FEDERAL BUREAU OF INVESTIGATION

FREEDOM OF INFORMATION/PRIVACY ACTS SECTION

COVER SHEET

SUBJECT: TWA FLIGHT 800

FORENSIC ANALYSIS

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 12/10/1996

To: FBIHQ LABORATORY DIVISION **Attn:** Section Chief,
Randall S. Murch,
Laboratory Division;
SSA [redacted]
Explosive Unit;
SSA [redacted]
NSD, RFU

b7c

From: New York
Squad I-46

Approved By: [redacted]

Drafted By: [redacted]lca

b7c

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUBS;
EXPLOSION OF FLIGHT TWA 800;
AOT-IT;
EOD; OO: NY

(X)
TC

Synopsis: Outstanding FBI HQ Laboratory Reports

Administrative: All persons interviewed were furnished the appropriate provisions of the Privacy Act. Express promises of confidentiality have not been granted.

FBIHQ, Laboratory Division is requested to advise results of these requests. Captioned investigation requires an on going dialogue with the National Transportation Safety Bureau (NTSB). NTSB has and continues to request these results on a timely basis. Any and all results should be directed to Supervisory Special Agents [redacted]-46, TWA Special) and [redacted] Calverton, Long Island Command Post. b7c

New York Office appreciates and recognizes that these laboratory requests be fully and thoroughly addressed in support of this on going investigation.

Details: The following are synopses of communications requesting examinations on items sent to the FBIHQ Laboratory. As of the date of this communication, New York Office has not received the resulting Laboratory Reports.

Lab Receipt dated 7/25/96, recognizes receipt of Q9 - one (1) strip of color 35mm (Fuji G-400) negatives (4 negatives exposed 1A-4A).

Electronic Communication dated 7/27/96, drafted by SA

4-14-00 SPS/SCMW 97-2069

[redacted] requested the Chemistry and Toxicology Unit to examine items #11- approximately 4' x 3' floor panel #22, #12 - magnet from Row 4, Seat 5, #13 - floor hatch forward cabin EE compartment and #14 - floor panel section #20 forward cabin of luggage, for the presence of explosives and other materials. b7C

Electronic Communication dated 7/28/96, drafted by SA [redacted] requested the Chemistry and Toxicology Unit to examine items #15- floor panel #187, #16- floor panel #177, #17 - floor panel #121 and #18 - floor panel #76, for the presence of explosives and other materials.

Electronic Communication dated 7/28/96, drafted by SA [redacted] requested Materials and Analysis Unit to conduct scanning electron microscope (SEM) examinations and metallurgical examinations of item #20 - one (1) silver piece of metal and #21 - one (1) silver colored meal strip, to determine type of metal and characterization of the small holes thereon. (Item #19 was submitted for comparison purposes.) b7C

Electronic Communication dated 7/29/96, drafted by SA [redacted] requested Materials and Analysis Unit to conduct scanning electron microscope (SEM) examinations and metallurgical examinations of item #22 - one (1) piece of shiny, silver colored metal strip, item #23 - one (1) piece of charred, pitted, dull, silver colored metal, item #24 - one (1) piece of charred pitted, dull, silver colored metal, item #25 - one (1) piece of charred, corroded, dull, silver colored metal, and item #26 - one (1) piece of shiny, silver colored meal with an egg crate appearance, to determine type of metal and characterization of the small holes thereon.

Lab Receipt dated 7/30/96, recognizes receipt of Q25 - Q81 - various types of cameras, film, video cameras and video tapes.

Electronic Communication dated 8/4/96, drafted by SA [redacted] requested Materials and Analysis Unit to examine item #27 - piece of glass fragment imbedded in lavatory E left outside wall panel, to determine the composition of the glass and possible sources of the specimen. b7C

Electronic Communication dated 8/14/96, drafted by SA [redacted] requested Special Photographic Unit to process and print eleven (11) cameras containing film, various 135 mm film and two (2) TDK TC-30 VHS.

Electronic Communication dated 8/16/96, drafted by SA [redacted] requested the Chemistry and Toxicology Unit to examine item #31- floor panel with attached tag bearing number

815-21 and identified lot number 8/9/96-1, for the presence of explosives and other materials.

Electronic Communication dated 8/17/96, drafted by SA [redacted] requested the Chemistry and Toxicology Unit to examine item #32- floor panel with attached tag bearing number 817-5 and identified lot number 8/5/96-70 and item #33- three (3) viles containing scrapings from floor panel, for the presence of explosives and other materials. b7C

Electronic Communication dated 8/26/96, drafted by SA [redacted] requested the Chemistry and Toxicology Unit to examine item #34- canvas sheet, for the presence of explosives and other materials.

Electronic Communication dated 9/07/96, drafted by SA [redacted] requested the Chemistry and Toxicology Unit to examine items #35 - one (1) piece of carpeting 20 1/2" x 15', #36 - one (1) piece of carpeting 20 1/2" x 9' 6", #37 - damaged section of starboard fuselage near section 920, #38 - metal fragment, #39- fractured duct flange, #40 - section of damaged fuel probe, for the presence of explosives and other materials. b7C

The communication also requested Materials and Analysis Unit to conduct appropriate metallurgical examinations of items #37 thru #40, to characterize the deformation, thermal damage and/or fractures.

Electronic Communication dated 9/09/96, drafted by SA [redacted] requested the FBI Laboratory to conduct appropriate examinations of six (6) pieces of leather to determine if the leather pieces are debris from captioned matter. b7C

Electronic Communication dated 9/11/96, drafted by SA [redacted] requested the Chemistry and Toxicology Unit to examine items #1 - surface of wing rib, #2 - black back pack, #3 - gray plastic child's car seat, #4 - tan bag made for York Luggage, #5 - fragmented piece of luggage, #6 - fragmented piece of silver colored metal and #8 - fragmented piece of silver colored metal, for the presence of explosives and other materials. Item #7 - white powder, was to be examined to identify the nature of the substance.

The communication also requested Materials and Analysis Unit to conduct scanning electron microscope (SEM) examinations and metallurgical examinations of item #6 and #8, to determine type of metal and characterization of the small holes thereon.

b7C

Electronic Communication dated 9/12/96 drafted by SA [redacted] requested Chemistry and Toxicology Unit to examine item #41- one (1) piece of blue carpet, for the presence of explosives and other materials.

Electronic Communication dated 10/04/96 drafted by SA [redacted] requested Chemistry and Toxicology Unit to examine items #42- one (1) piece of gray carpet approximately 4" x 9 1/2" and #43 - one (1) piece of gray carpet approximately 7" x 14", for the presence of explosives and other materials. b7C

Electronic Communication dated 11/08/96 drafted by SA [redacted] requested Materials Analysis Unit to conduct scanning electron microscope (SEM) examinations and other appropriate metallurgical examinations on item # 45 - one (1) "L-shaped" piece of metal approximately 3 1/2' believed to be a section of wing, to determine failures and whether this item suffered explosive damage of any type.

The communication also requested Chemistry and Toxicology Unit to examine #45 and conduct appropriate analysis including, but not limited to, tests for explosive residue.

Electronic Communication dated 11/13/96 drafted by SA [redacted] requested Chemistry and Toxicology Unit to examine items #46 - lower left back of seat 2 row 19, #47 - upper left corner back of seat 6 row 18, #48 - upper right corner back of seat 7 row 19, #49 - upper left corner back or seat 8 row 17, #50 - upper right corner back of seat 9 row 26, #51 - upper right corner back of seat 6 row 24, #52 - top center section back of seat 2 row 27, for explosive residues and identify the presence of any other materials, particularly those not normally associated with adhesives. b7C

The communication also requested Materials and Analysis Unit to examine the items to identify all known substances.

Electronic Communication dated 11/19/96 drafted by SA [redacted] requested Chemistry and Toxicology Unit to examine item #LF-5 - two (2) jars; one of swabbings of the outside of skin of LF-5 and one containing a sample of the solvent used, for the presence of explosives and other materials. b7C

CC: 1 - ADIC James K. Kallstrom
1 - SAC John O'Neill
1 - ASAC George H. Andrew
1 - SSA [redacted]
1 - SSA [redacted]
1 - SSA [redacted]

b7C

DEPARTMENT OF THE TREASURY
UNITED STATES CUSTOMS SERVICE

By [redacted] loff + Festa

No. 0679930

CUSTODY RECEIPT FOR RETAINED OR SEIZED PROPERTY

5234, P&PM

1. DISTRICT – PORT	2. SEIZURE NO.	3. GENERAL ORDER NO.	4. OTHER CONTROL NO.	5. DATE RET/SEIZED
4701	96-4701-		Item 2888	071796

6. [redacted] CI/USC
7. [redacted]
8. NAME & TYPE OF CARRIER: TWA 881
TIME OF DAY: 1745

b7c

9. [redacted]NER/CARRIER/CONSIGNEE
[redacted]

10. EIN/IRS NO.:
11. NO. OF PKGS.: 1
12. APPROX. WGT.:
13. ENTRY NO. (WHB, IT, TE, OTHER (DESCRIBE)): 6059 B
14. SEAL OR OTHER ID NOS. (Bag Tag, B/L, AWG): CTS#~~410~~ 716
15. IDENTIFYING MARKS PLACED ON SEIZURE: STK#13481

16. SECTION OF LAW VIOLATED OR REASON FOR RETENTION: 627 19 USC 952
17. IS PROPERTY TO BE HELD AS EVIDENCE? 1 - YES – Give Line Item No(s) 2 - NO
18. REMARKS (INCL. RECOMMENDED TYPE STORAGE, IF APPLICABLE): CS92004/K
Hold for Lab Analysis

19. DISTRICT DIRECTOR'S ADDRESS: Bldg. 77, JFK Int'l Airport, Jamaica, NY 11430

20. PROPERTY (By Line Item) Attach CF 58 if conveyance.

a LINE ITEM NO.*	b DESCRIPTION	c CONDITION	d TYPE OF CONTAINER	e U/M	f QTY	g APPRAISED DOMESTIC VALUE	h HELD BY DIST.
1	One package - White crystal powder						

21. ACCEPTANCE/CHAIN OF CUSTODY

b7c

a DATE	b BY - INDIVIDUAL, TITLE, ORGANIZATION	c ITEM(S)	d NO. OF UNITS	e SIGNATURE
071796	[redacted] 13481	1	ALL	[redacted]
071796	[redacted] 3248	1	ALL	[redacted]
071796	[redacted] ST/10279 SHIPS	1	ALL	[redacted]
7-18-9	[redacted]	1	ALL	[redacted]
7/18/96	[redacted] S/SA	1	ALL	[redacted]
7/19/96	[redacted] FBI 55 pm	1	ALL	[redacted]

22. NOTICE OF ABANDONMENT AND ASSENT TO FORFEITURE

I hereby abandon all claim to the above-described articles, line item(s) ________, and waiv [redacted] relation to these articles, other than my right to file a petition for administrative relief.

a. Signature of Importer	b. Date	c. Witness (Customs Officer)	d. Date

BUS-S2605S-XY-VSSE

INFORMATION CONTAINED

COPIES: OWNER/CARRIER/CONSIGNEE/VIOLATOR; RETAINING/SEIZING OFFICER; FP&F OFFICER; TRANSPORTATION; OTHER TRANSFERS OF CUSTODY

*For Additional Items Use CF 6051A.

Customs Form 6051 (122085)

OPCA-20 (12-3-96)

XXXXXX
XXXXXX
XXXXXX

FEDERAL BUREAU OF INVESTIGATION
FOIPA
DELETED PAGE INFORMATION SHEET

__7__ Page(s) withheld entirely at this location in the file. One or more of the following statements, where indicated, explain this deletion.

☐ Deletions were made pursuant to the exemptions indicated below with no segregable material available for release to you.

Section 552		Section 552a
☐ (b)(1)	☐ (b)(7)(A)	☐ (d)(5)
☐ (b)(2)	☐ (b)(7)(B)	☐ (j)(2)
☐ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
______	☐ (b)(7)(D)	☐ (k)(2)
______	☐ (b)(7)(E)	☐ (k)(3)
______	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☐ (b)(6)		☐ (k)(7)

☐ Information pertained only to a third party with no reference to the subject of your request or the subject of your request is listed in the title only.

☑ Documents originated with another Government agency(ies). These documents were referred to that agency(ies) for review and direct response to you.

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☑ The following number is to be used for reference regarding these pages:
265A-NY-254028-SUB FF2, Lab 15 Documents dated 12 November 1996 and 7 November 1996

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X for this page X
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FBI/DOJ

-291 (Rev. 1-6-93)
Evidence Shipping
FEDERAL BUREAU OF INVESTIGATION
BLDG 27958A
QUANTICO, VA. 22135

97

Date: JULY 31, 1996

Re: (265A-NY-259028)
(I-46)

To:
DADIC, NEW YORK
ATTN: SA [redacted]

b7C

Invoice of Contents

Description of Contents:

Q10 ONE ORIGINAL VHS-C VIDEO CASSETTE TAPE

(10) TEN PROCESSED VHS VIDEO CASSETTE TAPE COPIES

(30) THIRTY B & W VIDEO PRINTS

(49) FORTY-NINE COLOR VIDEO PRINTS

FBI File# ____

LAB# 60726017 E XX

Your# ____

Return to ____

[redacted] Section b7C

Ext. ____

Shipping# ____

EVIDENCE EVIDENCE EVIDENCE
PRIORITY HANDLING REQUESTED.
UPON RECEIPT, DELIVER TO
CASE AGENT, OR CASE SUPVR.

Shipping Methods

- [ ] Registered Mail/Return Receipt Requested
- [x] Overnight Security Signature Service
- [ ] Other ____

FED X

(X) TC

265A-NY-259028-SUB lab-
2

SEARCHED ____ INDEXED ____
SERIALIZED ✓ FILED F
AUG 17 1996
FBI — NEW YORK
TC

b7C

Packed by [redacted]ure

- [ ] Hand Delivered ____ Date ____

All items listed above are contained in this package. ____
Signature Written

97

DUPLICATE COPY

ALL INFORMATION CONTAINED
HEREIN IS UNCLASSIFIED
DATE 4-14-00 SPK | SC/PMN

7-1 (Rev. 2-21-91)

FBI LABORATORY

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

To: ADIC, NEW YORK

Date: August 5, 1996

FBI File No. 265A-NY-259028

Lab No. 60725009 D HD

Reference: Evidence receipt dated July 25, 1996

SAC

Your No. 265A-NY-259028

ASAC

Re: TWA Downing

Specimens received: July 24, 1996

Specimens:

Q9 One (1) strip of color 35-mm (Fuji G-400) negatives (4 frames exposed 1A-4A)

Results of examination:

The (Q9) strip of color negatives was examined and frame #4A was selected for further examination. Prints of the selected frame were made using conventional photographic techniques to extract maximum image detail. The selected frame was scanned electronically to produce a digital image. The image was processed digitally using an equalization operator and printed to extract maximum image detail.

265A-NY-259028-SUB LAB 4

Page 1

[redacted]closures (2)

photo of Party in Background
Unknown object in I-46

SEARCHED ____ INDEXED ____
SERIALIZED ____ FILED ____
AUG 8 1996
FBI — NEW YORK

b7C

16-96 ... to agency

ALL INFORMATION CONTAINED ...
4-19-00 ... SPS/JCP

This Report Is Furnished For Official Use Only

The submitted evidence and photographs produced in this examination are being returned herewith.

If there are any questions concerning this examination, please contact Examiner [redacted] b7C

Rev. 2-21-91)

FBI LABORATORY

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

To: ADIC, NEW YORK

Date: August 5, 1996

FBI File No. 265A-NY-259028

Lab No. 60725009 D HD

Reference: Evidence receipt dated July 25, 1996

Your No. 265A-NY-259028

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Enclosures (2)

(o265A-NY-259028-SUB LAB

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OPCA-20 (12-3-96)

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____ Page(s) withheld for the following reason(s): ________

☑ The following number is to be used for reference regarding these pages:
265A-NY-259028-Sub-Lab Dated 8/5/96 and stamped as received 9/16/96 - Page 2

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FBI/DOJ

7-1 (Rev. 2-21-91)

FBI LABORATORY

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

SRB

b7C

Date: October 29, 1996

To: [redacted]
Office of the Medical Examiner
Sidney B. Weinberg Center for
Forensic Sciences
Building #487, North County Complex
Veteran's Memorial Highway
Hauppauge, New York 11787-4311

FBI File No. 265A-NY-259028

Lab No. E-10969

Reference: FBI, New York telephone call July 17, 1996

Your No.

Re: UNKNOWN SUBJECT(S);
EXPLOSION OF TWA FLIGHT #800;
JULY 17, 1996;
ACTS OF TERRORISM - INTERNATIONAL
TERRORISTS - EXPLOSIVES AND INCENDIARY DEVICES

Specimens received:

The following report covers the work of the FBI Disaster Squad and the Suffolk County, New York, Police Department in connection with the examination of victims' remains in an effort to obtain inked prints for identification purposes through August 7, 1996.

One hundred ninety-six bodies and numerous body parts from two hundred thirty victims were examined, resulting in fingerprints and footprints being obtained.

Ninety-seven of the victims were identified by fingerprints and a footprint from one hundred parts of the remains. The FBI certifies the fingerprint and footprint identifications are positive identifications.

265A-NY-259028-SUB LAB

5

(Continued on next page)

2 - FBI, New York

I-46

ALL INFORMATION CONTAINED
HEREIN IS UNCLASSIFIED
DATE 4-14-00 BY SPS/JC [redacted]

SEARCHED ___ INDEXED ___
SERIALIZED ___ FILED ___
NOV 7 1996
[redacted]

b7C

[redacted] October 29, 1996 b7C

The identifications effected by fingerprints and the footprint are set forth on an attached list.

The fingerprint cards and personal effects received by the Suffolk County Police Department are being returned, under separate cover, to the Suffolk County Police Department for final disposition. The remaining items will be returned by the FBI Disaster Squad to the respective contributors.

1 - Commissioner
Suffolk County Police Department
Attention: [redacted] Homicide Section b7C
30 Yaphank Avenue
Yaphank, New York 11980

Aikens, Sandra Lee - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Amlund, Svein - [redacted]

He was identified with fingerprints [redacted]

Anderson, Seana Michele - [redacted]

She was identified with a fingerprint [redacted]

Babb, David Alfred - [redacted]

He was identified with a right footprint [redacted]

Baszczewski, Daniel - [redacted]

He was identified with [redacted]

b7C
b7D
b6

Beatty, Charles Ross - [redacted]

He was identified with fingerprints [redacted]

Becker, Michele - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Bohlin, Michelle Elizabeth - [redacted]

She was identified with fingerprints [redacted]

Bossuyt, Luc Yvon - [redacted]

He was identified with a fingerprint [redacted] b7C b7D b6

Braman, Rosemary Patterson - [redacted]

She was identified with fingerprints [redacted]

Buttaroni, Mirco - [redacted]

He was identified with fingerprints [redacted]

Caillaud, Anthony - [redacted]

He was identified with a fingerprint [redacted]

Callas, Daniel John - [redacted] b7C

He was identified with fingerprints [redacted] b7D b6

Campbell, Jr., Richard Gordon - [redacted]

He was identified with fingerprints [redacted]

Carven, Joseph A. (parents' name Vonhedrick) - [redacted]

He was identified with a fingerprint [redacted]

Carven, Paula Ann [redacted]

She was identified with a fingerprint [redacted] b7C b7D b6

Charbonnier, Jacques Raoul - [redacted]

He was identified with fingerprints [redacted]

b7C
b7D
b6

Chemtob, Monique Michele - [redacted]

She was identified with fingerprints [redacted]

Christopher, Janet Louise - [redacted]

She was identified with fingerprints [redacted]

Crandell, Pamela Lee - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Dadi, Marcel - [redacted]

He was identified with a fingerprint [redacted]

D'Alessandro, Anna - [redacted]

She was identified with a photographic copy of a fingerprint, [redacted]

Dickey, Deborah Ann - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Dodge, Jr., Warren Andrews - [redacted]

b7C
b7D
b6

He was identified with fingerprints [redacted]

Duarte-Coiner, Ana Tally - [redacted]

She was identified with fingerprints [redacted]

Edwards, Daryl Kevin - [redacted]

He was identified with fingerprints [redacted]

Eshleman, Douglas - [redacted]

He was identified with fingerprints [redacted]

b7C
b7D
b6

Estival, Alexandre - [redacted]

He was identified with fingerprints [redacted]

Feeney, Deirdre - [redacted]

She was identified with fingerprints [redacted]

Gabor, Daniel Kirk - [redacted]

He was identified with a fingerprint [redacted]

b7C
b7D
b6

Gasq, Francis Gaston - [redacted]

He was identified with fingerprints [redacted]

b7C
b7D
b6

Gough, Donald Ellis - [redacted]

He was identified with fingerprints [redacted]

Graham, Steven Kenneth - [redacted]

He was identified with a fingerprint [redacted]

Gray III, Charles H. - [redacted]

He was identified with fingerprints [redacted]

b7C
b7D
b6

Griffith, Donna - [redacted]

She was identified with fingerprints [redacted]

Griffith, Jo-Anne - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Grivet, Cyril Daniel - [redacted]

He was identified with fingerprints [redacted]

Hammer, Tracy Anne - [redacted]

She was identified with a fingerprint [redacted]

Hochard, Jean Pierre - [redacted]

He was identified with a fingerprint [redacted]

Hogan, Jr., Harry David - [redacted]

He was identified with fingerprints [redacted]

Holst, Eric - [redacted]

He was identified with a fingerprint [redacted]

Holst, Virginia - [redacted]

She was identified with a fingerprint [redacted]

Ingenhuett, Lonnie L. - [redacted]

He was identified with fingerprints [redacted]

b7C
b7D
b6

b7C
b7D
b6

b7C
b7D
b6

Johns, Courtney E. - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Johnsen, Arlene Ellen - [redacted]

She was identified with fingerprints [redacted]

Johnson, Eleanor Ann - [redacted]

She was identified with fingerprints [redacted]

Karschner, Amanda M. - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Kevorkian, Ralph George - [redacted]

He was identified with fingerprints [redacted]

Krick, Oliver - [redacted]

He was identified with fingerprints [redacted]

b7C
b7D
b6

Krikhan, Margot - [redacted]

She was identified with a fingerprint [redacted]

Krukar, Andrew - [redacted]

He was identified with a fingerprint [redacted]

Kwan, Barbara Lynn - [redacted]

She was identified with fingerprints [redacted]

Kwiat, Kimberly - [redacted]

She was identified with fingerprints [redacted]

Labys, Jane - [redacted]

She was identified with a fingerprint [redacted]

Laforge, Alain - [redacted]

He was identified with fingerprints [redacted]

Lamour, Yvon - [redacted]

He was identified with a fingerprint [redacted]

Lang, Raymond A. - [redacted]

He was identified with fingerprints [redacted]

Lockhart, Maureen Margaret - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

b7C
b7D
b6

b7C
b7D
b6

Loffredo, Elaine Frances - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Luevano, Jr., Elias V. - [redacted]

He was identified with fingerprints [redacted]

Lychner, Kathern Elizabeth - [redacted]

She was identified with fingerprints [redacted]

Lychner, Pamela Sue - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Lychner, Shannon Evain - [redacted]

She was identified with fingerprints [redacted]

Manchuelle, Edouard Francois - [redacted]

He was identified with fingerprints [redacted]

Mazzola, Salvatore - [redacted]

He was identified with a fingerprint [redacted]

b7C
b7D
b6

McPherson, Pamela Vincentia - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Meade, Sandra J. - [redacted]

She was identified with fingerprints [redacted]

Miller, Gideon B. - [redacted]

He was identified with fingerprints [redacted]

Miller, Joan - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Miller, Robert Philip - [redacted]

He was identified with fingerprints [redacted]

Nelson, Alecia Carlos - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Notes, Gadi, [redacted]

He was identified with fingerprints [redacted]

b7C
b7D
b6

O'Hara, Caitlin - [redacted]

She was identified with fingerprints [redacted]

O'Hara, John Joseph - [redacted]

He was identified with fingerprints [redacted]

Omiccioli, Monica - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Orman, Alan Jay - [redacted]

He was identified with fingerprints [redacted]

Price, Peggy Ann - [redacted]

She was identified with fingerprints [redacted]

Privette, Brenda Kay - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Rhoads III, Harry Short - [redacted]

He was identified with fingerprints [redacted]

b7C
b7D
b6

Rhoads, Marit E. - [redacted]

She was identified with fingerprints [redacted]

Richter, Annelyse - [redacted]

She was identified with a fingerprint [redacted]

Rojany, Yon Michael - [redacted]

He was identified with a fingerprint [redacted]

b7C
b7D
b6

Schuldt, Michael George - [redacted]

He was identified with fingerprints [redacted]

Scott, Joseph Michael - [redacted]

He was identified with fingerprints [redacted]

Shorter, Ana Maria - [redacted]

She was identified with fingerprints [redacted]

b7C
b7D
b6

Silverman, Candace Beth - [redacted]

She was identified with a fingerprint [redacted]

Simmons, Olivia J. - [redacted] b7C b7D b6

She was identified with fingerprints [redacted]

Torche, Melinda Diane - [redacted]

She was identified with fingerprints [redacted]

Uzupis, Larissa - [redacted]

She was identified with fingerprints [redacted]

Verhaeghe, Rick Lee - [redacted]

He was identified with fingerprints [redacted] b7C b7D b6

Warren, Lani Elaine - [redacted]

She was identified with fingerprints [redacted]

Watson, Jacqueline - [redacted]

She was identified with a fingerprint [redacted]

Weatherby, Thomas - [redacted]

He was identified with fingerprints [redacted] b7C b7D b6

Windmiller, Ruben - [redacted] b7C b7D b6

He was identified with fingerprints [redacted]

Wolfson, Wendy - [redacted]

She was identified with a fingerprint [redacted]

Wolters, Bonnie - [redacted]

She was identified with fingerprints [redacted]

Ziemkiewicz, Jill Ann - [redacted] b7C b7D b6

She was identified with fingerprints [redacted]

7-1 (Rev. 2-21-91)

FBI LABORATORY

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

Date: November 14, 1996

To: ADIC, New York

FBI File No. 265A-NY-259028

Lab No. 61112026 S RU VJ

Reference: Communication dated November 7, 1996

ASAC C

Your No. 265A-NY-259028 (Pending)

I-46

Re: UNSUB(S);
EXPLOSION OF TWA FLIGHT # 800;
07/17/96;
AOT - IT; EOD;

Specimens received: At Grumman on November 8, 1996

Specimens:

Q97 #44 entrapped material from SWB #2, CW702 approx. 41.7 RBL.

Result of examination:

Specimen Q97 is a piece of woven fiberglass.

The submitted item will be returned to you under separate cover by registered mail.

265A-NY-259028-SUB LAB

6

SEARCHED ____ INDEXED ____
SERIALIZED ____ FILED ____
NOV 21 1996
[redacted]

b7C

ALL INFORMATION CONTAINED
HEREIN IS UNCLASSIFIED
DATE 4-14-00 BY SPS/ JC/AVL

[redacted]

FD-302 (Rev. 3-10-82)

FEDERAL BUREAU OF INVESTIGATION

Date of transcription 9/10/96

The NATIONAL TRANSPORTATION SAFETY BOARD, Fuel Systems Sub-Group regarding the July 17, 1996 crash of Boeing 747-131, N93119 operated by TRANS WORLD AIRWAYS (TWA) as Flight 800 in East Moriches, New York met with representatives from the George C. Marshall Space Flight Center, National Aeronautics and space administration Huntsville, Alabama to review the following components of the above described aircraft.

1. 22 segments of fuel sensors.
2. 8 1/2 fuel transfer pumps.
3. 5 fuel gauges.
4. 1 flight engineer fuel jettison panel.
5. 1 flight engineer panel.
6. 5 circuit breakers.

These items were boxed by [redacted] b7C NATIONAL TRANSPORTATION SAFETY BOARD (NTSB) and transported by him from Long Island, New York to Huntsville, Alabama. [redacted] maintained care custody and control of these components along with [redacted] of the NTSB and [redacted] of the NTSB. Upon the completion of the investigation at the MARSHALL SPACE FLIGHT CENTER, [redacted] repacked the above described evidence and transported it back to Long Island, New York.

Attached is a list of the individuals from the NTSB Fuel Systems Sub-Group and employees of the MARSHALL SPACE FLIGHT CENTER who assisted in the dismantling of the above listed parts.

At the conclusion of the dismantling of the above-described parts, the NTSB reached the conclusion that none of these parts were the cause of the above described aircraft accident. A thorough report of this investigation will be written by [redacted] for the NTSB in the near future.

265A-NY-259028-SUB b7C

SEARCHED INDEXED SERIALIZED FILED JAN 1 1997 FBI-NEW YORK

Investigation on 08/24-26/96 at Huntsville, Alabama

File # 265A-NY-259028-FD302

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED DATE 4-14-00 BY [illegible]

by SA [redacted] kmm

Date dictated 08/30/96

)6/01/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 02/06/1997

To: LABORATORY DIVISION
ATTN: SCIENTIFIC ANALYSIS SECTION;
PAINTS AND POLYMER SUB UNIT;
FORENSIC EXAMINER [redacted]

b7C

From: ADIC, NEW YORK (SQUAD I-46)

Contact: [redacted]

Approved By: [redacted]

Drafted By: [redacted]

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUBS;
EXPLOSION OF TWA FLIGHT 800;
AOT-IT-EOD

Synopsis: Transmittal of evidence to the Laboratory Section.

X

Package Copy: Being forwarded under separate cover is one package containing evidence seized in connection with captioned matter. The items listed below will be sent via Federal Express to the Laboratory Division. The evidence being submitted is described as follows:

TC

Item Marked # MM1 CW-504 LBL-104 02/05/97
Item Marked # MM3 CW-504 LBL-106.72 02/05/97
Item Marked # MM4 CW-504 LBL-106 02/05/97
Item Marked # MM5 CW-114

The items set forth above, MM1, MM3, MM4, and MM5 represent one piece (in each bag) of splatter material, brown in color, retrieved from the upper outboard (port) posterior side of CW 504.

DETAILS: The above listed items were retrieved from the upper outboard (port) posterior side of CW 504 which is part of the front spar of the Center Wing Box of TWA flight 800, also known as TWA Equipment 17119.

265A-NY-259028 sub LAB-8

TC [redacted] [redacted] b7C

FEDERAL BUREAU OF INVESTIGATION

It should be noted that the same material, noted as Item MM1, Item MM3, Item MM4 and Item MM5, was submitted to the FBI Laboratory via Federal Express, airbill number 3920905015 on February 6, 1996.

♦♦

LEAD(s):

Set Lead 1:

LABORATORY DIVISION, SCIENTIFIC ANALYSIS SECTION, PAINTS AND POLYMER SUB UNIT; at FBIHQ, Washington, D.C.

CHEMISTRY TOXICOLOGY UNIT, PAINTS AND POLYMER SUB UNIT, is requested to examine items marked # MM1, MM3, MM4 and MM5, and attempt to determine the composition of the samples provided herein.

♦♦

06/01/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 02/06/1997

To: SAC, DIVISION I **Attn:** ASAC CHARLES DOMROE
SSA [redacted]
EVIDENCE CONTROL

b7C

From: NEW YORK
I-46
Contact: [redacted]

Approved By: [redacted]

Drafted By: [redacted]

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S)
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996
AOT-IT-EID

Synopsis: EVIDENCE TO BROOKHAVEN NATIONAL LABORATORY

Details: On February 4, 1996, a meeting was held at BROOKHAVEN NATIONAL LABORATORY, Upton, New York 11973-5000. The purpose of said meeting was to solicit any resources available at the Laboratory which might assist in determining a cause which resulted in the explosion of TWA flight 800 on January 17, 1996. Present at the aforementioned meeting were FBI investigators and FBI Laboratory personnel from FBIHQ, NTSB personnel, and BROOKHAVEN LAB personnel.

TC

Pursuant to a mutual agreement between the FBI and the [redacted] BROOKHAVEN LABS, [redacted] the following piece of material taken from TWA flight 800 on February 5, 1997, will be turned over to BROOKHAVEN for the express purpose of determining the composition of same:

b7C

MM7, CW-129
One piece of splatter material, brown in color, retrieved from the interior surface of CW 129 which is located on the upper surface of the center fuel tank.

TC [redacted]

Sub UAI # 9

b7C

to: FILE

from: [redacted]

Sandia National Laboratories
Dept. Explosives Applications (9333)

b7c

subject: Trip Report (11/7/96), Inspection of TWA800 wreckage

On Thursday, 11/7/96, at the request of the FBI, I inspected aircraft wreckage from the crash of TWA Flight 800. My FBI contact for this inspection tour was Special Agent [redacted] (FBI Laboratory Explosives Unit, [redacted] for this case), there were three other agents from that unit also present. While there I also met with two representatives from the NTSB Office of Aviation Safety [redacted] (Aerospace Engineer), as well as Special Agent [redacted] from the FAA Aviation Explosives Security Division.

[illegible] of all of the recovered parts areas, I focused my attention primarily on [illegible] of the remains of the center fuel tank.

[illegible]

[illegible] tank is a rigid, roughly rectangular, aluminum box. It is divided into [illegible] by floor-to-ceiling partitions which run side-to-side. The first [illegible] is sealed from the tank and is used as a dry-well (p[illegible] for special [illegible] space). The in-tank partitions, presumably used to reduce fuel sloshing, are constructed of vertical I-beams (aluminum) about a foot apart, covered on one side with thin aluminum sheet. There are fuel pass-through holes about three to four inches diameter along the bottom of the partitions an inch or two above floor level.

2. ELECTRICAL PUMPS AND PROBES

I was told that there are five electrical fuel pumps in the tank which are in sumps in the floor. There are seven electrical fuel level (or quantity) probes in the tank (I didn't see any, but their approximate original locations were given by plastic pipe surrogates suspended from the ceiling). I was shown a fuel probe from a wing tank, which is presumably similar to the center tank probes, but of shorter length. Individual electrical sections within the probe were connected to each other with bare electric wire running between screw-and-nut terminals.

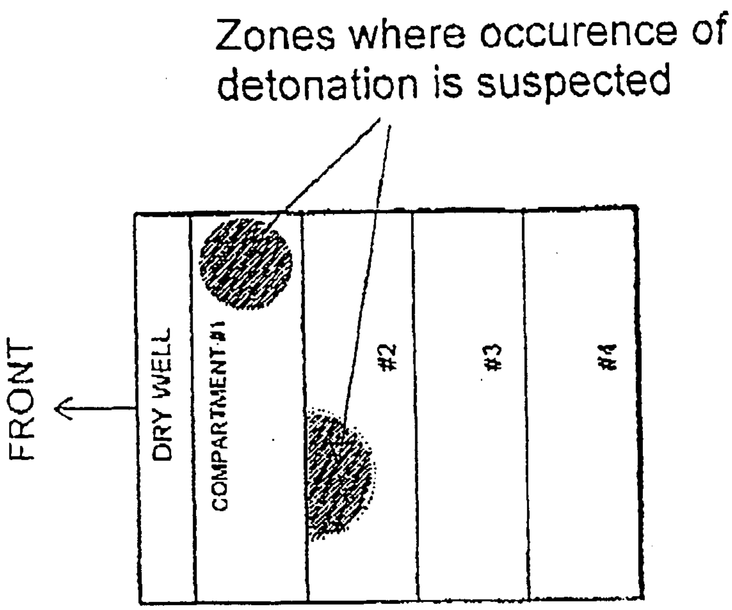
3. EVIDENCE OF GAS-PHASE DETONATION

[illegible] that there appear to be two zones in the center fuel tank that show evidence of possible gas phase detonation. One, adjacent to the side wall, on the right-hand side (facing forward) of the first compartment, and the second, toward the left-hand side of the second compartment. The reason for believing that detonations occurred in these two areas was the amount and degree of metal bending and crushing [illegible] in these areas.

There are several uniquely distorted and torn pieces of metal within the fuel tank which may be amenable to mechanical and computer analyses which could yield pressures and pressure distributions which had existed inside the tank at the time it exploded. (It should be noted here that evidence of gas-phase detonation is quite different than that from condensed-phase detonations, the former producing pressures of 10-20 atmospheres and the latter pressures of 50,000-400,000 atmospheres).

4. IGNITION POINT LOCATION

The ignition source or initiation point appears to originate at the same location that was once occupied by an as yet unrecovered electrical fuel level probe at the center of the zone which seemed to have detonated at the right front corner of the tank (in the first compartment)..


Zones where occurence of
detonation is suspected
FRONT
DRY WELL
COMPARTMENT #1
#2
#3
#4

OPCA-20 (12-3-96)

XXXXXX
XXXXXX
XXXXXX

FEDERAL BUREAU OF INVESTIGATION
FOIPA
DELETED PAGE INFORMATION SHEET

3 Page(s) withheld entirely at this location in the file. One or more of the following statements, where indicated, explain this deletion.

☑ Deletions were made pursuant to the exemptions indicated below with no segregable material available for release to you.

Section 552		Section 552a
☐ (b)(1)	☐ (b)(7)(A)	☐ (d)(5)
☐ (b)(2)	☐ (b)(7)(B)	☐ (j)(2)
☑ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
Rule 6(e) Federal Rules	☐ (b)(7)(D)	☐ (k)(2)
of Criminal Procedure	☐ (b)(7)(E)	☐ (k)(3)
______	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☐ (b)(6)		☐ (k)(7)

☐ Information pertained only to a third party with no reference to the subject of your request or the subject of your request is listed in the title only.

☐ Documents originated with another Government agency(ies). These documents were referred to that agency(ies) for review and direct response to you.

______ Pages contain information furnished by another Government agency(ies). You will be advised by the FBI as to the releasability of this information following our consultation with the other agency(ies).

______ Page(s) withheld inasmuch as a final release determination has not been made. You will be advised as to the disposition at a later date.

______ Pages were not considered for release as they are duplicative of ______

______ Page(s) withheld for the following reason(s): ______

☑ The following number is to be used for reference regarding these pages:
265A-NY-259028-SUB LAB 11

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X Deleted Page(s) X
X No Duplication Fee X
X for this page X
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FBI/DOJ

JAN-29-1997 14:37 P.03

(Rev. 7-5-91)

FBI LABORATORY

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

Date: January 24, 1997

To: ADIC, New York

FBI File No. 265A-NY-259028

Lab No. 60723031 S AD AR RU
60730006 S AD RU
60730007 S AD RU
60806002 S AD ZG
60909001 S AD AR RU
61118011 S AD HJ
61127057 S AD HK

Reference: Communication dated July 22, 1996

Your No. 265A-NY-259028

Re: UNSUBS;
EXPLOSION OF TWA FLIGHT #800;
AOT-IT;
EOD
OO: NEW YORK

265A-NY-259028-SUB LAB-13

JAN 3 0

FBI — NEW YORK

Specimens received: July 23, 1996

Specimens:

Q1	Section of aircraft wing (your item #1)
Q2	Black back pack (your item #2)
Q3	Children's car seat (your item #3)
Q4	Tan colored piece of luggage (your item #4)
Q5	Fragmented piece of luggage (your item #5)
Q6	Silver colored metal fragment (your item #6)
Q7	Unknown white powder (your item #7)
Q8	Silver colored metal fragment (your item #8)

FBI — NEW YORK
JAN 3 0

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED DATE 4-14-00 BY SPS/JC/

(over)

This Report Is Furnished For Official Use Only

Results of Examination:

BACKGROUND INFORMATION:

Your office advised that on 7/17/96 at approximately 8 PM a Boeing 747 aircraft designated TWA Flight 800 exploded over the Atlantic Ocean approximately 20 miles south of the Long Island, New York coast. In an effort to determine the cause of the explosion numerous pieces of wreckage have been sent to the Laboratory for examination.

METALLURGY EXAMINATIONS:

60723031 S AD AR RU

Metallurgical examinations of specimens Q6 and Q8 revealed no characteristic indicative of blast damage. The observed surface damage was concluded to be attributable to corrosion mechanisms, with the exception of certain manufacturing/service anomalies. ✓

60730006 S AD RU

Metallurgical examinations of specimens Q18 and Q19 revealed no characteristic indicative of blast damage. The surface damage exhibited is concluded to be the result of corrosion. ✓

60730007 S AD RU

Metallurgical examinations of specimens Q20 through Q24 revealed no characteristic indicative of blast damage. The observed surface damage was concluded to be attributable to corrosion mechanisms. ✓

60909001 S AD AR RU

Joint evaluation by FBI and National Transportation Safety Board (NTSB) metallurgists of the Q90 portion of fuselage and Q91 fuselage fragment revealed no exogenous deposit of apparent probative value or characteristic of proximity to a high order explosive.

The Q92 fractured duct flange and the Q93 section of fuel probe were released to the custody [redacted] NTSB, on September 11, 1996, and will be the subject of a separate report by NTSB. b7C

(over)

P.02 [redacted] FBI LABORATORY FO-PDC JAN-23-1997 13:55 b7C

61118011 S AD HJ

Metallurgical examinations of the Q110 section revealed no characteristic indicative of high explosive damage.

GLASS EXAMINATION:

60806002 S AD ZG

Although the origin of the Q83 glass fragment cannot be precisely realized, optically, physically and compositionally this glass is generally characteristic of that use in "light bulbs" and fluorescent tubes.

PAINT EXAMINATION:

Specimens Q98 through Q107, K1 and K2, were examined microscopically. The paint samples K1 and K2 exhibited the following layer structures:

1. Clear
2. Orange
3. Dark Orange
5. Black primer

Present in the debris removed from Q98 and Q99 were numerous particles of single layered paint-like samples and several multi-layered chips. Based upon the comparison examinations conducted, the paint samples from 98 and Q99 could not be associated with Q101, Q103, or Q107, however, the samples from Q98 and Q99 could not be eliminated as having originated from the sources represented by K1 or K2. The red smears on Q100 and Q102 were microscopically consistent with Q106. The blue samples Q104 and Q105 were compared and dissociated by microchemical tests. No source could be determined for Q104.

DISPOSITION OF SPECIMENS:

The submitted specimens will be returned to your office under separate cover via registered mail or equivalent.

Please call the Explosives Unit-Bomb Data Center, (202) 324[redacted] if you have any questions concerning the results of examinations in this case. b7C

[redacted] b7C

TOTAL P.05

7-1 (Rev. 2-21-91)

FBI LABORATORY

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

Date: March 26, 1997

To: ADIC, New York

FBI File No. 265A-NY-259028

Lab No.
60723031 S AD AR
60730006 S AD RU
60730007 S AD RU
60806002 S AD ZG
60909001 S AD AR RU
61118011 S AD HJ
61127057 S AD HK
60727032 S AD AR
60728031 S AD AR
60804032 S AD AR
60817031 S AD AR
60818061 S AD AR
60830005 S AD AR
60912038 S AD AR
61007005 S AD AR

Reference: Communication dated July 22, 1996

Your No. 265A-NY-259028

Re: UNSUBS;
EXPLOSION OF TWA FLIGHT #800;
AOT-IT;
EOD
OO: NEW YORK

Specimens received: July 23, 1996

Specimens: The following items were received in the Laboratory on July 23, 1996 under your communication dated July 22, 1996 and examined under Laboratory Number 60723031 S AD AR RU:

Q1 Section of aircraft wing (your item #1)

Q2 Black back pack (your item #2)

Q3 Children's car seat (your item #3)

Q4 Tan colored piece of luggage (your item #4)

Q5 Fragmented piece of luggage (your item #5)

Q6 Silver colored metal fragment (your item #6)

Q7 Unknown white powder (your item #7)

Q8 Silver colored metal fragment (your item #8)

SEARCHED ___ INDEXED ___
SERIALIZED ___ FILED ___
APR 3 1997
FBI — NEW YORK

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HEREIN IS UNCLASSIFIED
DATE 4-14-00 BY SPS/BC/PVR

(over)

This Report Is Furnished For Official Use Only

The results of Special Photo examinations of Q9 (Strip of film, Laboratory Number 60725009 D HD) will be provided in a separate report.

Specimens: The following items were received in the Laboratory on July 27, 1996 under your communication dated July 27,1996 and examined under Laboratory Number 60727032 S AD AR RU:

Q9 Section of floor panel (your item #11)

Q10 Magnet (your item #12)

Q11 Section of floor hatch (your item #13)

Q12 Section of floor panel (your item #14)

Specimens: The following items were received in the Laboratory on July 28, 1996 under your communication dated July 27,1996 and examined under Laboratory Number 60728031 S AD AR:

Q13 Floor panel #187 (Boeing part #65B06099-600) (1B44, item 15)

Q14 Floor panel #177 (Boeing part #65B08273-6) (1B45, item 16)

Q15 Floor panel #121 (Boeing part #65B08272-12) (1B46, item 17)

Q16 Floor panel #76 (Boeing part #65B06278-601) (1B47, item 18)

Specimens: The following items were received in the Laboratory on July 30, 1996 under your communication dated July 28,1996 and examined under Laboratory Number 60730006 S AD RU:

Q17 One (1) round, domed shaped piece of metal (1B54 - your item #19)

Q18 One (1) section of metal (consisting of two (2) pieces welded/bonded together) (1B55 - your item #20)

Q19 One (1) piece of metal with two (2) countersunk holes (1B46 - your item #21)

Specimens: The following items were received in the Laboratory on July 30, 1996 under your communication dated July 29,1996 and examined under Laboratory Number 60730007 S AD RU:

Q20 One (1) piece of metal silver in color approximately 11 3/4" with several manufacturer holes (1B70 - your item #22)

Q21 One (1) piece of alloy like metal 16 7/8" (1B72 - your item #23)

Q22 One (1) piece of alloy like metal 13 1/2" (1B73 - your item #24)

Q23 One (1) piece of alloy like metal approximately 7" with angled piece riveted to it (1B71 - your item #25)

Q24 One (1) piece of silver in color corrugated-like metal approximately 12" (1B74 - your item #26)

Specimens: The following items were received in the Laboratory on July 30, 1996 under your communication dated July 29,1996, submitted under 1B59 and examined under Laboratory Number 60730005 S AD ZO XO:

Q25 One (1) Pentax 35mm camera (item #1)

Q26 One (1) roll 35mm/24 film (item #2)

Q27 One (1) disposable Fugi camera (item #3)

Q28 One (1) roll of Fugi film (item #4)

Q29 One (1) Mamiya 645 camera (item #5)

Q30 One (1) Canon Owl camera with nine (9) rolls of canon film (item #6)

Q31 One (1) Nikon camera with one (1) roll of film (item #7)

Q32 One (1) roll of Kodak film/25 exposure (item #8)

Q33 Chinon camera with seven (7) rolls of film (item #9)

Q34	One (1) Olympus camera (item #11)
Q35	One (1) video cassette and one (1) roll of film (item #10)
Q36	One (1) Kodak Camera with one (1) roll of film (item #12)
Q37	One (1) Mamiya 645 camera (item #13)
Q38	One (1) Polaroid camera (item #14)
Q39	Five (5) rolls of film (item #15)
Q40	One (1) camera (item #16)
Q41	One (1) Polaroid film cartridge (item #17)
Q42	One (1) JVC video camera with tape (item #18)
Q43	One (1) Olympus AF-10/Super Camera (item #19)
Q44	Rolls of film (item #20)
Q45	One (1) Touch Zoom Nikon camera (item #21)
Q46	Five (5) rolls of film (item #22)
Q47	One (1) Minolta camera (item #23)
Q48	Three (3) rolls of film (item #24)
Q49	Cat Camera (item #25)
Q50	Polaroid camera (item #26)
Q51	Two (2) disposable cameras (item #27)
Q52	One (1) Contax camera (item #28)
Q53	Three (3) rolls of film (item #29)
Q54	Seven (7) rolls of film (item #30)
Q55	One (1) Minolta camera with two (2) rolls of film (item #31)
Q56	Super film shield containing film (item #32)

(over)

Q57 One (1) Nikon 35mm camera (item #33)

Q58 One (1) Minolta x700 camera with flash and one (1) roll of film (item #34)

Q59 Five (5) rolls of film (item #35)

Q60 Thirteen (13) rolls of film (item #36)

Q61 One (1) Keystone Camera (item #37)

Q62 One (1) Olympus camera and one (1) canister of film (item #38)

Q63 One (1) camera with film (item #39)

Q64 One (1) roll of film (item #40)

Q65 Two (2) disposable cameras (item #41)

Q66 One (1) roll of film (item #42)

Q67 One (1) Biboa click camera (item #43)

Q68 Two (2) cassettes with player (item #44)

Q69 One (1) roll of film (item #45)

The following items were submitted under 1B60:

Q70 One (1) Polaroid camera with four (4) rolls of film (item #101)

Q71 One (1) Vivitar series 440Z camera (item #102)

Q72 One (1) fanny pack containing a camera and four rolls of film (item #103)

Q73 One (1) Minolta Dinax 3xi camera with film (item #104)

Q74 One (1) Polaroid camera 635 CL with one (1) roll of film (item #105)

Q75 One (1) Ricoh camera and case (item #106)

Q76 Four (4) canisters of film (item #107)

Q77 One (1) Olympus camera with four (4) rolls of film in MacGregor case (item #108)

Q78 One (1) Minolta Freedom camera with one (1) roll of film (item #109)

Q79 One (1) Nikon Nice Touch camera and film (item #110)

Q80 One (1) JVC Camcorder and bag (item #111)

Q81 One (1) Sony video camera and film in case (item #112)

Specimens: The following item was received in the Laboratory on August 4, 1996 under cover of FD-192 dated August 3, 1996 referencing 1B104 item #28 and examined under Laboratory Number 60804032 S AD AR:

Q82 One (1) section of aircraft floor panel (1B104, your item # 28)

Specimens: The following item was received in the Laboratory on August 6, 1996 under your communication dated August 4, 1996 and examined under Laboratory Number 60806002 S AD ZG:

Q83 One (1) fragment of transparent glass (1B91, your item #27)

The results of Engineering Research Facility examinations of Q84 Laboratory Number 60809002 E QZ were provided in a separate report dated 9/23/96 (Laboratory #60809002 E QZ).

Specimens: The following item was received in the Laboratory on August 17, 1996 under your communication dated August 16, 1996 and examined under Laboratory Number 60817031 S AD AR:

Q85 One (1) section of aircraft floor panel (1B148, your item # 31)

Specimens: The following items were received in the Laboratory on August 18, 1996 under your communication dated August 17, 1996 and examined under Laboratory Number 60818061 S AD AR:

Q86 One (1) section of aircraft floor panel (your item #32) and three (3) vials of scrapings from floor panel (your item #33)

(over)

Specimens: The following items were received in the Laboratory on August 18, 1996 under your communication dated August 14, 1996 and examined under Laboratory Number 60818062 S AD HD:

ALSO SUBMITTED:

One (1) plastic bucket containing eleven (11) cameras containing film; various 135mm film canisters; and two (2) TDK TC-30 VHS video tapes

Specimens: The following item was received in the Laboratory on August 28, 1996 under your communication dated August 26, 1996 and examined under Laboratory Number 60830005 S AD AR:

Q87 One (1) sheet of canvas like material (1B167, your item #34)

Specimens: The following items were received in the Laboratory on September 8, 1996 under your communication dated August 29, 1996 and examined under Laboratory Number 60909001 S AD AR RU:

Q88 One (1) piece of carpet approximately 20.5" (inches) wide by 19' (feet) long (your 1B193, item 35)

Q89 One (1) piece of carpet approximately 20.5" (inches) wide by 9' (feet) 6" (inches) long (your 1B192, item 36)

Q90 One (1) section of aircraft fuselage (your 1B194, item 37)

Q91 One (1) metal fragment from 1B194, item 37; cutoff wheel control sample with vacuuming (your 1B195, item 38)

Q92 Fractured duct flange (your 1B196, item 39)

Q93 Section of damaged fuel probe (your 1B197, item 40)

ALSO SUBMITTED:

Two (2) sets of photographs

(over)

Specimens: The following item was received in the Laboratory on September 12, 1996 under your communication dated September 10, 1996 and examined under Laboratory Number 60912038 S AD AR:

Q94 One (1) section of blue carpet (1B200, your item #41)

Specimens: The following items were received in the Laboratory on October 7, 1996 under your communication dated October 4, 1996 and examined under Laboratory Number 61007055 S AD AR:

Q95 One (1) section of carpet approximately 4" X 9" with miscellaneous wires (your 1B236, item #42)

Q96 One (1) section of carpet approximately 7" X 14" (your 1B237, item #43)

The results of Materials Analysis examinations of Q97 (Laboratory Number 61112026 S VJ RU) will be provided in a separate report.

Specimens: The following items were received in the Laboratory on November 27, 1996 under your communication dated November 22, 1996 and examined under Laboratory Number 61127057 S AD HK:

Q98 Scrapings (A) (Lab #827-8)

Q99 Scrapings (B) (Lab #926-23)

Q100 Scrapings (C) (RF-4)

Q101 Samples from motorcase body (F)

Q102 Samples from LF59 (G)

Q103 Samples from engine thrust reverser actuator (H)

Q104 Scrapings (I) (z5087)

Q105 Sample from tray table insulation (J)

Q106 Paint samples from fuselage

Q107 Samples from drone body (E)

Q108 Not used

(over)

K1 Samples from orange dolly (D)

K2 Samples from orange dolly #2 (K)

Specimens: The following items were received in the Laboratory on November 18, 1996 under your communication dated November 7, 1996 and examined under Laboratory Number 61118010 S/D AD HD:

Q109 One (1) bucket containing various cameras and film

Specimens: The following item was received in the Laboratory on November 18, 1996 under your communication dated November 8, 1996 and examined under Laboratory Number 61118011 S AD HJ:

Q110 One (1) section of bent (L-shaped) light weight metal approximately 100" in length (your 1B45, item #1)

Specimens: The following items were received in the Laboratory on November 14, 1996 under your communication dated November 13, 1996 and examined under Laboratory Number 61114052 S AD HK:

Q110a Piece from aircraft seat (your 1B270, item #46)

Q111 Piece from aircraft seat (your 1B270, item #47)

Q112 Piece from aircraft seat (your 1B270, item #48)

Q113 Piece from aircraft seat (your 1B270, item #49)

Q114 Piece from aircraft seat (your 1B270, item #50)

Q115 Piece from aircraft seat (your 1B270, item #51)

Q116 Piece from aircraft seat (your 1B270, item #52)

Specimens: The following items were received in the Laboratory on January 28, 1997 under cover of communication dated January 27, 1997 and were examined under Laboratory Number 70128025 S AD AR:

Q117 Swabbing (Your #1)

(over)

Q118 Swabbing (Your #2)

Q119 Swabbing (Your #3)

Q120 Swabbing (Your #4)

Q121 Swabbing (your #5)

NE1 Photograph

NE2 Photograph

NE3 Photograph

NE4 Swabbing with gloves

Specimens: The following items were received in the Laboratory on January 24, 1997 under cover of communication dated January 23, 1997 and examined under Laboratory Number 70124029 S AD AR:

Q122 Swabbing (your #1)

Q123 Swabbing (your #2)

Q124 Swabbing (your #3)

Q125 Swabbing (your #4)

Q126 Swabbing (your #5)

Q127 Swabbing (your #6)

NE5 Photograph of swabbing locations #1 through #5

NE6 Photograph of swabbing location #6

NE7 Test swabbing with gloves

Specimens: The following items were received in the Laboratory February 7, 1997 under cover of communication dated February 6, 1997 and examined under Laboratory Number 70207064 S AD HK:

Q128 One (1) piece of splatter material (your item #MM1 CW-504LBL-104)

(over)

Q129 One (1) piece of splatter material (your item #MM3 CW-504LBL-106.72)

Q130 One (1) piece of splatter material (your item #MM4 CW-504LBL-106)

Q131 One (1) piece of splatter material (your item #MM5 CW-114)

NE8 One (1) blade

Results of Examination:

GENERAL INFORMATION:

This report incorporates the information provided in a draft report dated 1/31/97 (Laboratory #60723031 S AD RU, 60730006 S AD RU, 60730007 S AD RU, 60806002 S AD ZG, 60909001 S AD AR RU, 61118011 S AD HJ, 61127057 S AD HK) as well as all examinations conducted to date. Additional examinations are ongoing and you will be advised of the results of those examinations in a subsequent report.

The following examinations are currently being conducted:

Q25 through Q81 and Q109 - Special Photographic Unit
Q110 through Q131, NE4, NE7 - Chemistry Unit

BACKGROUND INFORMATION:

Your office advised that on 7/17/96 at approximately 20:31 EST a Boeing 747 aircraft designated TWA Flight 800 exploded over the Atlantic Ocean approximately 10 miles south of the Long Island, New York coast. In an effort to determine the cause of the explosion numerous pieces of wreckage have been sent to the Laboratory for examination.

METALLURGY EXAMINATIONS:

60723031 S AD AR RU

Metallurgical examinations of specimens Q6 and Q8 revealed no characteristic indicative of blast damage. The observed surface damage was concluded to be attributable to corrosion mechanisms, with the exception of certain manufacturing/service anomalies.

60730006 S AD RU

Metallurgical examinations of specimens Q18 and Q19 revealed no characteristic indicative of blast damage. The surface damage exhibited is concluded to be the result of corrosion.

Specimen Q17 was concluded to be a remnant of an aluminum can bottom degraded by long term corrosion, and irrelevant to the TWA 800 investigation.

60730007 S AD RU

Metallurgical examinations of specimens Q20 through Q24 revealed no characteristic indicative of blast damage. The observed surface damage was concluded to be attributable to corrosion mechanisms.

60909001 S AD AR RU

Joint evaluation by FBI and National Transportation Safety Board (NTSB) metallurgists of the Q90 portion of fuselage and Q91 fuselage fragment revealed no exogenous deposit of apparent probative value or characteristic of proximity to a high order explosive.

The Q92 fractured duct flange and the Q93 section of fuel probe were released to the custody of [redacted] b7C NTSB, on September 11. 1996, and will be the subject of a separate report by NTSB.

61118011 S AD HJ

Metallurgical examinations of the Q110 section revealed no characteristic indicative of high explosive damage.

GLASS EXAMINATION:

60806002 S AD ZG

Although the origin of the Q83 glass fragment cannot be precisely realized, optically, physically and compositionally this glass is generally characteristic of that use in "light bulbs" and fluorescent tubes.

PAINT EXAMINATION:

Specimens Q98 through Q107, K1 and K2, were examined microscopically. The paint samples K1 and K2 exhibited the following layer structures:

1. Clear
2. Orange
3. Dark Orange
5. Black primer

Present in the debris removed from Q98 and Q99 were numerous particles of single layered paint-like samples and several multi-layered chips. Based upon the comparison examinations conducted, the paint samples from Q98 and Q99 could not be associated with Q101, Q103, or Q107, however, the samples from Q98 and Q99 could not be eliminated as having originated from the sources represented by K1 or K2. The red smears on Q100 and Q102 were microscopically consistent with Q106. The blue samples Q104 and Q105 were compared and dissociated by microchemical tests. No source could be determined for Q104.

EXPLOSIVE COMPOSITION:

60723031

A physical and instrumental examination of residues removed from specimens Q1 through Q6, and Q8 did not detect any traces of nitroglycerine (NG), ethylene glycol dinitrate (EGDN), pentaerythritol tetranitrate (PETN), cyclotrimethylenetrinitramine (RDX), cyclotetramethylenetetranitramine (HMX), dinitrotoluene (DNT), trinitrotoluene (TNT), or trinitrophenylmethylnitramine (TETRYL). The specimens were not tested for the presence of any inorganic explosives due to this categories high water solubility.

A physical and instrumental analysis of specimen Q7 identified its major component to be sucrose with a minor component ibuprofen. The drug ibuprofen can be obtained over the counter in the United States in such products as Motrin and typically functions as an anti-inflammatory agent.

The specimens were examined using all or some of the following techniques: optical microscopy, chemical spot tests, gas chromatography with chemiluminescence detection, fourier transform infrared spectroscopy, x-ray powder diffraction, and liquid chromatography with mass spectrometry detection.

60727032

A physical and instrumental examination of residues removed from specimens Q9 through Q12 did not detect any traces of nitroglycerine (NG), ethylene glycol dinitrate (EGDN), pentaerythritol tetranitrate (PETN), cyclotrimethylenetrinitramine (RDX), cyclotetramethylenetetranitramine (HMX), dinitrotoluene (DNT), trinitrotoluene (TNT), or trinitrophenylmethylnitramine (TETRYL). The specimens were not tested for the presence of any inorganic explosives due to this categories high water solubility.

The specimens were examined using all or some of the following techniques: optical microscopy, chemical spot tests, gas chromatography with chemiluminescence detection, and liquid chromatography with mass spectrometry detection.

60728031

A physical and instrumental examination of residues removed from specimen Q15 (your item 17) identified the presence of cyclotrimethylenetrinitramine (RDX) and pentaerythritol tetranitrate (PETN) high explosive. The source of these materials is not known since live explosives were reportedly used on the aircraft for training purposes prior to this event.

A physical and instrumental examination of residues removed from specimens Q13, Q14 and Q16 did not detect any traces of nitroglycerine (NG), ethylene glycol dinitrate (EGDN), pentaerythritol tetranitrate (PETN), dinitrotoluene (DNT), cyclotrimethylenetrinitramine (RDX), trinitrotoluene (TNT), cyclotetramethylenetetranitramine (HMX), or trinitrophenylmethylnitramine (TETRYL). The specimens were not tested for the presence of any inorganic explosives because of their high water solubility.

The specimens were examined using all or some of the following techniques: optical microscopy, chemical spot tests, gas chromatography with chemiluminescence detection, ion mobility spectrometry, gas chromatography with mass spectrometry detection, and liquid chromatography with mass spectrometry detection.

(over)

60804032

A physical and instrumental examination of residues removed from specimen Q82 did not detect any traces of nitroglycerine (NG), ethylene glycol dinitrate (EGDN), pentaerythritol tetranitrate (PETN), dinitrotoluene (DNT), cyclotrimethylenetrinitramine (RDX), trinitrotoluene (TNT), cyclotetramethylenetetranitramine (HMX), or trinitrophenylmethylnitramine (TETRYL). The specimen was not tested for the presence of any inorganic explosives because of their high water solubility.

The specimen was examined using the following techniques: optical microscopy, gas chromatography with chemiluminescence detection, ion mobility spectrometry, gas chromatography with mass spectrometry detection, and liquid chromatography with mass spectrometry detection.

60817031

A physical and instrumental examination of residues removed from specimen Q85 identified the presence of nitroglycerine high explosive. The source of this material is not known since live explosives were reportedly used on the aircraft for training purposes prior to this event. Further examinations of the residue did not detect any traces of ethylene glycol dinitrate (EGDN), pentaerythritol tetranitrate (PETN), dinitrotoluene (DNT), cyclotrimethylenetrinitramine (RDX), trinitrotoluene (TNT), cyclotetramethylenetetranitramine (HMX), or trinitrophenylmethylnitramine (TETRYL). The specimen was not tested for the presence of any inorganic explosives because of their high water solubility.

The specimen was examined using the following techniques: optical microscopy, gas chromatography with chemiluminescence detection, ion mobility spectrometry, gas chromatography with mass spectrometry detection, and liquid chromatography with mass spectrometry detection.

60818061

A physical and instrumental examination of residues removed from specimen Q86 did not detect any traces of nitroglycerine (NG), ethylene glycol dinitrate (EGDN), pentaerythritol tetranitrate (PETN), dinitrotoluene (DNT), cyclotrimethylenetrinitramine (RDX), trinitrotoluene (TNT), cyclotetramethylenetetranitramine (HMX), or trinitrophenylmethylnitramine (TETRYL). The specimen was not tested for the presence of any inorganic explosives because of their high water solubility.

The specimen was examined using the following techniques: optical microscopy, gas chromatography with chemiluminescence detection, ion mobility spectrometry, gas chromatography with mass spectrometry detection, and liquid chromatography with mass spectrometry detection.

60830005

A physical and instrumental examination of residues removed from specimen Q87 (your item 34) identified the presence of cyclotrimethylenetrinitramine (RDX) high explosive. The source of this material is not known since live explosives were reportedly used on the aircraft for training purposes prior to this event. Further examinations of the residue did not detect any traces of nitroglycerine (NG), ethylene glycol dinitrate (EGDN), pentaerythritol tetranitrate (PETN), dinitrotoluene (DNT), trinitrotoluene (TNT), cyclotetramethylenetetranitramine (HMX), or trinitrophenylmethylnitramine (TETRYL). The specimen was not tested for the presence of any inorganic explosives because of their high water solubility.

The specimen was examined using the following techniques: optical microscopy, gas chromatography with chemiluminescence detection, ion mobility spectrometry, gas chromatography with mass spectrometry detection, and liquid chromatography with mass spectrometry detection.

60909001

A physical and instrumental examination of residues removed from specimens Q88 through Q93 did not detect any traces of nitroglycerine (NG), ethylene glycol dinitrate (EGDN), pentaerythritol tetranitrate (PETN), dinitrotoluene (DNT), cyclotrimethylenetrinitramine (RDX), trinitrotoluene (TNT), cyclotetramethylenetetranitramine (HMX), or trinitrophenylmethylnitramine (TETRYL). The specimens were not tested for the presence of any inorganic explosives because of their high water solubility.

The specimens were examined using the following techniques: optical microscopy, gas chromatography with chemiluminescence detection, ion mobility spectrometry, and liquid chromatography with mass spectrometry detection.

60912038

A physical and instrumental examination of residues removed from specimen Q94 did not detect any traces of nitroglycerine (NG), ethylene glycol dinitrate (EGDN), pentaerythritol tetranitrate (PETN), dinitrotoluene (DNT), cyclotrimethylenetrinitramine (RDX), trinitrotoluene (TNT), cyclotetramethylenetetranitramine (HMX), or trinitrophenylmethylnitramine (TETRYL). The specimen was not tested for the presence of any inorganic explosives because of their high water solubility.

The specimen was examined using the following techniques: optical microscopy, gas chromatography with chemiluminescence detection, ion mobility spectrometry, gas chromatography with mass spectrometry detection, and liquid chromatography with mass spectrometry detection.

61007055

A physical and instrumental examination of residues removed from specimens Q95 and Q96 did not detect any traces of nitroglycerine (NG), ethylene glycol dinitrate (EGDN), pentaerythritol tetranitrate (PETN), dinitrotoluene (DNT) cyclotrimethylenetrinitramine (RDX), or trinitrotoluene (TNT). The specimens were not tested for the presence of any inorganic explosives due to their high water solubility.

The specimens were examined using following techniques: optical microscopy, chemical spot tests, and gas chromatography with chemiluminescence detection.

Please call the Materials and Devices Unit, (202) 324[redacted] if you have any questions concerning the results of examinations in this case. b7C

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: IMMEDIATE **Date:** 03/14/1997

To: DIRECTOR, FBI

From: ADIC, NEW YORK

Approved By: Kallstrom James K

b7C

Drafted By: [redacted]jjr

Case ID #: 265-NY- (Pending)

Title: CRASH OF TWA FLIGHT 800
JULY 17, 1996

Synopsis: To provide FBIHQ with ATF report on this matter.

Enclosures: Enclosed is an original and one copy of a "Statement of ATF Certified Fire Investigator", I/N 63122 96 0060 Z, dated January 20, 1997.

Details: The enclosed report was provided to ADIC Kallstrom by NY ATF SAC Ballas on 3/13/97. It contains opinions regarding the sequence in which the aircraft came apart as well as cause of the crash. By way of background, NY notes that, at the outset of the TWA investigation, ATF agreed that, since the FBI is the lead criminal investigative agency for TWA Flight 800, they would not produce any independent reports regarding the investigation.

The publication of this unsolicited, premature report violates the agreement made by ATF regarding their participation in the TWA investigation. ADIC, NY believes ATF's preparation of a report providing an opinion regarding the cause of this tragedy while knowing full well, among other things, that the investigation is continuing; that parts of the aircraft are still being recovered; that substantial parts of the side walls of the center fuel tank have not been recovered or identified and potentially significant pieces, i.e., the scavenger pump, have not been recovered; that the reconstruction of the aircraft is ongoing; and that other testing, i.e., metallurgical examinations, China Lake missile testing, is planned or ongoing is unprofessional and reprehensible. ATF has produced a report which, it is fair to say, attributes the crash to a mechanical failure before the NTSB has completed its own inquiry or issued a report. If the cause of the crash is determined to be mechanical, ATF may find itself in conflict with the analysis of NTSB, the agency charged by law with responsibility for aircraft accident investigations. In addition, if in the end the evidence indicates that the crash resulted from a criminal act, the ATF report, prepared without benefit of a complete investigation or access to all the information available, will no doubt be discoverable as <u>Brady</u> material.

ADIC, New York is very concerned about the preparation of this report and the basis for the opinions expressed therein. ADIC request that the FBI Laboratory immediately review this report and obtain from ATF all information, including copies of any interviews conducted by ATF, which were relied upon to produce the opinions expressed therein. ADIC, New York also strongly recommends that the Director express to the highest levels of the ATF, the FBI's displeasure over this extraordinary breach of investigative protocol.

New York will provide copies to NTSB and the USA, EDNY, directly.

♦♦

U.S. Department of Justice

Federal Bureau of Investigation

In Reply, Please Refer to
File No.

26 Federal Plaza
New York, New York 10278
March 17, 1997

Mr. James E. Hall
Chairman
National Transportation Safety Board
490 L'Enfant Plaza East, S.W.
Washington, D.C.20594

Dear Mr. Chairman,

Enclosed please find one copy of a "Statement of ATF Certified Fire Investigator", I/N 63122 96 0060 Z, dated January 20, 1997. This report was provided to me on March 13, 1997 by the ATF Special Agent in Charge in New York.

The publication of this unsolicited and premature report by the ATF violates the agreement made by them regarding their participation in this investigation. I believe it is unfortunate that ATF, for reasons that are unknown to me, chose to prepare a report expressing an opinion regarding the cause of this tragedy before the investigation has been completed. It is an extraordinary violation of investigative protocol.

I have provided the original and a copy to FBIHQ and requested that the FBI Laboratory review the information in the report and contact ATF to obtain all information they relied upon to produce this document. I have also asked Director Freeh to express the FBI's displeasure regarding this incident to the highest levels of the ATF.

Sincerely,

James K. Kallstrom
Assistant Director in Charge

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FEDERAL BUREAU OF INVESTIGATION
FOIPA
DELETED PAGE INFORMATION SHEET

26 Page(s) withheld entirely at this location in the file. One or more of the following statements, where indicated, explain this deletion.

☐ Deletions were made pursuant to the exemptions indicated below with no segregable material available for release to you.

Section 552		Section 552a
☐ (b)(1)	☐ (b)(7)(A)	☐ (d)(5)
☐ (b)(2)	☐ (b)(7)(B)	☐ (j)(2)
☐ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
____________	☐ (b)(7)(D)	☐ (k)(2)
____________	☐ (b)(7)(E)	☐ (k)(3)
____________	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☐ (b)(6)		☐ (k)(7)

☐ Information pertained only to a third party with no reference to the subject of your request or the subject of your request is listed in the title only.

☑ Documents originated with another Government agency(ies). These documents were referred to that agency(ies) for review and direct response to you.

_____ Pages contain information furnished by another Government agency(ies). You will be advised by the FBI as to the releasability of this information following our consultation with the other agency(ies).

_____ Page(s) withheld inasmuch as a final release determination has not been made. You will be advised as to the disposition at a later date.

_____ Pages were not considered for release as they are duplicative of ____________

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☑ The following number is to be used for reference regarding these pages:
265A-NY-259028 - SUB FF2, LAB 15 Document dated January 20, 1997

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(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 04/18/1997

To: New York **Attn:** SSA [redacted] b7C

From: New York
FBI Command Post, Calverton, New York
Contact: SA [redacted] (516) 369-3313

Approved By: [redacted]

Drafted By: [redacted]bsm

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA 800;
7/17/96
AOT-IT-EOD;
OO: NEW YORK

Synopsis: Transfer of custody of evidence items 90 (1B-421) and 91 (1B-422) to NTSB for testing.

Details: Two FBI evidence items were released from the FBI Command Post, Calverton, New York to [redacted] on 4/18/1997 for metallurgical analysis at NTSB Materials Laboratory, 490 L'Enfant Plaza East, Southwest-Room 5140, Washington DC, office telephone [redacted] The items were: b7C

Item 90 (1B-421): One piece of 4" x 4" metal cut from pressure deck piece LF-137, FBI number 8/26/96-36, located at fuselage station 1444 and left buttock line 110. The piece was cut to enable testing on a 1/8" diameter penetration. (X) TC

Item 91 (1B-422): One piece of 4" x 6" metal cut from a fuselage piece identified by FBI number 9/24/96-16, located near fuselage station 1700, stringer 36 right. The piece was cut to enable testing on a 1/8" diameter penetration.

◆◆

ALL INFORMATION CONTAINED
HEREIN IS UNCLASSIFIED
DATE 4-14-00 BY SP5/JC/AL

265A-NY-259028-SUB [illegible] -14

APR 2 4 1998

CC: SSA [redacted]
SSRA [redacted]
SA [redacted]
I-46 Rotor

[redacted]

b7C

UPLOADED ✓
WITH TEXT ______
WITHOUT TEXT ______
BY ______
DATE 5/5/97

90 - 91 _ ec. upd

© [redacted] b7c

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

Date April 10, 1997

ADIC, NEW YORK

FBI File No. 265A-NY-2[illegible]

Lab No. [illegible]

Reference: Your communication dated March [illegible], 199[illegible]

Your No. 265A-NY-259028

[illegible]
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996
ACT-IT EID

Specimens received March 25, 1997

Specimens:

Q132 Five (5) photo negative strips from [redacted] b7c

The results of the photographic examination [illegible] included in this report.

Specimen Q132 is returned herewith. Phot[illegible] produced during this examination are being returned under separate cover.

265A-NY-259028-SUB LAB

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED DATE 4-14-00 BY SPS/JC/NL

SEARCHED [illegible] INDEXED
SERIALIZED FILED
AUG 20 1998
[redacted]

16

b7c

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Enclosure ( )

Received by FAX from FBIHQ [illegible]/97

[redacted]

RWVB/rwvb (5)

This Report Is Furnished For Official Use Only

08/19/97 08:55 [redacted] FBI NAD-DOG 005

7-1 (Rev. 2-21-91)

FBI LABORATORY

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

Date: April 10, 1997

To: ADIC, NEW YORK

FBI File No. 265A-NY-259028

Lab No. 70325037 S/I AD HD

Reference: Your communication dated March 14, 1997

Your No. 265A-NY-259028

Re: UNSUB(S)
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996
AOT-IT-EID

Specimens received: March 25, 1997

Specimens:

Q132 Five (5) photo negative strips from [redacted] b7c TC

The results of the photographic examinations are included in this report.

Specimen Q132 is returned herewith. Photographs produced during this examination are being returned under separate cover.

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED DATE 4-14-00 BY SPS /5c/pvr

265A-NY-259028-SUB LAB 16

SEARCHED INDEXED SERIALIZED FILED

APR 15 1997

FBI - NEW YORK

[redacted]

b7c

Enclosure (1)

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7-1a (7-16-96)

FBI LABORATORY

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

Report of Examination

Examiner Name: [redacted] Date: April 10, 1997 b7c

Unit: Special Photographic Phone No.: [redacted]

FBI File No.: 265A-NY-259028 Lab No.: 70325037 S/I AD HD

Results of Examinations:

The (Q132) film negatives were examined to locate unusual patterns in those portions of the negatives depicting the sky. The presence of scratches, dust, and other debris was noted on the negatives. A horizontal streak observed on one frame, #4A, was examined microscopically and found to be debris on the film surface. Conventional cleaning of the film removed this debris.

FAX/PACKAGE COPY

7-1 (Rev. 2-21-91)

FBI LABORATORY

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

Date: April 10, 1997

To: ADIC, NEW YORK

FBI File No. 265A-NY-259028

Lab No. 70325037 S/I AD HD

Reference: Your communication dated March 14, 1997

Your No. 265A-NY-259028

Re: UNSUB(S)
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996
AOT-IT-EID

Specimens received: March 25, 1997

Specimens:

Q132 Five (5) photo negative strips from [redacted] b7C

The results of the photographic examinations are included in this report.

Specimen Q132 is returned herewith. Photographs produced during this examination are being returned under separate cover.

265A-NY-259028-SUB 46

16

Enclosure (1)

4-14-00 SPS /SC/PVL

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SERIALIZED ___ FILED ___

FBI — NEW YORK
[redacted] b7C

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OPCA-20 (12-3-96)

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1 Page(s) withheld entirely at this location in the file. One or more of the following statements, where indicated, explain this deletion.

☐ Deletions were made pursuant to the exemptions indicated below with no segregable material available for release to you.

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________	☐ (b)(7)(E)	☐ (k)(3)
________	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
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265A-NY-259028-Sub Lab 16 page 2

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FBI/DOJ

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE Date: 05/09/1997

To: Laboratory Attn: SSA [redacted] b7C
Room 3971

From: New York
FBI Command Post, Calverton, New York
Contact: SA [redacted] (516) 369-3313

Approved By: [redacted]

Drafted By: [redacted]:bsm

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA 800;
7/17/96
AOT-IT-EOD
OO: NEW YORK

Synopsis: Submits eighteen evidence items, 1B435-1B452, to the FBI Lab for chemical residue tests.

Package Copy: Being forwarded under separate cover are eighteen New York Office evidence items 1B435 through 1B452.

Details: As the Laboratory Division is aware, numerous swabs of the wreckage of TWA Flight 800 were tested by the FBI for the presence of high explosive residue. The vast majority of these swabs were taken from the interior cabin area. To date, three confirmations of explosive chemicals were identified. From the standpoint of thoroughness, however, the tested sites did not represent all regions of the aircraft. Since the cause of the crash is currently unidentified, it is possible that undiscovered chemical evidence is present at an untested region, particularly around burned areas.

As desirable as testing the entirety of the wreckage is to investigators, it is unrealistic. The next best approach, then, is to test selected sites in each of the regions. Therefore, eighteen items were excised from sites that were nearby or subjected to apparent burning and that account for

CC: SAC John O'Neill
ASAC Charles Domroe
SSA [redacted]
SSA [redacted]
SSRA [redacted]
SA [redacted]
Det [redacted]
I-46 Rotor

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DATE 6-12-97

265A-NY-259028-LAB-17

JUN 6 1998

[redacted]

b7C

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DATE 4-14-00 BY SPS [illegible]

all regions of the aircraft. These items are being submitted to the FBI Laboratory for chemical analysis to ensure that residue testing was conducted representing most of the main structural areas of the airplane, e.g. both wings and fairing material from the belly. The items are:

1) 1B-435; Piece of composite material measuring approximately 3.5" x 2.25" having a charred appearance;

2) 1B-436; Piece of composite material measuring approximately 1" x 1.25", honeycomb construction;

3) 1B-437; Piece of composite material measuring approximately 2" x 4" having a charred appearance;

4) 1B-438; Piece of composite material measuring approximately 1.5" x 2.5" with honeycomb construction and having a charred appearance;

5) 1B-439; Piece of fabric-like material measuring approximately 2" x 3" and having a charred appearance;

6) 1B-440; Piece of fabric-like material measuring approximately 2" x 4" and having a charred appearance;

7) 1B-441; Piece of composite honeycomb material measuring approximately 1.5" x 2" and having a charred appearance;

8) 1B-442; Four pieces of a woven material that were adjacent layers and have a charred appearance;

9) 1B-443; Piece of composite material measuring approximately 4" x 5", includes honeycomb structure and has a charred appearance;

10) 1B-444; Piece of woven, layered material measuring approximately 1.5" x 1.25" with a charred appearance;

11) 1B-445; Piece of woven material measuring approximately 2.5" x 5.25" with a charred appearance;

12) 1B-446; Piece of composite material measuring approximately .75" x 2.25" with a honeycomb structure and a charred appearance;

13) 1B-447; Piece of woven material measuring approximately 1.75" x 2" with a charred appearance;

14) 1B-448; Piece of "feathered" metal measuring approximately 0.75" long;

15) 1B-449; Piece consisting of a white elastic substance adhering to metal foil that measures approximately 1" x .75";

16) 1B-450; Piece of sheet metal, apparently sooted, measuring approximately 2.5" x 1.5";

17) 1B-451; Piece of woven material measuring approximately 1.5" x 2" with a charred appearance;

18) 1B-452; Two chemical swabs taken from the interior of a titanium alloy engine bleed air duct.

LEAD (s):

Set Lead 1:

<u>LABORATORY</u>

FBI Laboratory Chemistry Unit is requested to conduct necessary examinations for the presence of explosive residue and volatile accelerant. Please provide a laboratory report of findings to the New York case squad, I-46, and:

FBI Command Post
Attn: SSRA [redacted] b7c
Naval Weapons Industrial Reserve Plant
4026 Grumman Blvd.
Calverton, NY 11933

♦♦

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE Date: 05/22/1997

To: Laboratory Attn: SSA [redacted]
Room 3971

b7C

From: New York
FBI Command Post, Calverton
Contact: SA [redacted] (516) 369-3313

Approved By: [redacted]

Drafted By: [redacted] bsm

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA 800;
7/17/96
AOT-IT-EOD
OO: NEW YORK

Synopsis: Submits four evidence items, 1B465-1B468, to the FBI Lab for chemical residue tests.

Package Copy: Being forwarded under separate cover are four New York office evidence items 1B465 through 1B468.

Details: The cause of the TWA Flight 800 crash is still unknown. All possibilities with regard to criminal involvement are being pursued by investigators. Part and parcel to this approach is chemical testing of all regions around the aircraft for explosive or accelerant residue. Sufficient representational testing will allay questions concerning the presence or lack of such residue.

The four evidence items referenced herein are from diplomatic pouches that were carried in the aft cargo bay. The items are:

1) 1B-465 (Item 118); Piece of woven fabric measuring approximately 1" x 1" with a charred appearance;

2) 1B-466 (Item 119); Piece of cardboard having a charred appearance;

CC: SAC John O'Neill
ASAC Charles Domroe
SSA [redacted]
SSA [redacted]
SSRA [redacted]
SA [redacted]
Det [redacted]
1-46-Rotor

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DATE 4-14-00 BY SPS JC/PVA

b7C

3) 1B-467 (Item 120); Piece of woven fabric measuring approximately 1.75" x 1.5" with a charred appearance;

4) 1B-468 (Item 121); Two pieces of woven fabric that were adjacent layers measuring approximately 1" x 1" with a charred appearance.

LEAD (s):

Set Lead 1:

LABORATORY

FBI Laboratory Chemistry Unit is requested to conduct necessary examinations for the presence of explosive residue and volatile accelerant. Please provide a laboratory report of findings to the New York case squad, I-46, and:

FBI Command Post
Attn: SSRA [redacted] b7C
Naval Weapons Industrial Reserve Plant
4026 Grumman Blvd.
Calverton, NY 11933

♦♦

FD-CA-20 (12-3-96)

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FEDERAL BUREAU OF INVESTIGATION
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☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
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FBI/DOJ

7-1 (Rev. 2-21-91)

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

To: ADIC, New York

Date: May 13, 1997

FBI File No. 265A-NY-259028

Lab No. 70207064 S AD HK HM
70224039 S AD HK HM

Reference: Communication dated February 6 and 19, 1997

Your No. 265A-NY-259028

Re: UNSUBS;
EXPLOSION OF TWA FLIGHT 800;
AOT-IT-EOD

Specimens received: February 7 and 24, 1997

Specimens received February 7, 1997 under cover of communication dated February 6, 1997 (70207064 S AD HK HM):

Q128 One (1) piece of splatter material (your item #MM1 CW-504 1BL-104)

Q129 One (1) piece of splatter material (your item #MM3 CW-504 1BL-106.72)

Q130 One (1) piece of splatter material (your item #MM4 CW-504 LBL-106)

Q131 One (1) piece of splatter material (your item #MM5 CW-114)

NE8 One (1) blade

(over)

Specimens received February 24, 1997 under cover of communication dated February 19, 1997 (70224039 S AD HK HM):

K3 One (1) sample of fiberglass like material taken from floor board (your item #57-1)

K4 One (1) sample of foam like material taken from floor board (your item #57-2)

K5 One (1) sample of fiberglass like material taken from air duct (your item #59-1)

K6 One (1) sample of foam like material taken from air duct (your item #59-2)

K7 One (1) sample of fiberglass like material taken from air duct (your item #61-1)

K8 One (1) sample of foam like material taken from air duct (your item #61-2)

GENERAL INFORMATION:

This report provides the results of examinations conducted in the Trace Evidence Unit and the Chemistry Unit. For a complete listing of specimens and the results of previous examinations conducted please refer to previous report dated 3/26/97 (Laboratory ##60723031 S AD AR RU, 60730006 S AD RU, 60730007 S AD RU, 60806002 S AD ZG, 60909001 S AD AR RU, 61118011 S AD HJ, 61127057 S AD HK, 60727032 S AD AR, 60728031 S AD AR, 60804032 S AD AR, 60817031 S AD AR, 60818061 S AD AR, 60830005 S AD AR, 60912038 S AD AR, 61007055 S AD AR).

7-2a (7-16-96)

FBI LABORATORY

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

Report of Examination

b7C

Examiner Name:	[redacted]	Date:	03/31/97
Unit:	Chemistry	Phone No.:	[redacted]
FBI File No.:	265A-NY-259028	Lab No.:	70207064 S AD HK 70224039 S AD HK

Results of Examinations:

Specimens Q128 through Q131 (FBI Laboratory #70207064) and specimens K3 through K8 (FBI Laboratory #70224039) were examined microscopically. Specimens Q128 through Q131 and specimens K6 and K8 were further examined instrumentally with Pyrolysis-Gas Chromatography/Mass Spectrometry and Fourier Transform Infrared Spectroscopy. Based upon the comparison examinations conducted, specimens Q128 through Q131 are consistent with having originated from the sources represented by K6 and K8, or a similar source.

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED DATE 4-13-00 BY SPS BC/PVN

This Report Is Furnished For Official Use Only

7-1a (7-16-96)

FBI LABORATORY

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

Report of Examination

Examiner Name: [redacted] mCB

Date: 3/14/97

b7C

Unit: Trace Evidence Unit

Phone No.: [redacted]

FBI File No.: 265A-NY-259028

Lab No.: 70207064 S AD HK HM
70224039 S AD HK HM

Results of Examinations:

Specimens K3, K5, K6 and K7 (70224039) ostensibly represent construction products that utilize fiber glass fabrics. These fabrics generally consist of woven and non-woven bundles of continuous-filament glass fibers. Specimens Q128 through Q131 (70207064) also contain continuous-filament glass fibers, but they cannot be specifically associated with specimens K3, K5, K6, and K7. The small size, limited amounts, and the altered and adulterated nature of specimens Q128 through Q131 preclude any further comparison.

OPCA-20 (12-3-96)

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________	☐ (b)(7)(E)	☐ (k)(3)
________	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☐ (b)(6)		☐ (k)(7)

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(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

SECRET

Precedence: ROUTINE   Date: 08/07/1997

To: New York   Attn: SSA [redacted]   b7C

From: New York
FBI Command Post, Calverton, New York
Contact: [redacted] 516-369-3313

Approved By: [redacted]

Drafted By: [redacted]:sab

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EOD

Synopsis: Custody transfer of a part of evidence item 92 (1B-423) to the Defense Intelligence Agency (DIA) for testing.

Details: One FBI evidence item was released from the FBI Command Post, Calverton, New York to [redacted] Redstone Arsenal, Huntsville, Alabama 35898, [redacted] on 8/07/1997 for analysis. The item--a sliver of metal polished and mounted in a clear resin cylinder--is one of two pieces comprising item 92 (1B-423).   b7C

[redacted] (S)   b1

(X) b7C
derived

CC: SSA [redacted]
SSRA [redacted]
SA [redacted]
Det [redacted]
I-46 Rotor

♦♦

4-14-00
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REASON: 1.5 (C)
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FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

1- [redacted] b7C

Date April 25, 1997

ADIC, New York

FBI File No. 265A-NY-259028

Lab No. 61114052 [illegible]
70207064 S [illegible]
70224039 [illegible]

Your communications dated February 6 and 20, [illegible]

265A-NY 259028

[illegible]
[illegible] OF TWA FLIGHT 800;
[illegible]

[illegible] ary 7 and 24, 1997

[illegible] February 7, 1997 under cover of communication [illegible] 6, 1997 (70207064 S AD HK):

[illegible] piece of splatter material (your item #MM1 CW-50[illegible] LBL-104)

[illegible] piece of splatter material (your item #MM3 CW-504 [illegible] 106.72)

[illegible] of splatter material (your item #MM4 CW-504 [illegible]

[illegible] atter material (your item #MM5 CW-

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[redacted] b7C

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SECRET [redacted]

This Report Is Furnished For Official Use Only

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED EXCEPT

SECRET

Specimens received February 24, 1997 under cover of communication dated February 19, 1997 (70224039 S AD HK):

K3 One sample of fiberglass like material taken from floor board (your item #57-1)

K4 One sample of foam like material taken from floor board (your item #57-2)

K5 One sample of fiberglass like material taken from air duct (your item #59-1)

K6 One sample of foam like material taken from air duct (your item #59-2)

K7 One sample of fiberglass like material taken from air duct (your item #61-1)

K8 One sample of foam like material taken from air duct (your item #61-2)

Results of Examination:

GENERAL INFORMATION:

This report provides the results of examinations conducted in the Chemistry Unit on specimens Q110 - Q116, Q126 - Q131, K3 - K8.

For a complete listing of specimens and the results of previous examinations please refer to previous report dated 3/26/97 (Lab. #60723031 S AD AR, 60730006 S AD RU, 60730007 S AD RU, 60806002 S AD ZG, 60909001 S AD AR RU, 61118011 S AD HJ, 61127057 S AD HK, 60727032 S AD AR, 60728031 S AD AR, 60804032 S AD AR, 60817031 S AD AR,60818061 S AD AR, 60830005 S AD AR, 60912038 S AD AR, 61007055 S AD AR).

Examinations are continuing on Q25 - Q81 and Q109 in the Special Photography Unit. You will be advised of the results of these examinations in a separate report.

(over)

CHEMICAL ANALYSES:

Specimens Q110 - Q116 were examined microscopically. Red material and amber material from specimen Q110 and red material from specimen Q111 were further examined instrumentally, including Fourier Transform Infrared Spectroscopy, Pyrolysis-Gas Chromatography/Mass Spectrometry, and Scanning Electron Microscopy [redacted] (S) The materials from Q110 and Q111 are consistent with a chlorinated, polymeric material commonly used as a contact adhesive. Based upon the comparison examinations conducted, with noted differences, specimens Q110 - Q116 are consistent with a common origin.

Specimens Q128 - Q131 (FBI Laboratory #70207064) and specimens K3 - K8 (FBI Laboratory #70224039) were examined microscopically. Specimens Q128 - Q131 and specimens K6 and K8 were further examined instrumentally with Pyrolysis-Gas Chromatography/Mass Spectrometry and Fourier Transform Infrared Spectroscopy. Based upon the comparison examinations conducted, specimens Q128 - Q131 are consistent with having originated from the sources represented by K6 and K8, or a similar source.

Specimens K3, K5, K6 and K7 (70224039) ostensibly [illegible] construction products that utilize fiber glass fabrics. These fabrics generally consist of woven and non-woven bundles of continuous-filament glass fibers. Specimens Q128 - Q131 (70207064) also contain continuous-filament glass fibers, but they cannot be specifically associated with specimens K3, K5, K6 and K7. The small size, limited amounts, and the altered and adulterated nature of specimens Q128 - Q131 preclude any further comparison.

b1

DISPOSITION OF SPECIMENS:

The submitted specimens referenced in the above analyses will be returned to your office under separate cover via registered mail or equivalent.

To: SSA [redacted]
Contracting Officer Technical Representative
Room 3346 JEH FBI Building
935 Pennsylvania Avenue, NW
Washington, D.C. 20535

From: [redacted] b7C

13 July 1997

RE: STATUS REPORT - REVIEW OF PRIORITY 2 AND 3 PENETRATIONS

As part of the TWA800 metallurgical review, I evaluated a series of "priority 2" and "priority 3" penetrations in the fuselage and at other locations in the reconstruction with the assistance and cooperation of [redacted] of the New York office of the FBI. This was intended to provide a backup to rankings conducted previously by NTSB personnel as well as to complement the documentation of a series of "priority 1" penetrations already compiled by NTSB and the FBI. For your convenience, the previously developed criteria for identifying a penetration's priority, taken verbatim from the NTSB communication dated 3/7/97 (provided to me by [redacted] are: b7C

Priority	Criteria
1	Penetrations that appeared to be coming from the outside of structure inward with missing material at the point of penetration. Penetrations where a clear direction could not be determined but exhibited a lack of material at the penetration, similar to a "bullet hole".
2	Penetrations that appeared to be coming from the outside of the structure inward without any missing material at the point of penetration, i.e.,a "flap" or tear of material inward. Penetrations that appear to be coming from the inside of the structure outward with missing material at the point of penetration.
3	All other penetrations not described in the above priorities but noted in the documentation.

My work was initiated during my second on-site period, June 9-13, and was effectively completed during my 3rd on-site period, June 25-27. A complete documentation of my observations is assembled as a spreadsheet in Appendix I. Penetrations already judged a "priority 1" from the prior NTSB work are included in the spreadsheet but I did not re-evaluate those.

Of primary interest may be the fact that additional priority 1 sites were identified. For example, in the fuselage piece at LF-69, two holes, at stations 1265 and 1340, were re-classified to 1 on the basis of a judgement of missing material. Another hole was found at station 1285 to meet the criteria for a "1".

The holes in piece RF-95 were also added; the one at station 920 was included because of an unusual extent of what might be possible melting on the fracture surface. This is shown in Figure 1(B), as photographed by [redacted] The extent of the anomalous region seemed much greater than would be accounted for by a shear plane sectioning through the expected Alclad layer of this material. A more in-depth metallographic analysis would be useful to corroborate whether melting has occurred. The hole b7C at station 930, on the other hand, was added on the basis of a judgement of missing material here, coupled with the apparent out-to-in direction of penetration.

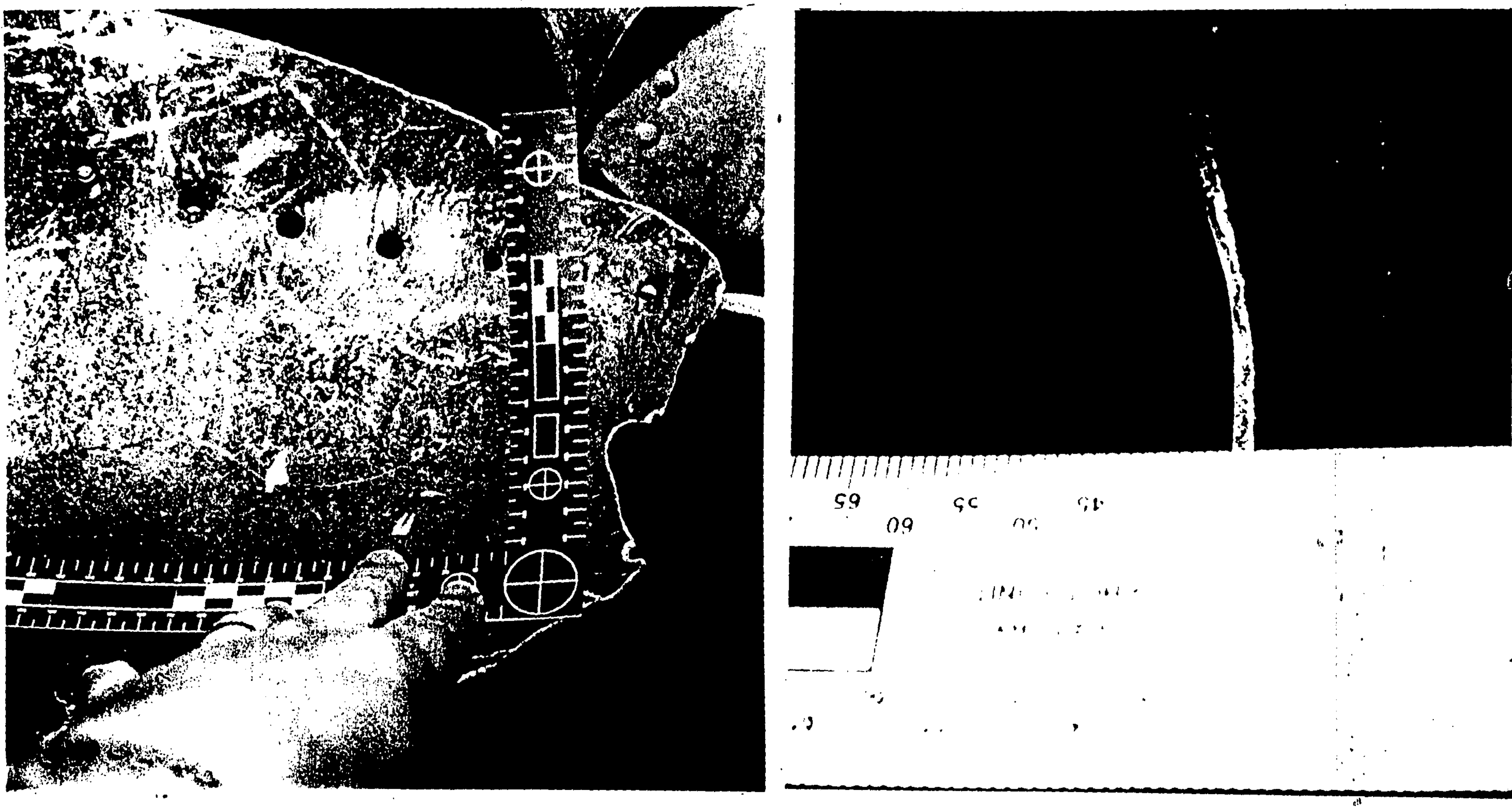
The remaining additions to the priority 1 list were the 2 clean holes initially observed by [redacted] in CW-1106, which our examination corroborated as meeting the priority 1 criteria. b7C

My examination of the remaining priority 2 and 3 holes did not lead to any significant changes. In several cases, ratings were altered from the previous listing, typically from 3 to 2, because I may have judged differently whether material was missing or we noted an inconsistency between the numerical rating and the previous observer's remarks, especially with respect to missing material.

Respectfully submitted,

[redacted] b7C

cc: SSRA [redacted] Calverton



(A) (B)

FIGURE 1 : PHOTO OF REGION AT STATION 920 WITH RE-CLASSIFIED PRIORITY 1 PENETRATION

A) Overall view near penetration(numbered divisions are 10 mm apart)

B) View of cross-section with shiny material on inboard edge (ruler divisions in mm)

Spreadsheet for Evaluation of Penetration Sites in TWA800 Reconstruction

Concentrate on sites initially rated priority 2 and 3 by NTSB

Priority	Criteria
1	Penetrations that appeared to be coming from the outside of structure inward with missing material at the point of penetration. Penetrations where a clear direction could not be determined but exhibited a lack of material at the penetration, similar to a "bullet hole".
2	Penetrations that appeared to be coming from the outside of the structure inward without any missing material at the point of penetration, i.e., a "flap" or tear of material inward. Penetrations that appear to be coming from the inside of the structure outward with missing material at the point of penetration.
3	All other penetrations not described in the above priorities but noted in the documentation. e.g., inside to outside penetration with no metal missing

* denotes previously assigned priority 1 by NTSB

GROUP 1 : FUSELAGE STATIONS 520-1620

	PIECE	STATION	STRINGER	DIR'N	SIZE	PRIORITY	REMARKS
	RF-19A	920	4R	out-in	2"x1"	2	no missing material;dent at entry surface;2 rust colored marks on entry surface
	LF-6B	780	39-40R	in-out	1.5"x0.5"	2	metal missing; very slight corner tear(petal-like)
	LF-6B	800	39-40R	in-out	2"x2"	3	no metal missing; slant fracture
	LF-22-9	540	40L	in-out	.25" diam	2	flange w/radial tears
	LF-22-11	580	42-43L	in-out	4"x2"	3	tearing, slant fracture
	LF-22-20	600	45-46R	in-out	0.5"x0.5"	3	star-like petal
	LF-22-20	600	45-46R	in-out	.5"x.5"	2	in stiffener behind skin-more damage in stiffener
	LF-22-4	730	43-44R	in-out	10"x4"	2	slant fracture;metal missing
	LF-22-2	680	47L	in-out	2"x1.5"	3	slant fracture
	LF-22-14	600	41L	in-out	2"x1.5"	3	some sawtooth fracture; stiffener behind also
							fractured; slight petaling
	LF-22-35	550	42L	in-out	2"x1.75"	3	slant fracture
	RF-92	570	34-35R	in-out	1"x0.25"	3	no metal missing
	LF-22-1	660	42L	in-out	3"x0.75"	3	slant fracture w/tear
	LF-22-1	685	44R	in-out	1"x1"	3	slant fracture w/tear
	RF-70	570	41-42R	in-ou	1"x1"	2	slight incipient sawtooth + tear;
							cracks in fracture surface ‖ penetr'n s
							as well as flange crack
	LF-22-35	550	44-45L	in-out	.5"x.5"	3	tearing; no metal missing
	LF-20	570	47R	in-out	.75"x1.25"	3	no metal missing
*	LF-12C	820	20L	out-in	.25" diam	1	
	LF-97	920	34-35L	out-in		2	IMPACT CURL
*	LF-5	920	28L	out-in	1.5"x1"	1	INWARD FLAP,LOW VEL HOLE
	LF-70A	930	30L	out-in		2	impact curl
	LF-87B	940	38L	out-in	.75"x.75"	2	no material missing
	LF-70B	950	31L	in-out		3	impact curl

GROUP 1 : FUSELAGE STATIONS 520-1620							
	PIECE	STATION	STRINGER	DIR'N	SIZE	PRIORITY	REMARKS
	LF-87C	955	29-30L	out-in	.25"x1"	2	no material missing
	LF-51	965	34-35l	out-in	.5"x1"	2	no missing material
*	LF-51	965	35-36L	out-in,up	.5"x1"	1	material missing
	LF-51	970	35-36L	out-in	.5"x1"	2	no material missing, tear next to crack
	LF-63	975	29-30L	out-in	.5"x1"	2	no material missing
	LF-87F	985	36L	out-in	.5" diam	2	no material missing
*	LF-38	1250	22-23L	in-out	.25"x.5"	1	mech damage -FB! #66
*	LF-67A	1330	25L	out-in		1	low vel hole FBI #63
reclassified	LF-69	1340	3-4R	out-in	1"x4"	1	tear;missing material at forward edge;petals curled
							down with potential spikes on curled petal; sawtooth fracture on other
							face;impact damage on entry face with 3 skid marks or slight gouges
reclassified	LF-69	1265	5R	out-in	2" diam	1	tear;missing material;beginning sawtooth on fracture surface
we added	LF-69	1285	4-5R	out-in	4"x.5"	1	slant + sawtooth fracture surface; small amount of missing material;
							slight curl downward
we added	LF-69	1290	4-5R	out-in	2"x.5"	2	no missing material; curl down
							approx. 2 foot tear associated with penetration at station 1265
	LF-39A	1380	11-12L	in-out	.5"x4"	3	tear
	LF-54B	1450	28L	in-out	.5"x1.5"	3	no material missing
	LF-45A	1500	28L	in-out	.24"x3"	3	no material missing, rivet
	LF-2	1520	22-23L	in-out	1"x3"	3	no material missing
	LF-2	1525	12-13L	in-out	.25"X1.5"	3	no material missing
	LF-2	1525	10L	out-in	1"x6"	2	no material missing; slight petaling with
							slant fracture; some tearing
	LF-2	1580	13-14L	out-in	2"x2"	2	shiny edge on entry rim & fracture surface
	LF-2	1580	16L	out-in	1"x3-6"	2	moderate curl inboard and forward
	LF-82F	1535	38-39L	in-out	.25" diam	3	rivet head impact, flange tears
	LF-82E	1540	35L	in-out	.5"x1"	2	material missing, flange gear w/sawtooth pattern
	LF-82E	1560	34L	in-out	.5"x1"	3	no material missing
	LF-29	1555	31-32L	in-out	5"x2"	3	no material missing
	LF-29	1560	31-32L	in-out	6"x3"	2	missing material
	LF-29	1560	32-33L	in-out	5"x2"	2	some material missing
	LF-29	1555	32-33L	in-out	5x1.5	3	
	LF-82P	1565	45L	in-out		3	curled edges-shiny features(melting?)
	LF-88B	1575	37L	in-out	.25"x1"	2	material missing, slight flange tear
	LF-82B	1595	40-41L	in-out	.5" diam	3	material missing?
	LF-82B	1610	40-41L	in-out	1" diam	2	material missing
	LF-82C	1600	43L	in-out	1"x2.5"	2	some material missing;thin rim of
							shiny material at forward exit surface
	LF-82T	1510	25-26L	out-in	1.5"x2"	2	a very small amount of material missing
	LF-82K	1615	45L	in-out	1"x2"	3	no material missing; slant fracture
	LF-88M	1840	32L	out-in	1"x2"	2	some material missing?
*	RF-18D	495	35R	in-out	.5" diam	1	low velocity hole, NTSB photo
	RF-18D	490	36-37R	in-out	.5" diam	2	a little material missing
	RF-18C	510	23R	in-out	2"x4"	3	no material missing
	RF-3B	600	23-24R	in-out	.75"x2.5"	3	no material missing
	RF-3C	640	27-28R	in-out	varx3"	3	no material missing; delamination observed

GROUP 1 : FUSELAGE STATIONS 520-1620

	PIECE	STATION	STRINGER	DIR'N	SIZE	PRIORITY	REMARKS
	RF-3C	645	27R	in-out	.5"	2	radial tears+delamination
	RF-3C	650	27R	in-out	.5"	2	radial tears + delamination
	RF-4	640	4L	out-in	1"x2"	2	no missing material;slant fracture;mechanical damage on outer surface
	RF-4	805	2L	in-out	3"x3.5"	3	tear;no missing material;slight damage on entry surface
	RF-3A	680	42-43R	in-out	1"x2"	2	cracking at ends of hole
	RF-3A	700	42-43R	in-out	1"x2"	2	
	RF-3A	725	41-42R	in-out	3.5"x6"	3	v. slight polish at entrance lip;
							crack entends to S42
	RF-3A	720	42-43R	in-out	1.5"x2"	3	slight polish at exit; v. slight sawtooth
							and v. slight inboard curl w/crack running to S43R
	RF-3A	730	42-43R	in-out	.5x1.5"	3	tear
	RF-3F	720	33-34R	in-out	.25" diam	2	sawtooth fracture w/radial tear
	RF-3F	760	28-29R	in-out	.125" diam	3	no material missing
*	RF-1	905	34R	out-in	.5"x.5:	1	low velocity hole; NTSB photo
*	RF-51	930	27-28R	in-out	.25"x.75"	1	partial flap, low velocity hole, FBI #37
we assigned	RF-95	920	36-37R	in-out	10"	1	shiny inboard edge of fracture(melting?) - looks like weld bead;
							shiny rims could also be smearing of Alclad layer but looks thicker than
							expected from geometry(assume 5% nominal clad/side);
we assigned	RF-95	930	36-37R	out-in	?	1	missing material; tear at rivet hole extends approx. 3";
							some surface abrasion on "entry" surface(& near rivet hole);
							mostly slant fracture
	RF-37	970	19R	in-out	1" diam	2	slant fracture
	RF-37	980	20-22R	aft	3" diam	2	missing material
	RF-42	1480	16R	out-in	1" diam	2	no material missing
	RF-52C	1500	44-45L	in-out	.25"x1"	2	tear; missing material
*	RF-52A	1520	45R	in-out	.75"x1"	1	low velocity hole, clean; NTSB Lab SEM;
							FBI # 64
	RF-31	1520	34-35R	out-in	2"x2"	2	no material missing
	RF-52B	1520	46-48L	in-out	12"x14"	3	no material missing
	RF-38	1360	RBL 15	forward	6"x10"	2	material missing; hole under pressure deck

GROUP 2 : OTHER LOCATIONS

PIECE	SITE		LOCATION	DIR'N	SIZE	PRIORITY	REMARKS
	UPPER WING SKIN						
CW-101	r/h end adjacent to SOB W/CW104			n/a	1" diam	n/a	not penetration
CW-102	fuel vent tube cover			up	1.5"x1.5"	2	inboard hole
CW-102	fuel vent tube cover			up	2"x1"	3	no material missing
CW-102	RBL70	SWB 2		?	1"x2"	2	material missing
	LOWER WING SKIN						
CW-205	Outboard right side at str 6-7			in-out	.75"x3"	1*	lower vel hole,def downward from inside
CW-205	38" left of C/L, at str 6-7			down	1.5"x2"	3	no material missing;slant fracture
CW-236	between SWB #2 and S13, RBL 62			down	1"x3"	1*	lower velocity damage, nearby fracture
							occurred before hole

PIECE	SITE	LOCATION	DIR'N	SIZE	PRIORITY	REMARKS
GROUP 2 : OTHER LOCATIONS						
	FRONT SPAR					
CW-501	LBL 19	14" below upper chord	forward	.375" diam	2	typical slant fracture
CW-501	LBL 21	13" below upper chord	forward	.5"x1"	2	typical slant fracture
CW-501	RBL 2	4" above lower chord	up,aft	.5" diam	1*	lower velocity hole
CW-501	RBL 6	21" below upper chord	forward	2" each	2	3 long slots, NTSB photo;
						inboard hole had spikes+curl, slant fracture on others
CW-501	RBL 39	14" above lower chord	aft	.5" diam	1*	partial flap;lower velocity hole;
						deformation aftward
CW-502	LBL 48	24" below upper chord	forward	.5"x1"	3	no material missing; slant fracture
CW-502	LBL 48	12" below upper cord	aft	6"x3"	2	material missing
CW-502	LBL 35	20" below upper chord	forward	2"x3"	3	
CW-504	LBL 91	20" below upper chord	forward	.5"x2"	2	material missing,slant fracture
CW-519	RBL 95	16" below upper chord	aft	.5"x2"	3	no material missing, NTSB photo
CW-519	RBL 77	16" below upper chord	aft,down	.5" diam	1*	lower velocity hole
CW-519	RBL 95	10" below upper chord	forward,dow	.25"x.5"	1*	lower velocty hole
CW-503	RBL 120	24" above lower chord	?	2"x3"	2	buckled and ripped, material missing;
						slant fracture, may not be penetr'n,
CW-515	LBL 76	11" below upper chord	aft	.375"x1.125"	1*	lower velocity hole, deformed afterwards
RF-37	RBL 110	20" from top	aft	6"x4"	2	combine w/CW519; missing material; mixed slant + sawtooth;
						curls aft, outboard; no spikes, scuff marks on "entry" surface
						fracture surface not sooted or smeared;
	SPANWISE BEAM # 3					
CW-601	RBL 100		fwd,out,up	1.5" diam	1*	lower velocity hole,clean fracture, minimal missing mat'l.
CW-602	RBL 43		aft	1"x3"	2	material missing
CW-604	LBL 39		forward	.75"X2"	2	material missing
CW-604	LBL 39		forward	1.5" diam	2	material missing
	SPANWISE BEAM # 2					
CW-702	RBL 87		?	.75" diam	n/a	manufactured hole
CW-704	RBL 17	adj to lower chord	outboard	1.25"	2	material missing;buckling related
CW-704	RBL 22		forward	.75" diam	2	material missing, tear at hole
CW-704	RBL 8		forward	.125" diam	2	material missing
CW-706	LBL 3	12" above lower chord	forward	.25" diam	2	n/a
	MID-SPAR					
CW-802	LBL 66		aft	3" diam	2	missing material;combines with CW-816 for hole;
						slant fracture; scallopped entry surface
	REAR SPAR					
CW-1004	LBL 6	near scavenger pump	inbd,fwd	.5" diam	1*	fastener head impact hole;
						FBI Item #65
	BUTT LINE 0 RIB					
CW-1106	AFT SWB#1	24" below top	outbd,rt	1.5"x1"	2	corrosion, mising material
CW-1106	AFT SWB#1	16" below top	outbd,rt	2"x.75"	1	clean hole
CW-1106	AFT SWB #1	19" below top	outbd,lft	.5" diam	1	clean hole, impact at angle
CW-1106	AFT SWB#1	21" below top	outbd,lft	1"x1"	2	missing material, corrosion

Precedence: ROUTINE**Date:** 08/20/1997

To: New York **Attn:** SSA [redacted] b7c

From: New York
FBI Command Post, Calverton, New York
Contact: SA [redacted] (516) 369-3313

Approved By: [redacted]

Drafted By: [redacted]bsm

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA 800;
7/17/96
AOT-IT-EOD;
OO: NEW YORK

Synopsis: Transfer of custody of evidence item 130 (1B-529).

Details: FBI evidence item 130 (1B-529) was released from the FBI Command Post, Calverton, New York, to [redacted] Materials Science Building 480, Brookhaven National Laboratory, New York, office telephone (516) 369-3313, on 8/20/1997 for analysis. Item 130 is a piece of alloy measuring 1 cm x .5 cm x .5 cm, cut from a compressor blade section marked with FBI evidence number 12-9-96-46. An FD-597 was accomplished and submitted to the evidence file. b7c

[redacted] will polish the piece and subject it to x-ray elemental analysis. The composition of this piece will be compared to the composition of FBI item 92 (1B-423), a metal piece of unknown origin, to aid in the identification of item 92. b7c

♦♦

b7c

CC: SSA [redacted]
SSRA [redacted]
SA [redacted]
Det [redacted]

I-46 Rotor

SECRET

Precedence: ROUTINE Date: 08/22/1997

To: New York

From: New York
FBI Command Post, Calverton, New York
Contact: [redacted] 516-369-3313

b7C

Approved By: [redacted]

Drafted By: [redacted] sab

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EOD

Synopsis: Transfer of custody of evidence item numbers 137-140 to the Defense Intelligence Agency (DIA) for testing.

Details: Four FBI evidence items were released from the FBI Command Post, Calverton, New York to [redacted] Army Missile Command by means of Federal Express (tracking number 1482817910) to [redacted] U.S. Army Aviation And Missile Command, Attn: [redacted] Redstone Arsenal, Huntsville, Alabama 35898-5247, [redacted] on 8/22/1997 for analysis, specifically [redacted] (S) Slides will have to be made in order for the analysis to be done and will involve some modification to the items aforementioned. The items sent were as follows:

b7C

b1

Item #137 (1B-43) - Labeled "96-5149, FOREIGN MATTER, Exhibit #7, Date (autopsy/seizure) 7/25/96" described as two approximately four (4) grain size fragments of unknown metallic material.

Item #138 (1B-39) - Labeled "96-5155, FOREIGN MATTER, 7/26/96" described as two objects - one object a small "ball bearing" looking silver metallic ball approximately 5/32 of an inch in diameter and the other object and the second object a similar (5/32 inch in diameter) "ball bearing" looking silver metallic ball attached to a small gold colored post (approximately 1/8 of an inch in length) at the end of which were screw threads (approximately 1/16 of an inch in length).

Item #139 (1B-532) - Labeled "1/30/97 1545, S/A PROVINE, PIECE FOUND IN FAIRING 1/30/97 (initialed) HFH"

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(e)
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described as a non-symmetric "V"-shaped piece of thin unknown material approximately three (3) inches by 1.5 inches.

Item #140 (1B-532) - Labeled "Misc. Debris 8-24-96-7" described as an approximate two (2) to (3) grain sized metallic magnetic fragment.

The items will be [redacted] (S) b1

♦♦

OPCA-20 (12-3-96)

XXXXXX
XXXXXX
XXXXXX

FEDERAL BUREAU OF INVESTIGATION
FOIPA
DELETED PAGE INFORMATION SHEET

17 Page(s) withheld entirely at this location in the file. One or more of the following statements, where indicated, explain this deletion.

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☐ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
______	☐ (b)(7)(D)	☐ (k)(2)
______	☐ (b)(7)(E)	☐ (k)(3)
______	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☐ (b)(6)		☐ (k)(7)

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XXXXXX

(06/01/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE Date: 09/12/97

To: New York Attn: I-46

From: New York
FBI Command Post, Calverton, New York
Contact: SA [redacted] (516) 369-3313 b7c

Approved By: [redacted]

Drafted By: [redacted]:rpg

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S)
EXPLOSION OF TWA 800;
7/17/96
AOT-IT-EOD;
OO: NEW YORK

Synopsis: Transfer of custody of evidence items, 1B555 and 1B556 to NTSB and BOEING for testing.

Details: Two FBI evidence items were released from the FBI Command Post, Calverton, New York to [redacted] TWA, on September 12, 1997 for testing at NTSB Laboratory, 490 L'Enfant Plaza Southwest, Washington, DC, office telephone number (202) 314-6535 and BOEING Laboratory, Box 3707, Seattle, Washington, office telephone number (206) 662-2532. The items were: b7c

Item 146: 1B555, One section of RF50, cut out of main section of the wheel well.

Item 147: 1B556, One section of the landing tire.

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UPLOADED ✓
WITH TEXT
WITHOUT TEXT
BY [illegible]
DATE 9-24-97

(X) TC

265A-NY-259028-SUB LAB 28

SEP 15 1998

evid 912.wpd

Precedence: ROUTINE**Date:** 10/07/1997

To: New York **Attn:** SSA [redacted]
SSA [redacted]
SA [redacted]
DET. [redacted]
I46 ROTOR

b7C

From: NEW YORK
FBI COMANDPOST, CALVERTON, NEW YORK
Contact: [redacted] (516)369-3313

Approved By: [redacted]

Drafted By: [redacted]

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EID

(142)

Synopsis: Evidence sent to Brookhaven National Laboratory (BHL) for testing.

TC

Enclosures: FD-302 by SA [redacted] dated 10/03/1997; FD-597 dated 10/03/1997.

b7C

Details: On October 3, 1997 the following items were forwarded to BHL for testing to determine the material composition of each item for the purpose of comparison to previously tested materials:

1) Item Number 167; 1B572- a grey metal piece approximately 3.0cm x 1.5 cm x .5 cm., taken from the casing of a fuel pump.

2) Item Number 171; 1B573- a silver and grey metal piece, 1.5cm x .5cm x .4cm, taken from what appears to be an engine support strut.

3) Item Number 172; 1B573- a silver and green colored metal piece, approximately 1.0cm x .5cm x .4 cm taken from the casing of an engine.

4) Item number 173; 1B573- a green and grey metal piece, 1.5cm x .75cm x .5cm, taken from an engine propeller blade, which came from engine number four.

5) Item number 174; 1B573- a green metal. piece approximately .6cm x .5cm x .3cm, taken from an engine propeller blade, which possibly came from engine number three

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DATE 4/13/00 BY SP8 [illegible]

6) Item number 175; 1B573- a silver colored piece of metal approximately 1.0cm x .6 cm x .2cm, taken from an engine propeller blade, which possibly came from engine number three.

7) Item number 176; 1B573- a silver colored piece of metal, approximately 2.5cm x .5cm x .2cm, taken from and engine blade, which possibly came from engine number one.

8) Item number 177; 1B573- a grey and green metal piece approximately .6cm x .5 cm x.3cm, taken from an engine blade mount, which possibly came from engine number three.

9) Item number 178; 1B573- a grey and green metal piece approximately 1.0cm x 1.0cm x .75cm taken from an engine blade, which possibly came from engine number four.

10) Item number 179; 1B573- a silver and grey metal piece approximately .75cm x .4cm x .2cm taken from an engine blade mount, which possibly came from engine number four.

11) Item number 180; 1B574- a green and grey metal piece approximately 1.2cm x 1.0 cm x .2cm taken from the casing of engine number four.

12) Item number 181; 1B574- a green and grey metal piece taken from an outer engine ring from engine number three, approximately 1.1cm x .5cm x .2cm.

13) Item number 182; 1B574- a green and grey metal piece, approximately .5cm x .75cm x .4cm, taken from a ring near the rear of engine number two.

14) Item number 183; 1B574- a green an grey metal piece approximately 1.0cm x .5cm x .25cm, taken from an engine radial support.

The above described items were all retrieved from the engine debris of TWA Flight 800.

♦♦

10/03/1997

On 10/03/1997, at approximately 2:45 p.m., Special Agent (SA) [redacted] Federal Bureau of Investigation (FBI), New York Office, took custody of the following FBI evidence items from the FBI Command Post, Calverton New York: b7C

1) Item Number 167- a grey metal piece approximately 3.0cm x 1.5 cm x .5 cm., taken from the casing of a fuel pump.

2) Item Number 171- a silver and grey metal piece, 1.5cm x .5cm x .4cm, taken from what appears to be an engine support strut.

3) Item Number 172- a silver and green colored metal piece, approximately 1.0cm x .5cm x .4 cm taken from the casing of an engine.

4) Item number 173- a green and grey metal piece, 1.5cm x .75cm x .5cm, taken from an engine propeller blade, which came from engine number four.

5) Item number 174- a green metal. piece approximately .6cm x .5cm x .3cm, taken from an engine propeller blade, which possibly came from engine number three

6) Item number 175- a silver colored piece of metal approximately 1.0cm x .6 cm x .2cm, taken from an engine propeller blade, which possibly came from engine number three.

7) Item number 176- a silver colored piece of metal, approximately 2.5cm x .5cm x .2cm, taken from and engine blade, which possibly came from engine number one.

8) Item number 177- a grey and green metal piece approximately .6cm x .5 cm x.3cm, taken from an engine blade mount, which possibly came from engine number three.

9) Item number 178- a grey and green metal piece approximately 1.0cm x 1.0cm x .75cm taken from an engine blade, which possibly came from engine number four.

10) Item number 179- a silver and grey metal piece approximately .75cm x .4cm x .2cm taken from an engine blade mount, which possibly came from engine number four.

11) Item number 180- a green and grey metal piece approximately 1.2cm x 1.0 cm x .2cm taken from the casing of engine number four.

12) Item number 181- a green and grey metal piece taken from an outer engine ring from engine number three, approximately 1.1cm x .5cm x .2cm.

13) Item number 182- a green and grey metal piece, approximately .5cm x .75cm x .4cm, taken from a ring near the rear of engine number two.

14) Item number 183- a green an grey metal piece approximately 1.0cm x .5cm x .25cm, taken from an engine radial support.

SA [redacted] then immediately presented these items to [redacted] at the FBI Command Post, for transport to Brookhaven National Laboratory, Brookhaven, New York, for testing. [redacted] executed a FD-597, indicating her receipt of these items.

b7C

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 04/14/1999

To: FBIHQ
New York

Attn: SSA [redacted] b7C
SAC O'Neill
ASAC D'Amuro
CDC [redacted]
SSA [redacted]

From: New York
I-46/TWA Task Force
Contact: SA [redacted] b7C

Approved By: [redacted]

Drafted By: [redacted] pac

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUBS(S);
EXPLOSION OF TWA FLIGHT 800,
JULY 17, 1996,

Report sent via fedex to NTSB 6/14/99 to [illegible] Additional copy to HQ for extra copies

Synopsis: Summary of TWA Flight 800 victim injury analysis patterns from [redacted] b7C

Enclosures: Attached report.

Details: On July 17, 1996 at 8:31pm Eastern Standard Time, a Boeing 747-131 airplane operated by TWA, known as Flight 800, was enroute from John F. Kennedy International Airport New York, NY to Charles DeGaulle International Airport, Paris, France. Shortly after departure from JFK and while climbing near the southern coast of Long Island the aircraft exploded and broke-up in flight crashing into the Atlantic Ocean neat East Moriches, NY.

The 18 crew members and 212 passengers aboard Flight 800 were fatally injured and the airplane was destroyed.

Attached is the autopsy analysis report as it relates to injuries of the victims that were aboard Flight 800 to the damage the airplane sustained. The main objective of this investigative team was to document and utilize medical and forensic data and biomechanical analysis to reconstruct injury events occurring during all phases of Flight 800's downing. Individual and group analysis of injuries were used to aid in determining whether an explosive device detonated within the cabin or if the aircraft was subject to any outside penetrating projectiles.

265A NY 259028
Sub LAB Rpts

36

PROJECT CONTRIBUTORS

Participating in this analysis were Doctors from the forensic pathology field to include, [redacted] Armed Forces Institute of Pathology; assisting these doctors were [redacted] Police Officer, Suffolk County Police Department, Data Services Section, [redacted] Human Performance Investigator, National Transportation and Safety Board, and FBI Special Agents, [redacted]

b7C

BACKGROUND: VICTIM RECOVERY

The remains of 230 of the 230 victims aboard the airplane were recovered and identified. The remains were recovered at sea and brought to a temporary morgue at the Coast Guard station at East Morches, New York. The first 99 bodies were found floating on the surface of the ocean. The remaining victims were recovered by US Navy divers and local police divers during the next three months. The remains of approximately ten individuals were recovered as a result of the trawling operation conducted for four months proceeding the dive operation.

Victims were placed in body bags and transported by boat to the temporary morgue which was staffed by personnel from the Suffolk County Medical Examiner's Office and Suffolk County Police Department. Victims were assigned a medical examiner accession number, photographed, and their clothing and possessions were cataloged. The remains were then placed in a refrigerated trailer and transported to the Suffolk County Medical Examiner's Office in Hauppage, NY.

At the ME's Office, the remains were photographed with and without clothing, radiographed, fingerprinted if possible, dentition was photographed and x-rayed and clothing and other personnel effects were catalogued. All victims were then autopsied by a forensic pathologist from either the ME or a pathologist temporarily assigned to the ME either by the State of New York or a neighboring jurisdiction.

In most cases, identification was accomplished through fingerprinting by the FBI or by forensic odontology. In rare cases, the ME utilized DNA or forensic anthropology as the primary means of identification. Additionally, more than one method of identification were employed. Body parts recovered separately were identified by DNA. FBI bomb technician and evidence responses personnel were present in the examination rooms to inspect and retrieve all items.

The primary concern of the ME was to identify the victims and was under constant pressure to do so. Therefore, for the sake of expediency, a complete and thorough forensic examination was not performed. For example, no record of the condition of tympanic membranes of the victims was made nor was the foreign material removed from the bodies recorded on the autopsy reports as found loosely in the body bag, in open wounds or whether the foreign body had penetrated the skin surface and lodged in the soft tissue.

METHOD: COMPUTER DATA BASE

A data base was established to document this important forensic information in a uniform matter. Microsoft Access, version 7.0 was used. Input included, demographic information, injury data, pertinent recovery data (longs and lats) and assigned seating of each victim. This information was later used to interpret data into a mapping software package for actual visual display on the computer screen and ultimately producing color prints.

Each injury was entered into one of three data fields; external injuries, internal injuries or fractures, using a carefully defined format. The format used a specific sequence, for example, left femur, fracture, transverse; right lung, laceration, extensive; etc. The review team made determinations as to which injuries were important for developing patterns of injuries as they relate to determining primary force vectors along with any other mechanisms of injury.

Seat assignments were available for purposes of seat reconstruction. Therefore the seat assigned was used in this analysis. However, the airplane was only half full and since the plane waited over an hour on the runway prior to take off, a few passengers must have changed seats, with the exception of first class seating. Prior to explosion, the Captain had not turned off the fasten seat belt sign and therefore it is assumed that passengers were sitting with their seat belts fastened. Additionally, the fourteen flight attendents were released to perform their required duties through out the cabin.

Copies of the autopsy protocols, toxicology reports, body diagrams and photographs (taken by the SCPD and ME) are entered into FBI evidence. The radiographs are kept on file at the ME's Office, along with tissue samples taken from the flight crew.

♦♦

OPCA-20 (12-3-96)

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FEDERAL BUREAU OF INVESTIGATION
FOIPA
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4 Page(s) withheld entirely at this location in the file. One or more of the following statements, where indicated, explain this deletion.

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Section 552		Section 552a
☐ (b)(1)	☐ (b)(7)(A)	☐ (d)(5)
☐ (b)(2)	☐ (b)(7)(B)	☐ (j)(2)
☐ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
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☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☐ (b)(6)		☐ (k)(7)

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☑ The following number is to be used for reference regarding these pages:
265A-NY-259028 SUB FF2 LAB 37 and 38

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XXXXXX

U.S. Department of Justice

Federal Bureau of Investigation

In Reply, Please Refer to
File No. 72-NY-261351

135 Pinelawn Road - Suite 350S
Melville, New York 11747
October 1, 1999

[redacted]
National Transportation Safety Board
490 L'Enfant Plaza East, S.W.
Washington, D.C. 20594

b7C

Dear [redacted]

Enclosed via FedEx Airbill #8156-9358-8489 is a copy of the West Coast Analytical Service, Inc. lab report that you requested from SA [redacted] of our Long Island Resident Agency. b7C

I hope that this report is of assistance to you.

Sincerely,

LEWIS D. SCHILIRO
ASSISTANT DIRECTOR IN CHARGE

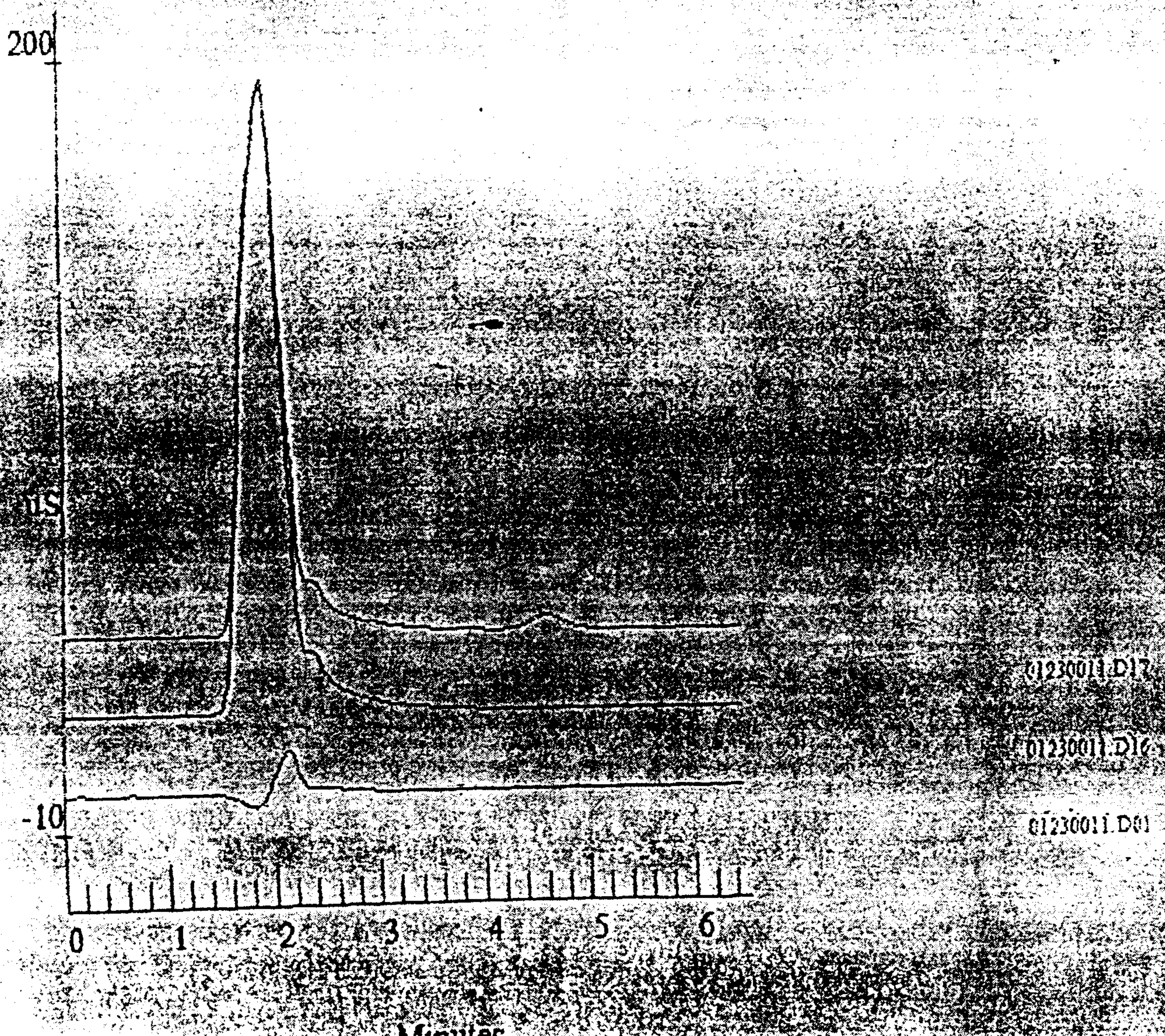
By: [redacted]
SUPERVISORY SPECIAL AGENT b7C

ALL INFORMATION CONTAINED
HEREIN IS UNCLASSIFIED
DATE 4-13-00 BY SPS/JC/PM

1 - [redacted] b7C

39

SEARCHED ___ INDEXED ___
SERIALIZED ___ FILED ___
OCT 20 1999
FBI — NEW YORK



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Minutes

[redacted] b7c

TO: WEST COAST ANALYTICAL SERVICE, INC.
9840 Alburtis Avenue
Santa Fe Springs, CA 90670

SPECTRODYNE CONSULTANTS
4525 East Industrial Street, Unit 4P
Simi Valley, California 93063
(805) 582-2511

Attention: [redacted]

PURCHASE ORDER NO. 01KG0123

Project No. 33986

January 30, 1997

SEMIQUANTITATIVE ANALYSIS

RECEIVED FEB 03 1997 WCAS INC. SFS

	Proj. No 33986 Foam Rubber with Orange Residue
Si	15.8
Fe	3.1
Ca	12.
Al	2.8
Mg	18.
Cu	0.053
Ti	1.7
Sb	0.53
Mn	0.21
B	0.081
Pb	2.4
Ag	0.032
Zn	3.6
Ni	0.38
Cr	0.032
Other Elements	NIL

Note: Only 1 mg of sample was obtained. Some of it is probably the foam rubber.

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED DATE [illegible]

Respectfully submitted,

[redacted] b7c

SPECTRODYNE CONSULTANTS

polysulfide binder - synthetic rubber

metal

oxidant

double bond system
nitro cellulose
nitro glycerine

polymeric binder
asphalt
syn rubber
butadiene acrylic
acid - acrylonitrile
butadiene

nitronium
Oxidants perchlorates K, NH_4, Li, Na
Nitrates

metals - Al, Be

perchlorate

RECEIVED
FEB 03 1997
WCAS INC.
SFS

SPECTRODYNE CONSULTANTS
4525 East Industrial Street, Unit 4P
Simi Valley, CA 93063
(805) 582-2511

Laboratory Service Reported To:

WEST COAST ANALYTICAL SERVICE, INC.
9840 Alburtis Avenue
Santa Fe Springs, CA 90670

Attention: Accounts Payable

INVOICE NO. 2450
DATE January 30, 1997
P.O. NO. 01K
Proj. #33986

Terms: NET CASH

	DESCRIPTION	UNIT PRICE	AMOUNT
	SEMIQUANTITATIVE ANALYSIS	$56.00	
1	Sample: Project No. 33986 [redacted] Foam Rubber with Orange Residue		$56.00
	Reported 1-30-97		
	Total:		$56.00

INVOICE RECORD
Vendor No.
Invoice No.
Due Date
Distribution: Account/Dept.
TOTAL INVOICE
Invoice Approval
Check Approval

INVOICE 3

WEST COAST ANALYTICAL SERVICE. INC.
Professional Analytical Chemists
9840 Alburtis Avenue, Santa Fe Springs, CA 90670
310/948-2225 FAX 310/948-5850

A/P notes:

Additional notes:
1-28-97 per JN sub-sample 1/4 of total sample to send for Emission spec. sub-sampled 0.75 inch of sample. -Kg
2-4-97 Faxed [redacted] GHL b7C

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OPCA-20 (12-3-96)

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☐ (b)(2)	☐ (b)(7)(B)	☐ (j)(2)
☐ (b)(3)	☑ (b)(7)(C)	☐ (k)(1)
________	☑ (b)(7)(D)	☐ (k)(2)
________	☐ (b)(7)(E)	☐ (k)(3)
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☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☑ (b)(6)		☐ (k)(7)

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FBI/DOJ

(03/31/95)

SECRET

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 07/29/1996

To: NEW YORK **Attn:** SAC, DIVISION I

From: NEW YORK
I-46, DIVISION I
Contact: SA [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]cmg

File Number(s): 265A-NY-259028 (Pending)

Title: UNSUB(S); EXPLOSION OF TWA FLIGHT 800 ON 7/17/96; AOT-IT;EID; OO:NY

Synopsis: SUB-FILE ADMINISTRATION

Details: In addition to the main file, the following is a listing of sub files for captioned matter:

SUB A. Outgoing communications.

SUB B. Incoming communications.

SUB C. Administrative Matters.

SUB D. Lead Sheets - Copies of all lead sheets.
D1. 800 Generated Leads
D2. Internet Generated Leads
D3. Miscellaneous Lead - No action to be taken.

SUB E. Secret - To maintain classified information.

SUB F. Press releases and news clippings.

SUB G. Searches
G1. Moriches recovery - reclass to FF.
G2. Articles received from JFK Airport.

SUB H. Claims of responsibilities.

SUB I. Logs - copies of Daily Activity Log.

SUB J. Top Secret - maintained in I-46 safe.

265A-NY-259028-SUB FF2-

SEARCHED INDEXED
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1996
FBI — NEW YORK

LL INFORMATION CONTAINED
HEREIN IS UNCLASSIFIED EXCEPT
WHERE SHOWN OTHERWISE

4-13-00
CLASSIFIED BY: SPS/SCP/rc derivative
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To: NEW YORK From: NEW YORK
Re: 265A-NY-259028, 07/29/1996

SUB K.	Investigative reports of outside Agencies/Police Departments.
SUB FD302	The original and one copy of FD302's.
SUB INS	The original and one copy of inserts.
SUB BC	Background checks.
SUB CE	Draft requests and financial related documents.
SUB LAB	Lab reports.
SUB SPB	Copies of subpoenas issued.
SUB TEL	Telephone subscriber and toll information.
SUB AA.	Flight Related investigative matters. AA1. Flight 800 passenger manifest. AA2. Interviews AA3. Flight 800 cargo manifest. AA4. Flight 881 passenger manifest. AA5. Flight 881 cargo manifest. AA6. Maintainance Flight 800.
SUB BB.	Previous bomb threats and related matters.
SUB CC.	Possible missile attack. CC1. Interviews - Land Canvass CC2. Interviews - Technical Data CC3. Interviews - Vessels and Aircraft CC4. Interviews - Marinas CC5. Stolen Crafts CC6. Police Canvass - Unusuals
SUB DD.	Airport Related/Port Authority DD1. [redacted] Information DD2. Pay Telephone Dumps DD3. Stolen/Abandoned vehicles at airports
SUB EE.	Manifest of International Flights.
SUB FF.	Recovery effort - Moriches/Grumman FF1. Copies of Outgoing Leads/Lab Request FF2. Lab reports FF3. Medical Examiner Reports

b3

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To: NEW YORK From: NEW YORK
Re: 265A-NY-259028, 07/29/1996

FF4. Temporary Morgue Reports
FF5. Dive Sheet/Logs

[redacted]

b1

(S)

PARTS LIST	BOEING	CORPORATE OFFICES SEATTLE, WA 98124	FSCM 81205	REV. DATE 11-19-92	PL 65B60278	REV. LTR A
LIST TITLE	DIVIDER ASSY - STATION 1920, BULK CARGO COMPT		GROUP CARGO SYS	CONTRACT NUMBER	SHT. 3 OF 10 SHTS.	

. . . ASSEMBLY BREAKDOWN LIST . . .

QTY REQD	PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	NOTE CODE	NOTES	REV SYM
-	-1	DIVIDER ASSY	- MD	PT MK C	
			DP	DRAWING PICTURE SHEET 2, 3	
-	-22	DIVIDER ASSY	- MD	ZONE 3A6 PT MK C	
			DP	DRAWING PICTURE SHEET 2, 3	
-	BAC5347	PROCESS SPEC			
ASSY	-1	DIVIDER ASSY	- MD	PT MK C	
			DP	DRAWING PICTURE SHEET 2, 3	
1	-10	NYLON FABRIC	- MD	PT MK R STOCK 54 X 65 DANTEX 1300, COLOR - FLAT GRAY BAC704, C.R.DANIELS CO. SEATTLE, WASH CODE IDENT 03369-3 OPTIONAL MATERIAL ARMOR SHELL LIGHT GRAY STOCK L13, COOLEY INC. PAWTUCKET, RHODE ISLAND, 02860.	A
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C0030-875-2L	
			GA	FABRIC DIMENSIONS APPROXIMATE, MAKE TO FIT. SEW WITH TEXTURED SIDE OF FABRIC TO NEAR SIDE	
1	-11	NYLON FABRIC	- MD	PT MK R STOCK 30 X 65 DANTEX 1300, COLOR - FLAT GRAY BAC704, C.R.DANIELS CO. SEATTLE, WASH CODE IDENT 03369-3 OPTIONAL MATERIAL ARMOR SHELL LIGHT GRAY STOCK L13, COOLEY INC. PAWTUCKET, RHODE ISLAND, 02860.	A
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C0030-875-2L	
			GA	FABRIC DIMENSIONS APPROXIMATE, MAKE TO FIT. SEW WITH TEXTURED SIDE OF FABRIC TO NEAR SIDE	
1	-12	NYLON FABRIC	- MD	PT MK R STOCK 30 X 65 DANTEX 1300, COLOR - FLAT GRAY BAC704, C.R.DANIELS CO. SEATTLE, WASH CODE IDENT 03369-3 OPTIONAL MATERIAL ARMOR SHELL LIGHT GRAY STOCK L13, COOLEY INC. PAWTUCKET, RHODE ISLAND, 02860.	A
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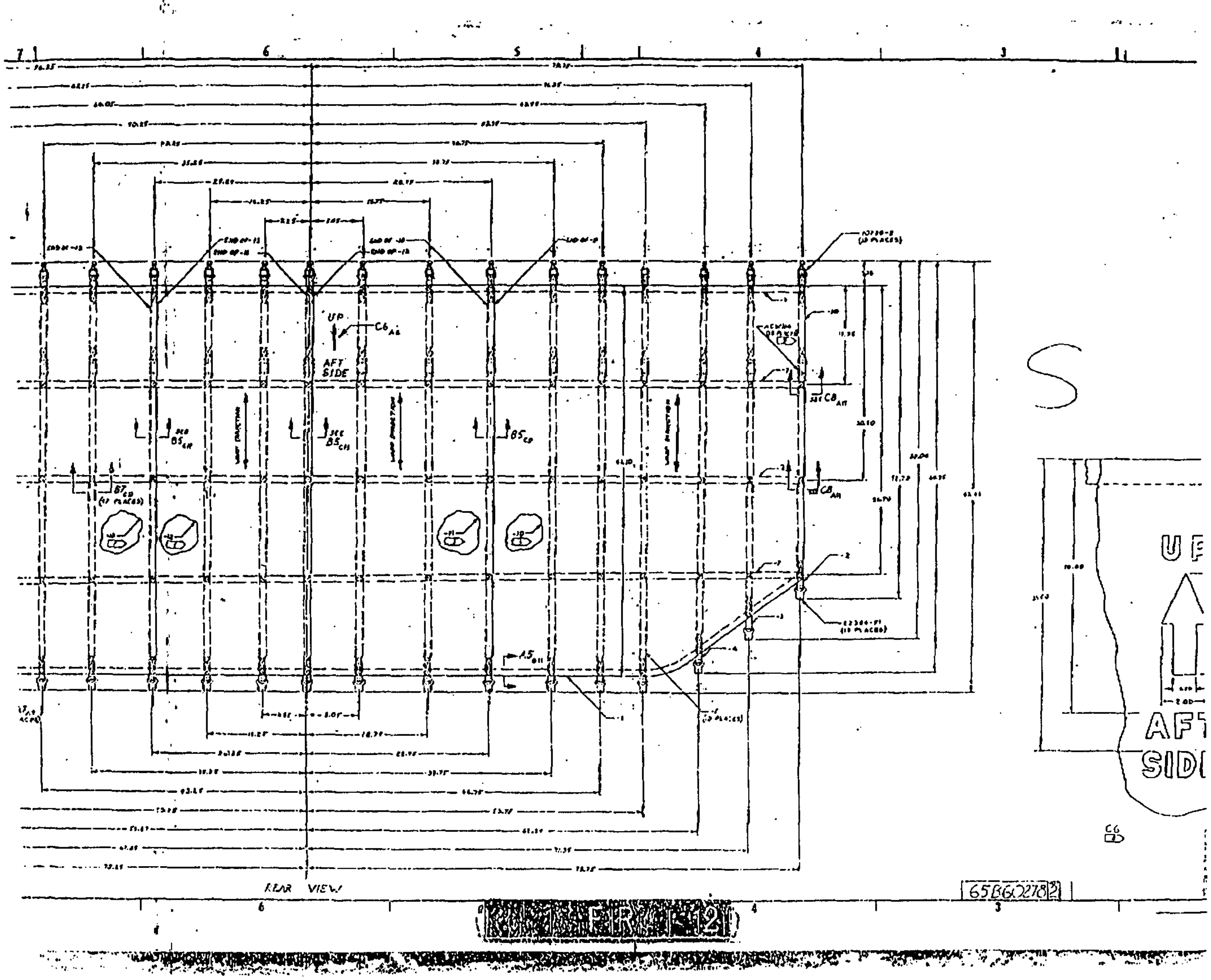
			GA	FABRIC DIMENSIONS APPROXIMATE, MAKE TO FIT. SEW WITH TEXTURED SIDE OF FABRIC TO NEAR SIDE	
1	-13	NYLON FABRIC	- MD	PT MK R STOCK 54 X 65 DANTEX 1300, COLOR - FLAT GRAY BAC704, C.R.DANIELS CO. SEATTLE, WASH CODE IDENT 03369-3 OPTIONAL MATERIAL ARMOR SHELL LIGHT GRAY STOCK L13, COOLEY INC. PAWTUCKET, RHODE ISLAND, 02860.	A
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C0030-875-2L	
		ASSY -1	GA	FABRIC DIMENSIONS APPROXIMATE, MAKE TO FIT. SEW WITH	

(CONTINUED ON NEXT PAGE)

PARTS LIST	BOEING	CORPORATE OFFICES SEATTLE, WA 98124	FSCM 81205	REV. DATE 11-19-92	PL 65B60278	REV. LTR A
LIST TITLE	DIVIDER ASSY - STATION 1920, BULK CARGO COMPT		GROUP CARGO SYS	CONTRACT NUMBER	SHT. 4 OF 10 SHTS.	

ASSY -1 (CONTINUED FROM PRECEDING PAGE)

QTY REQD	PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	NOTE CODE	NOTES	REV SYM
				TEXTURED SIDE OF FABRIC TO NEAR SIDE	
1	-14	THREAD NYLON	- AR	QUANTITY AS REQUIRED	
			GA	SEW PER BAC5437 TYPE 301, 7 PORM 1 STITCHES PER INCH, NYLON THREAD PER FED SPEC V-T-295, TYPE I, CLASS I, SIZE E, COLOR - FLAT GRAY BAC704	
2	-2	WEBBING	- MD	PT MK R STOCK .062 X 1.00 X 73.0 NYLON .06 X 1.00 PER MIL-W-4088 TYPE XVII TREATED PER MIL-W-27265 CLASS R, COLOR - FLAT GREY BAC704 (OR EQUIVALENT)	A
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C1805-003-25	
			GA	SEAR ENDS TO PREVENT UNRAVELLING	
2	-3	WEBBING	- MD	PT MK R STOCK .062 X 1.00 X 78.0 NYLON .06 X 1.00 PER MIL-W-4088 TYPE XVII TREATED PER MIL-W-27265 CLASS R, COLOR - FLAT GREY BAC704 (OR EQUIVALENT)	A
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C1805-003-25	
			GA	SEAR ENDS TO PREVENT UNRAVELLING	
2	-4	WEBBING	- MD	PT MK R STOCK .062 X 1.00 X 84.0 NYLON .06 X 1.00 PER MIL-W-4088 TYPE XVII TREATED PER MIL-W-27265 CLASS R, COLOR - FLAT GREY BAC704 (OR EQUIVALENT)	A
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C1805-003-25	
			GA	SEAR ENDS TO PREVENT UNRAVELLING	
13	-5	WEBBING	- MD	PT MK R STOCK .062 X 1.00 X 86.0 NYLON .06 X 1.00 PER MIL-W-4088 TYPE XVII TREATED PER MIL-W-27265 CLASS R, COLOR - FLAT GREY BAC704 (OR EQUIVALENT)	A
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C1805-003-25	
			GA	SEAR ENDS TO PREVENT UNRAVELLING	
1	-6	WEBBING	- MD	PT MK R STOCK .062 X 1.00 X 180.0 NYLON .06 X 1.00 PER MIL-W-4088 TYPE XVII TREATED PER MIL-W-27265 CLASS R, COLOR - FLAT GREY BAC704 (OR EQUIVALENT)	A
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C1805-003-25	
			GA	SEAR ENDS TO PREVENT UNRAVELLING	
4	-7	WEBBING	- MD	PT MK R STOCK .062 X 1.00 X 170.0 NYLON .06 X 1.00 PER MIL-W-4088 TYPE XVII TREATED PER MIL-W-27265 CLASS R, COLOR - FLAT GREY BAC704 (OR	A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REAR VIEW
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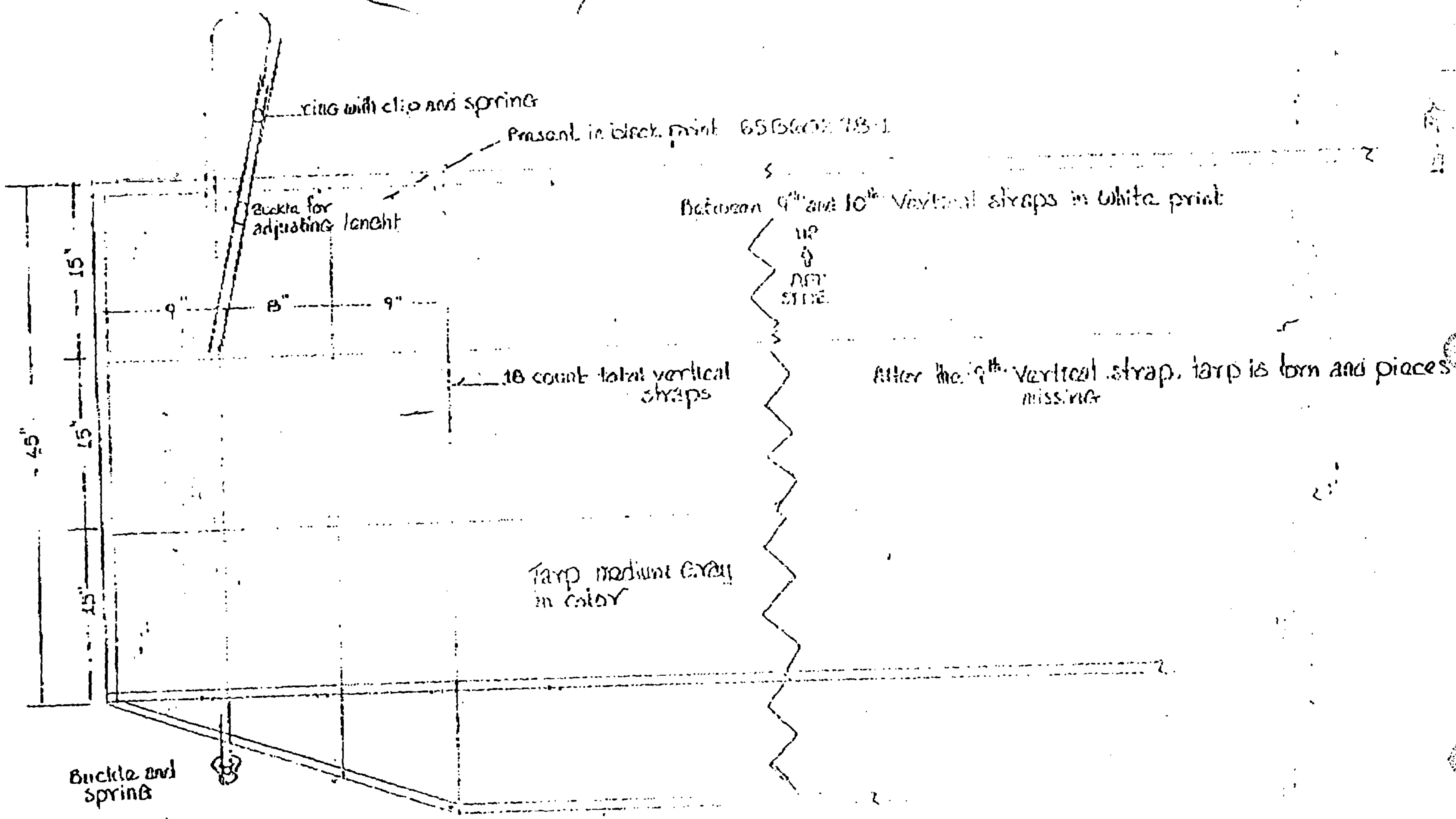
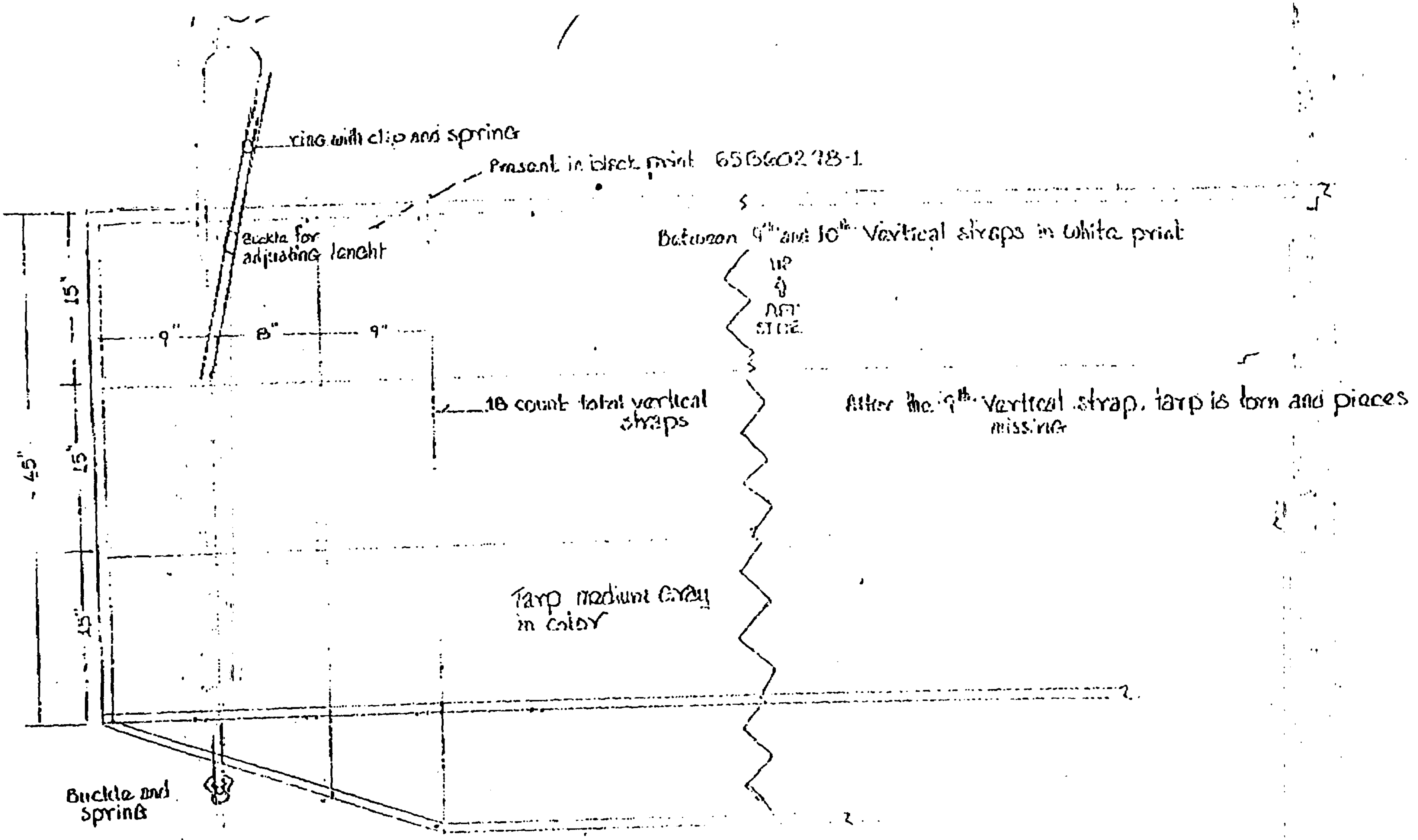
UP
AFT SIDE

FBI LABORATORY





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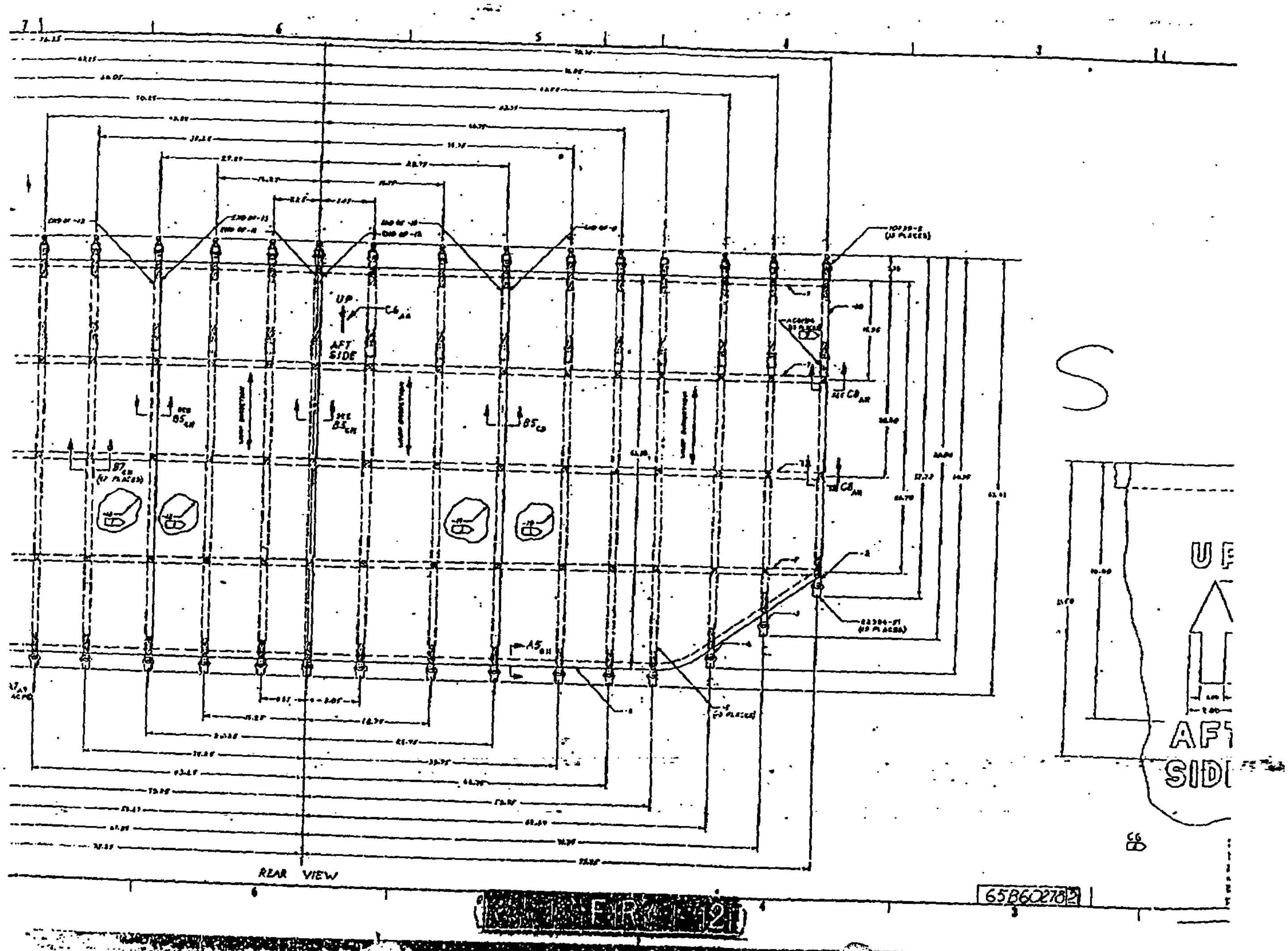

UP
AFT SIDE
REAR VIEW
65B60278
UP
AFT
SIDE

(06/01/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 10/10/1996

To: NEW YORK

From: NEW YORK
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted] ctv

Case ID #: 265A-NY-259028-FF2 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800
JULY 17, 1996;
AOT-IT-EID;

Synopsis: Item #30, 1B127, material sent to NTSB lab.

Details: Item #30 from 1B127, evidence control # E1191108, is a portion of "Span Wise Beam No.2, Boeing #65B 12010-10". This item was shipped to the National Transportation Safety Board (NTSB) lab for metallurgical testing, on 08/09/96. (NOTE: This part is from a location within the fuel tank which is NOT directly accessible during normal "transportation" use of the aircraft.)

Span Wise Beam #2 is at approximately station 1098, in the center wing fuel tank. This tank's location is from approximately station 1000 to station 1238. The station numbers are marked out in inches. The tank's overall length is approximately 240 inches (due to curvature).

The physical location in the center fuel tank of this portion of Span Wise Beam #2 is to the right of the center line. The "spars" and span wise beams in the center fuel tank are positioned from forward to aft as follows: the Front Spar (station 1000), Span Wise Beam #3 (station 1042), Span Wise Beam #2 (station 1098), the Mid Spar (station 1140), Span Wise Beam #1 (station 1181), then the Rear Spar (station 1238).

(NOTE: All station numbers given for each beam and spar are at the top. They are slightly different at the bottom. Also, the overall length is commonly cited as 240 inches, which is different from the 238 inches indicated by th 265A-NY-259028-SUB FF2 - 4

b7C

numbers. This is due to the curve of the upper skin of the tank.)

This item was returned in two (2) pieces on 08/15/96. It was cut during examination at the NTSB lab. Present during the examination was FBI metallurgist SSA [redacted] b7C

A copy of the NTSB report is attached to this communication.

The details of this report are reproduced as follows:

(<u>NOTE:</u> The center line of the aircraft is referred as the "Butt-Line", RBL designates the Right Butt Line, or to the right of the center line.)

[redacted]

referred

(06/01/1995)

FEDERAL BUREAU OF INVESTIGATION

To: NEW YORK From: NEW YORK
Re: 265A-NY-259028, 08/10/1996

[redacted]

referred

(06/01/1995)

FEDERAL BUREAU OF INVESTIGATION

To: NEW YORK From: NEW YORK
Re: 265A-NY-259028, 08/10/1996

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

referred

(06/01/1995)

FEDERAL BUREAU OF INVESTIGATION

To: NEW YORK From: NEW YORK
Re: 265A-NY-259028, 08/10/1996

[redacted]

[redacted]

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OPCA-20 (12-3-96)

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Section 552		Section 552a
☐ (b)(1)	☐ (b)(7)(A)	☐ (d)(5)
☐ (b)(2)	☐ (b)(7)(B)	☐ (j)(2)
☐ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
________	☐ (b)(7)(D)	☐ (k)(2)
________	☐ (b)(7)(E)	☐ (k)(3)
________	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☐ (b)(6)		☐ (k)(7)

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265A-NY-259028 SUBFF2, LAB 15 dated 8/13/96

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FBI/DOJ

Precedence: ROUTINE**Date:** 08/11/1996

To: New York **Attn:** ASAC George H. Andrew

b7C

From: [redacted]
I-46

Approved By: [redacted]

Drafted By: [redacted]emf

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EID

Synopsis: Contact with NTSB representative.

Details: [redacted] was contacted regarding status of investigation and autopsies being conducted at the Medical Examiner's Office. [redacted] was also contacted regarding a database being put together in connection with the autopsy information, this will be addressed on a separate communication.

b7C

[redacted] advised that the Medical Examiners at the SCMEO are not in receipt of any clothing worn by any of the victims. [redacted] would like to have the ability to review this clothing to correlate injuries on the bodies with the apparel they were wearing.

[redacted] advised that autopsies should be completed by the middle of this coming week. After the autopsies are completed, the team of medical doctors at the SCMEO, which consists of the Medical Examiner, an FAA Medical Doctor and a Colonel from the Military acting in a consulting role for the NTSB will conduct a quality review of the data and autopsy reports generated and initiate a force vector analysis. The force vector analysis will be a review of all the damage done to the victims thus far recovered in an attempt to determine and plot the various trajectories with which debris hit the bodies.

5

265A-NY-259028-SUB-FF2

11/19/96

[redacted] was advised of the interest of the FBI in being involved in this review. [redacted] informed that this would be welcomed. Previous steps have been taken to have an investigator from the squad involved with this process.

[redacted] was also interested in ensuring that the seats, seat backs, seat cushions, etc., were all thoroughly reviewed for any fragments of foreign objects that may be contained within. [redacted] recommended the utilization of an X-ray machine to conduct X-rays on all seat cushions, seat backs, etc., to ensure that any foreign objects are removed from these items.

[redacted] advised that foreign objects being removed by the medical examiners from the bodies of the victims have been provided tc the FBI.

Review of FD-192s discloses numerous green sheets reflecting foreign material being removed from victims' bodies. These bodies are being identified through a body number code. Per FD-192s, these are being stored at the hazardous material room at Grumman.

If not already done so:

Attempts should be made to identify the fragments removed from the bodies as to particular plane parts and areas. This will be particularly useful when trying to conduct trajectory analysis and determine the origin of forces..

- Identify seats recovered thus far by seat location, conduct X-ray of the seats to ensure that no fragments remain in them.

- X-ray seat cushions recovered. Is it possible to match seat cushions recovered with the seats from which they came? Are any cushions being recovered separated. If not, when they are separated are they referenced to the seat from where they came?

- Identify clothing recovered thus far through the body number. Examine this clothing for trajectory analysis, remaining debris, etc.

- Assign an investigator from the task force to work with the medical doctors in conducting this review and coordinating the flow of information needed to perform and complete force vector analysis as described above.

cc: 1 - SSA [redacted]
1 - SSA
1 - SA
1 - Det

b7C

(06/01/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: IMMEDIATE **Date:** 01/21/97

To: LABORATORY DIVISION **Attn:** SECTION CHIEF RANDALL MURCH/SSA [redacted] b7C

From: [redacted]
CALVERTON CP
Contact: 516-369-3313

Approved By: [redacted]

Drafted By: [redacted]

Case ID #: 265A-NY-259028-FF (Pending)

Title: UNSUB;
EXPLOSION OF TWA 800;
7/17/96
AOT-IT-EOD;
OO: NEW YORK

Synopsis: Notification of meeting at Boeing Corporation, Everett, Washington, to review status of Boeing overpressure analysis of B-747 center wing tank

Details: On Thursday, February 6, 1997, the Boeing Corporation will hold a meeting to review the status of Boeing overpressure analysis of the B-747 center wing tank. The meeting agenda is as follows:

Factory Visual (optional - limited number of people can be accommodated)	8:00-10:00
Official Meeting Start	10:00
Overpressure Analysis	
Introduction/Background	1/2-1 hr
Fuel/Air Explosion Physics	1 hr
Multi-Cell Compartments (Varied Ignition locations)	1/2-1 hr
Structural Analysis Status	1 hr

1-ADIC KALLSTROM
1-SAC O'NEILL
1-ASAC DOMROE
1-SSA [redacted]
1-SSA [redacted]

b7C

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED DATE 4-13-00 BY SPS/JC/PVN

265-NY-259028-285

FEDERAL BUREAU OF INVESTIGATION

To: ADIC, NEW YORK From: SA [redacted]

b7C

Re: 265A-NY-259028, 08/06/1996

SA [redacted] will attend as a representative from New York. SA [redacted] a Bureau Aircraft Accident Investigator, is one of two agents working in a liaison capacity with the National Transportation Safety Board (NTSB) and all of the parties participating in the investigation into the cause of the explosion and crash of TWA 800 on July 17, 1996. SA [redacted] will travel from the Phoenix Division to attend the above described meeting departing Phoenix late February 5 and returning on the evening of February 6, 1997.

It is requested that a representative from the FBI Laboratory attend the above meeting consistent with previous meetings concerning testing conducted to determine cause of the explosion and crash of TWA 800 July 17, 1997.

