NATIONAL BUREAU OF STANDARDS REPORT

3260

REPORT OF A SURVEY OF VISUAL LANDING AIDS

By
James E. Davis

NBS

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REPORT OF A SURVEY OF VISUAL LANDING AIDS

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ABSTRACT

This report presents the results of a survey of the visual landing aids at eleven Naval and Marine Corps Air Stations. Particular attention was given to airfield lighting difficulties and maintenance problems and methods. The survey was accomplished by interviewing the personnel performing the maintenance as well as those in charge and by completing a survey form for each station. Each installation is a special problem in itself, but some of the problems are sufficiently similar to warrant recommendations which may improve efficiency in operations and maintenance. The survey can serve as a basis for preparing maintenance manuals or instructions and in making preparations for any future surveys of a similar nature.

1. INTRODUCTION

The use of visual landing aids in conjunction with the electronic and other instrumental aids for landing, taxiing, and takeoff during low visibility conditions is increasingly important. With the advent of very high candlepower approach- and runway-lighting systems with their related specialized regulators, controls, etc., the problems of maintaining visual landing aids have become a specialized phase of airport operation. These systems are becoming increasingly more complicated and difficult to maintain. Some stations report that an abnormal amount of maintenance is required to keep this equipment operating satisfactorily while other stations appear to have very little maintenance trouble. A survey of various stations was therefore deemed desirable.

Accordingly, the Airborne Equipment Division, Bureau of Aeronautics, by letter of 7 April 1953, AER-AE-101, serial 47164, requested the National Bureau of Standards to make such a survey under Project TED No. NBS-AE-10011 and recommended the stations to be visited. (The stations visited are listed in Appendix II.)

From the results of this survey it is possible to make recommendations to reduce maintenance. The reports from the men who are assigned the maintenance of these aids are helpful in determining the need for modification of existing equipment, in the design of new equipment, and in determining the need for specialized and common maintenance instruments and tools.

2. SURVEY OBJECTIVES AND METHODS

The object of the survey was to obtain data on the following items:

a. Installation and performance of earth-burial cable, cable connectors, and splices.
b. Methods of locating and repairing faults in cables.
c. Difficulties encountered in the installation, operation, and maintenance of other visual landing aids equipment.
d. Methods of installing, testing, and maintaining equipment.

The survey included personal interviews with the electricians who accomplish the maintenance of these visual landing aids, Public Works Officers, Operations Officers, and others interested in the problem of airfield lighting maintenance. A survey form, Appendix I, was prepared to facilitate the interviewing and the tabulation of information.

Every effort was made to obtain unbiased replies to the questions of the survey form, particularly to those related to cable and equipment faults. However, several factors enter into answers to questions of this type. If no records are kept and faults are infrequent, the actual number of faults over a period of several years is not easy to determine. If some particular piece of equipment or cable has recently caused trouble, there may be undue emphasis on that item. Also, if potential faults are located and corrected before failure by adequate preventive maintenance, they cannot be included.

A demonstration of the use of a Navy model OBB Cable Detecting Equipment, a Wilkinson Line Locator, and a Takk Insulation Tester was made at each of the stations. A copy of NavAer 19-1-517 Airport Field Lighting Design Manual and a set of current Airfield Lighting Design Drawings not included in NavAer 19-1-517 were left at each station for future use. Other technical information and assistance was given to the personnel at each station.

3. DATA OBTAINED

Appendix II is a tabulation of replies to the questions of the survey form given in Appendix I. However, in view of the limited number of stations and the lack of adequate records, the findings cannot be readily summarized from a table of data. For this reason, many individual problems are included in the discussion below.

3.1 INSTALLATION AND PERFORMANCE OF EARTH BURIAL CABLES, CABLE CONNECTORS, AND SPLICES

The number of cable faults varied widely from station to station, from none in five years to one fault per week. The average for all stations is about eight to ten a year.

