NATIONAL BUREAU OF STANDARDS REPORT

8653

Development, Testing, and Evaluation of Visual Landing Aids
Consolidated Progress Report for the Period October 1 to December 31, 1964

By
Photometry and Colorimetry Section
Metrology Division

NBS

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

The National Bureau of Standards is a principal focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. Its responsibilities include development and maintenance of the national standards of measurement, and the provisions of means for making measurements consistent with those standards; determination of physical constants and properties of materials; development of methods for testing materials, mechanisms, and structures, and making such tests as may be necessary, particularly for government agencies; cooperation in the establishment of standard practices for incorporation in codes and specifications; advisory service to government agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; assistance to industry, business, and consumers in the development and acceptance of commercial standards and simplified trade practice recommendations; administration of programs in cooperation with United States business groups and standards organizations for the development of international standards of practice; and maintenance of a clearinghouse for the collection and dissemination of scientific, technical, and engineering information. The scope of the Bureau's activities is suggested in the following listing of its four Institutes and their organizational units.

Institute for Basic Standards. Electricity. Metrology. Heat. Radiation Physics. Mechanics. Applied Mathematics. Atomic Physics. Physical Chemistry. Laboratory Astrophysics.* Radio Standards Laboratory: Radio Standards Physics; Radio Standards Engineering.** Office of Standard Reference Data.

Institute for Materials Research. Analytical Chemistry. Polymers. Metallurgy. Inorganic Materials. Reactor Radiations. Cryogenics.** Office of Standard Reference Materials.

Central Radio Propagation Laboratory.** Ionosphere Research and Propagation. Troposphere and Space Telecommunications. Radio Systems. Upper Atmosphere and Space Physics.

Institute for Applied Technology. Textiles and Apparel Technology Center. Building Research. Industrial Equipment. Information Technology. Performance Test Development. Instrumentation. Transport Systems. Office of Technical Services. Office of Weights and Measures. Office of Engineering Standards. Office of Industrial Services.

---

* NBS Group, Joint Institute for Laboratory Astrophysics at the University of Colorado.
** Located at Boulder, Colorado.

NATIONAL BUREAU OF STANDARDS REPORT

NBS PROJECT		NBS REPORT
2120411 2120414 2120302	March 1965	8653

Development, Testing, and Evaluation of Visual Landing Aids

Consolidated Progress Report to
Ship Aeronautics Division
and
Meteorological Management Division
Bureau of Naval Weapons
Department of the Navy

and to
Federal Aviation Agency

For the Period
October 1 to December 31, 1964

By
Photometry and Colorimetry Section
Metrology Division

NBS

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

Development, Testing, and Evaluation of Visual Landing Aids
October 1 to December 31, 1964

I. REPORTS ISSUED

Report No.	Title
8168	Review of Elementary Theory of the Photometry of Projection Apparatus
8596	Guide to Use of the AN/TSM-11 Cable Test - Detecting Set
8612	Development, Testing, and Evaluation of Visual Landing Aids, Consolidated Progress Report for the Period July 1 to Septmeber 30, 1964
21P-44/62 Supp.	Output Maintenance of 500-Watt, 20-Ampere, PAR-56 "Quartzline" Approach- and Runway-Light Lamps
21P-34/64	Photometric Tests of a Deck Guide Light Manufactured by the L. C. Doane Company
21P-36/64 Supp.	Life Tests of Six Type Q20A/PAR56 and Six Type Q20A/PAR56/2 Developmental Approach- and Runway-Light Lamps

II. VISIBILITY METERS AND THEIR APPLICATION

Slant Visibility Meter.

No testing was carried out for this equipment, but the equipment was kept operating for demonstration to visitors and for use as a ceiling projector by FAA personnel in determining height of higher ceilings. Analysis of the data and preparation of a formal report will be resumed soon.

Shipboard Visibility Meter.

Details of the design of the feasibility model of the back-scatter visibility meter have been checked and the operation of the instrument has been checked in periods of good visibility and of fog. Construction

of an instrument suitable for field use is planned to start next quarter.

Hoffman Electronics is constructing, under Air Force-Coast Guard contract, a transistorized back-scatter meter using a gallium-arsenide source. Four units will be delivered, one of which will be assigned to the National Bureau of Standards. It is planned to conduct initial tests at Arcata using the four instruments. A visit was made to Arcata, to the University of California Fog Chamber at Richmond, California, and to the Hoffman plant at Santa Barbara, California, by personnel of the Air Force Cambridge Research Laboratories, Coast Guard, Weather Bureau, and the National Bureau of Standards, to inspect the work to date and to plan the test program.

Transmissometers.

High-Pulse-Rate Receiver The transmissometer modified to use a photo-pulse unit having a pulse rate five times normal has continued to operate with no failure or objectionable drifts in sensitivity. Tests will be made next quarter of the effects of changing trigger tubes in this unit and of the linearity of the output.

Air Force 100 Percent Setting Calibrator. The Air Force has obtained some commercially built units for determining the 100 percent setting of the transmissometer. These units are based on the 100 percent setting calibrator developed by the National Bureau of Standards and described in Report No. 7706, Development of a Transmissometer Calibrator, September 1962. A set of this equipment has been obtained from the Air Force for field evaluation. Test installations are planned at Arcata on NBS transmissometer installation T-M and on the Weather Bureau installation T-D. This evaluation should be completed in the next one or two quarters.

250-Foot-Baseline Transmissometer. A new task for evaluating the transmissometers has been proposed. It is proposed to check the transmittances recorded by a 250-foot-baseline transmissometer against those recorded by a 500-foot-baseline unit. This task is presently awaiting authorization and the availability of equipment. It is proposed that tests be made by installing two 250-foot-baseline transmissometers back-to-back alongside a 500-foot-baseline unit. The product of the transmittances from the 250-foot-baseline units should agree with the transmittance from the 500-foot-baseline unit. This method should virtually eliminate discrepancies in the measurements caused by sampling errors.

