

#11

Office of the Secretary of Defense 50 U.S.C. 3052
Chief, RDD, ESD, WHS
Date: 11 JAN 2013 Authority: EO 13526
Declassify: _____ Deny in Full: _____
Declassify in Part: X
Reason: (e)(2)(c)
MDR: 12-M-1572

~~SECRET~~
~~RESTRICTED DATA~~

AD 338553

DEFENSE DOCUMENTATION CENTER
FOR
SCIENTIFIC AND TECHNICAL INFORMATION
CAMERON STATION, ALEXANDRIA, VIRGINIA

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 1 1 2013



DEPARTMENT OF ENERGY DECLASSIFICATION REVIEW	
1ST REVIEW DATE: <u>20020208</u>	1. DETERMINATION (CIRCLE NUMBER(S))
AUTHORITY: <input type="checkbox"/> ACC <input type="checkbox"/> EADC <input type="checkbox"/> ASD	<input checked="" type="checkbox"/> CLASSIFICATION RETAINED
NAME: <u>DEAN KELLY</u>	<input type="checkbox"/> CLASSIFICATION CHANGED TO _____
2ND REVIEW DATE: <u>2/22/13</u>	<input type="checkbox"/> CONTAINS NO DOE CLASSIFIED INFO
AUTHORITY: <u>AD</u>	<input type="checkbox"/> COORDINATE WITH _____
NAME: <u>S. [unclear]</u>	<input type="checkbox"/> CLASSIFICATION CANCELLED
	<input type="checkbox"/> CLASSIFIED INFO BRACKETED
	7. OTHER (SPECIFY): _____

~~RESTRICTED DATA~~
~~SECRET~~

12-M-1572

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

NOTICE:

THIS DOCUMENT CONTAINS INFORMATION
AFFECTING THE NATIONAL DEFENSE OF
THE UNITED STATES OF AMERICA
IN ACCORDANCE WITH SECTION 18,
U.S. CODE, TITLE 50, CHAPTER 130,
AND EXECUTIVE ORDER 12958 OF
OCTOBER 6, 1962, AND/OR
UNLAWFUL TO BE RELEASED TO THE
PUBLIC
BY THE

⑤ 603 400

~~SECRET~~

~~RESTRICTED DATA~~
~~RESTRICTED DATA~~
~~RESTRICTED DATA~~
~~RESTRICTED DATA~~
1

Copy No. 13

NATIONAL BUREAU OF STANDARDS REPORT

3C103

9
338553
ID NO.

PRELIMINARY REPORT ON CASTLE

Project No. A/419/NBS

179

18C FILE COPY

ASTIA

APPROVED
MAY 17 1963
TIPDR

Prepared for

Headquarters, U. S. Air Force
AFOAT, DCS/O

By

A. Glenn Jean

*Central Radio Propagation Laboratory
National Bureau of Standards
Washington 25, D. C.

8

~~EXCLUDED FROM AUTOMATIC
RECORDING PER FAR 5200.10
DATE TO APPLY~~

~~RESTRICTED DATA~~
~~RESTRICTED DATA~~



U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

34
BL Control
No. 3333
COPY 23 OF 27 PAGES

62-02-5024

~~SECRET~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

U. S. DEPARTMENT OF COMMERCE

Stetson Weeks, Secretary

NATIONAL BUREAU OF STANDARDS

A. V. Astin, Director



THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section is engaged in specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant reports and publications, appears on the inside of the back cover of this report.

Electricity. Resistance and Reactance Measurements. Electrical Instruments. Magnetic Measurements. Electrochemistry.

Optics and Metrology. Photometry and Colorimetry. Optical Instruments. Photographic Technology. Length. Engineering Metrology.

Heat and Power. Temperature Measurements. Thermodynamics. Cryogenic Physics. Engines and Lubrication. Engine Fuels. Cryogenic Engineering.

Atomic and Radiation Physics. Spectroscopy. Radiometry. Mass Spectrometry. Solid State Physics. Electron Physics. Atomic Physics. Neutron Measurements. Infrared Spectroscopy. Nuclear Physics. Radioactivity. X-Ray. Betatron. Nuclear Instrumentation. Radiological Equipment. Atomic Energy Commission Radiation Instruments Branch.

Chemistry. Organic Coatings. Surface Chemistry. Organic Chemistry. Analytical Chemistry. Inorganic Chemistry. Electrodeposition. Gas Chemistry. Physics Chemistry. Thermochemistry. Spectrochemistry. Pure Substances.

Mechanics. Sound. Mechanical Instruments. Fluid Mechanics. Engineering Mechanics. Mass and Scale. Capacity, Density, and Fluid Meters. Combustion Control.

Organic and Fibrous Materials. Rubber. Textiles. Paper. Leather. Testing and Specifications. Polymer Structure. Organic Plastics. Dental Research.

Metallurgy. Thermal Metallurgy. Chemical Metallurgy. Mechanical Metallurgy. Corrosion.

Mineral Products. Porcelain and Pottery. Glass. Refractories. Enamels. Metals. Concreting Materials. Constitution and Microstructure.

Building Technology. Structural Engineering. Fire Protection. Heating and Air Conditioning. Floor, Roof, and Wall Coverings. Codes and Specifications.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering.