3.1.1 5000-Volt Polychloroprene-Jacketed Cable

Most stations visited were in the process of installing or had just recently completed the installation of new runway-and taxiway-lighting systems. Therefore it was not possible to determine the common faults of cable installations using the new 5000-volt, polychloroprene-jacketed, direct-burial cable. Patuxent River, Maryland, had had in operation for more than a year one runway- and one approach-lighting system using the new type cable and connectors. Several faults had occurred in a feeder line using this type of cable between the main vault and an underground vault in the field; however, here the cable was connected continuously to a 2400-volt power source instead of being used for the intermittent service for which it was intended. Faults in this line were confined to an area near the intersection of runways 2, 6, and 9. The same types of trouble have been experienced in this general area with other types of direct-burial cables and the maintenance personnel estimated that the majority of cable faults at that station have occurred in this area. Since no records had been kept, it could not be determined whether these faults were caused by lightning, soil-chemical action, or by other causes; however, one fault was attributed to lightning. No soil analysis had been made, so the relation of the soil condition to the faults could not be determined. Atlantic City reported that three cable faults occurred in the new cable as a result of lightning strokes and that in each case the strokes were observed by tower personnel. The few cases of cable failures in the new 5000-volt cable other than those noted above were attributed to faulty initial installation.

3.1.2 3000-Volt Polychloroprene-Jacketed Cable

In the 3000-volt polychloroprene-jacketed cable no unusual faults were reported except at Patuxent River where numerous failures in this type of cable have occurred. The causes of trouble were undetermined. However, other types of cable also have had the same types of failures in the same area of the field. Some of the faults at other stations were attributed to faulty installation and a few were attributed to lightning.

3.1.3 3000-Volt Lead-Sheathed Cables

Most stations with the 3000-volt, lead-sheathed cable had had considerable maintenance trouble. This cable had been installed for several years and is now being replaced at most stations. In general, the cable had just deteriorated, but Anacostia and Cherry Point have diagnosed the cause of the failures as chemical or soil action. Johnsville had had very little trouble.

3.1.4 Cable Connectors and Splices

No cable connector faults that could be attributed to the connector itself were reported. The only trouble experienced with the new connectors was that one above ground during construction of a manhole was damaged by a vehicle. The problem of having to remove dirt from the female connectors of runway lights was reported. Only isolated cases of trouble have been experienced with conventional splices in the synthetic rubber-type cables. Some stations that had considerable trouble with lead-sheathed cable also reported trouble with the splices.

3.1.5 Isolating Transformers

No trouble was reported from isolating transformers after replacing any of the bad units in the initial installation. Two stations reported a number of failures of these transformers shortly after installation, but that no failures had occurred after these first defective transformers were replaced.

3.2 METHODS OF LOCATING AND REPAIRING FAULTS IN CABLES

3.2.1 Isolation

Only three stations had any cable-fault locating equipment, so the most common method of fault locating was by isolation. Fault locating by this method is both time consuming and expensive. Along runway and taxiway series circuits, between the light units, this method is reasonably satisfactory if there are no more than two faults in the circuit.

3.2.2 Model OBB Cable Detecting Equipment

At the two stations where fault-locating equipment was available, faults were located with a minimum of effort and time. Both Patuxent River and Oceana were using a Navy model OBB Cable Detecting Equipment (Specification MIL-C-16163 (SHIPS) 15 March, 1951) with good results. Faults from shorts or from low-resistance grounds in cable runs over 5000 feet long were located to within a distance of a few feet. Some experience is needed by the maintenance personnel before good results can be obtained. However, the results obtained with this equipment were found to be very satisfactory after it had been used a few times.

3.2.3 Stewart Type L Cable Tester

Norfolk had constructed a pickup amplifier for use with a Stewart Type L Cable Tester manufactured by Kellogg Switchboard and Supply Company. This equipment, commonly called a "woodpecker," has a signal frequency estimated to be about 25 to 50 cycles per second. The signal can be interrupted for identification. It is used extensively by telephone personnel. The maintenance personnel did not feel the modified pickup amplifier was satisfactory, especially after having compared it on several occasions with the OBB Cable Detector at Oceana.

Oceana personnel had brought their OBB to Norfolk to assist in locating cable faults in a paved area and since that time Norfolk has abandoned the use of their "woodpecker." Patuxent River had attempted to use a "woodpecker" several times but with no success.

3.2.4 Line Locators

Cable and "Treasure" locators, similar to the Wilkinson Line Locator, that operate at high (radio) frequency have been satisfactory for locating buried conduits and cables but have not been useful for cable fault detection. Tests on this type of equipment for use as cable-fault detectors indicate that the signal would not stop at the location of a ground or short but would "ride" through.

3.2.5 Other Instruments

All stations, except one which reported only a voltmeter and an ammeter, had available for airfield lighting maintenance personnel use an ohmmeter, voltmeter, ammeter (usually the clamp-on type), and "megger" (500, 1000, or 2500 vdc) for determining cable condition and fault locating. One station had installed ammeters in the output circuit of the regulators. This provides a convenient method for checking operation of the regulators. One station had available for use a recording ammeter and voltmeter.