Signal Lines. The Federal Aviation Agency is planning to replace the power and control cables to the ILS glide-slope and localizer buildings at Arcata. We hope to salvage the present cables for use by the Field Laboratory to bring transmissometer signals from the field units into the laboratory.

Weather Bureau Transmissometer. The Weather Bureau transmissometer at Arcata was slowly decreasing in sensitivity. We assisted in tracing this problem to a faulty phototube. A ground on the signal cable to the remote weather station was located with the AN/TSM-11 cable test - detecting set. The fault was caused by gophers gnawing the shield on the cable.

Variation-of-Fog Studies.

The collecting of data illustrating the systematic variations in fog density has continued. Data are being obtained from the 6 transmissometers located at Arcata Airport. The locations of these instruments are shown in figure 1. Four of the transmissometers, T-F, T-M, T-S, and T-H, were installed especially for this study. These instruments and T-D are located in a relatively flat area near the center of the field. Instrument T-A is some distance away in the approach zone. It is about 20 feet lower in elevation and about 500 feet from the runway fill.

To illustrate the variability of transmittance as a function of time and space, records obtained during two fogs of moderate stability have been analyzed. The transmissometer records of the fog of the evening of December 14 are shown in figure 2. (The gaps in the traces are caused by the periodic hourly cutoffs to check indicator zero. In order to make the records more clear, the traces of the pen as it drops to zero and returns have been removed.)

Table 1 has been prepared to show the differences between simultaneous transmittance measurements at intervals throughout the fog. The transmissometer readings have been corrected for time, zero setting, and 100 percent setting.

As seen from figure 2, this fog has the appearance of a series of waves with periodic troughs and crests. A series of points, a, b, c, etc., which appear to be the troughs or crests of a particular wave, are designated as wave a, b, c, etc. The corrected transmittances and the times of occurrence for these points are given in table 2.