It is anticipated that the Boeing Corporation will furnish transportation to the meeting site in Everett, Washington from a hotel location near the Seattle-Tacoma International Airport. This information will be provided when it is obtained.

7-1 (Rev. 2-21-91)

FBI LABORATORY

SECRET

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

Date: April 25, 1997

To: ADIC, New York

FBI File No. 265A-NY-259028

Lab No. 61114052 S AD HK
70207064 S AD HK
70224039 S AD HK

Reference: Your communications dated February 6 and 19, 1997

Your No. 265A-NY-259028

Re: UNSUBS;
EXPLOSION OF TWA FLIGHT 800;
AOT-IT-EOD

Specimens received: February 7 and 24, 1997

Specimens received February 7, 1997 under cover of communication dated February 6, 1997 (70207064 S AD HK):

Q128 One piece of splatter material (your item #MM1 CW-504 LBL-104)

Q129 One piece of splatter material (your item #MM3 CW-504 LBL-106.72)

Q130 One piece of splatter material (your item #MM4 CW-504 LBL-106)

Q131 One piece of splatter material (your item #MM5 CW-114)

NE8 One blade

4-13-00
CLASSIFIED BY SDS/3KIN/[illegible]
REASON: 1.5 (C)
DECLASSIFY ON: X 1

265A-NY-259028-SUB FF 2

SEARCHED INDEXED SERIALIZED FILED
MAR 5 1997
FBI NEW YORK
[redacted]

[redacted] 4/7/1

Fax to SSA [redacted] Calnerten

b7C

(over)

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SECRET

OPCA-20 (12-3-96)

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FEDERAL BUREAU OF INVESTIGATION
FOIPA
DELETED PAGE INFORMATION SHEET

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☐ (b)(1)	☐ (b)(7)(A)	☐ (d)(5)
☐ (b)(2)	☐ (b)(7)(B)	☐ (j)(2)
☐ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
______	☐ (b)(7)(D)	☐ (k)(2)
______	☐ (b)(7)(E)	☐ (k)(3)
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☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
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265A-NY-259028-SUB FF2-7 pages 2 & 3

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FBI/DOJ

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE Date: 12/08/1997

To: New York Attn: ADIC JAMES KALLSTROM
SAC JOHN O'NEILL
ASAC PASQUALE DAMURO
SSA [redacted]
SA [redacted]
DET [redacted] b7c

From: New York
FBI Command Post, Calverton, New York
Contact: SA [redacted] b7c

Approved By: [redacted] SSRA

Drafted By: [redacted].pfr

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA 800;
7/17/96
AOT-IT-EOD;
00: NEW YORK

Synopsis: Incorporates the 185 items of 1B evidence submitted for laboratory analysis in the investigation of TWA Flight 800 into the case file.

Enclosures: Enclosed are folders documenting the identification, movement and analytical results of 185 items of 1B evidence submitted for laboratory analysis.

Details: A total of 185 items (items #1-#185) of 1B evidence were submitted for metallurgical and chemical analysis during the course of the investigation. The 1B numbers assigned to the 185 items of evidence submitted for analysis range from 1B9, the first item of evidence, through 1B 586 for items 184 and 185.

The laboratories that examined the 185 items of 1B evidence include FBI, NTSB, Brookhaven, DIA and Boeing.

Each enclosed folder for the 185 items of 1B evidence submitted for laboratory analysis contains photographs, electronic communications documenting the movement of the evidence, laboratory results and the FD-192 (green sheet).

Each folder provides a complete history of each item of evidence and should be made a permanent part of the case file 265A-NY-259028.

♦♦

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DATE 4-13-00 BY SPS/SC/PM

265A-NY-259028-SUB FF
SEARCHED ____ INDEXED ____
SERIALIZED ____ FILED ____
DEC 1997
FBI — NEW YORK
[redacted] TC b7c
9

b7C

Job Number 33986

Chemist [redacted] Date Received 01/23/97

* *

Company [redacted]
104 Arena Street
Williamsburg, VA
Zip 23185

PO PAID IN FULL
Project NEW CLIENT-PAID
Code
Date Sampled: / /

Technical Contact [redacted]

quote enclosed ____________

Phone [redacted]

Instructions Enclosed ____________

Retainer $ ________ Ck# ________

* * * * * * * WEST COAST ANALYTICAL SERVICE, INC. * * * * * * *

Sample Description: 1 Foam Rubber Sample

in baggie on log-in shelf ......
* Send report Fed-Ex ***

Group	No.	Analysis	Priority	Price Ea	Extension
IC	1	Perchlorate see c of c	7	[redacted]	[redacted]
OS	1	Emission Spectroscopy Sent to Spctrdn Cnsltnts	14	[redacted]	[redacted]

b2
b7E

Total [redacted]

01/23/97
14:06:00

January 31, 1997

b7C

[redacted]
104 Arena Street
Williamsburg, VA 23185

Attn: [redacted]

Job No: 33986 S

LABORATORY REPORT

Samples Received: One (1) Foam Rubber Sample
Date Received: 1-23-97
Purchase Order No: Paid In Full

The sample was analyzed as follows:

Samples Analyzed	Analysis	Page
One (1) sample	Perchlorate by IC	2
One (1) sample	Semiquantitative Analysis by Emission Spectroscopy Subcontracted to: Spectrodyne Consultants	3

[redacted] | [redacted] b7C

WEST COAST ANALYTICAL SERVICE, INC.

[redacted]

Job No: 33986 b7C
January 31, 1997

LABORATORY REPORT

Perchlorate by IC

IC Conditions

Column:	Dionex NS1 (with NG1 guard)
Eluent:	2 mM TBAOH*, 1 mM Na_2CO_3, 40% acetonitrile; 1.5 mL/min.
Inject. Vol.:	300 microliters
Detection:	Suppressed Conductivity

* - Tetrabutylammonium hydroxide

Approximately 0.05 g of the sample was extracted in 20 ml of 1 mM Na_2CO_3/0.38 mM $NaHCO_3$ buffer, with sonication for 30 min. A matrix spike was prepared by adding 1 ml of 100 ppm perchlorate stock with 19 ml of the buffer.

Sample ID	Parts Per Million (ug/g)
Foam Rubber w/ Orange Residue	ND
Detection Limit	40

Date Analyzed: 1-23-97

Matrix Spike Recovery Summary

Sample: Foam Rubber w/Orange Residue
Units: ppm (ug/g)

Analyte	Sample Result	Amount Spiked	MS Result	% Rec MS
Perchlorate	ND	2090	1940	93

QC Limits

Analyte	% Recovery
Perchlorate	60-140

WEST COAST ANALYTICAL SERVICE, INC.

[redacted]

Job No: 33986
January 31, 1997

b7C

LABORATORY REPORT

Semiquantitative Analysis by Emission Spectroscopy

Foam Rubber w/Orange Residue

Elements	Percent
Magnesium	18
Silicon	15
Calcium	12
Zinc	3.6
Iron	3.1
Aluminum	2.8
Lead	2.4
Titanium	1.7
Antimony	0.53
Nickel	0.38
Manganese	0.21
Boron	0.081
Copper	0.053
Silver	0.032
Chromium	0.032

Date Analyzed: 1-30-97

Note: Only 1 mg of sample was obtained. Some of it is probably the foam rubber.

Client: [redacted]

Job no.: 33986

b7C

Perchlorate by IC

IC Conditions

Column: Dionex NS1 (with NG1 guard)
Eluent: 2 mM TBAOH*, 1 mM Na2CO3, 40% acetonitrile, 1.5 mL/min.
Inject. Vol.: 300 microliters
Detection: Suppressed Conductivity

* - Tetrabutylammonium hydroxide

Approximately 0.05 g of the sample was extracted in 20 mL of 1 mM Na2CO3 / 0.38 mM NaHCO3 buffer, with sonication for 30 min. A matrix spike was prepared by diluting 1 ml of 100 ppm perchlorate plus a piece of the foam rubber sample with 19 mL of the buffer.

Parts Per Million (ug/g)

	Sample ID	
Analyte	Foam Rubber with Orange Residue	Detection Limit
Perchlorate	ND	40

Date Analyzed: 1/23/97
ND - Not Detected

Matrix Spike Recovery Summary

Sample:Foam Rubber
Matrix:Bicarbonate/Carbonate Buffer Extract

Analyte	Sample Result	Amount Spiked	MS Result	% Rec MS
Perchlorate	ND	2090	1940	93

ND - Not Detected

QC Limits

Analyte	% Recovery Warning		Control	
Perchlorate	80	120	60	140

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106 1/23/1997 perchlorate [redacted] b7C

1/23/1997 ~ 12:35 pm put perchlorate
Mob. Phase (w/ 40% ACN) on system
Col = NS1 SN 2210 Guard = NG1 SN 9653
put Suppressor SN 843 on System
start col flow w/ regenerant (oh SO4 anion regenerant) @ 1 pm
set He @ 14 psi 300 µl loop
1210 psi = col pressure BKgd = 10.1 µS

File	Job	Client	SAMPLE	Dilution
0123 001 .001			1/2 AS9 Buffer	1
.002			AUTOCHL 5K	1
.003			AUTOCHL 4K	1
.004			AUTOCHL 3K	1
.005			AUTOCHL 2K	1
.006			AUTOCHL 1K	1
.007			method bl	1
.008			5 ppm ICV	1
.009			H_2O	1
.010	33926	AEW	701717 01	1
.011	33953	"	701779 01	1
.012	33926	"	701717 01 MS	1.01
.013	"	"	" MSD	1.01
.014	33953	"	701779 01 MS	1.01
.015	"	"	" MSD	1.01
.016	33986	Sanders	Foam Buffer	444
.017	"	"	" MS	417
.018			5 ppm Std.	1
.019			H_2O	

PROJECT ClO4 on foam rubber

Notebook No.
Continued From Page START

33986 a piece of foam rubber
cut off 2 equal pieces

1 → 20 mL ½ strength AS 9 Eluent
2 → 1 mL 100 ppm perchlorate + 19 mL ½ strength AS 9 Eluent (MS)
Spike is @ 5 ppm

	mass g		
#1	0.0451	round off to 0.045 g	DF = 444
#2	0.0477	round off to 0.048 g	DF = 417

in ½ AS 9 buffer by 1:50 pm Sonicate 30 min

Continued on Page End

Read and Understood By

[redacted] 1/24/97 b7C

Signed Date Signed Date

Sample Name: 1/2 AS-9 BUFFER Date: 01/23/1997 13:23:50
Data File : C:\DX\DATA\ANIONS\01230011.D01
Method : C:\DX\METHOD\CLO4.met
ACI Address: 1 System: 1 Inject#: 1 Detector:CDM-1
Analyst : EC Column:

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	1950	5Hz	0.00	6.50	200

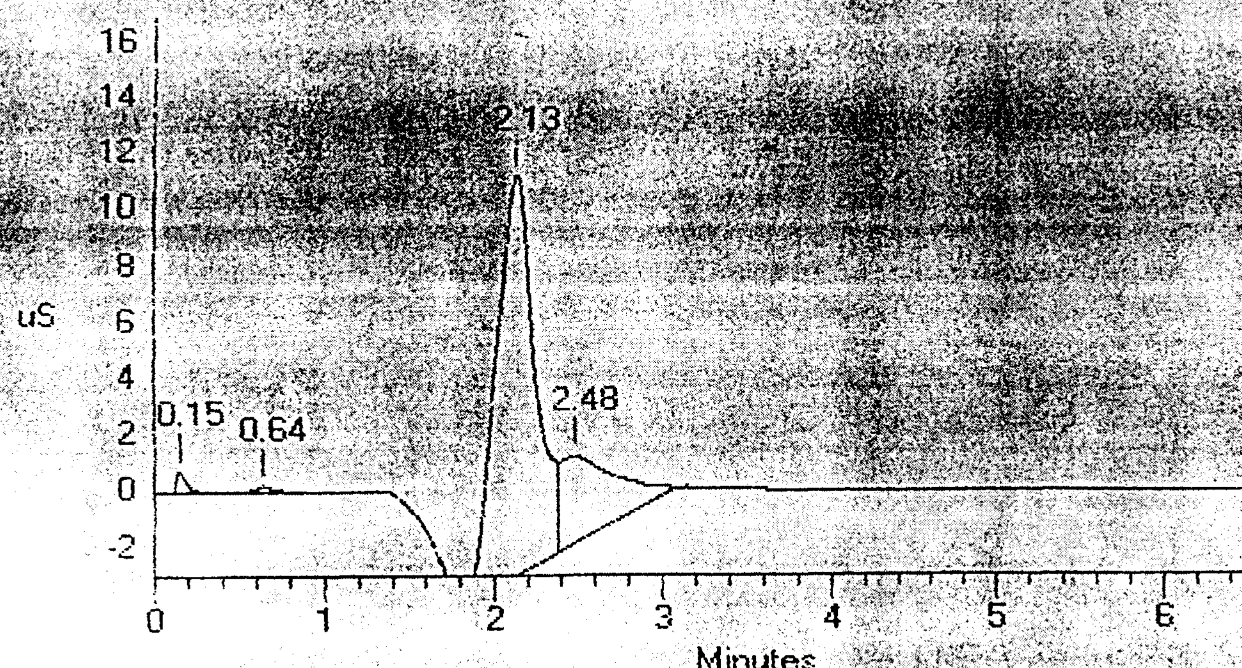
********************** Component Report: Components Found **********************

Pk. Num	Ret Time	Component Name	Concentration ppm	Height	Area	Bl. Code	%Delta
		Totals	0.000	0	0		

************************* Peak Report: Unknown Peaks *************************

Pk. Num	Ret Time	Component Name	Concentration ppm	Height	Area	Bl. Code	%Delta
1	0.15		0.000	759	3218	1	
2	0.64		0.000	224	1423	1	
3	2.13		0.000	14227	229220	2	
4	2.48		0.000	3074	66950	2	
		Totals	0.000	18284	300811		

File: 01230011.D01 Sample: 1/2 AS-9 BUFFER



Sample Name: AUTOCA[illegible]
Data File : C:\DX\DATA\ANION\X01230011.D06
Method : C:\DX\METHOD\CLO4.M[illegible]
AGI Address: 1 System: [illegible]
Analyst : EC Column: [illegible]

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	1950	5Hz	0.00	6.50	200

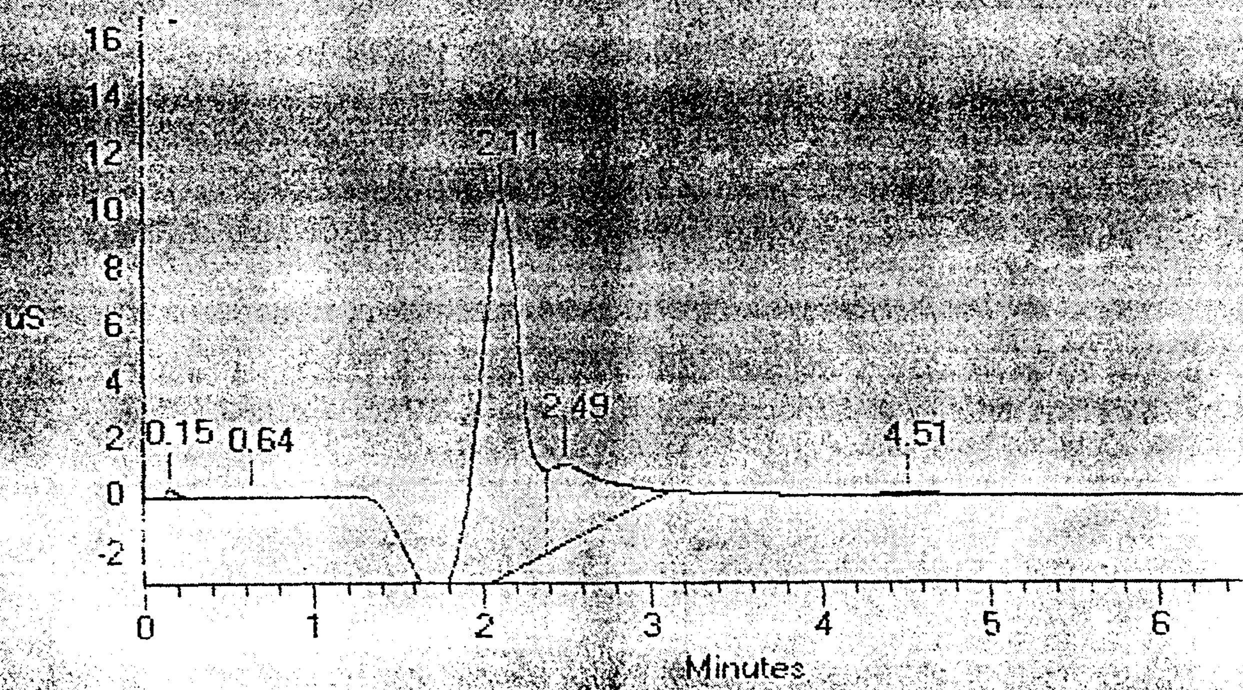
************************ Component Report : Components Found ************************

Pk Num	Ret Time	Component Name	Concentration ppm	Height	Area	Bl. Code	%Delta
5	4.51	CLO4	0.100	67	1469	1	-1.7[illegible]
		Totals	0.100	67	1469		

************************ Peak Report: Unknown Peaks ************************

Pk Num	Ret Time	Component Name	Concentration ppm	Height	Area	Bl. Code	%Delta
1	0.15		0.000	34[illegible]	1[illegible]80	1	
2	0.64		0.000	[illegible]	325	1	
3	2.11		0.000	13230	233797	2	
4	2.49		0.000	2754	65158	2	
		Totals	0.000	16420	300959		

File: 01230011.D06 Sample: AUTOCAL1R



5

| Sample Name: 33986 F[illegible]M RUBBER Date 01/23/1997 15:43:09
| Data File : C:\DX\DATA\ANIONS\01230011.D16
| Method : C:\DX\METHOD\CLO4.met
| ACI Address: 1 System: 1 Inject#: 16 Detector:CDM-1
| Analyst : EC Column:

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	444	1950	5Hz	0.00	6.50	200

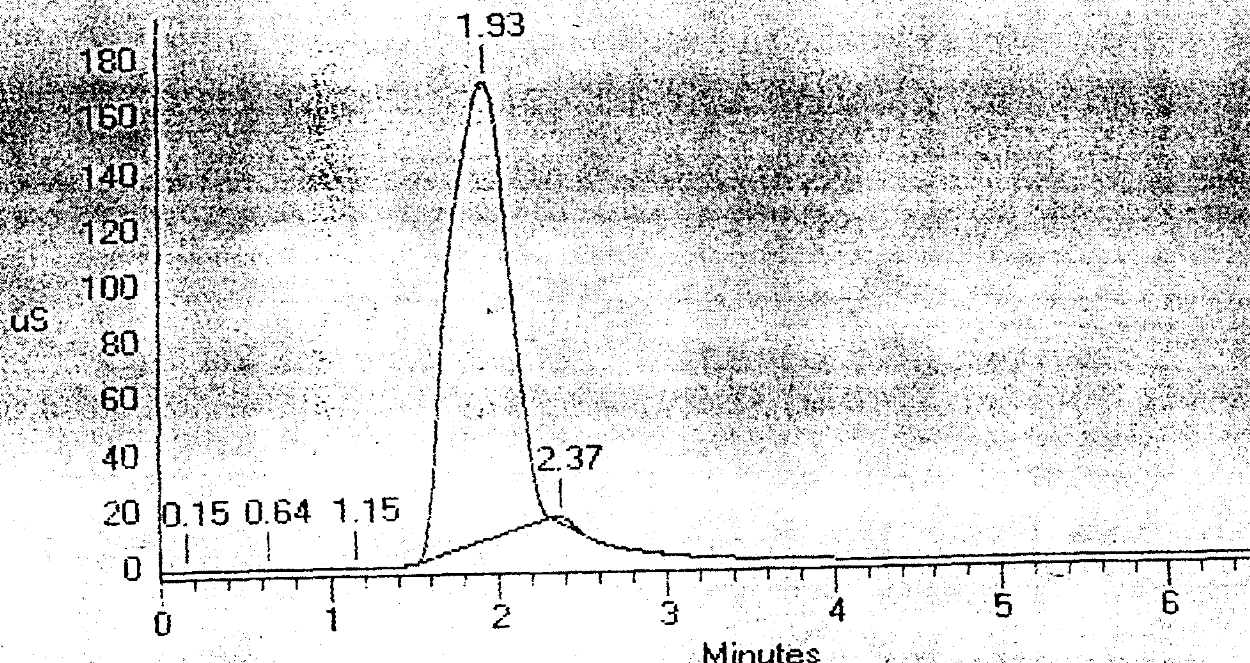
********************** Component Repor[illegible]: Components Found ********************

Pk. Num	Ret Time	Component Name	Concentration ppm	Height	Area	Bl. Code	%Delt[illegible]
		Totals	0.000	0	0		

************************* Peak Report: Unknown Peaks **********************

Pk. Num	Ret Time	Component Name	Concentration ppm	Height	Area	Bl. Code	%Del[illegible]
1	0.15		0.000	156	875	1	
2	0.64		0.000	50	384	1	
3	1.15		0.000	181	1501	1	
4	1.93		0.000	162529	3951655	1	
5	2.37		0.000	1582	13657	1	
		Totals	0.000	164497	3968472		

File: 01230011.D16 Sample: 33986 FOAM RUBBER



\2

| Sample Name: 33986 F[illegible] RUBBER MS   Date: [illegible]
| Data File   : C:\DX\DATA\ANIONS\01230011.D17
| Method   : C:\DX\METHOD\CL04.met
| ACI Address: 1 System: 1 Inject#: 17   Detector:CDM-1
| Analyst   : EC   Column:

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	417	1950	5Hz	0.00	6.50	200

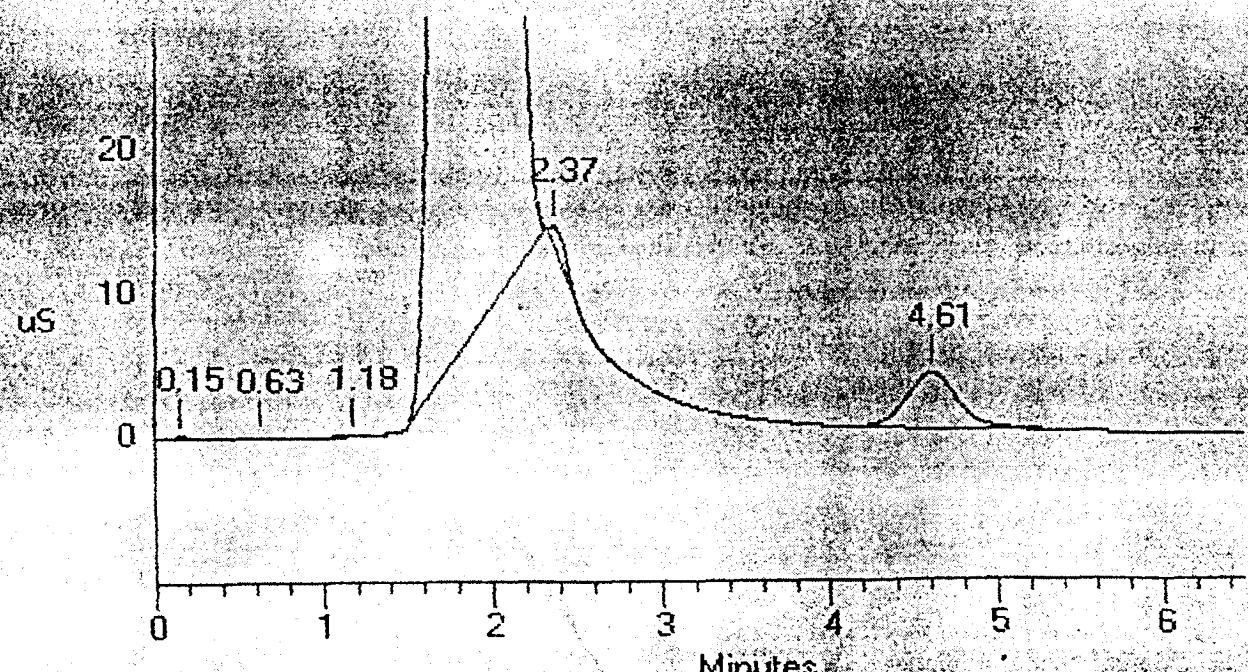
Component Report: Components Found

Pk. Num	Ret Time	Component Name	Concentration ppm	Height	Area	Bl. Code	%Delta
6	4.61	CL04	1939.986	3890	84541	1	2.22
		Totals	1939.986	3890	84541		

Peak Report: Unknown Peaks

Pk. Num	Ret Time	Component Name	Concentration ppm	Height	Area	Bl. Code	%Delta
1	0.15		0.000	115	449	1	
2	0.63		0.000	63	435	1	
3	1.18		0.000	73	745	1	
4	1.92		0.000	144480	3392034	1	
5	2.37		0.000	1440	11965	1	
		Totals	0.000	146170	3405628		

File: 01230011.D17 Sample: 33986 FOAM RUBBER MS



Sample Name: 5 PPM STD Date: 01/23/1997 16:01:46
Data File : C:\DX\DATA\ANIONS\01230011.D18
Method : C:\DX\METHOD\CLO4.met Detector:CDM-1
ACI Address: 1 System: 1 Inject#: 18
Analyst : EC Column:

Calibration	Volume	Dilution	Points	Rate	Start	Stop	Area Reject
External	1	1	1950	5Hz	0.00	6.50	200

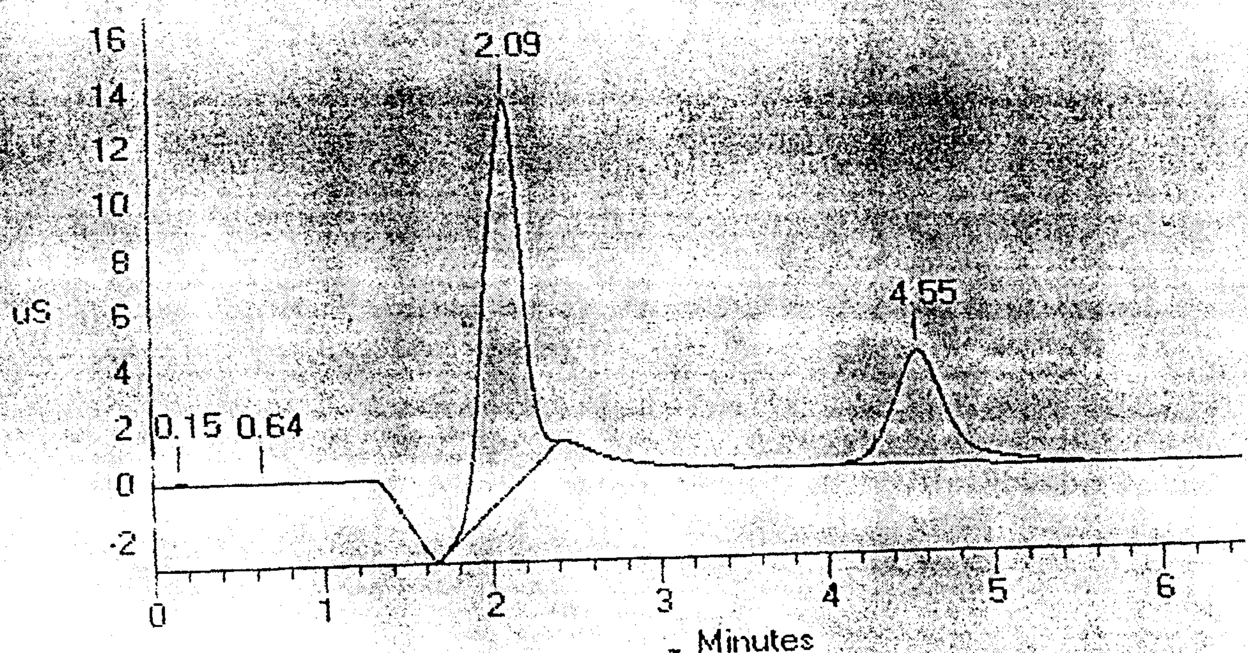
********************** Component Report: Components Found ******************

Pk. Num	Ret Time	Component Name	Concentration ppm	Height	Area	Bl. Code	%Delt
4	4.55	CLO4	4.983	3947	90902	1	0.8
		Totals	4.983	3947	90902		

************************ Peak Report: Unknown Peaks ************************

Pk. Num	Ret Time	Component Name	Concentration ppm	Height	Area	Bl. Code	%Delt
1	0.15		0.000	157	971	1	
2	0.64		0.000	54	401	1	
3	2.09		0.000	13998	213074	1	
		Totals	0.000	14210	214446		

File: 01230011.D18 Sample: 5 PPM STD



8

FEDERAL BUREAU OF INVESTIGATION

FREEDOM OF INFORMATION/PRIVACY ACTS SECTION

COVER SHEET

SUBJECT: TWA FLIGHT 800

MEDAL EDGE ANALYSIS

SECRET

265A-NY-259028

TWA Flight 800

Brookhaven National Laboratory Examinations

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SA [redacted]
SA [redacted]

December 1, 1997

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FEDERAL BUREAU OF INVESTIGATION
TWA Flight 800, Case 265A-NY-259028
Naval Weapons Industrial Reserve Plant
Calverton, New York

TWA Flight 800 Brookhaven National Laboratory Examinations

Date of Report: December 1, 1997

EXECUTIVE SUMMARY

Brookhaven National Laboratory was asked by the FBI to assist in the Trans World Airlines (TWA) Flight 800 investigation by providing scientific support. Its scientists graciously donated both expert advice and laboratory examinations of several evidence items.

Selected debris items and impact sites on the wreckage of TWA 800 that exhibited possible high energy characteristics were submitted to Brookhaven scientists for microscopic examination and chemical identification. No damage, characteristics, or material compositions were found to indicate the presence of non-TWA Flight 800 or weapons related material.

PROJECT CONTRIBUTORS

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BACKGROUND

It became apparent by the end of November 1996, about four months into the FBI's criminal investigation, that no aircraft debris recovered to that time had clear indicia of a high explosive event, although evidence recovery (i.e. ocean trawling for aircraft debris) and subsequent examination by bomb technicians for such indicia was continuing. In the face of no "classic" explosive artifacts,[1] little forensic documentation or guidance on large-body aircraft missile engagements, and no supportable mechanical or operational explanation for the crash of Trans World Airlines (TWA) Flight 800, FBI management decided that "...any investigative or scientific avenue that was reasonable and which could assist in providing a factual cause of the incident should and would be pursued."[2]

To supplement the already extensive scientific effort the FBI Laboratory was applying

[1]Bomb technicians and FBI Laboratory scientists often cited, based on their experiences, the associated presence of variable-depth surface pitting, melting, penetrations, spalling, and hot gas impingement as examples of classic explosive artifacts.

[2]FBI New York Electronic Communication by SSRA [redacted] January 7,1997, case file 265A-NY-259028 serial 1186.

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to the investigation, provide scientific peer review and a fresh perspective, and to have access to a nearby federal government facility with materials science experts capable of performing advanced imaging examinations in short turnaround, Brookhaven National Laboratory (BNL) was approached for assistance, resulting in a favorable response.[3] The NTSB and FBI Laboratory concurred with FBI New York Office's proposed utilization of BNL and participated in several meetings with BNL scientific staff during January and February 1997 held at both the Director's Office, BNL, and Hangar Six, Naval Weapons Industrial Reserve Plant, Calverton, New York (Calverton facility). During these meetings, participating BNL scientists were briefed on the investigation, introduced to FBI and NTSB investigators, and advised investigators on the scientific capabilities of their labs, offering gratis support that resulted in the efforts reported herein.[4]

At Calverton, the scientists were briefed on, among other topics, the evidence recovery, debris identification and placement, reconstruction projects, scientific observations, and NTSB's crash sequence theory. They were escorted through the TWA 800 debris and reconstruction projects.

Three projects ultimately resulted from this collaboration: metallurgical peer review of the wing center section failure assessment, chemical analysis of an unknown "splattered" material, and examinations of selected evidence items for indicia of high energy penetration. The scientists' project reports are at Attachments (1), (2), (3), and (4).

The cursory metallurgical peer review was conducted by [redacted] Department of Advanced Technology, BNL. His task was to provide an unbiased review of metallurgical findings. No analysis or microscopic examinations were conducted. [redacted] memorandum, Attachment (1), is self-explanatory and will not be addressed further. b7C

The unknown "splatter" material was found at various locations on the top of the wing center section. This location was significant because of the early role the wing center section had in NTSB's sequence theory.[5] Several specimens were taken for analysis by NTSB and

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[3]December 1996 meeting between Senior Supervisory Resident Agent [redacted] FBI; Special Agent [redacted] FBI; and [redacted] Planning and Policy, Brookhaven National Laboratory. b7C

[4]As a preface to discussions about the investigation, BNL personnel were informed of the sensitivity of the case regarding possible criminal prosecution and civil litigation. They agreed to restrict discussion and dissemination of related subject matter to those involved in the investigation. None of the non-government NTSB party members (e.g. Boeing, TWA) were involved in the BNL activities.

[5]NTSB's sequence theory points to the ignition of the fuel-air mixture in the center wing tank, part of the wing center section, as the event that led to the catastrophic airframe failure. The ignition source is as of the date of this report unknown. See NTSB Metallurgy/Structures Sequencing Report 97-38. As of the date of this report, NTSB was still studying the relationship and implication the splatter material had to the overall mishap

the FBI, one of which was submitted to [redacted] National Synchrotron Light Source, BNL. Once a preliminary chemical identification was done, several control specimens from known aircraft structure were submitted for comparison. [redacted] report, Attachment (2), comprehensively documents his analysis and will not be addressed further. b7C

[redacted] conducted materials science examinations, primarily looking for high energy penetrations.[6] The interest in high energy penetrations stemmed from the development of several hypotheses of criminally initiated events that might have accounted for the lack of a classic explosive signature. Among these hypotheses were the possibilities that a missile warhead detonated at some distance external to the TWA 800 airframe, resulting in only a few warhead fragment penetrations of the aircraft, or that an explosive device detonated in or on the aircraft but the explosive signature was, for some reason, masked or attenuated. If either of those scenarios were true, then the evidence of an explosive fragment penetration--amongst the myriad penetration sites throughout the airframe--might be discovered under microscopic examination.

[redacted] first examination was on a non-TWA 800 penetration site that Boeing made by firing a steel projectile through an aluminum alloy plate. [redacted] examination revealed a presence of steel, apparently transferred to the aluminum plate by the steel projectile, anecdotally supporting the possibility of discovering microscopic material from a penetrator in a penetration site. Her report, Examination of the Boeing Test Sample: The Fracture Surface of Al 2024 Alloy Following Penetration by Steel Projectile @ 3000 ft s^{-1} is at Attachment (3). b7C

Subsequently, two evidence items associated with the TWA 800 debris were submitted to [redacted] for examination because of their damage features. FBI evidence item 1B-377 was a penetration site in the vicinity of the L3 door. It appeared to have been made by a penetration directed into the fuselage. As well, the surrounding fuselage skin had various degrees of scraping, dimpling, and fracturing. The area was examined by FBI bomb technicians, yielded no identification of an explosive signature, so the site was cut from the fuselage and submitted to [redacted] whose report is at Attachment (4). b7C

The other item of intriguing appearance was 1B-423. This piece was recovered during trawling. There was no way to confirm that it came from the TWA 800 aircraft, but bomb technicians pulled the item aside because of its spike-feature fractures. To discover the item's composition and to search for possible transferred material, it was subjected to microscopic examination by [redacted]

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sequence.

[6]High energy in this context denotes a penetrant of such mass and/or velocity sufficient to leave certain characteristics in the penetration site, such as those identified in [redacted] Boeing Test Sample report at Attachment (3). b7C

Two other items, 1B-410 and -28, were submitted for identification because of their dissimilarity in appearance with TWA 800 debris, not for any particular damage features. This examination was an attempt to discover any probative characteristics in the material and was performed by BNL because of their close proximity to Calverton and fast turnaround.

METHOD

All items were tracked and documented as evidence. Unknown evidence items submitted for examination remained in the custody of SA [redacted]throughout. Items of known identity or samples extracted from an item were released into the custody of Brookhaven personnel only when necessary. The following four items were examined by [redacted]Materials Science, BNL:[7] b7C

1B-28

This item, one of 20 similar pieces removed during autopsy of Suffolk County Medical Examiner's case [redacted] was approximately 5mm in diameter and charcoal colored. The item was polished and then subjected to an energy dispersive spectrometer (EDS) analysis to determine its chemical composition. b7C b7D b6

1B-377

The item was a 5 x 5 cm square piece with a penetration at its center, cut from the fuselage aft of the L3 door. EDS analyses were performed on both of its fracture surfaces, the external coated areas, and indentations. The item was also analyzed using a synchrontron x-ray fluorescence microprobe.

1B-410

The item was a sliver of grey uncoated material that was submitted to BNL for an EDS analysis. No further tests were required.

1B-423

Item 1B-423 was transported to BNL for testing. An EDS analysis was performed on three areas: the spike-feature fracture surface, the green colored area, and the base of the "teeth" at some apparently melted areas. A small piece was cut from 1B-423 and mounted in an epoxy resin to facilitate alloy identification. This cut piece was released into [redacted] b7C

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[7]Attachment (4), Materials Analyses of Samples from TWA Flight 800.

custody and subsequently returned to the FBI.

The cut piece of 1B-423 was later [redacted] (S)

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SA [redacted] conducted an investigation to determine probable airframe sources of item 1B-423. His efforts are delineated in the Analysis/Conclusion section.

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FACTUAL RESULTS

See attached reports.

ANALYSIS/CONCLUSION

All items, excepting 1B-423, were satisfactorily discussed in the BNL reports. No probative characteristics were discovered. The origin of item 1B-423 remained inconclusive after initial BNL testing, however.

In an effort to locate possible material matches to item 1B-423, a preliminary survey was conducted of all engine debris. On September 18, 1997, a conference call was held between SA [redacted] of Pratt and Whitney Aircraft. [redacted] provided information concerning the use of titanium compounds in airline engines, suggesting engine blades, engine casings, and fuel impeller pumps as possible sources. Following this conference call, [redacted] sent a copy of a fuel pump schematic to SA [redacted] indicating the location of a fuel pump impeller. An exhaustive search of the engine debris from TWA Flight 800 was then conducted in an attempt to isolate all metals with compositions similar to 1B-423. Each section of debris was examined for the following characteristics: color, weight, texture, damage indicia (such as fracture types and spike-feature damage), and possible signs of corrosion or oxidation.

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On October 6, 1997 a [redacted] of Pratt and Whitney Aircraft spoke with SA [redacted] by telephone and provided further information concerning the use of titanium compounds. He stated that the fuel pumps on this type of airplane engine would not contain titanium and would more likely be made of mostly aluminum parts. The blades of the

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[8]See memorandum (not attached) dated September 29, 1997, by [redacted] Defensive Systems Office, Missile and Space Intelligence Center, Defense Intelligence Agency, and supporting documents. This report is on file under Metallurgical Analyses, DIA.

engine were suggested as possible matches to item 1B-423. He further stated that other areas of the airplane could also contain titanium compounds, such as the hydraulic or pneumatic pumps.

A total of fourteen different pieces were selected from the engine debris as having a similar appearance to 1B-423. On October 3, 1997, a sample was taken of each piece, assigned an item number and presented to [redacted] BNL, for composition comparison with 1B-423. The fourteen samples were as follows: b7C

1) 1B-572, item 167, a grey metal piece approximately 3.0cm x 1.5 cm x .5 cm., taken from the casing of a fuel pump.

2) 1B-573, item 171, a silver and grey metal piece, 1.5cm x .5cm x .4cm, taken from an apparent engine support strut.

3) 1B-573, item 172, a silver and green colored metal piece, approximately 1.0cm x .5cm x .4 cm taken from the casing of an engine.

4) 1B573, item 173, a green and grey metal piece, 1.5cm x .75cm x .5cm, taken from an engine propeller blade, which came from engine number four.

5) 1B573, item 174, a green metal piece approximately .6cm x .5cm x .3cm, taken from an engine propeller blade, which possibly came from engine number three

6) 1B573, item 175, a silver colored piece of metal approximately 1.0cm x .6 cm x .2cm, taken from an engine propeller blade, which possibly came from engine number three.

7) 1B573, item 176, a silver colored piece of metal, approximately 2.5cm x .5cm x .2cm, taken from and engine blade, which possibly came from engine number one.

8) 1B573, item 177, a grey and green metal piece approximately .6cm x .5cm x.3cm, taken from an engine blade mount, which possibly came from engine number three.

9) 1B573, item 178, a grey and green metal piece approximately 1.0cm x 1.0cm x .75cm taken from an engine blade, which possibly came from engine number four.

10) 1B573, item 179, a silver and grey metal piece approximately .75cm x .4cm x .2cm taken from an engine blade mount, which possibly came from engine number four.

11) 1B574, item 180, a green and grey metal piece approximately 1.2cm x 1.0 cm x .2cm taken from the casing of engine number four.

12) 1B574, item 181, a green and grey metal piece taken from an outer engine ring from engine number three, approximately 1.1cm x .5cm x .2cm.

13) 1B574, item 182, a green and grey metal piece, approximately .5cm x .75cm x .4cm, taken from a ring near the rear of engine number two.

14) 1B574, item 183, a green and grey metal piece approximately 1.0cm x .5cm x .25cm, taken from a large tube-shaped support.

These samples were examined using EDS in the same manner as item 1B-423. Two of the samples (Item 181 and Item 183) were found to have compositions of Ti-6.2Al-2.7Sn, which is consistent with AMS 49XX series alloys and most probably the same material as item 1B-423.[9]

On October 31, 1997 [redacted] Pratt and Whitney Aircraft, stated during a telephone conversation with SA [redacted] that AMS 4966 was used in the engines of TWA Flight 800 for various parts, two of which were the engine rings and radial supports. He provided fax copies of the Pratt & Whitney Parts Catalog, which indicated the location of these parts. Theses schematics also match the locations from which Items 181 and 183 were taken. b7C

Based on the probable composition match described above, it is a reasonable conclusion that item 1B-423 was from a TWA Flight 800 aircraft engine.

ATTACHMENTS

(1) October 27, 1997 memorandum by [redacted] Department of Advanced Technology, Environmental and Waste Technology Center, Brookhaven National Laboratory. b7C

(2) Report of Infrared Microscopic Analysis of Items # 62 and MM7, by [redacted] National Synchrotron Light Source, Brookhaven National Laboratory.

(3) Examination of the Boeing Test Sample: The Fracture Surface of Al 2024 Alloy Following Penetration by Steel Projectile @ 3000 ft s^{-1}, by [redacted] et al.

(4) Materials Analyses of Samples from TWA Flight 800 and Appendix I, by [redacted]

[9]See Attachment (4), Appendix I.

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October 27, 1997 memorandum by [redacted] Department of Advanced Technology, Environmental and Waste Technology Center, Brookhaven National Laboratory

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ATTACHMENT 1

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BROOKHAVEN NATIONAL LABORATORY

MEMORANDUM

Department of Advanced Technology
Environmental & Waste Technology Center

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DATE: October 8, 1997, **Revised October 27, 1997**

TO: [redacted]

FROM: [redacted]

SUBJECT: Flight 800 Review [redacted]

As previously discussed in my May 2, 1997 memorandum to you (attached), here are my impressions and observations regarding the Flight 800 investigations:

1) All of the personnel that I have interacted with during my review (either FBI or NTSB) have been competent, capable and dedicated to determining the cause of the aircraft disaster.

2) My review consisted of a walk-through at the hanger, inspection of wreckage and evaluation of the data and test results that have been generated to date. The following documentation was reviewed:

A) NTSB - Metallurgist's Factual Report No.97-81, dated April 29, 1997.
B) NTSB - Metallurgist's Factual Report No.97-82, dated April 22, 1997.
C) NTSB- Metallurgist's Factual Report No.97-85, dated May 2, 1997.
D) NTSB- Metallurgy/Structures Sequencing Report No.97-38, dated April 8,1997.

3) After reviewing the generated data, I re-inspected the wreckage for sequencing of events.

4) Observations and review of the aforementioned documents are consistent with the NTSB appraisal that the blast initiated in the center fuel tank area, somewhere in the vicinity of spanwise beams 1 and 2. The extensive reconstruction of the plane and detailed mapping of the recovered components substantiate this hypothesis.

5) Comparison of the recovered pieces to metal having received the blast of a missile, tend to significantly diminish the theory that the plane was shot down by a missile.

6) The apparent directionality of the blast did cause me some initial consternation. There did not appear to be any significant structural weakness or flaw that would induce the resultant fuel tank expansion in a "forward-port" direction. I am not an explosives expert by any means, but it seemed to me that a tank would have a tendency to blow outward in a more omni-directional mode after the appropriate pressure had built up upon ignition. This did not, by observation, appear to be the case. I have since had discussions with one of the BNL combustion/explosion experts and he assured me that the point of ignition for the incident could have been in a different location than the area where the explosion occured. So...

In conclusion, it appears that although a thorough and comprehensive evaluation has been performed by all parties involved, only the location of the explosion is reasonably fixed, while the cause of the explosion is still an open issue (mechanical failure, pre-meditated induced failure, etc.).

cc: [redacted] b7C

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Report of Infrared Microscopic Analysis of Items # 62 and MM7, by [redacted] National Synchrotron Light Source, Brookhaven National Laboratory

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ATTACHMENT 2

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Report of Infrared Microscopic Analysis of Items #62 and MM7

[redacted] National Synchrotron Light Source
Brookhaven National Laboratory, Upton, NY 11973

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Summary overview

Small quantities of material from the TWA 800 flight aircraft were brought to the NSLS by FBI Agent [redacted] The intention was to identify materials or correlate unknown materials from one category with known materials from another category. Two groups of evidence materials were investigated, one (item 62) from known aircraft components, the other (item MM7) of unknown origin.

Infrared spectroscopy measurements were performed to compare materials from each item. Spectra for the main constituent of item MM7 (a rubbery / elastic material) were found to match spectra taken from a foam-like material of item 62. Spectra were also take from what appeared to be fine glass-like fibers imbedded in the foam of item MM7, and compared to glass-like fibers from item 62. A good match was not obtained, possibly due to differences in the fiber diameters between the two item categories (smaller for item MM7).

Infrared microspectroscopy

Infrared microspectroscopy is a non-contact, non-destructive method for characterizing the chemical content of small specimens. The particular spectral range spans wavelengths from 2.5 microns out to nearly 20 microns. This corresponds to the frequency range (measured in wavenumbers, the inverse of the wavelength in cm) from 500 cm^{-1} to 4000 cm^{-1}. These frequencies match many of the bending or stretching vibrations that occur in complex organic (and inorganic) materials, leading to the absorption of light. Since some of these vibrational frequencies vary with even small changes in molecular structure, a mid-infrared absorbance spectrum can be a sort of "molecular-fingerprint" of a material. When spectroscopy is combined with microscope optics, small sample areas can be isolated and measured. The high brightness synchrotron infrared source allows specimens just a few microns in size to be measured.

The measurements reported here were performed using both a conventional infrared source and also with the synchrotron source. The latter proved to be important for obtaining good quality spectra from the small glass-like fibers, which were only ~ 3 microns in diameter.

Evidence items - visual description

Item 62 was described as a selection of material from known systems of the aircraft, i.e., their source location was understood. The selection contained irregularly shaped pieces of a soft, porous, foam-like material ("bulk foam") and a thin, semi-rigid, layered material composed of a foam layer ("layer foam") attached to a fiberglass-epoxy composite structure ("epoxy material" and "glass fibers"). The bulk foam and foam layer were both a light yellowish brown in color with the latter darkened in places. The epoxy was more yellow in color. Partially imbedded in the epoxy material were thin glass-like fibers, arranged in a square weave pattern.

Item MM7 was described as material of unknown origin. It consisted of small millimeter-sized) pieces of a heterogeneous rubbery/elastic material formed into an interconnected network.

The color ranged from yellow-brown to nearly black, giving the impression of fire or heat exposure. Small white polycrystalline grains were occasionally found imbedded in the material, as well as a few glass-like fibers.

Microspectroscopy method

Infrared spectra were obtained from the materials of items 62 and MM7. In most cases, a small section of material was squeezed between clean sections of KBr windows to provide a sample thin enough for a transmission measurement. The samples were translucent, and sample regions were chosen that had no evidence of inhomogeneity. Actual thicknesses were not measured or recorded, but were estimated at about 5 microns. Reference spectra were collected through clean areas of the KBr windows. The transmission data for all materials, except the glass-like fibers, were converted into absorbance units. Spectra for the reference materials of item 62 are shown individually in figures 1-4. Spectra were typically recorded for several locations in one type of specimen. The foam layer material had blackened regions, which was assumed due to the charring effects of exposure to fire, and a spectrum from both light and blackened regions were collected (see Figure 2).

Data: visual images and infrared spectra

Item 62 - reference specimens

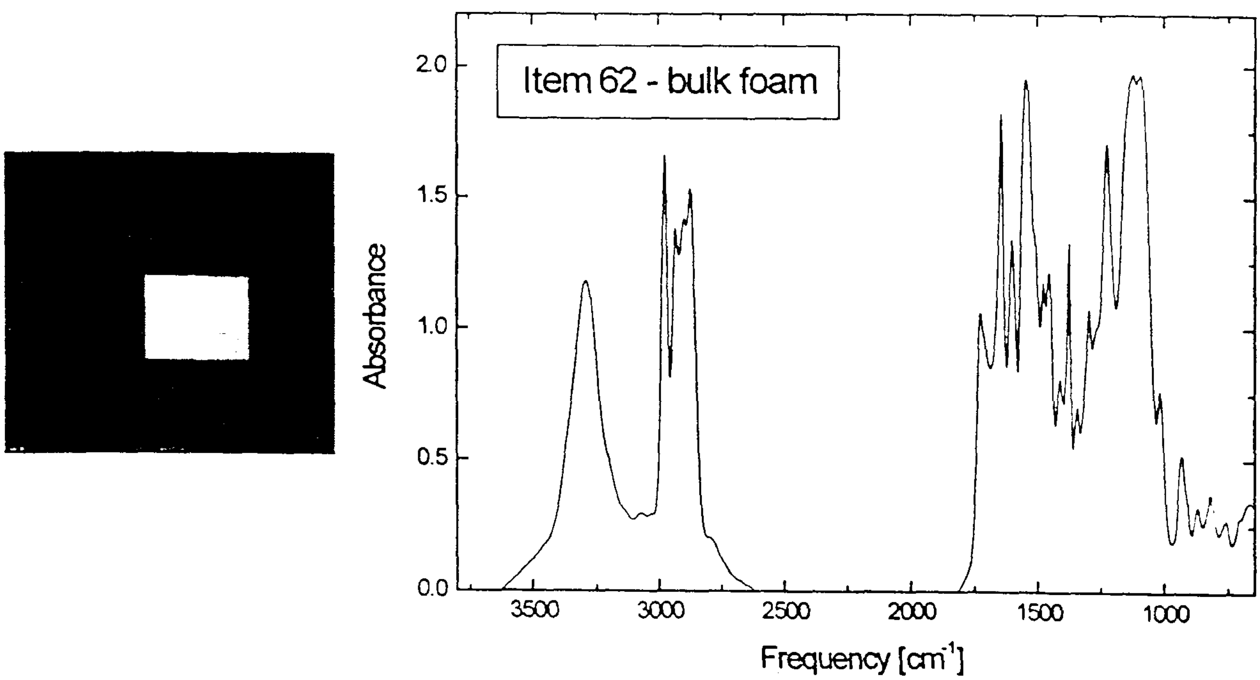

Figure 1: (Left) Visual image of a bulk foam section from item 62, pressed between KBr plates. The foam material is translucent, and occupies the region bordered by irregular dark margin. The highlighted rectangular region represents the 45 micron by 60 micron area probed with the infrared microspectrometer. (Right) Infrared absorbance spectrum from the bulk foam section of item 62.

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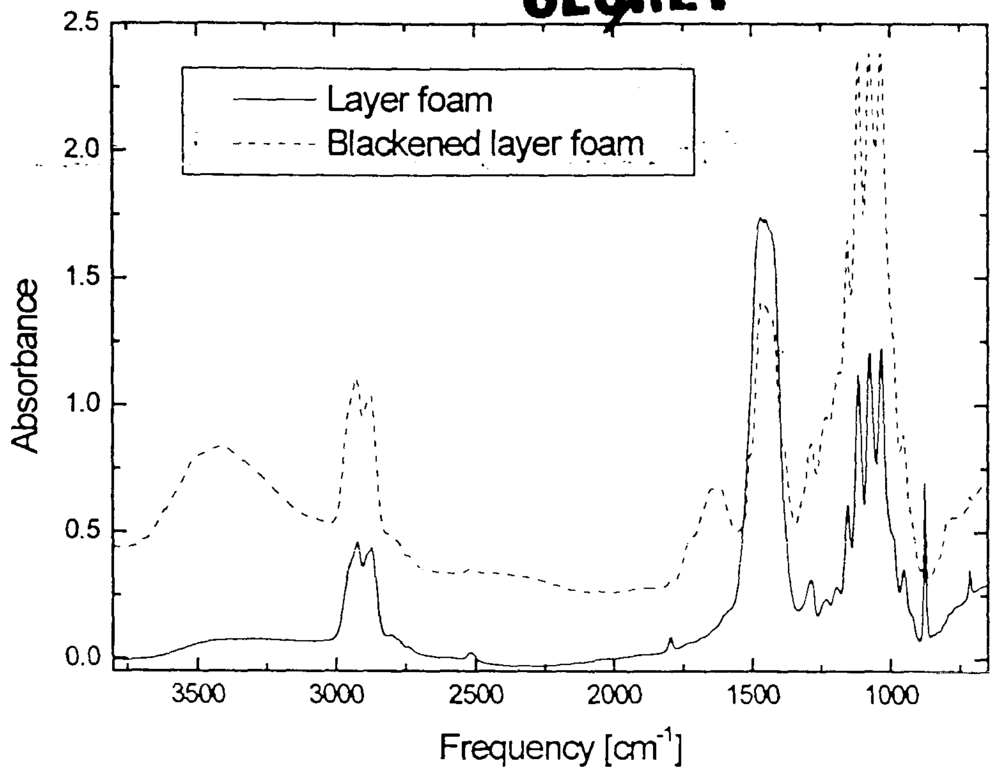

Figure 2: Item 62 - absorbance spectra of the thin layer foam material, both light brown and darkened regions

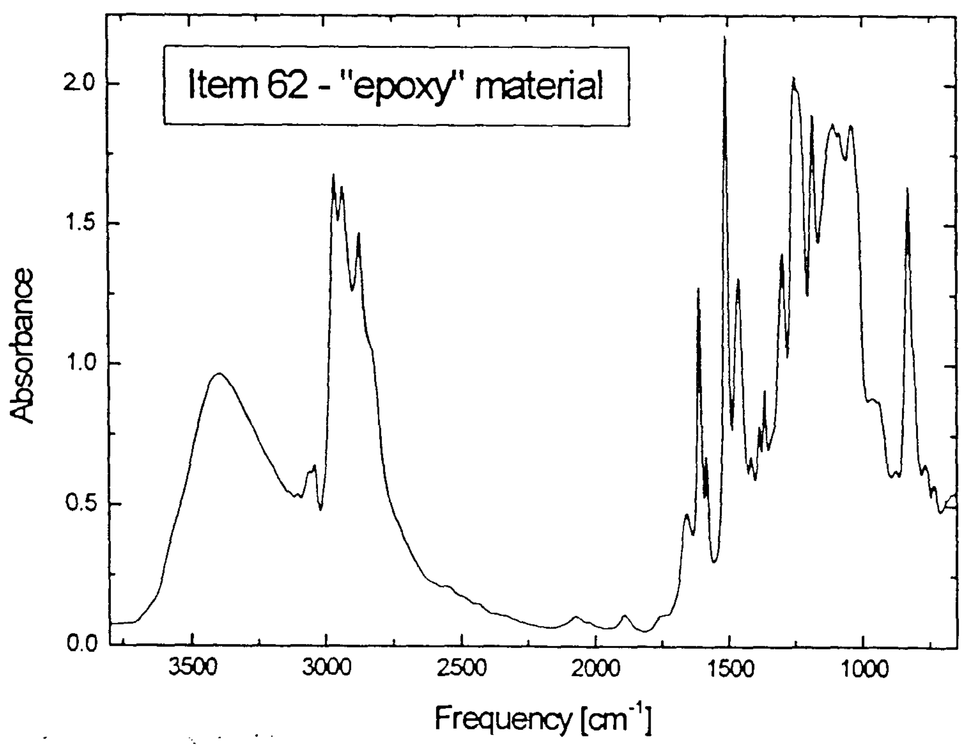

Figure 3: Item 62 - absorbance spectra from the epoxy-like material.

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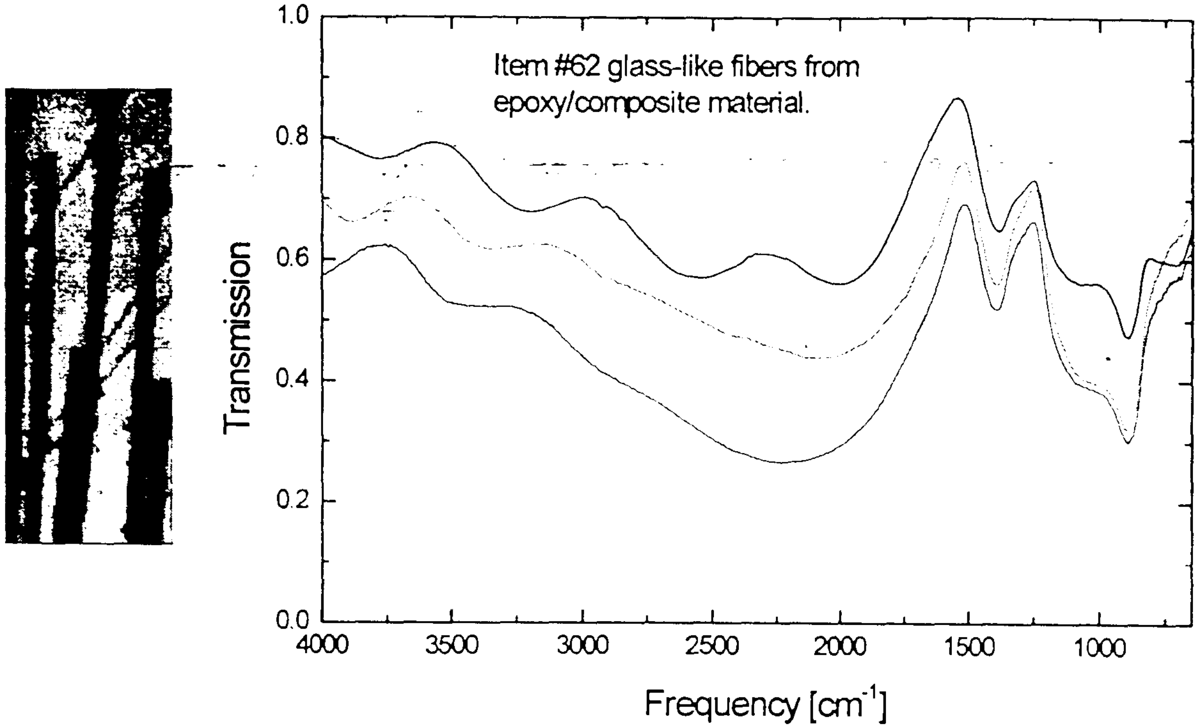

Figure 4: Optical image of item 62 glass-like fibers (left), and transmission spectra for several such fibers from item 62. Three measurements of different fiber locations were performed to check reproducibility.

Item MM7 specimens

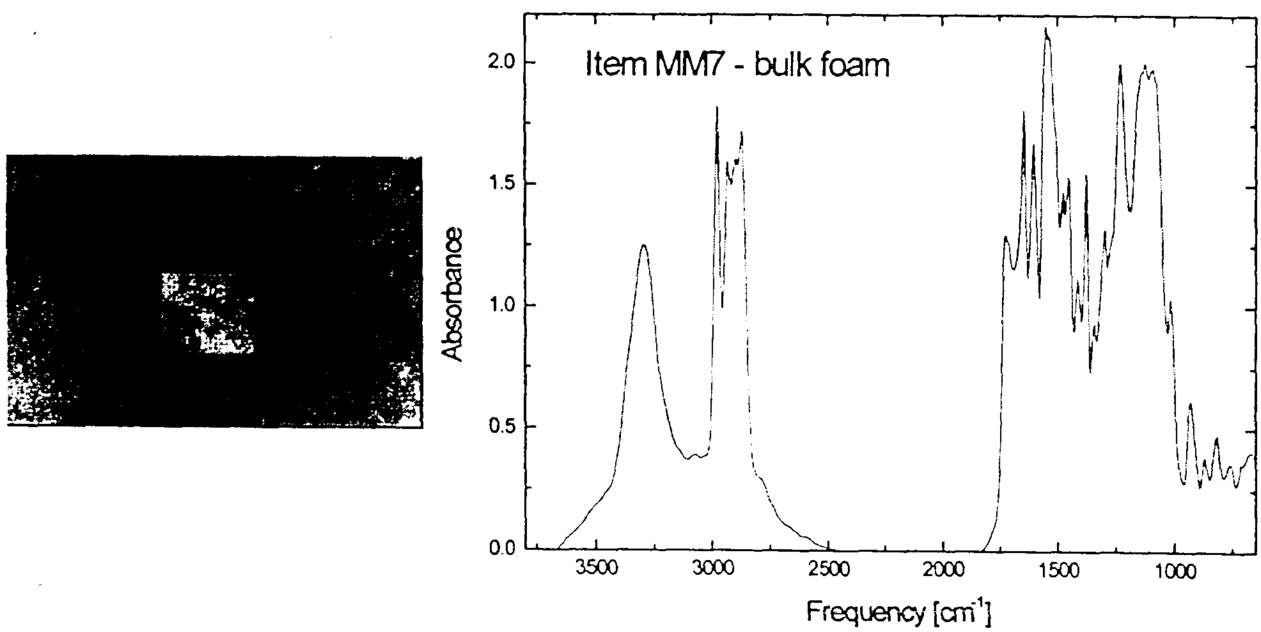

Figure 5: Optical image (left) and absorbance spectra (right) of compressed light brown foam material of item MM7. The highlighted area of the optical image shows the area probed with the infrared.

Spectra from other portions of the foam material, though darker in color, yielded nearly identical spectra..

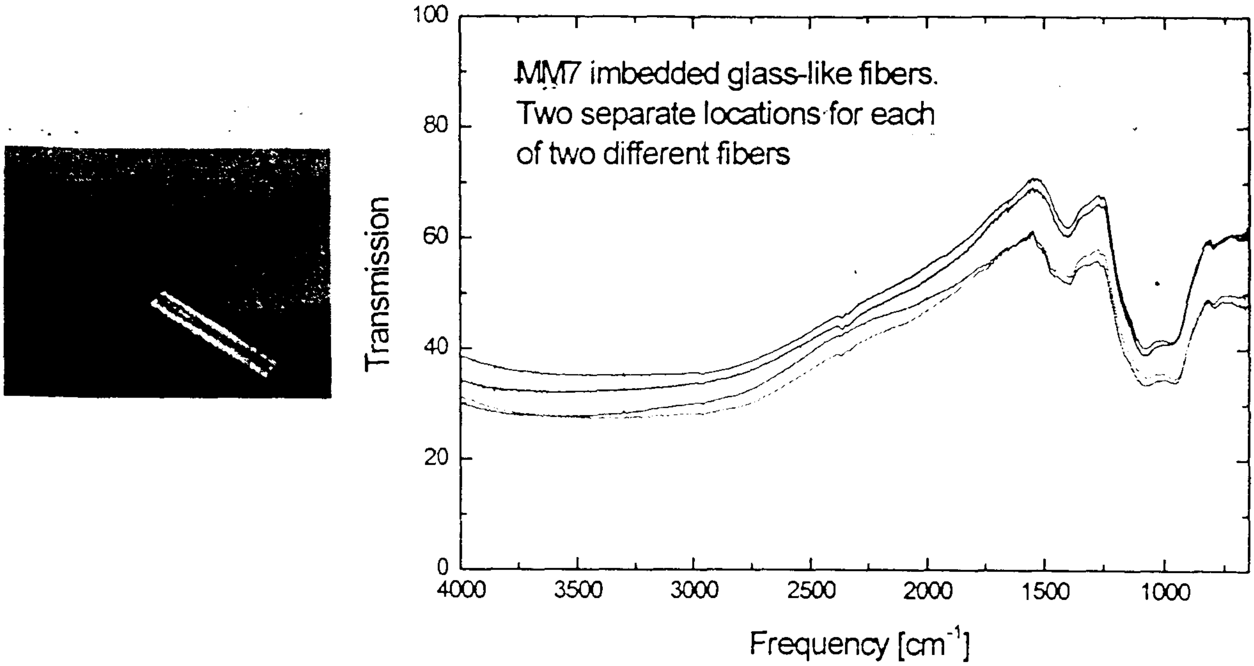

Figure 6: Optical image of a glass-like fiber with IR measure region highlighted(left), and transmission spectra for item MM7 - glass-like fibers (right). Two measurements each of two different fibers.

Comparisons & interpretation

With the exception of the glass-like fibers, the spectra are consistent with synthetic organic compounds. Since we do not maintain an extensive spectral library (though such libraries exist elsewhere), we have not attempted a detailed analysis of the spectra nor matching to actual materials. Instead, we compare spectra of item MM7 (unknown origin) components with item 62 (known aircraft origin) components and look for matching spectra.

A quick inspection reveals that the foam/gum material of item MM7 closely matches the bulk foam material of item 62. Each absorption feature occurs at the same frequency, and the relative strengths of the various absorptions are also relatively close. This is shown in Figure 7, below.

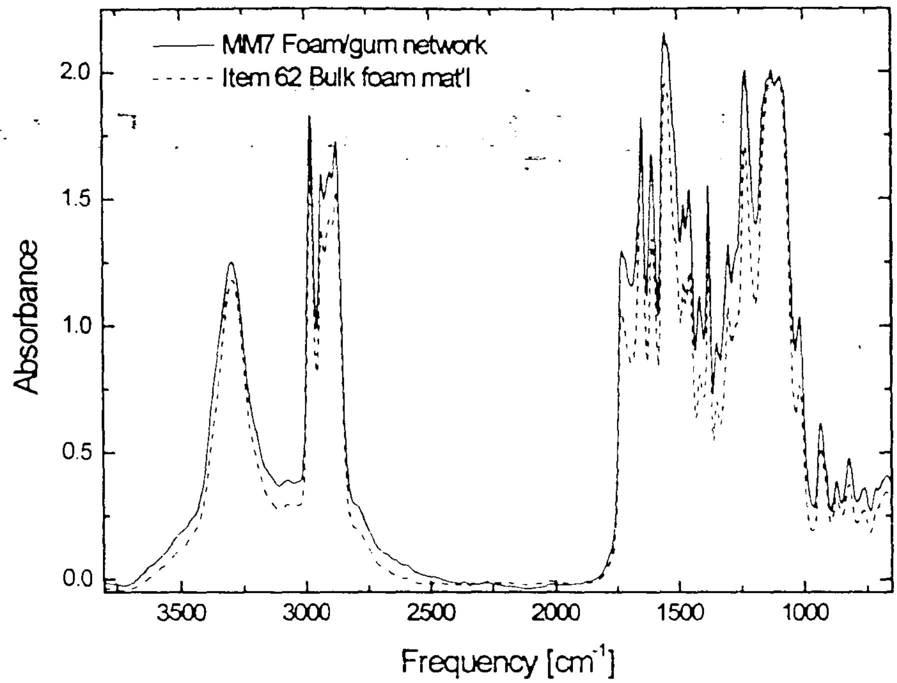

Figure 7: Spectral comparison for MM7 bulk foam and item #62 bulk foam illustrating the close match in spectral properties.

We can also show substantial disagreement between item MM7 foam and the other specimens from item 62. Neither the epoxy material nor the layer foam material have spectra that agree with the MM7 foam, as can be seen in Figure 8.

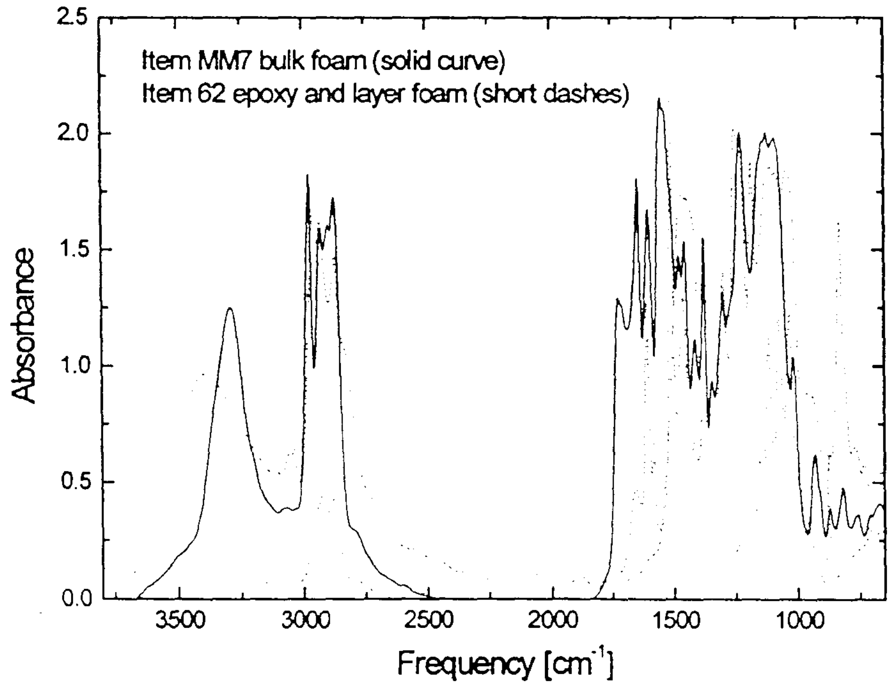

Figure 8: Spectral comparison of item MM7 bulk foam with item 62 epoxy-like material and item 62 thin layer foam (light brown or dark/black). Strong differences among the spectra indicate dissimilar material composition.

Finally, the glass-like fibers of MM7 have general characteristics similar to fibers in #62. The absorption (transmission minimum) near 1000 cm^{-1} is consistent with silica, and suggests both are simple glass fibers. However, differences in the MM7 and #62 spectra (oscillation period, variations through absorption region, overall frequency dependence) suggest MM7 fibers are smaller than item #62 fibers. This could be checked by visual microscopy.

Summary

Infrared spectra were recorded for materials from evidence items 62 and MM7. Chemical identification was not attempted due to a lack of spectral libraries at this facility. The spectra for the main constituent of item MM7 - a foam / gum network - were found to agree closely with the bulk foam material of item 62. The glass-like fibers of items MM7 and item 62 produced spectra consistent with glass material. However, differences in the spectra - interpreted as due to multiple reflection / interference effects - suggest the fibers have different diameters. Direct (visual microscopy) of the fibers should confirm the different diameter. Finally, the small white polycrystalline grains found in item MM7 (but not item 62) produced spectra consistent with basic salt.

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Examination of the Boeing Test Sample: The Fracture Surface of Al 2024 Alloy Following Penetration by Steel Projectile @ 3000 ft s^{-1}, by [redacted] et al.

ATTACHMENT 3

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<u>Examination of the Boeing Test Sample: The Fracture Surface of Al 2024 Alloy Following Penetration by Steel Projectile @ 3000 ft s^{-1}</u>

Corrosion Group, Materials Science Division, Brookhaven National Laboratory

February 20th 1997

[redacted] b7C

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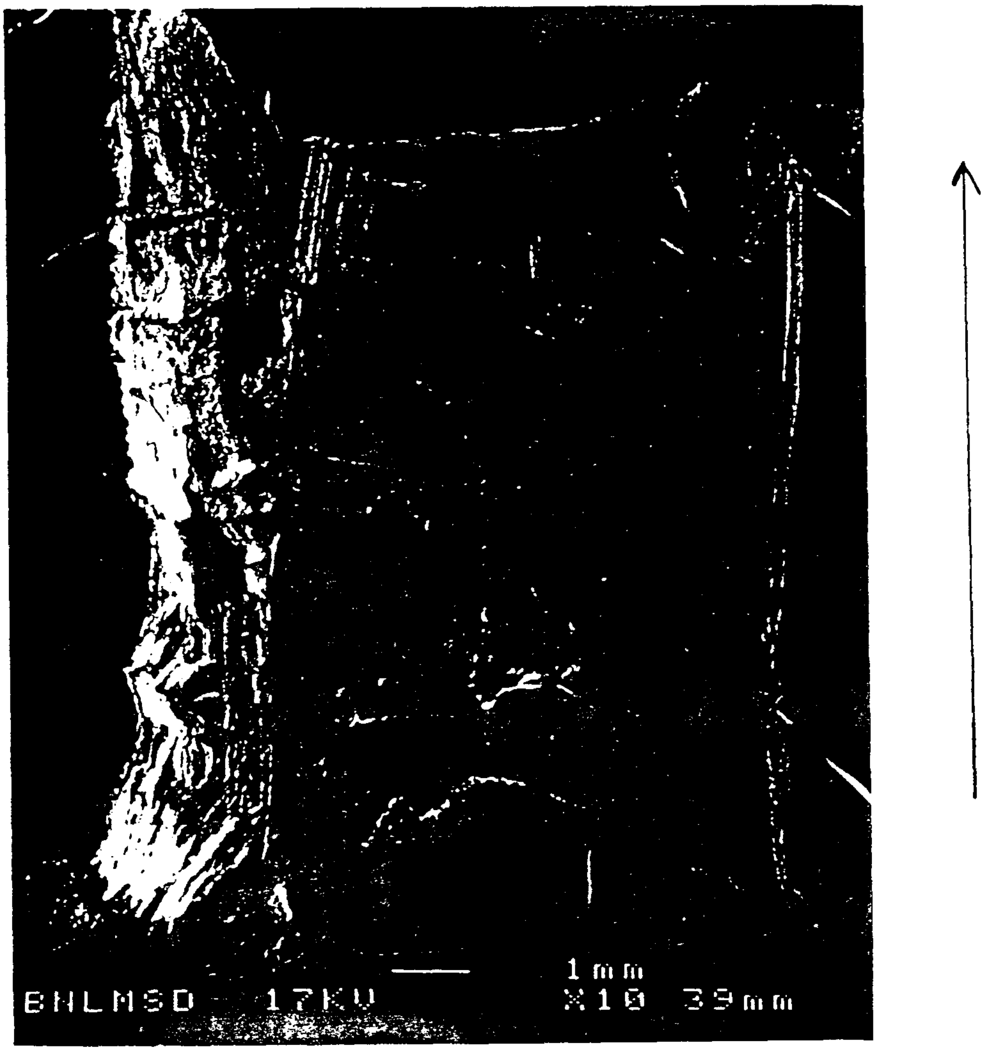
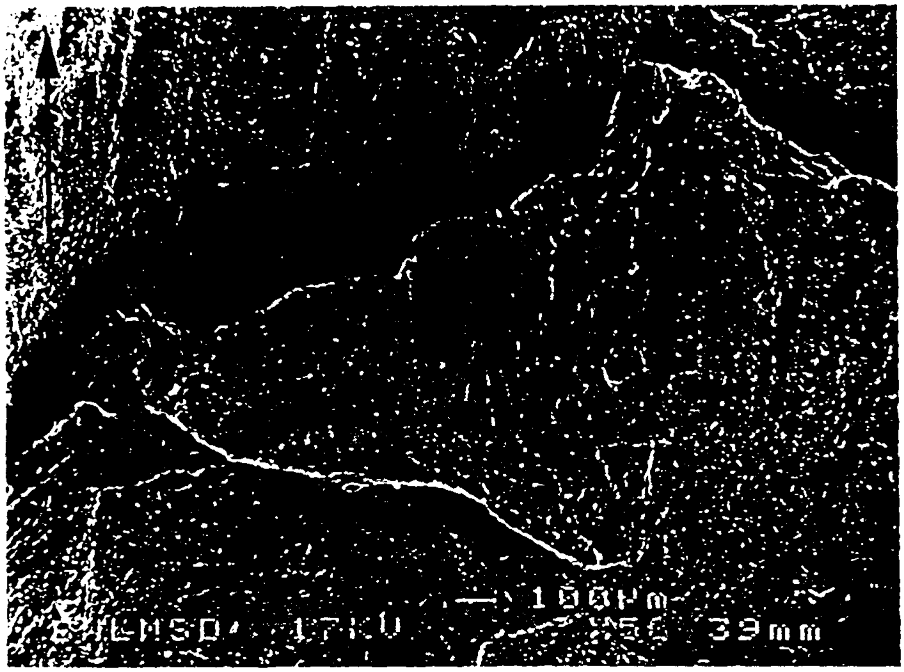
Optical Microscopic examination showed areas with distinctly different surface finishes. The general surface has a dull appearance and is sheared in the direction of the projectile motion. The resulting surface is "scale-like" with the cleaved plates pushed forward along the fracture surface (as shown in SEM micrograph - Fig. 1). Close to the entrance hole there were significant areas that had a much more shiny luster. These could be correlated to zones where surface melting had occurred during the impact. Metal extrusion occurs at both the entrance and exit and at first examination the direction of the projectile is not obvious. Thus it is important to establish whether deformation around the hole occurred under compressive or tensile forces.

Scanning Electron Microscopy of the surface clearly shows the sheared surface along the direction of the projectile: Figure 1 gives an overview of the entire fracture surface with the projectile direction indicated. Figure 2 shows a close up of one of the sheared platelets. Further examination showed areas where there is strong evidence of surface-melting and fluid like features are observed (Fig 3. middle). Figure 3 shows a series of micrographs taken along the fracture surface: the bottom figure is at the point of entrance and shows no unusual feature for cleavage of Al. The middle figure is close to the entrance on the fracture surface - the liquid appearance implies surface melting and a separate layer on the alloy surface. The amount of this material apparently decreases towards the exit possibly indicating a degree of cooling. Elemental analysis of the "melt-zones" shows a significant enrichment of Fe when compared to the base alloy (see Table 1), and there is **strong evidence of metal transfer between the projectile and the target** in these areas, i.e. during the surface melting, alloying between the Al 2024 and the mild steel occurs.



Al 2024 plate, cross-section of fracture surface

Fig 1



Al 2024 plate, sheared platelets in direction of fracture

Fig. 2

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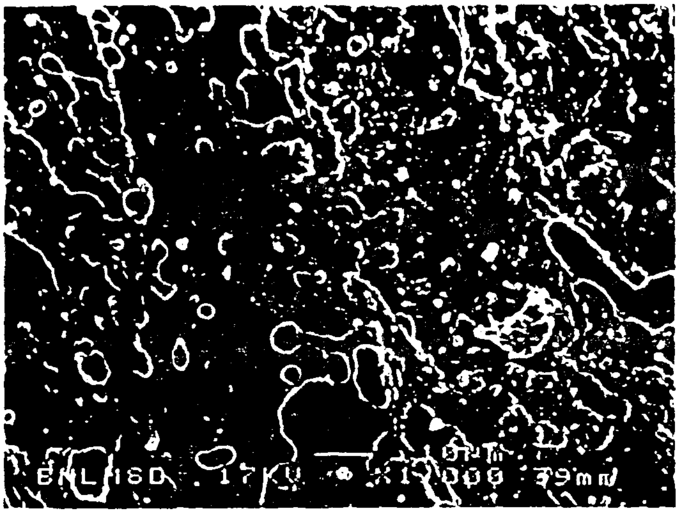
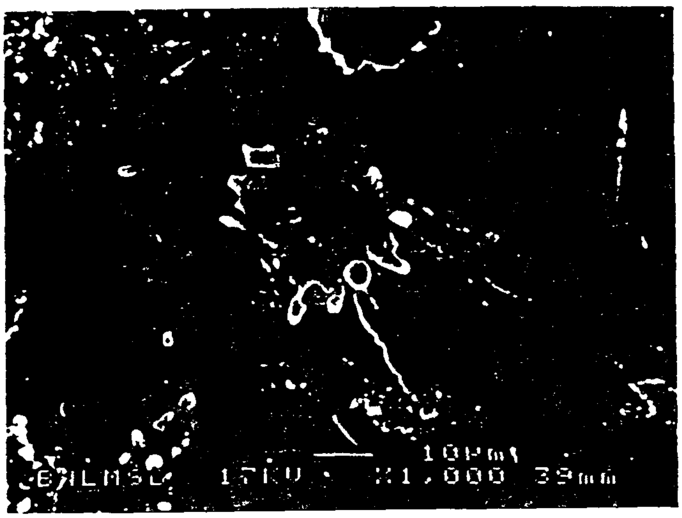
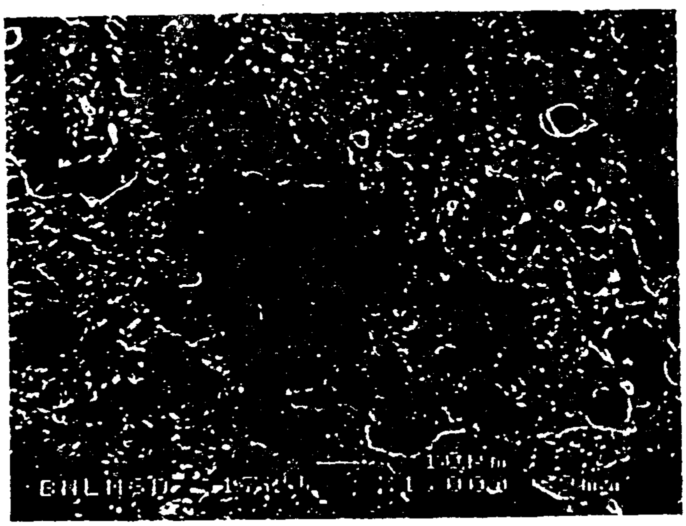


cooler area
near exit



"melt zone"

Fe-rich



classic
shear
surface

Fig 3

SECRET

	Aluminum kα (counts)	Copper kα (counts)	Iron kα (counts)	Fe/Cu
Base Alloy	63837	238	-------	0
"melt-zone"	57434	307	969	3.16

Table 1. Integrated intensities of peaks in EDS spectra for aluminum, copper and iron. The iron/copper ratio is a good way of comparing the regions since the technique has a similar sensitivity to both iron and copper. The iron enrichment in the melt-zone is clearly evident.

SECRET

Materials Analyses of Samples from TWA Flight 800 and Appendix I, by [redacted] b7C
[redacted]

ATTACHMENT 4

SECRET

Materials Analyses of Samples from TWA Flight 800

[redacted] b7C

Materials Science Division
Brookhaven National Laboratory

Samples associated with TWA flight 800 have been examined, primarily for materials identification, using scanning electron microscopy with [redacted] b1 (Materials Science Division). The objectives were to establish whether certain pieces were actually from the aircraft and to look for evidence of material transfer on fracture surfaces.

The chemical compositions of the samples were analyzed with a JEOL 6400 SEM configured to an EDS (Noran) series energy dispersive spectrometer and associated microanalyser. The accelerating voltage was 17 kV, the typical working distance was approximately 35-40 mm, and take-off angle was 40°. The net intensities for each peak were processed in *semi-quantitative* standardless mode (i.e. alloy standards were not measured) which uses ZAF (atomic number, absorption, fluorescence) corrections. (Micrographs of samples IB377, IB423 and IB28 were also taken but are not presented here - original data held by [redacted] b7C

Sample ID # IB377 (item 63) - penetration site on fuselage

A 5 x 5 cm square piece was cut from fuselage aft of L3 door, with the penetration at the center (~1.5 cm dia.). A primer coating and paint top-coat were intact away from the penetration site. Small indentations in the metal surface were observed around the penetration site. The sample was not examined in cross-section so *quantitative* analysis of the fracture surface were not obtained. (Further analysis of the fracture surface was to be carried out by [redacted] of the NTSB. It should be noted that simple comparison of the b7C fracture surface to test samples from Boeing may be misleading if the fracture surface is heavily corroded. In the case of an iron projectile evidence of surface melting on the fracture face can be lost after only 72 hours exposure to sea water. In this case, chemical analysis is critical in order to establish material transfer).

SEM/EDS analysis was performed on both the fracture surface (as far as sample geometry allowed), the external coated areas, and the indentations (Figs 1-4). The fracture surface showed flat "mud-cracked" oxide features; chemical analysis indicated the presence of Al, trace amounts of Fe and Mg and large signals from typical salts (Na, Ca, Cl). Spectra from the painted areas were all consistent with the known coatings on the aircraft (from comparison with EDS spectra provided by manufacturer). No foreign material was observed.

In the case of sample IB377 the surface was also analyzed using the synchrotron X-ray fluorescence microprobe (for [redacted] at beamline X26A of the National Synchrotron Light Source. The incident radiation was delivered at 45° to the plane of the sample as a 300 x 300 µm unfocussed white beam, and the fluorescence spectra were detected at 45° by a multi-element detector (Canberra). The Xray technique is more sensitive to trace elements but has a larger penetration depth (i.e. is less surface sensitive). Examination of the fracture surface was in general consistent with the SEM data except that small amounts of Cadmium were observed through the penetration surface. This is consistent with paint fragments dragged through (and deposited) on the penetration. Cadmium was also observed on the painted areas of the piece, and is commonly found in red pigments.

Sample ID # IB423 (item 92) - "spiketooth" - *Unknown origin.*

Metallic sample with spiketooth fracture surface characteristic of adiabatic shear during fast fracture. Evidence of high temperature exposure during failure indicated by areas of blue oxidized material and areas of apparent melting at the base of the "teeth". Olive green coloration of surface away from fracture.

A small piece of the material was cut from the original sample, mounted in epoxy resin and polished to 1 µm finish using SiC and diamond paste. The alloy composition was determined to be ~ Ti - 5Al - 3Sn (weight %) - (Fig. 5).

EDS analysis was performed on three areas on the main spiketooth sample:

1. Fracture surface - (Fig. 6) Consistent with base alloy composition but, additionally some trace Fe, Cu was observed.

SECRET

2. Green area- (Fig. 7) Spectrum is consistent with oxidation of base alloy material (O, Ti, Al, Sn and small trace of Ca observed).
3. Base of the teeth at apparent melted areas (Fig. 8) Again a trace amount of Fe is observed that was not seen on the bulk base alloy (as in 1).

This specimen shows evidence of fast fracture and possible transfer of Fe at the fracture surface. It should be noted however, that Fe is a common impurity in Ti alloys resulting from the extraction process (up to 0.2 wt. % for the most commonly used "Kroll" process - see Table 1 - from "The physical metallurgy of Titanium Alloys, [redacted] b7c
The bulk alloy is possibly engine material used on the aircraft (49XX series Ti alloys) and further tests are presently underway in order to match the sample to actual engine pieces {see Appendix 1}. Currently the origin of the piece remains unknown.

Sample ID # IB410 (item 86) - "fin"

Sliver of grey uncoated metal - *Unknown origin*

EDS spectrum of sample (unwashed) indicated the material to be Al based with Cu and Fe (consistent with a 2000 series alloy used in aircraft), additional peaks from salt contamination (Na, Ca, Cl, K, S, Mg) were also observed. No further tests were required.

Sample ID # IB28

Small charcoal colored particles (1 of ~20 similar pieces) measuring ~5 mm in diameter. On polishing the sample was orange colored and transparent. *Unknown origin.*

SEM analysis indicated that the material was multi-phase having a base matrix containing Al and Ti (Fig. 9). The sample showed significant charging under the electron beam indicating that it is a very poor conductor - i.e. not metallic. Three other distinct areas could be observed, two were similar to the matrix but contained significant amounts of Zr (Figs. 10,11), the other was mostly Al with Ca, Ba and Ce (Fig. 12).

SECRET

Table 1 — Total Impurity Contents of Iodide- and Kroll-Process Titaniums in Weight %

Element	Iodide Ti	Kroll Ti
Mg	0.01	0.13
Si	0.01	0.05
Al	0.02	
Fe	0.01	0.20
Ni	0.01	
Co		0.02
Cr	0.01	
Mn	0.005	0.02
C	0.01	0.08
N	0.02	0.04
O	0.02	0.11

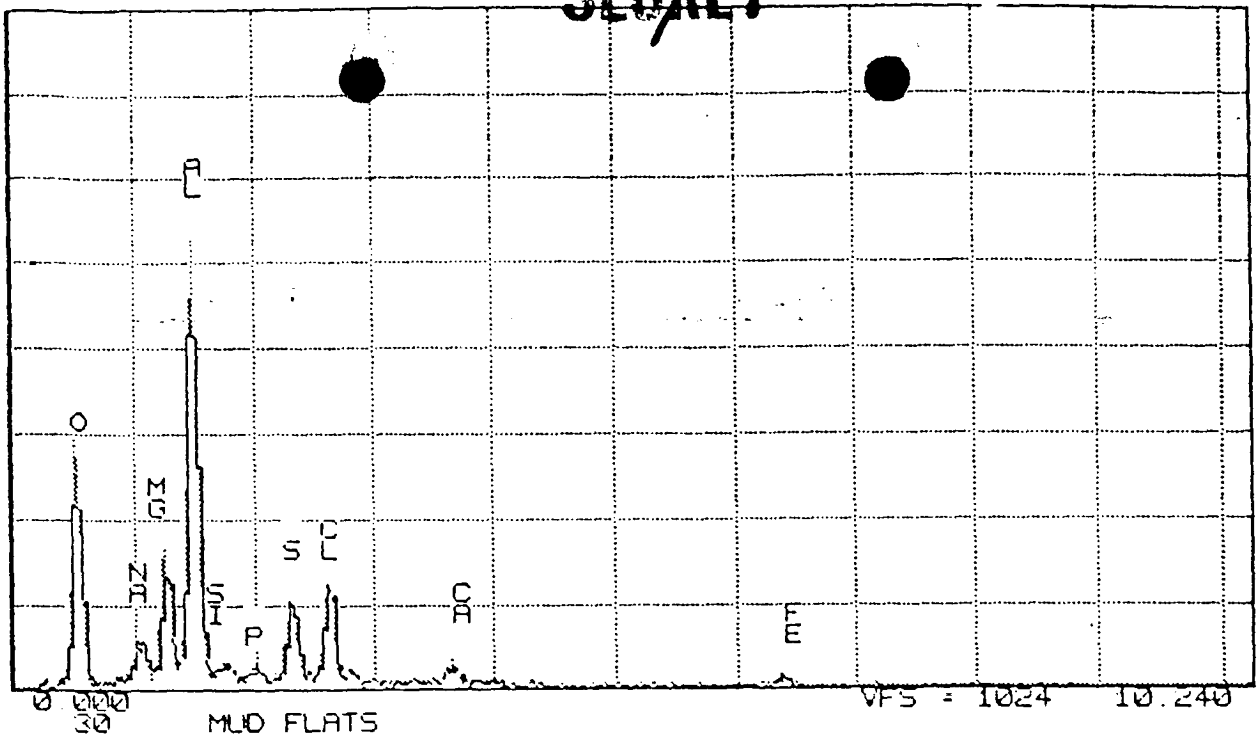


Figure 1. EDS Spectrum of IB377 (item 63) Fracture surface.

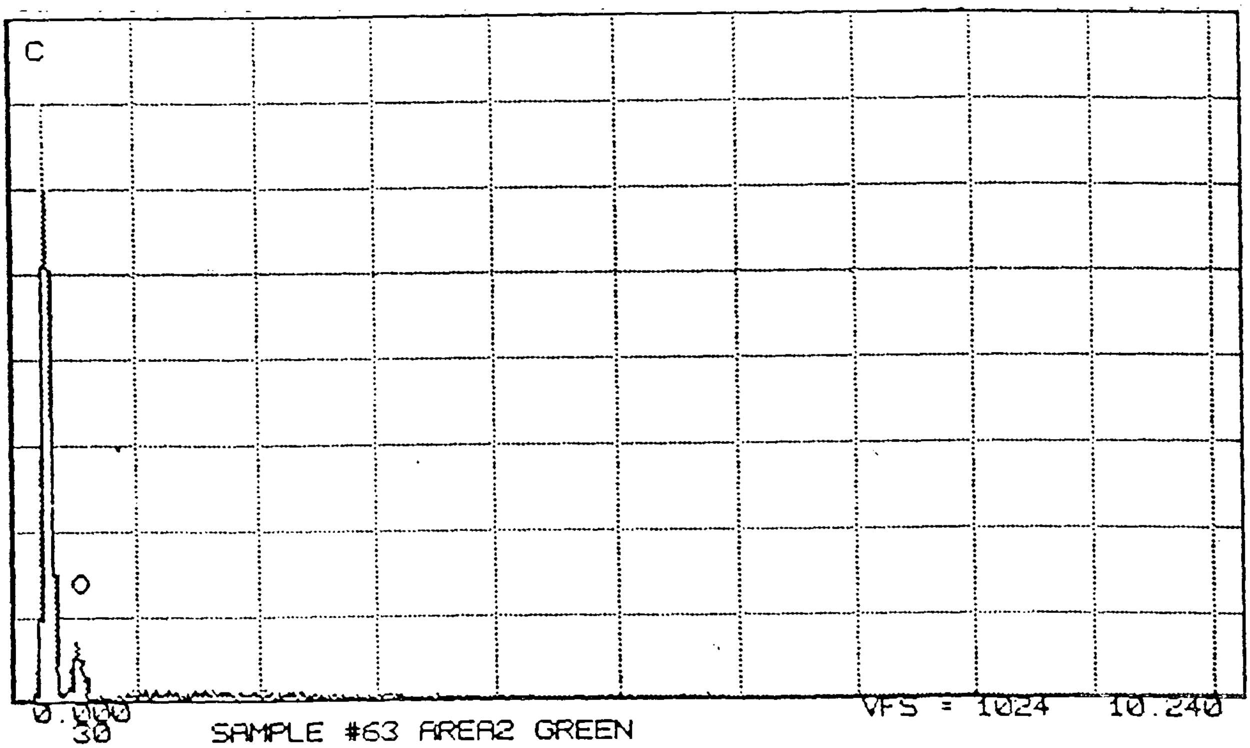


Figure 2. EDS Spectrum of IB377 (item 63) Green "primer" area.

SECRET

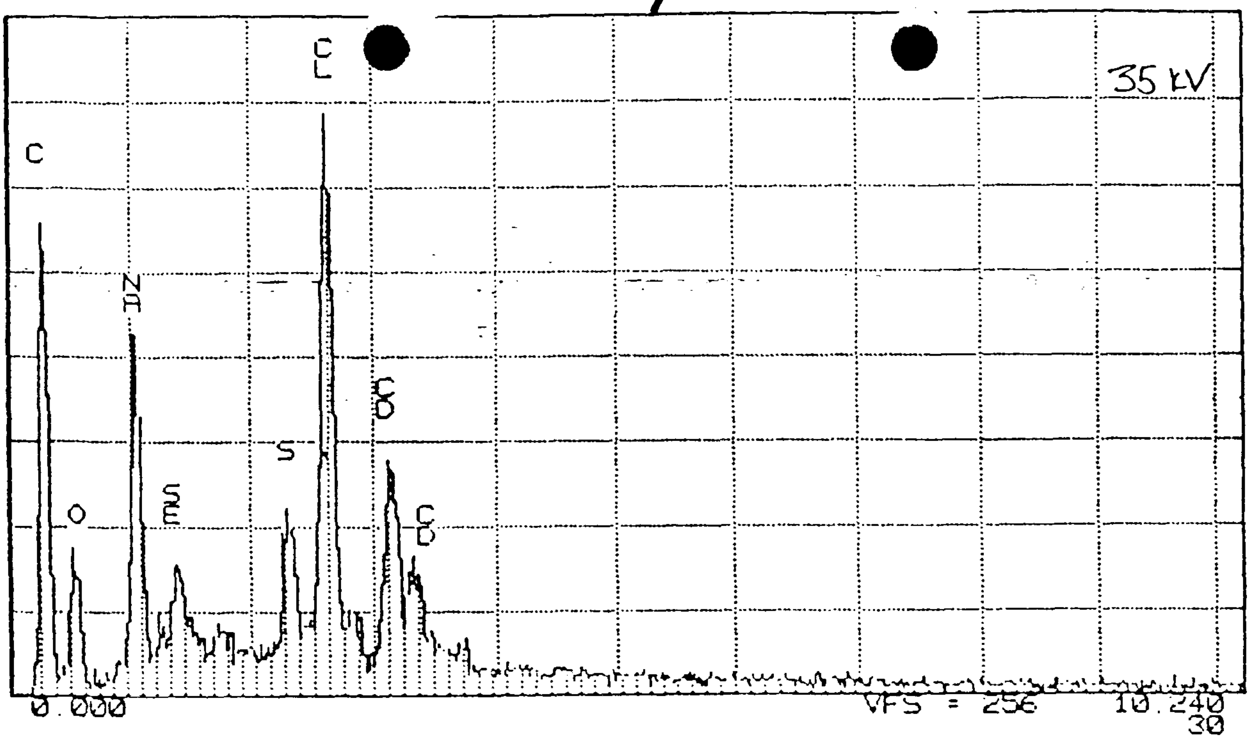


Figure 3. EDS Spectrum of IB377 (item 63) Red paint.

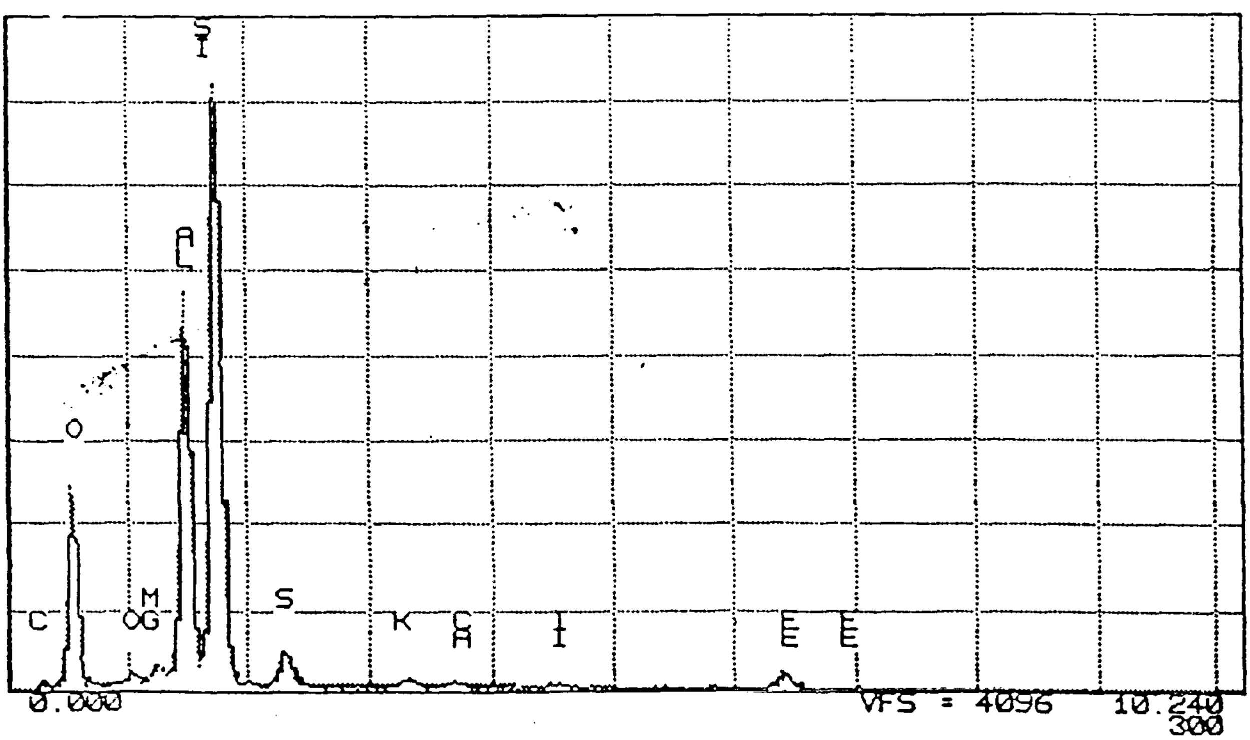


Figure 4. EDS Spectrum of IB377 (item 63) Indentation around penetration site.

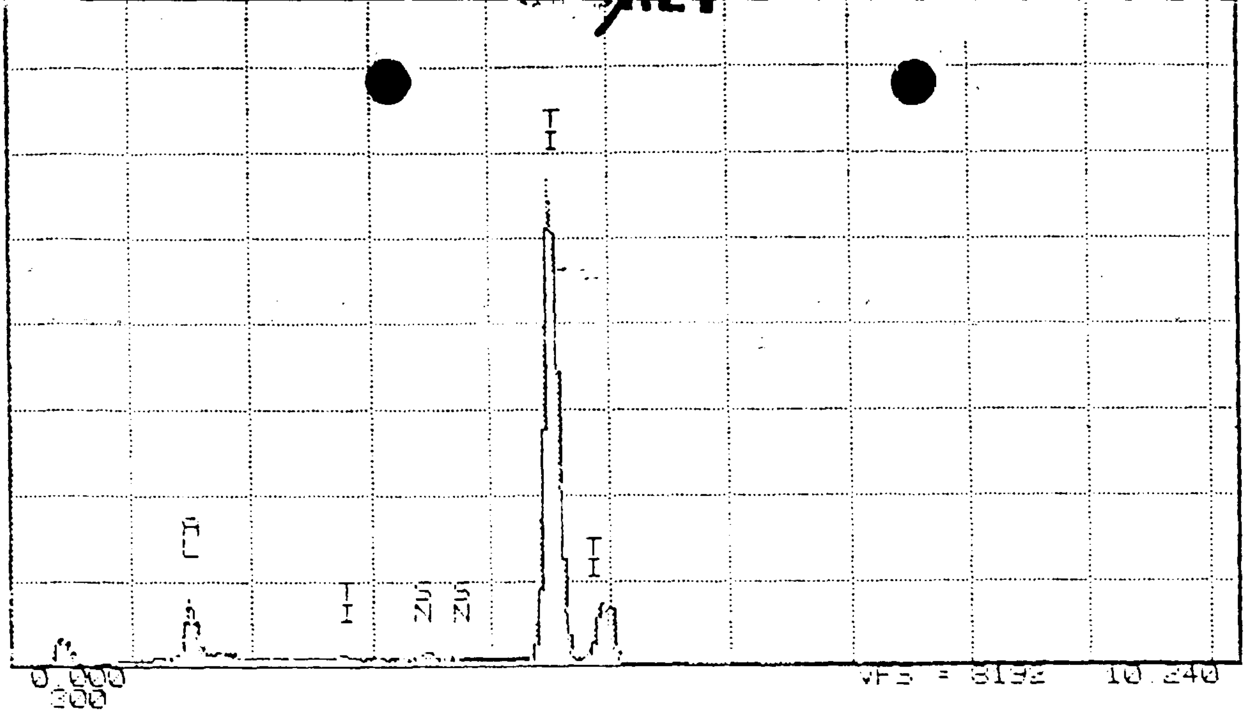


Figure 5. EDS Spectrum of IB423 (item 92) Polished sample - base alloy

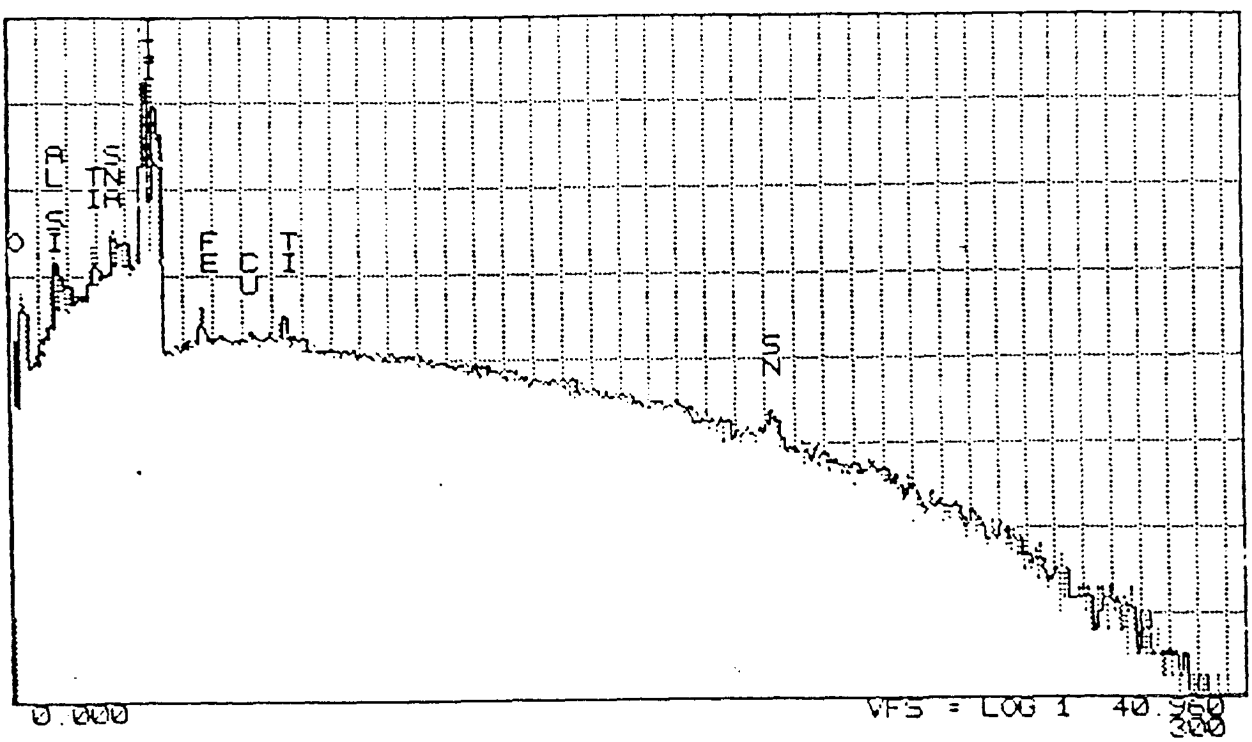


Figure 6. EDS Spectrum of IB423 (item 92) Fracture surface.

SECRET

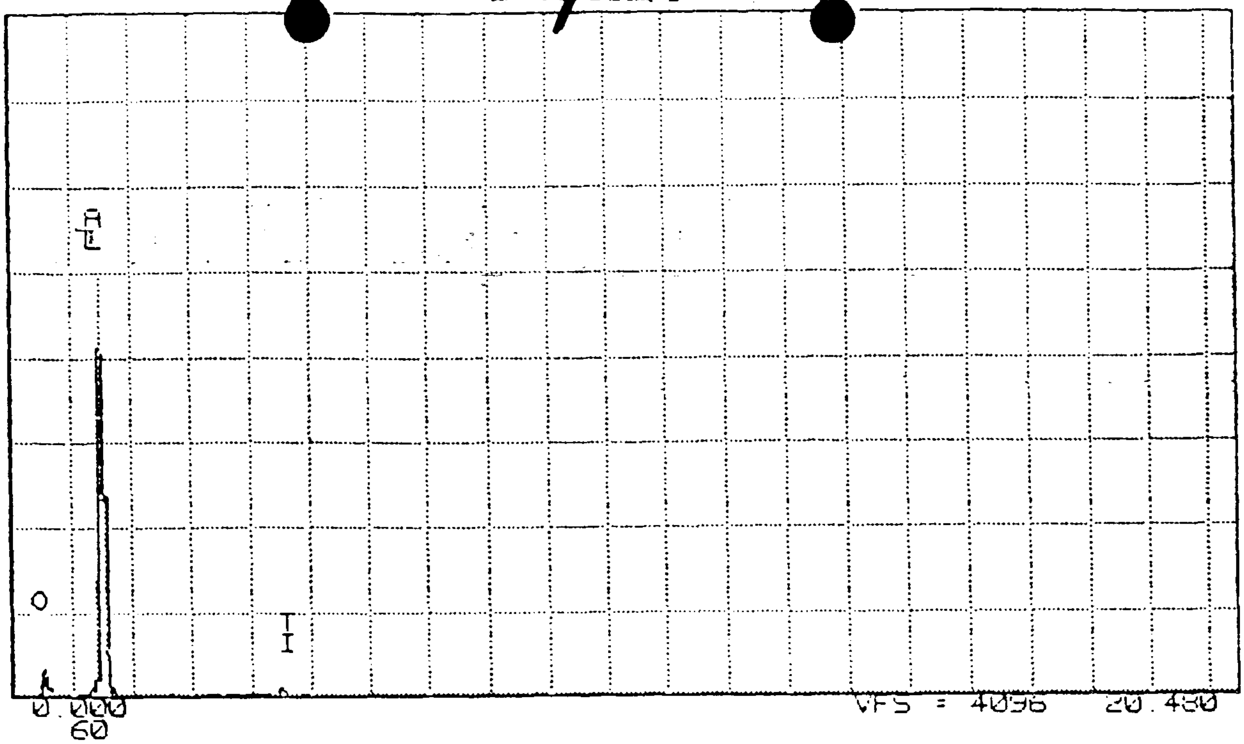


Figure 9. EDS Spectrum of IB 28 - Matrix

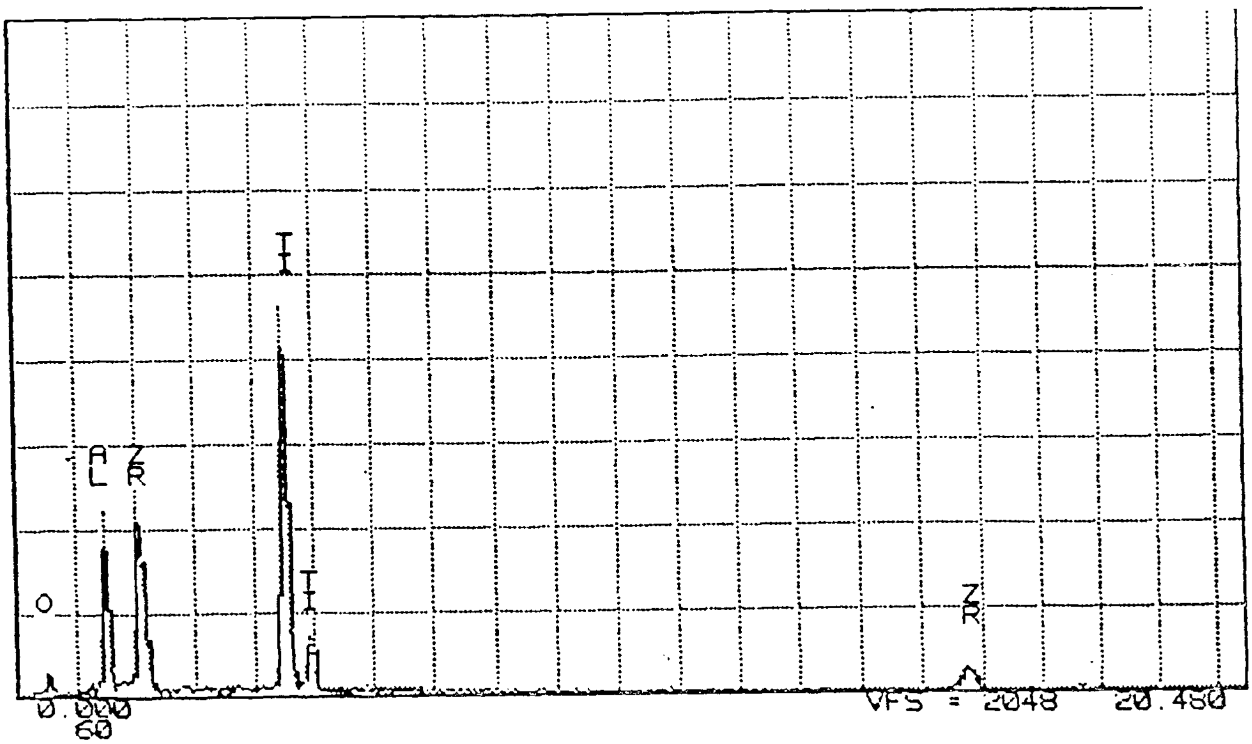


Figure 10. EDS Spectrum of IB 28 - Particulate 1

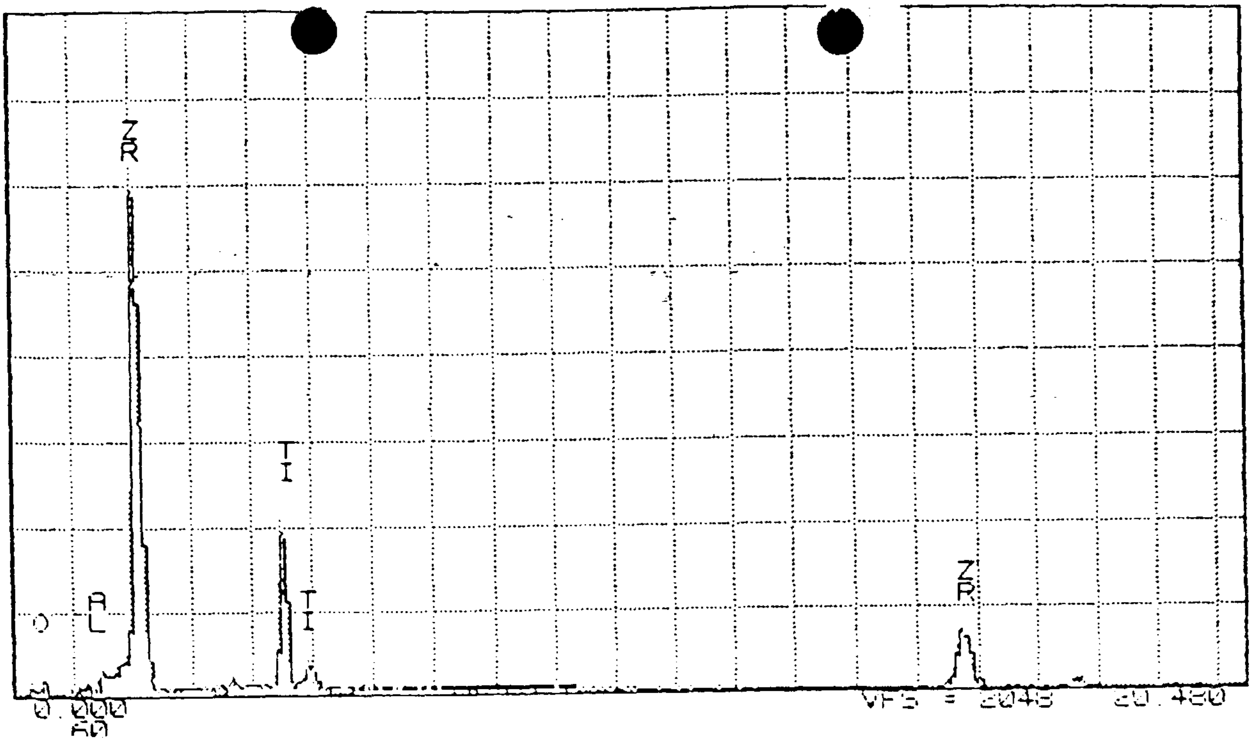


Figure 11. EDS Spectrum of IB 28 - Particulate 2

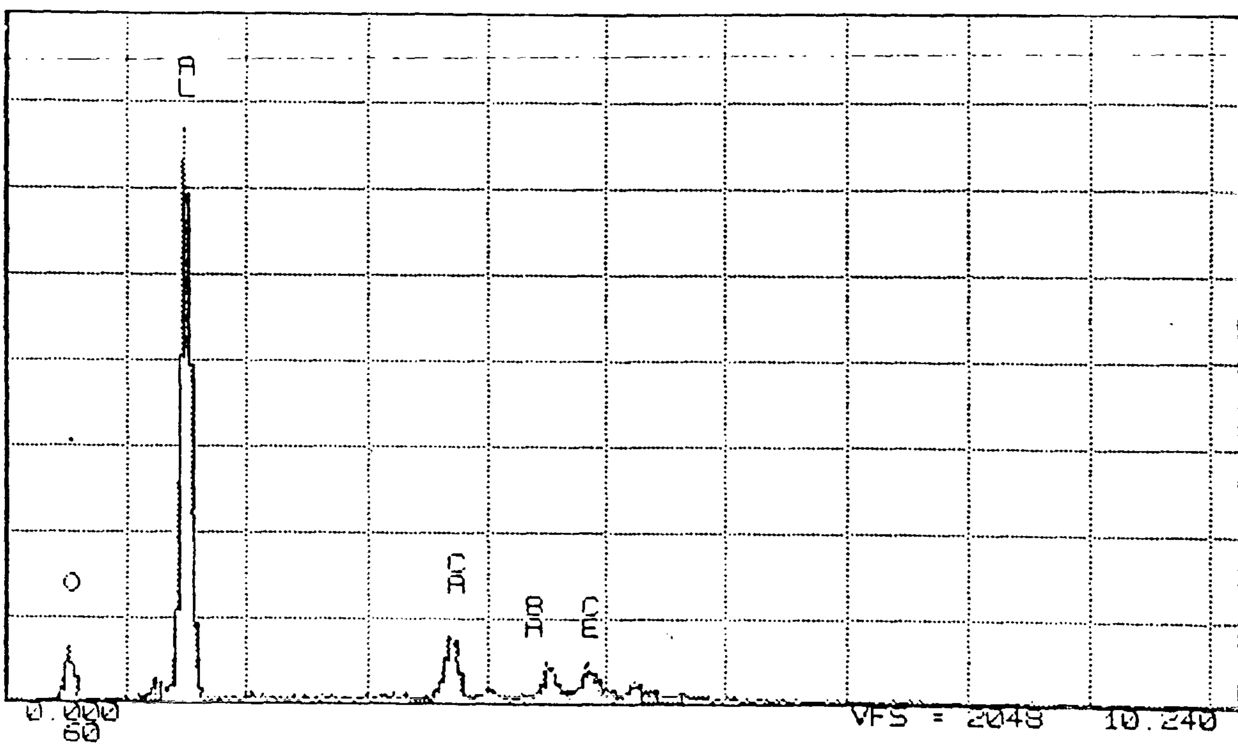


Figure 12. EDS Spectrum of IB 28 - Particulate 3

Appendix I

Samples tested for comparison to item # 92 (IB423)

Selected pieces of recovered aircraft engine material were examined using EDS as described previously. Composition of IB423 was ~ Ti - 5Al - 3Sn (weight %), most likely a 49XX α-phase alloy.

Item 130 - 'compressor blade'. Grey metal with greenish oxidation product. Samples mounted in epoxy resin and polished to 6 μm finish with diamond paste. Semiquantitative EDS analysis showed the material to be a Nickel based alloy with a composition of Ni-13.5Cr-6.2Al-5.7Mo-2.3Nb-0.6Ti (Figure A1).

Items 167-183 - samples taken from engine casing, supports and blades. All samples are qualitatively similar in appearance to item IB423. Samples were mounted in epoxy resin and initially ground on a rotary sander. At this stage it was easy to differentiate between the hard and soft alloys (the Titanium alloys are likely to be significantly harder than Aluminum or Nickel alloys). Two samples (181 and 183) were selected for further testing and were polished to 1 μm diamond finish.

Samples 181, 183 - samples from outer engine ring (#3) and engine radial support respectively. EDS spectra for the two samples were identical (Figure A2 shows the data for #181). The composition was determined to be Ti-6.2Al-2.7Sn. To within the error of the measurement this is consistent with the 49XX series alloy i.e. is most probably the same material as item 423 (note that there is only one common ternary Ti-Al-Sn alloy produced).

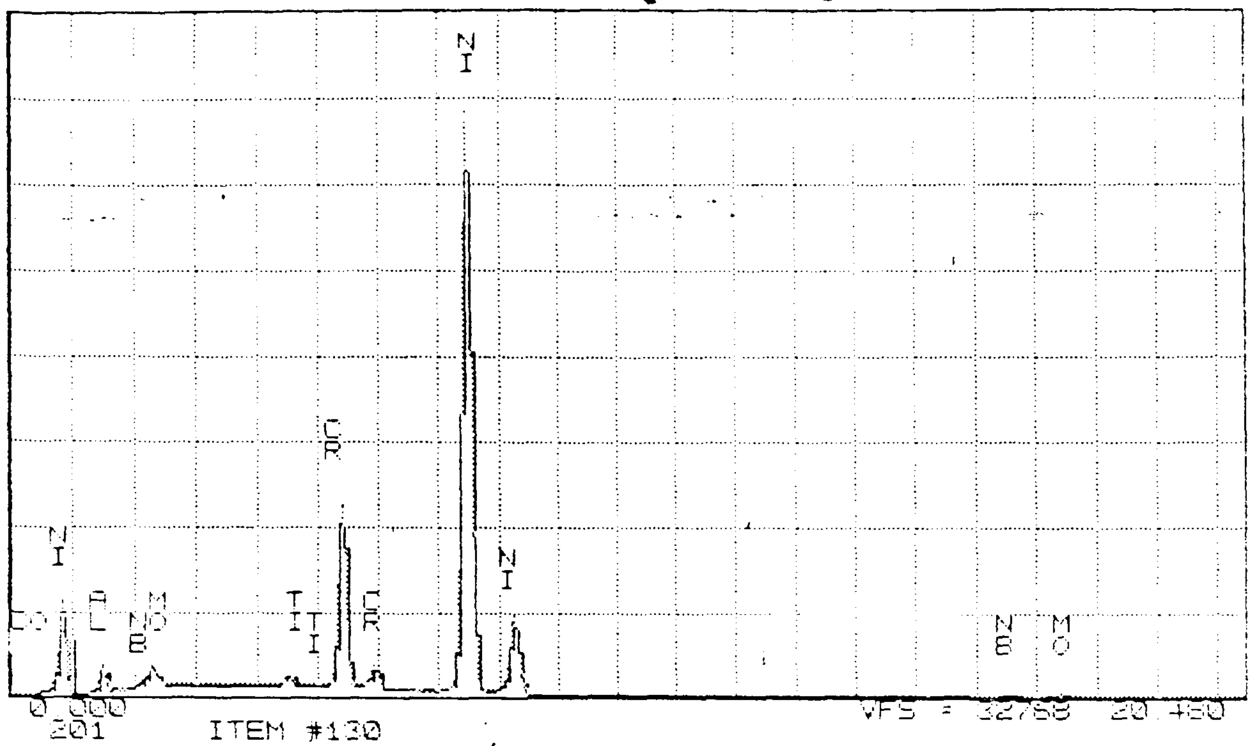


Figure A1. EDS spectrum of sample 130

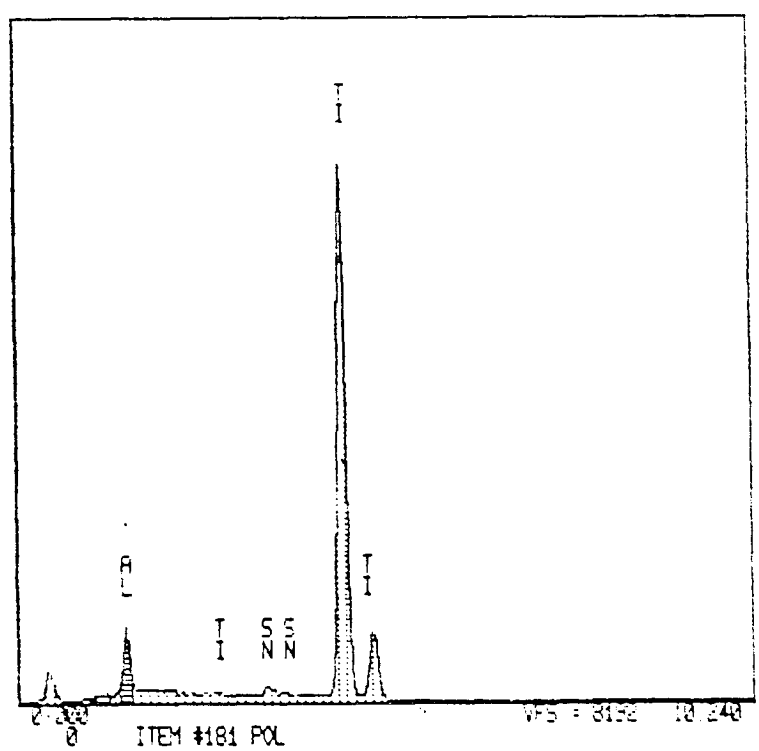


Figure A2. EDS spectrum of sample 181

(12/31/1995)

FEDE[redacted]AL BUREAU OF INVE[redacted]TIGATION

Precedence: ROUTINE **Date:** 03/13/1997

To: New York **Attn:** SSA [redacted]
SSA [redacted]

b7C

From: New York
FBI Command Post, Calverton
Contact: SA [redacted] (516) 369-3313

Approved By: [redacted]

Drafted By: [redacted]bsm

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA 800;
7/17/96
AOT-IT-EOD;
OO: NEW YORK

Synopsis: Encloses FD-302s documenting submission of an unknown material and comparison samples to Brookhaven National Laboratory for analysis.

Enclosures: Two FD-302s by SA [redacted] regarding chain of custody, with investigation dates of 2/11 and 2/27/1997. b7C

Details: An unknown brown material, with the appearance of having been splattered, was discovered at various locations on the top of the Wing Center Section. Several specimens were taken to analyze and identify at different laboratories.

The test specimen originally labeled by [redacted] National Transportation Safety Board, as MM7 was released to Brookhaven National Laboratory (BNL) by SA [redacted] on 2/10/1997. Preliminary elemental study was performed, without conclusion. MM7 was later redesignated in the FBI evidence files as item 56 (after the enclosed FD-302 concerning MM7 was written).

Subsequently, known material samples from aircraft structure around the extraction site of MM7 (item 56) were taken and secured as evidence items 58, 60, and 62. On 2/27/1997, the three known items were taken to BNL for comparative analysis with MM7. While MM7 was released to BNL custody, items 58, 60, and 62 remained in SA [redacted] custody. 427 b7C

265A-NY-259028-SUB FF

Only item 62, which is insulation foam around an environmental air duct, was examined. The BNL Physicists determined that there was a strong correlation between

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WITH TEXT ✓
WITHOUT TEXT
BY 5/6/97

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HEREIN IS UNCLASSIFIED
DATE 4-13-00 BY

SEARCHED INDEXED
SERIALIZED FILED
FBI — NEW YORK

spectroscopy characteristics of MM7 (item 56) and item 62. In other words, the brown material is probably made of the same substance as item 62, insulating foam.

Fibers in MM7, thought to be silica based (glass), did not correlate well with duct fibers in item 62. Further analysis is required on these fibers.

♦♦

FEDERAL BUREAU OF INVESTIGATION

FREEDOM OF INFORMATION/PRIVACY ACTS SECTION

COVER SHEET

SUBJECT: TWA FLIGHT 800

REPORTS ON VICTIMS

265A-NY-259028

WAT:iaw
1

b7C

On July 25, 1996, [redacted] National Disaster Medical System, advised the following:

He was told by [redacted] Regional Medical Examiners Office, State of New Jersey, Newark, New Jersey, (201) 648-7259, that she observed an individual taking pictures in the morgue at the Suffolk County Medical Examiner's Office on July 24, 1996. She was described as being a [redacted]

b7C

On July 26, 1996, [redacted] was telephonically contacted and subsequently provided a fax picture of the only [redacted] meeting that description. The faxed picture was that of [redacted] indicated that she could not be absolutely certain because she had focused on the camera rather than the face which was covered by a mask. She indicated that the hairstyle in the photo was consistent with the person she observed. She said that the woman had a cheap light-colored instamatic camera.

b7C

On July 26, 1996, [redacted] was paged and she quickly returned the page to the Long Island Resident Agency (LIRA). She was told that she had been tentatively identified as an individual who may have taken unauthorized pictures of bodies in the morgue area. She denied having done so and stated that she did not even have her camera with her. She was asked to identify her camera and she described it as a yellow disposal camera.

[redacted] was advised that despite her statement she was being advised that the crash of Trans World Airlines Flight #800 was a federal investigation and any unauthorized use of photographs taken at the morgue would have serious ramifications. [redacted] can be reached at pager number [redacted]

265A-NY-259028-F1

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CV2063

SEARCHED ___ INDEXED ___
SERIALIZED ___ FILED ___
AUG 12 1996
FBI — NEW YORK

OPCA-20 (12-3-96)

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☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
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FBI/DOJ

COUNTY OF SUFFOLK

ROBERT J. GAFFNEY
SUFFOLK COUNTY EXECUTIVE

DEPARTMENT OF HEALTH SERVICES
MARY E. HIBBERD, M.D. M.P.H.
COMMISSIONER

DIVISION OF MEDICAL-LEGAL INVESTIGATIONS &
FORENSIC SCIENCES
(OFFICE OF THE MEDICAL EXAMINER)

[redacted] b7c

FAX TRANSMITTAL

To: ADIC James Kallstrom
SAC Thomas Pickard 212 384-2745 8/3/96

From: [redacted] b7c

# of pages 2

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DATE 4-13-00 BY SP5 JCP

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AUG 5

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TC

b7c

SIDNEY B. WEINBERG
CENTER FOR FORENSIC SCIENCES
BLDG# 487 NORTH COUNTY COMPLEX
HAUPPAUGE, NEW YORK 11787-4311
(516) 853-5555
FAX NO. [redacted]

News Release...

from the Suffolk County Medical Examiner's Office
[redacted]

b7C

Contact: [redacted]
Phone: [redacted]
Fax: [redacted]

Bldg. #487 N. County Complex
Veterans Memorial Highway
Hauppauge, NY 11787-4311

AUGUST 3, 1996
9:45 AM ...
FOR RELEASE: IMMEDIATE

UPDATE

Total Decedents Received by the Suffolk County ME's Office	188
Total Positive Identifications	181
Total Positive Identifications with Family Notification	181

Decedents with Positive Identification
Families Have Been Notified
******

8/3/96

Last Name of Deceased	First Name of Deceased	Hometown	State	Country	Count
Grimm	Julia	Montoursville	Pennsylvania		180
Loo	Patricia	Springfield	New Jersey		181

- END -

FD-302 (Rev. 3-10-82)

FEDERAL BUREAU OF INVESTIGATION

Date of transcription 7/25/1996

On July 24, 1996, information developed indicating that an individual named [redacted] had been taking pictures at the Suffolk County Medical Examiner's Office (SCMO). Investigation determined that he was [redacted] Lewis County Sheriff's Department, and was attached to the State Emergency Management Office (SEMO). Contact with [redacted] SEMO, (518) 457-2222, indicated that no person working with or attached to his agency was authorized to be photographing anything related to the Trans World Airlines (TWA) flight 800 incident. b7C

On July 24, 1996, [redacted] was contacted and was directed to voluntarily surrender all film taken in connection with the air disaster. He was asked if he was aware of any other individuals taking pictures and he provided two additional names. [redacted] advised that [redacted] had also taken pictures. [redacted] took pictures at the Medical Examiner's Office (morgue) and at Calverton. He surrendered three rolls of film. b7C

On July 24, 1996, [redacted] was contacted at the [redacted] Melville, New York (NY), and was requested to surrender film he had taken at the morgue. [redacted] advised that he had made an arrangement with [redacted] Suffolk County, NY, to return the film to him. He refused to provide the Federal Bureau of Investigation (FBI) the film, but suggested that [redacted] should be contacted. [redacted] and Supervisory Special Agent (SSA) [redacted] traveled to the Medical Examiner's Office and [redacted] and SSA [redacted] met. [redacted] advised that he had authorized [redacted] to take morgue pictures and that doing so was a standard practice when official photographers were not available. [redacted] was asked if at any time he had authorized any other individuals to take pictures, to which he responded no. b7C

Receipts were given to [redacted] for their film and they were advised that they may or may not have the film returned at a later date.

4-12-00 SPS/JC

Investigation on 7/24/1996 at Hauppauge, New York

File # 265A-NY-259028

by SSA [redacted] iaw TW-3290 Date dictated 07/24/1996 b7C

It should be noted that at no time did [redacted] indicate why they had taken the unauthorized pictures.

b7C

265A-NY-259028
FMF:iaw
1 TW-713

The following investigation was conducted by Special Agent (SA) [redacted] Squad I-5/Long Island Resident Agency (LIRA), on July 26, 1996: b7C

At 9:00 AM, the writer received a brown envelop from [redacted] who just arrived at John F. Kennedy International Airport (JFKIA) from Trans World Airlines (TWA) flight 885 from Tel Aviv. The envelop was marked for [redacted] at the Suffolk County Medical Examiner's Office (SCMEO). [redacted] stated that he received this package from [redacted]

At 10:30 AM, the aforementioned envelop was hand delivered to [redacted] at the SCMEO, Hauppauge, New York.

4-13-00 SPS/JC/PVN

6 FF

265A-NY-259028-SUB

FBI — NEW YORK

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☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
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Precedence: ROUTINE**Date:** 08/11/1996

To: New York **Attn:** ASAC George H. Andrew

From: [redacted]
I-46

b7C

Approved By: [redacted]

Drafted By: [redacted]emf

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EID

Synopsis: Contact with NTSB representative.

Details: [redacted] was contacted regarding status of investigation and autopsies being conducted at the Medical Examiner's Office. [redacted] was also contacted regarding a database being put together in connection with the autopsy information, this will be addressed on a separate communication.

b7C

[redacted] advised that the Medical Examiners at the SCMEO are not in receipt of any clothing worn by any of the victims. [redacted] would like to have the ability to review this clothing to correlate injuries on the bodies with the apparel they were wearing.

[redacted] advised that autopsies should be completed by the middle of this coming week. After the autopsies are completed, the team of medical doctors at the SCMEO, which consists of the Medical Examiner, an FAA Medical Doctor and a Colonel from the Military acting in a consulting role for the NTSB will conduct a quality review of the data and autopsy reports generated and initiate a force vector analysis. The force vector analysis will be a review of all the damage done to the victims thus far recovered in an attempt to determine and plot the various trajectories with which debris hit the bodies.

b7C

265A-NY-259028-SUB-FF3
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11/19/96

224016

[redacted] was advised of the interest of the FBI in being involved in this review. [redacted] informed that this would be welcomed. Previous steps have been taken to have an investigator from the squad involved with this process. b7C

[redacted] was also interested in ensuring that the seats, seat backs, seat cushions, etc., were all thoroughly reviewed for any fragments of foreign objects that may be contained within. [redacted] recommended the utilization of an X-ray machine to conduct X-rays on all seat cushions, seat backs, etc., to ensure that any foreign objects are removed from these items.

[redacted] advised that foreign objects being removed by the medical examiners from the bodies of the victims have been provided to the FBI.

Review of FD-192s discloses numerous green sheets reflecting foreign material being removed from victims' bodies. These bodies are being identified through a body number code. Per FD-192s, these are being stored at the hazardous material room at Grumman.

If not already done so:

Attempts should be made to identify the fragments removed from the bodies as to particular plane parts and areas. This will be particularly useful when trying to conduct trajectory analysis and determine the origin of forces..

- Identify seats recovered thus far by seat location, conduct X-ray of the seats to ensure that no fragments remain in them.

- X-ray seat cushions recovered. Is it possible to match seat cushions recovered with the seats from which they came? Are any cushions being recovered separated. If not, when they are separated are they referenced to the seat from where they came?

- Identify clothing recovered thus far through the body number. Examine this clothing for trajectory analysis, remaining debris, etc.

- Assign an investigator from the task force to work with the medical doctors in conducting this review and coordinating the flow of information needed to perform and complete force vector analysis as described above.

CC: 1 - SSA [redacted] b7C
1 - SSA
1 - SA
1 - Det.

OPCA-20 (12-3-96)

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FEDERAL BUREAU OF INVESTIGATION
FOIPA
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☑ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
Rule 6(e) Federal Rules	☐ (b)(7)(D)	☐ (k)(2)
of Criminal Procedure	☐ (b)(7)(E)	☐ (k)(3)
	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
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FD-302 (Rev. 3-10-82)

FEDERAL BUREAU OF INVESTIGATION

Date of transcription 1/3/97

On the below date, the below listed Detective (DET.) and Special Agent (SA) met with [redacted] of Mortuary Services, New York City Medical Examiners (ME) Office, [redacted] provided the below SA and DET. one plastic bag containing what has been preliminarily identified as a female femur bone contained in ME case number [redacted] also provided copies of NYCPD reports concerning this item. b7C b7C/b6

The following is a summary of information contained in the NYCPD reports which will be retained in the 1A section of this file:

This bone was found on the beach approximately five (5) miles west of Montauk Point on 12/22/96 at around 4:30 PM by [redacted] transported the bone to her residence in Manhattan where she soaked the bone in bleach and water. On 12/28/96, [redacted] brought the bone to the 19th Precinct of the NYCPD where she was interviewed by NYCPD Police Officer [redacted] who obtained possession of this bone under NYCPD Form 61 case number 19902.. This bone was subsequently provided to the ME's office wherein [redacted] made the identification of the bone as being a human femur, possibly a female. b7C

NYC ME's office was in contact with [redacted] of the Suffolk County ME's (SCME) office, 516-853-5555, who requested that the remains be provided to SCME as it's origin may be the crash of TWA flight 800 on 7/17/96.

SA [redacted] and DET. [redacted] transported this bone to the SCME where custody was given to SCME [redacted] 516-853-5555. b7C

1/7/97

265A-NY-259028-SUB FF3 - 15

b7C

Investigation on 1/2/97 at New York, New York

File # 265A-NY-259028 SUB FD302 & SUB FF3

by DET.
SA [redacted]

Date dictated 1/3/97

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FD-302 (Rev. 10-6-95)

- 1 -

FEDERAL BUREAU OF INVESTIGATION

Date of transcription 3/31/97

The following investigation was conducted by SA [redacted] Federal Bureau of Investigation on March 27, 1997 at the Sufflok County Medical Examiner's Office, North County Complex, Hauppauge, New York:

In answer to a Federal Grand Jury Subpoena, [redacted]

[redacted]

b7C

b3

4-13-00 SRS/JC/PVN

265A-NY-259028-SUB FF3-20

UPL...
W... ✓
W... OTTE...
BY M
DATE 4/2/97

SEARCHED ___ INDEXED ___
SERIALIZED ___ FILED ___
MAR 3 1 1997
FBI — NEW YORK
[redacted]

b7C

Investigation on 3/27/97 at HAUPPAUGE, NEW YORK

File # 265A-NY-259028 Date dictated 3/31/97

by SA [redacted]

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181859Z APR 97

FBI NEW YORK (265A-NY-259028) (P) (I-46)

DIRECTOR FBI/PRIORITY/

CLAS

TE: //3540//

SS: FBIHQ FOR SSA [redacted] ITU; SSA [redacted]

PLOSIVES UNIT, LABORATORY.

b7C

BJECT: UNSUB(S); EXPLOSION OF TWA FLIGHT 800; JULY 17,

96; AOT-IT-EID; OO:NY.

AS PART OF THE CONTINUING INVESTIGATION INTO THE CAUSE OF

CRASH OF TWA FLIGHT 800, NEW YORK HAS HIRED [redacted] WHO

b7C

ECIALIZES IN CORRELATING THE INJURIES AND/OR CAUSE OF DEATH

VICTIMS AS THEY APPLY TO AIRCRAFT CABIN/STRUCTURAL DAMAGE.

82

265A-NY-259028 SUB FF

SEARCHED ___ INDEXED ___
SERIALIZED ___ FILED ___
APR 1 2 1998
FBI — NEW YORK
[redacted]

ALL INFORMATION CONTAINED
HEREIN IS UNCLASSIFIED
DATE 4-13-00 BY SP5/ JC/PVN

4/22/97

b7C

E TWO DE FBINY 0009 UNCLAS

K FORCE AGENTS [redacted] WILL b7c

ELOP GEOGRAPHICAL DISPLAYS AND ENHANCE THE FINDINGS OF NEW
ORMATION RECEIVED FROM THE SUFFOLK COUNTY MEDICAL
MINER'S OFFICE, AS WELL AS THE RECENT MISSILE TESTING IN
SON, ARIZONA THAT THE FBI LABORATORY EXPLOSIVES UNIT TOOK
T IN.

NEW YORK IS AWARE THAT ALL FOREIGN MATERIAL FOUND IN OR
THE VICTIM BODY DURING THE AUTOPSY WAS/WERE HIGHLY
UTINIZED BY FBI BOMB TECHS. HOWEVER, IN AN EFFORT TO FULLY
ISFY ALL AVENUES AS THEY RELATE TO THE MISSILE THEORY, NEW
K REQUESTS ALL DOCUMENTATION AND ACTUAL SAMPLES TAKEN FROM
SE TESTS FOR USE IN COMPARISON TO ACTUAL FRAGMENTS FOUND IN
VICTIM BODIES.

IT SHOULD BE UNDERSTOOD THAT THE FORENSIC ANALYSIS IN
S CASE IS ONLY USED AS AN INVESTIGATORY TOOL TO EITHER
PORT OR DISCOUNT A THEORY. THEREFORE, THE BODIES
MSELVES DID NOT TELL US WHAT HAPPENED TO THIS PLANE.

[redacted] AND TASK FORCE AGENTS WILL BEGIN THIS b7c
LYSIS THE WEEK OF APRIL 28 THROUGH MAY 6 AT THE GRUMMAN
CILITY IN CALVERTON, LONG ISLAND. NEW YORK WOULD APPRECIATE
Y INFORMATION PROVIDED FROM THE FBI LABORATORY TO AID IN

;E THREE DE FBINY 0009 UNCLAS

:S ANALYSIS.

)09

IN

Automated Serial Permanent Charge-Out
FD-5a (1-5-94)

Date: 05/08/97 Time: 09:43

Case ID: 265A-NY-259028-FF3 Serial: 83

Description of Document:

Type : TELETYPE
Date : 04/18/97

To   : ATHENS, et al.
From : NEW YORK
Topic: MRI 1125/108

Reason for Permanent Charge-Out:

INADVERTENTLY UPLOADED.

Employee: [redacted]

b7C

2

U.S. Department of Justice

United States Attorney
Eastern District of New York

ZWC:VC:atb
F. #9603373
VC970004.6E

United States Attorney's Office
225 Cadman Plaza East
Brooklyn, New York 11201

April 7, 1997

b7c

[redacted]
Special Agent
Federal Bureau of Investigation
26 Federal Plaza
New York, NY 10278

Re: Investigation Before the Regular Friday
<u>Grand Jury Impanelled on July 1, 1996</u>

b7c

Dear Special Agent [redacted]

Pursuant to Rule 6(e) of the Federal Rules of Criminal Procedure, I have written a letter dated April 7, 1997 to Chief Judge Sifton of the United States District Court for the Eastern District of New York, notifying him to whom I may be disclosing grand jury matters in the above-referenced investigation.

I am obligated by Rule 6 to advise you, and those to whom I have addressed a copy of this letter, as a potential recipient of grand jury information, of the secrecy obligations imposed by that provision. Rule 6(e) provides in relevant part:

> 6(e)(2) **General Rule of Secrecy....** (A)n attorney for the government, or any person to whom disclosure is made under paragraph (3)(A)(ii) of this subdivision shall not disclose matters occurring before the grand jury, except as otherwise provided for in these rules.
> ...

265A-NY-259028-SUB FF3
84

SEARCHED ___ INDEXED ___
SERIALIZED ___ FILED ___
APR 25 1997
FBI-NEW YORK
[redacted]

b7c

6(e)(3) **Exceptions.**
(A) Disclosure otherwise prohibited by this rule of matters occurring before the grand jury, other than its deliberations and the vote of any grand juror, may be made to....

(ii) such government personnel... as are deemed necessary by an attorney for the government to assist an attorney for the government in the performance of such attorney's duty to enforce federal criminal law.

(B) Any person to whom matters are disclosed under subparagraph (A)(ii) of this paragraph shall not utilize that grand jury material for any purpose other than assisting the attorney for the government in the performance of such attorney's duty to enforce federal criminal law.

Thus, grand jury matters disclosed to you in conjunction with your participation in this investigation should not be revealed to or discussed with anyone but an attorney for the government and the members of your agency receiving a copy of this letter. If you feel that such grand jury matters should be disclosed to additional individuals, please discuss this with me before making any such disclosure.

Very truly yours,

ZACHARY W. CARTER
United States Attorney

By: Valerie Caproni
Valerie Caproni
Assistant U.S. Attorney
(718) 254-6336

PCA-20 (12-3-96)

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FEDERAL BUREAU OF INVESTIGATION
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FBI/DOJ

FEDERAL BUREAU OF INVESTIGATION

Date of transcription 5/2/97

On the below date, Special Agent [redacted] New York Office of the Federal Bureau of Investigation, met with [redacted] Suffolk County Medical Examiner's Office (MEO), Hauppauge, New York, telephone number (516)853-5555. With the authorization of [redacted] provided the MEO x-ray records for the following MEO cases: b7c

All TWA Flight 800 Victims.

The above records were provided for official purposes in connection with the investigation involving TWA Flight 800 on 7/17/96.

The above records are to be returned to the MEO at the earliest possible time.

Investigation on 5/1/97 at Hauppauge, New York

File # 265A-NY-259028 SUBS FD302 AND FF3 Date dictated 5/2/97

by SA [redacted] CG:cg b7c

OPCA-20 (12-3-96)

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FEDERAL BUREAU OF INVESTIGATION
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265A-NY-259028-SUB FF3 88 through 90

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U.S. Department of Justice

Federal Bureau of Investigation

In Reply, Please Refer to
File No.

26 Federal Plaza
New York, New York 10278
May 20, 1997

[redacted] b7C
Suffolk County Medical Examiner's Office
Building # 487, North County Complex
Hauppauge, NY

ATTN: [redacted] VIA FACSIMILE # [redacted]

Dear [redacted]

In connection with the official investigation concerning TWA flight 800, your office has previously provided substantial information and assistance. In continuing this investigation the following Medical Examiner (ME) numbers have been identified, however, their association with any of the victims has not been determined. In all of the cases the ME numbers are associated with partial remains and may in some cases not be related to this investigation.

Your assistance in identifying any association of the attached list of ME numbers to the victims in this investigation is appreciated.

Special Agent [redacted] is handling this aspect of the investigation and may be contacted at telephone numbers 516-369-3313 or [redacted] Your response may be sent to facsimile number [redacted] b7C

[redacted] /JAS

Supervisory Special Agent

For: James K. Kallstrom
Assistant Director In Charge
FBI New York Office

Attached: 1 Page

265A-NY-259028-SUB -ff3 -91

SEARCHED INDEXED
SERIALIZED FILED
MAY 21 1997
FBI — NEW YORK

4-13-00 SPS/JCL

OPCA-20 (12-3-96)

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FEDERAL BUREAU OF INVESTIGATION
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265A-NY-259028 FF3 91 page 2

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FEDERAL BUREAU OF INVESTIGATION

Date of transcription 5/20/97

On the below date, the below listed Special Agent (SA) met with [redacted] representing the Suffolk County Medical Examiner's Office (SCMEO), Building 487, North County Complex, Hauppauge, New York, 516-853-5555. SA [redacted] provided [redacted] with 3,521 color photographic slides which are the property of the SCMEO which had been obtained by SA [redacted] on 4/11/97.

b7C

These slides depict the SCMEO photographs taken of the victims of the crash of TWA flight 800. These slides have been duplicated into photographs by the FBI New York Office (NYO) photo lab. These photographs are being maintained in a secure location and are being utilized in conducting a victim injury analysis. Assisting in this analysis are [redacted] U.S. Army Aeromedical Research Center, Ft. Rucker, Alabama and [redacted] National Transportation Safety Board (NTSB), W.D.C., [redacted]

b7C

These slides were maintained in the custody of SA [redacted] and the NYO photo lab while in possession of the FBI.

CONTAINED ... 4-13-00 BY SPS

265A-NY-259028-SUB - FF3 92

SEARCHED INDEXED SERIALIZED FILED MAY 21 1997 FBI — NEW YORK

Investigation on 5/16/97 at Calverton, New York

File # 265A-NY-259028-SUB FD302 & SUB FF3

by SA [redacted] /fjs Date dictated 5/20/97

b7C

FBI FACSIMILE

COVERSHEET

PRECEDENCE

- [X] Immediate
- [ ] Priority
- [ ] Routine

CLASSIFICATION

- [ ] Top Secret
- [ ] Secret
- [ ] Confidential
- [ ] Sensitive
- [X] Unclassified

Time Transmitted: 2:45P.M.
Sender's Initials: RSK
Number of Pages: 3
(including coversheet)

To: OFFICE OF THE ARMED FORCES MEDICAL EXAMINER — Date: 5/27/97
Name of Office

Facsimile Number: [redacted] b7C

Attn: [redacted]
Name Room Telephone

From: FEDERAL BUREAU OF INVESTIGATION
Name of Office

Subject: REQUEST THE ASSISTANCE OF TWO (2) PATHOLOGISTS FROM THE ARMED FORCES INSTITUTE OF PATHOLOGY (AFIP)

Special Handling Instructions: PLEASE DELIVER TO [redacted] b7C IMMEDIATELY.

Originator's Name: SA [redacted] Telephone: [redacted]

Originator's Facsimile Number: [redacted]

Approved: NTM

Brief Description of Communication Faxed:

265A-NY-259028-SUB FF3 93

SEARCHED ___ INDEXED ___
SERIALIZED ___ FILED ___
MAY 27 1997
FBI — NEW YORK
[redacted] b7C

ALL INFORMATION CONTAINED
HEREIN IS UNCLASSIFIED
DATE 4-13-00 BY SPS JC/PVN

U.S. Department of Justice

Federal Bureau of Investigation

In Reply, Please Refer to
File No.

26 Federal Plaza
New York, New York 10278
May 27, 1997

Office of the Armed Forces Medical Examiner
[redacted] Medical Examiner
1413 Research Boulevard
Rockville, Maryland 20850

b7C

Re: National Transportation Safety Board (NTSB) letter dated May 23, 1997, to the Office of the Armed Forces Medical Examiner

Dear [redacted]

b7C

In furtherance of an ongoing investigation being conducted by the Federal Bureau of Investigation (FBI) in conjunction with the NTSB into the matter of Transworld Airlines (TWA) Flight 800, the FBI will incur all expenses (i.e. travel, lodging, etc.) for the services of two (2) pathologists from the Armed Forces Institute of Pathology (AFIP) which have been requested by [redacted] the senior medical consultant to the FBI and NTSB on this matter.

The FBI recognizes that AFIP pathologists' services will be required for a period of two to three weeks during the months of June and July 1997.

Your cooperation in this matter is appreciated.

Sincerely,

JAMES K. KALLSTROM
Assistant Director in Charge

b7C

[redacted]

by:
[redacted]
Supervisory Special Agent

4-13-00 SPS/SC/PVL

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FOIPA
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________	☐ (b)(7)(F)	☐ (k)(4)
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FBI/DOJ

39 pgs.

FD-340 (Rev. 7-29-92)

1A2 265A-NY-259028-SUB 1A

Universal Case File Number

Field Office Acquiring Evidence NYO

Serial # of Originating Document

Date Receiv[redacted] 7/16/97

From [redacted] b7C
(Name of Contributor)

FBI NYO
(Address of Contributor)

[redacted]
(City and State)

By [redacted]
(Name of Special Agent)

To Be Returned ☐ Yes ☒ No

Receipt Given ☐ Yes ☒ No

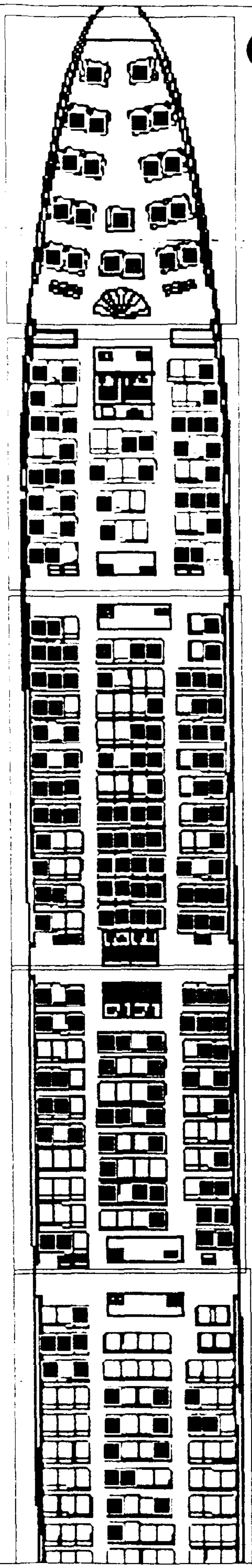
Grand Jury Material - Disseminate Only Pursuant to Rule 6 (e)
Federal Rules of Criminal Procedure
☐ Yes ☒ No

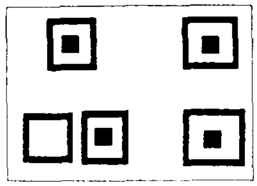
Title:

TWA 800 FF3-108

Reference [redacted] E/C dated 9.26.97 b7C
(Communication Enclosing Material)

Description: ☒ Original notes re interview of
Computer Charts of victim injury
to seats (38)





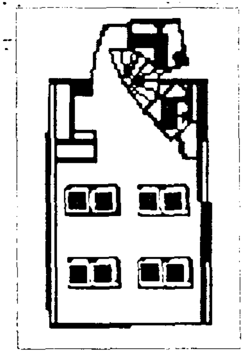
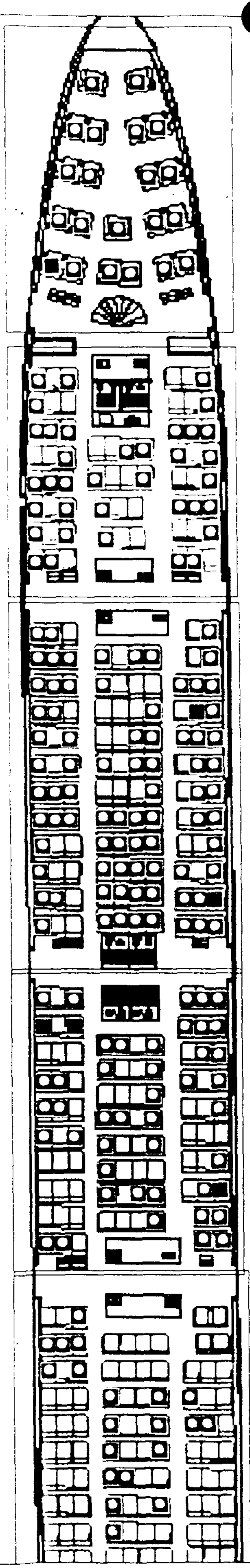
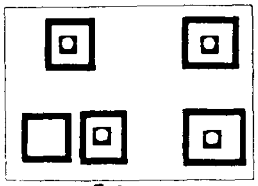


Chart 4.1
Assigned Seats (216)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

Assign 071497





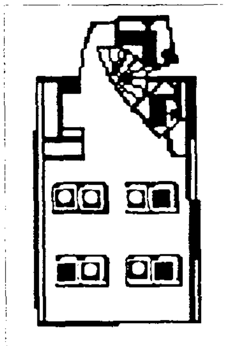


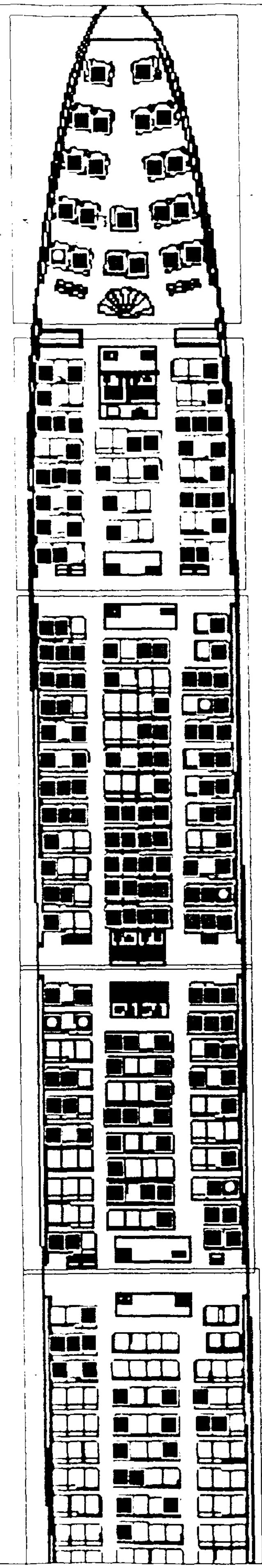
Chart 4.2
Assigned Seats with Recovered Victims

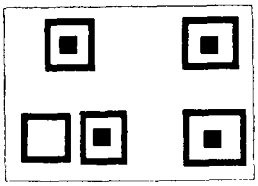
◷ Recovered victims (207)

■ Assigned seats (216)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

AsgnRcvr 071497





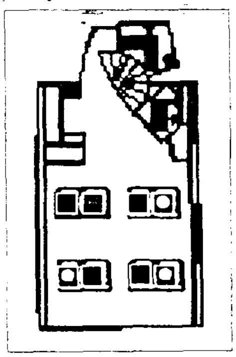


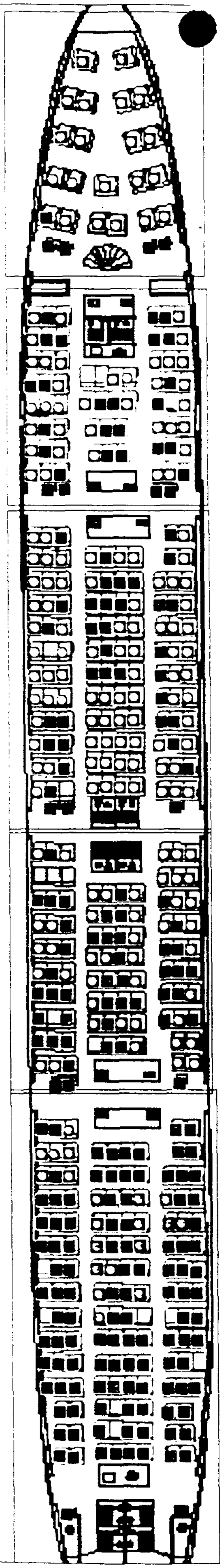
Chart 4.3
Assigned Seats with Unrecovered Victims

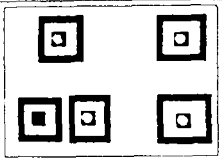
○ Unrecovered victims (9)

■ Assigned seats (216)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

AsgnUnRc 071497





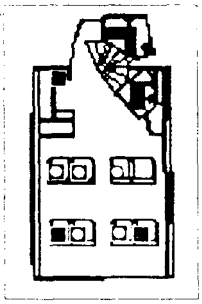


Chart 4.4
Seats and Victims Recovered

◉	Recovered victims (207)
■	Recovered seats (420)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

RcvStVc 071697

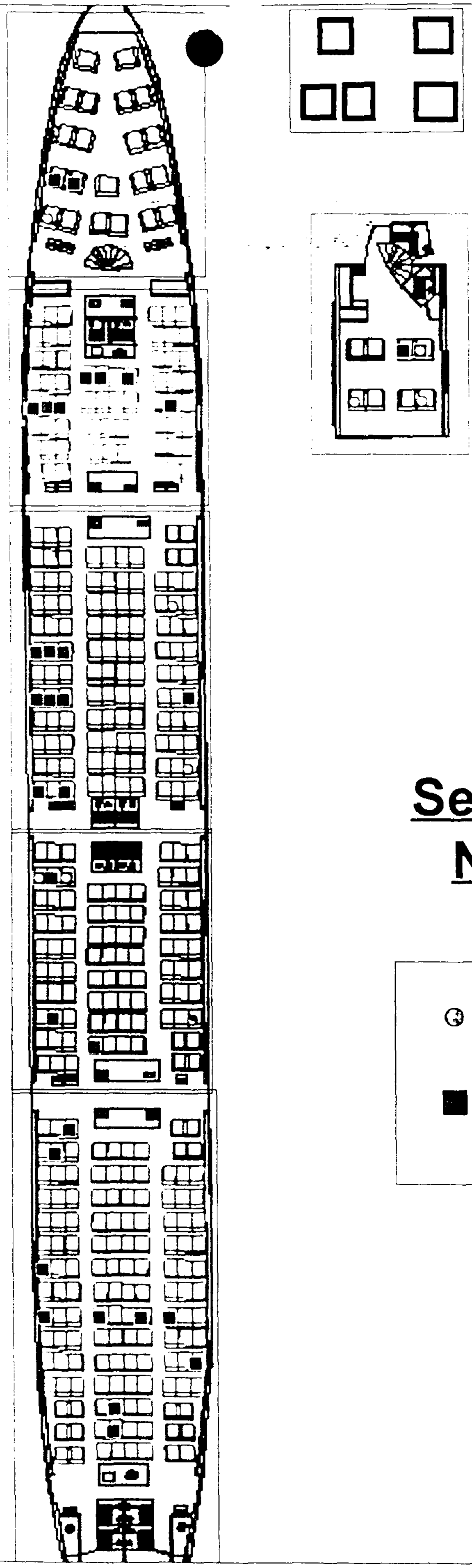


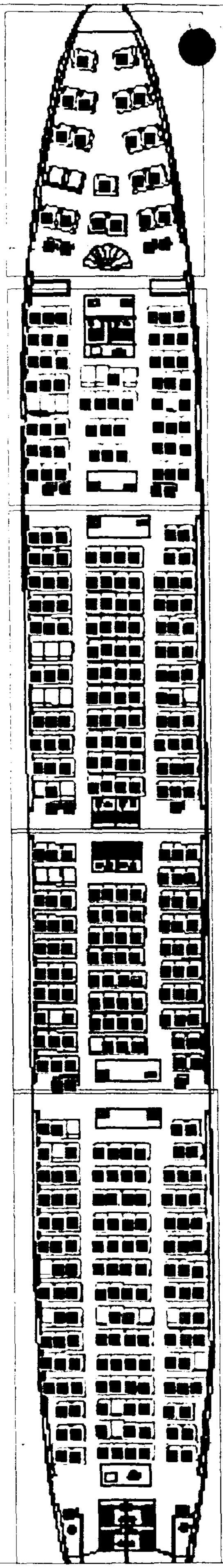
Chart 4.5
Seats and Victims Not Recovered

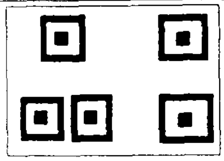
Victims not recovered (9)

Seats not recovered (35)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

UnRcvStVc 071697





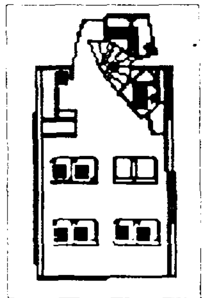


Chart 4.6 Recovered Seats and Fire Damaged Seats

○ Fire Damaged Seats (66)

■ Recovered seats (420)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

Fire Seat 071697

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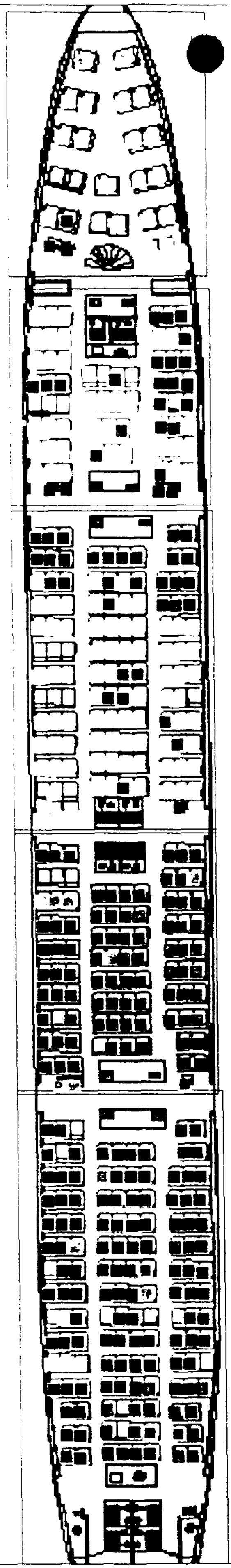

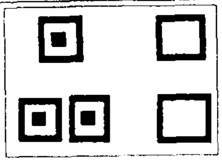

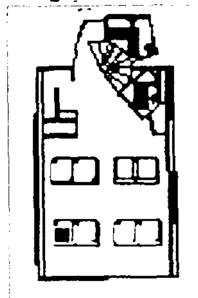

Chart 4.8
Seat Damage

- Minimal (17)
- Moderate (33)
- Severe (28)
- Destroyed (157)
- Fragmented (185)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

StDam 071697

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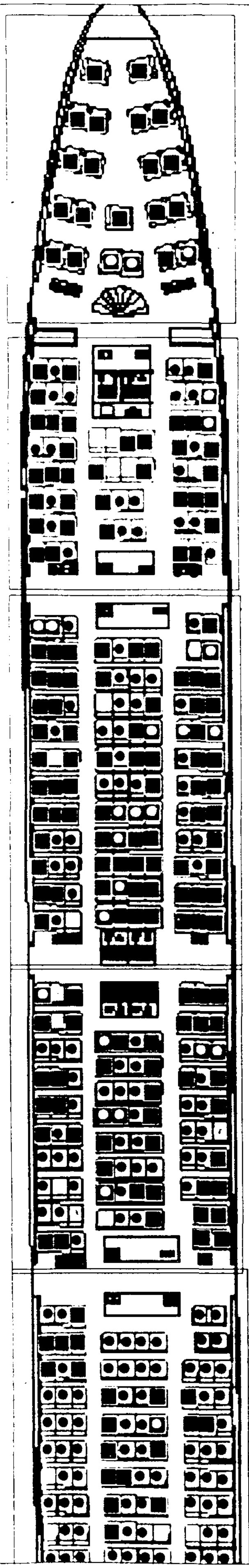

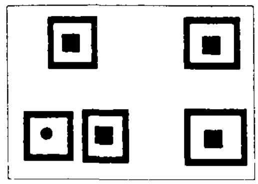

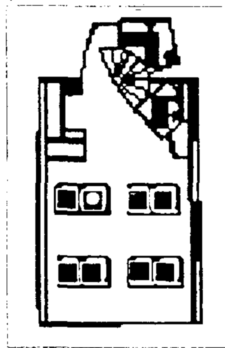

Chart 4.10 Evidence of Seat Restraint Use

- ● Yes (23)
- ◷ Likely (34)
- ● Possible (40)
- ● Unknown (323)
- ■ Assigned Seats (216)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

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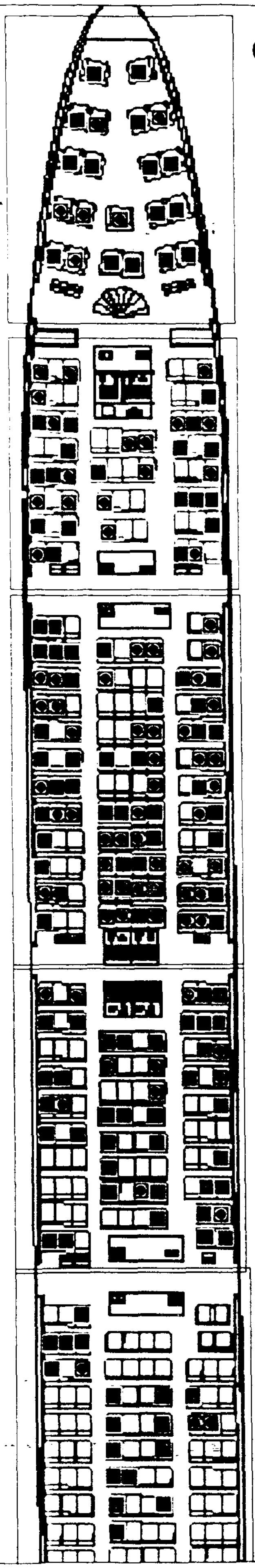

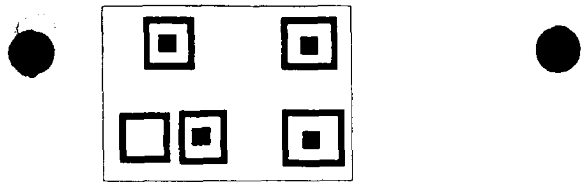

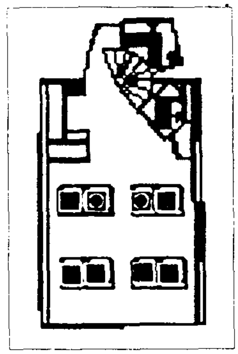

Chart 4.12
Floaters/Assigned Seats

● Floaters (88)

■ Assigned Seats (216)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

FltAsgn 071497

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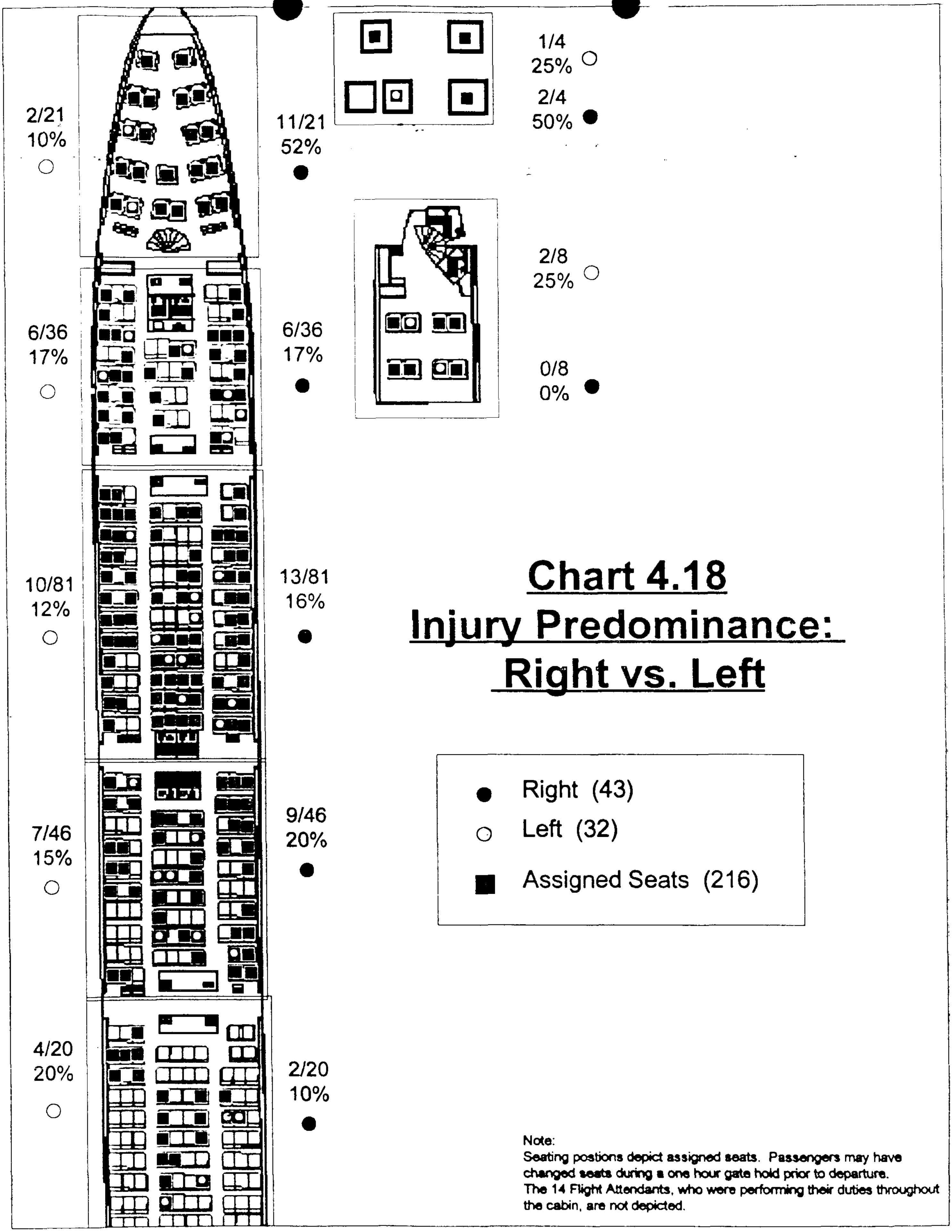
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25%
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2/21
10%
11/21
52%
2/8
25%
0/8
0%
6/36
17%
6/36
17%
10/81
12%
13/81
16%
7/46
15%
9/46
20%
4/20
20%
2/20
10%
Chart 4.18
Injury Predominance: Right vs. Left
Right (43)
Left (32)
Assigned Seats (216)
Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.
RL 071497

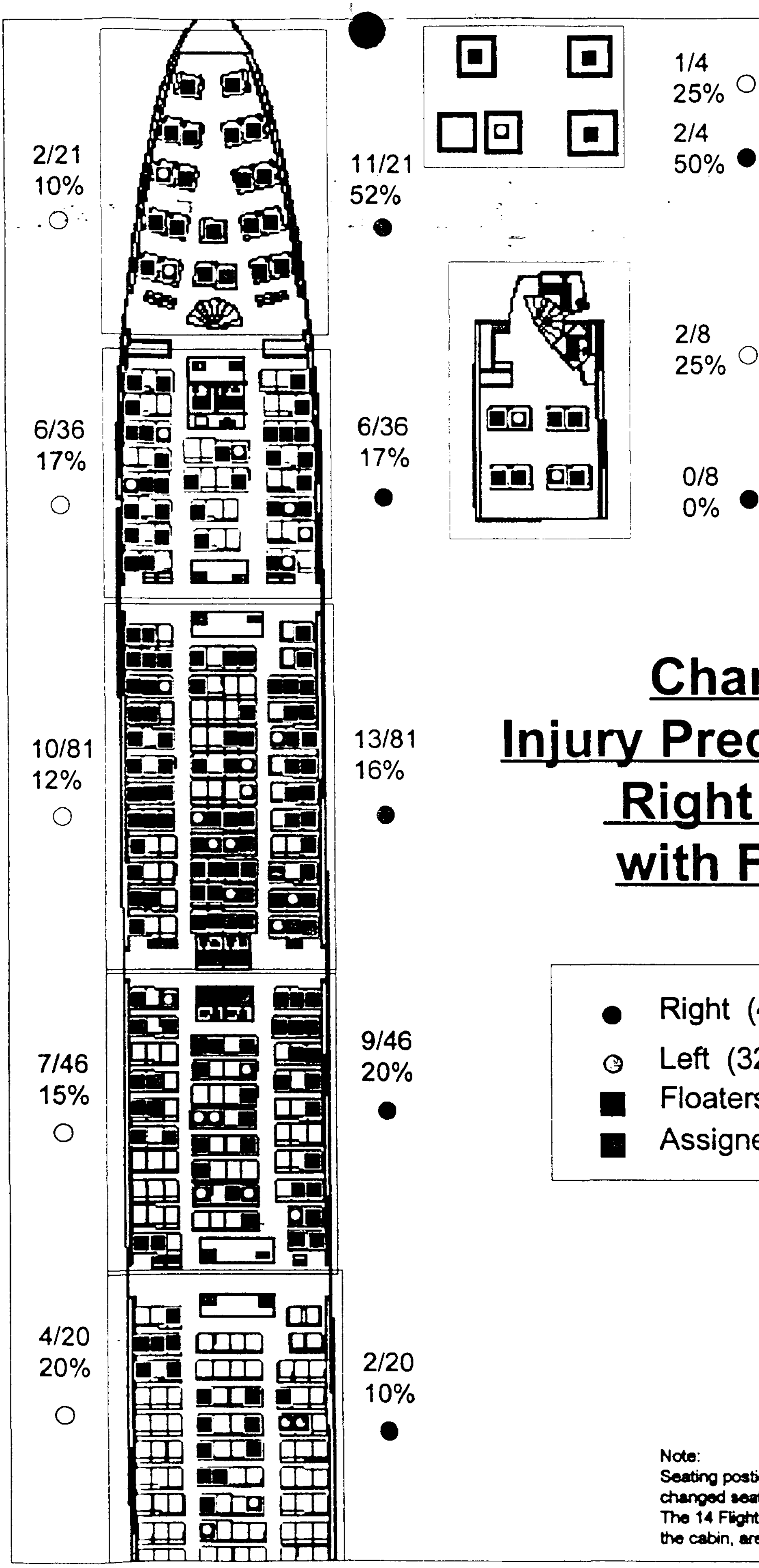
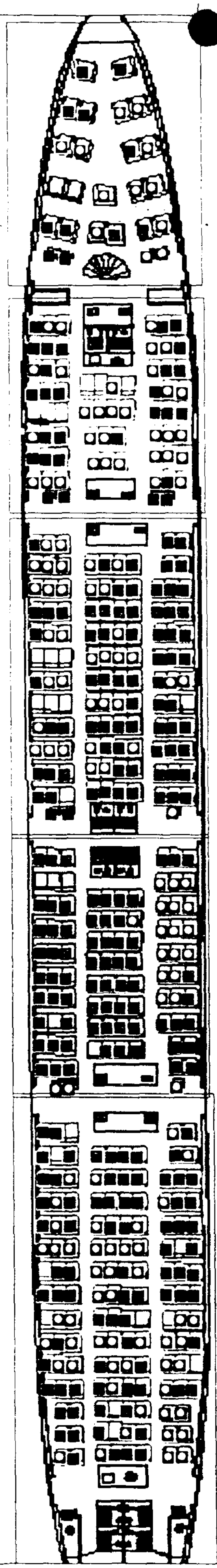


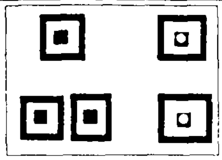
Chart 4.19 Injury Predominance: Right vs. Left with Floaters

- ● Right (43)
- ◎ Left (32)
- ■ Floaters (88)
- ■ Assigned Seats (216)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

RL&Float 071497





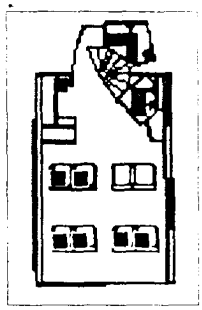


Chart 4.20 Seat Deformation: Right vs. Left

- ● Right Force Vector (191)
- ⊙ Left Force Vector (151)
- ■ Recovered seats (422)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

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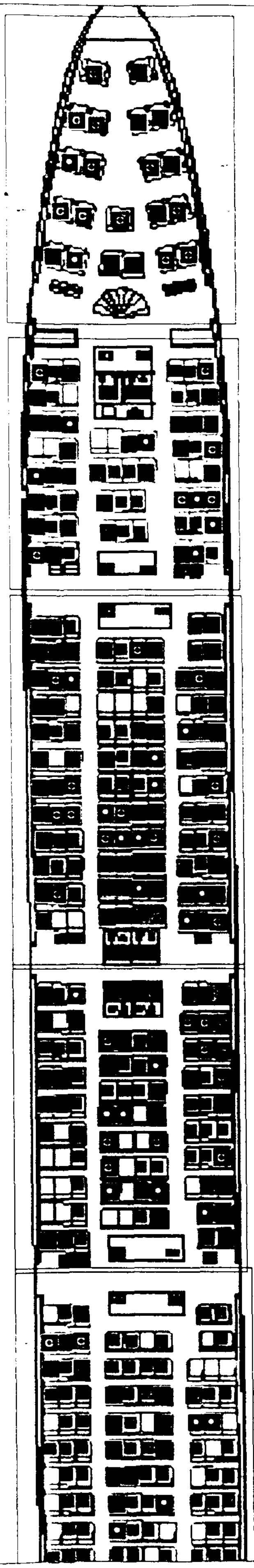
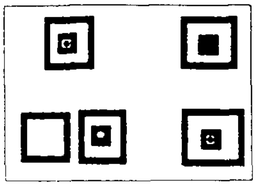




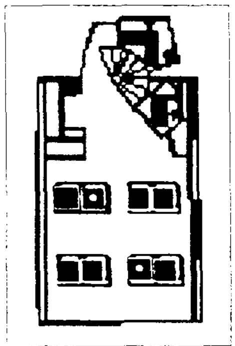


Chart 4.21 Right vs. Left Injury Predominance and Seat Deformation

●	Right Injury (43)
⊙	Left Injury (32)
■	Right Force Vector (191)
■	Left Force Vector (151)
■	Assigned Seats (216)

Seat deformation was determined by visual observation. The orientation of the examination was facing forward and deformation was indicated by the direction in which a given component(s) were bent.