3.2.6 Remarks

In general, at locations where no records were kept or no regular resistance measurements were made, cable faults were more frequent. At stations where records were kept and regular resistance measurements were made, potential cable faults were detected before an outage of the circuit occurred. This has reduced the number of faults reported from these stations. It is of interest to note that at the station with the most faults, maintenance personnel depended entirely on the use of a clamp-on ammeter and voltmeter for maintenance.

3.3 DIFFICULTIES ENCOUNTERED IN THE INSTALLATION, MAINTENANCE, OR OPERATION OF OTHER VISUAL LANDING AIDS

Difficulties encountered during installation could not be determined since most of the installations were made by contractors and their comments were not obtainable. The difficulties encountered in maintenance and operation may be common to several stations or they may be reported at only one or two stations. All difficulties reported which are considered sufficiently important to need further study or which may be encountered at other stations at present or in future installations are discussed below. See also Appendix II.

3.3.1 M-1 Lights

The most frequently encountered complaint was that the type M-1 lights would not stand up under jet and propeller blasts. These units were being blown off of the mounting clips that hold them down, particularly at turns, warm-up areas, and where they are used for threshold markers. In one instance where they were bolted to the clips, the cones collapsed under jet blast.

3.3.2 AN-L-9 Lights

A common complaint at all stations where the AN-L-9 semi-flush lights are installed without isolating transformers was that water collects in the bases, causing grounds. This difficulty is gradually being overcome by replacement with elevated lights and isolating transformers. In maintenance of present installations of this type, several solutions have been tried but none is satisfactory for all cases. Quonset Point has been successful in keeping the water out by using double gaskets between the base and top assemblies. Frequently the water seeps in through the lead-sheathed cable, as was found at Anacostia, and any permanent repairs would require replacing the cable.

3.3.3 Indication of Inoperative Sections

The Operations Officers at several stations wanted some means of positive indication to the control tower operator to show when a section of runway lights is inoperative since it is very disconcerting to a pilot, after landing in low visibility, to find no runway lights for guidance. A method of indication other than visual inspection from the control tower is required since, in periods of low visibility when the need for the lights is the greatest, sections of lighting systems cannot be seen from the tower. At some stations, woods, buildings, changes in ground elevation, etc. obscure parts of the runway even in clear weather. There is a similar need for positive indication of the operation of approach-light systems since the distance from the control tower to the approach lights is generally greater than the distance to the runway.

3.3.4 Lamp Burnouts

One common complaint reported in new installations was that the output current of the new type NC-3, 15-kilowatt, Hevi Duty regulators operating at near full load increased as lamps began to burn out when the lamps were operated through isolating transformers. When approximately 15% to 20% of the lamps in the circuit have burned out, the current has increased to such a level that the balance of the lamps in the circuit burn out when the system is operated on the 100% setting. When the initial lamp load is about half the capacity of the regulator, this condition does not seem to exist.

3.3.5 Lack of Information

A complaint which, although not an equipment fault, is important from the standpoint of maintenance, is the difficulty of supply of standard stock items. The items do not seem to be listed in ASO catalogs, or few people know how to find the stock number by the item description. In some instances maintenance personnel had prepared requisitions which were returned for additional information because the stock number given was not found in current catalogs. The fact that current information is not being passed on to the maintenance personnel was apparent. In some cases standard stock items were being purchased from manufacturers rather than through ASO. Only a few of the maintenance personnel had Technical Orders or Standard Drawings of equipment, and in some instances they were unaware of the existence of such drawings and technical orders.

3.4 METHODS OF INSTALLING, TESTING, AND MAINTAINING EQUIPMENT

Since most sizable installations were made by outside contractors, details of the methods of installation were unobtainable. Generally there has been no established procedure for testing and maintaining equipment. In most cases testing and maintenance was done only when a fault occurred. At a few stations where complete routine checks were made, most potential failures were located and corrected before an outage occurred.

With an occasional exception, maintenance appeared to be better where it was assigned specifically to one or two persons. Better records were kept and the individual peculiarities of the system were more familiar to the maintenance personnel.