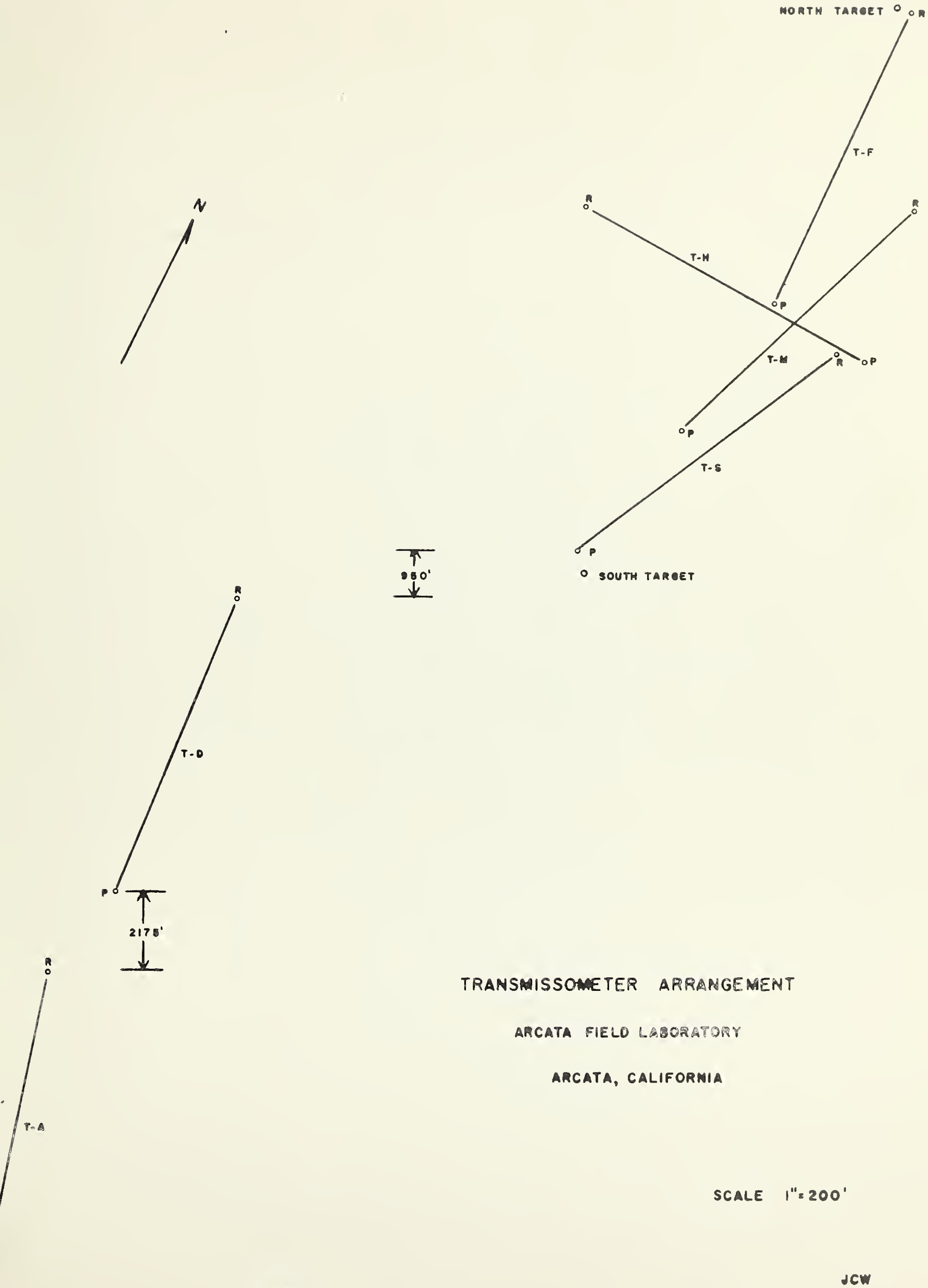
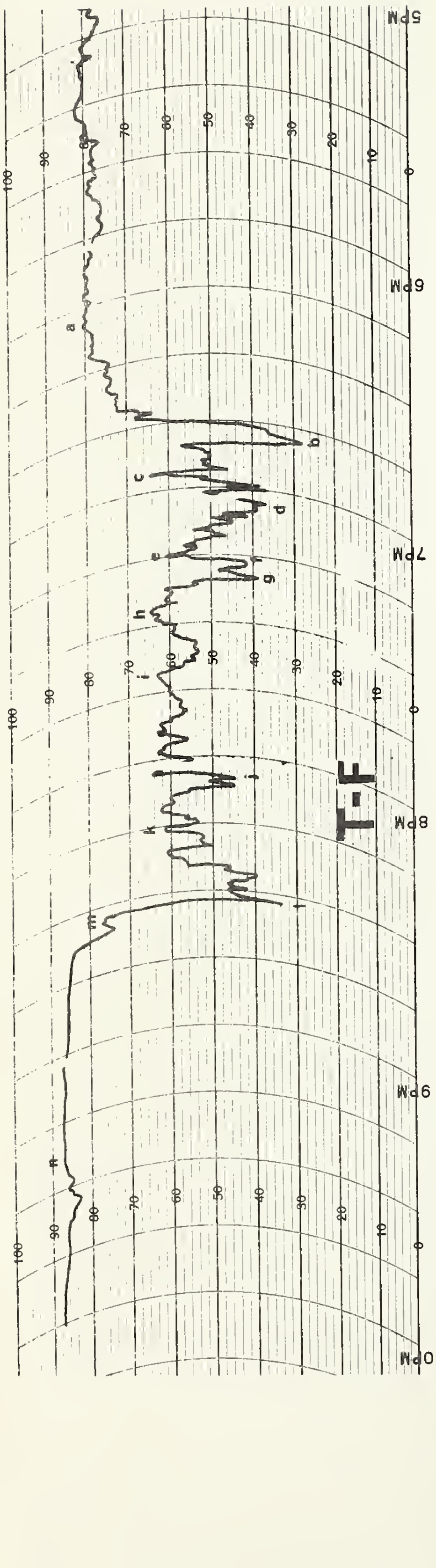
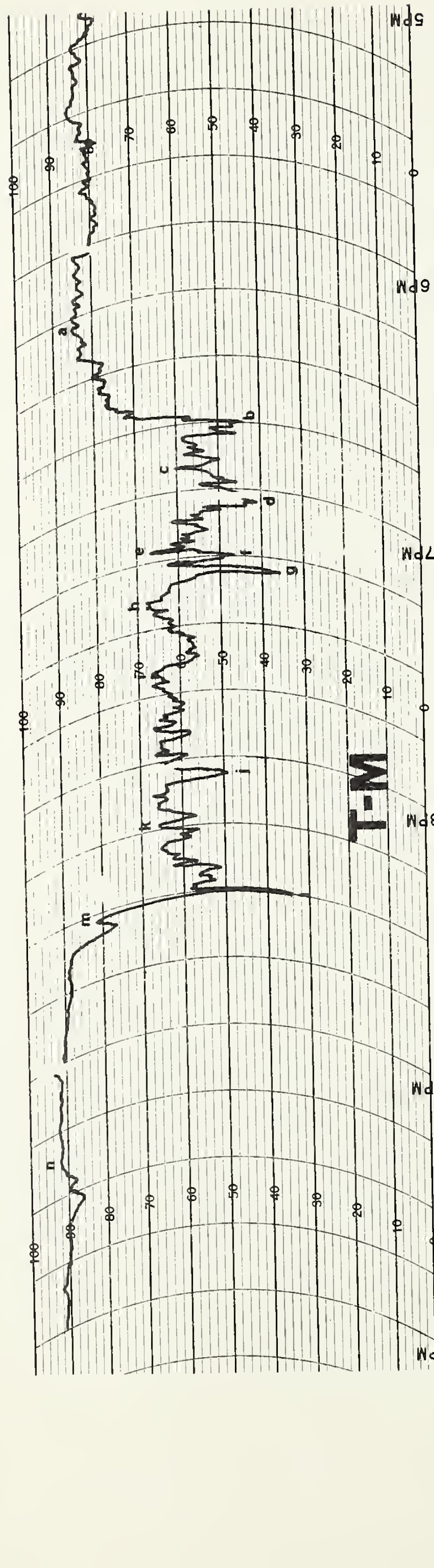
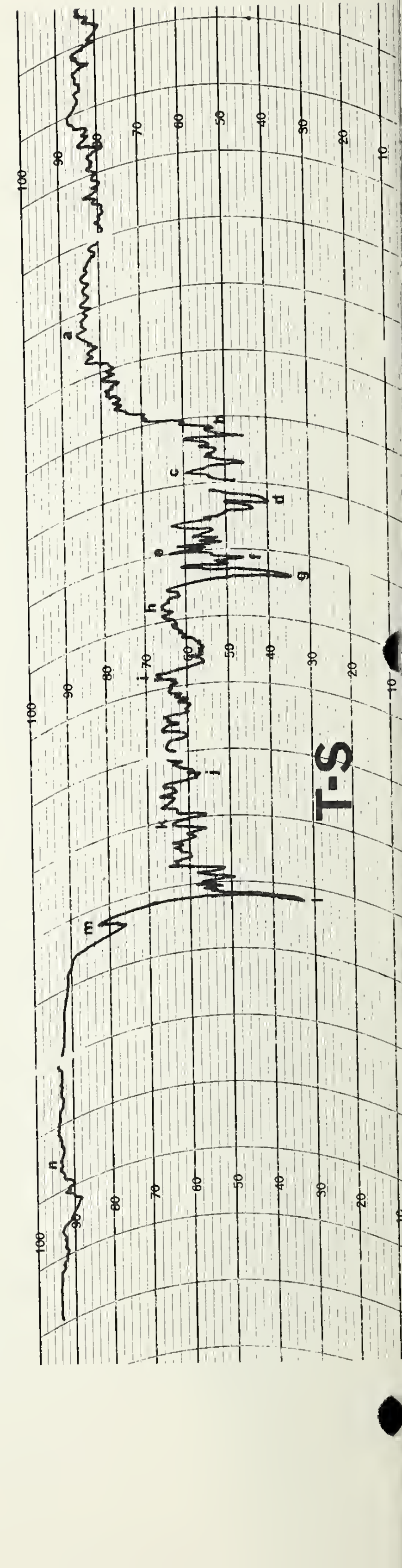
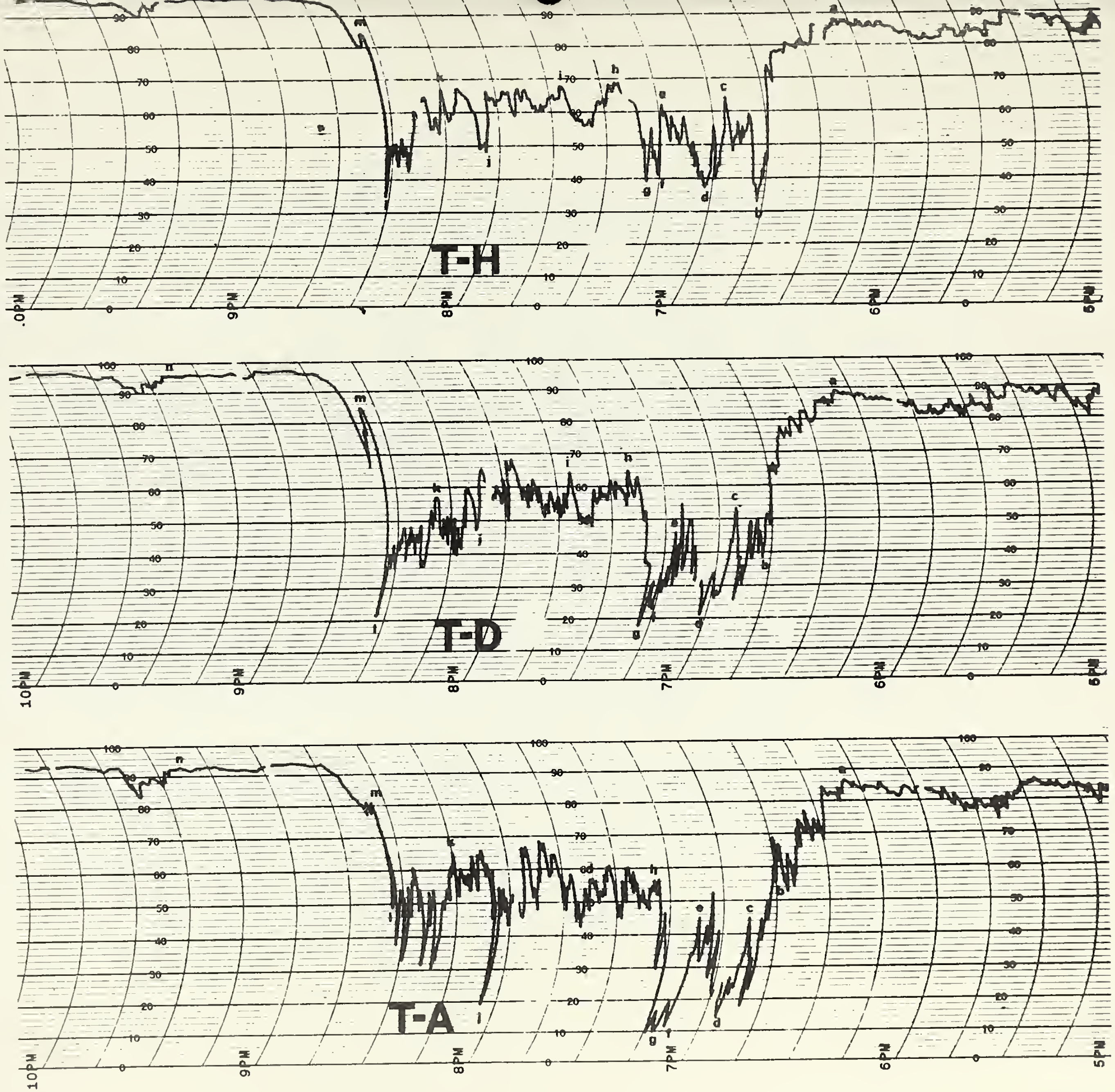