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

RtLandExt_L&Ry 071697

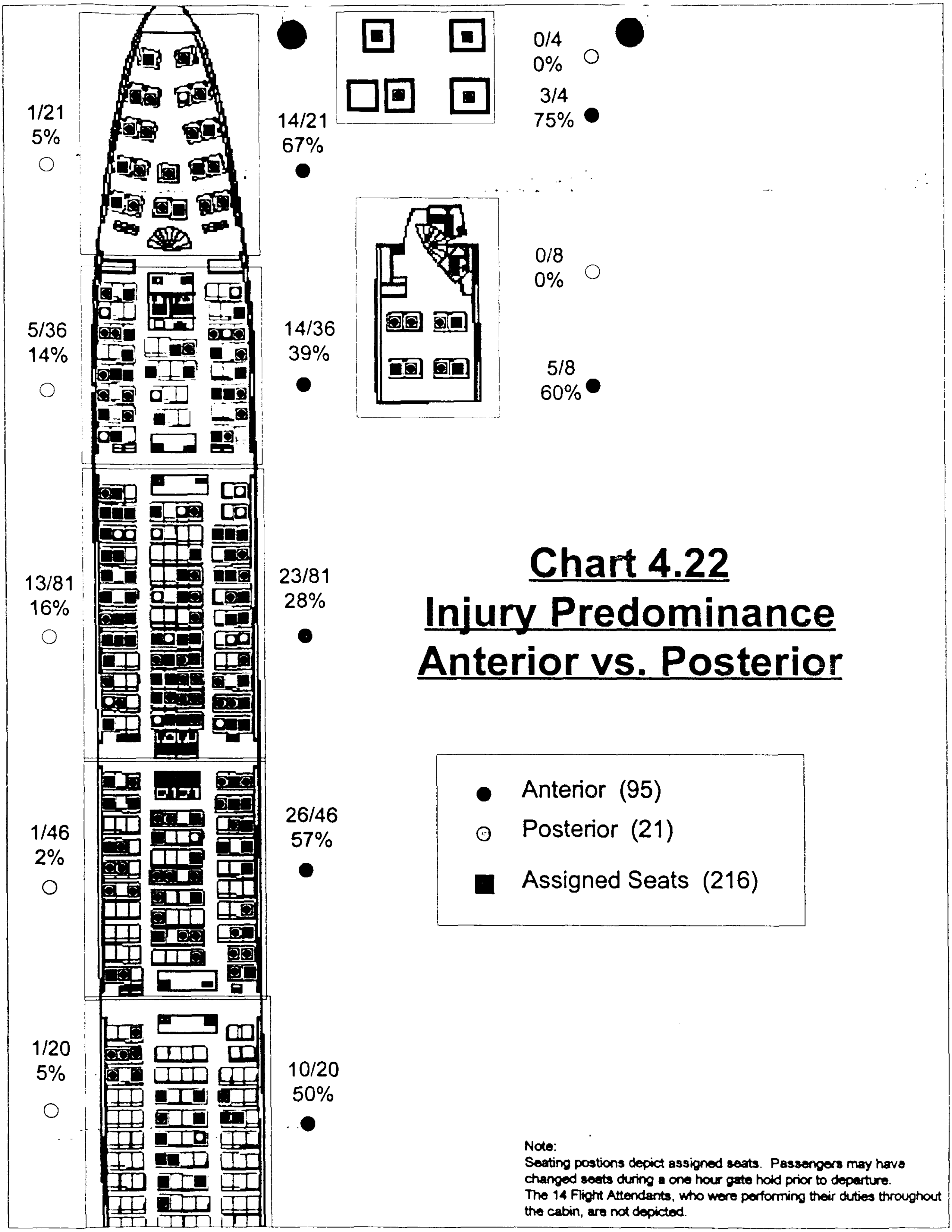
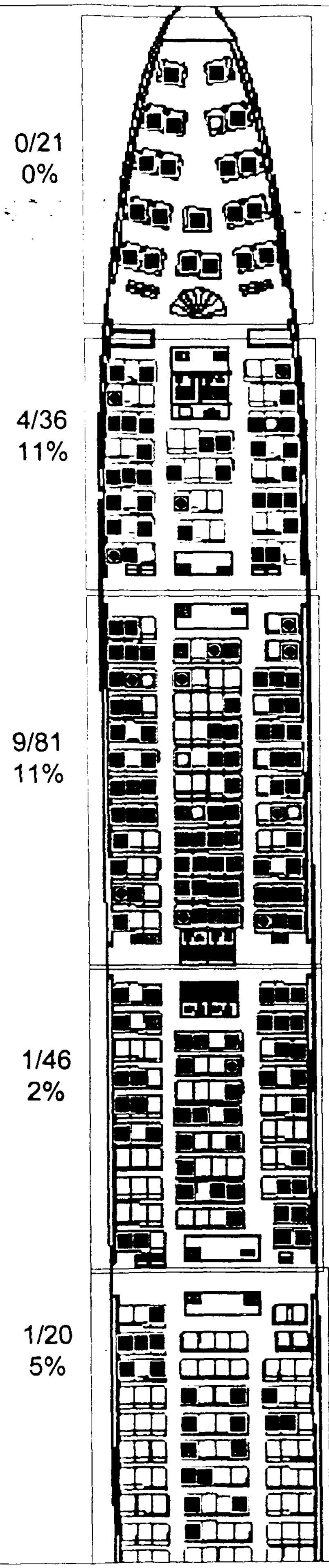


Chart 4.22
Injury Predominance
Anterior vs. Posterior

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

AP 071497



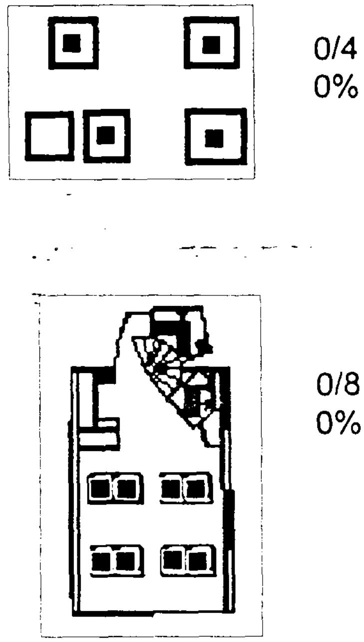


Chart 4.23
Posterior Injuries and Floaters

- ● Posterior Floater (15)
- ○ Posterior Not Floater (6)
- ■ Floaters (88)
- ■ Assigned Seats (216)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

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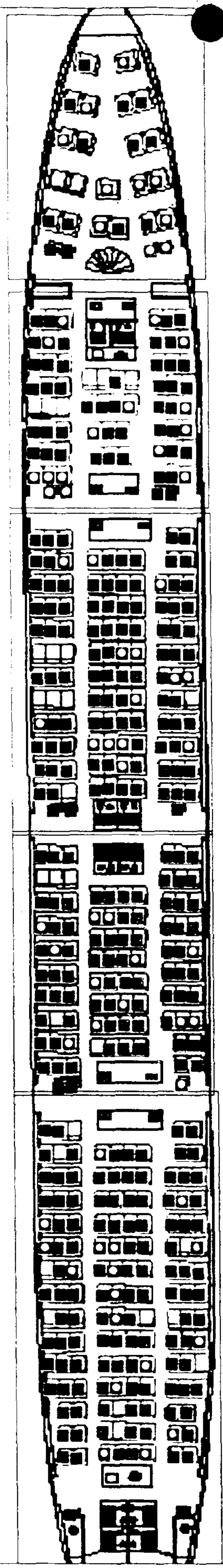

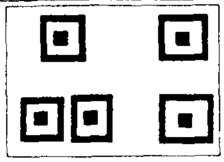

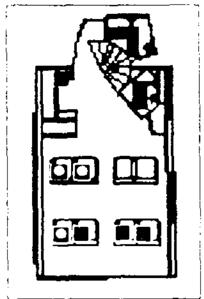

Chart 4.24 Seat Deformation: Fore vs. Aft

●	Fore Force Vector (250)
○	Aft Force Vector (72)
■	Recovered seats (422)

Seat deformation was determined by visual observation. The orientation of the examination was facing forward and defermation was indicated by the direction in which a given component(s) were bent.

Note:

Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.

The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

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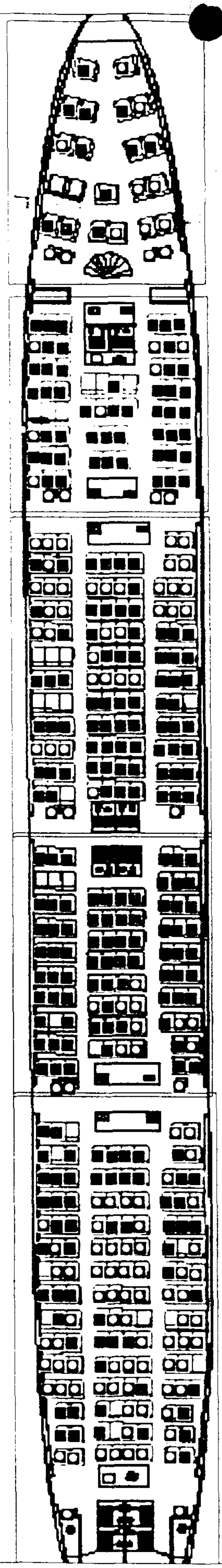

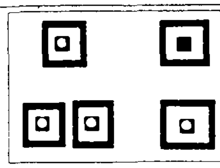

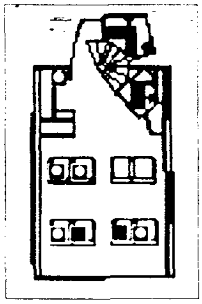

Chart 4.25 Seat Deformation: Up vs. Down

●	Up Force Vector (164)
⊙	Down Force Vector (157)
■	Recovered seats (422)

Seat deformation was determined by visual observation. The orientation of the examination was facing forward and defermation was indicated by the direction in which a given component(s) were bent.

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

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☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
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265A-NY-259028-SUB FF3 108 pages 27-29

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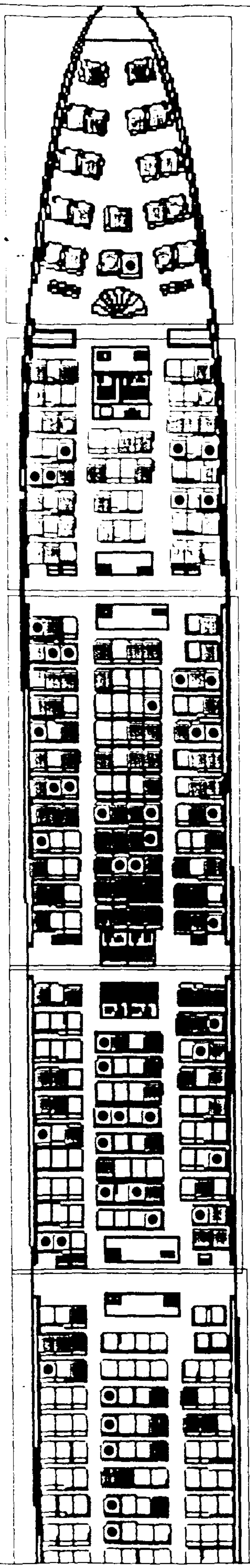

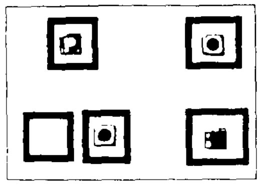

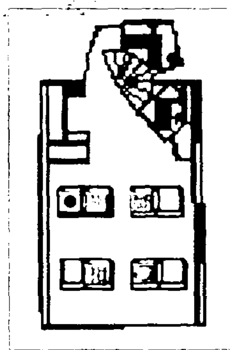

Chart 4.29
Area of Recovery and Recovered Victims

Area of Recovery

- 3 (36)
- 2 (7)
- 1 (16)

■ Recovered victims (207)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

Area 071597

OPCA-20 (12-3-96)

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☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
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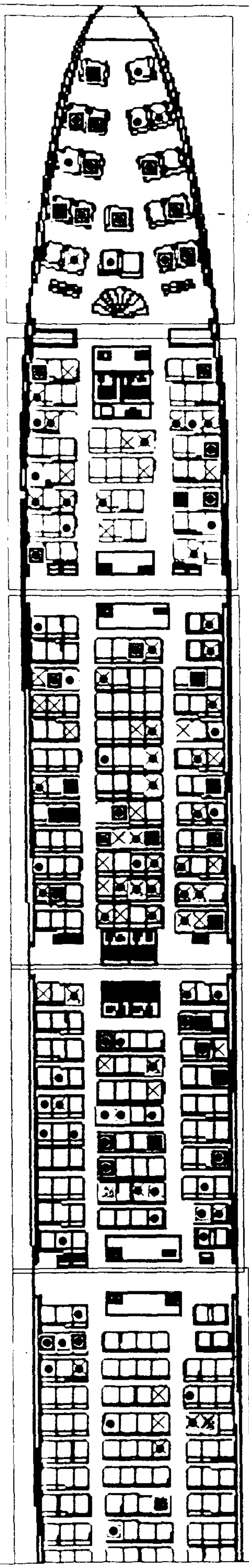

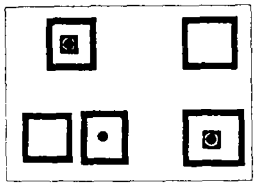

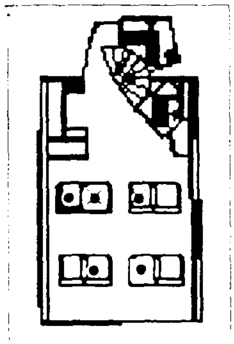

Chart 4.c Floaters with Injury Predominance: Anterior vs. Posterior, Right vs. Left

- ● Anterior (95)
- ● Posterior (21)
- ■ Right (43)
- □ Left (32)
- x Floaters (88)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

APRL&Flt 071597

OPCA-20 (12-3-96)

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265A-NY-259028-SUB FF3 108 pages 34 and 35

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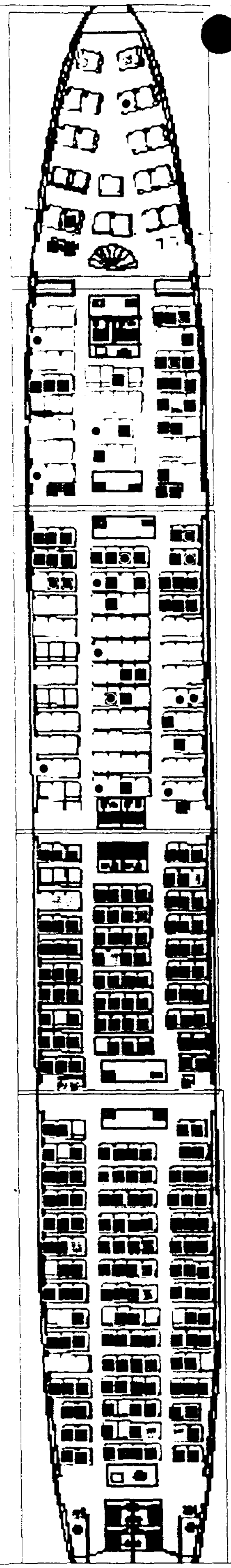

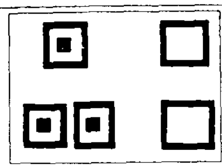

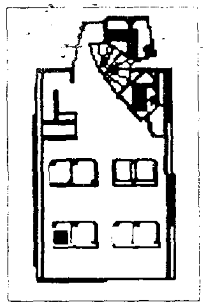

Chart 4.f
Posterior Injury and Seat Damage

- Minimal (17)
- Moderate (33)
- Severe (28)
- Destroyed (157)
- Fragmented (185)
- ● Posterior Injuries (21)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

APpStDam 071697

OPCA-20 (12-3-96)

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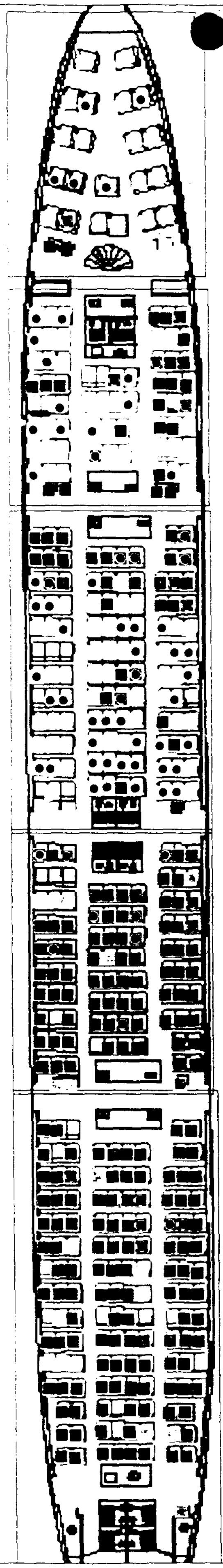

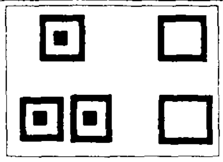

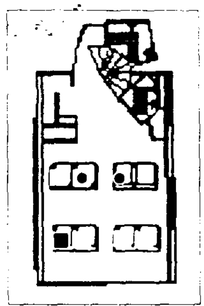

Chart 4.h Floater and Seat Damage

- Minimal (17)
- Moderate (33)
- Severe (28)
- Destroyed (157)
- Fragmented (185)
- Floater (88)

Note:
Seating postions depict assigned seats. Passengers may have changed seats during a one hour gate hold prior to departure.
The 14 Flight Attendants, who were performing their duties throughout the cabin, are not depicted.

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Precedence: ROUTINE **Date:** 07/29/1996

To: NEW YORK **Attn:** SAC, DIVISION I

From: NEW YORK
I-46, DIVISION I
Contact: SA [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted] cmg

File Number(s): 265A-NY-259028 (Pending)

Title: UNSUB(S); EXPLOSION OF TWA FLIGHT 800 ON 7/17/96;
AOT-IT;EID; OO:NY

Synopsis: SUB-FILE ADMINISTRATION

Details: In addition to the main file, the following is a listing of sub files for captioned matter:

SUB A. Outgoing communications.

SUB B. Incoming communications.

SUB C. Administrative Matters.

SUB D. Lead Sheets - Copies of all lead sheets.
D1. 800 Generated Leads
D2. Internet Generated Leads
D3. Miscellaneous Lead - No action to be taken.

SUB E. Secret - To maintain classified information.

SUB F. Press releases and news clippings.

SUB G. Searches
G1. Moriches recovery - reclass to FF.
G2. Articles received from JFK Airport.

SUB H. Claims of responsibilities.

SUB I. Logs - copies of Daily Activity Log.

SUB J. Top Secret - maintained in I-46 safe.

265A-NY-259028-SUB FF2-

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1996
FBI — NEW YORK

4-13-00 SP5/JHNA derivative
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HEREIN IS UNCLASSIFIED EXCEPT
WHERE SHOWN OTHERWISE

To: NEW YORK From: NEW YORK
Re: 265A-NY-259028, 07/29/1996

SUB K. Investigative reports of outside Agencies/Police Departments.

SUB FD302 The original and one copy of FD302's.

SUB INS The original and one copy of inserts.

SUB BC Background checks.

SUB CE Draft requests and financial related documents.

SUB LAB Lab reports.

SUB SPB Copies of subpoenas issued.

SUB TEL Telephone subscriber and toll information.

SUB AA. Flight Related investigative matters.
- AA1. Flight 800 passenger manifest.
- AA2. Interviews
- AA3. Flight 800 cargo manifest.
- AA4. Flight 881 passenger manifest.
- AA5. Flight 881 cargo manifest.
- AA6. Maintainance Flight 800.

SUB BB. Previous bomb threats and related matters.

SUB CC. Possible missile attack.
- CC1. Interviews - Land Canvass
- CC2. Interviews - Technical Data
- CC3. Interviews - Vessels and Aircraft
- CC4. Interviews - Marinas
- CC5. Stolen Crafts
- CC6. Police Canvass - Unusuals

SUB DD. Airport Related/Port Authority
- DD1. [redacted] Information
- DD2. Pay Telephone Dumps
- DD3. Stolen/Abandoned vehicles at airports

b3

SUB EE. Manifest of International Flights.

SUB FF. Recovery effort - Moriches/Grumman
- FF1. Copies of Outgoing Leads/Lab Request
- FF2. Lab reports
- FF3. Medical Examiner Reports

To: NEW YORK From: NEW YORK
Re: 265A-NY-259028, 07/29/1996

FF4. Temporary Morgue Reports
FF5. Dive Sheet/Logs

b1

[redacted]

(S)

OPCA-20 (12-3-96)

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FEDERAL BUREAU OF INVESTIGATION
FOIPA
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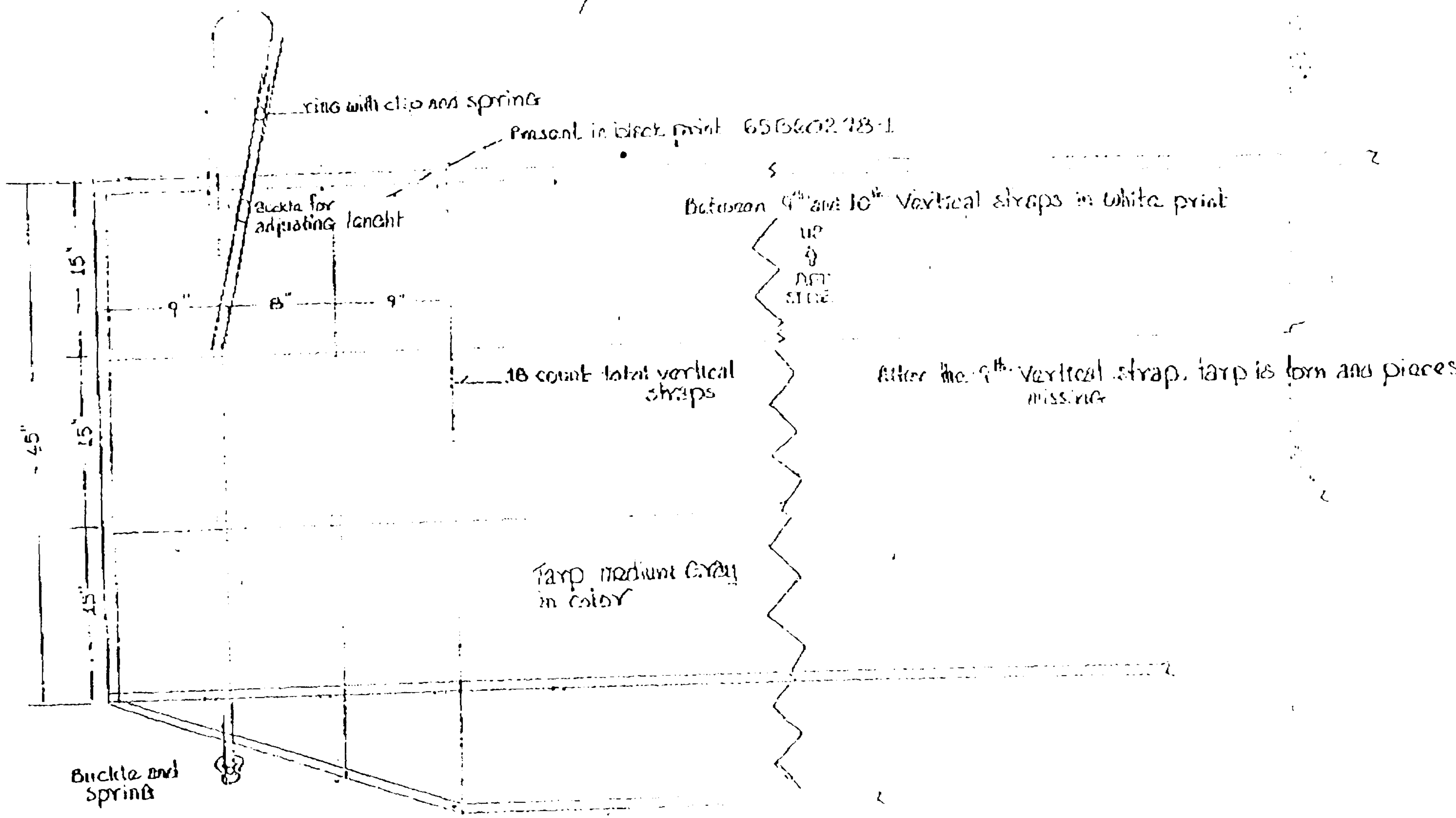

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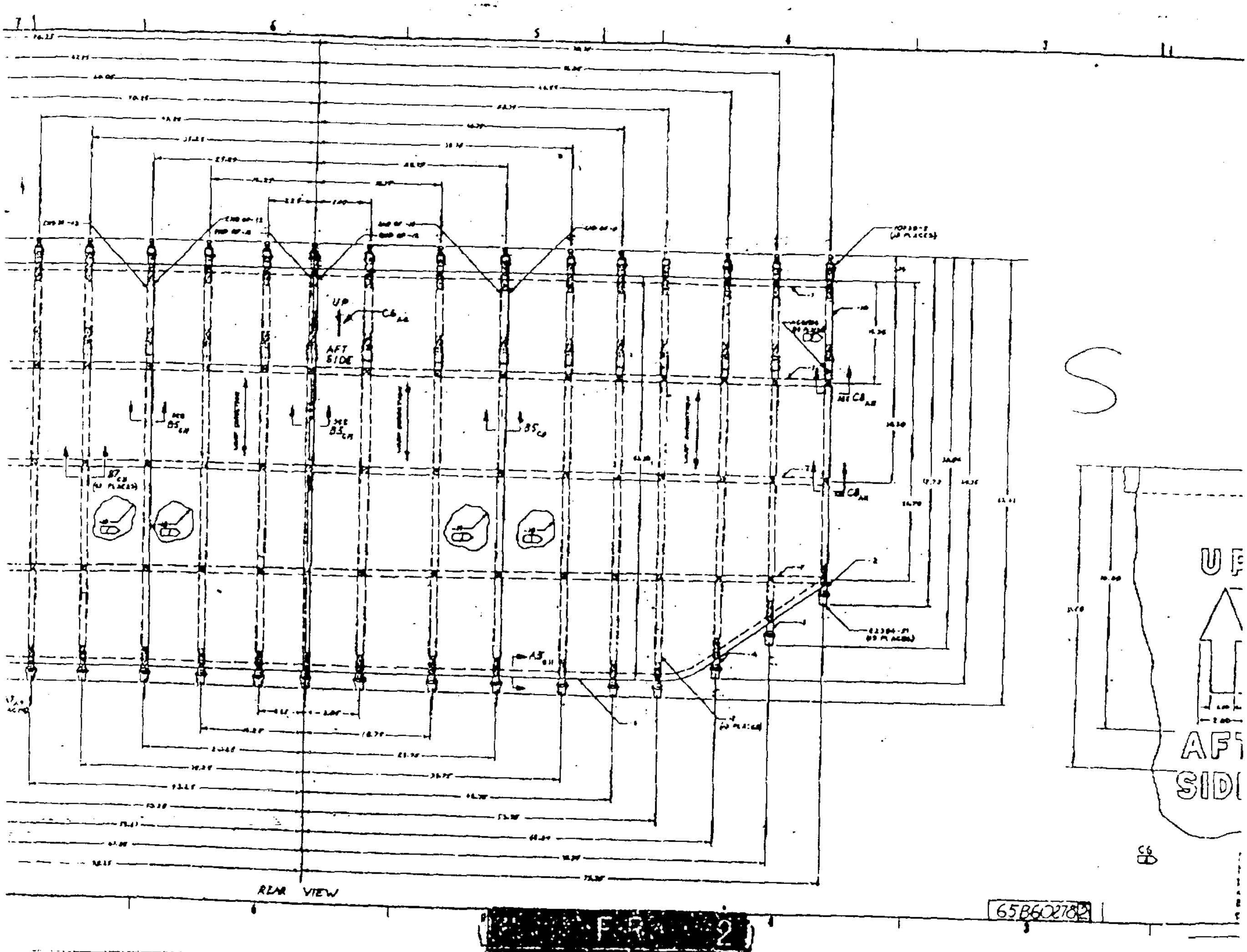
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AFT SIDE
REAR VIEW
UP
AFT
SIDE
65B60278
FR 2

PARTS LIST	BOEING	CORPORATE OFFICES SEATTLE, WA 98124	FSCM 81205	REV. DATE 11-19-92	PL 65B60278	REV LTR A
LIST TITLE	DIVIDER ASSY - STATION 1920, BULK CARGO COMPT		GROUP CARGO SYS	CONTRACT NUMBER		SHT. 3 OF 10 SHTS

ASSEMBLY BREAKDOWN LIST

QTY REQD	PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	NOTE CODE	NOTES	REV SYM
-	-1	DIVIDER ASSY	- MD	PT MK C	
			DP	DRAWING PICTURE SHEET 2, 3	
-	-22	DIVIDER ASSY	- MD	ZONE 3A6 PT MK C	
			DP	DRAWING PICTURE SHEET 2, 3	
-	BAC5347	PROCESS SPEC	-		

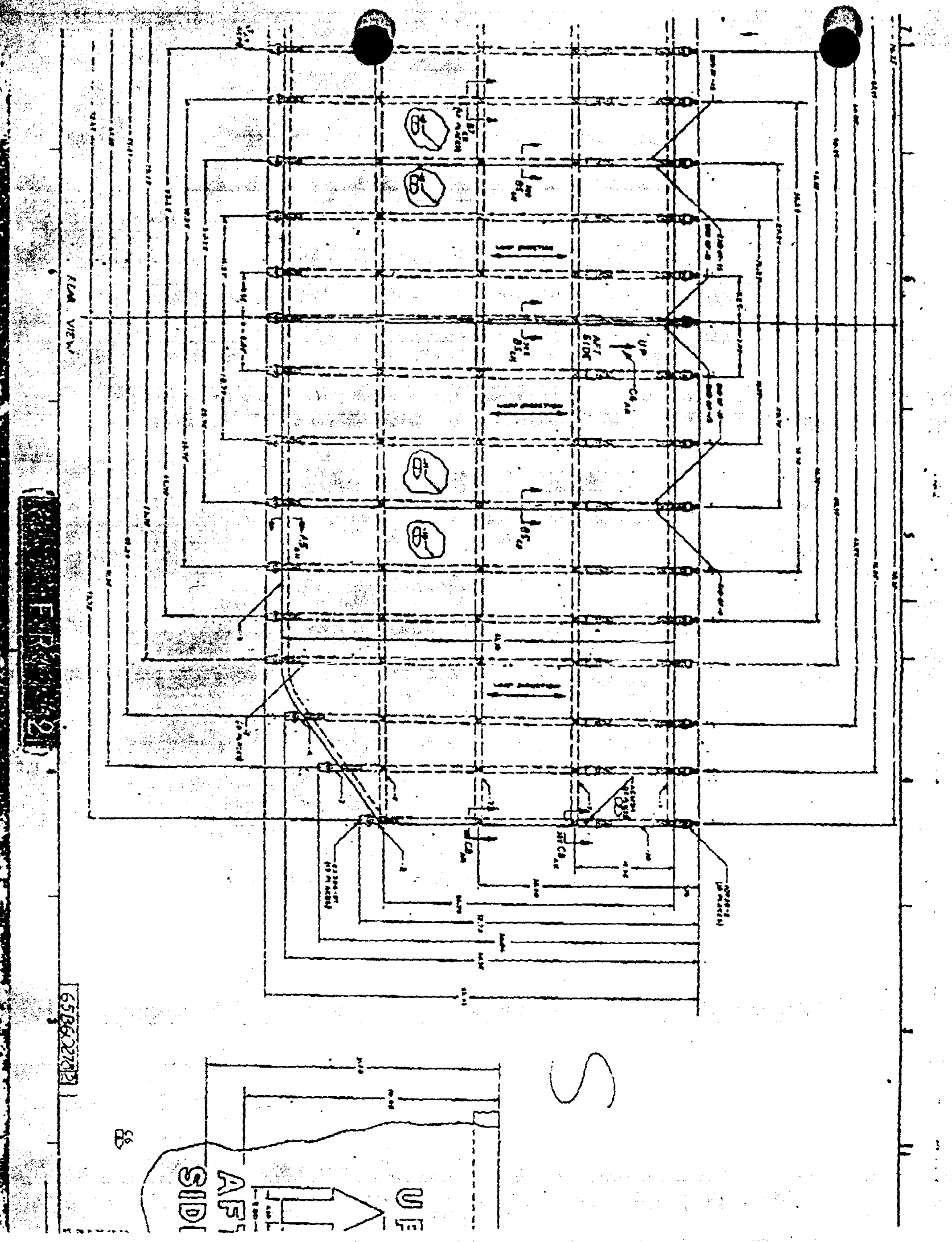
QTY REQD	PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	NOTE CODE	NOTES	REV SYM
ASSY	-1	DIVIDER ASSY	- MD	PT MK C	
			DP	DRAWING PICTURE SHEET 2, 3	
1	-10	NYLON FABRIC	- MD	PT MK R	
				STOCK 54 X 65	A
				DANTEX 1300, COLOR - FLAT GRAY BAC704, C.R.DANIELS CO. SEATTLE, WASH CODE IDENT 03369-3 OPTIONAL MATERIAL ARMOR SHELL LIGHT GRAY STOCK L13, COOLEY INC. PAWTUCKET, RHODE ISLAND, 02860.	
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C0030-875-2L	
			GA	FABRIC DIMENSIONS APPROXIMATE. MAKE TO FIT. SEW WITH TEXTURED SIDE OF FABRIC TO NEAR SIDE	
1	-11	NYLON FABRIC	- MD	PT MK R	
				STOCK 30 X 65	A
				DANTEX 1300, COLOR - FLAT GRAY BAC704, C.R.DANIELS CO. SEATTLE, WASH CODE IDENT 03369-3 OPTIONAL MATERIAL ARMOR SHELL LIGHT GRAY STOCK L13, COOLEY INC. PAWTUCKET, RHODE ISLAND, 02860.	
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C0030-875-2L	
			GA	FABRIC DIMENSIONS APPROXIMATE. MAKE TO FIT. SEW WITH TEXTURED SIDE OF FABRIC TO NEAR SIDE	
1	-12	NYLON FABRIC	- MD	PT MK R	
				STOCK 30 X 65	A
				DANTEX 1300, COLOR - FLAT GRAY BAC704, C.R.DANIELS CO. SEATTLE, WASH CODE IDENT 03369-3 OPTIONAL MATERIAL ARMOR SHELL LIGHT GRAY STOCK L13, COOLEY INC. PAWTUCKET, RHODE ISLAND, 02860.	
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C0030-875-2L	
			GA	FABRIC DIMENSIONS APPROXIMATE. MAKE TO FIT. SEW WITH TEXTURED SIDE OF FABRIC TO NEAR SIDE	
1	-13	NYLON FABRIC	- MD	PT MK R	
				STOCK 54 X 65	A
				DANTEX 1300, COLOR - FLAT GRAY BAC704, C.R.DANIELS CO. SEATTLE, WASH CODE IDENT 03369-3 OPTIONAL MATERIAL ARMOR SHELL LIGHT GRAY STOCK L13, COOLEY INC. PAWTUCKET, RHODE ISLAND, 02860.	
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C0030-875-2L	
			GA	FABRIC DIMENSIONS APPROXIMATE. MAKE TO FIT. SEW WITH	

ASSY -1 (CONTINUED ON NEXT PAGE)

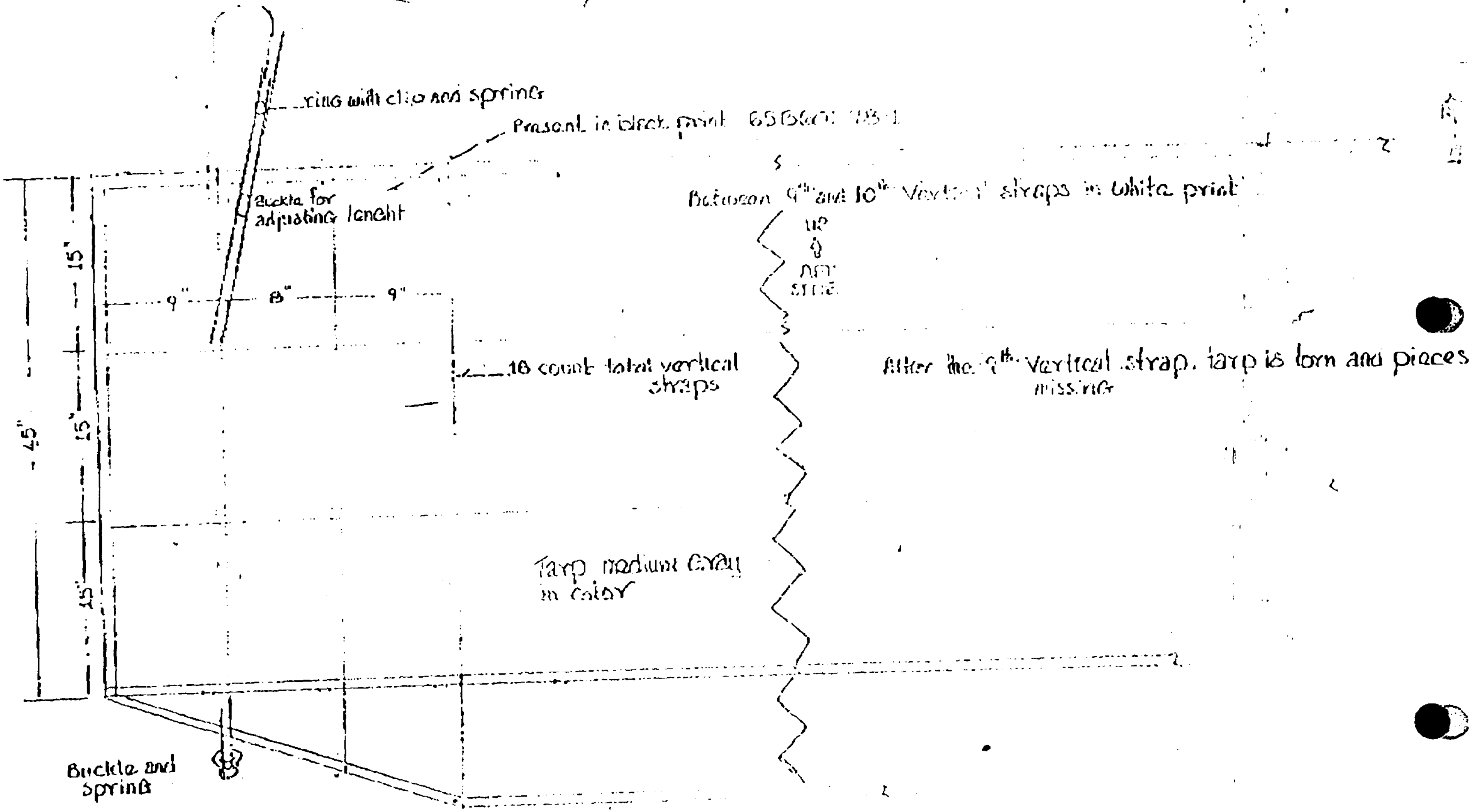
PARTS LIST	BOEING	CORPORATE OFFICES SEATTLE, WA 98124	FSCM 81205	REV. DATE 11-19-92	PL 65B60278	REV. LTR A
LIST TITLE	DIVIDER ASSY - STATION 1920, BULK CARGO COMPT		GROUP CARGO SYS	CONTRACT NUMBER		SHT. 4 OF 10 SHTS.

ASSY -1 (CONTINUED FROM PRECEDING PAGE)

QTY REQD	PART OR IDENTIFYING NUMBER	NOMENCLATURE OR DESCRIPTION	NOTE CODE	NOTES	REV SYM
				TEXTURED SIDE OF FABRIC TO NEAR SIDE	
1	-14	THREAD NYLON	- AR	QUANTITY AS REQUIRED	
			CA	SEW PER BAC5437 TYPE 301, 7 PORM 1 STITCHES PER INCH, NYLON THREAD PER FED SPEC V-T-295, TYPE I, CLASS 1, SIZE E. COLOR - FLAT GRAY BAC704	
2	-2	WEBBING	- MD	PT MK R	
				STOCK .062 X 1.00 X 73.0	A
				NYLON .06 X 1.00 PER MIL-W-4088 TYPE XVII TREATED PER MIL-W-27265 CLASS R. COLOR - FLAT GREY BAC704 (OR EQUIVALENT)	
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C1805-003-2S	
			GA	SEAR ENDS TO PREVENT UNRAVELLING	
2	-3	WEBBING	- MD	PT MK R	
				STOCK .062 X 1.00 X 78.0	A
				NYLON .06 X 1.00 PER MIL-W-4088 TYPE XVII TREATED PER MIL-W-27265 CLASS R. COLOR - FLAT GREY BAC704 (OR EQUIVALENT)	
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C1805-003-2S	
			GA	SEAR ENDS TO PREVENT UNRAVELLING	
2	-4	WEBBING	- MD	PT MK R	
				STOCK .062 X 1.00 X 84.0	A
				NYLON .06 X 1.00 PER MIL-W-4088 TYPE XVII TREATED PER MIL-W-27265 CLASS R. COLOR - FLAT GREY BAC704 (OR EQUIVALENT)	
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C1805-003-2S	
			GA	SEAR ENDS TO PREVENT UNRAVELLING	
13	-5	WEBBING	- MD	PT MK R	
				STOCK .062 X 1.00 X 96.0	A
				NYLON .06 X 1.00 PER MIL-W-4088 TYPE XVII TREATED PER MIL-W-27265 CLASS R. COLOR - FLAT GREY BAC704 (OR EQUIVALENT)	
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C1805-003-2S	
			GA	SEAR ENDS TO PREVENT UNRAVELLING	
1	-6	WEBBING	- MD	PT MK R	
				STOCK .062 X 1.00 X 180.0	A
				NYLON .06 X 1.00 PER MIL-W-4088 TYPE XVII TREATED PER MIL-W-27265 CLASS R. COLOR - FLAT GREY BAC704 (OR EQUIVALENT)	
			MI	MATERIAL IDENTIFIER AND TEST REQMT CODE C1805-003-2S	
			GA	SEAR ENDS TO PREVENT UNRAVELLING	
4	-7	WEBBING	- MD	PT MK R	
				STOCK .062 X 1.00 X 170.0	A
				NYLON .06 X 1.00 PER MIL-W-4088 TYPE XVII TREATED PER MIL-W-27265 CLASS R. COLOR - FLAT GREY BAC704 (OR	



FBI LABORATORY SKETCH



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(06/01/1995)

FEDERAL BUREAU OF INVESTIGATION

To: NEW YORK From: NEW YORK
Re: 265A-NY-259028, 08/10/1996

[redacted]

refer to

◆◆

(06/01/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: IMMEDIATE **Date:** 01/21/97

To: LABORATORY DIVISION **Attn:** SECTION CHIEF RANDALL MURCH/SSA [redacted] b7C

From: [redacted]
CALVERTON CP
Contact: 516-369-3313

Approved By: [redacted]

Drafted By: [redacted]

Case ID #: 265A-NY-259028-FF (Pending)

Title: UNSUB;
EXPLOSION OF TWA 800;
7/17/96
AOT-IT-EOD;
OO: NEW YORK

Synopsis: Notification of meeting at Boeing Corporation, Everett, Washington, to review status of Boeing overpressure analysis of B-747 center wing tank

Details: On Thursday, February 6, 1997, the Boeing Corporation will hold a meeting to review the status of Boeing overpressure analysis of the B-747 center wing tank. The meeting agenda is as follows:

Factory Visual (optional - limited number of people can be accommodated)	8:00-10:00
Official Meeting Start	10:00
Overpressure Analysis	
Introduction/Background	1/2-1 hr
Fuel/Air Explosion Physics	1 hr
Multi-Cell Compartments (Varied Ignition locations)	1/2-1 hr
Structural Analysis Status	1 hr

1-ADIC KALLSTROM
1-SAC O'NEILL
1-ASAC DOMROE
1-SSA [redacted]
1-SSA [redacted]

b7C

265-NY-259028-???

b7C

SA [redacted] will attend as a representative from New York. SA [redacted] a Bureau Aircraft Accident Investigator, is one of two agents working in a liaison capacity with the National Transportation Safety Board (NTSB) and all of the parties participating in the investigation into the cause of the explosion and crash of TWA 800 on July 17, 1996. SA [redacted] will travel from the Phoenix Division to attend the above described meeting departing Phoenix late February 5 and returning on the evening of February 6, 1997.

It is requested that a representative from the FBI Laboratory attend the above meeting consistent with previous meetings concerning testing conducted to determine cause of the explosion and crash of TWA 800 July 17, 1997.

It is anticipated that the Boeing Corporation will furnish transportation to the meeting site in Everett, Washington from a hotel location near the Seattle-Tacoma International Airport. This information will be provided when it is obtained.

7-1 (Rev. 2-21-91)

SECRET

FBI LABORATORY

FEDERAL BUREAU OF INVESTIGATION
WASHINGTON, D. C. 20535

To: ADIC, New York

Date: April 25, 1997

FBI File No. 265A-NY-259028

Lab No. 61114052 S AD HK
70207064 S AD HK
70224039 S AD HK

Reference: Your communications dated February 6 and 19, 1997

Your No. 265A-NY-259028

Re: UNSUBS;
EXPLOSION OF TWA FLIGHT 800;
AOT-IT-EOD

Specimens received: February 7 and 24, 1997

Specimens received February 7, 1997 under cover of communication dated February 6, 1997 (70207064 S AD HK):

Q128	One piece of splatter material (your item #MM1 CW-504 LBL-104)
Q129	One piece of splatter material (your item #MM3 CW-504 LBL-106.72)
Q130	One piece of splatter material (your item #MM4 CW-504 LBL-106)
Q131	One piece of splatter material (your item #MM5 CW-114)
NE8	One blade

265A-NY-259028-SUB FF2

SEARCHED ___ INDEXED ___
SERIALIZED ___ FILED ___
- 5 1997
FBI — NEW YORK [redacted]

b7C

(over)

Page 1

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REASON: 1.5 (c)
DECLASSIFY ON: X 1
912,063

[redacted] u7r1
Fax to SSA [redacted]

SECRET

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED EXCEPT WHERE SHOWN OTHERWISE

Specimens received February 24, 1997 under cover of communication dated February 19, 1997 (70224039 S AD HK):

K3 One sample of fiberglass like material taken from floor board (your item #57-1)

K4 One sample of foam like material taken from floor board (your item #57-2)

K5 One sample of fiberglass like material taken from air duct (your item #59-1)

K6 One sample of foam like material taken from air duct (your item #59-2)

K7 One sample of fiberglass like material taken from air duct (your item #61-1)

K8 One sample of foam like material taken from air duct (your item #61-2)

Results of Examination:

GENERAL INFORMATION:

This report provides the results of examinations conducted in the Chemistry Unit on specimens Q110 - Q116, Q128 - Q131, K3 - K8.

For a complete listing of specimens and the results of previous examinations please refer to previous report dated 3/26/97 (Lab. #60723031 S AD AR, 60730006 S AD RU, 60730007 S AD RU, 60806002 S AD ZG, 60909001 S AD AR RU, 61118011 S AD HJ, 61127057 S AD HK, 60727032 S AD AR, 60728031 S AD AR, 60804032 S AD AR, 60817031 S AD AR,60818061 S AD AR, 60830005 S AD AR, 60912038 S AD AR, 61007055 S AD AR).

Examinations are continuing on Q25 - Q81 and Q109 in the Special Photography Unit. You will be advised of the results of these examinations in a separate report.

(over)

CHEMICAL ANALYSES:

Specimens Q110 - Q116 were examined microscopically. Red material and amber material from specimen Q110 and red material from specimen Q111 were further examined instrumentally, including Fourier Transform Infrared Spectroscopy, Pyrolysis-Gas Chromatography/Mass Spectrometry, and Scanning Electron Microscopy [redacted] (S) The materials from Q110 and Q111 are consistent with a chlorinated, polymeric material, commonly used as a contact adhesive. Based upon the comparison examinations conducted, with noted differences, specimens Q110 - Q116 are consistent with a common origin. b1

Specimens Q128 - Q131 (FBI Laboratory #70207064) and specimens K3 - K8 (FBI Laboratory #70224039) were examined microscopically. Specimens Q128 - Q131 and specimens K6 and K8 were further examined instrumentally with Pyrolysis-Gas Chromatography/Mass Spectrometry and Fourier Transform Infrared Spectroscopy. Based upon the comparison examinations conducted, specimens Q128 - Q131 are consistent with having originated from the sources represented by K6 and K8, or a similar source.

Specimens K3, K5, K6 and K7 (70224039) ostensibly represent construction products that utilize fiber glass fabrics. These fabrics generally consist of woven and non-woven bundles of continuous-filament glass fibers. Specimens Q128 - Q131 (70207064) also contain continuous-filament glass fibers, but they cannot be specifically associated with specimens K3, K5, K6 and K7. The small size, limited amounts, and the altered and adulterated nature of specimens Q128 - Q131 preclude any further comparison.

DISPOSITION OF SPECIMENS:

The submitted specimens referenced in the above analyses will be returned to your office under separate cover via registered mail or equivalent.

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE Date: 12/08/1997

To: New York Attn: ADIC JAMES KALLSTROM
SAC JOHN O'NEILL
ASAC PASQUALE DAMURO
SSA [redacted]
SA [redacted]
DET [redacted]

b7C

From: New York
FBI Command Post, Calverton, New York
Contact: SA [redacted]

Approved By: [redacted] SSRA

Drafted By: [redacted]pfr

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA 800;
7/17/96
AOT-IT-EOD;
00: NEW YORK

Synopsis: Incorporates the 185 items of 1B evidence submitted for laboratory analysis in the investigation of TWA Flight 800 into the case file.

Enclosures: Enclosed are folders documenting the identification, movement and analytical results of 185 items of 1B evidence submitted for laboratory analysis.

Details: A total of 185 items (items #1-#185) of 1B evidence were submitted for metallurgical and chemical analysis during the course of the investigation. The 1B numbers assigned to the 185 items of evidence submitted for analysis range from 1B9, the first item of evidence, through 1B 586 for items 184 and 185.

The laboratories that examined the 185 items of 1B evidence include FBI, NTSB, Brookhaven, DIA and Boeing.

Each enclosed folder for the 185 items of 1B evidence submitted for laboratory analysis contains photographs, electronic communications documenting the movement of the evidence, laboratory results and the FD-192 (green sheet).

Each folder provides a complete history of each item of evidence and should be made a permanent part of the case file 265A-NY-259028.

♦♦

(06/01/1995)

FEDERAL BUREAU OF INVESTIGATION

To: NEW YORK From: NEW YORK
Re: 265A-NY-259028, 08/10/1996

[redacted]

[redacted]

[redacted]

[redacted]

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FEDERAL BUREAU OF INVESTIGATION

FREEDOM OF INFORMATION/PRIVACY ACTS SECTION

COVER SHEET

SUBJECT: TWA FLIGHT 800

RADAR DATA

(12-31-1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 03/14/1997

To: New York

From: SA [redacted]
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]

Case ID #: 265A-NY-259028 (Pending)
265A-NY-259028-C (Pending)

Title: UNSUB(S);
Explosion of TWA Flight 800;
AOT-IT;

Synopsis: Opening of subfiles NN - Radar Information; OO - Satellite Information; and PP - Air Traffic Controller Audio Information.

Details: Writer requests the following subfiles be opened.

NN - Radar Information 3/14/97

OO - Satellite Information

PP - Air Traffic Controller Audio Information

♦♦

265A-NY-259028-[redacted] NN - 1

3/14/97 [redacted] b7C

Texas Instruments Incorporated

TEXAS INSTRUMENTS

Post Office Box 655474
Dallas, Texas 75265
13500 North Central Expressway
Dallas, Texas 75243

(214) 995-2011

Direct Dial
(972) 995-5067

May 19, 1997

VIA AIRBORNE EXPRESS

b7c [redacted]
Special Agent
Federal Bureau of Investigation
Department of Justice
26 Federal Plaza
New York, NY 10278

Re: Airport Surveillance Radar Systems (ASR-8); TWO Flight 800

b7c Dear [redacted]

We have been able to recover from storage the enclosed booklet entitled "A Brief Description of the ASR-8 Airport Surveillance Radar," published in August 1976 by the Equipment Group, Texas Instruments Incorporated.

I hope it is helpful to you.

Very truly yours,

[redacted] b7c

[redacted] Corporate Staff
and General Litigation Counsel

[redacted] pla.522

Enclosure as noted

A BRIEF DESCRIPTION OF THE ASR-8 AIRPORT SURVEILLANCE RADAR

SP05A-EG76
Equipment Group
August 1976

TEXAS INSTRUMENTS
INCORPORATED

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

TEXAS INSTRUMENTS INCORPORATED
13500 North Central Expressway
P.O. Box 6015
Dallas, Texas 75222

August 1976

A BRIEF DESCRIPTION OF THE ASR-8 AIRPORT SURVEILLANCE RADAR

SECTION I

INTRODUCTION

The ASR-8 is a modular, solid-state, dual-channel, dual-beam/frequency diversity, S-band surveillance radar designed to meet the requirements of the Federal Aviation Administration for safe, efficient control of air traffic in the terminal area. It uses the latest state-of-the-art design and technology to improve not only the operational capability but also the reliability and maintainability of the system. Some of the new features are:

Performance

Increased range with frequency diversity, high-power klystron transmitter, and new low-noise receiver

Improved MTI with crystal-stable coherent design, quadrature MTI, and 10-bit processing

Improved clutter rejection with dual-beam antenna, improved circular polarization, reduced sidelobes, and increased range resolution

Improved weather operation with new wide-dynamic-range digital log processing

Operational

Improved display target quality with quadrature MTI, frequency diversity, new digital sweep integrator, and matched remoting system

Clutter-free display with dual-beam antenna and improved log receivers

Field-programmable range azimuth gate optimization of radar parameters for clean display

Reliability and Maintenance

Dual-drive pedestal

Modular solid-state fail-soft klystron transmitter

JAN-type integrated circuits and transistors

Maximum use of printed circuit board replaceable modules

Rapid change out of antenna bearings and gears with antenna in place

All-solid-state, low-noise parametric amplifier with 200-MHz bandwidth to eliminate field tuning.

In addition to improving operation, reliability, and maintenance, there are other factors which make the ASR-8 the optimum choice in terminal airport surveillance radar. These are:

- Modular concept permits tailoring of system to meet specific needs at minimum cost
- Equipment is currently in long-term production, incorporating the latest technology and components
- Although many new design features are incorporated, the ASR-8 is based on the proven design of the ASR-7 which has been used over the last 5 years at over 100 sites around the world
- Spares and logistics problems and costs are minimized because of usage of the same equipment by the FAA and other countries.

The ASR-8K is the klystron version of the ASR-8 modular radar family being procured by the U.S. Federal Aviation Administration (FAA) and the Bundesanstalt Fuer Flugsicherung (BFS) of West Germany.

The U.S. Air Force has purchased a magnetron version of the ASR-8 designated AN/GPN-14. This preproduction system will undergo extensive factory and field tests, as well as the USAF-controlled Initial Operational Tests and Evaluation (IOT&E) at Eglin AFB, Florida, in late 1976 and early 1977. The USAF has options to purchase large production quantities.

The ASR-8 has undergone full qualification testing with the FAA including performance tests, environmental tests, reliability demonstration (600-hour MTBF) and maintainability testing (25-minute MTTR).

Texas Instruments, a leading supplier of airport surveillance radars since 1959, has installed 174 of the highly successful ASR-4, -5, and -6 series vacuum-tube systems at locations throughout the free world. In 1968, Texas Instruments introduced the solid-state ASR-7 and 104 of these systems have been delivered to worldwide locations or are on order. The ASR-8 represents the latest in Texas Instruments new concept of modular airport surveillance radars which will meet the wide range of worldwide ATC requirements at a reasonable cost because of a high degree of commonality from configuration to configuration. The modular airport surveillance radar, ASR-8, uses the newly available technology and experience gained by Texas Instruments in the ATC equipment field over the last 18 years and has resulted in a modern standard for airport surveillance radars in both civil and military operations all over the world.

SECTION II
ASR-8 SYSTEM DESCRIPTION

The ASR-8 airport surveillance radar is designed to meet the requirements of FAA Specification FAA-E-2506. The system is completely dual-channel except for the antenna assembly and some portions of the power distribution equipment. The ASR-8 system equipment is divided into three groups: the antenna group, the transmitter building group, and the display site group. The transmitter building group and the antenna group are located at the radar head site. The display site group is located at the indicator site or ATC room (typically the airport terminal building). In normal operation, it is operated unattended, remotely controlled from the display (indicator) site, with periodic checks by maintenance personnel. A photograph of a typical ASR-8 radar head site is shown in Figure 2-1.

This section briefly describes the overall ASR-8 system and summarizes its characteristics. More detailed descriptions of the individual radar units are given in Section III.

A. RADAR HEAD SITE

As stated above, a standard ASR-8 system installation includes equipment at both the transmitter (radar head) site and the display (indicator) site and is shown in block diagram form in Figure 2-2. The transmitter site, in Figure 2-3, includes the antenna group and the transmitter building group. The antenna group includes the antenna and its associated equipment outside the

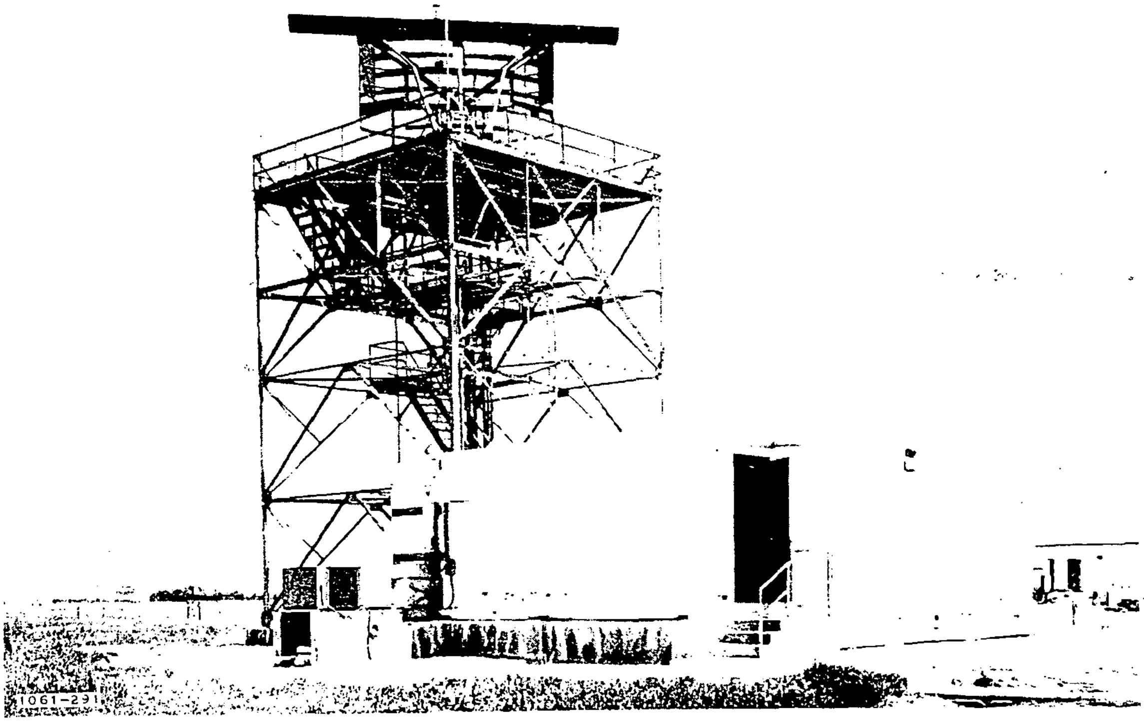

Figure 2-1. Radar Head Site

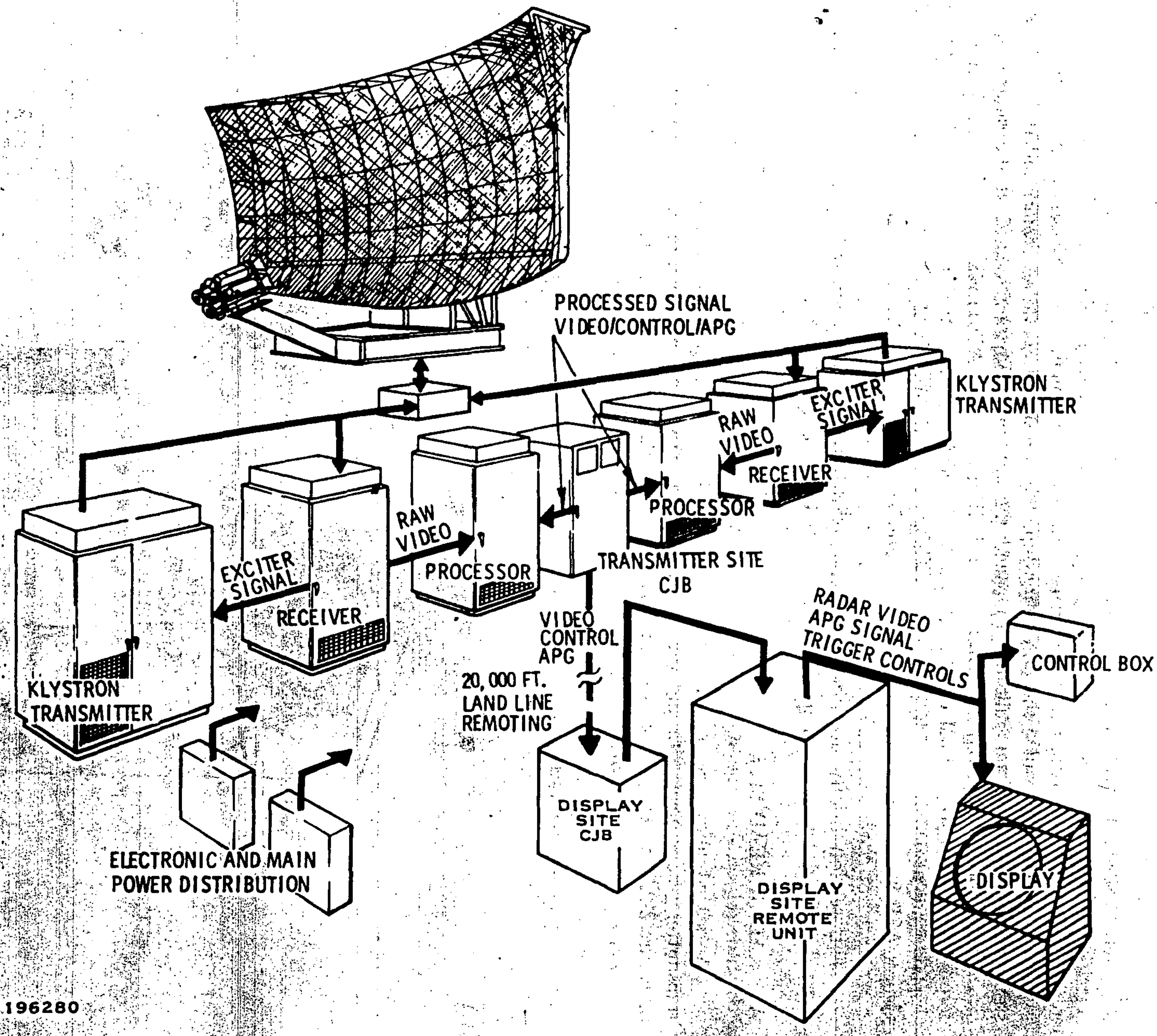

Figure 2-2. ASR-8 Block Diagram

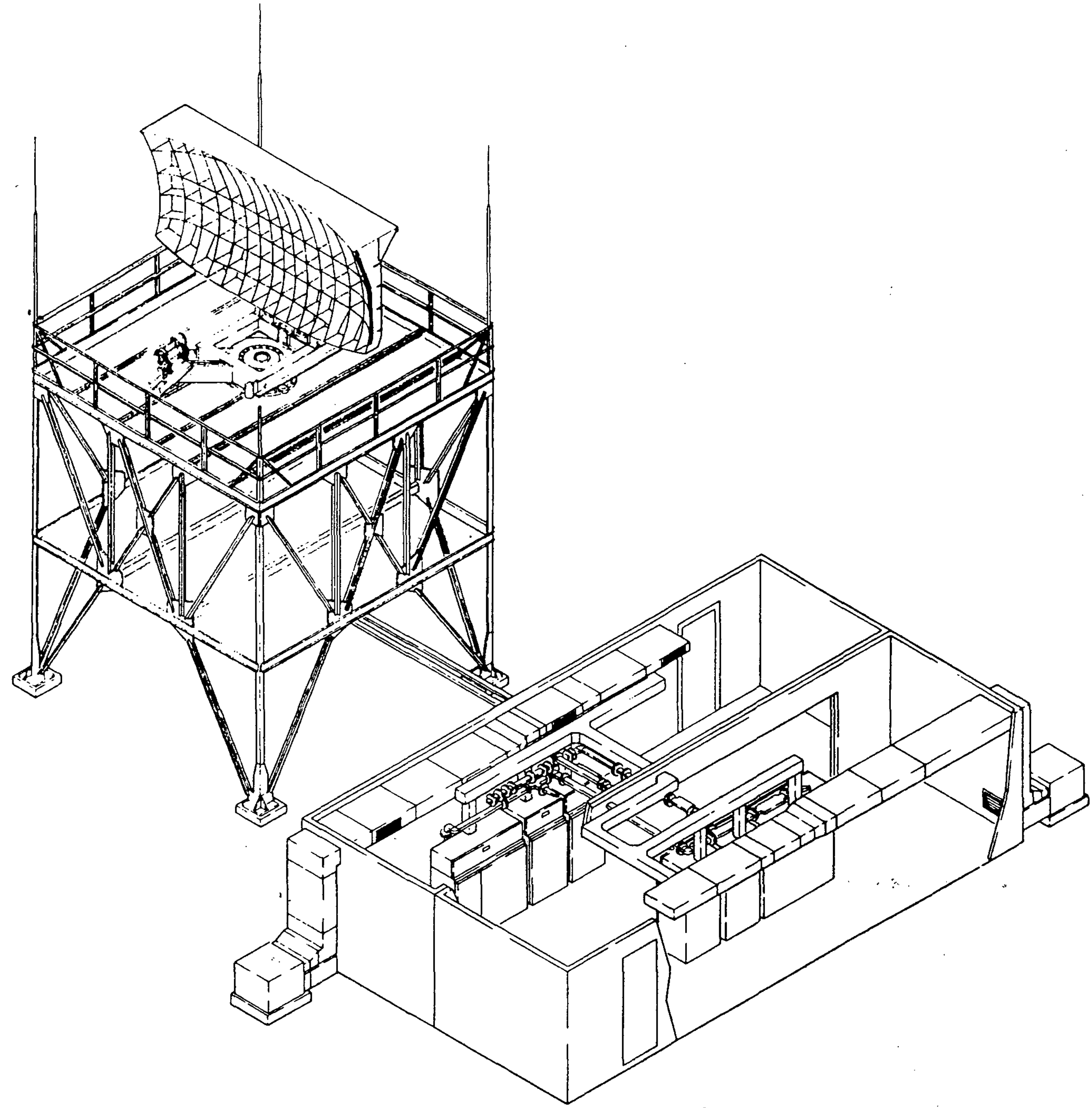

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Figure 2-3. Illustration of the ASR-8 Radar Head Site transmitter building. The antenna tower is not a part of the ASR-8 antenna group. The transmitter building group consists of two transmitters, two receivers, two processors, the power distribution and control equipment, and miscellaneous support equipment. The transmitter building group units are housed in a transportable building and are arranged as shown in Figure 2-3. The display site equipment, which is part of the standard ASR-8 system, includes the display site cable junction box, display site unit, a system control panel, and intercommunications stations. The transmitter site group and the display site group may be connected by means of land lines up to a maximum of 6,100 meters long. For greater distances, a radar microwave link should be used.

All of the ASR-8 equipment is fully redundant except for the antenna system. The two identical radar channels are connected to the antenna through a passive frequency-selective waveguide diplexer. In addition, a motor-driven waveguide switch is included in each channel so that either channel can be selected for active use, making the alternate channel available for maintenance. When both channels are selected, the radar operates in the frequency-diversity mode. Switchover of channels takes less than one revolution of the antenna. Selection of the active channel can be made using control panels which are located at the display and transmitter sites. There are two active control panels at the display site and one active control panel at the transmitter site. Of the three active panels, only one is allowed to control at a time, but all panels indicate system status. This redundancy, coupled with the inherent reliability built into the ASR-8, results in an availability figure of virtually 100 percent.

To achieve even higher reliability than that of the ASR-7, Texas Instruments has incorporated new features into the ASR-8 such as dual-drive pedestal, long-life klystron transmitter tube, solid-state RF driver, modular solid-state fail-soft modulator, solid-state parametric amplifier, and passive TR/limiter for receiver protection. In addition to this, Texas Instruments maintains a rigid reliability, quality assurance, and inspection testing program to ensure the highest standards of manufacturing. The ASR-8 has a design operational lifetime of 20 years. This equipment lifetime is further demonstrated by the Texas Instruments ASR-4 which has been in the field over 15 years, and is still in operation. Since the ASR-8 now uses solid-state design, long useful life is even more certain. The system is designed to operate under the most severe environmental conditions found in all parts of the world, including extreme cold, extreme heat and humidity, salt air, and high winds.

All ASR-8 cabinets are designed for exceptional ease of maintenance. Using front access only, all electronic circuitry is mounted on swing-out, or pull-out, racks for complete accessibility. It is not necessary to remove any component to get to any other component in the cabinet. The ASR-8 has a number of built-in-test features to facilitate testing and maintenance. The transmitter cabinet is forced-air-cooled through filtered inlets and is designed to be radio-frequency-interference (RFI) tight. The above-mentioned cabinets are all made of nonferrous material except for 300 series stainless steel.

1. Antenna System

The antenna group consists of a reflector, dual feed assembly, rotary joint, pedestal, and a dual-drive train assembly. The antenna system is designed to be highly reliable and capable of withstanding adverse weather ,and environmental conditions. Aluminum construction is used throughout except in components such as motors, gears, and bearings where steel is required.

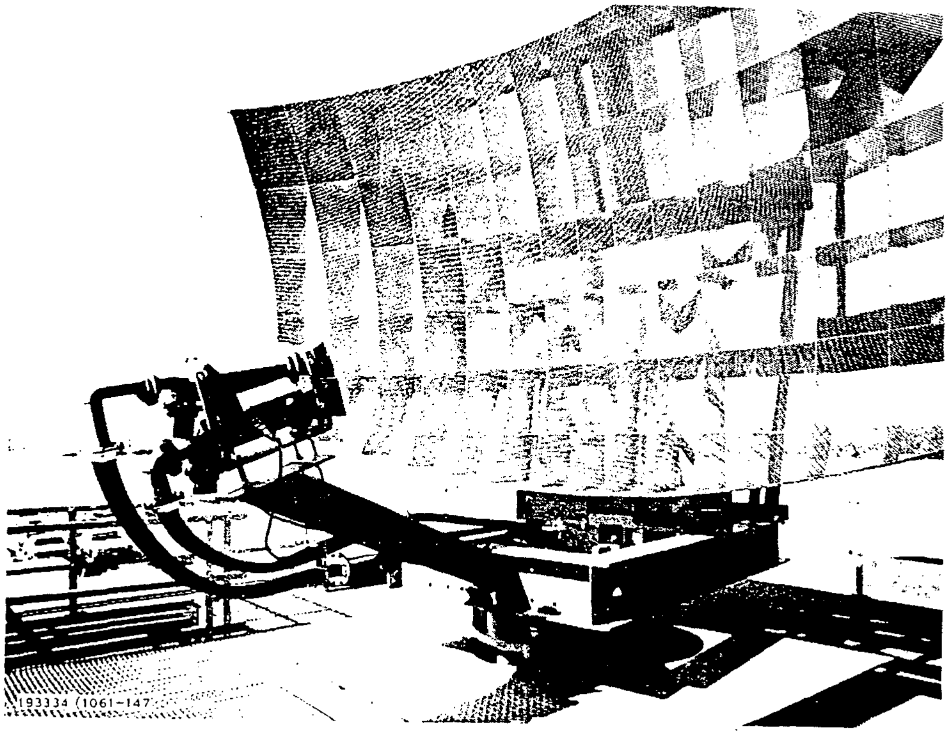

Figure 2-4. ASR-8 Antenna

The antenna, similar in concept to the ASR-7, has a new mechanical design for improved performance. The new mechanical design uses interlocking vertical and horizontal plates fabricated by computer-controlled machines to achieve excellent contour accuracy. This accuracy, combined with a new surface contour and feedhorn design, results in lower sidelobes, improved circular polarization, and sharper ground-side cut-off. The antenna is shown in Figure 2-4.

The ASR-8 antenna is a dual-beam design having both a normal and a passive channel that are provided with switchable linear and circular polarization. Its cosecant-squared elevation pattern provides a constant radiation altitude coverage up to 30 degrees above peak of beam. The passive receive-only feedhorn is tilted upward relative to the normal beam to reduce interference from ground clutter at short range.

The antenna is driven by dual-redundant drive motors to provide the maximum in maintainability and reliability. In case of failure, either motor is capable of driving the antenna by itself; the defective motor is disconnected from the common drive gear by an electric clutch. Both drive train assemblies are located below the pedestal for maintenance accessibility from the mezzanine platform. The main bearing and gear are also easily removed from above the pedestal using a hoist provided for the purpose and without the necessity for removing the antenna from the pedestal.

A five-channel rotary joint is included in the pedestal, with three S-band channels and two L-band channels. Attached to the bottom of the rotary joint are dual azimuth pulse generator (APG) units. The two APG units are identical, with one being driven directly by the rotary joint and the other through a single gear mesh. Either APG can be removed without disrupting the operation of the other, thus requiring only a short shutdown period for removal and replacement.

2. Transmitter

The ASR-8 transmitter, shown in Figure 2-5, includes an air-cooled klystron, solid-state modularized modulator, and a solid-state high-voltage power supply. The transmitter unit is totally solid state except for the klystron tube. The modularized modulator has 12 parallel plug-in switching modules which replace the conventional thyratron high-voltage switch. The air-cooled klystron transmitter provides increased performance in terms of high power and improved spectrum control; operational advantages are fully coherent MTI and an increase in reliability and maintainability due to the long life of the klystron tube (average operating life of tubes of similar design has exceeded 25,000 hours).

3. Receiver

The receiver unit, shown in Figure 2-6, processes both normal and passive channel S-band radar signals from the antenna and converts them into intermediate frequency signals, providing normal video, log video, and MTI video signals to the processor unit. The receiver also provides stable local oscillator (STALO) and the exciter output signals to control the transmitted and received signal frequency.

Some of the features of the ASR-8 receiver which have improved system performance are a new broadband solid-state parametric amplifier and quadrature MTI channel. The parametric amplifier, with a Gunn diode pump source, has a noise figure of less than 1.25 dB, a gain greater than 15 dB, and instantaneous bandwidth of 200 MHz which totally eliminates field tuning the assembly over the 2.7- to 2.9-GHz band. The new quadrature MTI channel, in conjunction with the in-phase MTI channel, provides stable signals to the display and increases the MTI performance 3 dB over conventional MTI receivers. Improved MTI performance has also been obtained through higher stability of the crystal oscillator multiplier STALO, RF exciter, and crystal oscillator (COHO) by the use of new state-of-the-art components.

4. Digital Processor

The ASR-8 digital processor (Figure 2-7) provides circuits for processing receiver videos, circuits for the new range/azimuth gate generator, and azimuth pulse generator (APG) and video cable-line drivers, as well as all radar timing and control circuits.

In-phase and quadrature MTI video signals are processed by two identical 10-bit digital feedback cancellers. It can also be selectively processed by a 10-bit digital log/FTC antilog unit. Normal video and normal digital log/FTC antilog video are also processed and all videos are realigned for constant PRF viewing on the display. Video sweep integration is provided for both the normal and MTI video channels which limit targets stretching.

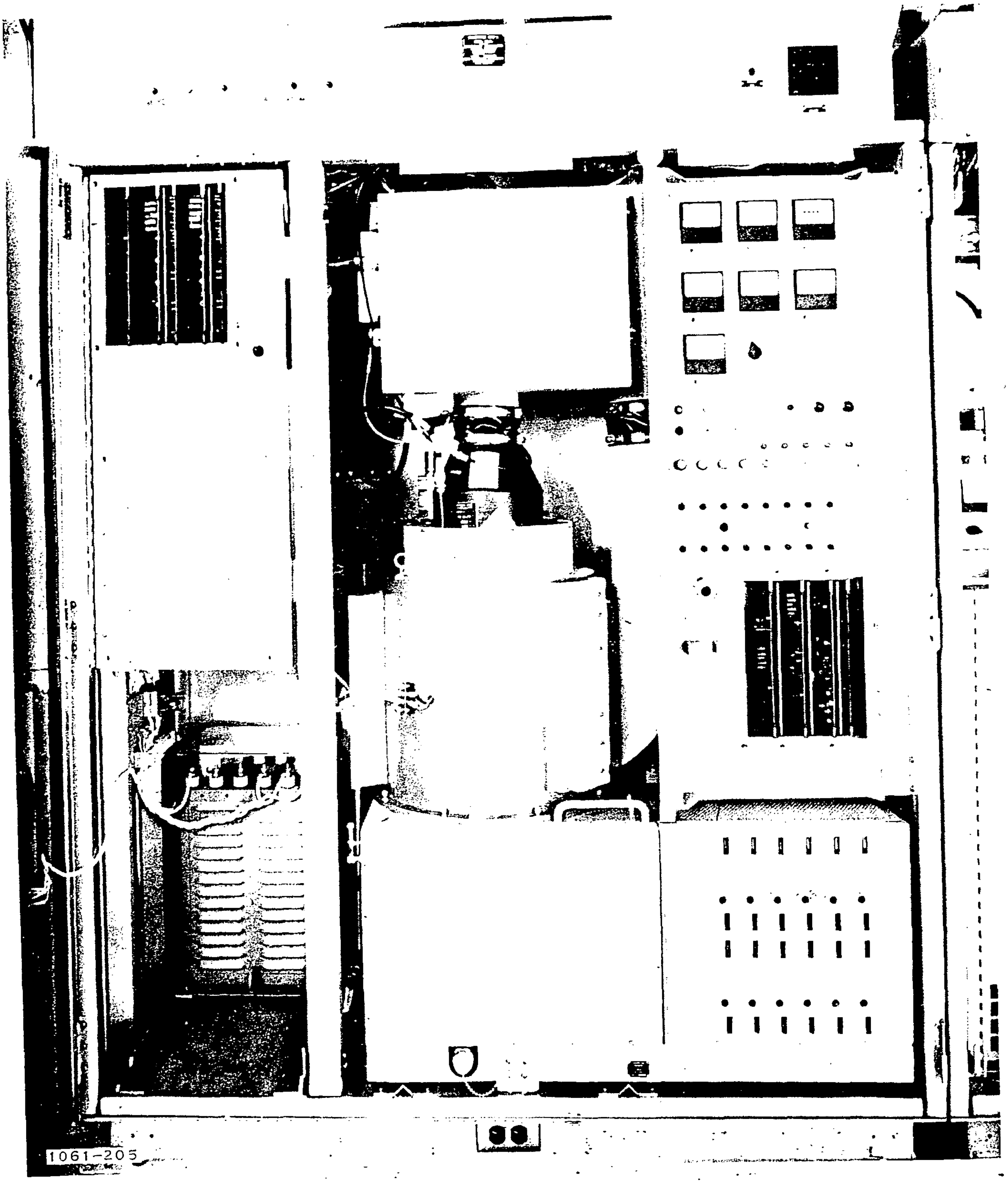

Figure 2-5. ASR-8 Transmitter Unit

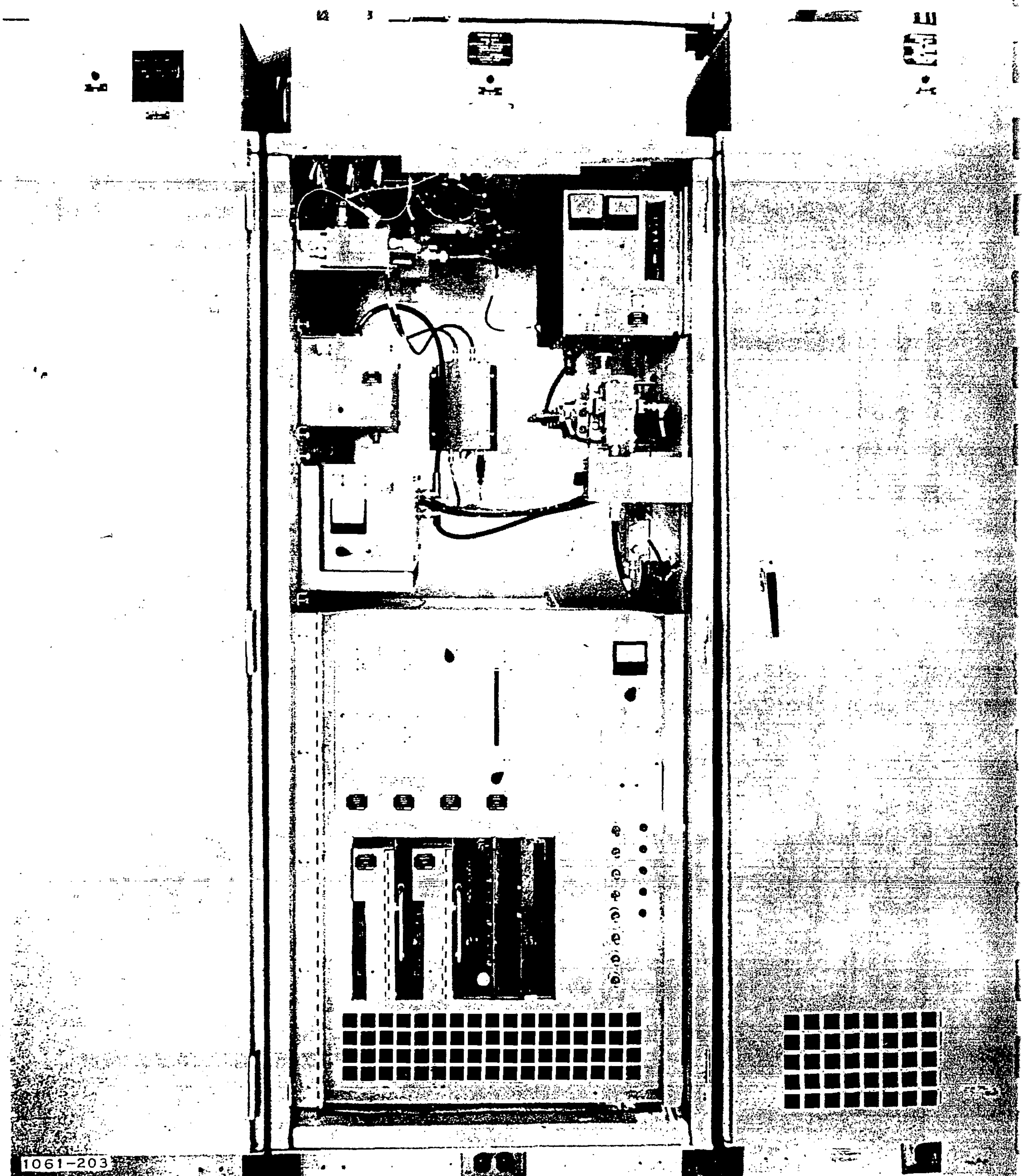

Figure 2-6. ASR-8 Receiver Unit

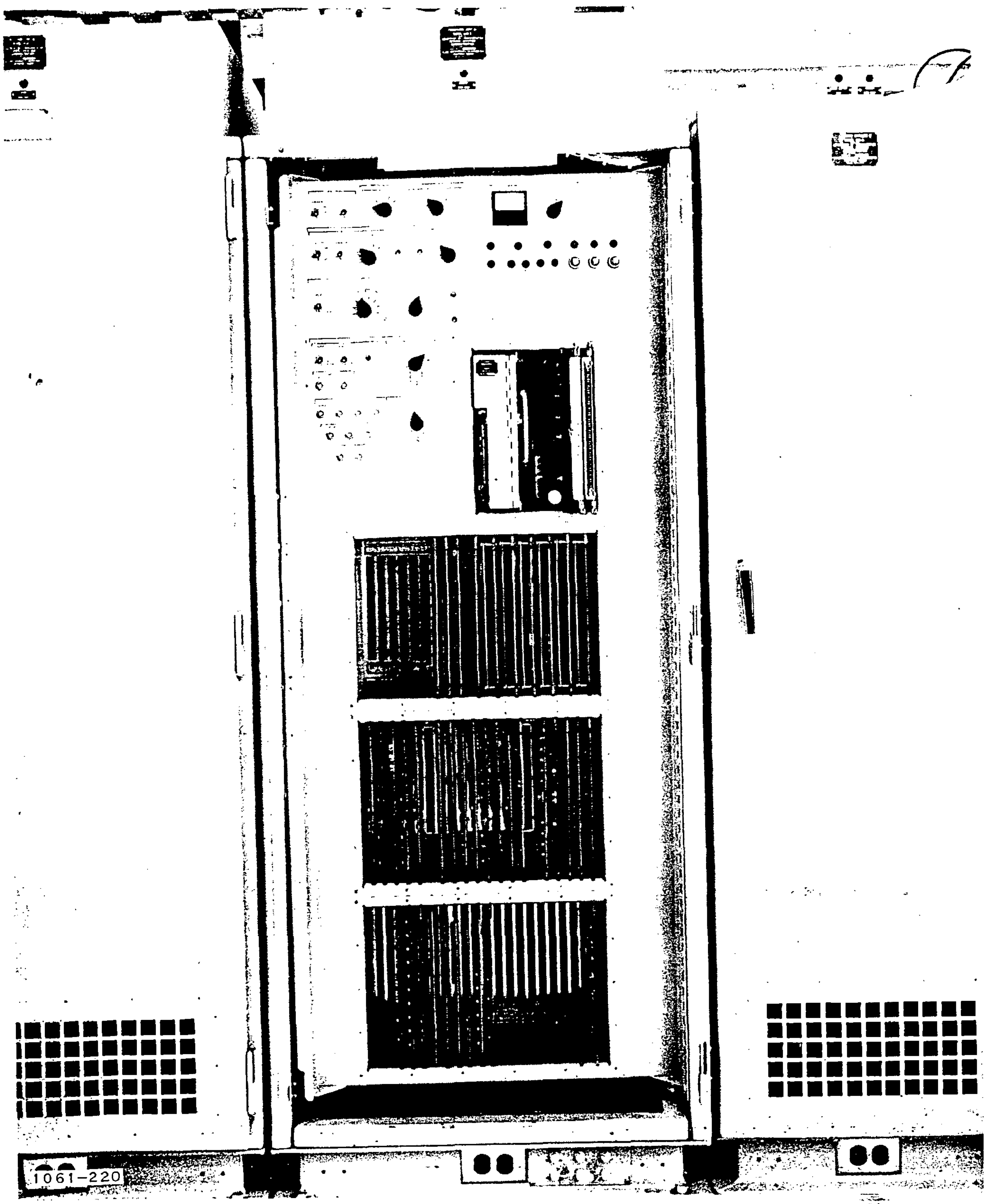

Figure 2-7. ASR-8 Processor Unit

Each of the cascaded digital cancellers provides four modes of feedback for reduction of clutter residue. The synchronizer provides four staggered triggers to the transmitter for staggered PRF operation to eliminate blind speeds. The ASR-8 has no blind speeds below 2,000 knots.

The range-programmable azimuth gate provides sectors and windows for automatic selection of normal or MTI video, high or low antenna beam, staggered or nonstaggered PRF, and two receiver gain STC curves. This permits a more complete use of the capabilities of the radar than was possible on previous ASRs.

5. System Control Interface and Distribution

The ASR-8 features a solid-state control system for radar command and status indication. The control system contains four control boxes as shown in Figure 2-8. Two are located on the radar site cable function box and one on the display site unit as shown in Figures 2-9 and 2-10. The fourth unit is to be installed. Each control box has release and take-control circuitry to ensure radar command at only the selected control box. All radar command and status signals are held in power-protected solid-state memory, isolating the control system from short-term power outages.

The ASR-8 provides significant improvement in the remoting and distribution of radar videos, triggers, and digital azimuth information. All remoting circuits, including the line drivers, cable equalizers, and line compensators, are designed for optimal signal-to-noise bandwidth up to the input to the display and provide for wide dynamic-range operation required by the new high-performance phosphors. The remoting system is capable of driving landlines up to 6,100 meters long.

6. Intercommunication System

The intercom system consists of five intercom stations: three masters and two slaves. At the radar head site, one master is located on the cable junction box (Figure 2-9) and one slave is located on the tower cable junction box. The other two masters and one slave are located at the display site. The master and slave intercom assemblies are shown in Figures 2-11 and 2-12.

7. Maintenance Plan Position Indicator (MPPI)

A solid-state 16-inch display is provided with the ASR-8 for system alignment and maintenance. The display provides for simultaneous viewing of range-gated normal and MTI video, range azimuth gate sectors and windows, and SSR video. Simultaneous viewing of range-azimuth gate and radar clutter permits rapid programming of the various strobes, sectors, and windows. Five selectable range positions are available. Nautical-mile range marks of 1, 2, 5, and 10 are provided and every fifth range mark is intensified. The display operates directly from the azimuth change-pulse information. A photograph of the display with a cart, hood, and other accessories as part of the display is shown in Figure 2-13.

B. DISPLAY SITE

The display site equipment consists of a display site remote unit, two system control panels, display site cable junction box, and intercom master and slave assembly.

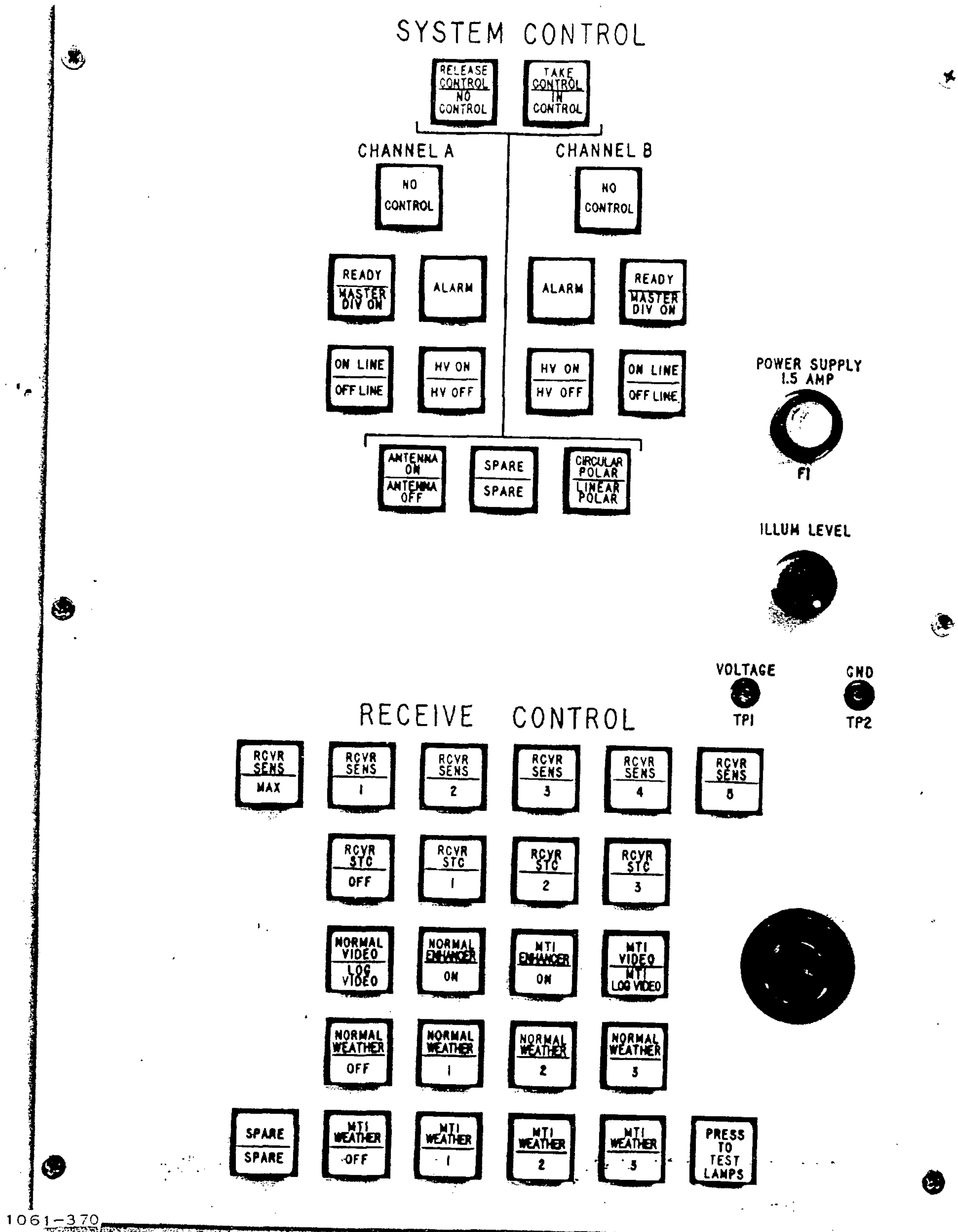

Figure 2-8. System Control Panel

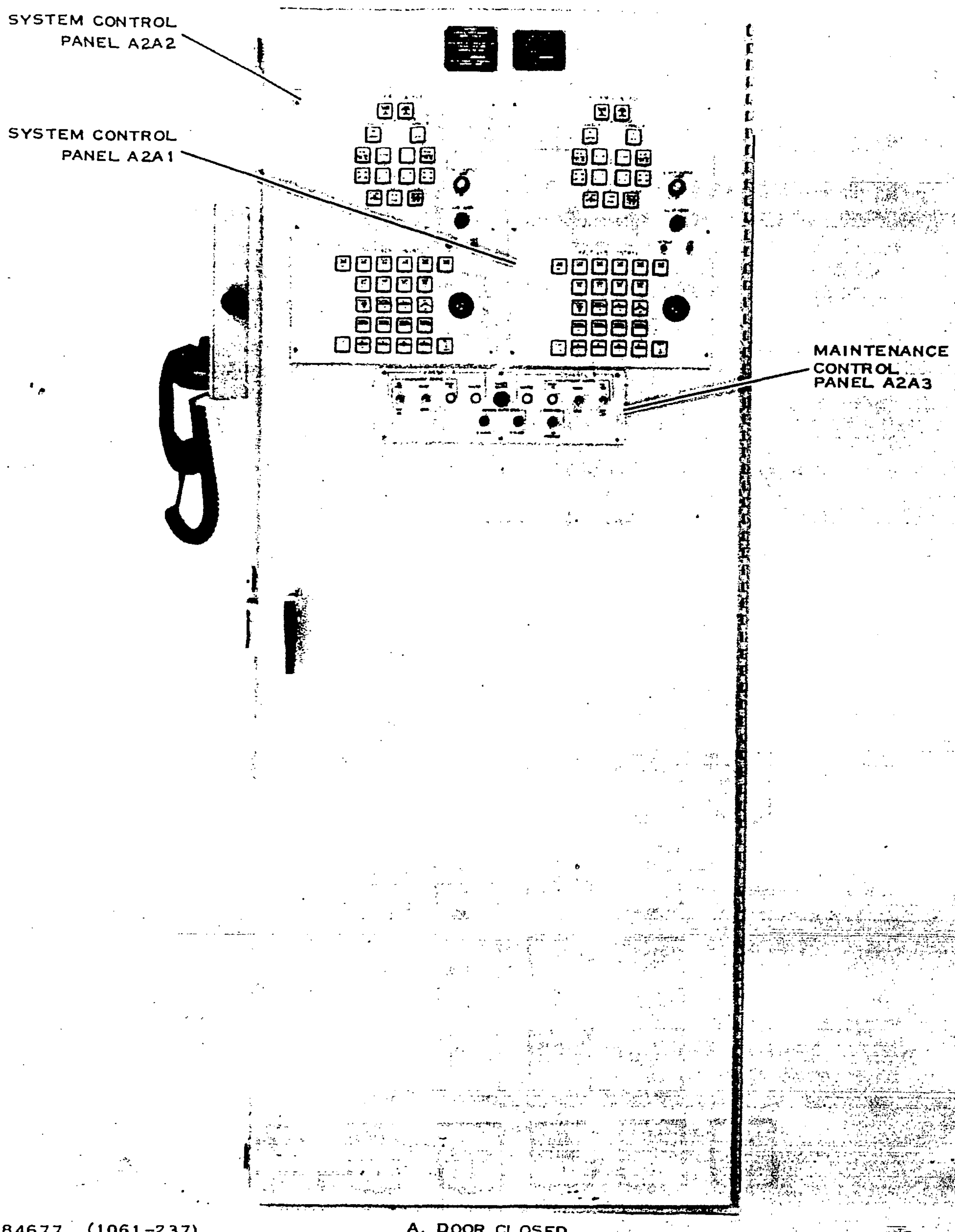

Figure 2-9. Radar Site Cable Junction Box

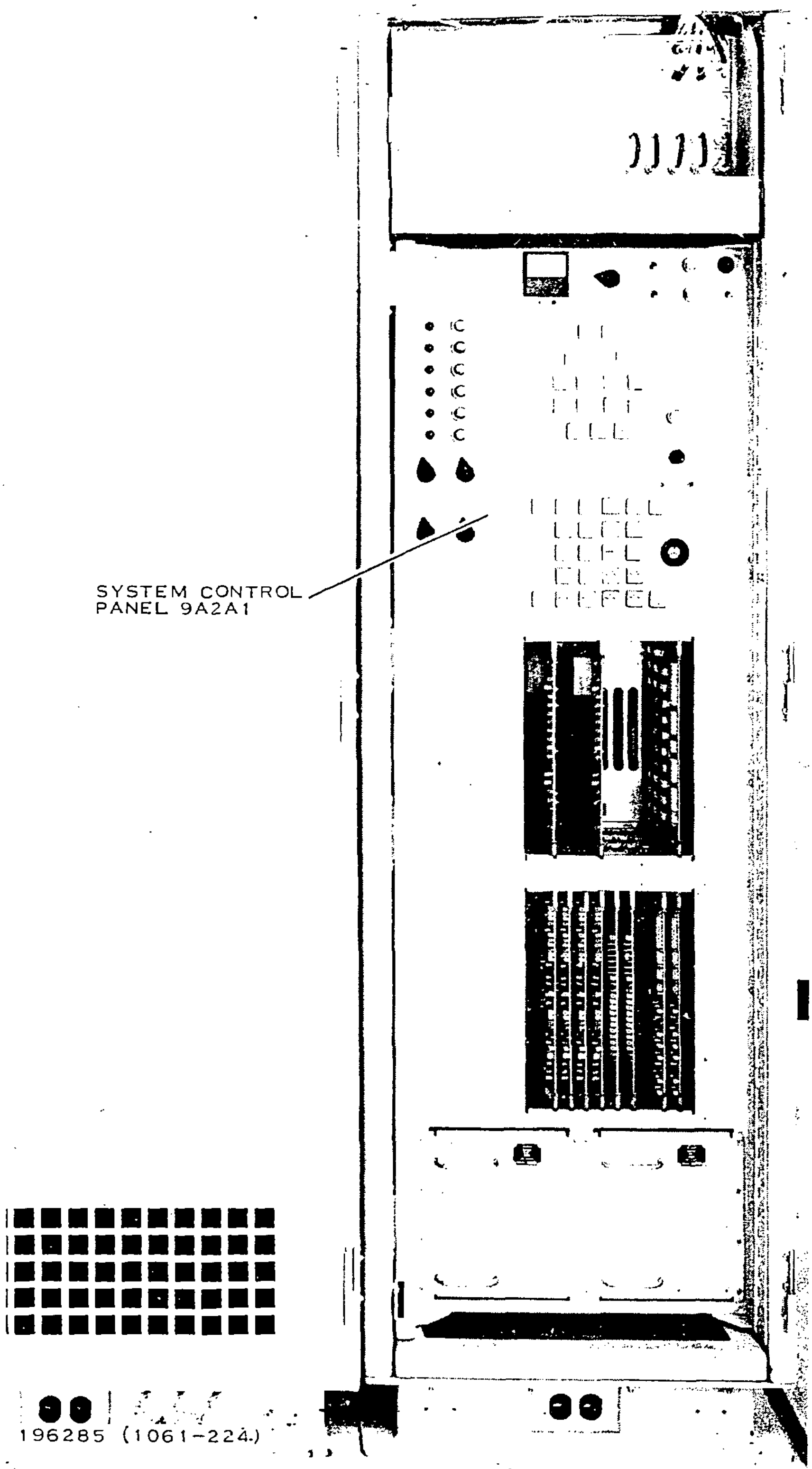

Figure 2-10. Display Site Unit

Figure 2-11. Intercom Master Assembly

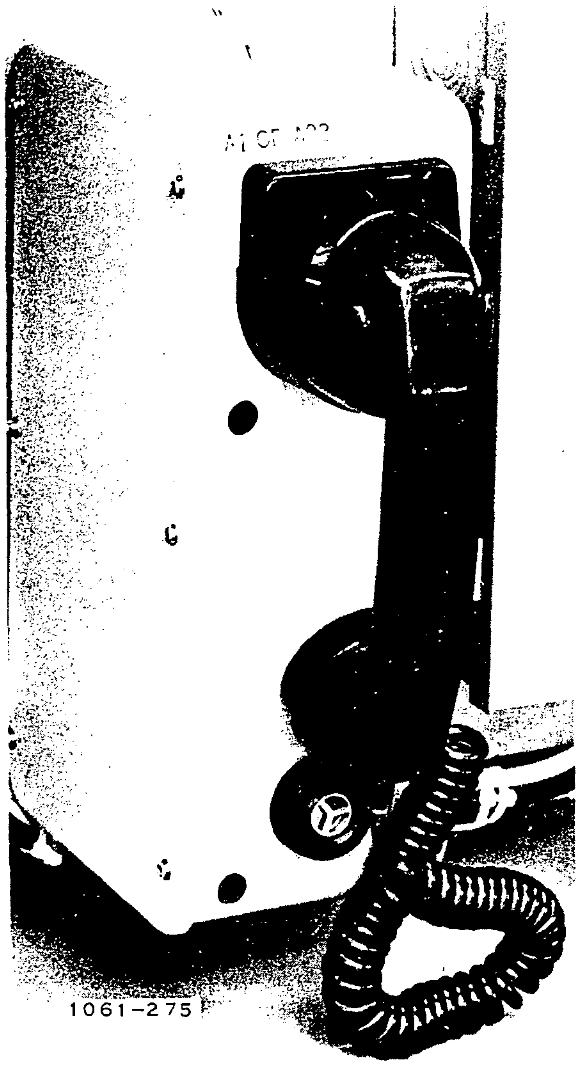

Figure 2-12. Intercom Slave Assembly

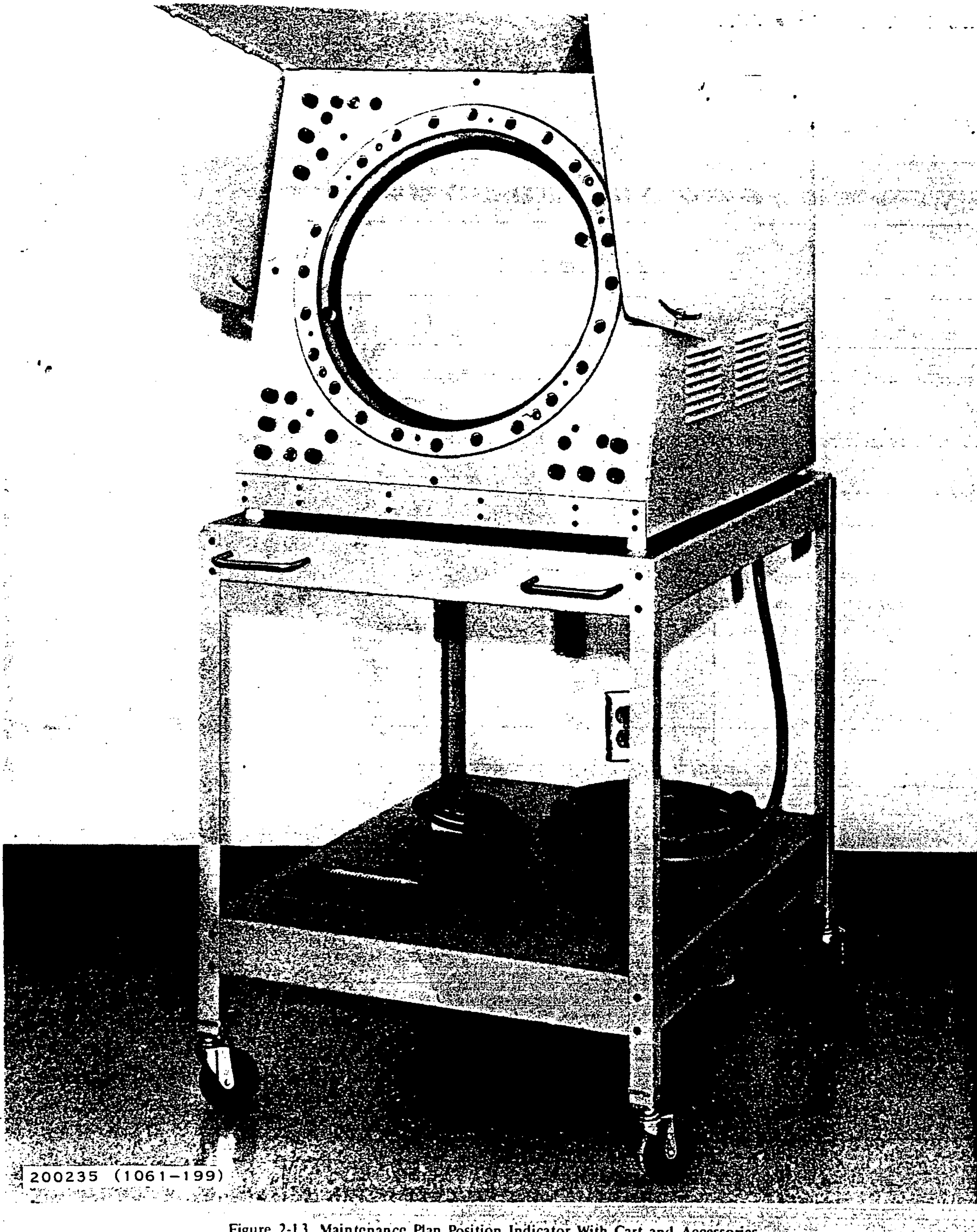

Figure 2-13. Maintenance Plan Position Indicator With Cart and Accessories

The display site remote unit consists of a line compensator; APG pulse shaper; and distribution center for trigger, video, and azimuth signals. This unit is matched to the line-driving equipment at the transmitter site and compensates up to 6,100 meters of remote cable. The distribution amplifiers provide isolated outputs and provide signal amplification to compensate for up to 90 meters of RG-59 coaxial cable length.

C. PERFORMANCE CHARACTERISTICS

The main ASR-8 radar parameters and characteristics are summarized in Table 2-1. Some of the most important characteristics are discussed in the following paragraphs and the range calculations are shown in paragraph 10.

1. Radar Coverage

The ASR-8 uses a combination of a 1.4-MW peak power transmitter, high-gain cosecant-squared antenna and a coherent quadrature receiver having a low-noise broadband parametric amplifier to achieve the coverage shown later in Figure 2-16. The range-altitude plot is based on the range calculation and supporting data shown in Figure 2-15.

2. Accuracy

Target tracking accuracy is usually limited by the display equipment in use and the ability of the operator to read position on the display. The inherent accuracy of the ASR-8 in range is excellent because of the narrow (0.6 μs) pulsewidth used corresponding to approximately 90 meters. The inherent azimuth accuracy capability also is quite good, being set primarily by the azimuth encoder (which with 4096 azimuth change pulses per revolution of the antenna corresponds to less than 0.1 degree).

3. Resolution

Range resolution of the ASR-8 is ultimately limited by the pulsewidth of 0.6 μs, corresponding to approximately 90 meters. The azimuth resolution also is quite good because of the use of a large azimuth aperture dimension, resulting in a beamwidth of only 1.35 degrees.

4. Frequency

The FAA and USAF have insisted on the use of S-band as the optimum frequency to achieve maximum range coverage, high azimuth resolution, and high data rate with acceptable antenna dimensions. The ASR-8 is tunable over a 200-MHz band from 2.7 to 2.9 GHz.

5. Data Renewal Rate

The rotation of the ASR-8 antenna is in a clockwise direction (as viewed from above) at 12.5 revolutions per minute with 60-Hz power. The antenna is designed to operate at these speeds in winds of 85 knots (43.7 meters per second) and with 33 kilograms per square meter of ice on the exposed surfaces and will operate in gusts, less ice load of more than 100 knots (52 meters per second).

TABLE 2-1. RADAR CHARACTERISTICS

Antenna Characteristics	
Aperture size	4.9 meters (16.1 feet) azimuth by 2.7 meters (9 feet) elevation
Gain (minimum)	
Normal beam	33.5 dB
Passive (high) beam	32.5 dB
Sidelobes (maximum)	
Normal beam	−24 dB
Passive beam	−22 dB
Beamwidth	
Elevation	4.8 degrees minimum at −3 dB, COSECANT to 30 degrees
Azimuth	1.35 degrees minimum at −3 dB point
VSWR	1.4:1
Polarization	Linear vertical or circular, remotely selectable
Integrated cancellation ratio (minimum)	
Normal beam	22 dB (25 dB typical)
Passive beam	22 dB (24 dB typical)
Rotary joint	5-channel, 3 S-band and 2 L-band channels
Data pickoff	
Dual azimuth pulse generators	2 sets reference pulse and 4,096 change pulses
Drive mechanism safety switch	On tower
Tilt angle: referenced to the lower 3 dB point of the normal beam	±2.5 degrees, manually adjusted
Drive motor (dual)	5.0 horsepower (each)
Antenna rotation rate	12.5 rpm (15 rpm optional)
Transmitter Characteristics	
Source	VA-87E air cooled klystron
Frequency	Tunable 2.7 to 2.9 GHz; derived from crystal STALO and COHO
Peak power	1.4 mW
Average power	875 W nominal
Pulsewidth	0.6 μs
Repetition frequency	4-pulse stagger with 1,040 average, or fixed (selectable from 700 to 1,200 pps)
Cooling	Forced air
Waveguide pressurization	Freon-12 for diplexer
Fault detection	Automatic recycling and shutdown sequence
Modulator	12 plug-in modules, fail-soft
HVPS	Solid-state, 250 Vdc
Receiver Characteristics	
Parametric amplifier	
Type	Solid-state with Gunn pump source
Noise figure	1.25 dB maximum
Bandwidth	200 MHz (2.7 to 2.9 GHz) fixed tuned
Gain	15 dB minimum
System noise figure	4.0 dB maximum, measured at noise coupler
Receiver channels	MTI IF Normal IF Log IF
STALO	VHF crystal oscillator with multiplier (2.7 to 2.9 GHz)
COHO	30 MHz crystal

TABLE 2-1. RADAR CHARACTERISTICS (Continued)

Receiver bandwidth	
Normal IF	1.1 MHz
MTI IF	5 MHz
MTI video	585 kHz
Log IF	1.1 MHz
Log IF (dynamic range)	80 dB
STC	Diode RF attenuator before parametric amplifier; 0 to 40 dB
Minimum discernible signal (MDS)	
Normal receiver	−110 dBm
Log receiver	−109 dBm
MTI receiver	−108 dBm
Processor Characteristics	
MTI/Normal Channel Operating Modes (video alignment in all modes)	
Regular video	
Enhanced video	
Log FTC video	
Log FTC with weather background	
Enhanced Log FTC	
Enchnced Log FTC with weather background	
Number of Bits	
MTI channel	10
Normal channel	6
Weather channel	7
Integrators (MTI and normal)	6
Storage (includes alignment)	97,177
Sample rate	2.14 MHz
MTI cancellers	In-phase and quadrature
MTI canceller modes	
Single canceller	
Dual canceller	
Dual canceller with feedback (25, 30, 35, 40 dB cancellation of scanning clutter)	
PRF stagger	4-pulse sequence
First blind speed	Greater than 2,150 knots
Velocity-response nulls	Less than 10 dB peak to peak
Log-CFAR	
MTI	Digital, 10 bits
Normal	Analog
System MTI improvement factor (stagger, scanning)	34 dB
STC function generator	
Initial attenuation	0 to 40 dB
Initial delay	100 μs
Range decay exponent	R^{-1} to R^{-5}
Receiver gain attenuation	0 to 40 dB
Range azimuth gate	
Generator	Field programmable
Controlled functions	MTI/Normal video gating Dual antenna beam switching Receiver noise generator gating Receiver test trigger gating Stagger/nonstagger select Azimuth strobe STC select Receiver gain control

TABLE 2-1. RADAR CHARACTERISTICS (Continued)

Display Site Remote Unit Characteristics	
Line compensator	30 dB minimum common mode rejection Compensates for up to 6,100 meters of coax
Distribution amplifier (91 meters coax with 75-ohm termination)	
Triggers	Rise time <0.1 microsecond Duration 1.0 to 1.5 microseconds Amplitude >15 volts
Video	Rise time <0.1 microsecond Droop (200 μs pulse) <10 percent Amplitude 0 to 4 volts
ACP/ARP	Pulsewidth 23 ±3.0 microseconds Amplitude 5 ±1 volt
Power requirement	115 Vac, single phase, 50/60 Hz
Power Supplies	Redundant diode floating +5 Vdc, +15Vdc, −15 Vdc, +24 Vdc
Maintenance PPI Characteristics	
Operational characteristics	
CRT size	40-centimeter diameter
Display ranges	Five selectable ranges Position 1: 5 to 20 nautical miles (nmi) preset Position 2: 15 to 20 nmi preset Position 3: 35 to 70 nmi preset Position 4: 40 to 135 nmi preset Position 5: 190 to 275 nmi preset (beacon pretrigger required)
Range marks	1, 2, 5, 10 nautical miles selectable Every fifth mark intensified
Videos	MTI Normal (MTI/normal range gate adjustable out to 60-nautical mile radar range) Beacon Map Intensity of all signals is adjustable
Azimuth synchronization	4,096 APC with ARP
Triggers	Radar and beacon pretrigger
Decentering	1 radius in any direction
Electrical characteristics	
CRT	P7 phosphor
Range mark accuracy	±0.25 nautical mile at 60 nautical miles
Sweep linearity	To ±2.5 millimeters for range marks
Azimuth accuracy	±0.5 degree
Pretrigger delay	45 to 120 μs
Deflection	Fixed yoke magnetic
Video bandwidth	3.5 MHz
Video inputs	75 ohms, 8 volts peak video amplitude
ACP, ARP inputs	Externally terminated to match line. Five volts P-P maximum amplitude, any width between 1 μs and 50 percent of ACP duty cycle; logic level or approximate sinusoid.
Pretrigger inputs	75 ohms, 5 to 70 volts peak amplitude
Voltage	102 to 138 volts, single phase, 47 to 470 Hz
Power	250 watts

6. **Environmental Operating Envelope**

The ASR-8 is designed to operate in the following environmental conditions:

Ambient temperature (except antennas and its associated equipment)	−10° to +52°C
Ambient temperature (antenna assembly and its associated equipment)	−50° to +70°C
Ambient relative humidity	Up to 100 percent including condensation because of temperature change
Normal ac line voltage	105- to 130-volt (single-phase) or 105- to 130-volt line-to-neutral, and 182- to 226-volt line-to-line, three-phase (can be supplied to operate with any input line voltage)
AC line frequency	50 or 60 ±2 Hz
Elevation	0 to 3,048 meters (10,000 feet) above sea level
Duty	Continuous, unattended
Salt atmosphere	As encountered in coastal regions
Winds	
Operating with 1½-inch ice thickness on exposed surface	85 knots
Nonoperating with 1½-inch ice thickness on exposed surface	130 knots

7. **Clutter Elimination**

One of the most important features of the ASR-8 is its ability to virtually eliminate clutter from the radar display and to detect targets in extreme clutter environments. This performance is achieved by the improved MTI performance and by using a digital dual-MTI canceller system. The improved MTI performance is due to the coherent klystron transmitter and state-of-the-art components such as the crystal oscillator multiplier (STALO), RF exciter, 30-MHz COHO, and quadrature receiver. When operating as a master oscillator power amplifier (MOPA) system, the transmitter signal is the amplified sum of the crystal STALO and crystal COHO signals. This crystal stability essentially eliminates transmitter frequency instabilities, resulting in exceptional MTI performance. In addition, the transmitter power supply and modulator components are designed for high stability to avoid degrading the inherent signal stability.

The digital dual-MTI canceller system is used to maintain good response on targets with low radial velocities. Digital processing eliminates degradation of performance (as occurs in analog systems) caused by thermal drift, unequal gain and bandwidth properties, and component aging.

In the ASR-8, careful attention is given to ensuring a high degree of system stability. The crystal STALO is shock-mounted for isolation against mechanical vibration and uses special voltage regulation. Careful layout and shielding are used to avoid picking up spurious signals. Receiver circuits are designed to preclude the effects of high-signal-level saturation, including the use of a diode RF attenuator ahead of the parametric amplifier. Other specific examples of design features ensuring more than 34 dB improvement factor with the antenna rotating are as follows.

The klystron output tube is operated into a ferrite circulator which provides in excess of 25-dB isolation between the klystron and the variable load represented by the rotating antenna. This feature precludes frequency and amplitude instabilities which could otherwise exist. Further, the klystron modulator includes an automatic voltage regulation circuit which ensures that the PFN is charged and settled at the same level before triggering the beam-voltage pulse into the klystron.

A highly stable crystal STALO is used to ensure excellent short-term frequency stability for a high level of MTI performance. Load isolators are also used in the outputs of the STALO to ensure sufficient isolation from load variations. The STALO is shock-mounted to isolate it from mechanical vibrations and is acoustically isolated as well.

The COHO uses an ultrastable crystal oscillator circuit mounted in a temperature-stabilized enclosure and is foam-encapsulated to avoid effects of vibration.

The digital canceller system is operated from clock pulses which are derived by counting down the 30-MHz crystal COHO signal. This ensures that cancellation is performed coherently with the actual transmitted pulse, eliminating the pulse-to-pulse jitter. Also radar timing triggers are generated from the crystal COHO oscillator reference for additional stability.

8. Weather Rejection

Since the ASR-8 must operate under all environmental conditions and is needed most critically when weather conditions are worst, it is designed to provide a high degree of weather (precipitation) rejection. Specific features are discussed in the following subsections.

a. High Resolution

The best way to reject precipitation returns is to avoid them by using a high-resolution (small clutter cell size) system. The combination of 1.35-degree beamwidth and 0.6-microsecond pulsewidth keeps the clutter cell size to the minimum possible value consistent with MTI, data rate, and peak power restrictions.

b. Dual Feedback Canceller

The dual feedback canceller with feedback can be set to provide the best filter response for cancellation of weather clutter.

c. *Circular Polarization*

The ASR-8 antenna has operator-selectable circular polarization to reject precipitation returns. A new high-quality polarizer, in conjunction with a computer-aided-designed reflector, ensures the best possible performance. Integrated cancellation ratio values for ASR-8 antennas are specified at 22 dB minimum and the production reflectors to date have produced a minimum of 24 dB.

d. *Log-FTC*

Both the MTI and normal receiver channels have a new type of digital log-FTC-antilog system which reduces all weather clutter to receiver noise level, without the large degradation in signal strength which characterized older log-FTC systems. By preventing weather clutter from saturating the display, targets which are greater than the clutter can now be displayed.

9. Interference Rejection

The ASR-8 is designed to maximize the received signal-energy to noise-power-per-cycle ratio to reduce the vulnerability of the system to outside interference. This includes proper filtering, good shielding, and the use of effective techniques and devices for interference rejection and signal-to-noise improvement. Specified features included in the ASR-8 to reject interference are:

Narrowband diplexer

Preselector filter

Sensitivity time control (STC)

Range-azimuth gate

Log-CFAR (log-FTC-antilog)

PRF stagger

Video integrator

RFI shielding.

The ASR-8 preselector filter is tunable from 2700 to 2900 MHz and has a bandwidth of 8 MHz at the 3-dB points. The filter attenuation to signals 60 MHz from the center of the passband is at least 60 dB and is at least 70 dB for signals 100 MHz from the center of the passband. In addition, the diplexer filter is approximately 20 MHz wide, and has 60-dB or greater rejection of signals 60 MHz from the center frequency.

The receiver includes a solid-state RF attenuator ahead of the parametric amplifier which uses both fixed-gain settings and digital STC to keep large signals from causing saturation and the creation of spurious signals. The normal and MTI log-FTC circuits will reduce large blocks of clutter and noise-like interference to receiver noise level.

The digital enhancers in the normal and MTI channels essentially eliminate nonsynchronous interference. Because of the specific design used, any signal that does not occur in the same range bin from pulse to pulse cannot achieve an output level greater than receiver noise.

10. Range Calculations

Radar range coverage for the ASR-8 is calculated later in Figure 2-15 and plotted in Figure 2-16. Range calculation is based on the following rationale and made in accordance with the NRL report 6930 method by L.V. Blake.[1]

a. Peak Power

The peak power of 1 MW is referenced to the diplexer output rather than the klystron output and is measured at the test coupler on the antenna side. One megawatt measured at this point is the specified minimum operating power level.

b. Pulsewidth

The pulsewidth is specified to be 0.6 ±0.05 μs.

c. Antenna Gain

The specified minimum antenna gain is 33.5 dB. Production antennas typically exceed the minimum a few tenths of a decibel. An assumed gain of 33.8 dB is considered an average of typical production antennas.

d. Target Size

The target specified for calculation purposes is a Swerling case I fluctuating 1 m^2.

e. Midband Frequency

Midband frequency of 2800 MHz is assumed.

f. Noise Temperature

The total receiver system noise temperature consists of three main parts: the antenna noise temperature, equivalent noise temperature of the transmission line losses, and input noise figure of the receiver. Using the approach of Blake, where all values are referenced to the output terminals of the receiver, the system noise temperature is given by

$$T_s = T_a + T_r + L_r T_e$$

where

T_s = system noise temperature, °K

T_a = antenna noise temperature, °K

T_r = effective noise temperature of the transmission line losses, L_r

L_r = ohmic losses of transmission line separating antenna and receiver

T_e = input noise temperature of the receiver, °K.

[1] L.V. Blake, *A Guide to Basic Pulse-Radar Maximum-Range Calculation*, Naval Research Laboratory Report 6930, AD 701321 (23 December 1969).

Antenna temperature relates to the noise power received by the antenna from sources such as blackbody radiation from the earth, atmospheric radiation, and emissions from extraterrestial sources. Using the technique described in the referenced Blake report, the antenna noise temperature is

$$T_a = (0.876\ T_a' - 254)/L_a + 290$$

where

T_a' = noise temperature for lossless idealized antenna

L_a = antenna ohmic losses = 0.2 dB for proposed antenna (including feedhorn and polarizer).

For a 2.5-degree point angle, this results in

$$T_a = (0.876 \times 38 - 254)/1.05 + 290$$

or

$$T_a = 79.7°K \text{ or } 80°K$$

This number compares favorably with values which have been measured on ASR-8 antennas. The measurement is difficult to make accurately since the antenna temperature is only 10 to 15 percent of the total system temperature and must be determined by taking the difference of two numbers which are of similar value. A noise temperature value of 80°K is considered reasonable. For example, an antenna of reasonably high directivity when pointed directly into space (vertically) will have a noise temperature of typically between 15° and 50°K. As the beam is lowered to within 10 to 20 degrees of horizontal, the noise temperature begins to increase rapidly. With the 3-dB beam nearly horizontal, the temperature will be on the order of 70° to 100°K. Finally, if pointed directly at the earth, it will nearly assume earth temperature of 270°K.

The effective noise temperature of the ohmic loses of the waveguide between the antenna polarizer output port and the receiver input is given by

$$T_r = T_{tr}\ (L_r - 1)$$

where

T_{tr} = transmission line thermal temperature (considered to be the standard 290°K)

L_r = ohmic loses, ratio greater than unit.

The losses associated with the ASR-8 waveguide, from the parametric amplifier up the tower and to the antenna, are shown in Figure 2-14 and are:

Rotary joint	0.06
Tower waveguide	0.4
Diplexer	0.33
Building waveguide	0.13

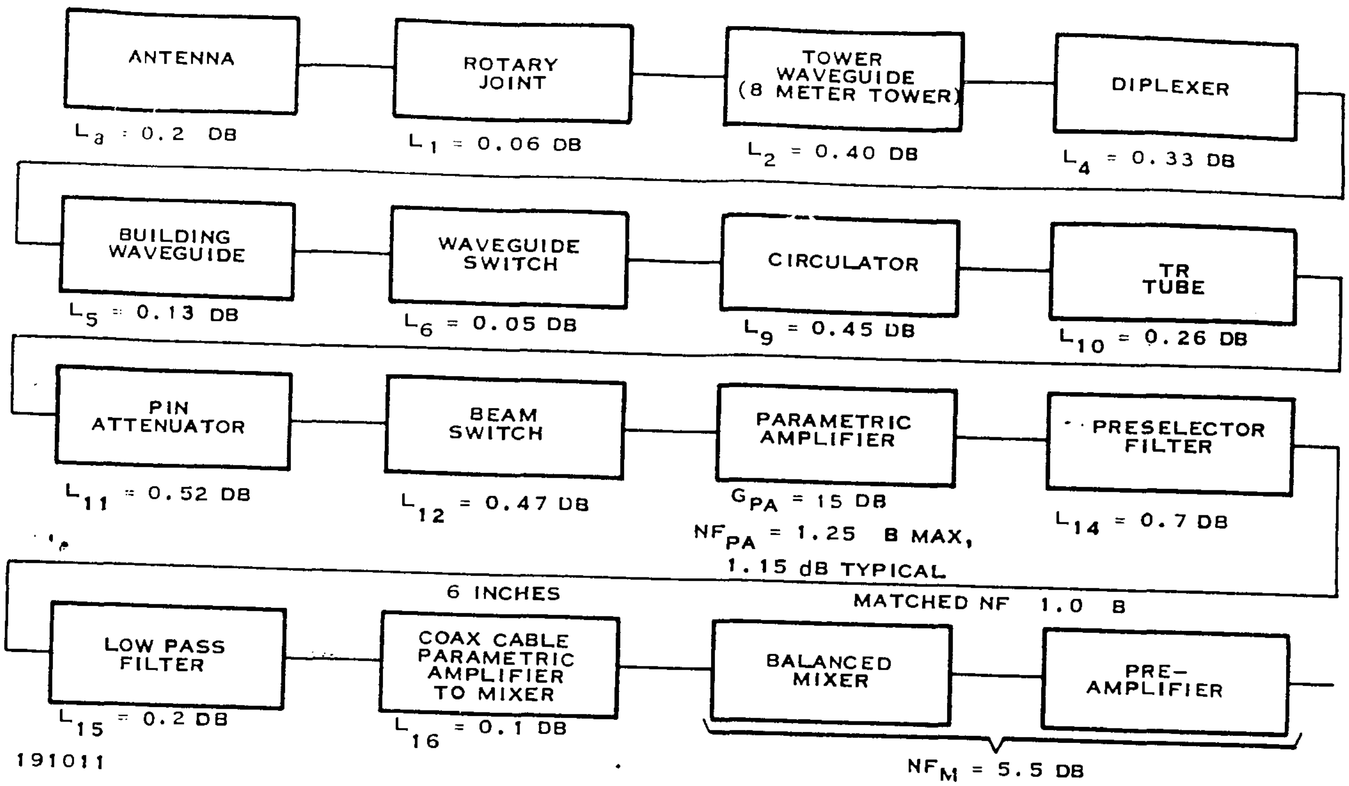

Figure 2-14. System Noise Figure Loss Budget

Waveguide switch	0.05
Circulator	0.45
TR-limiter	0.26
PIN attenuator	0.52
Beam switch	0.47
Total loses	2.67 dB (1.85 ratio).

Based on this loss value, the effective noise temperature is

$$T_r = 290\,(1.85 - 1)$$
$$= 246°K$$

The loss budget shown above is considered to be very close to the actual value that is realized in the field.

The effective input noise temperature of the receiver, T_e, is given by

$$T_e = T_o\,(NF_{in} - 1)$$

where T_o is by convention 290°K and the receiver input noise factor with the parametric amplifier installed in the system is given by

$$NF_{in} = NF_{pa} + \frac{NF_2 - 1}{G_{pa}}$$

where

NF_{in} = receiver input noise factor, measured at parametric amplifier input

NF_{pa} = noise factor of parametric amplifier alone = 1.25 dB (1.33 ratio)

NF_2 = noise factor of receiver circuitry following parametric amplifier (preselector filter L14, low-pass filter L15, coaxial cable L16, and the mixer and IF preamplifier NF_m)

= 0.7 + 0.2 + 0.1 + 5.5 = 6.5 dB (4.467 ratio)

G_{pa} = parametric amplifier gain = 15 dB (31.62 power ratio).

Using the above figures, this gives

$$NF_{in} = 1.33 + \frac{(4.467 - 1)}{31.62}$$

$$= 1.44 \text{ (1.58 dB)}$$

which gives the receiver input noise temperature of

$$T_e = T_o \,(NF_{in} - 1)$$

$$T_e = 290\,(1.44 - 1) = 127.6°K$$

therefore,

$$L_r T_e = (1.85)(127.6) = 236°K.$$

With the three factors of antenna temperature, line-loss temperature, and receiver noise temperature known, the system noise temperature can be determined. Using the values discussed above, the ASR-8 system noise temperature is

$$T_s = T_a + T_r + L_r T_e$$

$$= 80 + 246 + 236$$

$$= 562°K$$

g. *Visibility Factor*

The visibility factor is the per-pulse signal-to-noise ratio required in the IF amplifier to achieve the desired probability of detection. The values for visibility factor for 80-percent probability were interpolated from values taken from Figures 6d and 6e of the Blake report, for

75- and 90-percent probability, respectively. These figures are for a Swerling case I fluctuating target, using 10^{-6} false-alarm probability and 19 hits per scan:

Probability of Detection	Visibility Factor
75 percent	7.3 dB
90 percent	11.6 dB

Interpolating for 80 percent gives a required visibility factor of 8.7 dB.

h. Diversity Gain Factor

Operation of a pulsed radar system in dual-frequency diversity yields significant improvement in the visibility factor. The probability of detecting a fluctuating target in the presence of noise with a conventional pulsed radar has been presented in considerable detail by Swerling.[2] Also, the theoretical diversity gain factor has been calculated by Leger.[3] The works of both of these authors indicate that the probability-of-detection curves of Swerling can be used directly to determine the diversity gain factor. The diversity gain factor determined via this method and used in the calculation is 4.8 dB.

i. Matching Loss

The matching loss refers to the decrease in IF signal-to-noise ratio caused by not having an IF response which truly matches the transmitter pulse. The ASR-8 normal and MTI IF amplifier modules have been optimized for the 0.6-μs transmitted pulse. Although the ASR-8 has a matched bandpass receiver design, a conservative matching loss of 0.10 dB is used to compensate for production tolerances, etc.

j. Transmitter Losses

Transmitter line losses are measured from the klystron flange to the input to the antenna terminals. These are given in Figure 2-15 for channel B as:

Rotary joint	0.06
Tower waveguide	0.40
Diplexer	0.33
Building waveguide	0.13
Waveguide switch	0.05
Circulator	0.45
Total	1.42 dB

k. Pattern Loss

The pattern loss refers to the reduction in integrated signal-to-noise ratio which occurs because all received pulses are not of full amplitude. This results from the pulse train modulation

[2] P. Swerling, "Probability of Detection for Fluctuating Targets," Rand Research Memo, RM-1217, 17 March 1954. Republished in *IRE Transaction on Information Theory,* IT-6, No. 2 (April 1960) p. 269.

[3] J. Leger, "Surveillance Radar, Theoretical Study of Frequency Diversity," *Revue Technique C.F.T.H.,* No. 39, Paris (December 1963).

PULSE-RADAR RANGE-CALCULATION WORK SHEET

Based on Eq. (13)

1. Compute the system input noise temperature T_s, following the outline in section A below.
2. Enter range factors known in other than decibel form in section B below, for reference.
3. Enter logarithmic and decibel values in section C below, positive values in the plus column and negative values in the minus column. For example, if $V_{0(dB)}$ as given by Figs. 4 through 9 is negative, then $-V_{0(dB)}$ is positive and goes in the plus column. For C_B, see Figs. 1 through 3. For definitions of the range factors, see Eq. (13).

Radar antenna height: h = 8.1 METERS Target elevation angle: θ = 2.5°. (See Fig. 13.)

A. Computation of T_s:

$T_s = T_a + T_r + L_r T_e$

(a) Compute T_a.
For $T_{tg} = T_{ta} = 290$ and $T_g = 36$ use Eq. (37a).
Read T_a' from Fig. 11.
$L_{a(dB)}$: 0.2 L_a: 1.05
$T_a = (0.876 T_a' - 254)/L_a + 290$
T_a = 80 °K

(b) Compute T_r using Eq. (40).
For $T_{tr} = 290$ use Table 1.
$L_{r(dB)}$: 2.67 T_r = 246 °K

(c) Compute T_e using Eq. (41) or using Table 1.
$F_{n(dB)}$: 1.44 T_e: 127.6°K
L_r: 1.85 $L_r T_e$ = 236°K

Add. T_s = 562°K

B. Range Factors		C. Decibel Values	Plus (+)	Minus (-)
$P_{t(kW)}$	1000	$10 \log P_{t(kW)}$	30.00	.
$\tau_{\mu sec}$	0.6	$10 \log \tau_{\mu sec}$		2. 20
G_t		$G_{t(dB)}$	33.80	.
G_r		$G_{r(dB)}$	33.80	.
$\sigma_{(sq\ m)}$	1.0	$10 \log \sigma$	0.00	.
f_{MHz}	2800	$-20 \log f_{MHz}$	.	68. 94
T_s (°K)	562	$-10 \log T_s$	.	27. 50
V_0 80%	HS19, FAR 10⁻⁶	$-V_{0(dB)}$	4 80	8. 70
C_B		$-C_{B(dB)}$		0. 10
L_t		$-L_{t(dB)}$		1. 42
L_p		$-L_{p(dB)}$		1. 60
L_x		$-L_{x(dB)}$		.
Range-equation constant (40 log 1.292)			4.45	
4. Obtain the column totals →			106.85	110 . 46
5. Enter the smaller total below the larger →			.	106 . 85
6. Subtract to obtain the net decibels (dB) →			+ .	- 3 . 61

7. In Table 2 find the range ratio corresponding to this net decibel (dB) value, taking its sign (±) into account. Multiply this ratio by 100. This is R_0 → **81 . 2**

8. Multiply R_0 by the pattern-propagation factor $F = 1$ (see Eqs. (42) through (65) and Figs. 12 through 19):
$R_0 \times F = R'$ → **81 . 2**

9. On the appropriate curve of Figs. 21 and 22 determine the atmospheric-absorption loss factor, $L_{\alpha(dB)}$, corresponding to R'. This is $L_{\alpha(dB)(1)}$. → **1 . 2**

10. Find the range factor δ_1 corresponding to $-L_{\alpha(dB)(1)}$ from the formula $\delta = \text{antilog}(-L_{\alpha(dB)}/40)$ or by using Table 2. → **.9333**

11. Multiply R' by δ_1. This is a first approximation of the range R_1. → **75 . 8**

12. If R_1 differs appreciably from R', on the appropriate curve of Figs. 21 and 22, find the new value of $L_{\alpha(dB)}$ corresponding to R_1. This is $L_{\alpha(dB)(2)}$. → **–**

13. Find the range-increase factor (Table 2) corresponding to the difference between $L_{\alpha(dB)(1)}$ and $L_{\alpha(dB)(2)}$. This is δ_2. → **–**

14. Multiply R_1 by δ_2. This is the radar range in nautical miles, R. → **75 . 8**

Note: If the difference between $L_{\alpha(dB)(1)}$ and $L_{\alpha(dB)(2)}$ is less than 0.1 dB, R_1 may be taken as the final range value, and steps 12 through 14 may be omitted. If $L_{\alpha(dB)(1)}$ is less than 0.1 dB, R' may be taken as the final range value, and steps 9 through 14 may be omitted. (For radar frequencies up to 10,000 megahertz, correction of the atmospheric attenuation beyond the $L_{\alpha(dB)(2)}$ value would amount to less than 0.1 dB.)

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Figure 2-15. ASR-8 Dual-Channel Diplex Range Calculation caused by the antenna scanning across the target. Blake suggests that a standard loss of 1.6 dB be used.

l. Absorption Loss

The atmosphere contributes to radar losses in that some of the energy is dissipated during the two-way transmission. The value of two-way absorption loss is taken from Figure 22 of Blake. The antenna tilt angle is assumed to be 2.5 degrees. Since a figure is not included specifically for 2.5 degrees and 2.8 GHz, interpolation must be made between the 2- and 5-degree curves and the 2- and 3-GHz values. A loss factor of 1.2 dB is used.

m. Coverage Pattern

The calculated coverage diagram is shown in Figure 2-16.

D. RELIABILITY AND MAINTAINABILITY

The ASR-8 equipment has passed the numerous design qualification tests specified by the FAA General Requirements Specification FAA-G-2100 and Equipment Specification FAA-E-2506, as a part of the FAA ASR-8 design qualification. In addition, a reliability demonstration test was run under the continuous monitoring of the FAA to Test Plan III, Test Level A-1, of MIL-STD-781B which more than demonstrated compliance with a specified single-channel requirement of 600 hours mean time between failures (MTBF). A maintainability demonstration was also conducted on the ASR-8 per MIL-STD-471, Method L, Plan A1, plus Plan B2, at Texas Instruments, Plano, Texas, in April 1975. In summary, the maintainability demonstration proved a mean time to repair (MTTR) of 25 minutes, which is less than half of specified limit of 60 minutes. The following items are a partial listing of the maintainability features that contributed to this successful demonstration:

Dual-channel system allows single-channel operation while maintenance is performed on the down channel. Also, the second channel can be used as a test bed when placed in the off-line condition.

Modular layout allows replace-and-repair-later maintenance

Built-in test equipment

No external special test equipment required for maintenance

Minimum external general test equipment required for maintenance

All special tools are provided

Provisions are made for antenna alignment and checks

Antenna pedestal components can be removed and replaced without removing the reflector and feed assembly

Front access to all components

Easy access to and removal of short-life components

Swing-out panels for complete accessibility

Commonly used test points are front-panel mounted

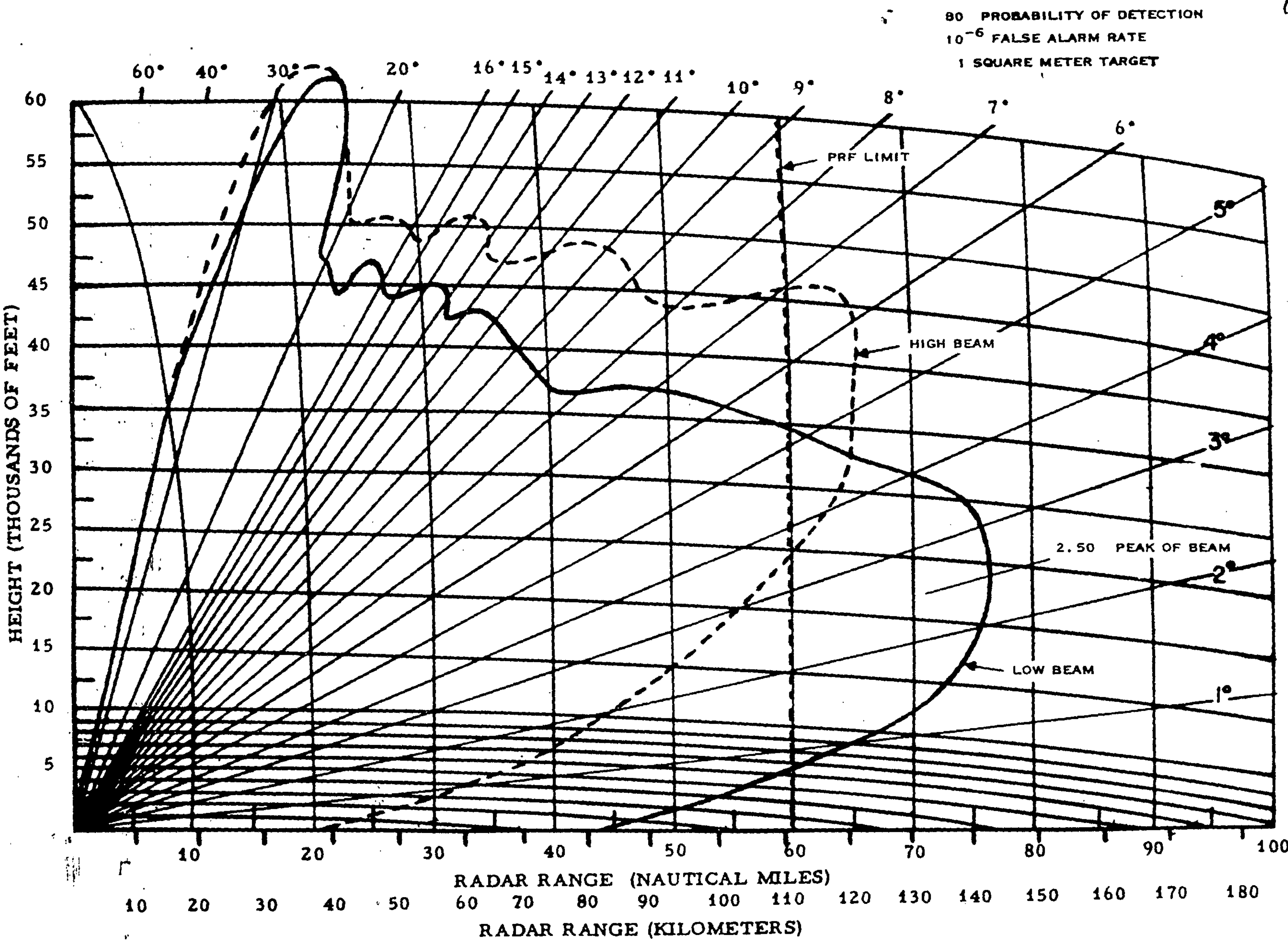

Figure 2-16. Calculated Free-Space Vertical Coverage Diagram

Front panel switches for checks, adjustment, and maintenance

Front panel meters

Failure indicators (power supplies and transmitter faults)

Card-edge test points

Card-edge adjustments

Extender boards provided.

SECTION III

ASR-8 TECHNICAL DESCRIPTION

The Texas Instruments ASR-8 surveillance radar is designed specifically to meet the requirements of the Federal Aviation Administration Specification FAA-E-2506. The purpose of this section is to describe briefly the standard system, show the layout of the system for both transportable and fixed-site building installations, and show items to be supplied.

The ASR-8 system is a dual-channel radar with a single antenna system. Figure 3-1 shows in block diagram form the antenna system, one of the two radar channels, and the display site equipment supplied as a part of the system.

A. ANTENNA GROUP

1. Pedestal Assembly and Drive

The ASR-8 pedestal assembly consists of two rigid aluminum sand castings: a fixed-base casting, attached to the antenna tower, to which the inner race of the main bearing is bolted; and an upper, rotating "spider" casting to which the outer, helically geared main bearing race is attached. Two drive shafts located 180 degrees apart, each with a pinion gear at its upper end, protrude upward from a drive train, through the base casting, and drive the main bearing geared outer race, thereby rotating the spider casting which is attached to the reflector support.

Each of the two 5-horsepower drive trains, shown in Figure 3-2, is capable of driving the antenna assembly. Each drive train consists of a horizontally mounted drive motor coupled to a right angle, worm-gear speed reducer, the vertical output shaft of which attaches to one of the pedestal drive shafts through an electromagnetic clutch, providing rotational drive for the antenna. A failure of either the motor or reducer is sensed and the clutch is automatically opened, disengaging the failed components from the drive train.

The drive-train layout shown in Figure 3-2 is only one of several possible layouts. Each of the two drive assemblies may be independently rotated about the centerline of the vertical drive shaft to fit the eccentricities of various existing antenna tower configurations.

A five-channel rotary joint is included in the pedestal, with three S-band channels and two L-band channels. Attached to the bottom of the rotary joint is a dual azimuth pulse generator (APG) unit which provide antenna timing information. The two APG units are identical, with one being driven directly by the rotary joint and the other through a single gear mesh. The redundant APG can be removed without disrupting operation of the other, requiring only a short shutdown period.

2. Reflector Assembly

The ASR-8 reflector assembly, shown in Figure 3-3, consists of the reflector, feed and polarizer assembly, and reflector support and tilt mechanism. The antenna is designed for dual-beam operation. The new mechanical design uses interlocking vertical and horizontal plates fabricated by computer-controlled machines to achieve excellent contour accuracy. This accuracy, combined with a new surface contour and feedhorn design, results in lower sidelobes, improved circular polarization, and sharper ground-side cutoff.

a. Electrical Design

The ASR-8 antenna is a conventional horn-fed doubly curved reflector with narrow azimuth beam and cosecant-squared elevation shaping to 30 degrees above peak of beam. It is designed to use a second receive-only high beam for close-in clutter rejection. The electrical design optimizes performance for air surveillance operation, including the following features:

- High azimuth resolution (1.35 degrees)
- Low sidelobes (−24 dB maximum)
- Fast ground-side cutoff (−20 dB at 4 degrees below peak of beam)
- High gain (33.5 dB minimum)
- Excellent circular polarization (22-dB integrated cancellation ratio minimum)
- Low back radiation (−30 dB)
- Dual-beam design.

These electrical performance parameters are achieved with an extremely rugged mechanical construction, designed for operation in any environment without a radome.

One of the more important functions of the ASR is to detect targets of small radar cross section in the presence of heavy ground clutter. The ability of the ASR-8 to do this is enhanced by the fast ground-side cutoff of the antenna elevation pattern. This prevents the ground clutter from being illuminated while still allowing detection of low-altitude targets. Figure 3-4 shows the measured elevation antenna pattern for the ASR-8 antenna, showing the fast roll-off feature. Also shown is the elevation pattern for the passive horn, or high beam. At the horizon angle (approximately 3 degrees below peak of beam), the high beam has 14 dB less gain than the low beam with essentially the same gain at higher angles. This effectively increases the target-to-clutter ratio of close-in targets by 14 dB.

A second, and just as important, operational requirement is to detect targets in the presence of precipitation clutter. The capability of the ASR to do this is very dependent on the quality of circular polarization of the antenna. Figure 3-5 shows the measured normal antenna elevation pattern with circular polarization, showing the high quality of the ASR-8 antenna circular polarization over all elevation angles. By FAA Specification FAA-E-2506, to which the antenna was designed, the integrated cancellation ratio (ICR) with circular polarization must exceed 22 dB; measured values typically exceed 25 dB. This performance results from a combination of a new electrical design with extended focal length, improved reflector accuracy because of new mechanical design, and a totally new feedhorn designed for excellent axial ratio in all planes.

As a result of the more accurate surface contour achieved with the new interlocking plate design and combined with the new feedhorn design, azimuth sidelobes are down at least 24 dB, as shown in the azimuth pattern of Figure 3-6 (the traces under the mainlobe are cross-polarized component measurements). Azimuth beamwidth in the principal plane is 1.35 degrees minimum at the −3-dB point and no greater than 4 degrees at the −20-dB point. This narrow beamwidth provides high azimuth resolution and accuracy while still providing, in combination with the 12.5-rpm rate and 1-kHz pulse repetition rate, a high MTI improvement factor (34 dB because of scanning) and target detection (19 hits per scan).

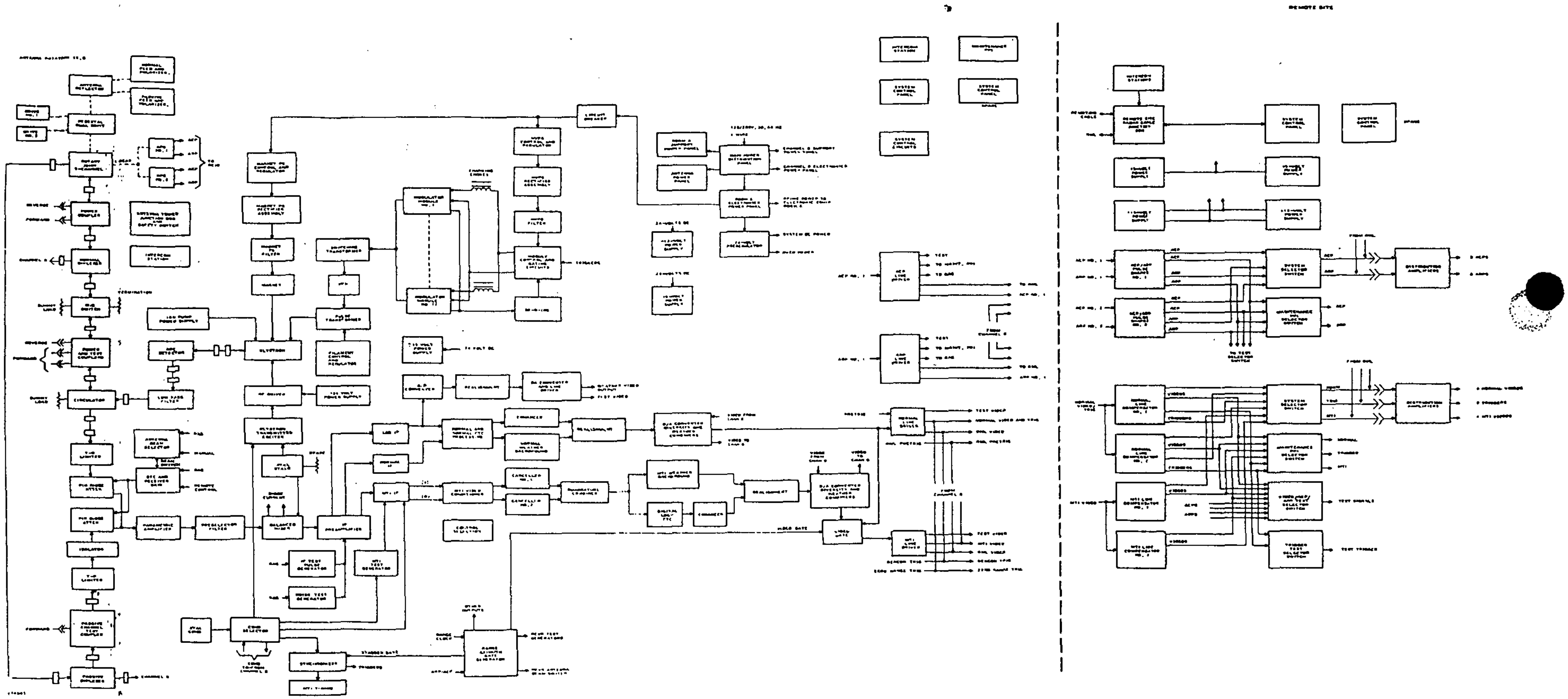

Figure 3-1. ASR-8 System Block Diagram

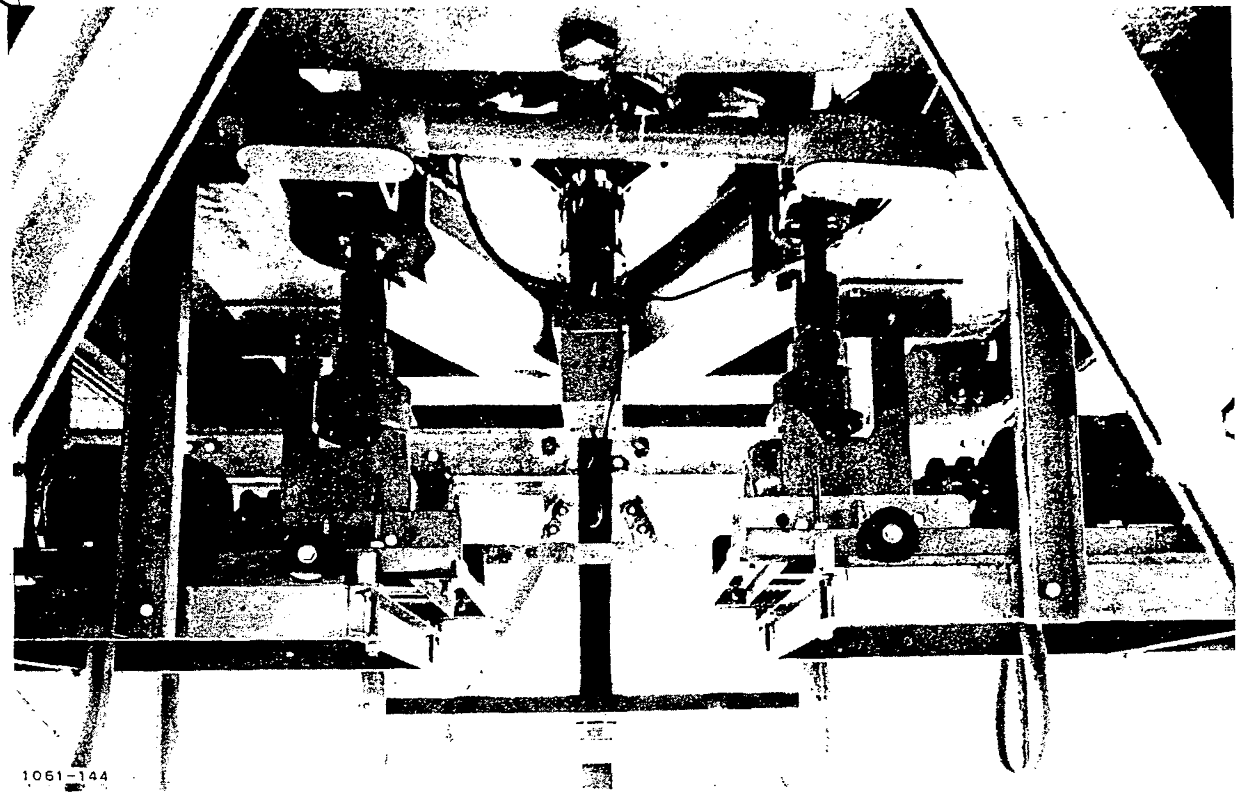

Figure 3-2. Drive Mounting Configuration

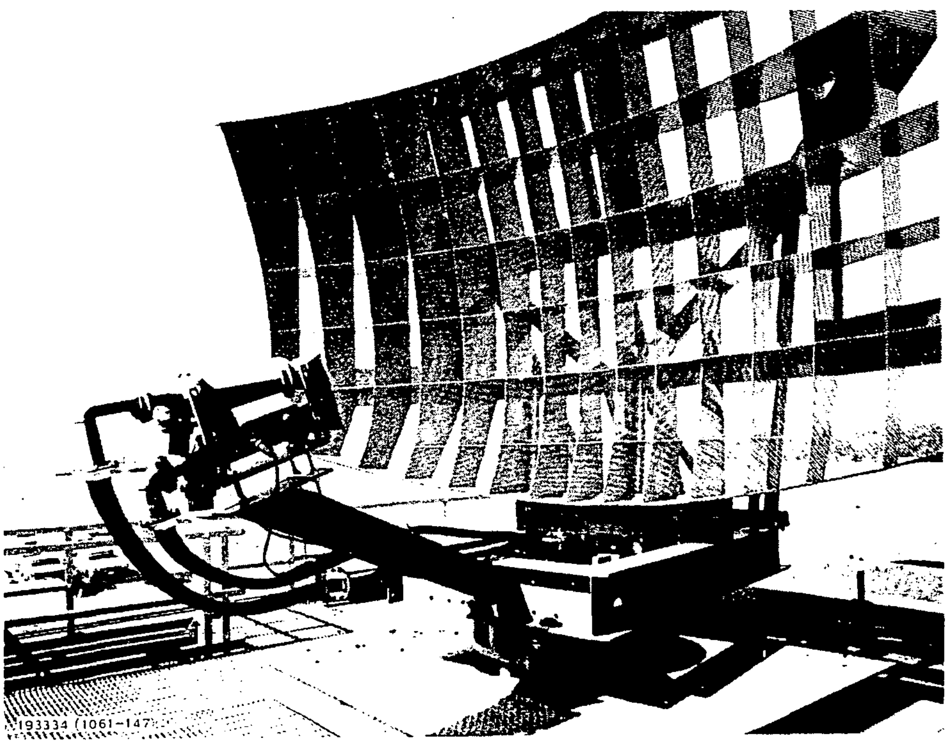

Figure 3-3. ASR-8 Antenna

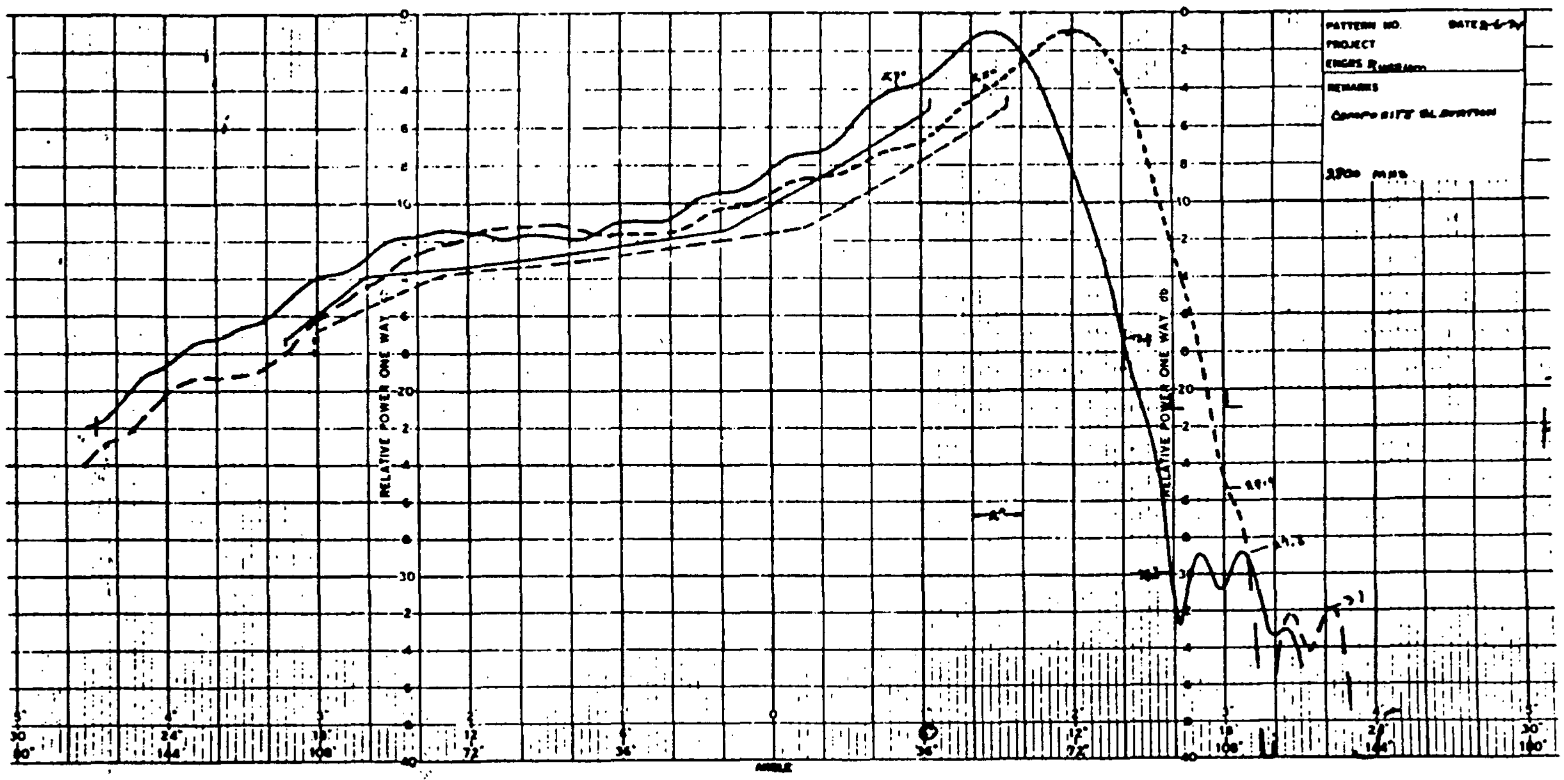

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Figure 3-4. Normal and Passive Elevation Patterns

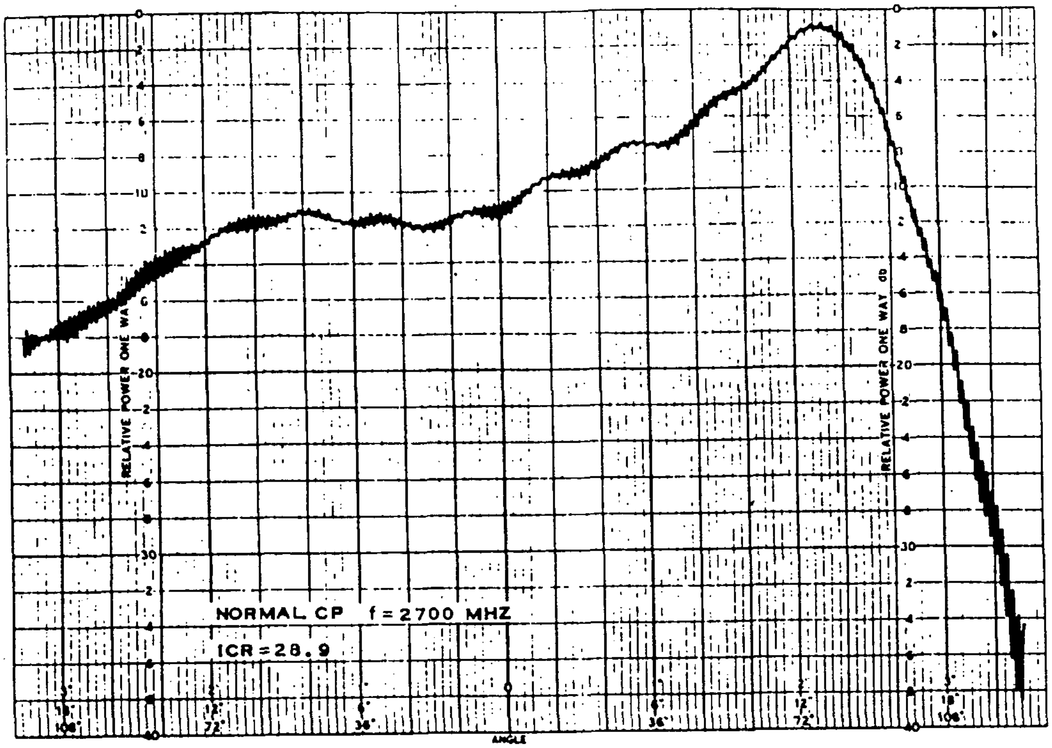

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Figure 3-5. Normal Beam Circularly Polarized Elevation Pattern

Both antenna feedhorn and polarizer assemblies (normal beam and passive beam) consist of a dual-mode transducer, polarization phase shifter, feedhorn, and radome, as shown in Figure 3-7.

The dual-mode transducer, fed by the waveguide from the rotary joint, creates two orthogonal field vectors within a square waveguide. These two vectors are each inclined at 45 degrees to the vertical. For vertical linear polarization, no relative phase shift is applied and the two vectors combine to re-create a single vertical field vector. For circular polarization, a relative phase shift of 90 degrees is applied to the orthogonal vectors by the phase-shift unit to create right-hand circular polarization. The relative phase shift is obtained in the phase shifter unit by inserting two dielectric strips into one side of the square guide, thus affecting only one of the two orthogonal fields. For vertical polarization, the dielectric strip is pulled back against the wall of the waveguide and therefore has no effect. This type phase shifter permits the polarizer to be a simple push-pull mechanism, resulting in a reliable, trouble-free design. It also greatly reduces the physical size to minimize aperture blockage effects.

The antenna feedhorn was specifically designed in conjunction with the new contour to achieve the low sidelobes and improved circular polarization characteristics. Special attention has been given to achieving excellent polarization ratios not only in the principal planes, as is usually done, but also in the off-axis planes. This ensures that all portions of the antenna reflector are illuminated with energy which has an excellent polarization ratio. The feedhorn is a single aluminium casting, covered with a small radome to exclude rain and foreign material, as well as to permit waveguide pressurization.

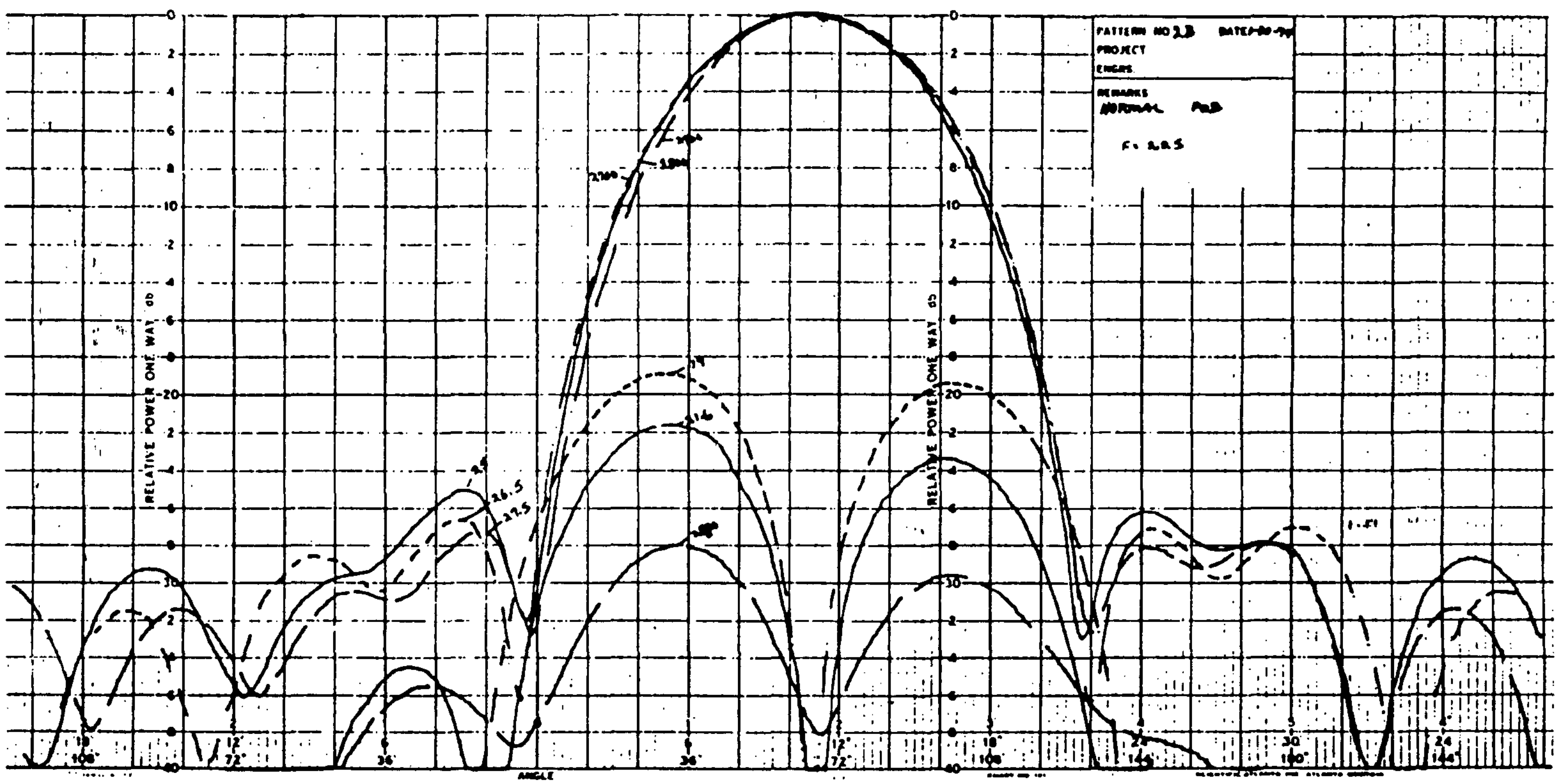

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Figure 3-6. Normal Beam Azimuth Patterns

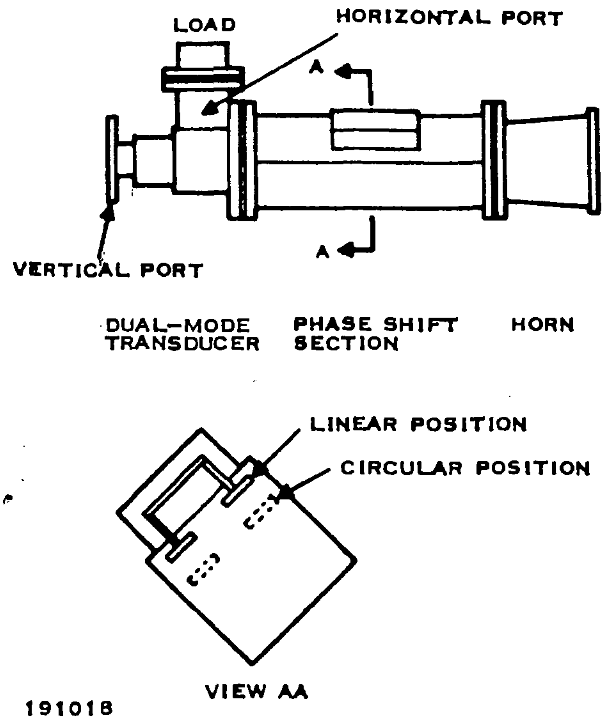

Figure 3-7. Antenna Feedhorn Assembly

When using circular polarization to reject weather clutter, the signals returned from the precipitation are polarized in the opposite circular sense. The action of the dual-mode transducer is such that these signals are routed to the matched termination on the orthogonal port. If it is desired to use this weather signal as an input to a weather channel, the termination is replaced with a waveguide-to-coaxial cable transition. The third S-band channel in the rotary joint is available to provide for a coaxial cable path to the ASR shelter.

b. Mechanical Design

The ASR-8 antenna reflector assembly is designed to operate on a continuous duty basis in the most severe environmental conditions to be found in the world. It is designed to operate, without a radome, in wind velocities to 85 knots and to survive velocities of 130 knots while covered with 38 mm of ice. It is constructed entirely of aluminum and protected with three separate primer/paint processes. The antenna can be tilted in elevation by a manually operated tilt-screw mechanism so that the elevation lower–3-dB point can be adjusted ±2.5 degrees relative to the horizon. A calibrated scale marked in degrees relative to the horizon indicates the elevation tilt angle.

As shown in Figure 3-3, the antenna assembly consists of the basic reflector, reflector-back structure, reflector support and tilt mechanism assembly, and the feed support and feed assembly. The basic reflector is assembled from interlocking vertical and horizontal plates machined from aluminum sheets using a numerically controlled automatic punch press with ±0.127-mm accuracy. The reflector contour was first synthesized using a computer program to produce the specified antenna patterns and characteristics. This computer-generated contour was then processed by a second program to compensate for mechanical factors such as screen thickness, rib station location, etc. This data was processed by a third computer program to generate the punched tape which controls the numerically controlled punch machine. Using this tape, the 16 vertical and 7 horizontal contour ribs are punched out, including the surface contour, interlocking slots, and tooling holes. The punched vertical plates are mounted to an assembly fixture using the precisely located tooling holes. The horizontal plates are inserted into the vertical plates using the prepunched slots. While on the fixture, the vertical and horizontal plates are riveted together at all intersections; riveting is used to avoid inducing stresses and mechanical errors due to welding.

After the reflector structure is riveted together, and while it is still on the fixture, a prefabricated back structure is moved into place, shimmed for accurate fit, and bolted to the reflector. The reflector is then screened by welding expanded aluminum to the front edges of the horizontal and vertical plates. The result is a highly accurate and rugged antenna reflector structure.

After fabrication, each antenna receives a three-step protective coating, as follows:

Wash primer with a thickness of 0.005 to 0.007 mm per MIL-C-8514.

Epoxy polyamide primer, thickness 0.015 to 0.023 mm, per MIL-P-23377, Class I.

Two-compound aliphatic isocyanate urethane paint by Andrew Brown Co. or equivalent, color international orange, color number 12197, thickness 0.023 to 0.033 mm, per FED-STD-595 and MIL-C-83286.

Using all-aluminum welded construction with the protective coating outlined ensures that the antenna will provide trouble-free service in all environments for the 20-year expected lifetime of the system. This confidence is supported by the experience with ASR-4 systems which have been in worldwide continuous operation since 1960.

The top horizontal plate of the reflector is designed for mounting of a secondary surveillance radar antenna, which is approximately 9 meters long and weighs approximately 134 kilograms.

3. Waveguide Assembly

Included in the ASR waveguide assembly are all waveguide components inside the ASR shelter and outside the ASR cabinets. In addition to the associated waveguide sections and bends are the major waveguide components (for dual-channel operation):

2 Frequency diplexers (for normal and passive channel)

2 Waveguide switches with high-power dummy load and diplexer termination

2 Four-port circulators

2 Test couplers

2 Low-pass, high-power filters.

The waveguide is standard rectangular aluminum WR-284 and the entire waveguide assembly is suspended above the ASR cabinets from the shelter ceiling.

The waveguide assembly, shown in Figure 3-8, connects the channel A and channel B systems simultaneously to the antenna for frequency-diversity operation. Also, either channel may be independently taken off line by the waveguide switch and operated on the high-power dummy load for maintenance purposes. The waveguide switch is operated remotely from the radar system control panel. Each four-port waveguide switch includes a convectively cooled high-power dummy load capable of handling the full average power of the klystron transmitter. Also, a matched termination is included to provide a matched line for the diplexer when the respective channel is switched off the diplexer.

Directional couplers are provided for measuring the transmitter power and for injecting test signals into the receiver or for making noise figure measurements.

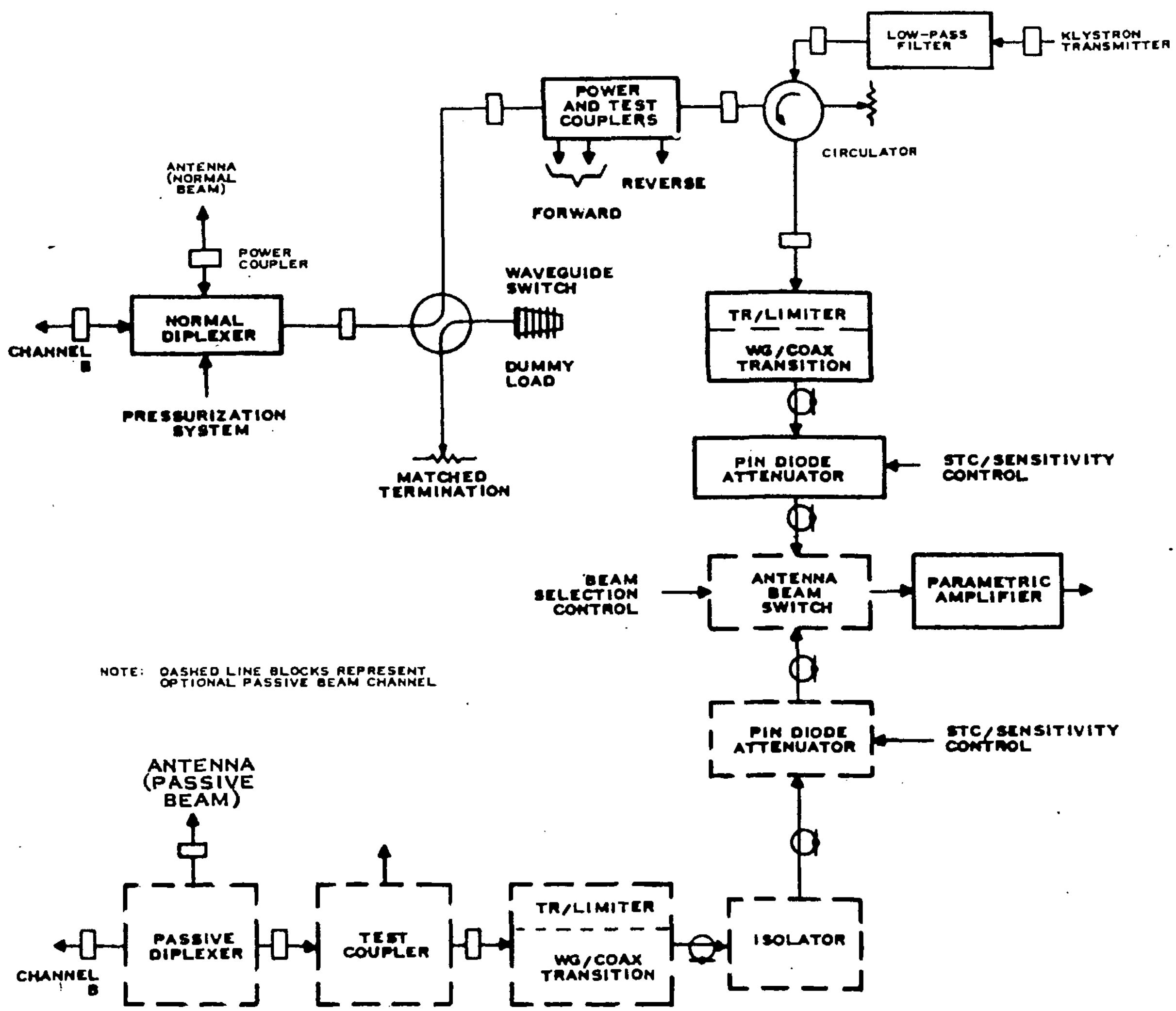

Figure 3-8. ASR Waveguide Assembly

A four-port ferrite circulator serves as a duplexer to connect the transmitter and receiver units to the diplexer, and hence to the antenna (a passive TR-limiter is included in the receiver to protect against transmitter leakage). The circulator is convectively cooled and provides in excess of 30 dB isolation with less than 0.5 dB insertion loss. Because of the high isolation between ports, the circulator isolates the klystron from load mismatch. By so doing transmitter stability is improved because of reduced frequency pulling. The result is improved MTI performance.

Each channel also includes a high-power low-pass waveguide filter to suppress any harmonic and spurious radiation which might be generated by the transmitter. The second harmonic of the transmitter is attenuated a minimum of 40 dB, the third harmonic is attenuated at least 30 dB, and the fourth harmonic at least 10 dB.

B. KLYSTRON TRANSMITTER

The ASR-8 transmitter (Figure 3-9) uses a VA-87E klystron power amplifier and solid-state modularized modulator to attain the utmost in MTI performance, reliability, and maintainability. All transmitter circuitry is contained in a single 152.4-cm-wide cabinet and is packaged to simplify maintenance in every way possible.

The primary alternating current (ac) power is brought into the cabinet cupola through a 3-phase circuit breaker and then through RFI filters into the RFI-tight portion of the cabinet. Upon turning on primary power, the cabinet blowers and support circuits are activated, along with the 15-minute preheat cycle. This cycle applies power to the focus solenoid and klystron filaments. After 15 minutes, the high voltage can be turned on. Both the solenoid and filament power supplies use totally solid-state regulation and control. A similar solid-state control and regulator circuit is used for the high-voltage power supply which supplies the modulator. This supply develops a nominal 250 volts dc at approximately 20 amperes.

A fully solid-state modularized modulator supplies the 75-kV pulse to the klystron cathode. Twelve identical modules plug into a card rack from the front of the transmitter unit. Each module contains a switching SCR and energy storage pulse capacitor, plus peripheral circuits. The outputs of the 12 modules are bussed together and connected to the high-voltage components in an oil-filled tank on which the klystron and solenoid are located. Spaces for four additional modules provide growth capability.

Within the klystron tank are the high-voltage components which convert the high-current pulse from the 12 modules to the 75-kV pulse required by the klystron. The modulator is a hybrid SCR-magnetic switching type, designed to minimize peak current values through the SCR device. This eliminates localized hotspots in the SCR junction, thus increasing lifetime. The magnetic switching transformer, hold-off coils, pulse-forming network, and pulse transformer are located in the high-voltage tank. All components are mounted on two slide-out mounting boards for accessibility.

The drive pulse for the klystron is generated in the RF exciter, located in the receiver cabinet, by mixing the S-band stable local oscillator (STALO) and the 30-MHz coherent oscillator (COHO). A 5-μs pulse is generated by the exciter to allow time for the signal to stabilize in phase through the narrowband sideband-rejection filters. This pulse is sent to the transistor RF driver located in the klystron transmitter cabinet where it is amplified to approximately 10 watts.

Specification FAA-E-2506 has stringent spectral-sidelobe-reduction requirements including the requirement that at 10 MHz on either side of center frequency the transmitter sidelobe level must be down at least 40 dB. To accomplish this, the high-level output of the RF driver is shaped by a PIN diode RF switch which gates out the 0.6-μs klystron drive pulse from the 5-μs drive pulse. The shaping forms the rise and fall times of the pulse and rounds off the corners to reduce spectral sidelobes to below the −40-dB requirement.

The transmitter metering, controls, and fault-detection circuitry are located on a swing-out front panel. All transmitter parameters which could cause damage by going out of tolerance are monitored and connected to the fault-protection circuitry. Faults which may occur on a one-of-a-kind basis, such as a waveguide arc, shut the transmitter high voltage down, but it is

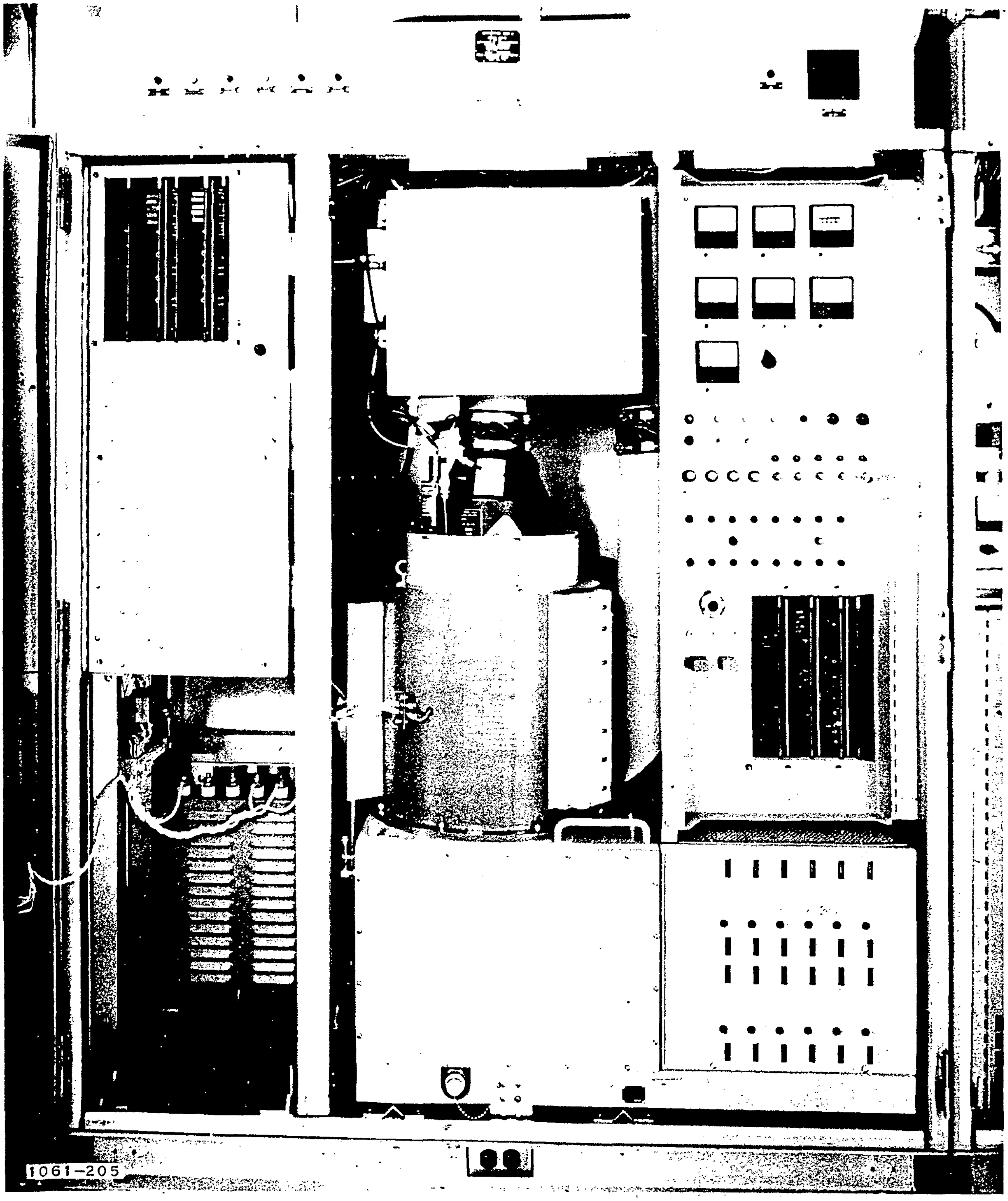

Figure 3-9. ASR Transmitter Unit

automatically recycled up to three times. If the fault clears, the transmitter continues to operate; otherwise, it is permanently shut down. Other faults, such as solenoid under current, which can damage the klystron, immediately cause permanent shutdown of the transmitter.

All elements of the transmitter system have been designed to optimize MTI performance in both fixed PRF and staggered PRF. A highly efficient de-Q'ing circuit tightly regulates the beam voltage while operating in stagger. Jitter of the beam voltage pulse is less than 5 ns rms. Measured MTI improvement factor of the transmitter is in excess of 47 dB. This stability manifests itself in the very low clutter residue experienced by Texas Instruments on its ASR-8 radar system.

1. HVPS/Modular Modulator

As shown in the transmitter block diagram of Figure 3-10, the main part of the transmitter is the HVPS/modulator chain. The unique part of the transmitter is the modular solid-state modulator which uses 12 identical plug-in SCR switching modules to replace the conventional thyratron, in conjunction with a triggered hybrid magnetic modulator concept which eliminates fast rise-time current pulses to prolong SCR life. This modulator combines the fail-soft advantage of the modular concept with the long life of solid-state components to offer ease of maintenance and exceptionally high reliability.

The HVPS is a solid-state, 250-volt, 20-ampere system using SCR phase-angle control of the input primary power for dc voltage regulation. The output dc voltage is sensed by a regulator circuit which controls the triggering of the input SCRs. By controlling the time of triggering relative to the ac phase angle, the input power is regulated to maintain constant output voltage. An LC filter is included in the output to reduce the ripple to a negligible amount. The SCR components, with associated heatsinks, are mounted on heavy-duty fiberglass printed wiring boards. The power supply regulator is a conventional double-side, flow-soldered printed wiring board.

Each of the 12 identical plug-in SCR switching modules contains a switching SCR and storage capacitor, plus ancillary components, including a protective fuse and fuse indicating light. The primary module components are shown enclosed within the dotted lines in Figure 3-11. It is a characteristic of an SCR that, although capable of switching large values of current, it can be damaged by rapid current turn-on. As shown in Figure 3-12, when first triggered, the current must propagate from the gate contact point across the entire junction. If excessive current is conducted before the entire junction is conducting, extreme temperature hot spots can develop, leading to eventual device failure. It is the purpose of the square-loop type of magnetic modulator components to preclude this problem by slowing down the current pulse in the SCR while forming the narrow cathode pulse through magnetic switching. How this is accomplished is discussed in detail in the following paragraphs.

Operation of the modulator can be best understood by referring to the simplified block diagram of Figure 3-11 with illustrative oscilloscope waveforms. During the radar receive time, the switching SCRs are turned off and the storage capacitors on the modules charge toward twice the power supply voltage. Each module capacitor charges through its own charging reactor, L1, according to the resonant 1-cosine curve, shown in trace 2 of Figure 3-11, which is characteristic of a line type of modulator. As the capacitors charge, the voltage is sensed by a control circuit which compares it to a reference level. When the voltage reaches the reference

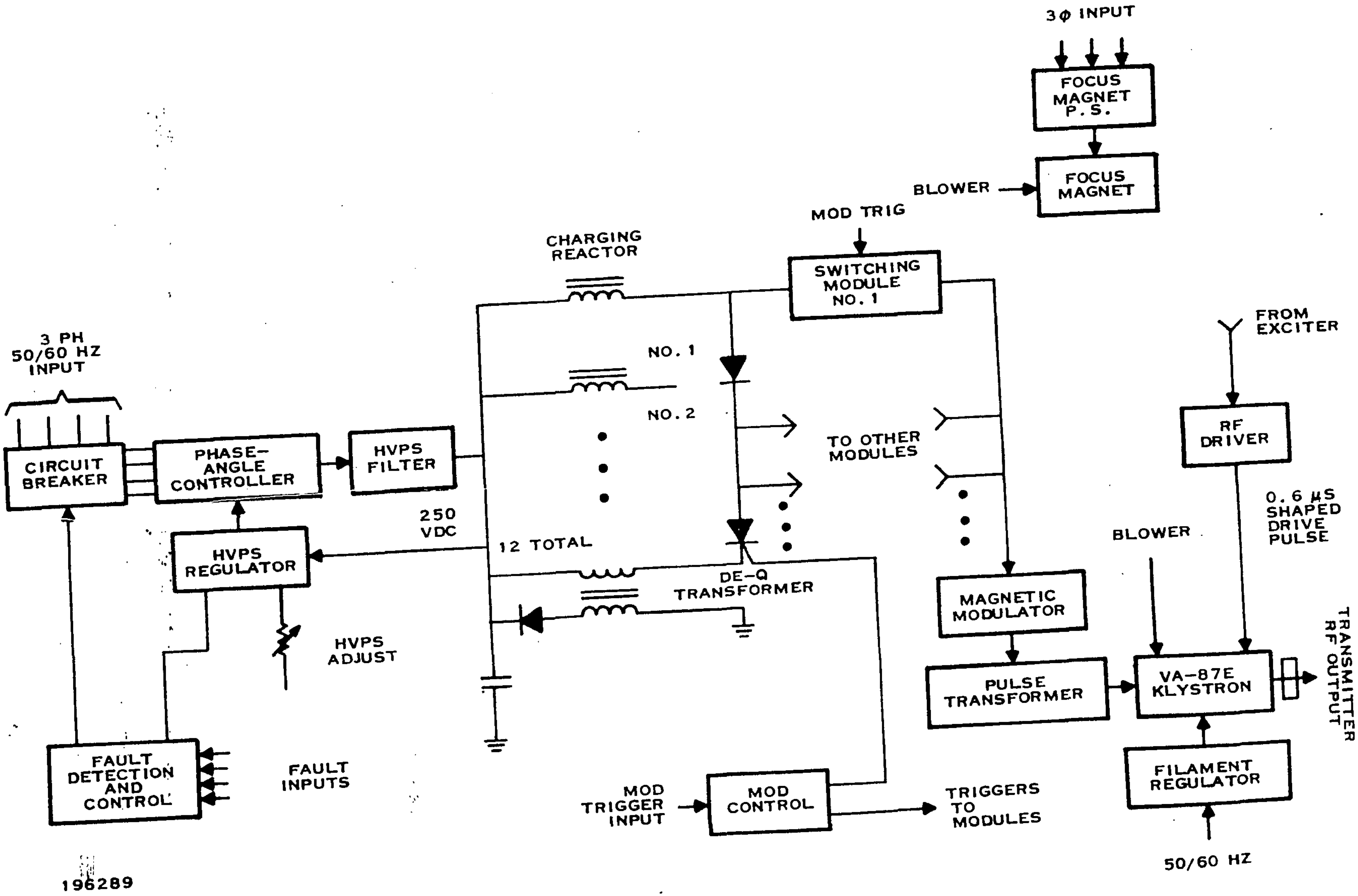

Figure 3-10. Klystron Transmitter Block Diagram

level, the de-Q SCR is triggered, connecting the modules back to the power supply through the de-Q transformer, T1, thus clamping the capacitor voltage at the preset level as shown in Figure 3-11. This type of de-Q circuit is nondissipative and returns the excess charging current to the power supply.

It is the function of the de-Q circuit to maintain a constant charge voltage and, thus, a constant beam voltage on the klystron, independent of power-supply ripple or variations caused by a staggered period. Long-term variations in the power-supply output are controlled by the power-supply regulator. However, ripple that is not completely eliminated by the power-supply filter must be removed by the de-Q circuit. Also, as indicated above, the capacitors charge following a resonant charging waveform. If the pulse repetition period varies, as it does in the staggered PRF mode, the capacitors would charge to different values. Since good MTI performance depends on a very stable transmitter pulse, these variations must also be removed by the de-Q circuit. As shown in trace 2 of Figure 3-11, the de-Q circuit clamps the capacitor voltage tightly to the preset level. A few microseconds before the actual klystron pulse, each of the module SCRs is triggered. At this point, the magnetic modulator components begin to function.

Prior to triggering the SCRs, the hold-off coil L2 is biased in a high impedance state so current cannot instantaneously flow through the SCR. The priming coil, L3, which is an air core coil, allows a low value of current to begin to flow, as shown in the initial portion of the current waveform in trace 2 of Figure 3-11. This small priming current establishes conduction across the entire SCR junction to prepare the SCR for full current conduction. At this point, the hold-off coil saturates and switches to a low impedance state, permitting full current conduction through the primary of T2. This is shown by the half-sine pulse in trace 2 of Figure 3-11. It is seen that this current pulse cycle requires over 5 μs to complete, even though the final transmitter pulse is less than 1 μs. As pointed out earlier, this slow current greatly prolongs the life of the SCR.

The current pulse flows through the primary of the switching transformer T2, which is also a square-loop type magnetic component, stepping the voltage up to approximately 7 kV. During the SCR current pulse, the energy from the 12 module storage capacitors is being transferred via T2, which is acting as a conventional transformer, to the storage capacitor C2. As shown in trace 3 of Figure 3-11, C2 is also charging according to a 1-cosine resonant curve, but over a much shorter period of less than 10 μs. Just as the peak charging voltage is reached and essentially all energy is transferred from the modules to C2, the switching transformer T2 saturates and switches to a low impedance.

As this switching occurs, capacitor C2 is discharged through the pulse-forming network (PFN) and the pulse transformer T3 primary. The PFN shapes the beam pulse to the proper pulsewidth for the klystron, and the pulse transformer steps the 7 kV up to approximately 75 kV as required by the klystron cathode. The 1.2-μs beam pulse, superimposed on the module current of trace 2, is shown in trace 4 of Figure 3-11.

In reviewing this complete cycle, it is seen that, although the beam pulse on the klystron is approximately 2 μs duration, current flows through the switching SCRs for nearly 15 μs total. By thus slowing down the SCR current, junction hot-spots are avoided and the SCR reliability is not compromised.

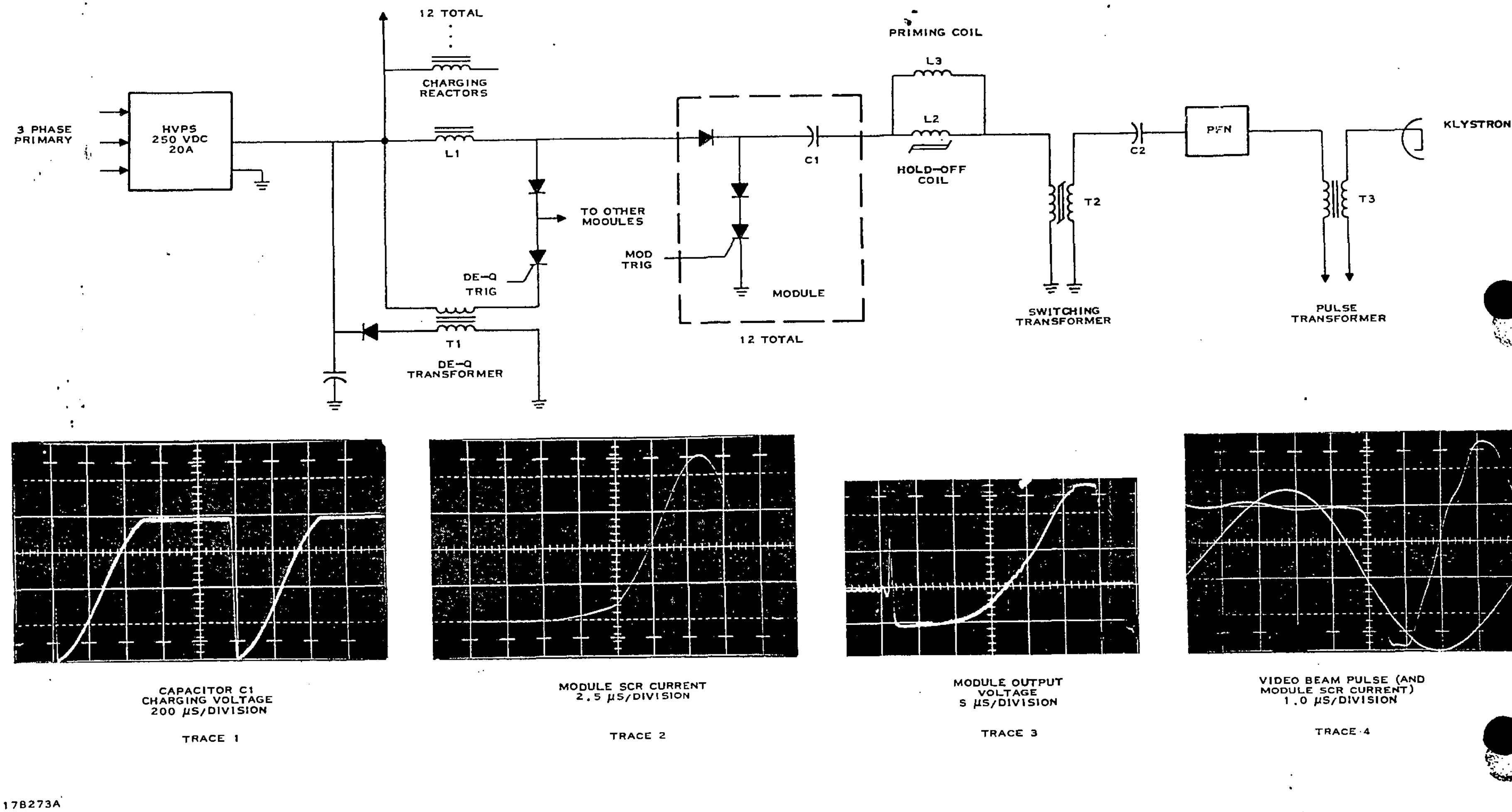

Figure 3-14. Modular Modulator Simplified Schematic Design

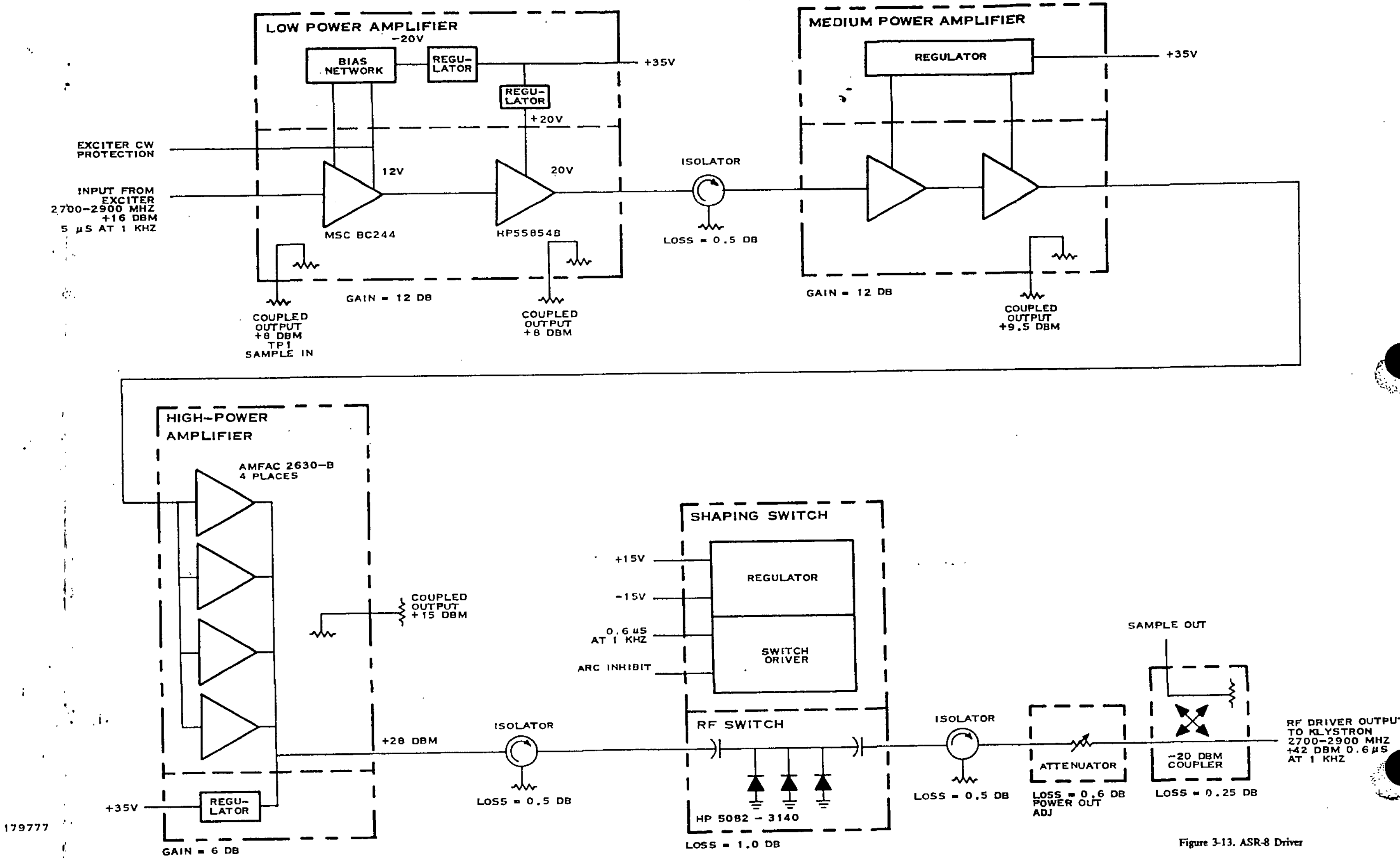

Figure 3-13. ASR-8 Driver

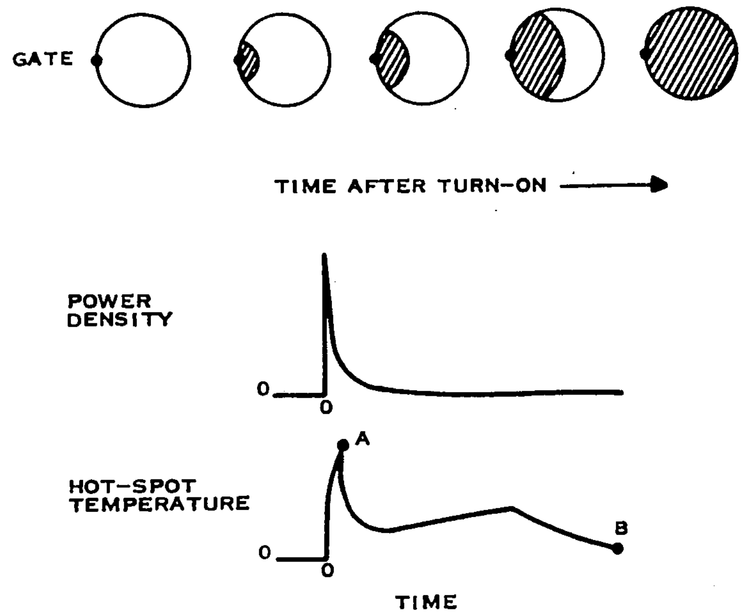

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Figure 3-12. Effect of Rapid Current Turn-On on SCR Junction Temperature

The transmitter tube is an S-band klystron amplifier, Type VA-87E, which is tunable from 2.7 to 2.9 GHz. Its peak power is a nominal 1400 kW, and the operating average RF power is approximately 840 watts.

A swing-out front panel provides control of the transmitter; meters for monitoring crucial parameters, and fault-status indicator lamps. Eight transmitter parameters, including beam overvoltage, beam undervoltage, beam overcurrent, beam undercurrent, SCR reverse voltage, tube temperature, tube airflow, and modulator inverse current, are continuously sensed by automatic fault detection circuits. The faults are grouped into two categories, i.e., 3-times (3X) faults and 1-time (1X) faults. When a 3X fault occurs, the transmitter HVPS will shut down and then turn back on. If the fault clears, the transmitter will continue to operate and a fault indicator lamp will indicate which fault occurred. If, after three attempts, the fault does not clear, the transmitter will shut down permanently and the failure alarms will be activated. A 1X fault is considered potentially damaging to the transmitter, which is immediately shut down with no recycling, and the appropriate fault indicator lamp is turned on.

From initial turn-on, the transmitter requires a preheat time of 15 minutes before the HVPS can be turned on. In the event of a momentary interruption of primary power of 15 seconds or less, transmitter operation is immediately resumed. For interruptions of greater duration, the preheat cycle is initiated.

2. Description of ASR-8 RF Driver

The ASR-8 RF driver features an all-solid-state, modularized design. Figure 3-13 shows the basic electronic function of each module, and the photograph of Figure 3-14 clearly shows that each unit in the block diagram is readily accessible. A number of test points are provided for ease of testing and maintenance as shown in the block diagram.

A minimum gain of 26 dB is obtained with a minimum peak power out of +42 dBm. The gain is provided by five cascaded, transistorized amplifier stages. Four parallel transistors are used in the final stage to provide the high S-band peak output power.

The three amplifier boxes and the shaping switch are manufactured by Texas Instruments and feature microstrip circuitry on Teflon-fiberglass substrates. The adjustable attenuator, the output directional coupler, and the isolators are standard purchased parts.

Spectrum control and pulsewidth control are provided by the RF diode shaping switch which selects a highly stable portion of the wide pulse output from the final amplifier. An inhibit input is provided on the switch for accepting fault signals such as from a waveguide arc.

Each of the amplifier boxes receives its dc power from a common 35-volt power supply, and each individual module contains its own internal voltage regulator circuit. This arrangement results in good isolation between modules, the proper operating voltage for each stage, simple power supply requirements, and excellent phase stability.

3. Waveguide Arc Detector

Sensing for the waveguide arc detector circuit is supplied by two small, solid-state, light-sensitive diodes. These diodes are located at a waveguide bend near the klystron RF output flange. The diodes are optically coupled to the interior of the guide by circular, below cutoff, viewing tubes. One diode looks directly at the klystron window and the other looks in the output direction. Visible light in the waveguide will cause the arc detector to supply a 3X fault signal to the fault control PWBs.

C. RECEIVER UNIT

The ASR-8 receiver unit (Figure 3-15) is contained in a 76- by 76- by 203-cm cabinet adjacent to the klystron transmitter unit. The two RF inputs from the normal and passive antenna beam waveguide channels enter through the top of the cabinet.

1. RF Components

As shown in the block diagram of Figure 3-16, the RF components include the receiver protector (TRL) for the normal and passive channel, the RF attenuator for each channel, a beam selector switch, preselector filter, phase shifter, and signal mixer. The TRL is a passive TR tube (radioactive isotope doped, requiring no keep-alive) followed by a diode spike limiter. The passive/solid-state nature of this component results in long life.

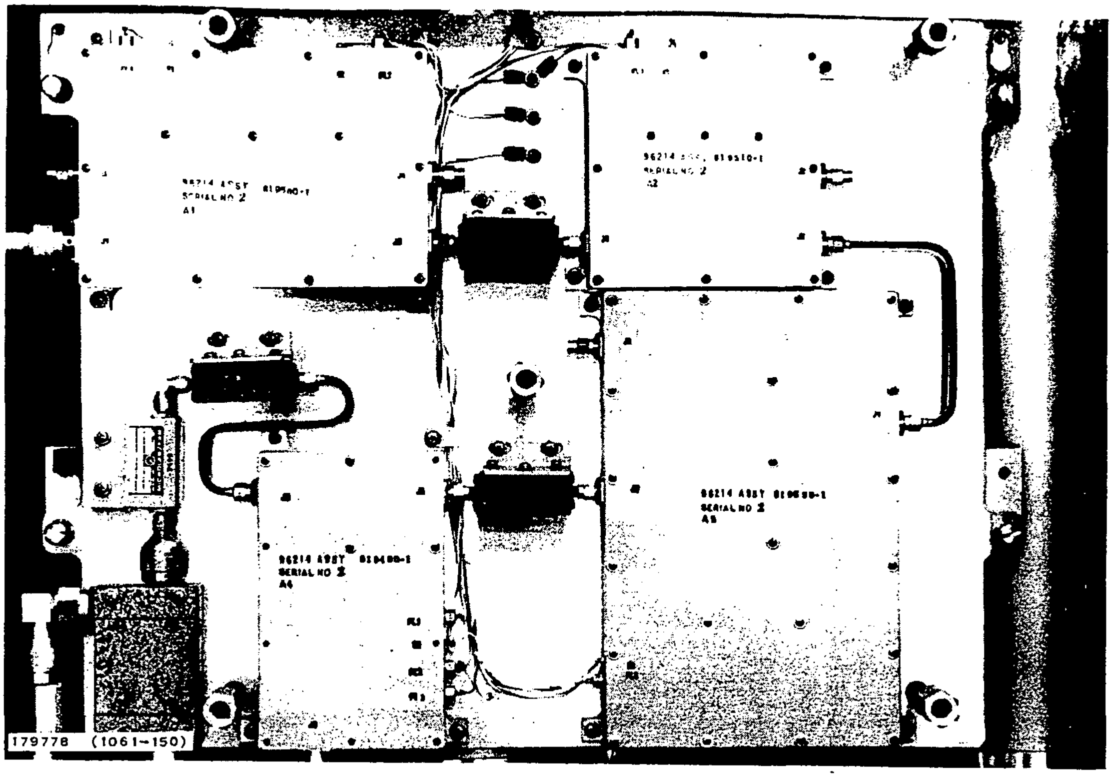

Figure 3-14. ASR-8 RF Driver Configuration

A special feature of the ASR-8 is the PIN-diode microwave attenuator which precedes the parametric amplifier. All receiver gain control functions, including sensitivity time control (STC) and fixed gain, are implemented using this attenuator. By so doing, three important benefits result: large amplitude clutter signals are precluded from saturating the parametric amplifier, the IF amplifiers operate at stable, fixed-gain points, and the output receiver noise level does not vary appreciably as the STC curve varies the gain. The insertion loss of the attenuator is 0.7 dB, and maximum attenuation is 40 dB. Since the parametric amplifier saturates at approximately −30 dBm, signals of up to +10 dBm can be kept out of receiver saturation. The receiver output noise level is held essentially constant with STC action because the attenuator effective noise temperature varies only from approximately 50°K to 300°K over its attenuation range. When this noise temperature is added to that of the parametric amplifier, antenna, and line-loss, the overall system noise temperature varies less than 3 dB. Five preset attenuation levels can be selected from the remote and local control units to control receiver gain; the difference in attenuation between levels is adjustable (maintenance adjust) to 40 dB.

In addition to the fixed gain levels, the STC unit is included in the system to control the gain with respect to time. The operator can select one of three STC control characteristics, each of which has the following range of adjustments:

The initial value of receiver attenuation is adjustable from the minimum level of the device to 40 dB.

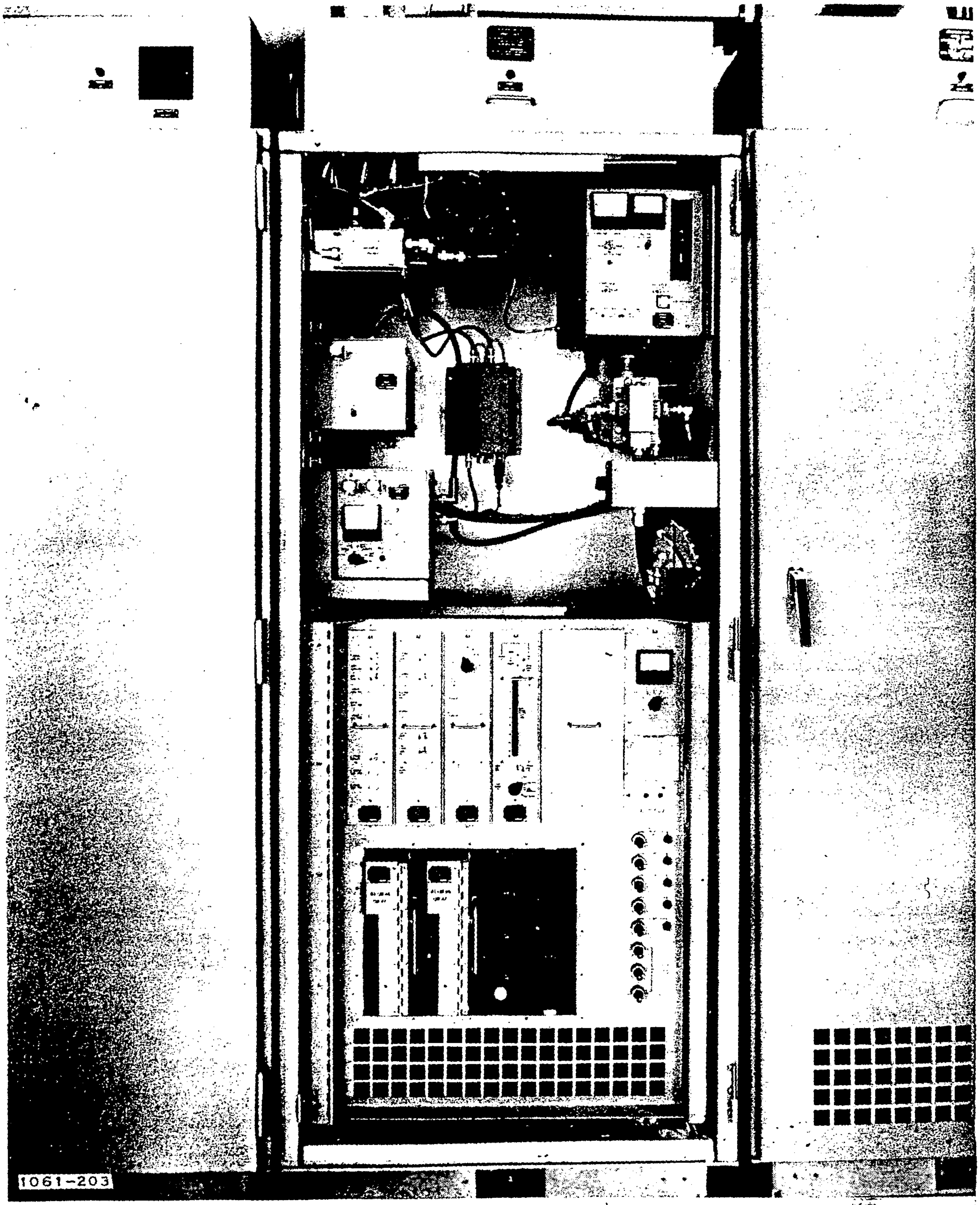

Figure 3-15. ASR-8 Receiver Unit

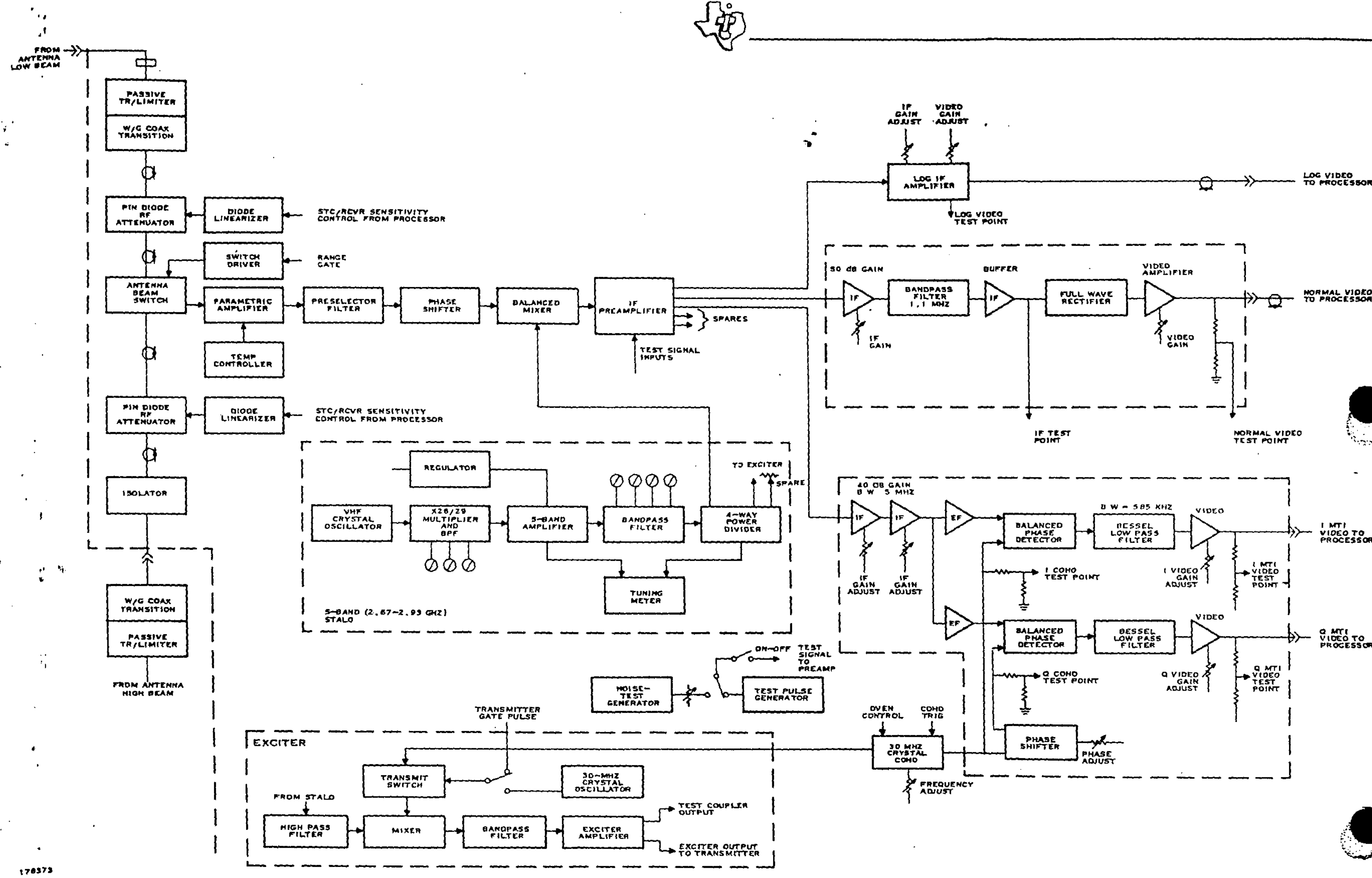

Figure 3-16. Receiver Block Diagram

The start of the exponential decrease in attenuation from the initial value is adjustable from a minimum of not more than 1 μs after the beginning of the transmitter pulse to at least 100 μs.

The shape of the attenuation curve is adjustable from a characteristic which is approximately inversely proportional to the first power of range to a characteristic which is approximately inversely proportional to the fifth power of range.

A separate PIN attenuator is provided for the normal and passive beams in the receiver. The STC function generator and receiver gain control are all digital and are located in the processor unit. Separate, identical STC generators are provided for the two RF attenuators and are described in detail in Subsection III.D.14.

The passive (high) and normal (low) waveguide channels are connected to the parametric amplifier by a solid-state beam switch, which serves as an RF SPDT selector switch with greater than 30-dB isolation between ports. The driver for the switch is located near the switch in the upper part of the cabinet. Switching is accomplished in less than 150 ns.

Following the parametric amplifier, described in the following subsection, is a four-cavity waveguide preselector filter. This filter is tunable across the 2.7- to 2.9-GHz band and has a nominal bandwidth of 8 MHz. At frequencies 50 MHz either side of center, the attenuation is at least 60 dB. Following the preselector filter is a single phase shifter and cross-bar image-terminated signal mixer. The phase shifter matches the signal to the image-terminated mixer. This mixer achieves a noise figure of less than 5 dB across the band, including the IF preamplifier. The mixer diodes have current monitoring on a front panel meter and the diodes are easily field-replaceable.

2. Parametric Amplifier

An all-solid-state wideband parametric amplifier (Figure 3-17) establishes the receiver noise figure. The parametric amplifier has a noise figure of less than 1.25 dB and an instantaneous bandwidth in excess of 200 MHz to cover the 2.7- to 2.9-GHz band without field tuning. Gain of the parametric amplifier is 15 dB minimum. A Ka-band Gunn diode pump is used as the parametric amplifier pump source, and both the Gunn diode pump and parametric amplifier varactor diode are field-replaceable. The Gunn diode pump and varactor diode are held at constant temperature by a heater system. The heater unit is controlled by a proportional controller circuit mounted on a plug-in printed wiring board which is installed in the card rack below the IF modules.

3. Stable Local Oscillator

A crystal VHF oscillator with excellent short-term stability serves as the reference source for the solid-state, S-band, stable local oscillator (STALO). The oscillator center frequency varies from approximately 95 to 101 MHz, depending on selected operating frequency, and is established by a plug-in crystal unit. The oscillator output is multiplied by X28 or X29, depending on the tuning of a three-cavity bandpass filter shown with the cover off in

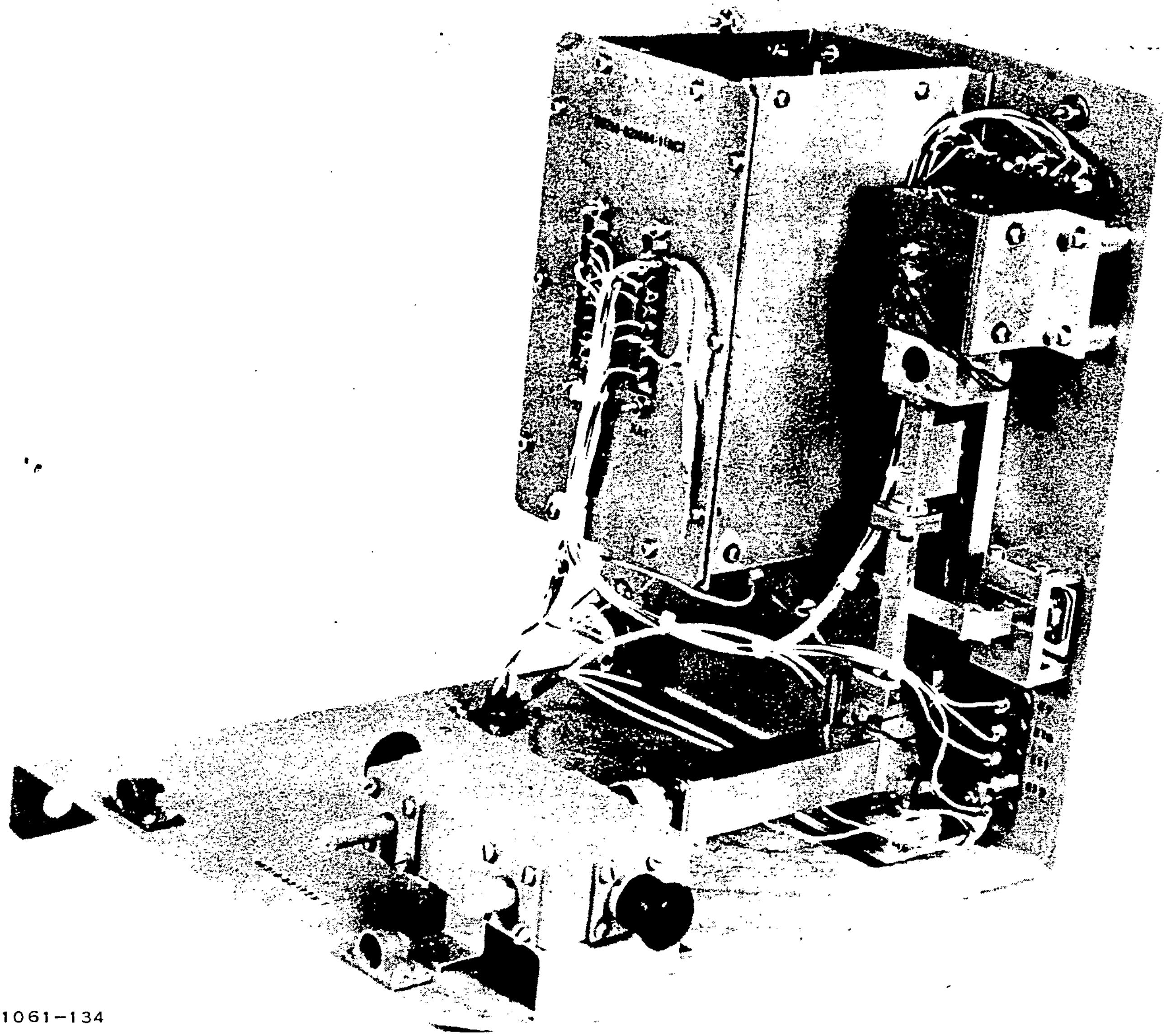

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Figure 3-17. ASR-8 Parametric Amplifier With Cover Removed

Figure 3-18. By proper selection of crystal frequency and multiplier, the STALO frequency varies from 2,670 to 2,930 MHz. Following this filter is a transistor S-band amplifier and a second four-cavity bandpass filter. The filter totally eliminates spurious signals from the STALO, resulting in an exceptionally stable source. A four-way passive power divider provides outputs for the signal mixer, exciter, STALO performance monitor, and a spare. The performance monitor samples the STALO output level at three strategic points; i.e., VHF oscillator output, multiplier output, and final output. This level is monitored on a front panel meter. In addition, a test output from the STALO amplifier is provided.

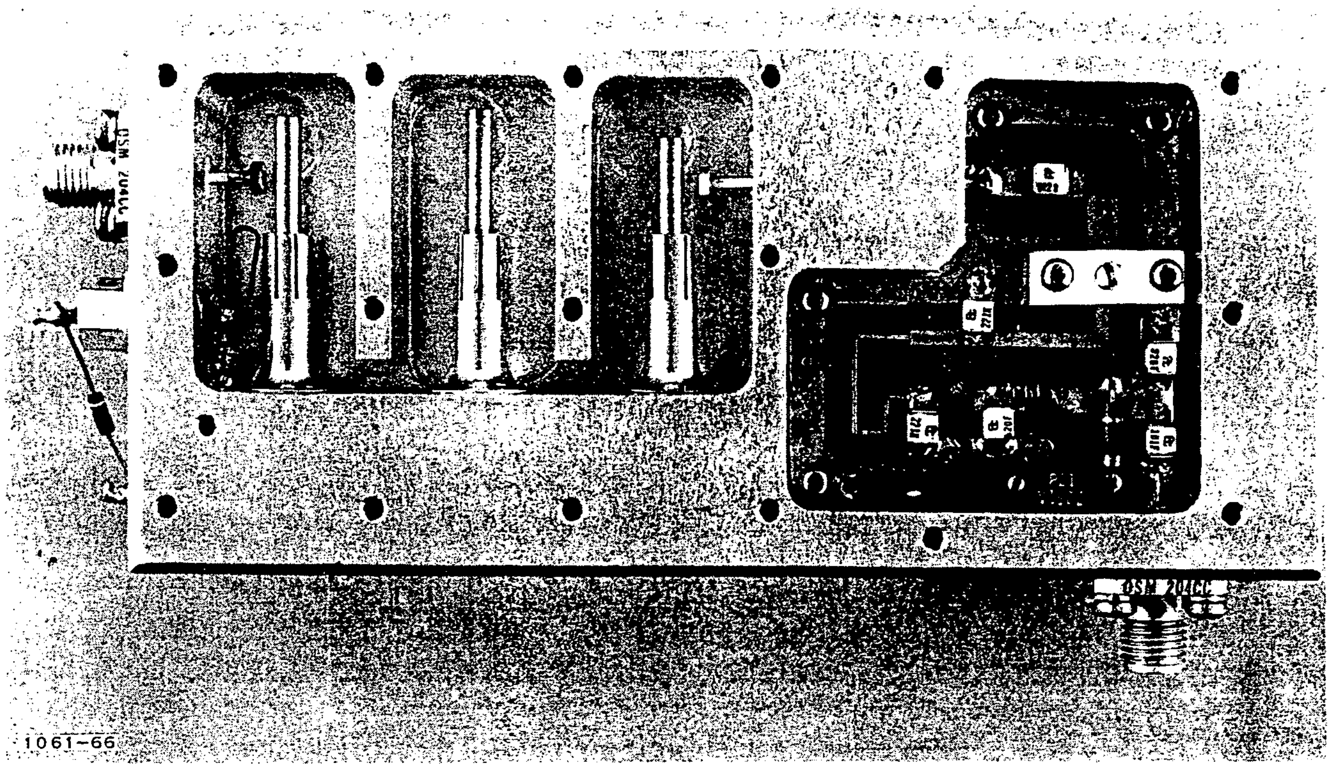

Figure 3-18. STALO ×28–×29 Multiplier

The STALO packaging shown in Figure 3-19 is designed for extremely high short-term stability while still providing field access. The package is shock-mounted to a shelf attached to the receiver cabinet to dampen mechanical vibrations. The entire unit can be removed by loosening four threaded fasteners. These fasteners are removable by hand, without tools. Each subassembly, such as the VHF oscillator, multiplier, and S-band transistor amplifier, is individually packaged in removable modules. Each module uses RF gasketing to prevent radiation and susceptibility to interference. By the use of two high-selectivity filters plus RF-tight packaging, no measurable spurious signals exist on the STALO output. MTI improvement factors of greater than 60 dB have been measured on the STALO unit.

4. IF Preamplifier

The 30-MHz IF output from the signal mixer is coupled to the IF preamplifier module. This module is located close to the mixer to minimize noise figure. Measured noise figure of the preamplifier is less than 1.0 dB. A fixed gain of over 30 dB is provided by the preamplifier, and the bandwidth is in excess of 12 MHz. Isolated output stages drive the various post-IF noise-test module and MTI test module test signals into the preamplifier to be distributed to the IF amplifiers. A symmetrical limiting action is provided to prevent the black-hole effect of saturation in the preamplifier stages.

5. Normal IF Amplifier

Special precautions have been taken in the design of the normal IF amplifier to optimize the signal-to-noise ratio and to preclude deleterious saturation effects. Approximately 50 dB of

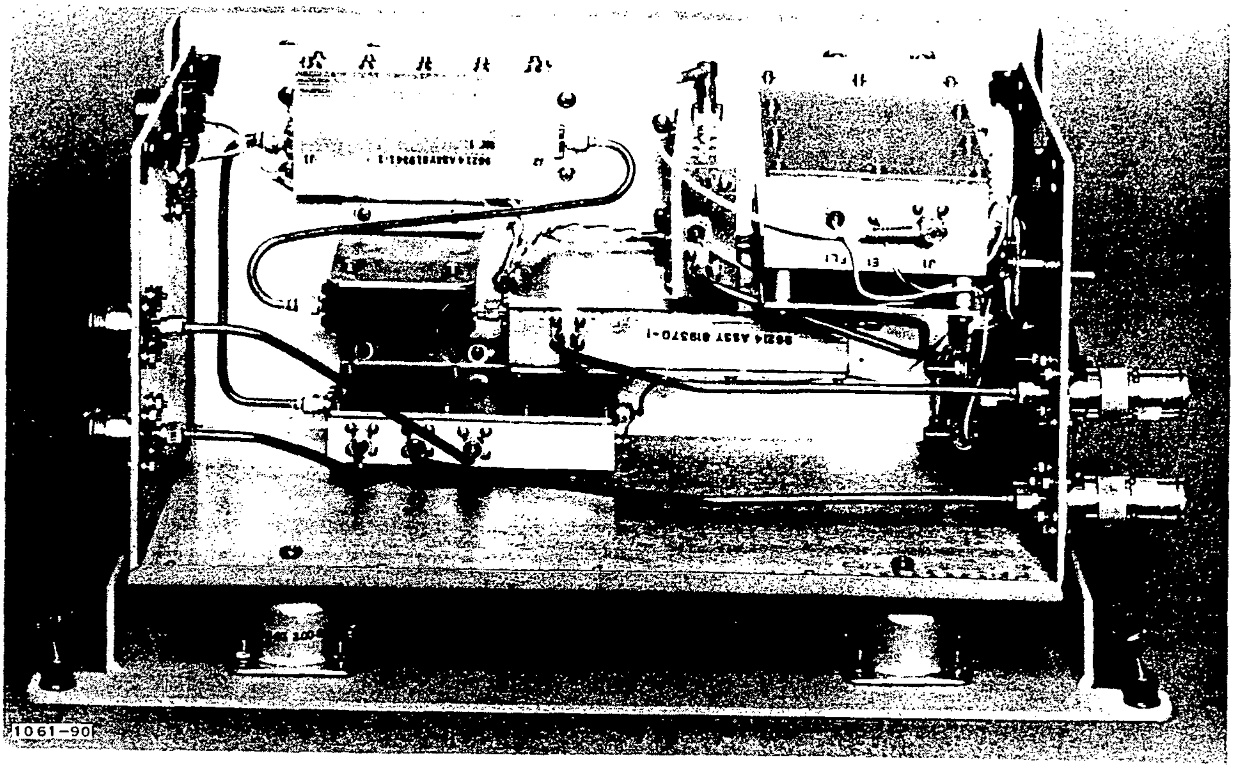

Figure 3-19. STALO Assembly With Cover Removed

gain is provided in a wideband (greater than 5 MHz) amplifier chain, each stage of which successively symmetrically limits. The amplifier pulse shape is therefore retained, without stretching, over a wide dynamic range. This amplified pulse is then applied to five cascaded single-tuned filter stages which establish the normal channel noise bandwidth. Skolnik* shows that this type of filter results in the minimum signal-to-noise ratio loss relative to a true matched filter.

By maximizing the signal-to-noise ratio before detection, the loss because of the nonlinear detection process is minimized. Figure 3-20 shows the near-Gaussian pulse from this amplifier. A full-wave detector follows the filter and a video amplifier provides the video output. Both the IF and video gain levels are adjustable from the front of the module. A nominal 4-volt peak signal level is provided and is routed to the processor unit for further signal processing.

6. MTI IF Module

The MTI IF module includes a standard MTI linear/limiter IF amplifier, phase detector, and video amplifier, as well as a quadrature phase detector and video amplifier channel. The quadrature channel is on a separate printed wiring board which can easily be included in or deleted from the MTI module. Wideband symmetrical limiting stages, similar to those in the normal IF amplifier, provide approximately 40 dB gain. The gain and limit levels of the amplifier are individually adjustable. The IF amplifier is kept wideband to retain linear phase for excellent pulse response to preclude degrading MTI performance.

*Merrill I. Skolnik, Introduction to Radar Systems, McGraw-Hill (New York, 1962) p. 414.

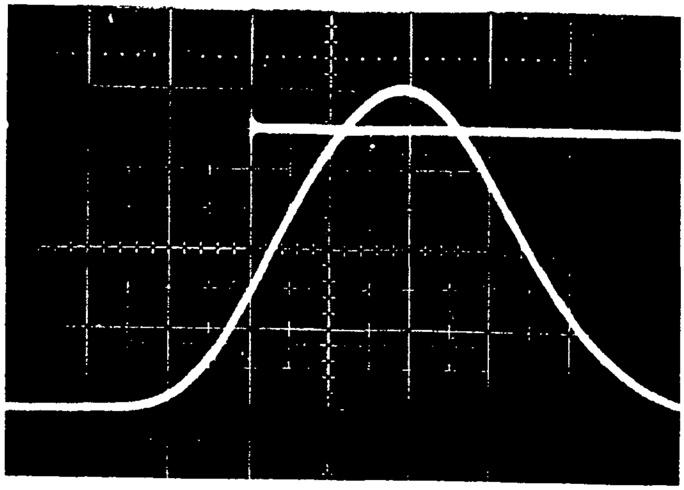

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Figure 3-20. Normal IF Amplifier Pulse Response

Following the IF amplifier is a doubly balanced mixer (diode bridge) type of phase detector which is also driven by the 30-MHz COHO reference oscillator. The quadrature video board includes a phase adjustment to establish a true quadrature relation between the two output signals. Each phase detector is followed by a three-pole Bessel filter to establish the matched bandwidth. This filter simulates the five-stage normal IF filter. Since the phase detector uses a linear process, filtering can be accomplished after detection without signal-to-noise degradation. This permits the wideband IF amplifier with linear phase for good MTI performance while retaining signal-to-noise ratio. As in the normal amplifier, a video amplifier with front-panel gain adjustment provides a bipolar 4-volt (peak-to-peak) signal to drive the processor.

7. Log IF Module

Included in the standard ASR-8 receiver unit is a log IF module for processing weather precipitation returns. The log amplifier works in conjunction with a CFAR circuit in the processor unit to reduce precipitation returns to receiver noise level. A bandpass filter precedes the amplifier to maintain constant noise bandwidth independent of signal level. The amplifier has in excess of 80 dB dynamic range and has separate IF and video gain adjustments.

8. Exciter

The exciter accepts the STALO signal, a 30-MHz signal and a 5-μs COHO gate and generates an RF transmitter signal in the 2.7- to 2.9-GHz band. The STALO signal is coupled to a high-pass filter. The filter restricts low-frequency intermodulation products, caused by the mixer, from getting into the STALO. Attenuation of these signals is in excess of 60 dB. Without the filter, the signals would pass through the STALO to the receiver, causing an error or false signal. The filter output signal is applied to the double-balanced mixer.

The transmitter signal is generated by mixing a 5-μs sample of the COHO in the mixer. The COHO sample is applied to 30-MHz transmit switch. The transmitter gate pulse is also applied to the 30-MHz transmit switch through locally operated CW/NORM switch. The switch permits CW operation of the exciter for testing purposes. The transmitter gate enables the COHO signal for 5-μs intervals at the PRF of the radar. The 5-μs RF signals are amplified and applied to the mixer. The mixer provides upper and lower sideband output signals to the bandpass filter. The four-pole bandpass filter selects either the lower or upper sideband for further amplification in the transmitter chain. A 0.6-μs section from the center of the output pulse is ultimately used as the transmitter pulse. The 5-μs input pulse to the filter was selected to allow the filter to be as narrowband as possible. Because filter bandpass is between 5 and 10 MHz, the filter reaches resonant frequency and stabilizes in approximately 1 to 2 μs. The remaining 0.5 μs of the pulse is used to stabilize the exciter driver before gating out a shaped pulse for the transmitter.

The output signal from the bandpass filter is applied to the exciter amplifier containing a three-stage S-band amplifier. Exciter amplifier bias network provides a temperature-compensated regulated voltage to the three-stage amplifier. Amplifier gain amplifies the pulse to approximately +19 dBm. Exciter output is routed via coaxial cable to the RF driver amplifier in the klystron transmitter cabinet.

9. Log Test Module

Two test generators are included in the receiver unit, the log-test generator and the MTI lock-test generator. Included in the log-test module are a noise-test generator and a random-speed test-target generator. It is the primary purpose of this module to provide test signals for use with the log-CFAR circuits. The noise generator produces a random noise signal to simulate precipitation clutter signals. A 30-MHz crystal oscillator simulates a target moving at a non-synchronous or pseudorandom velocity. These two signals are combined and fed through a front-panel 0- to 82-dB step-attenuator to the IF preamplifier. A separate front-panel control permits adjustment of the amplitude of the test target relative to the noise level. This test module can be used to confirm that the CFAR circuits will properly reduce weather clutter-to-noise level, as well as to check the super-clutter detection of targets.

10. MTI Test Generator

The MTI test generator produces a series of pulses in time that are delayed samples of the COHO pulse at the time of the transmitter pulse. The COHO pulse is injected into a recirculating delay line circuit. This pulse occurs at approximately 20-μs intervals during the repetition period.

Leveling circuits equalize the amplitude of these pulses. By connecting these pulses to the MTI IF module and viewing the MTI canceller output video, any instabilities in the COHO system can be identified.

11. Power Supplies

Postregulator power supplies for the ±15 volts and +5 volts are included in the receiver unit. These are switching-mode inverters supplied from the channel +24-volt preregulator. The supplies are highly efficient, convection cooled, and mount in a front-panel card-rack assembly.

12. Mechanical Packaging

Special emphasis in the receiver unit mechanical packaging has been placed on ease of access for good maintainability. The microwave components are mounted in the generally open area at the top of the cabinet, and the IF module is in the lower swing-out panel. The receiver output port of the circulator is connected to the receiver cabinet by waveguide through a special bulkhead adapter. Inside the cabinet, the TR-limiter is mounted to the waveguide, and a waveguide-to-coaxial transition converts to coaxial cable. The TRL is readily available and easy to replace. The PIN diode RF attenuators and beam switch mount to brackets between the TRL and parametric amplifier. These items are easily removed by disconnecting the coaxial cable and removing the mounting screws.

The parametric amplifier is mounted on a swing-out panel at the front of the cabinet. Quarter-turn fasteners release a cover panel, fully exposing the parametric amplifier components. The STALO unit mounts to the upper left wall, shock-mounted to a support plate. Quarter-turn fasteners release a cover panel, exposing the inner STALO modules. All major components of the STALO, such as the S-band amplifier and bandpass filters, are in individual RF-tight modules and can be individually removed. The entire STALO assembly can be easily removed from the cabinet by disconnecting the coaxial and power cables and removing four screws.

All IF amplifier and test modules are mounted in a swing-out front panel. Each individual module is completely enclosed and is RF-tight. Signal and power connectors are mounted to the rear of the module. Slides mounted to the top and bottom of each module guide the module into the panel rack and also allow it to extend out of the rack for access if required for troubleshooting. Panels on either side of the module can be removed by removing screws to expose both the component and etch side of the IF printed wiring boards.

Two low-voltage power supplies, providing ±15 volts and +5 volts dc, and the parametric amplifier heater driver circuit mount in a card rack in the lower portion of the swing-out panel containing the IF modules. All three assemblies are vertically mounted and slide into the rack from the front. Connectors on each board mate with wire-wrap connectors on the back of the rack. The wire-wrap connections are easily accessible by swinging open the panel. Because of the efficiency of the switching-mode inverter power supplies, no blowers for forced-air cooling are required in the cabinet.

D. DIGITAL PROCESSOR UNIT

The ASR-8 digital processor (Figure 3-21) is contained in a separate standard 76- by 76- by 203-cm cabinet and performs all video signal processing necessary to display aircraft target signals. The processor includes separate MTI and normal video channels, as well as the synchronizer, STC function generators, power supplies, and built-in test equipment. Normal, log-normal, and bipolar MTI video signals from the receiver unit serve as input signals to the processor, in addition to the control function signals which relate to the processor.

As shown in the block diagram of Figure 3-22, the processor includes the following functions:

- MTI channel
    - 10-bit analog-to-digital converter (I&Q)
    - Dual canceller, with switch-selected mode and feedback (I&Q)
    - Quadrature combiner
    - Digital log
    - Digital CFAR (delay and subtract plus antilog)
    - 6-bit integrator
    - Weather background
    - Stagger realignment
    - Digital-to-analog converter
    - Diversity combiner
    - Range azimuth gate
    - Video limiter/amplifier
    - Video line driver
- Normal/log channel
    - 6-bit analog-to-digital converter (normal)
    - 7-bit analog-to-digital converter (weather log)
    - Analog CFAR (delay and subtract plus antilog)
    - 6-bit integrator
    - Stagger realignment
    - Weather background
    - 7-bit realigned weather log output (analog output)
    - 6-bit normal digital-to-analog converter
    - Video limiter/amplifier
    - Range azimuth gate
    - Diversity combiner
    - Video line driver

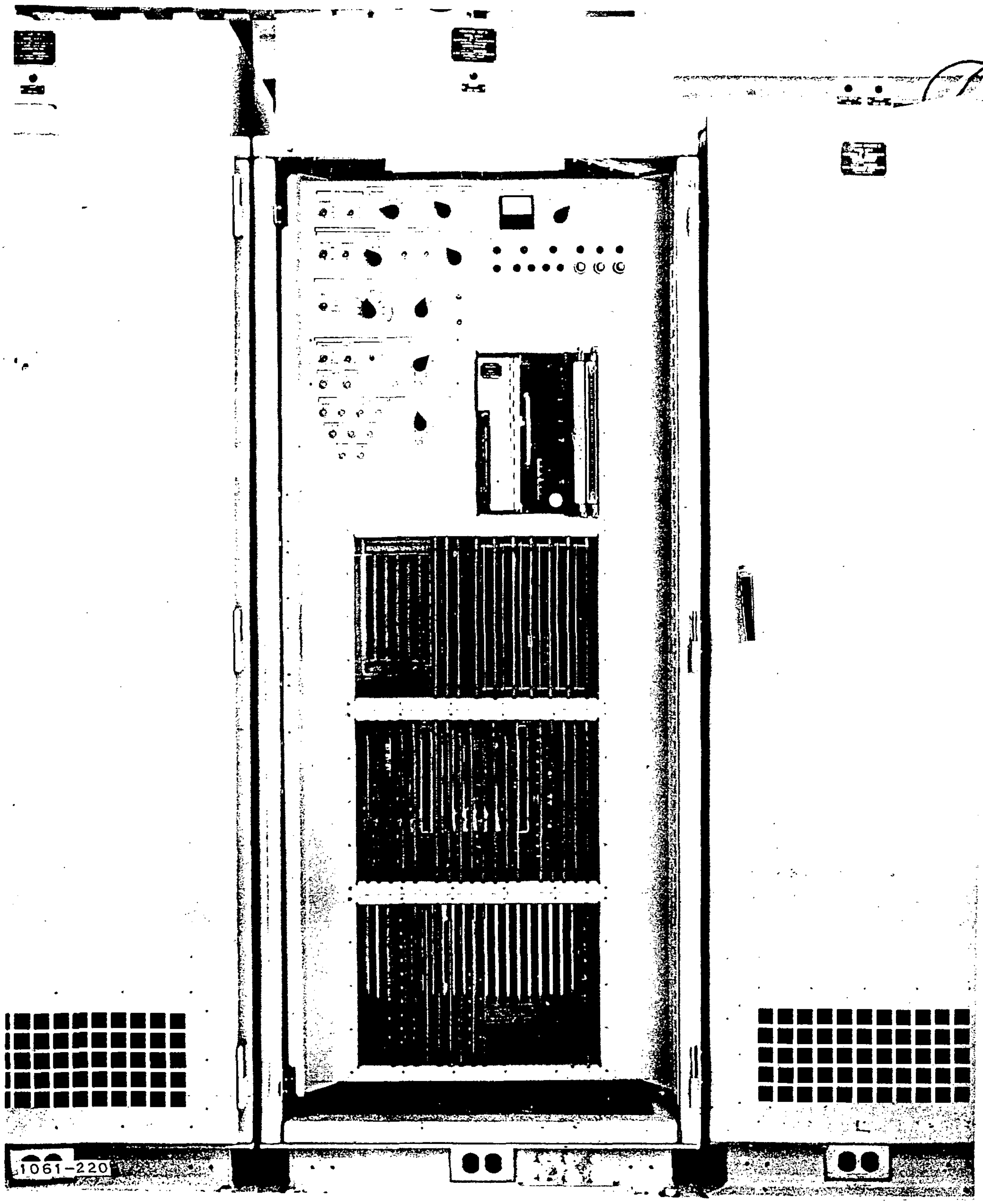

Figure 3-21. ASR-8 Processor Unit

Synchronizer

- Crystal oscillator system timing clock
- Radar aligned trigger generator
- Radar stagger trigger generator
- Digital storage shift-pulse generator
- Logic control clocks

Built-in test equipment

- Swept-velocity generator
- Ramp generator, stationary
- Ramp generator, optimum velocity
- Digital fixed and optimum velocity test targets (deadtime).

The functions are described in detail in the following paragraphs.

1. Analog-to-Digital Converters

The analog-to-digital converter (ADC) for the processor is a 10-bit system which is composed of a 4-bit primary quantizer and a 6-bit secondary quantizer. The full 10-bit quantizer is used for the MTI channel, and the weather output channel uses a primary and secondary quantizer to provide 7 bits. The 6-bit secondary quantizer is used for the normal channel and log-CFAR output. Each ADC has an input sample-and-hold circuit followed by the digital conversion circuitry. The samples are taken at approximately 2.15 MHz, resulting in a range quantization interval of slightly less than 0.47 μs. After each sampled value is converted to a parallel binary word, it is shifted into an output register, from which it is made available to the appropriate digital processing functions. The primary and secondary quantizers are each mounted on a single printed wiring board and are designed for stable performance over temperature and time.

2. Quadrature Moving Target Indicator

The ASR-8 includes a single dual-canceller moving target indicator (MTI) which processes the in-phase component of the received signal. A second dual-canceller MTI which processes the quadrature (90 degrees) component is included.

QMTI provides approximately 3 dB improvement in system performance through increased range or increased probability of detection. The QMTI minimizes target fade or scintillation, as well as signal degradation caused by blind phase (90-degree component) as is experienced with a standard single-phase MTI system. A second MTI IF module is provided in the receiver unit and a reference signal for the second phase detector is generated by shifting another output of the COHO by 90 degrees. A second dual-canceller MTI with feedback and a combiner circuit for the addition of the 0-degree and 90-degree signals are added to the processor.

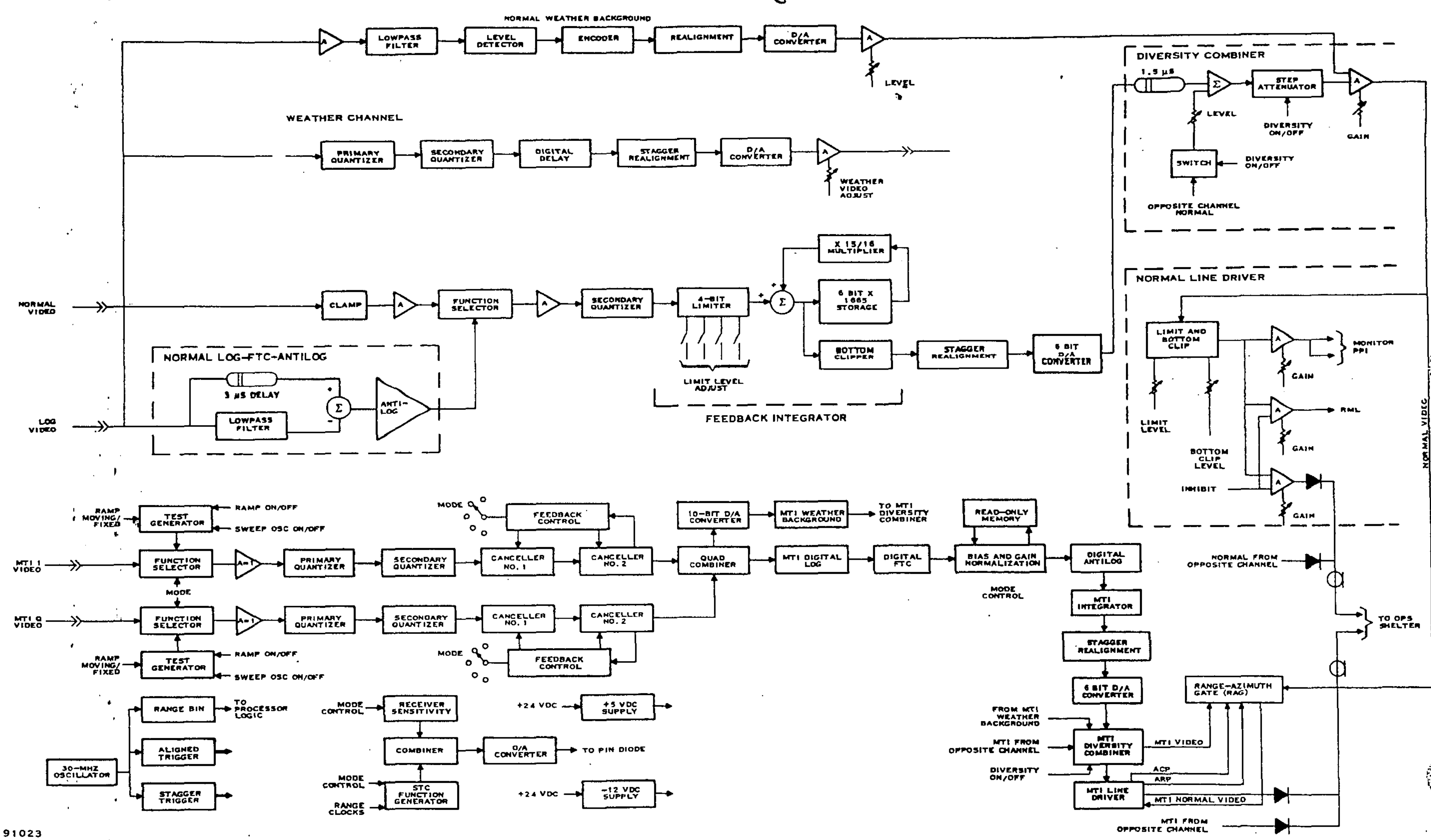

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Figure 3-22. Processor Block Diagram

3. Digital Canceller

The digital canceller, as shown in the simplified block diagram of Figure 3-23, consists of two identical cascaded delay-line type cancellers with switch-selectable feedback to shape the velocity response. Thus, the canceller system can be operated as a single (two-pulse) canceller, dual (three-pulse) canceller, or dual canceller with four different velocity responses. This type of canceller offers excellent clutter cancellation, as well as high reliability, because of its digital design and inherent simplicity.

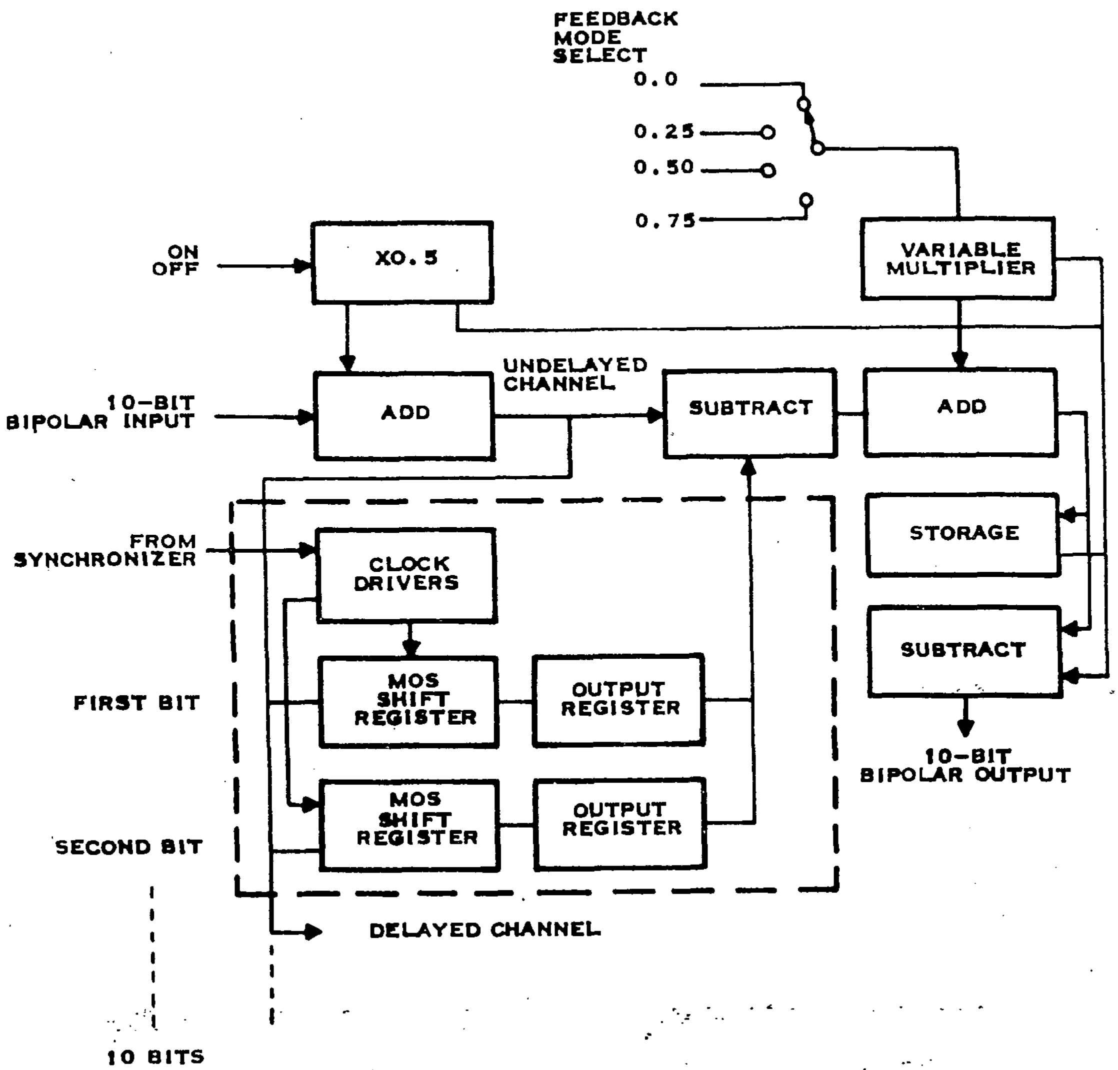

Figure 3-23. Dual Digital Canceller Block Diagram

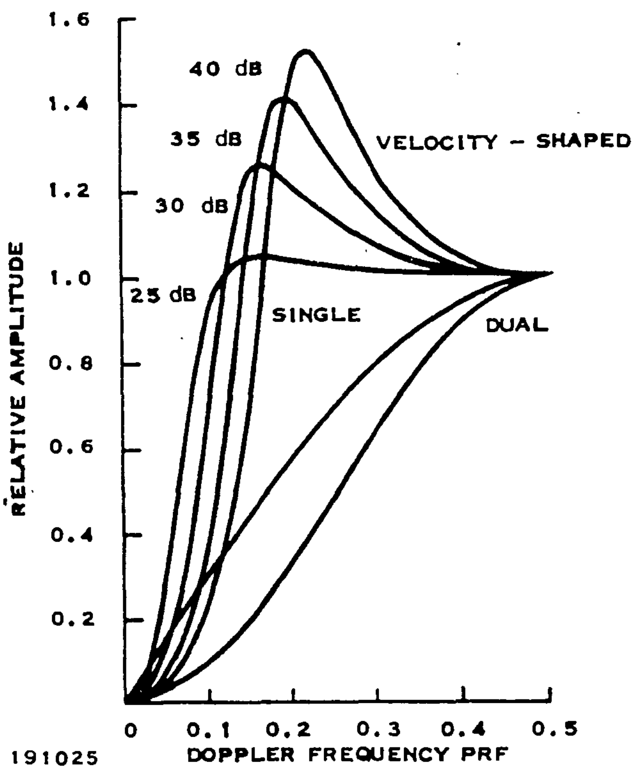

Figure 3-24. MTI Canceller Response Curves

In operation, each 10-bit binary word from the ADC output is sequentially shifted into the canceller input at the 2.15-MHz rate. In the nonfeedback mode, it is shifted through the digital storage as well as being fed directly through. The storage output, representing the signal from the same respective range for the preceding pulse repetition period, is subtracted from the direct input. For fixed targets, these two values will be identical and will cancel to zero. For moving targets, a nonzero value will result, dependent on the radial velocity of the signal. Thus, only targets with doppler velocity components are displayed. The response to moving targets is the familiar half-sine (single canceller) or sine-squared (dual canceller).

In the feedback mode, the outputs of the two shift register delay lines are multiplied by appropriate constants and summed with the inputs. Depending on the constants used, various velocity response curves are generated. Four discrete values are available by switch selection on the front panel. These four response curves, in addition to the half-sine and sine-squared response of the single and dual cancellers, respectively, are shown in Figure 3-24. The feedback curves shown result in 25, 30, 35, and 40 dB of cancellation on clutter caused by antenna scanning. These curves offer progressively better clutter cancellation with reduced target response at low velocity. Performance is not subject to drift or change in characteristic since the multiplication is performed by hardwired digital logic circuitry. However, the response curves can be displayed on an oscilloscope using the built-in swept-frequency generator to confirm that no failures have occurred in the canceller circuitry.

The canceller velocity responses of Figure 3-24 have nulls that repeat at integral multiples of the repetition frequency. These nulls result in loss of detection at corresponding aircraft radial velocities. This loss can be eliminated by using nonuniform or staggered repetition periods. For the ASR-8 system, a four-pulse stagger sequence, shown later in Figure 3-29, is used. The resulting improvement in MTI velocity response is shown in Figure 3-30. It is seen that there is no "blind speed" below at least 2,150 knots, and that all dips are less than 10 dB peak-to-peak. The average stagger period is 960 μs, corresponding to an average repetition frequency of 1041 Hz.

All delay-line storage in the dual cancellers, as well as in the digital video integrators and realignment circuits, uses metal-oxide-semiconductor (MOS) static shift registers. Each canceller delay line consists of 10 parallel bits, each of which is 1,665 bits (range bins) in length. A processor storage printed wiring board is shown in Figure 3-25.

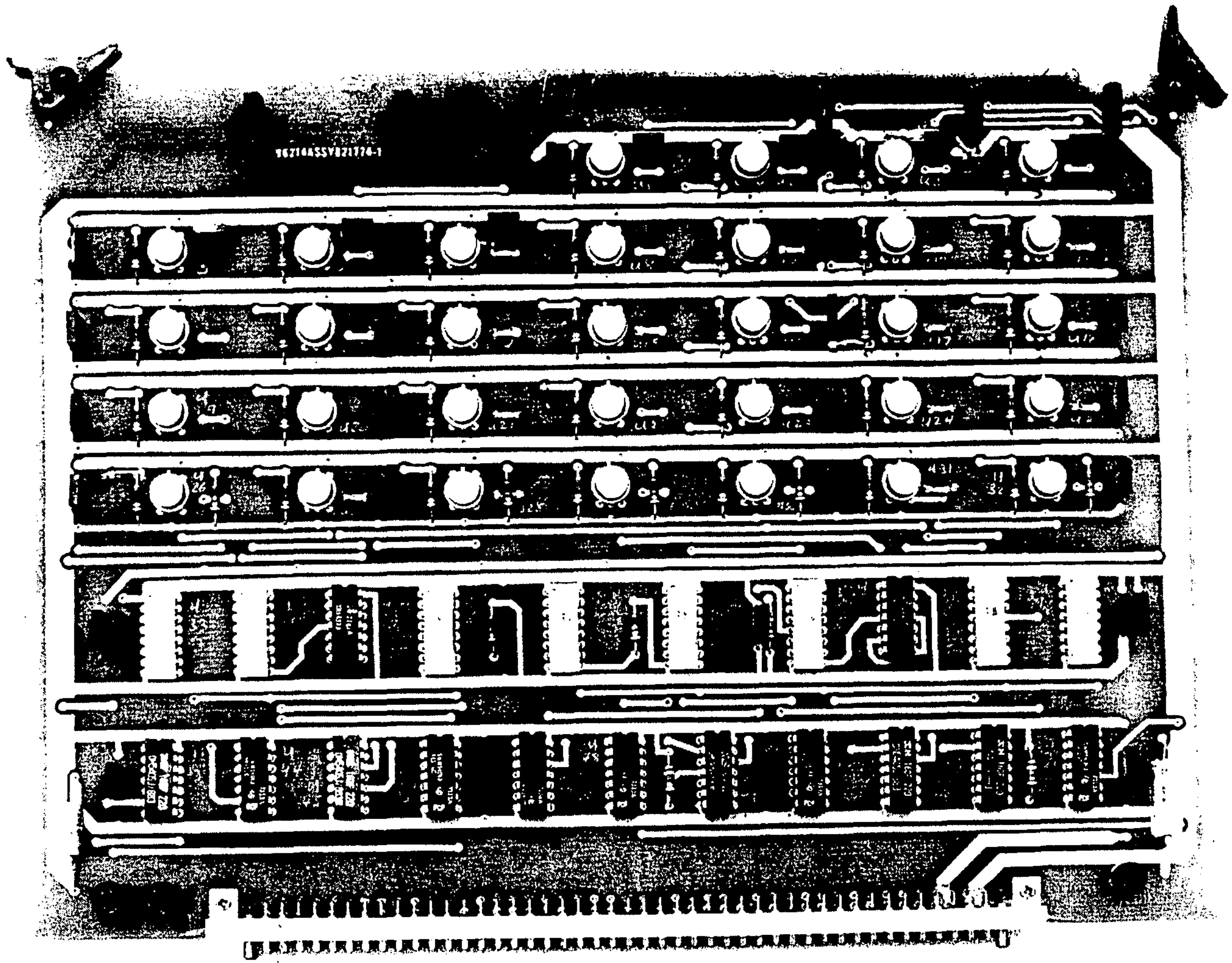

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Figure 3-25. Processor Storage Printed Wiring Board

The 10-bit binary words are shifted through the 1,665 range bins at the 2.15-MHz rate, providing slightly more than 110 km of MTI range. During the remaining portion of the pulse repetition interval (deadtime), the range clocks are stopped and data are statically stored until the clocks are reinitiated at the next transmitter pulse. The 0.47-μs period is slightly less than 80 percent of the 0.6-μs pulsewidth, which reduces range quantization losses to a negligible value. Tests conducted using an FAA ASR-7 digital MTI with 75-percent range-bit-to-pulsewidth ratio and an ASR-5 analog MTI simultaneously, showed no discernible MTI sensitivity loss at the PPI display.

After cancellation, the absolute value of the bipolar digital output is taken (which is equivalent to full-wave rectification in an analog canceller), since the PPI can display only unipolar video. The digital unipolar word is then routed to the log-CFAR circuits for further processing.

4. **MTI Digital Log-CFAR**

Following the quadrature combiner is an all-digital log-CFAR circuit, the primary purpose of which is to reduce precipitation clutter signals to receiver noise level. The circuit operates on the principle that certain classes of random signals, including single-sided Gaussian and Rayleigh, have a variance which is independent of the mean value after having passed through a circuit with logarithmic response. The output of the canceller absolute-value circuit has an approximate single-sided Gaussian distribution for precipitation signals. After having been processed by the 10-bit digital log function, the signals have a variance which is independent of the average value.

The CFAR circuit consists of two parallel paths, one of which filters the log video to form an average value, and a second which has a pure time delay of 2.3 μs (five range bins). The average value is then subtracted from the delayed direct signal, reducing the clutter-to-receiver-noise level. Since the variance is independent of the mean, and the mean value gets subtracted out, a constant residue level results regardless of the precipitation clutter level at the input to the digital log circuit.

5. **Gain Normalization**

The noise gain of the MTI channel varies over a several-decibel range as a function of the various canceller modes, log-CFAR on or off, etc. To keep this from causing the operator to have to reset his display each time a mode change is made, a programmed gain normalization circuit is included. This is accomplished by adding a constant to the log-CFAR circuit output prior to taking the antilog, based on the fact that the logarithm of the product is the sum of the logarithms. Taking the antilog of the log output summed with a constant is equivalent to multiplying the log input by that constant. This is equivalent to applying a gain factor to the input signal. Appropriate constants for all modes are stored in a read-only memory and are selected for each mode. The result is constant receiver noise level independent of processor mode.

6. **Integrator**

Both the MTI and normal processor channels include a digital sweep integrator. The purpose of this circuit is to sum all returns from a given target to maximize the signal-to-noise ratio

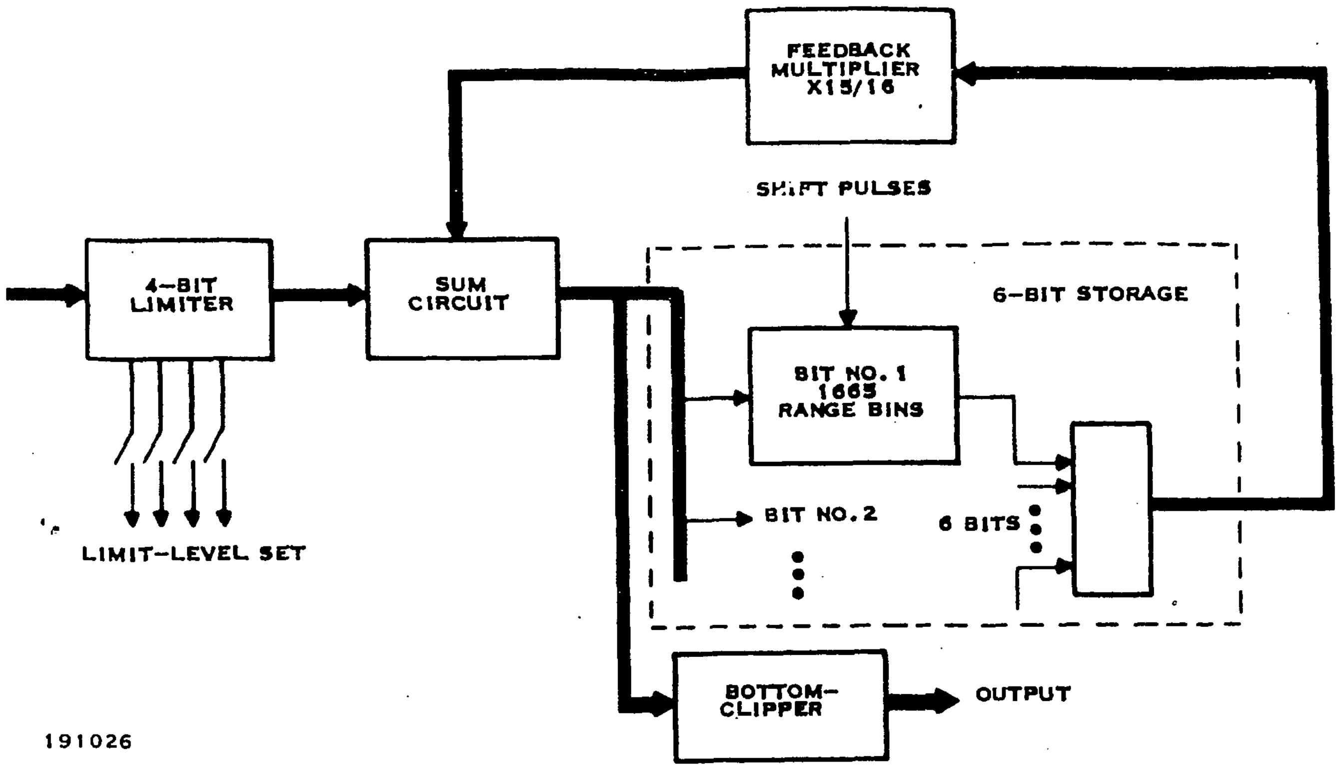

Figure 3-26. Integrator Block Diagram

before display. It also greatly reduces nonsynchronous pulse interference. As shown in Figure 3-26, an adjustable digital limiter is at the input of the integrator. The limit level is typically set just slightly above receiver noise, and it is this limiting function that reduces the nonsynchronous interference. After limiting, the input binary signal is summed with the output of the feedback multiplier and the sum is returned to storage. The storage is a 6-bit shift register delay line with 1,665 range bins similar to the 10-bit line used in the canceller. Its output is multiplied by a constant less than unity (15/16) and is then, as mentioned above, summed with the limited input. The integrator output signal is the sum-junction output. As pulses from a given range enter the integrator, the output increases rapidly in amplitude as the successive outputs are added and decays as the antenna scans off the target. This is also the basis for reduction of nonsynchronous pulse-type interference since the pulses never successively occur in the same range bin. Their maximum output amplitude is the integrator limit level.

Although the phosphor of the PPI performs a similar integration function, its limited dynamic range and storage characteristics result in integration losses. Experience with the digital sweep integrator described above shows that it offers substantial improvement in small target detectability over a conventional PPI display, with minimal azimuth shift and target stretching.

7. Normal Log-CFAR

The normal channel log-CFAR circuit, while functionally identical to the MTI log-CFAR circuit, is of analog design. The input to the CFAR circuits in the processor unit is the log video from the log IF module in the receiver unit. This input is connected to the delay and filter CFAR circuits as in the MTI channel. Analog circuit is used to preserve the wide dynamic range of the log circuit. Although the log IF has a dynamic range over 80 dB, experience has shown that the best CFAR operation results when the log function extends at least 20 dB into receiver noise. Thus, the usable dynamic range above receiver noise is approximately 60 dB. This would require a minimum of 10 bits if processed digitally. Since the normal channel basic dynamic range requirement is satisfied with a maximum of 6 bits, to use digital CFAR would add unnecessary circuitry. In the MTI case, the wider dynamic digital range is required for the MTI canceller, and the signal is already in a 10-bit digital format, so that digital log-CFAR is the logical solution.

The normal analog circuit is functionally the same as the MTI digital CFAR circuits. A Bessel narrowband video filter averages the log video and forms the average value. A lumped-constant, 3.2-μs video delay line delays the targets past the integrated target response in the video filter to avoid target loss from subtraction. After the average value has been subtracted from the log video clutter signal, a constant noise level results. This CFAR video is then available for further processing and display.

The output of the normal log-CFAR circuit and the normal video from the normal IF amplifier module are connected to a solid-state function selector, which serves as a single-pole, double-throw selector switch. This switch is operated by the radar control panel and selects the normal video or normal log-CFAR depending on the status of the control panel. The output of the switch is connected to a 6-bit ADC quantizer which converts the video to a 6-bit digital word at the 2.15-MHz range clock rate. Since the log-CFAR circuit normalizes precipitation clutter-to-noise level, an adequate dynamic range to process its output is 6 bits.

8. Synchronizer

The radar synchronizer has two major functions. The first is to generate all triggers for the radar, such as for the modulator, display, etc.; and the second is to generate the clock pulses and shift pulses required by the digital circuitry in the processor. All timing functions are derived from a 30-MHz crystal oscillator, including both the radar triggers and the range clocks. Each channel can be operated from its own oscillator or from the opposite channel. In diversity, both channels operate from the master channel oscillator to ensure synchronization of timing. If a channel is in standby and off line, it can be operated on its own oscillator, unless its transmitter is operating. In this case, to avoid cross-channel interference, it is slaved to the active channel. This approach avoids a requirement for cross-channel video blanking.

a. Trigger Generation

Two sets of triggers are generated by the synchronizer, the aligned triggers and staggered triggers. As discussed above, all triggers and clocks are generated from the appropriate oscillator which is selected by the processor control. For example, in diversity operation the master channel uses its own oscillator and the slave channel disconnects its own oscillator and selects the master channel. Also, in single-channel operation, the standby channel uses its own oscillator if high voltage is off, and the active channel if high voltage is on, to avoid interference. The aligned triggers always have a fixed repetition period equal to either the fixed radar period, if not in stagger, or to the average period, if in stagger. In stagger operation the staggered triggers follow the four-pulse stagger sequence and, therefore, have nonuniform periods.

As seen in the simplified synchronizer block diagram of Figure 3-27, two separate counters are used to generate the aligned and staggered triggers. The 30-MHz signal from the synchronizer oscillator in the receiver is buffered to preserve stability and then counted down by a factor of 14. This generates the basic timing clock for the processor with a period of 0.467 μs, or 2.15 MHz, which is used for both trigger generation and for the processing logic.

To generate the aligned triggers, the 2.15-MHz clock drives the 12-bit aligned-trigger counter. The counter provides 4,096 possible timing states of the 0.467-μs period which can be decoded to generate triggers at selected intervals. A set of 12 switches is used to preset the counter to establish the radar repetition period to the desired fixed PRF value from less than 700 Hz to greater than 1200 Hz. These switches are miniature dual in-line packages mounted on the trigger generator printed wiring board. As an example, for a fixed PRF of 1000 Hz, 2,143 of the 0.467-μs timing intervals are required to produce the repetition period of 1,000 μs. Thus, the switches would be set to preset the counter each period to the state of 1,953 (4,096 – 2,143). When the counter has progressed to state 4,096, resulting in a period of 1,000 μs, it resets to state 1,953, etc. By changing the switches to a different preset state, new fixed PRF values are generated.

To establish the relative position, or timing, of the aligned triggers, four 12-bit decoders are used in conjunction with the aligned-trigger 12-bit counter to establish four radar triggers which occur each repetition period. The four triggers and their timing relationship are shown in Figure 3-28. The four trigger decoders are set to decode the counter states which correspond to the times shown in Figure 3-29. The decoder states for these decoders are established by semiconductor ROMs which are permanently programmed at the factory.

In stagger operation, the duration of the periods in the four-period stagger sequence is established by the aligned trigger counter, a separate set of 12 preset switches and three separate decoder ROMs. As in the case of fixed PRF, the 12 miniature dual in-line package switches preset the aligned trigger counter to a state corresponding to the average PRF of the stagger sequence. In addition, three ROM 12-bit decoders establish three additional period durations derived from the average period by adding or subtracting a fixed amount. At the end of each of these periods, all of which occur every repetition period in the aligned decoders, a logic signal is generated to serve as a reset signal to the stagger trigger counter. These four signals are logically combined into a 2-bit parallel code which is sent to the stagger sequence circuits.

For proper velocity stagger response in the MTI, as shown in Figure 3-30, the staggered periods must not only be of the correct duration, but also must occur in the proper sequence. This sequence, shown in Figure 3-29, is established by a four-state counter and a "one-of-four" select circuit. The four-state counter determines the period sequence. The master channel counter free-runs through the four-state count, and the slave channel counter is reset by the master channel. Once each pulse repetition interval, the counter advances one count, through a total of four counts. This count is sent in 2-bit form to the one-of-four select circuit which also receives the 2-bit period reset logic signals from the aligned-trigger decoder circuits. Thus, for period number one, as established by the four-state counter, the selection circuit "reads" position number one from the 2-bit stagger period control signals sent from the 12-bit decoders. At the end of the respective period (established as described above by the aligned trigger decoders), a reset pulse resets the stagger 12-bit counter and its count restarts. On the second pulse, the selection circuit "reads" position number two from the 2-bit stagger period control. At the end

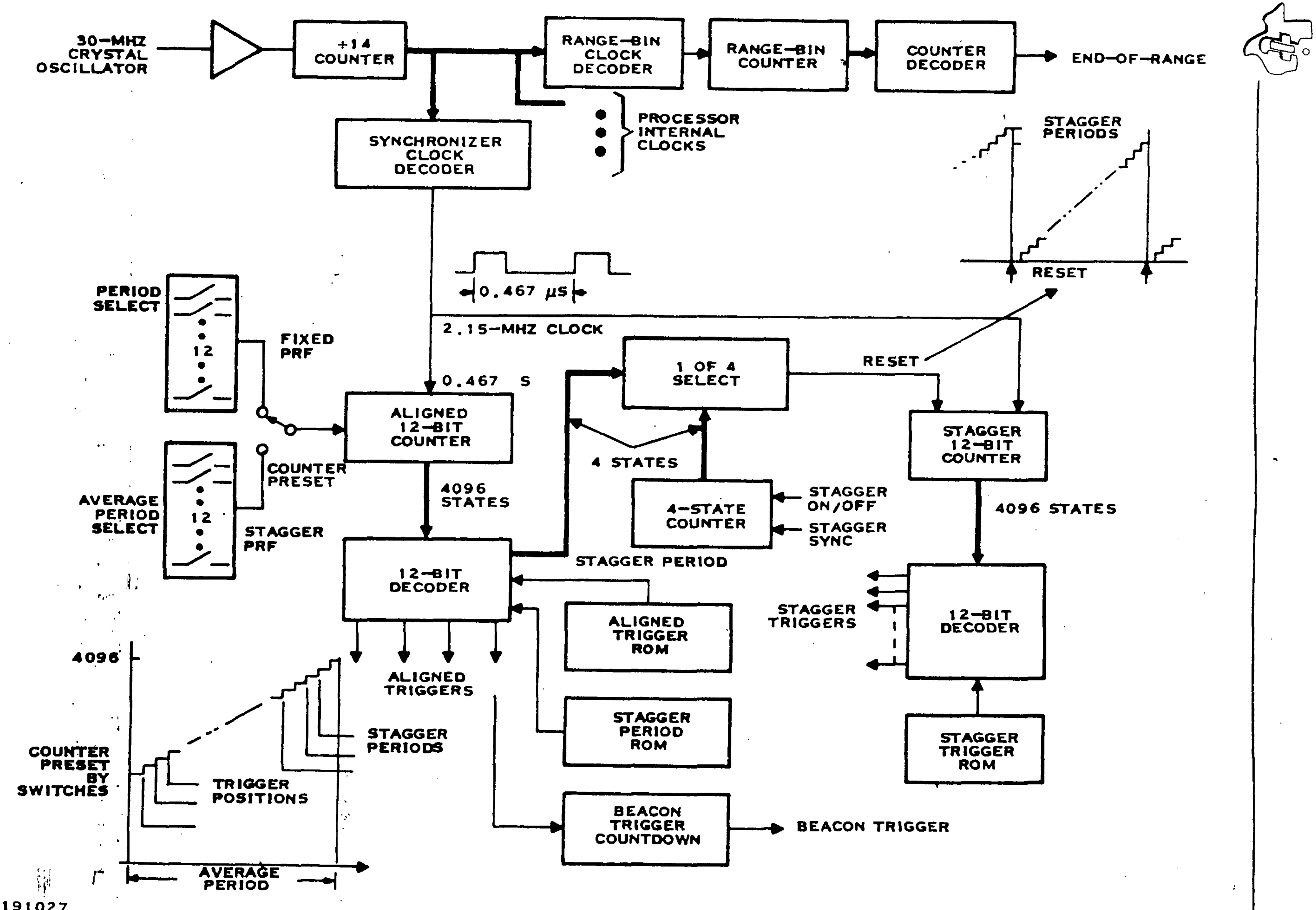

Figure 3-27. Synchronizer Simplified Block Diagram

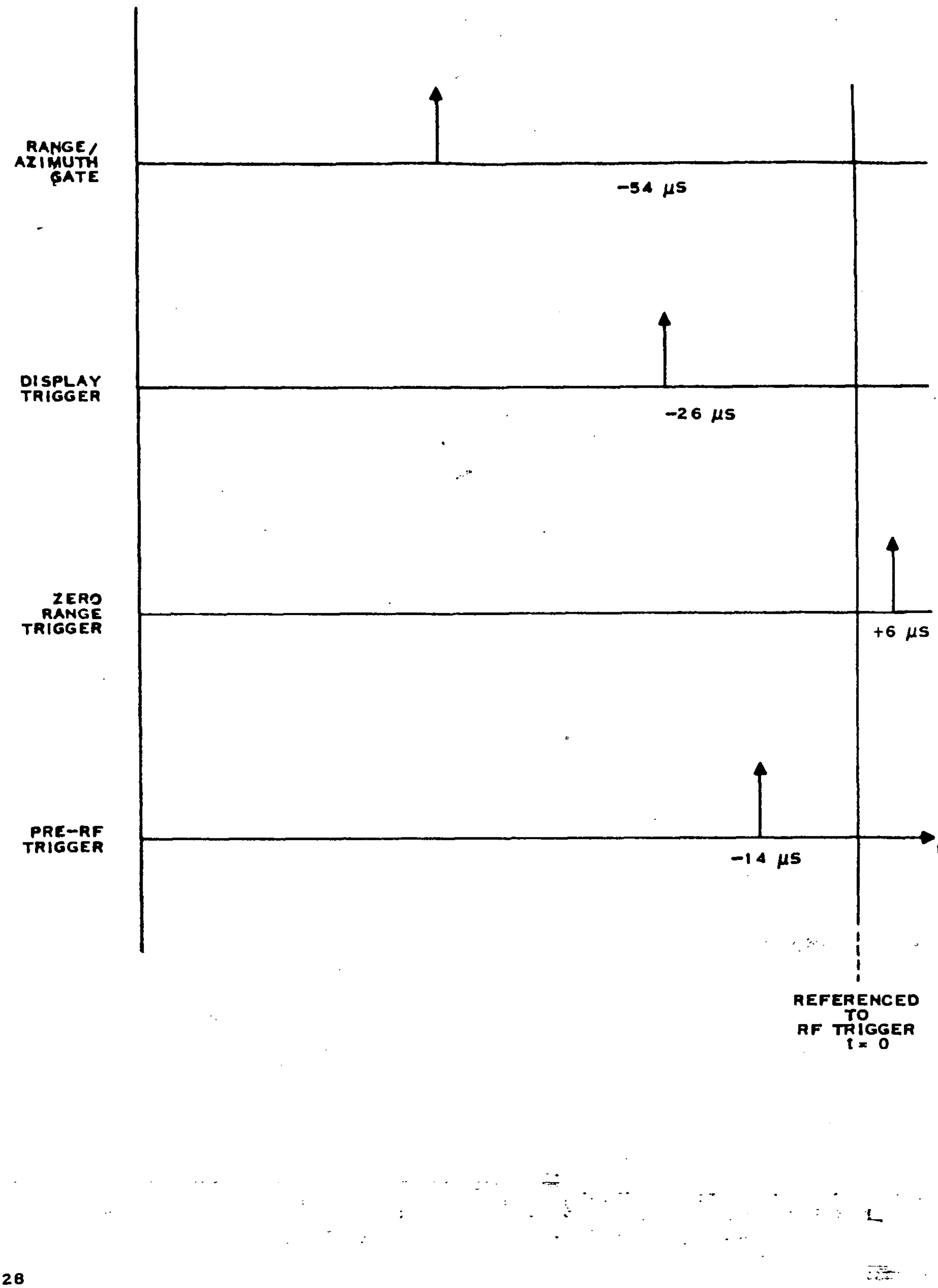

Figure 3-28. Aligned Trigger Timing

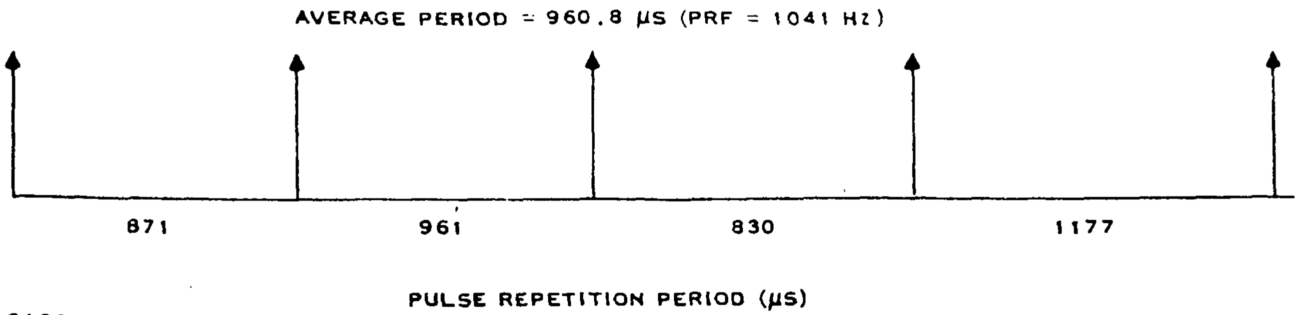

Figure 3-29. Four-Pulse Stagger Sequence

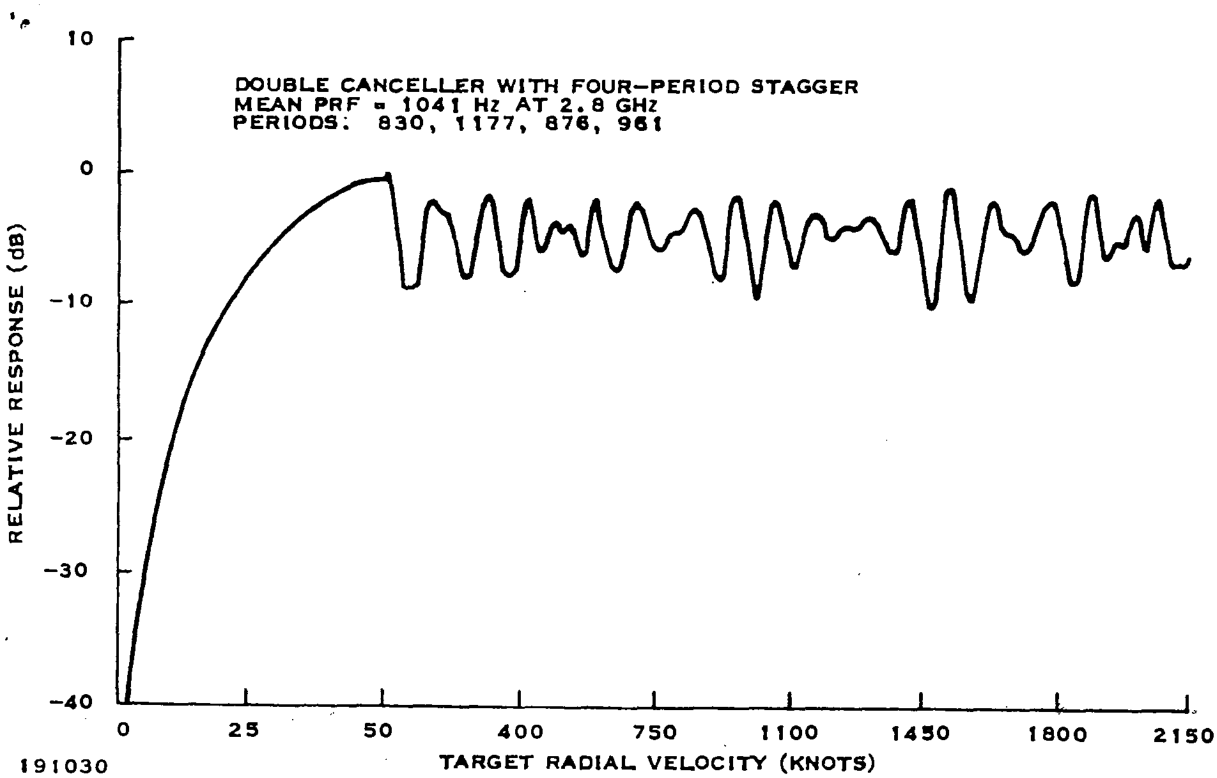

Figure 3-30. MTI Stagger Velocity Response

of this period, a reset pulse again restarts the stagger trigger 12-bit counter, and so on through the four periods. In frequency diversity operation, both the 30-MHz oscillator and start-stagger-count signals are sent from the master channel to the slave channel for complete synchronization of the two channels.

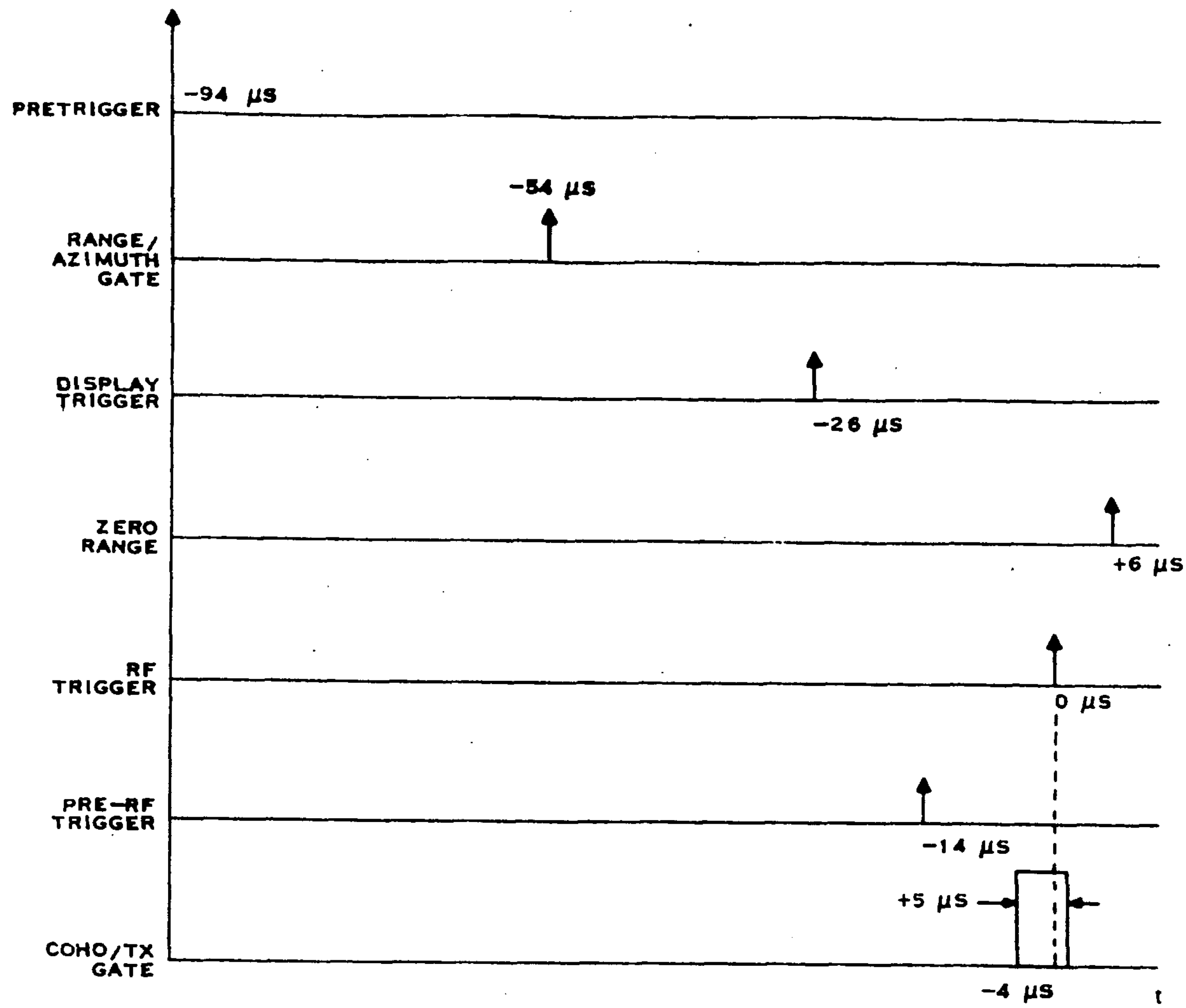

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Figure 3-31. Staggered Trigger Timing

During each stagger period, six radar triggers must be generated for overall operation of the radar. This is accomplished with a second 12-bit counter and six 12-bit trigger decoders, in a manner analogous to the aligned triggers described above. The 12-bit counter receives the 2.15-MHz clock and is reset to zero by the reset pulses from the one-of-four circuit function described above. The counter advances until reset by the next reset pulse. Thus, the initial (zero) state follows the stagger sequence. The 12-bit stagger trigger decoders, programmed by the six stagger-trigger ROMs, generate the actual stagger triggers with the timing relationships shown in Figure 3-31. Note that the timing interval between these triggers is always fixed, and the entire group occurs in the staggered period sequence. The pre-RF trigger serves as modulator trigger for the transmitter. The RF trigger and COHO/transmitter gate are used when a klystron transmitter is used with the radar.

b. Shift Pulse Generation

The clock signals required for the digital processing circuits and the shift pulses required by the MOS shift register storage are also derived from the 30-MHz crystal oscillator. As described above, the 30-MHz oscillator signal is counted down by a factor of 14 to form the basic timing interval of 0.467 μs. This countdown circuit, in effect, generates 14 intervals of 0.467 μs each, which are then decoded to form various clocks. For example, one clock may go high at interval number 1 and low at interval number 5. This forms a clock at the basic 2.15-MHz rate which is a logic 1 for 0.167 μs and logic 0 for 0.300 μs. In a similar manner, a total of 14 clock signals are decoded for use in the processing and storage circuits.

The 2.15-MHz clock pulses are used by the analog-to-digital converters to sample the video inputs received from the IF modules. The converted signals are then clocked through the various functions, such as the MTI cancellers, integrators, and log-CFAR circuits at the same rate. The radar range is nominally 110 km, provided by 1,665 range bins. At the end of the 1,665 range bins, a range bin counter and a decoder determine that end-of-range has occurred and stops the processing. Since there is a deadtime period after end-of-range and before the next pulse, during which test pulses and other functions occur, some clocks continue. At the end of the complete period, determined by the trigger generator circuits, the cycle repeats itself.

c. Beacon Triggers

As part of the trigger generation, counted-down beacon triggers are provided to synchronize the beacon-interrogator equipment to the radar. The triggers are always aligned, or unstaggered, since the beacon system is not susceptible to blind speeds. The countdown always keeps the beacon PRF between 325 and 400 pps when the radar is operating in stagger and between 300 and 450 pps when the radar is operating with fixed PRF.

9. Realignment

In normal operation, the radar will operate with the four-pulse staggered repetition periods shown in Figure 3-29 to eliminate blind speeds. Since some types of equipment that must interface with the radar will not operate properly with staggered periods, the final output video is realigned. That is, all periods are made uniform in duration. All three video outputs (normal/log-CFAR, weather log, and MTI) are realigned in digital stagger realignment circuits. Realignment is accomplished by making all periods equal to the average period which is derived from the aligned trigger generator. The staggered periods are derived as described in detail in the preceding section by varying the average period a specific interval of time for each of the three nonuniform periods. To realign the video, the video must be delayed equivalent periods of time to force all periods to be aligned with the aligned triggers.

The realignment delay is accomplished using MOS dynamic shift registers. Appropriate clocks are generated in the synchronizer clock generation circuits to delay or not delay the digital video. The realignment circuit is, in effect, three cascaded delay intervals with tapped outputs. The variable delay is obtained by selecting the appropriate point in the cascaded delay to tap off. Since the video is in digital format, this is accomplished using logic circuitry. For each of the MTI and normal video paths, the realignment circuitry has 6 parallel bits. For the log weather channel realignment, there are 7 parallel bits, and the weather background has 2 bits.

10. Diversity Combiner

After conversion from 6-bit digital to analog form, the MTI and normal video signals are connected to their respective video diversity combiner circuits. Diversity operation involves the simultaneous operation of both radar channels to increase the transmitted power and improve the probability of detection. To prevent waveguide breakdown problems, the two transmitter pulses are separated in time by approximately 1 μs. To sum the signals from the two channels corresponding to the same target, this offset must be realigned. A compensating delay line is therefore placed in the channel pulsed first, which is the master channel, thus making the two channels coincident. When two noise signals are summed, the output rms noise voltage increases by the square root of 2. To maintain constant output noise level from the radar, whether operating in diversity or single-channel mode, a compensating attenuator is also included in the combiner circuit. When operating single-channel, this attenuator is bypassed.

The radar weather background signal is added into the combined video from the master channel when the weather background circuit is turned on. Only the master channel weather background signal is used, and it is mixed in after diversity combining, to avoid the confusing situation which would occur if weather background from the two channels were to be summed together. After diversity combining and after the weather background is mixed in, a final video amplifier provides the composite output video. This amplifier has an adjustable video gain.

11. Video Line Drivers

Since the ASR is designed to operate at a remote location, it must be capable of delivering the output video signals over considerable distances. Each of the two processor units contains video line driver amplifiers which are capable of driving, in conjunction with their matched video line compensators at the receiving end of the cable, up to 6,096 meters of coaxial cable. Separate line driver/compensator pairs are provided for the MTI and normal video signals. In diversity operation, the master channel diversity combiners drive the master channel line drivers, which in turn drive the land line cables. In nondiversity operation the active, or selected, channel line drivers are used.

The line driver/compensator pairs are designed to exactly compensate for the attenuation/phase characteristics of RG-11/A coaxial cable. Bandwidth and frequency response characteristics are such as to make the overall driver-cable-compensator system function as a pure delay line, as illustrated by the pulse response oscilloscope photographs of Figure 3-32. The compensator printed wiring boards, located in the remote site unit, are designed to match to any length of coaxial line, within ±152 meters, by arrangement of jumpers on the PWB.

At the input to each line driver are adjustable limit-level and bottom-clip controls. Adjustable output level, or gain level, controls are also included. Thus, the nominal signal level, as well as the peak signal-to-rms-noise dynamic range, can be adjusted to match specific display characterstics. The bottom-clip circuit removes baseline noise so a wider signal dynamic range can be used. The output of each line driver in each processor is actively connected through diodes to the corresponding line driver in the opposite channel. Only the line drivers associated with the master (or active channel in nondiversity operation) are in use. The opposite channel drivers are disabled by an inhibit gate applied to the driver final amplifier. This technique avoids the need for video coaxial relays which are more prone to failure than the solid-state approach. Each line driver has four outputs, including the output to the land line, one to the radar monitor display, one for an RML, if used, and a test signal.

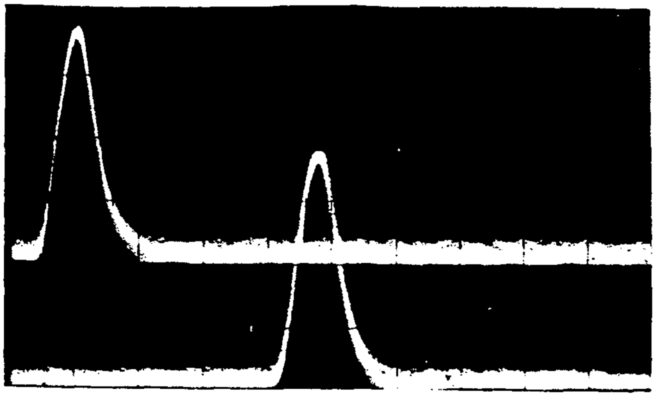

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Figure 3-32. Line Driver/Compensator Pulse Response

12. Weather Background Circuits

The weather background circuits can be selected to add a weather outline to the processor output video when the log-FTC-antilog video is selected. The weather background video is adjustable in amplitude relative to the log-FTC-antilog video to provide the operator with the proper contrast between operating video and background video.

There are two display modes for the weather background. The first is merely a limited and adjustable display of the entire detected storm area. In this mode the operator views the complete weather video pattern at a reduced brightness. The second mode is an adjustable brightness contour or outline of the storm or weather video area. In this mode the operator views the outline of the weather video pattern but is not distracted by the complete weather video pattern, which can compete with aircraft returns.

The weather background signals are generated in the same manner in both the MTI and normal channels of the processor unit; however, the input videos to the background generators differ in some respects. In the normal video channel, the background is generated from the receiver logarithmic video, which is filtered to reduce the noise variation amplitudes. The filtering reduces the possibility of weather background false-alarm signals which would clutter the display, yet does not degrade the detection of the extended weather blocks themselves. The filter is designed with a time constant which matches the logarithm-FTC delay in the normal channel.

In the MTI video channel, the background is generated from the output video of the canceller, but before the log function. At this point the video, which is in digital form, is converted to analog form to facilitate the weather background generation. Selectable scaling is accomplished at the point of conversion to analog voltage to normalize the noise out of the canceller for all canceller modes of operation. After the conversion and scaling, the video is filtered as in the normal channel to provide a video with reduced noise variations. The first portion of the background video generation circuits consists of variable threshold circuits. The filtered weather background video is presented to these circuits, and the threshold output signals are converted to a binary-coded signal. The threshold circuits are voltage comparators with adjustable reference voltages. The upper threshold, which is adjustable from 10 dB above rms noise to the maximum input amplitude, is used for blanking. The other two independently adjustable thresholds are for top clipping and bottom clipping. They are adjustable from 0 to 15 dB above rms noise. The fourth threshold is an intermediate threshold between the top-clipping and bottom-clipping thresholds and is used when the weather video output is reconstructed in a multiple-level form.

The four possible modes of weather background are:

Mode 1–No blanking, quantize with bottom clipping

Mode 2–Blanking, quantize with bottom clipping

Mode 3–No blanking, top and bottom clipping

Mode 4–Blanking, top and bottom clipping

Input videos, before and after filtering, as well as representative outputs for these four modes, are shown in Figure 3-33. The output waveforms are coded as 2-bit binary words and are then processed by the realignment logic. After realignment, the weather background signals are routed to the weather background variable digital-to-analog converter (DAC) and then to the summation circuitry.

The weather background signals generated by the previously described circuits are summed with the respective video channel signals at preset variable levels which are selectable at the system control panel. This requires that the binary words be converted to analog voltages in a DAC. To provide the three selectable intensities of the background video, as well as "off," the circuit is composed of three separate digital/analog ladder circuits driving one amplifier. Selection of the proper control lines provides three different intensities. In addition, an output adjustment on the amplifier permits setting of the maximum level from 0 to a level which will match log-FTC-antilog video at the other input to the additive summation amplifier.

13. Weather Channel

A separate realigned log video output is provided from the processor to drive supplemental weather and/or signal processing equipments not supplied with the basic radar. The log IF module video output is first converted to a 7-bit digital word. A digital delay matches the propagation delay through the MTI and normal processing circuits to maintain range alignment. The 7-bit digital word is then fed to a stagger realignment circuit, identical to the circuits used for the signal realignment, to provide uniform repetition periods. After realignment, the signal is converted to analog form. An output amplifier with adjustable gain control provides the output signal.

14. Sensitivity Time Control Generator

Sensitivity time control (STC) and receiver sensitivity control are accomplished using PIN diode RF attenuators ahead of the parametric amplifier, as discussed in the receiver unit, Section III.C. An all-digital STC function generator and sensitivity control located in the processor unit generates the exponential curves and bias value that control the RF attenuators.

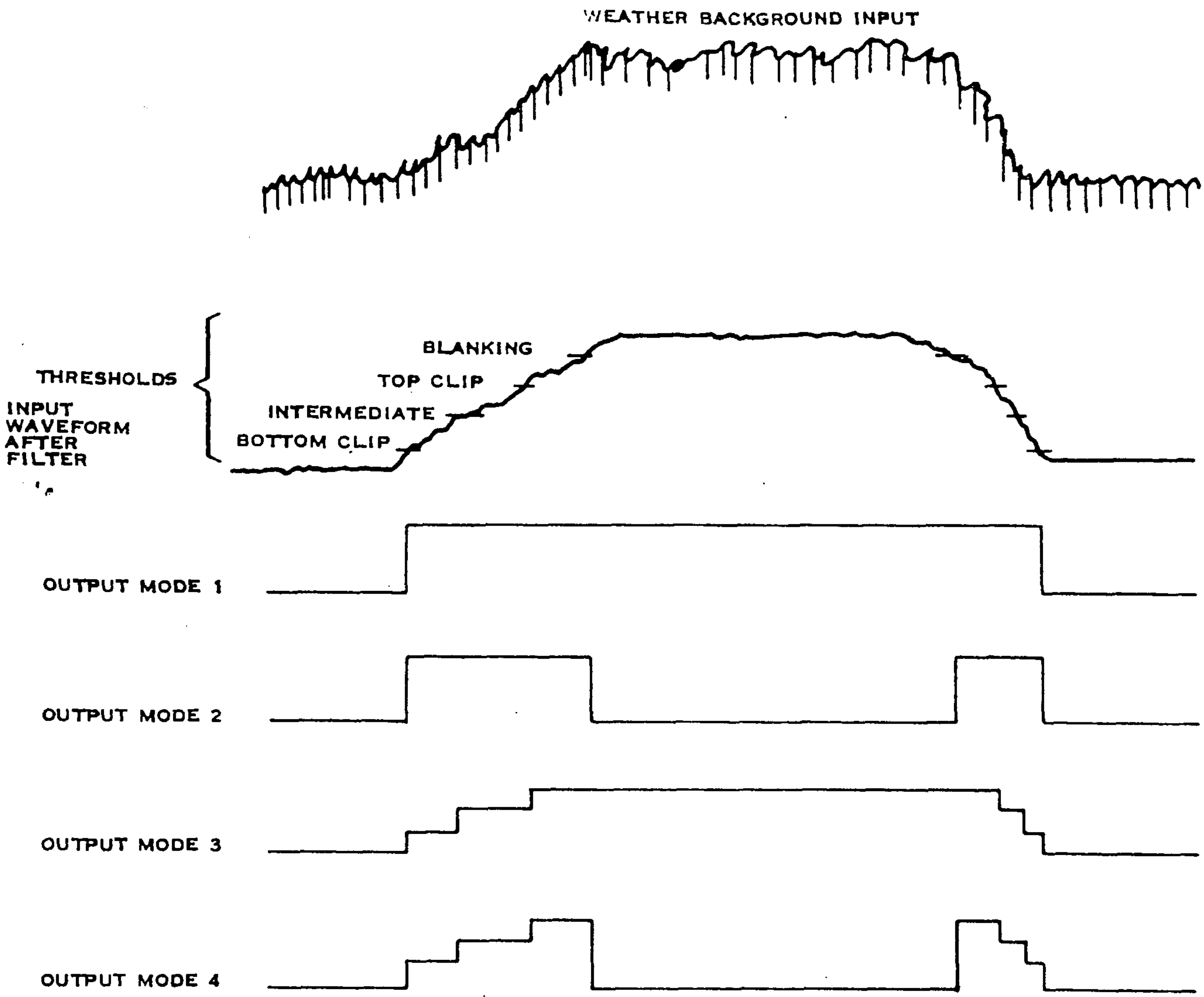

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Figure 3-33. Weather Background Modes Showing Representative Inputs and Outputs

Considerable flexibility is incorporated in the design to facilitate matching of the STC characteristics to the clutter problems of a particular site. This includes variable exponent control, variable initial attenuation value, and variable delay in starting the STC curve. For receiver sensitivity control, a fixed-attenuation bias is summed with the STC function. Figure 3-34 shows a simplified block diagram of the STC function generator. Two identical, but separate, function generators are included, one for the high-power (low-beam) receiver channel and one for the low-power (high-beam) receiver channel. By providing two independent function generators, complete flexibility is provided in matching the STC function to the clutter of the particular antenna beam.

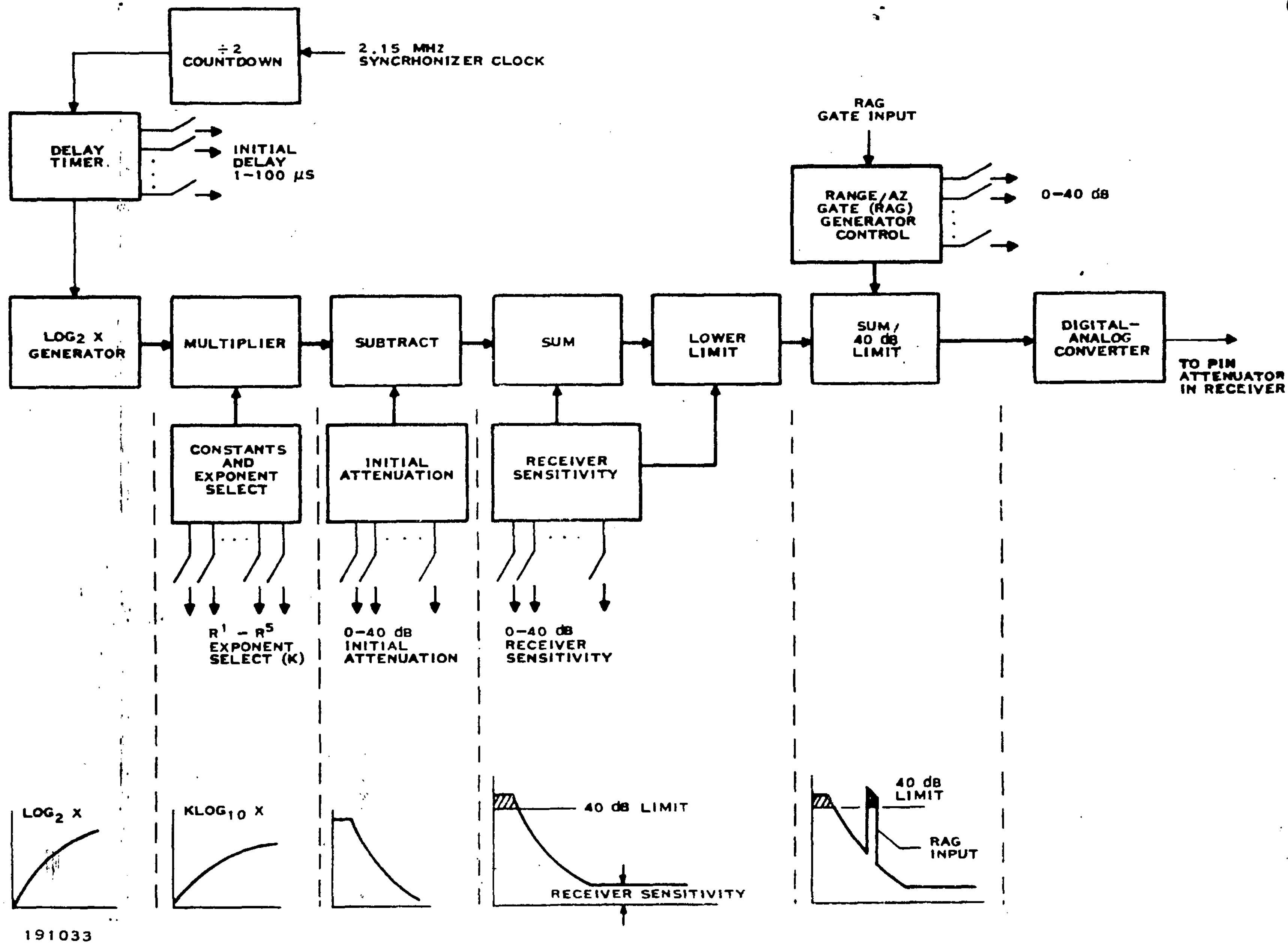

Figure 3-34. STC Function Generator Simplified Block Diagram

Referring to Figure 3-34, the STC function generation begins with the forming of a digital logarithmic function. Range clocks are received from the synchronizer at the 2.15-MHz rate. This clock is divided by 2 in frequency and applied to a variable delay timer. After the preset delay, the generator of the log function begins. The variable delay is set using the dual in-line switches mounted on the STC printed wiring boards. The basic log function is generated in base 2 and represents the unity exponential function. This basic function is then multiplied by a constant to change to base 10 and to select the exponent. This is based on the fact that multiplying the logarithm of a number by a constant is equivalent to raising that number to a power equal to the constant. The value of the range exponent can be varied using PWB dual in-line switches.

After establishing the exponent, a variable initial-attenuation value is combined with the STC curve. Since attenuation must decrease with range, the STC log function is subtracted from the initial value. This effectively generates a function which varies with the inverse of range, raised to the power of the preset exponent, and beginning with the initial value of attenuation. As indicated above, the STC curve does not begin until after the preset digital delay. Thus, at sites where close-in clutter is extremely heavy, the attenuation can be kept constant at the initial value until the preset delay (range) is reached, and can then decrease with the selected power, or exponent, in range. The delay is variable from 1 to 100 μs and the initial attenuation is adjustable from 0 to 40 dB.

A variable receiver sensitivity control function can also be summed with the STC function. This control is implemented by adding an adjustable attenuation bias to the STC curve of 0 to 40 dB. Thus, maximum gain corresponds to the 0-dB attenuation case, and minimum gain is the 40-dB case. The sensitivity bias is additively combined with the STC function; but, since the attenuator is capable of 40-dB maximum attenuation, a clamp limits the composite signal to a level corresponding to 40 dB. Since varying the attenuation in front of the parametric amplifier changes the overall system noise temperature only slightly while directly attenuating signals, the receiver sensitivity is controlled.

After the composite STC plus sensitivity control function is generated in digital form, a DAC converts the function to an analog voltage to apply to the RF attenuator. The DAC is located in the processor unit, and the final attenuator linearizer is an integral part of the attenuator in the receiver unit.

15. Range-Azimuth Gate

Another extremely useful feature, operationally, is the range-azimuth gate (RAG). It is extremely flexible and programmable in 28 different adjoining windows, 16 isolated windows, 6 sectors, 4 strobes, and 1 trigger. Once the RAG is programmed at any given site, it will automatically maximize the efficiency of the clutter processing features of the radar for that particular site.

As shown in Figures 3-35, 3-36, and 3-37, the optional RAG unit can gate MTI and normal video in 20 different adjoining range-azimuth windows and 0 to 16 isolated windows. In addition, in the dual-beam antenna configuration, high/low beam switching can be accomplished automatically in eight different adjoining windows and 0 to 16 isolated windows. As shown in Figures 3-35 and 3-37, the RAG unit can gate two different values of receiver gain in 0 to 16 isolated windows and one noise signal generator gate. The 0 to 16 groups of isolated windows can be proportioned between the four functions as desired.

	NO. OF ADJOINING WINDOWS STARTING 0 RANGE	NO. OF ISOLATED WINDOWS, GATE	NO. OF SECTORS	NO. OF STROBES, TRIGGERS
GATING OF VIDEO	20	0–16*		
ANTENNA BEAM SWITCHING	8	0–16*		
NOISE SIGNAL GENERATOR GATE		1		
AZIMUTH STROBE				4
DELAYED, GATED TRIGGER				1
STAGGER/NONSTAGGER			0–6**	
RECEIVER GAIN GATE NO. 1		0–16*		
RECEIVER GAIN GATE NO. 2		0–16*		
STC SECTOR NO. 1			0–6**	
STC SECTOR NO. 2			0–6**	

*THE 0–16 GROUPS OF ISOLATED WINDOWS CAN BE PROPORTIONED BETWEEN THE FOUR FUNCTIONS AS DESIRED.

**THE 0–6 GROUPS OF SECTORS CAN BE PROPORTIONED BETWEEN THE THREE FUNCTIONS AS DESIRED.

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Figure 3-35. Range Azimuth Gate Generator Programming Options

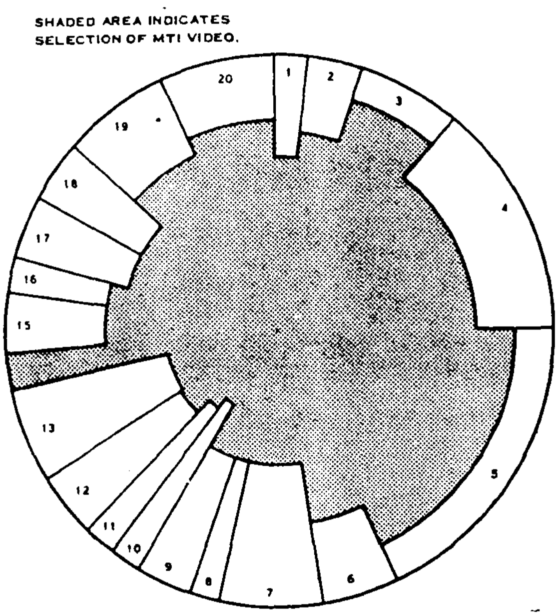

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Figure 3-36. Adjoining Video Gates

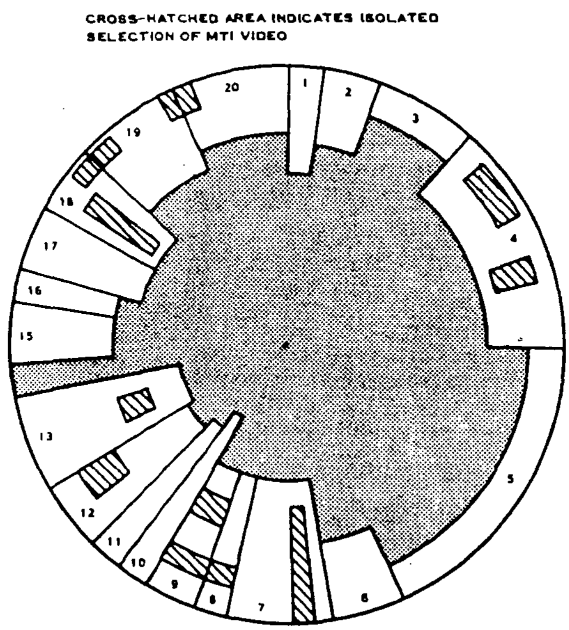

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Figure 3-37. Isolated Video Gates

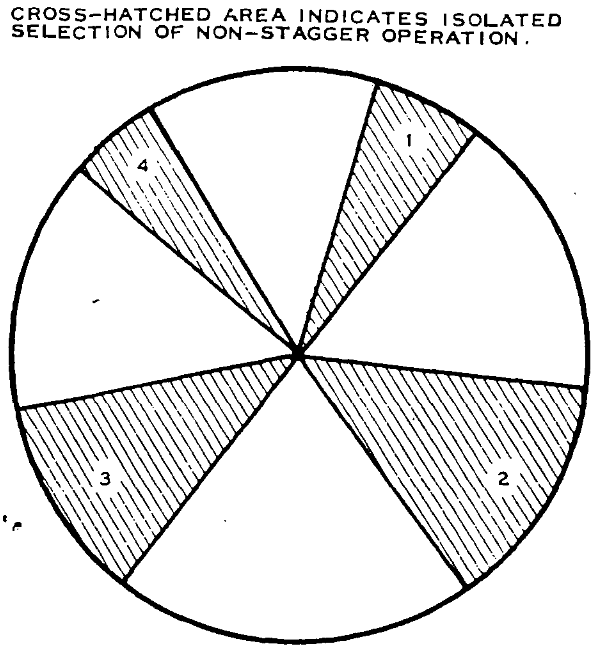

Figure 3-38. Azimuth Nonstagger Gates

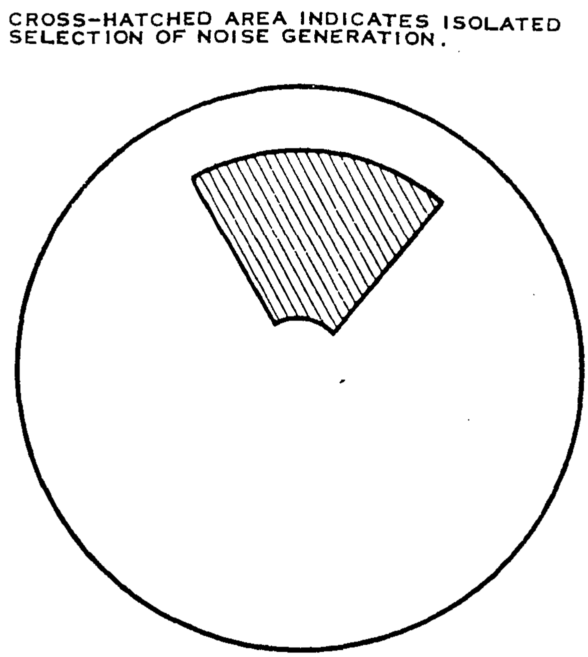

Figure 3-39. Noise Generator Gate

As shown in Figures 3-35 and 3-38, the RAG unit can gate stagger/nonstagger PRF in 0 to 6 sectors and two different STC curves in 0 to 6 sectors. These 0 to 6 groups of sectors can be programmed between the three functions as desired. As shown in Figures 3-35 and 3-39, the RAG unit can isolate one area for the noise generator.

16. Maintenance and Built-In Test Equipment.

The ASR-8 is designed to be easily maintained, including built-in test (BIT) function generators to aid in troubleshooting. All PWBs are accessible from the front of the cabinet and have card edge test points. Most troubleshooting can be accomplished with the boards in place, using the provided test points. However, extender boards are provided so every board can be completely accessible while still plugged in. Since the boards are double-sided and not multilayer, all circuit points are thus available.

The card rack connectors use wire-wrap interconnections. All racks are mounted to a hinged panel which swings open to make the wire-wrapped back connections readily accessible. Signals most often used in routine checking, such as triggers and video inputs and outputs, are available at BNC coaxial connectors on the front panel. Panel-mounted switches permit selection of all modes when the channel is off-line for checking, adjustment, and maintenance.

To aid in routine checking and troubleshooting in the processor unit, three BIT function generators are included. These circuits generate a swept-frequency signal for displaying the canceller responses, a linear ramp that can be made either fixed or optimum velocity, and test pulses in the radar deadtime. The swept frequency circuit generates sine and cosine signals with frequency which is linearly swept across the doppler band. The linear ramp is available to drive the horizontal sweep of an oscilloscope so the response of the cancellers can be viewed. The quadrature combining circuit can also be checked.

A linear ramp video signal is generated to dynamically test the cancellation in the canceller circuit at all video levels (all bits). The ramp polarity can be made to alternate each radar period to simulate an optimum velocity moving target for all amplitudes. This permits viewing the operation of circuits following the cancellers.

Fixed and moving test pulses are generated during deadtime each radar period so that the processor performance can be monitored while the radar is operating. The optimum velocity moving target can be superimposed upon the fixed target, and attenuated by at least 40 dB, to test cancellation ratio.

These BIT circuits, plus the provision of test points and outputs, make it possible to accomplish virtually all routine maintenance and troubleshooting with only an oscilloscope, precluding the need for unusual or specialized test equipment.

Processor mode controls, test signal connections, power supply status lamps, and monitoring meter are all mounted to the upper portion of the swing-out panel near eye level. BNC coaxial cable connections are provided for monitoring video signals and radar triggers.

E. CONTROL

The ASR-8 control and status system contains four control and transfer units. Two are located at the radar head and are mounted in the cable junction box. Only one of the two is active. The second is a redundant unit which can be quickly placed on-line by switching the connecting cables between the two units. The second two control and transfer units are located at the ATC display equipment site. One is typically mounted near the master PPI display and the second in the support equipment or maintenance area. Both control and transfer units at the display site are active units. Of the three active units, only one is allowed control, but all units indicate system status. Transfer of control from one unit to another requires action by persons located both at the unit having control and at the unit desiring control.

F. DISPLAY SITE REMOTE UNIT

The display site remote unit is located at the ATC display equipment site which can be located up to 6,100 meters from the radar head site. This unit is matched with the line driving equipment at the radar head site and can compensate for any remoting cable length from 0 to 6,100 meters and provides output distribution for video, trigger, and azimuth to PPI displays located up to 90 meters from the display site remote unit. The APG signals, MTI video, and the combined normal video and radar pretrigger enter the display site remote unit through BNC connectors on a connector panel assembly at the top front of the cabinet. From the connector panel, the video and trigger enter the MTI line compensators where the video is shaped to compensate for up to 6,100 meters of coaxial cable. From there the video is routed to a selector switch on the front panel assembly where the operator may select the output for connection to the input of the distribution amplifiers. In the event an RML link is used instead of the landline, it can be patched into the distribution amplifier. The outputs from the distribution amplifiers are available at the connector panel for connection to ATC display equipment. The trigger is separated and restored by the normal line compensators and fed through the front panel switches to the same distribution amplifiers. The APG signals are restored by the APG pulse shapers and routed through the front panel switches to the distribution amplifiers. From each distribution amplifier four ACP, four ARP, four trigger, two normal video, and two MTI video isolated outputs are supplied at the connector panel. Maintenance outputs from the selected line compensators and APG pulse shaper are available at BNC connectors on both the connector panel and the front panel. Space is provided on the connector panel and in the PWB rack for the addition of a third distribution amplifier if it should become necessary to drive additional display equipment.

1. **Line Compensator**

There are essentially four building blocks associated with the line compensator assemblies; a common mode rejection amplifier at the input, compensation networks for 300-, 600-, 1,200-, and 2,000-meter cable lengths, fixed-gain buffer amplifiers between compensators, and a buffer driver at the output. The input signal is applied to the first amplifier where the 50- to 60-Hz common mode interference is balanced out. An adjustment is provided to compensate for the impedance differences between the inner and outer conductor for the associated landline to reduce the difference-mode pickup of 50- to 60-Hz interference. An adjustable capacitor is provided as a high-frequency balance adjustment at the input to the amplifier, allowing greater than 45 dB of common mode rejection through the usable bandwidth of the amplifiers. Compensation networks between amplifiers are terminated in 500 ohms, and an adjustment provides the necessary gain depending on the length of landline cable compensated for. Each amplifier stage is a fixed-gain wideband amplifier. The output drivers for system video output and for maintenance video are buffer amplifiers capable of providing a 5-volt signal at the end of 90 meters of 75-ohm coaxial cable terminated in 75 ohms. Lengths of cable can be compensated by grounding the appropriate compensation networks and opening their associated shorting terminals. To remove a compensation network from the circuit, the ground terminals must be opened and the bypass terminals must be shorted. Specific connections required for various lengths of cable are listed in the installation section of the system manual. The trigger signal is limited in amplitude throughout the amplifier chain and is taken off at the input to the last state amplifier. A comparator regenerates the trigger pulse and fires a one-shot to produce a 1.2 μs pulse. The output of the one-shot drives two trigger-drivers, one for the system trigger output and one for maintenance, to produce a pulse with greater than 15 volts amplitude into a 75-ohm load.

2. **APG Pulse Shaper**

There are three basic building blocks for APG pulse shaper: a line receiver, a pulse forming and inhibiting network, and output drivers. Integrated circuit line receivers accept differential APG signals from each radar channel and produce TTL logic levels at the output. A monostable multivibrator forms 23-μs pulsewidths for the ACP and ARP signals at a frequency determined by the inhibit signal frequency and the inhibiting circuitry. The purpose of the inhibiting circuitry is to prevent noise from generating spurious ARP signals. The circuitry counts ACPs up to a preselected number between 4088 and 4095. When the selected number is reached, the count is stopped and a one-shot is fired when the next ARP appears. There are two independent emitter-follower outputs for each signal, one for system use and one for maintenance. The drivers are designed to drive 75-ohm coax terminated in 75 ohms with an output pulse amplitude of 5 ±1 volts and will not be damaged if shorted to ground.

3. Distribution Amplifier

Distribution amplifier assemblies amplify the outputs of the line compensator and APG pulse-shaper boards and provide isolated outputs for driving several displays. The distribution amplifier boards contain three types of drivers: APG drivers, trigger networks, and video amplifiers. The APG drivers are identical to those on the APG pulse-shaper boards. There are four buffered outputs each for ACP and ARP. There are two sets of trigger networks, each having two isolated outputs with a trigger amplitude greater than 15 volts. Normally, the same input signal will be applied to each network, but the networks may be used for two different triggers by rewiring the inputs. Each video amplifier consists of an input stage with a high impedance emitter-follower buffer at the input and two isolated output drivers with individual gain controls. All outputs from the distribution amplifier are capable of driving up to 90 meters of RG-59 coax terminated in 75 ohms. All inputs to the board are terminated in 75 ohms so that any distribution amplifier may be removed from the display site remote unit without affecting the signals on another distribution amplifier.

G. MAINTENANCE PLAN POSITION INDICATOR (MPPI)

An all-solid-state 40-cm (16-inch) maintenance plan position indicator (MPPI) is supplied as a part of the ASR-8 radar system. This is a high-quality display which is sometimes used in the operations room for air traffic control purposes when automatic signal processing and alpha-numeric tag writing is not a requirement. The MPPI is supplied as a part of the radar system and is part of the built-in-test capability of the ASR-8 system.

H. EQUIPMENT LAYOUT

The design of Texas Instruments ASR-8 equipment has been planned from the beginning to permit installation in either a Texas Instruments furnished transportable building or in a customer-furnished fixed-site building. In addition, each unit (cabinet) has been designed so as to permit installation against a wall (front access) or, if desired, in the middle of a room. In the following sections, the equipment layouts proposed by Texas Instruments for transportable buildings and fixed-site buildings are briefly described. However, these are not the only possible configurations and it is possible to arrange the cabinets, waveguide runs, etc., to accommodate the special requirements of existing fixed-site radar buildings. The display site equipment is generally installed in a display site building provided by the customer.

1. Transportable Building Layout

Two transportable building configurations are available to house the ASR-8 radar head equipment. One building is designed to be transportated by C-130 aircraft (Figure 3-40) or ocean ship. The second configuration is used by the FAA and is transportable by ocean ship. Both buildings use sandwich-panel fiberglass construction because of its strength, low heat transfer, corrosion resistance, and ease of repair, as well as its superior performance in previous Texas Instruments manufactured radar systems. Radar equipment furnished in these buildings will be completely installed, and tested before shipment from Texas Instruments.

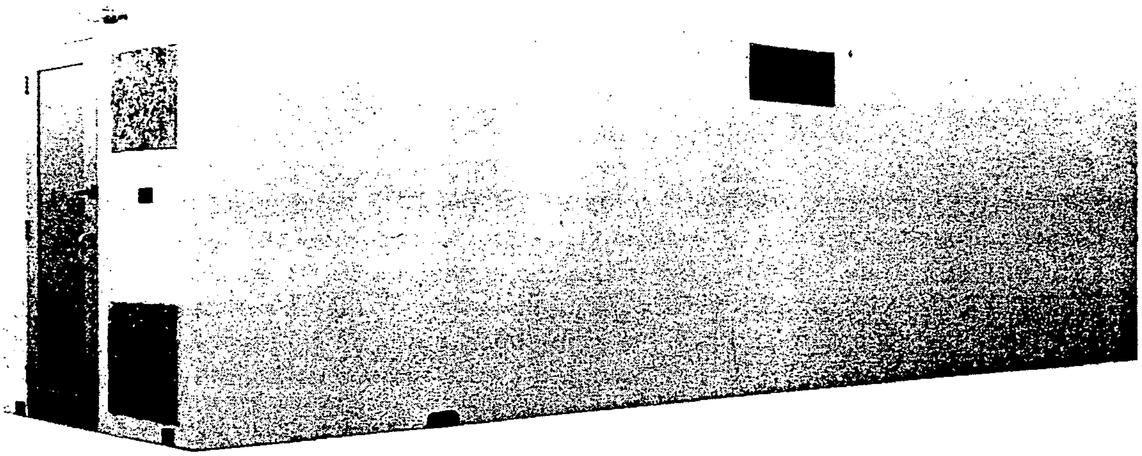

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Figure 3-40. C-130 Transportable Building

Figure 3-41 shows an FAA dual-channel ASR-8 installed in a 7.3-meter (24-foot) wide by 12.2-meter (40-foot) long by 3-meter (10-foot) high transportable building which consists of two identical modules, each 3.65 meters (12 feet) wide, joined together. A 7.3-meter (24-foot) wide by 2.2-meter (7-foot 2-inch) high opening along the center wall permits clear access to the two radar channels, each of which faces the 7.3-meter opening. As noted in Figure 3-41, the dashed lines show the locations planned for ancillary equipment typically associated with the ASR-8 radar system.

Figure 3-42 shows the air transportable configuration of the ASR-8 radar head equipment. The fiberglass building dimensions are 2.4 by 9.1 by 2.4 meters (8 by 30 by 8 feet).

2. Fixed Site Building Layout

Figure 3-43 shows a proposed equipment layout for use in a fixed-site building. The intent is to maintain the same relative positions of channel B with respect to channel A as was used in the transportable building. By so doing, the waveguide runs between channels and to the antenna will be identical to those used in the transportable building. This eliminates the need for special parts in the waveguide runs and keeps spare parts and technical manuals the same for both types of buildings.

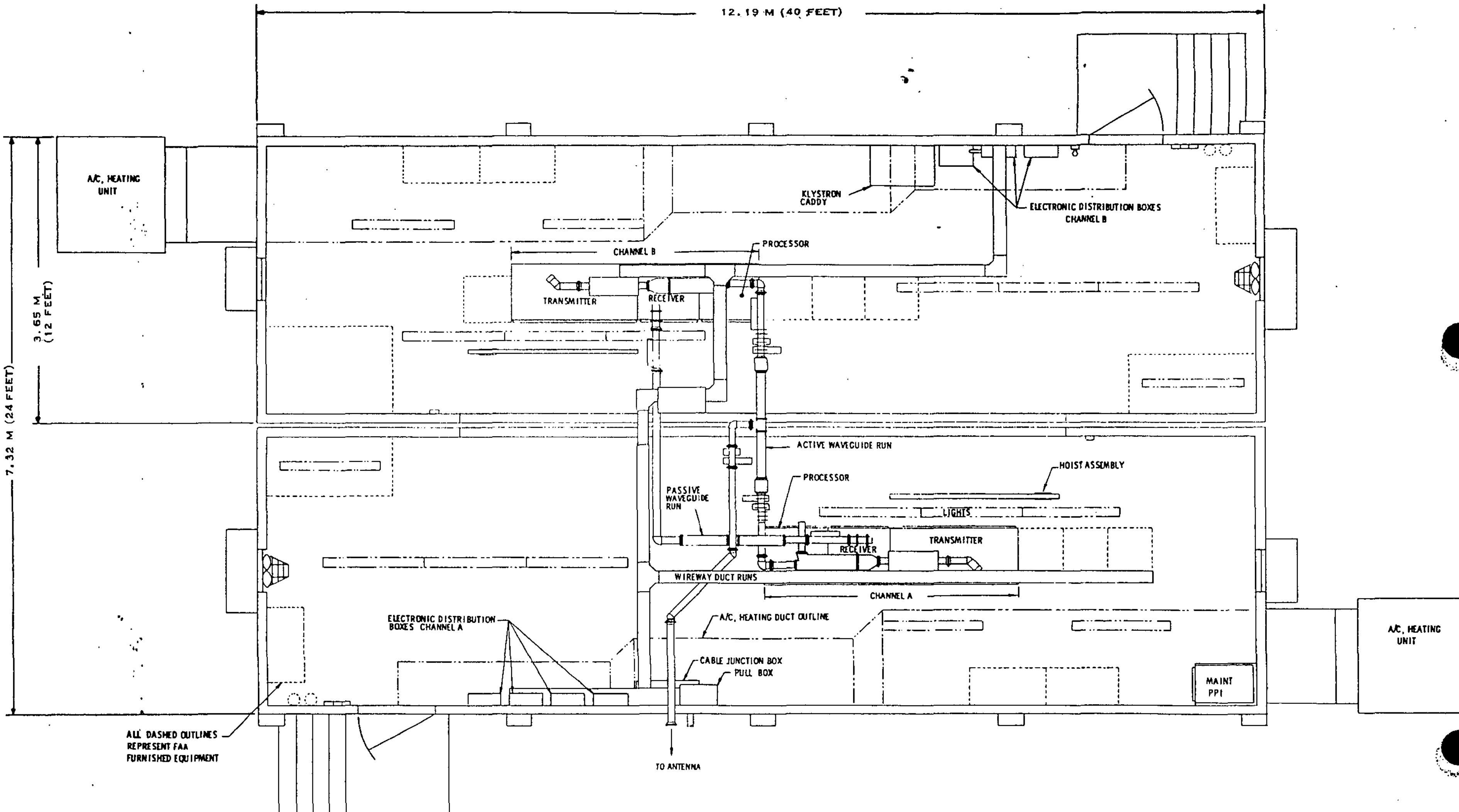

Figure 3-41. FAA Transportable Building Equipment Layout

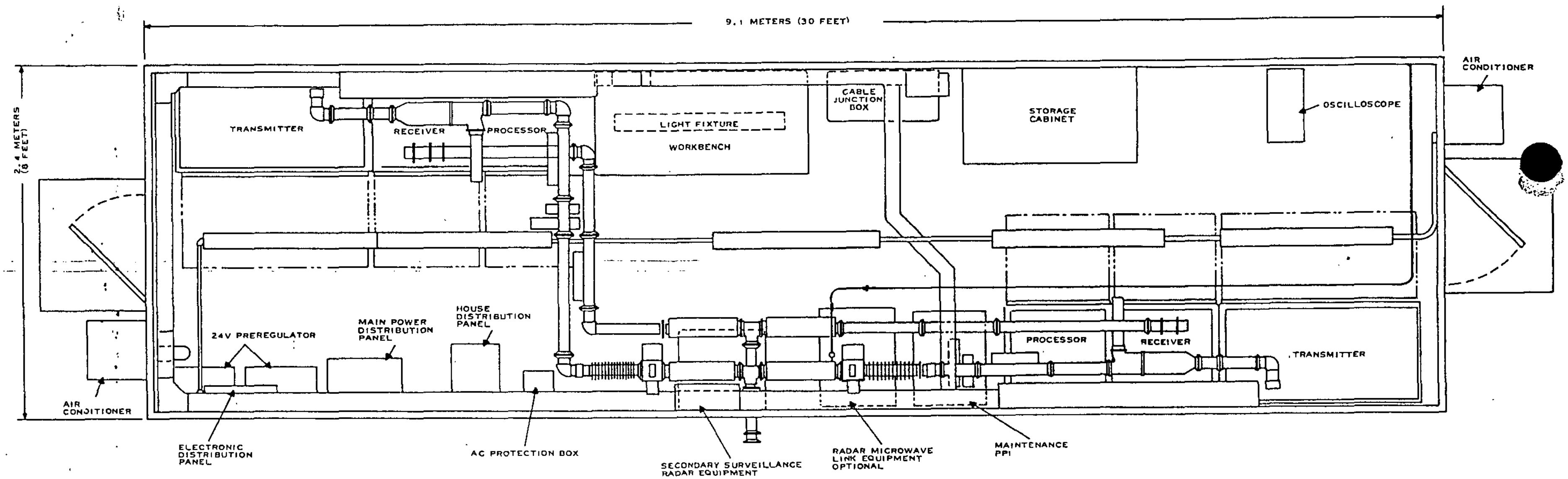

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Figure 3-42. Air Transportable Building Equipment Layout

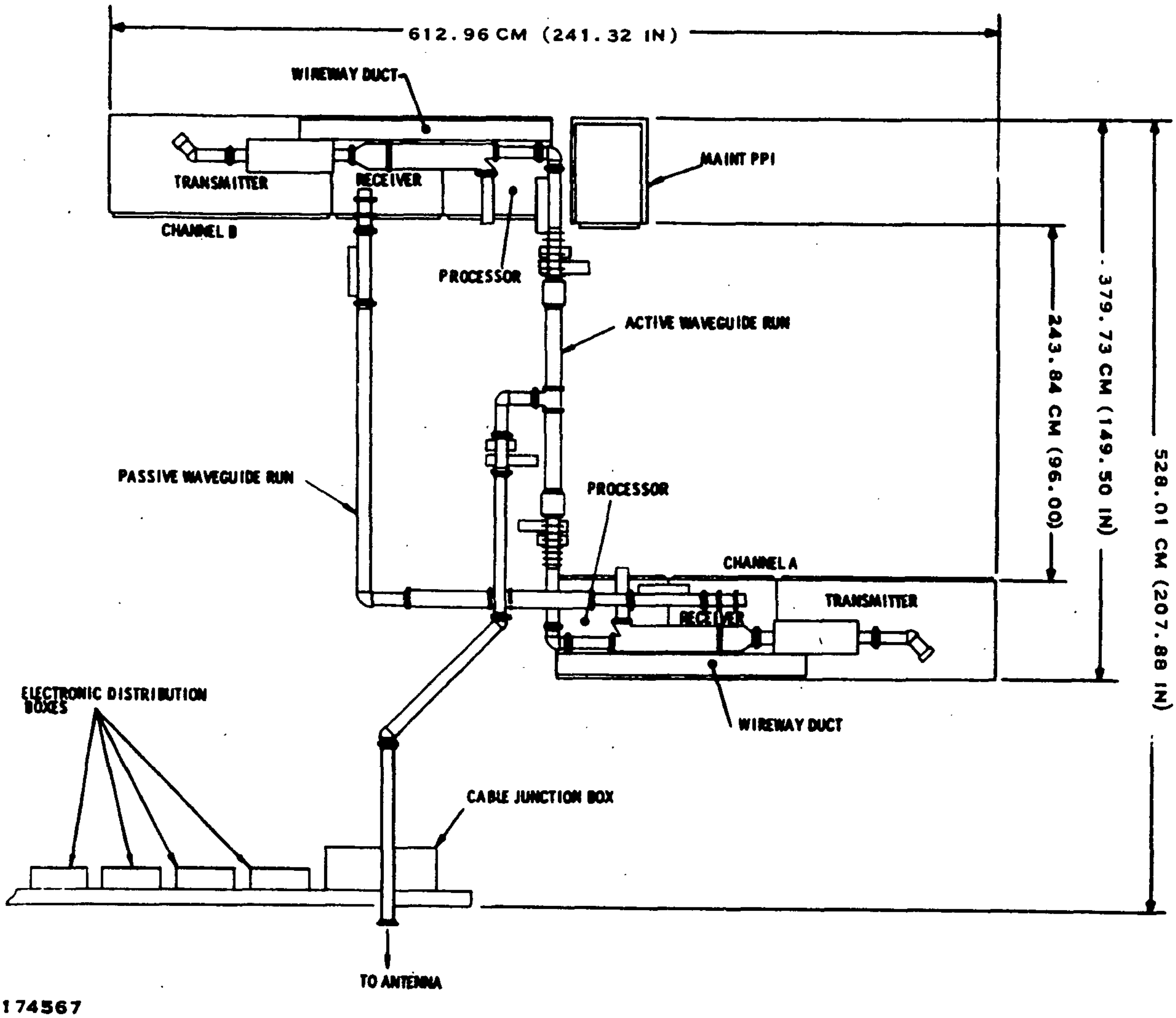

Figure 3-43. Fixed-Site Equipment Layout (Typical)

The electronic distribution boxes, which are located in each building half in the transportable building configuration, have all been moved to one location as shown in Figure 3-43. Another change shown is in the elimination of the wireway duct runs except for two short runs, one over each channel. The reason for this is that cable runs in fixed-site buildings can be routed under a false floor as is often done in computer installations.

I. TRANSPORTABLE BUILDING CONSTRUCTION TECHNIQUES

1. General

During the design phases of the ASR-8, Texas Instruments selected a foam and beam sandwich panel wall construction as the basic structural component for transportable buildings, meeting the FAA Specification FAA-C-2507. This building construction technique, described in detail below, and shown in Figure 3-44, offers a high strength-to-weight ratio while employing economical and reliable construction materials.

The technique described uses a rigid polyurethane foam core with plywood shins and a protective layer of fiberglass and gelcoat as the interior and exterior finish.

2. Panel Construction

The Texas Instruments building shell is erected from separately built walls, floor, and roof. The first step in the construction of such a component is the building of modular panels (1.22 m by 2.44 m). The periphery of the panel is a framework of wooden studs, nailed and glued together. Plywood sheets are then stapled and glued to both sides of the framework to form an enclosed cavity which is filled with polyurethane foam during an auto-froth self-expanding injection operation. These foamed panels are then joined with nails and glue to form a wall, roof, or floor. The large assembled component is then sprayed automatically with chopped fibers and polyester resin to form the fiberglass shins. This fiberglass coating, in addition to adding strength and stiffness, forms a weatherproof layer over the wood.

The design of members using sandwich construction is based on the principle that, in bending, the largest part of the load is carried near the extreme fibers of the beam and small bending stresses are developed near the neutral axis. This is shown in Figure 3-47 by the well-known I-beam principle: the facings of the sandwich structure act as the flanges of an I-beam and the core is equivalent to the web. The resulting stressed-skin construction is capable of the highest strength-to-weight and rigidity-to-weight ratios presently available with ordinary design methods and materials.

The thickness of both core and facings can be varied almost without limit to ensure that the building shell constructed from these panels will withstand imposed design loads. Sufficient plywood thickness on the inside skins of the wall, ceiling, and floor panels makes it possible to mount brackets, hangers, and equipment at practically any location without the use of special fasteners.

The weight per square meter for several variations of the sandwich panel is given in Table 3-1. These values do not include weights of the lumber studs which occur at joints between the plywood sheets, around the periphery of the panel, and around openings such as doors.

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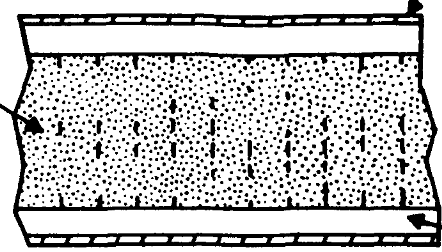


Figure 3-44. Texas Instruments Building Construction

TABLE 3-1. TYPICAL WEIGHTS PER SQUARE METER OF VARIOUS PANELS (STUDS NOT INCLUDED)

Material Used					
Outer Facing	Outer Plywood Skin	Inner Plywood Skin	Inner Facing	Kilograms Per Square Meter	Typical Use in Building
3.2 mm thick FG*	8.0 mm thick	19.0 mm thick	1.6 mm thick FG	24.71	Roof
1.6 mm thick FG*	8.0 mm thick	8.0 mm thick	1.6 mm thick FG	15.50	Walls
1.6 mm thick FG*	8.0 mm thick	28.6 mm thick	3.2 mm vinyl-asbestos tile	31.31	Floor

*Fiberglass

The composite facing material of plywood coated with a mixture of polyester resin and chopped fiberglass forms a strong, seamless, moisture-proof, dust-proof, and vermin-proof skin. The glass fibers are dispersed in a random array which provides a pleasing textured finish while simultaneously giving multidirectional strength and protection from pattern cracking.

3. Doors

Building doors are 4.4 cm thick with an 18-gage steel face and fiberglass bat insulation used as core material. Door frames are 16-gage steel with locking corners. Doors and door frames are chemically cleaned and phosphatized before application of a baked-on primer and a finish coat. The door frames themselves are mortised, reinforced, drilled, and tapped at the factory to receive full mortised hinges and strikes.

Door locksets are the Best Universal Lock Company part number 7K7EA6AUS10. Exterior door weather stripping provides a continuous and effective seal against water, dust, air infiltration, and light when the door is closed and latched with the lockset only. The weather stripping fits tightly at corners to maintain continuity around the entire periphery of the door. Installation is in accordance with manufacturer's recommendations and the weather stripping is not exposed in a way to make it susceptible to impact damage by traffic through the door.

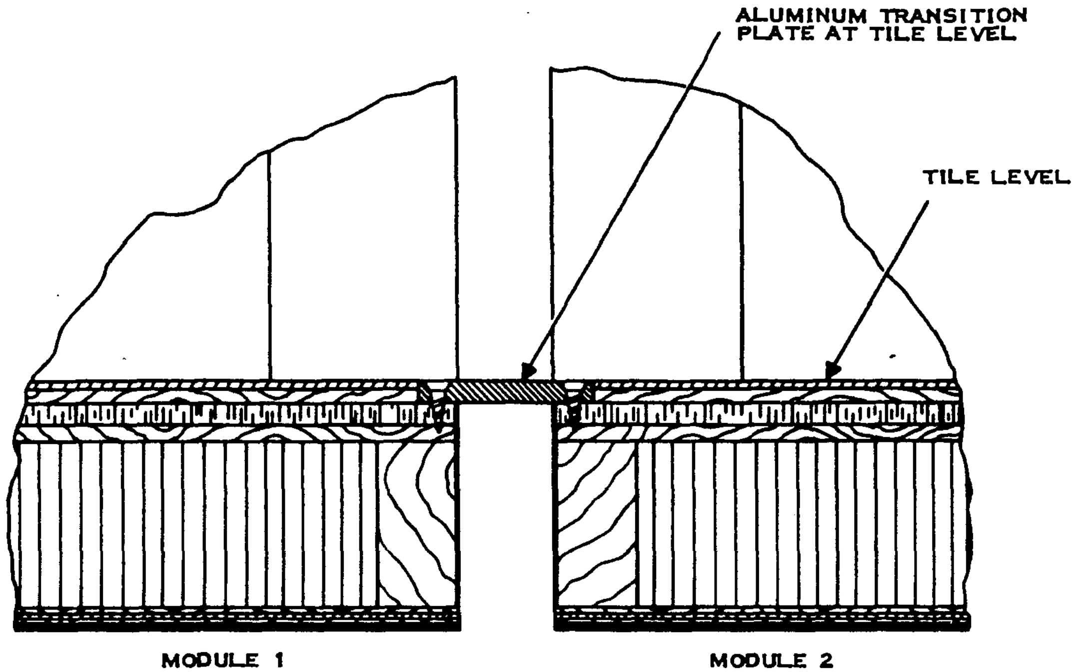


Figure 3-45. Transition Between Buildings

4. Openings

Flat transition plates bridge the gap between modules at mating openings. The top surfaces of these plates are at the same level as the tile floor to permit smooth passage of wheeled equipment. Figure 3-45 shows this concept. By notching the plywood floor beneath the tile, such plates can easily be installed at the tile level.

5. Finishes

The finish coat applied over the fiberglass building skin is a catalyzed polyester coating called Gel Coat. This coating provides an ultraviolet shield and protects the polyester fiberglass against degradation by solar radiation. The coating is not susceptible to oxidation or corrosion and is long-lasting and maintenance free.

Texas Instruments uses a white coating similar to color number 27875 of Federal Standard 595a, Colors. This color is the same as that now supplied on ASR-7 transportable buildings.

On the building exterior, the white color used on walls, roof, and foundation will be highlighted by contrast with doors and trim items painted medium gray, similar to color number 16187 of Federal Standard 595.

The white finish on the interior walls and ceiling is applied to the textured surface of the fiberglass to form a pleasing, randomly arrayed face. This color provides excellent reflectance for lighting and makes the room appear larger and more open. In addition, it blends well with the green, brown, and gray of the floor tile, electronic equipment, and wireway duct and junction boxes. Both the interior and exterior fiberglass surfaces and the light-green vinyl-asbestos floor tile are simple to clean and maintain with ordinary soap and water. Because no fasteners protrude, continuous surfaces which are easily scrubbed, wiped, or swabbed keep maintenance costs at a minimum.

6. **Fire Resistance**

All materials used in the sandwich-panel construction are chemically treated to impart fire-retardant qualities in compliance with FAA specifications. Plywood, lumber, polyurethane foam, and fiberglass resins are treated to exhibit a flame spread rating of less than 25 when tested in accordance with ASTM E-84. All items of interior trim such as moldings, coving, floor tile, etc., will comply with applicable fire-resistance specifications for the particular material type selected.

7. **Heat Transmission**

The heat transmission coefficient of the completed panel is extremely low and considerably exceeds the specification requirement of 20.3 cal/s-cm^2-°C (0.15 Btu/hr-ft^2-°F). A "U" factor of 12.2 cal/s-cm^2-°C (0.09 Btu/hr-ft^2-°F) is typical of a panel with 1.6 mm fiberglass facings and 8.0 mm plywood skins inside and out.

8. **Environmental Control System**

The ASR-8 environmental control system is composed of the air conditioning, heating system and the emergency air exhaust system. Both systems are duplicated in each building section. Figure 3-46 is a line drawing of the air-conditioning concept used in the ASR-8. The cooling unit is designed to keep the building at 27°C and below with relative humidity less than 50 percent, when the outside temperature is 33°C dry bulb and 28°C wet bulb. The heating unit is designed to keep the room temperature at 24°C when the outside temperature is −18°C.

The air-conditioning and heating system operates in three distinct modes, two for cooling and one for heating, depending on outside conditions.

When the outside temperature is above 10°C and cooling is required, the air-conditioner compressor is energized and cooling is accomplished by conventional refrigeration cycle. Under these conditions, the outside air intake louvers remain closed, the return air louvers remain open, and the room air exhaust louvers remain closed.

When the outside temperature drops below 10°C, the compressor is deenergized and cooling is accomplished by forcing cool outside air into the room. Under these conditions, the outside air intake louvers and the room air exhaust louvers adjust to an intermediate position, depending on the amount of cooling required and the temperature of the outside air. The return air louvers adjust to a partially closed position. These modulating louvers maintain constant inside pressure and exhaust hot air.

When room temperature drops below 24°C, the heating unit is energized. In the heating mode, the outside air intake louvers and the exhaust air louvers close and the return air louvers open.

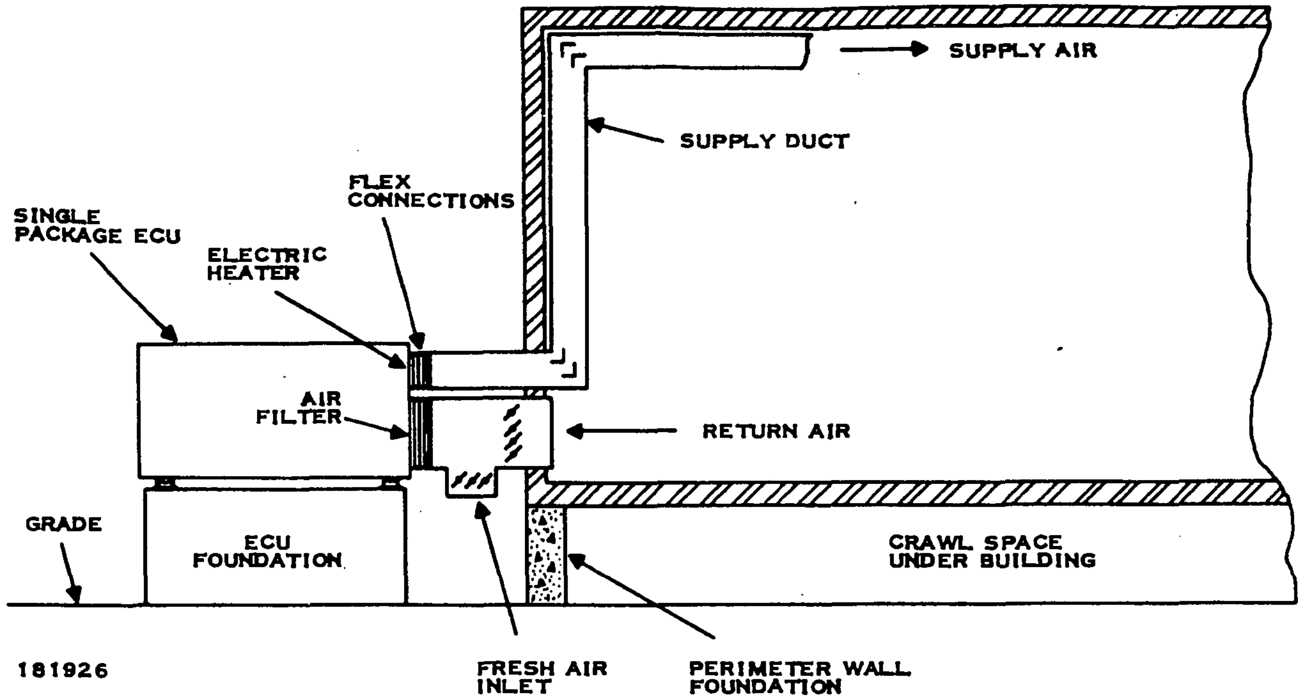


Figure 3-46. Air Conditioning Concept

The emergency air exhaust system is composed of an exhaust fan and louvers located in opposite ends of each room. In normal operating conditions, the louvers operate as exhaust but, under emergency conditions, they act as intake louvers. The system is designed to hold the inside room temperature to a maximum of 12°C above the outside temperature. When the inside temperature exceeds 35°C, the emergency air exhaust system energizes. The exhaust fan starts, the louvers open completely, and the outside air intake louvers open completely with the return air louvers remaining closed. Air is forced out of the building by the fan. Air enters through the open louvers and is forced into the building by the air-conditioner supply fan. The compressor remains deenergized. Table 3-2 lists conditions during each of the modes.

9. Environmental Conditions

The Texas Instruments building has been designed to sustain the maximum stresses imposed by the following ambient service conditions without permanent deformation, damage or degradation of operation:

Temperature	−50° to +70°C
Relative humidity	5 to 100 percent including condensation due to temperature changes
Wind velocity	100 mph (not including gusts)
Roof snow load	40 psf
Seismic	Zone 3 of Uniform Building Code

Environment	Hail stones—½ inch diameter Salt Spray Urban industrial fumes Fungus—as encountered in warm, humid atmosphere Wind borne sand and dust—as encountered in deserts and plains of Western U.S. Rain

TABLE 3-2. ENVIRONMENTAL EQUIPMENT CONDITIONS

Unit	Outside Temperature <10°C				Outside Temperature >10°C			
	<24°C	24°–27°C	27°–29°C	>35°C	<24°C	24°–27°C	27°–35°F	>35°C
A-C compressor	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF
Heaters	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
Evaporator fan	ON	OFF	ON	ON	ON	OFF	ON	ON
Inside air return louvers	OPEN	*	*	SHUT	OPEN	OPEN	OPEN	SHUT
Outside air return louvers	SHUT	*	*	OPEN	SHUT	SHUT	SHUT	OPEN
Emergency air exhaust louvers	SHUT	*	*	OPEN	SHUT	SHUT	SHUT	OPEN
Emergency exhaust fan	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON
Cooling thermostat	OFF	OFF	ON	ON	OFF	OFF	ON	ON
Heating thermostat	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
Outside air thermostat	ON	ON	ON	ON	OFF	OFF	OFF	OFF
Emergency air exhaust thermostat	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON

*Louvers will be neither fully open nor fully closed but somewhere between the two extremes.

J. REMOTING CABLES

The radar system remoting cables are not provided as a part of the basic ASR-8 radar since the distance between sites and the method of interconnection is generally unique to each radar system installation. As described in Subsection III.F, the ASR-8 can compensate for any length of landline up to 6,100 meters maximum. Where it is necessary to separate the radar head site and display site by more than 6,100 meters, the interconnection of sites can be accomplished by radar microwave link.

The usual method of interconnection is by underground landline, which can either be encased in conduit or directly buried. Generally, the direct burial cable is the most economical method and is the approach used when Texas Instruments provides the remoting cable. The direct burial cables should be equal or similar to those specified by FAA specifications FAA-E-2071 and FAA-E-2072. The cables specified are encased in an armor made of 0.152-mm copper clad steel or 0.254-mm annealed copper to prevent damage to the cable conductors as a result of activity by termites or rodents. The cable can be filled with a moisture-resistant compound such as petroleum-polyethylene to provide a positive moisture barrier and increase the electrical stability of the cable.

Additional physical and electrical characteristics are listed in Table 3-3 for the three types of direct burial cables required. Should additional technical information be needed, Texas Instruments will be pleased to supply it.

TABLE 3-3. DIRECT BURIAL CABLE CHARACTERISTICS

	Type of Cable		
	50-Pair	12-Pair	RG-11A/U Coax
Texas Instruments Part Number	808031	808032	808030
Purpose	Control and read-back signals	Azimuth and intercom data	Video and trigger
Conductor	Bare solid copper wire, 19 AWG	Bare solid copper wire, 19 AWG	Seven-strand tinned copper wire, 0.4-mm diameter
Insulation	High-molecular-weight polyethylene	High-molecular-weight polyethylene	Low-density polyethylene, 7.24-mm diameter
Cabling	Twisted pairs	Twisted pairs	
Shield		Each pair shielded	Single braid 33 AWG copper wire
Filler Compound	Moisture-resistant compound	Moisture-resistant compound	
Separator	Tape nonhygroscopic	Tape nonhygroscopic High-molecular-weight polyethylene	
Armor*	0.152-mm copper-clad steel or 0.254-mm annealed copper	0.152-mm copper clad steel or 0.254-mm annealed copper	0.152-mm copper clad steel or 0.254-mm annealed copper
Outer Jacket	High-molecular polyethylene	High-molecular* polyethylene	High-molecular* polyethylene
Resistance	8.73 ohms maximum	8.73 ohms maximum	
Nominal Attenuation at 1 kHz/m	0.0073 dB	0.0073 dB	1.57 dB/m/4000 MHz 5.6 dB/m/3000 MHz
Average Mutual Capacitance Pair/Meter	0.052 pF	0.052 pF	6.22 pF/cm
Dielectric Withstanding Voltage 3 Seconds			
Conductor to Conductor	4,500 Vdc	4,500 Vdc	4,500 Vdc
Conductor to Shield	10,000 Vdc	10,000 Vdc	10,000 Vdc
Impedance			75 ±3 ohms

*Not required for conduit burial cables.

For telephone and coax cables installed in underground conduit, the electrical requirements are the same and the physical characteristics are similar with the exception of the armor. For underground conduit, an aluminum armor (shield) will be applied over the core wrap of the telephone cable so that it is completely covered. The armor can be applied helically or longitudinally. The armor thickness will be 0.20 mm thick. In an underground conduit coax cable, the armor and outer jacket are not necessary; a standard RG-11A/U coax cable is satisfactory.

The ASR-8 and a typical SSR remoting signal requirement are summarized as follows:

Control and readback (75 conductors required for ASR-8 and 13 to 33 conductors for typical SSRs)–A 75-pair, No. 19 AWG telephone cable would cover this requirement and provide 42 to 62 spare conductors. If an SSR system is not considered, the ASR-8 requirement of 75 conductors can be covered by a 50-pair, No. 19 AWG telephone cable. This will provide 25 spare conductors for future use and/or failed conductor substitution.

Intercommunication and azimuth data (six pairs required)—One 6-pair twisted and shielded, No. 19 AWG telephone cable is adequate; however, it is good engineering practice to provide spare conductors. Therefore, a 12-pair, twisted, individually shielded telephone cable is recommended.

Video and trigger (three coax cables required)—Three each RG-11A/U coaxial cables are required, two for the ASR-8 and one for the SSR. However, to provide a spare signal path in the event of a cable failure, four each RG-11A/U coaxial cables are recommended.

System ground (one each, No. 2 AWG, stranded, annealed copper wire).

Figure 3-47 shows photographs of the three direct burial cables. Table 3-4 shows the quantity of the conductors used, origin and designations of each conductor, and the signal identification. Figure 3-48 provides the information for the cable termination hardware.

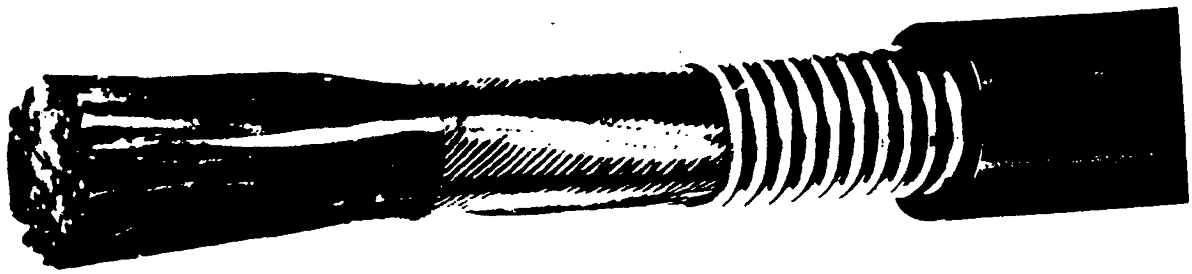
K. TEST EQUIPMENT AND SPECIAL TOOLS

The test equipment recommended to support the proposed equipment is listed in Table 3-5. This list of equipment is completely suitable for the day-to-day system maintenance. The FAA uses the same units, or their equivalent, in maintenance of their terminal control radar systems. This same list of equipment is also adequate for the installation checkout of the system.

All special tools required for system maintenance are supplied as a part of the radar system. All other tools required are typical to a good electronic repair facility and are readily available through various commercial sources.

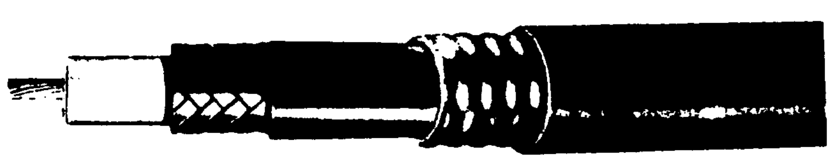
L. SYSTEM POWER REQUIREMENTS

The normal power consumption of the ASR-8 dual-channel radar system is 32 kW. Table 3-6 gives additional power requirements for equipment normally associated with the ASR-8 radar system and installed at the transmitter site.



A. ARMORED TELEPHONE CABLE (TWISTED PAIRS, DIRECT BURIAL)

B. ARMORED TELEPHONE CABLE (SHIELDED, TWISTED PAIRS, DIRECT BURIAL)



C. ARMORED COAXIAL CABLE, RG-11A/U (DIRECT BURIAL)

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Figure 3-47. ASR-8 Remoting Cables

TABLE 3-4. WIRE SPECIFICATIONS

Wire No.	Description	Component Connection for Start Station	Component Connection for Finish Station	Signal Identification	Type of Signal
1	No. 19 AWG	A20A1A1TB2-14	A2A4A1TB2-1	CH A ON/OFF LINE	CMD
2	No. 19 AWG	A20A1A1TB2-15	A2A4A1TB2-2	CH B ON/OFF LINE	CMD
3	No. 19 AWG	A20A1A1TB2-16	A2A4A1TB2-3	HV ON/OFF A	CMD
4	No. 19 AWG	A20A1A1TB2-17	A2A4A1TB2-4	HV ON/OFF B	CMD
5	No. 19 AWG	A20A1A1TB2-18	A2A4A1TB2-5	ANTENNA ON/OFF	CMD
6	No. 19 AWG	A20A1A1TB2-19	A2A4A1TB2-6	RELEASE CONTROL	CMD
7	No. 19 AWG	A20A1A1TB2-20	A2A4A1TB2-7	TAKE CONTROL CP2	CMD
8	No. 19 AWG	A20A1A1TB2-21	A2A4A1TB2-8	TAKE CONTROL CP3	CMD
9	No. 19 AWG	A20A1A1TB2-22	A2A4A1TB2-9	ANTENNA POLAR	CMD
10	No. 19 AWG	A20A1A2TB2-14	A2A4A1TB2-10	SPARE 1/2	CMD
11	No. 19 AWG	A20A1A2TB2-15	A2A4A1TB2-11	SPARE 3/4	CMD
12	No. 19 AWG	A20A1A2TB2-16	A2A4A1TB2-12	RCVR SEN MAX	CMD
13	No. 19 AWG	A20A1A2TB2-17	A2A4A1TB2-13	RCVR SENS 1	CMD
14	No. 19 AWG	A20A1A2TB2-18	A2A4A1TB2-14	RCVR SENS 2	CMD
15	No. 19 AWG	A20A1A2TB2-19	A2A4A1TB2-15	RCVR SENS 3	CMD
16	No. 19 AWG	A20A1A2TB2-20	A2A4A1TB2-16	RCVR SENS 4	CMD
17	No. 19 AWG	A20A1A2TB2-21	A2A4A1TB2-17	RCVR SENS 5	CMD
18	No. 19 AWG	A20A1A2TB2-22	A2A4A1TB2-18	RCVR STC OFF	CMD
19	No. 19 AWG	A20A1A3TB2-14	A2A4A1TB2-19	RCVR STC 1	CMD
20	No. 19 AWG	A20A1A3TB2-15	A2A4A1TB2-20	RCVR STC 2	CMD
21	No. 19 AWG	A20A1A3TB2-16	A2A4A2TB2-1	RCVR STC 3	CMD
22	No. 19 AWG	A20A1A3TB2-17	A2A4A2TB2-2	NORM VID/LOG VID	CMD
23	No. 19 AWG	A20A1A3TB2-18	A2A4A2TB2-3	NORM ENH ON/OFF	CMD
24	No. 19 AWG	A20A1A3TB2-19	A2A4A2TB2-4	MTI VID ON/OFF	CMD
25	No. 19 AWG	A20A1A3TB2-20	A2A4A2TB2-5	MTI ENH ON/OFF	CMD
26	No. 19 AWG	A20A1A3TB2-21	A2A4A2TB2-6	MTI WEA OFF	CMD
27	No. 19 AWG	A20A1A3TB2-22	A2A4A2TB2-7	MIT WEA 1	CMD
28	No. 19 AWG	A20A1A4TB2-14	A2A4A2TB2-8	MTI WEA 2	CMD
29	No. 19 AWG	A20A1A4TB2-15	A2A4A2TB2-9	MTI WEA 3	CMD
30	No. 19 AWG	A20A1A4TB2-16	A2A4A2TB2-10	NORM WEA OFF	CMD
31	No. 19 AWG	A20A1A4TB2-17	A2A4A2TB2-11	NORM WEA 1	CMD
32	No. 19 AWG	A20A1A4TB2-18	A2A4A2TB2-12	NORM WEA 2	CMD
33	No. 19 AWG	A20A1A4TB2-19	A2A4A2TB2-13	NORM WEA 3	CMD
34	No. 19 AWG	A20A1A1TB2-1	A2A4A2TB2-14	CH A ON/OFF LINE	RB
35	No. 19 AWG	A20A1A1TB2-2	A2A4A2TB2-15	CH B ON/OFF LINE	RB
36	No. 19 AWG	A20A1A1TB2-3	A2A4A2TB2-16	HV ON/OFF A	RB
37	No. 19 AWG	A20A1A1TB2-4	A2A4A2TB2-17	HV ON/OFF B	RB
38	No. 19 AWG	A20A1A1TB2-5	A2A4A2TB2-18	CH ALARM A	RB
39	No. 19 AWG	A20A1A1TB2-6	A2A4A2TB2-19	CH ALARM B	RB
40	No. 19 AWG	A20A1A1TB2-7	A2A4A2TB2-20	CH A READY	RB
41	No. 19 AWG	A20A1A1TB2-8	A2A4A3TB2-1	CH B READY	RB

TABLE 3-4. WIRE SPECIFICATIONS (Continued)

Wire No.	Description	Component Connection for Start Station	Component Connection for Finish Station	Signal Identification	Type of Signal
42	No. 19 AWG	A20A1A1TB2-9	A2A4A3TB2-2	NO CONTROL A	RB
43	No. 19 AWG	A20A1A1TB2-10	A2A4A3TB2-3	NO CONTROL B	RB
44	No. 19 AWG	A20A1A1TB2-11	A2A4A3TB2-4	ANTENNA ON/OFF	RB
45	No. 19 AWG	A20A1A1TB2-12	A2A4A3TB2-5	IN CONT/NO CONT CP2	RB
46	No. 19 AWG	A20A1A1TB2-13	A2A4A3TB2-6	IN CONT/NO CONT CP3	RB
47	No. 19 AWG	A20A1A2TB2-1	A2A4A3TB2-7	CIRC POLAR	RB
48	No. 19 AWG	A20A1A2TB2-2	A2A4A3TB2-8	LIN POLAR	RB
49	No. 19 AWG	A20A1A2TB2-3	A2A4A3TB2-9	SPARE 1/2	RB
50	No. 19 AWG	A20A1A2TB2-4	A2A4A3TB2-10	SPARE 3/4	RB
51	No. 19 AWG	A20A1A2TB2-5	A2A4A3TB2-11	RCVR SENS MAX	RB
52	No. 19 AWG	A20A1A2TB2-6	A2A4A3TB2-12	RCVR SENS 1	RB
53	No. 19 AWG	A20A1A2TB2-7	A2A4A3TB2-13	RCVR SENS 2	RB
54	No. 19 AWG	A20A1A2TB2-8	A2A4A3TB2-14	RCVR SENS 3	RB
55	No. 19 AWG	A20A1A2TB2-9	A2A4A3TB2-15	RCVR SENS 4	RB
56	No. 19 AWG	A20A1A2TB2-10	A2A4A3TB2-16	RCVR SENS 5	RB
57	No. 19 AWG	A20A1A2TB2-11	A2A4A3TB2-17	RCVR STC OFF	RB
58	No. 19 AWG	A20A1A2TB2-12	A2A4A3TB2-18	RCVR STC 1	RB
59	No. 19 AWG	A20A1A2TB2-13	A2A4A3TB2-19	RCVR STC 2	RB
60	No. 19 AWG	A20A1A3TB2-1	A2A4A3TB2-20	RCVR STC 3	RB
61	No. 19 AWG	A20A1A3TB2-2	A2A4A4TB2-1	NORM VID/LOG VID	RB
62	No. 19 AWG	A20A1A3TB2-3	A2A4A4TB2-2	NORM ENH ON	RB
63	No. 19 AWG	A20A1A3TB2-4	A2A4A4TB2-3	MTI VID/MTI LOG VID	RB
64	No. 19 AWG	A20A1A3TB2-5	A2A4A4TB2-4	MTI ENH ON	RB
65	No. 19 AWG	A20A1A3TB2-6	A2A4A4TB2-5	MTI WEA OFF	RB
66	No. 19 AWG	A20A1A3TB2-7	A2A4A4TB2-6	MTI WEA 1	RB
67	No. 19 AWG	A20A1A3TB2-8	A2A4A4TB2-7	MTI WEA 2	RB
68	No. 19 AWG	A20A1A3TB2-9	A2A4A4TB2-8	MTI WEA 3	RB
69	No. 19 AWG	A20A1A3TB2-10	A2A4A4TB2-9	NORM WEA OFF	RB
70	No. 19 AWG	A20A1A3TB2-11	A2A4A4TB2-10	NORM WEA 1	RB
71	No. 19 AWG	A20A1A3TB2-12	A2A4A4TB2-11	NORM WEA 2	RB
72	No. 19 AWG	A20A1A3TB2-13	A2A4A4TB2-12	NORM WEA 3	RB
73	No. 19 AWG	A20A1A4TB2-1	A2A4A4TB2-13	MASTER DIV ON A	RB
74	No. 19 AWG	A20A1A4TB2-2	A2A4A4TB2-14	MASTER DIV ON B	RB
75	No. 19 AWG	A20A1A4TB2-3	A2A4A4TB2-15	RELEASE CONT	RB
76	Cable, twisted pair	A2A4A5TB2	A20A1A5TB2	INTERCOM 1	COMM
76A	No. 19 blue	A2A4A5TB2-1	A20A1A5TB2-1	INTERCOM 1 HI	COMM
76B	No. 19 white	A2A4A5TB2-2	A20A1A5TB2-2	INTERCOM 1 LO	COMM
76S	Shield	A2A4TB7	A20A1TB10-1T	CHASSIS GND	COMM
77	Cable, twisted pair	A2A4A5TB2	A20A1A5TB2	INTERCOM 2	COMM
77A	No. 19 blue	A2A4A5TB2-3	A20A1A5TB2-3	INTERCOM 2 HI	COMM
77B	No. 19 white	A2A4A5TB2-4	A20A1A5TB2-4	INTERCOM 2 LO	COMM

TABLE 3-4. WIRE SPECIFICATIONS (Continued)

Wire No.	Description	Component Connection for Start Station	Component Connection for Finish Station	Signal Identification	Type of Signal
77S	Shield	A2A4TB7	A20A1TB10	CHASSIS GND	COMM
78	Cable, twisted pair	A2A4A5TB2	A20A1A5TB2	ACP 1	REF
78A	No. 19 blue	A2A4A5TB2-5	A20A1A5TB2-5	ACP 1 HI	REF
78B	No. 19 white	A2A4A5TB2-6	A20A1A5TB2-6	ACP 1 LO	REF
78S	Shield	A2A4TB7	A20A1TB10	CHASSIS GND	REF
79	Cable, twisted pair	A2A4A5TB2	A20A1A5TB2	ACP 2	REF
79A	No. 19 blue	A2A4A5TB2-7	A20A1A5TB2-7	ACP 2 HI	REF
79B	No. 19 white	A2A4A5TB2-8	A20A1A5TB2-8	ACP 2 LO	REF
79S	Shield	A2A4TB7	A20A1TB10	CHASSIS GND	REF
80	Cable, twisted pair	A2A4A5TB2	A20A1A5TB2	ARP 1	REF
80A	No. 19 blue	A2A4A5TB2-9	A20A1A5TB2-1	ARP 1 HI	REF
80B	No. 19 white	A2A4A5TB2-10	A20A1A5TB2-10	ARP 1 LO	REF
80S	Shield	A2A4TB7	A20A1TB10	CHASSIS GND	REF
81	Cable, twisted pair	A2A4A5TB2	A20A1A5TB2	ARP 2	REF
81A	No. 19 blue	A2A4A5TB2-11	A20A1A5TB2-11	ARP 2 HI	REF
81B	No. 19 white	A2A4A5TB2-12	A20A1A5TB2-12	ARP 2 LO	REF
81S	Shield	A2A4TB7	A20A1TB10	CHASSIS GND	REF
82	RG-11A/U, coaxial cable	P3(A2A4J31)	P2(A20A1J17)	NORMAL VID	VIDEO
83	RG-11A/U, coaxial cable	P4(A2A4J32)	P1(A20A1J16)	MTI VID	VIDEO
84	No. 2 AWG	A2A4TB7	A20A1TB10	CHASSIS GND	GROUND

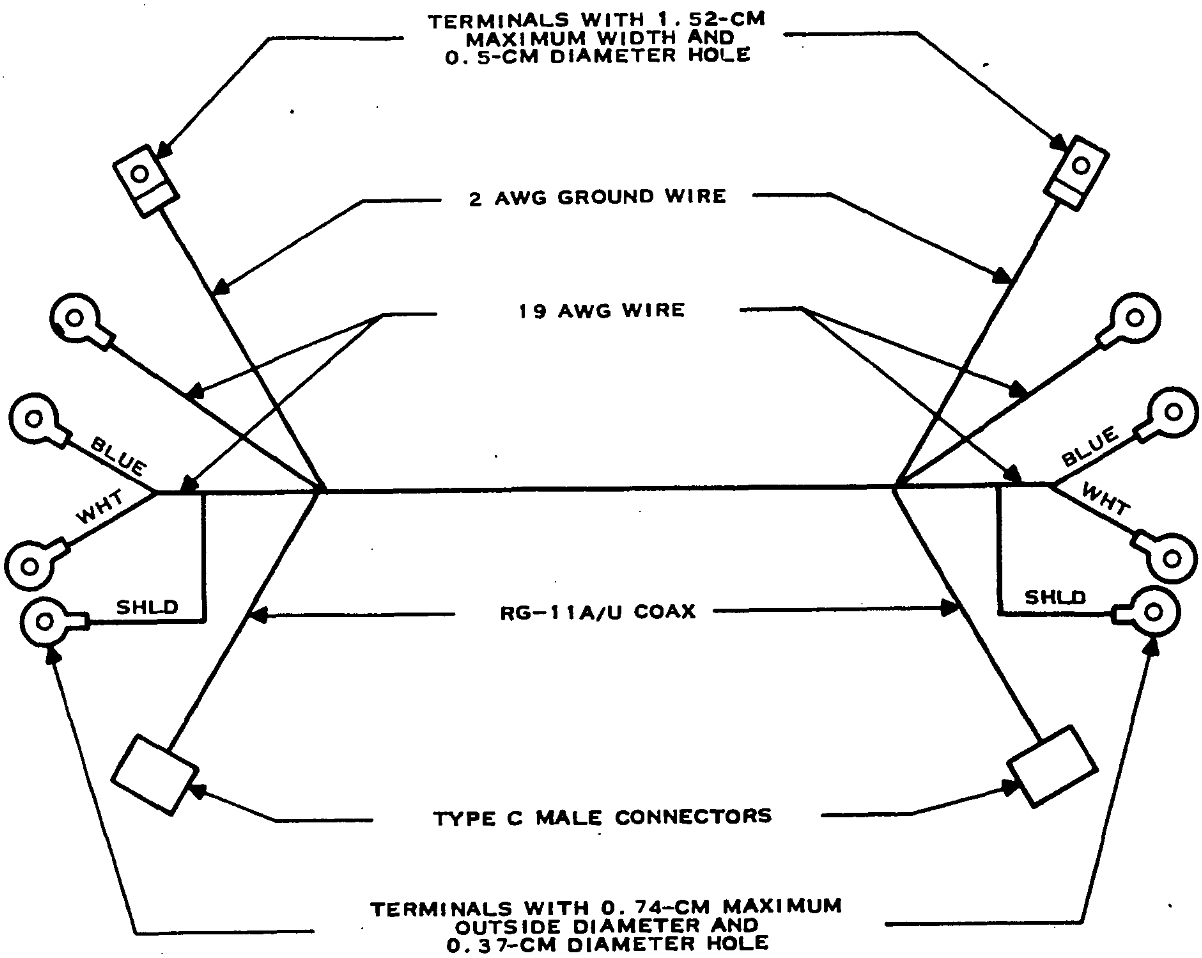

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Figure 3-48. Land Lines from Transmitter Site Room A Cable Junction Box A2 (CBJ A2) to Display Site Cable Junction Box A20 (CBJ A20)

TABLE 3-5. TEST EQUIPMENT FOR SYSTEM MAINTENANCE AND TEST

	Description	XMTR Site	IND Site	Total Quantity
1.	OSCILLOSCOPE			
	Oscilloscope, Tektronix, Model 475	1	1	2
	Probe P6063B, 010-6063-13	1	1	2
	Probe P6106, 010-6106-03	1	1	2
	Current Probe P6021, 010-0237-02	1	1	2
	Current Probe Amplifier, 134, 015-0057-02	1	1	2
	Cart 200C	1	1	2
2.	POWER METER			
	Power Meter, Hewlett-Packard, HP435A	1	0	1
	Power Sensor, Hewlett-Packard, HP8481A	1	0	1
3.	FREQUENCY METER			
	Frequency Meter, Hewlett-Packard, HP536A	1	0	1
4.	DIGITAL MULTIMETER			
	Multimeter, Hewlett-Packard, HP3466A, OP001	1	1	2
	High Frequency Probe, HP11096B	1	0	1
5.	SPECTRUM ANALYZER			
	Analyzer, Hewlett-Packard, HP8565A	1	0	1
6.	ELECTRONIC COUNTER			
	Counter, Hewlett-Packard, HP5300A	1	0	1
7.	SIGNAL GENERATOR (UHF)			
	Signal Generator, Hewlett-Packard, HP8616A	1	0	1
	Modulator, HP8403A, Option 3	1	0	1
8.	CRYSTAL DETECTOR			
	Crystal Detector, Hewlett-Packard, HP423A	1	0	1
	Crystal Detector, Hewlett-Packard, HP8472B	1	0	1
9.	LIMITER			
	Limiter, Hewlett-Packard, HP11693A	1	0	1
10.	NOISE FIGURE METER			
	Noise Figure Meter, Airborne Instruments Lab, 07511-C-020	1	0	1
	Noise Source, 230450	1	0	1
11.	ECHO BOX			
	Echo Box, Nuclear Instruments Corp., TS270A/UP	1	0	1
12.	MULTIMETER			
	Multimeter, Triplett, Model 630NA	1	1	2
13.	SWEEP GENERATOR			
	Sweep Generator, Wavetek, 2001B	1	0	1
14.	STEP ATTENUATOR			
	Step Attenuator, Hewlett-Packard, HP355C	1	0	1
15.	STEP ATTENUATOR			
	Step Attenuator, Hewlett-Packard, HP355D	1	0	1
16.	PULSE GENERATOR			
	Pulse Generator, Datapulse, Model 110B	1	0	1
17.	ATTENUATOR			
	Attenuator Set, Hewlett-Packard, HP11581A, Option 3	1	0	1
	Attenuator Set, Hewlett-Packard, HP11581A, Option 6	1	0	1
	Attenuator Set, Hewlett-Packard, HP11581A, Option 10	1	0	1
	Attenuator Set, Hewlett-Packard, HP11581A, Option 20	1	0	1

TABLE 3-6. TRANSMITTER SITE EQUIPMENT POWER CONSUMPTION

Item	Power Requirement (kW)
ASR-8 dual channel	32.0
SSR system	3.0
House lights and utility outlets	3.0
Convenience outlets for test equipment	2.0
Air condition and reserve for future expansion	26.0
Total power requirements at 120/208 V, 3 phase	66.0

SECTION IV
RELIABILITY AND MAINTAINABILITY

The ASR-8 system is a solid-state, pulse-modulated, S-band radar. The system includes digital MTI, capable of operation in both staggered and unstaggered modes. A dual-beam antenna provides extended low-angle coverage and improved short-range signal-to-clutter ratio. Circular polarization and log receivers provide improved operation under adverse weather conditions. The ASR-8 system design also provides for simultaneous operation of both channels in a frequency-diversity mode. Digital video enhancers for both MTI and normal video are provided to improve signal-to-noise ratio. Modular construction is used extensively to facilitate maintenance. ASR-8 reliability is enhanced by solid-state design throughout the system except for the klystron. The level of reliability achieved by solid-state design is complemented by redundant antenna drive components, a dual-feed assembly, and redundant azimuth pulse generators.

A. RELIABILITY

1. Reliability Experience

For the past 18 years, thousands of military and civilian operations have been flown safely in terminal areas in the United States and throughout the world because of the high availability factor of Texas Instruments manufactured ATC equipment. The proven availability factor for the AN/FPN-47, ASR-4, ASR-5, ASR-6, ASR-7, and AN/GPN-12 is 0.9971 (national average dual-channel), based on well over 1,000 system years of operation. The ASR-7 field experience has reflected an average part failure rate of 0.114×10^{-6} failure per hour for a 10,000 part/channel or an indicated single-channel field demonstrated MTBF of 877.2 hours.

The most recent addition to the Texas Instruments developed and manufactured ATC equipment is the ASR-8 for which, in early 1975, formal reliability and maintainability demonstration testing was completed.

2. Reliability Design and Test

The reliability program for the ASR-8 was planned and implemented to comply with the requirements of FAA-E-2506, FAA-G-2100/1b, MIL-STD-785, and MIL-STD-781B, and included the following items.

a. Reliability Design

During the development phase of the ASR-8 program, reliability human factors, and safety were an integral part of the design task, the ultimate goal being to produce, for the FAA and world market, an air traffic control radar with demonstrated reliability and maintainability at a competitive cost.

(1) Stress Analysis

An electrical-mechanical stress analysis was performed in accordance with Equipment Group Reliability Standards and FAA-E-2506 and was based on the following conservative assumptions:

continuous operation, maximum load, 15°C average equipment thermal rise, maximum voltage input, and specific thermal measurements for detailed rise above the equipment normal ambient of 25°C.

(2) Stress Verification Test

Detailed analytical stress analysis results were verified by the performance of a rating verification test per FAA-G-2100/1b wherein voltage, current, power dissipation, and temperature measurements were made on 10 percent of all of the components within the ASR-8.

(3) Reliability Prediction

The prediction procedure on the ASR-8 was based on the premise that subsystem failures are the result of random part failures. The numerical reliability prediction was determined from the number of part failures anticipated as a function of time. Part failures were assumed to occur at random intervals and at a constant rate over the time period of interest. This assumption permits the use of the exponential distribution and addition of failure rates for series elements in calculating subsystem MTBFs and probability of survival for discrete time intervals.

Component failure rates used to calculate subsystem reliability were based on average ASR-8 applied stress levels at a room ambient temperature of 25°C, except for antenna failure rates which were based on a temperature of 50°C plus rise. Failure rates for individual electrical and electromechanical part types were derived from RADC Notebook, Volume II, (TR-67-108) (AD-821640).

Prediction results indicated compliance with MTBF requirements as follows:

	Predicted MTBF (Hours)	Required MTBF (Hours)
Simplex system (excluding antenna)	663	600
Dual ASR (excluding antenna)	14,286	10,000
Antenna	14,641	10,000

(4) Failure Mode and Effects Analysis (FMEA)

A FMEA was performed to identify critical failure modes and correct them and to identify alternate modes with reduced capability for remedial action to be taken by the operator.

(5) Parts Control

A parts control effort was planned and implemented to ensure maximum use of standard parts to be consistent with a design-to-cost program. Standard parts are military preferred MIL-STD-701/MIL-STD-19500/MIL-STD-883 and MIL-STD-454. Equivalent conditioning was performed on parts not available as military preferred.

3. **Reliability Demonstration Test**

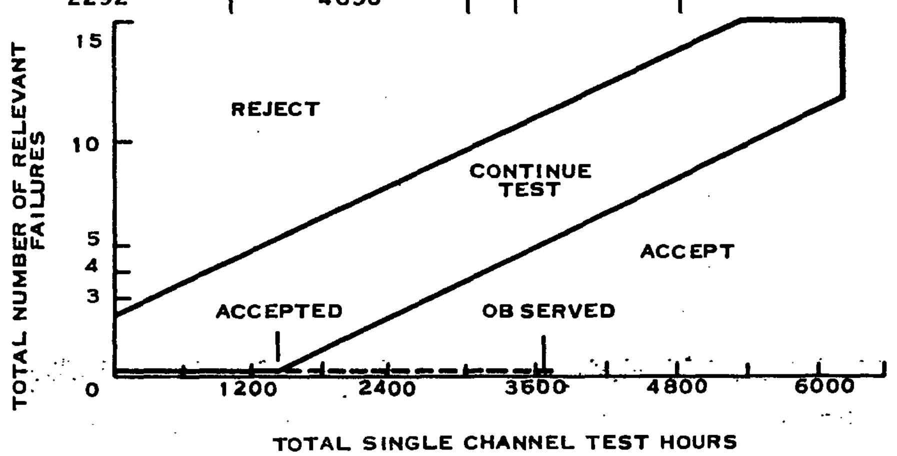
The ASR-8 reliability demonstration test was run under the continuous monitoring of the Federal Aviation Administration to test Plan III, Test Level A-1, of MIL-STD-781B to demonstrate compliance with a specified single-channel requirement of 600 hours mean time between failures (MTBF). This test was successfully run on System No. 1, a dual-channel ASR-8 system using both channels simultaneously for an accumulative failure-free test time of 1,320 hours. Texas Instruments continued this same system under test to complete 3,727 T/R observed channel hours with no relevant failures, demonstrating a single-channel MTBF of 4,073 hours at 60-percent confidence. The antenna, rotary joint, and pedestal for the ASR-8 have continued testing to accumulate over 8,000 test hours with no relevant failures, demonstrating an MTBF of 8,743 hours at 60-percent confidence.

The test was conducted at the Texas Instruments, Plano, Texas, facility in February 1975 on the first of the deliverable ASR-8s. The test plan, shown in Figure 4-1, indicates the acceptance point at 1,320 hours and the final equipment hours of 3,727 hours after all type, reliability demonstrations, maintainability demonstrations, installation, and acceptance test hours were accumulated.

No failures, either relevant or nonrelevant, were observed during the reliability demonstration test, except for one nonessential-redundant, 60-watt incandescent building light bulb. During the test, one preventive maintenance task was performed, waveguide pressurization freon bottle refill. No corrective action tasks occurred or were allowed. Redundant pulse modules that could fail without causing system degradation were excluded from preventive action tasks.

Figures 4-2 and 4-3 are copied from the Reliability Demonstration Test Report for Airport Surveillance Radar, ASR-8, Transmitter-Receiver (T/R) Subsystem P/N 826915-1, dated 14 March 1975, prepared for the FAA on contract No. DOT FA68WA-1965, Mod. 67.

NO. OF FAILURES	TOTAL TEST TIME (HRS)	
	REJECT EQUAL OR LESS	ACCEPT (EQUAL OR MORE)
0	N/A	1320
1	N/A	1734
2	N/A	2154
3	210	2568
4	624	2932
5	1044	3402
6	1458	3816
7	1872	4230
8	2292	4650
9	2706	5064
10	3120	5478
11	3540	5898
12	3854	6180
13	4368	6180
14	4782	6180
15	5202	6180
16	6180	N/A



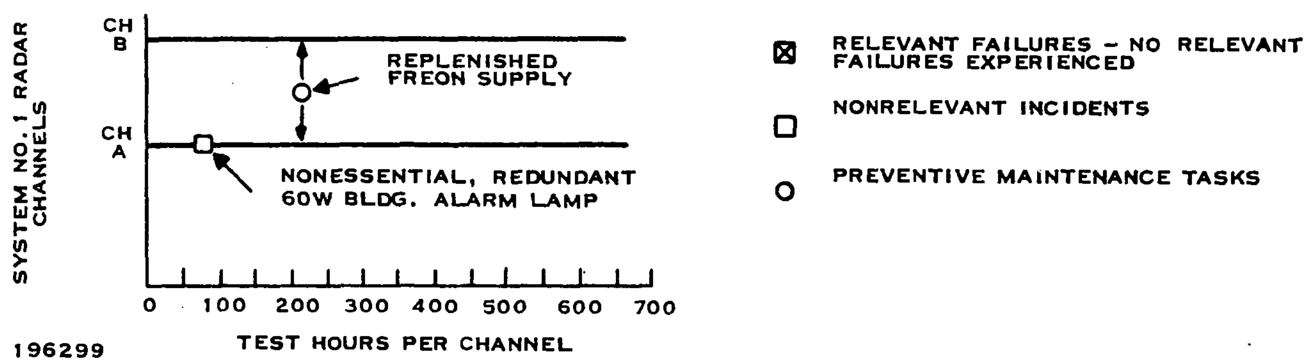
196297

Figure 4-1. Accept-Reject Criteria

SYSTEM SERIAL NO.	CHANNEL	START DATE	COMPLETE DATE	TEST TIME (HRS.)	HIGH VOLTAGE TIME	ELAPSED TIME (HRS.)	NO. OF FAILURE INCIDENTS	
							RELEVANT	NON-RELEVANT
1	A	2-11-75	3-10-75	660	656.8	660	0	1 (60 W LAMP)
1	B	2-11-75	3-10-75	660	655.9	660	0	0
TOTALS	-	2-11-75	3-10-75	1320	1312.7	1320	0	1

196298

Figure 4-2. Summary of RDT Results



196299

Figure 4-3. ASR-8 RDT Discrepancy/Preventive Maintenance Distribution

B. MAINTAINABILITY

1. Maintainability Experience

Formal maintainability demonstrations were not required on any of the various ASR models manufactured by Texas Instruments earlier than the ASR-8 radar. However, the reliability experience cited in previous paragraphs is proof of the maintainability of these systems. No specific data relative to mean time to repair (MTTR) have been accumulated in the field; however, extrapolated time from existing field data indicates a mean downtime of 2.5 hours for preventive, corrective, and administrative reasons on earlier equipment.

2. Maintainability Design

A formal maintainability program was planned and implemented on the ASR-8 in accordance with FAA-2506, FAA-G-2100/1b, MIL-STD-470 and MIL-STD-471.

a. Maintainability Design

During the development phase of the ASR-8, the maintenance concept was defined and program guidelines were issued to ensure that the specified meantime to repair could and would be met. The corrective maintenance philosophy is one of replacement of defective modules of PC card units with subsequent off-line repair of defective items. BIT is used to identify failed elements.

b. Maintainability Prediction and Apportionment

Mean corrective maintenance times were predicted, based on expected failure patterns, and maintenance tasks were apportioned down to the lowest replaceable unit. The design was reviewed and changed as necessary to ensure that these times were met in the apportioned limits. Preventive maintenance tasks were identified and scheduled; times were estimated. These predicted times were used in design reviews to change and influence design and packaging approaches.

c. Hardware Review

As equipment was developed and engineering models were produced, maintainability reviewed the hardware for removal and replacement times, tools required, fault indicators, and BIT. This review continued during all development tests, reliability demonstration tests, and acceptance tests before the maintainability demonstration test was to start.

d. Maintainability Features

The ASR-8 radar is designed to be easily maintained, including built-in test function generators to aid troubleshooting. All PWBs are accessible from the front of the cabinets and have card-edge test points and adjustments. Most troubleshooting can be accomplished with the boards in place, using the provided test points. However, extender boards are provided so every board can be completely accessible while plugged in. The boards are double-sided and all circuit points are accessible.

The card rack connectors use wire-wrap interconnections. All racks are mounted to a hinged panel which swings open to make the back connections readily accessible. Signals most often used in routine checking, such as triggers, video inputs, and outputs, are available at BNC coaxial connectors on the front panels. Panel-mounted switches permit selection of all modes when the channel is off-line for checking, adjustment, and maintenance.

BIT functions including sweep frequencies, linear ramp, sine and cosine signals, linear ramp video, and fixed and moving test targets make it possible to accomplish virtually all routine maintenance and troubleshooting with a minimum amount of external general test equipment. This precludes the need for unusual or specialized test equipment. Panel meters, signal selector switches, and fail indicators are used extensively throughout the system to provide rapid fault isolation to PWB or module.

(1) Transmitter Unit

The transmitter unit is designed for ease of maintenance, featuring front access to all components, card-edge test points, swing-out panels for ease of access, and individually removable components. All meter-status lights and controls are mounted at a convenient height on the swing-out front panel. All PWBs plug into card racks from the front.

Eight transmitter parameters, including HVPS overvoltage, HVPS undervoltage, HVPS overcurrent, HVPS undercurrent, modulator inverse current, modulator driver overload, tube temperature, and tube airflow are continuously monitored by automatic fault-detection circuits. The faults are grouped into two categories: three-times (3X) faults and one-time (1X) faults. When a 3X fault occurs, the transmitter HVPS will shut down and then turn back on. If the fault clears, the transmitter will continue to operate and a fault indicator will indicate which fault occurred. If after three attempts the fault does not clear, the transmitter will shut down permanently and the failure alarms will be activated. A 1X fault is considered potentially damaging to the transmitter, which is immediately shut down with no recycling and the appropriate fault indicator lamp turns on.

The status of all low-voltage power supplies is indicated by lamps on the swing-out front panel.

(2) Receiver Unit

Special emphasis in the receiver unit mechanical packaging has been placed on ease of access for good maintainability. The microwave components are mounted in the open area at top of the cabinet and the IF module is in the lower swing-out panel. The receiver output part of the circulator is connected to the receiver cabinet by a waveguide through a special bulkhead adapter. Inside the cabinet, the TR limiter is mounted to the waveguide and a waveguide-to-coaxial transition connects to coaxial cable. The TR-limiter is readily accessible and easy to replace. The PIN diode RF attenuator and beam switch mount to brackets between the TR limiter and parametric amplifier. The items are easily removed by disconnecting coaxial cable and removing the mounting screws.

The parametric amplifier is mounted on a swing-out panel at the front of the cabinet. The STALO unit is mounted on the upper left wall and is shockmounted to a support table. The entire STALO assembly can be easily removed from the cabinet by disconnecting the coaxial cables and the power cables and by removing the mounting screws.

The MTI, IF, LOG IF, AFC, COHO and LOG test modules are mounted in a swing-out front panel. Signal and power connectors are mounted on the rear of the module. Slides, mounted on the top and bottom of each module, guide the module into the panel rack and also allow it to extend out of the rack for access if required for troubleshooting. Input and output test points are provided on the front panel of each module and gain adjustments are on the two IF modules. Test signal controls are on the front panel of the LOG test modules. The swing-out panel contains status indicators (lamps) and a multimeter to monitor the two low-voltage power supply outputs and receiver crystal currents. All receiver alignment can be performed without removing any panels or assemblies to gain access to controls or adjustments. The test module allows receiver troubleshooting and maintenance to be performed with a minimum amount of external test equipment.

(3) Processor Unit

The special emphasis placed on mechanical design for ease of maintainability in the receiver is carried over to the digital processor unit. All circuit functions are on 3.1- by 4.3-cm printed wiring boards which plug in, bookcase-fashion, in three card racks. A fourth rack contains the two power supply modules. All racks are mounted on a swing-out panel which provides easy access to wire-wrap pins on the rear connectors.

Processor mode controls, test signal connections, power supply status lamps, and monitoring meters are all mounted on the upper portion of the swing-out panel near eye level. BNC coaxial cable connections are provided for monitoring video signals and radar triggers. This allows troubleshooting by functional analysis to the subassembly (PWB) level without removing any panels or racks, using a minimum amount of external general test equipment and no specialized or unusual test equipment.

(4) Remote Site Control Unit

The remote site control unit is designed for ease of access for good maintainability. The control unit is mounted on a swing-out panel, which also contains power supply metering and fuses. Status lamps are used to indicate power supply failures. The control panel contains backlighted switches to indicate mode and status. Radar signals are brought out on BNC connectors for use in fault isolation.

(5) Antenna Assembly

The pedestal is designed for easy maintenance operations. The feedhorn, polarizer, waveguide run, rotary joint, brush leaf assembly, and azimuth pulse generator can be removed and replaced without removal of the reflector or pedestal. If it is necessary to replace a component within the antenna pedestal which requires removal of the antenna reflector, support, and feed assembly, it is possible to do so without requiring a reflight check of the antenna system. The antenna reflector, reflector support, and feed assembly are designed so that they may be disassembled and reassembled to the same reference points. In addition, the antenna pedestal has a built-in level bubble so the reflector support pinning is accomplished relative to the horizontal. The antenna feed system is aligned with respect to the reflector by a precise optical alignment system. A tilt indicator is an integral part of the antenna reflector and indicates mainbeam angle with respect to the horizontal. The antenna reflector also has built-in gun sights that will allow mainbeam pointing of the antenna with respect to a geographical reference.

3. Maintainability Demonstration Test

A formal maintainability demonstration was conducted on the ASR-8 radar per MIL-STD-471, Method L, Plan A1, plus Plan B2, at Texas Instruments, Plano, Texas in April 1975. Texas Instruments maintainability personnel conducted the demonstration, monitored by the FAA. The test system was the first deliverable ASR-8 and had been used for the reliability demonstration test.

The test consisted of randomly selecting 100 faults allocated down to the major units of the ASR-8 based on the highest predicted failure rates of the system. The order of the fault inserted into the equipment was selected by FAA. The faults were inserted by technicians and were isolated and corrected by other technicians. Strict confidence was maintained on all faults, specifically the selected fault. Times were checked by FAA and Texas Instruments and a continuous log was maintained. Sixty-one faults were selected and corrected from the 100 possibles before the test was successfully completed. This information is documented in the

Maintainability Demonstration Test Report for Airport Surveillance Radar (ASR-8) Transmitter-Receiver (T/R) Subsystem, P/N 826915-1, for the FAA on contract No. DOT FA68WA-1965 Mod. 67. The test was successfully completed and the following times were demonstrated:

Task	Demonstrated	Specified
Mean time to repair (MTTR)	25.08 minutes	60 minutes
Maximum time to repair (90 percent)	49.0 minutes	180 minutes

In addition to the electronic equipment inside the shelters and on the antenna, specific maintenance task tests were required on the antenna; e.g., (1) the rotary joint is designed to be removed and replaced in less than 45 minutes by two technicians, and (2) the main antenna bearing and bull gear are designed to be removed and replaced in less than 3 hours. Special maintenance equipment, designed and supplied by Texas Instruments, makes this very difficult task possible. The maintenance equipment allowed Texas Instruments to demonstrate removal and replacement in approximately one-half of the specification allowed time. Replacement of the bearing or bull gear necessitates the removal of the rotary joint, all interconnecting waveguide and electrical wiring, draining the oil from the pedestal, and lifting the reflector approximately 7.6 cm to gain access to the spider casting. This 185-kg casting is unbolted, lifted, and pivoted to the side, exposing the bull gear and bearing. The 95-kg bull gear and bearing are then lifted and lowered to the ground from the top of the tower. A replacement unit is hoisted into place by the same means and is bolted into place using 36 bolts. The process is reversed for reassembly.

The antenna tilt mechanism can be adjusted through its full range in less than 2 minutes. These equipment designs were verified by Texas Instruments/FAA test with the following results:

Task	Demonstrated	Specified
Remove and replace rotary joint	25 minutes	45 minutes
Remove and replace main bearing and bull gear	110 minutes	180 minutes
Adjust tilt mechanism	105 seconds	120 seconds

C. SUMMARY

The reliability and maintainability of the ASR-8 radar have been designed in and have been tested to demonstrate specification requirements. Continuing the satisfactory field experience of past systems built by Texas Instruments, the ASR-8 has demonstrated performance exceeding the reliability and maintainability requirements in all areas.

(12/?/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 04/01/1997

To: New York

From: [redacted]
I-45
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]sab

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EID

Synopsis: Investigation by Bureau radar contractor of Sikorsky/Bridgeport radar data in preparation for [redacted]allegations.

Enclosures: One copy of "Memo For The Record" from [redacted] to the writer and SA [redacted] dated March 10, 1997, regarding Sikorsky/Bridgeport radar data.

b7C

Details: The writer contacted radar Bureau contractor [redacted] concerning Sikorsky/Bridgeport radar data and its analysis on March 8, 1997. The possibility existed that the [redacted] "Investigative Team" had obtained a copy of this data and were going to use it in their allegations of "friendly fire" and a "cover-up" regarding the explosion of TWA Flight 800 on July 17, 1997. The writer set-up a phone conversation between [redacted] and [redacted] Sikorsky Aircraft, home telephone [redacted] in which they discussed the data presented on Sikorsky radar videotape and the apparent double returns of the targets on the display.

The Sikorsky aircraft tracking system receives radar information from two radar systems - Bridgeport (BDR) and Riverhead (RVH). Bridgeport receives transponder ("secondary") information only in approximately four (4) second intervals and Riverhead receives transponder and primary ("skin return") information. Additionally, the latter system was incorporated in the Air Route Traffic Control Center (ARTCC) and was also referred to as long range radar (LRR) or "en route radar".

The Sikorsky tracking system, unlike standard air traffic systems, displayed both sets of data simultaneously. These two sets of data are not "mosaiced" - corrected or off-set for the relative position of each system. This causes the tracking system to display two tracks for each target with an operational transponder (providing "secondary" returns).

These apparent double tracks could become a source of confusion and concern for individuals not familiar with how the tracking system operates.

Initially, [redacted] was only concerned with a "primary return only" track that was later identified and confirmed by the Federal Aviation Administration (FAA) and [redacted] as a U.S. Navy P-3 Orion aircraft transitting the area at approximately 20,000 feet. All other information on the Sikorsky tracking system playback appeared very normal to [redacted]

b7C

♦♦

b7c [redacted]

March 10, 1997

VIA FACSIMILE TRANSMISSION
W/FOLLOW UP VIA PRIORITY MAIL

b7c SA [redacted]
FBI, New York Field Office
26 Federal Plaza, 23rd Floor
New York, NY 10278

VIA 1ST CLASS MAIL

✓ SA [redacted]
FBI, New York Field Office
26 Federal Plaza, 23rd Floor
New York, NY 10278

Gentlemen:

b7c The enclosed (*following*) MEMO is provided for your information. As [redacted] my normal handler is on travel, I am providing a copy to [redacted] via FAX with follow-up via snail-mail. Additionally, I am also forwarding a copy via mail to [redacted] for his records.

Sincerely,

b7c [redacted]

Encl.

TOTAL PAGES TRANSMITTED = 6

P.S. CALL IF YOU HAVE ANY QUESTION.

[redacted] b7C

March 10, 1997

MEMO FOR THE RECORD

Re: TELCON with [redacted] Sikorsky/Bridgeport, 03/08/97

b7C SUBJECT: Sikorsky/Bridgeport radar data

TO: SA [redacted] FBI/NYC
SA [redacted] FBI/NYC

On March 8, 1997, at approximately 1200, I received a telephone call from SA [redacted] regarding the possibility of publication of an article within the week regarding TWA800 wherein the writer(s) claim to have a video tape in their possession showing the latter portion of the flight track of the aircraft, and subsequent breakup sequence. Additionally, SA [redacted] advised that the "writers" had conducted an analysis of the tape which would most likely be the basis for their article.

b7C

SA [redacted] concern was what the various target symbols presented on the Sikorsky radar tracking system indicated relative to the type of target displayed. Although I had viewed a playback of the Sikorsky data while at TELEPHONICS Corporation in early December, I was not sure if the data displayed at that time was identical to the Sikorsky system when played back on the latter's in-house equipment. I recommended that SA [redacted] contact the individual at Sikorsky and arrange a convenient time where I could conduct a telephone interview with him regarding target symbology. SA [redacted] advised that he would look up the individual's name and number and get back to me as soon as possible since he was to depart early in the week on travel.

At approximately 1215, SA [redacted] contacted me and provided the name and number of [redacted] from Sikorsky who would be standing by for my call. Additionally, he requested that I contact him at the end of my interview and provide him with a short briefing regarding my findings.

Following the instructions of SA [redacted] I phoned [redacted] at approximately 1215. [redacted] provided an overview of the Sikorsky radar tracking system and a more detailed briefing on the concerns he had after initially reviewing the data on the night of the accident. He added that "ALL" of his concerns had been answered through discussions with FBI personnel from the New Haven Office. Additionally, I asked several detailed questions regarding target symbology displayed on the Sikorsky system. The conversation terminated at approximately 1315 and SA [redacted] was briefed on the discussion between 1320 and 1330. I have provided a summary of the interview below.

b7C

SIKORSKY TRACKING SYSTEM

Sikorsky Aircraft (company) operates a tracking system to monitor company aircraft on test and evaluation flights within the immediate area of their Bridgeport production facility and the area of Long Island Sound where a majority of the flight's are conducted. The tracking system receives data from two separate and independent radar systems, one system located at their Bridgeport facility (BDR) and the other system being located on Long Island at Riverhead (RVH), New York.

The BDR system receives and records secondary radar[1] or transponder data only; it **does not** display nor record primary radar targets. The antenna rotates clockwise at approximately 15 RPM which provides for a scan rate of a target at approximately 4 second intervals. Additionally, target information displayed on facility indicators (scopes) is generated by a computer processor versus a direct radar presentation of the received return. Target symbology associated with the display of secondary returns from this system are depicted as a solid diamond (♦). When contact is lost with a particular target, associated symbology depicts an open diamond (◇), to indicate a coasting (CST) status and will continue to do so until contact is reestablished or, at a predetermined time, without receipt of a valid return, the symbology will drop from the display.

---

[1]Secondary Radar - Also referred to BEACON targets.

Data received from the RVH system comprises both primary and secondary radar data with the secondary radar antenna co-located atop the larger primary antenna. The RVH system rotates clockwise at 5 RPM which provides for a scan rate of a target at approximately 12 second intervals. This particular system is owned and maintained by the FAA. Additionally, information from this site is provided to the Boston, New York, and Washington Air Route Traffic Control Centers (FAA), the U.S Air Force North American Air Defense Command (NORAD), and the U.S. Navy Virginia Capes Fleet Air Control Surveillance Facility (FACSFAC VACAPES) located at NAS Oceana, Virginia.

Secondary targets from the RVH system are also displayed by the diamond symbols described above (♦/◊) while primary targets are depicted by a solid circle symbol (●).

Of particular interest with the Sikorsky tracking system is the fact that target returns from both the BDR and RVH radar systems are displayed ***simultaneously*** on the radar display. This practice is contrary to all other computer tracking systems in use in the U.S. Traditionally, when dealing with direct radar displays, such as the New York TRACON in the terminal environment, data received from anyone of their five ASR antenna arrays is displayed to a single indicator only. As an example, data received from the ISP antenna is displayed only to those displays (scopes) where the data is deemed necessary for control of aircraft within a specified area of airspace commonly referred to as a SECTOR. Hence, all radar displays within the ISP Sector would display only ISP ASR data. Coincidently, data received from the TRACON's 4 other ASR systems located at JFK, EWR, HPN, and SWF, display their data to displays located within their assigned sectors of responsibilities. Additionally, after receipt of the raw data from an assigned ASR system, the ARTSIIIA(e) computer affixes target symbology to the various targets.

In contrast to the above, data received from the long range radar (LRR) systems (RVH) operating within the nation's en route air traffic environment wherein data from multiple LRR's are displayed on the same radar display through a mosaic process by a Center's NAS computer. Although this method would appear to cause the multiple display of a single aircraft due to overlapping coverage, the ARTCC NAS computer is programmed to select specific radar site data for display within a give area while discounting additional target returns. Additionally, the ARTCC tracking system is a totally computer generated display versus the terminal's computer symbology added to the direct radar displays.

The one thing common to both the terminal ASR and en route NAS, as well as the Sikorsky system, is that they display lateral position (X/Y) information for the most current return as well as a brief "track" history of an aircraft through selective retention of previously displayed targets. In a direct display environment such as the one in use at the New York TRACON ASR displays, the back side of the face of the display (CRT) contains a special coating that allows the scope operator to select an intensity level to the "RETAINED RETURNS". The operator also determines the number of trail returns by selection of the intensity level. In normal practice, the operator will see the last 3 to 5 returns with the oldest return as the weakest one presented. These retained returns are better known in the radar community as TARGET TRAIL with their primary purpose of providing the scope operator with a rapid determination of track direction with a mere glance at a particular aircraft target. In the direct display radar environment such as the ARTSIIIA, only the primary and secondary returns display target trail while the overlaid computer symbology is only presented for the most current return. The target trail feature can find its history dating back to development of the first Plan Position Indicator (PPI) scopes during World War 2. It is the only means that the operator of the early PPI scopes had to determine track heading without the use of some sort of a marking device such as a grease pencil or marker. Target trail on a radar scope is similar to the wake of a boat left on the surface of the water.

Within the en route environment where the entire display is computer generated, both the intensity and number of target trail returns can be selected for display by the scope operator with trail returns indicating a decrease in intensity rearward to the oldest return.

The Sikorsky system is a totally computer generated display and includes the target trail feature. However, due to the fact that data is received from two independent radar systems, operating at different rotational speeds, two separate flight tracks are displayed simultaneously along with their respective target trails. This unique setup could very well lead an uneducated individual to assume that there are two separate aircraft or airborne objects operating in very close proximity to one another, on identical tracks. With the BDR system providing 4 second updates on the current target location while displaying the last 4 to 5 target trail returns and the RVH system providing 12-second updates along with its own independent 4 to 5 target trail history, one might be lead to believe that the RVH data would indicated what would appear to be a faster target (12 second returns = greater distance covered between hits) was overtaking what would appear to be the slower BDR data for TWA800 (4 second returns = less distance covered between hits). Target trail for the BDR system would cover approximately 16 to 20 seconds of track history while RVH system would cover a period of between 48 to 60 seconds.

b7C [redacted] stated that only concern raised in his mind during the initial playback of recorded data was the fact that a primary target appeared immediately south of the Long Island shore line moving at an estimated 320-350 knots and that this particular target continued to the southwest and then reversed course and proceeded to the area of accident scene. However, he added that a few days after the accident he learned that the target in question was a U.S. Navy P-3 aircraft that was transiting the area at flight level 200 (20,000 ft.) which had experienced a malfunction and subsequent failure of its on-board transponder equipment. He stated that he later learned that this aircraft had agreed to ARTCC requests to divert from its scheduled flight and proceed to the accident area to render SAR assistance. He added that all other information observed during playback of the radar data recording appeared very normal.

It is important to note that all transponder returns within the coverage of both the BDR and RVH radars will also display the **"double"** targets at 4 & 12 second intervals. Hence, the flight track of each aircraft will depict a shadow like image. Additionally, computer generated alpha-numeric target symbology such as Mode "C" altitude and computed ground speed values are selectively displayed for only ***one*** of the apparent double tracks leaving the uneducated viewer with the impression that an "unknown" target was closely following or overtaking the return displaying selected target symbology.

BY: [redacted] b7C

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 04/03/1997

To: New York **Attn:** ASAC Charles Domroe

From: New York
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]pg

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800,
JULY 17, 1996;
AOT-IT-EID

Synopsis:

Details: Attached to the following EC are Federal Aviation transcripts from the evening of July 17, 1996. It should be noted that the transcripts reflect dates of July 18, 1996. This is caused by the fact Zulu time is utilized for air traffic travel.

The attached reflect transcripts from the following:

1. Boston Air Traffic Control Center Sardi Sector Radar Position.
2. New York Tracon.
3. New York Tracon Kennedy Departure Position
4. New York Tracon Liberty East Position
5. New York Tracon Kennedy Departure Hand-off
6. New York Tracon Area Manager in Charge
7. New York Tracon Watch Supervisor Position
8. New York Tracon Watch Supervisor
9. New York Tracon Calverton Position
10. Kennedy Airport ATCT Gate Hold
11. New York Tracon Beads

1,2

TC

265A-NY-259028-SUB UN 12

pg 09304 ec

4/4/97

12. Kennedy Airport ATCT Local Control

13. Kennedy Airport ATCT Ground Control Position

14. New York Automated Flight Service Station In-flight Position

15. New York Tracon HTO Coordinator

♦♦

OPCA-20 (12-3-96)

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FEDERAL BUREAU OF INVESTIGATION
FOIPA
DELETED PAGE INFORMATION SHEET

153 Page(s) withheld entirely at this location in the file. One or more of the following statements, where indicated, explain this deletion.

☐ Deletions were made pursuant to the exemptions indicated below with no segregable material available for release to you.

Section 552		Section 552a
☐ (b)(1)	☐ (b)(7)(A)	☐ (d)(5)
☐ (b)(2)	☐ (b)(7)(B)	☐ (j)(2)
☐ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
________	☐ (b)(7)(D)	☐ (k)(2)
________	☐ (b)(7)(E)	☐ (k)(3)
________	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☐ (b)(6)		☐ (k)(7)

☐ Information pertained only to a third party with no reference to the subject of your request or the subject of your request is listed in the title only.

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☒ The following number is to be used for reference regarding these pages:
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FBI/DOJ

-48 (Rev. 2-16-95)

FBI FACSIMILE

COVERSHEET

PRECEDENCE

- ☐ Immediate
- ☑ Priority
- ☐ Routine

CLASSIFICATION

- ☐ Top Secret
- ☐ Secret
- ☐ Confidential
- ☐ Sensitive
- ☑ Unclassified

Time Transmitted: ______

Sender's Initials: ______

Number of Pages: ______
(including coversheet)

To: ______ Date: 4/3/97
Name of Office

b7C

Facsimile Number: [redacted]

Attn: [redacted]
Name Room Telephone

From: Federal Bureau of Investigation ______
Name of Office

Subject: ______

Special Handling Instructions: ______ [redacted]

b7C

Originator's Name: [redacted] Telephone: [redacted]

b2

Originator's Facsimile Number: [redacted]

Approved: ______

Brief Description of Communication Faxed: ______

SEARCHED ____ INDEXED ____
SERIALIZED ____ FILED ____
APR 03 1997

b7C [redacted]

13

U.S. Department of Justice

Federal Bureau of Investigation

In Reply, Please Refer to
File No.

26 Federal Plaza
New York, New York 10278
April 2, 1997

84 Radar Evaluation Squadron
7676 Aspen Avenue
Hill A.F.B., UT 84056-5848

Att: [redacted]/Test Operations

In furtherance of an ongoing investigation being conducted by the Federal Bureau of Investigation (FBI) into the matter of Transworld Airlines (TWA) Flight 800, it is requested that your agency provide any video produced from the raw data material collected by Norad on July 17, 1996. In addition, a list of the names of the agencies and/or individuals who currently possess a copy of the video is also being requested. In the event that no such video was produced, it is requested that a letter stating so be forwarded to the FBI's New York Field Office by facsimile number [redacted]

b7C

b2

Your expeditious handling of this request is appreciated. Any questions may be directed to Special Agents [redacted] at telephone number [redacted]

Your cooperation in this matter is appreciated.

Sincerely,

[redacted]

Supervisory Special Agent

By:

JAMES K. KALLSTROM
Assistant Director in Charge
FBI New York Office

OPCA-20 (12-3-96)

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FEDERAL BUREAU OF INVESTIGATION
FOIPA
DELETED PAGE INFORMATION SHEET

1 Page(s) withheld entirely at this location in the file. One or more of the following statements, where indicated, explain this deletion.

☐ Deletions were made pursuant to the exemptions indicated below with no segregable material available for release to you.

Section 552		Section 552a
☐ (b)(1)	☐ (b)(7)(A)	☐ (d)(5)
☐ (b)(2)	☐ (b)(7)(B)	☐ (j)(2)
☐ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
________	☐ (b)(7)(D)	☐ (k)(2)
________	☐ (b)(7)(E)	☐ (k)(3)
________	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☐ (b)(6)		☐ (k)(7)

☐ Information pertained only to a third party with no reference to the subject of your request or the subject of your request is listed in the title only.

☒ Documents originated with another Government agency(ies). These documents were referred to that agency(ies) for review and direct response to you.

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☒ The following number is to be used for reference regarding these pages:
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FBI/DOJ

FD-302 (Rev. 10-6-95)

FEDERAL BUREAU OF INVESTIGATION

Date of transcription 03/11/97

On 03/10/97, [redacted] was interviewed telephonically at his Huntsville, Alabama residence. After being advised of the identity of the interviewing agent, [redacted] provided the folowing information:

[redacted] advised that he has known [redacted] since 1993. [redacted] stated that [redacted] contacted him last Saturday to inform that the FBI would be contacting him regarding several still-frame photographs regarding the crash of TWA Flight 800. [redacted] advised [redacted] that he did not have copies of the photographs. [redacted] further advised [redacted] that these photographs might be available on the Internet.

[redacted] informed the writer that the still-frame photographs could possibly be located on the Internet at the following address:

alt.conspiracynewsgroup
search under TWA and/or Missile

b7C

The following background information was obtained during the interview:

NAME: [redacted]
DOB:
POB:
SEX:
ADDRESS:

EMPLOYMENT:

Investigation on 03/10/97 at HUNTSVILLE, ALABAMA (telephonically)

File # 265A-NY-259028 Date dictated 03/11/97

b7C

by SA [redacted]

FD-302 (Rev. 10-6-95)

FEDERAL BUREAU OF INVESTIGATION

Date of transcription 03/10/97

On 03/10/97, [redacted] was interviewed telephonically at his Orlando, Florida office. After being advised of the identity of the interviewing agent, [redacted] provided the following information:

[redacted] advised that he has known [redacted] for many years. [redacted] stated that [redacted] recently contacted him regarding several still-frame photographs indicating a missile striking TWA Flight 800, which originated from the Internet. [redacted] asked [redacted] if he knew [redacted] (LNU) who uses the game bulletin board "Airpower", and resides in the Huntsville, Alabama area. [redacted] advised [redacted] that [redacted] utilizes the above mentioned bulletin board and resides in Huntsville, Alabama. [redacted] provided the following telephone numbers for [redacted]

[redacted]

b7C

[redacted] stated that he was unaware of any "still-frame" photos until [redacted] brought them to his attention. [redacted] advised that he has not had access to these photographs nor has he attemped to acquire the photographs from the Internet or by any other means [redacted] stated that he is unaware of where the photographs could be attained.

The following background information was obtainted during interview:

NAME: [redacted]
DOB:
POB:
SEX:
ADDRESS:

EMPLOYMENT:

Investigation on 03/10/97 at ORLANDO, FLORIDA (telephonically)

File # 265A-NY-259028 Date dictated 03/10/97

by SA [redacted] b7C

16

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 03/06/1997

To: SAC DIVISION I

From: NEW YORK
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]

Case ID #: 265A-NY-259028

Title: UNSUBS;
EXPLOSION OF TWA FLIGHT 800
JULY 17, 1996
AOT-IT-EID

Synopsis: Update on [redacted] video created from radar data showing missile striking TWA Flight 800 on July 17, 1997.

Details: On 03/06/97, [redacted] was telephonically interviewed at [redacted] by SA [redacted] advised that he had additional information pertaining to the explosion of TWA Flight 800 to share with the FBI.

[redacted] stated that [redacted] video contact works for Lockheed (defense contractor). [redacted] advised that the individual's name and telephone number is as follows:

b7C

[redacted]

[redacted] stated that [redacted] received a copy of this video from someone with MICOM (Army Military Communication or Command). [redacted] advised that MICOM was in the area of the crash on 07/17/96, to video tape the firing of a United States Navy missile. [redacted] stated that the video shows a missile striking TWA Flight 800.

[redacted] attempted to telephonically contact [redacted] at the above listed telephone number. [redacted] stated that the person answering the telephone advised that no one named [redacted] resides or works at that location.

[redacted] then called [redacted] regarding [redacted]

To: SAC DIVISION I From: NEW YORK
Re: 265A-NY-259028Title:

[redacted] advised [redacted] to contact [redacted] for aid in locating [redacted] further advised [redacted] to call [redacted] for [redacted] Crystal City work number.

[redacted] stated that the FBI should re-interview [redacted], telephone [redacted] regarding a missile sighting on 07/17/96. [redacted] advised that [redacted] witnessed a missile ascend from the Atlantic Ocean and strike TWA Flight 800. [redacted] noted that [redacted] was facing southwest when he witnessed the event.

[redacted] stated that he and [redacted] have data from a United States satellite that was positioned above the crash site on 07/17/96. [redacted] advised that two Russian satellites were also in orbit above the crash site on the night of the crash. The names of the two Russian satellites are listed below: b7C

OKO	Which means "eye"
PROGNOZ	Which means "forecast"

[redacted] stated that he does not have data from these two satellites. [redacted]

[redacted] advised that the radar video [redacted] only has video and no audio.

[redacted]

♦♦

FD-302 (Rev. 10-6-95)

FEDERAL BUREAU OF INVESTIGATION

Date of transcription 02/21/97

On February 14, 1997, [redacted] date of birth: [redacted] was interviewed at the Novotel Hotel, 226 West 52 Street, New York, New York. After being advised of the identities of the interviewing agents and the nature of the interview, [redacted] provided the following information:

[redacted]

[redacted] advised that he observed TWA Flight 800 conduct a normal takeoff and departure form JFK while his aircraft was positioned on the taxiway prior to being cleared for takeoff. [redacted] stated that he did not re-establish visual contact with TWA Flight 800, once Flight 800 departed the JFK airport traffic area.

[redacted] advised that the Air France Flight 007 cockpit flight crew were made aware of an aircraft explosion via another airliner on Boston Center frequency notifying Boston Center that an aircraft had exploded over the Atlantic Ocean. [redacted] stated that he did not observe the explosion of TWA Flight 800 nor witness the explosion other pilots reported. [redacted] advised that Air France Flight 007 was flying at an altitude between 14,000 - 20,000 feet, and the visibility was estimated at forty miles or better. b7C

[redacted] advised that he has never observed nor reported any missiles in flight while flying between New York's JFK International Airport and Paris, France. [redacted] further advised that Air France Flight 007 did not deviate from course to avoid a missile on the evening of 07/17/96, after departing JFK en route to Paris.

[redacted] stated that during the Air France flight, a flight attendant advised the cockpit crew that the TWA flight from New York to Paris had just crashed into the Atlantic. The flight attendant explained that a male passenger learned of the

Investigation on 02/14/97 at New York, New York

File # 265A-NY-259028 Date dictated 02/22/97

by SA [redacted]
SA [redacted] b7C

18

TWA crash while talking to a friend in the New York area on his cellular telephone. [redacted] stated that no passengers were admitted into the cockpit area on 07/17/96 while en route to Paris, France from JFK International Airport [redacted] advised that passengers do not have access to the cockpit area at any time.

[redacted] stated that he has not been in contact with [redacted] nor [redacted] and has never met these individuals.

b7C

The following background information was obtained through interview and observation:

NAME: [redacted]
DOB:
POB:
SEX:
ADDRESS:

HOME TELEPHONE:
EMPLOYMENT:

FD-302 (Rev. 10-6-95)

FEDERAL BUREAU OF INVESTIGATION

Date of transcription 02/18/97

On February 14, 1997, [redacted] date of birth: [redacted] was interviewed at the Novotel Hotel, 226 West 52 Street, New York, New York. After being advised of the identities of the interviewing agents and the nature of the interview, [redacted] provided the following information:

[redacted]

The interviewing agents asked [redacted] if he knows of any Boeing 747-100 or 200 series airliner that would not accept fuel during refueling, due to an overfill protection malfunction that would require a mechanic to pull the respective circuit breaker to override the problem. [redacted] advised that he is unaware of this problem occurring on any of Air France's fleet. [redacted] further advised that he would be concerned if this problem were to occur while refueling an Air France aircraft. He stated that the source of this problem should be identified and repaired.

b7C

The following background information was obtained through interview and observation:

NAME: [redacted]
DOB:
POB:
SEX:
ADDRESS:

HOME TELEPHONE:
EMPLOYMENT:

Investigation on 02/14/97 at New York, NY

File # 265A-NY-259028 Date dictated 02/18/97

by SA [redacted]
SA [redacted] b7C

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 03/04/1997

To: SAC DIVISION I

From: NEW YORK
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]

Case ID #: 265A-NY-259028

Title: UNSUBS;
EXPLOSION OF TWA FLIGHT 800
JULY 17, 1996
AOT-IT-EID

Synopsis: Update on [redacted] video created from radar data showing missile striking TWA Flight 800 on July 17,1996.

Details: On 03/04/97, the writer telephonically contacted [redacted] at [redacted] to inquire when [redacted] believes that the FBI has not analyzed this data properly, due to the FBI overlooking a radar anomaly (missile) striking TWA Flight 800.

[redacted] advised that the FBI should examine the "FAA Controller Tape" from the evening of 07/17/96. On this tape, at 8:17:31 p.m., when the C Controller is re-wound for forty seconds, an anomaly is visible in the left-hand corner of the screen. [redacted] stated that their experts have identified this anomaly as the missile that brought down TWA Flight 800. [redacted] advised that four radar sweeps show the anomaly traveling at mach two.

b7C

[redacted] that a Stinger Missile has a top-end altitude range of 10,000 feet, and could not have brought down Flight 800. [redacted] believes that a missile fired from a United States Navy vessel brought down TWA Flight 800 and the Department of Defense is trying to cover-up the incident. [redacted] stated that the FBI has not done their home-work regarding this investigation, and he and [redacted] are not going to hand-over information which would in fact solve the case.

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[redacted] would not reveal the radar/video source or any other sources. [redacted] stated that once the FBI analyzes the tape showing the anomaly, then he would be willing to listen to their explanation of the anomaly. [redacted] advised that he would be interested in hearing the FBI's explanation of the radar anomaly.

b7C

[redacted]

♦♦

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 03/05/1997

To: SAC DIVISION I

From: NEW YORK
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]

Case ID #: 265A-NY-259028

Title: UNSUBS;
EXPLOSION OF TWA FLIGHT 800
JULY 17,1996
AOT-IT-EID

Synopsis: Update on [redacted] video created from radar data showing missile striking TWA Flight 800 on July 17, 1996.

Details: On 03/05/97, [redacted] telephonically interviewed at [redacted] by SA [redacted] advised that he had information pertaining to the explosion of TWA Flight 800 to share with the FBI.

[redacted] stated that he has a forty-five page write-up describing how the United States Navy accidently shot down TWA Flight 800, while test firing a missile with a kinetic energy warhead. [redacted] believes that the missile exploded near the avionics bay, which caused the airliner to be torn apart.

b7C

[redacted] advised that a U.S. Navy P-3 Orion was in the area to observe the test firing. [redacted] believes the P-3 Orion was above TWA Flight 800 when the missile went awry and brought down the airliner. [redacted] stated that the missile detonated via a proximity fuse, which causes the warhead to explode prior to striking its target.

[redacted] advised that [redacted] should be interviewed by the FBI due to his knowledge of missiles. [redacted] advised that he [redacted] believe a missile approached the aircraft from the side, not the front.

[redacted] advised that the radar video [redacted] shows an anomaly moving in a zig-zag pattern in the lower right corner of the screen. Their experts believe the anomaly to be of no significance. [redacted] stated that another anomaly is present on the left side of the screen, which experts believe to be the missile that downed TWA Flight 800.

[redacted] advised that the radar utilized scans once every four (4) seconds. [redacted] would not identify who gave him the radar tape.

[redacted] advised that the FBI should "do a digital and analog of the tape". [redacted] stated that the tape should be forwarded to 8:31:17 p.m., then the "C-Controller" should be re-wound for forty (40) seconds, at which time the above described radar anomalies are visible. [redacted] advised that the anomaly on the left side of the screen has a steeper trajectory than the maximum climb angle of an F-14 Tomcat Navy fighter. [redacted] believes this proves the anomaly to be that of a U.S. Navy missile.

[redacted] advised that the FBI should analyze the [redacted] photo to identify the object in the sky, and the time indicated on an unidentified male's wristwatch.

b7C

[redacted] believes that the FBI should analyze all available satellite data, to include two (2) Russian satellites that were over the area at the time of the crash. [redacted]

[redacted] advised that he is aware of the FBI's attempt to interview [redacted] would not reveal how he attained this information and requested that the FBI not reveal him as the source.

[redacted] believes that the U.S. Navy was conducting a "Super Secret Navy Operation" on 07/17/96. [redacted] also believes that the National Security Council and the U.S. Navy are covering-up this secret operation.

♦♦

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 03/06/1997

To: SAC DIVISION I

From: NEW YORK
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]

Case ID #: 265A-NY-259028

Title: UNSUBS;
EXPLOSION OF TWA FLIGHT 800
JULY 17,1996
AOT-IT-EID

Synopsis: [redacted]

Details: On 03/06/97, [redacted] was interviewed at the Grumman facility located at Calverton, New York. [redacted] provided the following information:

b7C

[redacted] advised that [redacted] contacted [redacted]

[redacted] advised that [redacted] can be contacted at the above listed telephone number during normal business hours.

♦♦

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FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE Date:

To: SAC DIVISION I

From: NEW YORK
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]

Case ID #: 265A-NY-259028

Title: UNSUBS;
EXPLOSION OF TWA FLIGHT 800
JULY 17, 1996
AOT-IT-EID

Synopsis: Update on [redacted] video created from radar data showing missile striking TWA Flight 800 on July 17, 1996.

Details: On 02/17/97, [redacted] contacted SA [redacted] to advise that [redacted] TWA Flight 800 was downed by a United States Navy missile. [redacted] have a ten (10) minute video that depicts a missile striking TWA Flight 800. [redacted] advised that this video was created from "Advanced Radar Imagery" with complete trajectory readout.

[redacted] would not indicate where the source radar data was attained [redacted] advised that radar data along with the video were prepared by experts that were previously employed by the United Stated Government.

b7C

[redacted] stated that he would allow the FBI to view the video in New York, New York in the near future, if his associates will agree. [redacted] advised that he would contact SA [redacted] within two or three days following the 02/17/97 telephone conversation, to inform if the FBI will be allowed to view the video.

During an interview [redacted] on 1/22/97 by SA [redacted] and SA [redacted] at JFK International Airport, [redacted] stated that he had a source, who he would identify only as "semi-military," has a video tape of a missile shooting down Flight 800.

In a subsequent interview of [redacted], a source whom [redacted] advised that the FBI should speak with, [redacted] advised SAs [redacted] and [redacted] that an Internet contact of his [redacted] has been in communication with [redacted] stated that [redacted] told him that [redacted] had advised [redacted] that there was a video showing a missile hitting Flight 800. [redacted] stated that [redacted] is the source for the video. [redacted] stated that [redacted] told him that [redacted] told [redacted] to get the tape from him and that if he did not cooperate, [redacted] would get the National Security Council (NSC), to take the tape directly from the source.

A search was conducted by Butte Investigative Information Services Center to locate [redacted] The search revealed a total of twenty-four individuals with the name [redacted] in the United States. One individual from the group resides in Portland, Oregon. Butte was able to provide this individual's home and work addresses along with two telephone numbers. SA's [redacted] will be contacting [redacted] regarding the [redacted] video as soon as possible.

b7C

On 02/19/97, [redacted] telephone [redacted] was contacted telephonically by SA [redacted] regarding how an individual not employed by a government agency could attain radar data depicting an aircraft's speed, location, and altitude. [redacted] advised that several companies exist in the United States that provide air traffic control (ATC) data to their clients/subscribers. Listed below are sources for ATC data:

1. Mega Comp Data
   Johnson Avenue
   Ronkonkoma, NY
   (516) 673-3535

2. Aeronautical Radio Incorporated (ARINC)
   2551 Riva Road
   Annapolis, MD 21401-7465
   (410) 266-4000

3. The Trip
   6436 South Racine Circle
   Suite 202
   Englewood, Colorado
   (303) 790-9348

[redacted] advised that all U.S. ATC radar data is fed b7C via wire into the Federal Aviation Administration's (FAA) Central Flow Control Facility which is located in Herndon, Virginia. [redacted] stated that an outsider could tap into the incoming wire and gain access to this data. This data would indicate location, altitude, and ground speed of any aircraft with an operating mode-c transponder.

[redacted]

Referred

♦♦

BEST COPY AVAILABLE

(12 31 1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 03/07/1997

To: SAC DIVISION I

From: NEW YORK
I-46
Contact: [redacted]

b7C **Approved By:** [redacted]

Drafted By: [redacted]

Case ID #: 265A-NY-259028

Title: UNSUBS;
EXPLOSION OF TWA FLIGHT 800
JULY 17, 1996
AOT-IT-EID

Synopsis: Telephone conversation with [redacted] to schedule interview regarding the crash of TWA Flight 800.

Details: On 03/07/97, [redacted] telephonically contacted by SA [redacted] to schedule an interview regarding the crash of TWA Flight 800.

b7C The writer advised [redacted] that he is not being criminally investigated, and the FBI is interested in interviewing him due to his experience operating large transport category aircraft similar to the TWA 747 (Flight 800) airliner that crashed into the Atlantic Ocean on 07/17/96. [redacted]

[redacted] stated that his attorney had advised him not to talk to the FBI. [redacted] advised that it would be foolish to seek the advise of an attorney and not take it. [redacted] stated that he has done nothing wrong. [redacted] advised that he had nothing to gain by talking to the FBI, but the FBI has everything to gain by talking to him.

♦♦

FD-448 (Rev. 5-23-90)

FBI FACSIMILE

COVERSHEET

RSK

PRECEDENCE:

- ☐ Immediate
- ☒ Priority
- ☐ Routine

CLASSIFICATION:

- ☐ Top Secret
- ☐ Secret
- ☐ Confidential
- ☐ Sensitive
- ☒ Unclassified

Time Transmitted: 3:45PM

Sender's Initials: RSK

Number of Pages: 2 (including coversheet)

To: NORTHRUP GRUMMAN CORP. LAW DEPT. (Name of Office)

Date: 04/08/97

Facsimile Number: (410) 993-6743

b7C

Attn: [redacted] (Name Room [redacted] Telephone Number)

From: NEW YORK - FBI (Name of Office)

Subject: REQUEST OF LIST OF GRUMMAN COMPETITORS WHO MANUFACTURE RADAR SYSTEMS, ALONG WITH A LIST OF AIRPORTS FROM BOSTON CTR TO WASHINGTON CTR THAT UTILIZE THE GRUMMAN RADAR SYSTEM.

Special Handling Instructions:

Originator's Name: [redacted]

Telephone: [redacted] b7C

Originator's Facsimile Number: [redacted] b2

Approved:

265A-NY-259028-SUB NN

SEARCHED INDEXED
SERIALIZED FILED

APR 08 1997

FBI — NEW YORK

b7C [redacted] RSK

25

FBI/DOJ

U.S. Department of Justice

Federal Bureau of Investigation

In Reply, Please Refer to
File No.

26 Federal Plaza
New York, New York 10278
April 8, 1997

Northrup Grumman Corp. Law Department
ESSD
P.O. BOX 17319 MSA475
Baltimore, Maryland 21203

b7C

Attn: [redacted]

Dear [redacted]

In furtherance of an ongoing investigation being conducted by the Federal Bureau of Investigation (FBI) into the matter of Trans World Airlines (TWA) Flight 800, it is requested that your corporation provide a detailed list of its competitors in the field of radar manufacturing. In addition, a list of all the airports from Boston Center to Washington Center which utilize the Northrup Grumman Radar Systems is also being requested. It is requested that the information be forwarded to the FBI's New York Field Office by facsimile number [redacted] b2

Your expeditious handling of this request is appreciated. Any questions may be directed to Special Agents [redacted] at telephone number [redacted]

b7C

Your cooperation in this matter is appreciated.

Sincerely,

JAMES K. KALLSTROM
Assistant Director in Charge

[redacted]

b7C

by: [redacted]
Supervisory Special Agent

FEDERAL BUREAU OF INVESTIGATION

Date of transcription 04/17/97

[redacted] On 04/16/97, [redacted] residing at [redacted] telephone [redacted] was telephonically interviewed by Special Agent [redacted] was advised of the identity of the interviewing agent and the purpose of the interview. [redacted] provided the following information:

[redacted]

b7C

[redacted]

[redacted] advised that he and [redacted] were made aware of the explosion of TWA Flight 800 via radio traffic on Boston Center frequency. [redacted] when the explosion occurred. [redacted] stated that neither he or the First Officer witnessed the explosion, due to being past TWA Flight 800's flight path. [redacted]

The following background information was obtained during the interview:

NAME: [redacted]
DOB:
POB:
SEX:
ADDRESS:

Investigation on 04/16/97 at New York, New York (telephonically)

File # 265A-NY-259028 Date dictated 04/17/97

b7C by SA [redacted]

FD-302 (Rev. 10-6-95)

FEDERAL BUREAU OF INVESTIGATION

Date of transcription 04/17/97

On 04/16/97, [redacted] was telephonically interviewed by SA [redacted] was advised of the identity of the interviewing agent and the purpose of the interview. [redacted] provided the following information:

[redacted]

[redacted] advised that he and [redacted] became aware of the explosion of TWA Flight 800 via aircraft radio communication to Air Traffic Control on the Boston Center frequency [redacted] stated that neither he or [redacted] witnessed the explosion, due to possibly being past TWA Flight 800's flight path. [redacted] advised that nothing out of the ordinary was observed during the [redacted] flight.

b7C

The following background information was obtained during the interview:

NAME: [redacted]
DOB:
POB:
SEX:
ADDRESS:

Investigation on 04/16/97 at New York, New York (telephonically)

File # 265A-NY-259028 Date dictated 04/17/97

b7C by SA [redacted]

FEDERAL BUREAU OF INVESTIGATION

Date of transcription 4/7/1997

On April 2, 1997, and April 3, 1997, [redacted], work telephone number [redacted] was interviewed telephonically at his home and place of business. He was advised of the nature of the interview and the identity of the interviewing agent. By 10:00 a.m. EST, April 3, 1997, [redacted] had been provided via facsimile with a plot of Islip ASR radar data on July 17, 1996, from 8:30:00 p.m. EST to 8:31:00. This plot was obtained by the writer from [redacted] Bureau contracted radar analyst, [redacted] and contained nine "primary-only" ("primary") returns which [redacted] was asked to examine. Four of these returns were consistent with the "blip" track from [redacted] videotape which crossed behind TWA Flight 800 at a speed of approximately 450 nautical miles per hour (knots), a distance of five (5) to seven (7) miles, at approximately 8:30:35 p.m. EST, and approximately forty (40) to twenty-five (25) seconds before the last transponder reading of TWA Flight 800 which occurred at approximately 8:31:11 p.m. EST. [redacted] provided the following information: b7c

Upon examination of Boston Air Route Traffic Control Center En route radar from on or about 8:30:30 p.m. EST of the night of July 17, 1996, relative to the approximate location of 11.5 nautical miles South and 8.5 nautical miles East of the Islip radar antenna site, [redacted] observed the following radar "targets" (returns):

One or two "primary" stationary targets that were still painted after the explosion of TWA Flight 800 and located at approximately North 40 degrees 37.37 minutes, West 073 degrees 0.75 minutes. These targets appeared to travel "downward".

"Secondary" returns (targets) from a TWA 900 series aircraft, U.S. Air Flight 217, and an American Transair flight to the Northeast of the crash site.

A Piedmont aircraft, low and turning to the Northwest.

One isolated target to the Southwest of the site.

Investigation on 4/2/1997, 4/3/1997 at NEW YORK, NEW YORK (telephonically)

File # 265A-NY-259028 Date dictated 4/7/1997

b7c

by SA [redacted] (SAB:sab)

There were no "secondary" targets close to the given location.

[redacted] examined his radar data in search of any targets in the area that were traveling at approximately 450 knots and found an aircraft with a call sign of "Jet Express 18" to the East of the Islip radar antenna, approximately 15 nautical miles away from the area in question, and headed almost directly away from the Islip radar site. "Jet Express" was the call sign for Midway Airlines and the aircraft's transponder code was "5627". In comparing the track of the "Jet Express 18" aircraft to the apparent track of the nine "primary" returns under scrutiny, [redacted] noted that they were "shifted" approximately ninety (90) degrees - or "ninety (90) degrees out of phase" clockwise.

This "ninety degree rotated" relationship, combined with the 450 knot ground speed similarity and the fact that the Boston Center radar did not pick up a target around the nine "primary" returns, caused [redacted] to theorize that the nine "primary" returns were the result of a radar phenomena called "splits" - a false target painted far away from another real target. Present in the data and characteristic of this phenomena was that "split" targets tracked directly away from the radar site. This phenomena was also dependent on atmospheric conditions such as temperature inversions. [redacted] found it interesting that when both the track of "Jet Express 18" and the nine "primary" targets in question were traced back, they intersected at a shoreline - a common place for a temperature anomaly in the atmosphere close to the surface of the earth. [redacted] also pointed out that radar phenomena like "splits" happened more often with ASR radars such as the Islip site, because the energy from the ASR antennas was directed more downward then the air route traffic control centers' en route radar antennas.

b7C

[redacted] provided the writer with a plot of this radar information and his analysis entitled "A Hypothesis" via facsimile (attached).

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL # of pages ▸ /

To [redacted] From [redacted]

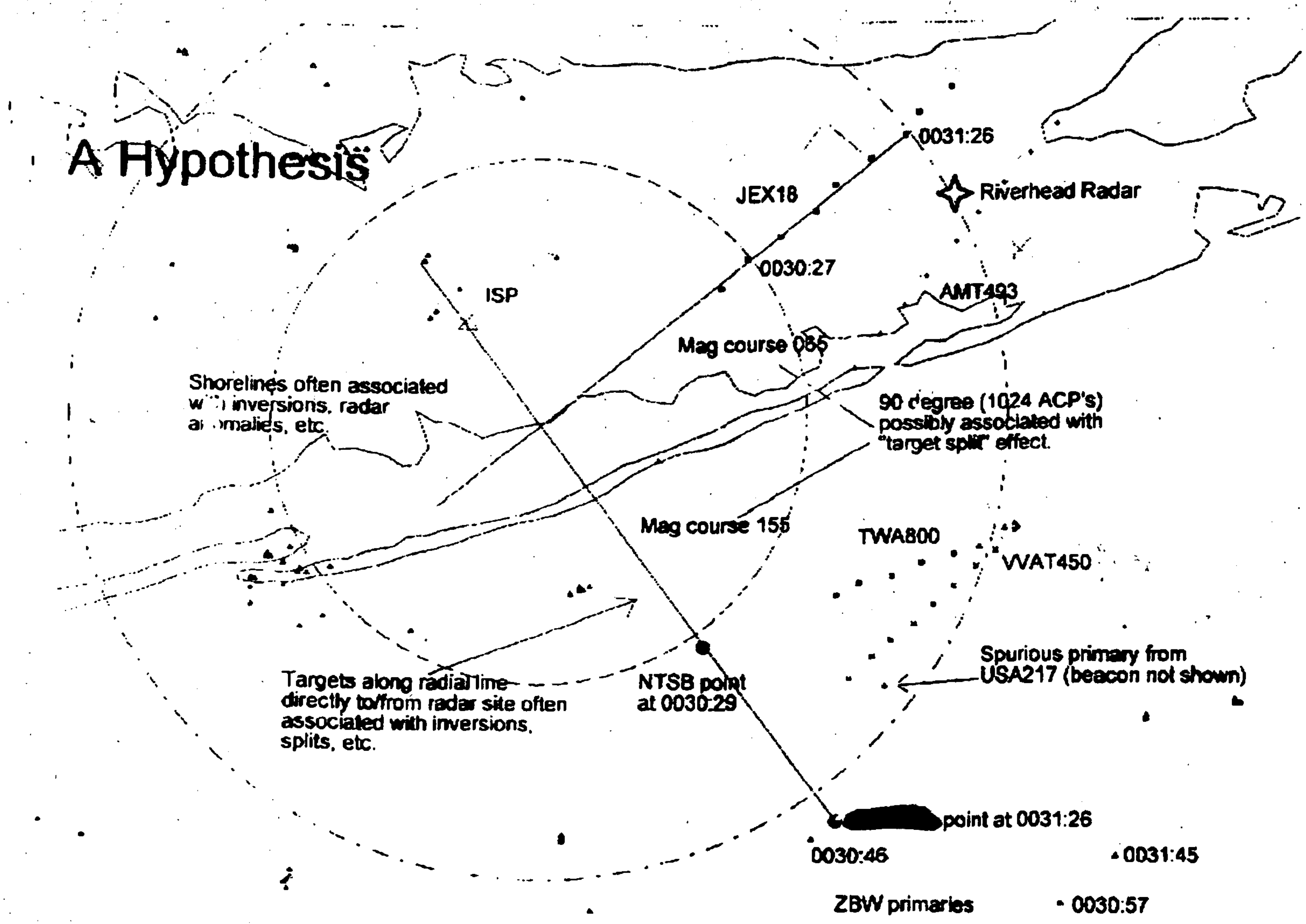
Dept./Agency Phone #

Fax # Fax #

NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

b7C

A Hypothesis



1.476,065 (5.84nm per inch) Radar ViewPoint(tm) by Airways Technology, Inc

b7C

U.S. Department of Justice

Federal Bureau of Investigation

In Reply, Please Refer to
File No.

26 Federal Plaza
New York, New York 10278
April 18, 1997

Federal Aviation Administration
Air Traffic Resource Management Program
Quality Control, ATX-110
800 Independence Avenue, S.W.
Washington, D.C. 20591

Attn: [redacted]

b7C

Transmitted via facsimile

Dear [redacted]

Pursuant to the investigation of the explosion of TWA Flight 800, by this letter, please note this agency's request for the New York Tracon Tracking Data (N90) from 2000:00 EDT thru 2040:00 EDT, July 17, 1996, for the following aircraft:

TWA 800	Transponder Code 2633
TWA 900	Transponder Code 3004
TWA 842	Transponder Code 3404
US Air 217	Transponder Code 2237
Air Italia 609	Transponder Code 1547
BBE (Stinger Bee) 507	Transponder Code 1346
ASH 5523	Transponder Code 7311
Virgin Air 009	Transponder Code 6720

The above aircraft were in the general area of TWA Flight 800 at the time of the explosion. When available, please send this data by Federal Express to:

Federal Bureau of Investigation
Attn: SA [redacted] Squad I-46
26 Federal Plaza
New York, New York 10278

b7C

The prompt obtainment of this data is vital to this agency's investigation of the explosion of TWA Flight 800. Should you have any questions please feel free to contact SA [redacted] at the New York Field Office at [redacted]

Thank you for all of your hard work and prompt assistance to date.

Sincerely,

James K. Kallstrom
Assistant Director in Charge

[redacted]

By: [redacted]

Supervisory Special Agent

b7C

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 1/28/1997

To: New York

From: SA [redacted]
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]sab

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA 800;
JULY 17, 1996;
AOT-IT-EID

Synopsis: Notes regarding unclassified NORAD radar data supplied to Oceaneering Technologies, Incorporated, for use in analysis in October, 1996.

Enclosures: One copy of NORAD Data Interpretation Notes authored by [redacted] 11/02/1996.

Details: The writer supplied unclassified radar data from the 84 Radar Evaluation Squadron, Hill Air Force Base, Utah, POC [redacted] Radar Analysis Flight, telephone number [redacted] to [redacted] Oceaneering Technologies, Incorporated, Upper Marlboro, Maryland, telephone number [redacted] in October, 1996. Oceaneering was working for the National Transportation Safety Board (NTSB), and [redacted] was attempting to assimilate all radar data regarding the explosion of TWA Fight 800. The writer also set up an interaction for data flow and analysis between [redacted] Telephonics, Farmingdale, New York, telephone number [redacted] had done work for the Bureau regarding Sikorsky radar data and the explosion of TWA Flight 800.

(1)

b7C

The enclosed notes of [redacted] were given to [redacted] who was working as a radar consultant for the Bureau for the explosion of TWA Flight 800. [redacted] gave the notes to the writer after his analysis of them for placement into the file. The notes contain some basic definitions of radar information, Oceaneering radar plots and [redacted] analysis and attempt at integrating the NORAD data, personal file names created by [redacted] to organize the data, and some questions [redacted] had with regards to compiling the data. [redacted] received data from the NTSB in different subsets.

nord.1+6.ec

b2

♦♦

FD-448 (Rev. 2-16-95)

FBI FACSIMILE

COVERSHEET

PRECEDENCE

- [X] Immediate
- [ ] Priority
- [ ] Routine

CLASSIFICATION

- [ ] Top Secret
- [ ] Secret
- [ ] Confidential
- [ ] Sensitive
- [X] Unclassified

Time Transmitted: 10:32 AM
Sender's Initials: RSK
Number of Pages: 2
(including coversheet)

To: RAYTHEON COMPANY
Name of Office

Date: 5/16/97

Facsimile Number: (508) 490-2570

④ RSK

b7C

Attn: [redacted] Name Room [redacted] Telephone

From: FEDERAL BUREAU OF INVESTIGATION AT NY
Name of Office

Subject:

Special Handling Instructions:

Originator's Name: SA [redacted] **Telephone:** [redacted]

b7C

Originator's Facsimile Number: [redacted]

b2

Approved:

Brief Description of Communication Faxed: REQUEST OF INFORMATION REGARDING AIRPORT SURVEILLANCE RADAR (ASR) SYSTEMS

U.S. Department of Justice

Federal Bureau of Investigation

In Reply, Please Refer to
File No.

26 Federal Plaza
New York, New York 10278
May 13, 1997

Raytheon Company
1001 Boston Post Road
Marlboro, Mass 01752

Attn: [redacted]

Dear [redacted]

In furtherance of an ongoing investigation being conducted by the Federal Bureau of Investigation (FBI) into the matter of Trans World Airlines (TWA) Flight 800, it is requested that your company provide a detailed list of its competitors in the field of Airport Surveillance Radar (ASR) Systems manufacturing. In addition, a list of all the airports (commercial or military) from Boston Center to Washington Center which utilize the Raytheon ASR Systems is also being requested. It is requested that the information be forwarded to the FBI's New York Field Office by facsimile number [redacted]

b7C
b2

Your expeditious handling of this request is appreciated. Any questions may be directed to Special Agents [redacted] at telephone number [redacted] at telephone number [redacted]

Your cooperation in this matter is appreciated.

Sincerely yours,

JAMES K. KALLSTROM
Assistant Director in Charge

[redacted]

b7C By: [redacted]
Supervisory Special Agent

FD-448 (Rev. 2-16-95)

FBI FACSIMILE

COVERSHEET

PRECEDENCE

- [X] Immediate
- [ ] Priority
- [ ] Routine

CLASSIFICATION

- [ ] Top Secret
- [ ] Secret
- [ ] Confidential
- [ ] Sensitive
- [X] Unclassified

Time Transmitted: 10:47 AM
Sender's Initials: RSK
Number of Pages: 2
(including coversheet)

To: LOCKHEED MARTIN CORPPORATION
Name of Office

Date: 5/30/97

Facsimile Number: 315-456-0286

b7C

Attn: [redacted] [redacted]
Name Room Telephone

From: FEDERAL BUREAU OF INVESTIGATION AT NY
Name of Office

Subject:

Special Handling Instructions:

b7C

Originator's Name: SA [redacted] Telephone: [redacted]

Originator's Facsimile Number: [redacted] b2

Approved: MCH

Brief Description of Communication Faxed: REQUEST OF INFORMATION REGARDING AIRPORT SURVEILLANCE RADAR (ASR) SYSTEMS.

U.S. Department of Justice

Federal Bureau of Investigation

In Reply, Please Refer to
File No.

26 Federal Plaza
New York, New York 10278
May 22, 1997

Lockheed Martin Corporation
Ocean Radar and Sensor Systems
P.O. Box 4840, EP5
Syracuse, New York 13221

Attn: [redacted]

Dear [redacted]

In furtherance of an ongoing investigation being conducted by the Federal Bureau of Investigation (FBI) into the matter of Transworld Airlines (TWA) Flight 800, it is requested that your corporation provide a detailed list of the various types of airport surveillance radar (ASR) systems it manufactures. In addition, a list of all the airports (commercial or military) from Boston Center to Washington Center which utilize the Lockheed Martin ASR systems is also being requested. It is requested that the information be forwarded to the FBI's New York Field Office by facsimile number (212) [redacted]

b7C

Your expeditious handling of this request is appreciated. Any questions may be directed to Special Agents [redacted] at telephone number [redacted]

Your cooperation in this matter is appreciated.

Sincerely,

JAMES K. KALLSTROM
Assistant Director in Charge

[redacted]

b7C by:
[redacted]
Supervisory Special Agent

FD-448 (Rev. 2-16-95)

FBI FACSIMILE

COVERSHEET

PRECEDENCE

- [X] Immediate
- [ ] Priority
- [ ] Routine

CLASSIFICATION

- [ ] Top Secret
- [ ] Secret
- [ ] Confidential
- [ ] Sensitive
- [X] Unclassified

Time Transmitted: 10:35 AM
Sender's Initials: RSK
Number of Pages: 2
(including coversheet)

To: TEXAS INSTRUMENTS CORP.
Name of Office

Date: 5/5/97

Facsimile Number: 972-927-3398

Attn: [redacted] Name Room [redacted] Telephone

(X) RSK

From: FEDERAL BUREAU OF INVESTIGATION
Name of Office

265A-NY-259028-SUBNN

Subject:

b7C

SEARCHED ___ INDEXED ___
SERIALIZED ___ FILED ___ 37
MAY 06 1997
FBI — NEW YORK
[redacted]

Special Handling Instructions:

Originator's Name: SA [redacted] Telephone: [redacted]

Originator's Facsimile Number: [redacted] b2

Approved:

Brief Description of Communication Faxed: REQUEST OF INFORMATION REGARDING AIRPORT SURVEILLANCE RADAR SYSTEMS (ARS)

U.S. Department of Justice

Federal Bureau of Investigation

In Reply, Please Refer to
File No.

26 Federal Plaza
New York, New York 10278
May 1, 1997

Texas Instruments Corp. Law Department
P.O. Box 655474
Mail Station 241
Dallas, Texas 75265

Attn: [redacted]

Dear [redacted]

In furtherance of an ongoing investigation being conducted by the Federal Bureau of Investigation (FBI) into the matter of Trans World Airlines (TWA) Flight 800, it is requested that your corporation provide a detailed list of its competitors in the field of Airport Surveillance Radar (ASR) Systems manufacturing. In addition, a list of all the airports (commercial or military) from Boston Center to Washington Center which utilize the Texas Instruments ASR Systems is also being requested. It is requested that the information be forwarded to the FBI's New York Field Office by facsimile number [redacted]

b7C

Your expeditious handling of this request is appreciated. Any questions may be directed to Special Agents [redacted] at telephone number [redacted] at telephone number [redacted]

Your cooperation in this matter is appreciated.

Sincerely yours,

JAMES K. KALLSTROM
Assistant Director in Charge

[redacted]

b7C

By: [redacted]
Supervisory Special Agent

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 05/21/1997

To: New York

From: New York
I-46
Contact: SA [redacted]

b7C **Approved By:** [redacted]

Drafted By: [redacted] emf

Case ID #: 265A-NY-259028 (Pending)

(14)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EID

Synopsis: Response to request made by the FBI of Texas Instruments Corp.

Administrative: Reference Buletter, dated 05/01/1997, which was sent to Texas Instruments Corp.

Details: Attached is a letter drafted by the Texas Instruments Corp. (TIC) responding to the FBI's request for information related to TIC's competitors in the field of Airport Surveillance Radar (ASR) Systems and their sites in New England and mid-Atlantic states.

♦♦

UPLOADED
WITH/TEXT ✓
WITH/OUT TEXT
BY
DATE 6-5-97

265A-NY-259028 SUB NN 38
SEARCHED INDEXED
SERIALIZED FILED
MAY 21 1997
FBI — NEW YORK

b7C [redacted]

E + 141047 tC

Texas Instruments Incorporated

TEXAS INSTRUMENTS

P.O. Box 801, M/S 8041
McKinney, Texas 75070

14 May 1997

In reply refer to:
431-330-3419

U.S. Department of Justice
Federal Bureau of Investigation
26 Federal Plaza
New York, New York 10278

ATTENTION: Mr. James K Kallstrom
Assistant Director in Charge

SUBJECT: Response to U.S. Department of Justice, Federal Bureau of Investigation request, faxed 05 May 1997, regarding Texas Instruments Incorporated Airport Surveillance Radar (ASR) Systems

Dear Mr. Kallstrom:

Texas Instruments Incorporated (TI) was a principal supplier of Air Traffic Control (ATC) hardware from the late 1950's through the early 1980's. In early 1986, TI made a business decision to discontinue the production of ATC spares and by mid 1987, TI completed the delivery to the Federal Aviation Administration (FAA) and Department of Defense (DoD) of residual material, tooling, and copies of engineering documentation required by the FAA and DoD for continued support of the TI manufactured equipment. Completion of this delivery terminated TI's ATC business unit.

TI no longer has and is unable to obtain a listing of the airports (commercial or military) which utilize TI manufactured ATC equipment. Information regarding the airports from the Boston Center to the Washington Center that utilize TI Airport Surveillance Radar Systems can be obtained from either National Transportation and Safety Board (NTSB) representative [redacted] telephone number [redacted] or FAA representative [redacted] telephone number [redacted] [redacted] should also be able to provide you with a current list of the manufacturers of ASR systems. b7C

TI-23268

In the event any additional information and/or clarification is desired, please contact Mr. [redacted] at [redacted] or by fax at (972) 952-2840, or [redacted] in the Legal Department at [redacted] or by fax at (972) 927-3398.

b7C

Sincerely,

[redacted], Systems Group
Manager, Electronic Systems Division
Defense Systems & Electronics

LGS/DQ/mh
MISC

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 05/06/1997

To: New York

From: New York
I-46
Contact: SA [redacted]

b7C **Approved By:** [redacted]

Drafted By: [redacted] emf

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EID

Synopsis: Response to request made by the FBI of Northrup Grumman Corp.

Administrative: Buletter, dated 04/08/1997, which was sent to Northrup Grumman Corp.

Details: Attached is a letter drafted by the Northrup Grumman Corp. (NGC) containing the names of NGC's competitors in the field of Airport Surveillance Radar (ASR) Systems, as well as a list of NGC/Westinghouse Radar Systems and their sites in New England and Mid-Atlantic states.

♦♦

UPLOADED
WITH TEXT ✓
WITH/OUT TEXT
BY 03
DATE 6-5-97

265A-NY-259028-SUB NN 39
SEARCHED INDEXED
SERIALIZED FILED
MAY 06 1997
FBI — NEW YORK
[redacted] b7C
EC 126047 EC

NORTHROP GRUMMAN

Electronic Sensors and Systems Division
Northrop Grumman Corporation
Post Office Box 17319
Baltimore, Maryland 21203

April 18, 1997

b7C SA [redacted]
Federal Bureau of Investigation
26 Federal Plaza
New York, New York 10278

Re: TWA Flight 800 Investigation

b7C Dear SA [redacted]

This letter responds to the Bureau's request for information dated April 8, 1997 concerning the various East Coast airport locations of radar systems manufactured by the Electronic Sensors and Systems Division of Northrop Grumman Corporation, formerly the Electronic Systems Group of Westinghouse Electric Corporation. The enclosed list provides the locations of Airport Surveillance Radar (ASR-9), Air Route Surveillance Radar (ARSR-4 and ARSR-3), Long and Short Range Tactical Radar (TPS-70/75, TPS-63), and Mode S Beacon System, a next-generation aircraft location system using both aircraft transponders and ground-based beacon system sensors. Competitors who may have sold operational radar systems in the Washington-Boston corridor include General Electric, Raytheon, Hughes Aircraft, Texas Instruments and Lockheed Martin.

I hope this information is helpful in your investigation.

Sincerely,

b7C [redacted]

Government Contracts
Commercial

Encl

TWAInvst.doc

Recycled Paper

NORTHROP GRUMMAN/WESTINGHOUSE RADAR SITES IN NEW ENGLAND AND MID-ATLANTIC STATES - 4/16/97

AIR ROUTE SURVEILLANCE RADAR, MODEL 4 (ARSR-4):

- Oceana, VA
- Bucks Harbor, ME
- Gibbsboro, NJ
- Caribou, ME
- Riverhead, NY (replaced ARSR-3)
- Remsen/Utica, NY
- North Truro, MA
- Baltimore, MD (Northrop Grumman)

MODE S BEACON SYSTEM:

- Atlantic City, NJ (2 each)
- Baltimore, MD
- Harrisburg, PA
- Hartford, CT (Windsor Locks)
- Buffalo, NY
- Syracuse, NY
- Washington, DC (Andrews AFB)
- Providence, RI (Coventry)
- Philadelphia, PA
- Pittsburgh, PA
- Bangor, ME
- Norfolk, VA
- Boston, MA
- Atlantic City, NJ (Elwood)
- Washington, DC (Dulles)
- New York, NY (JFK)
- Roanoke, VA
- Rochester, NY
- Saint Albans, VT
- Albany, NY
- Portsmouth, NH (Chester)
- West Point, NY (Stewart APT)
- Newark, NJ
- New York, NY (Islip)
- White Plains, NY
- Washington, DC (National)

AIRPORT SURVEILLANCE RADAR, MODEL 9 (ASR-9):

- Albany, NY
- Andrews AFB, MD
- Atlantic City, NJ
- Baltimore, MD

- Boston, MA
- Buffalo, NY
- Chantilly, VA (Dulles)
- Charlottesville, VA
- Chester, NH
- Coventry, RI (Providence)
- Cumberland, ME
- Harrisburg, PA
- Islip, NY
- Lynchburg, VA
- Nantucket, MA
- New York, NY (JFK)
- Newark, NJ
- Newburgh Stewart, NY
- Norfolk, VA
- Philadelphia, PA
- Pittsburgh, PA
- Richmond, VA
- Rochester, NY
- Syracuse, NY
- Washington, DC (National)
- White Plains, NY
- Windsor Locks, CT

AIR ROUTE SURVEILLANCE RADAR, MODEL 3 (ARSR-3):

- Bedford, VA
- Binns Hall, VA
- Clearfield, PA
- The Plains, VA

TPS-70/75 LONG RANGE TACTICAL RADARS:

- Baltimore, MD (Northrop Grumman - 3 each)
- Rome, NY
- State College, PA

TPS-63 SHORT RANGE TACTICAL RADARS:

- Dam Neck, VA

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 06/04/1997

To: New York

From: New York
I-46
Contact: SA [redacted]

b7c **Approved By:** [redacted]

Drafted By: [redacted]pg

(1) RSK

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800,
07/17/1996;
AOT-IT-EID

Synopsis: Response to request made by the FBI of Lockheed Martin Ocean, Radar and Sensor Systems.

Administrative: ReBuletter, dated 05/22/1997, which was sent to Lockheed Martin Corp on 05/30/1997.

Details: Attached is a letter drafted by Lockheed Martin Corp. in response to the FBI/NYO's request made of Lockheed Martin on 05/22/1997.

♦♦

UPLOADED
WITH/TEXT ✓
WITH/OUT TEXT
BY
DATE 6-24-97

265A-NY-259028-SUB NN 40

SEARCHED INDEXED
SERIALIZED FILED
JUN 06 1997
FBI — NEW YORK

b7c [redacted] RSK

Lockheed Martin Ocean, Radar [redacted]stems
P.O. Box 4840, EP5-111A Syracus[redacted]3221-4840
Telephone 315-456-1798 MARCAL[redacted]6-1798 Facsimile 315-456-0286

LOCKHEED MARTIN

[redacted] Radar/Sensor Systems

June 2, 1997

Special Agent [redacted]
Federal Bureau of Investigation
26 Federal Plaza
New York, New York 10278

b7C

Dear Agent [redacted]

In response to your request of 22 May, Lockheed Martin does not manufacture Airport Surveillance Radars. We do, however, manufacture long range radars that are used in air defense applications. Some of these, primarily the AN/FPS-117 as provided to the US Air Force, serve a dual role and provide enroute air traffic control information for air traffic control purposes.

To the best of our knowledge, none of our radars provide coverage for either Boston or Washington Center.

If we can be of further assistance, please feel free to contact us.

Sincerely

[redacted]

b7C

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 07/09/1997

To: New York

From: New York
I-46
Contact: SA [redacted]

b7C **Approved By:** [redacted]

Drafted By: [redacted] emf (151) RSK

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EID

Synopsis: Response to request made by the FBI of the Federal Aviation Administration (FAA).

Administrative: Reference Buletter, dated 06/02/1997, which was sent to the FAA.

Details: Attached is a letter drafted by the FAA in response to the FBI/NYO's request made of the FAA on 06/02/1997.

♦♦

[redacted]

b7C

e(190027.ec

OPCA-20 (12-3-96)

XXXXXX
XXXXXX
XXXXXX

FEDERAL BUREAU OF INVESTIGATION
FOIPA
DELETED PAGE INFORMATION SHEET

6 Page(s) withheld entirely at this location in the file. One or more of the following statements, where indicated, explain this deletion.

☐ Deletions were made pursuant to the exemptions indicated below with no segregable material available for release to you.

Section 552		Section 552a
☐ (b)(1)	☐ (b)(7)(A)	☐ (d)(5)
☐ (b)(2)	☐ (b)(7)(B)	☐ (j)(2)
☐ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
__________	☐ (b)(7)(D)	☐ (k)(2)
__________	☐ (b)(7)(E)	☐ (k)(3)
__________	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☐ (b)(6)		☐ (k)(7)

☐ Information pertained only to a third party with no reference to the subject of your request or the subject of your request is listed in the title only.

☒ Documents originated with another Government agency(ies). These documents were referred to that agency(ies) for review and direct response to you.

_____ Pages contain information furnished by another Government agency(ies). You will be advised by the FBI as to the releasability of this information following our consultation with the other agency(ies).

_____ Page(s) withheld inasmuch as a final release determination has not been made. You will be advised as to the disposition at a later date.

_____ Pages were not considered for release as they are duplicative of __________

_____ Page(s) withheld for the following reason(s): __________

☒ The following number is to be used for reference regarding these pages:
265A-NY-259028 Sub NN, serial 41

XXXXXXXXXXXXXXXX
X Deleted Page(s) X
X No Duplication Fee X
X for this page X
XXXXXXXXXXXXXXXX

XXXXXX
XXXXXX
XXXXXX

Transportation Systems
1001 Boston Post Road
Marlborough, MA 01752
Tel 508.490.3148
Fax 508.490.3940

Raytheon Electronic Systems

June 18, 1997

b7C

[redacted]
Supervisory Special Agent
U.S. Department of Justice
Federal Bureau of Investigation
26 Federal Plaza
New York, New York 10278

Re: Airport Surveillance Radar Systems

Dear [redacted]

b7C

We are in receipt of your letter dated May 13, 1997 to [redacted] of Raytheon Company requesting information regarding Airport Surveillance Radar (ASR) Systems, and have gathered together the information we had available to respond to your request. Please understand that we are not necessarily in the best position to know exactly what the Government has done with each one of the systems we have manufactured and would assume that the Federal Aviation Administration (FAA) and the Department of Defense would possess the most accurate information in this area. However, to the extent we have been able to locate information, the following is, to our knowledge and belief, an accurate response to your request.

ASR (also known as a Terminal Area Radar) has a 60 nautical mile range and is used for navigation and spacing of aircraft near an airport. Our competitors in the field of ASR Systems Manufacturing are both in the United States and overseas. The major systems competitors are Northrop Grumman (formally Westinghouse) in the United States, Alenia in Italy, Thomson in France, and Siemens Plessey in the United Kingdom.

Based upon our knowledge and belief, Raytheon has no civil Airport Surveillance Radars in operation at any airports from Boston Center to

265A-NY-259028 SUB NN

b7C

Washington Center. ASRs that would presumably be in operation at airports in the United States presently would be the ASR-7s and 8s which were manufactured by Texas Instruments in the 1970s and early 1980s, and ASR-9s, which were manufactured by Westinghouse (now Northrop Grumman) in the early 1990s. ASR-4s, 5s and 6s, which were also manufactured by Texas Instruments in the 1960s have now been decommissioned, though we do not necessarily know what has been done with the equipment.

The ASR-10 is a Raytheon-developed radar and has been sold only to foreign civil and military organizations, and is not in use in the United States. Raytheon won a contract in August, 1996 to provide the Digital Airport Surveillance Radar System (DASR or ASR-11) to the DOD/FAA in August 1996 and currently, per schedule, has not yet delivered any systems.

In the 1970s, Raytheon provided ASRs to the United States Air Force in a transportable version for deployment to locations without air traffic services. The system, known by the Air Force as the AN/TPN-19, is in use overseas in Bosnia and Saudi Arabia, and to our knowledge is not operational in the United States, though the Air Force would be in the best position to provide that information.

In the 1950s, Raytheon manufactured Air Route Surveillance Radars (ARSR-1 and ARSR-2) for the FAA. These long-range radars (approximately 200 nautical miles) provide primary surveillance for en route navigation of aircraft and are not considered airport surveillance radars. While still in operation, the ARSR 1s and 2s have been moved around by the FAA as newer ASARs were deployed, and Raytheon has no knowledge of their current location. The FAA/DOD also operates ARSR-3s and 4s which were manufactured by Westinghouse.

Raytheon Terminal Doppler Weather Radars (TDWR) servicing Washington National Airport and Boston Logan Airport were commissioned and operational in January 1996. These radars, which were built in the early 1990s, inherently filter out aircraft to concentrate on weather detection.

TDWR has a 40 nautical mile range for weather detection and has been designed and optimized for the detection of wind shear in the airport terminal area.

We hope this information has been helpful to your investigation. If there is any further information you desire, please do not hesitate to contact me.

Very truly yours,

b7c [redacted]

Transportation Systems

FD-302 (Rev. 10-6-95)

FEDERAL BUREAU OF INVESTIGATION

Date of transcription 8/06/97

b7C

On July 30, 1997, [redacted]

b3 Rule 6(e)

b7C

Investigation on 8/06/1997 at New York, New York

File # 265A-NY-259028 Date dictated N/A

b7C

by SA [redacted] (SAB:sab)

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 08/06/1997

To: New York

From: [redacted]
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted] sab

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EID

Synopsis: Documents [redacted]

b3 Rule 6(e)

Enclosures: One copy each of letters from [redacted] dated 7/21/1997 and 7/22/1997, FD-302 regarding [redacted]

Details: [redacted]

b7C

provide his expertise as Bureau radar consultant regarding the [redacted] investigation of TWA Flight 800.

♦♦

UPLOADED
WITH/TEXT ✓
WITH/OUT TEXT
BY
DATE 8-13-97

265A-259028-NN-44

[redacted]

b7C

SEARCHED INDEXED
SERIALIZED FILED
AUG 11 1997
FBI — NEW YORK
b7C [redacted] SAB

Vdoruss.ec

[redacted]

b7C

July 21, 1997

b7C

[redacted] was completed at the instructions of Special Agent [redacted] of the FBI's New York Field Office.

[redacted]

b3 Rule 6(e)

FEDERAL GRAND JURY SUBPOENA MATERIAL
<u>DO NOT DISSEMINATE</u>

b3 Rule 6(e)

[redacted]

[redacted]

[redacted]

b3 Rule 6(e)

[redacted]

b7C

July 22, 1997

VIA UPS NEXT DAY AIR

b7C SA [redacted]
FBI, New York Field Office
26 Federal Plaza, 23rd Floor
New York, NY 10278

b7C Dea[redacted]

[redacted]

[redacted]

b3
Rule
6(e)

Sincerely,

[redacted]

b7c

Encl.

TOTAL PAGES TRANSMITTED = 2

3-448 (Rev. 2-16-95)

FBI FACSIMILE

COVERSHEET

PRECEDENCE

- [x] Immediate
- [ ] Priority
- [ ] Routine

CLASSIFICATION

- [ ] Top Secret
- [ ] Secret
- [ ] Confidential
- [ ] Sensitive
- [x] Unclassified

Time Transmitted: 3:15 P.M

Sender's Initials: RSK

Number of Pages: 3
(including coversheet)

To: FEDERAL AVIATION ADMINISTRATION (FAA) — Name of Office

Date: 6/3/97

Facsimile Number: (202) 267-5043

b7C

Attn: [redacted] (Name) — Room: — Telephone: (202) 267-9633

From: FEDERAL BUREAU OF INVESTIGATION — Name of Office

Subject:

Special Handling Instructions:

b7C

Originator's Name: SA [redacted] **Telephone:** [redacted]

Originator's Facsimile Number: [redacted] b2

Approved: n2H

Brief Description of Communication Faxed: REQUEST OF INFORMATION REGARDING AIRPORT RADAR SURVEILLANCE (ARS) SYSTEMS.

45

U.S. Department of Justice

Federal Bureau of Investigation

In Reply, Please Refer to
File No.

26 Federal Plaza
New York, New York 10278
June 2, 1997

Federal Aviation Administration
800 Independence Avenue SW
Washington, DC 20591

Re: Telephone conversation between Special Agent [redacted] of the Federal Bureau of Investigation and Federal Aviation Administration Air Safety Investigator [redacted]

b7c

Dear [redacted]

Based on recent contact the Federal Bureau of Investigation (FBI) has had with Texas Instruments Incorporated (TI) regarding TI Airport Radar Surveillance (ARS) Systems, the FBI learned that TI had discontinued production of its ARS Systems in early 1986 and by 1987, TI completed the delivery to the FAA of residual material, tooling and copies of engineering documentation for continued support of the TI manufactured equipment.

In furtherance of an ongoing investigation being conducted by the FBI into the matter of Transworld Airlines (TWA) Flight 800, it is requested that your agency provide a detailed list of TI ARS Systems currently in use. In addition, a list of all the airports (commercial or military) from Boston Center to Washington Center which utilize the TI ARS Systems is also being requested. It is requested that the information be forwarded to the FBI's New York Field Office by facsimile number [redacted]

b2

Your expeditious handling of this request is appreciated. Any questions may be directed to Special Agents [redacted] at telephone number [redacted]

b7C [redacted] at telephone number [redacted]

Your cooperation in this matter is appreciated.

Sincerely,

JAMES K. KALLSTROM
Assistant Director in Charge

[redacted]

b7C By: [redacted]
Supervisory Special Agent

FD-448 (Rev. 2-16-95)

FBI FACSIMILE

COVERSHEET

PRECEDENCE

- [X] Immediate
- [ ] Priority
- [ ] Routine

CLASSIFICATION

- [ ] Top Secret
- [ ] Secret
- [ ] Confidential
- [ ] Sensitive
- [X] Unclassified

Time Transmitted: 4:06 P.M.
Sender's Initials: RSK
Number of Pages: 2H
(including coversheet)

To: HUGHES AIRCRAFT COMMAND AND CONTROL SYSTEMS
Name of Office

Date: 9/25/97

Facsimile Number: 714-446-3260

b7C

Attn: [redacted]
Name Room Telephone

From: FEDERAL BUREAU OF INVESTIGATION AT NY
Name of Office

Subject:

Special Handling Instructions:

Originator's Name: SA [redacted] Telephone: [redacted]

b7C

Originator's Facsimile Number: [redacted] b2

Approved: 2E67

Brief Description of Communication Faxed: REQUEST OF INFORMATION REGARDING AIRPORT SURVEILLANCE RADAR (ASR) SYSTEMS.

46

U.S. Department of Justice

Federal Bureau of Investigation

In Reply, Please Refer to
File No.

26 Federal Plaza
New York, New York 10278
September 25, 1997

Hughes Aircraft Command
and Control Systems
P.O. Box 3310
F.U. Bldg. 676, Mail Stop F-216
Fullerton, California 92833

Attn: [redacted] Communications

Dear [redacted]

In furtherance of an ongoing investigation being conducted by the Federal Bureau of Investigation (FBI) into the matter of Transworld Airlines (TWA) Flight 800, it is requested that your company provide a detailed list of the various types of airport surveillance radar (ASR) systems it manufactures. In addition, a list of all the airports (commercial or military) from Boston Center to Washington Center which utilize the Hughes ASR systems is also being requested. It is requested that the information be forwarded to the FBI's New York Field Office by facsimile number [redacted]

b7C

b2

Your expeditious handling of this request is appreciated. Any questions may be directed to Special Agents [redacted] at telephone number [redacted] or [redacted] at [redacted].

Your cooperation in this matter is appreciated.

Sincerely,

JAMES K. KALLSTROM
Assistant Director in Charge

[redacted]

By: [redacted]
Supervisory Special Agent

b7C

265A-NY-259028
JJF/jjf

On December 13, 1996, Special Agent (SA) [redacted] conducted the following investigation at Jamaica, New York: b7c

Referred

[redacted]

265A-NY-259028- NN - 47

SEARCHED ___ INDEXED ___
SERIALIZED ___ FILED ___
OCT 27 1997
FBI — NEW YORK
[redacted] SAB

b7c

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 10/28/1997

To: New York

From: [redacted]
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]sab

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EID

Synopsis: Summary of six radar reports/memos from Bureau contracted radar analyst regarding transponder/DFDR (Digital Flight Data Recorder)/CVR (Cockpit Voice Recorder) alignment, and plots of corresponding correlated radar data.

Enclosures: Radar reports to the writer from [redacted] dated:

b7C

(2)

1. 10/20/1997 (report) re probable aircraft primary returns for JFK, Islip, and White Plains (HPN) ASR ("four second") radar.

2. 10/03/1997 (report) re primary returns for JFK, Islip, and White Plains (HPN) ASR ("four second") radar.

3. 08/21/1997 (report) re plots of Islip ASR radar returns for TWA Flight 800 on July 17, 1996.

4. 06/25/1997 (report) re alignment of radar data/transponder returns with DFDR/CVR data and loss of data.

5. 06/21/1997 (memo) re examples of alignment of radar data/transponder returns with DFDR/CVR data.

6. 04/13/1997 (memo) re initial review of NTSB's Preliminary DFDR report.

Details: Enclosure (1) was [redacted] estimate for which returns were initial debris, TWA 800's nose section, and the aft fuselage/wing section (which traveled the furthest east).

b7C

Enclosure (2) contained the JFK ASR ("four second") radar data, which, in [redacted] estimation, provided the most b7C accurate data available in the surrounding area of the TWA 800 explosion. It was [redacted] belief from his conversations with representatives from the NTSB (National Transportation Safety Board) that this data had been in their possession but had not been plotted or correlated with the Islip ASR ("four second") radar data.

Enclosure (4) contained the final alignment of radar data/transponder returns, DFDR, and CVR data to plus or minus ½ (.5) of a second. All times were calibrated to Boston Center Air Route Traffic Control radar time because it was within ½ (.5) second of correct ZULU time. Consequently, the time resolution error was estimated to be plus or minus ½ (.5) seconds. The following is the result of the alignment (all times in ZULU - HHHH:MM.SS):

0031:11.27	Islip ASR transponder return (last for Islip)
0031:11.50	Last DFDR update
0031:11.88	JFK ASR transponder return (the FINAL return for TWA Flight 800)
0031:12.26	DFDR end
0031:12.50	CVR end

Of importance to note was that the NEXT transponder return would not have been until 0031:14.54 - that was when the White Plains (HPN) ASR radar would have interrogated TWA Flight 800's transponder and, had it still been functioning, would have sent an altitude and transponder code for TWA Flight 800. Additionally, the DFDR would have recorded its next update at time 0031:12.18.

Enclosures (1), (2), (3), and (4) include large size plots.

Referred

[redacted]

♦♦

[redacted]

b7c

October 20, 1997

VI SIMILE TRANSMISSION
W/FOLLOW UP
VIA E-MAIL

SA [redacted]
FBI, New Field Office
Federal 23rd Floor
New York, N 10278

De [redacted]

he good news is that the large plots went out early this evening via FEDEX (#7 1844 9550) in one of their tube boxes.

b7c

bad news is that I really did not have too much time to compare the items down with the primary data. However, I did make clear copies of the ( ) and shipped them back to you in the tube. Very briefly, these clear are nearly the same scale as my small plots that depict a 3x3 NM area. Hence, y can lay them over any of the 3x3 NM plots for a quick look-see at what m align with [redacted] traje data.

I tried to get in touch [redacted] fter I received the faxed material but was not able to chase him down. Since I was running up on a time limit to ship the large plots before the cu for FEDEX shipping, I did not have the benefit of picking his bra re his plots. As mentioned previously, the last time I spoke [redacted] e advised me that he did not do any trajectory analysis. This was after I asked if he could provided me with estimated weights. This leads me to believe that perhaps [redacted] did these himself, or possibly [redacted] If they were completed by either [redacted] the product is of excellent and accurate quality.

Data from their plots can be utilized two ways. **(1** - look for a part or object that exits an aircraft by estimating its trajectory commencing at time of separation and attempting to match up primary radar returns with the trajectory analysis in an effort to pin down the most probable surface impact point. And, **(2** - from a documented resting place of a part or piece, determine its "flying" characteristics, weight, and winds, and work the problem backwards from its resting place to determine the most probable position (X/Y/Z) of the aircraft when it separated. However, since I was not able to get in touch [redacted] I am not aware whether they figured the trajectory from the aircraft down or from the resting place back up to the aircraft.

b7c

The one thing I did do (*and it was based solely on my experience with radar*) was to provide copies of the "7" series plots previously marked up in orange, green, and blue with additional markings in green or blue to indicate the probable track of the forward and aft portions of the aircraft based on a combination of target timing and TRL. I'll be the first to admit that it is a ***"a best guesstimate"*** on my part but one based on spending some time watching little blips work their way through space. Additionally, I provided copies of the primary target **.DAT** files with appropriate lines highlighted in blue and/or green for a ready reference.

TELEPHONUS INTERRUPTUS

So okay, we just discussed the above, and then some, so I guess I can put the fingers to rest. **BUT!** I am still in this mess to the end and don't worry about the $$$$. If it gets to the point where "your" time starts cutting in my "BIG $$$$ TIME", I'll let you know and we can take it from there. [redacted]

b7c

Sincerely,

[redacted]

b7c

TOTAL PAGES TRANSMITTED = 2

Filename: FAA-JFK1.DAT

	TIME	XCOORD	YCOORD	TRL	TOTIM
	0, 31, 16.65	50.4599	.1187	7.00	1876.65
2	0, 31, 16.65	50.2500	-.0359	7.00	1876.65
3	0, 31, 21.25	50.8688	.3538	7.00	1881.25
4	0, 31, 21.25	50.6800	-.0362	6.00	1881.25
5	0, 31, 21.25	50.4000	.0413	7.00	1881.25
6	0, 31, 21.25	50.3099	-.1131	7.00	1881.25
7	0, 31, 25.88	50.2488	.3495	5.00	1885.88
8	0, 31, 25.88	50.8096	.1975	7.00	1885.88
	0, 31, 25.88	51.2488	.3565	7.00	1885.88
10	0, 31, 25.88	50.6199	-.1138	7.00	1885.88
11	0, 31, 25.88	50.4296	-.1908	4.00	1885.88
12	0, 31, 30.48	51.4956	.6742	7.00	1890.48
13	0, 31, 30.48	50.6793	.2747	5.00	1890.48
14	0, 31, 30.48	51.0900	-.0365	6.00	1890.48
15	0, 31, 30.48	50.3700	-.0360	6.00	1890.48
16	0, 31, 35.11	51.6405	.9930	7.00	1895.11
17	0, 31, 35.11	51.1788	.3560	7.00	1895.11
18	0, 31, 35.11	51.4999	-.1158	5.00	1895.11
19	0, 31, 39.72	51.7445	.7568	6.00	1899.72
20	0, 31, 39.72	51.6733	.8351	7.00	1899.72
21	0, 31, 39.72	51.2088	.3562	5.00	1899.72
22	0, 31, 44.36	51.7613	1.3926	4.00	1904.36
23	0, 31, 44.36	51.9232	.8391	7.00	1904.36
24	0, 31, 44.36	50.5599	-.1137	5.00	1904.36
25	0, 31, 44.36	51.2492	.2778	4.00	1904.36
26	0, 31, 48.96	51.9219	.918[illegible]	7.00	1908.96
27	0, 31, 48.96	52.0555	.6815	7.00	1908.96
28	0, 31, 48.96	50.5296	.1964	5.00	1908.96
29	0, 31, 48.96	50.8999	.1198	5.00	1908.96
30	0, 31, 53.60	51.9904	.9997	6.00	1913.60
31	0, 31, 53.60	52.0832	.8417	6.00	1913.60
32	0, 31, 53.60	50.5593	-.2688	5.00	1913.60
33	0, 31, 58.21	52.1404	1.0026	7.00	1918.21
34	0, 31, 58.21	52.0518	.9211	7.00	1918.21
35	0, 31, 58.21	51.2499	.1206	7.00	1918.21
36	0, 32, 02.84	51.2788	.3567	5.00	1922.84
37	0, 32, 02.84	52.1118	.9221	6.00	1922.84

[1] TRL = Target Run Length. Indicated in a value of 1 (*small*) target through 7 (*large target*).

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	.3569	[illegible]	[illegible]
42	[illegible]	[illegible]	[illegible]	52.1455	.6827	[illegible]	[illegible]
43	0	32	12.08.	51.2799	.1207.	7.00.	1932.08
44	0.	32.	16.68.	52.1132.	.8422.	7.00.	1936.68
45	0.	32.	16.68.	52.0518.	.9211.	6.00.	1936.68.
46	0.	32.	16.68.	50.7099.	-.1140.	5.00.	1936.68.
47	0.	32.	21.31.	52.0488.	1.0807.	7.00.	1941.31.
48	0.	32.	21.31.	50.4996.	-.1910.	5.00.	1941.31.
49	0.	32.	21.31.	50.8400.	.0417.	5.00.	1941.31.
50	0.	32.	21.31.	50.6796.	-.1917.	5.00.	1941.31.
51	0,	32,	21.31.	50.8400.	.0417,	5.00.	1941.31.
52	0,	32,	21.31,	50.6796.	-.1917,	5.00.	1941.31,
53	0,	32,	25.94,	52.2687,	1.0853,	5.00.	1945.94.
54	0,	32,	25.94,	52.1455,	.6827,	7.00,	1945.94.
55	0,	32,	30.55,	52.3018,	.9255,	6.00,	1950.55,
56	0,	32,	30.55,	52.1765,	.6030,	6.00,	1950.55,
57	0,	32,	35.18,	52.3392,	.2837,	5.00,	1955.18,
58	0,	32,	35.18,	52.2004,	1.0038,	7.00,	1955.18,
59	0,	32,	39.79,	52.1088,	1.0820,	5.00,	1959.79,
60	0,	32,	39.79,	52.2987,	1.0859,	5.00,	1959.79,
61	0,	32,	49.02,	52.2403,	1.0046,	7.00,	1969.02,
62	0,	32,	53.65,	52.2781,	.4438,	7.00,	1973.65,
63	0,	32,	58.25,	52.3065,	.6045,	5.00,	1978.25,
64	0,	32,	58.25,	51.5296,	.2003,	4.00,	1978.25,
65	0,	33,	02.89,	52.3944,	.7663,	5.00,	1982.89,
66	0,	33,	02.89,	52.3032,	.8452,	5.00,	1982.89,
67	0,	33,	07.51,	52.2987,	1.0859,	5.00,	1987.51,
68	0,	33,	12.12,	52.4974,	.5262,	6.00,	1992.12,

Filename: FAA-ISP1.DAT

	TIME			XCOORD	YCOORD	TRL[1]	TOTIM
1	0	31	15.97	19.6635	-8.7194	7.00.	1875.97
2	~~0,~~	~~31,~~	~~15.97,~~	~~19.8255,~~	~~-8.5738,~~	~~7.00,~~	~~1875.97.~~
3	0.	31.	20.66	19.5812.	-9.1178.	3.00.	1880.66.
4	0.	31.	20.66.	19.5412.	-8.9900.	2.00.	1880.66.
5	0,	31,	20.66,	20.5219,	-7.9555,	3.00,	1880.66,
6	0.	31,	25.36,	19.5589.	-9.0710,	2.00,	1885.36.
7	0,	31,	25.36,	20.8402,	-7.8226,	7.00,	1885.36,
8	0.	31,	30.05.	19.6552,	-8.8604,	1.00.	1890.05.
9	0,	31,	30.05,	21.0380,	-7.7499,	2.00,	1890.05,
10	0,	31,	34.77,	20.6674,	-8.2683,	3.00,	1894.77.
11	0,	31,	34.77,	21.1461,	-7.5694,	7.00.	1894.77.
12	0,	31,	39.46,	21.2729,	-7.5412,	7.00,	1899.46,
13	0,	31,	39.46,	21.1692,	-7.5045,	7.00,	1899.46,
14	0,	31,	44.16,	21.4237,	-7.5947,	7.00,	1904.16,
15	0,	31,	48.85,	21.5673,	-7.6084,	3.00,	1908.85,
16	0,	31,	53.84,	20.1209,	-8.5189,	7.00,	1913.84,
17	0,	31,	58.25,	20.6719,	-8.4176,	4.00,	1918.25,
18	0,	32,	02.94,	20.7440,	-8.3728,	1.00,	1922.94,
19	0,	32,	07.63,	20.7903,	-8.3916,	1.00,	1927.63,
20	0,	32,	17.04,	21.6710,	-7.6450,	4.00,	1937.04,
21	0,	32,	21.76,	21.7064,	-7.6949,	4.00,	1941.76,
22	0,	32,	26.45,	19.9470,	-8.9185,	1.00,	1946.45,
23	0,	32,	31.14,	20.8015,	-8.4704,	1.00,	1951.14,
24	0,	32,	31.14,	21.4118,	-7.7759,	1.00,	1951.14,

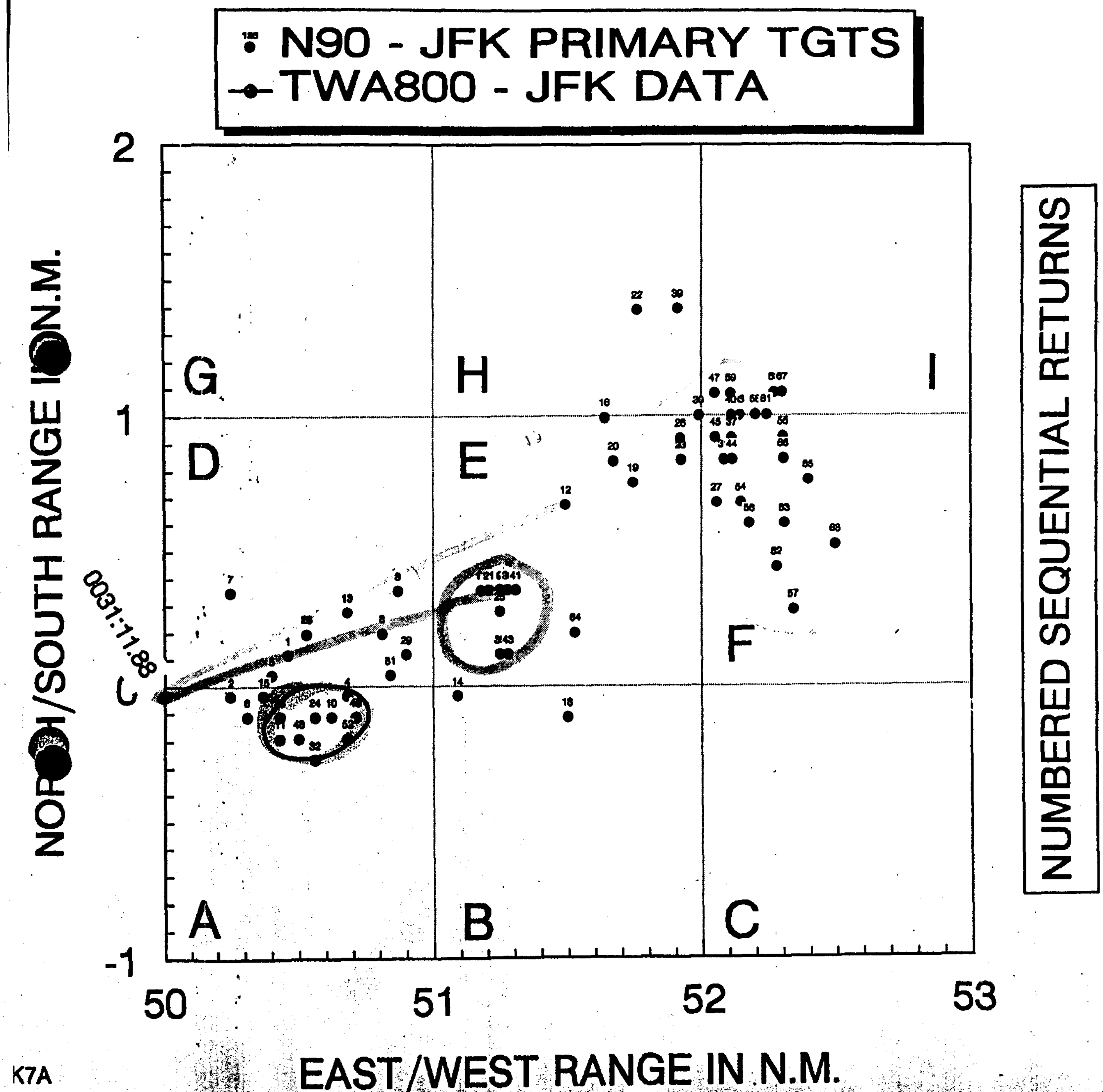
30.05

[1] TRL = Target Run Length. Indicated in a value of 1 (*small*) target through 7 (*large target*).

Filename: FAA-HPN1.DAT

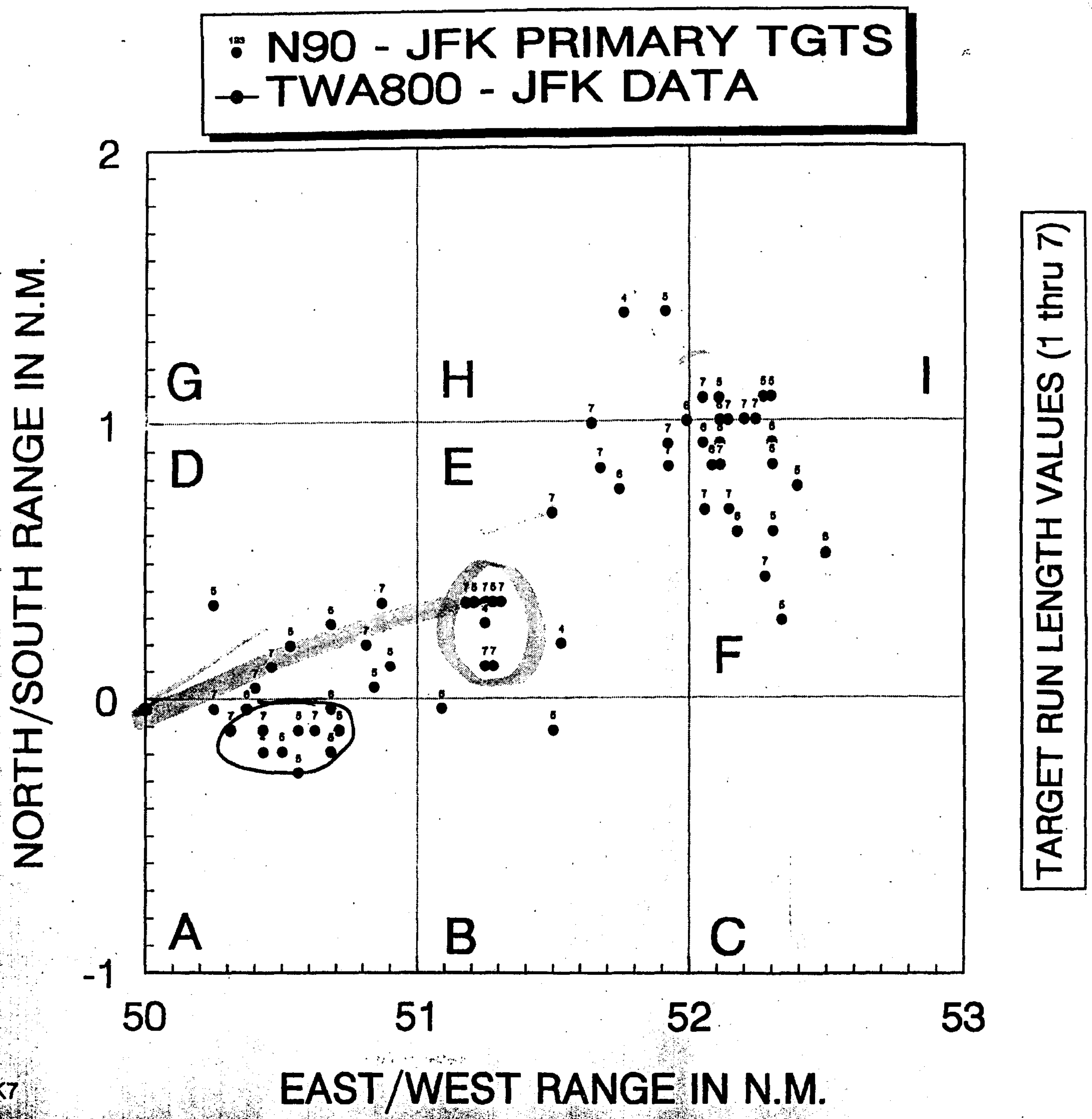
	TIME			XCOORD	YCOORD	TRL	TOTIM
1	0.	31	14.54.	47.3303.	-25.1555.	7.00	1874.54
2	0.	31.	33.34	47.3599.	-25.5452.	3.00.	1893.34
3	0.	31.	33.34.	47.7938.	-25.0270.	1.00.	1893.34.
4	0.	31.	38.03.	47.7111.	-25.0770.	2.00.	1898.03.
5	0.	31.	38.03.	47.9267,	-25.0966.	1.00.	1898.03.
6	0.	31.	42.58.	48.4985,	-24.6425.	1.00.	1902.58.
7	0.	31.	42.58,	48.9408,	-24.1162,	4.00.	1902.58.
8	0,	31,	47.42.	47.3462.	-25.4441.	7.00	1907.42.
9	0.	31.	51.97,	48.2311.	-24.5066.	1.00.	1911.97.
10	0,	31,	51.97,	48.9778.	-24.0411.	3.00,	1911.97.
11	0,	31,	52.11,	47.7817,	-24.8341.	1.00	1912.11.
12	0,	32,	15.60,	47.4343,	-25.4914,	1.00,	1935.60,
13	0,	32,	25.01,	47.4391,	-25.5879,	1.00,	1945.01,
14	0,	32,	34.42,	47.4438,	-25.6844,	1.00,	1954.42.

[1] TRL = Target Run Length. Indicated in a value of 1 (*small*) target through 7 (*large target*).



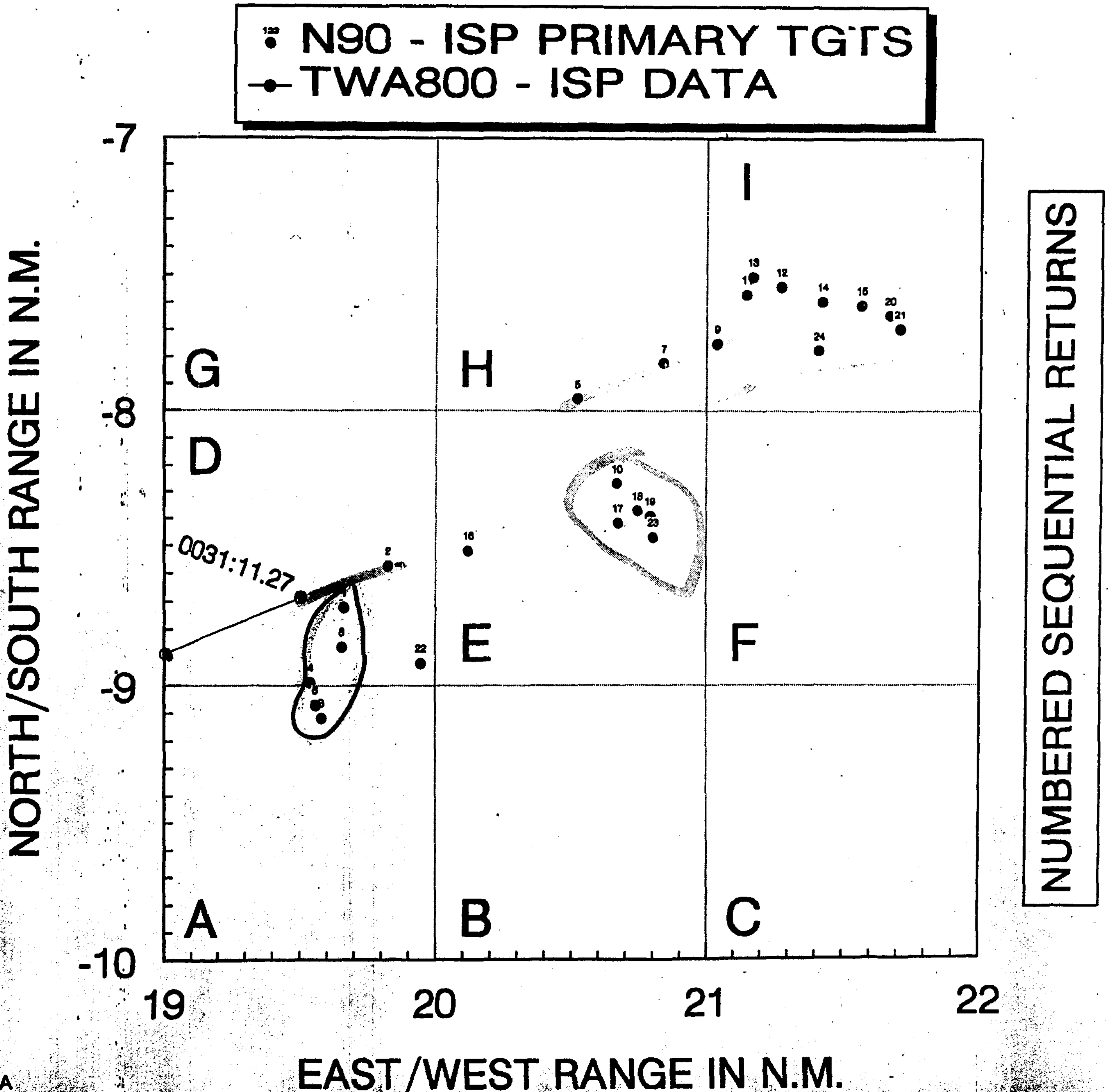
N90 - JFK PRIMARY TGTS
TWA800 - JFK DATA
NORTH/SOUTH RANGE IN N.M.
EAST/WEST RANGE IN N.M.
NUMBERED SEQUENTIAL RETURNS
0031:11.88
G
H
I
D
E
F
A
B
C
2
1
-1
50
51
52
53

K7A



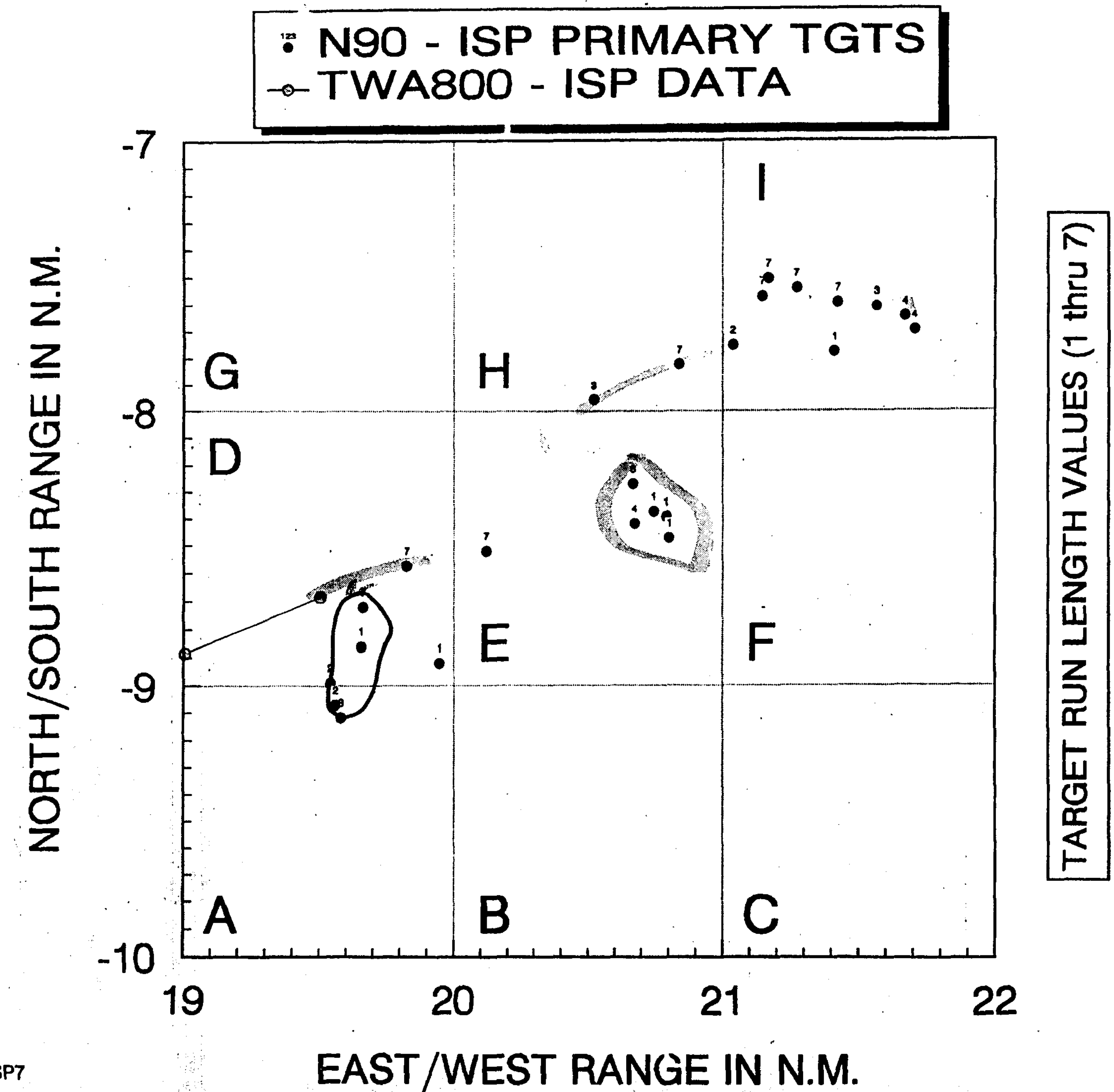
N90 - JFK PRIMARY TGTS
TWA800 - JFK DATA
NORTH/SOUTH RANGE IN N.M.
EAST/WEST RANGE IN N.M.
TARGET RUN LENGTH VALUES (1 thru 7)
G
H
I
D
E
F
A
B
C
2
1
0
-1
50
51
52
53

TWAJFK7



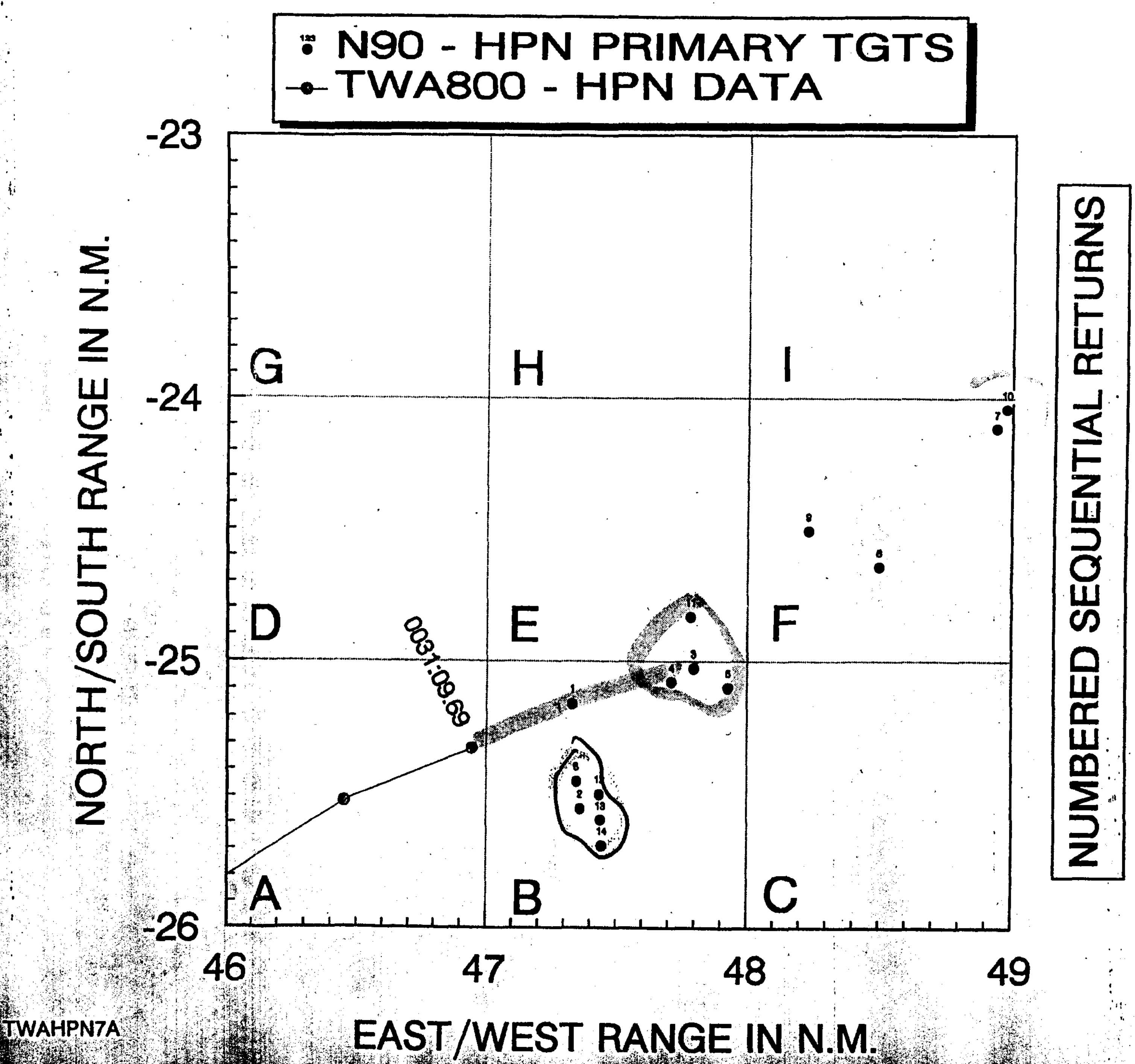
N90 - ISP PRIMARY TGTS
TWA800 - ISP DATA
NORTH/SOUTH RANGE IN N.M.
EAST/WEST RANGE IN N.M.
NUMBERED SEQUENTIAL RETURNS
-7
-8
-9
-10
19
20
21
22
G
H
I
D
E
F
A
B
C
0031:11.27

7A

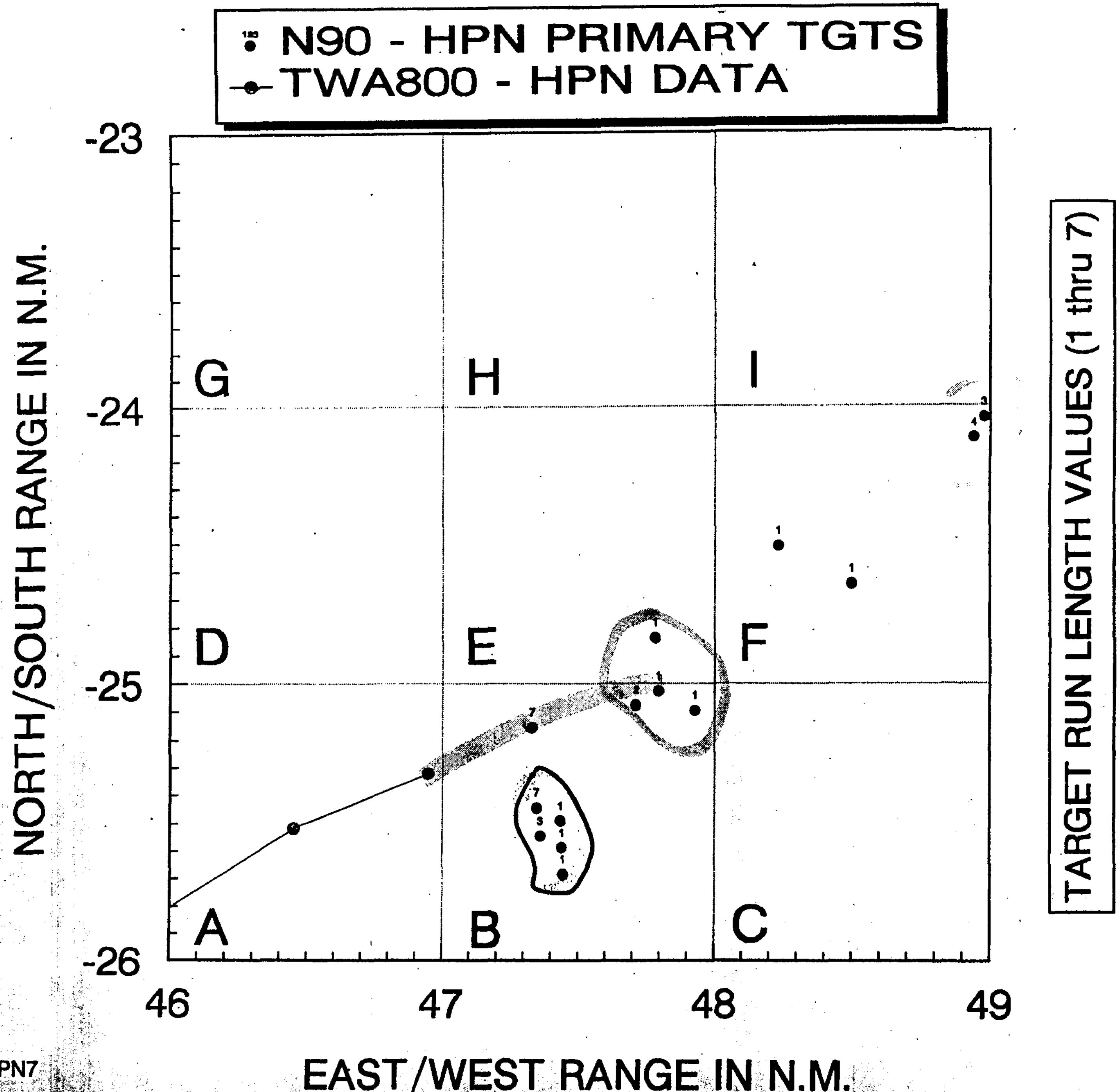


TWAISP7

TWAIS



N90 - HPN PRIMARY TGTS
TWA800 - HPN DATA
NORTH/SOUTH RANGE IN N.M.
EAST/WEST RANGE IN N.M.
NUMBERED SEQUENTIAL RETURNS
-23
-24
-25
-26
46
47
48
49
G
H
I
D
E
F
A
B
C
0031:09.69
TWAHPN7A


N90 - HPN PRIMARY TGTS
TWA800 - HPN DATA
-23
-24
-25
-26
46
47
48
49
G
H
I
D
E
F
A
B
C
NORTH/SOUTH RANGE IN N.M.
EAST/WEST RANGE IN N.M.
TARGET RUN LENGTH VALUES (1 thru 7)

TWAHPN7

[redacted]

b7C

October 3, 1997

VIA EXPRESS MAIL

SA [redacted]
FBI, New York Field Office
26 Federal Plaza, 23rd Floor
New York, NY 10278

b7C

Dear [redacted]

Enclosed please find copies of primary data plots as you requested. You will note that I opted to plot all three data sets (ISP, JFK, & HPN) in order to develop the best possible picture relative to parts/debris disbursement. However, I did not incorporate or blend them into a single plot for two reasons. Firstly, the published magnetic variations for the JFK and HPN ASR systems (12°) do not appear correct. Hence, any attempt to offset values received by these sites would not have placed the targets in their proper relative positions to ISP data.

Secondly, target data received by the JFK and HPN systems would differ from the data received by the ISP ASR due to slant range from the receiving antenna. As an example of the slant range factor, I have enclosed a copy of a page (#39) extracted from FAA training Manual ETM 12-0-1 ***[Attachment #1]***.

Since the altitude of the primary target returns are not known, the determination of slant range correction factor(s) was not feasible.

In an effort to provide the broadest possible picture relative to primary target returns, along with plots that would not appear *"busy"* due to too much information crammed into a confined space, data presentations were completed in pair s from JFK, ISP, and HPN. One plots depicts target run length values associated with each return while the second plot (in the pair) depicts a numerical value associated with sequential timing of receipt of the data.

Per your request, I contacted [redacted] at the NTSB to obtain the estimated weight of the nose section. However, [redacted] advised me that the Safety Board did not know the estimated weight and further reported that calculations relative to the weight were not attempted.

b7C

A description of the data and plots is provided below.

DATA

A review of primary data returns in the immediate area of TWA800 was completed utilizing data received by the ISP, JFK, and ISP ASR systems. After selected data points were entered, they were plotted and reviewed in detail so as to eliminate targets that were associated with aircraft known to be in the area at the time of the mishap (*USN P-3, etc*). Returns selected in this process were entered in the computer utilizing the following format: TIME(UTC), nautical mile (NM) range, magnetic azimuth values in ACPS, and a single digit value between 1 and 7 which denoted target run length values. After entry, range and ACP data were converted to an X/Y grid format aligned to true north based on magnetic variation values contained in the NOS Digital Aeronautical Chart Supplement in effect at the time of the accident.

The term, target run length (TRL), in effect, refers to the size of a specific target. However, it does not directly reflect the size of a target but rather the radar cross section of a particular target. As an example, one needs to visualize a billboard located beside the highway. When viewed straight-on (*like the advertising folks want*), you will see the full size of the billboard, as 20 feet x 40 feet in height and width, and 6 inches thick. However, if the viewer were at a 45° angle and the viewed surface appeared as a 10 x 40 foot surface, its cross section would be reduced by approximately half. When the same billboard was viewed from a 90° point relative to the advertisement, the same object would appear as 10 foot in height and only 6 inches in width. At this angle, its 40 foot width would not be visible. Hence, a tumbling primary target, such as a large piece of aircraft skin, or a part from an aircraft, could register as a TRL value of 1 through 7, depending on the size of the cross section it presented at the time of detection. As an aid in visualizing the above, see ***[ATTACHMENT #2]***.

File: FAA-ISP1.DAT

All primary radar returns received by the ISP ASR system between 0031:15.97[1] and 0032:31.14 with line numbers added to the left of the time column for timing reference in plan view plots ***[ATTACHMENT #3]***.

File: FAA-JFK1.DAT

All primary radar returns received by the JFK ASR system between 0031:16.65 and 0033:12.12 with line numbers added to the left of the time column ***[ATTACHMENT #4]***.

File: FAA-HPN1.DAT

All primary radar returns received by the HPN ASR system between 0031:14.54 and 0032:34.42 with line numbers added to the left of the time column ***[ATTACHMENT #5]***.

PLOTTING

A series of plan view plots were completed utilizing the data listed above. Plots numbered as 1, 2, and 3 were utilized in development of the final plots described below.

PLOT: TWAISP4

Plan view plot covering a 3x3 NM area depicting the last two transponder returns received from TWA800 at 0031:06.57 and 0031:11.27, and all data contained in file TWA-ISP1.DAT. The numbers immediately above the primary target symbols (●) correspond to the line numbers in the data file and denote the sequence in which they were received. Additionally, each square mile grid is identified by a letter between A and I. Scale: major increments = 1 NM (*6,071 feet*), minor increments = 0.10 NM (*607 feet*). As can be seen by the over-writing of numerical and target symbols, addition and display of real time values would have made for a busy and very hard to read plot. Hence, it was determined that display of the appropriate line number signifying time sequence made for a more readable plot ***[ATTACHMENT #6]***.

---

[1] All times shown herein reflect adjusted timing per DFDR correlation and indicate Coordinated Universal Time (UTC).

PLOT: TWAISP4A thru 4I

A series of plan view plots (9) depicting 1x1 square NM areas with the letter indicated on the smaller (*3x3 NM*) plot appended to the number 4 to signify the area covered by the individual plots. Numbers immediately above the primary target symbols correspond to the line numbers in the data file and denote the sequence in which they were received. Evident in this series of plots is the fact that the over-writing of numerical and target symbols does not occur as was apparent in the 3x3 square mile plot. These plots are provided for the purpose of digitally scanning the material into a computer should further analysis be required by outside agencies. Scale: major increments = 1 NM, minor increments = 0.10 NM ***[ATTACHMENT #7]***.

PLOT: TWAISP5

Plan view plot covering a 3x3 nautical mile NM area depicting the last two transponder returns received from TWA800 at 0031:06.57 and 0031:11.27, and all data contained in file TWA-ISP1.DAT. In this plot, the numbers immediately above the primary target symbols (●) correspond to the Target Run Length values (*1 thru 7*) indicated under the column headed TRL in the data file. As with the above plot, each square mile grid is identified by a letter between A and I. Scale: major increments = 1 NM , minor increments = 0.10 NM As can be seen in this plot, over-writing of numerical and target symbols is also evident and demonstrates that had time values been added to the display, information would have been nearly impossible to distinguish ***[ATTACHMENT #8]***.

PLOT: TWAISP5A thru 5I

A series of plan view plots (9) depicting 1x1 square NM areas with the letter indicated on the smaller (*3x3 NM*) plot appended to the number 5 to signify the area covered by the individual plots. Numbers immediately above the primary target symbols correspond to the Target Run Length values indicated under the column headed TRL in the data file. Scale: major increments = 1 NM, minor increments = 0.10 NM ***[ATTACHMENT #9]***.

PLOT: TWAJFK4

Plan view plot covering a 3x3 NM area depicting the last transponder returns received from TWA800 at 0031:11.88 and all data contained in file TWA-JFK1.DAT. Numbers immediately above the primary target symbols correspond to the line numbers in the data file ***[ATTACHMENT #10]***.

PLOT: TWAJFK4A thru 4I

A series of plan view plots (9) depicting 1x1 square NM areas with the letter indicated on the smaller (*3x3 NM*) plot appended to the number 4 to signify the area covered by the individual plots. Numbers immediately above the primary target symbols correspond to the line numbers in the data file ***[ATTACHMENT #11]***.

PLOT: TWAJFK5

Plan view plot covering a 3x3 NM area depicting the last transponder returns received from TWA800 at 0031:11.88 and all data contained in file TWA-JFK1.DAT. Numbers immediately above the primary target symbols correspond to the Target Run Length values (*1 thru 7*) indicated under the column headed TRL in the data file ***[ATTACHMENT #12]***.

PLOT: TWAJFK5A thru 5I

A series of plan view plots (9) depicting 1x1 square NM areas with the letter indicated on the smaller (*3x3 NM*) plot appended to the number 5 to signify the area covered by the individual plots. Numbers immediately above the primary target symbols correspond to the Target Run Length values indicated under the column headed TRL in the data file. ***[ATTACHMENT #13]***.

PLOT: TWAHPN4

Plan view plot covering a 3x3 NM area depicting the last two transponder returns received from TWA800 at 0031:04.99 and 0031:09.69, and all data contained in file TWA-HPN1.DAT. Numbers immediately above the primary target symbols correspond to the line numbers in the data file ***[ATTACHMENT #14]***.

PLOT: TWAHPN4A thru 4I

A series of plan view plots (9) depicting 1x1 square NM areas with the letter indicated on the smaller (*3x3 NM*) plot appended to the number 4 to signify the area covered by the individual plots. Numbers immediately above the primary target symbols correspond to the line numbers in the data file ***[ATTACHMENT #15]***.

PLOT: TWAHPN5

Plan view plot covering 3x3 NM area depicting the last two transponder returns received from TWA800 at 0031:04.99 and 0031:09.69, and all data contained in file TWA-HPN1.DAT. Numbers immediately above the primary target symbols correspond to the Target Run Length values (*1 thru 7*) indicated under the column headed TRL in the data file ***[ATTACHMENT #16]***.

PLOT: TWAHPN5A thru 5I

A series of plan view plots (9) depicting 1x1 square NM areas with the letter indicated on the smaller (*3x3 NM*) plot appended to the number 5 to signify the area covered by the individual plots. Numbers immediately above the primary target symbols correspond to the Target Run Length values indicated under the column headed TRL in the data file. ***[ATTACHMENT #17]***.

LINE-OF-SIGHT

Since the subject of line-of-sight (LOS) came up early on in our discussions, I have provided LOS values for the JFK, HPN, and ISP ASR systems below. The calculations were completed utilizing a program developed at the NTSB, and still in use by that agency. The values listed below depict the NM range of the first primary target received by the site listed after loss of the flight's transponder signal, and represent the minimum MSL altitude that a target would be detected given all things atmospheric were normal at the time of the event. However, as you are aware from the presence of surface (primary) targets extracted from the ISP primary data set at ranges exceeding 40 NM, it appears that these targets were the result of a temperature inversion at the time of the incident.

ASR	RANGE from ASR	MINIMUM ALTITUDE
JFK	50.46nm	1,687'
HPN	53.34nm	1,885'
ISP	21.51nm	306'

Keep in mind that, based on a standard set of circumstances (*weather, atmosphere, radar tuning, etc.*), the ASR antenna should not receive or detect primary targets below the minimum altitudes listed above.

TARGET SELECTION

For the most part, primary targets were selected in the area of the last received transponder return commencing with the time of the next expected return and continuing for approximately 1¼ minutes (0031:14 - 0032:00), with the exception of JFK data which continues through 0033:12.

The selection of above times is based on my experience with past in-flight break-up accident sequences and the intentional destruction of target drones, while a GCI controller in the military. These experiences have shown that after a time period of approximately 60-75 seconds after an airframe experiences a catastrophic in-flight failure, primary radar targets tend to represent a scenario more closely associated with a chaff [2] drop rather than an intact aircraft, or portion of one.

---

[2]CHAFF - Thin, narrow metallic strips of various lengths that reflect RF energy. These reflectors, when dropped from an aircraft and allowed to drift downward, with the wind, result in the appearance of targets of varying sizes on radar scopes (displays).

A brief visual review of plotted data indicates the HPN ASR system received the least amount of primary target returns while the JFK system received a larger number of returns. The difference in the number of primary returns received from these sites, at nearly identical ranges, tends to indicate that the temperature inversion played a factor in contributing to the lessor number of targets received by HPN versus the larger number of targets received by JFK.

Of interest in the HPN data is that after 0032:34.671, primary target returns become very intermittent and cease in the accident area at 0033:07. Within the JFK data, only 11 targets are recorded after 0032:30, and become increasingly intermittent in the accident area with primary targets ceasing after 0035:21.

Although primary data associated with the ISP ASR was selected through 0032:31.387 for the purposes of the aforementioned plots, primary target returns within the ISP data are indicated beyond 0040:00. Many of the latter targets appeared near stationary and no determination could be made as to whether these targets were aircraft debris aloft or surface targets (small boats) that reportedly responded to the scene of the crash. Additionally, the possibility exists that a portion of the ISP primary data points could be attributed to heavy dense smoke from a fossil (jet) fuel fire. The foregoing statement may garnish a few snickers, however, I have witnessed several occurrences where such smoke conditions appeared on radar (JFK & EWR ASR systems) as very faint (*TRL 1 values*) from structural fires in and around the New York City area while a controller at JFK. Additionally, I have observed this occurrence in the Minneapolis area while an FAA controller.

DISCUSSION

In an effort to present both sequential target listings and TRL values in a combined view, a series of three joint-plots were created for each of the ASR systems. These plots were designated as TWA**JFK**7/7A, TWA**HPN**7/7A, and TWA**ISP**7/7A ***[ATTACHMENT # 18]***.

Based on information you provided relative to debris locations documented during the recovery phase ***[ATTACHMENT # 19]***, I have marked each of the above plots with circles to indicate the locations of debris from the forward portion of the aircraft in ***green*** and the aft portion of the aircraft in ***blue***. Additionally, I have placed an ***orange*** circle around a grouping of returns that appear immediately to the right of the apparent flight track of TWA800, approximately 1 N.M. southwest of the area encompassing the nose or forward section.

Since I could not recall seeing a similar depiction of primary target data while visiting CTO nor was there an indication of this debris pattern in the copy of the Oceaneering plot indicating TWA800 Tag Locations provided by FAX, I became quite curious as to what portions of the aircraft these could be.

Within the ISP and HPN plots, targets located in the orange circle appear to be closely grouped within an area measuring approximately 0.2 NM east/west and 0.4 NM north/south. Within these plots, both data sets indicate TRL values generally at 3 and below. However, both data sets also include a single TRL value of 7 near the northern end of the target field.

In the JFK plots, targets within the orange circle indicate TRL values of between 5 and 7 while for the most part they appear near the end of the data set. The grouping of the JFK data appears to be generally within a 0.4 NM diameter area.

The relatively tight grouping of these targets in all three data sets (less than ½ NM) would tend to indicate more vertical movement versus lateral movement.

Additionally, plotted data indicates targets located within the orange area appear immediately to the right (*abeam*) of the projected flight path of TWA800 at a distance of approximately 0.5 NM, at 0031:16.224 in the ISP data set. Coincidentally, the first appearance of this target in the HPN data occurred at 0031:14.792 and was also located approximately 0.5 NM to the right of the projected flight path.

A similar target appears to the right of the projected flight track at 0031:16.895 in the JFK data set but at a distance of approximately 0.25 NM.

The above information indicates that some portion or component of the aircraft kicked out to the right nearly immediately after loss of the transponder signal and experienced a throw to the right of the aircraft's flight track of between 0.25 and 0.5 NM. Once it lost the momentum that caused its departure from the aircraft, the part or parts associated with this debris descended to the ocean surface very near vertically with minimal lateral movement.

Target returns located within the green (fwd) and blue (aft) coincide with the information depicting debris fields in the Oceaneering TWA800 Tag Location plot.

I doubt that NTSB personnel have plotted all three primary data sets as contained in the enclosed attachments although the recommendation to complete such a process was communicated.

For your convenience, I have provided three complete sets of text and plots. Also, I have provided six large (30x30") plots depicting numbered sequential returns as well as TRL values from the three ASR systems.

Feel free to call if you have any questions, comments , or suggestions. I should be in for the next few weeks.

Very truly yours,

[redacted]

b7c

Encl.

VIA EXPRESS MAIL

PACKAGE 1 of 2 = EH549463815US

PACKAGE 2 of 2 = EH549463824US

ATTACHMENT #1

FROM
FUNDAMENTALS OF PRIMARY AND SECONDARY SURVEILANCE RADAR
REFERENCE MANUAL # ETM 12-0-1, JULY 1975, PAGE 39

displayed as two targets if they are separated by at least 7°. If a twenty-eight foot antenna (effective beam width 4°) is being used, two targets will be displayed if the aircraft are separated by 5° or more.

A beacon target close to the antenna will sometimes be displayed as a concentric circle around the main bang rather than a distinct target on a definite azimuth. This display is identified as "ring around".

Properly adjusted Sensitivity Time Control (STC) will prevent the display of ring around. Side lobe suppression (SLS) systems will prevent the cause of the ring around by preventing transponder replies to side lobe interrogations.

The transponder is equipped with a Low Sensitivity feature. Operation of a switch on the transponder control panel will reduce the sensitivity level of the receiver unit. Thus, only the strongest interrogation signals will be accepted; generally the main lobes from I/R sites within 20 miles of the aircraft. Although most side lobes will be rejected, this feature should be used with discretion due to the greatly reduced effective range of the transponder.

Both primary and secondary radar display slant range. Slant range is the most direct line between the ground antenna and the aircraft. Thus, the position of the aircraft, as displayed on a PPI, is only an approximate geographical position (see Fig. 23).

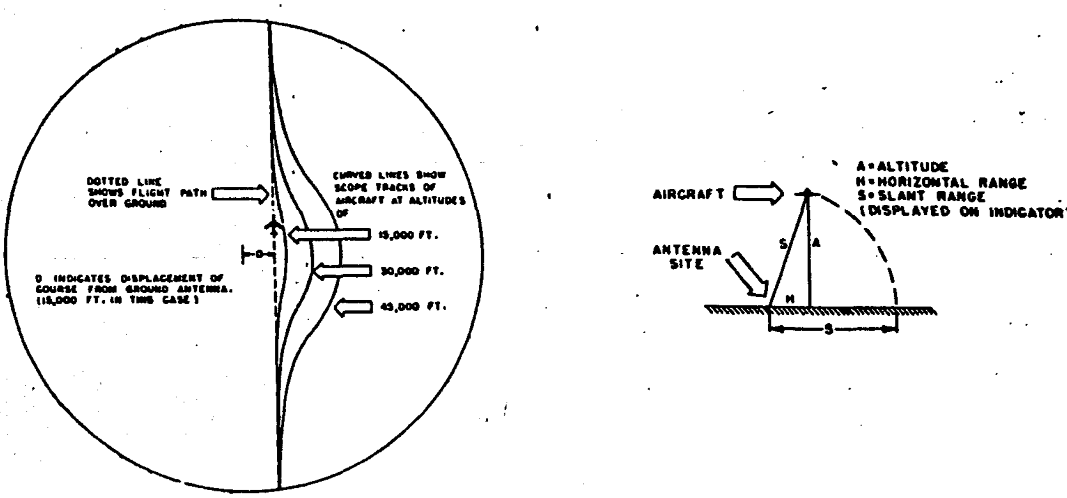
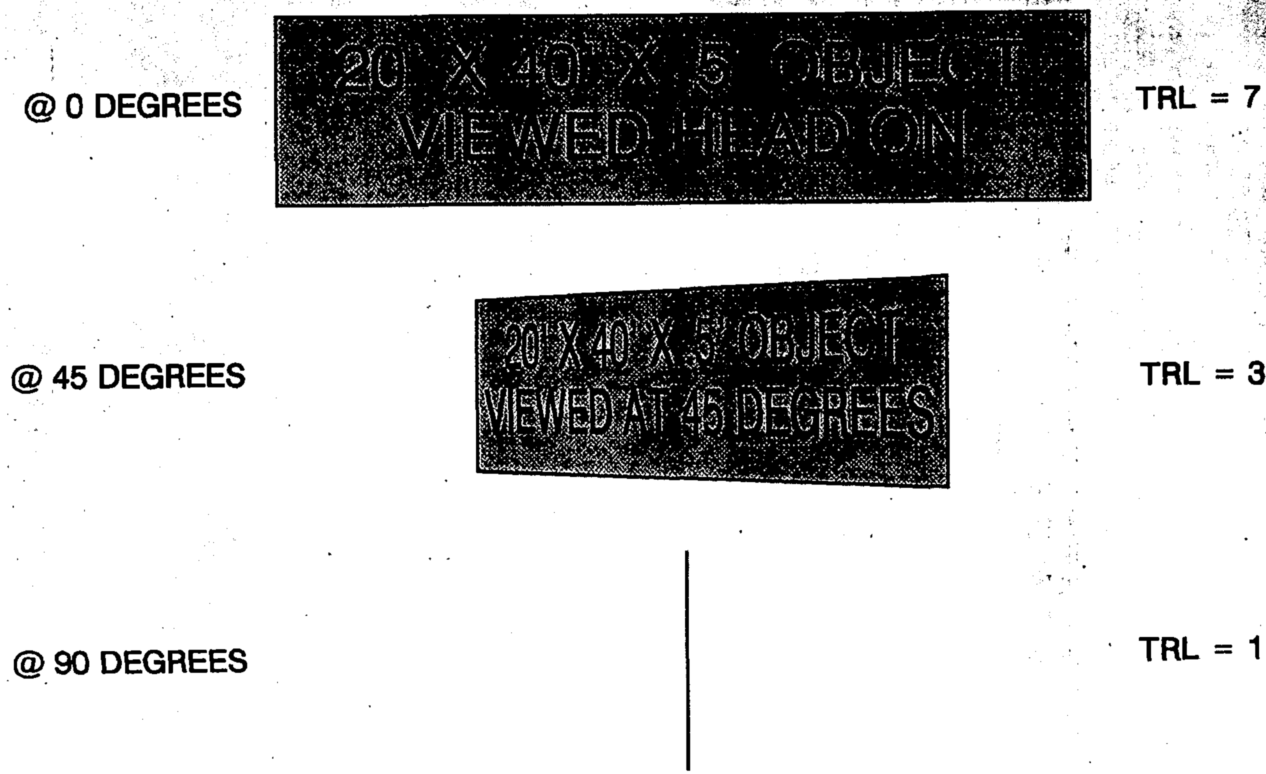


FIGURE 23. Slant Range.

ATTACHMENT #2

EXAMPLE OF TARGET RUN LENGTH (TRL) VALUES versus TARGET CROSS SECTION



EXAMPLE

ATTACHMENT #3

Filename: FAA-ISP1.DAT

	TIME			XCOORD	YCOORD	TRL[1]	TOTIM
1	0,	31,	15.97,	19.6635,	-8.7194,	7.00,	1875.97,
2	0,	31,	15.97,	19.8255,	-8.5738,	7.00,	1875.97,
3	0,	31,	20.66,	19.5812,	-9.1178,	3.00,	1880.66,
4	0,	31,	20.66,	19.5412,	-8.9900,	2.00,	1880.66,
5	0,	31,	20.66,	20.5219,	-7.9555,	3.00,	1880.66,
6	0,	31,	25.36,	19.5589,	-9.0710,	2.00,	1885.36,
7	0,	31,	25.36,	20.8402,	-7.8226,	7.00,	1885.36,
8	0,	31,	30.05,	19.6552,	-8.8604,	1.00,	1890.05,
9	0,	31,	30.05,	21.0380,	-7.7499,	2.00,	1890.05,
10	0,	31,	34.77,	20.6674,	-8.2683,	3.00,	1894.77,
11	0,	31,	34.77,	21.1461,	-7.5694,	7.00,	1894.77,
12	0,	31,	39.46,	21.2729,	-7.5412,	7.00,	1899.46,
13	0,	31,	39.46,	21.1692,	-7.5045,	7.00,	1899.46,
14	0,	31,	44.16,	21.4237,	-7.5947,	7.00,	1904.16,
15	0,	31,	48.85,	21.5673,	-7.6084,	3.00,	1908.85,
16	0,	31,	53.84,	20.1209,	-8.5189,	7.00,	1913.84,
17	0,	31,	58.25,	20.6719,	-8.4176,	4.00,	1918.25,
18	0,	32,	02.94,	20.7440,	-8.3728,	1.00,	1922.94,
19	0,	32,	07.63,	20.7903,	-8.3916,	1.00,	1927.63,
20	0,	32,	17.04,	21.6710,	-7.6450,	4.00,	1937.04,
21	0,	32,	21.76,	21.7064,	-7.6949,	4.00,	1941.76,
22	0,	32,	26.45,	19.9470,	-8.9185,	1.00,	1946.45,
23	0,	32,	31.14,	20.8015,	-8.4704,	1.00,	1951.14,
24	0,	32,	31.14,	21.4118,	-7.7759,	1.00,	1951.14,

[1] TRL = Target Run Length. Indicated in a value of 1 (*small*) target through 7 (*large target*).

ATTACHMENT #4

***Filename*: FAA-JFK1.DAT**

	TIME			XCOORD	YCOORD	TRL[1]	TOTIM
1	0,	31,	16.65,	50.4599,	.1187,	7.00,	1876.65,
2	0,	31,	16.65,	50.2500,	-.0359,	7.00,	1876.65,
3	0,	31,	21.25,	50.8688,	.3538,	7.00,	1881.25,
4	0,	31,	21.25,	50.6800,	-.0362,	6.00,	1881.25,
5	0,	31,	21.25,	50.4000,	.0413,	7.00,	1881.25,
6	0,	31,	21.25,	50.3099,	-.1131,	7.00,	1881.25,
7	0,	31,	25.88,	50.2488,	.3495,	5.00,	1885.88,
8	0,	31,	25.88,	50.8096,	.1975,	7.00,	1885.88,
9	0,	31,	25.88,	51.2488,	.3565,	7.00,	1885.88,
10	0,	31,	25.88,	50.6199,	-.1138,	7.00,	1885.88,
11	0,	31,	25.88,	50.4296,	-.1908,	4.00,	1885.88,
12	0,	31,	30.48,	51.4956,	.6742,	7.00,	1890.48,
13	0,	31,	30.48,	50.6793,	.2747,	5.00,	1890.48,
14	0,	31,	30.48,	51.0900,	-.0365,	6.00,	1890.48,
15	0,	31,	30.48,	50.3700,	-.0360,	6.00,	1890.48,
16	0,	31,	35.11,	51.6405,	.9930,	7.00,	1895.11,
17	0,	31,	35.11,	51.1788,	.3560,	7.00,	1895.11,
18	0,	31,	35.11,	51.4999,	-.1158,	5.00,	1895.11,
19	0,	31,	39.72,	51.7445,	.7568,	6.00,	1899.72,
20	0,	31,	39.72,	51.6733,	.8351,	7.00,	1899.72,
21	0,	31,	39.72,	51.2088,	.3562,	5.00,	1899.72,
22	0,	31,	44.36,	51.7613,	1.3926,	4.00,	1904.36,
23	0,	31,	44.36,	51.9232,	.8391,	7.00,	1904.36,
24	0,	31,	44.36,	50.5599,	-.1137,	5.00,	1904.36,
25	0,	31,	44.36,	51.2492,	.2778,	4.00,	1904.36,
26	0,	31,	48.96,	51.9219,	.9188,	7.00,	1908.96,
27	0,	31,	48.96,	52.0555,	.6815,	7.00,	1908.96,
28	0,	31,	48.96,	50.5296,	.1964,	5.00,	1908.96,
29	0,	31,	48.96,	50.8999,	.1198,	5.00,	1908.96,
30	0,	31,	53.60,	51.9904,	.9997,	6.00,	1913.60,
31	0,	31,	53.60,	52.0832,	.8417,	6.00,	1913.60,
32	0,	31,	53.60,	50.5593,	-.2688,	5.00,	1913.60,
33	0,	31,	58.21,	52.1404,	1.0026,	7.00,	1918.21,
34	0,	31,	58.21,	52.0518,	.9211,	7.00,	1918.21,
35	0,	31,	58.21,	51.2499,	.1206,	7.00,	1918.21,
36	0,	32,	02.84,	51.2788,	.3567,	5.00,	1922.84,
37	0,	32,	02.84,	52.1118,	.9221,	6.00,	1922.84,

[1] TRL = Target Run Length. Indicated in a value of 1 (*small*) target through 7 (*large target*).

38	0,	32,	02.84,	50.4299,	-.1134,	7.00,	1922.84,
39	0,	32,	07.45,	51.9112,	1.3966,	5.00,	1927.45,
40	0,	32,	07.45,	52.1104,	1.0021,	6.00,	1927.45,
41	0,	32,	07.45,	51.3088,	.3569,	7.00,	1927.45,
42	0,	32,	12.08,	52.1455,	.6827,	7.00,	1932.08,
43	0,	32,	12.08,	51.2799,	.1207,	7.00,	1932.08,
44	0,	32,	16.68,	52.1132,	.8422,	7.00,	1936.68,
45	0,	32,	16.68,	52.0518,	.9211,	6.00,	1936.68,
46	0,	32,	16.68,	50.7099,	-.1140,	5.00,	1936.68,
47	0,	32,	21.31,	52.0488,	1.0807,	7.00,	1941.31,
48	0,	32,	21.31,	50.4996,	-.1910,	5.00,	1941.31,
49	0,	32,	21.31,	50.8400,	.0417,	5.00,	1941.31,
50	0,	32,	21.31,	50.6796,	-.1917,	5.00,	1941.31,
51	0,	32,	21.31,	50.8400,	.0417,	5.00,	1941.31,
52	0,	32,	21.31,	50.6796,	-.1917,	5.00,	1941.31,
53	0,	32,	25.94,	52.2687,	1.0853,	5.00,	1945.94,
54	0,	32,	25.94,	52.1455,	.6827,	7.00,	1945.94,
55	0,	32,	30.55,	52.3018,	.9255,	6.00,	1950.55,
56	0,	32,	30.55,	52.1765,	.6030,	6.00,	1950.55,
57	0,	32,	35.18,	52.3392,	.2837,	5.00,	1955.18,
58	0,	32,	35.18,	52.2004,	1.0038,	7.00,	1955.18,
59	0,	32,	39.79,	52.1088,	1.0820,	5.00,	1959.79,
60	0,	32,	39.79,	52.2987,	1.0859,	5.00,	1959.79,
61	0,	32,	49.02,	52.2403,	1.0046,	7.00,	1969.02,
62	0,	32,	53.65,	52.2781,	.4438,	7.00,	1973.65,
63	0,	32,	58.25,	52.3065,	.6045,	5.00,	1978.25,
64	0,	32,	58.25,	51.5296,	.2003,	4.00,	1978.25,
65	0,	33,	02.89,	52.3944,	.7663,	5.00,	1982.89,
66	0,	33,	02.89,	52.3032,	.8452,	5.00,	1982.89,
67	0,	33,	07.51,	52.2987,	1.0859,	5.00,	1987.51,
68	0,	33,	12.12,	52.4974,	.5262,	6.00,	1992.12,

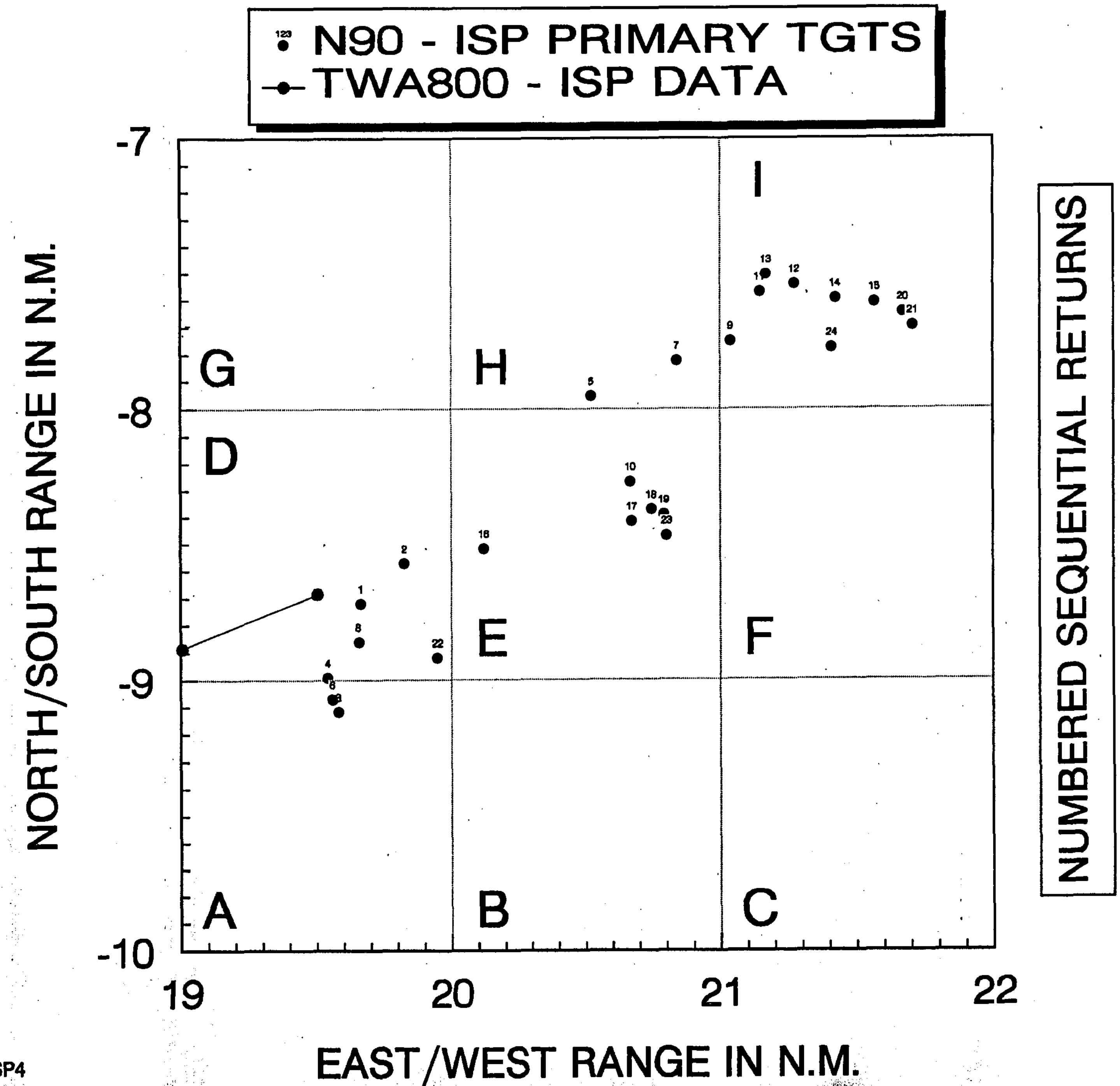
ATTACHMENT #5

Filename: FAA-HPN1.DAT

	TIME			XCOORD	YCOORD	TRL[1]	TOTIM
1	0,	31,	14.54,	47.3303,	-25.1555,	7.00,	1874.54,
2	0,	31,	33.34,	47.3599,	-25.5452,	3.00,	1893.34,
3	0,	31,	33.34,	47.7938,	-25.0270,	1.00,	1893.34,
4	0,	31,	38.03,	47.7111,	-25.0770,	2.00,	1898.03,
5	0,	31,	38.03,	47.9267,	-25.0966,	1.00,	1898.03,
6	0,	31,	42.58,	48.4985,	-24.6425,	1.00,	1902.58,
7	0,	31,	42.58,	48.9408,	-24.1162,	4.00,	1902.58,
8	0,	31,	47.42,	47.3462,	-25.4441,	7.00,	1907.42,
9	0,	31,	51.97,	48.2311,	-24.5066,	1.00,	1911.97,
10	0,	31,	51.97,	48.9778,	-24.0411,	3.00,	1911.97,
11	0,	31,	52.11,	47.7817,	-24.8341,	1.00,	1912.11,
12	0,	32,	15.60,	47.4343,	-25.4914,	1.00,	1935.60,
13	0,	32,	25.01,	47.4391,	-25.5879,	1.00,	1945.01,
14	0,	32,	34.42,	47.4438,	-25.6844,	1.00,	1954.42,

[1] TRL = Target Run Length. Indicated in a value of 1 (*small*) target through 7 (*large target*).

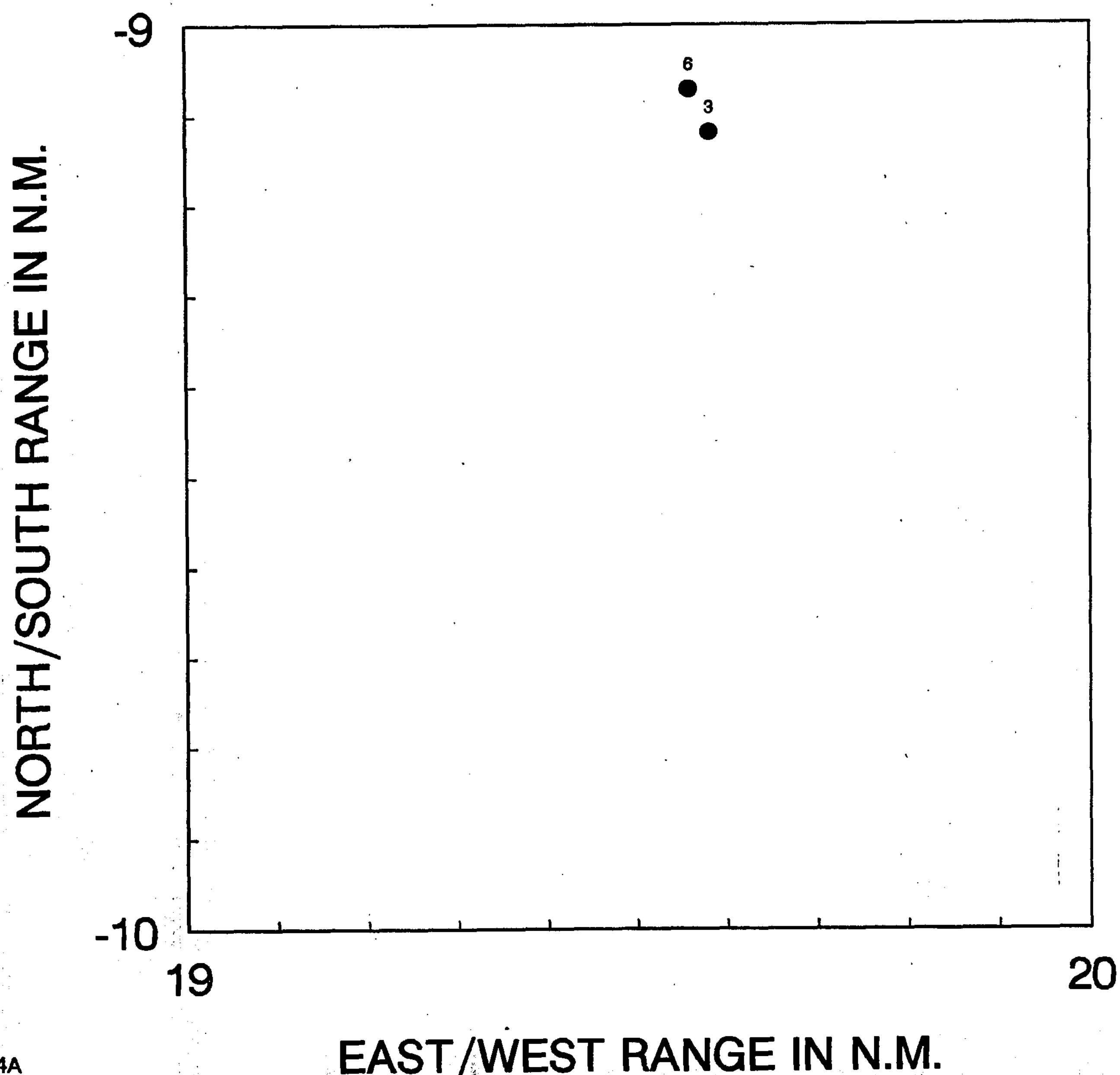
ATTACHMENT #6



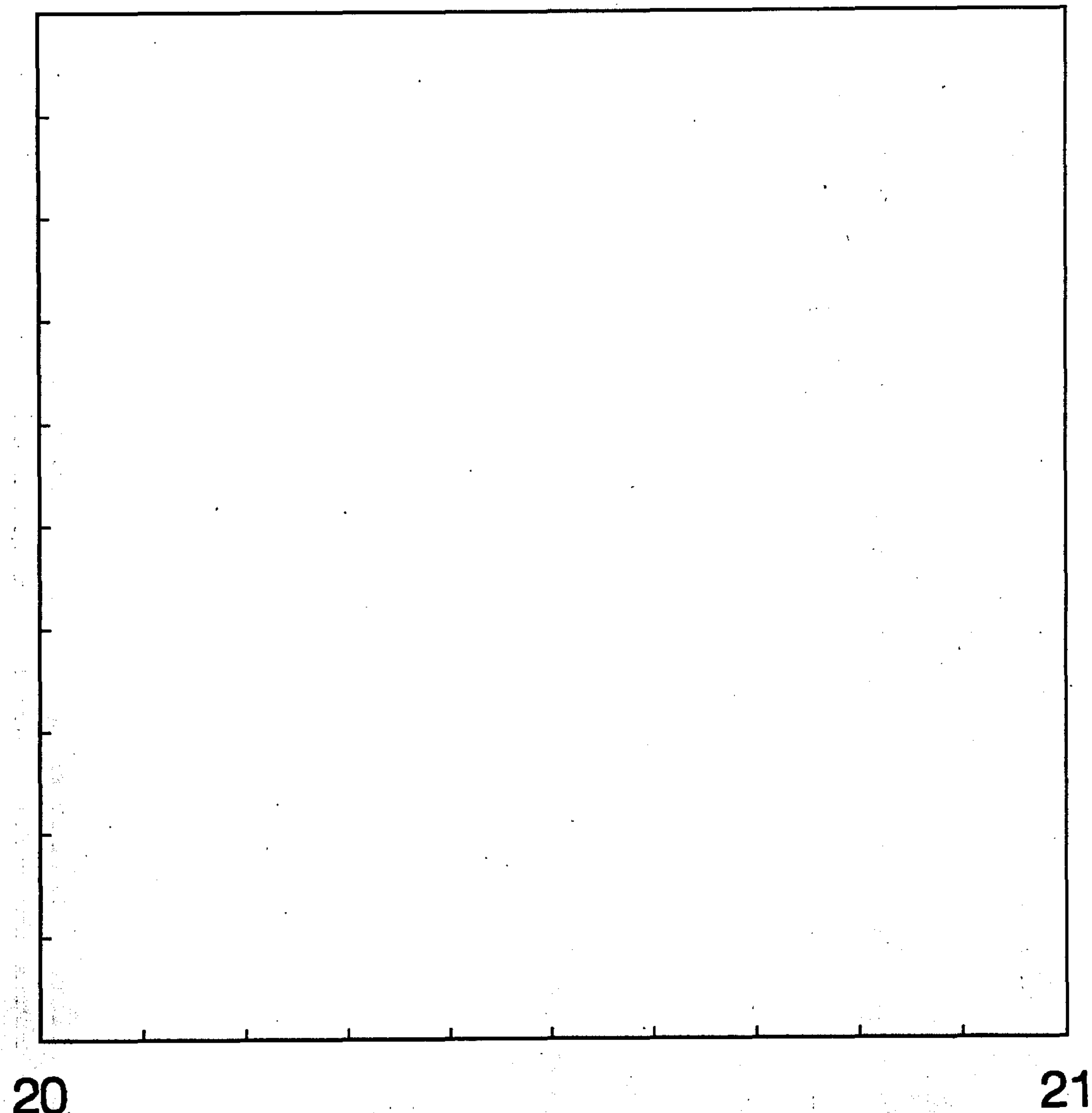
N90 - ISP PRIMARY TGTS
TWA800 - ISP DATA
NORTH/SOUTH RANGE IN N.M.
EAST/WEST RANGE IN N.M.
NUMBERED SEQUENTIAL RETURNS
-7
-8
-9
-10
19
20
21
22
A
B
C
D
E
F
G
H
I

TWAISP4

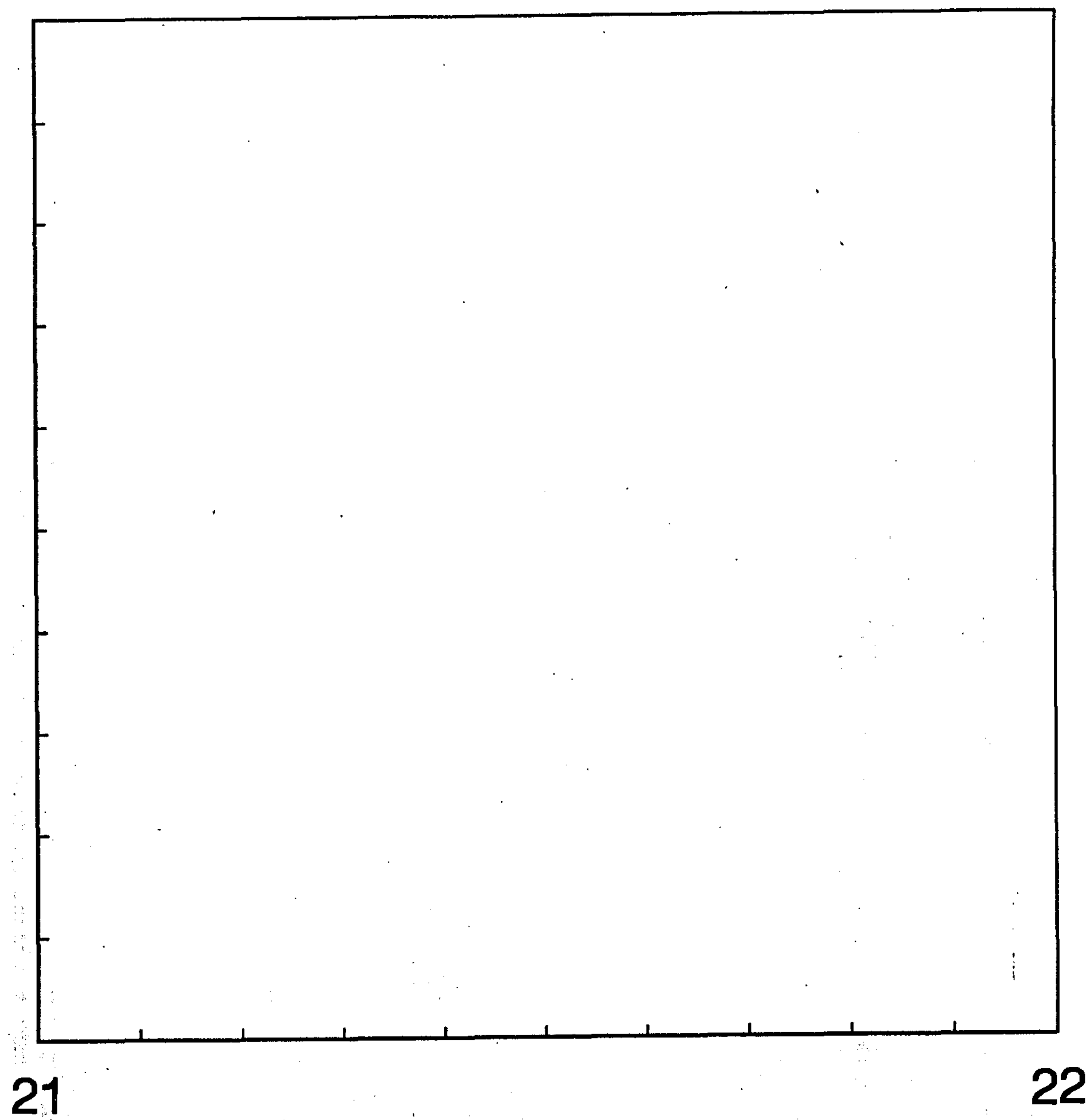
ATTACHMENT #7



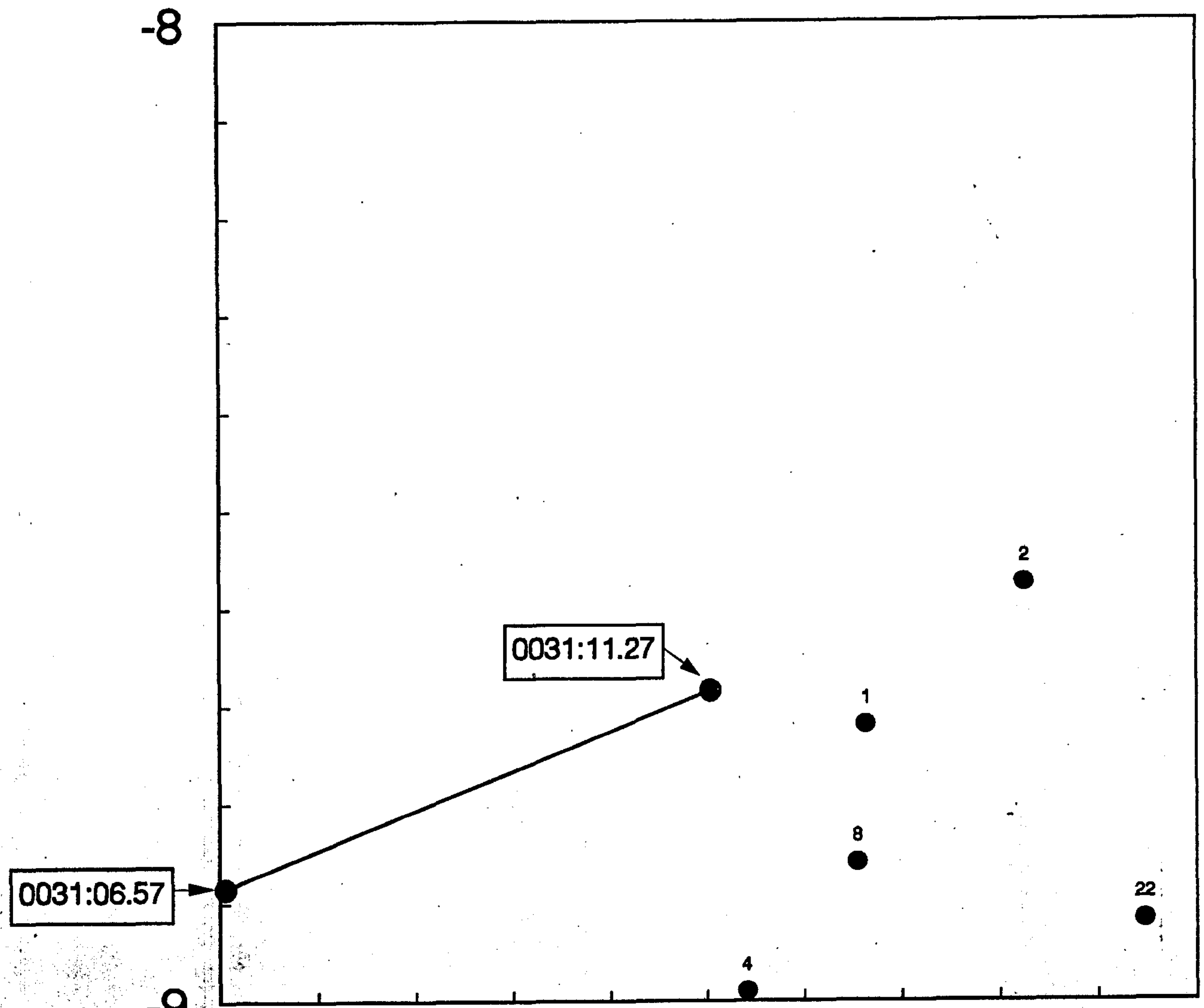
TWAISP4A



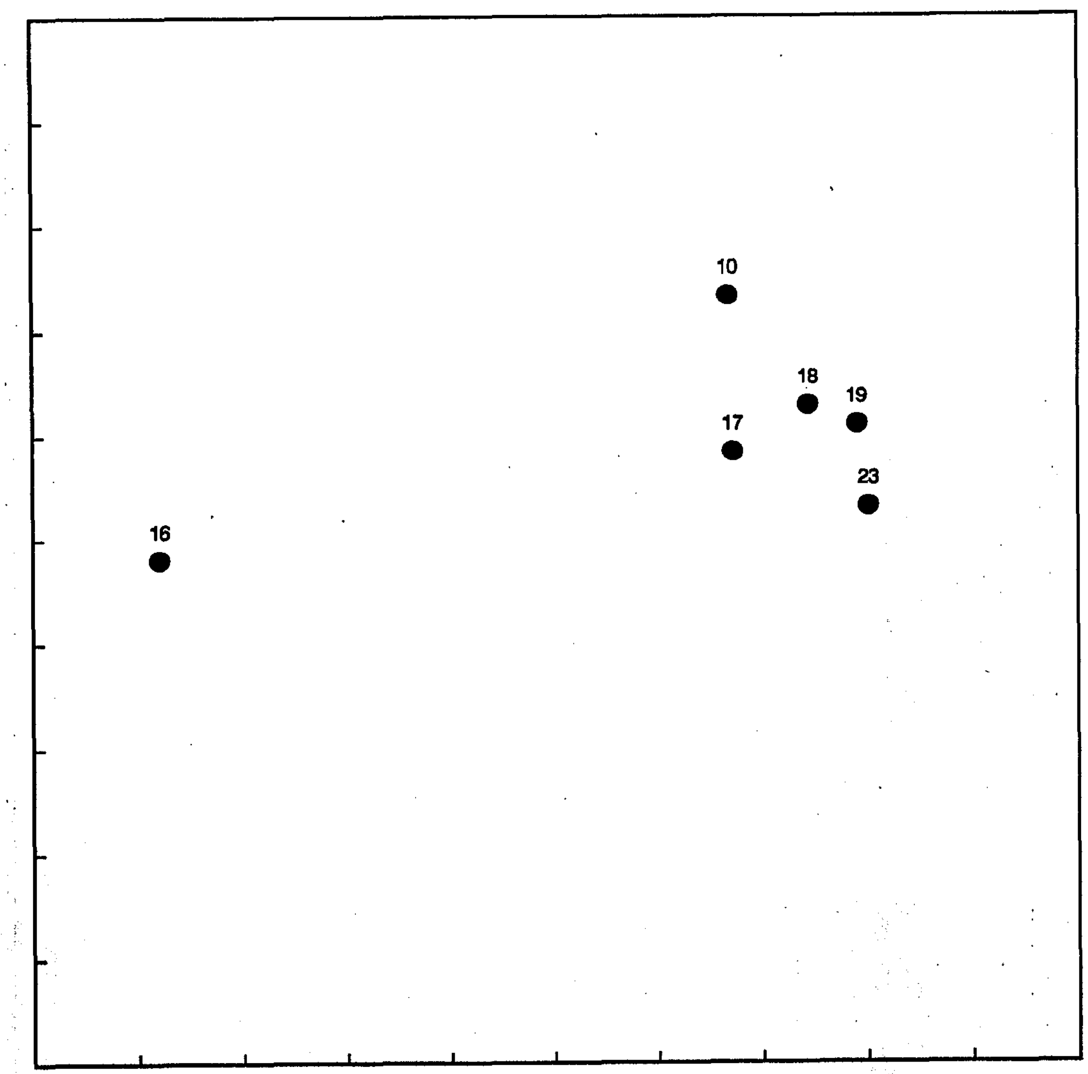
TWAISP4B



TWAISP4C

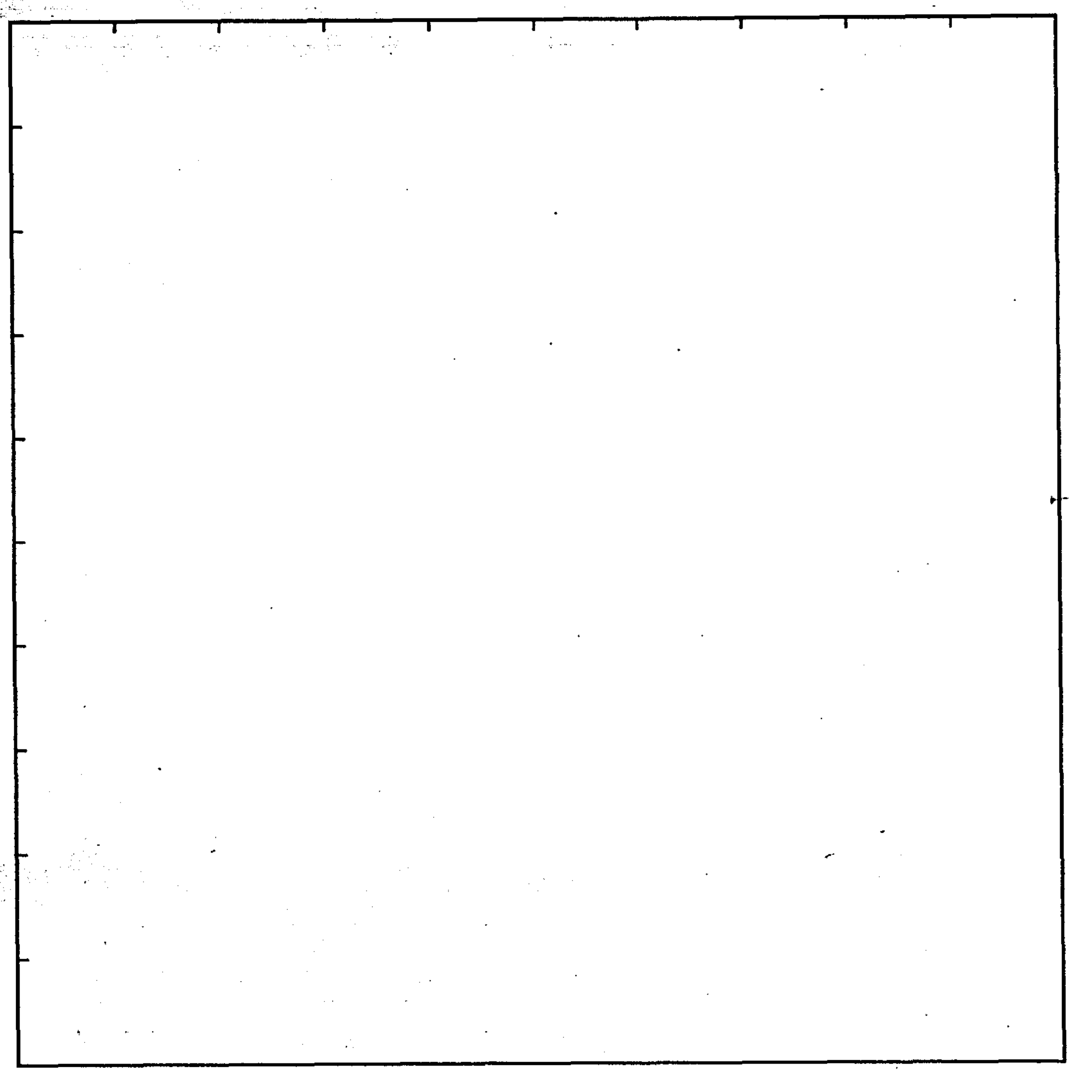


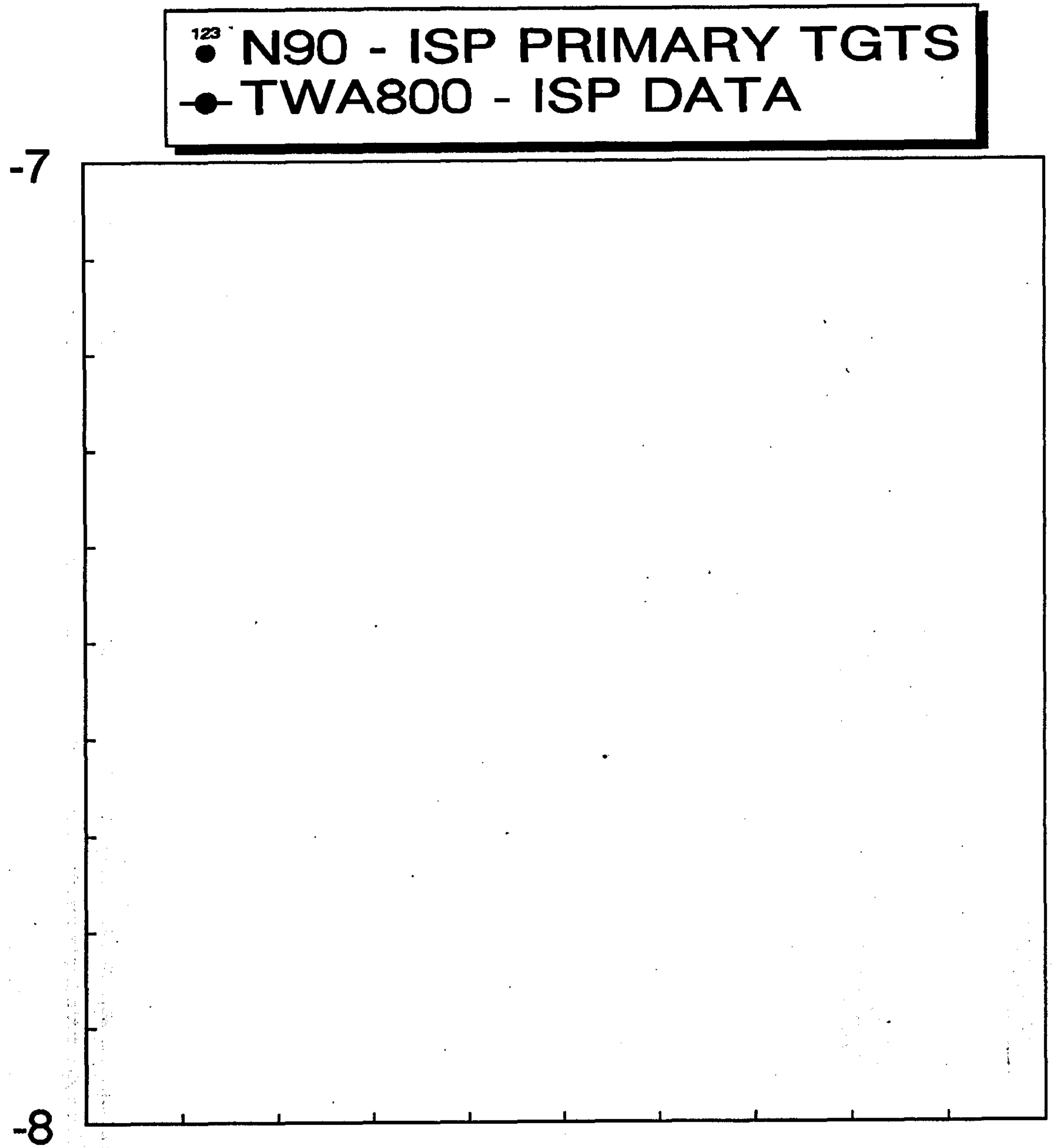
TWAISP4D



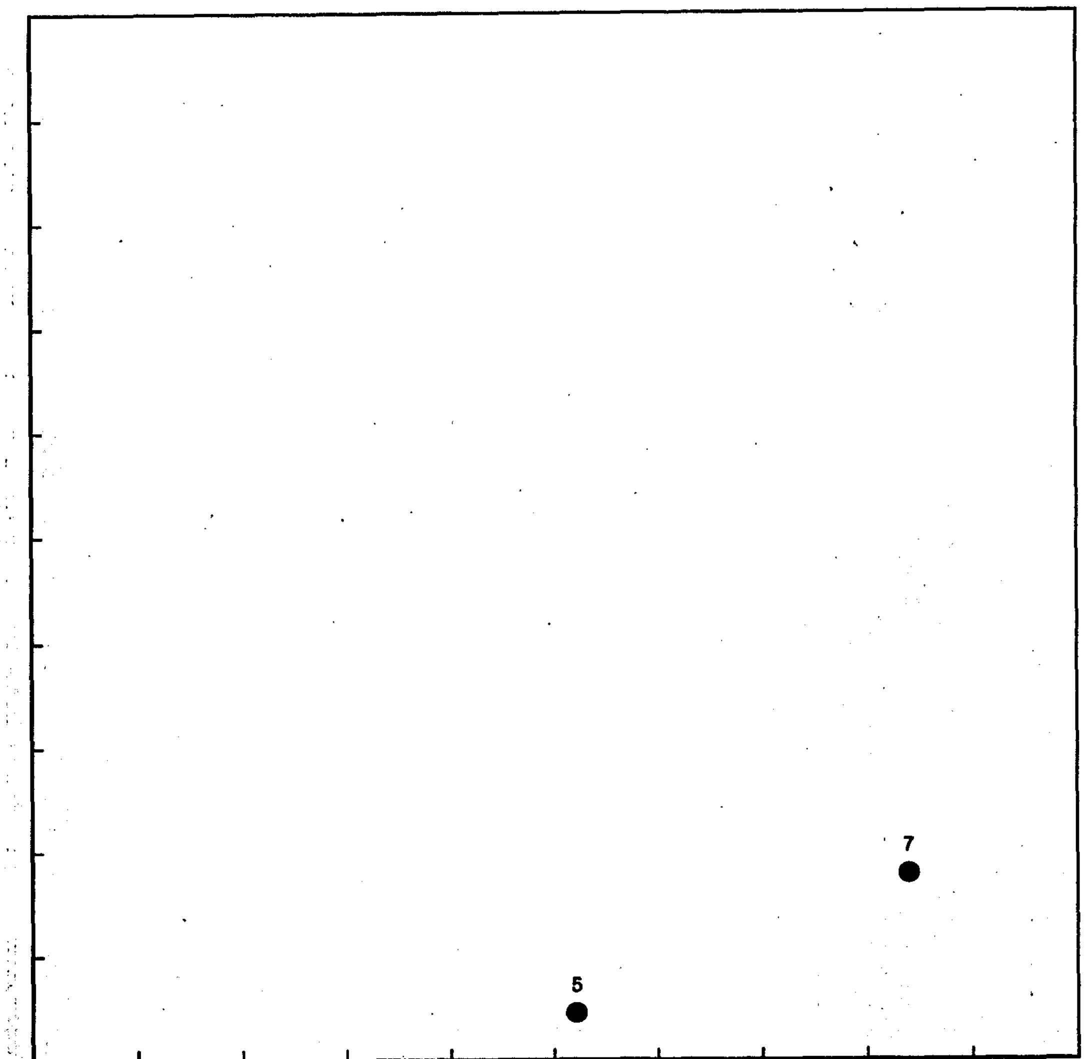
TWAISP4E

TWAISP4F



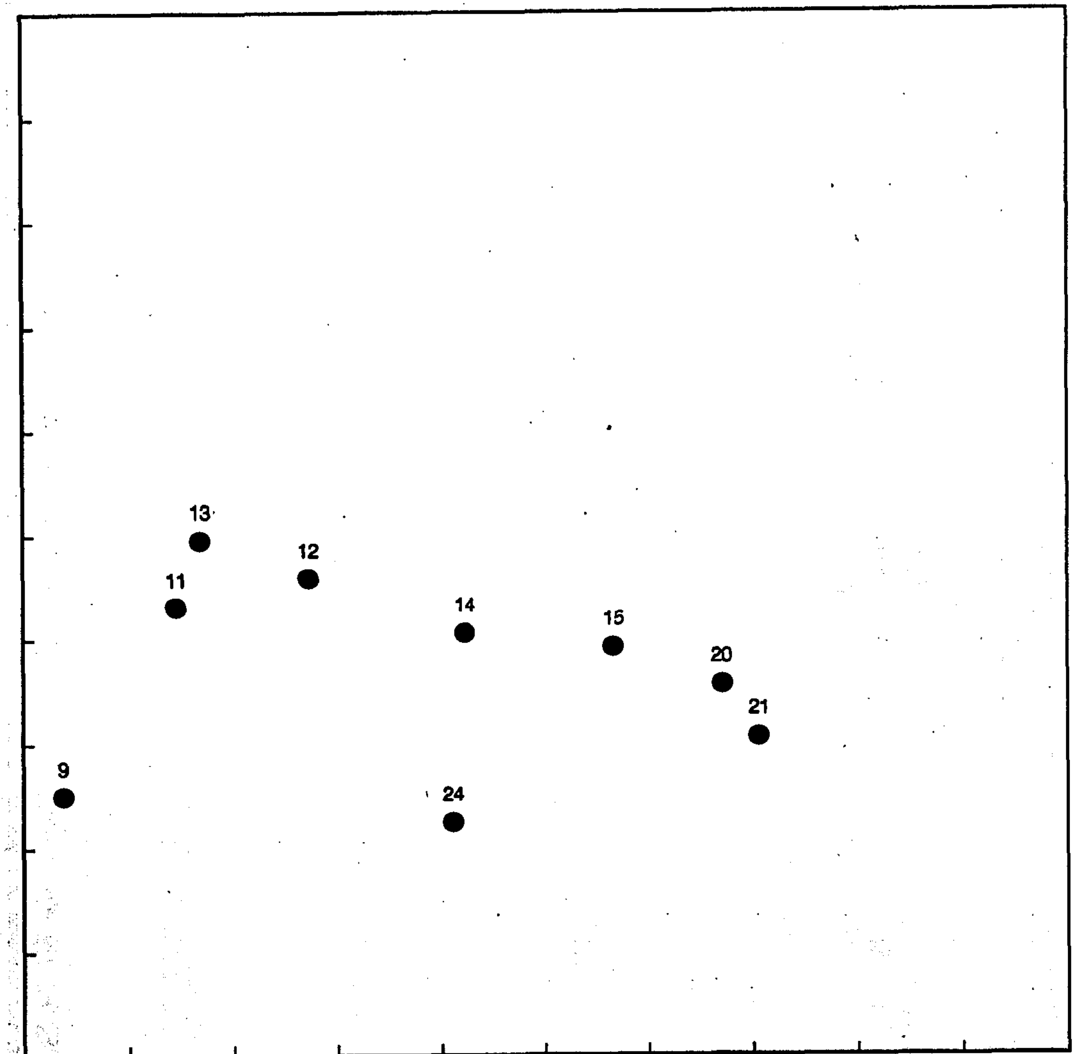


TWAISP4G



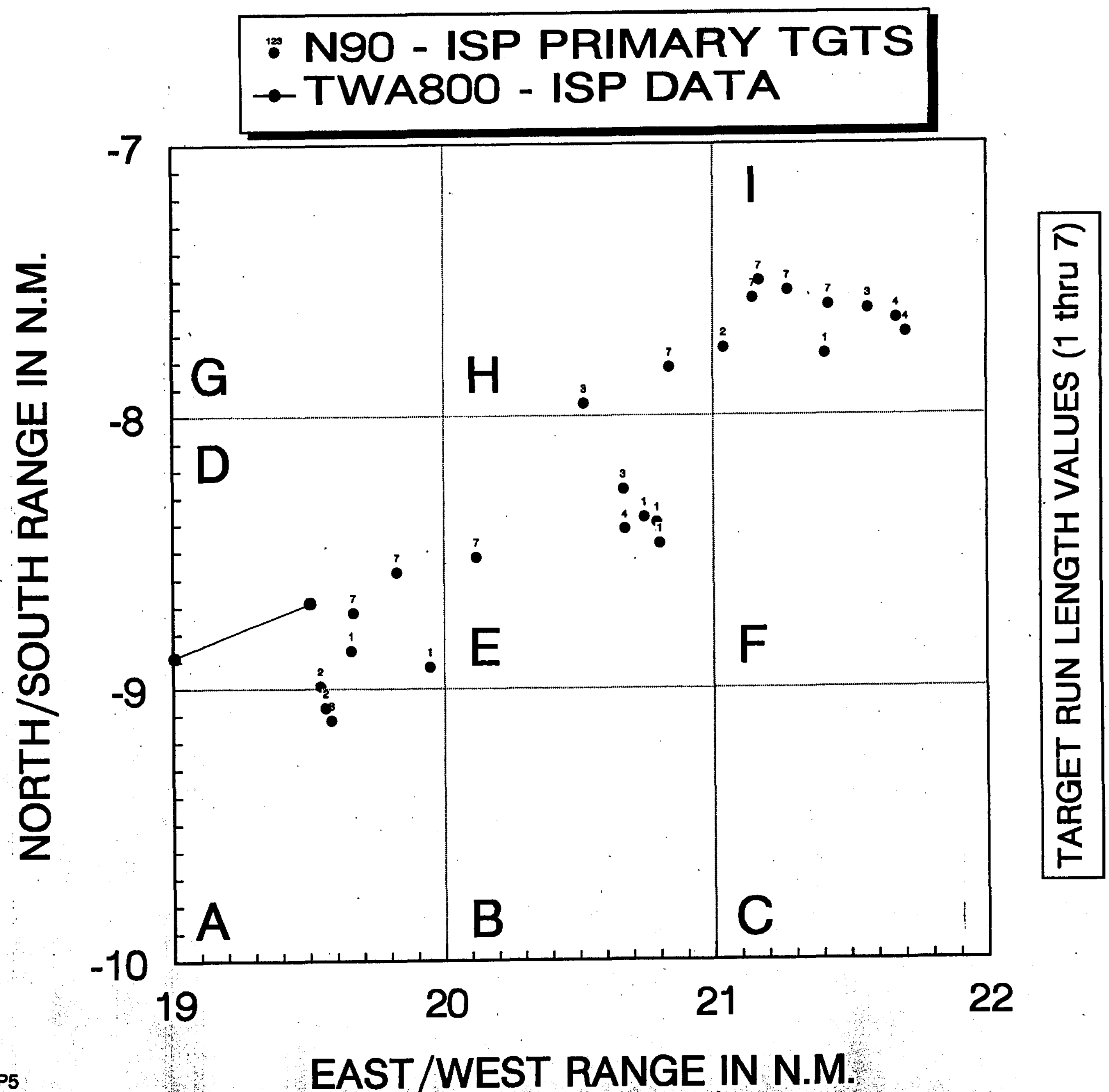
TWAISP4H

NUMBERED SEQUENTIAL RETURNS



TWAISP4I

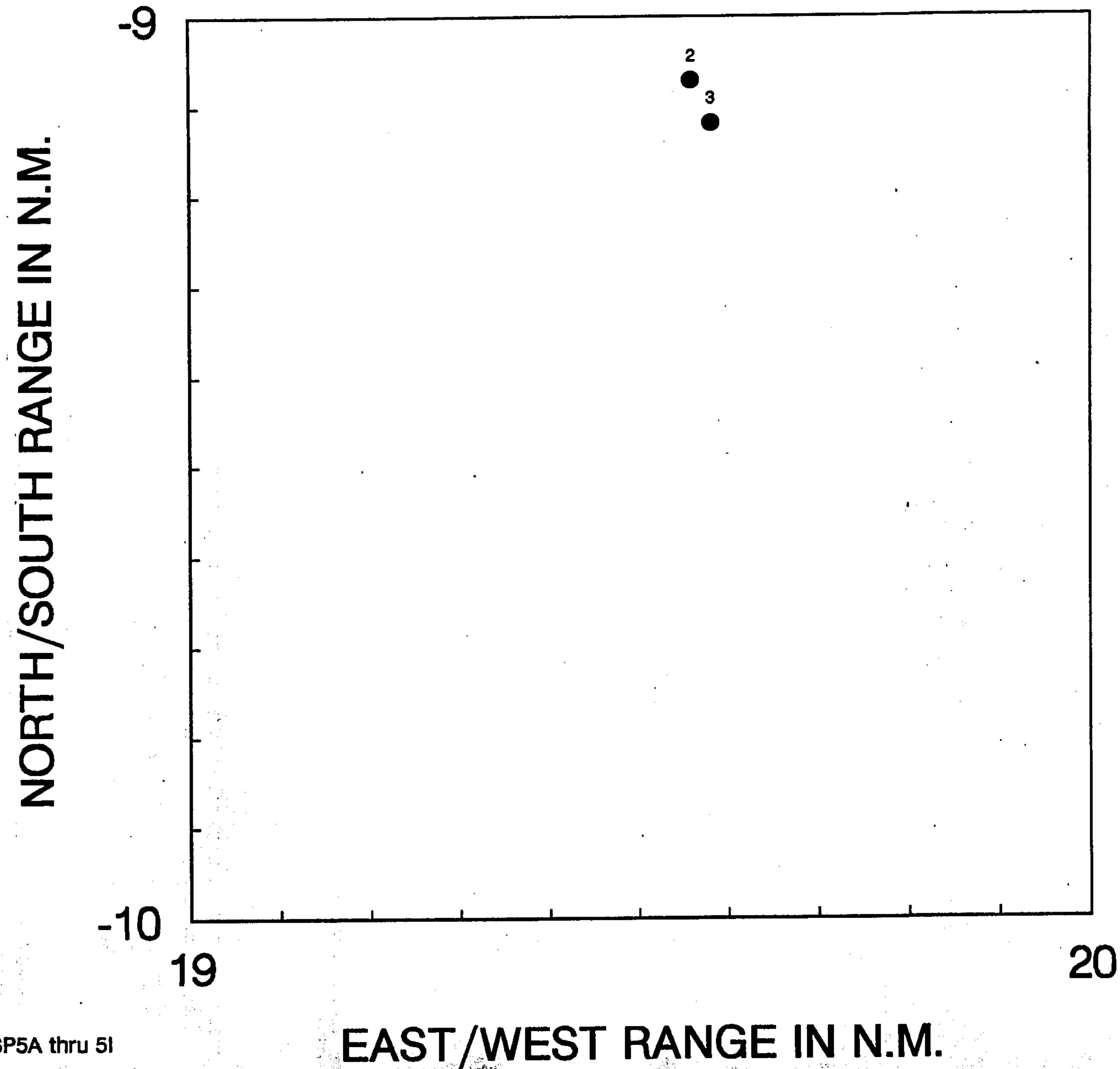
ATTACHMENT #8



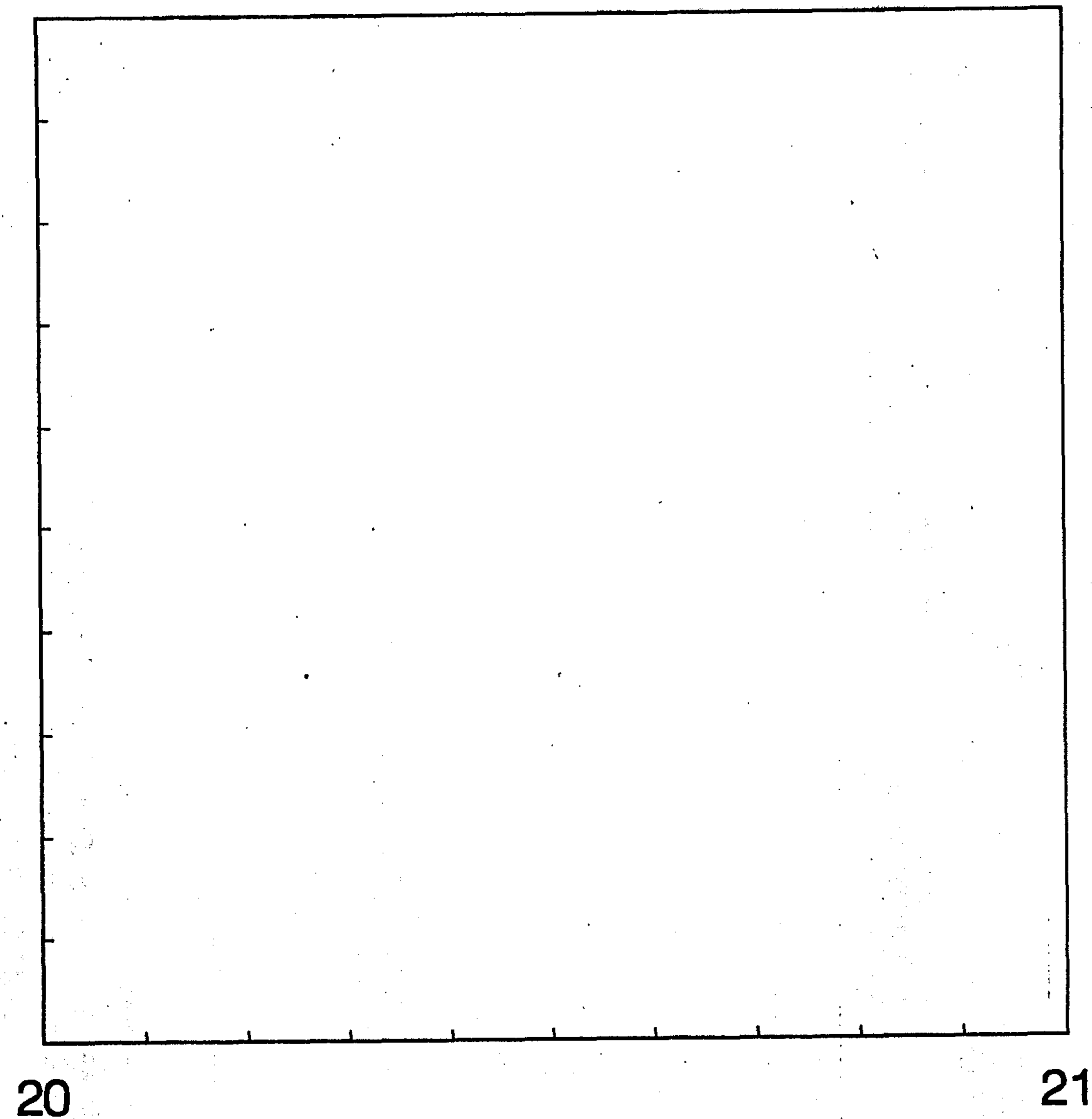
N90 - ISP PRIMARY TGTS
TWA800 - ISP DATA
NORTH/SOUTH RANGE IN N.M.
EAST/WEST RANGE IN N.M.
TARGET RUN LENGTH VALUES (1 thru 7)
-7
-8
-9
-10
19
20
21
22
G
H
I
D
E
F
A
B
C

TWAISP5

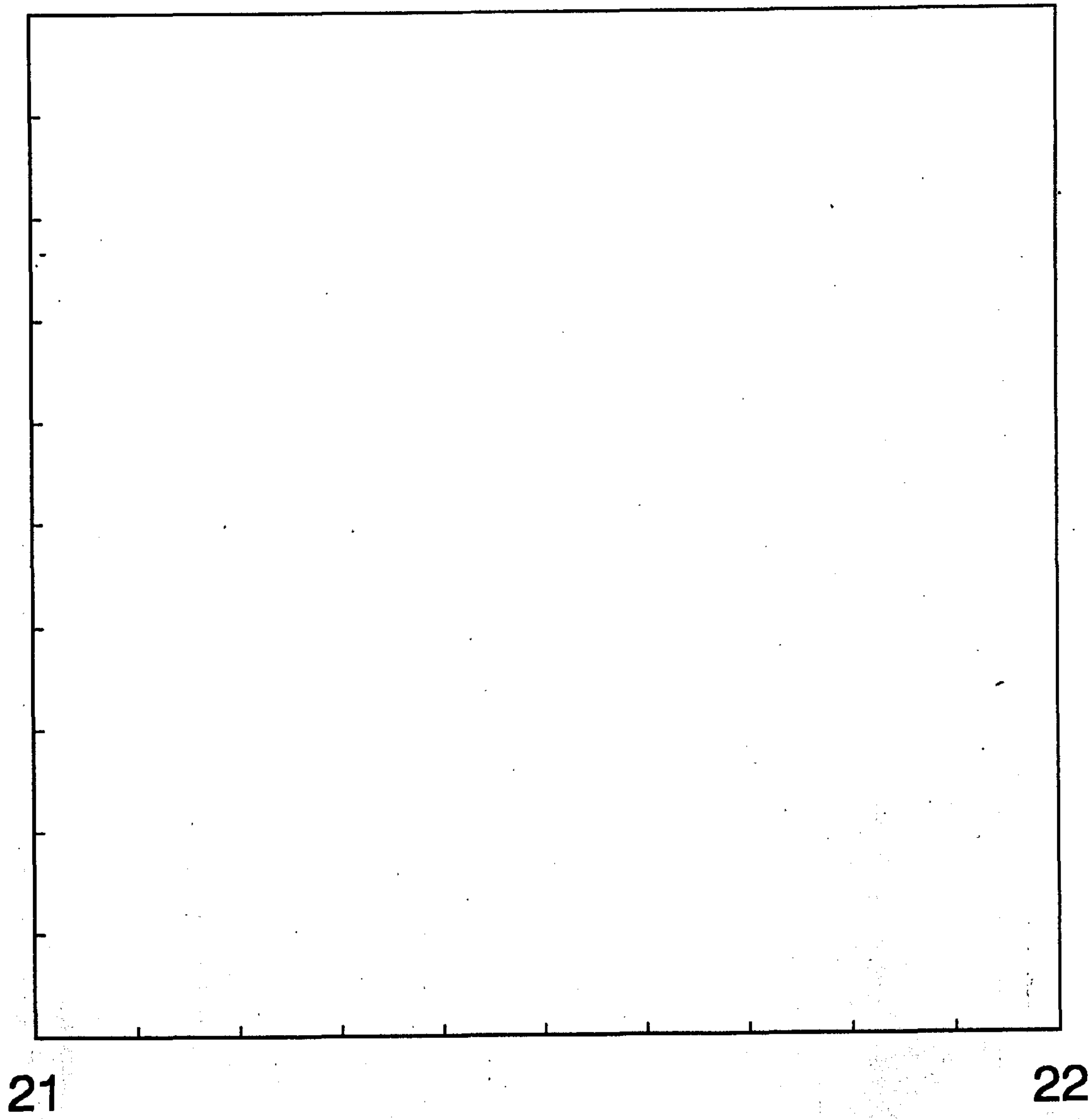
ATTACHMENT #9



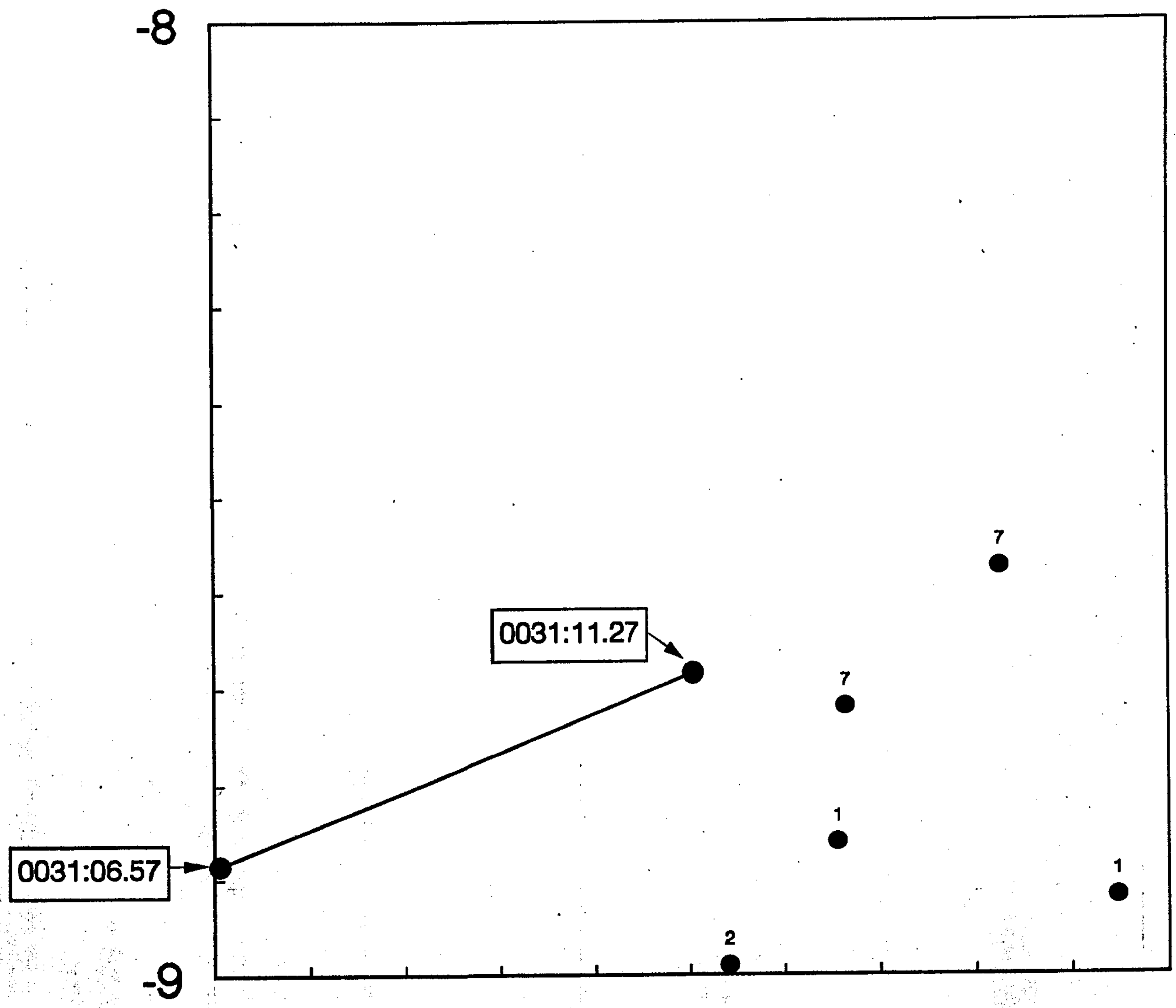
TWAISP5A thru 5I



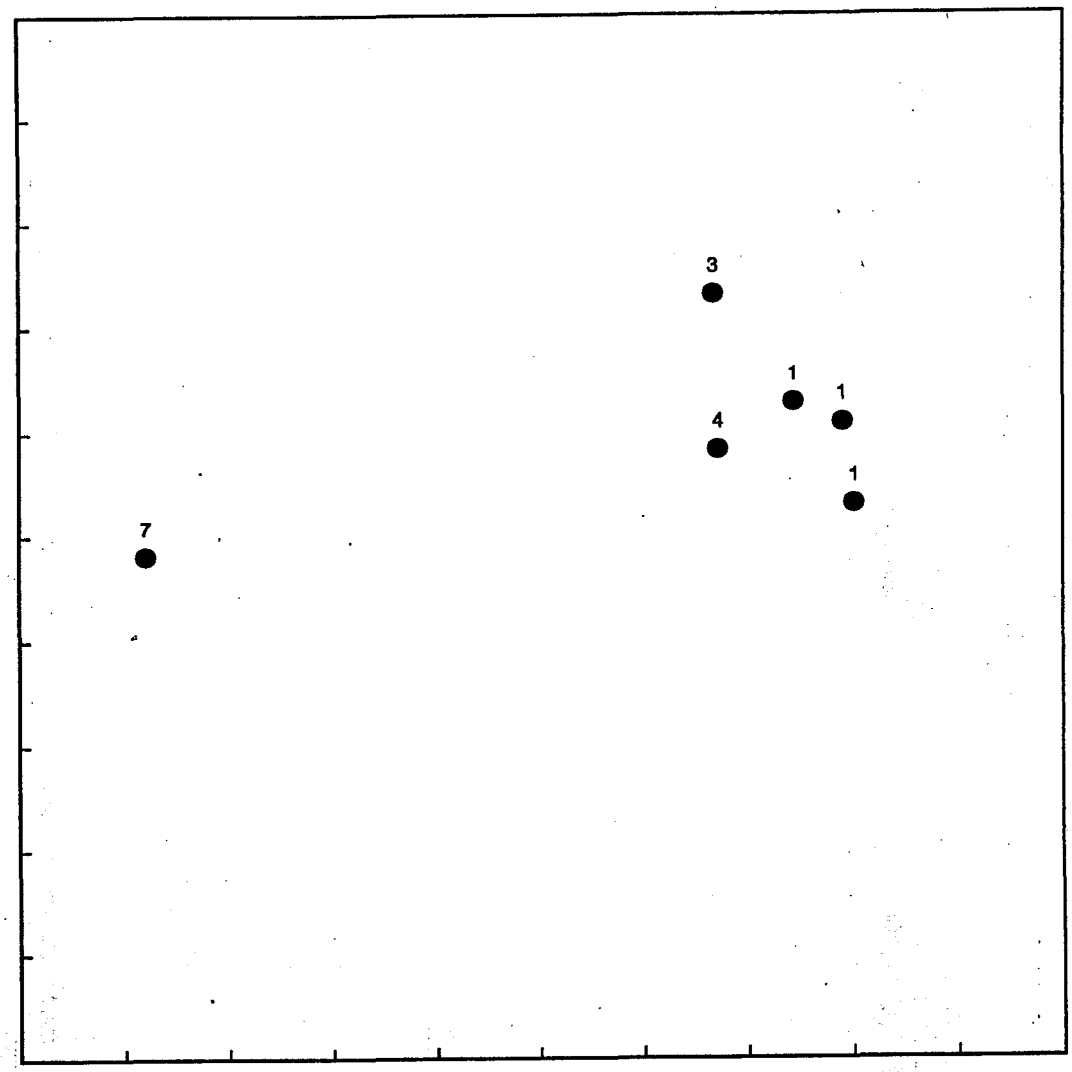
TWAISP5B



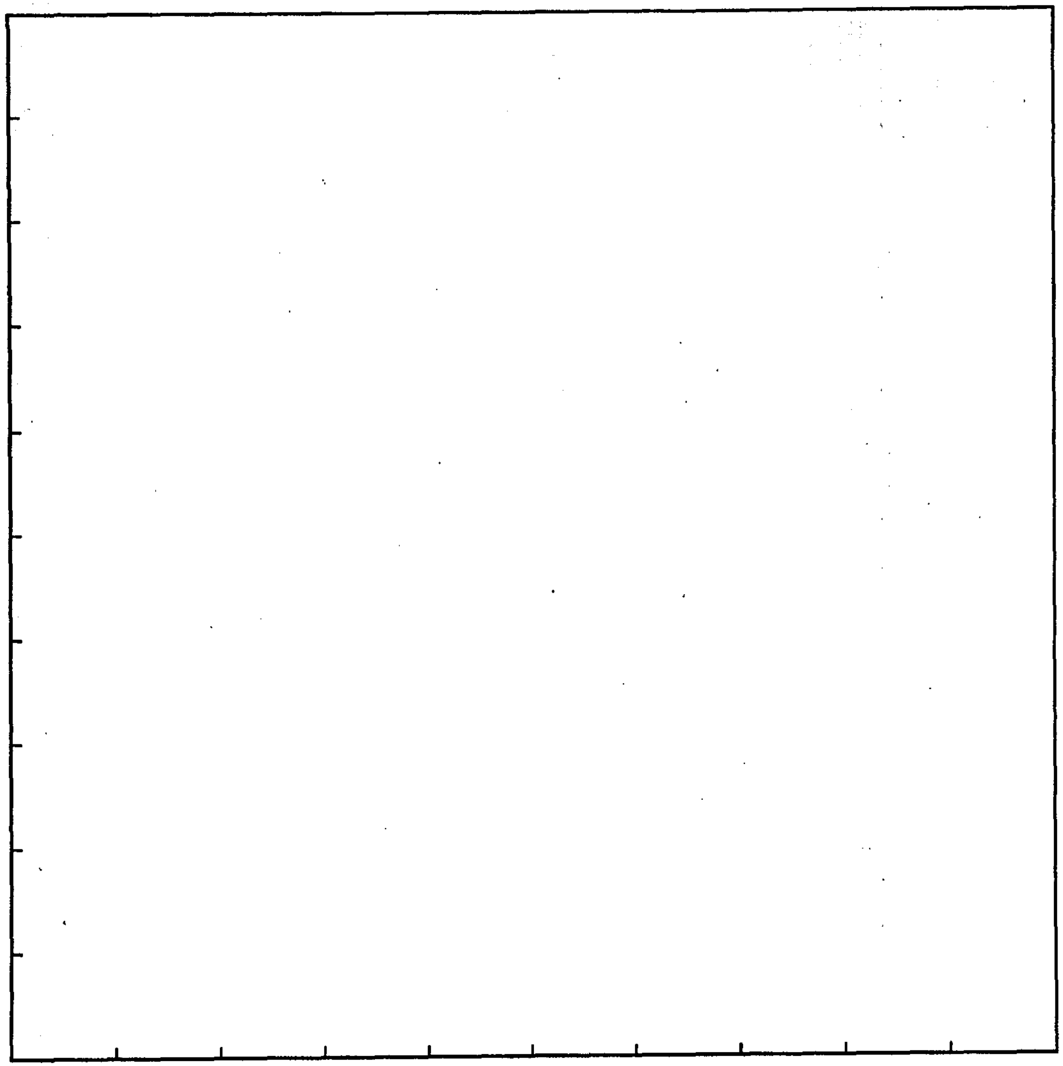
TWAISP5C



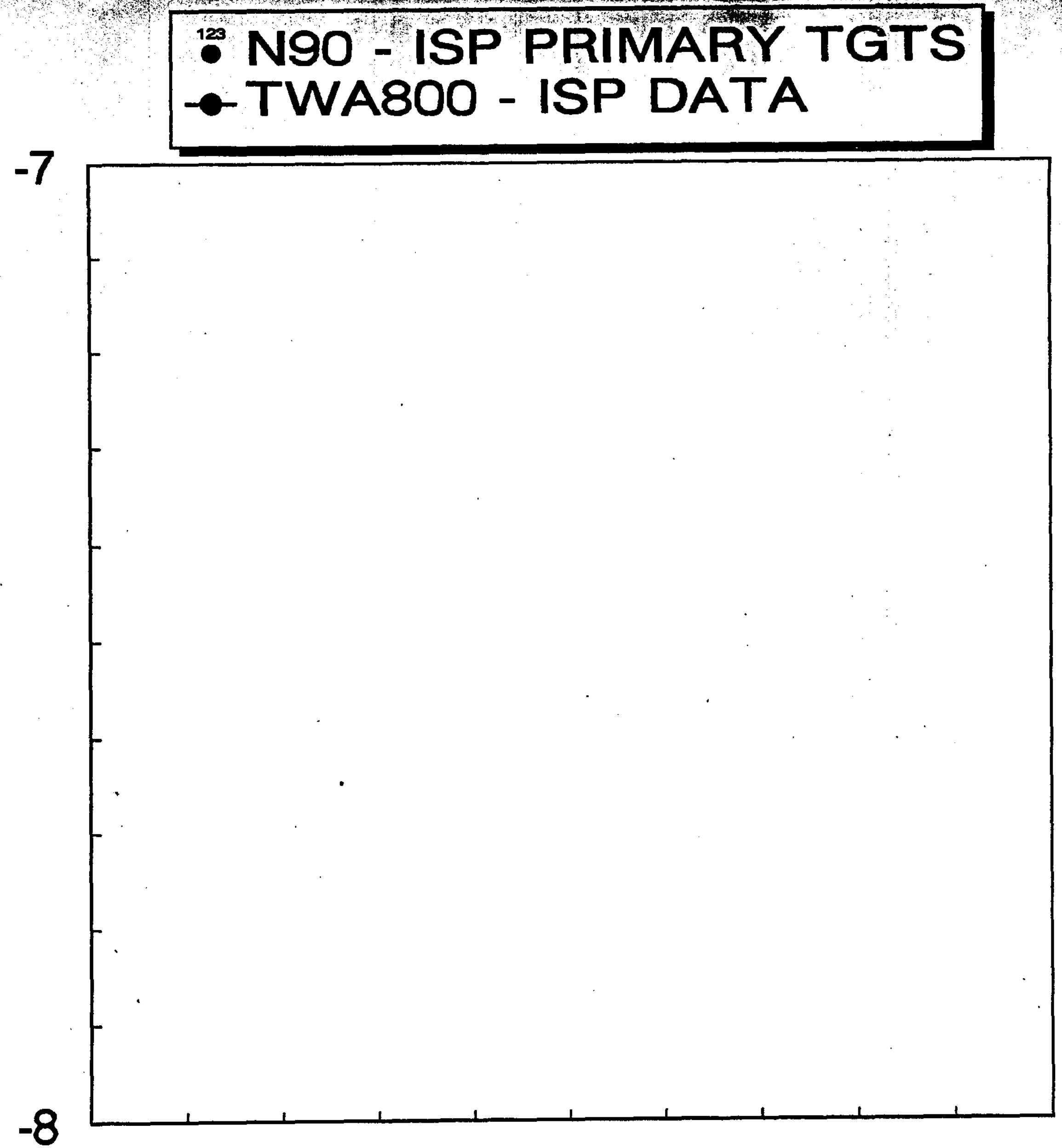
TWAISP5D



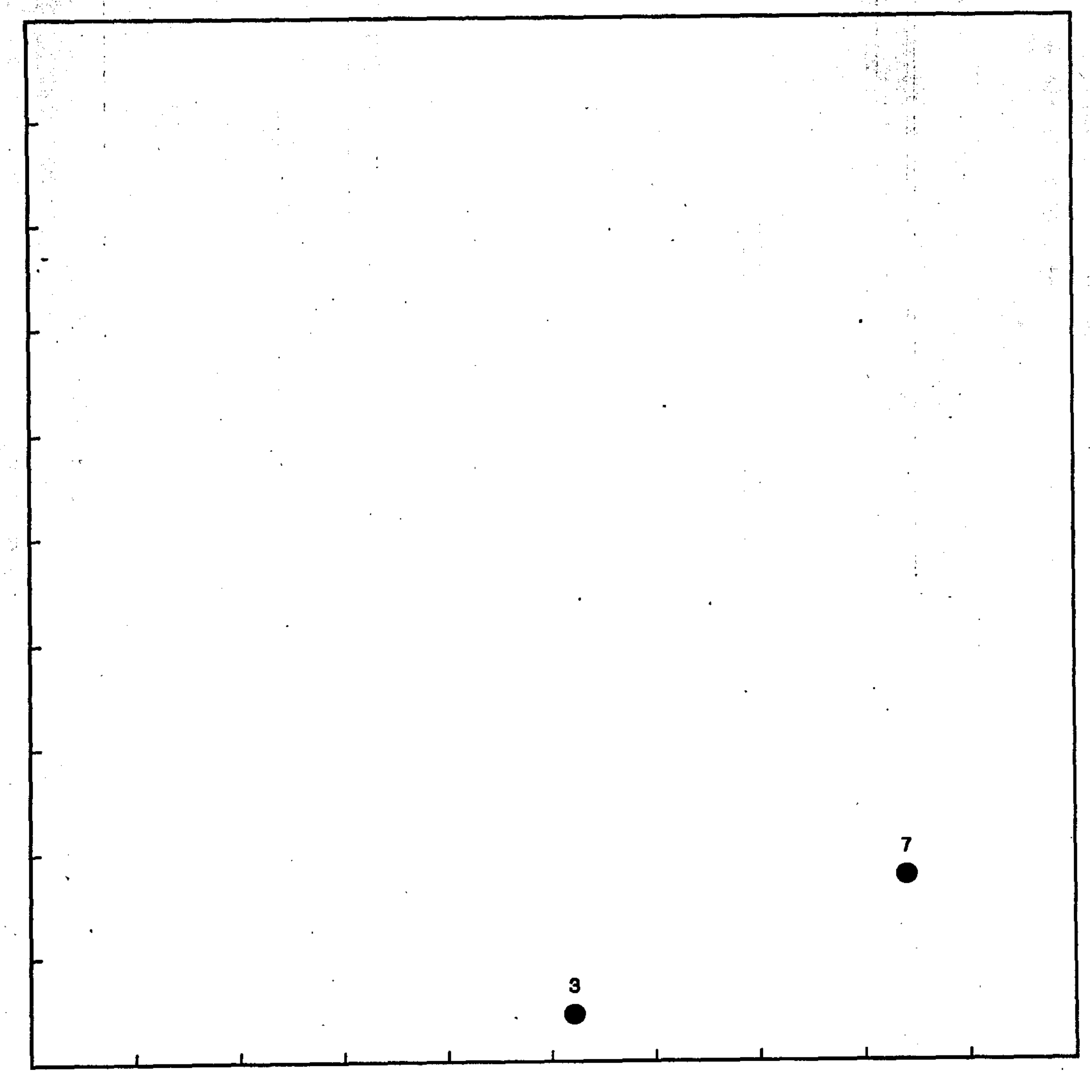
TWAISP5E



TWAISP5F

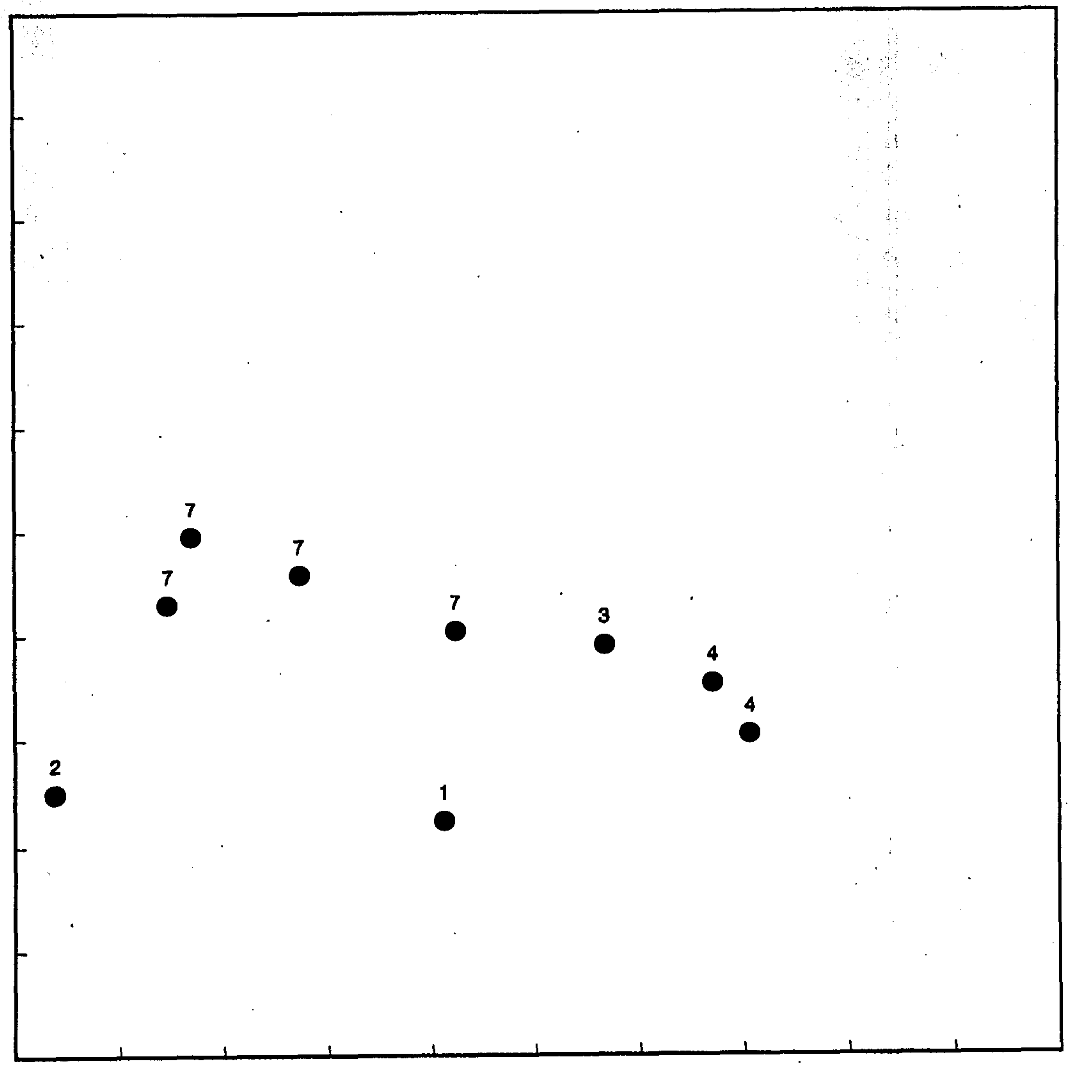


TWAISP5G



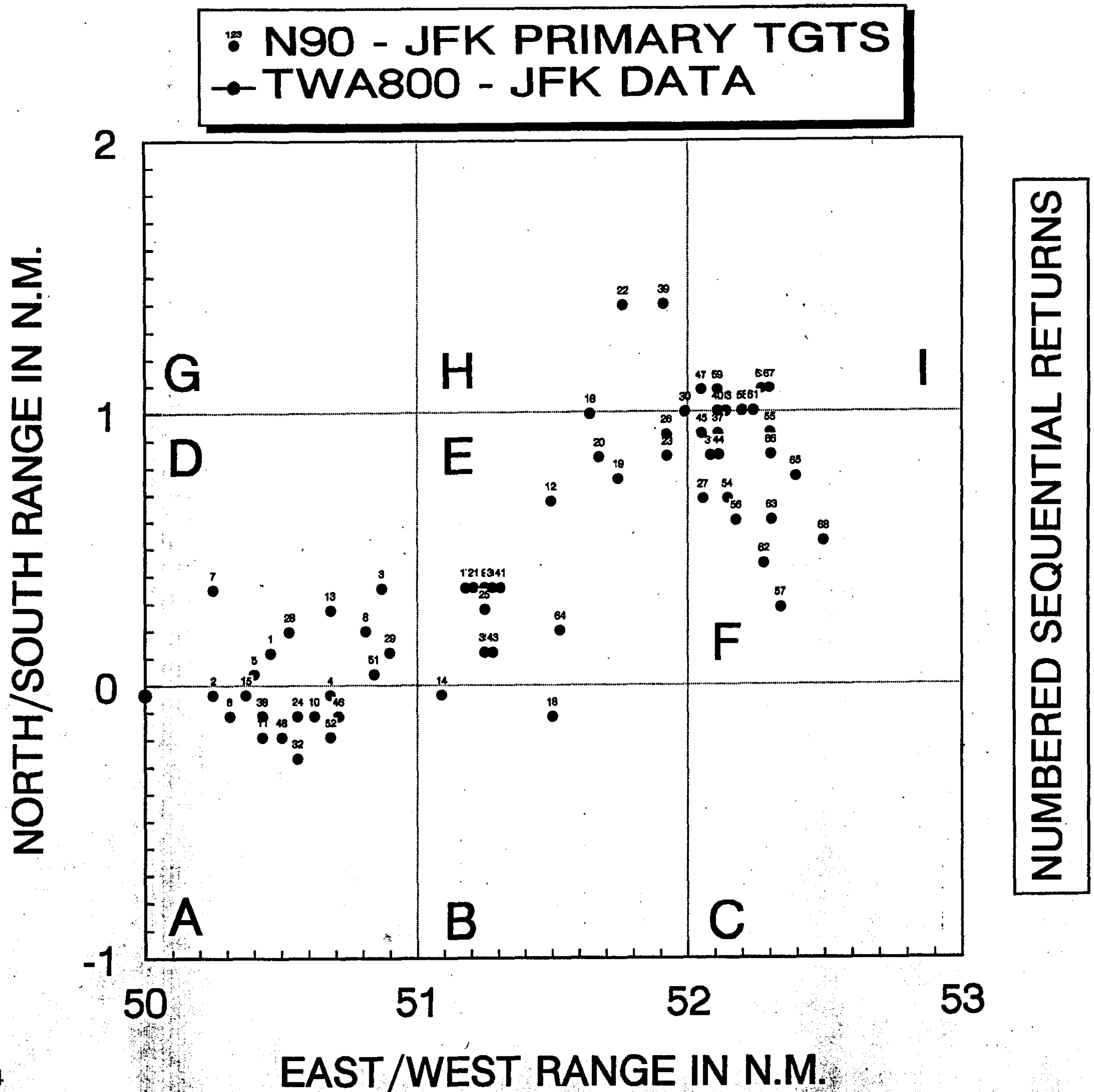
TWAISP5H

TARGET RUN LENGTH VALUES (1 thru 7)



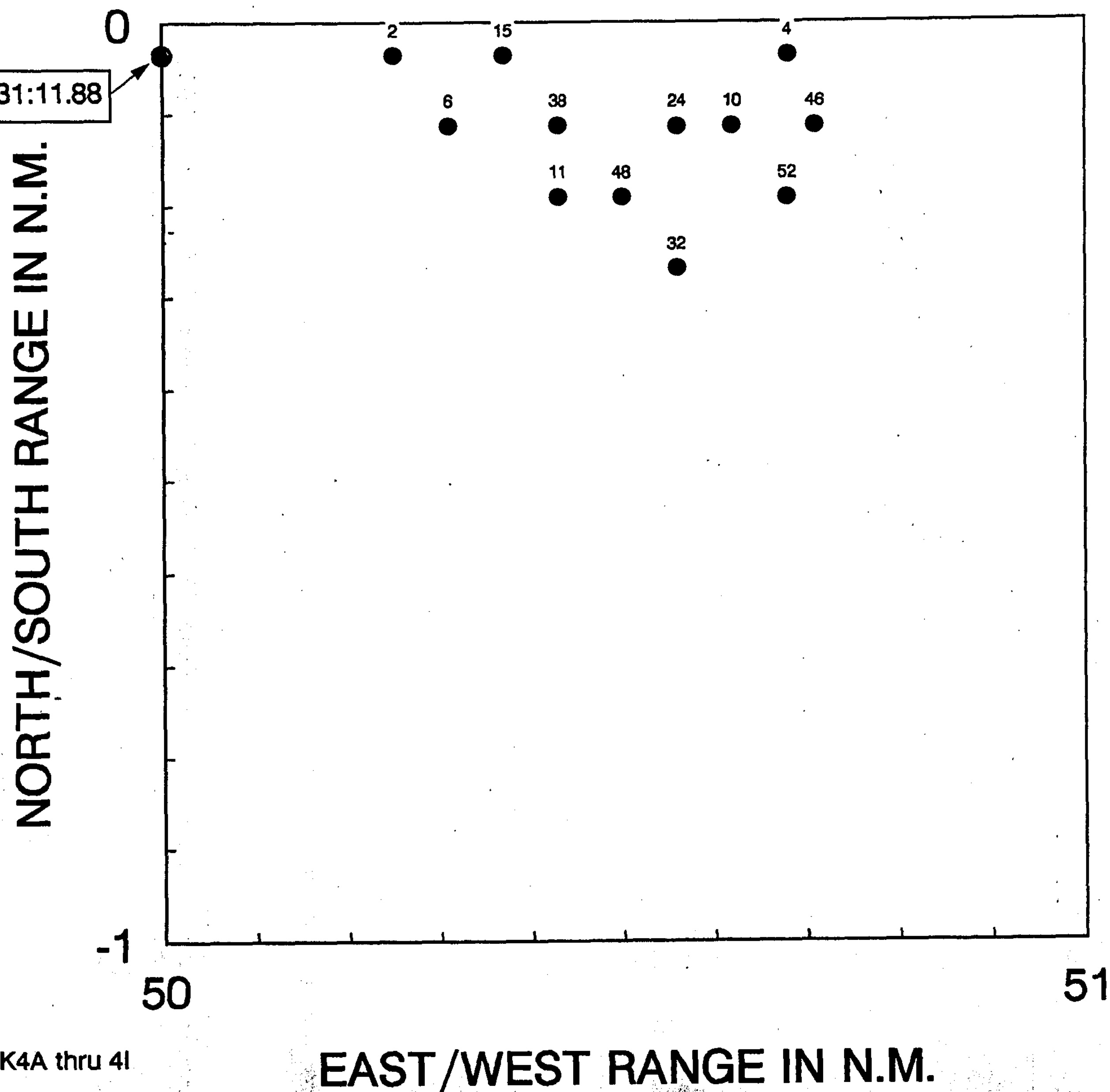
TWAISP5I

ATTACHMENT #10

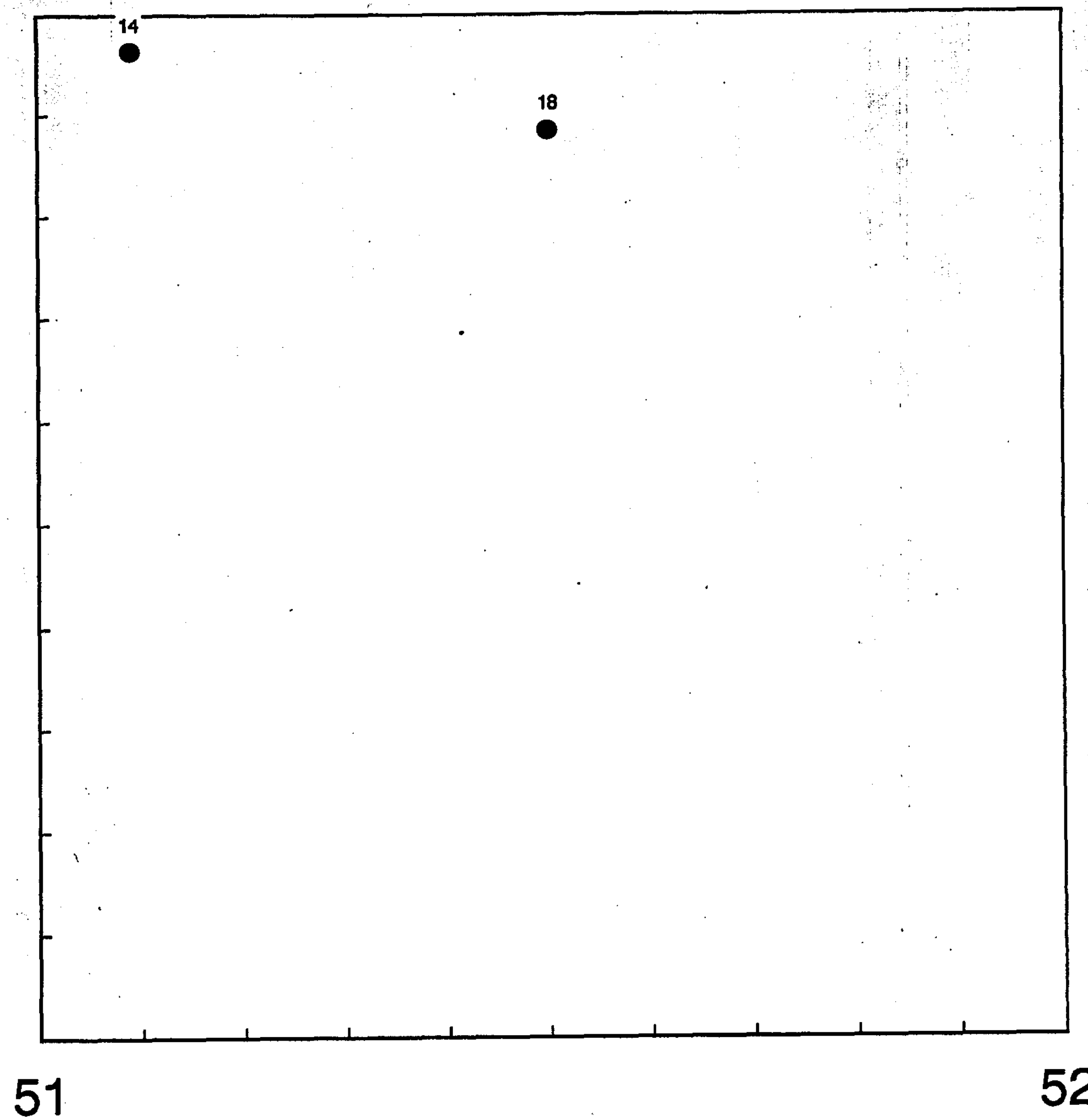

N90 - JFK PRIMARY TGTS
TWA800 - JFK DATA
NORTH/SOUTH RANGE IN N.M.
EAST/WEST RANGE IN N.M.
NUMBERED SEQUENTIAL RETURNS
2
1
0
-1
50
51
52
53
G
H
I
D
E
F
A
B
C

TWAJFK4

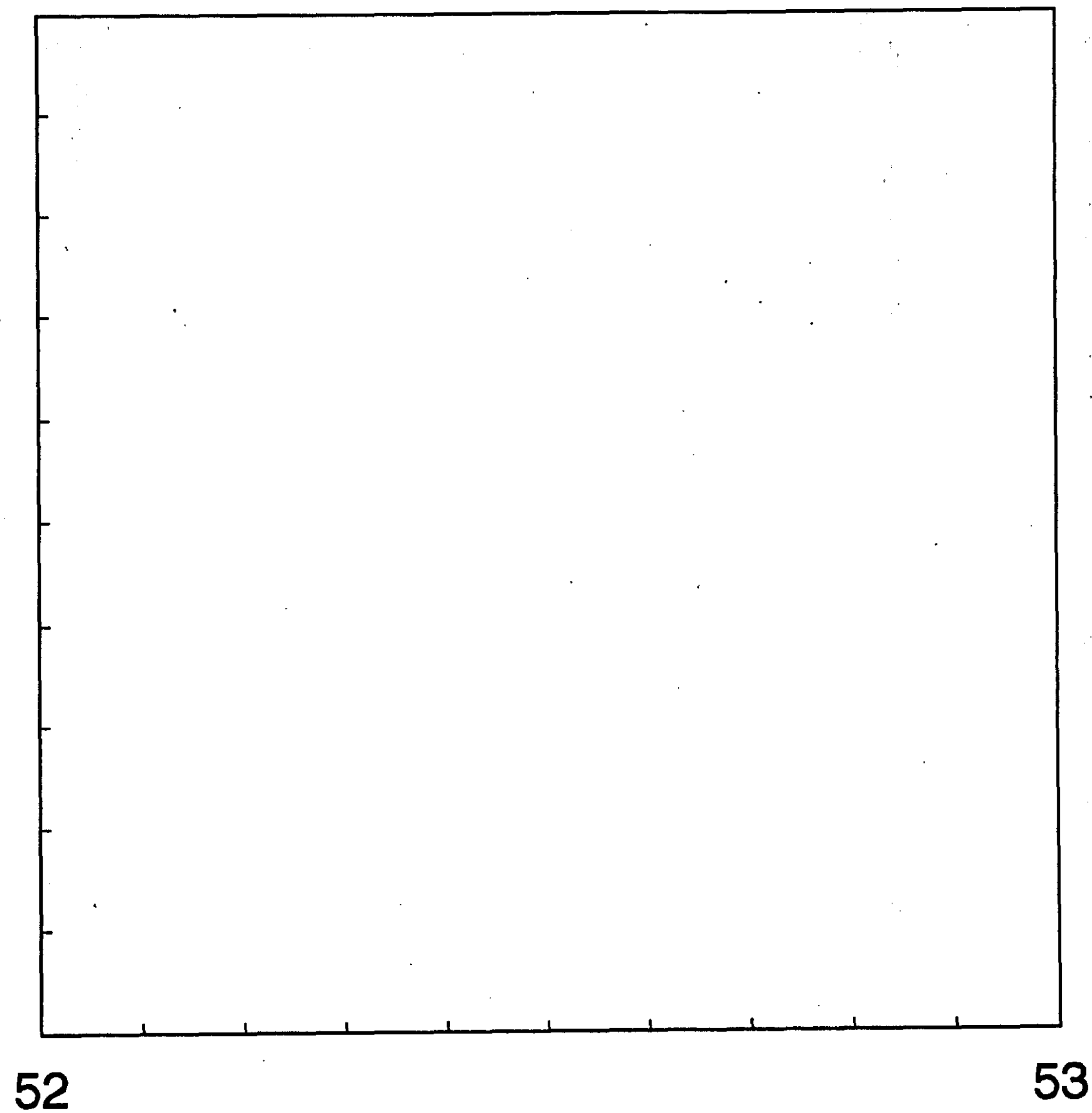
ATTACHMENT #11



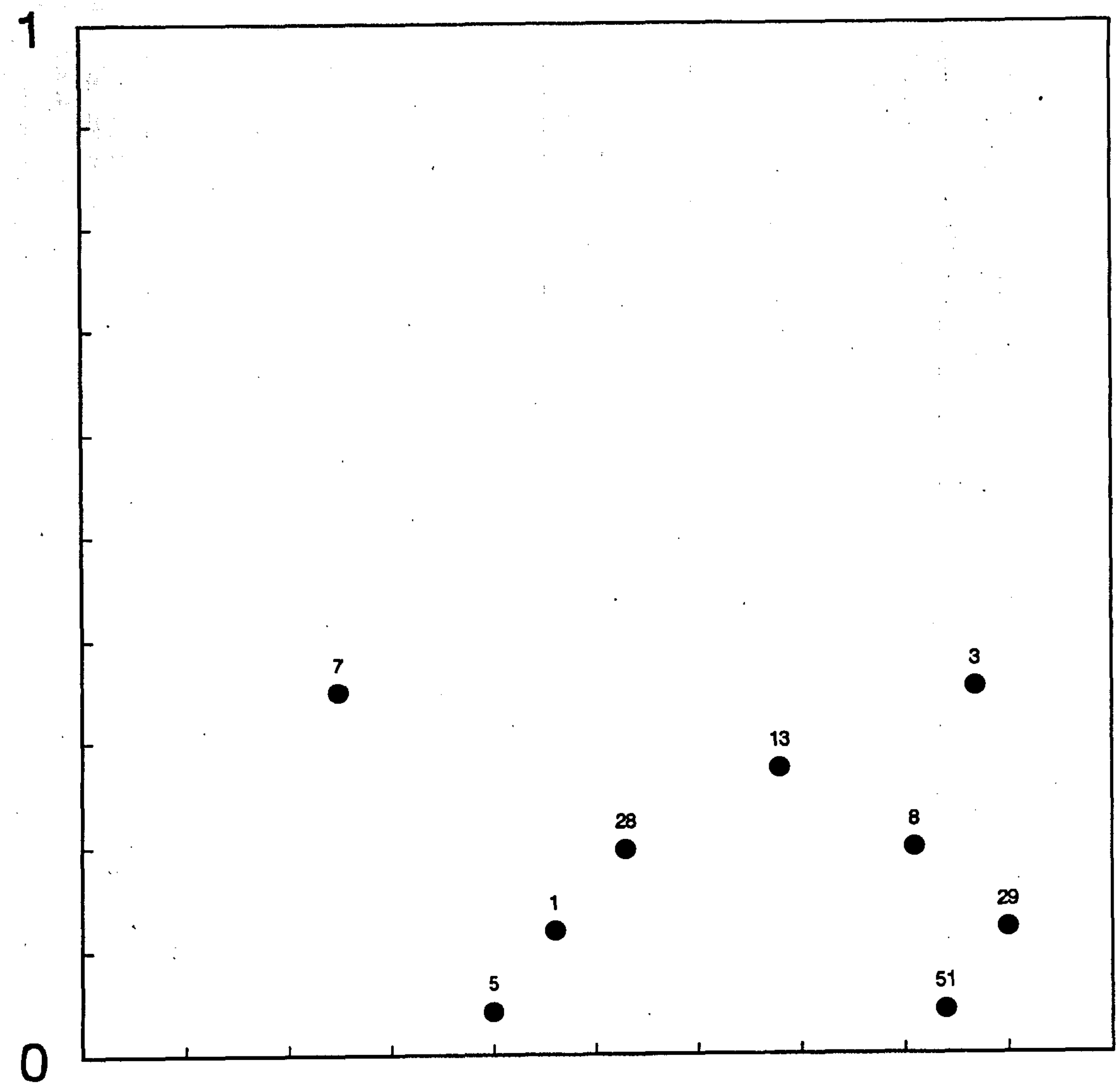
TWAJFK4A thru 4I



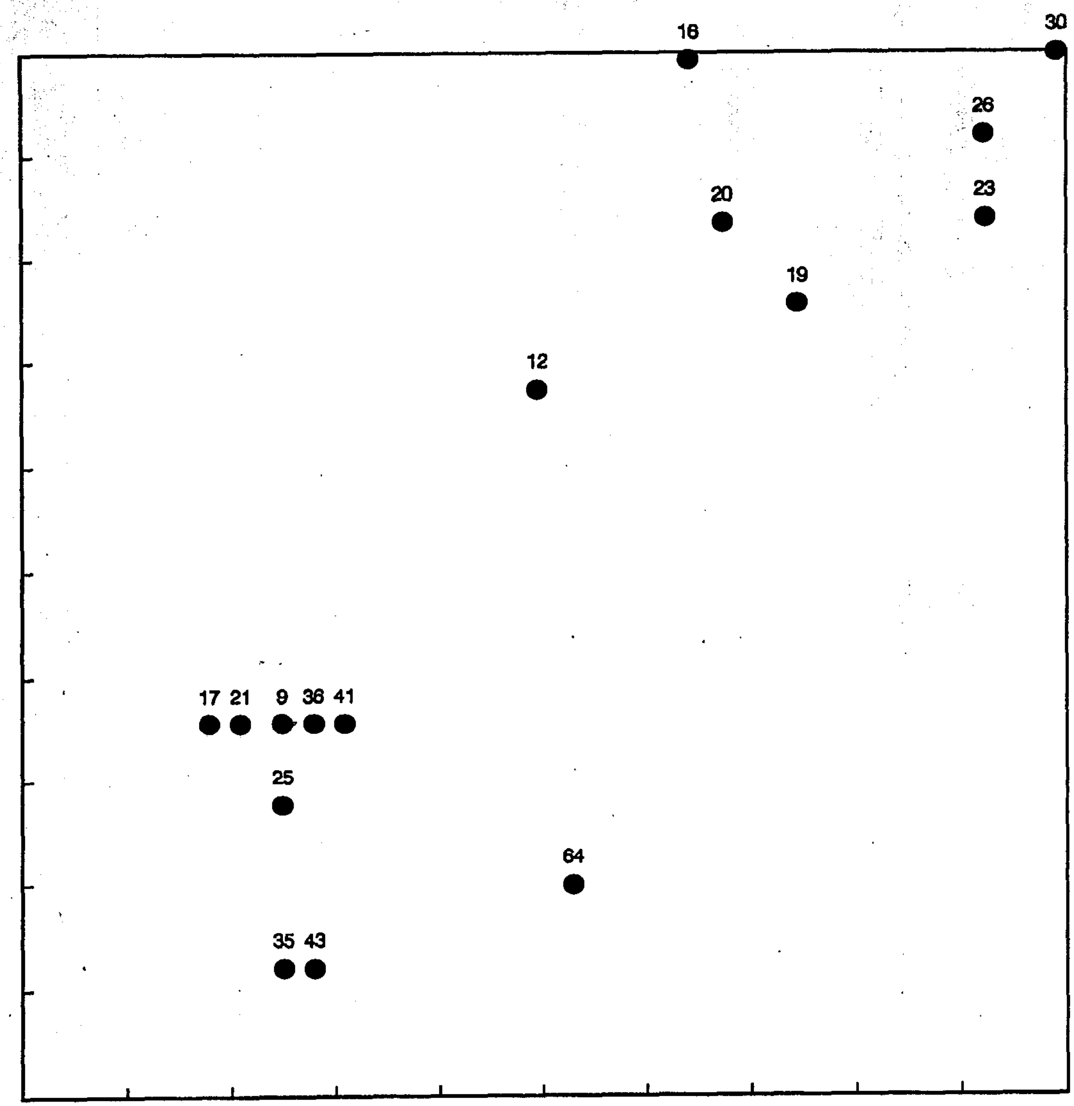
TWAJFK4B



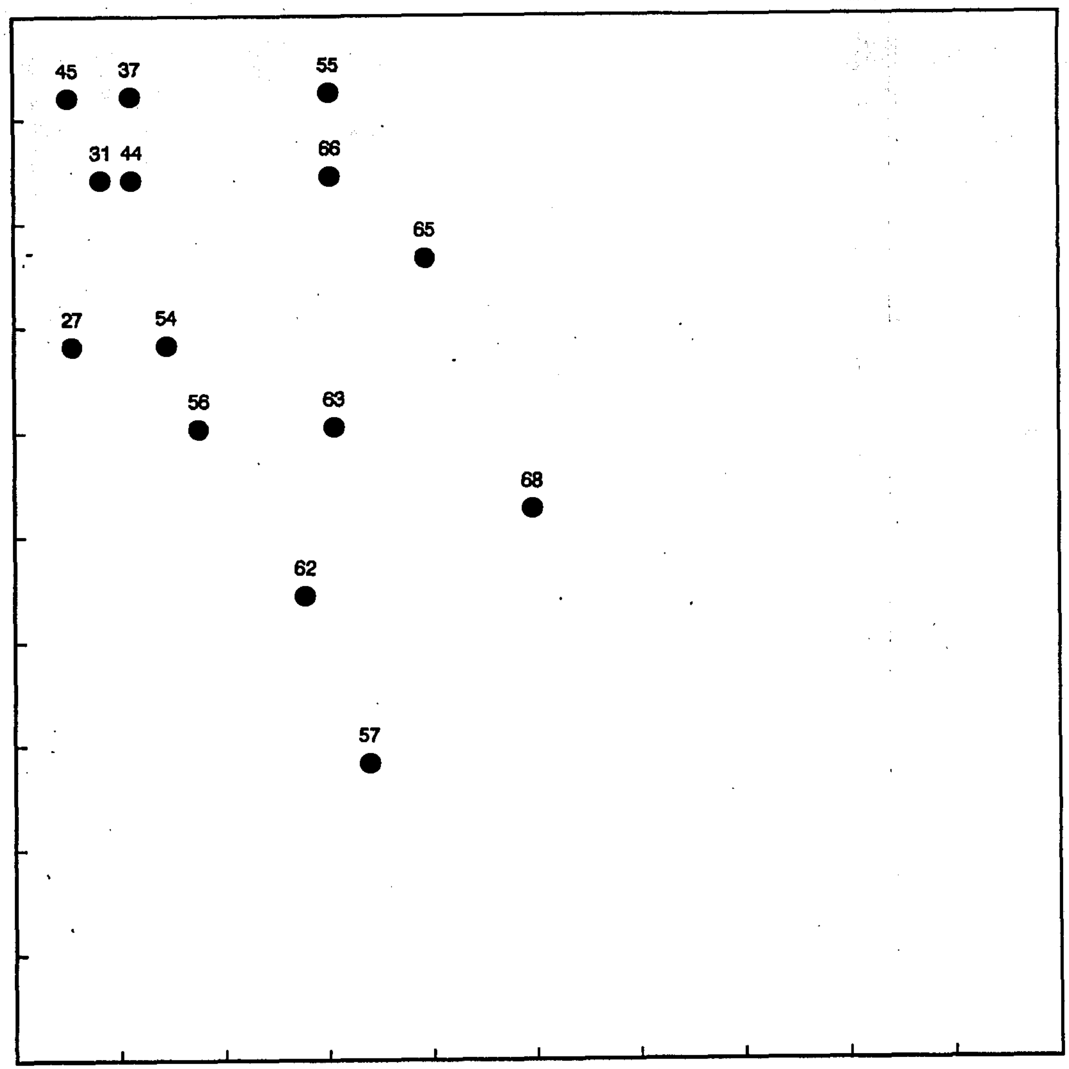
TWAJFK4C



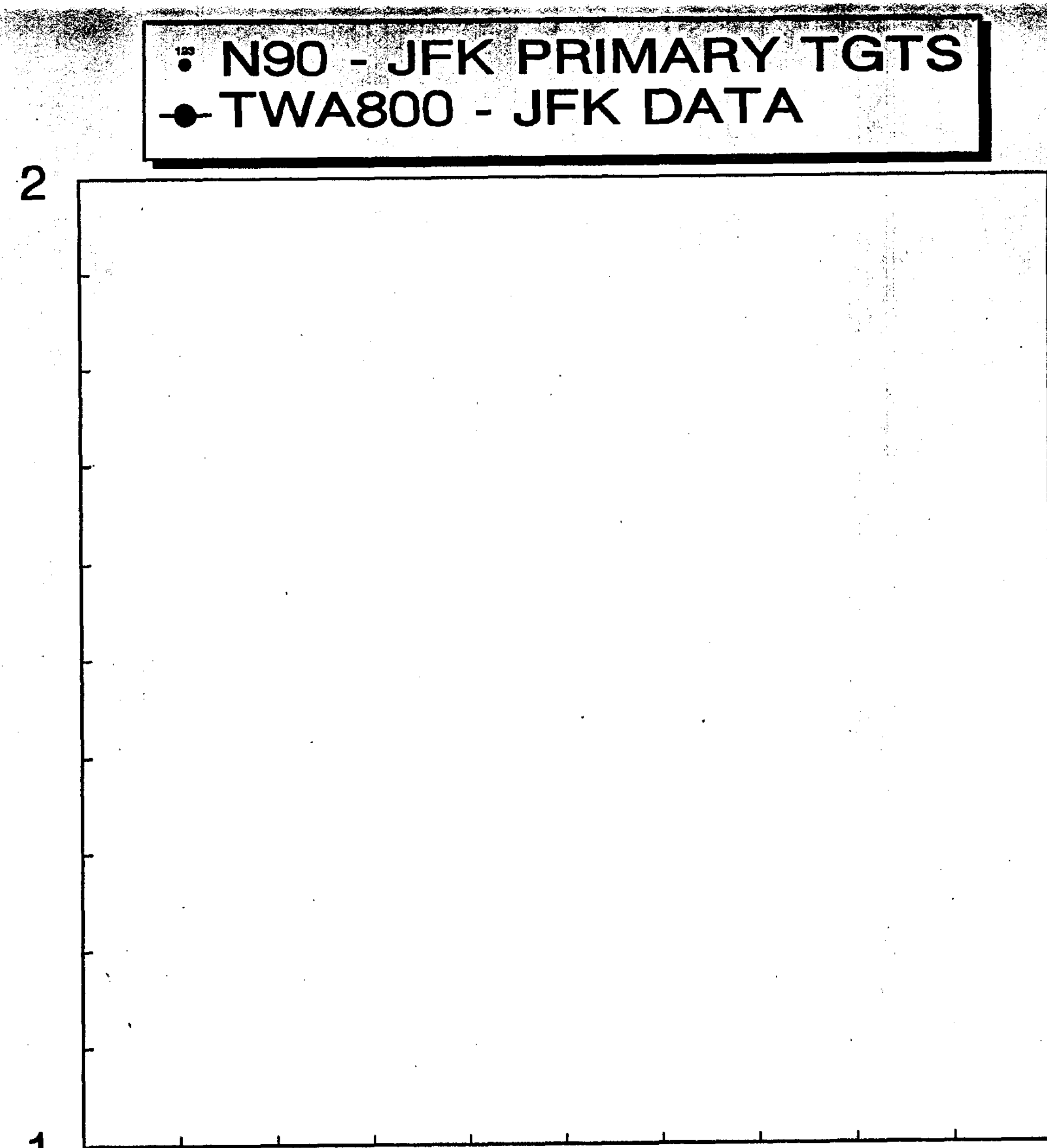
TWAJFK4D



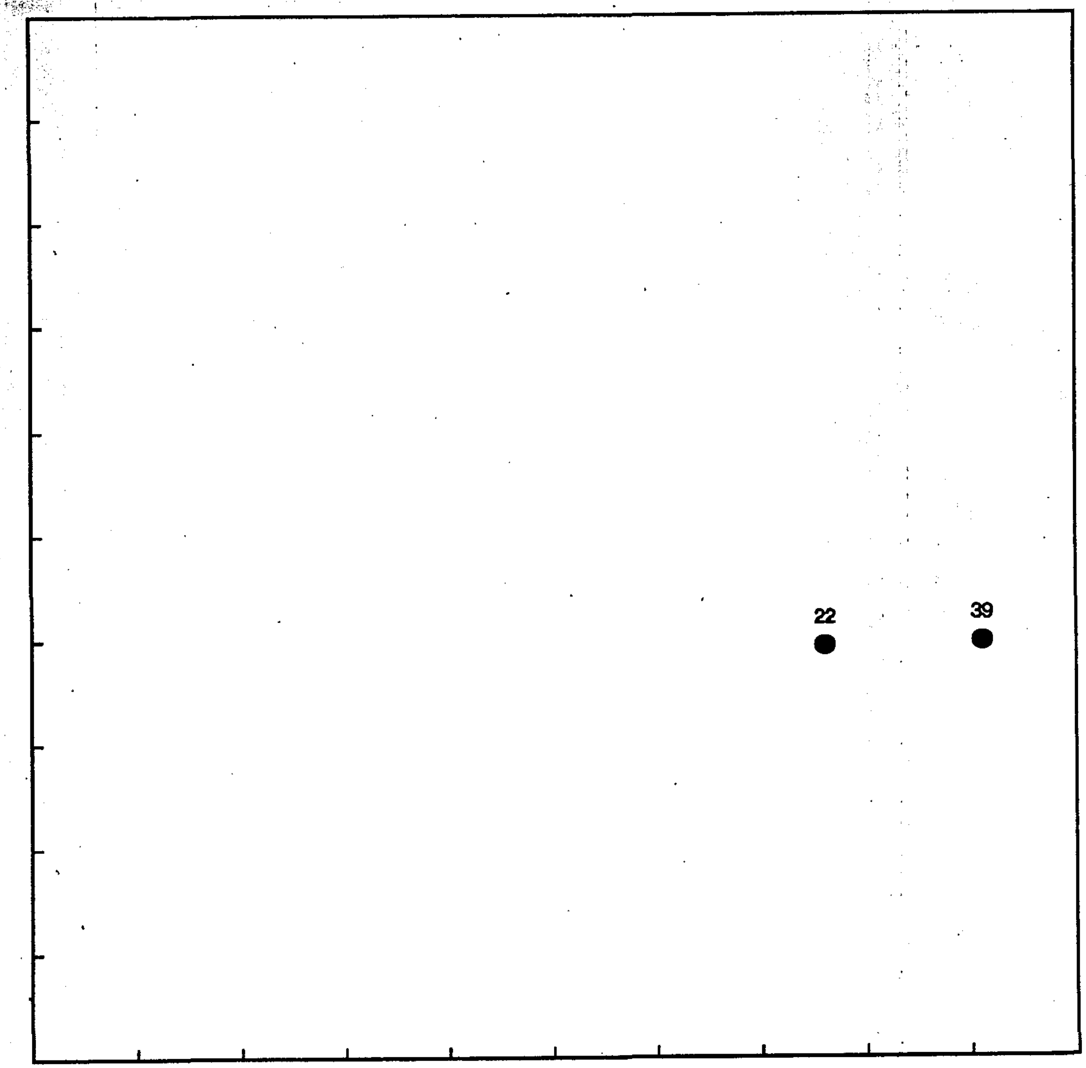
TWAJFK4E



TWAJFK4F

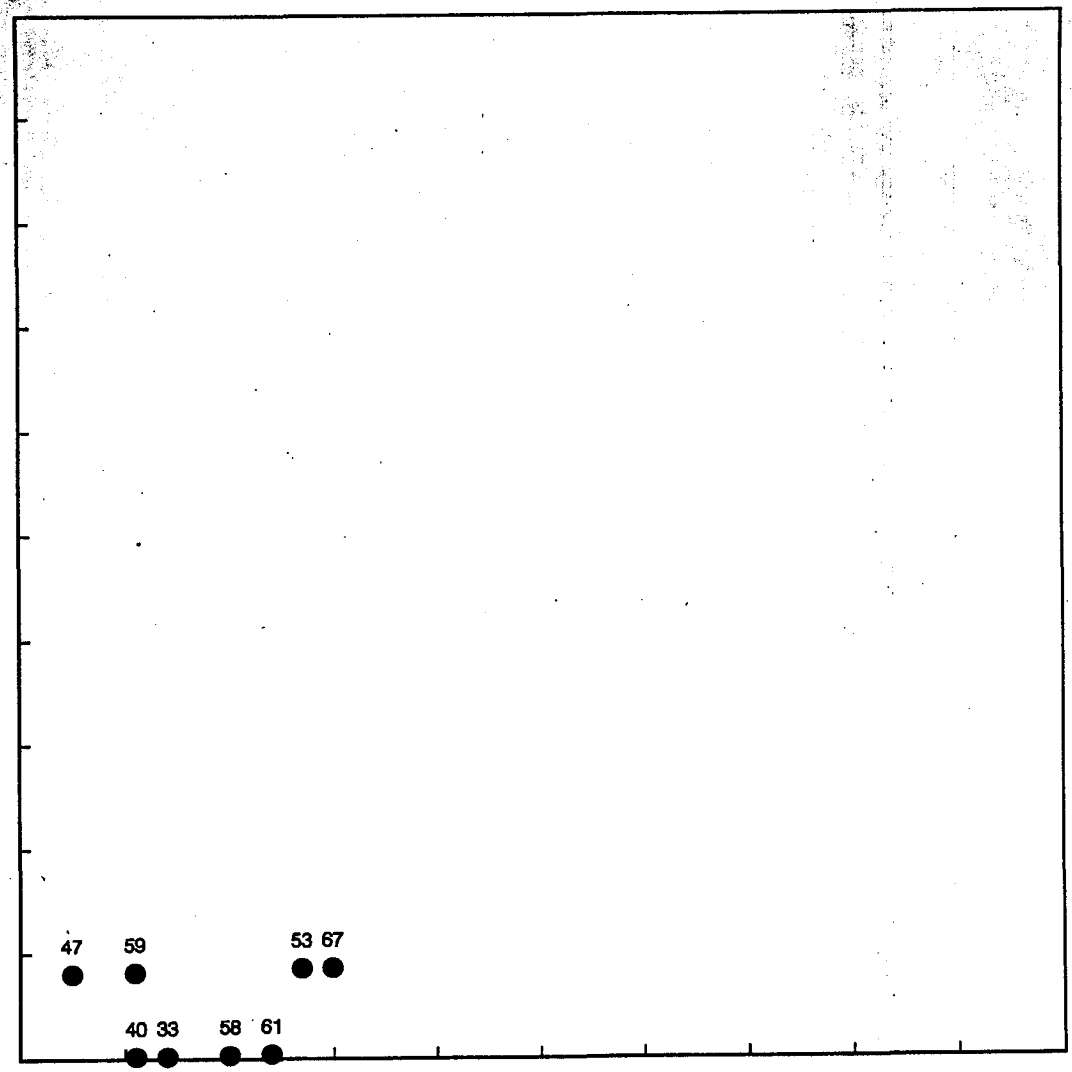


TWAJFK4G



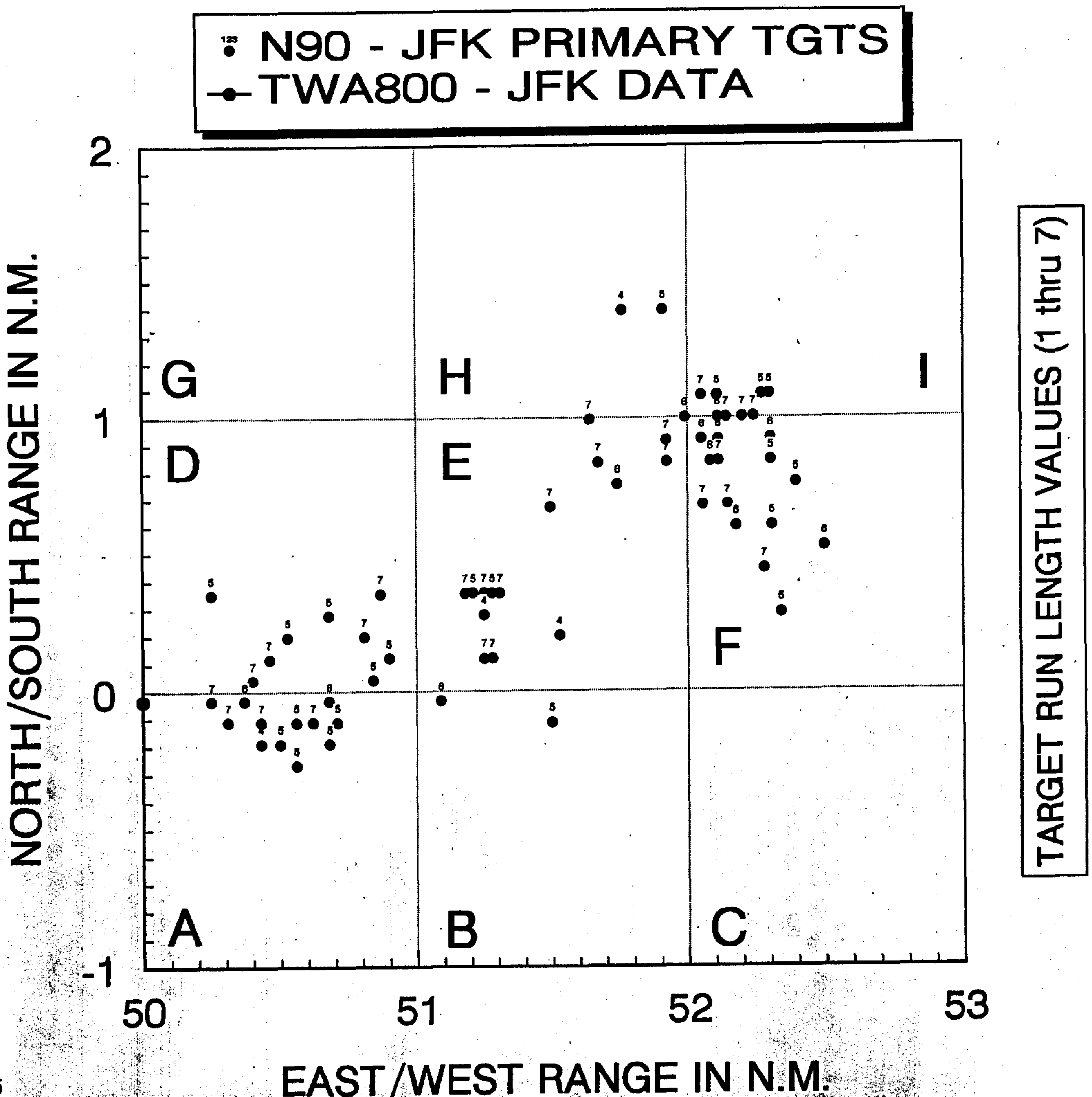
TWAJFK4H

NUMBERED SEQUENTIAL RETURNS



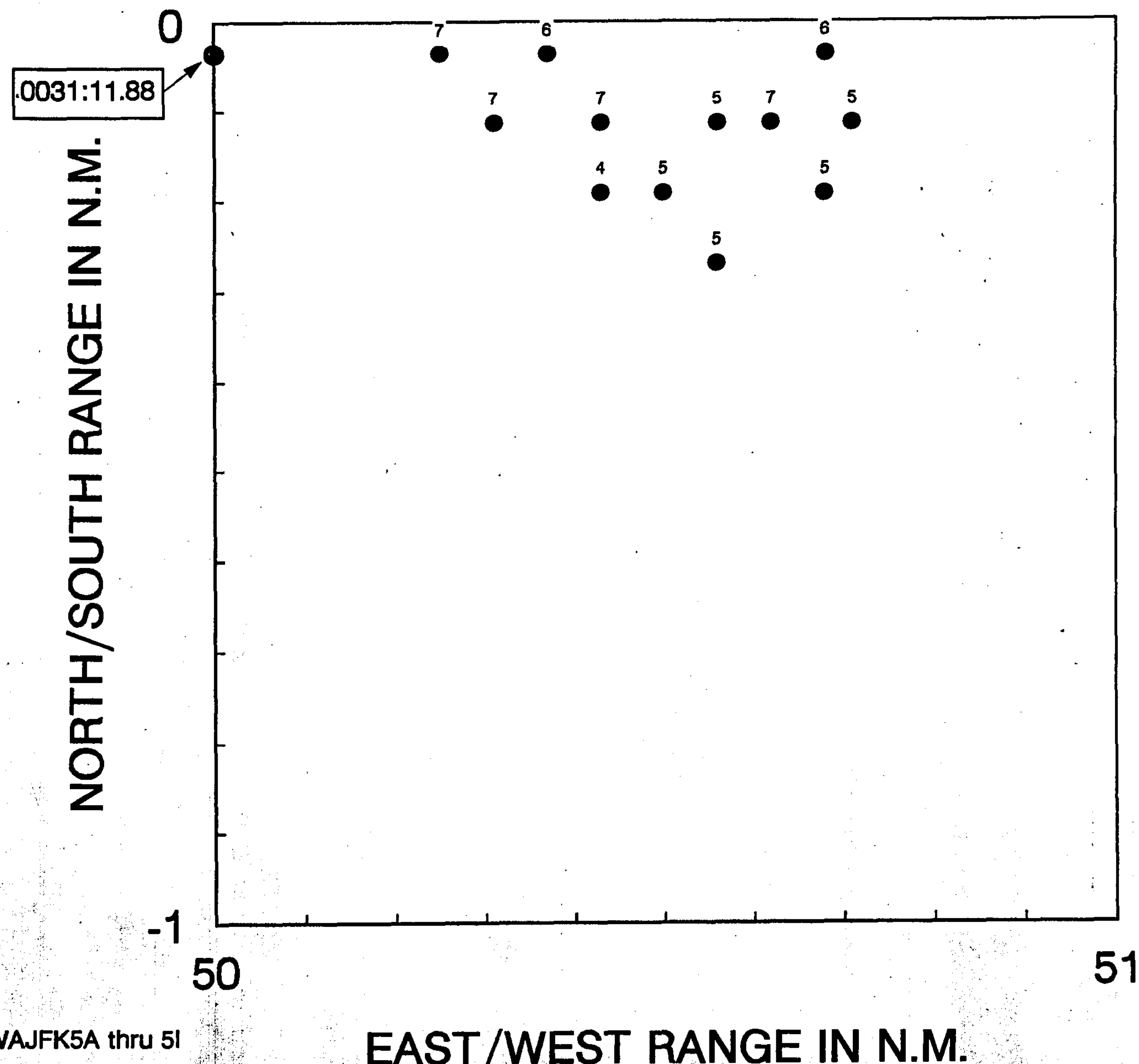
TWAJFK4I

ATTACHMENT #12

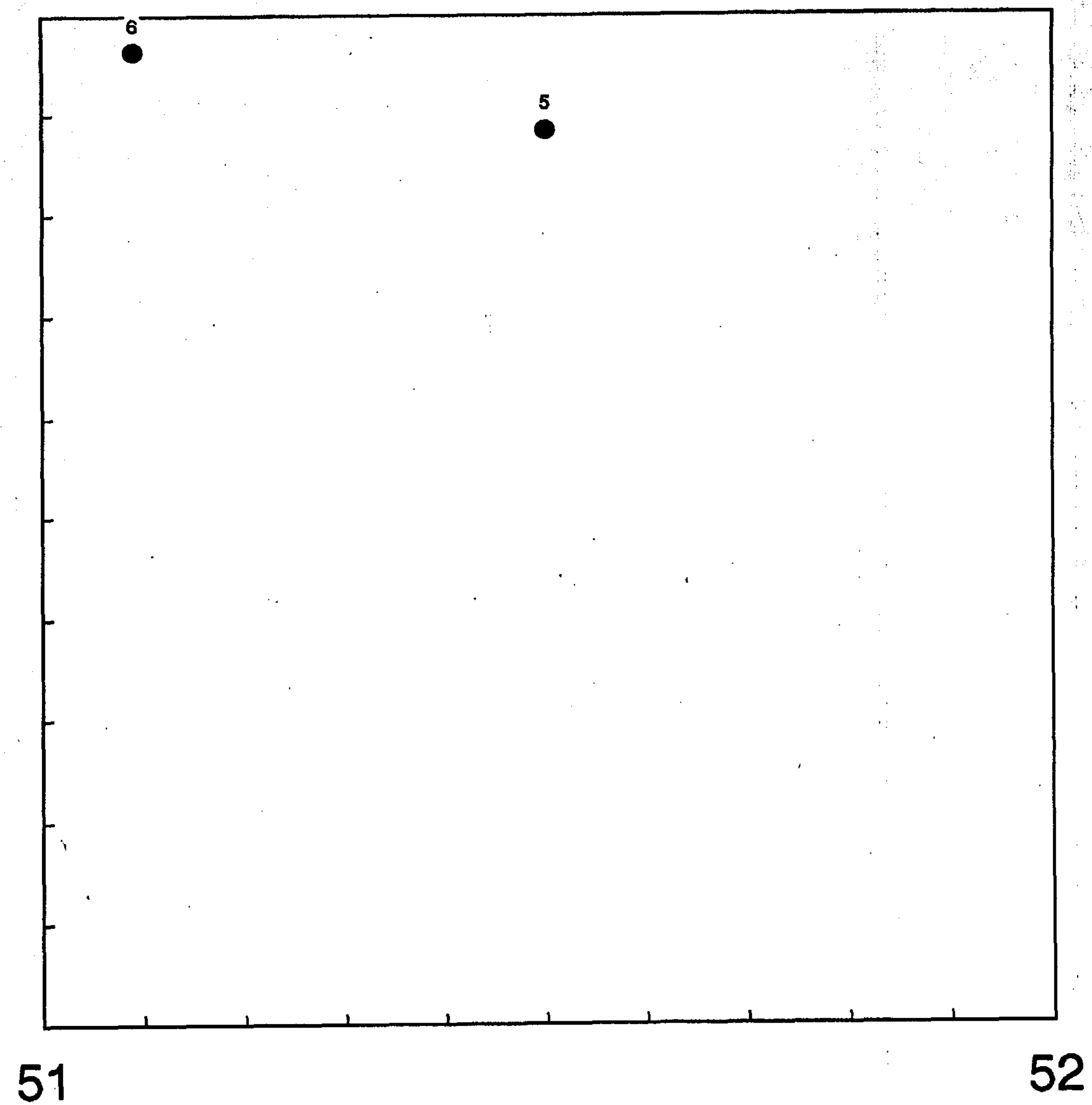

N90 - JFK PRIMARY TGTS
TWA800 - JFK DATA
NORTH/SOUTH RANGE IN N.M.
EAST/WEST RANGE IN N.M.
TARGET RUN LENGTH VALUES (1 thru 7)
G
H
I
D
E
F
A
B
C
2
1
0
-1
50
51
52
53

TWAJFK5

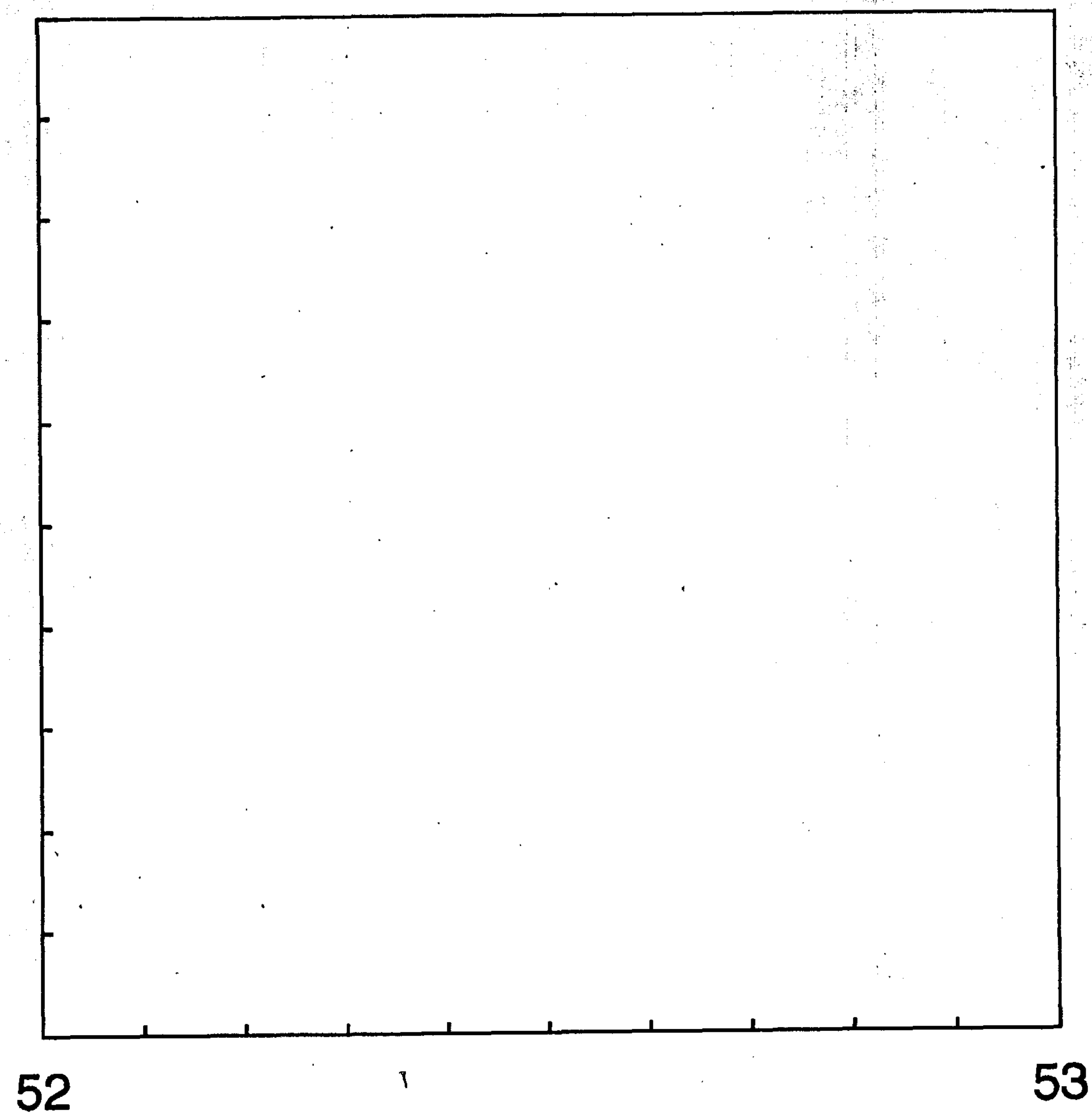
ATTACHMENT #13



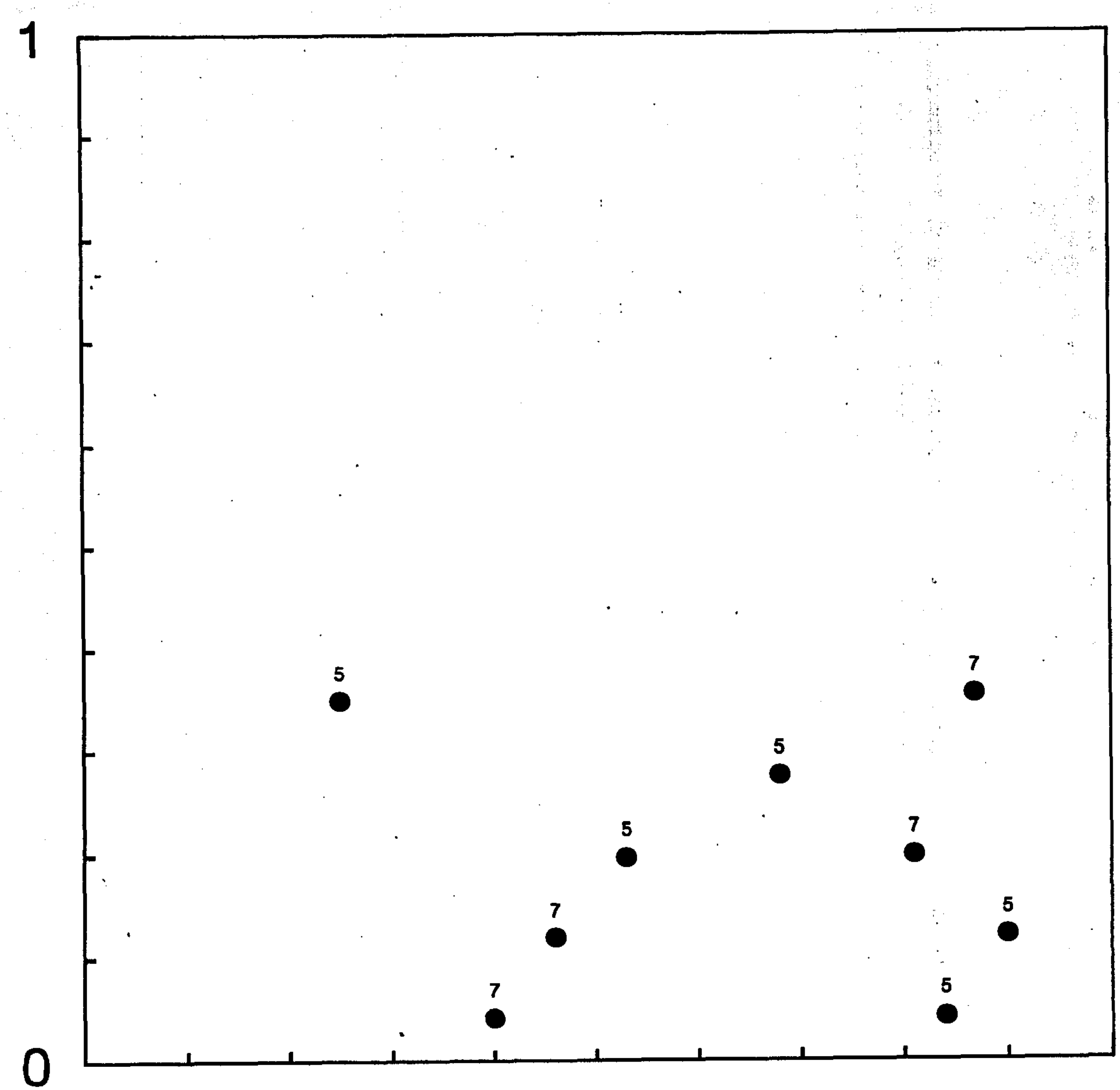
TWAJFK5A thru 5I



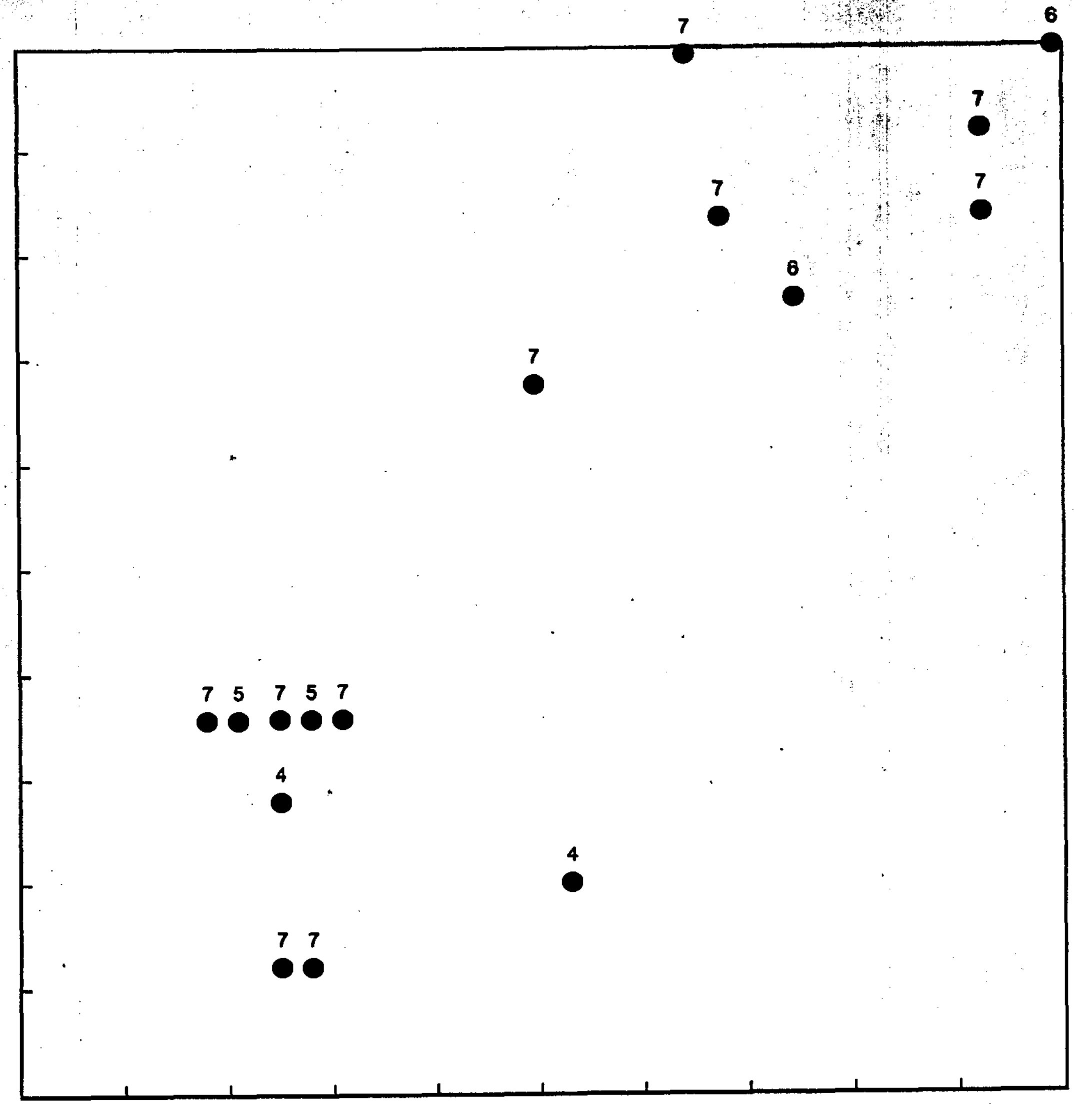
TWAJFK5B



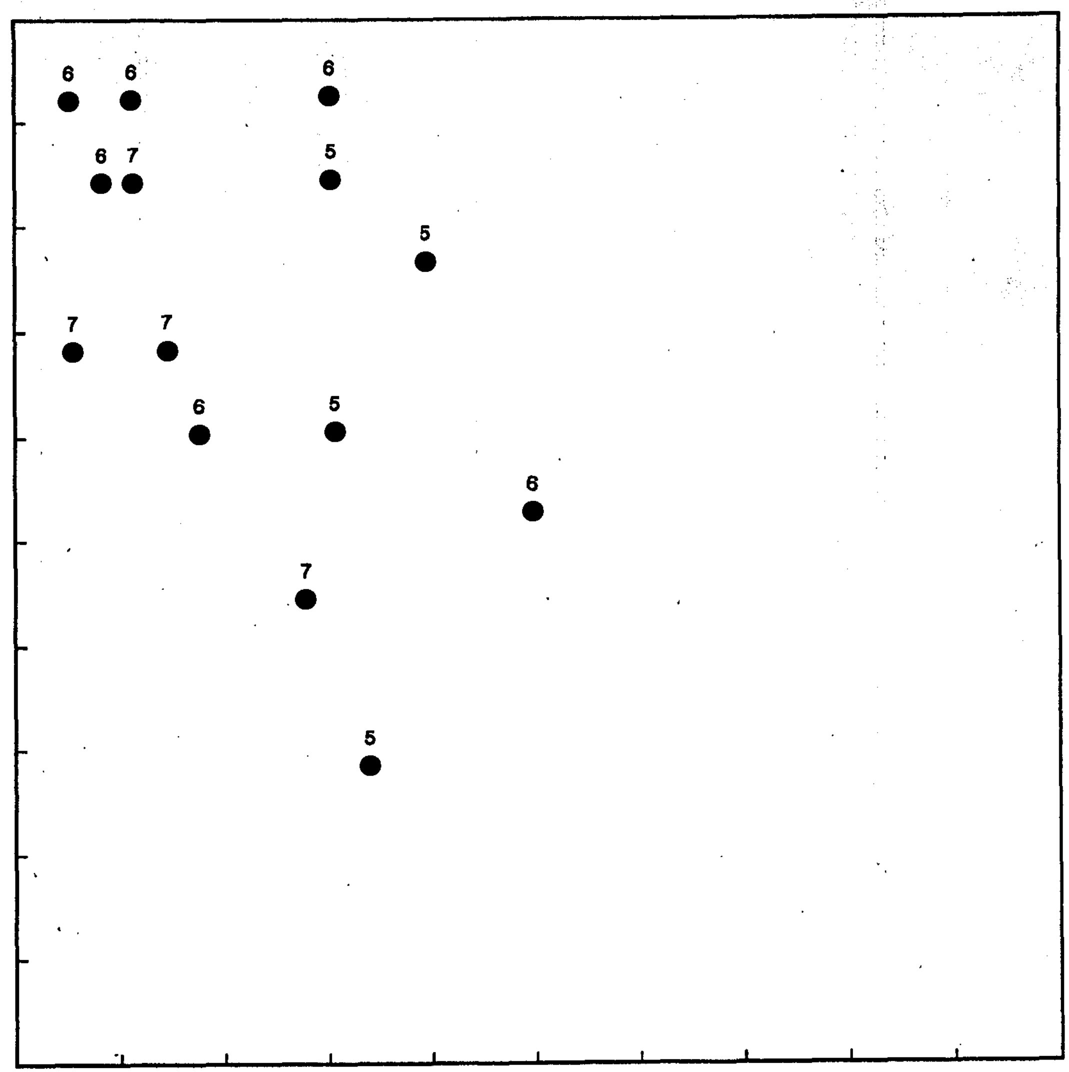
TWAJFK5C



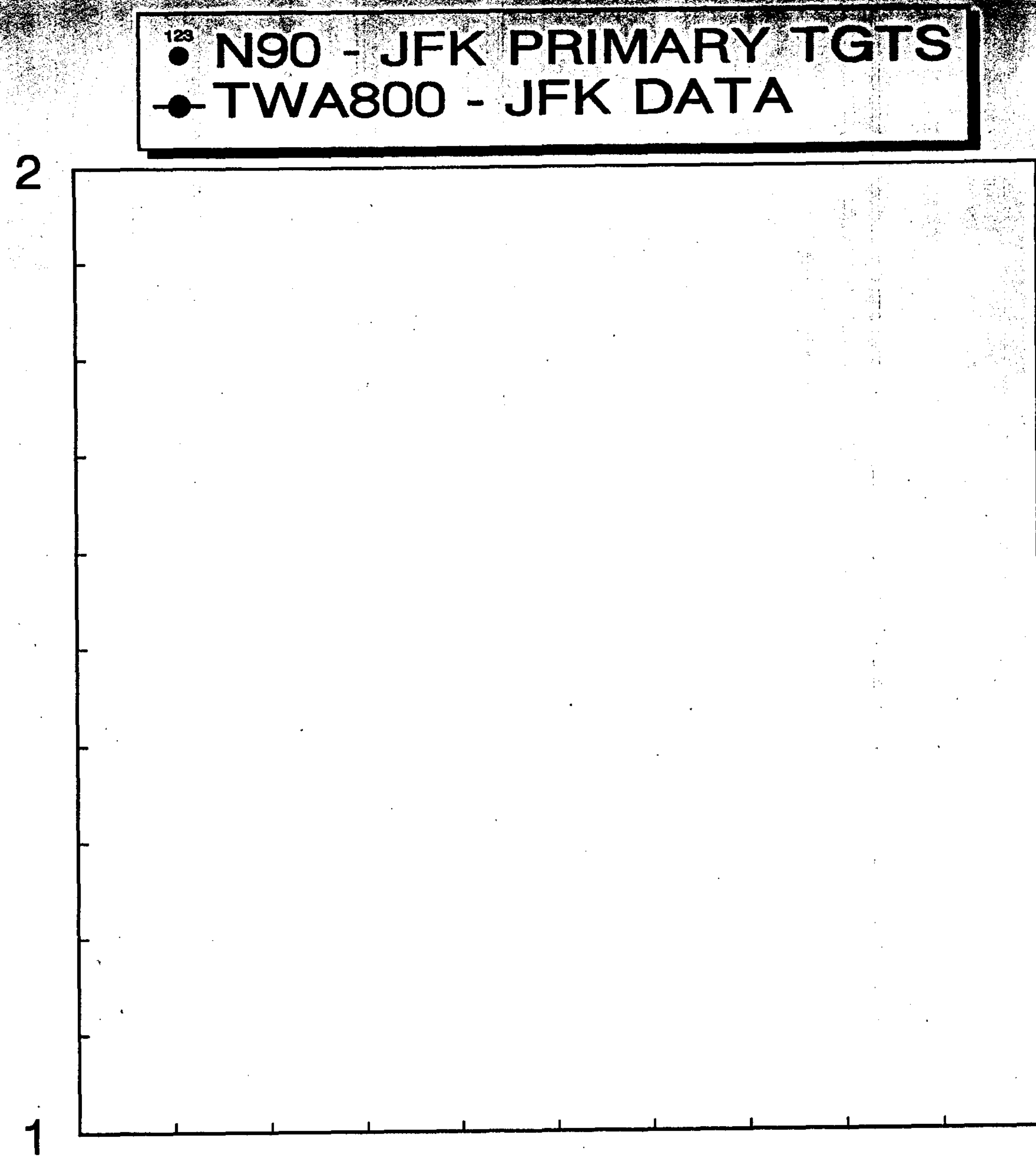
TWAJFK5D



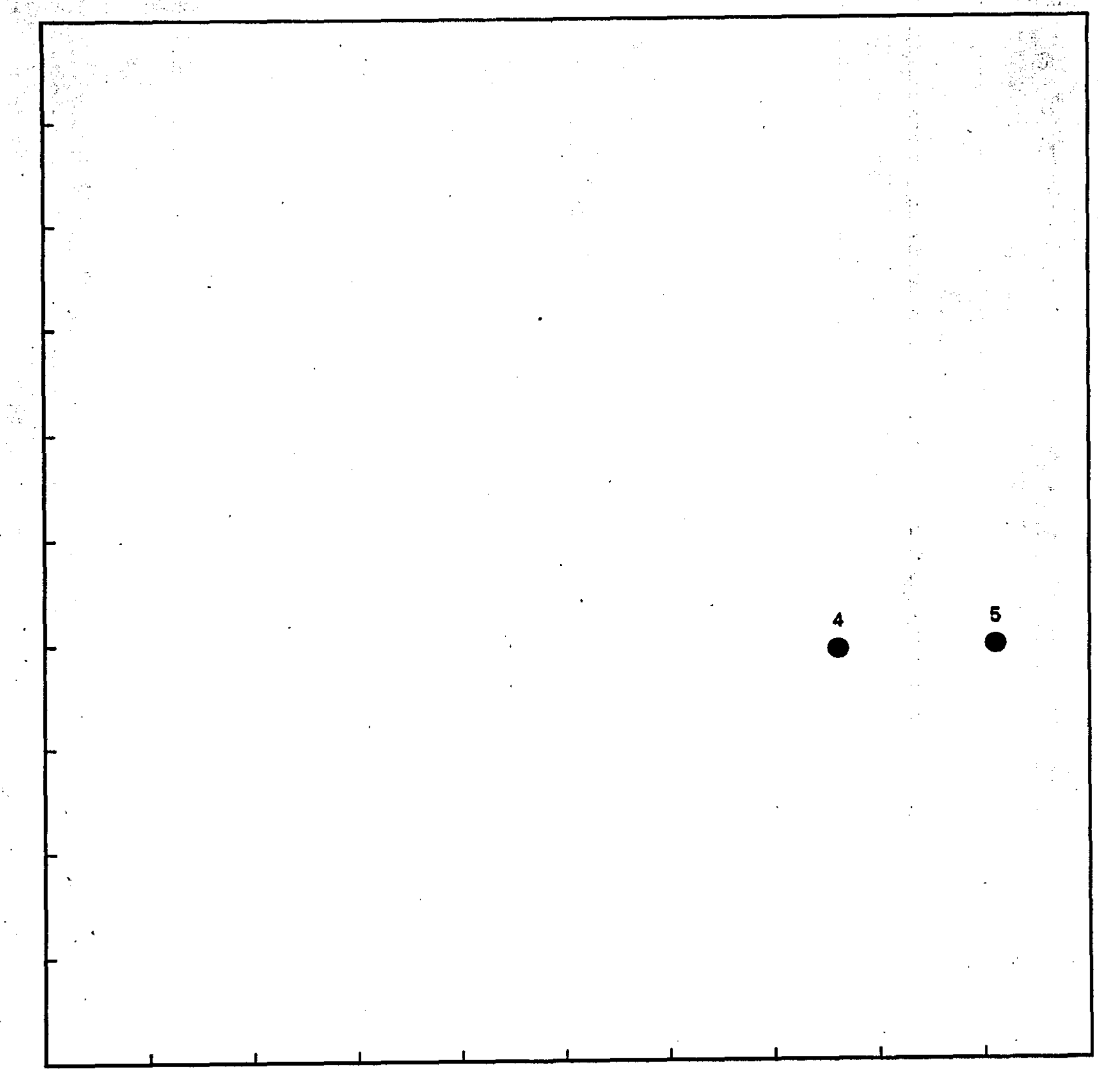
TWAJFK5E



TWAJFK5F

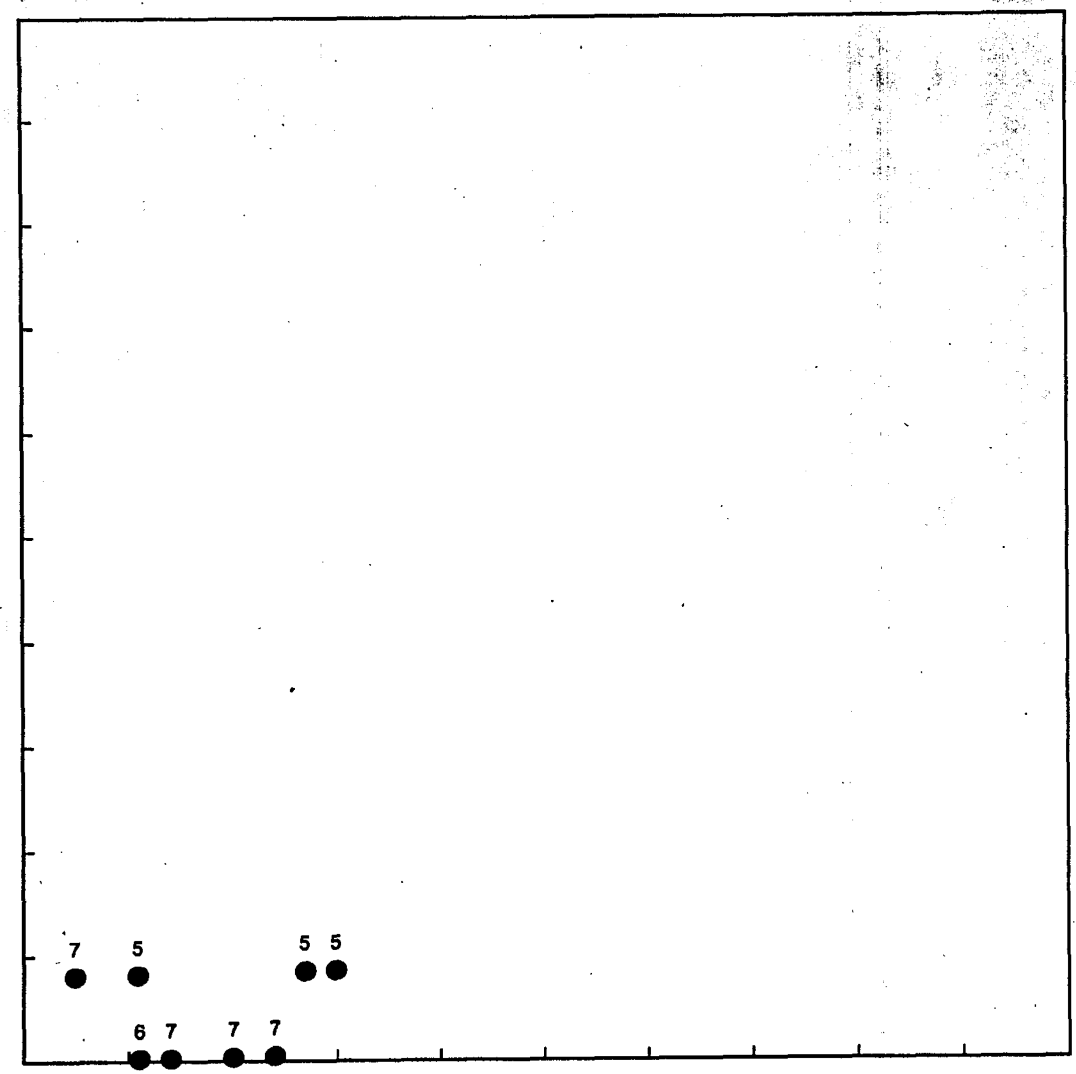


TWAJFK5G



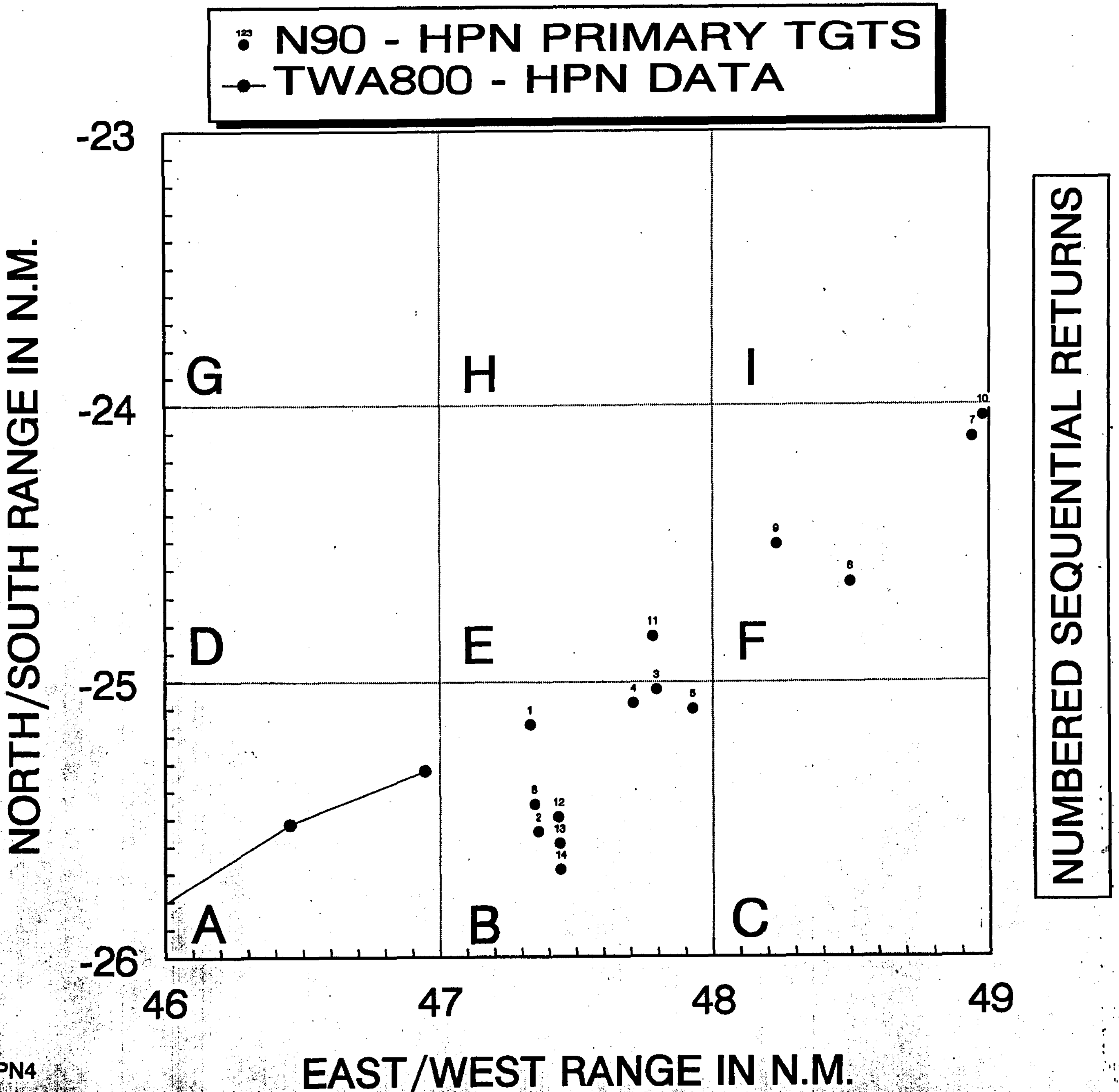
TWAJFK5H

TARGET RUN LENGTH VALUES (1 thru 7)



TWAJFK5I

ATTACHMENT #14


N90 - HPN PRIMARY TGTS
TWA800 - HPN DATA
NORTH/SOUTH RANGE IN N.M.
EAST/WEST RANGE IN N.M.
NUMBERED SEQUENTIAL RETURNS
-23
-24
-25
-26
46
47
48
49
G
H
I
D
E
F
A
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1
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3
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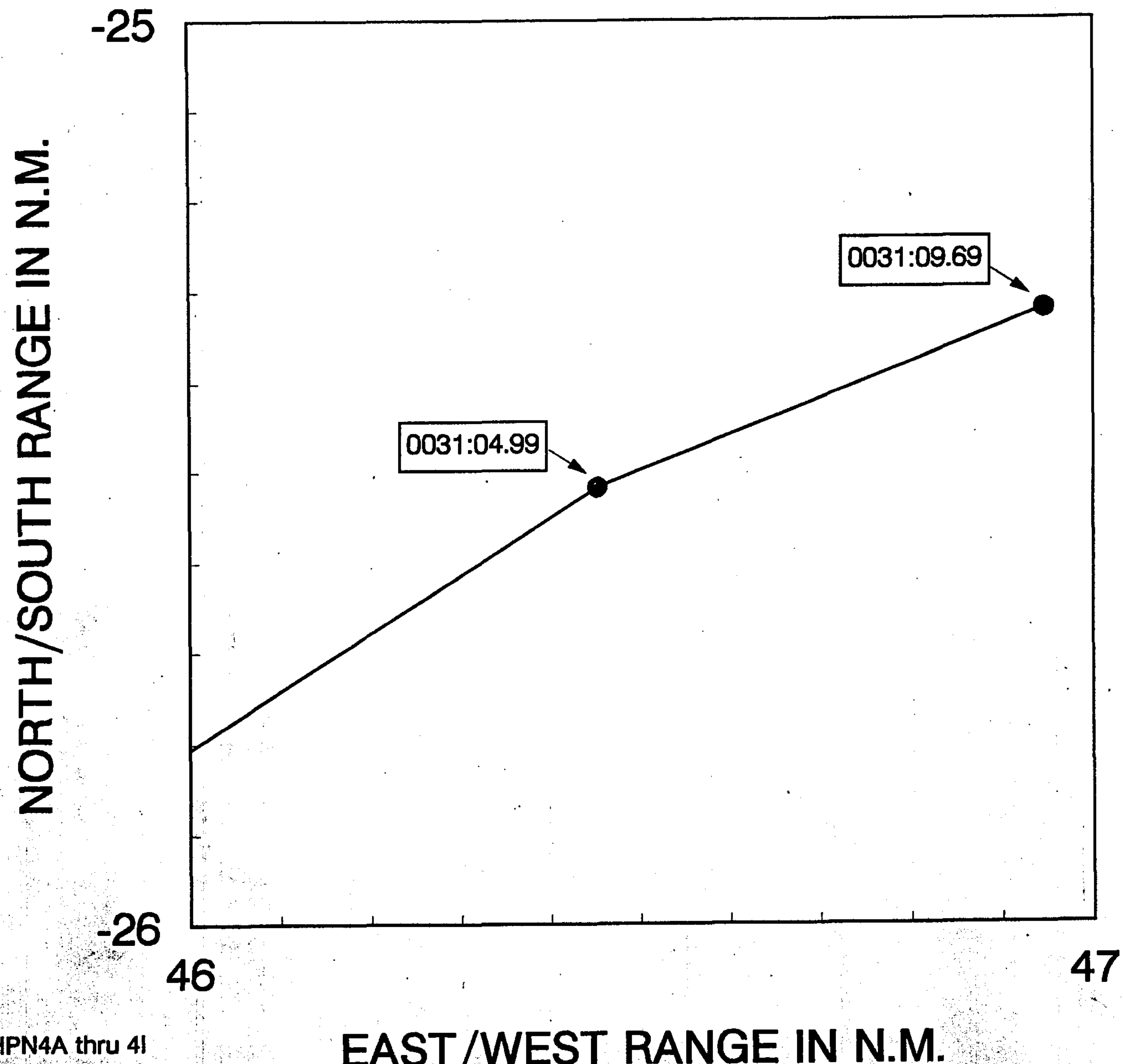
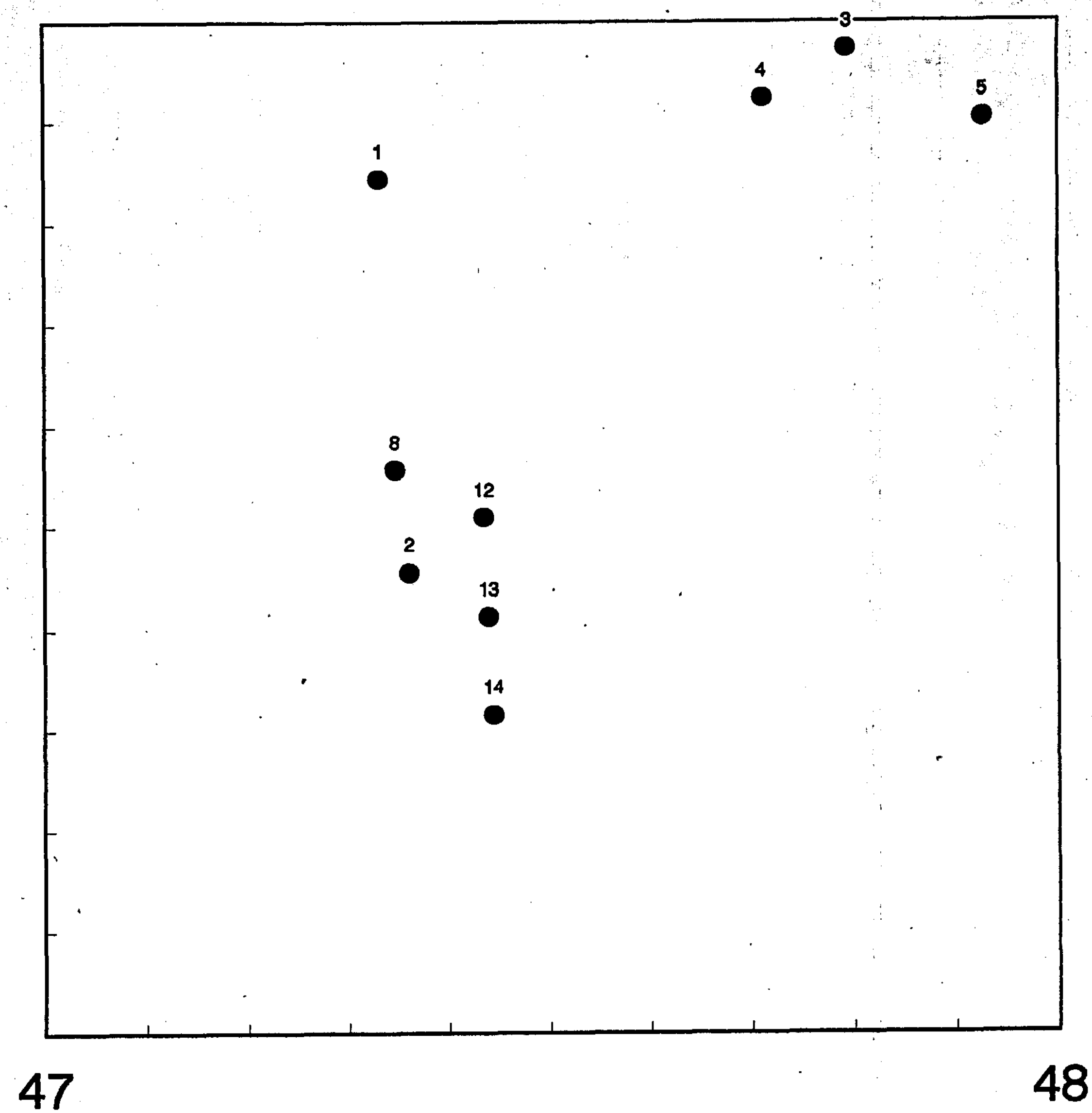
14

TWAHPN4

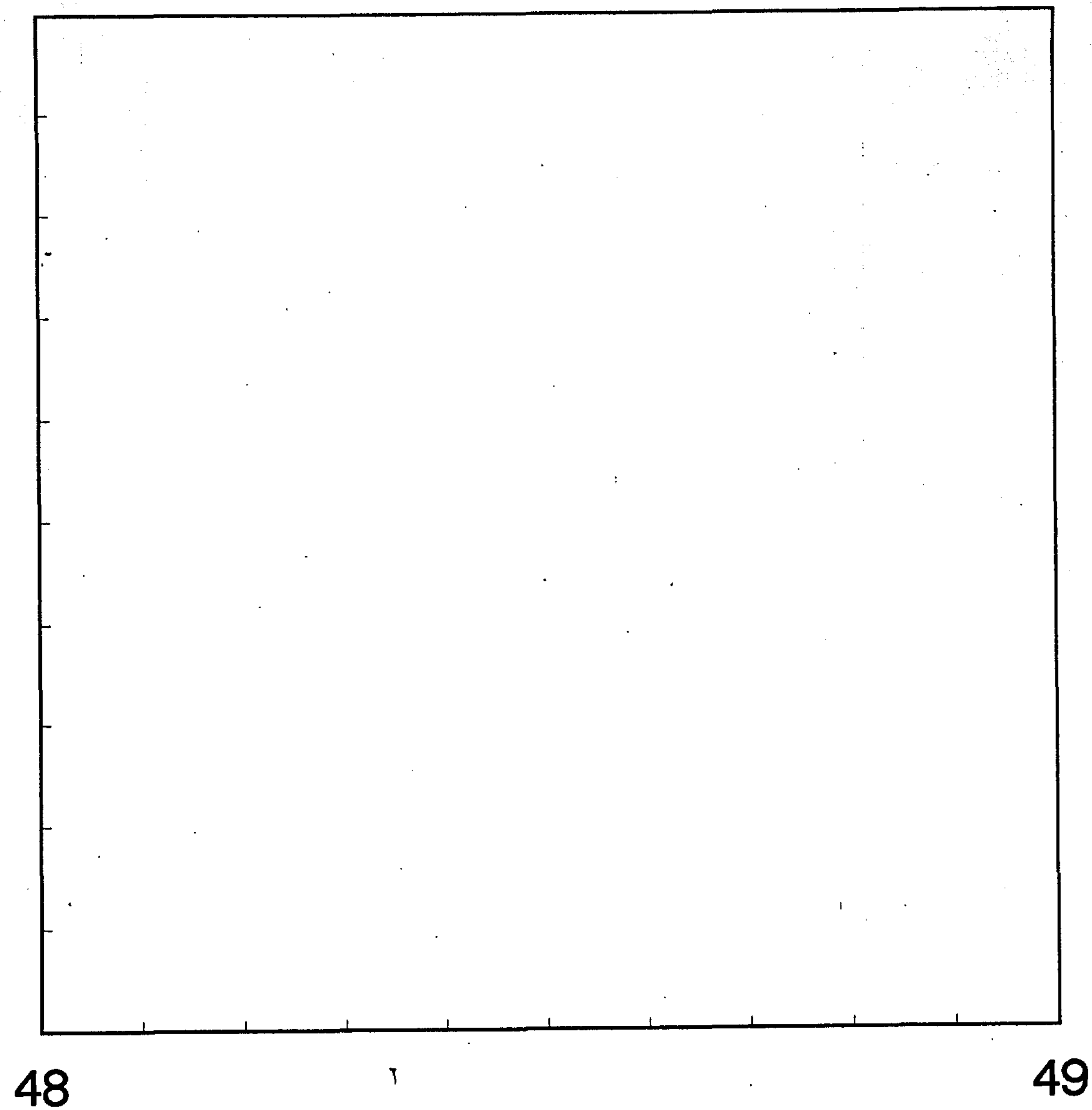
ATTACHMENT #15



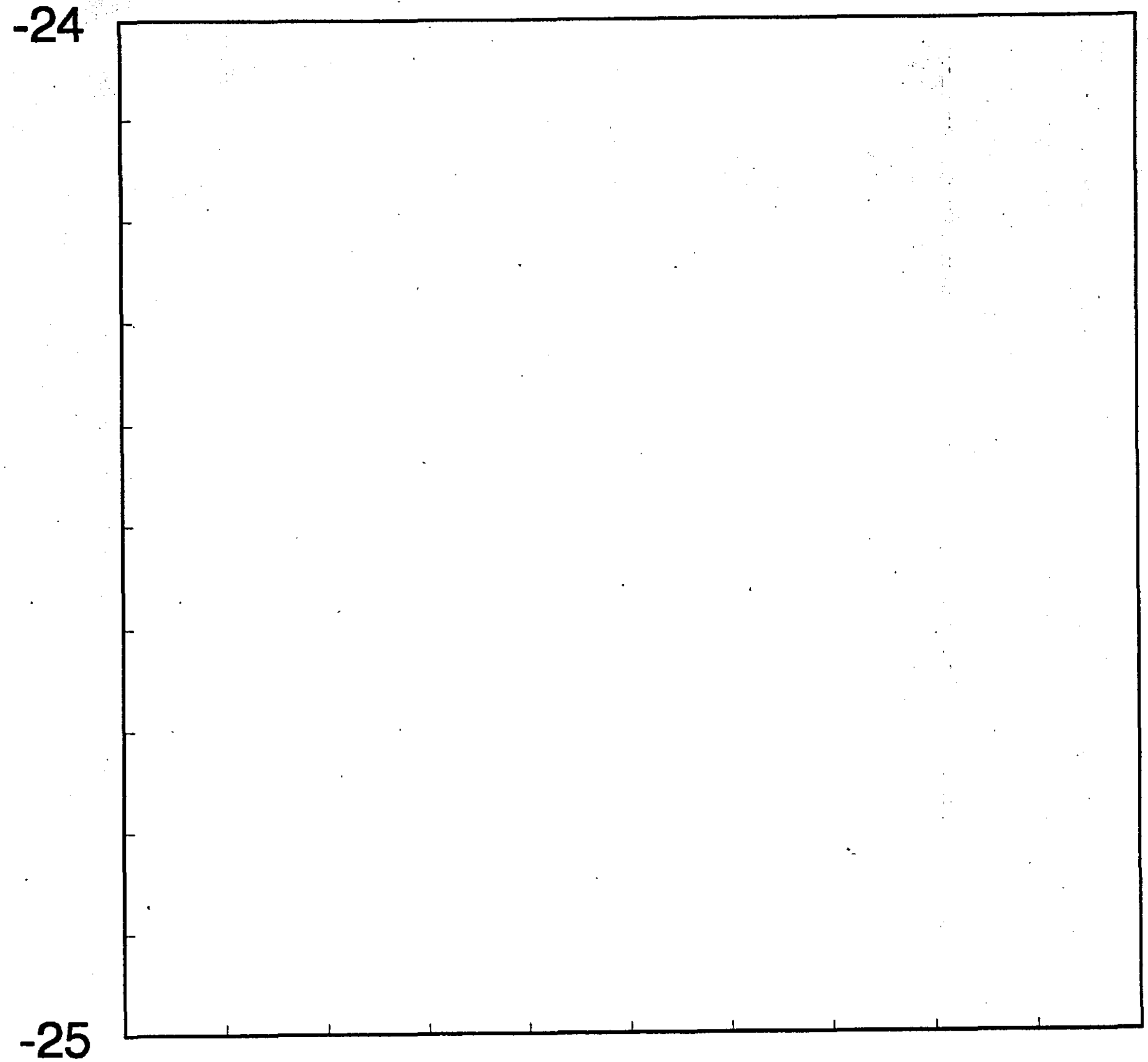
TWAHPN4A thru 4I



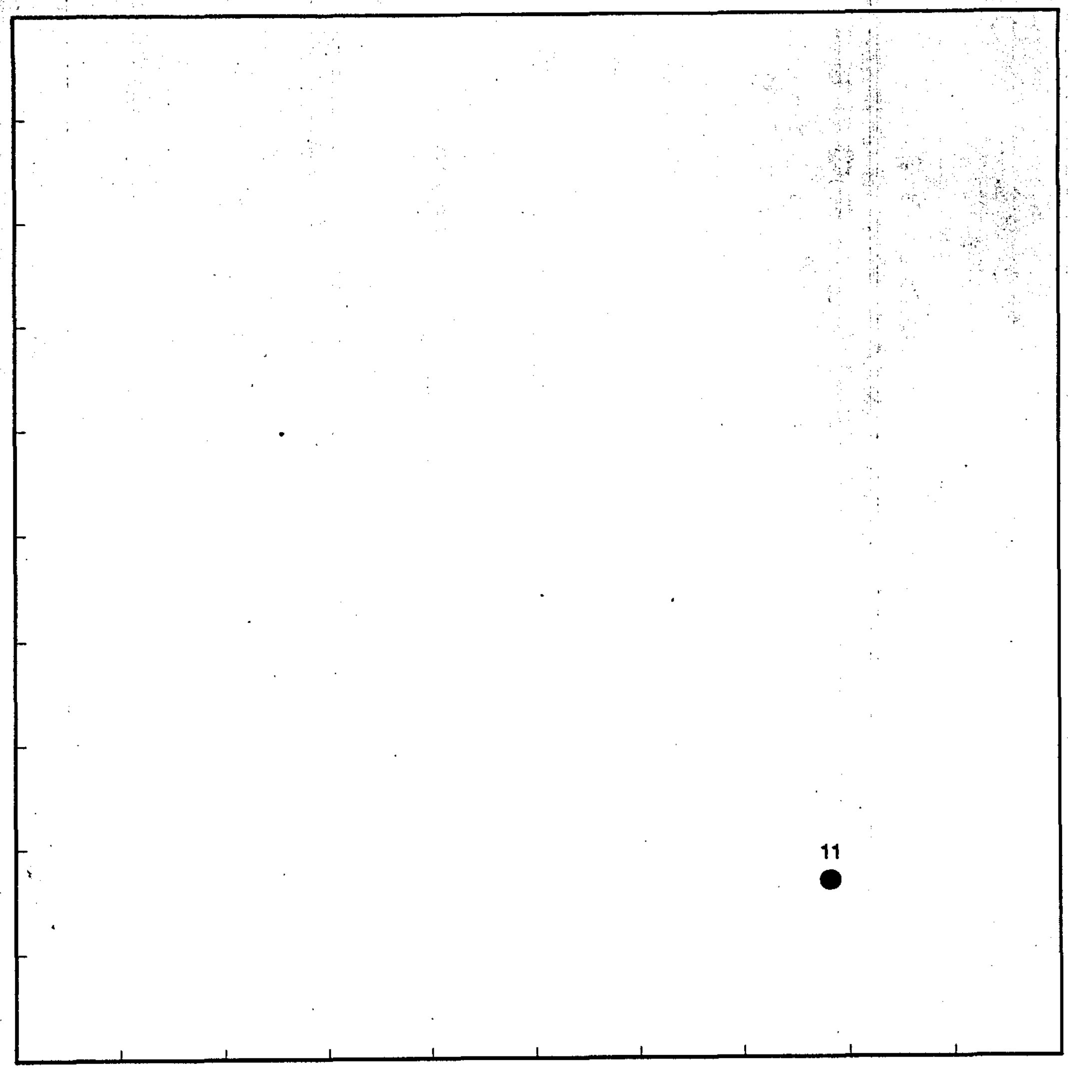
TWAHPN4B



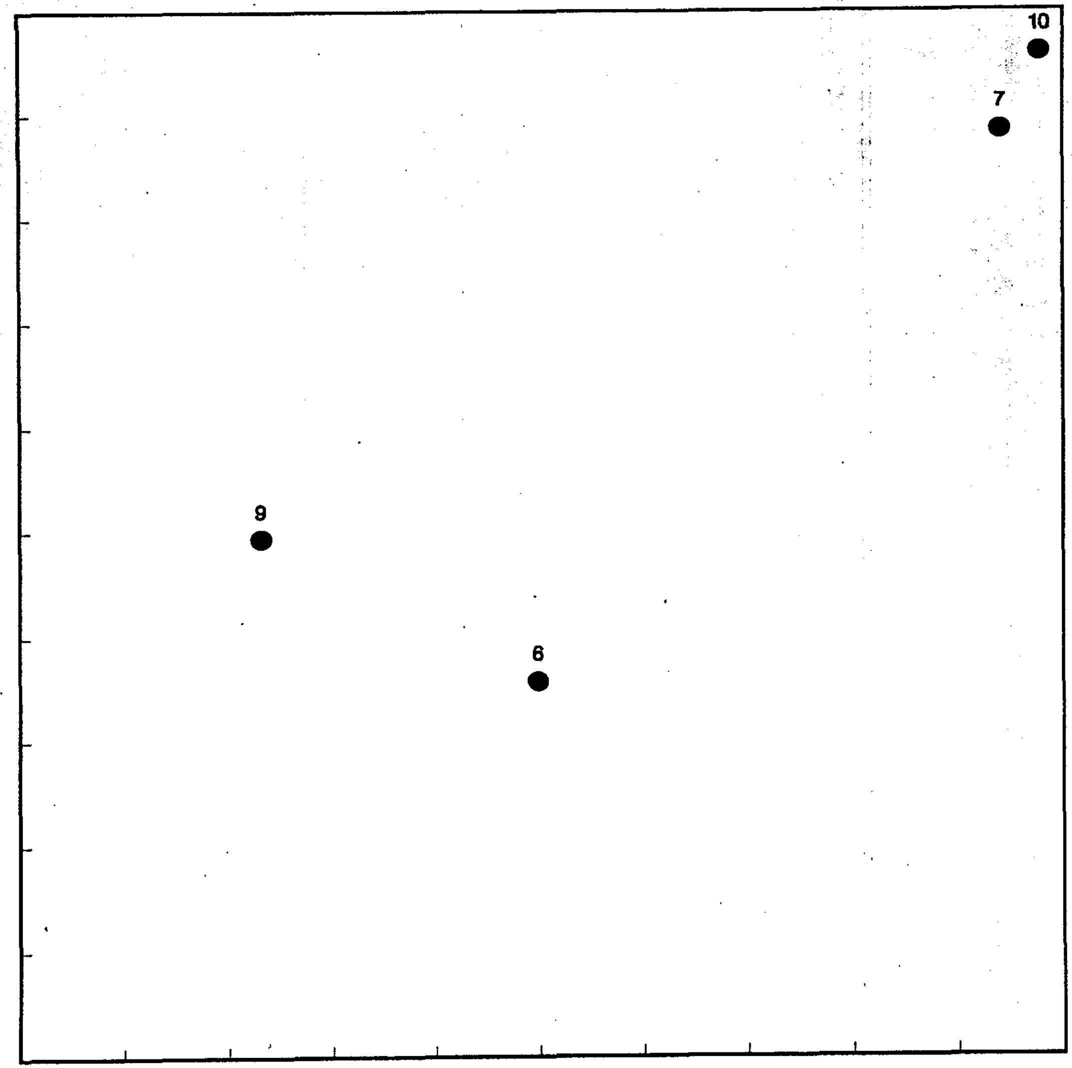
TWAHPN4C



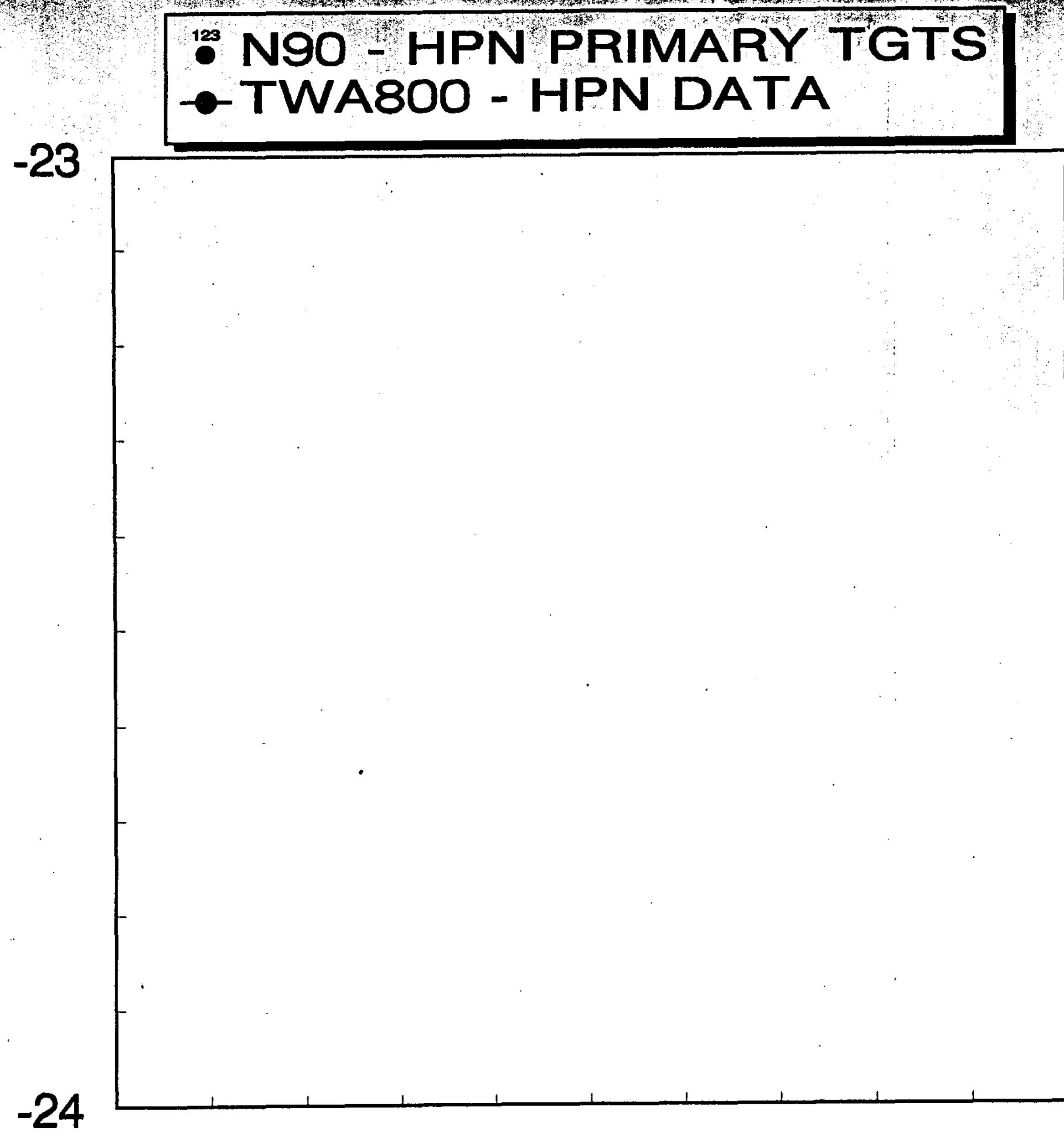
TWAHPN4D



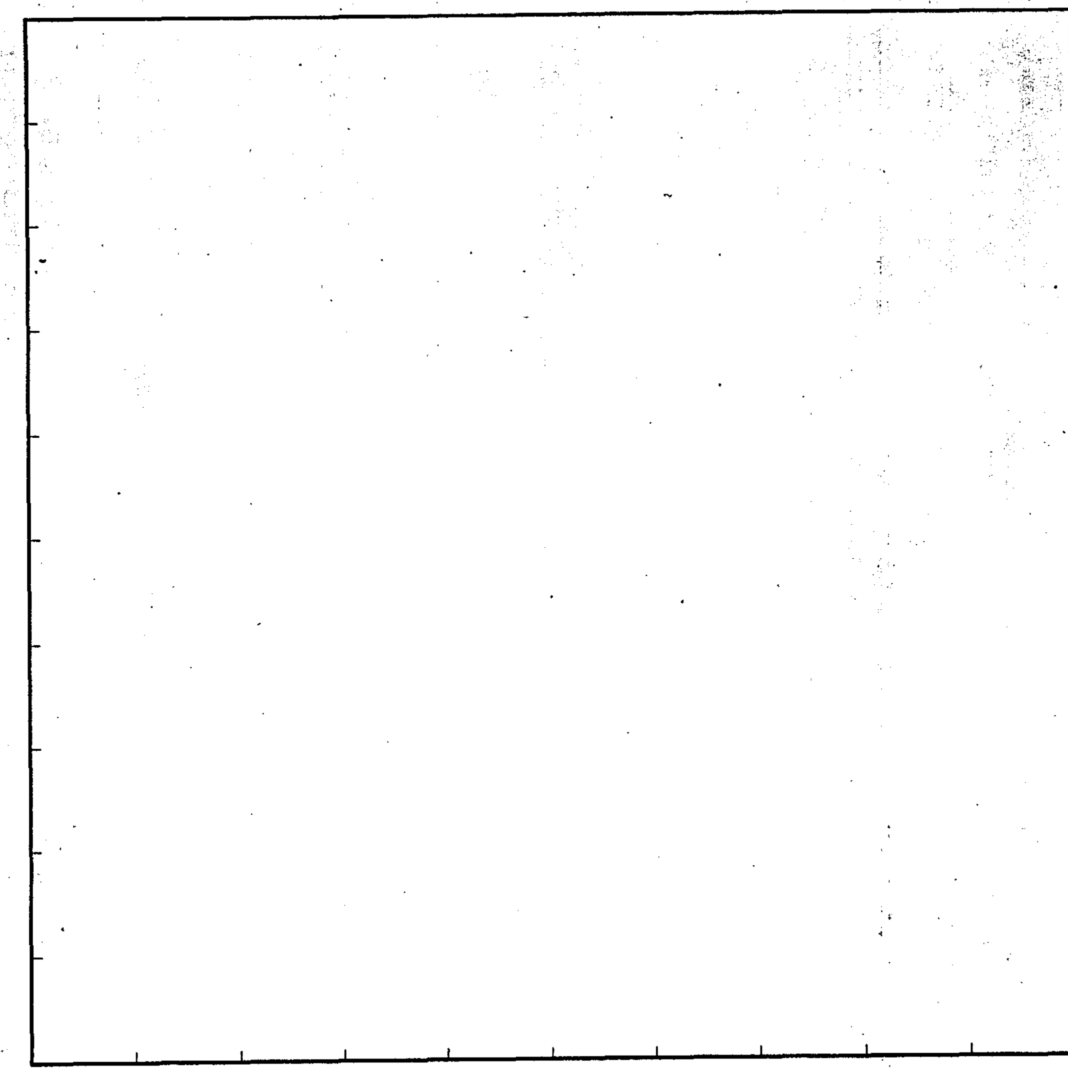
TWAHPN4E



TWAHPN4F

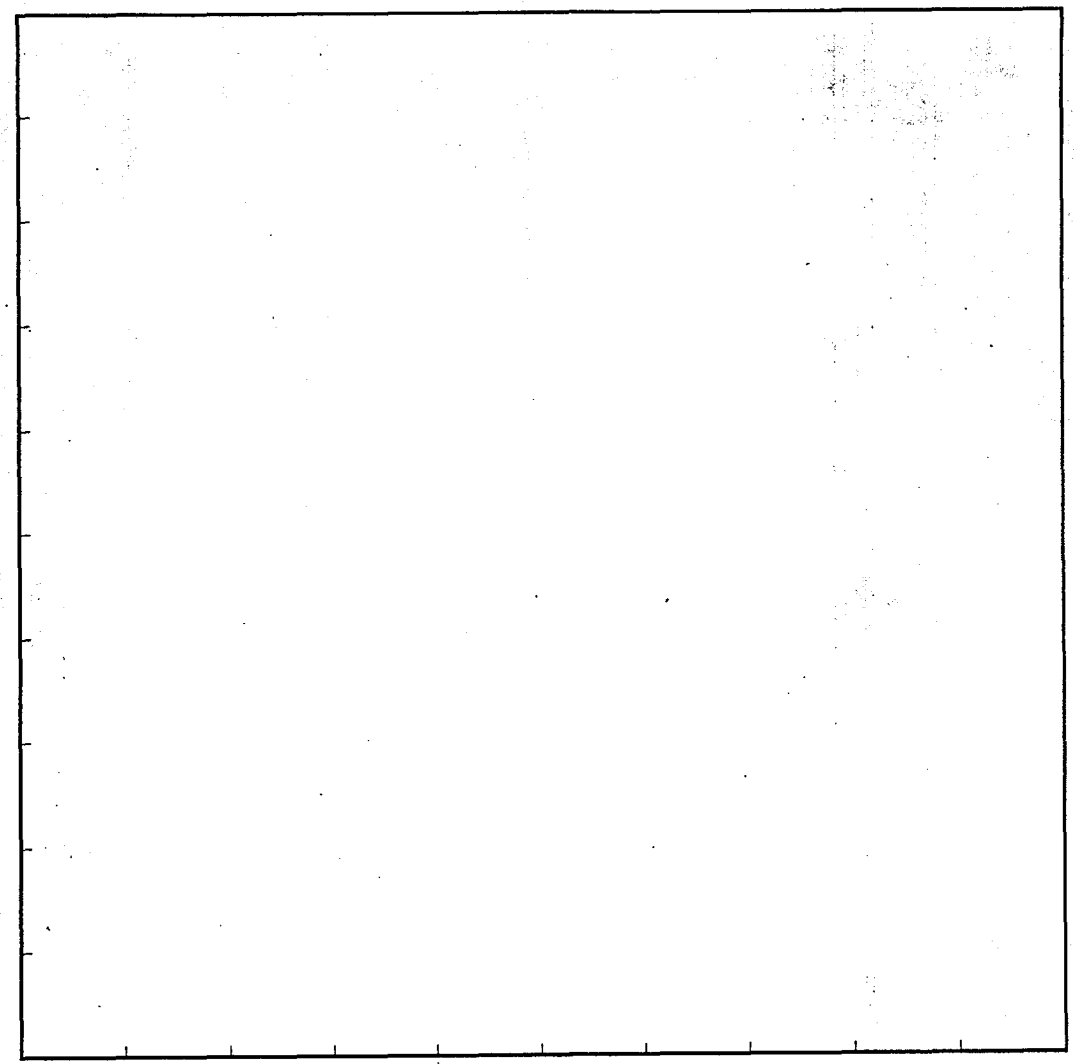


TWAHPN4G



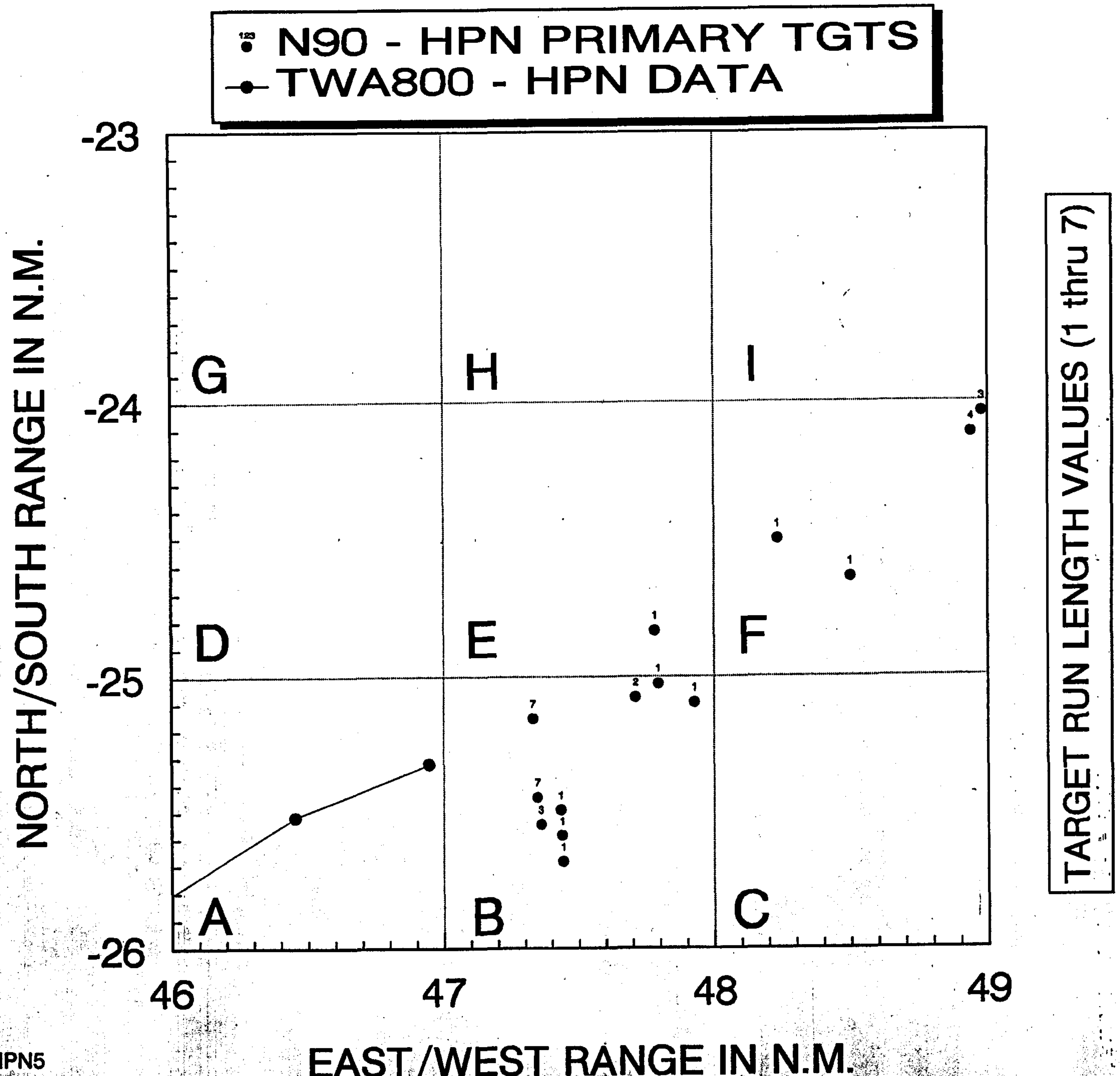
TWAHPN4H

NUMBERED SEQUENTIAL RETURNS



TWAHPN4I

ATTACHMENT #16



N90 - HPN PRIMARY TGTS
TWA800 - HPN DATA
NORTH/SOUTH RANGE IN N.M.
-23
-24
-25
-26
46
47
48
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G
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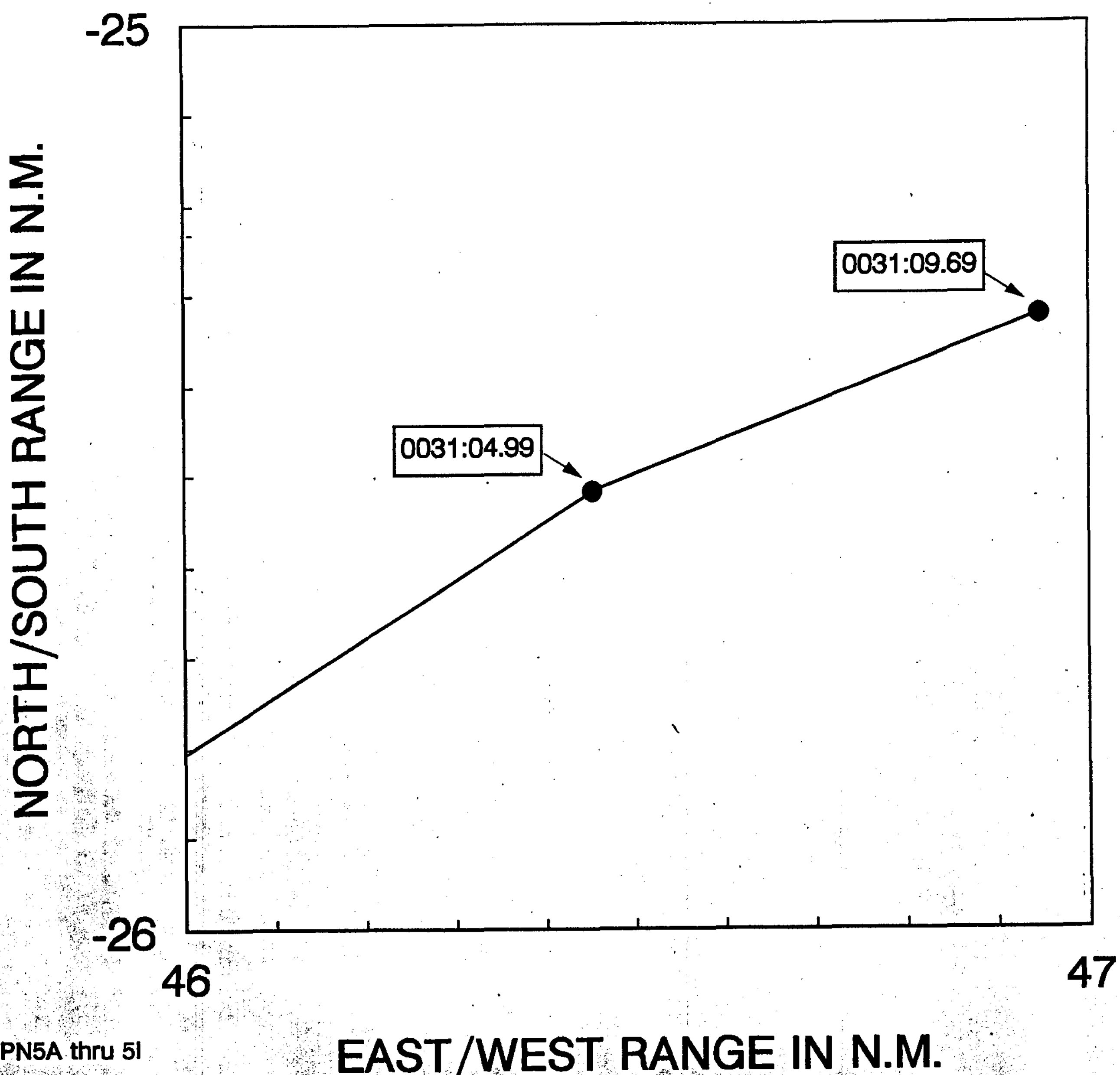
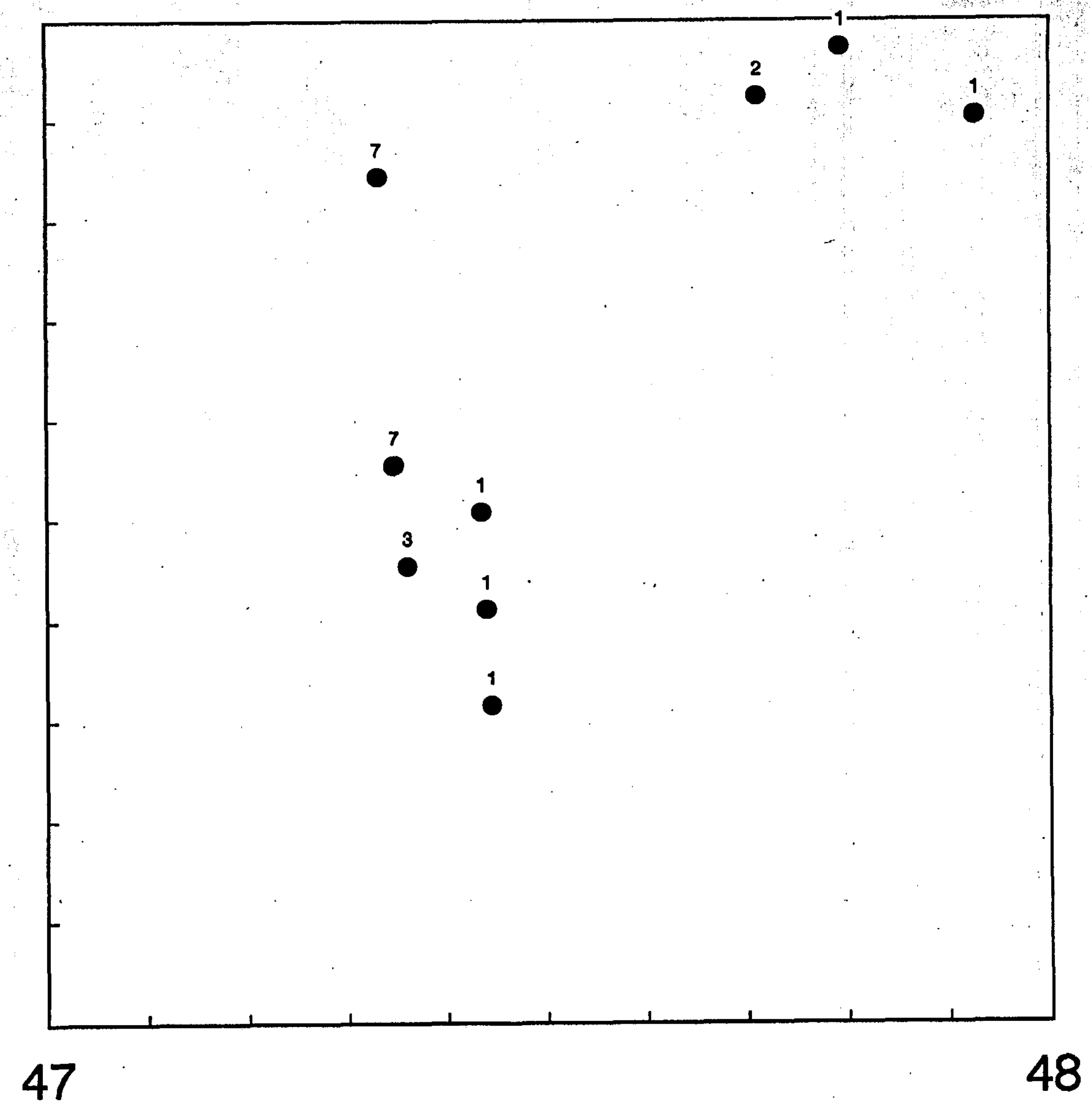
B
C
TARGET RUN LENGTH VALUES (1 thru 7)
EAST/WEST RANGE IN N.M.

TWAHPN5

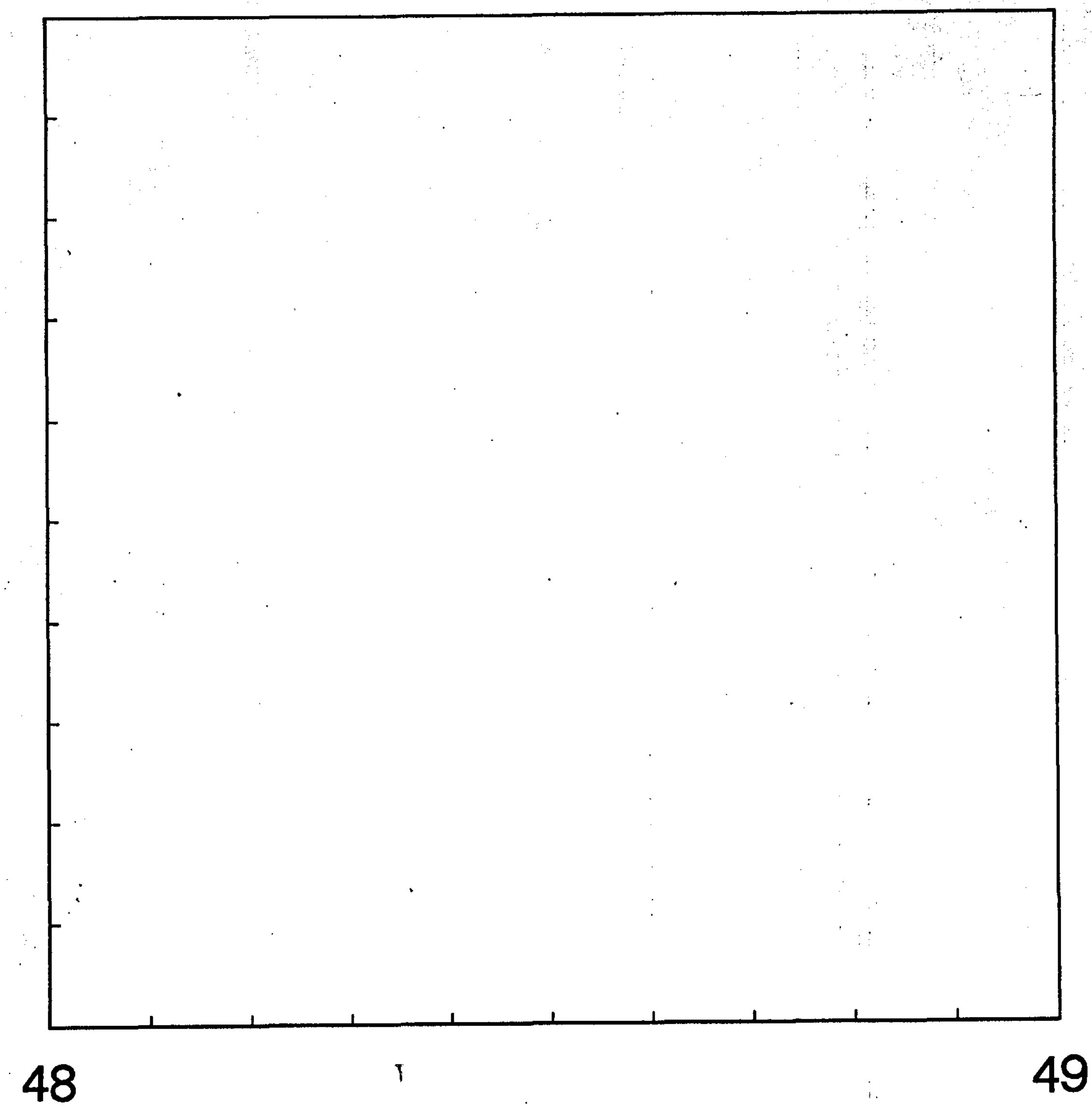
ATTACHMENT #17



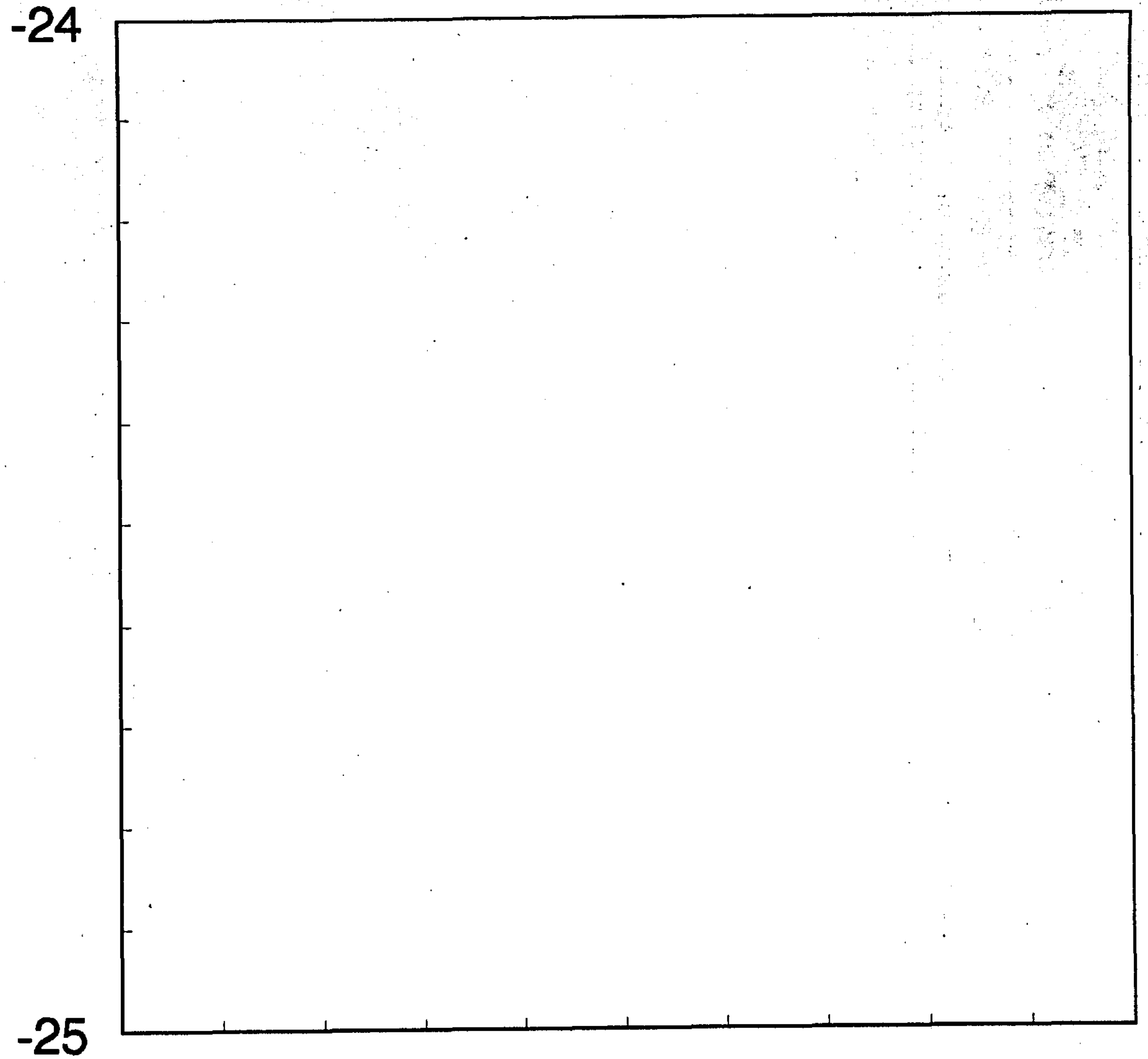
TWAHPN5A thru 5I



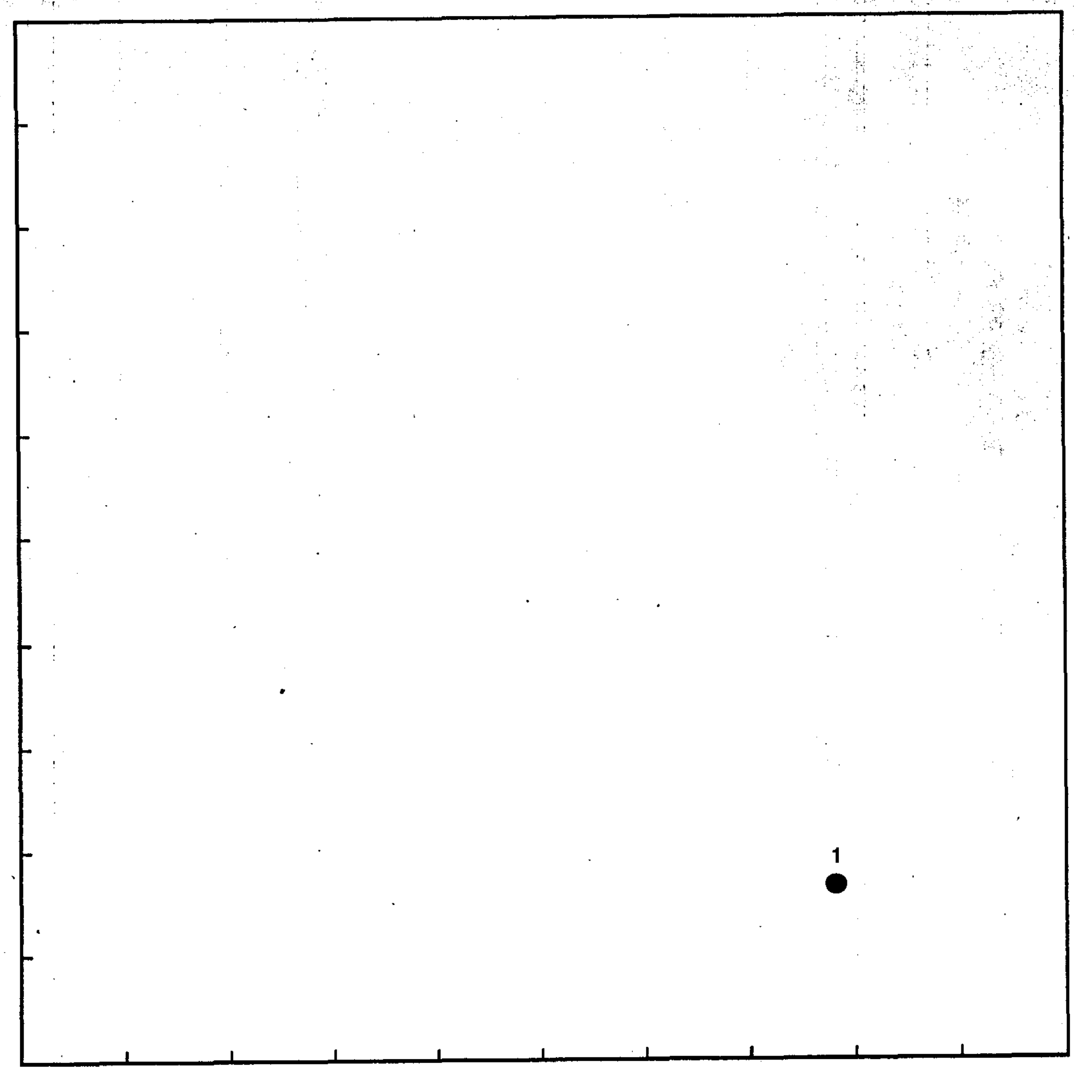
TWAHPN5B



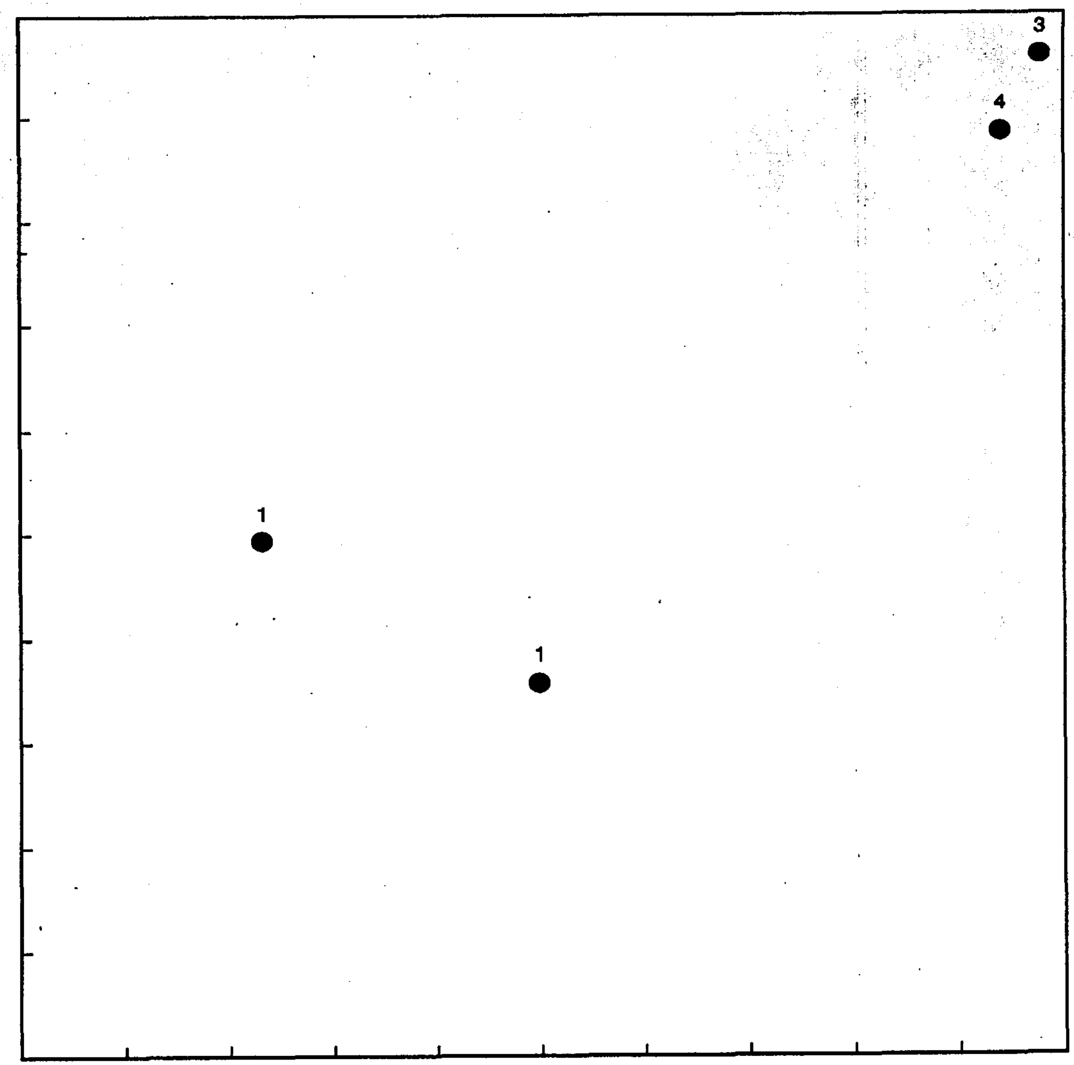
TWAHPN5C



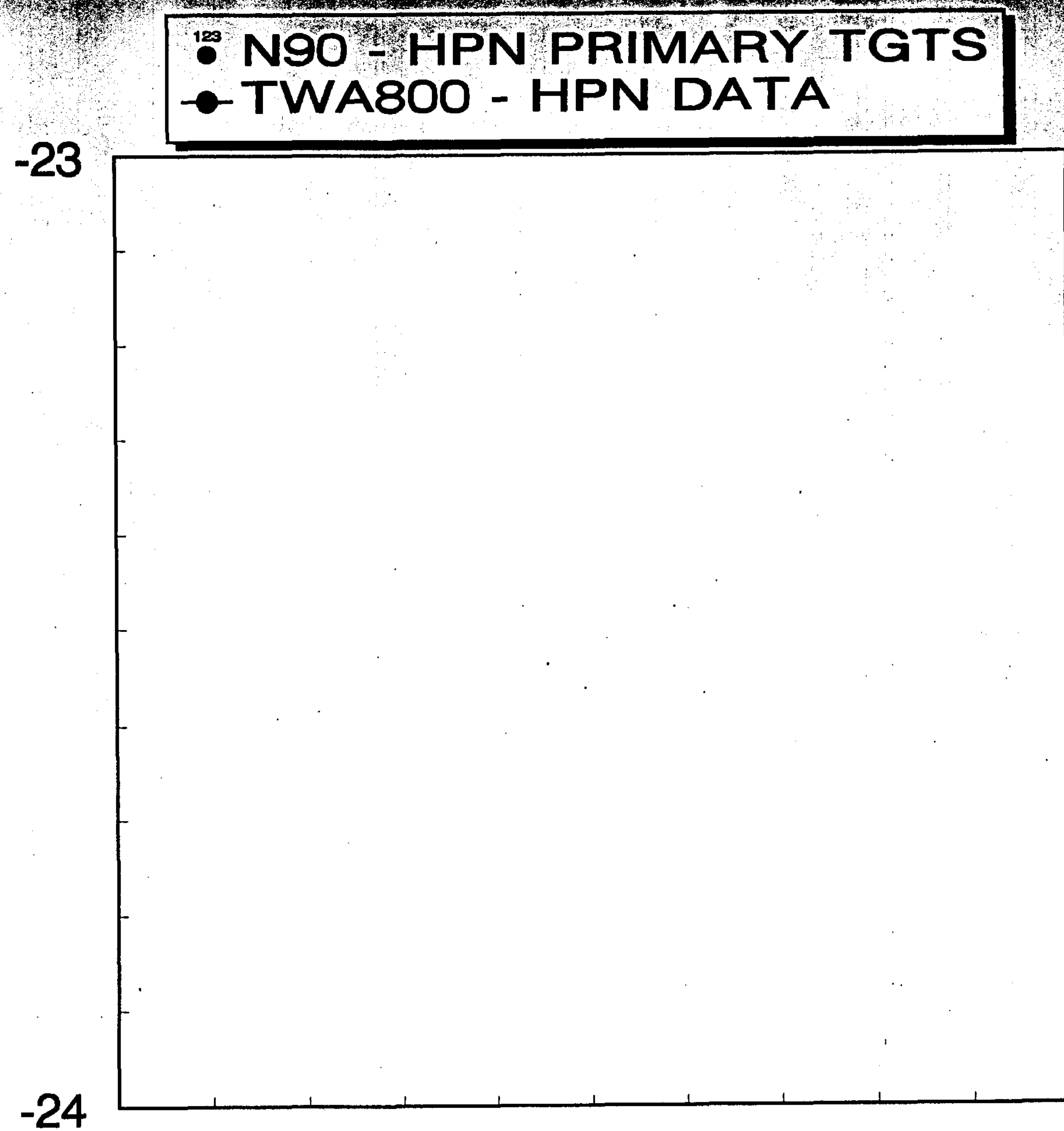
TWAHPN5D



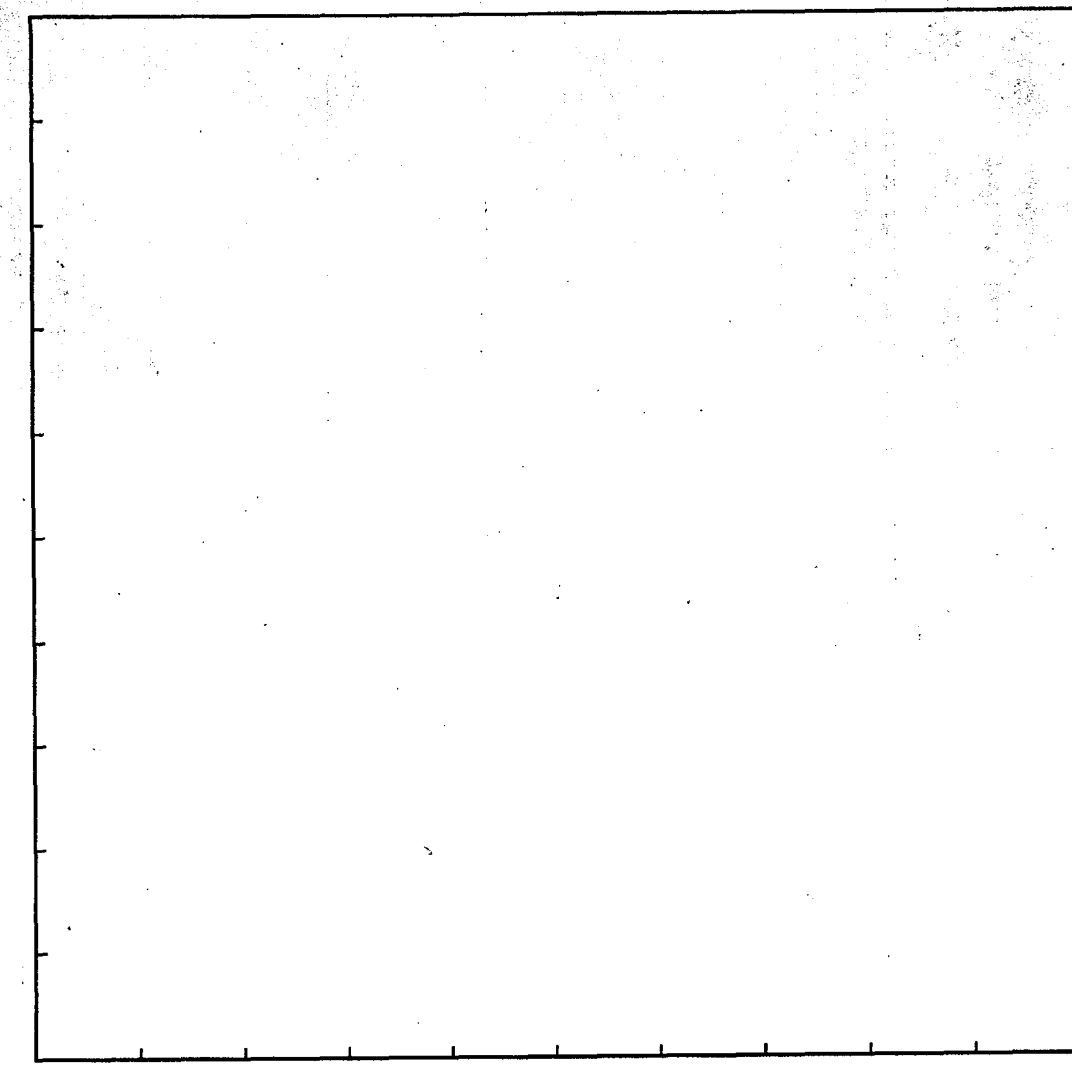
TWAHPN5E



TWAHPN5F

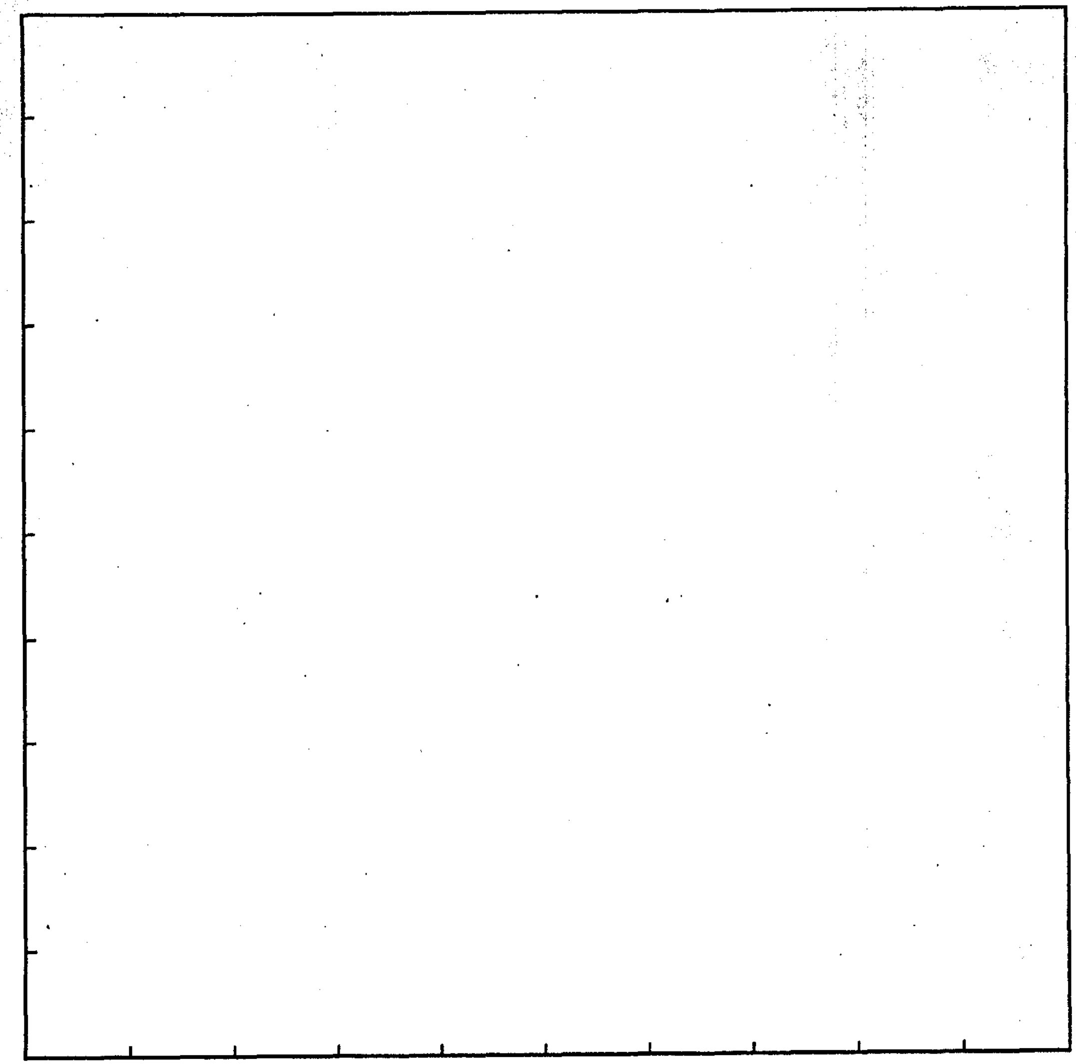


TWAHPN5G



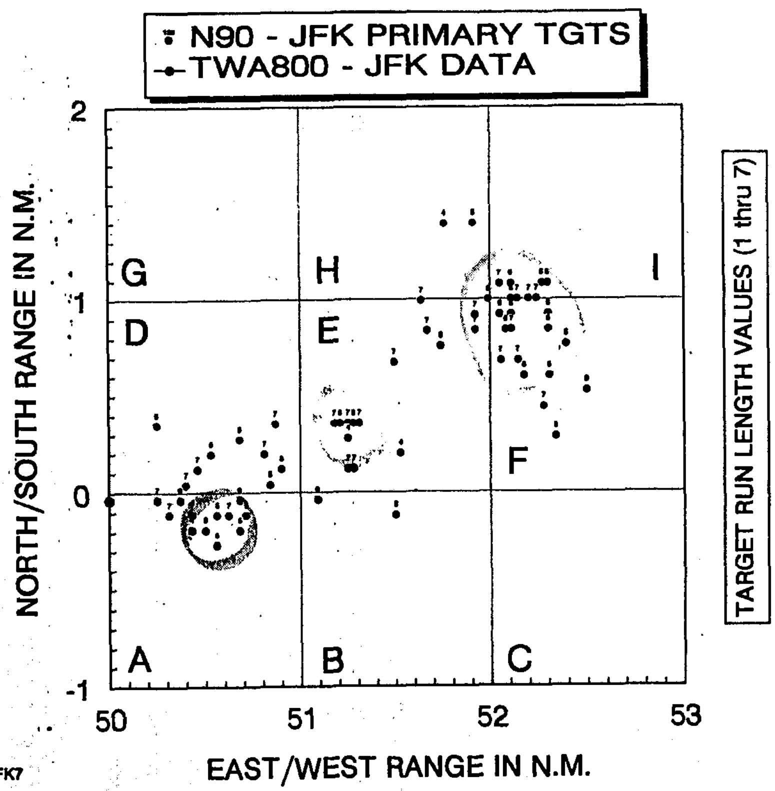
TWAHPN5H

TARGET RUN LENGTH VALUES (1 thru 7)

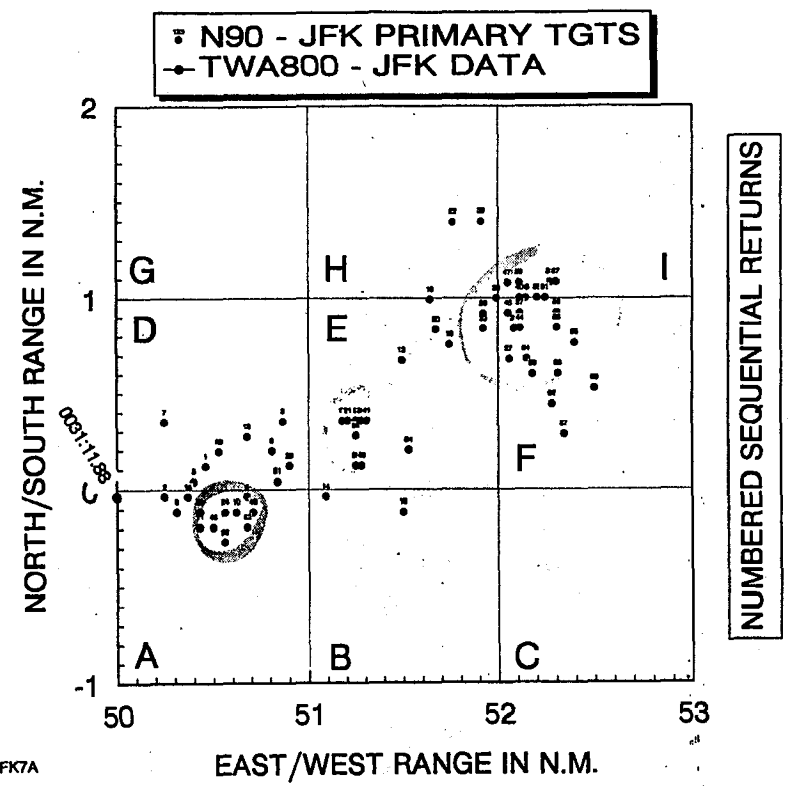


TWAHPN5I

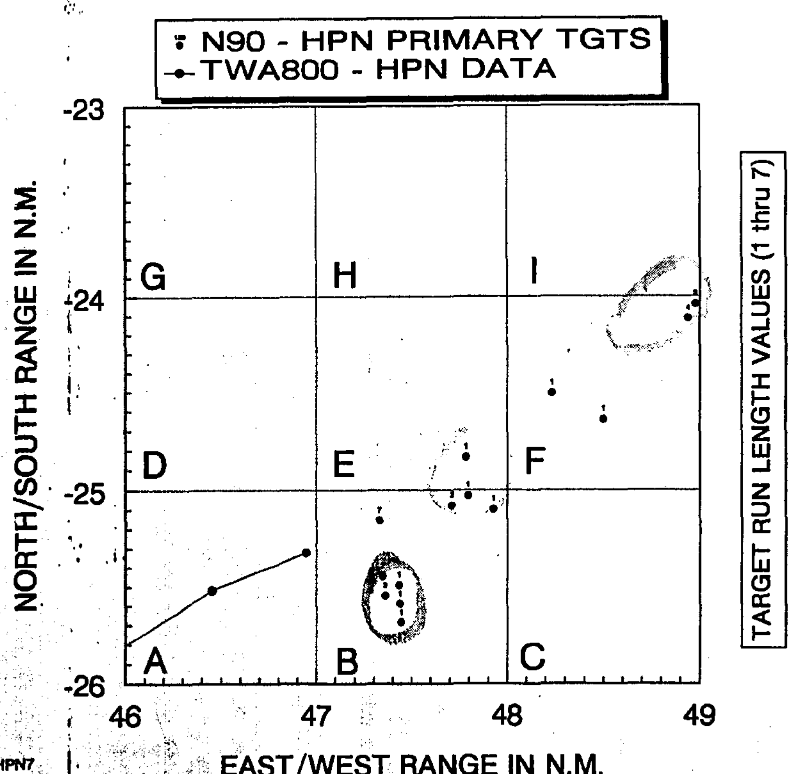
ATTACHMENT #18



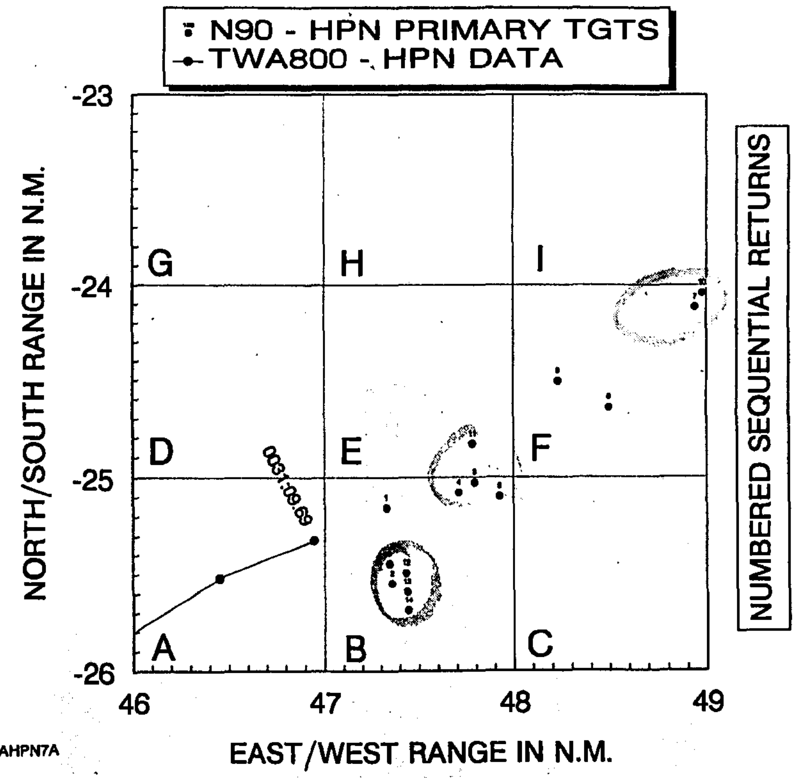
TWAJFK7



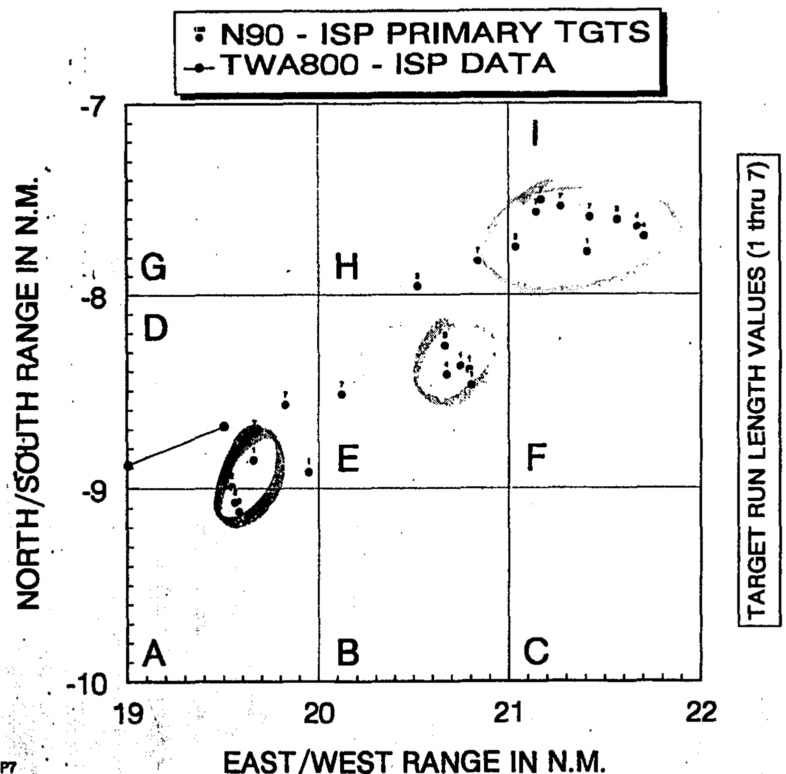
TWAJFK7A



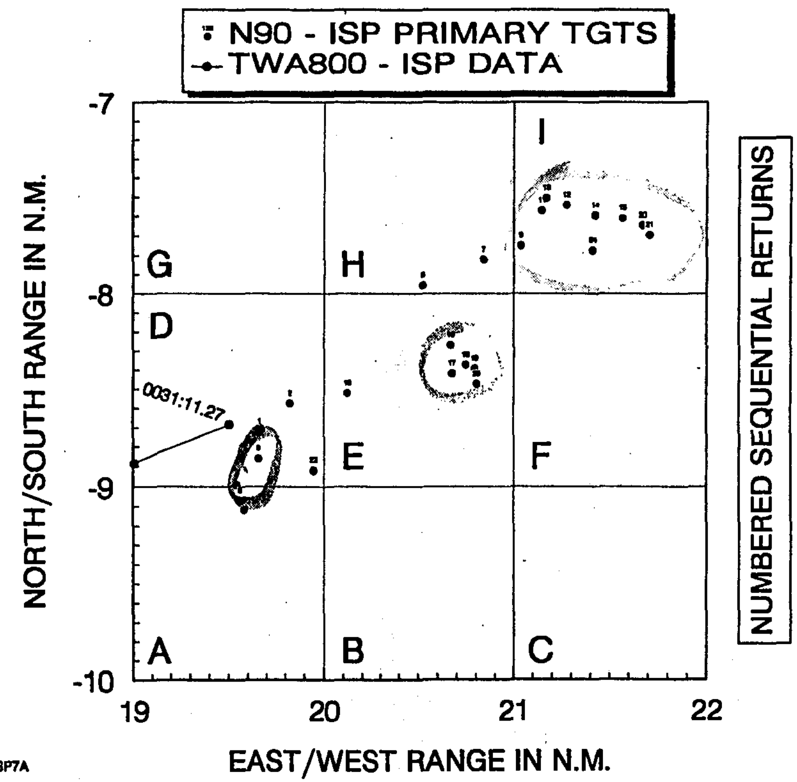
TWAHPN7



TWAHPN7A

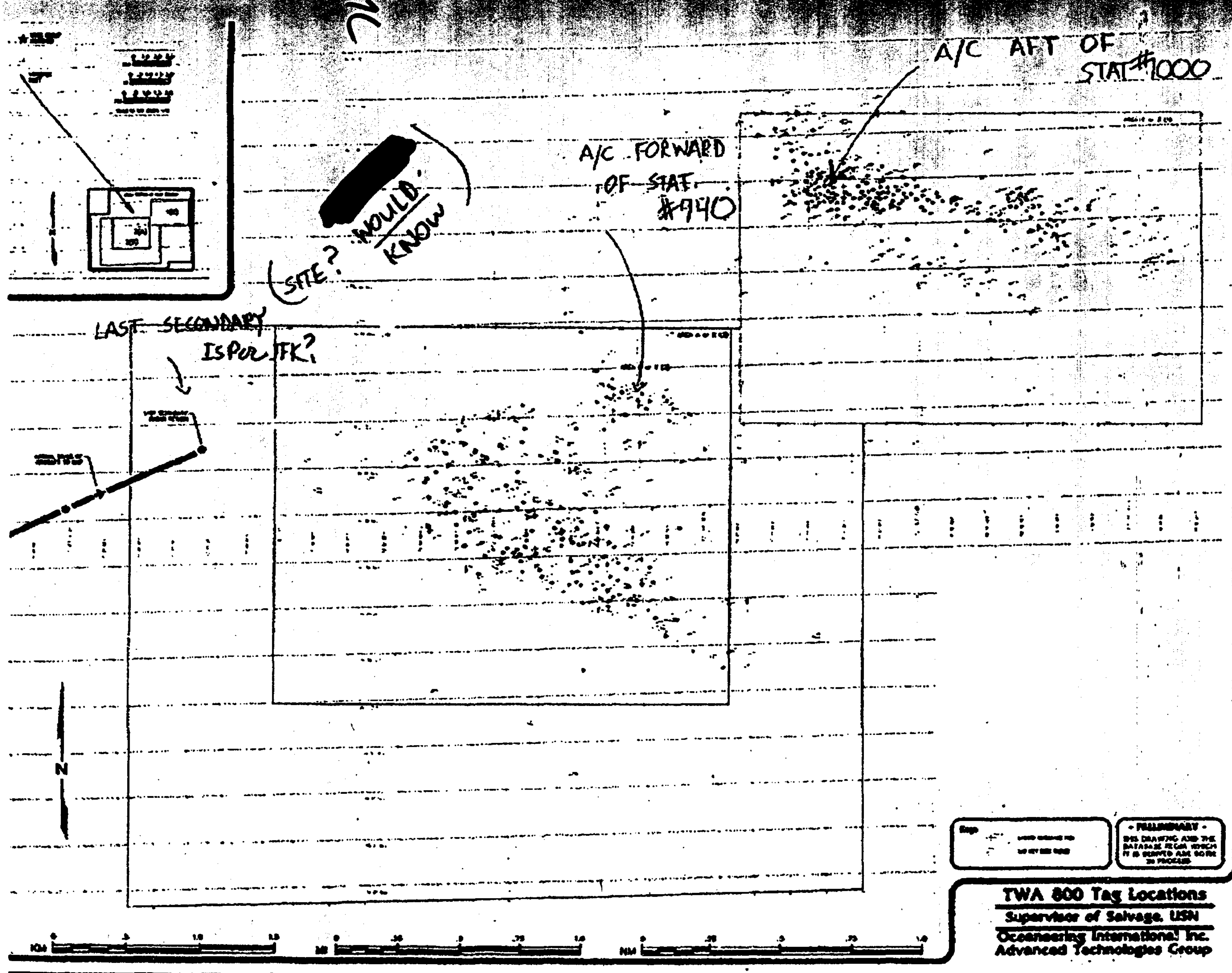


TWAISP7



TWAISP7A

ATTACHMENT #19


A/C AFT OF STAT #1000
A/C FORWARD OF STAT #940
[redacted] WOULD KNOW
SITE?
LAST SECONDARY IS PER JFK?
N
TWA 800 Tag Locations
Supervisor of Salvage, USN
Oceaneering International Inc.
Advanced Technologies Group

[redacted]

b7C

August 21, 1997

VIA FACSIMILE TRANSMISSION

W/FOLLOW UP

VIA PRIORITY MAIL

SA [redacted]
FBI, New York Field Office
26 Federal Plaza, 23rd Floor
New York, NY 10278

b7C

Dear [redacted]

Enclosed [*following*] please find copies of final plot material and time adjusted data files for TWA800 and the unknown surface target.

As you can see on plots TWA10 and TWA 10C, time is depicted at approximately one minute intervals. By counting the target points between the depicted times, you can refer to the enclosed data files to determine exact target times. It was impossible to list or depict the time for each target return without the plot being so busy that it made no sense.

Feel free to call if you have any questions, comments , or suggestions. I should be in for the next 2 weeks.

Very truly yours,

[redacted] b7c

Encl.

TOTAL PAGES TRANSMITTED = *17*

[redacted]

b7c

August 21, 1997

VIA E-MAIL
W/FOLLOW-UP
VIA PRIORITY MAIL

WITH PLOTS/OVERLAYS VIA EXPRESS MAIL

SA [redacted]
FBI, New York Field Office
26 Federal Plaza, 23rd Floor
b7C New York, NY 10278

Dear [redacted]

The plot overlays and maps went out late this afternoon via Express Mail # EH144596275US with delivery scheduled at your office prior to 1200 tomorrow, August 22, 1997, before to noon. UPS may be back to work but they are so backlogged that they could not guarantee delivery prior to next Monday. Hence, I opted for the U.S. Mule.

You will note that each map (1:250,000 & 1:80,000) have four "bulls eyes" at specific points on the maps. These points correspond to the bulls eyes located on each of the overlays. Simply line up the bulls eyes on the overlays with those on the maps and you're in business. You may note that there may be a very minor miss-alignment or error with the alignment of the bulls eyes. This is due, in part, to two separate factors as explained below.

I complete the overlays on 8½ x 11 inch paper in black & white exactly as provided to you in other plots. This plot is then photographed (in a contact process) to an 8½ x 11 negative. Once completed, the negative in utilized to complete a photo-like process where the contents of the negative is applied to clear acetate. In the process to enlarge information on the negative to align with the reference points on the map, an enlargement value is arrived at to "same-size" the overlay to the map. During this process, the development of the enlargement factor is limited to a whole number value only. Hence, if the enlargement factor is put at between 345% & 346%, the technician will select the whole number value which most closely matches the alignment marks since the camera settings do not allow for settings in percentages of decimal values. In some cases, this will cause the alignment marks to be off very slightly as the machine is unable to adjust between whole number settings.

The second problem lies in the printing of the map itself. During the printing (drying) process, a map can stretch or shrink ever so minimally that its overall accuracy (for its intended use) is not affected. Additionally, rolling and un-rolling, or folding a map will change its overall size (hence scale) to a very minor degree.

The minimal "miss" or "non" alignment will usually not represent more than a +/- 100 foot error.

For ready reference, the scales of the maps relative to real-life values are as follows.

1:250,000	1" = 6.86 NM
1:80,000"	1" = 1.10 NM

From the above scales, it is clear that the width of a pencil line drawn on the maps could be as wide as ¼ NM which could tend to miss-lead the viewer relative to accuracy.

The start position of the surface target really (still) baffles me as it does not align with any of the inlets providing access from the area of protected waters to the ocean. At the least, this craft did not want to be around when big things were happening and kept going when the "sun" came out above it with the documented in-flight explosion.

I will FAX copies of the plots utilized for the overlays to you later this evening (8288) so you can have a ready reference. I do this only because you are pilot and they always seem to have a bit of trouble understanding controllers. Specially them

Navy pilots!

By the way, you can track the whereabouts of the overlays at the web address below. Simply enter the Express Mail number (EH144596275US) and you will be informed where it is in the delivery picture.

http://www.usps/cttgate/

Call if you have any questions.

Sincerely,

[redacted] b7c

Encl. (Priority Mail only)

Filename: UNK-13W.DAT **UNKNOWN SURFACE TARGET**

	TIME (UTC)			XCOORD	YCOORD	TGT QUAL	TOTIM
1	0,	12,	23.57,	23.2972,	-2.0814,	3.00,	743.57,
2	0,	12,	42.38,	23.3305,	-2.1566,	2.00,	762.38,
3	0,	14,	53.90,	23.3057,	-3.2413,	2.00,	893.90,
4	0,	15,	12.70,	23.3235,	-3.5361,	1.00,	912.70,
5	0,	15,	17.39,	23.3235,	-3.5361,	1.00,	917.39,
6	0,	15,	22.09,	23.3289,	-3.5003,	1.00,	922.09,
7	0,	15,	36.18,	23.3069,	-3.6434,	1.00,	936.18,
8	0,	16,	41.98,	23.2297,	-4.1074,	2.00,	1001.98,
9	0,	16,	46.67,	23.2105,	-4.2143,	1.00,	1006.67,
10	0,	16,	56.07,	23.2170,	-4.1787,	1.00,	1016.07,
11	0,	17,	38.35,	23.1780,	-4.6506,	2.00,	1058.35,
12	0,	17,	57.16,	23.1491,	-4.7928,	1.00,	1077.16,
13	0,	18,	39.44,	23.0240,	-5.1364,	1.00,	1119.44,
14	0,	19,	45.22,	22.8646,	-5.8052,	1.00,	1185.22,
15	0,	19,	49.92,	22.8734,	-5.7701,	2.00,	1189.92,
16	0,	19,	54.61,	22.9130,	-5.8175,	1.00,	1194.61,
17	0,	19,	59.32,	22.8556,	-5.8402,	1.00,	1199.32,
18	0,	20,	18.09,	22.7916,	-6.0853,	1.00,	1218.09,
19	0,	20,	32.33,	22.7538,	-6.2250,	1.00,	1232.33,
20	0,	21,	56.91,	22.4842,	-6.9370,	1.00,	1316.91,
21	0,	22,	01.63,	22.4842,	-6.9370,	2.00,	1321.63,
22	0,	27,	21.10,	21.5079,	-9.4191,	1.00,	1641.10,
23	0,	27,	49.29,	21.3459,	-9.7806,	1.00,	1669.29,
24	0,	28,	08.06,	21.3158,	-9.8461,	2.00,	1688.06,
25	0,	28,	12.76,	21.2550,	-9.9767,	1.00,	1692.76,
26	0,	28,	17.45,	21.2550,	-9.9767,	1.00,	1697.45,
27	0,	28,	45.65,	21.0995,	-10.3016,	1.00,	1725.65,
28	0,	28,	59.75,	21.1310,	-10.2368,	3.00,	1739.75,
29	0,	30,	19.73,	20,7903,	-10.9120,	1.00,	1819.73,
30	0,	30,	24.42,	20.7567,	-10.9758,	2.00,	1824.42,
31	0,	31,	11.42,	20.5512,	-11.3560,	1.00,	1871.42,
32	0,	32,	07.80,	20.3026,	-11.7947,	1.00,	1927.80,
33	0,	32,	26.59,	20.2912,	-11.9133,	1.00,	1946.59,
34	0,	32,	35.97,	20.1435,	-12.1614,	2.00,	1955.97,
35	0,	33,	04.18,	20.1574,	-12.2543,	1.00,	1984.18,
36	0,	33,	18.26,	20.1197,	-12.3161,	1.00,	1998.26,
37	0,	33,	27.65,	20.0055,	-12.5008,	1.00,	2007.65,
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40	0,	35,	20.42,	19.5863,	-13.4858,	4.00,	2120.42,
41	0,	35,	25.13,	19.6564,	-13.4897,	1.00,	2125.13,
42	0,	36,	21.51,	19.4138,	-13.9910,	1.00,	2181.51,
43	0,	36,	30.90,	19.3924,	-14.0208,	2.00,	2190.90,
44	0,	36,	40.31,	19.4113,	-14.0798,	2.00,	2200.31,
45	0,	36,	54.39,	19.2590,	-14.2875,	3.00,	2214.39,
46	0,	37,	03.77,	19.3510,	-14.2639,	1.00,	2223.77,
47	0,	39,	20.21,	18.9455,	-15.4554,	1.00,	2360.21,
48	0,	39,	29.59,	18.7785,	-15.6580,	1.00,	2369.59,
49	0,	39,	34.32,	18.8503,	-15.5714,	1.00,	2374.32,
50	0,	39,	53.10,	18.7508,	-15.8309,	1.00,	2393.10,
51	0,	40,	21.32,	18.6877,	-16.0746,	4.00,	2421.32,
52	0,	40,	35.40,	18.7009,	-16.1359,	1.00,	2435.40,
53	0,	40,	44.81,	18.6142,	-16.3118,	1.00,	2444.81,
54	0,	40,	54.20,	18.6891,	-16.2260,	1.00,	2454.20,
55	0,	40,	58.89,	18.5689,	-16.4238,	4.00,	2458.89,
56	0,	41,	03.59,	18.5437,	-16.4523,	1.00,	2463.59,
57	0,	41,	22.39,	18.5050,	-16.5708,	2.00,	2482.39,
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59	0,	41,	31.79,	18.4731,	-16.6960,	5.00,	2491.79,
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62	0,	45,	03.21,	17.8221,	-18.7242,	1.00,	2703.21,
63	0,	45,	17.32,	17.7122,	-18.8968,	1.00,	2717.32,
64	0,	45,	31.42,	17.7532,	-18.9406,	2.00,	2731.42,
65	0,	45,	45.49,	17.6999,	-19.0587,	2.00,	2745.49,
66	0,	47,	38.40,	17.1879,	-20.1174,	1.00,	2858.40,
67	0,	48,	01.90,	17.1908,	-20.2462,	1.00,	2881.90,
68	0,	48,	06.60,	17.2296,	-20.2920,	1.00,	2886.60,
69	0,	48,	11.29,	17.1673,	-20.3447,	4.00,	2891.29,

Filename: 2633XISP.DAT

TWA800 N90 ISP DATA
TIME ADJUSTED

	TIME (UTC)			XCOORD	YCOORD	MODE "C"	TOTIM
1	0,	19,	56.53,	-31.2440,	-10.3702,	500.00,	1196.53,
2	0,	20,	01.23,	-31.3896,	-10.3117,	600.00,	1201.23,
3	0,	20,	05.91,	-31.4652,	-10.4972,	700.00,	1205.91,
4	0,	20,	10.63,	-31.5827,	-10.4289,	800.00,	1210.63,
5	0,	20,	15.33,	-31.4363,	-11.1347,	800.00,	1215.33,
6	0,	20,	20.00,	-31.4600,	-11.3063,	900.00,	1220.00,
7	0,	20,	24.70,	-31.4474,	-11.5749,	900.00,	1224.70,
8	0,	20,	29.40,	-31.6038,	-11.4676,	1000.00,	1229.40,
9	0,	20,	34.09,	-31.5457,	-11.9972,	1000.00,	1234.09,
10	0,	20,	38.79,	-31.5834,	-12.2339,	1000.00,	1238.79,
11	0,	20,	43.51,	-31.5909,	-12.5163,	1100.00,	1243.51,
12	0,	20,	48.21,	-31.6248,	-12.7548,	1200.00,	1248.21,
13	0,	20,	52.90,	-31.5452,	-13.2889,	1300.00,	1252.90,
14	0,	20,	57.59,	-31.6689,	-13.2267,	1300.00,	1257.59,
15	0,	21,	02.32,	-31.6469,	-13.5609,	1400.00,	1262.32,
16	0,	21,	07.01,	-31.6117,	-13.7184,	1400.00,	1267.01,
17	0,	21,	11.70,	-31.4808,	-14.0652,	1500.00,	1271.70,
18	0,	21,	16.41,	-31.2564,	-14.4858,	1500.00,	1276.41,
19	0,	21,	21.11,	-31.1444,	-14.7251,	1500.00,	1281.11,
20	0,	21,	25.80,	-30.8504,	-14.8767,	1600.00,	1285.80,
21	0,	21,	30.49,	-30.5993,	-15.1627,	1700.00,	1290.49,
22	0,	21,	35.18,	-30.3367,	-15.4405,	1800.00,	1295.18,
23	0,	21,	39.90,	-30.0957,	-15.6683,	2000.00,	1299.90,
24	0,	21,	44.59,	-29.9017,	-15.8012,	2100.00,	1304.59,
25	0,	21,	49.14,	-29.6759,	-16.0330,	2200.00,	1309.14,
26	0,	21,	53.83,	-29.3052,	-16.4775,	2300.00,	1313.83,
27	0,	21,	58.53,	-29.1508,	-16.5677,	2400.00,	1318.53,
28	0,	22,	03.25,	-28.8849,	-16.8294,	2500.00,	1323.25,
29	0,	22,	07.94,	-28.6863,	-16.9504,	2600.00,	1327.94,
30	0,	22,	12.64,	-28.3462,	-17.3415,	2800.00,	1332.64,
31	0,	22,	17.33,	-27.9126,	-17.7904,	2900.00,	1337.33,
32	0,	22,	22.03,	-27.7945,	-17.7152,	3100.00,	1342.03,
33	0,	22,	26.74,	-27.5068,	-17.8299,	3200.00,	1346.74,
34	0,	22,	31.44,	-27.4328,	-17.9618,	3300.00,	1351.44,
35	0,	22,	36.13,	-26.7648,	-18.1170,	3400.00,	1356.13,
36	0,	22,	40.82,	-26.2743,	-18.3189,	3500.00,	1360.82,
37	0,	22,	45.51,	-25.9000,	-18.2952,	3600.00,	1365.51,
38	0,	22,	50.22,	-25.5782,	-18.1267,	3800.00,	1370.22,
39	0,	22,	54.92,	-25.2375,	-18.0019,	4000.00,	1374.92,

40	0,	22,	59.62,	-24.8623,	-17.9074,	4200.00,	1379.62,
41	0,	23,	04.34,	-24.4450,	-17.8357,	4400.00,	1384.34,
42	0,	23,	09.03,	-24.2350,	-17.5121,	4600.00,	1389.03,
43	0,	23,	13.73,	-24.0489,	-17.1540,	4800.00,	1393.73,
44	0,	23,	18.42,	-23.7981,	-16.9201,	5100.00,	1398.42,
45	0,	23,	23.12,	-23.6059,	-16.6204,	5300.00,	1403.12,
46	0,	23,	27.81,	-23.3782,	-16.3531,	5500.00,	1407.81,
47	0,	23,	32.51,	-23.1325,	-16.1284,	5600.00,	1412.51,
48	0,	23,	37.20,	-22.8616,	-15.8875,	5800.00,	1417.20,
49	0,	23,	41.89,	-22.5975,	-15.6014,	5800.00,	1421.89,
50	0,	23,	46.60,	-22.3871,	-15.2541,	5800.00,	1426.60,
51	0,	23,	51.29,	-22.0036,	-15.1415,	5800.00,	1431.29,
52	0,	23,	55.99,	-21.5904,	-15.0532,	5800.00,	1435.99,
53	0,	24,	00 .69,	-21.2704,	-14.8302,	5900.00,	1440.69,
54	0,	24,	05.38,	-20.9240,	-14.7321,	6100.00,	1445.38,
55	0,	24,	10.08,	-20.4271,	-14.8083,	6300.00,	1450.08,
56	0,	24,	14.77,	-20.0259,	-14.8481,	6600.00,	1454.77,
57	0,	24,	19.50,	-19.6194,	-14.9232,	6900.00,	1459.50,
58	0,	24,	24.20,	-19.2528,	-14.9734,	7300.00,	1464.20,
59	0,	24,	28.89,	-18.9182,	-14.9947,	7600.00,	1468.89,
60	0,	24,	33.57,	-18.5538,	-14.9860,	7800.00,	1473.57,
61	0,	24,	38.26,	-18.1529,	-15.0339,	8000.00,	1478.26,
62	0,	24,	42.84,	-17.8150,	-15.0327,	8100.00,	1482.84,
63	0,	24,	47.53,	-17.4408,	-14.9939,	8200.00,	1487.53,
64	0,	24,	52.22,	-16.9843,	-15.0606,	8300.00,	1492.22,
65	0,	24,	56.91,	-16.7062,	-14.9519,	8400.00,	1496.91,
66	0,	25,	1.61,	-16.2461,	-15.0414,	8600.00,	1501.61,
67	0,	25,	6.30,	-15.8426,	-15.0332,	8700.00,	1506.30,
68	0,	25,	11.03,	-15.4577,	-14.9866,	8800.00,	1511.03,
69	0,	25,	15.31,	-15.0369,	-14.9868,	8900.00,	1515.31,
70	0,	25,	20.41,	-14.5730,	-15.0231,	9000.00,	1520.41,
71	0,	25,	25.10,	-14.2570,	-14.9247,	9100.00,	1525.10,
72	0,	25,	29.79,	-13.7996,	-14.9427,	9200.00,	1529.79,
73	0,	25,	34.51,	-13.3916,	-14.9086,	9400.00,	1534.51,
74	0,	25,	39.21,	-12.9545,	-14.9211,	9500.00,	1539.21,
75	0,	25,	43.90,	-12.5538,	-14.8692,	9700.00,	1543.90,
76	0,	25,	48.59,	-12.1241,	-14.8620,	9800.00,	1548.59,
77	0,	25,	53.14,	-12.1861,	-14.4337,	10000.00,	1553.14,
78	0,	25,	57.83,	-11.3220,	-14.7823,	10100.00,	1557.83,
79	0,	26,	02.53,	-10.8819,	-14.7628,	10200.00,	1562.53,
80	0,	26,	07.23,	-10.4915,	-14.7001,	10300.00,	1567.23,
81	0,	26,	11.95,	-10.1002,	-14.6691,	10400.00,	1571.95,
82	0,	26,	16.64,	-9.6570,	-14.6422,	10500.00,	1576.64,

83	0,	26,	21.34,	-9.2243,	-14.6120,	10600.00,	1581.34,
84	0,	26,	26.04,	-8.8294,	-14.5740,	10800.00,	1586.04,
85	0,	26,	30.73,	-8.3548,	-14.5868,	11000.00,	1590.73,
86	0,	26,	35.43,	-7.9567,	-14.5574,	11300.00,	1595.43,
87	0,	26,	39.98,	-7.5095,	-14.5234,	11500.00,	1599.98,
88	0,	26,	44.68,	-7.0721,	-14.5415,	11700.00,	1604.68,
89	0,	26,	49.37,	-6.6926,	-14.4890,	11900.00,	1609.37,
90	0,	26,	54.06,	-6.2636,	-14.4836,	12000.00,	1614.06,
91	0,	26,	58.76,	-5.8573,	-14.4478,	12100.00,	1618.76,
92	0,	27,	03.48,	-5.3897,	-14.4261,	12100.00,	1623.48,
93	0,	27,	08.18,	-4.6298,	-14.5302,	12100.00,	1628.18,
94	0,	27,	12.87,	-4.5001,	-14.3510,	12200.00,	1632.87,
95	0,	27,	17.41,	-3.9980,	-14.3536,	12200.00,	1637.41,
96	0,	27,	22.13,	-3.5883,	-14.3172,	12200.00,	1642.13,
97	0,	27,	26.83,	-3.1395,	-14.2789,	12300.00,	1646.83,
98	0,	27,	31.52,	-2.6359,	-14.2686,	12300.00,	1651.52,
99	0,	27,	36.20,	-2.2708,	-14.2401,	12400.00,	1656.20,
100	0,	27,	40.90,	-1.7136,	-14.2372,	12400.00,	1660.90,
101	0,	27,	45.47,	-1.2907,	-14.2015,	12400.00,	1665.47,
102	0,	27,	50.16,	-.7209,	-14.1917,	12500.00,	1670.16,
103	0,	27,	54.86,	-.2412,	-14.1779,	12500.00,	1674.86,
104	0,	27,	59.56,	.2807,	-14.1672,	12600.00,	1679.56,
105	0,	28,	04.25,	.7585,	-14.1497,	12700.00,	1684.25,
106	2,	28,	08.95,	1.3366,	-14.7496,	12700.00,	1688.95,
107	0,	28,	13.50,	1.7592,	-14.1007,	12700.00,	1693.50,
108	0,	28,	18.19,	2.2418,	-14.0827,	12800.00,	1698.19,
109	0,	28,	22.88,	2.8604,	-14.0518,	12800.00,	1702.88,
110	0,	28,	27.58,	3.3084,	-14.0353,	12800.00,	1707.58,
111	0,	28,	32.28,	3.8681,	-13.9849,	12900.00,	1712.28,
112	0,	28,	36.85,	4.3433,	-13.9390,	12900.00,	1716.85,
113	0,	28,	41.54,	4.7852,	-13.8465,	12900.00,	1721.54,
114	0,	28,	46.24,	5.2922,	-13.7250,	13000.00,	1726.24,
115	0,	28,	50.93,	5.7471,	-13.5843,	13000.00,	1730.93,
116	0,	28,	55.62,	6.3217,	-13.3708,	13100.00,	1735.62,
117	0,	29,	00 .34,	6.7922,	-13.1944,	13000.00,	1740.34,
118	0,	29,	04.88,	7.1828,	-13.0544,	13000.00,	1744.88,
119	0,	29,	09.57,	7.6301,	-12.8679,	12900.00,	1749.57,
120	0,	29,	14.29,	8.0412,	-12.7454,	13000.00,	1754.29,
121	0,	29,	18.98,	8.5092,	-12.5709,	13000.00,	1758.98,
122	0,	29,	23.67,	9.0108,	-12.3898,	12900.00,	1763.67,
123	0,	29,	28.36,	9.4475,	-12.2248,	12800.00,	1768.36,
124	0,	29,	33.05,	9.8886,	-12.0526,	12800.00,	1773.05,
125	0,	29,	37.60,	10.4018,	-11.8398,	12800.00,	1777.60,

126	0,	29,	42.32,	10.7686,	-11.7389,	12800.00,	1782.32,
127	0,	29,	47.01,	11.2031,	-11.5908,	12800.00,	1787.01,
128	0,	29,	51.71,	11.6760,	-11.4310,	12800.00,	1791.71,
129	0,	29,	56.40,	12.1312,	-11.2724,	12900.00,	1796.40,
130	0,	30,	01.09,	12.5711,	-11.0845,	13000.00,	1801.09,
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132	0,	30,	10.35,	13.4897,	-10.7994,	12900.00,	1810.35,
133	0,	30,	15.04,	13.9412,	-10.6439,	12900.00,	1815.04,
134	0,	30,	19.73,	14.3685,	-10.4895,	12900.00,	1819.73,
135	0,	30,	24.42,	14.8524,	-10.3274,	13000.00,	1824.42,
136	0,	30,	29.15,	15.2727,	-10.2079,	13000.00,	1829.15,
137	0,	30,	33.84,	15.7567,	-10.0147,	13100.00,	1833.84,
138	0,	30,	38.53,	16.2312,	-9.7994,	13200.00,	1838.53,
139	0,	30,	43.22,	16.6710,	-9.6849,	13300.00,	1843.22,
140	0,	30,	47.91,	17.1173,	-9.5272,	13300.00,	1847.91,
141	0,	30,	52.48,	17.6470,	-9.2622,	13300.00,	1852.48,
142	0,	30,	57.19,	18.0534,	-9.1947,	13400.00,	1857.19,
143	0,	31,	01.88,	18.5474,	-9.0555,	13500.00,	1861.88,
144	0,	31,	06.57,	19.0056,	-8.8853,	13600.00,	1866.57,
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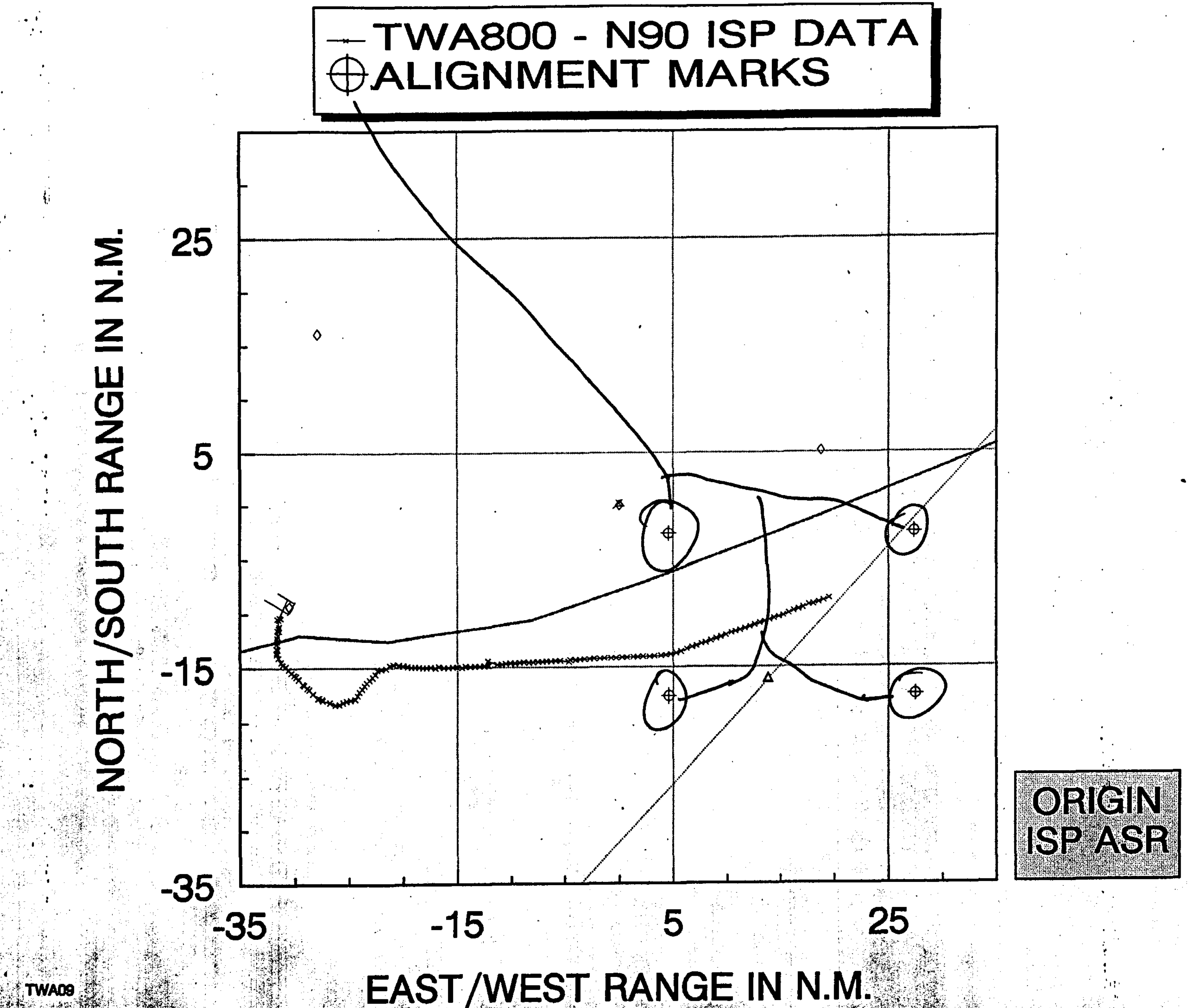
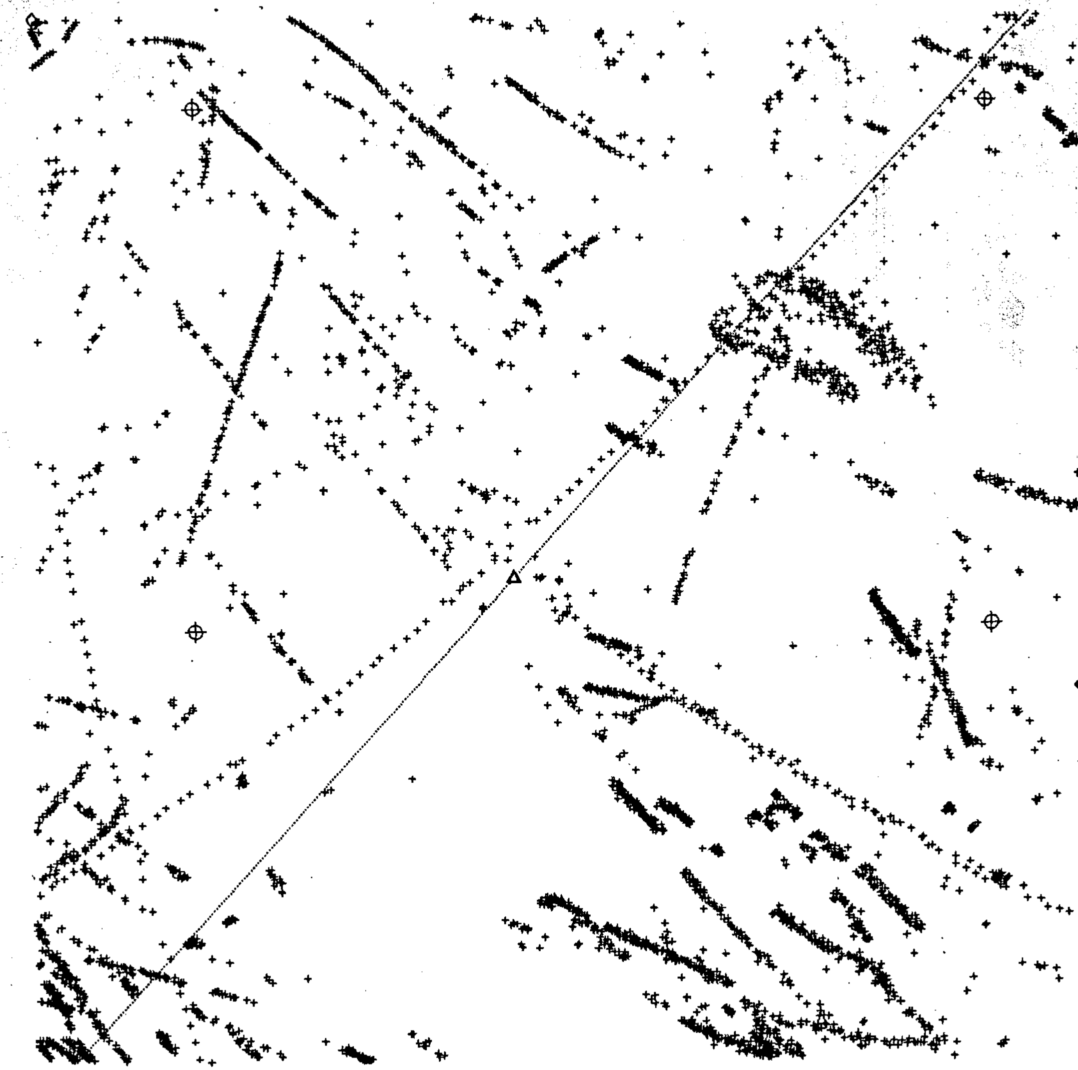
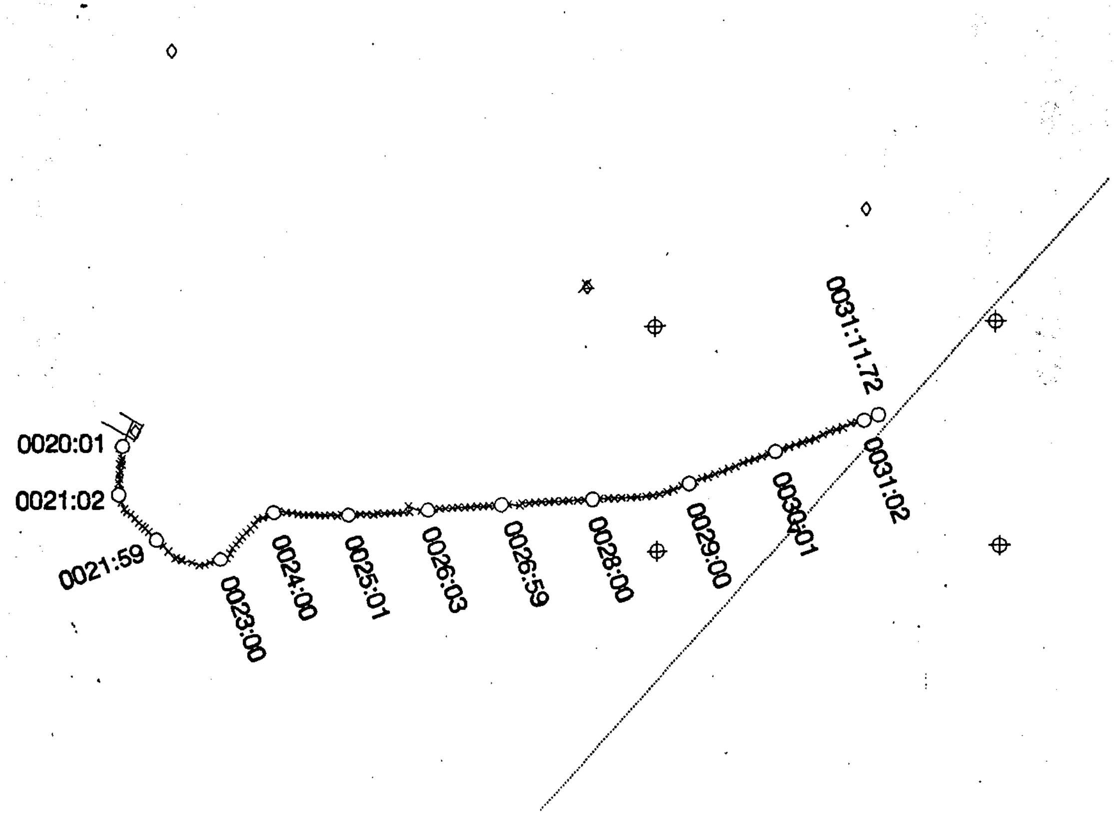


TWA800 - N90 ISP DATA
ALIGNMENT MARKS
NORTH/SOUTH RANGE IN N.M.
25
5
-15
-35
-35
-15
5
25
EAST/WEST RANGE IN N.M.
ORIGIN
ISP ASR
TWA09

N90 ISP PRIMARY TGTS

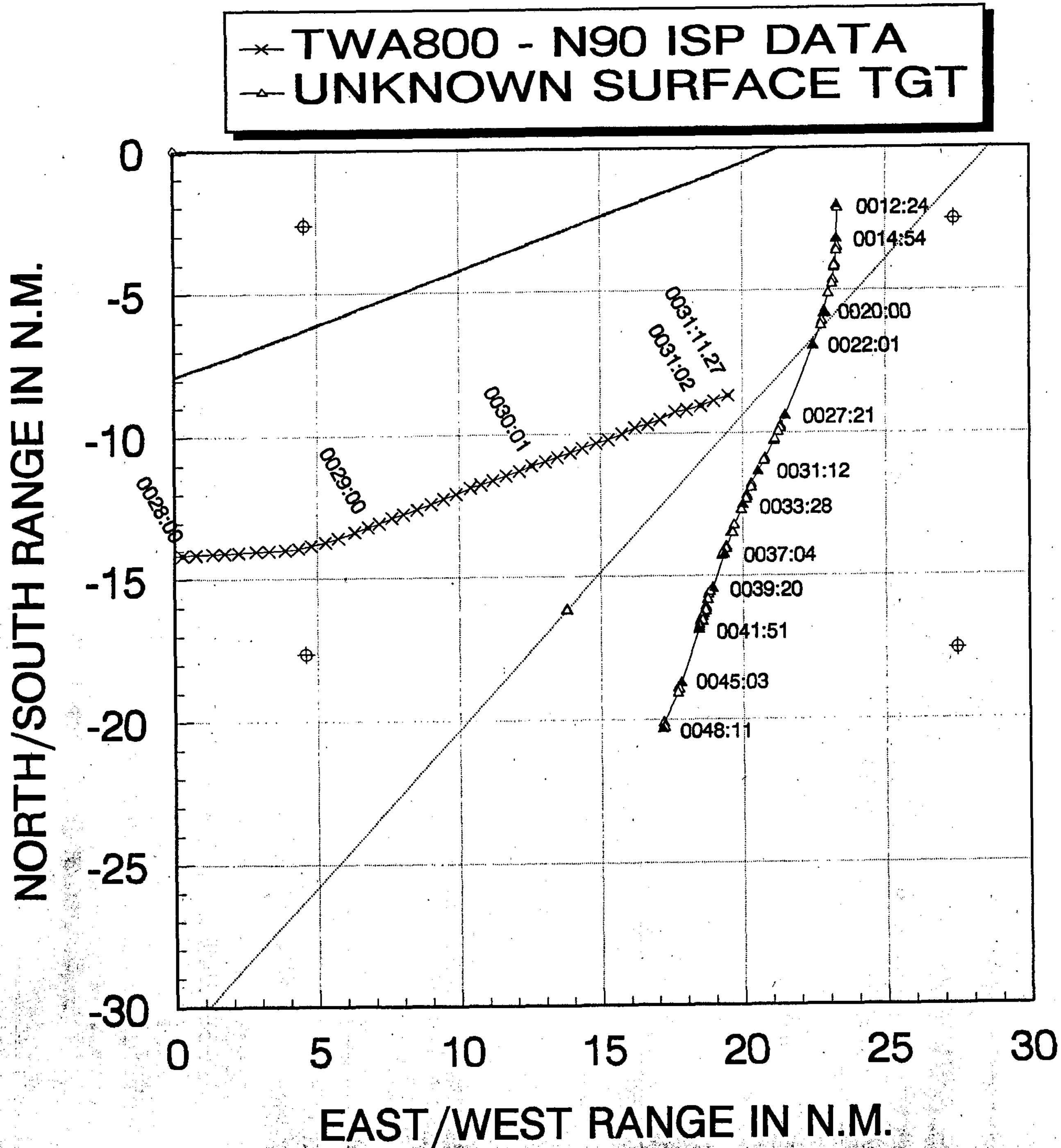


TWA09D



TWA800 - N90 ISP DATA

TWA10



TWA800 - N90 ISP DATA
UNKNOWN SURFACE TGT
NORTH/SOUTH RANGE IN N.M.
EAST/WEST RANGE IN N.M.
0
-5
-10
-15
-20
-25
-30
0
5
10
15
20
25
30
0028:00
0029:00
0030:01
0031:02
0031:11.27
0012:24
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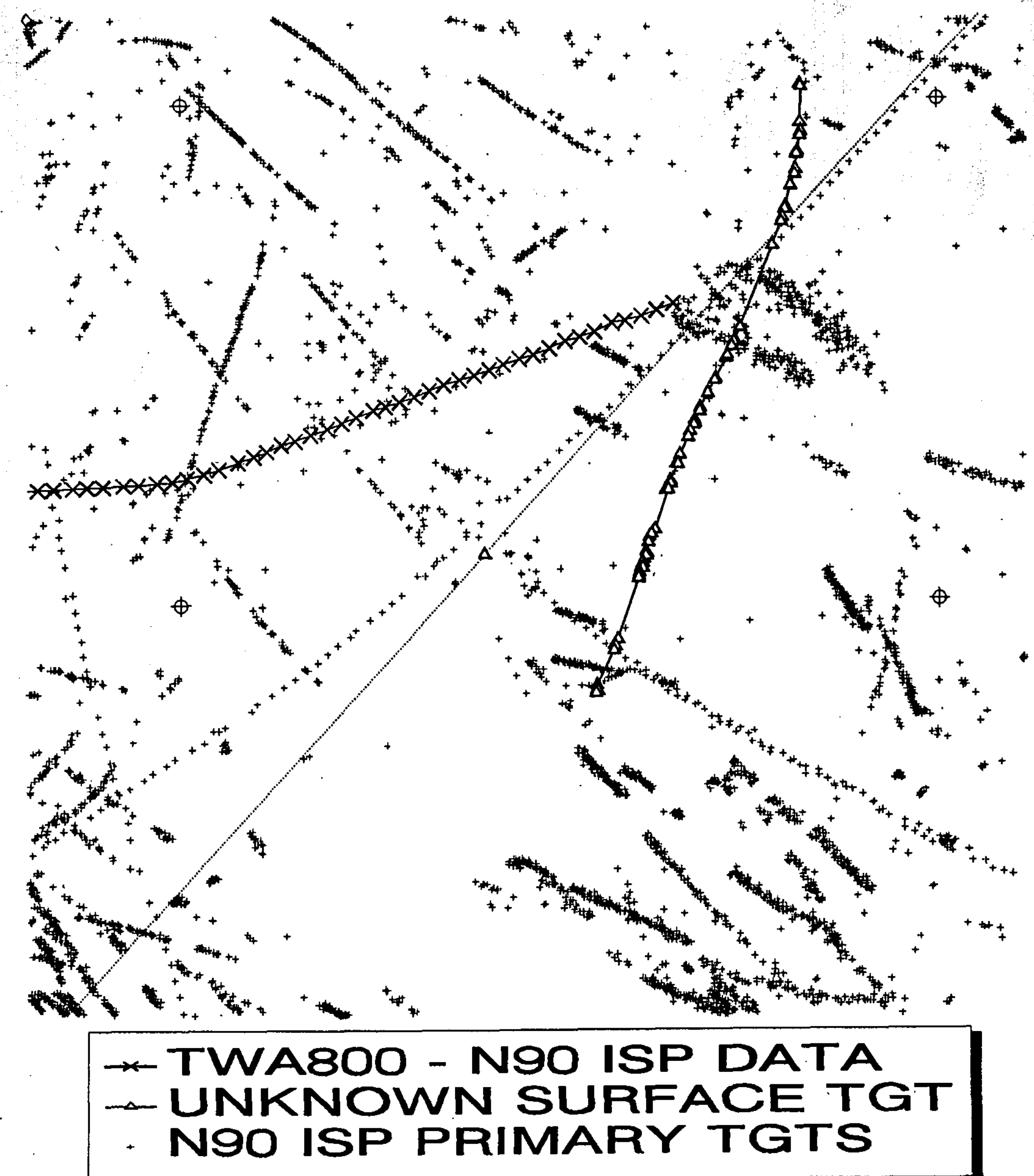
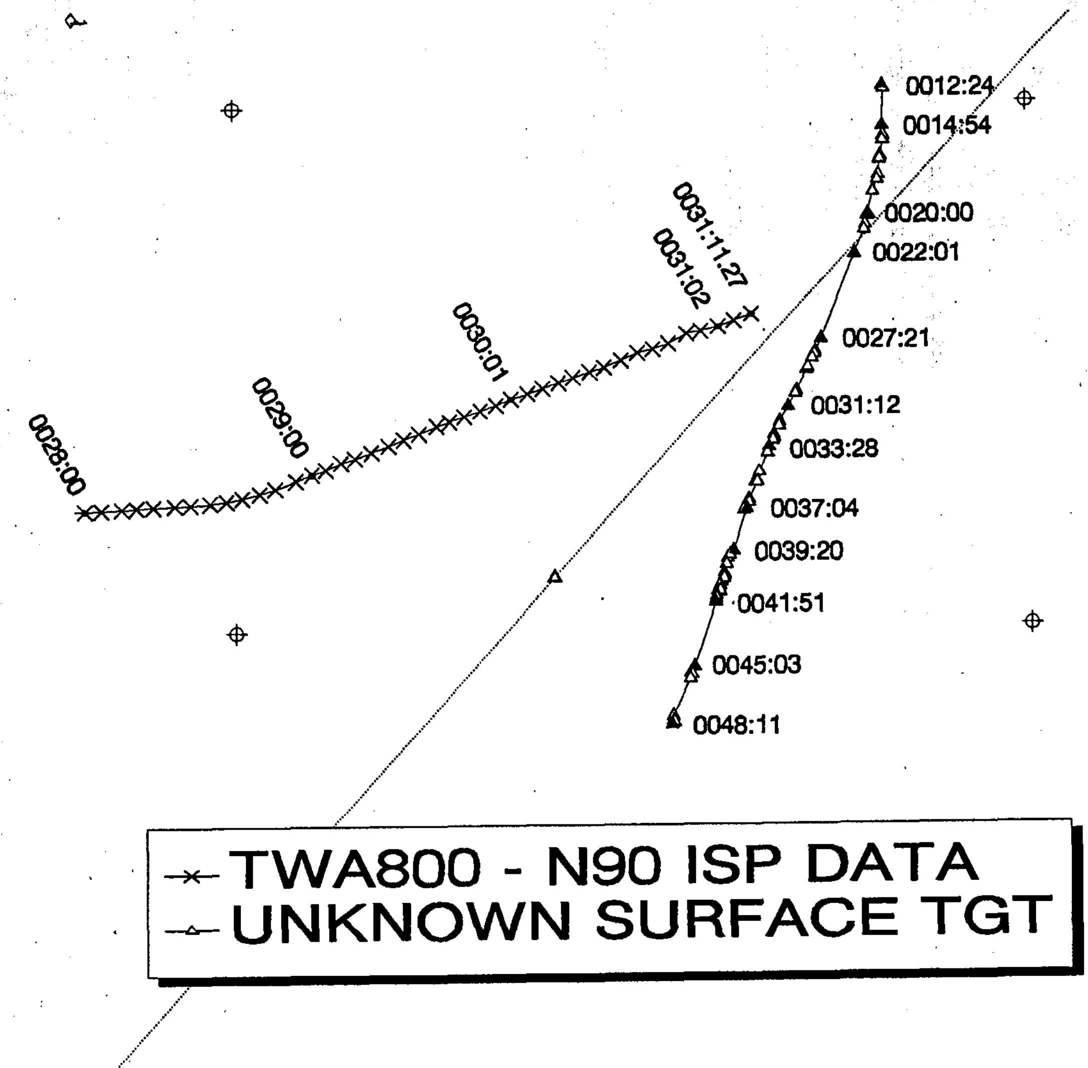
0045:03
0048:11

TWA10C


TWA800 - N90 ISP DATA
UNKNOWN SURFACE TGT
N90 ISP PRIMARY TGTS

TWA10D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0014:54
0020:00
0022:01
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0031:12
0033:28
0037:04
0039:20
0041:51
0045:03
0048:11
0028:00
0029:00
0030:01
0031:02
0031:11.27
TWA800 - N90 ISP DATA
UNKNOWN SURFACE TGT

TWA11B

[redacted]

b7c

June 25, 1997

VIA FACSIMILE TRANSMISSION
W/follow up
VIA UPS NEXT DAY AIR

ORIGINAL

SA [redacted]
FBI, New York Field Office
26 Federal Plaza, 23rd Floor
New York, NY 10278

b7c

Dea[redacted]

I spoke with [redacted] during the early evening of June 19, 1997, regarding his time alignment of radar data. Additionally, we discussed the FDR data he provided earlier this month. Following our discussion, I commenced development of a series of profile view plots of FDR and radar data sets to assist in an assessment of final time alignment.

Below, please find a listing describing the enclosed plots along with the data sets provided by the Safety Board.

One important item that must be addressed before a discussion can proceed is the presentation of time values. In the normal world, time is dealt within the traditional manner with 60 seconds equaling 1 minute, 60 minutes equaling 1 hour, and 24 hours equaling 1 day. However, when it comes to plotting time through the use of a computer, one must convert the traditional values listed above (HHMM:SS) to a computer usable format based on a value indicating tenths. This process is completed through a subroutine within the program that converts range and azimuth values to an X/Y coordinate system which appends converted time values to each (individual) line of data. Converted time is known as *Total Time in Minutes* or **TOTIM** (MMMM.MM). In the case involving data relative to TWA800, the reader will note in attachments containing information provided by the NTSB that time values start at 1135.1835 and continue through a value of 1872.5000.

In the traditional HHMM:SS time format, the aforementioned TOTIM value indicates the earliest time as 0018:55.10 UTC[1] with the latter time being 0031:12.5 UTC. As an additional example of the conversion process, the latter time above which indicates the time the CVR terminated versus the tenths value of same is provided for clarification:

TIME(UTC)	**TOTIM**
0031:12.5:	31 minutes X 60 = 1860.00 + 12.5 seconds = 1872.5

A. DATA

At the request of FBI/NYC officials, the undersigned received three files from the NTSB via INTERNET transmission on June 3, 1997. The first transmission was unreadable and a second was requested in ASCII format. The second transmission was successful and the files transmitted are indicated in **[*ATTACHMENT #1*]**.

1. File: FDRMSLALT-27.CSV

File (*5 columns x 1,097 lines*) containing information extracted from TWA800's FDR by NTSB personnel. Column 1 depicts TOTIM data based on alignment with Boston ARTCC voice information. Column 2 depicts altitudes adjusted to the height of the altitude sensor aboard TWA800. Column 3 depicts altitude values based on pressure altitude while the flight was on the runway prior to the application of corrections. Based on NTSB documents reviewed by the undersigned, corrections applied to values in column 2 were as follows: 12 feet [*runway elevation*] + 10 feet [*approximate elevation of altitude sensor above runway*] (-105 feet [*pressure altitude recorded while on runway*]) = 127 (-)-105 = 22 feet MSL. Column 4 depicts the value of column 2 divided (÷) by 10. Column 5 depicts column one data corrected to the altimeter setting programmed into the N90 TRACON's ARTSIIIA(e) computer during the time period TWA800 was operating within the TRACON's airspace which also includes the time that the break up sequence commenced **[*ATTACHMENT #2*]**.

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[1] All times or timing values contained herein (TOTIM or HHMM:SS) reflect Coordinate Universal Time (UTC).

2. File: FDREND.CSV

File (*2 columns* x *2 lines*) depicts time established by the NTSB as termination of the FDR aboard TWA800 as TOTIM 1872.2586 (0031:12.2586 UTC). The listing of two separate altitude values with the same time is for the purpose of generating a vertical line on profile view plots denoting the time the time FDR data ceased **[*ATTACHMENT #3*]**.

3. File: CVREND.CSV

File (*2 columns* x *2 lines*) depicting time established by the NTSB as termination of the CVR aboard TWA800 as TOTIM 1872.5000 (0031:12.500 UTC). As with the FDR data above, the listing of two separate altitude values at the same time is for the purpose of generating a vertical line on profile view plots denoting the time the time CVR data ceased **[*ATTACHMENT #4*]**.

B. PROFILE VIEW PLOTS

A series of profile view plots were generated for the purpose of verifying, and adjusting, time alignment of the various radar data sets. The plots listed and described below represent final alignment values. The various plots generated to arrive at the final product are not included.

1. PLOT: TWALT22A

Profile view plot depicting data contained in Column 1 and 5 from file MSLALT-1.CSV commencing at 0031:00.0 and continuing through 0031:11.5585. Data from column 2 (*symbol* "x") depicts data adjusted to a base elevation commencing at 22 feet MSL. Data depicted from column 5 (*symbol* "⊗") depicts data adjusted to the N90 ARTSIII altimeter setting at the time of the incident (30.03). Additionally, the termination times of the FDR and CVR are depicted by vertical lines at their appropriate times and are common to all profile view plots. The reader will note that the altitude difference between displayed files is a consistent value of 27 feet. Horizontal scale: major increments = 5 minutes, minor increments = 1 minute. Vertical scale: major increments = 100 feet, minor increments = 50 feet **[*ATTACHMENT #5*]**.

2. **PLOT: TWALT22B**

Profile view plot depicting data contained in Column 1 and 5 from file MSLALT-1.CSV commencing at 0031:00.0 and continuing through 0031:11.5585 (x & ⊗). Additionally, radar data from the N90 ARTSIII and ZBV were added to the plot as follows: ○ = N90 ISP raw RB/BT data between 0031:02.128 & 0031:11.552, ◇ = N90 JFK raw RB/BT data between 0031:02.885 & 0031:12.133, □ = N90 HPN raw RB/BT data between 0031:00.693 & 0031:09.939, △ = NTSB ISP raw RB/BT data between 0031:03.180 & 0031:07.790, and ▽ = ZBV raw NTAP data at 0031:09. Horizontal scale: major increments = 5 minutes, minor increments = 1 minute. Vertical scale: major increments = 100 feet, minor increments = 50 feet **[*ATTACHMENT #6*]**.

3. **PLOT: TWALT22C**

Profile view plot identical to the previous plot with the exception that this plot covers a 15 second time period by a 500-foot vertical view. Target depictions (symbols) also remain the same. Horizontal scale: major increments = 5 minutes, minor increments = 1 minute. Vertical scale: major increments = 100 feet, minor increments = 50 feet **[*ATTACHMENT #7*]**.

4. **PLOT: TWALT22D**

Profile view plot identical to the previous plot with the exception that the target symbol associated with ISP raw data was changed to " ● " while the symbol associated with N90 ISP data was changed to "▲". Additionally, the minimum and maximum (MIN/MAX) MSL altitude values that would be associated with an ARTSIII 13,700 target reply have been added to this and all following plots. As with the preceding plot, the depiction covers a 15 second time period by a 500-foot vertical view. Horizontal scale: major increments = 5 minutes, minor increments = 1 minute. Vertical scale: major increments = 100 feet, minor increments = 50 feet **[*ATTACHMENT #8*]**.

Of interest in this plot is the difference in timing between the last received ISP return in the raw data obtained by the FBI and the digital data file received from the NTSB. This difference was brought to the attention of senior NTSB officials immediately during a meeting conducted at CTO in early January 1997. Also of interest is that fact that the difference in timing between the data sets was not consistent as the difference between the time of the last return was 3.73 seconds while the time difference between the return immediately preceding the last return was 3.64 seconds.

5. **PLOT: TWALT22E**

Profile view plot identical to the previous plot with the addition of a box or bracket based on the time of the last two returns received by the JFK ASR system. This particular method of placing a time bracket was selected based on the fact that all other raw data time fall within the period between the last two JFK returns (0031:07.496 - 0031:12.133). Additionally, data associated column 1 of file MSLALT-1.CSV has been deleted from this and all subsequent plots. As with the preceding plot, the depiction covers a 15 second time period by a 500-foot vertical view. Horizontal scale: major increments = 5 minutes, minor increments = 1 minute. Vertical scale: major increments = 100 feet, minor increments = 50 feet **[*ATTACHMENT #9*]**.

6. **PLOT: TWALT22F**

Profile view plot identical to the previous plot with the addition of a box or bracket based on applying the timing difference between the raw and NTSB ISP data to the raw JFK points. The application of the known ISP time discrepancy to the JFK data points adjusted the last raw times 0031:12.133 to 0031:08.403 while the next to last return at 0031:07.496 was adjusted to 0031:03.856. The basis for the use of assumed timing for JFK data is the fact that at the time of the undersigned's visit to the NTSB to obtain copies of N90 data, JFK data as well as HPN data were not made available to the FBI's consultant. Horizontal scale: major increments = 5 minutes, minor increments = 1 minute. Vertical scale: major increments = 100 feet, minor increments = 50 feet **[*ATTACHMENT #10*]**.

7. **PLOT: TWALT23A**

Profile view plot depicting N90 ARTSIII data with time adjusted by subtracting 0.25 seconds from the raw time indicated in the data printouts and also by subtracting 1.25 seconds from ZBW NTAP data. In addition to depicting the last of beacon return data from 0031:00, time associated with the reception of the first N90 primary returns after loss of beacon data are depicted with the -0.25 second time adjustment. As a point of reference, the times depicted for receipt of the primary returns received by the HPN, ISP, and JFK ASR systems would have also been the time that the next beacon return would have been expected. Horizontal scale: major increments = 5 minutes, minor increments = 1 minute. Vertical scale: major increments = 100 feet, minor increments = 50 feet **[*ATTACHMENT #11*]**.

8. PLOT: TWALT23B

Profile view plot depicting identical information as the previous plot with the addition of data contained in Column 5 from file MSLALT-1.CSV. Horizontal scale: major increments = 5 minutes, minor increments = 1 minute. Vertical scale: major increments = 100 feet, minor increments = 50 feet **[*ATTACHMENT #12*]**.

9. PLOT: TWALT23C

Profile view plot identical to the previous plot with the addition of a box or bracket based on the adjusted times of the last two returns received by the JFK ASR system and the altitude (vertical) limits that would produce a Mode "C" altitude value of 13,700 feet. Horizontal scale: major increments = 5 minutes, minor increments = 1 minute. Vertical scale: major increments = 100 feet, minor increments = 50 feet **[*ATTACHMENT #13*]**.

10. PLOT: TWALT23D

Profile view plot identical to the previous plot but with the line(s) connecting radar data points removed for clarity. Additionally, a vertical line has been added to this as well as all subsequent plots to indicate the time that the next FDR update point would occur. The basis for placement of NEXT FDR UPDATE line at this point was the addition of a time value of 0.6719 seconds (*elapsed time between FDR updates*) added to the last TOTIM value indicated in file MSLALT-1.CSV (*Column 1, line 1097*) of 1871.5585 (0031:11.5585). This produced a TOTIM value of 1872.2304 (0031:12.2304). Horizontal scale: major increments = 5 minutes, minor increments = 1 minute. Vertical scale: major increments = 100 feet, minor increments = 50 feet **[*ATTACHMENT #14*]**.

11. PLOT: TWALT23E

Profile view plot depicting a 3 minute by 200 foot altitude view of the last N90 JFK and ISP returns, the final three FDR updates, the next expected FDR update, and termination of the FDR and CVR data as established by the NTSB. Horizontal scale: major increments = 1 minute, minor increments = 0.10 seconds. Vertical scale: major increments = 100 feet, minor increments = 10 feet **[*ATTACHMENT #15*]**.

The reader will note from this plot that the next expected FDR return is indicated at 0031:12.2304, 0.0282 seconds prior to the termination time of FDR data depicted in file FDREND.CSV. As I advised in our recent telephone conversation, I have no knowledge as too exactly how much time is actually required for the FDR to have recorded a full frame or cycle of data after the time indicated in file MSLALT-1.CSV. This point would be best addressed by the FDR specialist at the Safety Board.

12. PLOT: TWALT23F

Profile view plot with the line(s) connecting radar data points removed for clarity. Additionally, data from file MSLALT-1.CSV Column 5 is indicated by a line only versus the display of data points. Horizontal scale: major increments = 5 minutes, minor increments = 1 minute. Vertical scale: major increments = 1,000 feet, minor increments = 50 feet **[*ATTACHMENT #16*]**.

The viewer will note that with the absence of individual points, the line of data generated from file MSLALT-1.CSV (Column 5) indicates a slight curve denoting a slight reduction in vertical velocity commencing at approximately 0031:05 through termination of the file. However, to fully appreciate the purpose of this plot, the viewer should hold the plot perpendicular to the floor and look up the data line from the lower left to the upper right of the plot. Through this "primitive" method of viewing, the decrease in the flight's vertical velocity during approximately the last 6 minutes is more evident. The fact that the last two JFK returns, recorded 4.6 seconds apart (*evident during initial review of the data in mid December 1996*), indicated at the time that the flight's vertical velocity appeared to decrease slightly prior to loss of radar contact.

B. TIME ALIGNMENT

Although it would appear that final time alignment of the radar data was centered on the five returns recorded at 13,700 feet, the determination was also based, in part, on a review of the digital time channel information on the certified rerecording, transcripts of FAA radio communications, and microphone keying information presented in the FDR printout. Additionally, a review of pilot reported altitudes versus FDR and radar data altitude information was factored into the alignment process by the undersigned.

It is important to note that the FDR [redacted] and CVR [redacted] specialists at the Safety Board are by far the best in the business and past experience with their work products leads me to believe that the termination times relative to the FDR and CVR are as accurate as humanly possible to determine. Hence, I have relied on these figures as being b7C absolute unless they are changed at a later time by the respective specialist. Additionally, the Board's CVR specialist has at his disposal the complete timed text of the CVR communications, thereby providing the possibility of additional altitude information that may have been mentioned by the flight crew. This information would have been provide[redacted]to assist him in alignment of the radar. b7C

Review of the data indicates that the value of 0.25 seconds subtracted from N90 ARTS JFK, HPN, and ISP raw time as presented in the CDR printouts provided by the FAA is the most valid figured. Also, the subtraction of 1.25 seconds from the times presented in ZBW NTAP data was also a valid figure. NTAP data from the ZNY and ZDC ARTCC's was not part of the alignment process as it was a near duplicate of ZBW data and did not offer any additional information pertaining to the accident. Additionally, U.S. Navy FACSFAC and U.S. Air Force NORAD data were not factored into the alignment process as these data sets were received from the same LRR sites providing information to the ZBW ARTCC.

In support of the -0.25 second adjustment to N90 ARTS data, a series of three plan view plots were generated to detail the alignment process. All plots depict a 10 minute time frame (*horizontal*) commencing at 0031:05 and continuing through 0031:15, by a 400 foot (*vertical*) altitude segment commencing at 13,500 and terminating at 13,900 feet. The scale of all plots are identical and contain vertical lines depicting the next expected FDR update and termination time of both the FDR and CVR. Each plots depicts a bracket or box, based on the last two JFK returns, that represents the area that 13,700 foot Mode "C" altitude would appear. Plot characters representing raw time data are presented by an open target symbol (O - ISP, ◇ - JFK, □ - HPN, and ▽ - ZBW. Data extracted from file MSLALT-1.CSV is represented in all three plots by a solid red (●) symbol. Horizontal scale: major increments = 5 minutes, minor increments = 1 minute. Vertical scale: major increments = 100 feet, minor increments = 50 feet.

13. PLOT: TWALT24A

Although the last seven FDR updates fall within the appropriate Mode "C" altitude limits, the 16,655' FDR point at 0031:07.527 and the last JFK return at 0031:12.133 appear at the extreme limits of validity due to the very short time duration from a corresponding event. The time between the FDR altitude value at 13,655' (0031:07.527) and the next to last JFK target return recorded at 0031:07.496 totals a mere 0.031 seconds while time between the last JFK return at 0031:12.133 relative to the time of the next expected FDR update at 0031:12.2304 totaled only 0.097 seconds, cause me to suspect that the raw times are not valid.

Based on my experience, there is enough "slop" within such a timing situation to suspect the raw time alignment and to adjust the bracket or box to center the FDR data set based on an assessment of the two JFK returns that make up lateral time limits of the box **[*ATTACHMENT #17*]**.

b7c

14. PLOT:- TWALT24B

Although [redacted] stated he had determined that a time adjustment of -0.25 seconds be applied to N90 ARTS data, a series of time values were checked before settling on [redacted] figures. Results of the various selected values were reviewed within the respective adjusted Mode "C" box based on the last two JFK returns as well as an assessment of points early on within the various data sets as well as corresponding altitude reports and altitude profile history.

Data presented in this plot reflects a -0.25 adjustment to N90 ARTS data and a -1.25 second adjustment to ZBW NTAP data. Additionally, target symbols representing time adjusted data points are depicted by solid symbols.

The adjustment in timing of radar data by the aforementioned values represents the most probable and logical time sequence available. These adjustments produced the following sequence of events commencing with the next to last JFK target return. For clarity, the appropriate Mode "C" value for the corresponding FDR altitude is indicated in *italics*. Additionally, time values have been rounded off to the nearest $^{1}/_{100}$th of a second.

ADJUSTED TIME	DATA SOURCE	MODE "C" VALUE	FDR VALUE
0031:07.25	JFK return	13,700 feet	
0031:07.58	FDR	*13,700 feet*	13,655 feet
0031:07.75	ZBW return	13,700 feet	
0031:08.20	FDR	*13,700 feet*	13,675 feet
0031:08.87	FDR	*13,700 feet*	13,690 feet
0031:09.43	FDR	*13,700 feet*	13,705 feet
0031:09.69	HPN return	13,700 feet	
0031:10.22	FDR	*13,700 feet*	13,720 feet
0331:10.83	FDR	*13,700 feet*	13,730 feet
0031:11.27	ISP return	13,700 feet	
0031:11.50	FDR	*13,700 feet*	13,745 feet [LAST FDR UPDATE]
0031:11.88	JFK return	13,700 feet	
0031:12.18	Next expected FDR update time		
0031:12.26	FDR end		
0031:12.50	CVR end		

The aforementioned plot can be found as ***[ATTACHMENT #18]***.

15. PLOT: TWALT24C

Profile view plot depicting data described in the two preceding plots and is provided for a direct comparison of raw and adjusted timing information. Raw data points are indicated by open target symbols while time adjusted data points are indicated by solid target symbols **[*ATTACHMENT #19*]**.

[redacted] b7C

Attachments: 19

ATTACHMENT #1

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ATTACHMENT #2

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☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
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ATTACHMENT #3

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______	☐ (b)(7)(E)	☐ (k)(3)
______	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
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☐ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
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☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☐ (b)(6)		☐ (k)(7)

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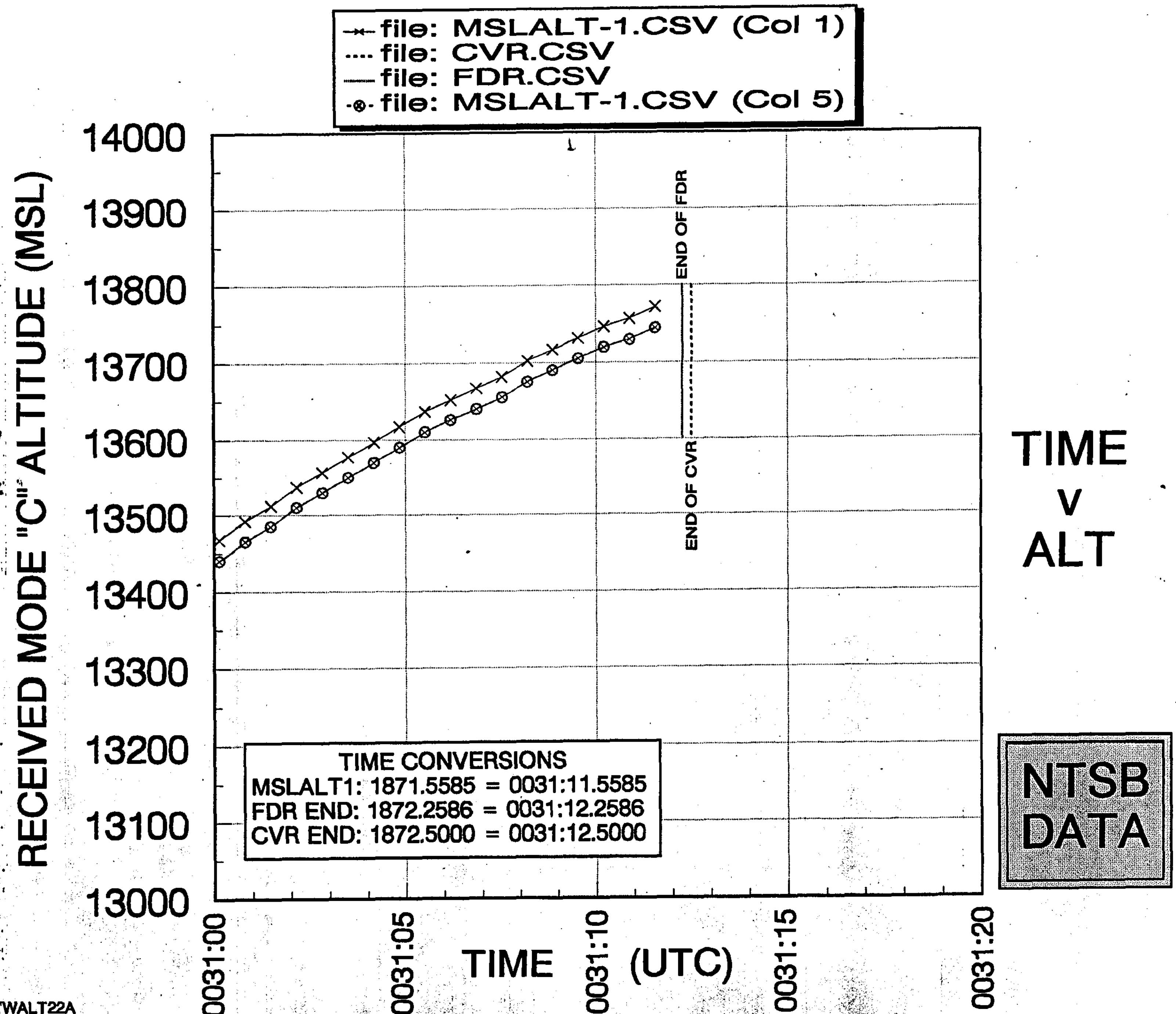
ATTACHMENT #5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file: CVR.CSV
file: FDR.CSV
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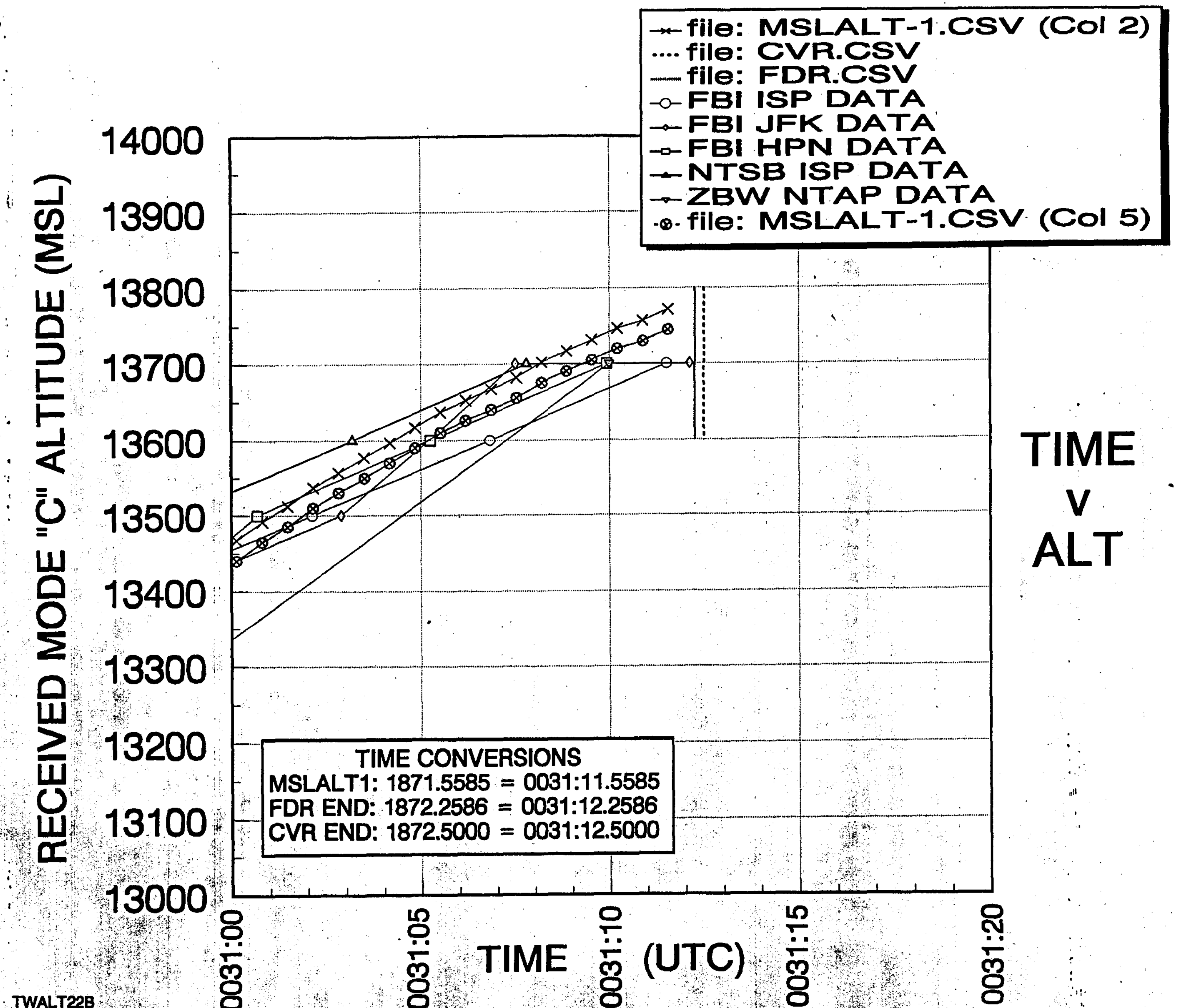
14000
13900
13800
13700
13600
13500
13400
13300
13200
13100
13000
END OF FDR
END OF CVR
TIME CONVERSIONS
MSLALT1: 1871.5585 = 0031:11.5585
FDR END: 1872.2586 = 0031:12.2586
CVR END: 1872.5000 = 0031:12.5000
0031:00
0031:05
0031:10
0031:15
0031:20
TIME (UTC)
TWALT22A
TIME
v
ALT
NTSB
DATA

ATTACHMENT #6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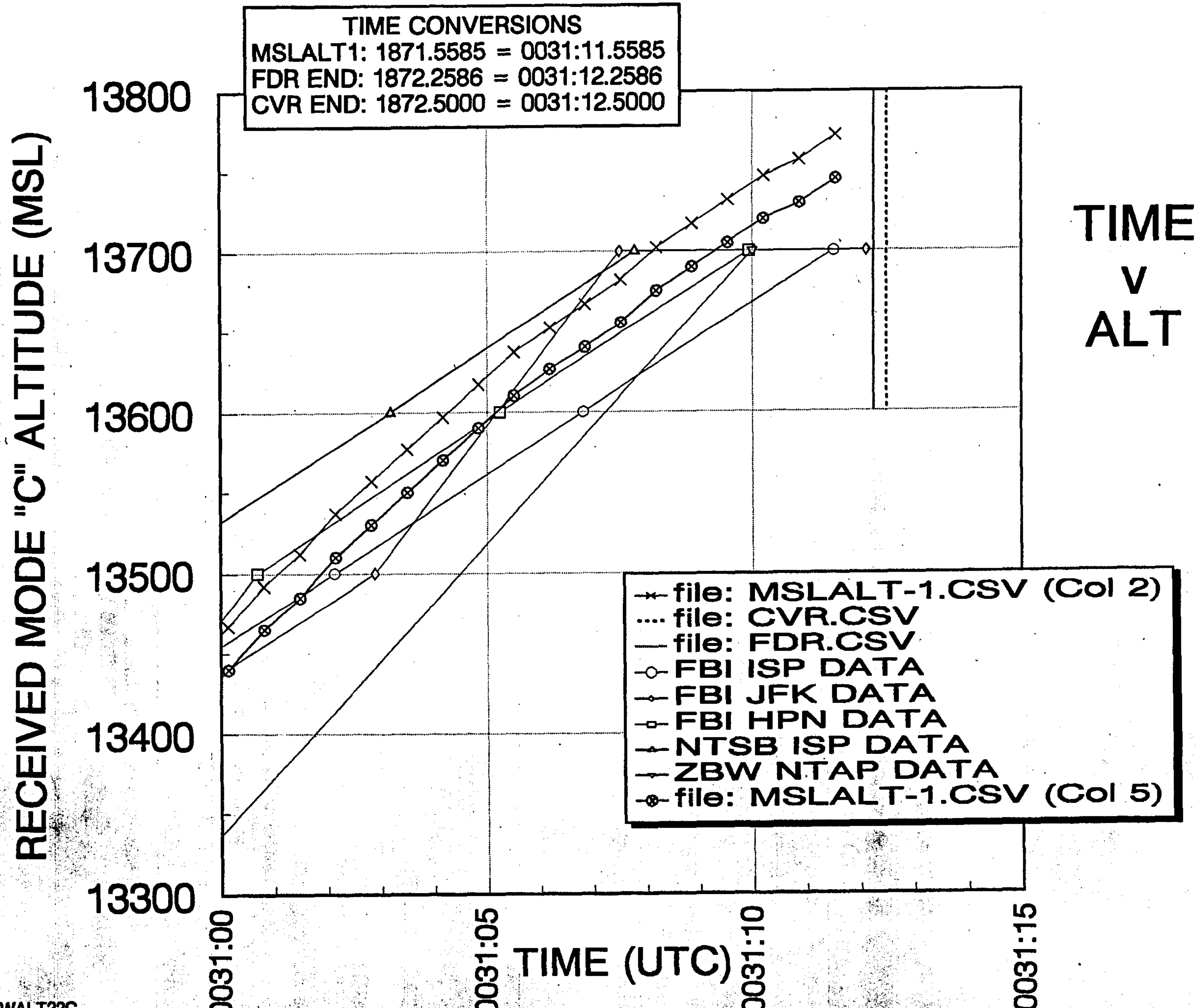
FBI JFK DATA
FBI HPN DATA
NTSB ISP DATA
ZBW NTAP DATA
file: MSLALT-1.CSV (Col 5)
RECEIVED MODE "C" ALTITUDE (MSL)
14000
13900
13800
13700
13600
13500
13400
13300
13200
13100
13000
TIME CONVERSIONS
MSLALT1: 1871.5585 = 0031:11.5585
FDR END: 1872.2586 = 0031:12.2586
CVR END: 1872.5000 = 0031:12.5000
0031:00
0031:05
0031:10
0031:15
0031:20
TIME (UTC)
TIME
v
ALT
TWALT22B

ATTACHMENT #7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CVR END: 1872.5000 = 0031:12.5000
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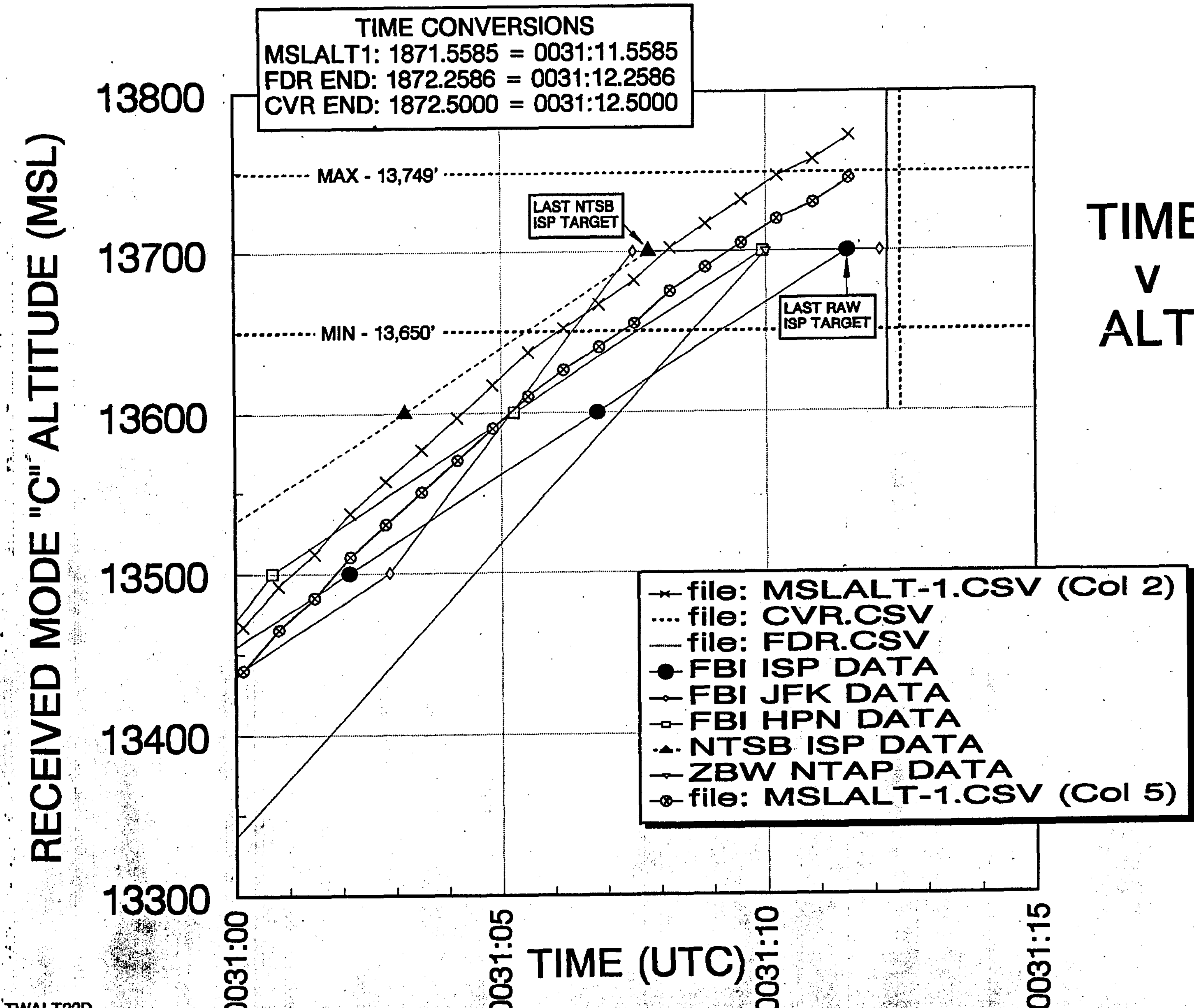
13800
13700
13600
13500
13400
13300
TIME (UTC)
0031:00
0031:05
0031:10
0031:15
file: MSLALT-1.CSV (Col 2)
file: CVR.CSV
file: FDR.CSV
FBI ISP DATA
FBI JFK DATA
FBI HPN DATA
NTSB ISP DATA
ZBW NTAP DATA
file: MSLALT-1.CSV (Col 5)
TIME
v
ALT
TWALT22C

ATTACHMENT #8



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FDR END: 1872.2586 = 0031:12.2586
CVR END: 1872.5000 = 0031:12.5000
MAX - 13,749'
MIN - 13,650'
LAST NTSB ISP TARGET
LAST RAW ISP TARGET
13800
13700
13600
13500
13400
13300
RECEIVED MODE "C" ALTITUDE (MSL)
0031:00
0031:05
0031:10
0031:15
TIME (UTC)
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file: FDR.CSV
FBI ISP DATA
FBI JFK DATA
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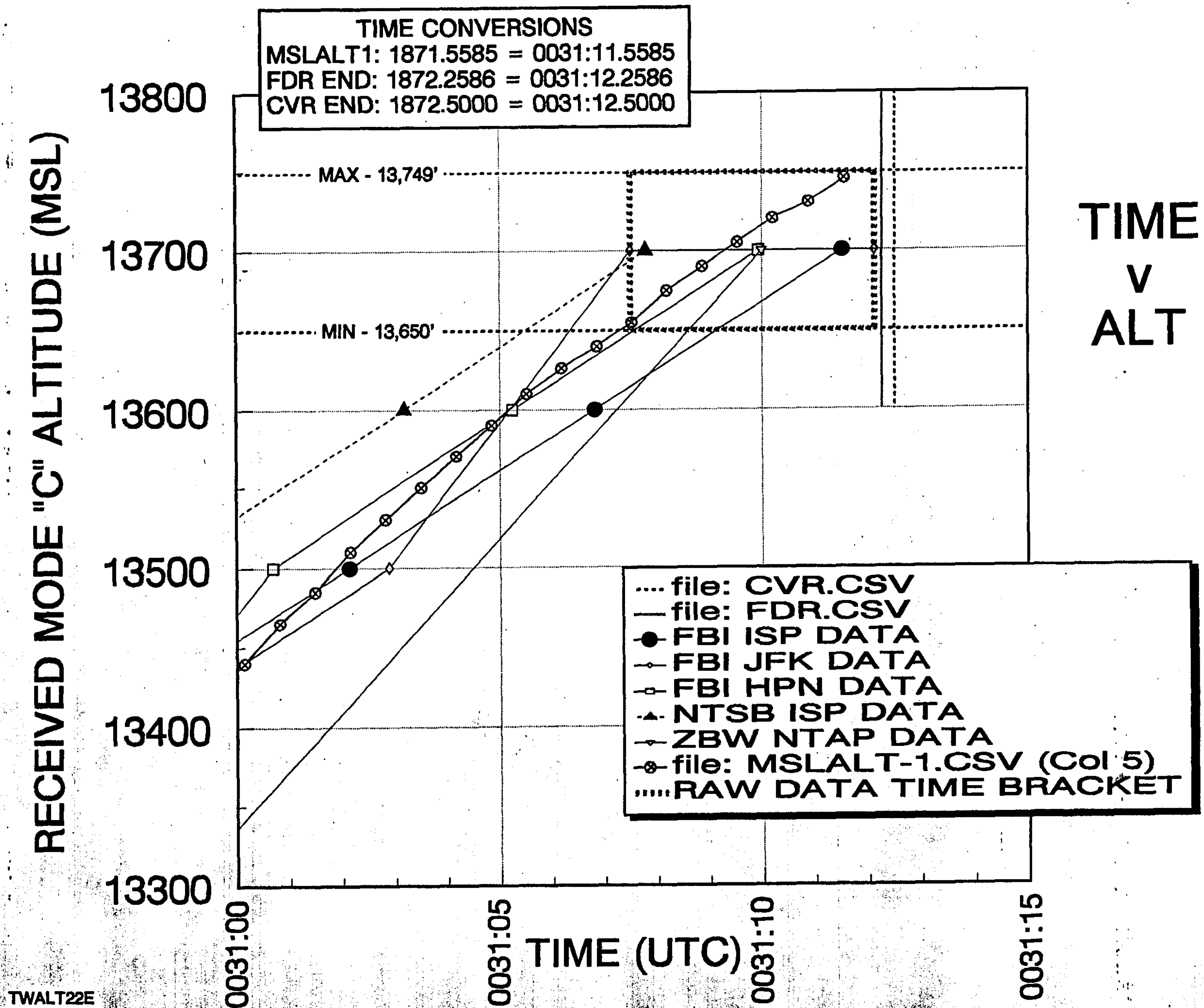
NTSB ISP DATA
ZBW NTAP DATA
file: MSLALT-1.CSV (Col 5)
TWALT22D

TIME v ALT

ATTACHMENT #9


TIME CONVERSIONS
MSLALT1: 1871.5585 = 0031:11.5585
FDR END: 1872.2586 = 0031:12.2586
CVR END: 1872.5000 = 0031:12.5000
13800
13700
13600
13500
13400
13300
RECEIVED MODE "C" ALTITUDE (MSL)
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MIN - 13,650'
0031:00
0031:05
0031:10
0031:15
TIME (UTC)
file: CVR.CSV
file: FDR.CSV
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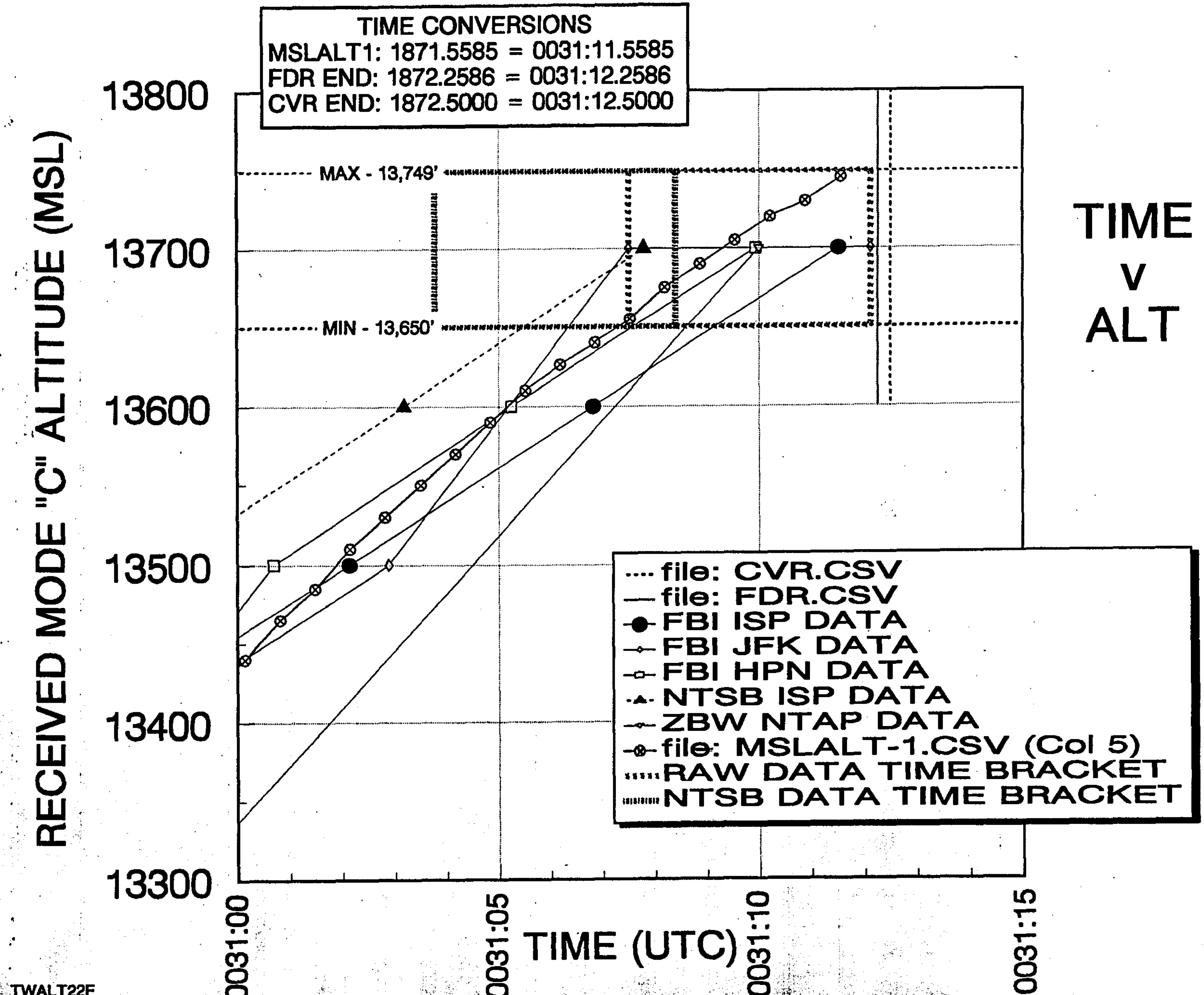
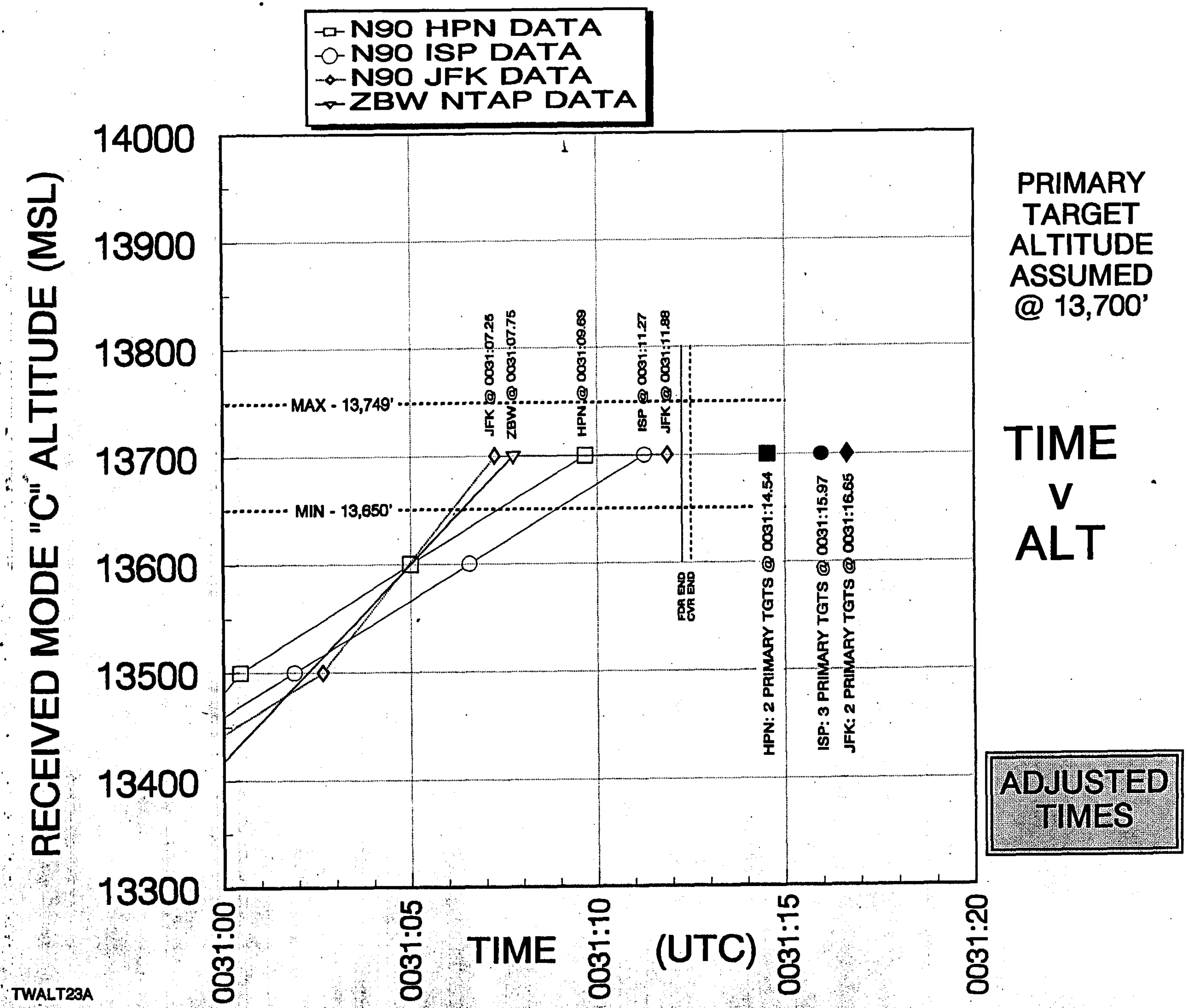
FBI JFK DATA
FBI HPN DATA
NTSB ISP DATA
ZBW NTAP DATA
file: MSLALT-1.CSV (Col 5)
RAW DATA TIME BRACKET
TIME
v
ALT
TWALT22E

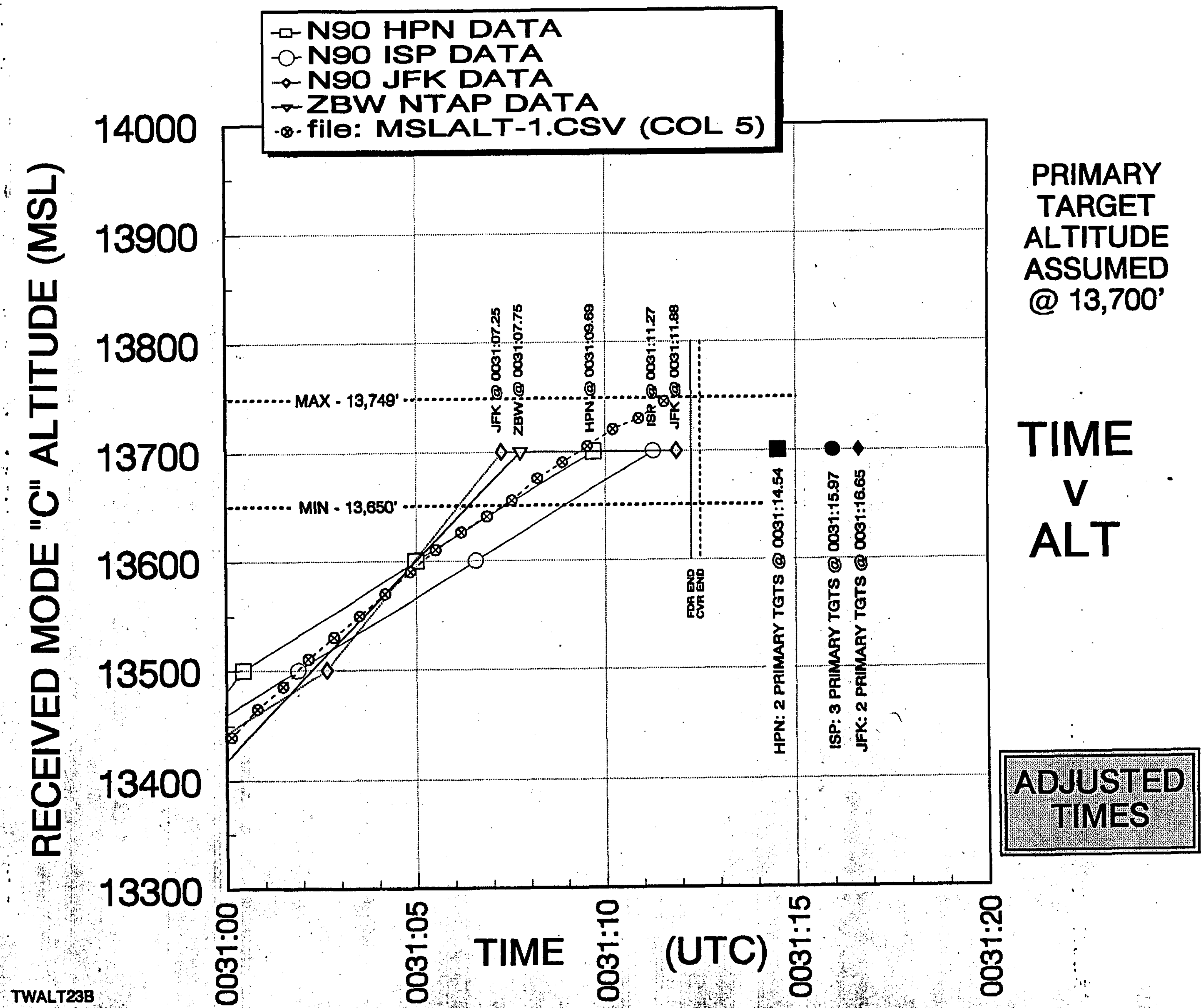
ATTACHMENT #10


TIME CONVERSIONS
MSLALT1: 1871.5585 = 0031:11.5585
FDR END: 1872.2586 = 0031:12.2586
CVR END: 1872.5000 = 0031:12.5000
MAX - 13,749'
MIN - 13,650'
RECEIVED MODE "C" ALTITUDE (MSL)
13800
13700
13600
13500
13400
13300
TIME (UTC)
0031:00
0031:05
0031:10
0031:15
file: CVR.CSV
file: FDR.CSV
FBI ISP DATA
FBI JFK DATA
FBI HPN DATA
NTSB ISP DATA
ZBW NTAP DATA
file: MSLALT-1.CSV (Col 5)
RAW DATA TIME BRACKET
NTSB DATA TIME BRACKET
TIME
v
ALT
TWALT22F

ATTACHMENT #11

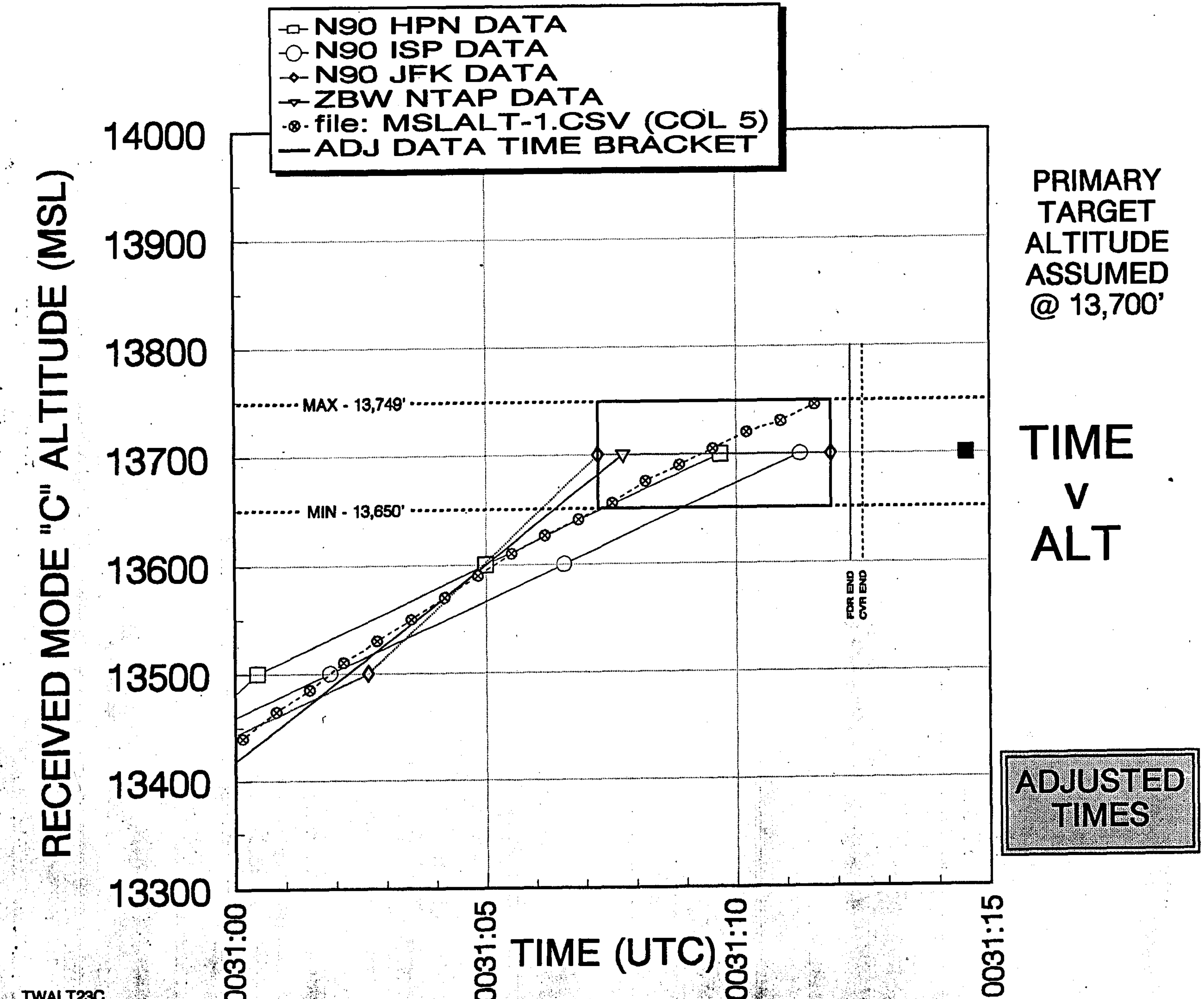

N90 HPN DATA
N90 ISP DATA
N90 JFK DATA
ZBW NTAP DATA
RECEIVED MODE "C" ALTITUDE (MSL)
14000
13900
13800
13700
13600
13500
13400
13300
MAX - 13,749'
MIN - 13,650'
JFK @ 0031:07.25
ZBW @ 0031:07.75
HPN @ 0031:09.69
ISP @ 0031:11.27
JFK @ 0031:11.88
FDR END
CVR END
HPN: 2 PRIMARY TGTS @ 0031:14.54
ISP: 3 PRIMARY TGTS @ 0031:15.97
JFK: 2 PRIMARY TGTS @ 0031:16.65
0031:00
0031:05
0031:10
0031:15
0031:20
TIME (UTC)
PRIMARY TARGET ALTITUDE ASSUMED @ 13,700'
TIME v ALT
ADJUSTED TIMES
TWALT23A

ATTACHMENT #12



N90 HPN DATA
N90 ISP DATA
N90 JFK DATA
ZBW NTAP DATA
file: MSLALT-1.CSV (COL 5)
RECEIVED MODE "C" ALTITUDE (MSL)
14000
13900
13800
13700
13600
13500
13400
13300
MAX - 13,749'
MIN - 13,650'
JFK @ 0031:07.25
ZBW @ 0031:07.75
HPN @ 0031:09.69
ISP @ 0031:11.27
JFK @ 0031:11.88
FDR END
CVR END
HPN: 2 PRIMARY TGTS @ 0031:14.54
ISP: 3 PRIMARY TGTS @ 0031:15.97
JFK: 2 PRIMARY TGTS @ 0031:16.65
0031:00
0031:05
0031:10
0031:15
0031:20
TIME (UTC)
PRIMARY TARGET ALTITUDE ASSUMED @ 13,700'
TIME v ALT
ADJUSTED TIMES
TWALT23B

ATTACHMENT #13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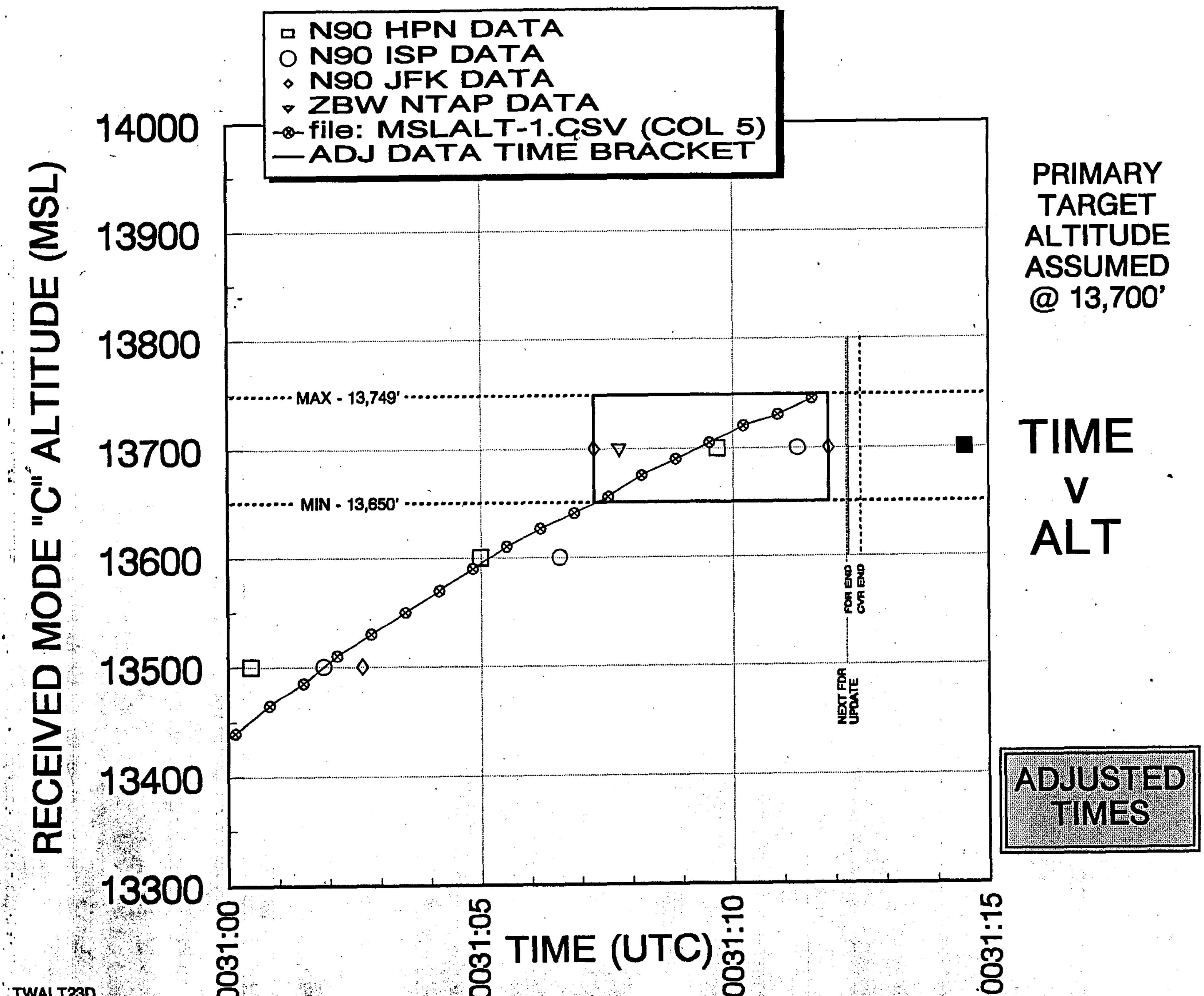
N90 ISP DATA
N90 JFK DATA
ZBW NTAP DATA
file: MSLALT-1.CSV (COL 5)
ADJ DATA TIME BRACKET
14000
13900
13800
13700
13600
13500
13400
13300
RECEIVED MODE "C" ALTITUDE (MSL)
MAX - 13,749'
MIN - 13,650'
FDR END
CVR END
0031:00
0031:05
0031:10
0031:15
TIME (UTC)
PRIMARY TARGET ALTITUDE ASSUMED @ 13,700'
TIME v ALT
ADJUSTED TIMES
TWALT23C

ATTACHMENT #14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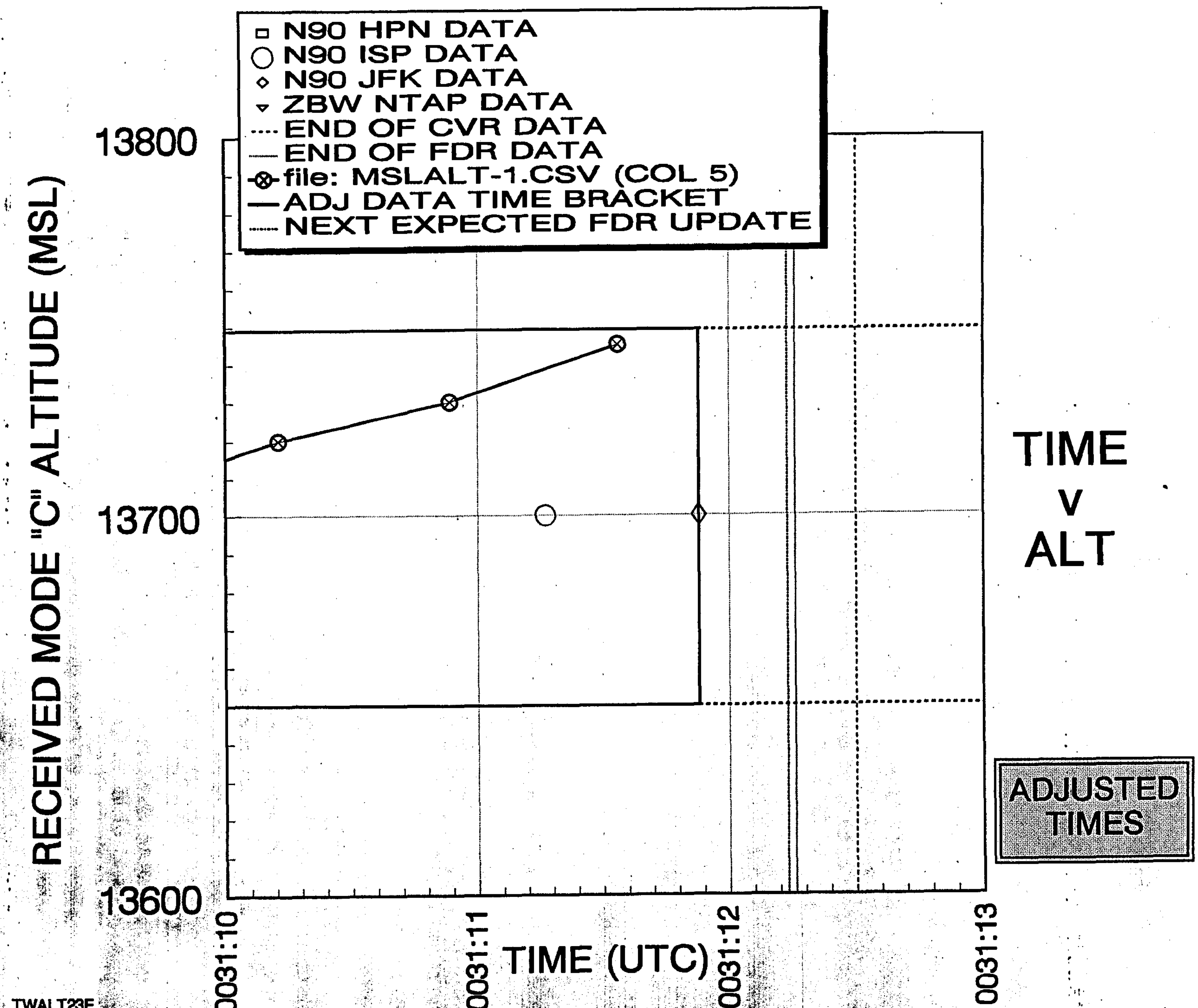
N90 ISP DATA
N90 JFK DATA
ZBW NTAP DATA
file: MSLALT-1.CSV (COL 5)
ADJ DATA TIME BRACKET
RECEIVED MODE "C" ALTITUDE (MSL)
14000
13900
13800
13700
13600
13500
13400
13300
MAX - 13,749'
MIN - 13,650'
FDR END
CVR END
NEXT FDR UPDATE
0031:00
0031:05
0031:10
0031:15
TIME (UTC)
PRIMARY TARGET ALTITUDE ASSUMED @ 13,700'
TIME v ALT
ADJUSTED TIMES
TWALT23D

ATTACHMENT #15



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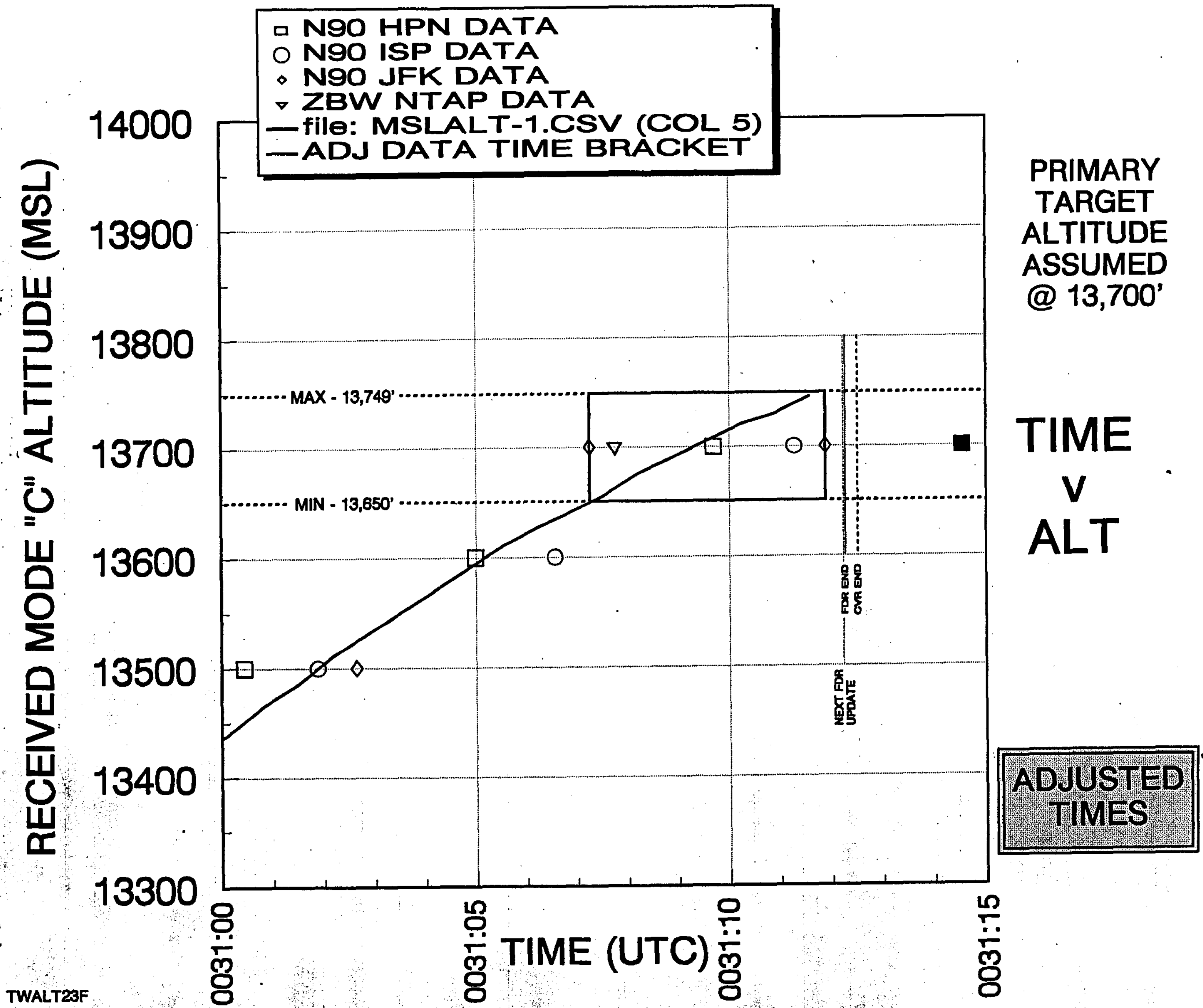
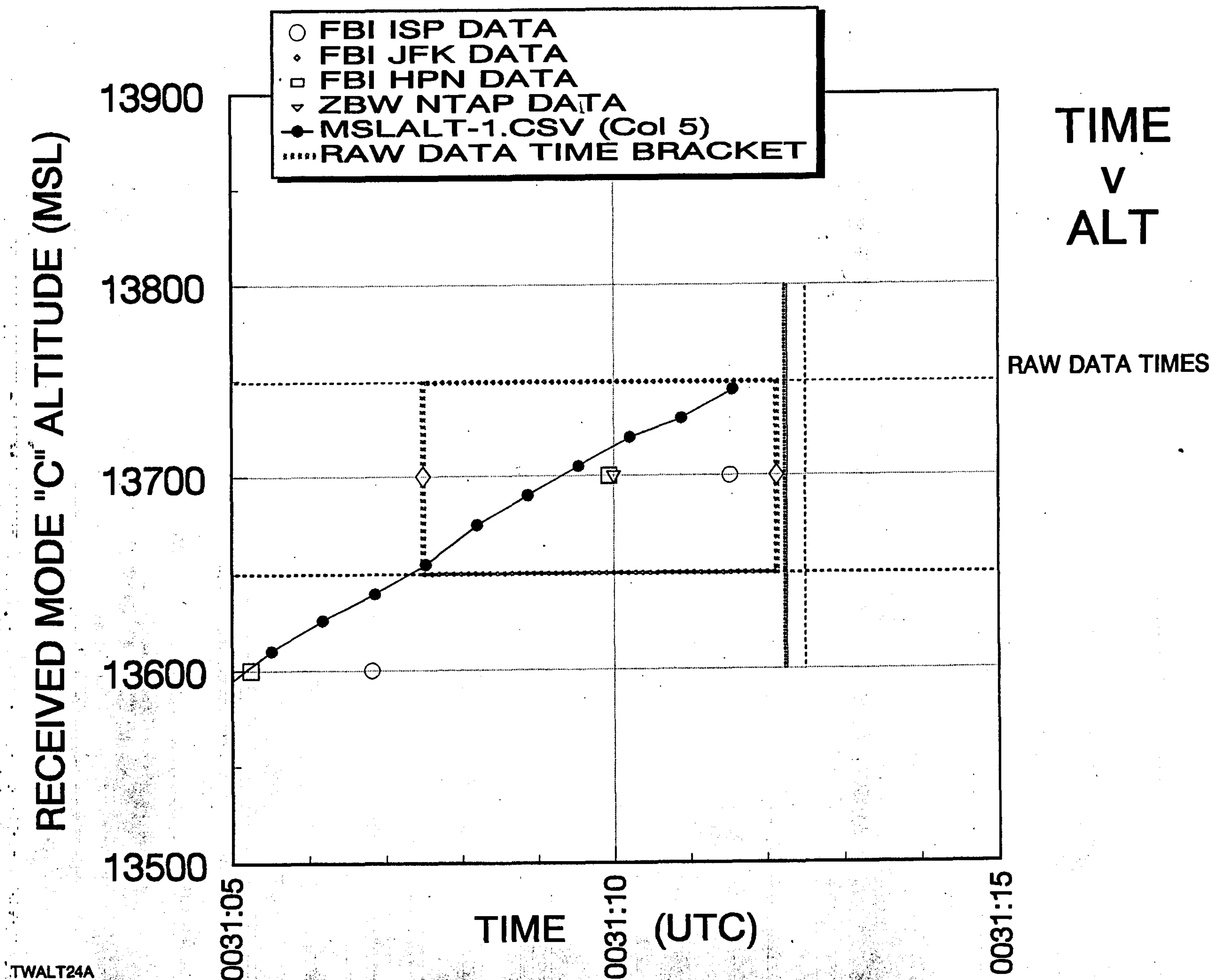
N90 ISP DATA
N90 JFK DATA
ZBW NTAP DATA
END OF CVR DATA
END OF FDR DATA
file: MSLALT-1.CSV (COL 5)
ADJ DATA TIME BRACKET
NEXT EXPECTED FDR UPDATE
13800
13700
13600
RECEIVED MODE "C" ALTITUDE (MSL)
0031:10
0031:11
0031:12
0031:13
TIME (UTC)
TIME
v
ALT
ADJUSTED
TIMES
TWALT23E

ATTACHMENT #16

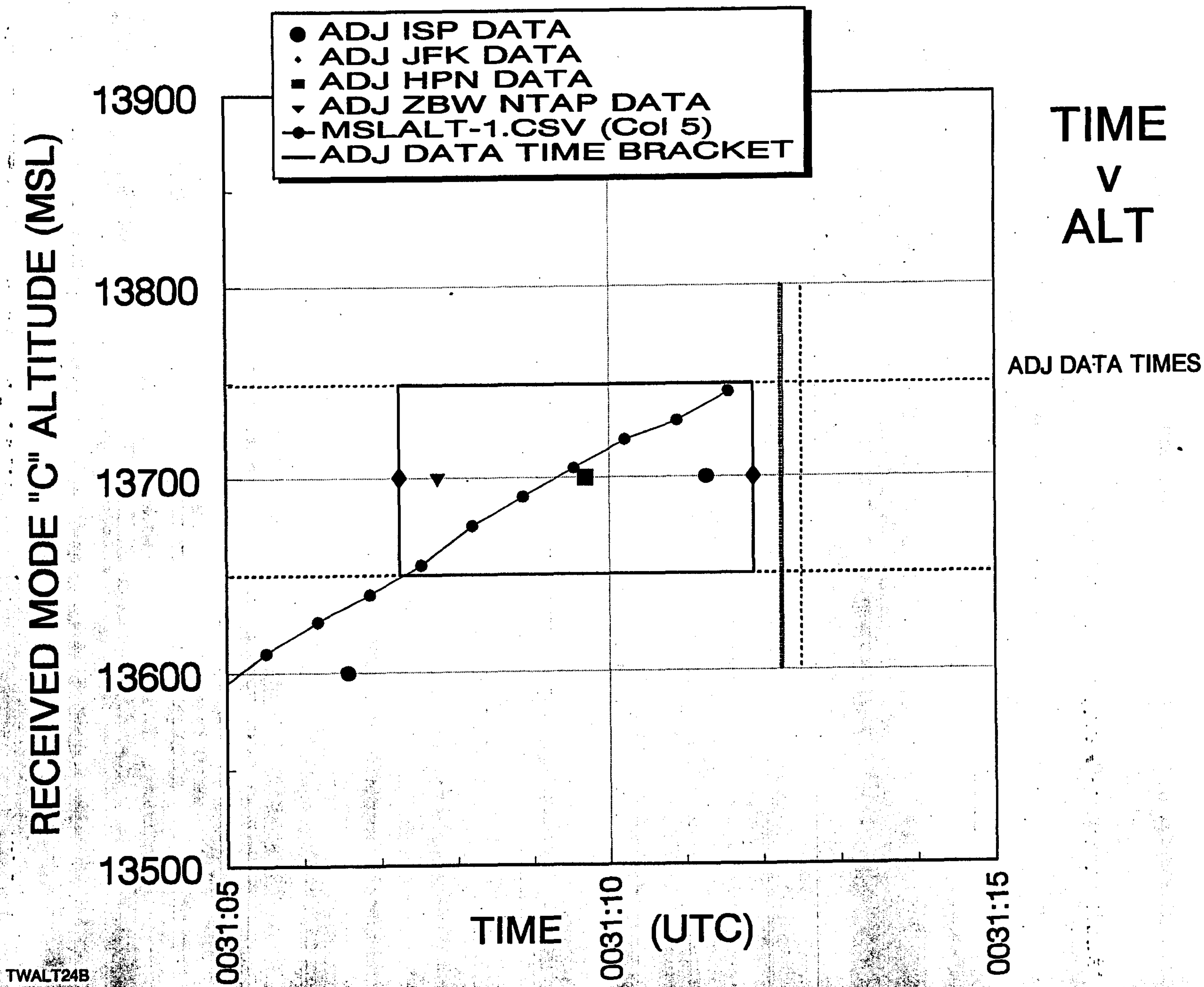


N90 HPN DATA
N90 ISP DATA
N90 JFK DATA
ZBW NTAP DATA
file: MSLALT-1.CSV (COL 5)
ADJ DATA TIME BRACKET
14000
13900
13800
13700
13600
13500
13400
13300
RECEIVED MODE "C" ALTITUDE (MSL)
MAX - 13,749'
MIN - 13,650'
FDR END
CVR END
NEXT FDR UPDATE
0031:00
0031:05
0031:10
0031:15
TIME (UTC)
PRIMARY TARGET ALTITUDE ASSUMED @ 13,700'
TIME v ALT
ADJUSTED TIMES
TWALT23F

ATTACHMENT #17

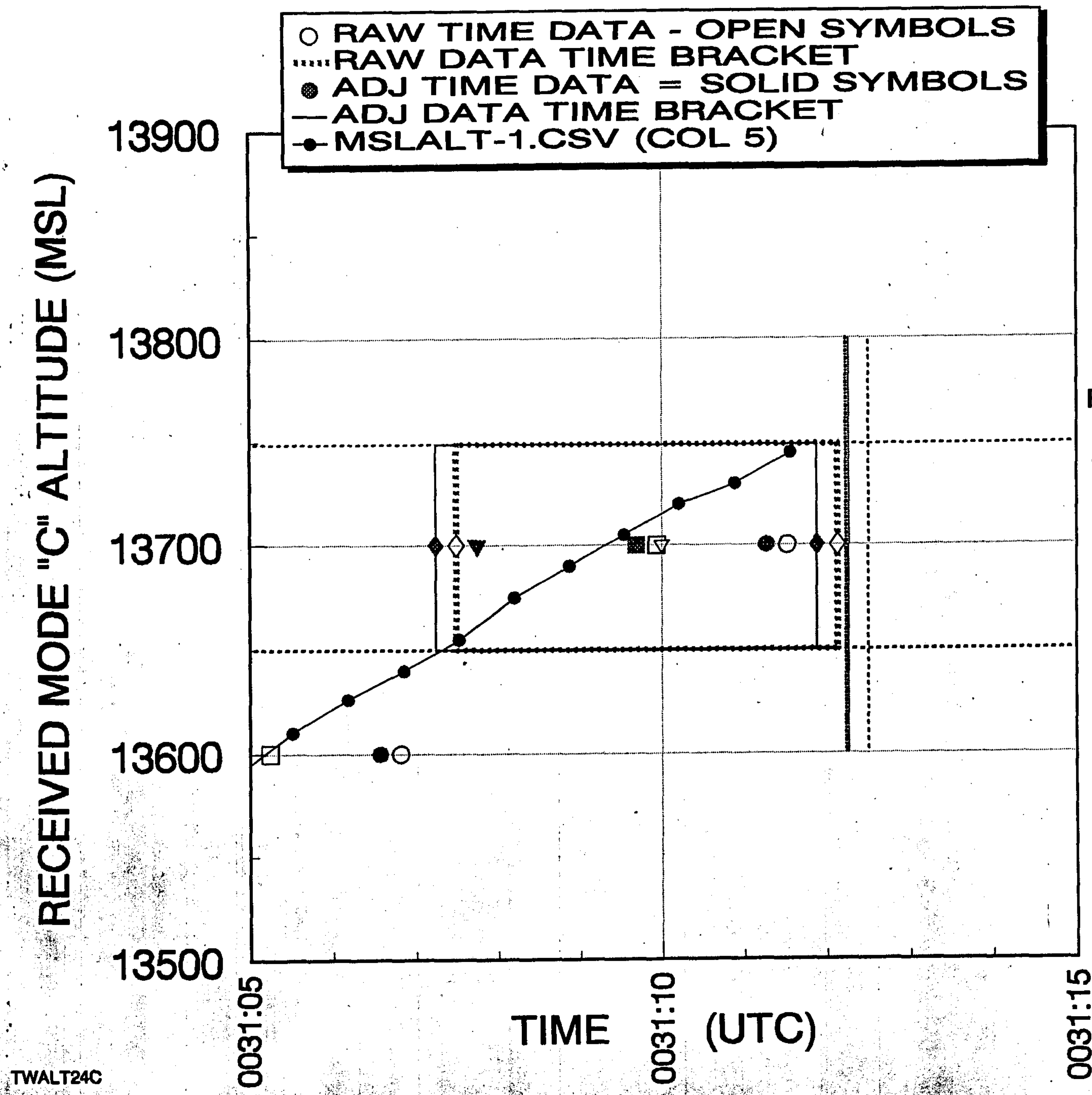

FBI ISP DATA
FBI JFK DATA
FBI HPN DATA
ZBW NTAP DATA
MSLALT-1.CSV (Col 5)
RAW DATA TIME BRACKET
RECEIVED MODE "C" ALTITUDE (MSL)
13900
13800
13700
13600
13500
0031:05
0031:10
0031:15
TIME (UTC)
TIME
v
ALT
RAW DATA TIMES
TWALT24A

ATTACHMENT #18



ADJ ISP DATA
ADJ JFK DATA
ADJ HPN DATA
ADJ ZBW NTAP DATA
MSLALT-1.CSV (Col 5)
ADJ DATA TIME BRACKET
13900
13800
13700
13600
13500
RECEIVED MODE "C" ALTITUDE (MSL)
0031:05
0031:10
0031:15
TIME (UTC)
TIME
v
ALT
ADJ DATA TIMES
TWALT24B

ATTACHMENT #19



TIME v ALT

RAW DATA TIMES versus ADJ DATA TIMES

[redacted]

b7c

June 21, 1997

VIA FACSIMILE TRANSMISSION

SA [redacted]
FBI, New York Field Office
26 Federal Plaza, 23rd Floor
New York, NY 10278

Dear [redacted]

I completed the following plots early Saturday morning. [redacted] opted to hold these for transmittal until you returned to work on Monday. [redacted] Supporting text and clean copies of the plots will be shipped to you via UPS Next Day Air NLT Tuesday, June 24, 1997.

Very truly yours,

[redacted]

b7c

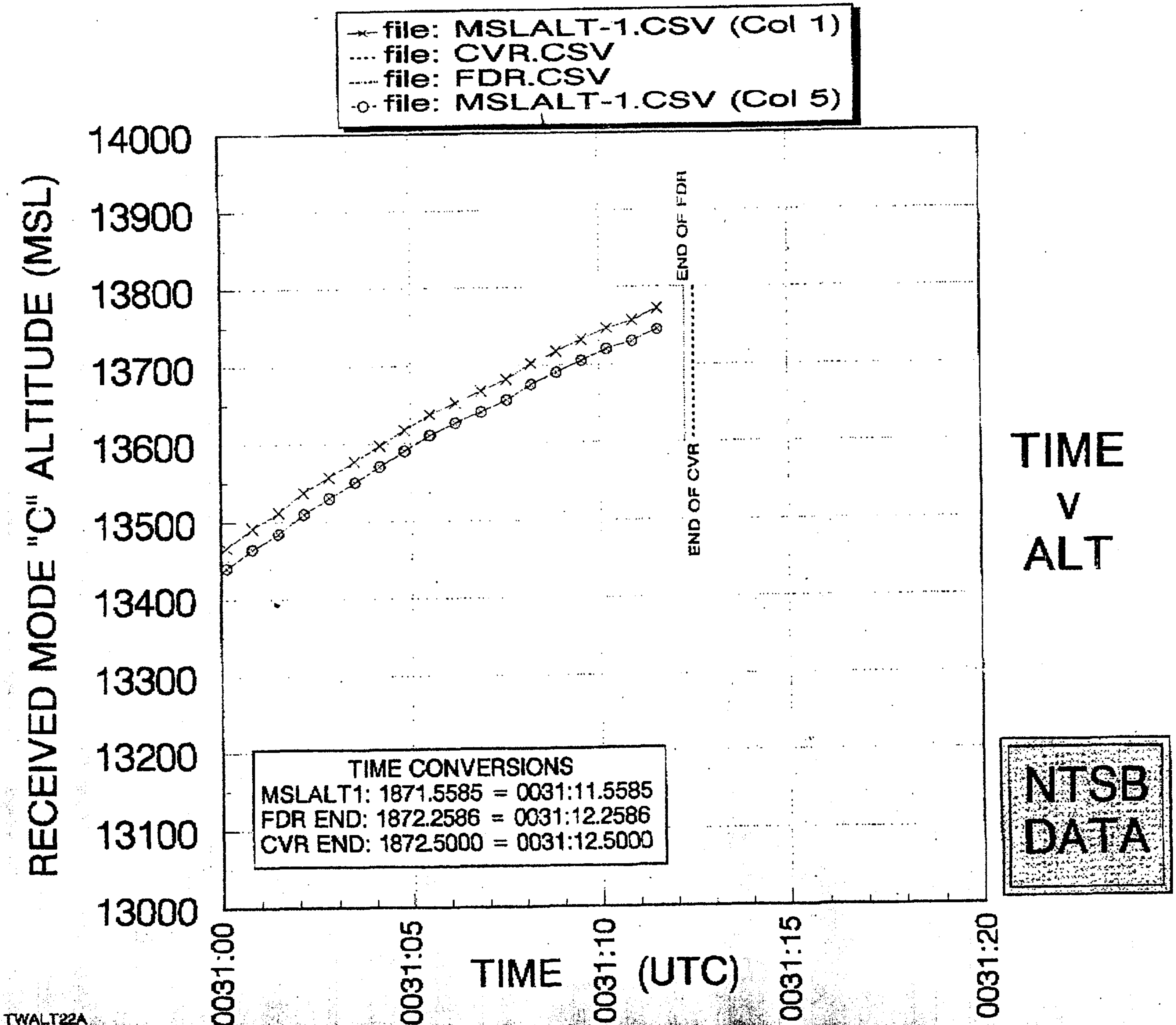
TOTAL PAGES TRANSMITTED = 9

PAGE 02

b7c

[redacted]

[redacted]



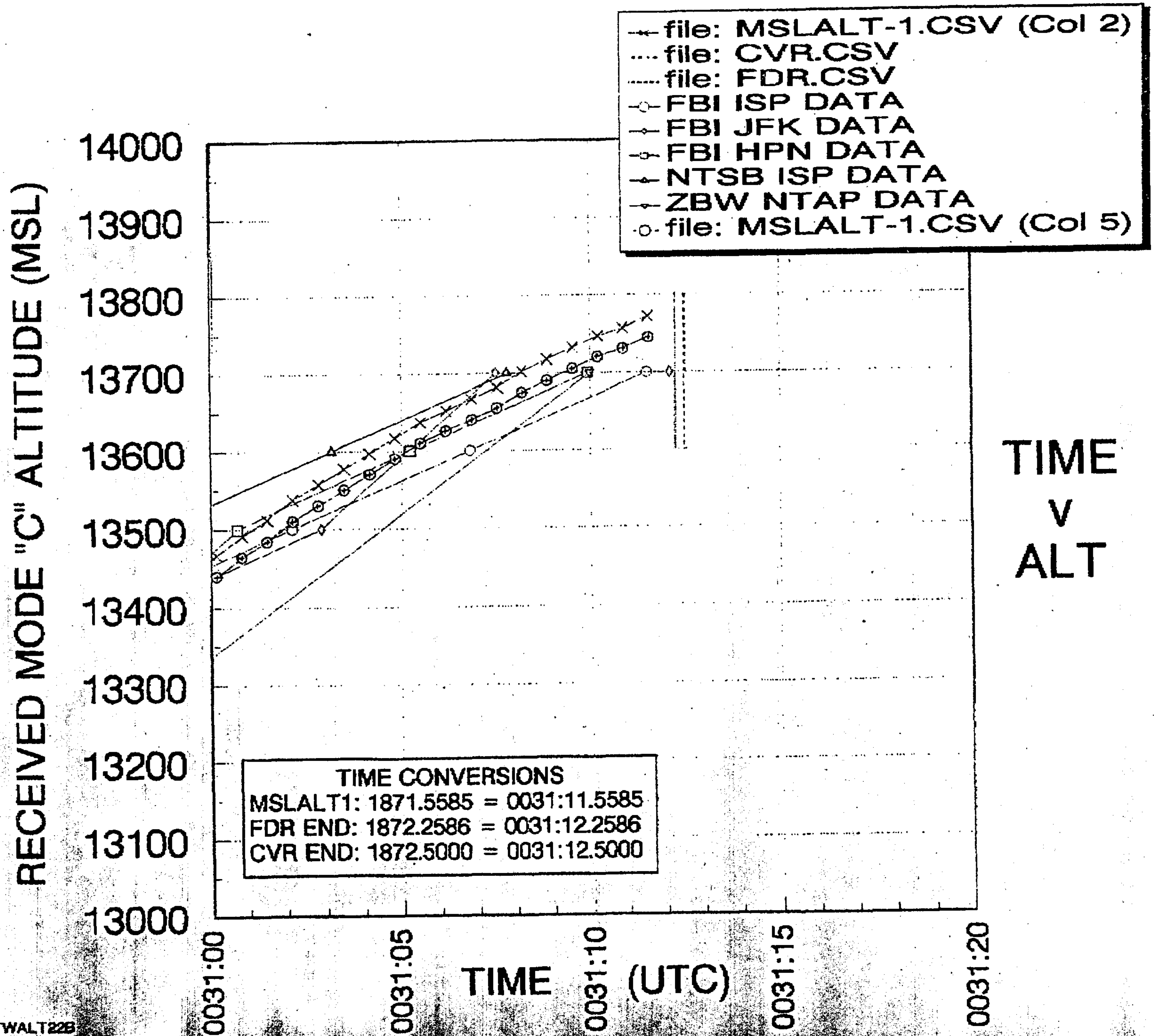
TWALT22A

b7c

[redacted]

[redacted]

TIME v ALT



TWALT22B

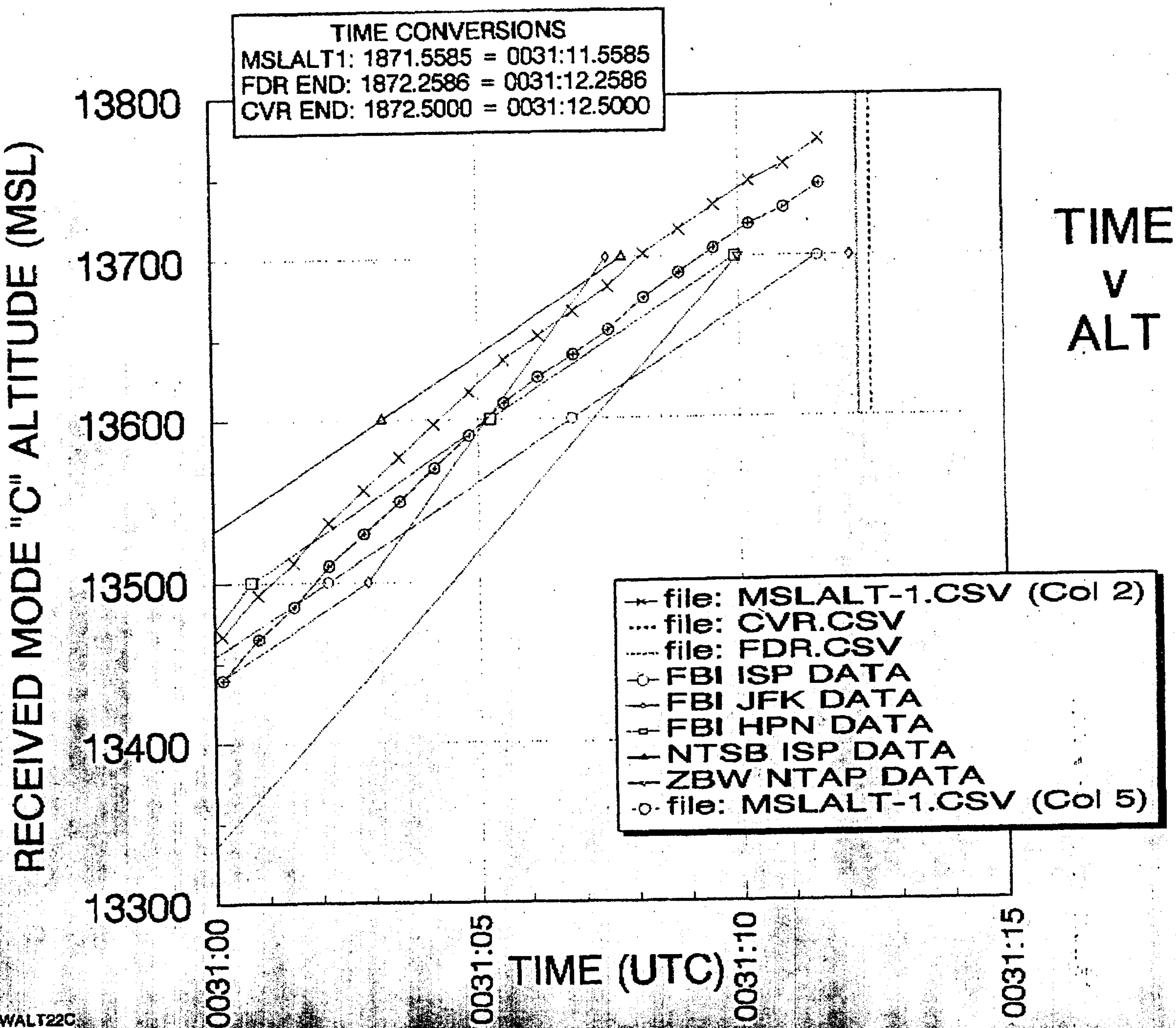
PAGE 04

b7C

[redacted]

[redacted]

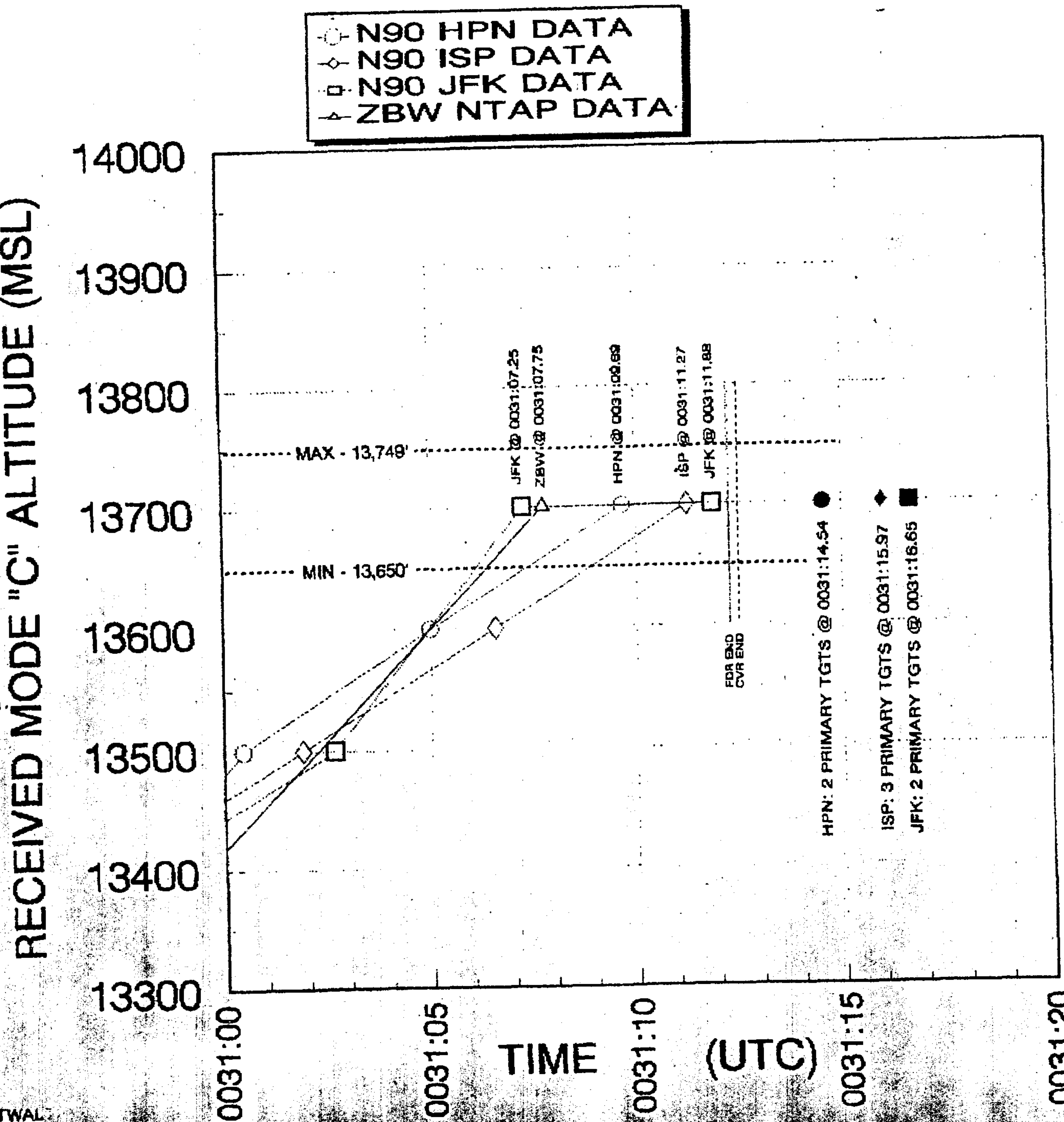
TIME v ALT



PAGE 95

b7c

[redacted]



PRIMARY TARGET ALTITUDE ASSUMED @ 13,700'

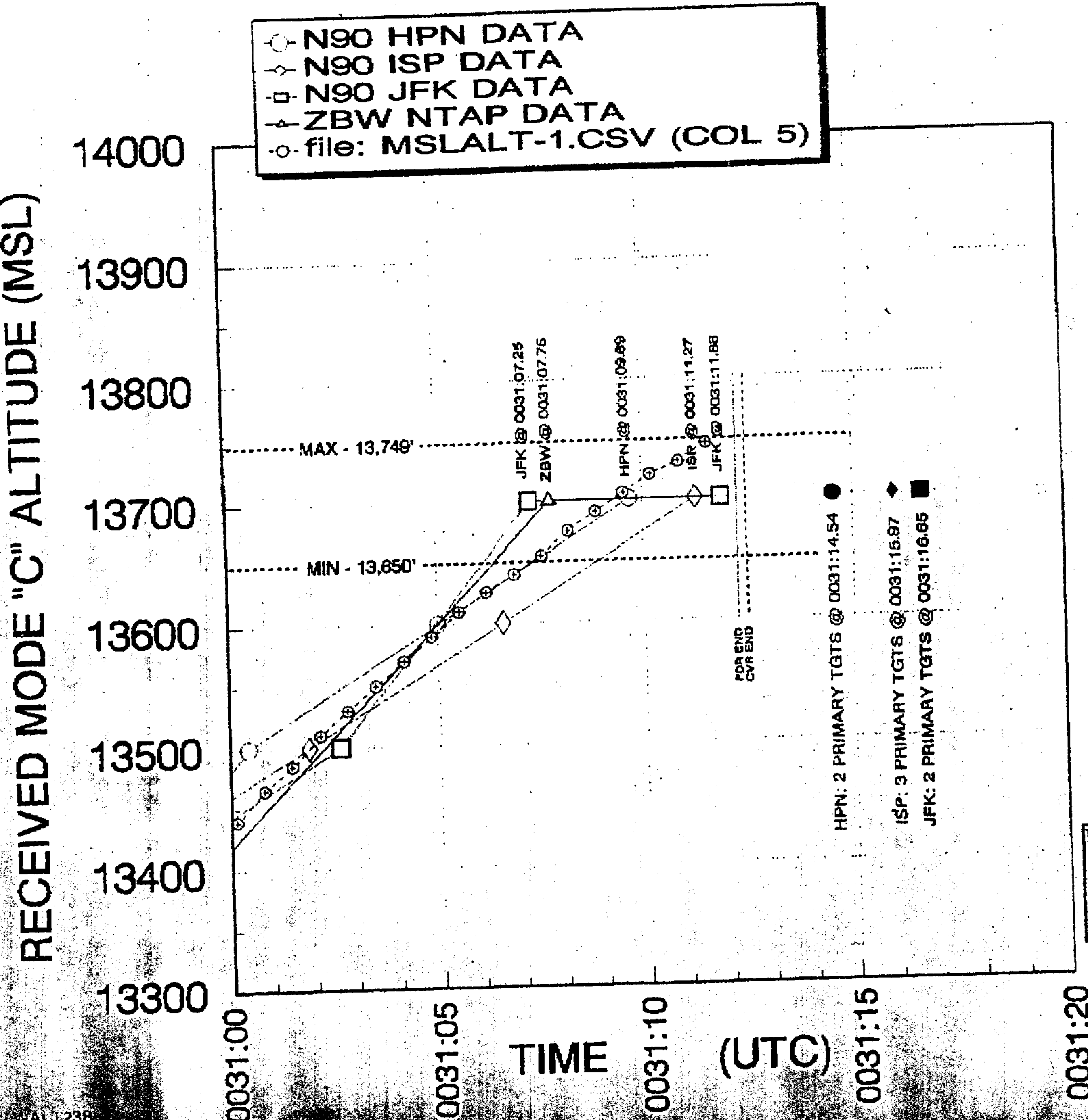
TIME v ALT

ADJUSTED TIMES

TWAL

b7C

[redacted]

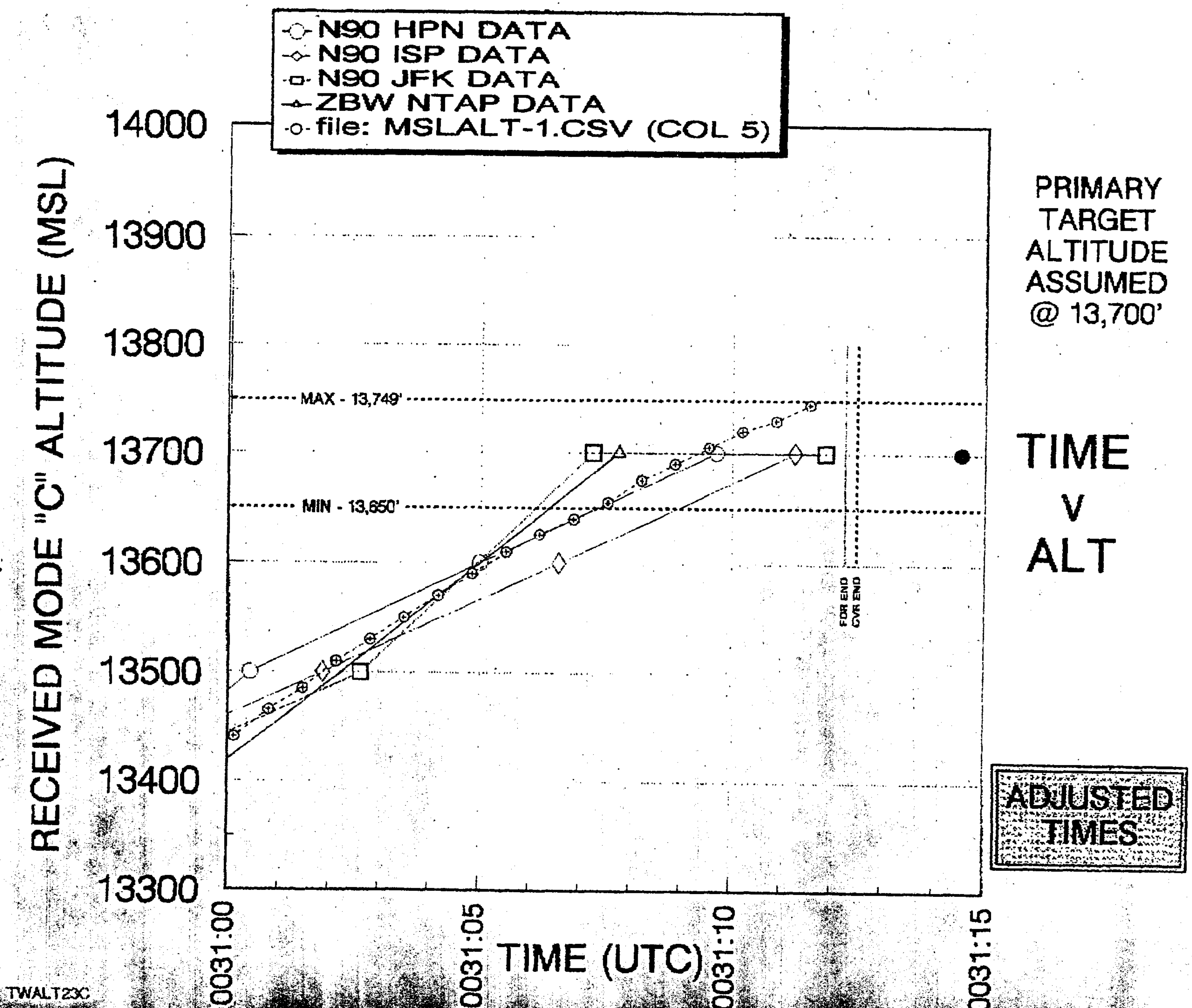


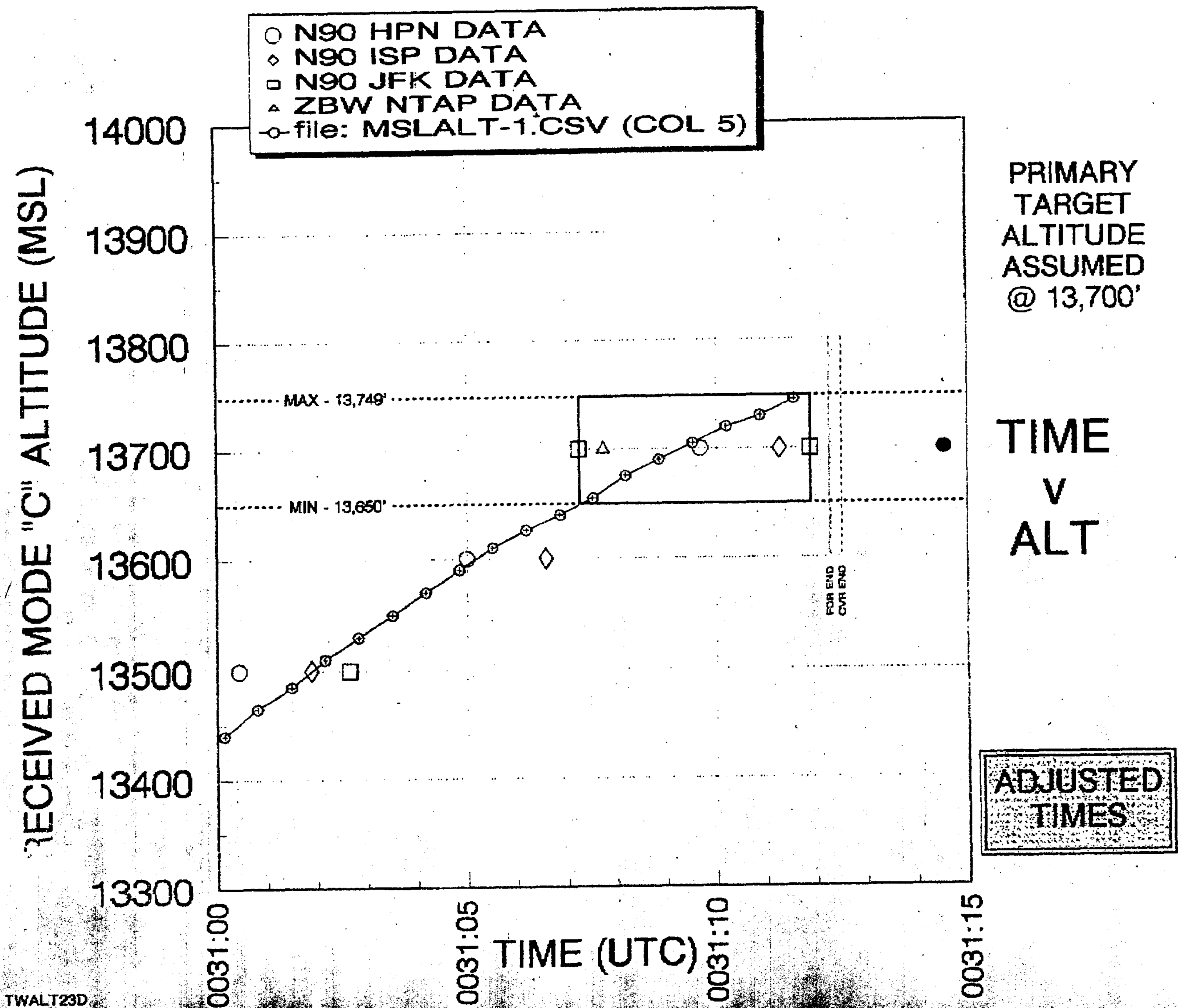
PRIMARY TARGET ALTITUDE ASSUMED @ 13,700'

TIME v ALT

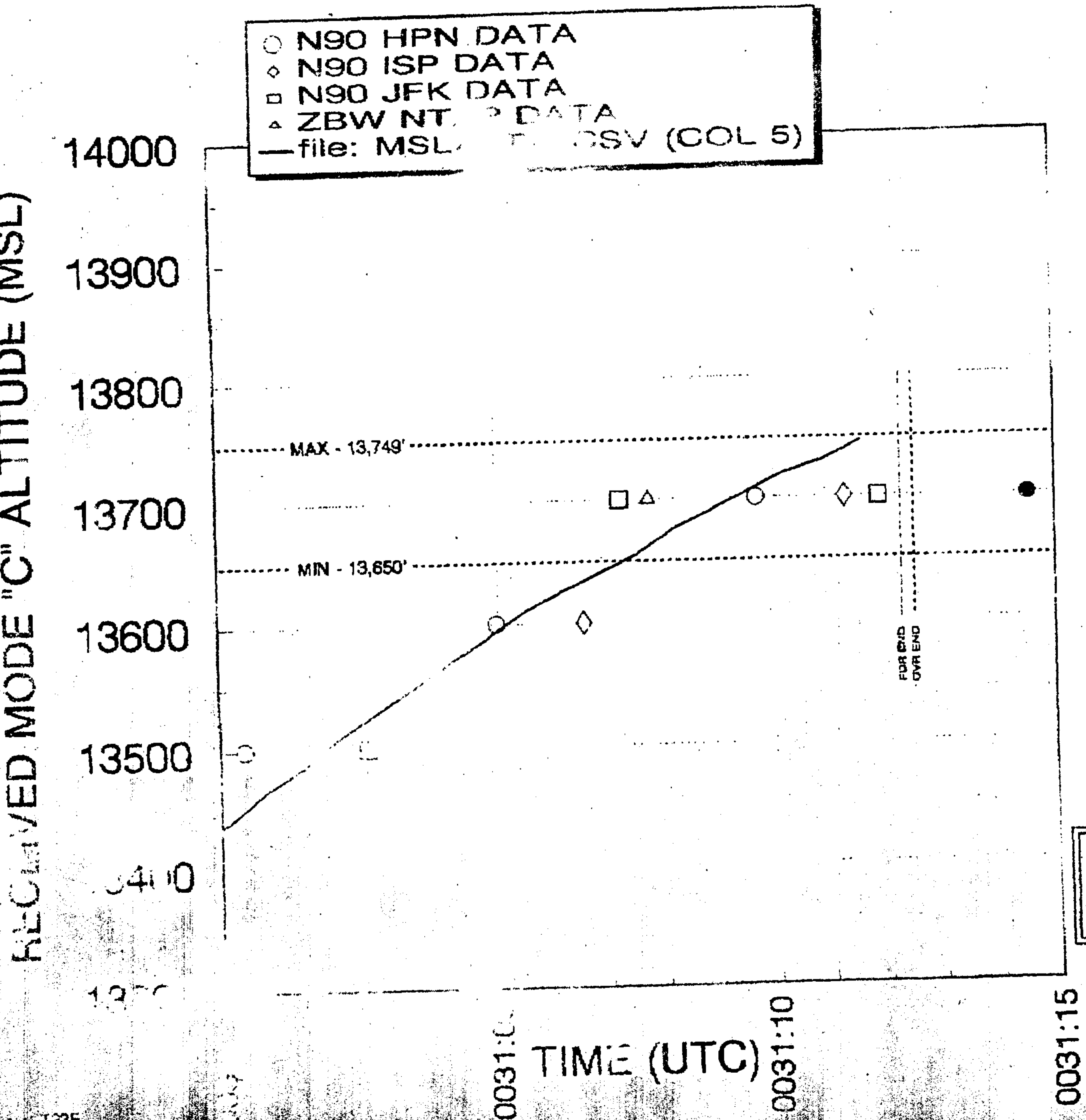
ADJUSTED TIMES

b7c


N90 HPN DATA
N90 ISP DATA
N90 JFK DATA
ZBW NTAP DATA
file: MSLALT-1.CSV (COL 5)
RECEIVED MODE "C" ALTITUDE (MSL)
14000
13900
13800
13700
13600
13500
13400
13300
MAX - 13,749'
MIN - 13,650'
FDR END
CVR END
0031:00
0031:05
0031:10
0031:15
TIME (UTC)
PRIMARY TARGET ALTITUDE ASSUMED @ 13,700'
TIME v ALT
ADJUSTED TIMES
TWALT23C



N90 HPN DATA
N90 ISP DATA
N90 JFK DATA
ZBW NTAP DATA
file: MSLALT-1.CSV (COL 5)
RECEIVED MODE "C" ALTITUDE (MSL)
14000
13900
13800
13700
13600
13500
13400
13300
MAX - 13,749'
MIN - 13,650'
FDR END
CVR END
0031:00
0031:05
0031:10
0031:15
TIME (UTC)
PRIMARY TARGET ALTITUDE ASSUMED @ 13,700'
TIME v ALT
ADJUSTED TIMES
TWALT23D



PRIMARY
TARGET
ALTITUDE
ASSUMED
@ 13,700'

TIME
v
ALT

ADJUSTED
TIMES

b7C

[redacted]

April 13, 1997

VIA FACSIMILE TRANSMISSION

SA [redacted]
FBI, New York Field Office
26 Federal Plaza, 23rd Floor
New York, NY 10278

b7C

Dear [redacted]

I have reviewed the NTSB's DFDR report and completed a comparison of time in various radar data sets, transcripts, and time indicated in the DFDR printout along with MSL altitude values and VHF radio key indicators.

I will give them the benefit of the doubt in that their timing of the VHF radio key relative to ZBW ARTCC transcripts appears right on the mark. The proper and accepted method of aligning time of the DFDR and CVR is always based on the ATC transcript from the communicating facility. They (*the CVR Lab*) do not use the times in the printed transcript but rather a certified rerecording of ATC communications by means of a digital time information signal applied to the tape simultaneously with application of the voice channel. This process is completed by utilizing a stereo recorder and placing the voice data on one track and the digital time signal on the opposite track. When the rerecording (*tape cassette*) is played back in the CVR Lab, verbiage recorded is evident on the speakers or headphones while the digital time signal appears on and LED clock face. You may note a near continuous **"tick-tick-tick"** like sound on the tape cassettes I returned. That ticking is the digital time signal.

Any adjustments in time relative to our radar data sets will reflect a time alignment to DFDR/CVR/ZBW ARTCC time lines. Hence, I will take this adjustment into account as I prepare the final datasets and plots.

Since you advised that the "spooks" utilize GPS or satellite time, I would be curious to know if any difference exists between National Bureau of Standards (WWV) time signals, which is the basis for ARTCC timing, and GPS time.

When you get a chance on Monday (*4/14*), give me a call and I'll provide some intell on the latest "missile" reports. Actually, they are more apply referred to as war stories but are more accurately defined as life experiences.

Sincerely,

[redacted] b7C

PS. DLTMROTHSBGYD!

TOTAL PAGES TRANSMITTED = 2

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 11/13/1997

To: New York

From: [redacted]
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]:sab

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EID

Synopsis: Radar data received from U.S. Air Force, North American Air Defense Command regarding explosion of TWA Flight 800.

Enclosures: Hard copy of radar data contained on CD-ROM obtained from [redacted] 84 Radar Evaluation Squadron, Hill A.F.B., Utah, [redacted], by SSA [redacted] on 7/29/96.

b7C

Details: Radar data was captured by Air Force squadron on the night of July 17, 1996, regarding the explosion of TWA Flight 800.

CD-ROM from which the data was obtained was placed in an FD-340 on 11/13/96.

♦♦

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OPCA-20 (12-3-96)

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FEDERAL BUREAU OF INVESTIGATION
FOIPA
DELETED PAGE INFORMATION SHEET

94 Page(s) withheld entirely at this location in the file. One or more of the following statements, where indicated, explain this deletion.

☐ Deletions were made pursuant to the exemptions indicated below with no segregable material available for release to you.

Section 552		Section 552a
☐ (b)(1)	☐ (b)(7)(A)	☐ (d)(5)
☐ (b)(2)	☐ (b)(7)(B)	☐ (j)(2)
☐ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
______	☐ (b)(7)(D)	☐ (k)(2)
______	☐ (b)(7)(E)	☐ (k)(3)
______	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☐ (b)(6)		☐ (k)(7)

☐ Information pertained only to a third party with no reference to the subject of your request or the subject of your request is listed in the title only.

☒ Documents originated with another Government agency(ies). These documents were referred to that agency(ies) for review and direct response to you.

____ Pages contain information furnished by another Government agency(ies). You will be advised by the FBI as to the releasability of this information following our consultation with the other agency(ies).

____ Page(s) withheld inasmuch as a final release determination has not been made. You will be advised as to the disposition at a later date.

____ Pages were not considered for release as they are duplicative of ______

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265A-NY-259028 Sub NN, serial 49

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X Deleted Page(s) X
X No Duplication Fee X
X for this page X
XXXXXXXXXXXXXXXX

XXXXXX
XXXXXX
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FBI/DOJ

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 11/19/1997

To: New York

From: New York
I-46
Contact: SA [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]emf

Case ID #: 265A-NY-259028-NN (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EID

Synopsis: Sources of radar.

Details: As provided by SA [redacted] the following numbered locations are the sources of radar that were used in analysis of the TWA Flight 800 catastrophe.

FAA Radar Sources (Air Traffic Control)

N90 (4 second/ASR radar)

1. JFK - Located at JFK Airport
2. Newark (EWR) - Located at Newark Airport
3. White Plains (HPN) - Located at Westchester County Airport, NY
4. Islip (ISP) - Located at Mac Arthur Airport
5. Stewart's Field (SWF) - Located in Newburgh, NY
6. Riverhead, NY
7. Trevose, PA
8. North Truro, MA
9. Cummington, MA

ARTCC (Air Route Traffic Control Center) LRR (Long Range Radar) - (NTAP -12 second/En route)

New York ARTCC ***
Boston ARTCC ***
Washington ARTCC ***

50

(***These three locations <u>receive</u> radar data mosaicked from numerous sites. They are <u>not</u> sources.)

265A-NY-259028-SUB NN

9

b7C [redacted]

To: New York From: New York
Re: 265A-NY-259028-RR, 11/19/1997

Other Radar Sources

10. Sikorsky Aircraft, Stratford, CT
    Radar returns from Riverhead site(6) +
        SEPARATE Transponder only returns from Pitney
        Bowes (located at Bridgeport, CT (4 seconds)

National Oceanic and Atmospheric Administration (NOAA)
National Weather Service

11. Boston (NOAA)
12. New York (NOAA)

♦♦

OPCA-20 (12-3-96)

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FEDERAL BUREAU OF INVESTIGATION
FOIPA
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☐ Deletions were made pursuant to the exemptions indicated below with no segregable material available for release to you.

Section 552		Section 552a
☐ (b)(1)	☐ (b)(7)(A)	☐ (d)(5)
☐ (b)(2)	☐ (b)(7)(B)	☐ (j)(2)
☐ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
______	☐ (b)(7)(D)	☐ (k)(2)
______	☐ (b)(7)(E)	☐ (k)(3)
______	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☐ (b)(6)		☐ (k)(7)

☐ Information pertained only to a third party with no reference to the subject of your request or the subject of your request is listed in the title only.

☒ Documents originated with another Government agency(ies). These documents were referred to that agency(ies) for review and direct response to you.

____ Pages contain information furnished by another Government agency(ies). You will be advised by the FBI as to the releasability of this information following our consultation with the other agency(ies).

____ Page(s) withheld inasmuch as a final release determination has not been made. You will be advised as to the disposition at a later date.

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____ Page(s) withheld for the following reason(s): ______

☒ The following number is to be used for reference regarding these pages:
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(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 11/21/1997

To: New York

From: [redacted]
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]sab

Case ID #: 265A-NY-259028 (Pending)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EID

Synopsis: Summary of radar analyzed by Bureau radar contractor.

b7C **Enclosures:** Report from [redacted] to the writer dated 11/13/97.

Details: Report was a summary of radar data analyzed with regards to the explosion of TWA Flight 800 on July 17, 1996.

♦♦

[redacted]

b7c

November 13, 1997

VIA E-MAIL
W/FOLLOW-UP
VIA FACSIMILE TRANSMISSION

SA [redacted]
FBI, New York Field Office
26 Federal Plaza, 23rd Floor
New York, NY 10278

b7c

Dear [redacted]

Per your request, a detailed list of radar data reviewed by me during the course of the TWA800 investigation is provided below.

A. FAA TERMINAL RADAR DATA

1. NEW YORK TERMINAL RADAR APPROACH CONTROL (N90 TRACON)

Terminal Airport Surveillance Radar (ASR) systems have a useable range of 60 nautical miles (NM) and rotate clockwise at approximately 13 RPM which provides a scan rate of approximately 4.6 seconds between returns or updates. They are constructed so that the transponder or secondary radar antenna is co-located atop the larger primary radar antenna array. Data from these ASR systems are processed by the N90 TRACON ARTSIIIA(e) computer tracking system.

(a). **JFK ASR system (N90 ARTS Sensor "0")**

The following N90 JFK data was reviewed covering the time period from 1 hour prior to the event and continuing through 2 hours after the event.

(a1). Radar Reinforced Beacon (RB) returns wherein a valid transponder signal was received along with the validation that a primary radar return was also received.

(a2). Beacon Tracking Level (BT) returns wherein only a valid transponder signal was received.

(a3.) Radar Tracking (RT) returns wherein only a valid primary radar return was received.

(b). **EWR ASR system (N90 ARTS Sensor "1")**

The following N90 EWR data was reviewed covering the time period from 30 minutes prior to the event and continuing through loss of TWA800's primary and secondary contact when the flight exceeded the maximum range (60 NM) of the EWR ASR approximately 1 minute prior to the event.

(b1). Radar Reinforced Beacon (RB) returns wherein a valid transponder signal was received along with the validation that a primary radar return was also received.

(b2). Beacon Tracking Level (BT) returns wherein only a valid transponder signal was received.

(c). **ISP ASR system (N90 ARTS Sensor "2")**

The following N90 ISP data was reviewed covering the time period from 1 hour prior to the event and continuing through 2 hours after the event.

(c1). Radar Reinforced Beacon (RB) returns wherein a valid transponder signal was received along with the validation that a primary radar return was also received.

(c2). Beacon Tracking Level (BT) returns wherein only a valid transponder signal was received.

(c3.) Radar Tracking (RT) returns wherein only a valid primary radar return was received.

(d). HPN ASR system (N90 ARTS Sensor "3")

The following N90 HPN data was reviewed covering the time period from 1 hour prior to the event and continuing through 30 minutes after the event.

(d1). Radar Reinforced Beacon (RB) returns wherein a valid transponder signal was received along with the validation that a primary radar return was also received.

(d2). Beacon Tracking Level (BT) returns wherein only a valid transponder signal was received.

(d3.) Radar Tracking (RT) returns wherein only a valid primary radar return was received.

B. FAA EN ROUTE RADAR DATA

Radar data utilized by FAA Air Route Traffic Control Centers (ARTCC) is received from a series of long range radar (LRR) systems located within the ARTCC airspace jurisdiction. Generally, inland LRR sites have a range exceeding 150 NM while those sites located on the coast will have a maximum range of 200 NM or greater. Additionally, data from LRR's located in an adjacent ARTCC's area can be "remoted" to another ARTCC to provided overlapping coverage. In addition to sharing LRR data between ARTCC's, data from selected LRR's is shared or remoted to both U.S. Military entities and selected civilian contractors where there is a requirement for a contractor to have access to the data during the course of providing services to the U.S. Government. These LRR systems rotate clockwise at 5 RPM which produces a scan rate of approximately 12 seconds

Although multiple LRR sites within a particular ARTCC's airspace may provide duplicate coverage of an aircraft, the ARTCC National Airspace System (NAS) computer is programmed to select, display, and record only a single return for a given aircraft. This process is completed through computer program code wherein a specific LRR is designated as the primary receiving antenna for specific area while an alternate LRR is designated as a secondary source. Hence, if the primary LRR fails to detect a target in given area while the secondary LRR detects a target, the NAS computer will display and record target information from the alternate site. When radar data is recorded through the NTAP process, the determination of the (actual) receiving LRR is quite often difficult in that the receiving radar site is not always indicated in the NTAP printout. This primary/secondary target selection display feature (known as MOSAICING) is unique to the FAA's ARTCC current NAS computer system which has been in use since the late 1960's.

In the case of TWA800, radar data was recorded by the Boston, Washington, and New York ARTCC's which received data from the same three (identical) sites located at Riverhead, New York; North Truro, Massachusetts; and Trevose, Pennsylvania.

1. **BOSTON (ZBW) ARTCC**

   ZBW NTAP data was reviewed covering the time period from 1 hour prior to the event and continuing through 1 hour after the event.

2. **WASHINGTON (ZDC) ARTCC**

   ZDC NTAP data was reviewed covering the time period from 1 hour prior to the event and continuing through 1 hour after the event.

3. **NEW YORK (ZNY) ARTCC**

   ZNY NTAP data was reviewed covering the time period from 1 hour prior to the event and continuing through 1 hour after the event.

C. <u>USAF NORAD DATA</u>

NORAD (North American Air Defense Command) data consisted of a review of primary and secondary radar remoted to the NORAD computer system received from LRR's located at Riverhead, NY, North Truro, MA, and Trevose, PA, commencing 10 minutes prior to the event and continuing through 10 minutes after the event.

D. USN FACSFAC VACAPES

FACSFAC VACAPES (Fleet Air Control and Surveillance Facility, Virginia Capes), located at NAS Oceana, data consisted of a review of primary and secondary radar remoted to the FACSFAC computer system received from LRR's located at Riverhead, NY, North Truro, MA, and Trevose, PA, commencing 15 minutes prior to the event and continuing through 30 minutes after the event.

E. SIKORSKY (BRIDGEPORT)

Sikorsky Aircraft Company, located at Bridgeport, CT, a manufacturer of rotary wing aircraft for the U.S. Government, operates a computer radar tracking system for the purpose of monitoring test and evaluation flights of military aircraft that is mandated by the government. To support requirement of their tracking system, Sikorsky utilizes a feed or remote from the Riverhead, NY LRR system and a company owned secondary-only radar system located at Bridgeport.

A review of Sikorsky data was conducted at facilities of the commercial vendor providing software (contract) support for the tracking system commencing 10 minutes prior to the event and continuing through 15 minutes after the event. Additionally, digital information maintained by the contractor was transmitted electronically for a detailed review.

F. NWS DATA

A review of NWS (National Weather Service) data utilizing four 8mm QG-112M data cartridges containing digital information recorded by the NWS WSR-88B weather radar systems located at Boston, MA (KBOX) and Upton, NY (KOKX) was conducted commencing 10 minutes prior to the event and continuing through 10 minutes after the event.

G. FAA ARTS RETRACK TAPE

A detailed review and analysis was conducted utilizing a VHS copy of a "RETRACK" playback of the New York TRACON's ARTSIIIA(e) data containing a video playback of ISP and JFK ASR data. Upon completion of the analysis, voice-over commentary and graphic highlighting was added to the tape for demonstrative purposes prior to shipment to your office.

H. SUMMARY

Review and analysis of recorded information encompassed radar data received from seven (8) ground based air surveillance radar systems wherein four (4) were 60 NM range ASR terminal radars systems, three (3) were 200+ NM LRR systems, and one (1) was a special use 200 NM range system operated by a government contractor.

In an effort to obtain the most objective overview of the LRR data, North Truro and Trevose data were reviewed as they were processed by five (5) separate and independent computer processors while Riverhead data was reviewed after processing by six (6) separate and independent computer processors. Design technology of these processors ranged from the ARTCC NAS computer (mid-1960's) through the late 1980's with USN and NORAD data.

Respectfully,

[redacted] b7c

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 03/19/1998

To: New York

From: [redacted]
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]sab

Case ID #: 265A-NY-259028 (Pending Inactive)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EID

Synopsis: Radar data used by radar analyst as part of TWA Flight 800 investigation.

Enclosure: Letter from [redacted] to the writer dated 01/16/1998.

b7C

Details: The writer received two (2) parcels of radar data on 1/20/1998 from [redacted] Bureau radar analyst. This data was the digital data [redacted] had generated and stored in his computer as part of the TWA Flight 800 explosion investigation.

♦♦

UPLOADED
WITH/TEXT ✓
WITH/OUT TEXT
BY
DATE 3/26/98

265A-NY-259028-SUB NN-53

[redacted]

b7C

b7C

[redacted]

January 16, 1998

VIA FACSIMILE TRANSMISSION
W/Follow up
VIA FEDEX & PRIORITY MAIL

SA [redacted]
FBI, New York Field Office
26 Federal Plaza, 23rd Floor
New York, NY 10278

b7C

Dear [redacted]

I am shipping two (2) separate parcels to you today which contain copies of all digital data stored in my computer re. the TWA800 investigation. Hence, you will now have everything I generated on the computer from my initial entries in December 1996, up through but not including a copy of this letter. In this day and age, digital data is just as important, if not more so, than hard copy information. Hence, I opted to send copies of all of the digital material should someone desire to play with it at a later date.

The larger of the two parcels contains four (4) tapes in QIC 80 Format, the operating program utilized for plotting (GRAFTOOL), along with a complete listing of all files provided. This parcel should be considered "*official*" material and be stored along with the four large parcels containing hard copy data shipped on January 2, 1998. The smaller parcel (via Priority Mail) also contains all of the above material but I copied all of the material on a single QIC 80 Format tape. Although this one contains the same material, it is provided for your own personal records and use. Now you will have to go out and buy a QIC 80 Format tape drive.

I have two more items to send relative to the case but they are more of a information type ite s that you might want to file away for future reference. All I need is some free time to get them together between the other cases ar 3 their related travel.

Call if you have any questions.

Sincerely,

[redacted] b7c

TOTAL PAGES TRANSMITTED = 2

P.S. E-mail notification of tracking number also sent.

(12/31/1995)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE **Date:** 03/19/1998

To: New York

From: [redacted]
I-46
Contact: [redacted]

b7C

Approved By: [redacted]

Drafted By: [redacted]sab

Case ID #: 265A-NY-259028 (Pending Inactive)

Title: UNSUB(S);
EXPLOSION OF TWA FLIGHT 800;
JULY 17, 1996;
AOT-IT-EID

Synopsis: Radar data used by radar analyst as part of TWA Flight 800 investigation.

Enclosure: Letter from [redacted] to the writer dated 12/29/1997.

b7C

Details: The writer received four (4) boxes of radar data on 1/16/1998 from [redacted] Bureau radar analyst. This data was the printed data [redacted] had analyzed as part of the TWA Flight 800 explosion investigation.

♦♦

265A-NY-259028- SUB NN-54

SEARCHED ____ INDEXED ____
SERIALIZED ____ FILED ____

FBI — NEW YORK

[redacted]

b7C

UPLOADED
WITH/TEXT ✓
WITH/OUT TEXT ____
BY ____
DATE 3/26/98

[redacted]

b7c

December 29, 1997

VIA E-MAIL
W/FOLLOW UP
VIA PRIORITY MAIL

SA [redacted]
FBI, New York Field Office
26 Federal Plaza, 23rd Floor
New York, NY 10278

b7c

Dear [redacted]

I have completed a detailed inventory of all items utilized in the radar reconstruction efforts related to TWA800 which are provided below. Additionally, I have boxed up all item listed below for shipping to a destination of your choice. Currently, I have the four listed items and will provide you with a fifth (*small*) parcel at a later date which will include a magnetic tape cartridge containing copies of all material stored on my computer relating to the case.

BOX 1 of 4

Printouts of recorded radar data

1. N90 SENSOR "2" RT Data, cover + 903 pages [2215:10.233-2303:54.776 UTC]
2. N90 SENSOR "2" RT Data, cover + 794 pages [2303:54.918-0000:59.655 UTC]
3. N90 SENSOR "2" RT Data, 900+ pages [2303:54.918-0000:59.655 UTC]

BOX 2 of 4

Printouts of recorded radar data

1. N90 SENSOR "2" RT Data, cover + 576 pages [0002:41.548- 0039:59.685 UTC]
2. N90 SENSOR "0" RT Data, cover + 137 pages [0002:43.192-0039:59.860 UTC]
3. N90 SENSOR "3" RT Data, cover + 261 pages [0002:44.522-0039:59.248 UTC]
4. N90 SENSOR "0" BT Data, cover + 98 pages [0002:43.192-0039:59.978 UTC]
5. N90 SENSOR "3" BT Data, cover + 148 pages [0002:44.522-0039:59.248 UTC]
6. N90 SENSOR "3" RB Data, cover + 199 pages [0002:44.522-0039:56.730 UTC]
7. ZBW, ZDC, ZNY ARTCC Data, cover + 481 pages [various times UTC]

BOX 3 of 4

Printouts of recorded radar data

1. N90 SENSOR "2" RB Data, cover + 465 pages [0002:41.256-0039:59.685 UTC]
2. N90 SENSOR "2" BT Data, cover + 137 pages [0002:41.696-0039:59.542 UTC]
3. N90 SENSOR "0" RT Data, cover + 290 pages [0002:43.043-0039:59.565 UTC]
4. N90 SENSORS "0/1/2/3" TG Data, cover + 88 pages [0019:44.850-0031:12.133 UTC]
5. NORAD Data, cover + 71 pages [0025:25.080-0029:56.285 UTC]
6. N90 SENSORS "0/1/2/3" TG Data, Saudia Airlines Flight 035, 187 pages [in 1" 3-ring binder]
7. NTSB Primary radar data from N90 SENSOR "2" (with timing error), 683 pages [in 4" 3-ring binder]
8. [redacted] TWA800 Workbook. Various processed datasets and Initial Plots [in 3" 3-ring binder]

b7c

BOX 4 of 4

Miscellaneous Items

1. N90 SENSOR "2" Beacon Data, ZBV & ZDC ARTCC NTAP Data obtained from NTSB [in 2" 3-ring binder]
2. Four (4) Fuji QG-112M 8mm Data Cartridges of NWS Weather Radar Data
3. Twenty (20) 3.5" Computer Disks containing Digital Radar Data obtained from FAA W/content listing pages [in 1" 3-ring binder]
4. Master Dub Copy of Salinger Video Tape of FAA RETRACK

5. Copy of NTSB DFDR Printout received from [redacted] NTSB, RE-2, on March 12, 1997. Document cover stamped "CONFIDENTIAL" by NTSB.
6. Documents Provided to [redacted] by SA [redacted] FBI NYO, on December 12, 1996, @ CTO.

b7c

Since Box #4 contains magnetic recording media, I have marked the outside as "DO NOT X-RAY" & "DO NOT PLACE NEAR MAGNETIC FIELDS" markings in the hope that all will survive shipping and storage without being corrupted.

I took into account that many employees at your location are of the "gentler" gender and have packed each box so as not to exceed the weight of about a 2 year old crumb cruncher (*which they should be used to*) so there would be less of a chance of one of "them" suffering a lifting related injury. The weight of the parcels is as follows:

Box 1 of 4 = 39 pounds
Box 2 of 4 = 38 pounds
Box 3 of 4 = 37 pounds
Box 4 of 4 = 10 pounds

I have packed each parcel to include a detailed contents lising both inside the box and on the outside in a combination back & orange plastic envelope which states "PACKING LIST ENCLOSED"

As they sit now, all are ready for UPS GROUND shipment to you at the NYO which would be the most economic way if I foot the bill which is not a problem. However, you (*or those above you*) may want the material shipped elsewhere for storage.

If it would be more advantageous to your internal operations, I can deliver them to the northern Virginia F.O. and they can handle (*pay*) the shipping. This would get them into the FBI system right from the get-go. Just an idea of course. However, I will await your decision prior to shipping them.

A point of interest re. UPS shipping. I had planned to send them via ground which is the most economical form. Shippment via this method would ensure delivery in a 2-3 day timeframe. Addititonally, I have affixed a UPS delivery confirmation tag to each parcel so I can maintain a receipt/chain-of-custody on the items.

Please be assured that I do not mind taking the 4 items to UPS and paying the shipping as the cost is a write-off re. Income Tax.

The parcels are currently address to "you" from "me" and each parcel has a label on the top and end that list the following:

BOX # of 4
TWA800 INVESTIGATION
RECORDED RADAR DATA

Each parcel is packed solid with a Styrofoam buffer to ensure minimum displacement while in transit. The markings described above make it clear exactly what the material is regarding long term storage/retention.

I await your authoritative decision.

Sincerely,

[redacted]

b7c

Encl. (W/Priority Mail only)

CONTENTS

BOX 1 of 4

b7C

[redacted]

TWA800 ACCIDENT

NEW YORK TRACON (N90)
RT Data, SENSORS "2"

0040:02.033 UTC
thru
0120:58.749 UTC
Cover + 794 pages

FBI CONTRACT
ORDER NUMBER
#J7N761661

b7C

[redacted]

TWA800 ACCIDENT

NEW YORK TRACON (N90)
RT Data, SENSORS "2"

2303:54.918 UTC
thru
0000:59.655 UTC
900 + pages

FBI CONTRACT
ORDER NUMBER
#J7N761661

b7C

TWA800 ACCIDENT

NEW YORK TRACON (N90)
RT Data, SENSORS "2"

2215:10.233 UTC
thru
2303:54.776 UTC
Cover + 903 pages

FBI CONTRACT
ORDER NUMBER
#J7N761661

CONTENTS

BOX 2 of 4

b7C

[redacted]

TWA800 ACCIDENT

NEW YORK TRACON (N90)
ISP [SENSOR 2] RT DATA

0002:41.548 UTC
thru
0039:59.685 UTC
Cover + 576 pages

b7C

[redacted]

TWA800 ACCIDENT

NEW YORK TRACON (N90)
HPN [SENSOR 3] RT DATA

0002:44.522 UTC
thru
0039:59.248 UTC
Cover + 261 pages

FBI CONTRACT

b7C

[redacted]

TWA800 ACCIDENT

NEW YORK TRACON (N90)
JFK [SENSOR 0] BT DATA

0002:43.192 UTC
thru
0039:59.978 UTC
Cover + 98 pages

FBI CONTRACT
ORDER NUMBER
[illegible]

b7C

[redacted]

TWA800 ACCIDENT

NEW YORK TRACON (N90)
HPN [SENSOR 3] BT DATA

0002:44.522 UTC
thru
0039:59.248 UTC
Cover + 148 pages

FBI CONTRACT
ORDER NUMBER
#J7N761661

b7C

[redacted]

TWA800 ACCIDENT

NEW YORK TRACON (N90)
JFK [SENSOR 0] RT DATA

0002:43.192 UTC
thru
0039:59.860 UTC
Cover + 137 pages

FBI CONTRACT
ORDER NUMBER

b7C

[redacted]

TWA800 ACCIDENT

ARTCC NTAP DATA

BOSTON (ZBW) ARTCC
WASHINGTON (ZDC) ARTCC
NEW YORK (ZNY) ARTCC

481 pages

b7C

[redacted]

TWA800 ACCIDENT

NEW YORK TRACON (N90)
HPN [SENSOR 3] RB DATA

0002:44.522 UTC
thru
0039:56.730 UTC
Cover + 199 pages

FBI CONTRACT
ORDER NUMBER
#J7N761661

CONTENTS

BOX 3 of 4

b7C

[redacted]

TWA800 ACCIDENT

NEW YORK TRACON (N90)
ISP [SENSOR 2] RB DATA

0002:41.256 UTC
thru
0039:59.685 UTC
Cover + 465 pages

FBI CONTRACT
ORDER NUMBER
#J7N761661

b7C

[redacted]

TWA800 ACCIDENT

NEW YORK TRACON (N90)
ISP [SENSOR 2] BT DATA

0002:41.696 UTC
thru
0039:59.542 UTC
Cover + 151 pages

FBI CONTRACT
ORDER NUMBER
#J7N761661

b7C

[redacted]

TWA800 ACCIDENT

NEW YORK TRACON (N90)
JFK [SENSOR 0] RB DATA

0002:43.043 UTC
thru
0039:59.565 UTC
Cover + 290 pages

FBI CONTRACT
ORDER NUMBER
#J7N761661

b7C

[redacted]

TWA800 ACCIDENT

NEW YORK TRACON (N90)
TG Data, SENSORS 0, 1, 2, & 3

0019:44.850 UTC
thru
0031:12.133 UTC
Cover + 88 pages

FBI CONTRACT
ORDER NUMBER
#J7N761661

b7C

[redacted]

Fri 12/12/96
≈ 0545 Local - "green flare" sighting
Regards, [redacted]

b7C

CDR EDITOR LISTING

ALL SENSORS - REF.SVA035 CODE 2464

DATA SELECTED

TG

FILTERS

TIME: 12/12/96 08:47:00 - 12/12/96 12:47:00

CONTROLLER:
ALTITUDE: ACID: SVA035 SUBSYSTEM: 0 1 2 3 4
BEACON CODE: 2464
RANGE: AZIMUTH:
ETG: N INTERFACILITY: NON-CONFLICT: N

N90 TG-1

[redacted]

b7c

N90 ISP PRIMARY RADAR DATA

from

NTSB

[redacted]

b7C

TWA800

RECORDED RADAR DATA WORKBOOK

FBI CONTRACT
ORDER #J7N761661

[redacted]

b7c

TWA800 ACCIDENT

NORAD DATA

0025:25.080 UTC

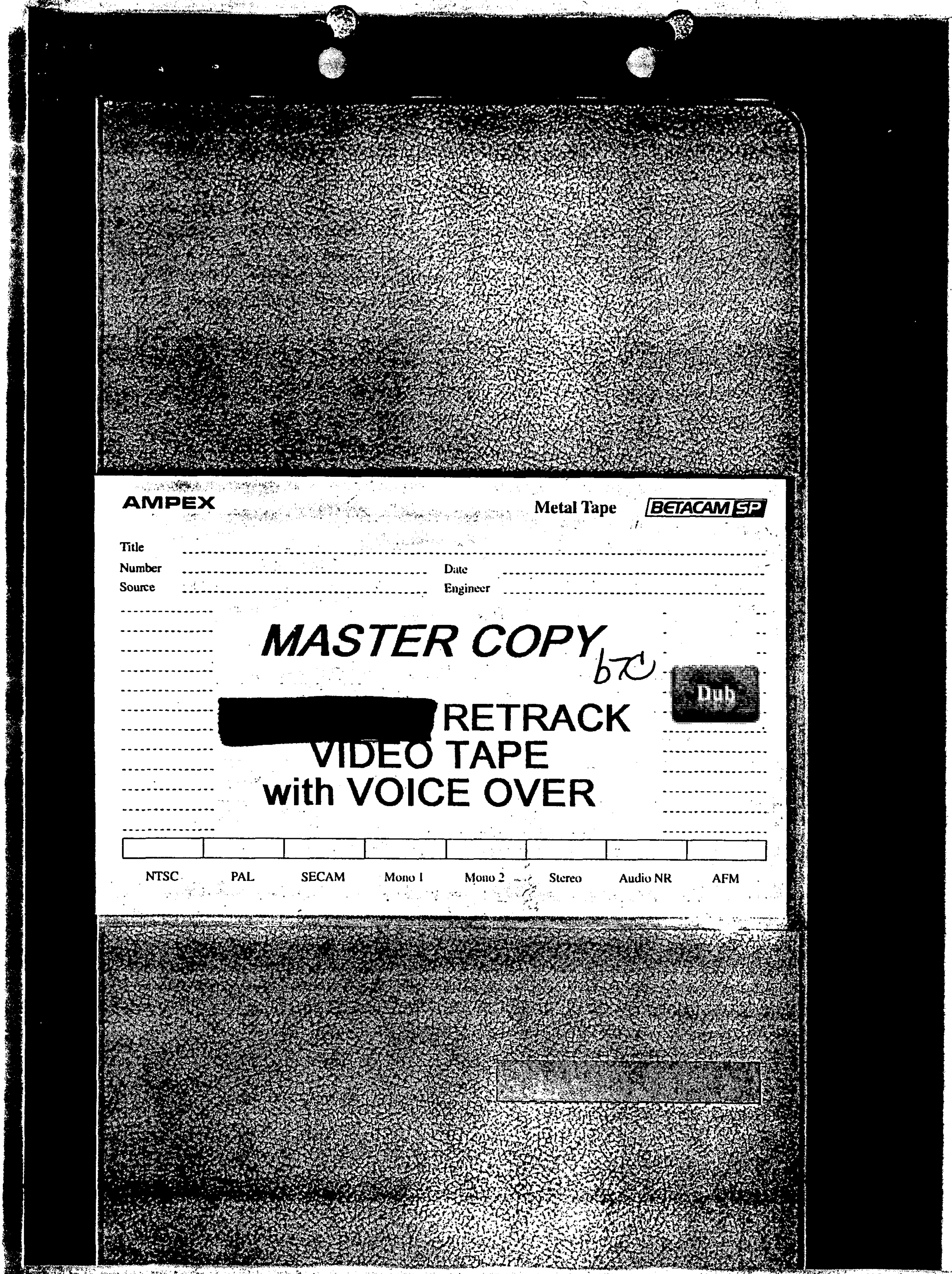
thru

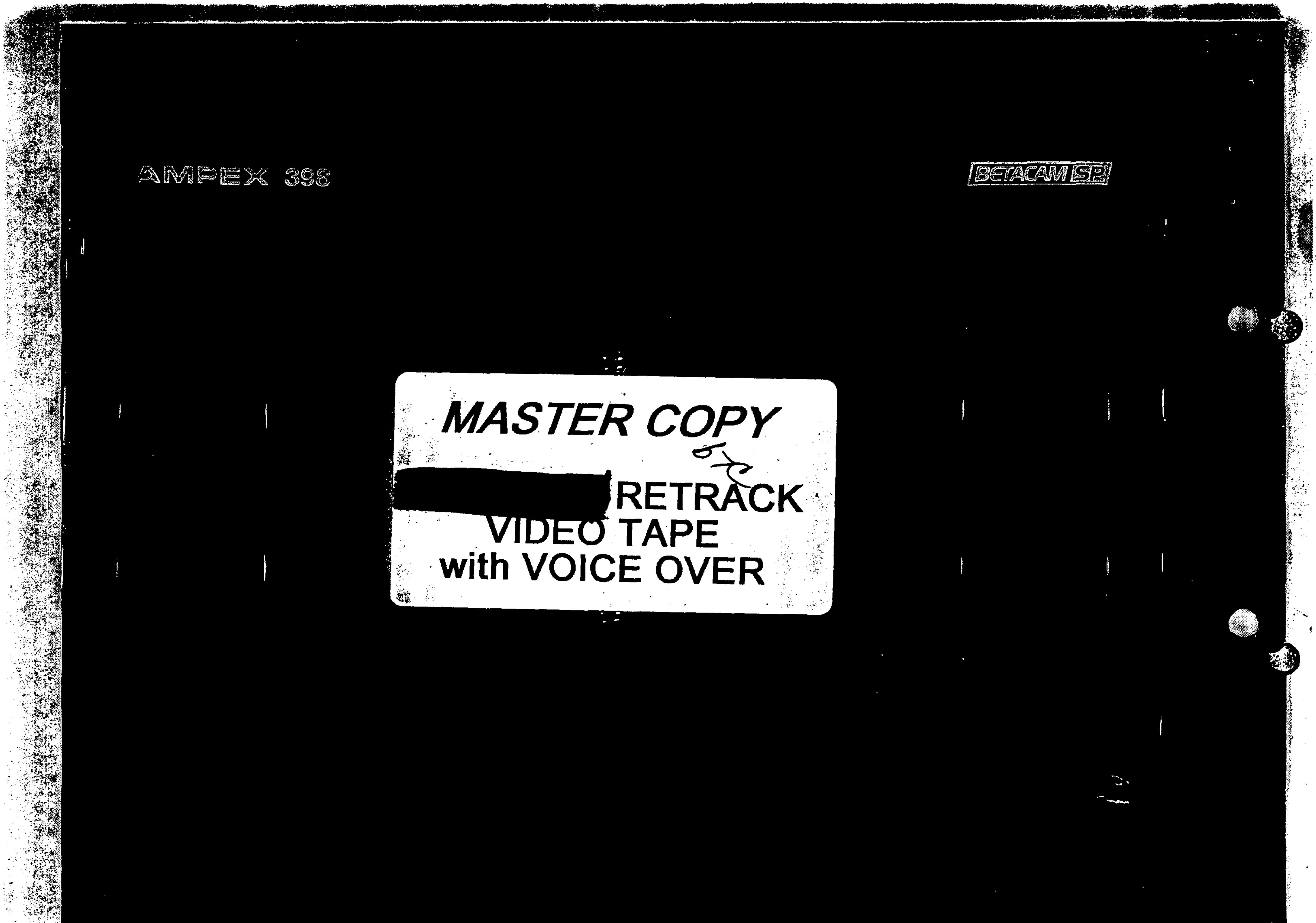
0029.56.285 UTC

71 pages

CONTENTS

BOX 4 of 4


AMPEX
Metal Tape
BETACAM SP
Title
Number
Date
Source
Engineer
MASTER COPY
b7C
Dub
[redacted] RETRACK
VIDEO TAPE
with VOICE OVER
NTSC
PAL
SECAM
Mono 1
Mono 2
Stereo
Audio NR
AFM


AMPEX 398
BETACAM SP
MASTER COPY
b7c
[redacted] RETRACK
VIDEO TAPE
with VOICE OVER

[redacted]

b7c

TWA800

DATA RECEIVED
IN
DIGITAL FORMAT

FBI CONTRACT
ORDER #J7N761661

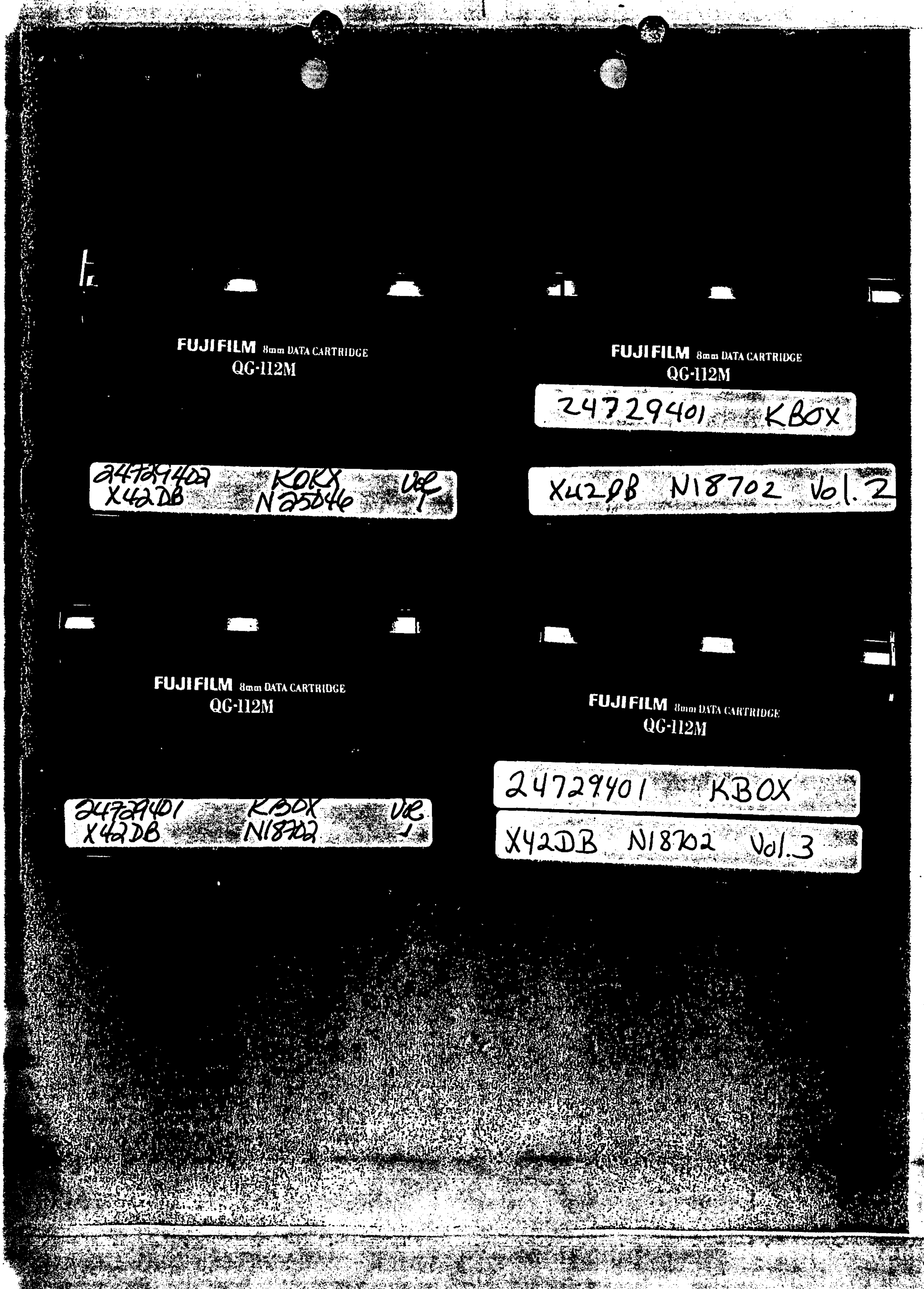
[redacted]

b7c

N90 ISP BEACON
ZBV NTAP PRIMARY
ZDC NTAP PRIMARY
DATA

from

NTSB


FUJIFILM 8mm DATA CARTRIDGE
QG-112M
FUJIFILM 8mm DATA CARTRIDGE
QG-112M
24729401 KBOX
X42DB N18702 Vol. 2
FUJIFILM 8mm DATA CARTRIDGE
QG-112M
24729401 KBOX
X42DB N18702
FUJIFILM 8mm DATA CARTRIDGE
QG-112M
24729401 KBOX
X42DB N18702 Vol.3

OPCA-20 (12-3-96)

XXXXXX
XXXXXX
XXXXXX

FEDERAL BUREAU OF INVESTIGATION
FOIPA
DELETED PAGE INFORMATION SHEET

1 Page(s) withheld entirely at this location in the file. One or more of the following statements, where indicated, explain this deletion.

☐ Deletions were made pursuant to the exemptions indicated below with no segregable material available for release to you.

Section 552		Section 552a
☐ (b)(1)	☐ (b)(7)(A)	☐ (d)(5)
☐ (b)(2)	☐ (b)(7)(B)	☐ (j)(2)
☐ (b)(3)	☐ (b)(7)(C)	☐ (k)(1)
______	☐ (b)(7)(D)	☐ (k)(2)
______	☐ (b)(7)(E)	☐ (k)(3)
______	☐ (b)(7)(F)	☐ (k)(4)
☐ (b)(4)	☐ (b)(8)	☐ (k)(5)
☐ (b)(5)	☐ (b)(9)	☐ (k)(6)
☐ (b)(6)		☐ (k)(7)

☐ Information pertained only to a third party with no reference to the subject of your request or the subject of your request is listed in the title only.

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____ Page(s) withheld inasmuch as a final release determination has not been made. You will be advised as to the disposition at a later date.

1 Pages were not considered for release as they are duplicative of first page, serial 49

____ Page(s) withheld for the following reason(s): ______

☒ The following number is to be used for reference regarding these pages:
265A-NY-259028 Sub NN, serial 54

XXXXXXXXXXXXXXXX
X Deleted Page(s) X
X No Duplication Fee X
X for this page X
XXXXXXXXXXXXXXXX

XXXXXX
XXXXXX
XXXXXX

FBI/DOJ