Maintenance personnel at Oceana have set up and maintained an excellent test procedure and a carefully kept set of records. Resistance of all circuits was measured daily with a low-voltage ohmmeter and recorded. When these measurements indicated any significant change in resistance, a "megger" measurement was made, and plans for repairs could be made before a failure occurred. Thus measurements were available for all seasons and weather conditions. They have installed ammeters on each of the new type NC-3 regulators to aid in daily checks. Since they had previously experienced difficulty with all lamps in a circuit burning out after a certain percentage of normal lamp failures, the ammeter checks are a valuable maintenance test. A higher than normal current is an indication that some of the lamps in that particular circuit have burned out and that checks in the field are necessary.

Oceana has established a system of numbering each fixture and component of all circuits. Individual records of each unit are kept by means of these numbers. All maintenance of each component is recorded including lamp changes. Thus the records provide a detailed account of all operations.

With one exception, lamps were replaced as the burned out lamps were noticed on a visual inspection. Patuxent River has been using group lamp replacement for one runway and expects to extend this method to the rest of the field in the immediate future. They reported that by using this method, frequency of visual inspection was reduced and considerable saving in time for replacement was effected and work could be planned more efficiently since the time for replacement can be estimated.

3.5 ADDITIONAL COMMENTS

3.5.1 Control Panels

Several tower operators were not satisfied with the type of control panel in use. A panel simulating the field layout, sections of which are automatically illuminated by the operation of the field controls, was desired. If this was not possible, the installation of pilot lights to indicate which runway- and approach-light circuits are in operation was requested.

At Atlantic City the control panel had been moved from the console in front of the operator to a point about 10 feet away. This is very unhandy, and the switch positions cannot now be seen from the tower operator's position.

3.5.2 Taxiway Lighting Systems

Atlantic City in particular was not satisfied with the control system for the taxiway lights. To change the pattern on the field it is necessary to turn off all taxiway lights before a section can be added or turned out. For stations like Atlantic City which have both civilian and military traffic going to different locations on the field, this is a serious problem, since all traffic on the field must be stopped when a change is being made or aircraft may run off of the taxiway during the period the lights are off, as has happened on occasions.

Ordinarily when several taxiway circuits are energized from the same regulator, an open in one circuit will cause all the lights to go out. To eliminate this, Quonset Point has installed "Thyrite" cutouts across each circuit. These cutouts function on an open series circuit by short circuiting the faulty circuit without affecting the others. This eliminates a series of checks by the tower operators to determine the faulty circuit.

3.5.3 Miscellaneous

Only one station had radio communication between the control tower and the airfield lighting maintenance vehicle. Nearly all station maintenance personnel felt that radio communications would expedite routine maintenance.

Personnel at some stations felt that the maintenance of airfield lighting equipment is considered of secondary importance; that maintenance items were difficult to procure; and that time was not allowed for adequate preventive maintenance.

Personnel at several stations felt that the control circuits should be protected by more than one main circuit breaker so that a fault could not cause a complete blackout of all the visual landing aids.

4. SUMMARY AND RECOMMENDATIONS

As a result of this survey some recommendations may be made to improve maintenance and operation of the visual landing aids. Some of these recommendations have general application, but many of them have special applications to problems similar to those encountered at a given station. After a good procedure for maintenance is eatablished, many of the airfield lighting problems that arise may be solved locally. In some cases replacement of obsolete equipment is the only satisfactory answer; in other cases a good airfield lighting maintenance manual will be of considerable assistance. Recommendations as a result of the survey are as follows.

4.1 MAINTENANCE PROCEDURES AND EQUIPMENT

4.1.1 Establishment of Regular Maintenance Test Procedures And Records

Regular and frequent checks of circuit resistance should be made, recorded, and kept available. Analyses of faults, other pertinent information, and checks should be carefully studied and recorded.

4.1.2 Assignment of Full Time Personnel

One or two persons should be assigned full time for airfield lighting maintenance. They should participate in the acceptance testing and inspection of all airfield lighting installations at their stations. All applicable technical information should be supplied them and should be kept current; e.g., drawings, instructions, technical orders, lists of standard stock items with stock numbers,and descriptions of new developments in maintenance and lighting equipment.

4.1.3 Recommended Maintenance and Test Equipment

Radio communication between the maintenance vehicle and the control tower is virtually a necessity. This communication equipment can be obtained by using locally modified surplus aircraft radio communication equipment. In addition to the standard test equipment such as voltmeter, clamp-on ammeter, ohmmeter, and "megger" there should be available a high-voltage insulation tester similar to the Takk Insulation Tester and a cable-fault locating detector similar to the OBB Equipment. Permanently installed ammeters for the measurement of the output current of runway regulators should be included as part of the regulators.