NORTH TARGET
N
R
P
T-F
T-H
T-M
T-S
SOUTH TARGET
950'
T-D
2175'
T-A
TRANSMISSOMETER ARRANGEMENT
ARCATA FIELD LABORATORY
ARCATA, CALIFORNIA
SCALE 1"=200'
JCW

FIGURE 1.


T-F


T-M


T-S



Fog of December 14

Figure 2

Table 1. Transmittances at Selected Times for Fog of December 14, 1964

Trans-missome-ter	Time →	1800	1815	1830	1845	1900	1915	1930	1945	2000	2015	2030	2045	2100	2115	2130
T-F		0.83	0.84	0.80	0.58	0.43	0.64	0.62	0.63	0.60	0.58	0.48	0.91	0.92	0.93	0.92
T-M		.84	.89	.84	.47	.51	.49	.65	.65	.65	.66	.58	.93	.95	.96	.92
T-S		.84	.88	.80	.64	.50	.66	.66	.67	.66	.62	.55	.95	.97	.99	.95
T-H		.86	.90	.82	.51	.56	.57	.65	.65	.64	.69	.47	.98	.99	.99	.97
T-D		.86	.88	.82	.61	.33	.23	.62	.58	.63	.47	.41	.98	.98	.98	.92
T-A		.86	.86	.72	.56	.22	.22	.51	.54	.51	.66	.50	.95	.95	.95	.88