Electronics. Engineering Electronics. Electron Tubes. Electronic Computers. Electronic Instrumentation. Process Technology.

Radio Propagation. Upper Atmosphere Research. Ionospheric Research. Regular Propagation Services. Frequency Utilization Research. Tropospheric Propagation Research. High Frequency Standards. Microwave Standards.

●Office of Basic Instrumentation

●Office of Weights and Measures

Page determined to be Unclassified
Reviewed Chief, RDD, WHS
IAW EO 13526, Section 3.5
Date: JAN 11 2013

④ AIA ⑤ 603 400

② AIA
① K

~~SECRET~~

~~RESTRICTED DATA~~
~~RESTRICTED DATA~~
~~RESTRICTED DATA~~
~~RESTRICTED DATA~~

This is a 34 Page Document

NATIONAL BUREAU OF STANDARDS REPORT

NBS PROJECT

1401-40-6822

⑪ May 13, 1954

⑨ NBS REPORT

3C103

⑨ PRELIMINARY REPORT ON CASTLE ^① U.S.

⑬ Project No. A/419/E/NBS

⑫ 22 p
⑬ AIA
⑭ AIA
⑮ AIA
⑯ AIA
⑰ AIA
⑱ SRD
⑳ AIA

Prepared for
Headquarters, U. S. Air Force
AFOAT, DCS/O

By
A. Glenn Jean
Central Radio Propagation Laboratory
National Bureau of Standards
Washington 25, D. C.

~~RESTRICTED DATA~~
~~RESTRICTED DATA~~
~~RESTRICTED DATA~~
~~RESTRICTED DATA~~



**U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS**

~~RESTRICTED DATA~~
~~RESTRICTED DATA~~
~~RESTRICTED DATA~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

~~SECRET~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 1 1 2013

RESTRICTED DATA
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

RESTRICTED DATA
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

Preliminary CASTLE Report

Objectives and Preparation for Tests

In accordance with AFQAF-1 Project Authorization A/419/WBS the ~~Central Radio Propagation Laboratory prepared for and conducted~~ electromagnetic measurements during Operation CASTLE. The major tasks undertaken under this authorization are outlined below.

(1) Standard monitoring equipment for use by the CRPL and other agencies during CASTLE was designed and constructed; The following reports, which describe this equipment, its operation and calibration, were prepared and distributed to the participating stations.

a) "Equipment for Electromagnetic Measurements to be Made by CRPL during CASTLE",

b) "Notes on the Calibration and Operation of the CRPL Equipment to be used at Remote Field Stations during Operation CASTLE", dated Feb. 8, 1954,

c) "Timing", a memorandum suggesting terminology for reporting the time of arrival of pulses at all stations, dated Feb. 9, 1954,

d) "Proposed Schedule for Recording Peak Field Strength Values from Stations NSS, NPM, and GBR during Operation CASTLE", dated Feb. 9, 1954,

e) Suggested log sheets and additional memoranda were prepared as needed in order to keep the various stations informed of the overall progress, etc.

(2) Estimates of field strengths at remote stations were made and distributed to the participating stations before each event;

(3) At suitable "close-in" (330 km or less) sites in the Bering and

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

[REDACTED]

[REDACTED]

5

[REDACTED]

Bikini Atolls, measurements were performed to:

- a) determine the true shape of the entire electromagnetic pulses, *to*
- b) relate the pulse amplitudes to field strength values, *to*
- c) determine the relationship between electromagnetic pulses and bomb phenomenology, *and*
- d) to determine the time of arrival of the electromagnetic pulses which are emitted at the time of an atomic detonation;

(4) Using both broad-band and narrow-band recording equipment, measurements were made at Guam; Maui, T. H.; Boulder, Colorado; Ft. Barrow, Alaska; Ft. Belvoir, Va. near Washington, D. C.; and Stanford, University, at Palo Alto, California to:

- a) determine the true shape of the entire electromagnetic pulses as received at each station, *to*
- b) relate amplitudes to field strength values, *and to*
- c) determine time of pulse arrival related to world time; *and*

(5) At all the locations mentioned above, records of field strengths received from low-frequency broadcasting stations and distant atmospherics are to be made to assist in determining propagation attenuation as a function of time and distance.

↑
Close-in Measurements

Measurements were made using broad-band equipment at a distance of about 330 km from ground zero to determine the true pulse shape before being altered materially by the effects of propagation. A six-foot vertical antenna was used to receive the vertically polarized electromagnetic pulse, and a suitable broad-band cathode follower unit was used to attenuate

[REDACTED]

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

[REDACTED]

[REDACTED]

uate the signal and to distribute it to several oscilloscopes operating at different sweep rates and sensitivities.

Additional equipment was used to determine the time of arrival of the electromagnetic pulse. Also, an experiment was carried out using a long wire antenna and an Ampex tape recorder, in an attempt to record any pulses occurring milliseconds or seconds after shot time.