4.2 CABLE AND CABLE CONNECTORS

In general the new 5000-volt, polychloroprene-jacketed cable, connectors, and isolating transformers are satisfactory but they should be checked after they have had more time in service.

In unusual cases where faults are confined to a small area of an airfield and the cause of the faults cannot be determined, it may be desirable to use duct or metallic-sheathed cable. With properly designed duct, the effects of lightning, soil-chemical action, and other causes of failure would probably be reduced. The cost of installing duct will be expensive but in some instances it may be more economical than maintenance of cables, especially when the results of outages are considered. In some cases duct may be desirable to reduce the damage resulting from digging and trenching.

With one exception the lead-sheathed type of cable still in use has deteriorated until it has become a major maintenance problem. Early replacement of this cable is indicated.

The protective caps used to protect the connectors during shipment should be saved and reinstalled whenever a connection is opened during maintenance.

4.3 RUNWAY AND TAXIWAY LIGHTING

4.3.1 Improvement of Water Removal from Semi-Flush Lights

The AN-L-9 semi-flush lights continue to cause trouble from water leaking into the fixtures and grounding the circuits. Improving the seals and gasketing or providing a more convenient means of removing the water are generally unsatisfactory except as temporary measures. A possible means of removing the water is to use compressed air to blow out the water. The use of isolating transformers will prevent multiple grounds in the circuit due to water in the units.

4.3.2 Prevention of Damage to Elevated Lights

The problem of the cones of type M-1 lights being blown over by jet and propeller blasts requires a redesign of the cones or of the mounting, since jet blast can collapse the cone if it is bolted down. Taxiing aircraft and other vehicles frequently damage lights, especially the type C-1 lights. This damage may be reduced by improving their identification by painting the area around the fixture with yellow paint or by using other easily identified objects and paint to mark the location. Adequate marking of each fixture will help prevent damage by snow removal equipment.

4.3.3 Correction of Lamp Failures Due to High Current

Increasing current from type NC-3 regulators feeding circuits with isolating transformers as lamps burn out can cause the rest of the lamps in the circuit to burn out. Since this characteristic appears to be inherent in the design of the regulators, care in keeping lamps replaced is required to improve the current regulation.

4.3.4 Group Lamp Replacement

Group replacement will be especially helpful in preventing excessive current from regulators with isolating transformers if the lamps are replaced before too large a percentage has failed. Also it will help in planning work and aid in reducing outages from lamp burnouts. It may be desirable to provide elapsed time meters to determine the length of time the lamps have burned on the 100% setting.

Various methods of group replacement are possible, but probably total replacement at a fraction of rated life recommended by lamp manufacturers will be satisfactory. For runway lights or lights at critical locations, it will probably be desirable to replace burnouts occurring before total replacement time.

Another satisfactory method for determining when to replace all lamps is to replace individual burnouts until a given fraction (say 10%) of the lamps of the circuit have been replaced and then to replace all the lamps in the circuit.

4.3.5 Taxiway Lighting

A taxiway lighting intensity regulator appears necessary for use with the type M-1 taxiway lights to reduce glare on clear dark nights. It is believed that a two-step system will be adequate. The taxiway controls should provide for instantaneous changing of one or more circuits without affecting the others. For the moderate expense involved, the installation of "Thyrite" cutouts to eliminate the possibility of complete taxiway lighting blackout due to an open circuit in one of the circuits appears justified.

4.3.6 Intensity Setting

Where high intensity runway lights are installed, the control tower operators have a tendency to set the intensity too high for existing conditions. To aid the tower operators in setting the intensity of runway lights, the installation of a runway light directed toward the control tower and connected so it will burn when any runway equipped with high intensity lights is selected, is recommended. This fixture should be located 1000 to 1200 feet from the tower. This provides a check by the tower personnel of the appearance of the lights.

4.3.7 Indication of Runway- and Approach-Light Operation

A positive method of indicating to the tower operator the satisfactory operation of all sections of approach- and runway-lighting systems is needed, particularly for the runways two miles long and longer, now being constructed for operation of jet aircraft. This may be accomplished by a simple system of meters or of relays and pilot lights which indicate the nominal output voltage of current regulators or the nominal output current of voltage regulators.