Table 2. Times and Transmittances of Selected Points of Fog of December 14, 1964

Selected Points →	Time (PST) a	b	c	d	e	f	g	Transmittance T_{500} a	b	c	d	e	f	g
Transmissometer														
T-F	1819	1847	1856	1902	1914	1916	1919	0.87	0.29	0.68	0.38	0.65	0.43	0.41
T-M	1818	1847	1855	1901	1913	1915	1918	.89	.43	.64	.42	.68	.49	.37
T-S	1820	1848	1857	1903	1915	1916	1920	.89	.52	.61	.40	.66	.47	.34
T-H	1819	1846	1856	1902	1914	1916	1918	.89	.32	.64	.36	.62	.41	.39
T-D	1820	1847	1857	1902	1912	1915	1918	.91	.38	.54	.20	.47	.23	.17
T-A	1820	1846	1854	1858	1908	1911	1914	.89	.57	.46	.16	.48	.14	.12

Selected Points	Time (PST) h	i	j	k	l	m	n	Transmittance T_{500} h	i	j	k	l	m	n
Transmissometer														
T-F	1926	1941	2004	2016	2032	2034	2124	0.68	0.67	0.47	0.65	0.34	0.82	0.95
T-M	1924	1940	2004	2014	2031	2032	2122	.71	.70	.52	.70	.36	.86	.96
T-S	1926	1941	2005	2016	2032	2034	2124	.68	.70	.60	.67	.34	.87	.98
T-H	1926	1941	2004	2016	2032	2034	2123	.69	.68	.48	.67	.34	.85	.98
T-D	1924	1941	2007	2019	2032	2034	2125	.66	.65	.51	.58	.21	.86	.97
T-A	1922	1938	2006	2016	2034	2036	2126	.57	.59	.20	.68	.51	.83	.95

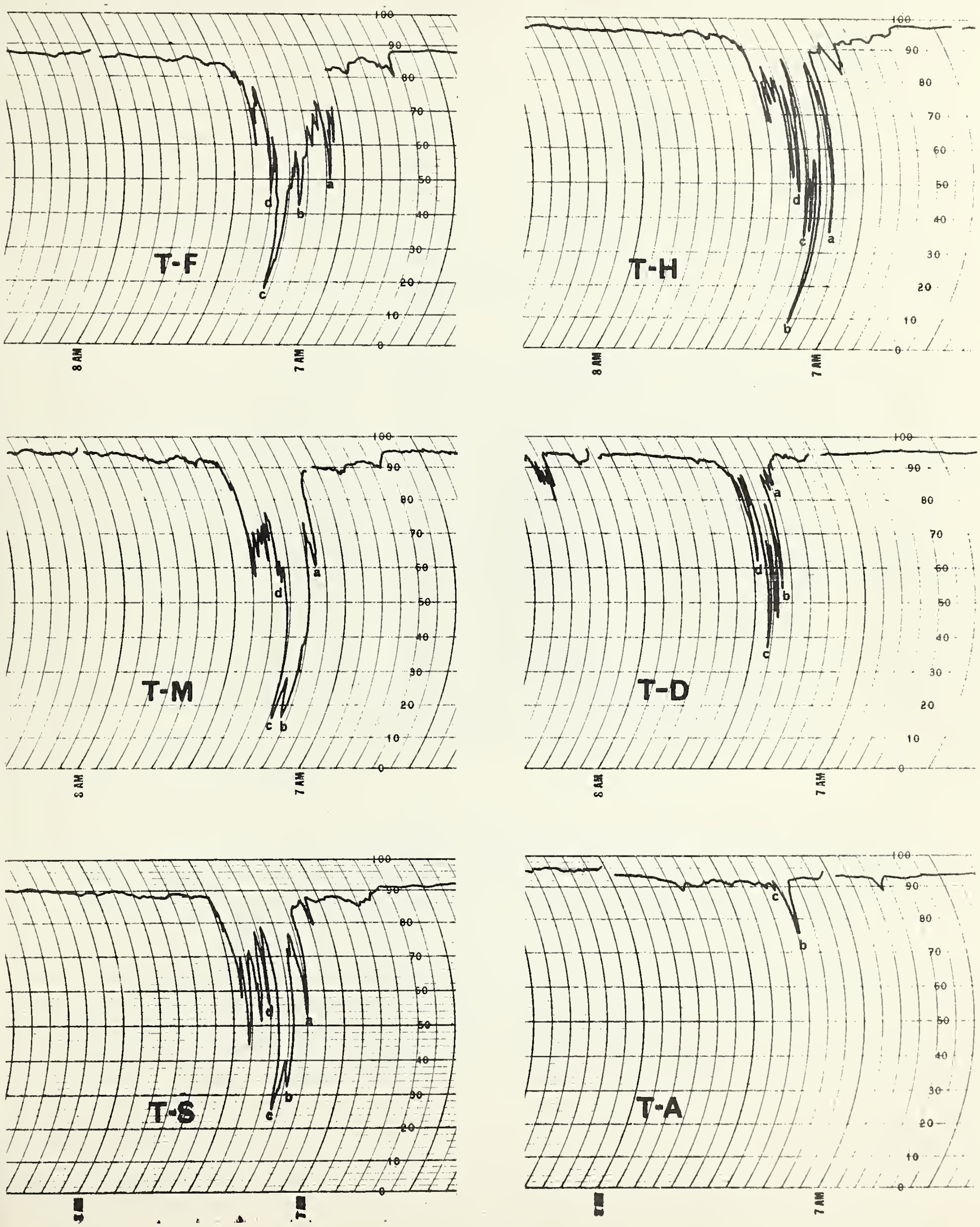
The records of the fog of the morning of December 15, 1964 are shown in figure 3 and the data are summarized on tables 3 and 4.

