

AN INFORMATION MANAGEMENT AND COMMUNICATIONS SYSTEM  
FOR EMERGENCY OPERATIONS

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## SUMMARY

In the mid 1980s the U.S. Department of Energy (DOE) recognized the need to dramatically expand its Emergency Operations Centers to deal with the large variety of emergencies for which DOE has an obligation to manage, or provide technical support. This paper describes information management, display, and communications systems that have been implemented at the DOE Headquarters Forrestal Operations Center (OC), DOE Operations Offices, and critical laboratory locations.

Major elements of the system at the DOE Headquarters facility include computer control, information storage and retrieval, processing, Local Area Networks (LANs), videoconferencing, video display, and audio systems. These Headquarters systems are linked by Wide Area Networks (WANs) to similar systems at the Operations Office and critical Laboratory locations.

System control, information storage and retrieval, and processing and data communications are accommodated by a total of 80 computer workstations installed in the Headquarters OC and Operations Office Emergency Operations Center. The OC video system consists of 115 video monitors, and a 96-input by 144-output computer controlled video switcher, linked to a 48-input by 48-output audio switcher. Accident/Incident Geographical information, satellite, and aerial photography imagery, and database census data are integrated using a Geographical Information System (GIS). Dial-up and Priority Restoration dedicated terrestrial communications circuits to operations offices and laboratories are also supported by a backup satellite network currently being installed.

## I. INTRODUCTION

The Department of Energy must be prepared to respond in real time to a broad array of accidents and

incidents ranging in scope from industrial accidents at DOE-owned facilities, disruption of the nation's energy supply, environmental impacts from spills or leaks, to the unthinkable event of a nuclear explosion. DOE, as a major federal owner/operator of large technical facilities, laboratories, and sites previously used for nuclear production and testing has responsibility for a very large spectrum of potential emergencies. DOE is the "Steward" of both the nation's energy supply and the nuclear weapons stockpile. As such, DOE must be prepared to recommend actions in response to disasters, accidents, threats, or rapidly changing world conditions, or to address issues concerning the nuclear stockpile.

The DOE has recognized these responsibilities and committed substantial resources to the construction and operation of an Emergency Operations System (EOS) consisting of three major elements: 1) an Operations Center (OC) located in the Forrestal building in Washington, D.C.; 2) special interface and compatibility equipment at DOE Germantown, DOE Operations Offices, Laboratories, Contractor facilities, and supporting agencies; and 3) an Emergency Operations Communications Network (EOCN) that interconnects the various facilities. Since the OC must accommodate accidents involving oil, gas, or other natural resources, and accidents or incidents involving nuclear weapons or materials, it supports both classified and unclassified operations.

## II. FORRESTAL OPERATIONS CENTER

Major elements of the system at the DOE Headquarters facility include computer control, Local Area Networks (LANs), information storage and retrieval, processing, videoconferencing, video display, and audio systems. The OC systems are linked by Wide Area Networks (WANs) to similar systems at DOE Operations Offices, Laboratories,

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contractor facilities, and supporting agency locations. The following describes the sub-elements of the OC located in the Forrestal Building.

A. Computer Control: System control, in varying degrees, is available from any of the 35 computer workstations located in the Headquarters OC. Controls include storing and retrieving text, graphics, or other information; operating the video/audio switch; establishing system configurations; configuring the EOCN; operating the telephone recording system; establishing multi-user telephone conferences; and a variety of other operations. An additional 20 workstations are located at various field Emergency Operations Centers, and provide the same functions.

B. Local Area Networks and Information Storage/Retrieval: The LANs use star topology and consist of file servers, communications networks (backbones), and fiber optic receiver/transmitters. Two LANs are available in the OC. The first is normally operated in a "black" mode but is configured to be switched to a classified or "red" mode, and therefore it is often referred to as a "gray" network. The second is an unclassified or always "black" system. Workstations are connected to the fiber optic backbones and operate at standard ethernet rates.

Each of these networks operate internal to the OC and connects to a similar WAN that communicates with operations offices, laboratory, contractor, or other agency locations. The file servers have internal mirror systems that assure that information written to one disk drive is immediately written to a second drive. Failure of the primary disk drives will result in an automatic switch to the secondary drive with no noticeable effect on operations. An external redundant server backs up the "gray" server every half hour, and can be brought on line in approximately one hour in the event of failure of the primary server.

A Map System database is available and contained on an independent file server that is connected to the "gray" network and therefore can be converted from "red" to "black" (or the reverse) as required by the operation. Maps can be annotated with overlays that provide road, water and utility locations, available transportation systems, evacuation routes, population density data, and area details with high resolution down to street level for general United States coverage. Also included are high detail maps and overlays for all major DOE facilities such as nuclear power plants, naval reactor facilities, nuclear

fuel cycle sites, waste storage sites, and petroleum reserve sites.

C. Processing: The Processing functions are performed at each of the workstations where data are generated, received, or analyzed. Results of such processing are presented as status boards, text, maps, or graphics information on executive, other-team room, or remote field location display systems.

D. Video System: The Video System consists of Videoconferencing, Video Switching, still video, and video display elements. The Videoconferencing system is connected as live video between the various OC team rooms. Connections between the OC, field offices, laboratories, contractor facilities, and other remote locations are made via standard videoconferencing codecs operating at 768 Kb/S, and encrypted using standard National Security Agency-approved encryption equipment.

The Video Switching system is a computer controlled 96-input by 144-output video switcher. A 48-input by 48-output audio switcher is slaved to selected video input/outputs. Video switcher inputs consist of computer x-terminals (to convert computer data to video displays) cameras; video recorders; still video; live television; satellite; and information from remote locations such as field offices, laboratory and contractor facilities. Similarly, video outputs are distributed to a video wall in the executive team room; video displays in the watch office and other team rooms; video recorders; and external locations such as operations offices, laboratories, and contractor facilities. The video switch can be controlled from any system workstation. Controls are graphical interfaces that appear as icons which are "dragged" from one location on the display to another to designate the video source and destination.

The Video Display system consist of approximately 115 video monitors distributed throughout the OC watch office, executive team room video wall, and the smaller team rooms. In virtually all cases, these are connected to the video switcher outputs.

E. Telephone System: The Forrestal OC also contains an independent, dedicated telephone system. This telephone switch is equipped with 160 user lines, and 48 trunk circuits from the telephone switch that provide service to the entire Forrestal Building. The system also contains an additional 24 trunks that

bypass the Forrestal Building telephone system and connect directly to the commercial International Direct Dial (IDD) telephone network. A STU-III is connected to each user line except where specialized equipment such as facsimile machines, modems, conference bridges, or similar items are required. The telephone system provides recording equipment that allow users or Watch Office operators to record conversations on command. Both "red" and "black" conference bridges are available for multiparty conferences.

F. Audio/Infrared Systems: Audio control and distribution are provided by a 48-input by 48-output computer controlled audio switch slaved to selected video switch functions. A 12 channel infrared distribution system (earphone receivers) with coverage throughout the OC provides one-way audio from broadcast news programs, emergency paging, or other audio sources as selected by the OC operations team. This system allows OC members in the same vicinity to monitor different audio sources without mutual disturbance.

### III. DOE OPERATIONS OFFICES AND OTHER OUTSIDE LOCATIONS

The Emergency Operations System depends greatly upon data collected from, and distributed to, field offices or other EOC system locations. Each external EOC location contains videoconferencing, computer workstations, facsimiles, audio, telephone, and other systems that are fully compatible with the Forrestal Operations Center equipment. This equipment was installed, checked out, and is maintained by the same technical team that installed and maintains the OC systems.

### IV. EMERGENCY OPERATIONS COMMUNICATIONS NETWORK

Dedicated, high speed data links provide communications between the Forrestal OC and various DOE Operations Offices, Laboratories, Contractor facilities, and selected government locations. These communications links are a standard 1.544 MB/s (T-1) data service that uses the FTS 2000 as the transmission medium. The T-1 link is subdivided into specific links that provide communications for the videoconferencing, black WAN, gray WANs, and other functions, as necessary. Although each of the links has a specific normal operating data rate, these rates can be dynamically reassigned to accommodate differing requirements.

As previously indicated, the basic communications medium is terrestrial service provided by FTS-2000. Backup for critical elements of the EOCN are provided by a dedicated satellite network.

## V. OPERATIONS

The basic OC operations concept is that the DOE Headquarters Executive Management Team (EMT) assemble in the OC Executive Team Room. Supporting functions or working groups occupy the alternate team rooms and focus on their specific areas of expertise. Information relative to the emergency such as GIS maps and overlays, archival data, organizational expertise, and real-time specifics of the emergency are collected and provided to the appropriate working group where it will be processed, concentrated, organized, and analyzed, as necessary for presentation to the EMT for decision or action. Status information boards for various stages and elements of the emergency are created by specialty groups on workstations and electronically moved to the Executive Team Room to provide additional information to the EMT. The status information boards, GIS graphics, and overlays are updated on a regular basis to assure time progression accuracy.

EMT decisions or supporting information is distributed to the appropriate DOE Operations Office or area of the emergency via the EOCN. In the event that the emergency is not in the immediate area of an external fixed area system, the information can be routed to on-site EMTs using the Nuclear Emergency Search Team (NEST) deployable communications system.

In conclusion, the Emergency Operation System combines the current technology hardware systems, user oriented software, and skilled operations/maintenance support necessary to allow the DOE to effectively manage emergencies. The system can accommodate emergencies of a general nature at DOE facilities, in the nations energy supply, or the weapons stockpile. These systems can also be used to help resolve many national level emergencies that are the responsibility of other elements of government.

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