4.4 GENERAL

4.4.1 Provision for Emergency Escape from U-Shaped Vault

Due to the possibility that a person can be trapped in the back of the new U-shaped vault, some means of easy emergency escape should be provided.

4.4.2 Additional Surveys

The above is based on information acquired from a limited number of stations located near Washington. To determine if the faults and maintenance problems found are common throughout all Navy and Marine Corps stations, surveys covering groups of stations more remote from Washington are recommended.

4.4.3 Higher Echelon Inspection of Visual Landing Aids

In order to improve the efficiency of the operation and maintenance of visual landing aids, it is suggested that each installation be visited at least once a year by a representative of a higher echelon. The visits should include conferences with the station personnel who do the maintenance. During these visits the maintenance records of the visual landing aids could be checked and failures in cable and equipment noted. If the visits are made by personnel of the District level, an annual conference between them and personnel of the Bureau level would be helpful. Adoption of such a policy should improve the morale of the maintenance men, promote a more rapid interchange of information at all levels, and bring knowledge of common maintenance problems, equipment failures, and requirements promptly to the attention of those concerned with evaluation and remedial action.

Appendix I

Survey Questionnaire

National Bureau of Standards

Visual Landing Aids Survey

Conducted for
Visual Landing Aids Section
Code AE-10, Bureau of Aeronautics

Station Date

Location

1. Number of Runways

2. Type of Runway Lights

   Runway Runway
   Runway Runway
   Runway Runway

3. Total Number of Runway Lights

4. Types of Taxiway Lights

5. Number of Taxiway Light Circuits

6. Total Number of Taxiway Lights

7. Approach Lights Yes No

8. Approach Lights on Runways

9. Type of Cable

   A. In Ducts Yes No
   B. Total Length of Cable (Estimate)
   C. When Installed

10. Isolating Transformers Yes No

11. Types of Cable Faults

    A. Splices   C.
    B. Connectors   D.

12. Type of Soil

13. Frequency of Cable Faults (All Runways & Taxiways)

    A. Particular Runway   C. Circuit
    B. Taxiway   D. Section

14. Types of Fault-Locating Equipment

    A.
    B.
    C.
    D.
    E.
    F.

15. Test Equipment Other Than Fault-Locating

    A.
    B.
    C.
    D.
    E.
    F.
    G.
    H.

16. Regularity of Resistance Measurements

    Annually   Semi-annually   Quarterly
    Monthly   When Fault Occurs   No

17. Type of Records Kept of Measurements

    Record Book   Record Cards (Biddle)   Mental
    Other   None

18. Availability of Records. Readily Other (Explain)

19. Record of Location of Faults Record Book

Field Plan Mentally None

20. Field Plan of Cable Location Available to Maintenance Personnel:

Readily Other (Explain)

21. Method Used to Determine Location of Cable Fault (Explain Fully)

22. Is this Method Easily Adaptable to Other Stations?

Yes No

23. Probable Cause of Most Cable Faults in Relation to Frequency of Occurrence

Faulty Installation
A.
B.
C.
Digging and Trenching in Cable Areas
Faulty Cable (Explain Fully)
Termites Rodents
Lightning Soil Chemical Action
Other (Explain)

24. Method of Repair: Splice in Short Sections, Replace Cable Between Lights, Handholes, Manholes Other

25. Relamping Frequency

26. Group Relamping Yes No

27. Frequency of Routine Maintenance of Equipment

28. Fixture Cleaning

29. Alignment (End of Runway Lights)

30. Maintenance Personnel: Assigned as Needed

    Total Assignment Number of Men
    Part Assignment with Other Duties

31. Items of Equipment that Require Most Maintenance in Order of Number of Faults and Probable Remedial Action to Minimize Fault

    A.
    B.
    C.
    D.
    E.

32. Substandard Equipment Noted

33. Does System Meet Current Requirements?

34. Do Runway and Taxiway Markings Conform to ANC-1100?

    Yes No

    A. Turn-offs Indicated Yes No

    B. Special Runway Marking

    C. Destination Markers Yes No

        1. Illuminated Yes No

35. Special Features in Use Adaptable to Other Stations

36. Additional Remarks

Appendix II

Summary of Replies to Survey Questionnaire

The following is a summary of the answers to the Visual Landing Aids Survey questionnaire questions of Appendix I. For questions with many different answers or opinions only the more frequent or characteristic answers are included.