Table 3. Transmittances at Selected Times for Fog of December 15, 1964

Transmissometer / Time →	0700	0705	0710	0715	0720	0725	0730
T-F	0.88	0.69	0.66	0.50	0.47	0.85	0.90
T-M	.92	.89	.50	.16	.72	.71	.94
T-S	.91	.91	.56	.38	.66	.65	.92
T-H	.93	.92	.88	.35	.67	.72	.97
T-D	.95	.95	.93	.95	.90	.67	.83
T-A	.96	.95	.95	.80	.93	.94	.94

Table 4. Summary of Selected Points for Fog on December 15, 1964 Between 7:00 A.M. and 7:30 A.M.

	Time (PST)				Transmittance T_{500}			
Selected Points	a	b	c	d	a	b	c	d
Transmissometer								
T-F	0704	0714	0717	0720	0.52	0.44	0.17	0.47
T-M	0708	0712	0714	0717	.61	.16	.15	.56
T-S	0710	0714	0717	0722	.56	.34	.26	.54
T-H	0708	0712	0715	0717	.36	.07	.35	.48
T-D	0719	0722	0726	0729	.87	.56	.38	.64
T-A	--	0715	0718	--	--	.80	.94	--



Fog of December 15 **Figure 3**

Note from table 4 that for wave a the effect shown on the transmissometers is in the order T-F, T-M, T-H, T-S and T-D, with no evidence of any effect on T-A. The order of the effect of the wave indicates a movement from the north. Also note the identical times for T-M and T-H. For the times to be identical, the movement of the wave must be from the northeast. Wave b also approaches from the northeast since T-M and T-H are again identical, and, since T-F is affected later, this wave must come more from the east than does wave a. Waves c and d follow a pattern similar to that of wave a. Transmissometer T-A does not seem to follow the same wave pattern as the other transmissometers, probably because of its geographical location. Note that the transmittances are not as closely related to each other as are the times. Hence, although the waves are somewhat parallel, they are not iso-transmittance lines.

Because of the way in which T-M overlaps T-F and T-S, one would expect that at any given time the transmittances indicated by T-M would be approximately equal to the geometric mean of the transmittances indicated by T-F and T-S. However, as seen from tables 1 and 3, frequently this is not the case and the deviations are large. The agreement between the transmittances indicated by T-M and T-H is closer than is the agreement between the transmittances indicated by T-M and T-F, T-S, or the mean of the transmittances indicated by T-F and T-S. Thus, for these particular fogs, changing the orientation of the transmissometer baseline has less effect on the transmittances indicated than does shifting the baseline parallel to itself about one-half the length of the baseline.

On the other hand, as seen from tables 2 and 4, the agreement between the transmittance indicated by T-M and the geometric mean of the transmittances indicated by T-F and T-S is considerably improved when the transmittances of crests or troughs of particular waves are read.

Visibility Thresholds.

On four occasions in dense daytime fog, visual observations were made of 4-foot by 4-foot black targets to compare the visual range of the targets with the indicated visibility obtained from the transmissometers. The observation range was near and approximately parallel with the baselines of transmissometers T-F and T-S. This range was limited to 1000 feet, which is the total of the baselines for the two transmissometers. The observed ranges were in reasonable agreement with the indicated visibility at ranges near 1000 feet but were consistently greater than the indicated visibility for ranges of 500 feet or less. Additional observations are planned, using some smaller size targets at various heights above the ground and also checking the transmissometers

for possible errors to determine if sampling errors or instrument errors may be responsible for the discrepancies. One reason to question the data is that some of the observed visual ranges indicate threshold constants for the observers on the order of 0.002. In addition to the visual range observations, measurements will be made of the brightness of the targets and background to determine the threshold constants more accurately. A summary of the observed and indicated visual range data is given in table 1.

III. AIRFIELD LIGHTING AND MARKING

Navy Taxiway Lighting Standard.

The work on the taxiway lighting standard is nearing completion. The figures for the standard have been drafted and are being prepared for reproduction. The paragraphs on centerline lighting of high-speed runway exits are still subject to minor changes. This standard should be completed during the next reporting period.

Stub Approach Beacon.

At the request of pilots operating at the Arcata Airport, including airline and executive pilots, the stub approach beacon was operated for most conditions when the winds favord use of runway 13. The comments received were favorable to use of five type 20A/PAR56Q/1 lamps rotating at 12 revolutions per minute. One problem developed in that these lamps would break when they were operated in moderate or heavy rain. A malfunction report has been prepared. Difficulties in obtaining satisfactory lamps are not anticipated.

The necessary comments and information for evaluating the stub approach beacon have now been obtained. The stub approach beacon is a useful visual aid for use on runway approaches which are not equipped with precision instrument approach aids or high intensity approach lights. This beacon is especially valuable on circling type approaches where the end of the runway is not easily identified on the downwind and base legs of the approach. The beacon was useful as a supplement to the visual approach slope indicator (VASI) lights when the aircraft was outside the beams of the VASI and to mark the center of the runway when the aircraft was on final approach. This beacon may be installed within 300 feet of the runway threshold and within 200 feet of the low profile instrument landing system (ILS) localizer antennas without creating problems. When the beacon is located this close to the runway it may be necessary to mount the turntable in a pit with only the lamps projecting above the ground surface. In the tests a 12-inch board covered with a mesh wire and dirt served adequately as a visual shield from the runway and taxiways and as an electromagnetic shield to keep the approach beacon from interfering with the ILS localizer signal.

The stub approach beacon is recommended for use only when the more complete approach beacon system can not be installed. (See NBS Report No. 5902, An Approach Beacon System.)

The recommended stub approach beacon installation should consist of the following:

1. A beacon base and turntable with the turntable rotating at 12 revolutions per minute, installed on the extended runway centerline 200 to 1000 feet before the threshold.