Sample records from ROMEO and KOCM are given in this report. The legend with each figure gives the name of the event, the propagation distance in kilometers, the sweep rate in usec/cm along the x-axis, and the sensitivity in volts/meter/cm along the y-axis. The plus and minus signs on each figure indicate the polarity of the electric vector; a minus sign represents a downward electric vector and a plus sign an upward one. A pre-amplifier, which reverses the polarity of signals, was used to record the wave forms shown in Figures 2, 4, 7, and 8. All of the initial half-cycles observed at the close-in stations during CASTLE are negative; this fact was also observed during UPSHOT-KNOTHOLE.

Figure 1 is a ROMEO waveform consisting of a ground wave pulse and a pulse that was reflected from an ionospheric layer height of about 92 km. The peak amplitude of the pulse received along the surface of the earth was about 22 volts/meter, and the peak amplitude of the pulse received after reflection from the ionosphere was about 12 volts/meter. Hence, the ionospheric reflection coefficient for this mode is about 0.8.

The pulse, which is reflected from the ionosphere, is much smoother than the ground wave pulse, indicating a loss of high-frequency energy in the ionosphere.

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

[REDACTED]

[REDACTED]

[REDACTED]

JAN 1 1 2013

[REDACTED]

The total attenuation of the surface wave over 350 km of sea water ($\sigma = 4 \times 10^{-11}$ cmn, and $\epsilon = 80$) is within 3 db of the inverse distance attenuation value at frequencies up to approximately 1.0 Mc. Using this inverse distance relationship, the field strength 20 km from ground zero would be of the order of 350 volts/meter.

Another ROMEO pulse, recorded using a sweep speed of 10 usec/cm, is shown in Figure 2. The pre-amplifier was used in recording this particular pulse; therefore, the first half-cycle, which appears as an upward oscilloscope deflection, corresponds to a downward electric vector.

OSD
Section 6.2 (a)

DOE
Section 6.2(a)

[REDACTED]

Superimposed on this half-cycle are three cycles having a frequency near 80 kc.

Figure 3 shows the first 15 usec of the waveform in greater detail than either of the preceding figures.

A train of pulses recorded from ROMEO is shown in Figure 4. The first pulse, which overloaded the recording equipment, is about 166 usec long. The succeeding pulses, in order of arrival, are the first, second, third, fourth, and fifth hop sky-wave modes, all of which were reflected from an ionospheric layer height of about 94 km.

OSD
Section 6.2 (a)

DOE
Section 6.2(a)

Figure 5 is a pulse from ROMEO comparable to the ROMEO pulse in Figure 2.

[REDACTED]

Using the first half cycles of Figures 1 and 6 as an indication of the fundamental frequency, it is

[REDACTED]

[REDACTED]

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

[REDACTED]

[REDACTED]

[REDACTED]

JAN 11 2013

11

found that for ROMEO the frequency is about 11 kc and for KOOK it is about 45 kc.

In Figure 6 it can be seen that the peak amplitude of the ground wave pulse is about 13 volts/meter, and the corresponding value for the pulse reflected from the ionosphere is about 5 volts/meter. The ionospheric reflection coefficient for this particular mode is about 0.5. Figure 6 reveals the extent to which the character of the original pulse was preserved after ionospheric reflection. For comparison with the ROMEO pulse, see Figure 1.

The early detail associated with the atomic detonation is shown in Figure 7, which was recorded using a sweep speed of 12.8 usec/cm.

A train of pulses consisting of the ground wave pulse followed by others reflected from the ionosphere is shown in Figure 8. The individual reflections are not as easily distinguished as those in Figure 4, the corresponding ROMEO presentation.

In Figure 9 a sweep rate of 1 usec/cm and high gain were used to disclose the initial portions of the pulse.

Distant Measurements

A set of ROMEO pulses is shown in Figures 10 through 15 as received at Guam, Maui, Stanford, Barrow, Boulder, and Washington. The length as well as the amplitude of the pulses are related to the propagation distance, and these facts were used at each station to assist in locating the desired pulse on the film records.

A value of field strength expected to be recorded at each station was issued in advance of each shot. The estimates of field strength

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date:

JAN 11 2013

[REDACTED]

[REDACTED]

[REDACTED]

13

[REDACTED]

for BRAVO were based upon the predicted value of bomb yield and information gained during IVY relating field strength and distance from a megaton weapon. Fortunately, all CRPL stations except one recorded the BRAVO pulse. Using these results, it was determined that the field strength attenuation beyond 4000 km varied as the inverse square root of the distance and an additional propagation loss at the rate of about 2 or 3 db per 1000 km.

The ROMEO yield was estimated, as shown, to be 12 megatons, using the values of field strength recorded at Maui from ROMEO and BRAVO and a yield of 14 megatons for BRAVO. Since all the events took place at the same time relative to sunrise, the propagation attenuation was considered to be the same for all events.

$$\log Y_R = \frac{E_R}{E_B} \log Y_B$$

Y_R = ROMEO yield

Y_B = BRAVO yield

E_R = ROMEO peak field strength

E_B = BRAVO peak field strength

The maximum center to peak values of field strength recorded at the CRPL stations during CASTLE, which are available at the present time, are plotted against distance in Figure 17. The first letter of the name of each event is placed near the appropriate value of field strength. The attenuation rates between stations for the different events are approximately the same, with the exception of Barrow, Alaska. At this time it is not known why the values of field strength recorded at Guam are as low as they are.