Station Surveyed	Location	Date
Naval Air Station	Atlantic City, N.J.	5-7-53
Naval Air Station	Brunswick, Maine	5-4-53
Marine Corps Air Station	Cherry Point, N.C.	4-22,23-53
Naval Auxiliary Air Station	Chincoteague, Va.	4-24-53
Naval Air Station	Johnsville, Pa.	5-6-53
Naval Air Station	Norfolk, Va.	4-20-53
Naval Air Station	Oceana, Va.	4-21-53
Naval Air Station	Patuxent River, Md.	5-11-53
Marine Corps Air Station	Quantico, Va.	4-30-53
Naval Air Station	Quonset Point, R.I.	5-5-53
Naval Air Station, Anacostia	Washington, D.C.	5-1-53

1. Number of Runways: 37

2. Type of Runway Lights:

   AN-L-9 at eight stations
   C-1 at five stations
   M-1 at seven stations
   M-2 at three stations

3. Total Number of Runway Lights:

AN-L-9	845
C-1	712
M-1	867
M-2	285
Total	2709

4. Types of Taxiway Lights: AN-L-9 and M-1

5. Number of Taxiway Light Circuits: 74 plus 13 more in future

6. Total Number of Taxiway Lights: 2857

7. Approach Lights: Yes: One station plus one for near future
No: 10

8. Approach Lights on 1 Runway of 74 runways (ends).

9. Type of Cable:

3000-volt lead-covered (VCLC) at six stations
3000-volt polychloroprene at six stations
5000-volt polychloroprene at nine stations

9A. In Ducts:

Paved areas only at eight stations
Paved areas and one or more runways at three stations
Taxiways and other areas at no stations

9B. Total Length of Cable (Estimate): 3,185,000 feet

9C. When Installed:

Most of installation 1945 or before at five stations
Part of installation 1946 - 1950 at four stations
Part or all of installation since 1950 at six stations
Replacement of early installation planned or being made at time of survey at three stations

Average installation six years old

10. Isolating Transformers: Yes: No:

No isolating transformers at two stations
All isolating transformers at two stations
Part of installation has isolating transformers at seven stations

11. Types of Cable Faults:

Installation faults at three stations
Lightning damage at three stations
Faulty splices at three stations
Soil-chemical action on lead-sheath at two stations
Old 3000-volt, lead-sheath cable bad at one station
3000-volt, polychloroprene cable bad at one station
Rock punctures from ground movement at one station

12. Type of Soil:

Soil analysis not available. About one-half of the stations are primarily hydraulic fill and the others are soil from the local area.

13. Frequency of Cable Faults (All Runways and Taxiways):

None at two stations
Less than one per year at one station
One per year at two stations
Two to three per year at two stations
One per month at two stations
Two per month at one station
One per week at one station

Average: About ten faults per year per station

13D. Section: One station reports frequency of faults to be chiefly localized to one general area
Two stations report one runway with old cable bad

14. Types of Fault-Locating Equipment:

Model OBB Cable Detecting Equipment at two stations
Stewart Type L Cable Tester at two stations, but results unsatisfactory
None at eight stations

15. Test Equipment Other than Fault-Locating:

Ammeters and voltmeters at eleven stations
"Megger" (500 to 2500 vdc) at ten stations
Ohmmeter at ten stations
Recording ammeter and voltmeter at one station
Fisher M Scope on order at one station

16. Regularity of Resistance Measurements:

When fault occurs at six stations
Daily at one station
Monthly at one station
Annually at one station
No schedule yet at one station
No measurements at one station (at the station with the most frequent occurrence of faults)

17. Type of Records Kept of Measurements:

    None at nine stations
    Record book at two stations

18. Availability of Records:

    Readily available at three stations
    No records kept at eight stations

19. Record of Location of Faults:

    Record book at three stations
    Mentally at three stations
    None at three stations
    Plans in office at two stations
    New installation at one station

20. Field Plan of Cable Location Available to Maintenance Personnel:

    Readily available at eight stations
    Readily available but not complete at one station
    Readily available on recent installations but very sketchy on original installations at one station
    Complete plans, etc., of new installations available, but no plans of old system were available at one station

21. Method Used to Determine Location of Cable Fault:

    OBB Cable Detecting Equipment primarily at two stations
    Stewart Type L Cable Tester with modified pickup coil, but not very successfully at one station
    Sectionalizing and "cut and try" methods at eleven stations

22. Is This Method Easily Adaptable to Other Stations?

    Model OBB Cable Detecting Equipment, with some practice, yes
    Sectionalizing and "cut and try" method, yes
    Modified Stewart Cable Tester, no