2. Five lampholders equally spaced around the turntable, with axes of the beams 8 degrees above horizontal.

3. Type 20A/PAR56Q/1 lamps mounted in the lampholders.

4. Remote control for energizing the beacon and selecting the intensity setting by the tower or controlling agency. If necessary, manual control may be used.

5. Intensity control for the beacon. Two intensities, one for daytime and one for nighttime, are required, but three intensities are desirable when remote control is available. The low intensity should be between 20 and 30 percent of full intensity (15.6 amperes for each lamp) and the medium intensity, if provided, should be about 50 percent of full intensity (17.8 amperes). If remote control is not available, the intensity selection may be made by a photoelectric switch or by a timing switch.

6. Shields on the beacon when they are needed, to prevent glare on nearby traffic surfaces of the airfield and to prevent distortion of the localizer beam.

Runway Identification Lights.

The capacitor motors in the runway identification lights have been replaced with synchronous motors, and a revised synchronizing circuit has been designed. Some of the components necessary for the completion of the revision have not yet been received.

Intensity Maintenance of 500-Watt, PAR-56 Iodine-Cycle Lamps.

NBS Report 21P-44/62 Supplementary was issued, giving the results of a study of the output maintenance of two types (stippled and prismatic covers) of 500-watt, 20-ampere, PAR-56 iodine-cycle lamps. The photometric characteristics of these lamps were reported in NBS Report 21P-44/62. In this supplementary report, intensity distributions, taken at 100-hour intervals of burning time, are presented. Also shown are curves of relative peak intensity vs. time for the iodine-cycle lamps

as compared with similar curves for the conventional 500-watt lamps. The average relative peak intensity of the stippled-cover iodine-cyle lamps was 101% after 500 hours of burning. For the conventional lamps it was 57% after 100 hours of burning. For the prismatic-cover lamps it was 98% after 500 hours for the iodine-cycle lamps and 58% after 100 hours for the conventional type.

Developmental 300-Watt, 20-Ampere, PAR-56 Iodine-Cycle Approach- and Runway-Light Lamps.

NBS Report 21P-36/64 Supplementary was issued, giving the results of life tests of the 300-watt, 20-ampere, 500-hour, types Q20A/PAR56 and Q20A/PAR56/2 developmental approach- and runway-light lamps. The photometric characteristics of these lamps were reported in NBS Report 21P-36/64. The average life was as follows:

Type Q20A/PAR56 (prismatic cover):	509 hours
Type Q20A/PAR56/2 (stippled cover) :	494 hours
Both types:	502 hours

SATS Runway Centerline Lights.

A drawing of a proposed design for a centerline light fixture has been made, and a source of armored cable that will fit into the edge raceway of the mat has been located. This design should provide a light of much greater intensity, and it should reduce the damage resulting from the crushing of the power cable.

Distance-To-Go Lights.

A study has been undertaken to determine the feasibility of using a configuration of pancake lights embedded in the runway surface to indicate the distance remaining to the end of the runway. Models (10' = 1") have been constructed of several different systems of symbols and digits for laboratory observations.

6000-Hour, 700PS40 Lamps for the 300-mm Code, or Hazard, Beacon.

The life testing of this group of lamps continued through the quarter.

Q6.6PAR64/3 Iodine-Cycle Lamps for VASI Systems.

NBS Test Report 21P-47/64 was drafted giving a limited amount of maintenance information on a group of 13 Q6.6A/PAR64/3 iodine-cycle lamps for use in the VASI systems. Most of the lamps failed when they were removed from the life test racks at various times. Of those which could be measured, four lamps gave a mean lumen maintenance of 98% after 1000 hours, while one gave 91% after 1400 hours and burned out at 1986 hours.

Cable Test - Detecting Set.

The report on the use of this equipment has been completed and issued as NBS Report 8596, Guide to Use of AN/TSM-11 Cable Test-Detecting Set. This completes work on this task.

Airfield Lighting Cable Connectors Field Test. The leakage resistances for the cable connectors on field tests were measured. No appreciable changes have occurred since the previous measurements.

IV. SEADROME LIGHTING AND MARKING

No work was conducted in this field during the quarter.

V. CARRIER LANDING AIDS

Modified Source-Light Indicator Assembly of the Mark 6 Fresnel-Lens Optical Landing System.

Photometric measurements were made to determine the effect on vertical subtense of the beam from the source-light indicator assembly when the source height (narrow, horizontal slit) was reduced from 0.07" to 0.06" (both dimensions nominal) by means of an overlay. The results show a decrease in the subtense at 50% of peak intensity (11.0 kilocandelas) from 0.25° to 0.22°, which is roughly comparable to the fractional reduction in source height. The overlay changed the source distance, and, as a consequence, the virtual image distance of the system. The peak intensity decreased from 22.5 kilocandelas to 21.8 kilocandelas. This decrease in peak intensity would have been greater if the image distance had not been changed.

Deck Guide Light.

Photometric tests of a bidirectional deck guide light manufactured by the L. C. Doane Company using a 100- and a 45-watt iodine-cycle lamp have been completed, and the results have been reported in NBS Test Report 21P-34/64. The unit has a peak intensity, in the beam from the 100-watt lamp, of 650 candelas and a beam spread to 50% of peak, of 32° horizontal by 7° vertical. The unit had undergone hook-impact tests before the photometric tests were made.

LPH Angle-of-Approach Lights.

Review of the draft specification prepared by NAEL(SI) for an LPH angle-of-approach light was completed. This specification was considered in detail at a conference with personnel of the Bureau of Naval Weapons and of NAEL(SI).

VI. MISCELLANEOUS TECHNICAL AND CONSULTIVE SERVICES

Review of Specifications.

Review of specifications, MS drawings, and proposed revisions has continued.

Field Tests of Retroreflectors.

