of these (resources and GEOLOC) are relatively complete or easy to complete. While the Research Design envisioned the use of orthophotography to obtain fuel type classification, no actual design work in that area was accomplished until the 1980 time period. The vegetative fuels and terrain data bases are now in

varying stages of completion. These represent two of the major data bases which must be in place for applications testing of any improved fire modeling capability.

The establishment of the orthophoto mapping as the basic mapping system has materially assisted in the data base development effort, as many of the data bases elements are readily obtainable by digitizing from the orthophotos.

In any 1970 reoccurrence, we would see a mixed capability in FIREScope FIMS data processing. Assuming no outages caused by communications or computer failure (for which there is currently no back up), FIMS would provide a much improved vehicle for obtaining incident situation information through the INC 209 software program. It would also provide the vehicle for agency use of the basic FIREMOD Program. The FIMS electronic mail feature would allow rapid transmission of information on an inter-agency basis. The air tanker software program could be used to make the overall air program more cost effective. Some application could be made of the Operating System software to create demobilization plans and better coordinate that effort between incidents and agencies. National Weather Service forecast information is now available to all MACS Coordination Points. There is no question that all of these developments would enhance both incident, agency, and OCC operations in any major multi-incident reoccurrence.

Requirements Definition It has been very difficult to obtain inter-agency concurrence on matters pertaining to specific software developments. The reasons for this are varied; but include lack of awareness of the need for specification, lack of understanding of inter-agency differences in operation, and uncertainty on the actual design concept and operational need.

Lack of Communication Between Users and Software Development Team It has been difficult to establish a closely coordinated link between the user group (usually represented by the Task Force) and the software development team. The Task Force generally consists of personnel with little data processing experience who may not have a universally held position with regard to the desired performance of a specific piece of software. As a result, insufficient guidance is given to the software development team. Infrequent reviews, changing personnel, and lack of a common language between user and software developers all contribute to this problem.

Much of the work envisioned in the Research Design for development of several software modules relating to fire behavior modeling and suppression effectiveness modeling has not yet been accomplished. Several of these modules need some additional research and design effort. However, two major obstacles in performing more software design in this area have been the lack of an adequate vegetative fuels data base, and the absence of a validated surface wind model. Until these are available,

meaningful activity in the further design, development and testing of software fire behavior and suppression effectiveness models cannot be accomplished.

In 1980, a version of the FIREMOD Program, which included the Rothermel model for predicting, fire spread, was made available for use on the FIMS. Over a period of three years, efforts have been made to improve the effectiveness of this model as well as improve the ability of the personnel in the field to use the model.

The fire behavior prediction capability of FIMS would still not be realized in any reoccurrence of a 1970 fire situation. The ability to perform more sophisticated fire behavior and fire suppression effectiveness modeling is still several years away.

Additionally, if FIMS is to assume the role of the primary information processing system (especially in fire modeling), it would be highly desirable to have a back-up computer capability to ensure redundancy and to carry on other data processing functions.

3.8 Training

3.8.1 Research Design Intent

The Research Design intent for training was "to provide the training aids and support necessary to complete training in all aspects of the implemented FIRESCOPE design, and to coordinate and integrate all training efforts with external organizations." (4)

Several objectives were established for the training effort:

- a. To identify and complete the training activities which could not be accomplished by the member agencies.
- b. To coordinate FIRESCOPE training with external State and National organizations.
- c. To complete all training guides and materials and conduct evaluation training on all completed FIRESCOPE design elements.
- d. To extend FIRESCOPE training to personnel as required beyond the FIRESCOPE region. (4)

3.8.2 Program Description and Development

The need to provide ICS training became very evident in 1976 when the first attempts were made to utilize the system on actual incidents. The FIRESCOPE Task Force and a few other individuals from the agencies who had been directly involved in the design effort were the only personnel who were adequately oriented and comfortable in describing the ICS to others.

Two kinds of training issues became readily apparent:

- a. The need to provide familiarization training in ICS organization terminology and procedures to individuals involved in the initial implementation. Generally, these were personnel already skilled and experienced in performing that same function in another organizational setting.
- b. The need to develop more complete training courses that would teach individuals to perform specific tasks in the ICS organizational structure.

The Program Office formed a Training Specialist Group in 1978 to assist in the development of a training capability. The Training Specialist Group became active in 1979, coordinated by the

OCC/SSM. The group assisted in establishing the training courses and participated in the familiarization training. However, the Task Force took on the bulk of the initial training by developing and conducting a General Familiarization Training Course, which was followed by familiarization courses for 18 of the more commonly used ICS positions.

In 1980, the Program Office contracted with the California Department of Forestry (CDF) to begin the development of complete ICS training courses at the CDF Training Academy at Ione. Multi-agency project work groups were established in the ICS Planning and Logistics areas. The courses were to be developed over a period of 18 months to 24 months and would be designed using the National Wildfire Coordinating Group (NWCG) standards and format guidelines, so as to make them applicable for national use. Subject matter experts from various agencies contributed to this long term effort.

Several members of the FIRESCOPE Training Specialist Group participated in the training course development activity. Although the Training Specialist Group and Ione training course development work were separate efforts, both groups were chaired by the same person and emphasis was on the longer term training course development. An outgrowth of this was that the yearly familiarization training program tended to be largely coordinated by the Task Force. Each year, the agencies would be asked to determine the probable number of individuals who should take familiarization training in certain ICS positions. Based on this, the Task Force would meet and determine the approximate numbers of courses and regional training locations. A course coordinator would be appointed (sometimes Task Force members) and a schedule for the courses would be established. There were problems with this process. No single focus of responsibility for training existed. The complexities of the annual multiagency training load combined with distributed responsibilities caused confusion. In 1979 the Board of Directors appointed the Operations Coordination Center/Support Services Manager (OCC/SSM) as Training Coordinator. This began to centralize the responsibility and improvements were recognized.

In 1980, familiarization training was extended to cover certain MACS functions, primarily in the use of the Fire Information Management System and in the use of the reporting procedures between MACS Coordination Points and the OCC. This training was conducted by Program Office staff, the OCC/SSM and Task Force members. In 1982, the Task Force designed, developed and conducted a large-scale multi-incident exercise to evaluate the adequacy of the MACS/OCC and GHO Procedures.

Major accomplishments in the training area included:

1979 - Development of a Familiarization Training Course and 18 positional familiarization courses.

1979-81 - Training given to hundreds of fire agency

personnel in both ICS and MACS courses conducted.

- 1982
- Near completion of 21 full training courses under the CDF contract with the Program Office.
 - A major MACS exercise developed and conducted.

3.8.3 Program Analysis

ICS familiarization training has been continuously conducted since the introduction of the ICS into the field in 1978.

The familiarization training was never a smooth process. Problems were:

- a. Overlap and duplication in course material.
- b. Confusion on scheduling.
- c. Materials and instructors not always adequate to meet the need.

The training did, however, acquaint hundreds of personnel with the necessary organizational and procedural material to allow them to function within the ICS structure. Several of the lesson plans developed for use in the transfer training process have become continuing ICS training guides.

Work proceeds on the development of complete training courses in the ICS Operations Section with additional training course development included in current planning efforts. By the end of calendar 1982, 21 of the ICS positions should have a completed training course. Those courses will be implemented in 1983. The bulk of the remaining section training courses will be scheduled for completion by June of 1984. The results of the training course development effort cannot be measured until after the courses are in the field.

The ICS training course development now under way will eventually satisfy the needs of the State and Federal agencies. In fact, the training development effort will in all likelihood meet the needs for the National Inter-agency Incident Management System (NIIMS). Thus, the FIRESCOPE Program training effort will have served to not only meet the local needs but also those of the national user.

The impact that the training course development may have on urban fire agencies has yet to be assessed. While there has been involvement of urban agencies in the course development, the extent that these courses will be adopted or recognized within these departments is not clear. Thus far, the courses under

development in the ICS Planning and Logistics areas are, in a large number of cases, for positions which urban agencies would seldom fill.

MACS training largely consisted of training in:

- a. Use of MACS incident and resources reporting procedures.
- b. FIMS training in terminal operation and program use.
- c. MACS OCC operations.

These types of training sessions were normally scheduled annually beginning in 1980 as a part of the multi-agency familiarization training activity. They were conducted by the personnel responsible for the operation of FIMS and by Task Force members who had been involved in the development of MACS procedures. This type of training will need to be continued in subsequent years and should be made a part of any formal training plan.

In 1982, the first exercise was conducted to evaluate the adequacy of existing MACS/OCC and GHO procedures. (70) The exercise, conducted largely by the FIRESCOPE Task Force, provided considerable information on areas needing procedural improvements. It also served as a valuable pre-incident training activity to the participants. Such exercises are highly recommended and should be done annually in the future.

The Training Specialist Group is now developing an ICS Qualifications and Certification System. This program, when completed and approved, should point the way to a better utilization of qualified personnel on multi-agency incidents. Accomplishing this should produce a faster response to incidents and appreciable cost savings.

The ICS familiarization training effort has already done a great deal to make the ICS more effective. Not only have hundreds of personnel become familiar with the ICS through this type of training, they have also come to know one another better because of the multi-agency nature of the training sessions. These factors combined, help to make the ICS in 1982 a much better on-the-ground multi-agency organization than that which existed in 1970.

3.9 Infrared (IR)

3.9.1 Research Design Intent

The principal IR system proposed within the Research Design was a line scan system operating from a fixed wing aircraft. A down link transmission system would telemeter the imagery to a mobile ground station at the incident. It was also proposed that a fixed ground station be established at the OCC to obtain IR information for use in updating fire models. (12)

3.9.2 Program Description and Development

An outgrowth of the 1970 fire analysis pointed out the need to improve the ability of fire personnel to assess the situation rapidly and determine where priority emphasis should be placed. The increased and improved use of infrared technology was seen as contributing significantly to the early and ongoing fire situation assessment. In 1978, a comprehensive survey of IR technology was made as a part of the Aerospace Corporation contract in examining support technologies. (56)

In order for infrared technology to be of significant use, the time element between overflight (scanning), interpretation, and the ground delivery must be significantly reduced. The most common method of delivery in the 1970 time period was for the IR aircraft to land at a nearby airport, have the film processed, have the interpretation done by a trained observer(s) and provide an IR map to the incident via ground vehicle. This process took hours and made the IR information primarily useful only as a validation of earlier assessments.

The IR components for use in FIRESCOPE now include aircraft equipped with a line scan IR receivers, a film processor which creates a positive (black and white) IR film strip, a down link transmitter and a ground station. Up until 1982, the down link transmitter (used for the past five years) has taken a digitized record of the IR imagery and transmitted it to a ground station. At the ground station, the digital data was recorded and recreated into black and white imagery. The quality of imagery varied depending upon transmitting distances, equipment performance, operator skill, quality of imagery, etc. In 1982, a new imagery down link system was being implemented which will allow a video transmission of selected frames of the black and white film strip from the aircraft. (55)

At the ground station, operators will produce hard copies of the video imagery and overlay the imagery onto an area map using a linear measuring system. The operator, by viewing a monitor, observes the overlaid imagery and manually traces the perimeter lines, hot spot, etc., onto the map.

One ground receiving station has now been equipped and is in service for use at incidents. A fixed IR receiving station improved tracking antenna is being installed at the OCC. Two IR equipped aircraft are now available for use with this system, however, neither of these aircraft are permanently assigned to Southern California.

Accomplishments in the IR field include:

- * Development of improved down link transmission and ground station receiving systems.
- * Development of a fixed location tracking antenna and ground station at the OCC.
- * The equipping of a second Forest Service IR aircraft with down link capability.

3.9.3 Program Analysis

Emphasis on the use of IR has been placed on improving:

- a. The application of fixed wing line scan IR systems.
- b. The ability to down link the IR data to a ground receiving station(s).

All of the work on improving IR has been done as an in-house effort within the USFS. There has been no significant activity in looking at other forms of IR applications (i.e., hand-held, helicopter transportable or satellite).

Two problems have tended to dilute the interest of the agencies in the use of IR:

- a. IR is not well-understood

The contribution that timely, high quality IR information can make to both planning and operations is not well-understood by fire personnel. This can be attributed to lack of training, and the historic lack of high quality IR information provided in a timely fashion to incident planning staffs. The Research Design viewed the use of IR as an active ingredient in updating OCC based sophisticated fire modeling and in providing incident planning personnel with up-to-the-hour information on perimeter, burning intensity, hot spots, etc. Even with improved IR service, it will be necessary to provide better training in the use of IR information.

b. Providing the IR information

The ability to provide IR information has been dependent upon the in-service status and availability of a single aircraft which is normally not under the direct dispatch control of the requesting agency. Thus, as has occurred, when it was wanted it was not available or availability was at least several hours away. The users/agencies have tended not to really think of IR as one of their operational tools.

In the development effort, several steps have been taken to improve the speed by which IR information from fixed wing line scan surveys of incidents can be obtained. These include the video image (TV) transfer capability from aircraft to ground, and a system at the ground receiving station to correlate video received images to maps. It is not clear that this system of transmission will improve the quality of the imagery over the previous system. A fixed IR receiving station and tracking antenna is now being installed at the OCC which can serve to provide a greater use of IR in the case of multiple incidents and also provide the IR information necessary for updating fire behavior models when they become available.

Planning and development work in IR is a Forest Service responsibility. Considerable more work could and should be done to improve the utilization of IR information at both MACS and ICS levels. This work would include:

- a. An examination of tactical IR applications using both ground and helicopter transportable systems.
- b. Training courses in the use of IR imagery in planning and operations.
- c. Providing a fixed wing line scan aircraft primarily assigned for use in FIRESCOPE region.
- d. Investigating the use of satellite IR technology to augment and/or replace the fixed wing line scan systems.

In a 1970 reoccurrence, there would be improvement in the IR field. Two aircraft are now equipped to scan and transmit imagery, a ground mobile station is now available and a fixed station should be operational shortly. Multiple incident scanning can now be accomplished and the imagery transmitted to either the portable mobile or fixed ground station. The transfer process of placing imagery onto maps is still manual, and the method of delivery of imagery to more than one incident is dependent upon telecopier transmission where phone lines exist, or delivery by ground vehicles or helicopters.

3.10 Meteorological

3.10.1 Research Design Intent

The Research Design called for the procurement and installation of a number (minimum of 30) of remote automatic weather stations at unspecified locations. These stations would collect elements of meteorological data (including wind direction and speed, temperature, humidity and precipitation) and transmit the data in digital form via an associated station transmitter to a satellite. The satellite would transmit the digital data to a central earth station where it would be sent via conventional telephone lines to a computer and be reprocessed for display and use. (58)

The meteorological data would be made a part of the other regional weather information already being collected through the facilities of the National Weather Service (NWS). A meteorologist at the OCC would use the collected data to prepare fire weather forecasts and to assist user agencies in fire modeling activities. The meteorological data would be a primary input into the OCC fire modeling programs.

In addition to the fixed automatic stations, the Research Design called for the procurement of portable networks of weather stations to collect site specific information at incidents. It was planned that each incident network would be made up of six stations. (59)

3.10.2 Program Description and Development

The Program Office closely monitored technology developments in the field of remote automatic reporting weather stations. While such stations are readily available, the Program Office wanted to ensure that station microprocessors had the capability to arithmetically average the wind speed and direction so as to provide more applicable estimates of these factors for sophisticated fire behavior models.

In 1981, the Program Office purchased six automatic stations which have the necessary microprocessor capability. These stations are now remotely sited and are involved in a test program which includes the use of the Geostationary Operational Environmental Satellite (GOES). A computer software program has been developed for the Prime Computer which will convert the data from a hexadecimal format to integers.

An Automation of Field Operations and Service system (AFOS) was purchased in 1980, and the equipment has been installed in the OCC. (See previous discussion of AFOS under Section 3.7.2) This equipment includes a Data General Eclipse minicomputer, graphic

displays, other peripherals and system software to handle meteorological data input. Plans are to integrate this equipment into the National Weather Service national network system when it is operational.

To date, no developmental work has been accomplished on the portable incident based meteorological systems.

Accomplishments in the meteorological program have included:

- * Successful testing and approval of station microprocessor for wind averaging. Six stations installed and operating.
- * AFOS equipment procured and installed at the OCC.
- * Surface wind model (Fosberg) software put onto Eclipse computer.
- * Plan developed by Program Office on integrating the meteorological and fire modeling programs.

3.10.3 Program Analysis

The major stumbling block to development of the required network of meteorological stations is the determination of the number of stations which are required. Station siting must be done in such a manner to provide adequate coverage in support of surface wind modeling.

Research Design intention is to provide reliable estimates of surface wind conditions at any location based upon modeling of known meteorological conditions at some number of fixed points. To date, no surface wind model has been validated; therefore, it is not possible to determine the required siting pattern and thus the number of stations required. The six stations presently in test may be used in conjunction with others to assist in the wind model validations.

No activity has taken place to procure, test and provide the incident based meteorological measuring capability. Costs for such systems are included within the Development Plan.

The FIRESCOPE meteorological program has neither been fully developed or implemented. Given another 1970 situation, there would be improvement in the meteorological field over what existed then, but it would be in terms of National Weather Service provided information on improved fire weather forecasting, and the use of the FIMS system to provide this information to the various Coordination Points.

4 PROGRAM FUNDING HISTORY

FIRESCOPE funding is considered in two phases. The first phase funding (1972-1977) was for research and design of the various components. This phase was a planned five-year program at an annual expenditure rate of approximately \$900,000 a year. (3) Federal funding committed to the first phase of FIRESCOPE was \$4.7 million. (4) The Program Office has estimated that contributions (manpower, equipment and funds) from the State and local member agencies during this first phase was over \$1 million. Program management and funding during the Research and Design phase was under Forest Service Research.

The second phase (1978-1982) was directed toward development and implementation of the Research Design, and program administration and management was under the direction of State and Private Forestry. Federal funding of the second phase (through 1982) has been \$7.8 million. (14) Over this period, the member agencies contributed about \$9.0 million in supporting efforts.

Figure 4-1 shows the annual funding history of the program since its beginning.

In January of 1977, the Program Office published the FIRESCOPE Implementation Plan which described in detail the steps required for program completion over a four-year period (1978-1981). (4) Detailed funding requirements for the first two years were included for \$4.9 million, and an estimated \$11.3 million was needed for the final two years. The total estimate for the four-year implementation program was \$16.2 million however, the final two-year funding requirements were left open pending decisions to be made in the first two years of implementation efforts. Actual funding never met planned needs and was provided on an annual basis that hampered smooth development.

During 1978, the Aerospace Corporation performed an economic effectiveness benefit cost analysis of the 1977 Research Design. This comprehensive study examined three alternative total system configurations primarily based on the number of Incident Command System configurations required to manage several simultaneous incidents. The recommendation presented from the benefit cost analysis called for a recommended configuration costing \$11.04 million. (8-9) Aerospace also estimated the annual Operations and Maintenance costs to be \$997,000 for the recommended configuration.

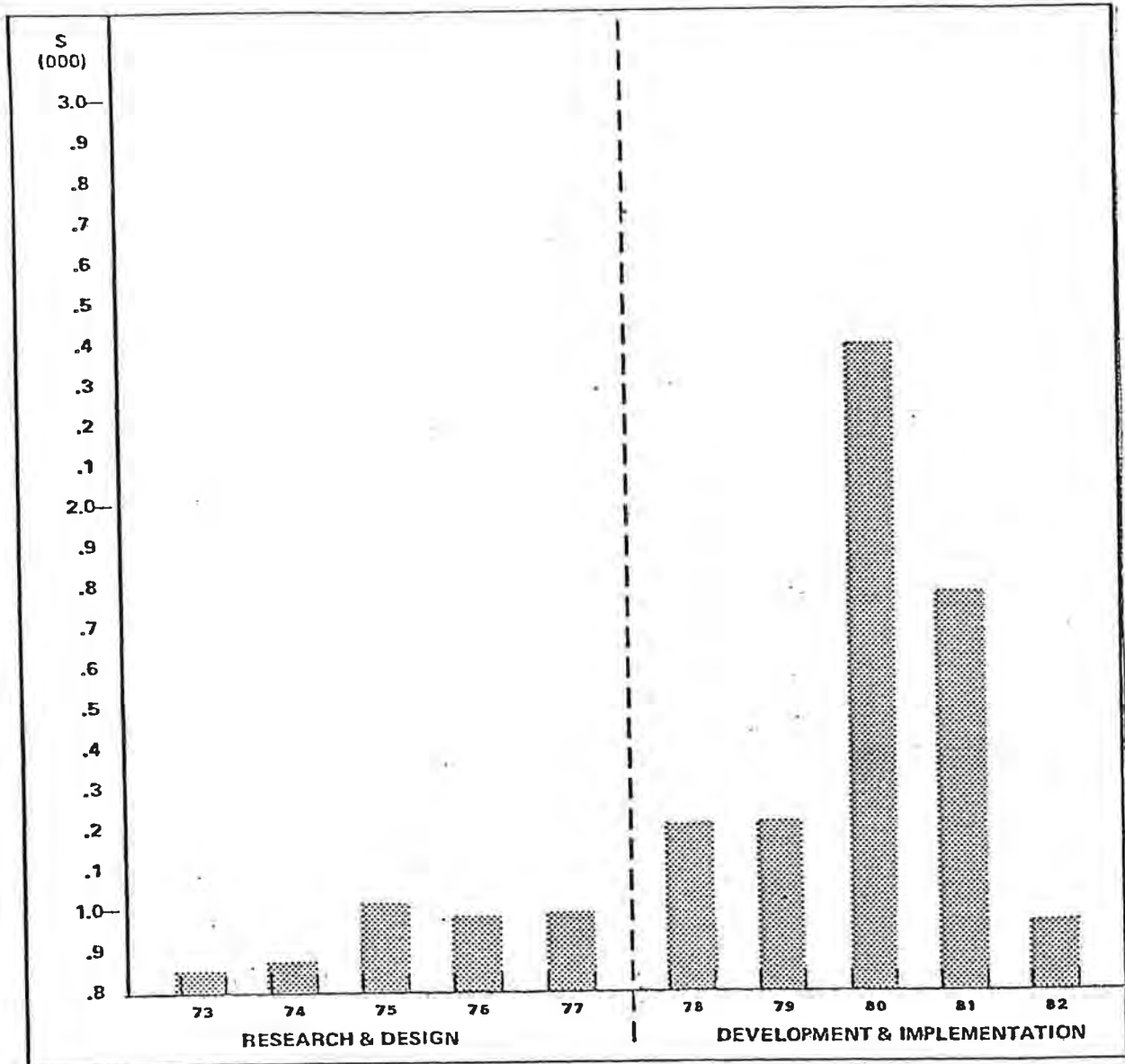


Figure 4-1

Program Funding Summary

During the period 1979-1982, the FIREScope Program Office consistently monitored the implementation effort and reviewed program cost to completion estimates. As of this writing, the best estimate to complete and implement the FIREScope Design is \$8.1 million. See Section 5 for details on estimated funding.

Member agency direct and in-kind (staffing, training, facilities, and equipment) contributions to the the FIRESCOPE Program have been significant. During the period 1978 through 1980, the matching contributions of the member agencies was \$4.3 million, for an average of \$1.4 million per year. Since 1980, the members matching contributions have steadily increased as the agencies took on greater roles and responsibility toward the program. It is conservatively estimated that the total matching contributions of the agencies (including the 1972-1977 period) is \$10 million. (4) This represents an 80 per cent match to the Federal program dollars. Table 4-1 shows the estimated member agency contributions.

<u>YEAR</u>	<u>MATCHING CONTRIBUTIONS</u> (Millions)
1973-1977 estimate	\$ 1.0
1978-1980 estimate	4.3
1981 estimate	2.3
1982 estimate	2.4
	<u>\$10.0</u>

Table 4-1
Agency Matching Contributions

5 PROGRAM DEVELOPMENT AND COST PLAN

The following is a description of development and implementation tasks and estimated costs necessary to complete the systems and technologies included within the FIRESCOPE design. The primary assumptions used in preparing this section are as follows:

- a. The five-incident ICS capability selected by the FIRESCOPE Board of Directors is still part of the overall implementation plan.
- b. A new OCC facility is no longer being considered.
- c. No additional FIRESCOPE development money will be used for MACS/ICS Operations and Maintenance (O&M) activities. The USFS will, however, continue to participate in O&M as a member agency.
- d. Added to the system design is a requirement, based on an all-hazards approach, to develop a MACS inter-agency communication system to back up the existing systems of wire lines and microwave. (See Conclusions.)

Development costs are those costs necessary to develop, implement and test a single element. Implementation costs are those costs required to provide the total number of validated elements necessary to complete the design.

Two tables follow: Table 5-1 provides costs for each individual development or implementation task: Table 5-2 (page 46) shows summary costs by major component. These include program management and associated administrative costs.

Table 5-1 Development & Implementation Tasks for Completion of the FIRESCOPE Program

DEVELOPMENTAL WORK REQUIRED TO COMPLETE FIRESCOPE DESIGN	COST TO DEVELOP (M)	COST TO IMPLEMENT (M)
1.0 MULTI-AGENCY COORDINATION SYSTEM (MACS)		
1.1 Policy and procedures development on BOD goal statements	\$ 32	
1.2 Test and evaluate policy and procedures		
1.3 Develop and document data base/software specifications pertaining to development programs	63	
1.4 Provide additional OCC facility space to test MACS design components		\$200
1.5 Develop operational procedures for:		
a. OCC facility internal operations		10
b. MACS Coordination Points (manual & auto ated)	12	
c. GHQ/Agency Representative operations		10
1.6 Improved internal OCC/GHQ information displays (manual & semi-automated)	63	5
----- MACS SUBTOTAL	170	225
=====		
2.0 FIRE INFORMATION MANAGEMENT SYSTEM (FIMS)-ALL ADP		
2.1 Data Bases (collection, formats, entry)		
a. Fuels	125	
b. Terrain (slope, elevation)	20	
c. Cultural features (including fixed facilities, meteor net, etc.)	64	
d. Resources (expanded file)	50	
e. All risk (spec. equip., hazardous materials)	38	
f. Communication frequencies	20	
g. Work production rates	64	
h. Qualification/training records	5	

2.2 Software Programs		
a. Initial attack assessment	115	
b. Wind model (develop/test/validate)	938	
c. AFOS/Prime meteor data transfer.	38	
d. Order processing	88	
e. Urban fire spread	190	
f. Large fire prediction module	500	
g. Resource summary	50	
h. GEOLOC data retrieval software	25	
i. Cost accounting software	72	
j. General interface support software	65	

2.3 Hardware		
a. Back-up computer and peripherals	625	
b. Coordination Point terminals for graphic/expanded display	65	
c. AFOS/Prime interface connect	38	
d. Improved incident terminals	32	
e. Hardware interconnect to meteorological net ground station system	38	

FIMS SUBTOTAL	3265
=====	

3.0 INCIDENT COMMAND SYSTEM

3.1 Incident Command Post equipment/facilities (generators & command, planning trailers, etc.).	80	200

ICS SUBTOTAL	80	200
=====		

4.0 COMMUNICATIONS

4.1 Modular systems for agency owned communication van/trailers	64	200
4.2 MACS radio communications system (satellite or redundant terrestrial) for both voice and data channels. (System to interconnect MACS Coordination Points and OCC. Must be independent of Ground telephone lines.	375	
4.3 Communication system (terrestrial, microwave or satellite) to connect on and off-incident incident locations with 12 voice and data handling channel	188	80
4.4 Portable synthesized radio caches (5)	188	500
4.5 Incident personnel paging systems (5)		

4.6	Internal OCC telephone switching svstem which will accommodate all agency user needs		25
4.7	Frequency allocations to support ICS, MACS, meteor. net & IR needs	5	
	-----	820	805
	COMM. SUBTOTAL		
	=====		
5.0	<u>TRAINING</u>		
5.1	ICS Section training courses	350	
5.2	Command Staff training courses	145	
5.3	MACS training courses	65	
5.4	ICS and MACS all-hazard simulation exercises	65	

	TRAINING SUBTOTAL	625	
	=====		
6.0	<u>MAPPING</u>		
6.1	Mapping program training package	20	

	MAPPING SUBTOTAL	20	
	=====		
7.0	<u>WEATHER</u>		
7.1	Validation test of existing WX, station network	63	
7.2	Meteor. network regional plan (based on wind model, existing net, RAWS, etc.)	20	
7.3	Additional remote fixed weather stations	488	605
7.4	Satellite ground station for remote monitoring (Consider interfacing with Incident Communications system.)	94	
7.5	Portable meteor net systems for incidents	5	20

	WEATHER SUBTOTAL	670	625
	=====		

8.0 INFRARED (IR)

8.1	OCC fixed IR receiving station	4	
8.2	Additional mobile IR receiving stations		400
8.3	Enhanced imagery transfer capability to auto plot imagery on maps	25	
8.4	Video image transmission capability between incidents and OCC	21	150
----- IR SUBTOTAL		50	550
=====			

The planning for final completion calls for a three-year development and implementation cycle.

Funding levels would range from approximately \$2 million to \$2.7 million annually depending upon whether implementation completion costs are handled by the Federal government or by the member agencies.

Even with the inclusion in the design for an all-hazard inter-agency communications system, the total program estimated costs (including 1978-1982 actuals) comes to \$15.9 million or very close to \$16.2 million estimated program cost reflected in the 1977 FIRESCOPE Implementation Plan. (4)

(M)	MACS	ICS	COMM	MAP	ADP	TRAINING	IR	METEOR	TOTAL
Development	170	80	820	20	3265	625	50	670	5700
Complete Implement.	225	200	850				550	625	2405

Totals	395	280	1625	20	3265	625	600	1295	8105
=====									

Table 5-2

Estimated Cost for Completion of the FIRESCOPE Program (in thousands)

6 CONCLUSIONS

A program of the size and complexity of FIREScope provides a large quantity of information upon which to draw conclusions. In the Program Description and Analysis Section (Section 3), a number of the more important conclusions which were related to the specific systems and technologies were pointed out. In this section, some of the other major conclusions which are more program related will be briefly discussed.

6.1 Development and Implementation Progress

The estimated level of completion of the various FIREScope systems and technologies is reflected in Figure 6-1. Factors relating to the level of completion are found in Section 3. The completion average for the total program is approximately 60 per cent.

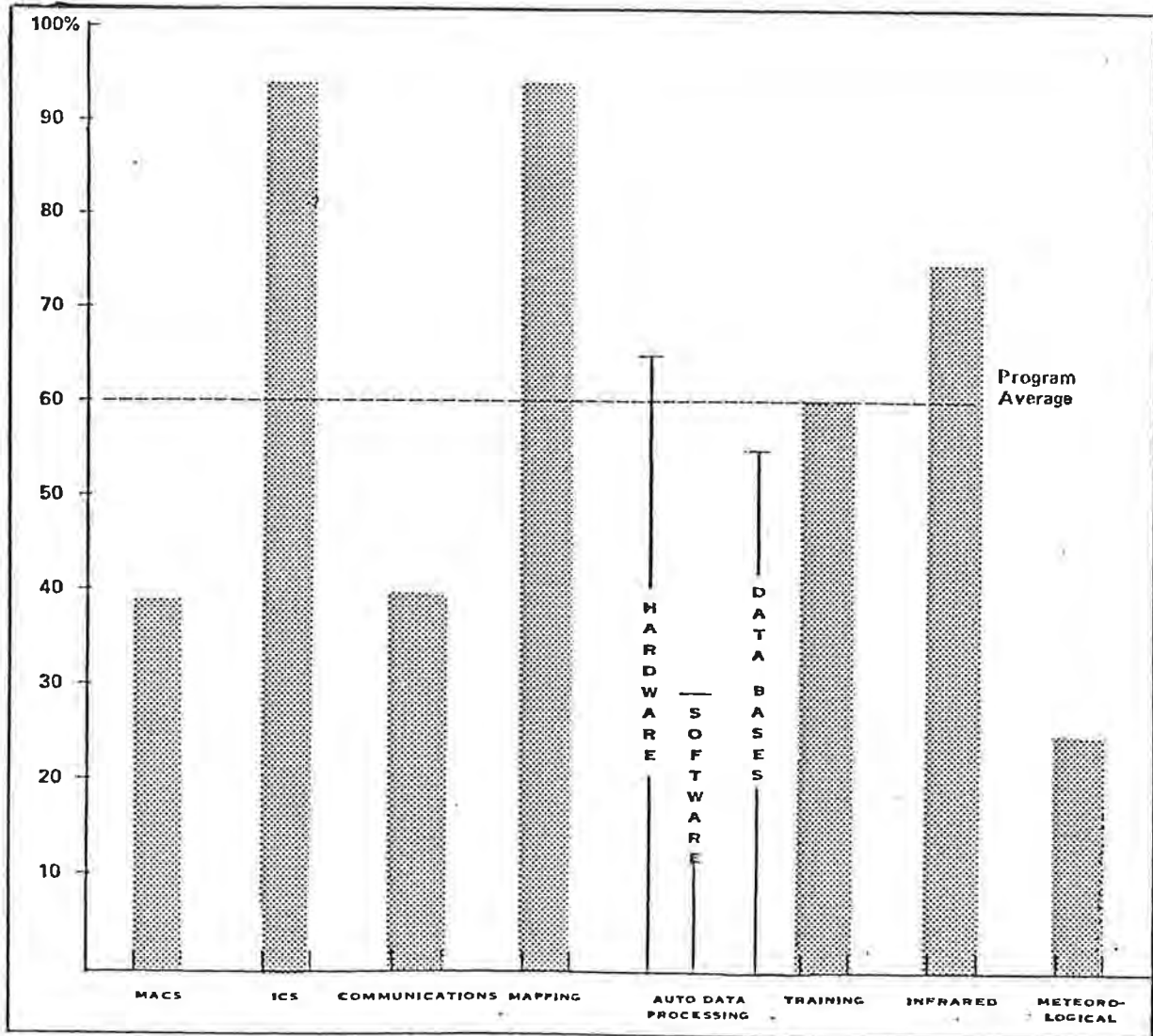


Figure 6-1 Completion Estimate for Various FIREScope Systems and Technologies

6.2 Program Effectiveness

While it is virtually impossible and risky to make across-the-board comparisons of one year against another because of the large number of variables, a general improvement appears evident over what existed in 1970.

The Program Office in 1980 reviewed statistics for a near comparable time period with 1970 (13 days in 1970 versus 14 days in 1980). In 1980, there was a 60-per cent increase in major fire activity within the period. However, there was a 76-per cent reduction in acres burned; a 36-per cent reduction in structures lost; and a 69-per cent reduction in deaths. (66) To what extent those reductions can be traced directly to FIRESCOPE systems and technologies is not known. However, in the analysis of 1970 versus 1980 situation, the agencies did determine the following:

- * The ICS enabled agencies to work together more effectively, increased trust level and improved overall performance.
- * The ICS Incident Action Plan and Frequency Management Plan facilitated a better understanding between agencies and improved the utilization of available radios.
- * There was definite improvement in coordination of aircraft and crews.
- * There was definite improvement in inter-agency contact and communication.
- * Agencies did more preplanning to meet regional needs.
- * The ICS procedure of classifying resources by capabilities facilitated ordering and incident planning.
- * The strength and mobility of engine Strike Teams was evident and probably significant in reducing losses. (66)

Although the program is only approximately 60-per cent implemented, the benefit/cost ratio appears to be rising. The Aerospace Corporation Benefit/Cost Analysis projected that the program would be cost effective with only a 5-per cent increase in fire service performance attributable to the FIRESCOPE Program. With annual cost and losses averaging \$45 million per year, an annual cost-loss reduction of 10 per cent (\$4.5 million) appears still to be a very real possibility with a fully implemented program.

6.3 Commitment to Program Goals and Decision Process

The FIREScope Program has demonstrated that it takes both time and patience to build good products. Multi-agency groups can work together effectively if they do so with commitment and in a cohesive organizational structure.

Programs such as FIREScope can and do produce positive changes in both personnel attitudes and agency relationships. Both have been accomplished.

The commitment of time and energy by all agencies to making an inter-governmental Decision Process work effectively is an investment which contributes significantly to increasing the effectiveness of all design, development and implementation efforts. The Decision Process used in the FIREScope Program evolved from an informal advisory role in its early beginnings to a major and important technology in guiding an orderly development and implementation process.

The continued existence of a Decision Making Process is critical to completion of the program effort. It is essential that all members of the process be fully informed and understand the importance and implications of their decisions -- not just to their own agency, but to the common good of the Decision Process membership.

6.4 Program Planning

Complex inter-governmental development programs require a dedicated planning effort. The uncertainties associated with annual funding levels mandate a planning process whereby component parts of the systems and technologies can be integrated as they become available, and where the lack of funding to procure a component will not degrade the total design effort. Multiple agency involvement and the use of the Decision Process dictates that the planning effort take more time and involvement than normal planning tasks do within individual agencies. The complexity of this type of planning calls for a flexible planning process, a process which can adapt itself to an ever-changing fiscal and user requirements environment.

The importance of continuing the planning effort established in the FIREScope Program cannot be overstated. The need for a central planning activity, (e.g. a "Program Office") closely coordinated with the planning and procurement plans of the participating agencies is essential.

6.5 All-Hazards Incident Management

As originally chartered, the FIRESCOPE Program mission was to "make a quantum jump in the capability of Southern California wildland fire protection agencies to effectively coordinate inter-agency action and to allocate suppression resources in dynamic multiple fire situations." (5)

Southern California fire agencies are faced with a wide range of potentially hazardous situations which require effective and coordinated incident management. In addition to the ever-present annual wildland fires, there are winter floods, hazardous chemical situations, major highrise conflagrations, harbor/refinery incidents, major aircraft crashes, and the increasing danger of major earthquakes.

While each of these situations will be tactically handled somewhat differently, the overall incident management approach will still utilize the five major functions which are a part of the Incident Command System. Similarly, each of these other situations may require a multi-agency response, and thus impose the need for a Multi-Agency Coordination System.

The Incident Command System has thus far been developed to meet the need seen within the original mission. The system is now well-documented in that regard, has been tested and is now being implemented. The agencies, of course, desire a single incident management system which can be applied on an all-hazards basis.

The first steps have been taken to accomplish this broadening of the application of the Incident Command System by the work done in developing the National Inter-Agency Incident Management System (NIIMS). By introducing relatively minor terminology, organizational and procedural modifications, the Incident Command System part of NIIMS is now better equipped for adaptation to an all-hazards environment.

Further development activity should now aim at ensuring that the procedures applicable to other hazards are well-documented and made a part of the system description.

6.6 Communications Redundancy

Inter-agency communications presently rely on telephone services (FTS/ATSS/commercial) and on a state owned and operated microwave system. There is only limited radio backup and in some cases, it, too, is accessed via the telephone system.

It has become evident in the program implementation that the ICS and MACS systems and some of the technologies have application in any kind of emergency situation the fire services may be called upon to support. In other words, these systems and technologies

are as applicable in flood and earthquake incident management as they are in fire. According to studies done by the State Department of Mines and Geology and the Department of Communications, a major earthquake in the Southern California area is a distinct possibility. Such an earthquake would disrupt both telephone and microwave communications for an extended period of time thus rendering inter-agency coordination useless. To ensure an effective multi-agency coordination capability, it is important to provide redundancy in communications by systems which can survive the immediate effects of a major earthquake. Such a system should be made a priority for further program development efforts.

6.7 Specifications Documentation

Computers are not at all flexible in their approach to a problem. For most people who have dealt for years with manual procedures and processes, it is sometimes difficult to understand the inflexibility and rigid nature of a machine-driven process.

It is essential that user requirements and specifications associated with computerized software development be carefully and completely documented. By so doing, the software program designer has a blueprint to follow. Without such a guideline, the designer is often left to his/her own imagination and inventiveness in the program design effort. An innovative program designer may come up with a very plausible design which cannot be implemented for political, policy or procedural reasons. The same designer may also, of course, come up with a design which will do the job -- but only a system programmer/analyst specialist would be able to interface with the computer in accomplishing the activity.

The establishment of written requirements and specifications, coupled with a close liaison between user representative and designer is essential to effective program design. The absence of these elements can and usually does end up in an unworkable design; rework and patches; time delays to other programs; and most importantly, unhappy users and designers.

6.8 Design Evaluation

A considerable amount of work in developing conceptual and preliminary designs of systems and technologies was done by contract early in the program. Some of these designs often had no formal feasibility evaluation. Thus, contractors were not always aware that either an individual agency or, in some cases, all member agencies may not agree to eventual implementation of that design.

The lack of expedient feasibility evaluation of contractor end-item products caused downstream delay and redesign efforts.

When member agencies did become aware of what the design meant in terms of implications to existing agency procedures, a no-go decision sometimes resulted. Had there been a more rigid evaluation process in place at the time the conceptual design work was taking place, some of the detailed design effort could have been avoided.

Future contract efforts which require product development should have an evaluation and feasibility test incorporated as a part of the contract.

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