[REDACTED]

[REDACTED]

[REDACTED]

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass. Div, WHS
Date: JAN 11 2013

[REDACTED]

[REDACTED]

[REDACTED]

16

[REDACTED]

In Figure 16 is shown a wave-form recorded from KCOH at Guam, a distance of 2200 km. The delay times between successive pulses suggest that these individual pulses were reflected from an ionospheric layer height of about 90 km. The wave-form consists of part of the ground wave pulse, followed by the first, second, third, fourth, and fifth hop sky-wave modes. It is of interest to note the high frequency detail present at this distance. Figure 10 is a pulse recorded from ROMEO at Guam, and it is shown for comparison with Figure 16. A reasonable interpretation of Figure 10 may also be made assuming the ionospheric layer height of 90 km. This choice is mainly based upon the recognizable time delay of 84 usec which is the calculated delay between the first and second hop sky-wave modes. The succeeding reflections due to the third, fourth, and fifth hops are not clearly separated as in Figure 16. The first half-cycle seen in Figure 10 is taken to be part of the ground wave pulse. The one-hop pulse received from KCOH at Guam is similar to the first-hop sky-wave pulse seen in Figure 6 which was recorded at 330 km; it contains components at much higher frequencies than the pulses received at Guam from ROMEO. The ratios of peak amplitudes of the ground wave pulses to the peak amplitudes of the first-hop sky-wave pulses suggest that the ionospheric reflection coefficient for KCOH was approximately twice the value for ROMEO.

In Figure 18, preliminary times reported by each station for the first five events are tabulated. Better agreement between the values of T_d (detonation time) may be achieved after more accurately calculating T_p (propagation delay time for the pulse) and T_s (propagation delay time

[REDACTED]

[REDACTED]

[REDACTED]

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

[REDACTED] ET

[REDACTED]
[REDACTED]
[REDACTED]

[REDACTED]
[REDACTED]
[REDACTED]

[REDACTED]

[REDACTED]

17 [REDACTED]

for the H/V or W/VH seconds pulses).

The relatively low value of field strength recorded at Barrow for ROMEO may be found to be related to a disturbance of the earth's magnetic field which existed on that day. The attenuation of field strength in db/1000 km from Maui to Barrow is about 3 db for BRAVO and 5 db for ROMEO. The Barrow, Alaska magnetic K figures for the three hour period containing the BRAVO and ROMEO detonation times are respectively 2 and 5.

[REDACTED]

[REDACTED]

[REDACTED]

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

[REDACTED]

[REDACTED]

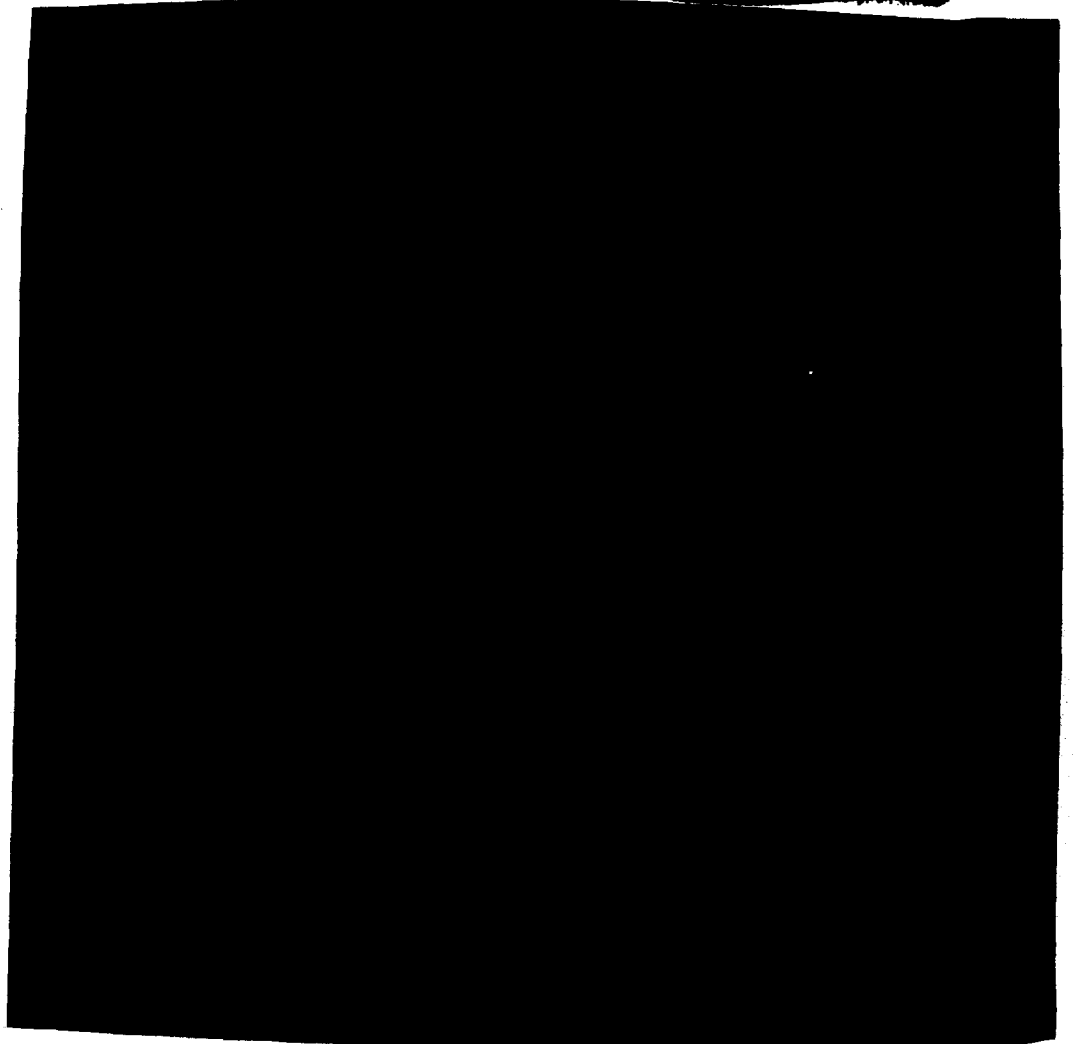
[REDACTED]

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

19

DOE
Section 6.2(a)

OSD
Section 6.2 (a)



DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 1 1 2013

SECRET

RESTRICTED DATA
[REDACTED]
[REDACTED]
[REDACTED]

SECRET

[REDACTED]

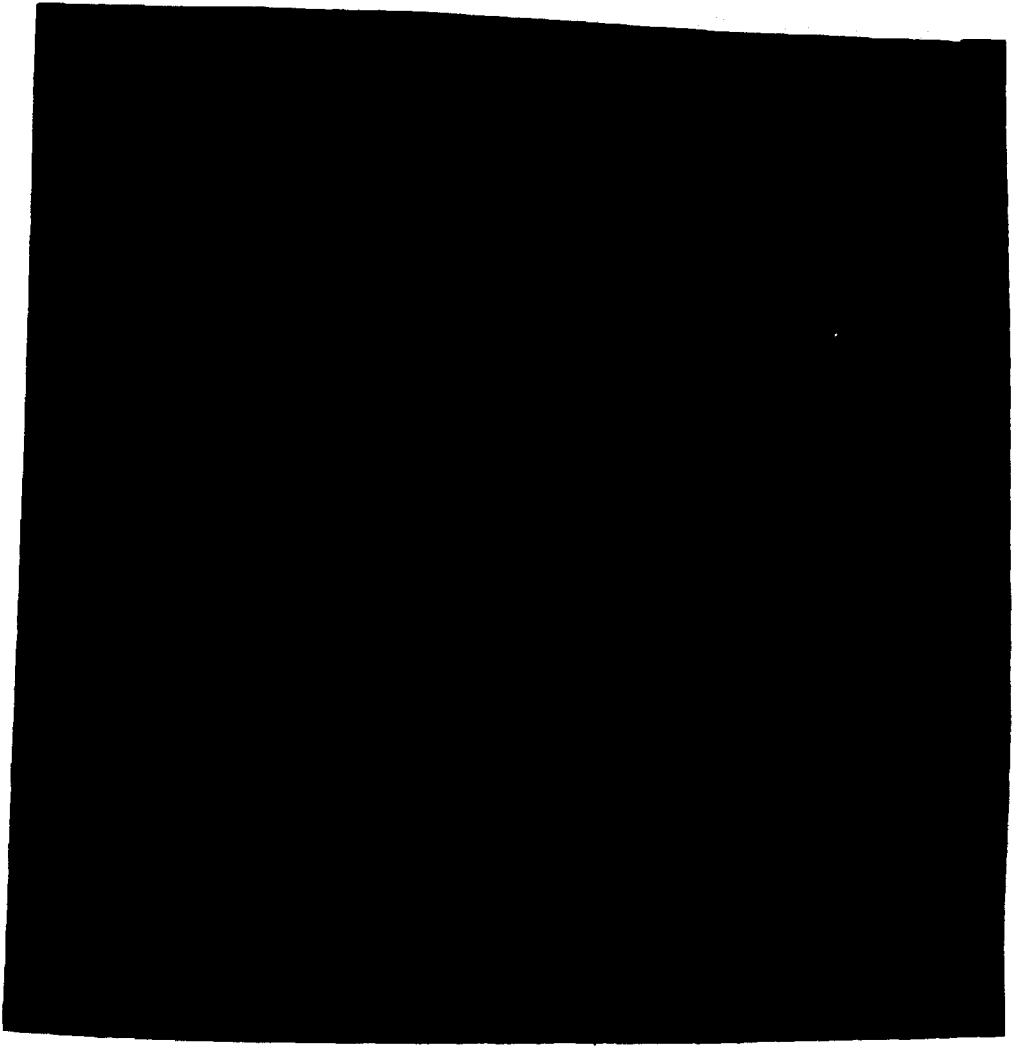
DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

~~CONFIDENTIAL DATA~~
~~CONFIDENTIAL DATA~~
~~CONFIDENTIAL DATA~~

21.

DOE
Section 6.2(a)

OSD
Section 6.2 (a)



~~CONFIDENTIAL DATA~~
~~CONFIDENTIAL DATA~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 1 1 2013

[REDACTED]

[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED] person is prohibited.

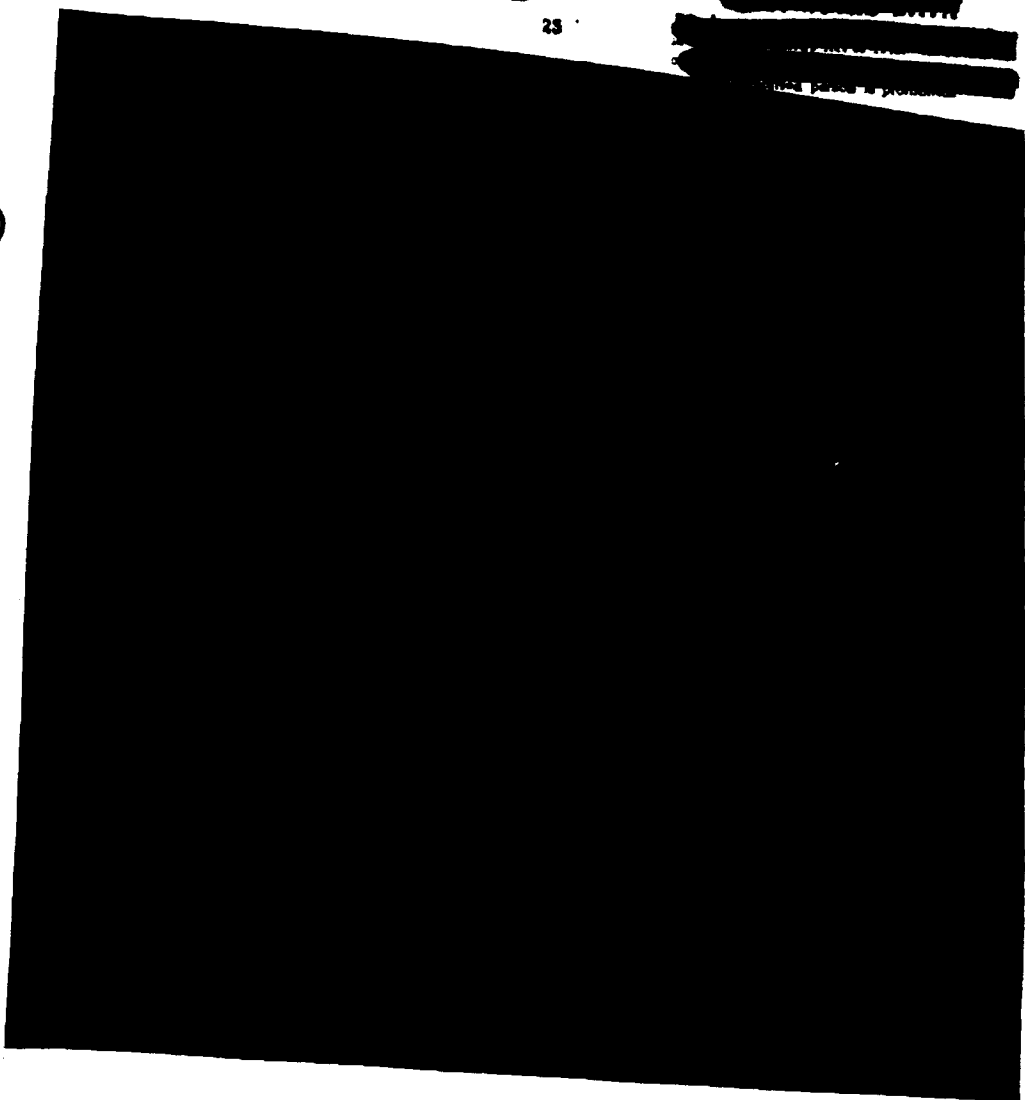
[REDACTED]

[REDACTED]

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

DOE
Section 6.2(a)

OSD
Section 6.2 (a)



23



DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

[REDACTED]

RESTRICTED DATA
[REDACTED]
[REDACTED]
[REDACTED]

[REDACTED]

[REDACTED]

26

[REDACTED]

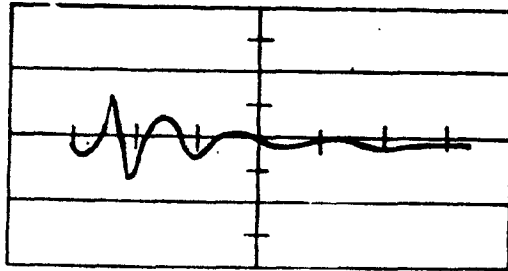


Fig. 10

ROMEO
Olan, 2200 km path
Sweep rate 100 usec/cm
Sensitivity 1v/m/cm

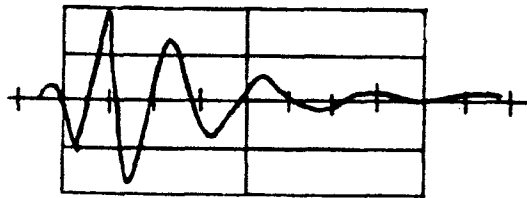


Fig. 11

ROMEO
Maui, 4200 km path
Sweep rate 68 usec/cm
Sensitivity 0.98 v/m/cm

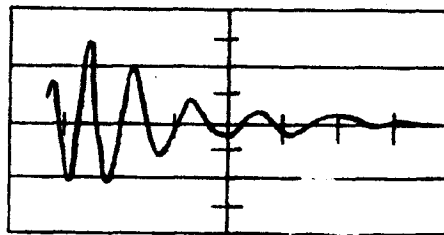


Fig. 12

ROMEO
Stanford, 7400 km path
Sweep rate 125 usec/cm
Sensitivity 0.280 v/m/cm

NBS

[REDACTED]

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

CONFIDENTIAL DATA
[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

27

Not available

Fig. 13

ROME0
Barrow, 6800 km path

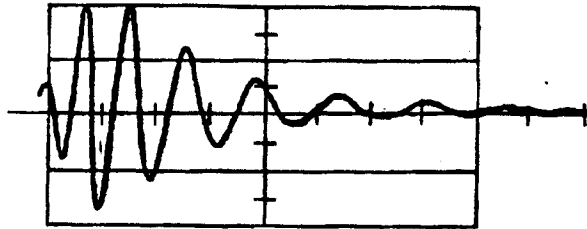


Fig. 14

ROME0
Boulder, 8900 km path
Sweep rate 100 usec/cm
Sensitivity .164 v/m/cm

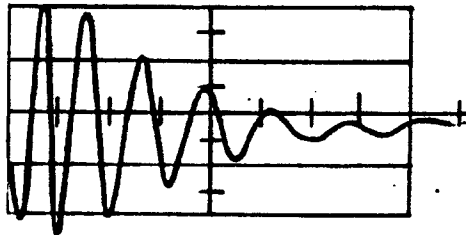


Fig. 15

ROME0
Wash. D. C., 11,100 km
Sweep rate 100 usec/cm
Sensitivity .035 v/m/cm



[REDACTED]

[REDACTED]

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

~~SECRET~~

~~RESTRICTED DATA~~
~~RESTRICTED DATA~~
~~RESTRICTED DATA~~

~~SECRET~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date:

JAN 11 2013

29

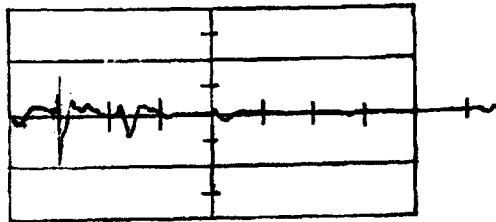


Fig. 16

KOCN
Guam, 2200 km path
Sweep rate 70 usec/cm
Sensitivity .25 v/m/cm

NSA

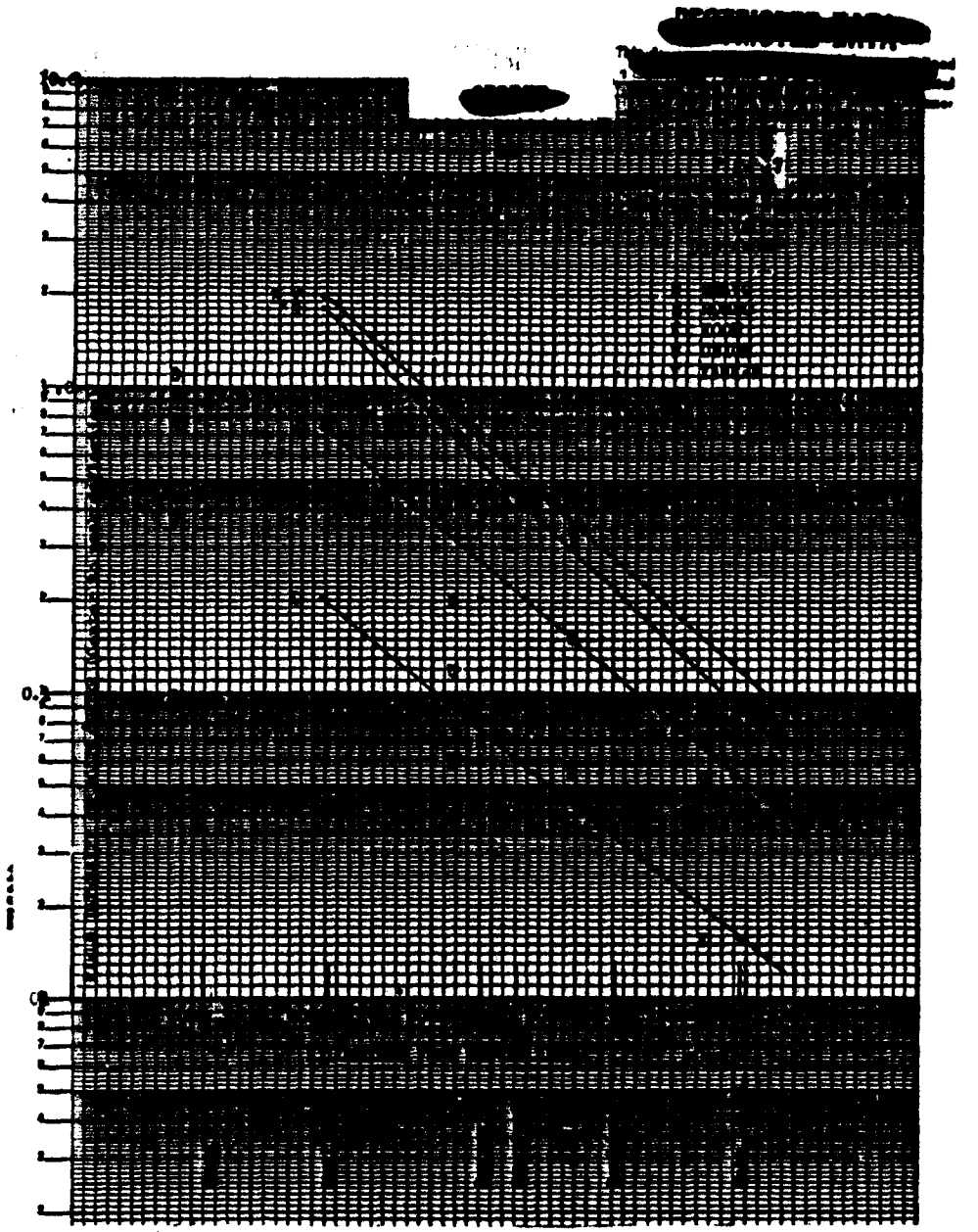
DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 1 1 2013

