Fire Protection and Safety Activities Throughout the Deep Space Network

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Comprehensive fire and safety studies have been initiated to determine the effort required to protect the tracking network from loss of life, property, and operational continuity due to fire. The studies recommend the installation of water storage tanks, new water mains and fire hydrants, installation of fire hose cabinets, automatic early fire warning devices, automatic smoke detectors, and manual alarm stations. The protection offered to the Deep Space Network with the installation of this equipment will be equal to the highly protective risk category used by private industry to describe maximum installed protection against loss of life and property. This article describes the scope of the initial surveys, the follow-on preliminary engineering reports, and the design/construction efforts.

I. Development of Fire Protection Survey Reports

In 1968 the Jet Propulsion Laboratory engaged the firm of Gage-Babcock and Associates, Inc. (fire protection engineers and consultants), to survey the Goldstone Complex and DSSs 51, 61, 62, and 71 to determine and evaluate exposures to loss of life or damage to property by fire and to prepare recommendations of fire prevention and protection features for all facilities.

The surveys included, but were not limited to, the analysis of the following factors:

(1) Sources of fuels for accidental fires.

(2) Sources of ignition which might start an accidental fire.

(3) Arrangements, materials, construction, etc., which might contribute to the intensity and spread of fire or fire effects, including materials of construction, materials of contents, heating and air conditioning equipment, other mechanical equipment, etc.

(4) Means of protecting personnel from the damaging effects of fires with special attention to access to and adequacy of exits.

(5) Means of detecting fires and means of alerting personnel to the existence of a fire.

(6) Means of confining and minimizing the effects of fires.

(7) Means of extinguishing fires, including fixed and portable equipment, and private and public fire fighting facilities.

(8) The program, organization and activities concerned with fire prevention, fire protection, fire fighting and disaster control.

The intent of the recommendations developed by the fire protection engineer was to provide a system of fire prevention and fire protection that will result in a high level of protection for the stations, to safeguard human life, and preserve operational continuity. Also considered were site conditions, economic factors, practical construction and rehabilitation restrictions, operational needs, and the most effective and economically feasible methods of providing above-average degree of fire protection.

Standards and guides which were considered included the following:

(1) *Design Criteria and Construction Standards*, NASA Publication NPC 325-1, 1965.

(2) *Fire Protection for Essential Electronic Equipment*, Recommended Practices No. 1, Federal Fire Council.

(3) *Loss Prevention Data, Electronic Computer Systems*, Factory Mutual Engineering Division, 1964.

(4) NFPA Standard No. 75 for the *Protection of Electronic Computer/Data Processing Equipment*, 1968.

(5) *The Installation of Nonmetallic Jacketed Cables in Troughs and the Protection of Electrical Center Rooms*, Factory Insurance Association, 1965.

(6) *Recommended Good Practice for the Protection of Electronic Data Processing*, Factory Insurance Association, 1965.

(7) *National Fire Codes*, National Fire Protection Association, 1968.

(8) *Handbook of Industrial Loss Prevention*, Factory Mutual System, 1967.

(9) *Fire Protection Handbook*, National Fire Protection Association, Thirteenth Edition.

Order of magnitude cost estimates to implement the corrective measures recommended by the fire protection consultant were also part of the survey reports.

The basic conclusion of all survey reports was that the overall level of fire protection at all surveyed stations was unsatisfactory. Little exposure to loss of life was noted, but protection against loss of operations and property damage was incomplete and inadequate.

Prominently undesirable features and deficiencies at all stations were determined to be as follows:

(1) Combustible materials were stored in underfloor areas, which are used as an air conditioning plenum.

(2) Rooms with ordinary combustibles, exposing operations areas through unprotected openings.

(3) Electrical power subject to loss from a single fire and not protected from fire by automatic protection systems.

(4) Incomplete and somewhat unreliable systems to detect incipient fires and sound local fire alarms and the alarm at the fire department.

(5) Incomplete and inadequate fire watch service during unattended periods.

(6) Air conditioning systems not arranged to avoid spreading smoke, heat, and fire gases throughout operations.

(7) Incomplete procedures for damage control action in the event of a fire or other emergency.

(8) Inadequate water systems.

(9) Inadequate fire alarm systems.

The probability of a fire starting at any one station was noted as relatively low, due to the below average number of causative fire hazards. However, fires can occur; once started, if not detected and extinguished almost immediately, the fire will most likely result in heavy property damage and possibly interrupt operations.

Due to susceptibility of much of the operational equipment to damage by heat and the products of combustion, even relatively small fires can cause considerable damage and loss of operational time, if not extinguished in the incipient stage at all stations. Since the outlying auxiliary buildings and portions of major buildings are unattended for extended periods and with inadequate coverage by automatic fire detection equipment, fires can easily gain considerable headway before they become apparent.

All recommendations by the Fire Protection Engineer were grouped by priority, or in groups of descending importance. Each recommendation was assigned a priority indicative of its importance, according to the following indices:

(1) ***Priority I—URGENT.*** Considered essential to prevent or alleviate exposures to loss of life, or major exposures to operational continuity or property, and which should receive prompt attention.

(2) ***Priority II—IMPORTANT.*** Considered necessary to develop the stated level of protection and prevent serious loss exposures, and which should be programmed for the next fiscal year.

(3) ***Priority III—DESIRABLE.*** Improvements considered desirable conform with accepted good fire prevention and protection practices, but involving less serious exposures and which may therefore be implemented on a program basis.

Priority I improvements generally included the following:

(1) Automatic fire detection and alarm systems.

(2) Fire annunciating system.

(3) Fire control training.

(4) Watch service.

(5) Smoking restriction.

(6) Welding and cutting precautions.

(7) Emergency lights.

(8) Fire extinguishers.

Priority II improvements generally included the following:

(1) Central fire alarm systems.

(2) Automatic fire sprinklers.

(3) Water supply and distribution systems.

(4) Inside fire hose stations.

(5) Outside fire hydrants.

Priority III improvements generally included the following:

(1) Tape storage containers.

(2) Sealing of cable trenches.

(3) Dikes for fuel oil storage tanks.

(4) Second means of off-site communications.

(5) Electrical maintenance.

II. Development of Preliminary Engineering Reports

After submittal and approval of the herein before described fire protection survey reports, another contract with Gage-Babcock was executed to provide JPL with follow-on preliminary fire protection engineering reports. These reports, using the fire protection surveys as guides, detail the design features, specify approved construction methods and materials, and, in general, guide the architect and engineer in his design of fire protection/detection systems for each station. These preliminary engineering reports also included budget estimates to secure funding for the follow-on construction efforts.

III. Design of Fire Protection Systems

The design of fire protection and detection systems was the responsibility of local architects and engineers. The design of all systems was based on the criteria as outlined in the Preliminary Engineering Reports.

At DSSs 61/61A and 42/42A the design of the fire protection/detection systems was included with the design of the 64-m-diameter antenna facilities and is completed. In Australia, this work was performed by the Australian Department of Works. Gibbs and Hill, Architects and Engineers, under the direction of the U.S. Naval Facilities Engineering Command, Madrid, accomplished the design for DSSs 61/61A.

The design for the Goldstone Complex was accomplished by Koebig and Koebig, Architects and Engineers, Los Angeles. This effort is now completed.

In Johannesburg, DSS 51, the design of fire protection/detection systems is being performed by the South African Council for Scientific and Industrial Research. This effort is still under way and is estimated to be completed early in 1972.

At DSS 62, Madrid, the design effort is being accomplished by the Austin Co., Architects and Engineers, under the direction of the U.S. Naval Facilities Engineering Command, Madrid. This work is estimated to be completed by late 1971.

The fire protection/detection design for DSS 71 is being held in abeyance until a decision on the future use of this station is made.

IV. Fire Protection Construction Activities

A. DSSs 42/42A, Australia

The construction effort at these stations is well under way and the estimated completion date is May 1972.

B. DSSs 61/61A, Spain

The construction effort at these stations started in September 1970, and is scheduled to be completed by September 1972.

C. Goldstone Complex

All fire protection/detection construction work is being performed in two phases. Phase I included all work as detailed by Koebig and Koebig, Architects and Engineers. This work was started in July 1970, and was completed in August 1971. Phase II of the construction effort consists of adding fire detection devices to mission critical areas to bring these facilities up to the "highly protective risk" standards. Phase II started in September 1971, and should be completed in December 1971.

D. DSS 51, Johannesburg

As noted earlier, the fire protection/detection design is still being performed. Construction is scheduled to start in July 1972 and to be completed by March 1973.

E. DSS 62, Spain

At this station the fire protection/detection design is also still in the development stage. Construction is scheduled to start in June 1972 and to be completed by February 1973.

V. Future Fire Protection Activities

Facility fire protection resurveys, similar to the surveys as outlined in *Section I* of this article, are scheduled to be performed by fire protection engineers/consultants after the present fire protection design and construction effort has been completed. Constant changes in mission requirements, changes in facility occupancy, changes in NASA guidelines, and addition of new facilities make these resurveys mandatory. It is our intention to resurvey all stations every 3 to 4 years and, if necessary, to follow-on with corrective construction efforts if fire protection deficiencies exist.

With the implementation of this program, all of the DSIF facilities will be regularly checked and fire protection standards can be kept within NASA guidelines.