23. Probable Cause of Most Cable Faults in Relation to Frequency of Occurrence:

    Digging and trenching in cable areas reported at six stations
    Faulty installation reported at four stations
    Lightning reported at four stations

23. Probable Cause of Most Cable Faults in Relation to Frequency of Occurrence (cont.):

Faulty splices (primarily in lead-sheath cable) reported at three stations
Old cable bad (primarily in lead-sheath cable) reported at three stations
Soil-chemical action on lead-sheath cable reported at three stations
Ground movement causing rock punctures reported at one station
Many other faults have no determined causes

24. Method of Repair:

Splice in short sections especially in feeders at nine stations
Replace cable between lights at six stations
Replace cable between manholes or handholes at five stations
Splice in short sections in all cases except in duct at four stations

25. Relamping Frequency:

Daily as needed at nine stations
Weekly as needed at two stations

26. Group Relamping:

None at ten stations, but all were favorable to using it in the future
On one runway and will use it on new installation when completed at one station

27. Frequency of Routine Maintenance of Equipment:

Continuous at one station
Visual check weekly at one station
Visual check semi-weekly at one station
Visual check daily at five stations
Visual and meter checks daily at one station
Visual check daily with annual check with meters at one station
No set routine, as needed when fault occurs, at one station

28. Fixture Cleaning:

"As needed" at eleven stations
During daily checks at three stations (if lamp was replaced)
With lamp replacements at two stations which did not replace lamps during daily checks

29. Alignment (End of Runway Lights):

Correct at eight stations
Incorrect at three stations, but correction was made during the visit

30. Maintenance Personnel: Assignment:

One to three men on total assignment at six stations
Two and three men on part assignment with other duties at two stations
Men assigned only as needed at three stations

31. Items of Equipment that Require Most Maintenance in Order of Number of Faults and Probable Remedial Action to Minimize Fault:

Water in bases of type AN-L-9 lights at four stations
Runway lights damaged by jet and propeller blast and by ground traffic at three stations
Old 3000-volt cable is bad at three stations
Corrosion of contacts of AN-L-9 light fixtures at two stations
High output current of 15-kilowatt Hevi Duty regulators with isolating transformers at two stations
Old telephone-type control panel at one station
Snow removal equipment damaging fixtures at one station
Polychloroprene-type cable bad at one station
Female connector fills with dirt during repairs at one station
Brightness selector switch jumps stop at one station
Taxiway control panel is in wrong location and switching circuits are unsatisfactory as all circuits must be turned off before making a change at one station

32. Substandard Equipment Noted:

Obsolete telephone-type control panels at two stations
Experimental-design control panel at one station

33. Does System Meet Current Requirements?

Requirements met at eleven stations (when two installations are completed)

34. Do Runway and Taxiway Markings Conform to ANC-1100?

Yes, at ten stations
No, at one station, but new markings under contract

34A. Turn-offs Indicated:

Indicated at ten stations
Not indicated at one station, but indicator lights are being installed

34B. Special Runway Markings:

None, except carrier decks at two stations

34C. Destination Markers:

Illuminated markers at one station
No destination markers at ten stations

35. Special Features in Use Adaptable to Other Stations:

One station had a large sign near touchdown point reading "WHEELS" as a reminder to pilots
One station had installed wind socks near touchdown point beside each runway
One station had installed G. E. Thyrite units in each taxiway light feeder circuit so that in case of an open circuit the Thyrite will function, thus preventing all lights going out due to a fault in one circuit
One station had installed ammeters in each 15-kilowatt Hevi Duty regulator to read the output current and provide an easy means of determining if the output current was increasing due to some lamps being out.
One station had numbered each fixture and kept a complete record of lamp changes, etc., by fixture number

36. Additional Remarks:

Tower operators are setting high-intensity runway lights at too high intensity
Plan to install elapsed time meters on brightness step 5 for runway lights

36. Additional Remarks (cont.):

Type M-1 taxiway lights are too bright for dark nights
Desire indicator in tower to show circuit failures
Voltage varies 10% daily plus 10% seasonally
Feel need for emergency exit in rear of U-shaped vaults
Feeling that airfield lighting is considered secondary
Experience difficulty in obtaining equipment from stock for maintenance
Airfield lighting maintenance needs radio communications to tower
(Remarks are covered more completely in the report.)

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