[REDACTED]

[REDACTED]
[REDACTED]
[REDACTED]

[REDACTED]

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 1 1 2013



[Redacted text block]

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

~~SECRET~~

~~RESTRICTION DATA~~
~~THE INFORMATION CONTAINED~~
~~HEREIN IS UNCLASSIFIED EXCEPT~~
~~WHERE SHOWN OTHERWISE~~
No unauthorized person is prohibited.

~~[REDACTED]~~

Station	BLAYO - Mar. 1 T _d = 1845:00.009		ROMEO - Mar. 26 T _d = 1830:00.576		KOOH - Apr. 6 T _d = 1820:00.409		UNION - Apr. 26 T _d = 1810:00.689		YANKEE - May 4 T _d = 1810:00.164	
	T _o	T _d	T _o	T _d	T _o	T _d	T _o	T _d	T _o	T _d
Close-in	:59.996	:00.009	:00.363	:00.376	:00.396	:00.409	:00.676	:00.689	:00.141	:00.164
Quam	:59.996	:00.010	:00.363	:00.377	:00.396	:00.412	:00.677	:00.691	:00.139	:00.163
Maui	:00.023	:00.009	No time record		No time record		No time record		:00.170	:00.166
Stanford	No records		:00.388	:00.377	:00.424	:00.413	:00.703	:00.692		
Barrow	:59.963	:59.959	:00.384	:00.380	:00.394	:00.407				
Boulder	:00.034	:00.012	:00.401	:00.379	:00.430	:00.412	:00.713	:00.691	:00.161	:00.169
Washington	:00.047	:00.009	:00.418	:00.380	:00.451	:00.413	:00.731	:00.693	:00.198	:00.160

Figure 16. Preliminary times (GMT) reported by CRPL stations for the first five events.

REPRODUCED FROM THE
 NATIONAL CENTER FOR
 GEOPHYSICAL RESEARCH
 AND OBSERVATION
 SYSTEMS
 WASHINGTON, D.C. 20541
 UNCLASSIFIED
 INFORMATION
 PRESENTED
 HEREIN IS UNCLASSIFIED
 EXCEPT WHERE SHOWN
 OTHERWISE

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date:

JAN 11 2013

RESTRICTED DATA
[REDACTED]

[REDACTED]

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JAN 11 2013

RESTRICTED DATA

THE NATIONAL BUREAU OF STANDARDS

Functions and Activities

The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to Government Agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. A major portion of the Bureau's work is performed for other Government Agencies, particularly the Department of Defense and the Atomic Energy Commission. The scope of activities is suggested by the listing of divisions and sections on the inside of the front cover.

Reports and Publications

The results of the Bureau's work take the form of either actual equipment and devices or published papers and reports. Reports are issued to the sponsoring agency of a particular project or program. Published papers appear either in the Bureau's own series of publications or in the journals of professional and scientific societies. The Bureau itself publishes three monthly periodicals, available from the Government Printing Office: The Journal of Research, which presents complete papers reporting technical investigations; the Technical News Bulletin, which presents summary and preliminary reports on work in progress; and Basic Radio Propagation Predictions, which provides data for determining the best frequencies to use for radio communications throughout the world. There are also five series of nonperiodical publications: The Applied Mathematics Series, Circulars, Handbooks, Building Materials and Structures Reports, and Miscellaneous Publications.

Information on the Bureau's publications can be found in NBS Circular 460, Publications of the National Bureau of Standards (\$1.25) and its Supplement (\$0.75), available from the Superintendent of Documents, Government Printing Office. Inquiries regarding the Bureau's reports and publications should be addressed to the Office of Scientific Publications, National Bureau of Standards, Washington 25, D. C.

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date:

JAN 11 2013

[REDACTED]

RESTRICTED DATA

[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]



[REDACTED]

[REDACTED]