Three retroreflectors were tested by visual observation and comparison with a standard lamp along the 6000-foot test range at Arcata. The light source was kept at a fixed intensity and a fixed position 700 feet from the retroreflector. Two observers were used with observations at several distances along the test range. All three reflector samples indicated an apparent increase in intensity out to at least 2000 feet, but comparison of the results from the two observers indicates poor quantitative agreement. Further tests will be delayed to try to obtain a telephotometer for quantitative measurements.

Miscellaneous Consultive Services.

Visitors. Representatives from the Air Force, Coast Guard, and Weather Bureau visited our Arcata Laboratory, timing their visit to coincide with Mr. Douglas'. The Air Force and Weather Bureau representatives were primarily interested in the transmissometer, the slant visibility meter, and fog variation. The Coast Guard personnel's interest was in a practical fog detector.

VII. MISCELLANEOUS

Colors of Signal Lights.

NBS Handbook 95, "United States Standard for the Colors of Signal Lights," has been issued. This Handbook was prepared by Mr. F. C. Breckenridge of the National Bureau of Standards in collaboration with the U. S. National Committee on the Colors of Signal Lights. It has been prepared as a recommended standard to help bring the specifications used in this country for signal light colors into agreement with international usage, to improve specifications technically, to eliminate wasteful differentiation, and to contribute toward maximum reliability in signal light recognition. Much of the technical data embodied in this Handbook was obtained from aviation signal lighting projects.

Visual Aids Panel.

The Third Meeting of the ICAO Visual Aids Panel was held in Montreal October 14 to 30, 1964. Mr. Douglas attended as a member nominated by the International Commission on Illumination and served as Chairman of the Panel.

Visit to University of California Fog Chamber.

A visit was made to the fog chamber to participate in a conference concerning the intensities of touchdown zone and centerline lights required for Categories II and III operations.

Theory of Photometry of Projection Apparatus.

NBS Report 8168, 'Review of Elementary Theory of the Photometry of Projection Apparatus," has been completed and issued. This report develops equations based upon simple geometric relations which related measurements of the illuminance produced by projectors producing non-collimated beams to the distance from the projector. Hence the relations developed in the report make possible the compuation of the visual range of such lights as the lens cells of the Fresnel Lens Optical Landing System from photometric measurements made in the laboratory.

Activities During Flood Emergency.

The Northern California coastal area suffered unprecedented flooding starting December 21, 1964. All major streams reached record heights, most of which were several feet higher than in 1955. The results were that about 15,000 people were evacuated from their homes, perhaps 2500 homes were destroyed or severely damaged, several sizable communities were completely wiped out, an area of about 4000 square miles and

120,000 people were completely isolated for weeks without surface transportation. Many communities were cut off from all outside contact for more than a week despite valiant attempts by helicopters. Fortunately, the loss of life was small, being less than 25 dead or still missing. Damage to state and federal highways alone has been estimated at over $32,000,000, with 18 major bridges destroyed. After one month some emergency traffic was allowed through on three major routes out of the area. The railroads are still estimating four to six months before they will be able to handle any traffic. Even marine shipping, with one or two exceptions, was unable to reach the area for over two weeks because of the storms at sea. Therefore all supplies and outside assistance had to be brought into the area by air, coming, for the greatest part, into the Arcata Airport.

Our station at Arcata Airport was used as an unofficial base for operations because of its location in the tower building and our personnel's knowledge of the facilities of the airport and the Humboldt County area. The office was open daily from December 21 to January 16. From December 21 through 26 the primary effort was on the rescue of people caught in the floods. From December 26 to January 22, the major emphasis was on the airlift into the area although much of the supply to the remote isolated communities was handled from this airport. During this period there were more than 4700 air operations into the Arcata Airport bringing in more than 9,000,000 pounds of supplies and equipment, and approximately 12,000 people were flown in or out. All of this activity was handled by an overloaded airport with many people relatively inexperienced in this type of work and with a minimum of coordination, but with a maximum of cooperation, without a serious accident and with only a couple of incidents in some of the severest kind of flying conditions.

The major part of the work of the Field Laboratory was answering questions and the telephone; directing people to facilities, equipment, and other people; arranging quarters for rescue and emergency personnel; providing transportation about the airport and arranging for transportation away from the airport; and performing a great number of minor but important tasks. The Field Laboratory was assigned the task of arranging flights on military aircraft out of the area for stranded military personnel and their dependents and officials on emergency duties. Approximately 500 people were manifested out on military aircraft through our office. This required contacting pilots for their destination, departure time, and capability of taking passengers; manifesting passengers to the most convenient destination; obtaining releases from civilians; and coordinating the passengers with the crews and planes. Several of the people had been caught by the floods and had nothing but the clothing they were wearing and a letter from Red Cross confirming their status and perhaps an extension of their leave. One problem was explaining to people that they would be unable to fly out their private automobiles no matter how far away they were based.

Some of the particular tasks performed by our personnel were as follows: participation in a ground search mission for a crashed helicopter at night in pouring rain over extremely rugged terrain —no success; briefing search and rescue crews, including the obtaining of aerial photos of the areas from the County Assessor's office; aiding in installing a GCA unit, including site selection, helping to survey the site, arranging for telephones and power, and obtaining a housetrailer for use of the standby crews; arranging for obtaining aviation weather reports from several isolated communities through a network of Citizen-Band radios and relaying the reports to the local FAA towers at the three airports involved in rescue efforts (this arrangements was used for 10 days); assisting on aircraft emergencies at this airport; helping to handle aircraft traffic taxiing and parking; helping to unload air cargo, including tons of Christmas mail; and assisting in maintaining the airfield lighting.

We suffered only minor damages to our equipment and installations. The tower carrying our targets for visual observations in conjunction with the slant visibility meter evaluation was blown down although it had been lowered to only about 30 feet high and was guyed. One target used for observations in the fog variability studies was blown down and the other was tilted. The shelter was toppled and moisture into the variable autotransformer knocked out the special taxiway intersection lighting installation.

NBS Report 8653
March 1965

US COMM NBS DC

DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS