RECORD REPRODUCTION COVER SHEET

The attached records are:

Releasable to the Public ☑

Denied to the Public ☐

Subject:

1999 Global Hawk Accident Report

FOIA Control Number: 07-283 LK

Date Reproduced: 11 Oct 07

[redacted] [redacted] [redacted]

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE MATERIEL COMMAND
WRIGHT-PATTERSON AFB, OH 45433-5000

CL
to [illegible]

DATE 10 DEC 1999

MEMORANDUM FOR: CC

Sir:

The changes to the AIB President's conclusion more clearly describe his rationale for finding fault with the scheduling activities for this GH mission. Obviously, this is in response to Teledyne's and the SPO's desire to be exonerated.

I think the AIB makes a reasonable case that the add-on scheduling activity was not well disciplined and therefore could be expected to have flaws and hence contribute to the accident.

VICE COMMANDER

vr
Stev

Mission Number: ____________________
Mission Date: ____________________
Operations Engineer: ____________________

UAV Operations Engineer Mission Checklist

- ☐ T – 2 Weeks
  - ☐ Review Draft Flight Cards__________
  - ☐ Submit Schedule Requests for Flight and Support Activity (Monday – Week Prior)
    - ☐ Flight__________
    - ☐ Engine Run__________
    - ☐ Taxi Test__________
    - ☐ Test Beds (A-3, King Air)__________
    - ☐ Rehearsal__________
    - ☐ Chase
      - ☐ F-16__________
      - ☐ NT-39A__________
      - ☐ WB-57__________

- ☐ T – 1 Week
  - ☐ Coordinate Support for Scheduled Activity (See UAV Phone List)
  - ☐ Airspace (RCOs schedule)
  - ☐ Submit ROA/Profile If flight requires FAA airspace outside R2508.
  - ☐ Notify Acquisition Security__________(Jack Ekhert)
  - ☐ Notify Freq Management if sensor activity__________ (Jim Rizzo)
  - ☐ Chase
    - ☐ F-16__________
    - ☐ NT-39A__________
    - ☐ WB-57__________

- ☐ T – 3 Days
  - ☐ Start Flight Card Coordination (Assist)__________.
  - ☐ Notify Hi Test Personnel__________ (Bill Collette, Mike Collins,) Send Profile if requested.
  - ☐ Submit After Hours Support Request Worksheet for Tower/Sport if applicable (prior to 0600L or after 2200L).

- ☐ T – 2 Days
  - ☐ Flight Cards Approved__________
  - ☐ Prepare for FRR (Assist)
  - ☐ Provide Collection Plan to Acquisition Security for Sensor mission 24 Hrs prior. __________
  - ☐ FAX ROA Mission Worksheet to 412 OSS/OSA NLT 24 Hrs Prior to Taxi__________ or Free Flight__________ (Test Director provides worksheet)

- ☐ T – 1 Day
  - ☐ Make Schedule Changes A/R Prior to 1000 Hrs.__________
  - ☐ Attend FRR
  - ☐ Notify Acq Security if mission changes. __________
  - ☐ Confirm Scheduled Support (Get hardcopy after final inputs)__________

- ☐ T – 0 Day
  - ☐ Take Notes During Mission for Quicklook
  - ☐ Support with Coordination A/R.
  - ☐ Cancel B/U Support if Mission Completes. __________
  - ☐ Confirm B/U if Mission Slips. __________

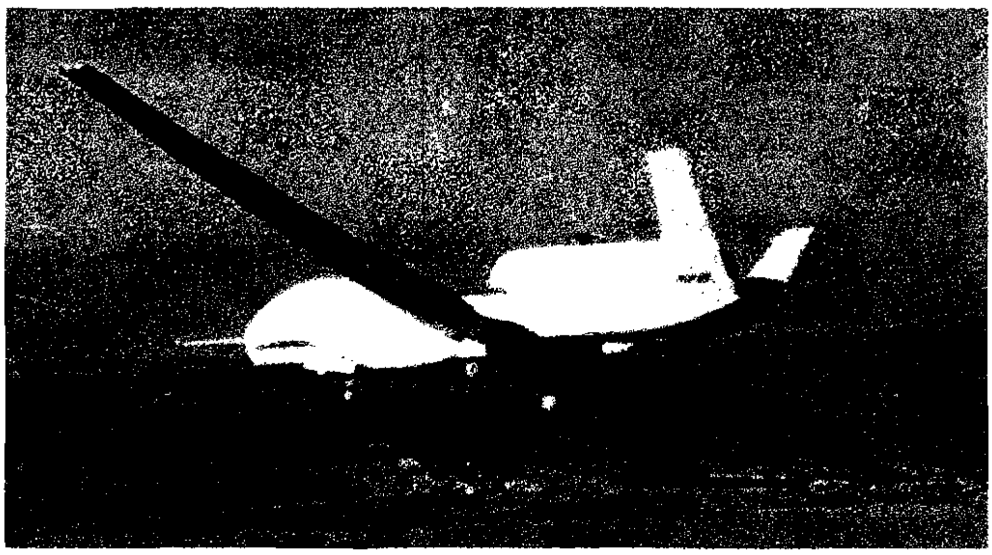
- ☐ T + 1
  - ☐ Complete 419th Quicklook
  - ☐ Complete Flight Folder
  - ☐ Provide copy of Flight Notes to TD

UNITED STATES AIR FORCE AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

Part 1 of 2

RQ-4A GLOBAL HAWK UAV, 95-2002

EDWARDS AFB, CA



LOCATION: CHINA LAKE NAS, CA

DATE OF ACCIDENT: 29 MAR 99

BOARD PRESIDENT: COLONEL STEPHEN T. VIRGILIO

Conducted IAW Air Force Instruction 51-503

ACTION

The Report of Investigation, prepared pursuant to AFI 51-503, concerning the 29 Mar 99 crash of the RQ-4A Global Hawk Unmanned Aerial Vehicle (UAV), serial number (S/N) 95-2002, in restricted Area R2524, China Lake NAS, is approved.

GEORGE T. BABBITT
General, USAF
Commander

EXECUTIVE SUMMARY

Aircraft RQ-4A Global Hawk UAV, S/N 95-2002 impacted the ground at 1014L, 29 Mar 99, in Restricted Area R2524, China Lake NAS, California.

The UAV mission on 29 March 99 was a short notice add-on mission, planned the afternoon of 26 March 99 due to an incomplete UAV flight on 26 Mar 99. The mission profile for the UAV 26 Mar 99 flight was to be used for the 29 Mar 99 UAV flight. The flight termination receivers used for the 26 Mar 99 flight were set for 421 megahertz and on loan from another program; however, the receivers were changed to 425 megahertz receivers prior to the 29 Mar 99 UAV flight. The Edwards range mission control center was not aware of the frequency change until approximately 2 hours before the UAV flight 29 Mar 99. The Edwards range mission control center made the appropriate change to their flight termination transmitter prior to the UAV launch.

No one was injured in the accident. The aircraft was totally destroyed upon impact with no damage to government or private property sustained. The wreckage was contained within an area approximately one wing span in diameter and there was no post-impact fire.

The testing of the Nellis Test Range flight termination system transmitter at the time of the UAV flight and at the UAV's flight termination receivers' exact frequency (425 megahertz) caused the UAV to accept a flight termination command and execute the flight termination sequence. The testing /calculations made of the signal strength from the Nellis transmitter and the capability of the UAV receivers to accept the signal were verified. The UAV program did not use a "high alphabet" or "encrypted" flight termination UHF signal for activation of the UAV flight termination system. It must be noted that as we fly UAV's at higher altitudes there is a greater potential for UHF "overlap" between test range complexes since UHF is line of sight, i.e. hundreds to thousands of miles. At present, coordination and deconfliction of frequencies is only required within a DoD Area Frequency Coordinator's area of responsibility. The Edwards and Nellis ranges are in different training range areas, and thus have different DoD area frequency coordinators and different areas of responsibility. Therefore, each range could legitimately fly test aircraft utilizing the same flight termination frequency and tones, and a termination signal sent by either range could terminate both aircraft.

Under 10 U.S.C. 2254(d), any opinion of the accident investigators as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report may not be considered as evidence in any civil or criminal proceeding arising from an aircraft accident, nor may such information be considered an admission of liability by the United States or by any person referred to in those conclusions or statements.

SUMMARY OF FACTS AND STATEMENT OF OPINION
RQ-4A GLOBAL HAWK UAV ACCIDENT
29 MAR 99

TABLE OF CONTENTS

COMMONLY USED ACRONYMS & ABBREVIATIONS

ACC	Air Combat Command
AFB	Air Force Base
AFFTC	Air Force Flight Test Center
AFM	Air Force Manual
AFI	Air Force Instruction
AFMC	Air Force Material Command
CDL	Communication Data Link
CCO	Command Control Element
FTS	Flight Termination System
HAE	High Altitude Endurance
ISS	Integrated Sensor Suite
LRE	Launch Recovery Element
L	Local Time
LOS	Line of Sight
MALD	Miniature Air Launch Decoy
MCE	Mission Control Element
MCC	Mission Control Center
MSL	Mean Sea Level
PST	Pacific Standard Time
SATCOM	Satellite Communications
S/N	Serial Number
UAV	Unmanned Aerial Vehicle
USAF	United States Air Force
Z	Zulu or Greenwich Meridian Time (GMT)

The above list was compiled from the Summary of Facts, the Statement of Opinion, the Index of Tabs, and witness testimony (Tab V).

SUMMARY OF FACTS

1. AUTHORITY, PURPOSE, AND CIRCUMSTANCES

a. Authority.

On 19 Apr 99, General George T. Babbit, Commander Air Force Material Command (AFMC) appointed Colonel Stephen T. Virgilio to conduct an aircraft accident investigation of the 29 Mar 99 crash of an RQ-4A Global Hawk Unmanned Aerial Vehicle (UAV), serial number (S/N) 95-2002, in Restricted Area R2524, China Lake NAS, N35'28.7 W117'19.5. The investigation was at Edwards Air Force Base (AFB), CA, from 20 Apr 99 through [ending date]. The technical advisor was Joseph P. Harrington. The legal advisor was Major Raymond F.Chamberland III.

b. Purpose.

This aircraft accident investigation was convened under Air Force Instruction (AFI) 51-503. The primary purpose is to gather and preserve evidence for claims, litigation, and disciplinary and administrative actions. In addition to setting forth factual information concerning the accident, the board president is also required to state his opinion as to the cause of the accident or the existence of factors, if any, that substantially contributed to the accident. This investigation is separate and apart from the safety investigation, which is conducted pursuant to AFI 91-204 for the purpose of mishap prevention. The report is available for public dissemination under the Freedom of Information Act (5 United States Code (U.S.C.) §552) and AFI 37-131.

c. Circumstances.

The accident board was convened to investigate the Class A accident involving an RQ-4A Global Hawk UAV, S/N 95-2002, owned by Teledyne Ryan Aeronautical, which crashed on 29 Mar 99.

2. ACCIDENT SUMMARY

Aircraft RQ-4A Global Hawk UAV, S/N 95-2002 executed its flight termination sequence during a sensor payload test flight on 29 Mar 99 and impacted the ground in Restricted Area R2524, China Lake NAS, N35'28.7 W117'19.5 (Tab B-2). No one was injured in the accident. The aircraft was totally destroyed upon impact with the loss valued at $45,000,000.00 (Tab M-2). No damage to government or private property (other than the aircraft), was sustained. Articles appeared in local media immediately after the accident, but no activity has been reported recently.

3. BACKGROUND

Teledyne Ryan Aeronautical contracted with the USAF to develop and demonstrate an HAE UAV system capable of affordable, continuous, all-weather wide area surveillance in support of military operations.

4. SEQUENCE OF EVENTS

a. Mission.

Flight test of the Global Hawk airframe and sensor payloads.

b. Planning.

The mission planning, flight plan, procedures, and flight card required to fly the UAV Global Hawk in the Edwards Test Range complex were coordinated and understood. The 29 Mar 99 sortie was going to duplicate an aborted sortie from 26 Mar 99. The aborted sortie FTS frequency was 421 megahertz. On 29 March 1999 at approximately 0615L AFFTC schedulers were notified that the flight termination system frequency was changed to 425 megahertz. Proper coordination and notification of the new frequency was made to all required agencies.

c. Preflight.

There were no reported anomalies from preflight activities.

d. Flight.

Take off was delayed from 0800 until 0945 (PST) due to LN-100 real-time parameter display problems and Mission Control Room data system re-boot. Take-off was made from South Base runway 06 under UHF Line of Sight (LOS) control, which was much improved over flight 2-08. The UHF Satellite Communication (SATCOM) link was also improved. ISS DC and AC power were applied as briefed. Climb-out to orbit 'A' was initiated with a good turn-short at waypoint #14. Satisfactory Communication Data Link (CDL) checks were accomplished between waypoints #13 and #14. Both LN211s were disabled before waypoint #14 due to excessive cross-track error and degraded navigation quality. ISS boot-up and control hand-off to the Mission Control Element (MCE) were accomplished prior to the turn start at waypoint #15. The air vehicle was climbing through FL410 as it entered the turn. During the turn (1010 local) the MCE Command and Control Officer (CCO) reported momentary 'FTS red' faults and Mission Control Center (MCC) observers noticed intermittent 'arm/terminate' indications. Approximately 45 seconds after the CCO call, the chase pilot called the air vehicle rolling inverted, concurrent with MCC indications the vehicle was responding to a vehicle terminate

c. Maintenance Procedures.

Not applicable.

d. Maintenance Personnel and Supervision:

Not applicable.

e. Fuel, Hydraulic and Oil Inspection Analysis.

Not applicable.

f. Unscheduled Maintenance.

UAV Global Hawk flight termination receivers #359 and #360 (421 megahertz) were removed on 27 March 1999, and flight termination receivers #0086 and #0087 (425 megahertz) were installed on 27-28 March 1999. Flight termination receivers #0086 and #0087 were certified for flight (Tab H-6).

6. AIRCRAFT AND AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Condition of Systems.

Indicative of FTS activation all the spoilers were deployed (Tab S-6), the main fuel shut-off valve was in the closed position (Tab S-8) and both inboard and outboard left aileron actuators were fractured (Tab S-10) while the right ones were left intact. Flight termination receiver #0086 was last certified on 17 Feb 1999 and met all certification requirements, next due date is 17 August 1999. Flight termination receiver #0087 was last certified on 17 Feb 1999 and met all certification requirements, next due date is 17 August 1999. Flight Termination receivers #0086 and #0087 were FTR Model Loral FTR-915A, and meet the Range Commanders Council, Flight Termination Systems Commonality Standard 319-92.

b. Testing.

Flight termination receivers #0086 and #0087 were removed from the UAV wreckage and taken to Vandenberg AFB, CA, RF Measurement Lab to be tested. Tested receivers met all certification requirements (Tab J-2 thru J-14) command. Neither the Launch Recovery Element (LRE), MCE nor Edwards AFB Range Safety had initiated such a command.

MCC real-time data and LRE/MCE all indicated the air vehicle was responding with the expected terminate sequence:

Engine shut-down
Spoilers Deployed
Flight controls commanded and held full right aileron

The vehicle as described by the chase and from the nose video, transitioned from the roll inverted into a right vertical roll. Initial turns were nose-low with fuel observed streaming from both outer wing panels. Midway during the decent the fuel streaming ceased. The air vehicle remained intact throughout the descent. Pitch attitude gradually decreased due to approximately 45 nose low at impact.

e. Impact.

The air vehicle impacted approximately 35 mi. NE of Edwards AFB, south of Searles Dry Lake, on the Naval Weapons Center 'Echo' Range at 1014 hrs. local. The wreckage was contained within an area approximately one wing span in diameter (Tab S-2) and there was no post-impact fire. Indicative of FTS activation all the spoilers were deployed (Tab S-6), the main fuel shut-off valve was in the closed position (Tab S-8) and both inboard and outboard left aileron actuators were fractured (Tab S-10) while the right ones were left intact.

f. Life Support Equipment, Egress and Survival.

Not applicable. Aircraft was unmanned.

g. Search and Rescue.

Not applicable. Aircraft was unmanned.

h. Recovery of Remains.

Not applicable. Aircraft was unmanned.

5. MAINTENANCE

a. Forms Documentation.

See Tab H-2.

b. Inspections.

See Tab H-3.

7. WEATHER

a. Forecast Weather.

See TAB K

b. Observed Weather.

See TAB K

c. Space Environment.

Not applicable.

d. Conclusions.

UAV global hawk was flown within operational weather limitations.

8. CREW QUALIFICATIONS

a. Mishap Pilot

Not applicable.

9. MEDICAL

a. Qualifications.

Not applicable.

b. Health.

Not applicable.

c. Pathology.

Not applicable.

d. Lifestyle.

Not applicable.

e. Crew Rest and Crew Duty Time.

Not applicable.

10. OPERATIONS AND SUPERVISION

a. Operations.

The UAV Global Hawk was on its ninth flight test misssion. The flight on 29 Mar 1999 was an add-on mission which was requested by Teledyne Ryan Aeronautical and scheduled on 26 March 1999.

b. Supervision.

See Misc. Tab CC-2 (Flight test summary mission PL-3, Flight 2-09, 29 March 1999).

11. HUMAN FACTORS ANALYSIS

There is no evidence that human factors contributed to this mishap.

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Primary Operations Directives and Publications.

AFI 33-118, Radio Frequency Spectrum Management (Tab BB-58)
AFM 33-120, Radio Frequency Spectrum Management (Tab BB-73)
Air Force Flight Test Center Instruction 11-15, Scheduling Procedures for Aircraft and Air/Ground Support (Tab BB-95)
Document 306-93, Flight Termination Receiver Catalog (Tab BB-5)
Global Hawk, AV 2 – 10PL, Green Flag Mission Plan (Tab BB-2)
IRIG Standard 313-94, Design, Performance and Test Standards for Flight Termination Receivers/Decoders (Tab BB-14)
Standard 319-92, Flight Termination Systems Commonality Standard (Tab BB-24)

b. Maintenance Directives and Publications.

Not applicable.

c. Known or Suspected Deviations from Directives or Publications.

Not applicable.

13. NEWS MEDIA INVOLVEMENT

Minimal information has been released to the public (Tab CC-4).

11 May 99

Stephen T. Virgilio, Colonel, USAF
President, Accident Investigation Board

RQ-4A Global Hawk Unmanned Aerial Vehicle Accident 29 March 1999

1. Under 10 U.S.C. 2254(d) any opinion of the accident investigators as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report may not be considered as evidence in any civil or criminal proceeding arising from an aircraft accident, nor may such information be considered an admission of liability of the United States or by any person referred to in those conclusions or statements.

2. OPINION SUMMARY:

The Global Hawk UAV #2 was on its ninth flight and at approximately 41,150 feet when it received a flight termination command (V-1.18) 29 March 1999. The UAV integrated mission management computer then properly accomplished terminate flight configuration – engine shutdown, zeroing and erasing of classified data, flight control actuators to perform a flat spin or spiral maneuver until ground impact of the UAV. At approximately 10,000 feet the range safety officer sent a flight terminate command (V-1.55), to the UAV because it violated flight safety rules (N-4, V-7.1). The terminate command was received by the UAV integrated mission management computer, and the UAV continued to stay in the flight termination configuration through ground impact.

The flight termination command is sent to the UAV on a unsecured UHF signal (BB-16, 25, 33, 41, 43), and the UAV UHF flight termination receivers are at a predetermined frequency prior to flight (BB-40). The UAV flight termination receivers for this flight were set for 425 megahertz. Both receivers were removed from the UAV wreckage and tested for proper operation (V-7.2), both passed certification tests (J-2 thru J-14). The flight termination system of the UAV was tested prior to flight and passed all ground checks (V-7.1).

All agencies with flight termination system transmitters in the Edwards test range complex were queried, none were transmitting at the time of the UAV flight (CC-6, 7). However, the Nellis test and training range, northeast of the Edwards test range, was transmitting at the time of the UAV flight (CC-5, CC-8 thru CC-13). The Nellis test range was conducting planned tests of its transmitter at the UAV flight termination frequency of 425 megahertz in preparation of the Global Hawk UAV participating in a Green Flag exercise scheduled for 1 April 1999 (BB-2 thru BB-4, CC-5). The UAV was to be flown from the Edwards test range to the Nellis test range and back into Edwards. Positive control of the UAV flight termination system is required on each range during flight (V-7.1, BB-25, 29).

The Edwards test range complex is under the frequency control and coordination of the Western Area Frequency Coordinator, Pt Mugu, CA (BB-90), the Nellis test range complex is under the frequency control and coordination of the DoD Area Frequency Coordinator, 99 Communication Squadron/SCXF, Nellis AFB, NV (BB-90). Each test range is under different DoD Area

Frequency Coordinators area of responsibility and is not required to coordinate any frequency or flight management between regions during daily operations.

In my opinion, it is likely that the testing of the Nellis Test Range transmitter at the time of the UAV flight and at the UAV's flight termination receivers' exact frequency caused the UAV to accept a flight termination command and execute the flight termination sequence. The testing /calculations made of the signal strength from the Nellis transmitter and the capability of the UAV receivers to accept the signal were verified. The UAV program did not use a "high alphabet" or "encrypted" flight termination UHF signal for activation of the UAV flight termination system. It must be noted that as we fly UAV's at higher altitudes there is a greater potential for UHF "overlap" between test range complexes, since UHF is line of sight, i.e. hundreds to thousands of miles. At present, coordination and deconfliction of frequencies is only required within a DoD Area Frequency Coordinator's area of responsibility (BB-75). The Edwards and Nellis ranges are in different training range areas, thus have different DoD area frequency coordinators and different areas of responsibility. Therefore, each range could legitimately fly test aircraft utilizing the same flight termination frequency and a termination signal sent by either range could terminate both aircraft.

3. CONTRIBUTING FACTORS:

- The UAV mission for 29 March 1999 was a short notice (less than 24-hours/1 workday) add-on mission.

- Teledyne Ryan Aeronautical did not follow established notification procedures for the add-on mission.

- Teledyne Ryan Aeronautical failed to identify to AFFTC schedulers a planned change of flight termination receivers from 421megahertz to 425megahertz.

- A new mission profile was not accomplished for the 29 March 1999 UAV mission, instead Teledyne Ryan Aeronautical directed the same mission profile as the 26 March 1999 mission.

- The mission profile used for 29 March 1999 UAV flight did not have the correct flight termination receiver frequency identified.

- Edwards range mission control center was not aware of the correct UAV flight termination receiver frequency for the 29 March 1999 UAV flight, until approximately 2 hours before launch.

- The frequency area coordinator for the Edwards test range was not notified of the change to the UAV flight termination frequency for 29 March 1999 UAV flight.

- The frequency area coordinator for the Edwards test range did not coordinate with the Nellis test range frequency area coordinator to deconflict the flight termination receiver frequency used on the 29 March 1999 UAV flight.

- AFM 33-120, Radio Frequency Spectrum Management, does not make it mandatory for frequency coordination between the area frequency coordinators on nearby test ranges before start of actual operations within their areas of responsibility.

- The flight termination system receivers received the flight termination command on an unsecured UHF signal.

- The flight termination system was incapable of distinguishing between the authorized signals from the Edwards transmitter and unauthorized signals from the Nellis transmitter.

11 May 99

Stephen T. Virgilio, Colonel, USAF
President, Accident Investigation Board

Index of Tabs

Tab A: AF Form 711, USAF Mishap Report

Tab B: Preliminary Message Report

Tab C: AF Form 711B, Aircraft Flight Mishap Report

TAB D: AF Form 711C, Aircraft Maintenance and Materiel Report

Tab E: Blank

Tab F: Blank

TAB G: Flight and Personnel Records

This Tab Not Used

TAB H: AFTO Form 781 Series

TAB I: Product Quality Deficiency Reports

TAB J: Technical and Engineering Evaluations of Materiel

TAB K: DD Form 175 or Authorized Substitute Flight Plan Forms

TAB L: DD Form 365-4, Form F - Weight and Balance Clearance

TAB M: Certificate of Damage

TAB N: Transcript of Recorded Communications

TAB O: Additional Substantiating Data

This Tab Not Included

TAB P: Statement of Damage to Private Property

This Tab Not Used

TAB Q: Orders Appointing SIB Members

TAB R: Diagrams

TAB S: Photographs

Tab T: Individual Flight Records and Orders (Not Included in Tab G)

This Tab Not Used

Tab U: Aircraft Maintenance Records (Not Included in Tabs H or O)

Tab V: Witness Testimony and Statements

Tab W: Weather Observations

See Tab K-5

Tab X: Statements of Injury

This Tab Not Used

Tab Y: Documents Appointing the AIB Members

Tab Z: Photographs (Not Included in Tab S)

This Tab Not Used

Tab AA: Flight Documents

This Tab Not Used

Tab BB: Government Documents and Regulations

Tab CC: Miscellaneous

AF FORM 711
USAF FLIGHT MISHAP REPORT

Tab A

TAB A

INDEX

USAF MISHAP REPORT

(Fill in all spaces applicable. If additional space is needed, use additional sheet(s).)

1.DATE OF OCCURANCE *(Day, Month and Year)*	2.VEHICLES(S) OR MATERIEL INVOLVED *(Model designation and serial no. if applicable*	3. FOR GROUND ACCIDENTS ONLY *(Base Code and Report Serial No.)*
29 Mar 99	**RQ-4A (Global Hawk), 95-2002**	

4.PLACE OF OCCURANCE	5. HOUR AND TIME ZONE (LOCAL)	6.
Restricted Area R2524, China Lake NAS, N35'28.7 W117'19.5	**1014 PST**	☒DAY ☐NIGHT ☐DAWN ☐DUSK

7. ORGANIZATION POSSESSING OR OWNING VEHICLE OR MATERIEL AT TIME OF MISHAP

MAJOR COMMAND	SUBCOMMAND OR AF	AIR DIVISION	WING	GROUP	SQUADRON OR UNIT	NAME AND BASE CODE
AFMC	ASC	RA	N/A	N/A	N/A	**Edwards AFB, CA FSPM**

8. *(List of organizations of second vehicle, if they differ from item 7 above)*

9. ORGANIZATION AND BASE SUBMITTING REPORT *(Do not abbreviate)*

Safety Investigation Board, Edwards Air Force Base, California

10. LIST OF PERSONNEL DIRECTLY INVOLVED
(See AFI 91-204 for specific instructions)

LAST NAME, FIRST NAME, MIDDLE INITIAL	GRADE	SSAN	ASSIGNED DUTY	AERO RATING	DEGREE INJURY*	DAYS LOST ON TT ONLY
Jella, Christopher B.	**Maj**		**MCE Control**	**N/A**	**N**	**N/A**
Greenway, Vance E.	**Civ**		**Contractor**	**N/A**	**N**	**N/A**
Munski, Michael S.	**Civ**		**Contractor**	**N/A**	**N**	**N/A**
Norman, Bradley T.	**Civ**		**Contractor**	**N/A**	**N**	**N/A**

**(Enter applicable letter(s) in DEGREE INJURY column. None-N; Temporary Total-TT; Permanent Partial-PP; Permanent Total-PT; Fatal-F; Missing-M)*

11. FACTUAL SUMMARY OF CIRCUMSTANCES. GIVE A DETAILED HISTORY OF FLIGHT OR CHRONOLOGICAL ORDER OF FACTS AND CIRCUMSTANCES LEADING TO THE MISHAP. THE RESULTS OF INVESTIGATION WILL BE CONTAINED IN THE "ANALYSIS PART" OF THE REPORT. ANALYSIS OF AND CONCLUSION DRAWN FROM ORAL OR WRITTEN STATEMENTS OBTAINED ONLY IN THE INTEREST OF MISHAP PREVENTION WILL NOT BE INCLUDED IN THIS SUMMARY.

The mishap aircraft (MA) was scheduled for its ninth flight test mission. MA was Unmanned Aerospace Vehicle (UAV). Engine start, taxi, lineup, and takeoff were uneventful. MA's climb profile to 41,000 feet was normal. MA's flight progress was monitored by an F-16 chase ship. Approximately 17 minutes into the test mission, the MA's flight termination receiver (FTR) #1 received a flight terminate command signal. The MA's flight computer processed this flight terminate signal and commanded the MA to perform the flight termination maneuver- engine shutoff, left and right flight spoilers full up, and ailerons locked in the right turn position. The MA entered a series of right aileron rolls followed by a sustained oscillating right flat spin. The MA impacted the ground in the flight termination maneuver configuration and was destroyed. There was no post-crash fire.

12. AUTHENTICATION

CERTIFICATION BY *(Title)*	TYPED NAME AND GRADE	SIGNATURE	DATE
Board President	**Reed L. Roberts, Col, USAF**	Reed L. Roberts	19 April 99

AF FORM 711 FOR OFFICIAL USE ONLY *(When filled in)*

B

TAB B

INDEX

SUBJECT: GLOBAL HAWK UAV, CLASS A, FLIGHT, 8 HOUR PRELIMINARY REPORT, 19990329FSPM030A

1. DATE AND TIME OF MISHAP: 1999/03/29, 1330 LOCAL, DAY
2. BASE: FSPM/OFF BASE
3. DUTY STATUS: ON DUTY
4. NEAREST BASE TO MISHAP: CHINA LAKE NAS, CA
5. LOCATION OF MISHAP: R-2524
6. LAT/LONG: 35-28.7N, 117-19.5W
7. OBJECT INFORMATION:

7.1 NOMENCLATURE: GLOBAL HAWK UAV, ALLISON AE3007H TURBOFAN

7.2 ACCOUNTABILITY: AF

7.3 WITHIN 10 MILES: NO

7.4 OBJECT DESTROYED: YES

8. PERSONNEL INFORMATION: N/A
9. NARRATIVE: THE GLOBAL HAWK UAV WAS FLYING AT APPROXIMATELY 41,000FT MSL ON A SCHEDULED TEST FLIGHT WITH AN F-16 CHASE. THE UAV ROLLED RIGHT, ENTERED A SPIN AND IMPACTED THE GROUND, DESTROYING THE VEHICLE.
10. COST ESTIMATE: TBD
11. INTERIM SAFETY INVESTIGATION BOARD PRESIDENT: JOHN L. BUSH, COL, USAF, DSN:527-3316, COMM 661-277-3316; COGNIZANT OFFICIAL: BILL KOUKOURIKOS, MAJ, USAF, DSN: 527-2623, COMM: 661-277-2623

AF FORM 711b

AIRCRAFT FLIGHT MISHAP REPORT

tab C

TAB C

INDEX

AIRCRAFT FLIGHT MISHAP REPORT

(To be filled out for principal aircraft involved. Appropriate items should be filled out on secondary aircraft)

1. MISHAP CLASS	2. ACFT MDS AND SERIAL NUMBER	3. DATE	4. UNIT CONTROL NUMBER	5. ACFT ASSIGNMENT/STATUS CODE
A DEST.	RQ-4A, 95-2002	99-03-29	19990329FSPM030A	AFMC ASC/RA

PILOT(S) INVOLVED (FLIGHT CREW)[1]

6. OPERATOR AT CONTROLS

A. LAST NAME, INITIALS	B. COMPONENT
Norman, B. T.	**CIV**

POSITION IN AIRCRAFT AT TIME OF MISHAP: ☐ FRONT SEAT ☒ LEFT SEAT ☐ REAR SEAT ☐ RIGHT SEAT ☐ JUMP SEAT

D. NATIONALITY

E. AGE

F. MAJCOM, NAF, DIV, WG, SQ ASSIGNED	G. MAJCOM, NAF, DIV, WG, SQ ATTACHED FOR FLYING
Contractor Operator	

7. OTHER PILOT

A. LAST NAME, INITIALS	B. COMPONENT
Jella, C. B.	**REGAF**

POSITION IN AIRCRAFT AT TIME OF MISHAP: ☐ FRONT SEAT ☐ LEFT SEAT ☐ REAR SEAT ☒ RIGHT SEAT ☐ JUMP SEAT

D. NATIONALITY USA

E. AGE **34**

F. MAJCOM, NAF, DIV, WG, SQ ASSIGNED	G. MAJCOM, NAF, DIV, WG, SQ ATTACHED FOR FLYING
Air Combat Command, 53 WG, 31 Test and Evaluation Squadron	

8. OTHER PILOT

A. LAST NAME, INITIALS	B. COMPONENT
Greenway, V. E.	**CIV**

POSITION IN AIRCRAFT AT TIME OF MISHAP: ☐ FRONT SEAT ☒ LEFT SEAT ☐ REAR SEAT ☐ RIGHT SEAT ☐ JUMP SEAT

D. NATIONALITY

E. AGE

F. MAJCOM, NAF, DIV, WG, SQ ASSIGNED	G. MAJCOM, NAF, DIV, WG, SQ ATTACHED FOR FLYING
Contractor Operator	

9. OTHER PILOT

A. LAST NAME, INITIALS	B. COMPONENT
dunski, M. S.	**CIV**

POSITION IN AIRCRAFT AT TIME OF MISHAP: ☐ FRONT SEAT ☐ LEFT SEAT ☐ REAR SEAT ☒ RIGHT SEAT ☐ JUMP SEAT

D. NATIONALITY

E. AGE

F. MAJCOM, NAF, DIV, WG, SQ ASSIGNED	G. MAJCOM, NAF, DIV, WG, SQ ATTACHED FOR FLYING
Contractor Operator	

10. CLEARANCE

FROM: ☒ VFR ☐ IFR ☒ LOCAL ☐ PT TO PT

TO: ☐ DIRECT ☐ AIRWAYS ☐ NO CLEARANCE ☐ NA

11. DURATION OF FLIGHT	12. TYPE OF MISSION	13. ALTITUDE/ELEVATION
HOURS TENTHS 4	**Flight Test**	**41,000 MSL**

14. PHASE OF OPERATION	15. TYPE OF MISHAP
Climb to Cruise Altitude	**Uncommanded Flight Termination**

16. METEOROLOGICAL CONDITIONS

17. AIRFIELD DATA APPLICABLE TO TAKEOFF AND LANDING MISHAPS OCCURING WITHIN 2 MILES OF AIRFIELD

A. FIELD ELEVATION *(Feet)*	B. COMPOSITION OF RUNWAY

C. LENGTH OF RUNWAY *(Feet)*	D. RUNWAY HEADING	E. DISTANCE OF TOUCHDOWN FROM RUNWAY *(Feet)*	F. SURFACE CONDITION

G. LENGTH OF OVERRUN	H. COMPOSITION OF OVERRUN *(Specify)*	I. BARRIER TYPE	USED	LOCATION
			☐ YES ☐ NO	

J. CONDITIONS AFFECTING OCCURANCE *(For example, type of instrument or lighting approach used, obstructions, barrier, airspeed, gross weight, forced landing)*

[1] If more than four pilots are involved (Flight Crew) report same information required on additional sheet for each

AF Form 711B OFFICIAL USE ONLY *(When Filled in)*

AF FORM 711c

AIRCRAFT MAINTENANCE AND MATERIAL REPORT

Tab D

TAB D

INDEX

AIRCRAFT MAINTENANCE AND MATERIEL REPORT

1. AIRCRAFT SERIAL NUMBER	2. MISSION DESIGN AND SERIES(MDS)
95-2002	RQ-4A

3. HISTORICAL DATA

AIRCRAFT		DEFICIENT PART COMPONENT OR ACCESSORY				
AIR FORCE ACCEPTANCE DATE	N/A	NOUN				
TOTAL FLIGHT HOURS	54.4	PART NUMBER				
LAST OVERHAUL DATE	N/A	T.O. REFERENCE				
OVERHAULING ACTIVITY *(Name and Loc.)*	N/A	FIGURE				
HOURS SINCE OVERHAUL	N/A	INDEX				
HOURS SINCE LAST SCHEDULED INSP.	54.4	WORK UNIT CODE				
DATE OF LAST SCHEDULED INSPECTION	10 Nov 98	TDR REQUESTED	☐ Yes	☐ No	☐ Yes	☐ No
TYPE OF LAST SCHEDULED INSPECTION	Transfer Inspection	MDR SUBMITTED	☐ Yes	☐ No	☐ Yes	☐ No
DATE ASSIGNED PRESENT ORG.	1 Jun 98	MDR NUMBER				
ORGANIZATION TRANSFERRED FROM	Manuf	MIP NUMBER				

ENGINE

(Complete a column for each engine)

INSTALLED POSITION	1			
ENGINE MODEL AND SERIES	AE3007H			
ENGINE SERIAL NUMBER	XCAE330037			
TOTAL ENGINE HOURS	158.6			
NUMBER OF MAJOR OVERHAULS	0			
HOURS SINCE LAST MAJOR OVERHAUL	N/A			
DATE OF LAST OVERHAUL	N/A			
OVERHAUL ACTIVITY	N/A			
DATE LAST INSTALLED	12 Oct 98			
HOURS SINCE LAST INSTALLED	125.1			
DATE OF LAST SCHEDULED INSPECTION	22 Jan 99			
TYPE OF LAST SCHEDULED INSPECTION	Mag Plug Insp			
FUEL *(Type and Octane Rating)*	JP-8			
TDR REQUESTED	No			

4. SOAP SAMPLES

(Engine, CSD, Gearbox or EPU failure of which occurred or was suspected)

ITEM AND SERIAL NUMBER

Engine has 3 Micron filter. JOAP records not maintained.

OVERHAUL	OIL CHANGE	Fe	Cr	Ag	Al	Cu	Sn	Mg	Ti	Si	Pb
N/A	9 Feb 99	1	0	0	0	0	3	0	0	5	0

5. DAMAGED AIRCRAFT

(Furnish complete damage information under Tab "L". See AF Form 711h.

DAMAGE TO AIRCRAFT	MANHOURS TO REPAIR	COST (ESTIMATE)
☒ DESTROYED OR DAMAGED BEYOND ECONOMICAL REPAIR ☐ SUBSTANTIAL ☐ MINOR ☐ LESS THAN MINOR OR NONE		$

AF Form 711C OFFICIAL USE ONLY *(When filled in)*

FLIGHT AND PERSONNEL RECORDS

Tab G

TAB G

INDEX

THIS TAB NOT USED

AFTO FORM 781 SERIES

Tab H

TAB H

INDEX

H. AFTO FORM 781 SERIES

RQ-4A 95-2002

1) Review of the current AFTO 781 series records revealed eleven open discrepancies and one informational note:

   a. (Red Diagonal) Removed TDS bumper mounts. Sent to San Diego to be machined per DVA 145885. Ref: Drawing 3671224F122. QAR 2481.
   b. (Red Diagonal) Disconnected UHF SATCOM antenna switch electrical connector to prevent switching in flight until software mod to fix.
   c. (Red Diagonal) AC Generator output has frequency oscillations. QAR 1910.
   d. (Red Diagonal) ERU is extremely difficult to remove from A/C. QAR 2669.
   e. (Red Diagonal) Brake control unit has deceleration spike during braking. QAR 2758.
   f. (Red Diagonal) TSPI Nav Data was erratic during Flt 02-04. QAR 2709.
   g. (Red Diagonal) ERU did not stow during Flt 02-04. QAR 2781.
   h. (Red Diagonal) During pre-launch checks, the MLG inner door actuators were seeping hydraulic fluid – both. QAR 2943.
   i. (Red Diagonal) SV-7 solenoid valve P/N 56830-6 on Ku wave guide pressurization system leaks. QAR 2374.
   j. (Red Diagonal) Added plastic baggie to blow-down vent hose and hydraulic drain in left hand hell hole to catch hydraulic fluid during flight.
   k. (Red Diagonal) Install new ID plates on FADECs for software change (Data plates with engine log book).
   l. (Note) Installed new FTRs, Freq 421, 'A' serial # 0359, 'B' serial # 0360, part number: LCP11004850-37, VSB Hrs: 0098.

2) The contractor does not use the 781s to document flight discrepancies. The following are the flight discrepancies for the last month as reported in the "Quick Look" reports generated after each flight:

   a. Flight 02-06, 11 Mar 99:
      (i) Left hand main landing gear did not lock up after take-off.
      (ii) UHF LOS intermittent during start and taxi.
      (iii) LN100 would not pass C-BIT.
      (iv) Bleed valve would not close on engine start.

   b. Flight 02-07, 13 Mar 99:
      (i) LN211s did not navigate properly and had to be disabled prior to landing.
      (ii) IFF BIT failure on start—OK on recycle.
      (iii) IMMC 'A' appeared to fail after engine shutdown.
      (iv) IMC calibrations continue to cause ISS shutdown.
      (v) LCP2 failed in flight.
      (vi) Ku link exhibited C2 dropouts (no status).

(vii) Inter-stage bleed valve did not close during engine start.
(viii) Need intercom between MCC and MCE.

c. Flight 02-08, 26 Mar 99:
(i) LN211B was intermittent throughout the flight.
(ii) UHF LOS link was marginal throughout the flight.
(iii) SAR REC is bad.
(iv) Left-hand inboard ruddervator actuator stuck hard over during landing rollout.

3) All other scheduled inspection requirements and maintenance actions reviewed are current. Aircraft and engine time changes are also found to be current.

4) TRA's Quality Assurance Database is used to record air vehicle anomalies which may require corrective action. It is analogous to the record of Deficiency Reports and Time Compliance Technical Orders which are used on fielded aircraft. The following table is a summary of the relevant QAR entries which reference the FTS system.

Relevant Entries from TRA's Quality Assurance Report Database

QAR #/ Date/Status	Issue	Disposition
1159/9-10-97/ Closed	Create a VTC Script to simulate flight mode. This script will support the Flight Terminate System demonstration to the EAFB Range Safety Office.	Has been demonstrated on the hot bench and on the CLS. Results satisfactory. VTC script installed on the VTC's at EAFB. This QAR is now closed.
1195/9-26-97/ Closed	SV3, Engine fuel shut-off, was closed without VTC or TIER II+ operator command. Suspect unauthorized receipt of flight terminate command.	Added IMMC fault log recording of FTS Arm and Terminate commands received from FTS receiver, for maintenance analysis of occurrences when UAV is on the ground.
1736/3-13-98/ Closed	As a result of the mis-wiring in QAR 1732, the Flight Termination Receivers were damaged and need to be returned to supplier for Failure Investigation.	The Flight Termination Receivers were returned to the supplier for Failure Investigation. The hybrid circuit card was found to be damaged and was repaired by the supplier. The receivers were returned to Edwards AFB and were recertified by China Lake.
1817/4-15-98/ Open	Currently IMMC S/W terminates aircraft during Hangar Test Mode (Flight	

	termination initiation should have no effect in Hangar Test Mode).	
1818/4-15-98/ Defer	Currently there is no way to verify that secure erase procedures have occurred (3.1.1.10.2 Sentence 2), Part 2) S-2) If Weight is OFF Wheels, the command terminate software shall perform the following actions: P-2) Perform secure erase procedures).	
2138/7-9-98/ Open	During Hangar Test, the Flight Terminate command was accepted and executed.	
2686/12-4-98/ Open	During the CCO-initiated ground test of the FTS, the GID mode as indicated in the LRE CCO HCI, displayed PRELAUNCH mode. After PRELAUNCH was displayed, the mode recycled back to READY mode as the FTS performed the automatic disarm. All other indications (FTS flashing Red, Spoiler Activity, and Blue illuminated Terminate Button on FTS HCI) were normal. Indications in the Birk MCC and Ridley RSO were normal.	The problem here is, I believe, the result of latency in the downlink data. In particular, the data that were correct (Flashing Red, etc.) downlinked to the LRE in the 1 Hz data, but the "mode" is downlinked in the 1/5 Hz data. The duration of the termination test is only a few seconds to begin with, so the mode change report was simply missed by the 1/5 Hz data. RSO and MCC both received correct terminate behavior reports. There are a couple of options: 1) do nothing because there is no bug – just a communications artifact, or 2) increase the time that the terminate posture is held to 10 or more seconds so the TERMINATE mode appears in the LRE downlink more reliably. I recommend option 1) i.e. cancellation, but 2) is trivial to implement if that is desired.
2858/2-6-99/Open	During Flight 02_03, the LRE thought that it got an extraneous terminate on the ground.	The situation occurred during the terminate checks that are done at Ready for Taxi. The termination sequence from the RSO completed cleanly and was observed to be correct in the MCC and at the UAV. The LRE was left with

		a flashing red FTS indication from one IMMC. When the disarm command was requested and sent the flashing red indication went away. This behavior is believed to be the result of the machine gun protocol used on the terminate command. The terminate command is initiated, executes, and there are still terminate commands in the comm links which results in a flashing red FTS indication (due to a terminate being received with no corresponding arm). The disarm clears the indication as expected. Recommend CCO procedures be updated to reflect that the potential for this indication exists and that a disarm is needed to clear it.
2887/2-11-99/ Closed	During removal of the CDL mounting tray for modification, the connector on the Ring coupler end of cable 367 1220E416-3 was pulled off. The opposite end of this cable connects to the FTS receiver.	Rework, test and reinstall cable in UAV-2. Visually inspect the other cable for proper assembly of the RF connectors too. The TNC connector was good. The cable had pulled out of the connector. Both cables and TNC connectors were reassembled and retested with acceptable results. (367 1200E416-3 VSWR=1.302:1 & insertion loss =0.21db. 367 1200E415-3 VSWR=1.256:1 & Insertion loss =0.27db.
2955/2-24-99/Cnx	Investigate the cause of the possible error of the FTS that occurred during the flight. A RED FTS was reported during Climb Out.	This was a one-time occurrence and has not been repeated. No further action required.
3048/3-16-99/ Open	During testing of the "Test Terminate" the mode did not return to "AVM\GNC=READY FOR TAXI". Instead, it transitioned to shutdown and logged a FLASHING RED engine fault during engine shutdown. On retest, it performed nominally.	Looking at the fault logs it looks like the IMMC decided that this was a real terminate instead of a test terminate. This could have happened if the IMMC thought that it lost communications during the test terminate.

5) The table below is an SIB created log of the Flight Termination Receivers (FTRs) installed in the mishap air vehicle. Removals were generated by FTR failure, 50 hour inspection interval and shared use with another program.

Flight Termination Receiver Log

Date	A/V 2 Installations/Removals	Resulting Freq	Monitor Tone
10-9-98	Installed 0084 & 0085 from A/V 1	425 MHz	7
11-3-98	Removed 0084 & 0085. Installed 0086 & 0087 from A/V 1	425 MHz	5
11-19-98	Removed 0086 & 0087. Installed 0084 & 0085 from A/V I	425 MHz	7
1-6-99	Removed 0084 & 0085. Installed 0086 & 0087 from spares	425 MHz	5
2-12-99	Removed 0086 & 0087. Installed 0084 & 0085 from A/V 1	425 MHz	7
2-15-99	Removed, Inspected & Reinstalled 0084 & 0085	425 MHz	7
3-17-99	Removed 0084 & 0085. Installed 0270 & 0404 from spares	425 MHz	7
3-23-99	FTR 0404 bad. Removed 0270 & 0404. Installed 0181 & 0239	421 MHz	5
3-23-99	FTR 0239 bad. Removed 0181 & 0239. Installed 0086 & 0087 from A/V 1	425 MHz	5
3-25-99	Removed 0086 & 0087. Installed 0359 & 0360	421 MHz	?
3-27-99	Removed 0359 & 0360 for return to MALD. Installed 0086 & 0087 from A/V 1	425 MHz	5

6) Maintenance actions accomplished post mishap

a. The following classified equipment was secured from the wreckage by TRA under supervision of the interim safety board, and are in secure storage by TRA at Edwards AFB:

(i) IFF Transponder S/N B1002
(ii) Telemetry Support Package (Sp3068-001) S/N D2105, containing KIK-68 S/N D0416 & KGV-68 S/N 12639
(iii) LN-100 S/N 0002
(iv) LN-100 S/N 1010
(v) GPS Receiver

b. The following items were removed from the wreckage pursuant to investigation of the mishap. Items removed by TRA under supervision of the safety review board and are secured by the safety board at Edwards:

(i) Flight Termination System (FTS) Antennas (2 ea)
(ii) RF Coupler for the FTS System
(iii) Aileron Actuators (4 ea)
(iv) Radar Altimeter
(v) FTS Control Boxes (2 ea)
(vi) UHF Antenna
(vii) Fuel Shutoff Valve

c. The wreckage was removed from the crash site and secured in bay 3 in Bldg 151.

d. In addition, samples were taken of the fuel (JP-8), hydraulic fluid (5606) and engine oil (5808) and sent to the proper labs for analysis. No anomalies bearing on the investigation were discovered.

I

Tab I

TAB I

INDEX

Teledyne Ryan Aeronautical Project:367- Global Hawk

Quality Assurance Report

367- Global Hawk Project:

Official QAR Status: OPEN

QAR Number: 2686

Title: Inappropriate Mode Indication During FTS Ground Check

CA Status: 1-Cause Under Investigation

QAR Type:	Priority:	Cost Impact:	Safety Impact:	Cat:	Freq:	Reporting Activity:	Activity Location:	Ref Initiating QAR or Document:
D	4		No	IV	C	Flight Test	Edwards AFB, CA	

Initiation Date: 12/14/98
Initiator: NORMAN, B.T. (BRAD)
Initiator Dept:
Initiator Phone:
Milestone Need:
Ref Spinoff QAR or Document:

Responsible IPT: 11000
Responsible Engineer: RILEY, T.V. (TOM)
Resp Dept:
Responsible Eng Phone:
99-NONE
Old QAR Number:

Subsystem: SYSTEM
End Item: 367A000
Article No: AV-002
Flight No: Flight
Hardware Type:
Operation/Procedure No: Paragraph 5.0 of Flight 2-2 Test Card
Part/CSCI Number:
Part/ CSCI Name:
Serial / Version Number:
Operation/Procedure Name or Description: Preflight CCO Ground Check of FTS
Supplier Part Number:
Supplier:
Total Hours On Item:

ISSUE Details:

During the CCO-initiated ground test of the FTS, the GID mode as indicated in the LRE CCO HCI, displayed PRELAUNCH mode. TERMINATE was never indicated as the vehicle GID mode. After PRELAUNCH was displayed, the mode recycled back to READY mode as the FTS performed the automatic disarm. All other indications (FTS Flashing Red, Spoiler Activity and Blue illuminated Terminate Button on FTS HCI) were normal. Indications in the Birk MCC and at Ridley RSO were normal.

Current Applicable Rqmt:

Both RSO-initiated and CCO-initiated FTS checks should cause the GID mode at the CCO station to display TERMINATE during the check. When the check is concluded, either autonomously or by RSO disarm, the GID mode should return directly to READY. PRELAUNCH should not be displayed, as the Ground Safety Pin is always removed for this test. When the pin is removed, PRELAUNCH is an invalid mode.

How Detected:
Conditions:
Problem Duplicated: No
FS:
WL:
BL:

INVESTIGATIVE ACTIVITY:

The problem reported here is, I believe, the result of latency in the downlink data. In particular, the data that were correct (Flashing Red, etc) are downlinked to the LRE in the 1 Hz data, but the "mode" is downlinked in the 1/5 Hz data. The duration of the termination test is only a few seconds to begin with, so the mode change report was simply missed by the 1/5 Hz data. RSO and MCC both received correct terminate behavior reports.

There are a couple of options: 1) do nothing because there is no bug - just a communications artifact, or 2) increase the time that the terminate posture is held to 10 or more seconds so the TERMINATE mode appears in the LRE downlink more reliably. I recommend option 1), i.e. cancellation, but 2) is trivial to implement if that is desired.

- Rsumner 2/12/99

Work Order Number: Work Order Approval: Shop Approval: No Inspect: No Reject: Insp Stamp:

DISPOSITION # Accepted: # UseAsIs: # Rework: # Repair: # RtnToSup # Scrap:

Disposition:
Retest Requirements:
Corrective Action Review Required?: No

Disp. Approval Date: Shop/Test Approval: Quality Approval: Principal Engineer Approval: MRB/SRB Approval: Customer Approval:

Record of All Disposition Action Completion:
Est Hrs Req For Maint: Part Number Removed: Serial Number Removed: Part Number Installed: Serial Number Installed:

Disp. Completed Date: Shop/Test: Quality: Government:

Teledyne Ryan Aeronautical
367- Global Hawk

Quality Assurance Report

Official QAR Status: CANCELLED
QAR Number: 2955

Title: FTS Anomaly During Flight 2_5
CA Status: 5C-Cancelled Action

QAR Type: P | Priority: 3 | Cost Impact: | Safety Impact: Yes | Cat: NA | Freq: NA | Reporting Activity: Flight Test | Activity Location: Edwards AFB, CA | Ref Initiating QAR or Document:

Initiation Date: 2/24/99 | Initiator: MUNSKI, M.S. (MICHAEL) | Initiator Dept: | Initiator Phone: | Milestone Need: 09E_AV2_FLB_PLT4 | Ref Spinoff QAR or Document:

Responsible IPT: 15000 | Responsible Engineer: WAYNE, T (DUKE) | Resp Dept: | Responsible Eng Phone: | Old QAR Number:

Subsystem: AV_FTS | End Item: 367A100 | Article No: AV-002 | Flight No: | Hardware Type: | Operation/Procedure No:

Part/CSCI Number: | Part/CSCIName: | Serial / Version Number: | Operation/Procedure Name or Description:

Supplier Part Number: | Supplier: | Total Hours On Item:

ISSUE Details:
Current Applicable Rqmt:

Investigate the cause of the possible error of the FTS that occurred during the flight. A RED FTS was reported during Climb Out.

How Detected: | Conditions: Flight Ambient | Problem Duplicated: No | FS: | WL: | BL:

INVESTIGATIVE ACTIVITY:

Work Order Number: | Work Order Approval: | Shop Approval: | No Inspect: | No Reject: | Insp Stamp:

DISPOSITION # Accepted: | # UseAsIs: | # Rework: | # Repair | # RtnToSup | # Scrap:

Disposition:
Retest Requirements:
Corrective Action Review Required?: No

This was a one time occurance and has not repeated. No futher action required

Disp. Approval Date: | Shop/Test Approval: ☐ | Quality Approval: ☐ | Principal Engineer Approval: ☐ | MRB/SRB Approval: ☐ | Customer Approval: ☐

Record of All Disposition Action Completion:

Est Hrs Req For Maint: | Part Number Removed: | Serial Number Removed: | Part Number Installed: | Serial Number Installed:

Disp. Completed Date: | Shop/Test: | Quality: | Government:

CORRECTIVE ACTION Assignee: | Assignee Phone: | Defect Code: TBD | Cause Code: TBD | Escape:

Defect Description: To Be Determined
Root Cause Description: To be determined

Corrective Action Description / Plans:

Impact Check List:
- ○ Hardware
- ○ Software
- ○ Tooling
- ○ Support Equipt
- ○ SIL Equipt
- ○ Engineering
- ○ Manufacturing Planning
- ○ Test/Support Procedures
- ○ Requirement Docs
- ○ Contract Docs
- ○ Analysis / Reports

CA Approval Date: | Approval to Implement Corrective Action: | Change Class: | Effectivity: | SW Version To Incl Change: | Mfg Date CA Required:

QAR CLOSURE DB Sig | Signatures

Closure Date: 3/24/99

☑ Library Copy

DB Sig	Role	Signature	Statement
☐	CA Assignee:		Assured All Corrective Action Complete and Documentation Released
☑	Responsible Engr:	WAYNE, T (DUKE)	Assured Database Entries Complete and All Supporting Data Provided
☑	QAR Initiator:	MUNSKI, M.S. (MICHAEL)	Tested /Verified Changes to Assure the Issue is Completely Resolved
☑	Closure Approval:	Owen, Gerry	Check that all System and Programatic Impacts were Identified and addressed

Teledyne Ryan Aeronautical Project:367- Global Hawk **Quality Assurance Report**

367- Global Hawk Project

Official QAR Status: **CLOSED** QAR Number: **1195**

Title: SV3, Engine fuel shut-off (FTS Arm and Terminate Fault Logging)

CA status: **5A-All Action Complete**

QAR Type:	Priority:	Cost Impact:	Safety Impact:	Cat:	Freq.	Reporting Activity:	Activity Location:	Ref Initiating QAR or Document:
6	1		No	I	C	Engineering Design	San Diego, CA	

Initiation Date: 9/26/97 Initiator: LOFSHULT, R.M. (ROLLY) Initiator Dept: Initiator Phone: Ref Spinoff QAR or Document:

Milestone Need: 2b-UAV1_TAXI_M

Responsible IPT: 15600 Responsible Engineer: SUMNER, R. (ROGER) Resp Dept: Responsible Eng Phone: Old QAR Number:

Subsystem: AV_FTS End Item: 367A000 Article No. A1-001 Flight No: Hardware Type: Operation/Procedure No:

Part/CSCI Number: Part/ CSCI Name: Serial / Version Number: Operation/Procedure Name or Description:

Supplier Part Number: Supplier: Total Hours On Item:

ISSUE Details:

SV3, Engine fuel shut-off, was closed without VTC or TIER II+ operator command. suspect unauthorized receipt of flight terminate

Current Applicable Rqmt: **DON'T terminate flight unless you really want to!**

How Detected: Conditions: Problem Duplicated: No FS: WL: BL:

INVESTIGATIVE ACTIVITY:

Work Order Number: Work Order Approval: Shop Approval: No Inspect: No Reject: Insp Stamp:

DISPOSITION # Accepted: # UseAsIs: # Rework: # Repair: # RtnToSup # Scrap:

Corrective Action Review Required?: Yes

Disposition:

Add IMMC fault log recording of FTS Arm and Terminate commands received from FTS receiver, for maintenance analysis of occurances when UAV is on ground.

Retest Requirements:

Disp. Approval Date: Shop/Test Approval: Quality Approval: Principal Engineer Approval: MRB/SRB Approval: Customer Approval:

Record of All Disposition Action Completion:

Est Hrs Req For Maint: Part Number Removed: Serial Number Removed: Part Number Installed: Serial Number Installed:

Disp. Completed Date: Shop/Test: Quality: Government:

CORRECTIVE ACTION Assignee: KRUSE, O. (OTTO) Assignee Phone: Defect Code: 4N_Assy/Instl Cause Code: ENG Escape:

Defect Description: Miscellaneous Root Cause Description: Engineering design unclear or incorrect

Impact Check List:

Hardware	SIL Equipt	Requirement Docs
Software	Engineering	Contract Docs
Software	Engineering	Contract Docs
Tooling	Manufacturing Planning	Analysis / Reports
Support Equip	Test/Support Procedures	

Corrective Action Description / Plans:

Added IMMC fault log recording of FTS Arm and Terminate commands received from FTS receiver and C2 link, for maintenance analysis of occurances when UAV is on ground. The event is recorded in the log as "AVM_FTS_SIGNAL - not a fault" with the "Signal" having the following meanings:

Signal = 1 Arm received from FTR
Signal = 2 Disarmed by 2 minute timeout
Signal = 3 Terminate received from FTR
Signal = 4 Arm received from LRE/MCE
Signal = 5 Disarm received from LRE/MCE
Signal = 6 Terminate received from LRE/MCE

Note that these steps are logged even if a terminate is not performed (e.g. terminate command without prior arming). The AVM_MODE_CHANGE log entry indicates actual flight terminate mode transitions. The AVM_FTS_SIGNAL log entries indicate the signal received (and when).

21 Apr 99

MEMO FOR RECORD

SUBJECT: Product Quality Deficiency Reports (PQDRs) on Components Removed for Post Mishap Analysis, Global Hawk UAV, SN 95-2002

1. No PQDRs were generated from this mishap. Instead mishap aircraft components were shipped directly to contractors and labs to expedite analysis. The attached table documents the components sent out for analysis, where they were sent, and where in this report the analysis can be found.

2. All components were returned to Edwards AFB upon completion of analysis.

LARRY A. MARTINSEN, Major, USAF
Maintenance Member, AFMC SIB

Attachment:
Component Inventory

COMPONENT INVENTORY

COMPONENT	CONTRACTOR/LAB	REPORT IN TAB
Flight Termination Receivers (2)	Teledyne Ryan Aeronautical	W

TECHNICAL AND ENGINEERING
EVALUATIONS OF MATERIAL

Tab J

TAB J

INDEX

ITT DEFENSE

ITT Federal Services Corporation

Vandenberg AFB, Calif. 93437

RF MEASUREMENT LAB

FAX COVER SHEET

TO:
Name: Steve Cronk
Telephone: 805 277 3224

FROM:
Name: Darrell Otsuki
Telephone: (805) 734-8232 Ext 6-8255

COVER SHEET PLUS ______ PAGES

NOTES/COMMENTS/ADDITIONAL INSTRUCTION:

Data taken from FTR-915A [redacted] CRDs

STANDARD COMMAND RECEIVER DECODER PERFORMANCE TEST T2430A

1. MANUFACTURER	Loral
2. RECEIVER MODEL NUMBER	FTR-915A
. PART NUMBER	LCP11004850-31
. TEST ORGANIZATION	ITT - FSC / RFML
. RECEIVER SERIAL NUMBER	0086
. DATE OF TEST	03 APR 99
7. RETEST DUE DATE	[redacted]
8. TEST SET USED	CRMF
16. ISOLATION TEST	[ ] GO [ ] NO GO
17. ABNORMAL LOGIC	[X] GO [ ] NO GO

9. REASON FOR TEST	[ ] CERT	[ ] RECERT	[X] SPL [ ] TRBLSHOOT
10. POWER ON 1301		POWER OFF 1530	
TOTAL TIME		149 MINUTES	
11. TEST PROCEDURE USED	N/A		
12. PROGRAM	Global Hawk		
13. MISSION NUMBER	N/A		
14. DATE FLOWN	N/A		
15. MAJOR OPERATION NUMBER	N/A		
25. USABLE RF INPUT	[X] GO	[ ] NO GO	

18. INPUT CURRENT

[redacted]	24 LO V	28 V	35.8 HI V
UIESCENT	180 mA	180 mA	180 mA
100 μV CW	192 mA	192 mA	192 mA
RM	199 mA	200 mA	202 mA
EST	199 mA	200 mA	202 mA
C	N/A mA	N/A mA	N/A mA
Monitor	195 mA	196 mA	197 mA

19. SENSITIVITY

[redacted]	24 LO V	28 V	35.8 HI V
Monitor	.355 μV	.355 μV	.355 μV
RM	.355 μV	.316 μV	.316 μV
EST	.355 μV	.355 μV	.355 μV
C	N/A μV	N/A μV	N/A μV

20. DEVIATION SENSITIVITY/COMPATIBILITY

[redacted]	27 kHz	30 kHz	33 kHz	4kHz NO RESP
Monitor	.355 μV	.355 μV	.316 μV	X
RM	.355 μV	.355 μV	.316 μV	X
DEST	.355 μV	.355 μV	.316 μV	X
C	N/A μV	N/A μV	N/A μV	N/A

DEVIATION THRESHOLD SENSITIVITY

RM	25.2 kHz	TONE 1	13.3 kHz
EST	25.7 kHz	TONE 2	13.4 kHz
Monitor	12.5 kHz	TONE 4	N/A kHz
	N/A kHz	TONE 5	12.5 kHz

2. CW PEAK TO VALLEY	0.6 db

OPERATIONAL BANDWIDTH

[redacted]	LOWER	UPPER	BW
Monitor	99 kHz	90 kHz	189 kHz
RM	85 kHz	78 kHz	163 kHz
EST	82 kHz	76 kHz	158 kHz
C	N/A kHz	N/A kHz	0 kHz
60 dB BANDWIDTH		UPPER 167 kHz	LOWER 157 kHz

26. DECODER CHANNEL BANDWIDTH

[redacted]	2 dB		14 dB	
	LOWER	UPPER	LOWER	UPPER
CHANNEL 1	7360 Hz	7630 Hz	7300 Hz	7690 Hz
CHANNEL 2	8330 Hz	8570 Hz	8260 Hz	8670 Hz
CHANNEL 4	N/A Hz	N/A Hz	N/A Hz	N/A Hz
CHANNEL 5	11890 Hz	12380 Hz	11860 Hz	12430 Hz

27. RESPONSE TIME

ARM	11 ms
DEST	6 ms
DLD DEST	N/A ms
OC	N/A ms
CK CH	N/A ms

28. CAPTURE RATIO 100 μV 1.07 4 μV 1.05

29. TLM SIGNAL STRENGTH VOLTAGE (Vdc)

QUIESCENT	0.42
1 μV	0.91
10 μV	3.37
100 μV	4.64
1 KμV	4.64
10 KμV	4.64
100 KμV	4.64

30. TLM SIGNAL STRENGTH CURVE ATTACHED [X] YES [ ] NO

31. COMMAND VOLTAGE DROP [ ] GO N/A [ ] NO GO

32. ALL REQUIREMENTS OF PROCEDURE MET [ ] YES [X] NO
IF NO, WSMC FORM 5632 ATTACHED [X]

33. VSWR 1.15:1 @ 425MHz

34. REMARKS

1. During RF Deviation Test, the CRD locked up and would not receive functions. The CRD was powered down to reset CRD.
2. J2 connector has some debris in socket 20.
3. The center pin on the IF cable for P1 is recessed.
4. The SSTLM voltage reached saturation @ -69dBm Spec is >= -53dBm

PERFORMED BY uki, D. / Hopson, W.	DATE 4/3/99	QA N/A	DATE N/A	30SPW/SESE Mark Gotfraind	DATE 4/3/99

mputer Generated WSMC Form 1

COMMAND RECEIVER DECODER AGC DATA SHEET

T2430

1. MANUFACTURER	Loral	9. RF INPUT OPPOSITE INPUT	[ ] A [ ] B [ ] N/A [ ] TERMINATED [X] CONNECTED [ ] OPEN [ ] N/A
2. RECEIVER MODEL NUMBER	FTR-915A		
3. PART NUMBER	LCP11004850-31		
4. TEST ORGANIZATION	ITT - FSC / RFNL	10. TEST PROCEDURE USED	N/A
5. RECEIVER SERIAL NUMBER	0086	11. PROGRAM	Global Hawk
6. DATE OF TEST	03 APR 99	12. MISSION NUMBER	N/A
7. TEST SET USED	CRMF	13. DATE FLOWN	N/A
8. CONFIGURATION	[X] BENCH [ ] NAT	14. MAJOR OPERATION NUMBER	N/A
[ ] PROBE	[ ] OPEN LOOP	15. REMARKS: N/A	

18. AGC DATA

ATTEN dB	RF IN MICROVOLTS	AGC VOLTS	ATTEN dB	RF IN MICROVOLTS	AGC VOLTS
-107.0	1.00	0.91	-55.0	398.11	4.64
-105.0	1.26	1.07	-53.0	501.19	4.64
-103.0	1.58	1.26	-51.0	630.96	4.64
-101.0	2.00	1.50	-49.0	794.33	4.64
-99.0	2.51	1.78	-47.0	1000.00	4.64
-97.0	3.16	2.08	-45.0	1258.93	4.64
-95.0	3.98	2.45	-43.0	1584.89	4.64
-93.0	5.01	2.73	-41.0	1995.26	4.64
-91.0	6.31	2.98	-39.0	2511.89	4.64
-89.0	7.94	3.19	-37.0	3162.28	4.64
-87.0	10.00	3.37	-35.0	3981.07	4.64
-85.0	12.59	3.54	-33.0	5011.87	4.64
-83.0	15.85	3.67	-31.0	6309.57	4.64
-81.0	19.95	3.80	-29.0	7943.28	4.64
-79.0	25.12	3.92	-27.0	10000.00	4.64
-77.0	31.62	4.04	-25.0	12589.25	4.64
-75.0	39.81	4.19	-23.0	15848.93	4.64
-73.0	50.12	4.34	-21.0	19952.62	4.64
-71.0	63.10	4.51	-19.0	25118.86	4.64
-69.0	79.43	4.64	-17.0	31622.78	4.64
-67.0	100.00	4.64	-15.0	39810.72	4.64
-65.0	125.89	4.64	-13.0	50118.72	4.64
-63.0	158.49	4.64	-11.0	68095.73	4.64
-61.0	199.53	4.64	-9.0	79432.82	4.64
-59.0	251.19	4.64	-7.0	100000.00	4.64
-57.0	316.23	4.64			

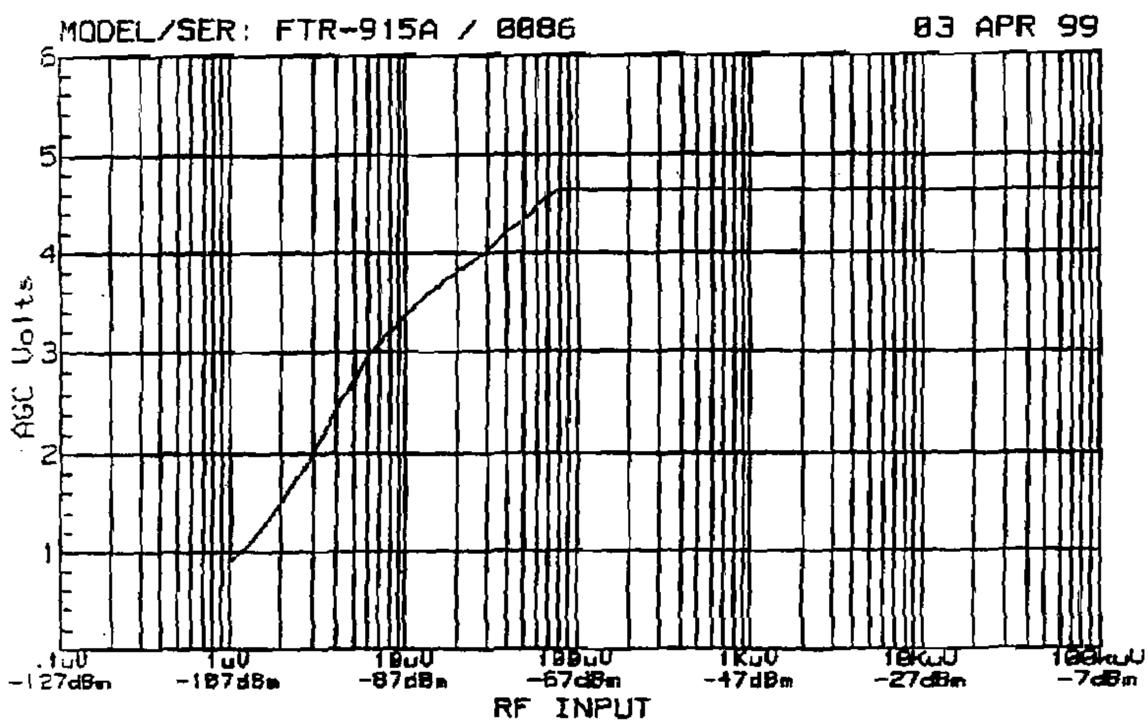
TEST PERFORMED BY	DATE	QA	DATE	30SPW/SESE	DATE
Suki, D. / Hopson, D.	4/3/99	N/A	N/A	Mark Gotfreind	4/3/99

Computer Generated WSMC Form 3

AGC Voltages

-107dBm=0.91V	-105dBm=1.07V	-103dBm=1.26V	-101dBm=1.50V
-99dBm=1.78V	-97dBm=2.08V	-95dBm=2.45V	-93dBm=2.73V
-91dBm=2.98V	-89dBm=3.19V	-87dBm=3.37V	-85dBm=3.54V
-83dBm=3.67V	-81dBm=3.80V	-79dBm=3.92V	-77dBm=4.04V
-75dBm=4.19V	-73dBm=4.34V	-71dBm=4.51V	-69dBm=4.64V
-67dBm=4.64V	-65dBm=4.64V	-63dBm=4.64V	-61dBm=4.64V
-59dBm=4.64V	-57dBm=4.64V	-55dBm=4.64V	-53dBm=4.64V
-51dBm=4.64V	-49dBm=4.64V	-47dBm=4.64V	-45dBm=4.64V
-43dBm=4.64V	-41dBm=4.64V	-39dBm=4.64V	-37dBm=4.64V
-35dBm=4.64V	-33dBm=4.64V	-31dBm=4.64V	-29dBm=4.64V
-27dBm=4.64V	-25dBm=4.64V	-23dBm=4.64V	-21dBm=4.64V
-19dBm=4.64V	-17dBm=4.64V	-15dBm=4.64V	-13dBm=4.64V
-11dBm=4.64V	-9dBm=4.64V	-7dBm=4.64V	

Remark:N/A



STANDARD COMMAND RECEIVER DECODER PERFORMANCE TEST T24308

1. MANUFACTURER	Loral	9. REASON FOR TEST [ ]CERT [ ]RECERT [X]SPL [ ]TRBLSHOOT	
2. RECEIVER MODEL NUMBER	FTR-915A	10. POWER ON 1610	POWER OFF 1725
3. PART NUMBER	LCP11004850-31	TOTAL TIME	75 MINUTES
4. TEST ORGANIZATION	ITT - FSC / RFML	11. TEST PROCEDURE USED	N/A
5. RECEIVER SERIAL NUMBER	0087	12. PROGRAM	Global Hawk
6. DATE OF TEST	03 APR 99	13. MISSION NUMBER	N/A
7. RETEST DUE DATE	[redacted]	14. DATE FLOWN	N/A
8. TEST SET USED	CRMF	15. MAJOR OPERATION NUMBER	N/A

16. ISOLATION TEST [ ] GO [ ] NO GO

17. ABNORMAL LOGIC [X] GO [ ] NO GO

18. INPUT CURRENT

[redacted]	24 LO V	28 V	35.8 HI V
QUIESCENT	188 mA	188 mA	188 mA
100 µV CW	201 mA	202 mA	201 mA
ARM	208 mA	210 mA	211 mA
DEST	208 mA	209 mA	210 mA
OC	204 mA	205 mA	205 mA
Monitor	N/A mA	N/A mA	N/A mA

19. SENSITIVITY

[redacted]	24 LO V	28 V	35.8 HI V
Monitor	.355 µV	.355 µV	.355 µV
ARM	.355 µV	.355 µV	.355 µV
DEST	.355 µV	.355 µV	.355 µV
OC	N/A µV	N/A µV	N/A µV

20. DEVIATION SENSITIVITY/COMPATIBILITY

[redacted]	27 kHz	30 kHz	33 kHz	4kHz NO RESP
Monitor	.355 µV	.355 µV	.316 µV	X
ARM	.355 µV	.355 µV	.316 µV	X
DEST	.355 µV	.355 µV	.316 µV	X
OC	N/A µV	N/A µV	N/A µV	N/A

21. DEVIATION THRESHOLD SENSITIVITY

ARM	24.8 kHz	TONE 1	13.9 kHz
DEST	25.3 kHz	TONE 2	12.5 kHz
Monitor	13.2 kHz	TONE 4	N/A kHz
OC	N/A kHz	TONE 5	13.2 kHz

22. CW PEAK TO VALLEY 1.3 db

23. OPERATIONAL BANDWIDTH

[redacted]	LOWER	UPPER	BW
Monitor	100 kHz	85 kHz	185 kHz
ARM	91 kHz	73 kHz	164 kHz
DEST	87 kHz	71 kHz	158 kHz
OC	N/A kHz	N/A kHz	0 kHz

24. 60 dB BANDWIDTH UPPER 158 kHz LOWER 184 kHz

25. USABLE RF INPUT [X] GO [ ] NO GO

26. DECODER CHANNEL BANDWIDTH

[redacted]	2 dB		14 dB	
	LOWER	UPPER	LOWER	UPPER
CHANNEL 1	7370 Hz	7640 Hz	7310 Hz	7700 Hz
CHANNEL 2	8330 Hz	8580 Hz	8260 Hz	8670 Hz
CHANNEL 4	N/A Hz	N/A Hz	N/A Hz	N/A Hz
CHANNEL 5	11890 Hz	12400 Hz	11860 Hz	12440 Hz

27. RESPONSE TIME

ARM	8 mS
DEST	6 mS
DLD DEST	N/A mS
OC	N/A mS
CX CH	N/A mS

28. CAPTURE RATIO 100 µV 1.01 4 µV 1.05

29. TLM SIGNAL STRENGTH VOLTAGE (Vdc)

QUIESCENT	0.38
1 µV	0.89
10 µV	3.44
100 µV	4.60
1 KµV	4.60
10 KµV	4.60
100 KµV	4.60

30. TLM SIGNAL STRENGTH CURVE ATTACHED [X] YES [ ] NO

31. COMMAND VOLTAGE DROP [ ] GO N/A [ ] NO GO

32. ALL REQUIREMENTS OF PROCEDURE MET [ ] YES [X] NO
IF NO, WSMC FORM 5632 ATTACHED [X]

33. VSWR 1.34:1 @ 425MHz

34. REMARKS

1. During the 2 & 20dB test on Tone 2, the Monitor indicator lit momentary. The test was repeated but we could not duplicate the problem.
2. $STLM voltage reached saturation @ -71dBm
Spec is >= -53dBm

TEST PERFORMED BY	DATE	QA	DATE	30SPW/SESE	DATE
Uzuki, D. / Hopson, O.	4/3/99	N/A	N/A	Mark Gotfraind	4/3/99

Computer Generated WSMC Form 1

COMMAND RECEIVER DECODER AGC DATA SHEET

T243C

1. MANUFACTURER	Loral	9. RF INPUT OPPOSITE INPUT	[ ] A [ ] B [ ] N/A [ ] TERMINATED [X] CONNECTED [ ] OPEN [ ] N/A
2. RECEIVER MODEL NUMBER	FTR-915A		
3. PART NUMBER	LCP11004850-31		
4. TEST ORGANIZATION	ITT - FSC / RFML	10. TEST PROCEDURE USED	N/A
5. RECEIVER SERIAL NUMBER	0087	11. PROGRAM	Global Hawk
6. DATE OF TEST	03 APR 99	12. MISSION NUMBER	N/A
7. TEST SET USED	CRMF	13. DATE FLOWN	N/A
8. CONFIGURATION [X] BENCH [ ] MAT		14. MAJOR OPERATION NUMBER	N/A
[ ] PROBE [ ] OPEN LOOP		15. REMARKS: N/A	

16. AGC DATA

ATTEN dB	RF IN MICROVOLTS	AGC VOLTS	ATTEN dB	RF IN MICROVOLTS	AGC VOLTS
-107.0	1.00	0.89	-55.0	398.11	4.60
-105.0	1.26	1.06	-53.0	501.19	4.60
-103.0	1.58	1.27	-51.0	630.96	4.60
-101.0	2.00	1.51	-49.0	794.33	4.60
-99.0	2.51	1.80	-47.0	1000.00	4.60
-97.0	3.16	2.11	-45.0	1258.93	4.60
-95.0	3.98	2.49	-43.0	1584.89	4.60
-93.0	5.01	2.78	-41.0	1995.26	4.60
-91.0	6.31	3.04	-39.0	2511.89	4.60
-89.0	7.94	3.26	-37.0	3162.28	4.60
-87.0	10.00	3.44	-35.0	3981.07	4.60
-85.0	12.59	3.63	-33.0	5011.87	4.60
-83.0	15.85	3.77	-31.0	6309.57	4.60
-81.0	19.95	3.90	-29.0	7943.28	4.60
-79.0	25.12	4.03	-27.0	10000.00	4.60
-77.0	31.62	4.15	-25.0	12589.25	4.60
-75.0	39.81	4.30	-23.0	15848.93	4.60
-73.0	50.12	4.46	-21.0	19952.62	4.60
-71.0	63.10	4.60	-19.0	25118.86	4.60
-69.0	79.43	4.60	-17.0	31622.78	4.60
-67.0	100.00	4.60	-15.0	39810.72	4.60
-65.0	125.89	4.60	-13.0	50118.72	4.60
-63.0	158.49	4.60	-11.0	68095.73	4.60
-61.0	199.53	4.60	-9.0	79432.82	4.60
-59.0	251.19	4.60	-7.0	100000.00	4.60
-57.0	316.23	4.60			

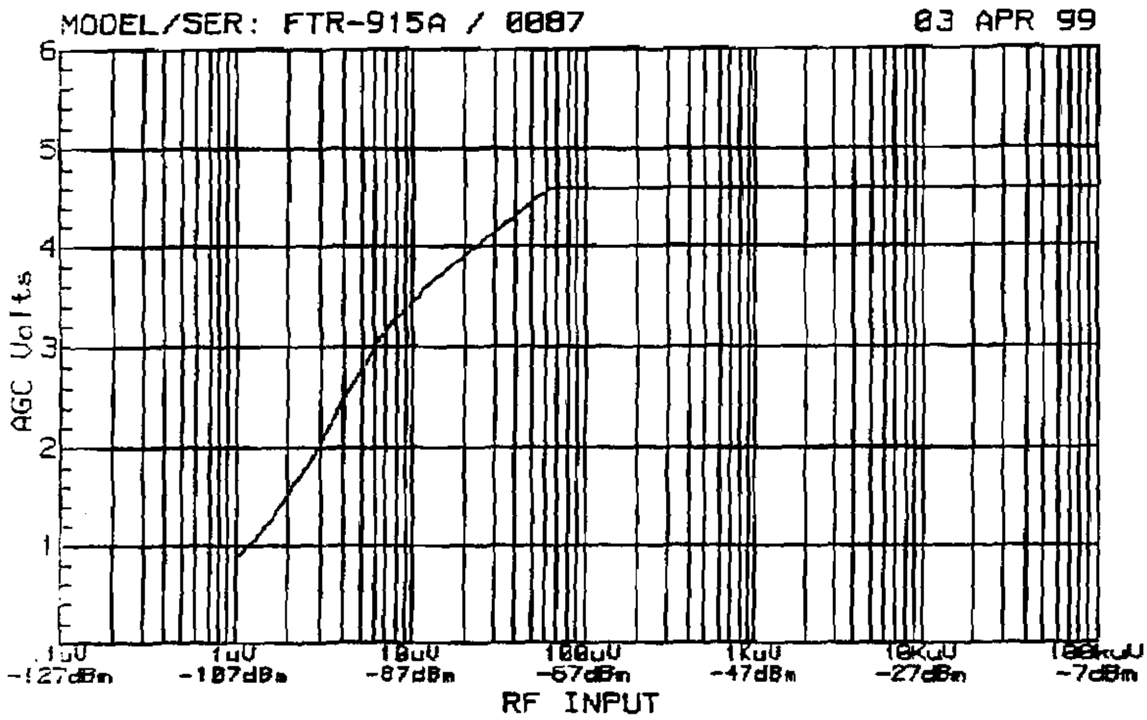
TEST PERFORMED BY	DATE	QA	DATE	30SPW/SESE	DATE
Tsuki, D. / Hopson, D.	4/3/99	N/A	N/A	Mark Gotfraind	4/3/99

Computer Generated WSMC Form 3

AGC Voltages

-107dBm=0.89V	-105dBm=1.06V	-103dBm=1.27V	-101dBm=1.51V
-99dBm=1.80V	-97dBm=2.11V	-95dBm=2.49V	-93dBm=2.78V
-91dBm=3.04V	-89dBm=3.26V	-87dBm=3.44V	-85dBm=3.63V
-83dBm=3.77V	-81dBm=3.90V	-79dBm=4.03V	-77dBm=4.15V
-75dBm=4.30V	-73dBm=4.46V	-71dBm=4.60V	-69dBm=4.60V
-67dBm=4.60V	-65dBm=4.60V	-63dBm=4.60V	-61dBm=4.60V
-59dBm=4.60V	-57dBm=4.60V	-55dBm=4.60V	-53dBm=4.60V
-51dBm=4.60V	-49dBm=4.60V	-47dBm=4.60V	-45dBm=4.60V
-43dBm=4.60V	-41dBm=4.60V	-39dBm=4.60V	-37dBm=4.60V
-35dBm=4.60V	-33dBm=4.60V	-31dBm=4.60V	-29dBm=4.60V
-27dBm=4.60V	-25dBm=4.60V	-23dBm=4.60V	-21dBm=4.60V
-19dBm=4.60V	-17dBm=4.60V	-15dBm=4.60V	-13dBm=4.60V
-11dBm=4.60V	-9dBm=4.60V	-7dBm=4.60V	

Remark:N/A



STANDARD COMMAND RECEIVER DECODER PERFORMANCE TEST

T24305

1. MANUFACTURER	Loral	9. REASON FOR TEST [ ]CERT [ ]RECERT [X]SPL [ ]TRBLSHOOT	
2. RECEIVER MODEL NUMBER	FTR-915A	10. POWER ON 1301	POWER OFF 1530
3. PART NUMBER	LCP11004850-31	TOTAL TIME	149 MINUTES
4. TEST ORGANIZATION	ITT - FSC / RFML	11. TEST PROCEDURE USED	N/A
5. RECEIVER SERIAL NUMBER	0086	12. PROGRAM	Global Hawk
6. DATE OF TEST	03 APR 99	13. MISSION NUMBER	N/A
7. RETEST DUE DATE	[illegible]	14. DATE FLOWN	N/A
8. TEST SET USED	CRMF	15. MAJOR OPERATION NUMBER	N/A
16. ISOLATION TEST [ ] GO [ ] NO GO		25. USABLE RF INPUT [X] GO [ ] NO GO	
17. ABNORMAL LOGIC [X] GO [ ] NO GO			

26. DECODER CHANNEL BANDWIDTH

[redacted]	2 dB LOWER	2 dB UPPER	14 dB LOWER	14 dB UPPER
CHANNEL 1	7360 Hz	7630 Hz	7300 Hz	7690 Hz
CHANNEL 2	8330 Hz	8570 Hz	8260 Hz	8670 Hz
CHANNEL 4	N/A Hz	N/A Hz	N/A Hz	N/A Hz
CHANNEL 5	11890 Hz	12380 Hz	11860 Hz	12430 Hz

18. INPUT CURRENT

[redacted]	24 LO V	28 V	35.8 HI V
QUIESCENT	180 mA	180 mA	180 mA
[illegible] RV CW	192 mA	192 mA	192 mA
[illegible]	199 mA	200 mA	202 mA
[illegible]	199 mA	200 mA	202 mA
[illegible]	N/A mA	N/A mA	N/A mA
Monitor	195 mA	196 mA	197 mA

27. RESPONSE TIME

ARM	11 mS
DEST	6 mS
OLD DEST	N/A mS
OC	N/A mS
CK CH	N/A mS

19. SENSITIVITY

[redacted]	24 LO V	28 V	35.8 HI V
Monitor	.355 µV	.355 µV	.355 µV
[illegible]	.355 µV	.316 µV	.316 µV
[illegible]	.355 µV	.355 µV	.355 µV
[illegible]	N/A µV	N/A µV	N/A µV

28. CAPTURE RATIO 100 µV 1.07 4 µV 1.05

29. TLM SIGNAL STRENGTH VOLTAGE (Vdc)

QUIESCENT	0.42
1 µV	0.91
10 µV	3.37
100 µV	4.64
1 KµV	4.64
10 KµV	4.64
100 KµV	4.64

20. DEVIATION SENSITIVITY/COMPATIBILITY

[illegible]	27 kHz	30 kHz	33 kHz	4kHz NO RESP
Monitor	.355 µV	.355 µV	.316 µV	X
[illegible]	.355 µV	.355 µV	.316 µV	X
[illegible]	.355 µV	.355 µV	.316 µV	X
[illegible]	N/A µV	N/A µV	N/A µV	N/A

21. DEVIATION THRESHOLD SENSITIVITY

[illegible]	25.2 kHz	TONE 1	13.3 kHz
[illegible]	25.7 kHz	TONE 2	13.4 kHz
Monitor	12.5 kHz	TONE 4	N/A kHz
[illegible]	N/A kHz	TONE 5	12.5 kHz

22. PEAK TO VALLEY 0.6 db

30. TLM SIGNAL STRENGTH CURVE ATTACHED [X] YES [ ] NO

31. COMMAND VOLTAGE DROP [ ] GO N/A [ ] NO GO

32. ALL REQUIREMENTS OF PROCEDURE MET [ ] YES [X] NO
IF NO, WSMC FORM 5632 ATTACHED [X]

33. VSWR 1.15:1 @ 425MHz

23. OPERATIONAL BANDWIDTH

[redacted]	LOWER	UPPER	BW
Monitor	99 kHz	90 kHz	189 kHz
[illegible]	85 kHz	78 kHz	163 kHz
[illegible]	82 kHz	76 kHz	158 kHz
[illegible]	N/A kHz	N/A kHz	0 kHz

24. 60 dB BANDWIDTH UPPER 167 kHz LOWER 157 kHz

34. REMARKS

1. During RF Deviation Test, the CRD locked up and would not receive functions. The CRD was powered down to reset CRD.
2. J2 connector has some debris in socket 20.
3. The center pin on the RF cable for P1 is recessed.
4. The SSTLM voltage reached saturation @ -69dBm Spec is >= -53dBm

PERFORMED BY [illegible], D. / Hopson, W.	DATE 4/3/99	QA N/A	DATE N/A	30SPW/SESE Mark Gottfraind	DATE 4/3/99

Computer Generated WSMC Form 1

COMMAND RECEIVER DECODER AGC DATA SHEET

T24331

MANUFACTURER	Loral	9. RF INPUT OPPOSITE INPUT [ ] A	[ ] B [ ] TERMINATED [X] CONNECTED [ ] OPEN [ ] N/A [ ] N/A
RECEIVER MODEL NUMBER	FTR-915A		
PART NUMBER	LCP11004850-31		
TEST ORGANIZATION	ITT - FSC / RFML	10. TEST PROCEDURE USED	N/A
RECEIVER SERIAL NUMBER	0086	11. PROGRAM	Global Hawk
DATE OF TEST	03 APR 99	12. MISSION NUMBER	N/A
TEST SET USED	CRMF	13. DATE FLOWN	N/A
CONFIGURATION [X] BENCH	[ ] HAT	14. MAJOR OPERATION NUMBER	N/A
[ ] PROBE	[ ] OPEN LOOP	15. REMARKS: N/A	

AGC DATA

ATTEN dB	RF IN MICROVOLTS	AGC VOLTS	ATTEN dB	RF IN MICROVOLTS	AGC VOLTS
-107.0	1.00	0.91	-55.0	398.11	4.64
-105.0	1.26	1.07	-53.0	501.19	4.64
-103.0	1.58	1.26	-51.0	630.96	4.64
-101.0	2.00	1.50	-49.0	794.33	4.64
-99.0	2.51	1.78	-47.0	1000.00	4.64
-97.0	3.16	2.08	-45.0	1258.93	4.64
-95.0	3.98	2.45	-43.0	1584.89	4.64
-93.0	5.01	2.73	-41.0	1995.26	4.64
-91.0	6.31	2.98	-39.0	2511.89	4.64
-89.0	7.94	3.19	-37.0	3162.28	4.64
-87.0	10.00	3.37	-35.0	3981.07	4.64
-85.0	12.59	3.54	-33.0	5011.87	4.64
-83.0	15.85	3.67	-31.0	6309.57	4.64
-81.0	19.95	3.80	-29.0	7943.28	4.64
-79.0	25.12	3.92	-27.0	10000.00	4.64
-77.0	31.62	4.04	-25.0	12589.25	4.64
-75.0	39.81	4.19	-23.0	15848.93	4.64
-73.0	50.12	4.34	-21.0	19952.62	4.64
-71.0	63.10	4.51	-19.0	25118.86	4.64
-69.0	79.43	4.64	-17.0	31622.78	4.64
-67.0	100.00	4.64	-15.0	39810.72	4.64
-65.0	125.89	4.64	-13.0	50118.72	4.64
-63.0	158.49	4.64	-11.0	68095.73	4.64
-61.0	199.53	4.64	-9.0	79432.82	4.64
-59.0	251.19	4.64	-7.0	100000.00	4.64
-57.0	316.23	4.64			

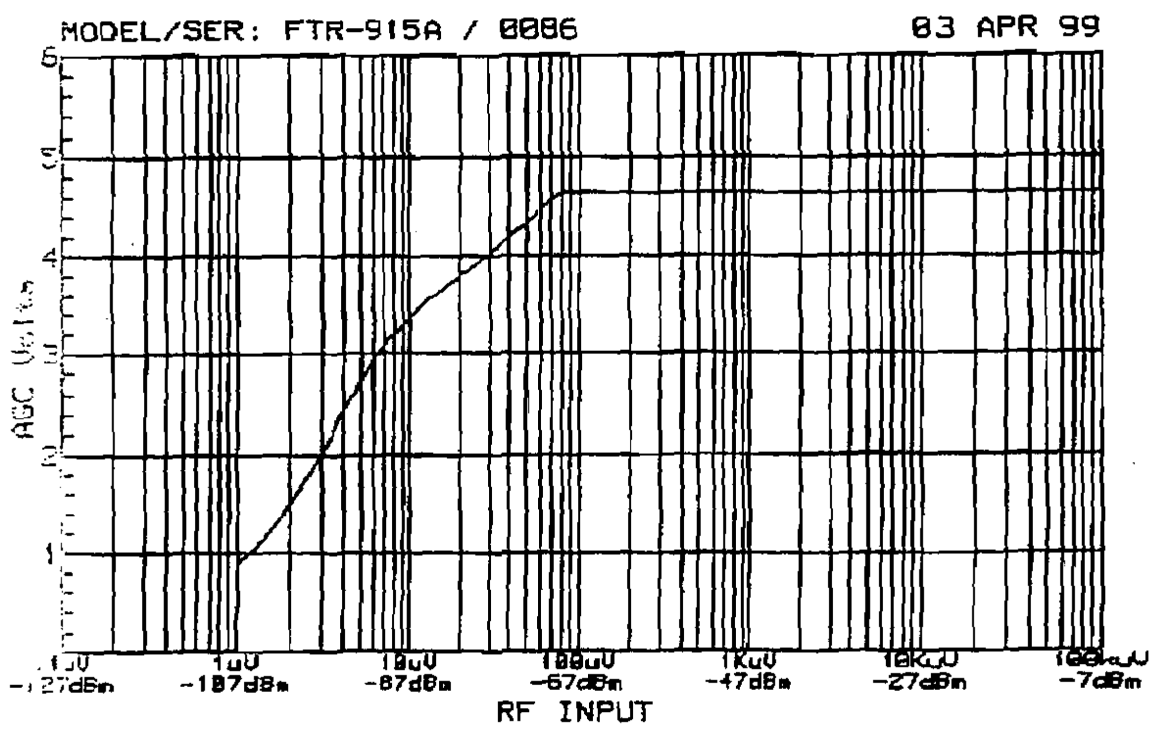
PERFORMED BY	DATE	QA	DATE	30SPW/SESE	DATE
[illegible], D. / Hopson, D.	4/3/99	N/A	N/A	Mark Gotfreind	4/3/99

Computer Generated WSMC Form 3

AGC Voltages

-107dBm=0.91V	-105dBm=1.07V	-103dBm=1.26V	-101dBm=1.50V
-99dBm=1.78V	-97dBm=2.08V	-95dBm=2.45V	-93dBm=2.73V
-91dBm=2.98V	-89dBm=3.19V	-87dBm=3.37V	-85dBm=3.54V
-83dBm=3.67V	-81dBm=3.80V	-79dBm=3.92V	-77dBm=4.04V
-75dBm=4.19V	-73dBm=4.34V	-71dBm=4.51V	-69dBm=4.64V
-67dBm=4.64V	-65dBm=4.64V	-63dBm=4.64V	-61dBm=4.64V
-59dBm=4.64V	-57dBm=4.64V	-55dBm=4.64V	-53dBm=4.64V
-51dBm=4.64V	-49dBm=4.64V	-47dBm=4.64V	-45dBm=4.64V
-43dBm=4.64V	-41dBm=4.64V	-39dBm=4.64V	-37dBm=4.64V
-35dBm=4.64V	-33dBm=4.64V	-31dBm=4.64V	-29dBm=4.64V
-27dBm=4.64V	-25dBm=4.64V	-23dBm=4.64V	-21dBm=4.64V
-19dBm=4.64V	-17dBm=4.64V	-15dBm=4.64V	-13dBm=4.64V
-11dBm=4.64V	-9dBm=4.64V	-7dBm=4.64V	

Remark:N/A



STANDARD COMMAND RECEIVER DECODER PERFORMANCE TEST T2430[illegible]

MANUFACTURER	Loral	9. REASON FOR TEST [ ]CERT [ ]RECERT [X]SPL [ ]TRBLSHOOT	
RECEIVER MODEL NUMBER	FTR-915A	10. POWER ON 1610	POWER OFF 1725
PART NUMBER	LCP11004850-31	TOTAL TIME	75 MINUTES
TEST ORGANIZATION	ITT - FSC / RFML	11. TEST PROCEDURE USED	N/A
RECEIVER SERIAL NUMBER	0087	12. PROGRAM	Global Hawk
DATE OF TEST	03 APR 99	13. MISSION NUMBER	N/A
RETEST DUE DATE	[redacted]	14. DATE FLOWN	N/A
TEST SET USED	CRMF	15. MAJOR OPERATION NUMBER	N/A

ISOLATION TEST [ ] GO [ ] NO GO

ABNORMAL LOGIC [X] GO [ ] NO GO

25. USABLE RF INPUT [X] GO [ ] NO GO

INPUT CURRENT

[redacted]	24 LO V	28 V	35.8 HI V
QUIESCENT	188 mA	188 mA	188 mA
[illegible] CH	201 mA	202 mA	201 mA
	208 mA	210 mA	211 mA
	208 mA	209 mA	210 mA
	204 mA	205 mA	205 mA
Monitor	N/A mA	N/A mA	N/A mA

SENSITIVITY

[redacted]	24 LO V	28 V	35.8 HI V
Monitor	.355 µV	.355 µV	.355 µV
	.355 µV	.355 µV	.355 µV
	.355 µV	.355 µV	.355 µV
	N/A µV	N/A µV	N/A µV

DEVIATION SENSITIVITY/COMPATIBILITY

	27 kHz	30 kHz	33 kHz	4kHz NO RESP
Monitor	.355 µV	.355 µV	.316 µV	X
	.355 µV	.355 µV	.316 µV	X
	.355 µV	.355 µV	.316 µV	X
	N/A µV	N/A µV	N/A µV	N/A

DEVIATION THRESHOLD SENSITIVITY

	24.8 kHz	TONE 1	13.9 kHz
	25.3 kHz	TONE 2	12.5 kHz
Monitor	13.2 kHz	TONE 4	N/A kHz
	N/A kHz	TONE 5	13.2 kHz

TLM PEAK TO VALLEY 1.3 db

OPERATIONAL BANDWIDTH

[redacted]	LOWER	UPPER	BW
Monitor	100 kHz	85 kHz	185 kHz
	91 kHz	73 kHz	164 kHz
	87 kHz	71 kHz	158 kHz
	N/A kHz	N/A kHz	0 kHz

DECODER BANDWIDTH | UPPER 158 kHz | LOWER 184 kHz

26. DECODER CHANNEL BANDWIDTH

[redacted]	2 dB		14 dB	
	LOWER	UPPER	LOWER	UPPER
CHANNEL 1	7370 Hz	7640 Hz	7310 Hz	7700 Hz
CHANNEL 2	8330 Hz	8580 Hz	8260 Hz	8670 Hz
CHANNEL 4	N/A Hz	N/A Hz	N/A Hz	N/A Hz
CHANNEL 5	11890 Hz	12400 Hz	11860 Hz	12440 Hz

27. RESPONSE TIME

ARM	6 mS
DEST	6 mS
OLD DEST	N/A mS
OC	N/A mS
CK CH	N/A mS

28. CAPTURE RATIO 100 µV 1.01 | 4 µV 1.05

29. TLM SIGNAL STRENGTH VOLTAGE (Vdc)

QUIESCENT	0.38
1 µV	0.89
10 µV	3.44
100 µV	4.60
1 KµV	4.60
10 KµV	4.60
100 KµV	4.60

30. TLM SIGNAL STRENGTH CURVE ATTACHED [X] YES [ ] NO

31. COMMAND VOLTAGE DROP [ ] GO N/A [ ] NO GO

32. ALL REQUIREMENTS OF PROCEDURE MET [ ] YES [X] NO
IF NO, WSMC FORM 5632 ATTACHED [X]

33. VSWR 1.34:1 @ 425MHz

34. REMARKS

1. During the 2 & 20dB test on Tone 2, the Monitor indicator lit momentary. The test was repeated but we could not duplicate the problem.
2. SSTLM voltage reached saturation @ -71dBm
Spec is >= -53dBm

TEST PERFORMED BY	DATE	QA	DATE	30SPW/SESE	DATE
[illegible] / Hopson, D.	4/3/99	N/A	N/A	Mark Gotfraind	4/3/99

[illegible]er Generated WSMC Form 1

COMMAND RECEIVER DECODER AGC DATA SHEET

T2439B

MANUFACTURER	Loral	9. RF INPUT OPPOSITE INPUT [ ] A [ ] B [ ] N/A	[ ] TERMINATED [X] CONNECTED [ ] OPEN [ ] N/A
MODEL NUMBER	FTR-915A		
NUMBER	LCP11004850-31		
ORGANIZATION	ITT - FSC / RFML	10. TEST PROCEDURE USED	N/A
SERIAL NUMBER	0087	11. PROGRAM	Global Hawk
DATE OF TEST	03 APR 99	12. MISSION NUMBER	N/A
TEST SET USED	CRMF	13. DATE FLOWN	N/A
CONFIGURATION [X] BENCH [ ] MAT		14. MAJOR OPERATION NUMBER	N/A
[ ] PROBE [ ] OPEN LOOP		15. REMARKS: N/A	

AGC DATA

ATTEN dB	RF IN MICROVOLTS	AGC VOLTS	ATTEN dB	RF IN MICROVOLTS	AGC VOLTS
-107.0	1.00	0.89	-55.0	398.11	4.60
-105.0	1.26	1.06	-53.0	501.19	4.60
-103.0	1.58	1.27	-51.0	630.96	4.60
-101.0	2.00	1.51	-49.0	794.33	4.60
-99.0	2.51	1.80	-47.0	1000.00	4.60
-97.0	3.16	2.11	-45.0	1258.93	4.60
-95.0	3.98	2.49	-43.0	1584.89	4.60
-93.0	5.01	2.78	-41.0	1995.26	4.60
-91.0	6.31	3.04	-39.0	2511.89	4.60
-89.0	7.94	3.26	-37.0	3162.28	4.60
-87.0	10.00	3.44	-35.0	3981.07	4.60
-85.0	12.59	3.63	-33.0	5011.87	4.60
-83.0	15.85	3.77	-31.0	6309.57	4.60
-81.0	19.95	3.90	-29.0	7943.28	4.60
-79.0	25.12	4.03	-27.0	10000.00	4.60
-77.0	31.62	4.15	-25.0	12589.25	4.60
-75.0	39.81	4.30	-23.0	15848.93	4.60
-73.0	50.12	4.46	-21.0	19952.62	4.60
-71.0	63.10	4.60	-19.0	25118.86	4.60
-69.0	79.43	4.60	-17.0	31622.78	4.60
-67.0	100.00	4.60	-15.0	39810.72	4.60
-65.0	125.89	4.60	-13.0	50118.72	4.60
-63.0	158.49	4.60	-11.0	68095.73	4.60
-61.0	199.53	4.60	-9.0	79432.82	4.60
-59.0	251.19	4.60	-7.0	100000.00	4.60
-57.0	316.23	4.60			

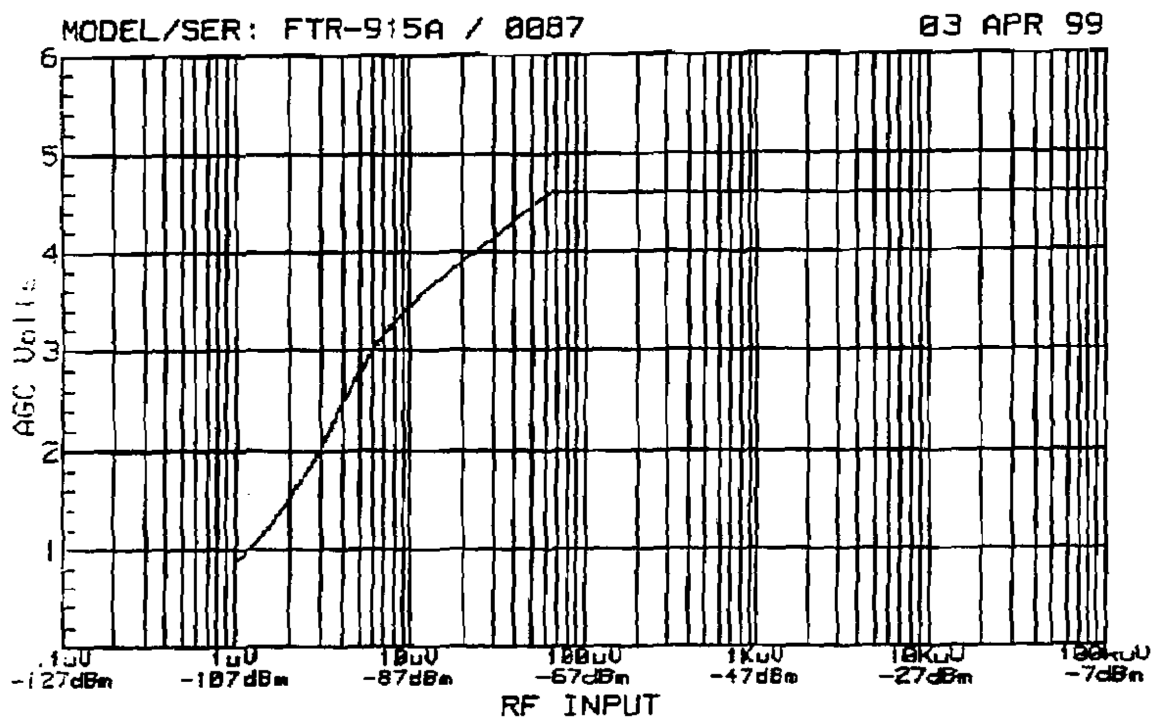
TEST PERFORMED BY D. / Hopson, D.	DATE 4/3/99	QA N/A	DATE N/A	30SPW/SESE Mark Gotfraind	DATE 4/3/99

Computer Generated WSMC Form 3

AGC Voltages

-107dBm=0.89V	-105dBm=1.06V	-103dBm=1.27V	-101dBm=1.51V
-99dBm=1.80V	-97dBm=2.11V	-95dBm=2.49V	-93dBm=2.78V
-91dBm=3.04V	-89dBm=3.26V	-87dBm=3.44V	-85dBm=3.63V
-83dBm=3.77V	-81dBm=3.90V	-79dBm=4.03V	-77dBm=4.15V
-75dBm=4.30V	-73dBm=4.46V	-71dBm=4.60V	-69dBm=4.60V
-67dBm=4.60V	-65dBm=4.60V	-63dBm=4.60V	-61dBm=4.60V
-59dBm=4.60V	-57dBm=4.60V	-55dBm=4.60V	-53dBm=4.60V
-51dBm=4.60V	-49dBm=4.60V	-47dBm=4.60V	-45dBm=4.60V
-43dBm=4.60V	-41dBm=4.60V	-39dBm=4.60V	-37dBm=4.60V
-35dBm=4.60V	-33dBm=4.60V	-31dBm=4.60V	-29dBm=4.60V
-27dBm=4.60V	-25dBm=4.60V	-23dBm=4.60V	-21dBm=4.60V
-19dBm=4.60V	-17dBm=4.60V	-15dBm=4.60V	-13dBm=4.60V
-11dBm=4.60V	-9dBm=4.60V	-7dBm=4.60V	

Remark:N/A



DD FORM 175 or
AUTHORIZED SUBSTITUTE FLIGHT PLAN
FORMS

Tab K

TAB K

INDEX

LOCAL FLIGHT CLEARANCE/FLIGHT AUTHORIZATION
(SEE PRIVACY ACT STATEMENT OF 1974)

AUTHORITY: 10 U.S.C. 8012, Secretary of the Air Force powers and duties delegation by 37 U.S.C. 301A, Public Law 92-570, Public Law 93-294; 00007730.57.
PRINCIPAL PURPOSE(S) To record authorization for crew member/operational support personnel in performance of their duties in AFMC Aircraft.

ROUTINE USES(S): May be described for any of the blanket routine uses.
DISCLOSURE: Is voluntary; however failure to provide the information may prevent authorization to perform crew member/operational support duties in AFMC Aircraft.
Reserve Personnel not on extended active duty are subject to provisions of UCMJ.

1. DATE OF FLT: 29 Mar 1999	2. BASE: EDWARDS AFB, CA
3. SIGNATURE OF AUTHORIZING OFFICIAL (Type Name, Grade, Title): [signature] PETER J. JONES, MAJ, USAF, CHIEF, CURRENT OPERATIONS or KEVIN T. REILLY, MAJ, USAF, B-52 FLIGHT COMMANDER	4. ITINERARY: LOCAL (VARIATIONS IN ITINERARY AUTHORIZED)
5. FLT AUTH NO.: 99-079	6. UNIT ISSUING FLIGHT AUTHORIZATION: 419TH FLTS
7. DATE OF AUTHORIZATION: 26 Mar 1999	8. PEID: E
Page 01 of 01	

* INDICATES AIRCRAFT COMMANDER
\# INDICATES FORMATION LEADER (#ALT)

9. CALL SIGN	10. CREW POS	11. NAME	12. GRADE	13. LAST FOUR SSAN	14. ACFT TYPE AND NO	15. MSN SYM	16. ETD / ATD	17. ETE / ATE	18. WT AND BAL	19. ALT / ETE	20. FUEL O/B (AAR)	21. WX / NTMS	22. ROUTE OF FLIGHT	23. FCIF #	24. SIGNATURE OF PILOT IN COMMAND	25. REMARKS/LOCAL USE	26. JON#/MSN#/OPS#	27. OPS OFF INIT
RY 01	CCD	*#MUNSKI, M	CIV		RQ-4A 95-2002	O-4	0800 / 0954	6.0	O/F	N/R / N/A	23+	✓ / ✓	D-1	99-025	[signature]	GLOBAL HAWK FLIGHT	C6743A A98UGH00	[initials]
	CCD	GREENWAY, V	CIV															
	CCD	WATSON, E	CIV															

AFMC FORM 83 EF ESS, MAY 94 REPLACES AFMC FORM 83 JUL 92 WHICH IS OBSOLETE

```
KEDW FCST COR 13-13 VRB06KT 7 SKC ALSTG30.06INS VIS 30 T01/14Z
    T25/23Z
    BECMG 18-19 25012KT 7 SKC LGT TURB SFC-050 ALSTG30.04INS VIS 35
    WND 27015G20KT AFT 21Z
    BECMG 01-02 25012G18KT 7 FEW250 LGT-MDT CAT SFC-080
    ALSTG30.00INS VIS 30 WND 25010KT AFT 04Z
    BECMG 10-11 24015G20KT 7 SCT250 LGT TURB SFC-060 ALSTG29.95INS
    VIS 25 COR 1310 11/RW
FTNA26 KAWN 291300 RTD
KEDW COR 291313 VRB06KT 9999 SKC QNH3006INS T01/14Z T25/23Z
    BECMG 1819 26012KT 9999 SKC 510005 QNH3004INS WND 27015G20KT AFT
    21Z
    BECMG 0102 26012G18KT 9999 FEW250 520008 QNH3000INS WND 25010KT
    AFT 04Z
    BECMG 1011 25015G20KT 9999 SCT250 510006 QNH2995INS COR 1310
```

R2508 / PALMDALE FORECAST WEATHER MESSAGE

HIS PRODUCT IS PRODUCED ONCE A DAY AT 0400L AND IS *FOR PLANNING PURPOSES ONLY* AND WILL NOT BE AMENDED
CONTACT 412 OSS/OSW EDWARDS AFB WEATHER FOR FLIGHT WEATHER INFORMATION AT (805)277-4472

INFORMATION GIVEN IN THE FOLLOWING UNITS UNLESS OTHERWISE NOTED:
TEMPERATURE:CELSIUS / **HEIGHTS:**MSL / **VSBY:**STATUTE MILES / **WINDS:**KNOTS / **TIMES:**ZULU
VALID TIME: 29/1400Z (0600L) TO 30/0600Z (29/2200L) INITIALS:RW

SUN / MOON DATA

SUNRISE: 0543L **MOONRISE:** 1619L
SUNSET: 1810L **MOONSET:** 30/0442L **ILLUMINATION:** 93%

R2508 FORECAST

CLOUDS: SKC/ AFT 20Z: SCT250
VISIBILITY AND WEATHER: 7+ / NONE
MIN ALSTG: 30.03 **INS**
SFC WNDS: VRB06KT / AFT 18Z: 26012KT / AFT 21Z: 27015G20KT / AFT 04Z: 25010KT
HAZARDS: TSTMS: NONE **ICING:** NONE
TURBULENCE: AFT 21Z: LGT SFC - 060
INDUCTION ICING (T<47 &RH >50%): YES TIL 17Z

FLIGHT LEVEL WINDS & TEMPERATURES

	WINDS	TEMPS		WINDS	TEMP		WINDS	TEMP
030:	26015	20	**040:**	26018	18	**050:**	27020	16
100:	25016	03	**150:**	24024	-08	**200:**	24033	-19
250:	24041	-31	**300:**	24053	-41	**350:**	24058	-53
400:	25063	-61	**450:**	25061	-61	**500:**	25051	-63
550:	25046	-65	**600:**	26043	-64			

DIVERT WEATHER

PALMDALE: SKC/ AFT 21Z: SCT250 7+ / NONE
(SEE WINDS BELOW) **MIN ALSTG:** 30.05 **INS**
CHINA LAKE: SKC / AFT 22Z: SCT250 7+ / NONE
VRB06KT / AFT 20Z: 25012KT / AFT 23Z: 27015G20KT / AFT 05Z: 25010KT **MIN ALSTG:** 30.06 **INS**

PALMDALE FORECAST SURFACE WINDS

0600L: VRB06KT **0900L:** 26010KT **1200L:** 26012G18KT
1500L: 27015G20KT **1800L:** 26014KT **2100L:** 25010KT

FORECAST TEMPERATURES AND PRESSURE ALTITUDES FOR EDWARDS AND PALMDALE

	TEMPERATURE		PRESSURE ALTITUDE			TEMPERATURE		PRESSURE ALTITUDE	
TIME	°F	°C	EDW	PMD	TIME	°F	°C	EDW	PMD
00L / 08Z	40	4	2216	2457	12L / 20Z	69	21	2142	2383
01L / 09Z	38	3	2152	2393	13L / 21Z	72	22	2152	2393
02L / 10Z	36	2	2142	2383	14L / 22Z	76	24	2152	2393
03L / 11Z	35	2	2132	2373	15L / 23Z	76	24	2142	2383
04L / 12Z	33	1	2122	2363	16L / 00Z	74	23	2142	2383
05L / 13Z	32	0	2112	2353	17L / 01Z	69	21	2132	2373
06L / 14Z	33	1	2102	2343	18L / 02Z	63	17	2132	2373
07L / 15Z	38	3	2122	2363	19L / 03Z	56	13	2122	2363
08L / 16Z	42	6	2132	2373	20L / 04Z	50	10	2122	2363
09L / 17Z	49	9	2142	2383	21L / 05Z	47	8	2112	2353
10L / 18Z	55	13	2142	2383	22L / 06Z	45	7	2112	2353
11L / 19Z	63	17	2142	2383	23L / 07Z	43	6	2102	2343

http://ews.elan.af.mil/text/hpmg.htm

SURFACE WEATHER OBSERVATIONS (METAR/SPECI)

LATITUDE	LONGITUDE	STATION ELEVATION	TIME CONVERSION	MAG to TRUE	DAY (LST)	MONTH	YEAR	STATION (or grid coord) & STATE or COUNTRY
34°54'N	117°53'W	2302 Feet (MSL)	(LST to (+) 8 Hrs. UTC) - 8 Hrs.	(+)10 Deg.	29	MAR	1999	EDWARDS AFB, CA

SYNOPTIC DATA

TIME (UTC) (41)	TIME (LST) (42)	NO (43)	PRECIP (water equiv.) (44)	SNOW FALL (45)	SNOW DEPTH (46)
Mid (LST) to: 1150	Mid to: 0350		O	O	
1150	0350	(1)	O	O	O
1750	0950	(2)			
2350	1550	(3)			
0550	2150	(4)			
Mid (LST)	Mid (LST)				

SUMMARY OF THE DAY

24-HR MAX TEMP (oC) (18)	PRECIP. (water equiv.) (19)	SNOW FALL (20)	SNOW DEPTH (70)
24-HR MIN TEMP (oC) (17)	**SPEED (knots) (21)**	**DRCTN (true) (72)**	**TIME (UTC) (73)**

ACTIVE RNWY AND EQUIP CHANGE

TIME (UTC)	RWY No.
CONT	22

(90) REMARKS, NOTES, AND MISCELLANEOUS PHENOMENA (all times UTC)

TIME CHECK -23 Seconds
MAX TEMP °F
MIN TEMP °F
AFLD OPEN@
AFLD CLSD@
AIRCRAFT MISHAP 1844

TYPE (1)	TIME (UTC) (2)	WIND DRCTN (true) (9A)	WIND SPEED (knots) (10)	MAX WIND (knots) (11)	VARIABILITY (true) (9B)	VISIBILITY METERS (4A)	VISIBILITY MILES (4B)	RUNWAY VISUAL RANGE LOCAL (4C)	WEATHER AND OBSTRUCTIONS TO VISION (5)	SKY CONDITION (3)	TEMP (oC) (7)	DEW POINT (oC) (8)	ALSTG (inches) (12)	STA PRESSURE (inches) (17)	TOTAL SKY CVR (21)	OBS INIT (18)
SA	0855	160	07				25			SKC	06	M02	3012	27.705	0	JD
(13) RMK SLP 188 56005 RCRNR																
SA	0955	260	03				35			SKC	02	M01	3012		0	JD
(13) RMK SLP 189 RCRNR																
SA	1055	210	01				45			SKC	00	M05	3012		0	JD
(13) RMK SLP 190 RCRNR																
SA	1155	010	01				45			SKC	01	M05	3011	27.695	0	JD
(13) RMK SLP 188 57003 RCRNR																
SA	1255	300	01				45			SKC	M00	M05	3012		0	JD
(13) RMK SLP 193 RCRNR																
SA	1355	160	01				45			SKC	M00	M05	3012		0	JD
(13) RMK SLP 195 RCRNR																
SA	1455	250	03				45			SKC	03	M04	3013	27.710	0	JD
(13) RMK SLP 195 53005																
SA	1555	350	01				35			SKC	09	M04	3012		0	RW
(13) RMK SLP 195																
SA	1655	150	05				35			SKC	11	M03	3012		0	RW
(13) RMK SLP 195																
SA	1755	060	02				40			SKC	15	M03	3011	27.690	0	RW
(13) RMK SLP 195 58007																
L	1844	220	05				40			SKC	18	M03	3009	27.670	0	RW
(13) RMK																
(13) RMK																
(13) RMK																

AF FORM 3803, Jul 93. PREVIOUS EDITION IS OBSOLETE.

RECORD REPRODUCTION COVER SHEET

The attached records are:

Releasable to the Public ☑

Denied to the Public ☐

Subject:

1999 Global Hawk Accident Report

FOIA Control Number: 07-283 LK

Date Reproduced: 11 Oct 07

2 of 7

DD FORM 365-4, FORM F
WEIGHT AND BALANCE CLEARANCE

Tab L

TAB L

INDEX

DARPA GLOBAL HAWK USAF TELEDYNE RYAN AERONAUTICAL

MEMORANDUM

DATE: **March 30, 1999** **367-1200-1046**

TO: **S. Harris**

FROM: **T. Johanson**

SUBJECT: **AV2_FLT08 Post Flight Weight and CG Summary**

CC: **Distribution**

Documentation of pertinent weight, cg, and fuel quantity information for AV2's 8th flight is provided below. Configuration was identical to AV2_FLT07, except for fuel load. Center of Gravity values were derived from previous measurements.

Fuel Load Build-Up of AV2. for FLT08 :

CONDITION	WEIGHT (Pounds)	C.G. Yf F.S. (in)	C.G. % MAC
DRY WEIGHT	11985	385.5	32.6
UNUSABLE FUEL	200	368.1	
ZERO FUEL WEIGHT	12185	385.2	32.1
USABLE FUEL	9296	382.9	
GROSS WEIGHT Pre-Engine Start	21481*	384.2**	30.5
GROSS WEIGHT End-Of-Flight, Engine Shut Down	17969*	~385.7 **	33.0

Δ Measurements-Scale Fuel Usage-	3512	Total Fuel Used
Fuel Remaining-	5984	Engine shut-down

* Actual Measured Values, ** Calculated using previous test data.

FQR VALUES TO COMPARE WITH SCALE READINGS

Condition	FQR Reading (pounds)	
Engine Start	9496	
		432 pounds fuel used for pre-flight checkout, taxi & hold
Take-Off (start of roll)	9064	
		2918 pounds fuel used for flight.
Touch-Down, Vehicle Stopped	6146	
		47 pounds fuel used before engine shut down on ground for taxi.
Engine shutdown	6099	
		3397 pounds total fuel usage from FQR readings.

CERTIFICATE OF DAMAGE

Tab M

TAB M

INDEX

CERTIFICATE OF DAMAGE

The RQ-4A aircraft, serial number 95-2002, was totally destroyed as a result of the mishap. The aircraft was configured with an integrated sensor suite consisting of an electro-optical/infrared camera and a synthetic aperture radar. It carried no external stores or pods and did not have any electronic warfare system equipment installed. The damage/loss costs were provided by ASC/RAV.

RQ-4A (prototype)	$30,000,000	$30,000,000
Integrated Sensor Suite	$15,000,000	$15,000,000
	GRAND TOTAL	$45,000,000

LARRY A MARTINSEN, Major, USAF
Maintenance Officer

TRANSCRIPTS OF RECORDED COMMUNICATIONS

Tab N

TAB N

INDEX

Transcript of Taped Conversation between Ryan One, Ryan Test Range Safety and Zoom 75
29 Mar 99

TIME UTC		
18:10:31	Zoom 75:	Wind 239 at 54, passing 41,500, speed 142, still in a left turn.
18:10:42	Ryan 1:	Ryan 1 copy.
18:10:44	Ryan 1:	And, uh, Ryan Test, Ryan 1.
18:10:48	Ryan Test:	Ryan 1, Ryan Test. Read you five square.
18:10:51	Ryan 1:	Uh, did you pick up the transient FTS 00?
18:10:54	Ryan Test:	Negative.
18:10:56	Ryan 1:	Uh, O.K.
18:11:00	Ryan 1:	Uh, roger. Cleared for your configuration MC.
18:11:03	Zoom 75:	She's going upside down. Station will back out. She's in a spin. She's in a spin. OK, right hand wing. Both wings are dumping fuel. She's in a spin. Still going straight down slowly throughout. She's in a flat spin.
18:11:23	Zoom 75:	She's in a flat spin.
18:11:25	Ryan 1:	O.K. Ryan Test, Ryan 1. We're in a terminate.
18:11:30	Zoom 75:	Both wings have fuel….
18:11:31	Ryan Test:	Range Safety, Ryan Test.
18:11:33	Zoom 75:	Still in a right hand spin, (garbled), both spoilers out.
18:11:42	Zoom 75:	Need to get the nose down.
18:11:51	Ryan Test:	Yeah, we show engine off.

18:11:58	Zoom 75:	Spoilers are still out.
18:12:00	Range Safety:	Ryan Test, Range Safety.
18:12:01	Zoom 75:	Spin. Right-hand flat spin.
18:12:05	Ryan Test:	Range Safety, Ryan Test.
18:12:07	Range Safety:	Yes, sir.
18:12:10	Range Safety:	Go ahead Ryan Test.
18:12:11	Ryan Test:	Standby a second.
18:12:18	Zoom 75:	O.K. She's nose (garbled).
18:12:21	Ryan Test:	OK, are we going straight down?
18:12:23	Zoom 75:	She still looks intact. She's passing 22,000 feet. Still in a right hand spin.
18:12:31	Ryan Test:	Copy 75. Range Safety, Ryan Test. What's our ground track show?
18:12:40	Range Safety:	What's your ground track show?
18:12:43	Ryan Test:	Are we pretty much going straight down?
18:12:44	Range Safety:	Roger that, sir.
18:12:45	Zoom 75:	Affirmative, that's, uh, Zoom 75.
18:12:54	Ryan Test:	I prefer not to have you, uh, do anything, uh, if that's, uh, ok with you if we are going straight down.
18:13:00	Zoom 75:	Break, break. The ground underneath is clear before (garbled) we try to recover.
18:13:06	Range Safety:	RSO copies.
18:13:11	Zoom 75:	Still in a right hand spin. Aircraft still intact. Spoilers are still out.

18:13:18	Ryan Test:	Roger, 75.
18:13:26	Zoom 75:	He's got the nose down. It's about a 20 to 25 degree, but it doesn't look like he can get it to come out. You need to get that nose down more if at all possible.
18:13:36	Ryan Test:	Uh, (garbled) sorry. Nothing we can do, but keep on talking though.
18:13:44	Range Safety:	Ryan Test, RSO.
18:13:45	Ryan Test:	Go ahead RSO.
18:13:47	Range Safety:	I was, uh, directed by, uh, Chief Range Safety to terminate vehicle.
18:13:51	Ryan Test:	Understand, RSO.
18:13:54	Zoom 75:	There is absolutely nothing within 10 miles of the craft. She's going straight down. Spoilers are still out.Still in a right hand spin. The wingtips have quit spewing out whatever looked like fuel. It's about 2,000 feet above the ground. I'm leveling out. Spoilers are still out.
18:14:17	Ryan Test:	OK, watch your terrain fuzzy.
18:14:20	Zoom 75:	Yeah. I'm at a safe range, no problem.
18:14:25	Ryan Test:	Terrain clearance.
18:14:35	Zoom 75:	It's about to impact.
18:14:42	Zoom 75:	And she's in the ground. No flames, just dust.
18:14:48	Ryan Test:	Roger, say general location.
18:14:50	Zoom 75:	O.K. Standby one. I'll get you a lat/long in a second.
18:14:54	Ryan Test:	Roger.

18:14:57	Zoom 75:	O.K. Absolutely no flames. Looks like the nose and the tail snapped off. Wings are still intact.

ANY ADDITIONAL SUBSTANTIATING DATA REPORTS

TAB O

INDEX

THIS TAB NOT INCLUDED

Tab O

STATEMENT OF DAMAGE TO PRIVATE PROPERTY

Tab P

TAB P

INDEX

THIS TAB NOT USED

ORDERS APPOINTING INVESTIGATIVE BOARD

Tab Q

TAB Q

INDEX

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE MATERIEL COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

SPECIAL ORDER: SE-99-01/1 30 Mar 99

Pursuant to AFI 91-204, para 1.4, and the authority of COMAFMC to convene aircraft safety investigations under that instruction, the following individuals, organizations indicated, are appointed as Safety Investigation Board Members to investigate the Class A UAV mishap, Global Hawk 95-2002, possessed by Teledyne-Ryan Co. and contracted by AFMC, from the Birk Flight Test Facility, Edwards AFB, CA, which occurred on 29 March 1999. The SIB will determine the cause(s) of this mishap, make recommendations to prevent recurrence, and prepare a formal mishap report as prescribed in AFI 91-204. Board duties imposed on these individuals will take precedence until the investigation is complete. The unit to which the individual is assigned will prepare orders for TDY funding.

Col Reed Roberts SIB President	SSN	WR-ALC/LBP Robins AFB GA
Maj Scott L. McLaughlin Investigating Officer	SSN	SA-ALC/SEF Kelly AFB TX
Maj Paul S. Daly UAV Operator	SSN	31 TES (ACC) Edwards AFB CA
Maj Larry A. Martensen Maintenance Officer	SSN	ASC/RAV WP AFB OH
2Lt Anthony R. Deguchi Recorder (Non Primary)	SSN	412 TS Edwards AFB CA
GS-13 James R. Coates Technical Representative (Non Primary)	SSN	ASC/RAV WP AFB OH

FOR THE COMMANDER

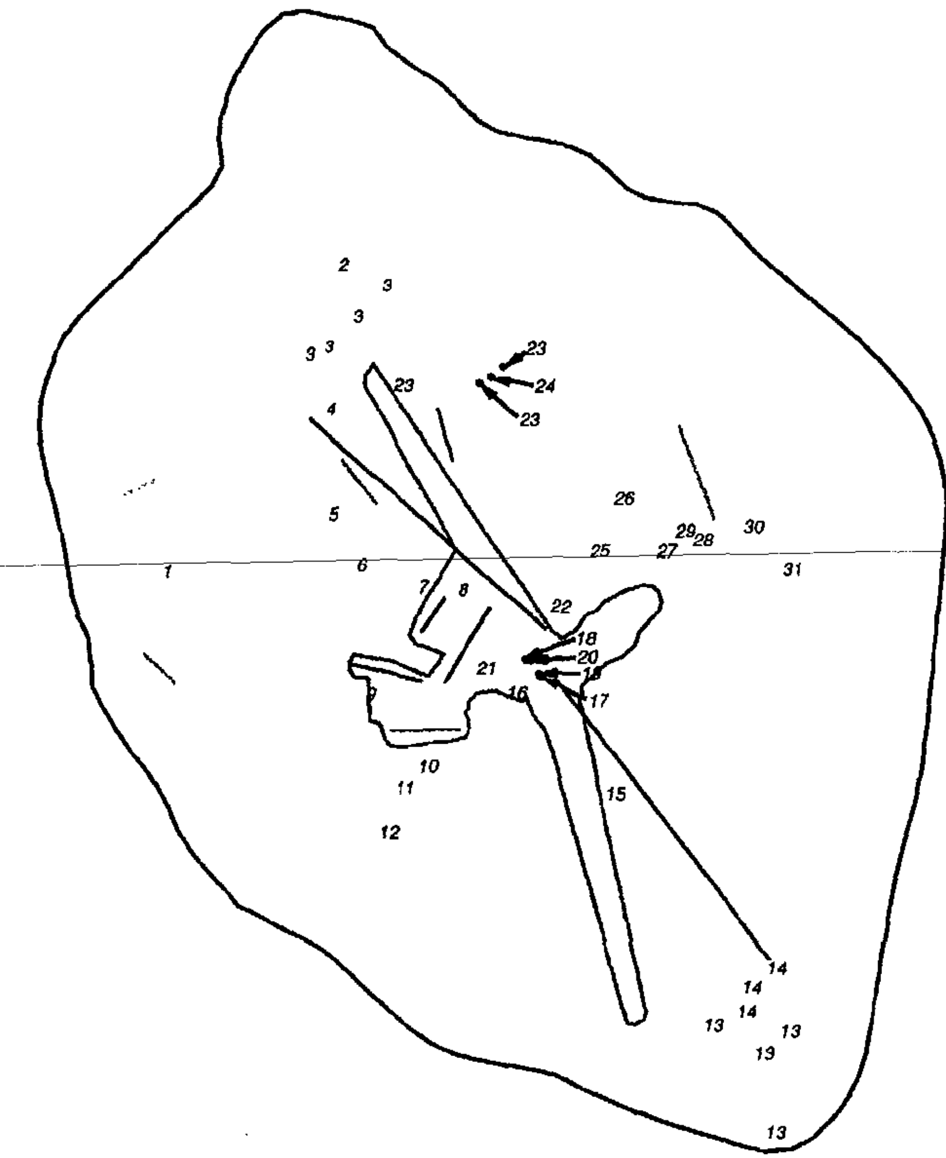
MICHAEL E. SCOTT, COLONEL, USAF
Director of Safety

DIAGRAMS

Tab R

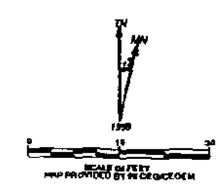
TAB R

INDEX



- OUTLINE OF CRASH SITE BOUNDARY
- AIRCRAFT RESTING POSITION
- RIGHT AND LEFT WING IMPACT SITES
- AFT ENGINE NACEL
- PNEUMATIC TUBE
- LEFT TAIL WING
- RIGHT TAIL WING
- ENGINE
- SATCOM / RADOME COVER
- ENGINE COVER
- OUTER AELERON
- INNER AELERON

1 ENGINE NACEL IMPACT SITE
2 WING TIP CAP
3 RED GLASS
4 WING UNDERSIDE
5 AFT TAIL PIPE SHROUD
6 FORWARD NACEL
7 COOLING TUBE
8 INLET ENGINE BULKHEAD
9 CENTER OF TAIL
10 RIGHT COMPOSITE BULKHEAD
11 AFT FUSELAGE MOUNT ROD
12 AFT COMPOSITE FUSELAGE SECTION
13 GREEN GLASS
14 CLEAR GLASS
15 LINE OF SITE ANTENNA
16 REAR MAIN BODY IMPACT SITE
17 MAIN BODY SPLIT POINT - FRONT SECTION
18 MAIN BODY SPLIT POINT - REAR SECTION
19 RIGHT MAIN LANDING GEAR
20 LEFT MAIN LANDING GEAR
21 REAR SECTION MAIN BODY RESTING POINT
22 ACCESS COVER
23 ENGINE INLET BULKHEAD
24 FUSELAGE COWLING
25 BULKHEAD
26 TURTLEBACK
27 SATCOM ANTENNA
28 NOSE ALIGNING ROD
29 TRANSDUCER
30 BULKHEAD INLET
31 ACCESS PANEL



GLOBAL HAWK IMPACT SITE

S

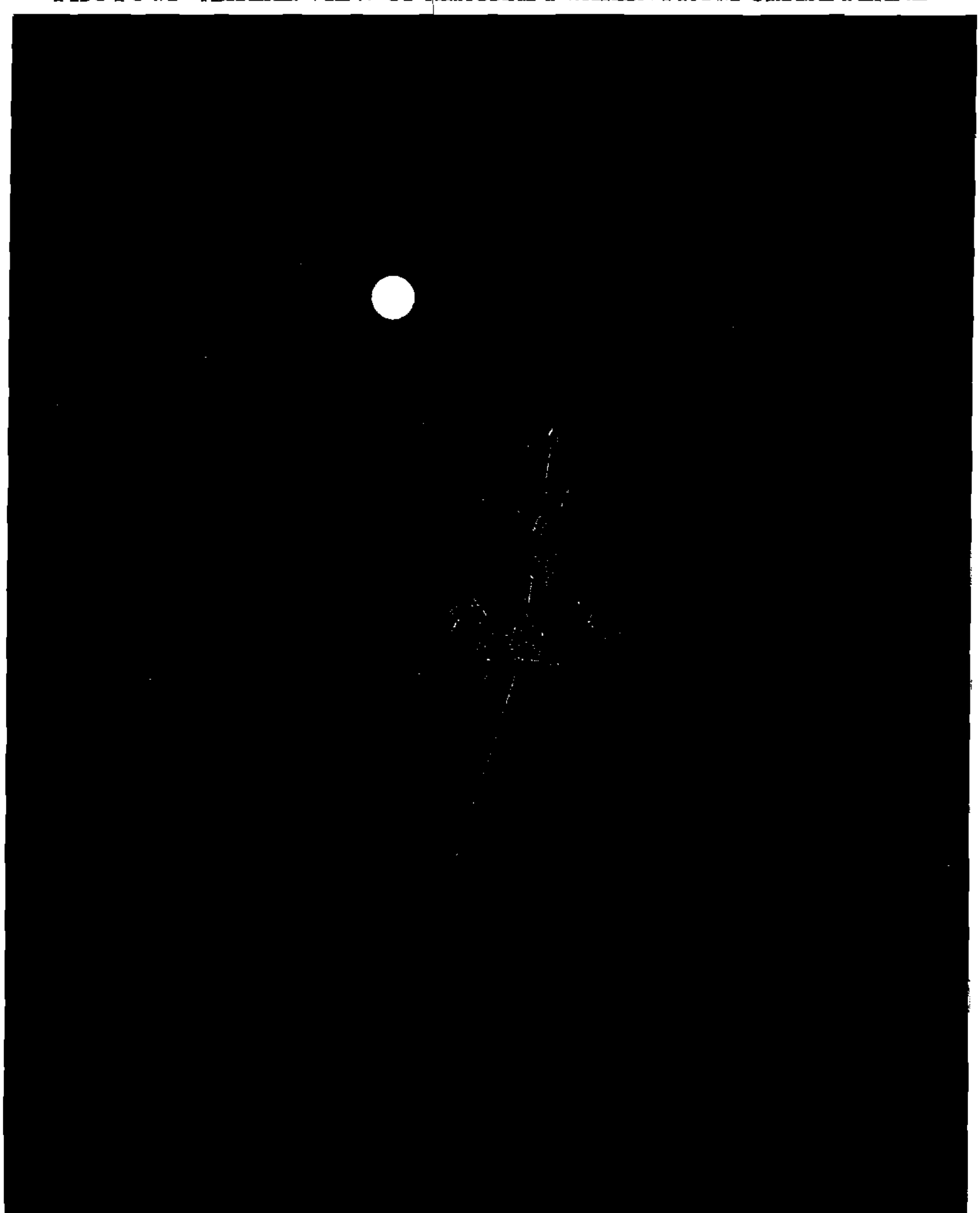
Tabs

TAB S

INDEX

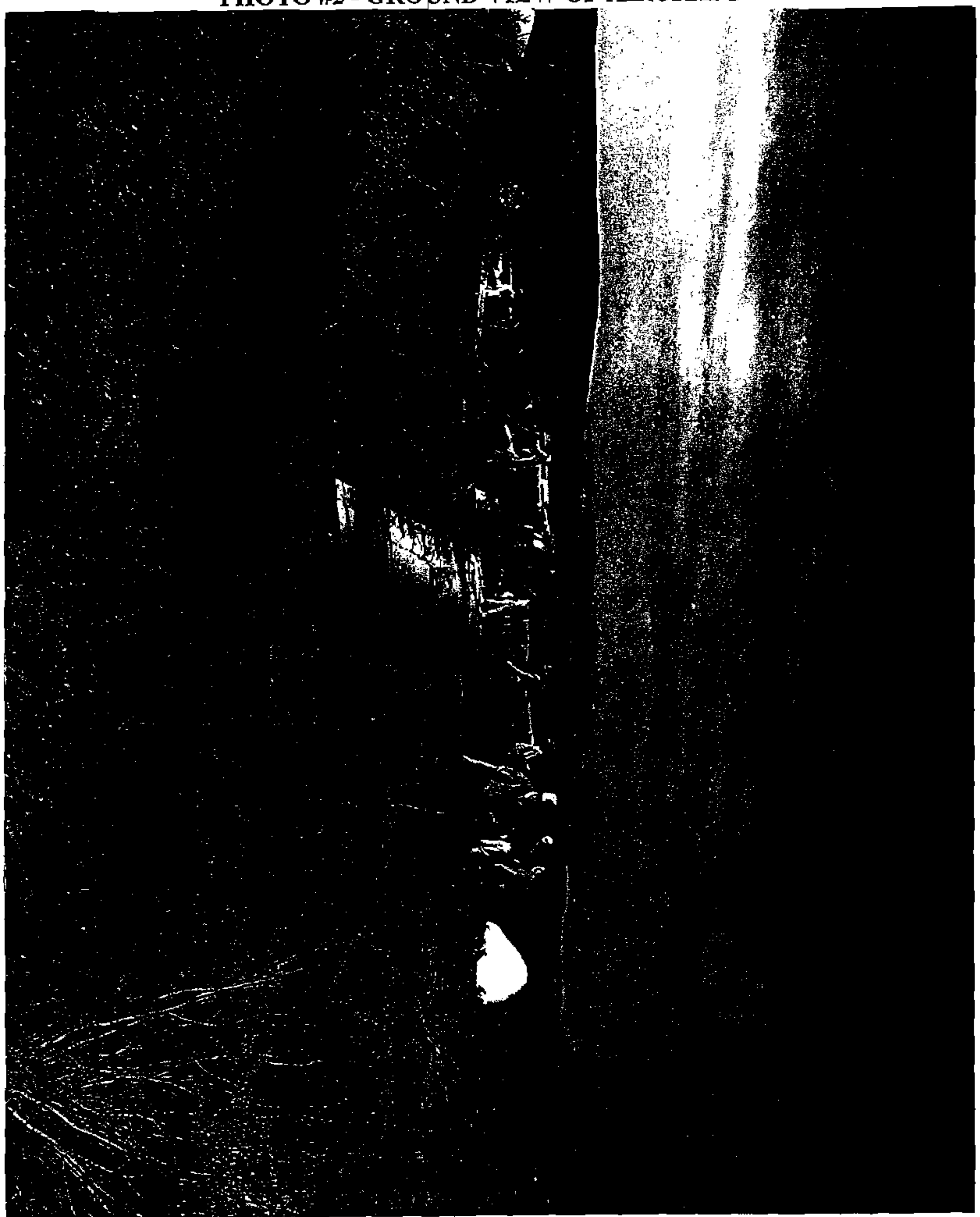
TAB S

PHOTO #1 - AERIAL VIEW OF AIRCRAFT TAKEN FROM CHASE PLANE



TAB S

PHOTO #2 - GROUND VIEW OF AIRCRAFT

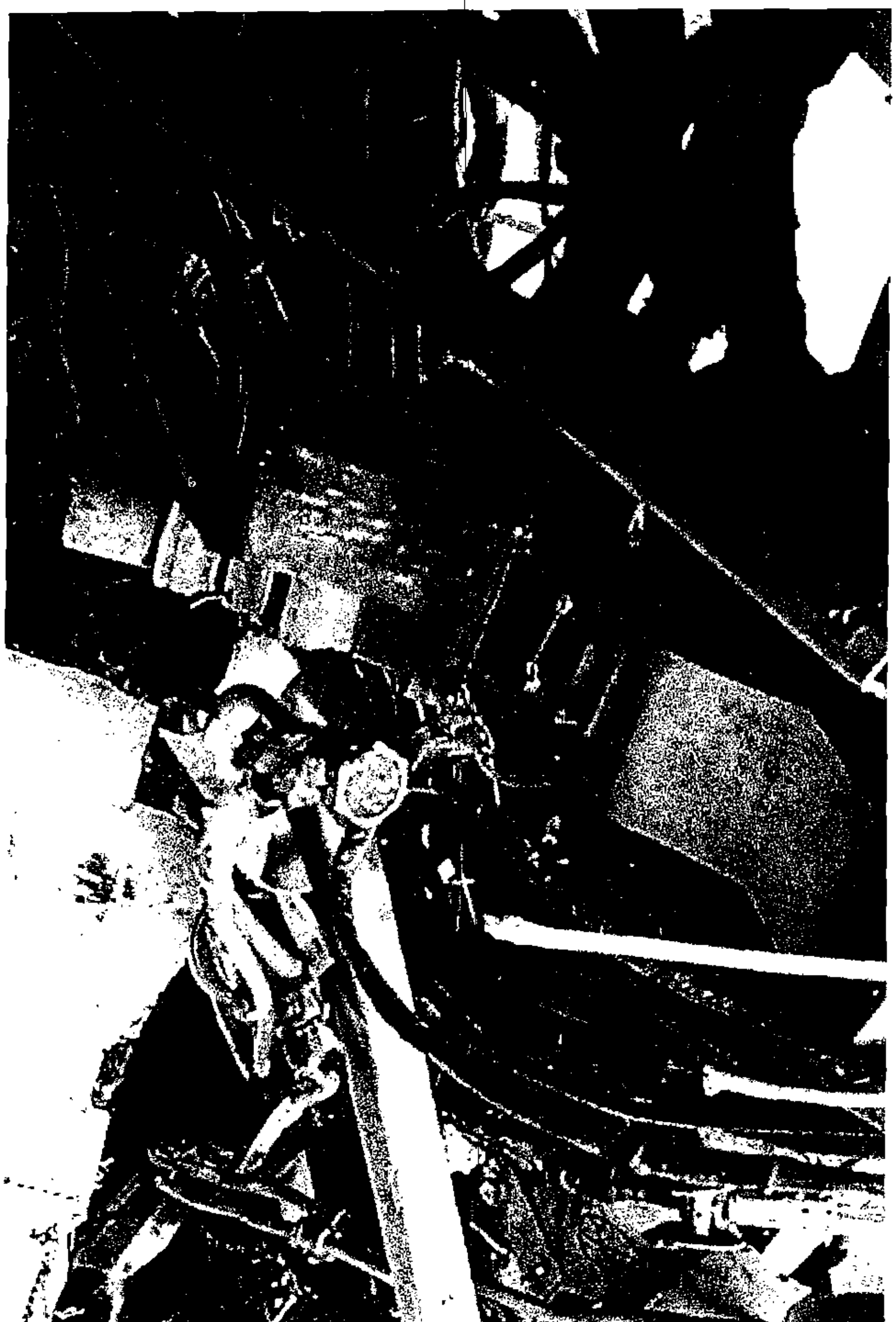


TAB S

PHOTO #3 - CLOSEUP OF SPOILERS STILL DEPLOYED (TYPICAL OF ALL), KEY PART OF FLIGHT TERMINATION SEQUENCE

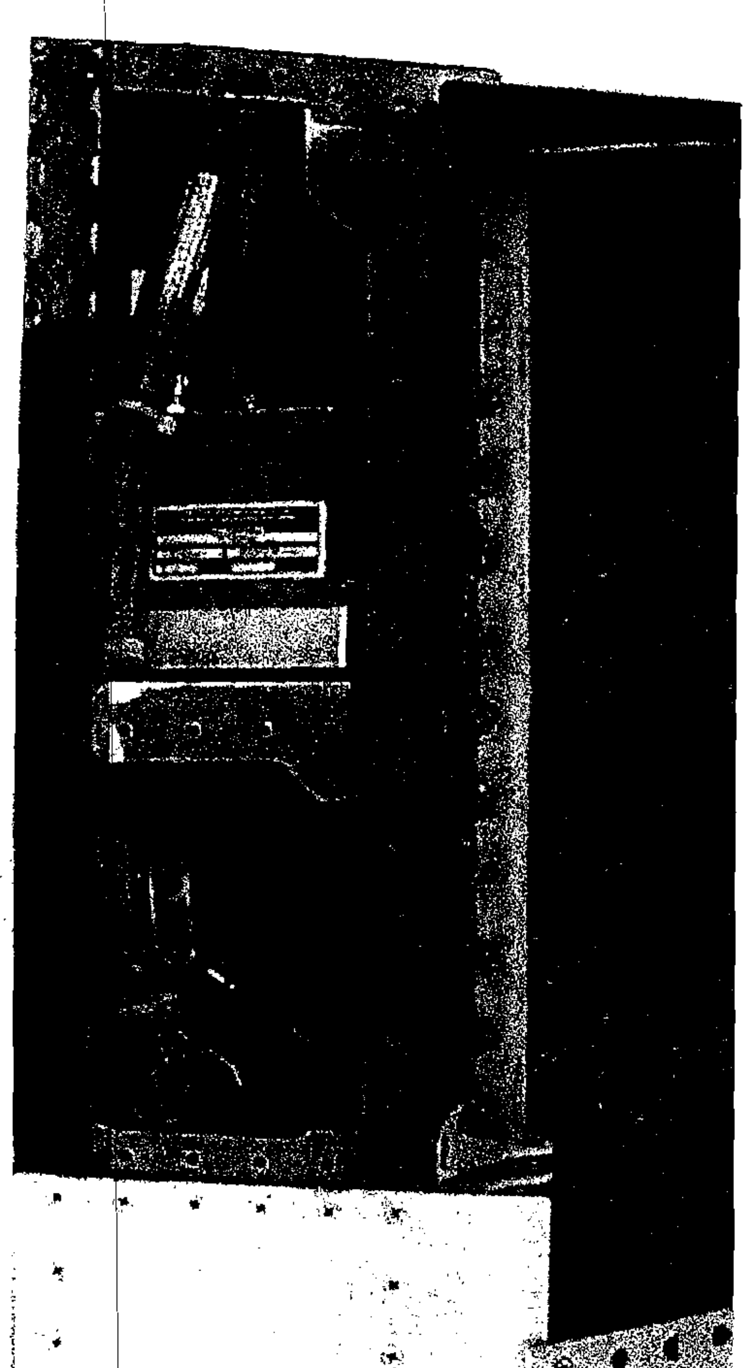
TAB S

PHOTO #4 - MAIN FUEL SHUT-OFF VALVE IN CLOSED POSITION, KEY PART OF FLIGHT TERMINATION SEQUENCE



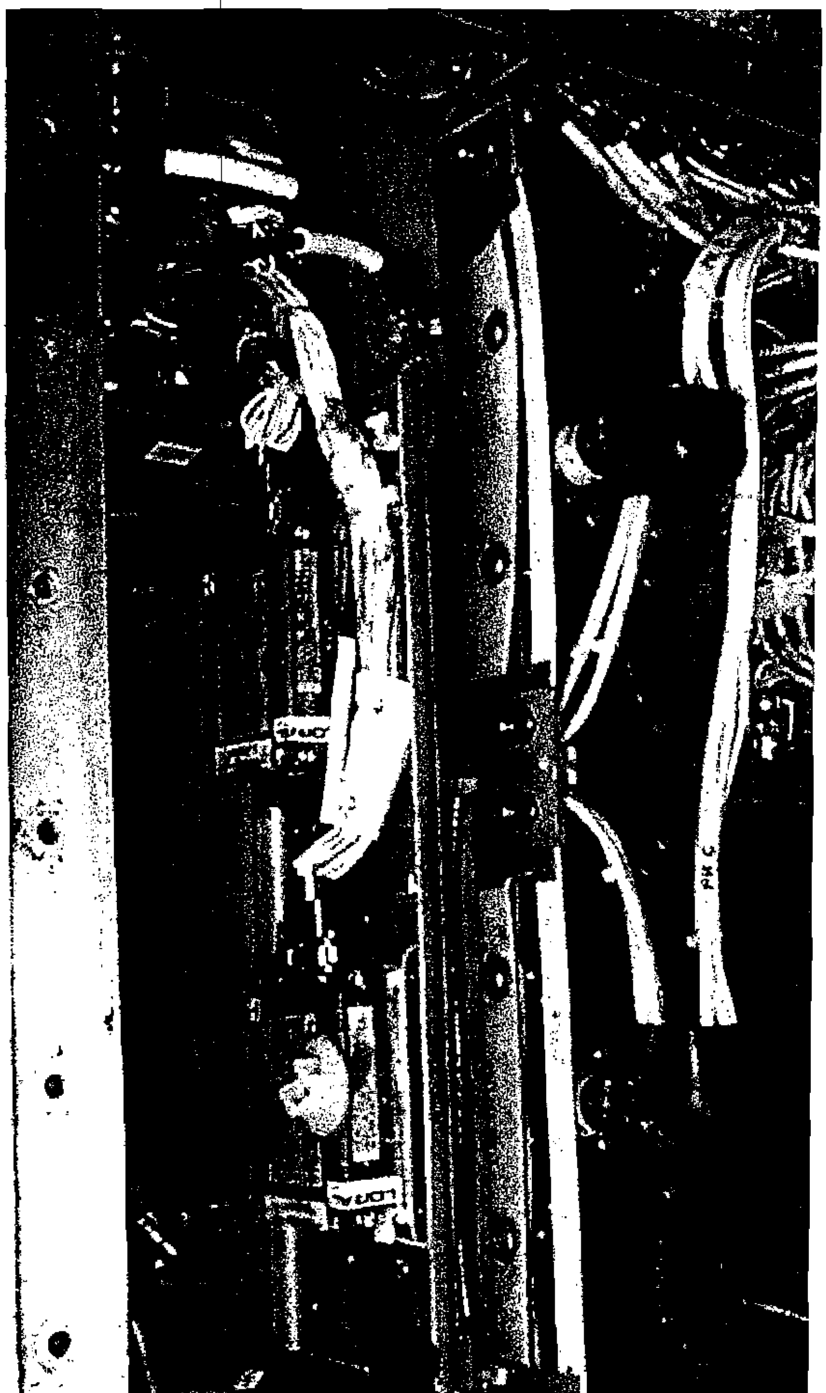
TAB S

PHOTO #5 - LEFT OUTBOARD AILERON ACTUATOR (BOTH INBOARD AND OUTBOARD LEFT AILERON ACTUATORS FRACTURED AT IMPACT, BOTH RIGHT AILERON ACTUATORS STILL INTACT), INDICATIVE OF FLIGHT TERMINATION MANEUVER



TAB S

PHOTO #6 - FLIGHT TERMINATION RECEIVERS (SUSTAINED NO EXTERNAL DAMAGE ON IMPACT)



INDIVIDUAL FLIGHT RECORDS
AND ORDERS
(NOT INCLUDED IN TAB G)

Tab I

TAB T

INDEX

THIS TAB NOT USED

RECORD REPRODUCTION COVER SHEET

The attached records are:

Releasable to the Public ☑

Denied to the Public ☐

Subject:

1999 Global Hawk Accident Report

FOIA Control Number: 07-283 LK

Date Reproduced: 11 Oct 07

3 of 7

AIRCRAFT MAINTENANCE RECORDS
(NOT INCLUDED IN TABS H OR O)

Tab U

TAB U

INDEX

```
******************************************************
*                                                    *
*          FLIGHT TERMINATION RECEIVER TEST          *
*                                                    *
*     Naval Air Warfare Center - Weapons Division    *
*          Code 543     China Lake California        *
*                                                    *
******************************************************
```

FTR Model : Loral FTR-915A **Serial No. 0086**

Test Date : 02-16-1999 , 9:19:23 AM

FTR Test Set Calibration
Expiration Date : 9/10/99

Operating Frequency : 425 MHz
3dB IF BW Spec.: 180 KHz
60dB IF BW Spec.: 360 KHz
Tone C : Tone 5 12.14 KHz

Temperature : Ambient (+25 deg C)

Tested by : George Fields

Test Set Position: 1

Configuration Comments : Certification Test

Test Sequence Comments : Standard 17 Tests

Software Version : 1.7.0

Certification DATE: 17 FEB 99
CERT. Due DATE: 17 AUG 99

Loral FTR-915A **Serial No. 0086**

Ambient (+25 deg C) (425 MHz) 02-16-1999 , 9:19:23 AM

Case Isolation Test

Command Output	Value Measured	Spec. Min. (Megohms)	Pass/Fail
Monitor	9.90E+31	1.00	Pass
Optional	9.90E+31	1.00	Pass
Arm	9.90E+31	1.00	Pass
Destruct	9.90E+31	1.00	Pass

Test completed : 9:20:33 AM Test Time(min): 0:42 **Test PASSED**

Input Current/Voltage Test

Input Voltage	Relays Deenergized (Spec < 225mA)	Pass/ Fail	Relays Energized (Spec < 225mA)	Pass/ Fail
28 Volts	0.1834	Pass	0.2	Pass
24 Volts	0.1834	Pass	0.2	Pass
36 Volts	0.1834	Pass	0.2	Pass

Test completed : 9:21:12 AM Test Time(min): 0:38 **Test PASSED**

Loral FTR-915A **Serial No. 0086**

Ambient (+25 deg C) (425 MHz) **02-16-1999 , 9:19:23 AM**

Standard Logic Test

Tone Sequence #	Pass/Fail
1	Pass
2	Pass
3	Pass
4	Pass
5	Pass
6	Pass
7	Pass
8	Pass
9	Pass
10	Pass
11	Pass
12	Pass
13	Pass
14	Pass
15	Pass
16	Pass
17	Pass
18	Pass
19	Pass
20	Pass
21	Pass
22	Pass
23	Pass
24	Pass
25	Pass
26	Pass
27	Pass
28	Pass
29	Pass
30	Pass
31	Pass
32	Pass
33	Pass
34	Pass
35	Pass
36	Pass
37	Pass
38	Pass
39	Pass
40	Pass
41	Pass
42	Pass

Test completed : 9:23:30 AM Test Time(min): 2:17 **Test PASSED**

U-4

Loral FTR-915A | Serial No. 0086

Ambient (+25 deg C) | (425 MHz) | 02-16-1999 , 9:19:23 AM

Output Load Capacity Test

Output	Command	Measured	Spec.	Pass/Fail
Optional	Decoder current (Amps)	2.07	> 2	Pass
	Pulse duration (sec.)	5.44	> 5	Pass
Arm	Decoder current (Amps)	2.03	> 2	Pass
	Pulse duration (sec.)	5.44	> 5	Pass
Destruct	Decoder current (Amps)	2.03	> 2	Pass
	Pulse duration (sec.)	5.44	> 5	Pass

Test completed : 9:24:07 AM | Test Time(min): 0:37 | **Test PASSED**

Maximum RF Test

Maximum RF Input, dBm	Spec. Limit	Pass/Fail
-18	> -20	Pass

Test completed : 9:25:08 AM | Test Time(min): 1:00 | **Test PASSED**

RF Threshold Sensitivity Test

Input Voltage	Minimum RF Input, dBm	Spec. Limit	Pass/Fail
28	-116	< -107	Pass
24	-116	< -107	Pass
36	-116	< -107	Pass

Test completed : 9:26:47 AM | Test Time(min): 1:39 | **Test PASSED**

Operational (RF) Bandwidth Test

Output Command	Bandwidth (KHz) Lower	Bandwidth (KHz) Upper	Spec. Limit	Pass/Fail
Monitor	-86.61		< -45	Pass
Monitor		84.59	> +45	Pass
Optional	-71.50		< -45	Pass
Optional		72.51	> +45	Pass
Arm	-71.50		< -45	Pass
Arm		71.50	> +45	Pass
Destruct	-70.50		< -45	Pass
Destruct		69.49	> +45	Pass

Test completed : 9:32:17 AM | Test Time(min): 5:29 | **Test PASSED**

Loral FTR-915A Serial No. 0086

Ambient (+25 deg C) (425 MHz) 02-16-1999 , 9:19:23 AM

CW (IF) Bandwidth Test

Parameter	Min. Spec	Max. Spec	BW (KHz)	Pass/Fail
3-dB BW	180 KHz	-------	206.930	Pass
60-dB BW	-------	360 KHz	323.270	Pass

Test completed : 9:33:10 AM Test Time(min): 0:52 **Test PASSED**

Operating Center Frequency Test

Input Voltage	Operating Frequency (MHz)	Expected Frequency	Delta Percent	Spec. Limit	Pass/Fail
28	425.0029	425.0	0.000675	(0.005)	Pass
24	425.0029	425.0	0.000675	(0.005)	Pass
36	425.0029	425.0	0.000675	(0.005)	Pass

Test completed : 9:34:53 AM Test Time(min): 1:42 **Test PASSED**

Loral FTR-915A **Serial No. 0086**

Ambient (+25 deg C) (425 MHz) 02-16-1999 , 9:19:23 AM

Signal Strength Test

AGC rises 0.25 volts with a minimum RF input, TEST PASSED
AGC does not rise monotonically (between -107 to -51), TEST FAILED
AGC is within the 4.5 to 5.0 volts limits, TEST PASSED

Input,dBm	AGC Volts 10K Load	
	0.439	Quiescent Voltage
-121	0.483	
-116	0.567	
-111	0.750	
-106	1.075	
-101	1.659	
-96	2.446	
-91	3.098	
-86	3.541	
-81	3.873	
-76	4.208	
-71	4.656	
-66	4.752	
-61	4.751	
-56	4.751	
-51	4.751	
-46	4.751	
-41	4.751	
-36	4.751	
-31	4.751	

IRIG 313-94
3.2.13.3

SSTD Reaches Max With
Less Than -53 dBm

Test completed : 9:35:38 AM Test Time(min): 0:44 **Test FAILED**

ck/[illegible]

Tone Response, Normal Test

Command Output	Pass/Fail
Monitor	Pass
Optional	Pass
Arm	Pass
Destruct	Pass

Test completed : 9:35:54 AM Test Time(min): 0:16 **Test PASSED**

Page 7

Loral FTR-915A **Serial No. 0086**

Ambient (+25 deg C) **(425 MHz)** **02-16-1999 , 9:19:23 AM**

Tone Response, Off frequency Test (+/- 1%)

Command Output	Low Freq. Offset Pass/Fail	High Freq. Offset Pass/Fail
Monitor	Pass	Pass
Optional	Pass	Pass
Arm	Pass	Pass
Destruct	Pass	Pass

Test completed : 9:36:26 AM Test Time(min): 0:31 **Test PASSED**

Tone Response, Off deviation Test (+/- 2.5dB)

Command Output	Under Dev. Oper. Pass/Fail	Over Dev. Oper. Pass/Fail
Monitor	Pass	Pass
Optional	Pass	Pass
Arm	Pass	Pass
Destruct	Pass	Pass

Test completed : 9:36:58 AM Test Time(min): 0:31 **Test PASSED**

Output Response Time Test (Avg. of 10 cycles)

Command	Response Time (mSec)	Specification	Pass/Fail
Monitor	5.78	< 25	Pass
Optional	6.61	< 25	Pass
Arm	7.71	< 25	Pass
Destruct	19.47	< 25	Pass

Test completed : 9:37:23 AM Test Time(min): 0:25 **Test PASSED**

DC Power Cycling Test (30x)

Command Output	Transient/Erratic Output Detected	Pass/Fail
Optional	NO	Pass
Arm	NO	Pass
Destruct	NO	Pass

Test completed : 9:37:46 AM Test Time(min): 0:22 **Test PASSED**

Loral FTR-915A **Serial No. 0086**

Ambient (+25 deg C) **(425 MHz)** **02-16-1999 , 9:19:23 AM**

Spurious Response Rejection Test

0 Spurious Responses. Test Passed

Test completed : 9:53:32 AM Test Time(min): 15:45 **Test PASSED**

Output Voltages Test

Command Output	28V In (-1.5V)	Pass/Fail	24V In (-1.5V)	Pass/Fail	36V In (-1.5V)	Pass/Fail
Monitor	27.53	Pass	23.53	Pass	35.53	Pass
Optional	27.52	Pass	23.52	Pass	35.52	Pass
Arm	27.52	Pass	23.52	Pass	35.52	Pass
Destruct	27.52	Pass	23.53	Pass	35.53	Pass

Test completed : 9:54:33 AM Test Time(min): 1:00 **Test PASSED**

```
**********************************************************
*                                                        *
*          FLIGHT TERMINATION RECEIVER TEST              *
*                                                        *
*       Naval Air Warfare Center - Weapons Division      *
*           Code 543     China Lake California           *
*                                                        *
**********************************************************
```

FTR Model : Loral FTR-915A   Serial No. 0086

Test Date : 02-16-1999 , 9:19:23 AM

FTR Test Set Calibration
Expiration Date : 9/10/99

Operating Frequency : 425 MHz
3dB IF BW Spec.: 180 KHz
60dB IF BW Spec.: 360 KHz
Tone C : Tone 5 12.14 KHz

Temperature : Cold (-40 deg C)

Tested by : George Fields

Test Set Position: 1

Configuration Comments : Certification Test

Test Sequence Comments : Standard 17 Tests

Software Version : 1.7.0

Loral FTR-915A **Serial No. 0086**

Cold (-40 deg C) **(425 MHz)** **02-16-1999 , 9:19:23 AM**

Case Isolation Test

Command Output	Value Measured	Spec. Min. (Megohms)	Pass/Fail
Monitor	9.90E+31	1.00	Pass
Optional	9.90E+31	1.00	Pass
Arm	9.90E+31	1.00	Pass
Destruct	9.90E+31	1.00	Pass

Test completed : 10:18:42 AM Test Time(min): 0:42 **Test PASSED**

Input Current/Voltage Test

Input Voltage	Relays Deenergized (Spec < 225mA)	Pass/ Fail	Relays Energized (Spec < 225mA)	Pass/ Fail
28 Volts	0.1856	Pass	0.203	Pass
24 Volts	0.185	Pass	0.203	Pass
36 Volts	0.1856	Pass	0.205	Pass

Test completed : 10:19:21 AM Test Time(min): 0:38 **Test PASSED**

Loral FTR-915A **Serial No. 0086**

Cold (-40 deg C) **(425 MHz)** **02-16-1999 , 9:19:23 AM**

Standard Logic Test

Tone Sequence #	Pass/Fail
1	Pass
2	Pass
3	Pass
4	Pass
5	Pass
6	Pass
7	Pass
8	Pass
9	Pass
10	Pass
11	Pass
12	Pass
13	Pass
14	Pass
15	Pass
16	Pass
17	Pass
18	Pass
19	Pass
20	Pass
21	Pass
22	Pass
23	Pass
24	Pass
25	Pass
26	Pass
27	Pass
28	Pass
29	Pass
30	Pass
31	Pass
32	Pass
33	Pass
34	Pass
35	Pass
36	Pass
37	Pass
38	Pass
39	Pass
40	Pass
41	Pass
42	Pass

Test completed : 10:21:39 AM Test Time(min): 2:17 **Test PASSED**

Loral FTR-915A | **Serial No. 0086**

Cold (-40 deg C) | **(425 MHz)** | **02-16-1999 , 9:19:23 AM**

Output Load Capacity Test

Output Command		Measured	Spec.	Pass/Fail
Optional	Decoder current (Amps)	2.08	> 2	Pass
	Pulse duration (sec.)	5.44	> 5	Pass
Arm	Decoder current (Amps)	2.04	> 2	Pass
	Pulse duration (sec.)	5.44	> 5	Pass
Destruct	Decoder current (Amps)	2.04	> 2	Pass
	Pulse duration (sec.)	5.44	> 5	Pass

Test completed : 10:22:14 AM   Test Time(min): 0:34   **Test PASSED**

Maximum RF Test

Maximum RF Input, dBm	Spec. Limit	Pass/Fail
-18	> -20	Pass

Test completed : 10:23:15 AM   Test Time(min): 1:00   **Test PASSED**

RF Threshold Sensitivity Test

Input Voltage	Minimum RF Input, dBm	Spec. Limit	Pass/Fail
28	-116	< -107	Pass
24	-117	< -107	Fail
36	-117	< -107	Fail

IRIG 313-94 3.2.3 RF Threshold Is more Sensitive Than -116dBm

Test completed : 10:24:47 AM   Test Time(min): 1:31   **Test FAILED**

Ok /[illegible]

Operational (RF) Bandwidth Test

Output Command	Bandwidth (KHz) Lower	Upper	Spec. Limit	Pass/Fail
Monitor	-85.60		< -45	Pass
Monitor		91.64	> +45	Pass
Optional	-70.50		< -45	Pass
Optional		78.55	> +45	Pass
Arm	-71.50		< -45	Pass
Arm		78.55	> +45	Pass
Destruct	-70.50		< -45	Pass
Destruct		76.54	> +45	Pass

Test completed : 10:30:30 AM   Test Time(min): 5:43   **Test PASSED**

Loral FTR-915A **Serial No. 0086**

Cold (-40 deg C) **(425 MHz)** **02-16-1999 , 9:19:23 AM**

CW (IF) Bandwidth Test

Parameter	Min. Spec	Max. Spec	BW (KHz)	Pass/Fail
3-dB BW	180 KHz	-------	207.110	Pass
60-dB BW	-------	360 KHz	328.610	Pass

Test completed : 10:31:19 AM Test Time(min): 0:48 **Test PASSED**

Operating Center Frequency Test

Input Voltage	Operating Frequency (MHz)	Expected Frequency	Delta Percent	Spec. Limit	Pass/Fail
28	425.0088	425.0	0.002080	(0.005)	Pass
24	425.0089	425.0	0.002086	(0.005)	Pass
36	425.0089	425.0	0.002089	(0.005)	Pass

Test completed : 10:32:41 AM Test Time(min): 1:21 **Test PASSED**

Loral FTR-915A **Serial No. 0086**

Cold (-40 deg C) **(425 MHz)** **02-16-1999 , 9:19:23 AM**

Signal Strength Test

AGC rises 0.25 volts with a minimum RF input, TEST PASSED
AGC does not rise monotonically (between -107 to -51), TEST FAILED
AGC is within the 4.5 to 5.0 volts limits, TEST PASSED

Input, dBm	AGC Volts 10K Load	
	0.384	Quiescent Voltage
-121	0.480	
-116	0.653	
-111	1.015	
-106	1.573	
-101	2.192	See Ambient Test
-96	2.661	
-91	2.997	
-86	3.320	
-81	3.762	
-76	4.368	
-71	4.741	
-66	4.741	
-61	4.741	
-56	4.741	
-51	4.741	
-46	4.741	
-41	4.741	
-36	4.741	
-31	4.741	

Test completed : 10:33:26 AM Test Time(min): 0:44 **Test FAILED**

CL /12 [illegible]

Tone Response, Normal Test

Command Output	Pass/Fail
Monitor	Pass
Optional	Pass
Arm	Pass
Destruct	Pass

Test completed : 10:33:42 AM Test Time(min): 0:16 **Test PASSED**

Loral FTR-915A **Serial No. 0086**

Cold (-40 deg C) **(425 MHz)** **02-16-1999 , 9:19:23 AM**

Tone Response, Off frequency Test (+/- 1%)

Command Output	Low Freq. Offset Pass/Fail	High Freq. Offset Pass/Fail
Monitor	Pass	Pass
Optional	Pass	Pass
Arm	Pass	Pass
Destruct	Pass	Pass

Test completed : 10:34:14 AM Test Time(min): 0:31 **Test PASSED**

Tone Response, Off deviation Test (+/- 2.5dB)

Command Output	Under Dev. Oper. Pass/Fail	Over Dev. Oper. Pass/Fail
Monitor	Pass	Pass
Optional	Pass	Pass
Arm	Pass	Pass
Destruct	Pass	Pass

Test completed : 10:34:46 AM Test Time(min): 0:31 **Test PASSED**

Output Response Time Test (Avg. of 10 cycles)

Command	Response Time (mSec)	Specification	Pass/Fail
Monitor	5.13	< 25	Pass
Optional	6.91	< 25	Pass
Arm	7.54	< 25	Pass
Destruct	17.80	< 25	Pass

Test completed : 10:35:11 AM Test Time(min): 0:25 **Test PASSED**

DC Power Cycling Test (30x)

Command Output	Transient/Erratic Output Detected	Pass/Fail
Optional	NO	Pass
Arm	NO	Pass
Destruct	NO	Pass

Test completed : 10:35:34 AM Test Time(min): 0:22 **Test PASSED**

Loral FTR-915A **Serial No. 0086**

Cold (-40 deg C) **(425 MHz)** **02-16-1999 , 9:19:23 AM**

Spurious Response Rejection Test

0 Spurious Responses. Test Passed

Test completed : 10:51:20 AM Test Time(min): 15:46 **Test PASSED**

Output Voltages Test

Command Output	28V In (-1.5V)	Pass/Fail	24V In (-1.5V)	Pass/Fail	36V In (-1.5V)	Pass/Fail
Monitor	27.39	Pass	23.40	Pass	35.40	Pass
Optional	27.39	Pass	23.39	Pass	35.39	Pass
Arm	27.39	Pass	23.39	Pass	35.39	Pass
Destruct	27.39	Pass	23.39	Pass	35.39	Pass

Test completed : 10:52:20 AM Test Time(min): 0:59 **Test PASSED**

```
***************************************************
*                                                 *
*        FLIGHT TERMINATION RECEIVER TEST         *
*                                                 *
*    Naval Air Warfare Center - Weapons Division  *
*       Code 543    China Lake California         *
*                                                 *
***************************************************
```

FTR Model : Loral FTR-915A **Serial No. 0086**

Test Date : 02-16-1999 , 9:19:23 AM

FTR Test Set Calibration
Expiration Date : 9/10/99

Operating Frequency : 425 MHz
3dB IF BW Spec.: 180 KHz
60dB IF BW Spec.: 360 KHz
Tone C : Tone 5 12.14 KHz

Temperature : Hot (+70 deg C)

Tested by : George Fields

Test Set Position: 1

Configuration Comments : Certification Test

Test Sequence Comments : Standard 17 Tests

Software Version : 1.7.0

Loral FTR-915A **Serial No. 0086**

Hot (+70 deg C) **(425 MHz)** **02-16-1999 , 9:19:23 AM**

Case Isolation Test

Command Output	Value Measured	Spec. Min. (Megohms)	Pass/Fail
Monitor	9.90E+31	1.00	Pass
Optional	9.90E+31	1.00	Pass
Arm	9.90E+31	1.00	Pass
Destruct	9.90E+31	1.00	Pass

Test completed : 11:25:43 AM   Test Time(min) : 0:43   **Test PASSED**

Input Current/Voltage Test

Input Voltage	Relays Deenergized (Spec < 225mA)	Pass/ Fail	Relays Energized (Spec < 225mA)	Pass/ Fail
28 Volts	0.1806	Pass	0.195	Pass
24 Volts	0.1784	Pass	0.195	Pass
36 Volts	0.18	Pass	0.198	Pass

Test completed : 11:26:22 AM   Test Time(min) : 0:38   **Test PASSED**

Loral FTR-915A **Serial No. 0086**

Hot (+70 deg C) **(425 MHz)** **02-16-1999 , 9:19:23 AM**

Standard Logic Test

Tone Sequence #	Pass/Fail
1	Pass
2	Pass
3	Pass
4	Pass
5	Pass
6	Pass
7	Pass
8	Pass
9	Pass
10	Pass
11	Pass
12	Pass
13	Pass
14	Pass
15	Pass
16	Pass
17	Pass
18	Pass
19	Pass
20	Pass
21	Pass
22	Pass
23	Pass
24	Pass
25	Pass
26	Pass
27	Pass
28	Pass
29	Pass
30	Pass
31	Pass
32	Pass
33	Pass
34	Pass
35	Pass
36	Pass
37	Pass
38	Pass
39	Pass
40	Pass
41	Pass
42	Pass

Test completed : 11:28:40 AM Test Time(min): 2:17 **Test PASSED**

Loral FTR-915A **Serial No. 0086**

Hot (+70 deg C) **(425 MHz)** **02-16-1999 , 9:19:23 AM**

Output Load Capacity Test

Output Command		Measured	Spec.	Pass/Fail
Optional	Decoder current (Amps)	2.06	> 2	Pass
	Pulse duration (sec.)	5.44	> 5	Pass
Arm	Decoder current (Amps)	2.02	> 2	Pass
	Pulse duration (sec.)	5.44	> 5	Pass
Destruct	Decoder current (Amps)	2.03	> 2	Pass
	Pulse duration (sec.)	5.44	> 5	Pass

Test completed : 11:29:15 AM Test Time(min): 0:34 **Test PASSED**

Maximum RF Test

Maximum RF Input, dBm	Spec. Limit	Pass/Fail
-18	> -20	Pass

Test completed : 11:30:16 AM Test Time(min): 1:00 **Test PASSED**

RF Threshold Sensitivity Test

Input Voltage	Minimum RF Input, dBm	Spec. Limit	Pass/Fail
28	-115	< -107	Pass
24	-115	< -107	Pass
36	-115	< -107	Pass

Test completed : 11:31:51 AM Test Time(min): 1:34 **Test PASSED**

Operational (RF) Bandwidth Test

Output Command	Bandwidth (KHz) Lower	Upper	Spec. Limit	Pass/Fail
Monitor	-84.59		< -45	Pass
Monitor		82.58	> +45	Pass
Optional	-68.48		< -45	Pass
Optional		69.49	> +45	Pass
Arm	-68.48		< -45	Pass
Arm		69.49	> +45	Pass
Destruct	-67.47		< -45	Pass
Destruct		68.48	> +45	Pass

Test completed : 11:37:11 AM Test Time(min): 5:19 **Test PASSED**

Page 6

Loral FTR-915A **Serial No. 0086**

Hot (+70 deg C) **(425 MHz)** **02-16-1999 , 9:19:23 AM**

Signal Strength Test

AGC rises 0.25 volts with a minimum RF input, TEST PASSED
AGC does not rise monotonically (between -107 to -51), TEST FAILED
AGC is within the 4.5 to 5.0 volts limits, TEST PASSED

Input,dBm	AGC Volts 10K Load	
	0.339	Quiescent Voltage
-121	0.343	
-116	0.357	
-111	0.486	
-106	0.775	See Ambient Test
-101	1.129	
-96	1.666	
-91	2.450	
-86	3.173	
-81	3.689	
-76	4.035	
-71	4.334	
-66	4.712	
-61	4.732	
-56	4.732	
-51	4.731	
-46	4.731	
-41	4.731	
-36	4.731	
-31	4.731	

Test completed : 11:40:20 AM Test Time(min): 0:44 **Test FAILED**

ck 4/2/99

Tone Response, Normal Test

Command Output	Pass/Fail
Monitor	Pass
Optional	Pass
Arm	Pass
Destruct	Pass

Test completed : 11:40:37 AM Test Time(min): 0:15 **Test PASSED**

Loral FTR-915A **Serial No. 0086**

Fot (+70 deg C) (425 MHz) **02-16-1999 , 9:19:23 AM**

Spurious Response Rejection Test

0 Spurious Responses. Test Passed

Test completed : 11:58:15 AM Test Time(min): 15:45 **Test PASSED**

Output Voltages Test

Command Output	28V In (-1.5V)	Pass/Fail	24V In (-1.5V)	Pass/Fail	36V In (-1.5V)	Pass/Fail
Monitor	27.62	Pass	23.62	Pass	35.62	Pass
Optional	27.61	Pass	23.61	Pass	35.61	Pass
Arm	27.61	Pass	23.61	Pass	35.60	Pass
Destruct	27.61	Pass	23.61	Pass	35.61	Pass

Test completed : 11:59:16 AM Test Time(min): 1:00 **Test PASSED**

25

```
*****************************************************
*                                                   *
*        FLIGHT TERMINATION RECEIVER TEST           *
*                                                   *
*    Naval Air Warfare Center - Weapons Division    *
*        Code 543     China Lake California         *
*                                                   *
*****************************************************
```

FTR Model : Loral FTR-915A **Serial No. 0087**

Test Date : 02-16-1999 , 12:41:19 PM

FTR Test Set Calibration
Expiration Date : 9/10/99

Operating Frequency : 425 MHz
3dB IF BW Spec.: 180 KHz
60dB IF BW Spec.: 360 KHz
Tone C : Tone 5 12.14 KHz

Temperature : Ambient (+25 deg C)

Tested by : George Fields

Test Set Position: 1

Configuration Comments : Certification Test

Test Sequence Comments : Standard 17 Tests

Software Version : 1.7.0

CERTIFICATION DATE: 17 FEB 99
CERT. DUE DATE: 17 AUG 99

Loral FTR-915A **Serial No. 0087**

Ambient (+25 deg C) **(425 MHz)** **02-16-1999 , 12:41:19 PM**

Case Isolation Test

Command Output	Value Measured	Spec. Min. (Megohms)	Pass/Fail
Monitor	9.90E+31	1.00	Pass
Optional	9.90E+31	1.00	Pass
Arm	9.90E+31	1.00	Pass
Destruct	9.90E+31	1.00	Pass

Test completed : 12:42:30 PM Test Time(min): 0:42 **Test PASSED**

Input Current/Voltage Test

Input Voltage	Relays Deenergized (Spec < 225mA)	Pass/ Fail	Relays Energized (Spec < 225mA)	Pass/ Fail
28 Volts	0.1906	Pass	0.208	Pass
24 Volts	0.188	Pass	0.205	Pass
36 Volts	0.19	Pass	0.208	Pass

Test completed : 12:43:09 PM Test Time(min): 0:38 **Test PASSED**

Loral FTR-915A Serial No. 0087

Ambient (+25 deg C) (425 MHz) 02-16-1999 , 12:41:19 PM

Standard Logic Test

Tone Sequence #	Pass/Fail
1	Pass
2	Pass
3	Pass
4	Pass
5	Pass
6	Pass
7	Pass
8	Pass
9	Pass
10	Pass
11	Pass
12	Pass
13	Pass
14	Pass
15	Pass
16	Pass
17	Pass
18	Pass
19	Pass
20	Pass
21	Pass
22	Pass
23	Pass
24	Pass
25	Pass
26	Pass
27	Pass
28	Pass
29	Pass
30	Pass
31	Pass
32	Pass
33	Pass
34	Pass
35	Pass
36	Pass
37	Pass
38	Pass
39	Pass
40	Pass
41	Pass
42	Pass

Test completed : 12:45:26 PM Test Time(min): 2:17 **Test PASSED**

Loral FTR-915A **Serial No. 0087**

Ambient (+25 deg C) (425 MHz) **02-16-1999 , 12:41:19 PM**

Output Load Capacity Test

Output Command		Measured	Spec.	Pass/Fail
Optional	Decoder current (Amps)	2.07	> 2	Pass
	Pulse duration (sec.)	5.38	> 5	Pass
Arm	Decoder current (Amps)	2.03	> 2	Pass
	Pulse duration (sec.)	5.49	> 5	Pass
Destruct	Decoder current (Amps)	2.03	> 2	Pass
	Pulse duration (sec.)	5.44	> 5	Pass

Test completed : 12:46:00 PM Test Time(min): 0:33 **Test PASSED**

Maximum RF Test

Maximum RF Input, dBm	Spec. Limit	Pass/Fail
-18	> -20	Pass

Test completed : 12:47:02 PM Test Time(min): 1:00 **Test PASSED**

RF Threshold Sensitivity Test

Input Voltage	Minimum RF Input, dBm	Spec. Limit	Pass/Fail
28	-116	< -107	Pass
24	-116	< -107	Pass
36	-116	< -107	Pass

Test completed : 12:48:35 PM Test Time(min): 1:33 **Test PASSED**

Operational (RF) Bandwidth Test

Output Command	Bandwidth (KHz) Lower	Upper	Spec. Limit	Pass/Fail
Monitor	-90.64		< -45	Pass
Monitor		82.58	> +45	Pass
Optional	-74.52		< -45	Pass
Optional		70.50	> +45	Pass
Arm	-74.52		< -45	Pass
Arm		69.49	> +45	Pass
Destruct	-74.52		< -45	Pass
Destruct		68.48	> +45	Pass

Test completed : 12:54:09 PM Test Time(min): 5:33 **Test PASSED**

Page 5

Loral FTR-915A **Serial No. 0087**

Ambient (+25 deg C) **(425 MHz)** **02-16-1999 , 12:41:19 PM**

CW (IF) Bandwidth Test

Parameter	Min. Spec	Max. Spec	BW (KHz)	Pass/Fail
3-dB BW	180 KHz	-------	207.010	Pass
60-dB BW	-------	360 KHz	336.990	Pass

Test completed : 12:55:19 PM Test Time(min): 1:10 **Test PASSED**

Operating Center Frequency Test

Input Voltage	Operating Frequency (MHz)	Expected Frequency	Delta Percent	Spec. Limit	Pass/Fail
28	424.9913	425.0	-0.002040	(0.005)	Pass
24	424.9913	425.0	-0.002051	(0.005)	Pass
36	424.9913	425.0	-0.002054	(0.005)	Pass

Test completed : 12:57:11 PM Test Time(min): 1:51 **Test PASSED**

Loral FTR-915A **Serial No. 0087**

Ambient (+25 deg C) (425 MHz) **02-16-1999 , 12:41:19 PM**

===

Signal Strength Test

===

AGC rises 0.25 volts with a minimum RF input, TEST PASSED
AGC does not rise monotonically (between -107 to -51), TEST FAILED
AGC is within the 4.5 to 5.0 volts limits, TEST PASSED

Input, dBm	AGC Volts 10K Load	
	0.411	Quiescent Voltage
-121	0.460	
-116	0.555	
-111	0.755	
-106	1.118	
-101	1.756	
-96	2.561	
-91	3.216	
-86	3.668	
-81	4.011	
-76	4.363	
-71	4.728	
-66	4.728	
-61	4.728	
-56	4.728	
-51	4.728	
-46	4.728	
-41	4.728	
-36	4.728	
-31	4.728	

IRIG 313-94
3.2.13.3
SSTD Reaches Max With
Less Than -53 dBm

Test completed : 12:57:56 PM Test Time(min): 0:44 **Test FAILED**

===

Tone Response, Normal Test

===

Command Output	Pass/Fail
Monitor	Pass
Optional	Pass
Arm	Pass
Destruct	Pass

Test completed : 12:58:12 PM Test Time(min): 0:16 **Test PASSED**

Loral FTR-915A **Serial No. 0087**

Ambient (+25 deg C) (425 **MHz**) 02-16-1999 , 12:41:19 PM

Tone Response, Off frequency Test (+/- 1%)

Command Output	Low Freq. Offset Pass/Fail	High Freq. Offset Pass/Fail
Monitor	Pass	Pass
Optional	Pass	Pass
Arm	Pass	Pass
Destruct	Pass	Pass

Test completed : 12:58:44 PM Test Time(min): 0:31 **Test PASSED**

Tone Response, Off deviation Test (+/- 2.5dB)

Command Output	Under Dev. Oper. Pass/Fail	Over Dev. Oper. Pass/Fail
Monitor	Pass	Pass
Optional	Pass	Pass
Arm	Pass	Pass
Destruct	Pass	Pass

Test completed : 12:59:16 PM Test Time(min): 0:31 **Test PASSED**

Output Response Time Test (Avg. of 10 cycles)

Command	Response Time (mSec)	Specification	Pass/Fail
Monitor	5.12	< 25	Pass
Optional	6.75	< 25	Pass
Arm	7.36	< 25	Pass
Destruct	19.69	< 25	Pass

Test completed : 12:59:41 PM Test Time(min): 0:25 **Test PASSED**

DC Power Cycling Test (30x)

Command Output	Transient/Erratic Output Detected	Pass/Fail
Optional	NO	Pass
Arm	NO	Pass
Destruct	NO	Pass

Test completed : 1:00:03 PM Test Time(min): 0:22 **Test PASSED**

Loral FTR-915A **Serial No. 0087**

Ambient (+25 deg C) **(425 MHz)** **02-16-1999 , 12:41:19 PM**

Spurious Response Rejection Test

0 Spurious Responses. Test Passed

Test completed : 1:15:49 PM Test Time(min): 15:45 **Test PASSED**

Output Voltages Test

Command Output	28V In (-1.5V)	Pass/Fail	24V In (-1.5V)	Pass/Fail	36V In (-1.5V)	Pass/Fail
Monitor	27.52	Pass	23.53	Pass	35.52	Pass
Optional	27.52	Pass	23.52	Pass	35.52	Pass
Arm	27.51	Pass	23.52	Pass	35.51	Pass
Destruct	27.52	Pass	23.52	Pass	35.52	Pass

Test completed : 1:16:46 PM Test Time(min): 0:56 **Test PASSED**

```
*********************************************************
*                                                       *
*        FLIGHT TERMINATION RECEIVER TEST               *
*                                                       *
*      Naval Air Warfare Center - Weapons Division      *
*           Code 543     China Lake California          *
*                                                       *
*********************************************************
```

FTR Model : Loral FTR-915A Serial No. 0087

Test Date : 02-16-1999 , 12:41:19 PM

FTR Test Set Calibration
Expiration Date : 9/10/99

Operating Frequency : 425 MHz
3dB IF BW Spec.: 180 KHz
60dB IF BW Spec.: 360 KHz
Tone C : Tone 5 12.14 KHz

Temperature : Cold (-40 deg C)

Tested by : George Fields

Test Set Position: 1

Configuration Comments : Certification Test

Test Sequence Comments : Standard 17 Tests

Software Version : 1.7.0

Loral FTR-915A **Serial No. 0087**

Cold (-40 deg C) (425 MHz) 02-16-1999 , 12:41:19 PM

Case Isolation Test

Command Output	Value Measured	Spec. Min. (Megohms)	Pass/Fail
Monitor	9.90E+31	1.00	Pass
Optional	9.90E+31	1.00	Pass
Arm	9.90E+31	1.00	Pass
Destruct	9.90E+31	1.00	Pass

Test completed : 1:41:42 PM Test Time(min): 0:42 **Test PASSED**

Input Current/Voltage Test

Input Voltage	Relays Deenergized (Spec < 225mA)	Pass/ Fail	Relays Energized (Spec < 225mA)	Pass/ Fail
28 Volts	0.1934	Pass	0.21	Pass
24 Volts	0.193	Pass	0.21	Pass
36 Volts	0.1934	Pass	0.2118	Pass

Test completed : 1:42:21 PM Test Time(min): 0:38 **Test PASSED**

Loral FTR-915A **Serial No. 0087**

Cold (-40 deg C) **(425 MHz)** **02-16-1999 , 12:41:19 PM**

Standard Logic Test

Tone Sequence #	Pass/Fail
1	Pass
2	Pass
3	Pass
4	Pass
5	Pass
6	Pass
7	Pass
8	Pass
9	Pass
10	Pass
11	Pass
12	Pass
13	Pass
14	Pass
15	Pass
16	Pass
17	Pass
18	Pass
19	Pass
20	Pass
21	Pass
22	Pass
23	Pass
24	Pass
25	Pass
26	Pass
27	Pass
28	Pass
29	Pass
30	Pass
31	Pass
32	Pass
33	Pass
34	Pass
35	Pass
36	Pass
37	Pass
38	Pass
39	Pass
40	Pass
41	Pass
42	Pass

Test completed : 1:44:39 PM   Test Time(min): 2:17   **Test PASSED**

Loral FTR-915A **Serial No. 0087**

Cold (-40 deg C) **(425 MHz)** **02-16-1999 , 12:41:19 PM**

Output Load Capacity Test

Output Command		Measured	Spec.	Pass/Fail
Optional	Decoder current (Amps)	2.08	> 2	Pass
	Pulse duration (sec.)	5.43	> 5	Pass
Arm	Decoder current (Amps)	2.04	> 2	Pass
	Pulse duration (sec.)	5.44	> 5	Pass
Destruct	Decoder current (Amps)	2.04	> 2	Pass
	Pulse duration (sec.)	5.44	> 5	Pass

Test completed : 1:45:13 PM Test Time(min): 0:33 **Test PASSED**

Maximum RF Test

Maximum RF Input, dBm	Spec. Limit	Pass/Fail
-18	> -20	Pass

Test completed : 1:46:14 PM Test Time(min): 1:00 **Test PASSED**

RF Threshold Sensitivity Test

Input Voltage	Minimum RF Input, dBm	Spec. Limit	Pass/Fail
28	-117	< -107	Fail
24	-117	< -107	Fail
36	-117	< -107	Fail

IRIG 313-94
3.2.3
RF Threshold Is More Sensitive Than -116dBm

Test completed : 1:47:48 PM Test Time(min): 1:34 **Test FAILED**

[illegible]

Operational (RF) Bandwidth Test

Output Command	Bandwidth (KHz) Lower	Upper	Spec. Limit	Pass/Fail
Monitor	-88.62		< -45	Pass
Monitor		91.64	> +45	Pass
Optional	-74.52		< -45	Pass
Optional		77.55	> +45	Pass
Arm	-73.52		< -45	Pass
Arm		77.55	> +45	Pass
Destruct	-73.52		< -45	Pass
Destruct		77.55	> +45	Pass

Test completed : 1:53:38 PM Test Time(min): 5:49 **Test PASSED**

Loral FTR-915A Serial No. 0087

Cold (-40 deg C) (425 MHz) 02-16-1999 , 12:41:19 PM

CW (IF) Bandwidth Test

Parameter	Min. Spec	Max. Spec	BW (KHz)	Pass/Fail
3-dB BW	180 KHz	-------	211.070	Pass
60-dB BW	-------	360 KHz	336.410	Pass

Test completed : 1:54:41 PM Test Time(min): 1:03 **Test PASSED**

Operating Center Frequency Test

Input Voltage	Operating Frequency (MHz)	Expected Frequency	Delta Percent	Spec. Limit	Pass/Fail
28	425.0005	425.0	0.000122	(0.005)	Pass
24	425.0005	425.0	0.000127	(0.005)	Pass
36	425.0006	425.0	0.000131	(0.005)	Pass

Test completed : 1:56:25 PM Test Time(min): 1:43 **Test PASSED**

Loral FTR-915A **Serial No. 0087**

Cold (-40 deg C) **(425 MHz)** **02-16-1999 , 12:41:19 PM**

Signal Strength Test

AGC rises 0.25 volts with a minimum RF input, TEST PASSED
AGC does not rise monotonically (between -107 to -51), TEST FAILED
AGC is within the 4.5 to 5.0 volts limits, TEST PASSED

Input, dBm	AGC Volts 10K Load	
	0.351	Quiescent Voltage
-121	0.417	
-116	0.587	
-111	0.962	
-106	1.564	
-101	2.236	
-96	2.746	See Ambient Test
-91	3.106	
-86	3.434	
-81	3.868	
-76	4.475	
-71	4.727	
-66	4.727	
-61	4.727	
-56	4.727	
-51	4.727	
-46	4.727	
-41	4.727	
-36	4.727	
-31	4.727	

Test completed : 1:57:09 PM Test Time(min): 0:44 **Test FAILED** ✓ ck/m Cut.

Tone Response, Normal Test

Command Output	Pass/Fail
Monitor	Pass
Optional	Pass
Arm	Pass
Destruct	Pass

Test completed : 1:57:26 PM Test Time(min): 0:16 **Test PASSED**

```
***********************************************************
*                                                         *
*         FLIGHT TERMINATION RECEIVER TEST                *
*                                                         *
*     Naval Air Warfare Center - Weapons Division         *
*         Code 543     China Lake California              *
*                                                         *
***********************************************************
```

FTR Model : Loral FTR-915A **Serial No. 0087**

Test Date : 02-16-1999 , 12:41:19 PM

FTR Test Set Calibration
Expiration Date : 9/10/99

Operating Frequency : 425 MHz
3dB IF BW Spec.: 180 KHz
60dB IF BW Spec.: 360 KHz
Tone C : Tone 5 12.14 KHz

Temperature : Hot (+70 deg C)

Tested by : George Fields

Test Set Position: 1

Configuration Comments : Certification Test

Test Sequence Comments : Standard 17 Tests

Software Version : 1.7.0

Loral FTR-915A **Serial No. 0087**

Hot (+70 deg C) **(425 MHz)** **02-16-1999 , 12:41:19 PM**

Case Isolation Test

Command Output	Value Measured	Spec. Min. (Megohms)	Pass/Fail
Monitor	9.90E+31	1.00	Pass
Optional	9.90E+31	1.00	Pass
Arm	9.90E+31	1.00	Pass
Destruct	9.90E+31	1.00	Pass

Test completed : 2:48:43 PM Test Time(min): 0:42 **Test PASSED**

Input Current/Voltage Test

Input Voltage	Relays Deenergized (Spec < 225mA)	Pass/ Fail	Relays Energized (Spec < 225mA)	Pass/ Fail
28 Volts	0.1856	Pass	0.203	Pass
24 Volts	0.185	Pass	0.2024	Pass
36 Volts	0.185	Pass	0.203	Pass

Test completed : 2:49:22 PM Test Time(min): 0:38 **Test PASSED**

Loral FTR-915A **Serial No. 0087**

Hot (+70 deg C) **(425 MHz)** **02-16-1999 , 12:41:19 PM**

Standard Logic Test

Tone Sequence #	Pass/Fail
1	Pass
2	Pass
3	Pass
4	Pass
5	Pass
6	Pass
7	Pass
8	Pass
9	Pass
10	Pass
11	Pass
12	Pass
13	Pass
14	Pass
15	Pass
16	Pass
17	Pass
18	Pass
19	Pass
20	Pass
21	Pass
22	Pass
23	Pass
24	Pass
25	Pass
26	Pass
27	Pass
28	Pass
29	Pass
30	Pass
31	Pass
32	Pass
33	Pass
34	Pass
35	Pass
36	Pass
37	Pass
38	Pass
39	Pass
40	Pass
41	Pass
42	Pass

Test completed : 2:51:40 PM Test Time(min): 2:17 **Test PASSED**

Page 4

Loral FTR-915A **Serial No. 0087**

Hot (+70 deg C) (425 MHz) **02-16-1999 , 12:41:19 PM**

Output Load Capacity Test

Output Command		Measured	Spec.	Pass/Fail
Optional	Decoder current (Amps)	2.06	> 2	Pass
	Pulse duration (sec.)	5.49	> 5	Pass
Arm	Decoder current (Amps)	2.02	> 2	Pass
	Pulse duration (sec.)	5.49	> 5	Pass
Destruct	Decoder current (Amps)	2.02	> 2	Pass
	Pulse duration (sec.)	5.44	> 5	Pass

Test completed : 2:52:17 PM Test Time(min): 0:36 **Test PASSED**

Maximum RF Test

Maximum RF Input, dBm	Spec. Limit	Pass/Fail
-18	> -20	Pass

Test completed : 2:53:18 PM Test Time(min): 1:00 **Test PASSED**

RF Threshold Sensitivity Test

Input Voltage	Minimum RF Input, dBm	Spec. Limit	Pass/Fail
28	-115	< -107	Pass
24	-115	< -107	Pass
36	-115	< -107	Pass

Test completed : 2:54:49 PM Test Time(min): 1:31 **Test PASSED**

Operational (RF) Bandwidth Test

Output Command	Bandwidth (KHz) Lower	Upper	Spec Limit	Pass/Fail
Monitor	-87.62		< -45	Pass
Monitor		78.55	> +45	Pass
Optional	-71.50		< -45	Pass
Optional		64.45	> +45	Pass
Arm	-71.50		< -45	Pass
Arm		65.46	> +45	Pass
Destruct	-70.50		< -45	Pass
Destruct		65.46	> +45	Pass

Test completed : 3:00:07 PM Test Time(min): 5:17 **Test PASSED**

Loral FTR-915A **Serial No. 0087**

Hot (+70 deg C) **(425 MHz)** **02-16-1999 , 12:41:19 PM**

CW (IF) Bandwidth Test

Parameter	Min. Spec	Max. Spec	BW (KHz)	Pass/Fail
3-dB BW	180 KHz	-------	211.850	Pass
60-dB BW	-------	360 KHz	337.280	Pass

Test completed : 3:00:56 PM   Test Time(min): 0:48   **Test PASSED**

Operating Center Frequency Test

Input Voltage	Operating Frequency (MHz)	Expected Frequency	Delta Percent	Spec. Limit	Pass/Fail
28	424.9879	425.0	-0.002836	(0.005)	Pass
24	424.9879	425.0	-0.002839	(0.005)	Pass
36	424.9880	425.0	-0.002834	(0.005)	Pass

Test completed : 3:02:34 PM   Test Time(min): 1:37   **Test PASSED**

Loral FTR-915A **Serial No. 0087**

Hot (+70 deg C) (425 MHz) 02-16-1999 , 12:41:19 PM

Signal Strength Test

AGC rises 0.25 volts with a minimum RF input, TEST PASSED
AGC does not rise monotonically (between -107 to -51), TEST FAILED
AGC is within the 4.5 to 5.0 volts limits, TEST PASSED

Input,dBm	AGC Volts 10K Load	
	0.338	Quiescent Voltage
-121	0.340	
-116	0.348	
-111	0.445	
-106	0.747	See Ambient Test
-101	1.126	
-96	1.701	
-91	2.513	
-86	3.250	
-81	3.779	
-76	4.125	
-71	4.428	
-66	4.704	
-61	4.704	
-56	4.703	
-51	4.703	
-46	4.703	
-41	4.703	
-36	4.703	
-31	4.703	

Test completed : 3:03:19 PM Test Time(min): 0:44 **Test FAILED**

Tone Response, Normal Test

Command Output	Pass/Fail
Monitor	Pass
Optional	Pass
Arm	Pass
Destruct	Pass

Test completed : 3:03:35 PM Test Time(min): 0:15 **Test PASSED**

Loral FTR-915A **Serial No. 0087**

Hot (+70 deg C) **(425 MHz)** **02-16-1999 , 12:41:19 PM**

Tone Response, Off frequency Test (+/- 1%)

Command Output	Low Freq. Offset Pass/Fail	High Freq. Offset Pass/Fail
Monitor	Pass	Pass
Optional	Pass	Pass
Arm	Pass	Pass
Destruct	Pass	Pass

Test completed : 3:04:07 PM Test Time(min): 0:31 **Test PASSED**

Tone Response, Off deviation Test (+/- 2.5dB)

Command Output	Under Dev. Oper. Pass/Fail	Over Dev. Oper. Pass/Fail
Monitor	Pass	Pass
Optional	Pass	Pass
Arm	Pass	Pass
Destruct	Pass	Pass

Test completed : 3:04:39 PM Test Time(min): 0:31 **Test PASSED**

Output Response Time Test (Avg. of 10 cycles)

Command	Response Time (mSec)	Specification	Pass/Fail
Monitor	4.43	< 25	Pass
Optional	5.96	< 25	Pass
Arm	6.79	< 25	Pass
Destruct	18.72	< 25	Pass

Test completed : 3:05:05 PM Test Time(min): 0:25 **Test PASSED**

DC Power Cycling Test (30x)

Command Output	Transient/Erratic Output Detected	Pass/Fail
Optional	NO	Pass
Arm	NO	Pass
Destruct	NO	Pass

Test completed : 3:05:27 PM Test Time(min): 0:22 **Test PASSED**

Loral FTR-915A **Serial No. 0087**

Hot (+70 deg C) **(425 MHz)** **02-16-1999 , 12:41:19 PM**

Spurious Response Rejection Test

0 Spurious Responses. Test Passed

Test completed : 3:21:13 PM Test Time(min): 15:46 **Test PASSED**

Output Voltages Test

Command Output	28V In (-1.5V)	Pass/Fail	24V In (-1.5V)	Pass/Fail	36V In (-1.5V)	Pass/Fail
Monitor	27.61	Pass	23.62	Pass	35.61	Pass
Optional	27.61	Pass	23.61	Pass	35.61	Pass
Arm	27.60	Pass	23.60	Pass	35.60	Pass
Destruct	27.61	Pass	23.61	Pass	35.61	Pass

Test completed : 3:22:11 PM Test Time(min): 0:57 .**Test PASSED**

48

```
Part Name:      Command Receiver       Date/Time: 3/17/99  6:06 PM
Part Number:    LCP11004850-37         Environment: Port# 1, 28Vdc, +85C
Model Number:   FTR-915A               Technician:   mt
Serial Number: 359                     Inspector:

RF Carrier Center Frequency: 421.000 MHz    IRIG Tones: A=1 B=2 C=7


10.2.2  Input Current
        Quiescent (No RF)
        27.99V   35.98V   21.99V
        0.183A   0.185A   0.183A
        5.12W    6.66W    4.02W
        Command (-40 dBm, TERM CMD)
        27.99V   35.98V   21.99V
        0.205A   0.210A   0.203A
        5.74W    7.56W    4.46W

11.2.2  Logic Sequence at -107 dBm (see Table 1)
        Complies

12.2.2  VSWR (<-10 dB)
        421.000 MHz      -24.87 dB
        422.000 MHz      -22.75 dB
        420.000 MHz      <-25 dB

13.2.2  RF Sensitivity (-107 dBm to -117 dBm "Hold TERM")
        Loss of ARM     Hold ARM        Hold TERM
        -116.10         -115.90         -115.90

14.2.2  Dynamic Range & Operational Bandwidth (+/- 45 kHz) (see Table 2)
        FC           -107dBm -67dBm -27dBm 13dBm    Complies
        FO+45 kHz    -107dBm -67dBm -27dBm 13dBm    Complies
        FO-45 kHz    -107dBm -67dBm -27dBm 13dBm    Complies

15.2.2  Operational Bandwidth (Edges)
        Lower Edge  Upper Edge  FC            BW
        420.914     421.056     420.985       142
        Delta Lower    Delta Upper
        -86            56

16.2.2  CW Bandwidth (-3 dB)
        Lower Edge  Upper Edge  FC            BW
        420.888     421.104     420.996       216
        Delta Lower    Delta Upper
        -112           104

16.2.3  CW Bandwidth (-60 dB)
        Lower Edge  Upper Edge  FC            BW
        420.840     421.155     420.998       315
        Delta Lower    Delta Upper
        -160           155

17.2.2  CW Peak to Valley  (< +/- 3dB within Fo +/- 45kHz)
        Complies
```

Part Name: Command Receiver
Part Number: LCP11004850-37
Model Number: FTR-915A
Serial Number: 359

Date/Time: 3/17/99 6:06 PM
Environment: Port# 1, 28Vdc, +85C
Technician: mt
Inspector:

18.2.2 Tone Decoder Performance @ -80 dBm
Deviation Sensitivity (10-17 kHz)
2dB Bandwidth (> +/- 1%) 14dB Bandwidth (< +/- 3.5%)
2dB Center Frequency (< +/- 0.5%)

	Tone A	Tone B	Tone C
DevSens	12	12	12
Lower 2dB	7330	8287	15118
Lower 2dB%	-2.27	-2.04	-2.15
Upper 2dB	7675	8663	15732
Upper 2dB%	2.33	2.40	1.83
Lower 14dB	7295	8262	15068
Lower 14dB%	-2.73	-2.34	-2.48
Upper 14dB	7695	8688	15782
Upper 14dB%	2.60	2.70	2.15
2dB FC	7502	8475	15425
FC Delta%	0.03	0.18	-0.16

19.2.2 Shortest Response Time (>4ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
7.4	6.5	5.4	8.2

19.2.3 Longest Response Time (<25ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
7.8	6.9	6.0	8.8

19.2.4 Avg. Response Time (<25ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
7.6	6.7	5.7	8.5

20.2.2 Signal Strength Sweep

RF	RSS
-130	0.34
-125	0.34
-120	0.34
-115	0.35
-110	0.42
-105	0.82
-100	1.29
-95	1.72
-90	2.39
-85	3.17
-80	3.82
-75	4.25
-70	4.55
-65	4.81
-60	4.83
-55	4.83
-50	4.83
-45	4.83
-40	4.83
-35	4.83
-30	4.83
-25	4.83
-20	4.83

Model Number: FTR-915A   Technician: mt [stamp: 89M]
Serial Number: 359   Inspector:

20.2.3 Signal Strength Test

RF	RSS	
-140	0.34	
-107	0.64	-140 to -107 delta = 0.29
-53	4.83	

21.2.2 Image Rejection (>60 dB)
76.0 dB

22.2.2 Near Carrier Spurious Rejection
Complies

22.2.3 Spurious Responses Calculated
Complies

23.2.2 AM Rejection
Complies

24.2.2 Adjacent Tone Channel Rejection
Complies

25.2.2 Tone Telemetry Voltage Levels

	Tone A	Tone B	Tone C
off	0.00	0.00	0.00
on	5.55	5.72	5.69

26.2.2 Command Leakage Current (<50uA)

MON	ARM	TERM	OPT
0.0E+0	0.0E+0	0.0E+0	0.0E+0

27.2.2 CMD & TLM Output Stability
Fail TONE B OUTPUT ONLY

28.2.2 Power ON/OFF Stability
Complies

29.2.2 Command Load Test

MON	ARM	TERM	OPT
1.94Vdc	1.81Vdc	1.48Vdc	2.12Vdc

```
Part Name:      Command Receiver      Date/Time: 3/17/99  7:50 PM
Part Number:    LCP11004850-37        Environment: Port# 1, 28Vdc, +25C
Model Number:   FTR-915A              Technician:   mt
Serial Number:  359                   Inspector:

RF Carrier Center Frequency: 421.000 MHz   IRIG Tones: A=1 B=2 C=7

10.2.2  Input Current
        Quiescent (No RF)
        27.99V    35.98V    21.99V
        0.188A    0.190A    0.188A
        5.26W     6.84W     4.13W
        Command (-40 dBm, TERM CMD)
        27.99V    35.98V    21.99V
        0.213A    0.215A    0.208A
        5.96W     7.74W     4.57W

11.2.2  Logic Sequence at -107 dBm (see Table 1)
        Complies

12.2.2  VSWR (<-10 dB)
        421.000 MHz      -24.56 dB
        422.000 MHz      -24.88 dB
        420.000 MHz      -23.32 dB

13.2.2  RF Sensitivity (-107 dBm to -117 dBm "Hold TERM")
        Loss of ARM     Hold ARM        Hold TERM
        -117.50         -117.10         -117.10 Fail

14.2.2  Dynamic Range & Operational Bandwidth (+/- 45 kHz) (see Table 2)
        FO          -107dBm -67dBm -27dBm 13dBm    Complies
        FO+45 kHz   -107dBm -67dBm -27dBm 13dBm    Complies
        FO-45 kHz   -107dBm -67dBm -27dBm 13dBm    Complies

15.2.2  Operational Bandwidth (Edges)
        Lower Edge  Upper Edge  FC          BW
        420.928     421.070     420.999     142
        Delta Lower   Delta Upper
        -72           70

16.2.2  CW Bandwidth (-3 dB)
        Lower Edge  Upper Edge  FC          BW
        420.892     421.108     421.000     216
        Delta Lower   Delta Upper
        -108          108

16.2.3  CW Bandwidth (-60 dB)
        Lower Edge  Upper Edge  FC          BW
        420.840     421.160     421.000     320
        Delta Lower   Delta Upper
        -160          160

17.2.2  CW Peak to Valley  (< +/- 3dB within Fo +/- 45kHz)
        Complies
```

Part Name: Command Receiver
Part Number: LCP11004850-37
Model Number: FTR-915A
Serial Number: 359

Date/Time: 3/17/99 7:50 PM
Environment: Port# 1, 28Vdc, +25C
Technician: mt
Inspector:

18.2.2 Tone Decoder Performance @ -80 dBm
Deviation Sensitivity (10-17 kHz)
2dB Bandwidth (> +/- 1%) 14dB Bandwidth (< +/- 3.5%)
2dB Center Frequency (< +/- 0.5%)

	Tone A	Tone B	Tone C
DevSens	12	12	12
Lower 2dB	7350	8307	15152
Lower 2dB%	-2.00	-1.81	-1.93
Upper 2dB	7680	8668	15742
Upper 2dB%	2.40	2.46	1.89
Lower 14dB	7330	8292	15102
Lower 14dB%	-2.27	-1.99	-2.25
Upper 14dB	7700	8693	15788
Upper 14dB%	2.67	2.75	2.18
2dB FC	7515	8488	15448
FC Delta%	0.20	0.33	-0.02

19.2.2 Shortest Response Time (>4ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
9.7	10.5	7.5	7.8

19.2.3 Longest Response Time (<25ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
10.7	12.0	9.6	8.1

19.2.4 Avg. Response Time (<25ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
10.0	10.9	8.4	7.9

20.2.2 Signal Strength Sweep

RF	RSS
-130	0.53
-125	0.55
-120	0.59
-115	0.70
-110	0.90
-105	1.20
-100	1.74
-95	2.52
-90	3.25
-85	3.77
-80	4.14
-75	4.45
-70	4.83
-65	4.85
-60	4.85
-55	4.85
-50	4.85
-45	4.85
-40	4.85
-35	4.85
-30	4.85
-25	4.85
-20	4.85

Slope Complies

Model Number: FTR-915A
Serial Number: 359

Technician: mt
Inspector:

20.2.3 Signal Strength Test

RF	RSS	
-140	0.52	
-107	1.07	-140 to -107 delta = 0.54
-53	4.85	

21.2.2 Image Rejection (>60 dB)
76.0 dB

22.2.2 Near Carrier Spurious Rejection
Complies

22.2.3 Spurious Responses Calculated
Complies

23.2.2 AM Rejection
Complies

24.2.2 Adjacent Tone Channel Rejection
Complies

25.2.2 Tone Telemetry Voltage Levels

	Tone A	Tone B	Tone C
off	0.00	0.00	0.00
on	5.56	5.65	5.63

26.2.2 Command Leakage Current (<50uA)

MON	ARM	TERM	OPT
0.0E+0	0.0E+0	0.0E+0	0.0E+0

27.2.2 CMD & TLM Output Stability
Complies

28.2.2 Power ON/OFF Stability
Complies

29.2.2 Command Load Test

MON	ARM	TERM	OPT
1.74Vdc	1.66Vdc	1.38Vdc	1.86Vdc

Part Name: Command Receiver
Part Number: LCP11004850-37
Model Number: FTR-915A
Serial Number: 359

Date/Time: 3/17/99 2:51 PM
Environment: Port# 1, 28Vdc, -54C
Technician: mt
Inspector: (stamp: NSA 89M)

RF Carrier Center Frequency: 421.000 MHz IRIG Tones: A=1 B=2 C=7

10.2.2 Input Current
Quiescent (No RF)

27.99V	35.98V	21.99V
0.188A	0.190A	0.188A
5.26W	6.84W	4.13W

Command (-40 dBm, TERM CMD)

27.99V	35.98V	21.99V
0.213A	0.215A	0.210A
5.96W	7.74W	4.62W

11.2.2 Logic Sequence at -107 dBm (see Table 1)
Complies

12.2.2 VSWR (<-10 dB)

421.000 MHz	-20.43 dB
422.000 MHz	<-25 dB
420.000 MHz	-18.46 dB

13.2.2 RF Sensitivity (-107 dBm to -117 dBm "Hold TERM")

Loss of ARM	Hold ARM	Hold TERM
-118.30	-117.70	-117.70 Fail *(initialed)*

14.2.2 Dynamic Range & Operational Bandwidth (+/- 45 kHz) (see Table 2)

FO	-107dBm	-67dBm	-27dBm	13dBm	Complies
FO+45 kHz	-107dBm	-67dBm	-27dBm	13dBm	Complies
FO-45 kHz	-107dBm	-67dBm	-27dBm	13dBm	Complies

15.2.2 Operational Bandwidth (Edges)

Lower Edge	Upper Edge	FC	BW
420.922	421.070	420.996	148
Delta Lower	Delta Upper		
-78	70		

16.2.2 CW Bandwidth (-3 dB)

Lower Edge	Upper Edge	FC	BW
420.890	421.106	420.998	216
Delta Lower	Delta Upper		
-110	106		

16.2.3 CW Bandwidth (-60 dB)

Lower Edge	Upper Edge	FC	BW
420.840	421.155	420.998	315
Delta Lower	Delta Upper		
-160	155		

17.2.2 CW Peak to Valley (< +/- 3dB within Fo +/- 45kHz)
Complies

Part Name: Command Receiver
Part Number: LCP11004850-37
Model Number: FTR-915A
Serial Number: 359

Date/Time: 3/17/99 2:51 PM
Environment: Port# 1, 28Vdc, -54C
Technician: mt
Inspector: NASA 89M

18.2.2 Tone Decoder Performance @ -80 dBm
Deviation Sensitivity (10-17 kHz)
2dB Bandwidth (> +/- 1%) 14dB Bandwidth (< +/- 3.5%)
2dB Center Frequency (< +/- 0.5%)

	Tone A	Tone B	Tone C
DevSens	12	12	13
Lower 2dB	7360	8307	15132
Lower 2dB%	-1.87	-1.81	-2.06
Upper 2dB	7670	8653	15722
Upper 2dB%	2.27	2.28	1.76
Lower 14dB	7320	8282	15092
Lower 14dB%	-2.40	-2.10	-2.31
Upper 14dB	7685	8668	15762
Upper 14dB%	2.47	2.46	2.02
2dB FC	7515	8480	15428
FC Delta%	0.20	0.24	-0.15

19.2.2 Shortest Response Time (>4ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
11.2	6.8	7.3	8.4

19.2.3 Longest Response Time (<25ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
11.7	7.0	10.5	9.4

19.2.4 Avg. Response Time (<25ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
11.4	6.9	8.9	8.8

20.2.2 Signal Strength Sweep

RF	RSS
-130	0.38
-125	0.39
-120	0.45
-115	0.58
-110	0.89
-105	1.46
-100	2.15
-95	2.66
-90	3.02
-85	3.34
-80	3.76
-75	4.33
-70	4.80
-65	4.80
-60	4.80
-55	4.80
-50	4.80
-45	4.80
-40	4.80
-35	4.80
-30	4.80
-25	4.80
-20	4.80

Slope Complies

```
Part Name:     Command Receiver       Date/Time: 3/17/99  2:51 PM
Part Number:   LCP11004850-37         Environment: Port# 1, 28Vdc, -54C
Model Number:  FTR-915A               Technician:   mt
Serial Number: 359                    Inspector:    89M

RF Carrier Center Frequency: 421.000 MHz   IRIG Tones: A=1 B=2 C=7


10.2.2  Input Current
        Quiescent (No RF)
        27.99V   35.98V   21.99V
        0.188A   0.190A   0.188A
        5.26W    6.84W    4.13W
        Command (-40 dBm, TERM CMD)
        27.99V   35.98V   21.99V
        0.213A   0.215A   0.210A
        5.96W    7.74W    4.62W

11.2.2  Logic Sequence at -107 dBm (see Table 1)
        Complies

12.2.2  VSWR (<-10 dB)
        421.000 MHz     -20.43 dB
        422.000 MHz     <-25 dB
        420.000 MHz     -18.46 dB

13.2.2  RF Sensitivity (-107 dBm to -117 dBm "Hold TERM")
        Loss of ARM     Hold ARM      Hold TERM
        -118.30         -117.70       -117.70 Fail  MAJ

14.2.2  Dynamic Range & Operational Bandwidth (+/- 45 kHz) (see Table 2)
        FO         -107dBm -67dBm -27dBm 13dBm    Complies
        FO+45 kHz  -107dBm -67dBm -27dBm 13dBm    Complies
        FO-45 kHz  -107dBm -67dBm -27dBm 13dBm    Complies

15.2.2  Operational Bandwidth (Edges)
        Lower Edge  Upper Edge  FC          BW
        420.922     421.070     420.996     148
        Delta Lower   Delta Upper
        -78           70

16.2.2  CW Bandwidth (-3 dB)
        Lower Edge  Upper Edge  FC          BW
        420.890     421.106     420.998     216
        Delta Lower   Delta Upper
        -110          106

16.2.3  CW Bandwidth (-60 dB)
        Lower Edge  Upper Edge  FC          BW
        420.840     421.155     420.998     315
        Delta Lower   Delta Upper
        -160          155

17.2.2  CW Peak to Valley  (< +/- 3dB within Fo +/- 45kHz)
        Complies
```

Model Number: FTR-915A
Serial Number: 359

Technician: mt
Inspector:

20.2.3 Signal Strength Test

RF	RSS	
-140	0.37	
-107	1.22	-140 to -107 delta = 0.85
-53	4.80	

21.2.2 Image Rejection (>60 dB)
72.0 dB

22.2.2 Near Carrier Spurious Rejection
Complies

22.2.3 Spurious Responses Calculated
Complies

23.2.2 AM Rejection
Complies

24.2.2 Adjacent Tone Channel Rejection
Complies

25.2.2 Tone Telemetry Voltage Levels

	Tone A	Tone B	Tone C
off	0.00	0.00	0.00
on	5.51	5.53	5.52

26.2.2 Command Leakage Current (<50uA)

MON	ARM	TERM	OPT
0.0E+0	0.0E+0	0.0E+0	0.0E+0

27.2.2 CMD & TLM Output Stability
Fail TONE B   MAJ TM OUTPUT ONLY

28.2.2 Power ON/OFF Stability
Complies

29.2.2 Command Load Test

MON	ARM	TERM	OPT
1.49Vdc	1.46Vdc	1.28Vdc	1.59Vdc

```
Part Name:      Command Receiver          Date/Time: 3/17/99  8:06 PM
Part Number:    LCP11004850-37            Environment: Port#,0, 28Vdc, +25C
Model Number:   FTR-915A                  Technician:  mt
Serial Number: 360                        Inspector:

RF Carrier Center Frequency: 421.000 MHz   IRIG Tones: A=1 B=2 C=7


10.2.2  Input Current
        Quiescent (No RF)
        27.99V   35.98V   21.99V
        0.188A   0.190A   0.188A
        5.26W    6.84W    4.13W
        Command (-40 dBm, TERM CMD)
        27.99V   35.98V   21.99V
        0.210A   0.215A   0.208A
        5.88W    7.74W    4.57W

11.2.2  Logic Sequence at -107 dBm (see Table 1)
        Complies

12.2.2  VSWR (<-10 dB)
        421.000 MHz      -20.91 dB
        422.000 MHz      -23.66 dB
        420.000 MHz      -19.45 dB

13.2.2  RF Sensitivity (-107 dBm to -117 dBm "Hold TERM")
        Loss of ARM     Hold ARM       Hold TERM
        -117.60         -117.20        -117.20 Fail mw

14.2.2  Dynamic Range & Operational Bandwidth (+/- 45 kHz) (see Table 2)
        FO          -107dBm -67dBm -27dBm 13dBm    Complies
        FO+45 kHz   -107dBm -67dBm -27dBm 13dBm    Complies
        FO-45 kHz   -107dBm -67dBm -27dBm 13dBm    Complies

15.2.2  Operational Bandwidth (Edges)
        Lower Edge  Upper Edge  FC         BW
        420.928     421.074     421.001    146
        Delta Lower   Delta Upper
        -72           74

16.2.2  CW Bandwidth (-3 dB)
        Lower Edge  Upper Edge  FC         BW
        420.896     421.108     421.002    212
        Delta Lower   Delta Upper
        -104          108

16.2.3  CW Bandwidth (-60 dB)
        Lower Edge  Upper Edge  FC         BW
        420.835     421.170     421.002    335
        Delta Lower   Delta Upper
        -165          170

17.2.2  CW Peak to Valley  (< +/- 3dB within Fo +/- 45kHz)
        Complies
```

Part Name: Command Receiver
Part Number: LCP11004850-37
Model Number: FTR-915A
Serial Number: 360

Date/Time: 3/17/99 8:06 PM
Environment: Port# 0, 28Vdc, +25C
Technician: mt
Inspector:

18.2.2 Tone Decoder Performance @ -80 dBm
Deviation Sensitivity (10-17 kHz)
2dB Bandwidth (> +/- 1%) 14dB Bandwidth (< +/- 3.5%)
2dB Center Frequency (< +/- 0.5%)

	Tone A	Tone B	Tone C
DevSens	12	12	12
Lower 2dB	7355	8297	15178
Lower 2dB%	-1.93	-1.93	-1.76
Upper 2dB	7685	8653	15772
Upper 2dB%	2.47	2.28	2.09
Lower 14dB	7340	8282	15122
Lower 14dB%	-2.13	-2.10	-2.12
Upper 14dB	7700	8673	15822
Upper 14dB%	2.67	2.52	2.41
2dB FC	7520	8475	15475
FC Delta%	0.27	0.18	0.16

19.2.2 Shortest Response Time (>4ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
8.1	6.2	5.6	8.9

19.2.3 Longest Response Time (<25ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
10.9	6.5	5.9	12.1

19.2.4 Avg. Response Time (<25ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
9.1	6.4	5.8	10.1

20.2.2 Signal Strength Sweep

RF	RSS
-130	0.53
-125	0.54
-120	0.58
-115	0.69
-110	0.88
-105	1.17
-100	1.67
-95	2.40
-90	3.14
-85	3.68
-80	4.07
-75	4.38
-70	4.76
-65	4.81
-60	4.81
-55	4.81
-50	4.81
-45	4.81
-40	4.81
-35	4.81
-30	4.81
-25	4.81
-20	4.81

Slope Complies

Model Number: FTR-915A
Serial Number: 360

Technician: mt
Inspector: [NSI stamp]

20.2.3 Signal Strength Test

RF	RSS
-140	0.51
-107	1.04
-53	4.81

-140 to -107 delta = 0.53

21.2.2 Image Rejection (>60 dB)
74.0 dB

22.2.2 Near Carrier Spurious Rejection
Complies

22.2.3 Spurious Responses Calculated
Complies

23.2.2 AM Rejection
Complies

24.2.2 Adjacent Tone Channel Rejection
Complies

25.2.2 Tone Telemetry Voltage Levels

	Tone A	Tone B	Tone C
off	0.00	0.00	0.00
on	5.52	5.64	5.63

26.2.2 Command Leakage Current (<50uA)

MON	ARM	TERM	OPT
0.0E+0	0.0E+0	0.0E+0	0.0E+0

27.2.2 CMD & TLM Output Stability
Complies

28.2.2 Power ON/OFF Stability
Complies

29.2.2 Command Load Test

MON	ARM	TERM	OPT
1.45Vdc	1.43Vdc	1.40Vdc	1.79Vdc

```
Part Name:     Command Receiver        Date/Time: 3/17/99  3:12 PM
Part Number:   LCP11004850-37          Environment: Port# 0, 28Vdc, -54C
Model Number:  FTR-915A                Technician:   mt
Serial Number: 360                     Inspector:   MSA 89M

RF Carrier Center Frequency: 421.000 MHz   IRIG Tones: A=1 B=2 C=7


10.2.2  Input Current
        Quiescent (No RF)
        27.99V   35.98V   21.99V
        0.188A   0.190A   0.188A
        5.26W    6.84W    4.13W
        Command (-40 dBm, TERM CMD)
        27.99V   35.98V   21.99V
        0.213A   0.215A   0.208A
        5.96W    7.74W    4.57W

11.2.2  Logic Sequence at -107 dBm (see Table 1)
        Complies

12.2.2  VSWR (<-10 dB)
        421.000 MHz     -21.41 dB
        422.000 MHz     <-25 dB
        420.000 MHz     -18.99 dB

13.2.2  RF Sensitivity (-107 dBm to -117 dBm "Hold TERM")
        Loss of ARM    Hold ARM       Hold TERM
        -118.80        -118.20        -117.80 Fail

14.2.2  Dynamic Range & Operational Bandwidth (+/- 45 kHz) (see Table 2)
        FO          -107dBm -67dBm -27dBm 13dBm    Complies
        FO+45 kHz   -107dBm -67dBm -27dBm 13dBm    Complies
        FO-45 kHz   -107dBm -67dBm -27dBm 13dBm    Complies

15.2.2  Operational Bandwidth (Edges)
        Lower Edge  Upper Edge  FC           BW
        420.916     421.066     420.991      150
        Delta Lower   Delta Upper
        -84           66

16.2.2  CW Bandwidth (-3 dB)
        Lower Edge  Upper Edge  FC           BW
        420.890     421.100     420.995      210
        Delta Lower   Delta Upper
        -110          100

16.2.3  CW Bandwidth (-60 dB)
        Lower Edge  Upper Edge  FC           BW
        420.830     421.165     420.998      335
        Delta Lower   Delta Upper
        -170          165

17.2.2  CW Peak to Valley  (< +/- 3dB within Fo +/- 45kHz)
        Complies
```

Part Name: Command Receiver
Part Number: LCP11004850-37
Model Number: FTR-915A
Serial Number: 360

Date/Time: 3/17/99 3:12 PM
Environment: Port# 0, 28Vdc, -54C
Technician: mt
Inspector:

18.2.2 Tone Decoder Performance @ -80 dBm
Deviation Sensitivity (10-17 kHz)
2dB Bandwidth (> +/- 1%) 14dB Bandwidth (< +/- 3.5%)
2dB Center Frequency (< +/- 0.5%)

	Tone A	Tone B	Tone C
DevSens	13	13	13
Lower 2dB	7330	8252	15102
Lower 2dB%	-2.27	-2.46	-2.25
Upper 2dB	7645	8593	15692
Upper 2dB%	1.93	1.57	1.57
Lower 14dB	7305	8232	15072
Lower 14dB%	-2.60	-2.70	-2.44
Upper 14dB	7660	8613	15728
Upper 14dB%	2.13	1.81	1.80
2dB FC	7488	8422	15398
FC Delta%	-0.17	-0.44	-0.34

19.2.2 Shortest Response Time (>4ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
9.5	6.7	8.3	8.3

19.2.3 Longest Response Time (<25ms)

ARM&C	ARM&A	TRM&B	CPT&B+C
10.6	6.9	8.8	8.8

19.2.4 Avg. Response Time (<25ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
10.1	6.8	8.5	8.5

20.2.2 Signal Strength Sweep

RF	RSS
-130	0.34
-125	0.34
-120	0.34
-115	0.39
-110	0.64
-105	1.15
-100	1.83
-95	2.36
-90	2.72
-85	3.04
-80	3.47
-75	4.04
-70	4.74
-65	4.74
-60	4.74
-55	4.75
-50	4.74
-45	4.74
-40	4.74
-35	4.75
-30	4.75
-25	4.74
-20	4.74

Slope Complies mw

Model Number: FTR-915A　　Technician: mt
Serial Number: 360　　Inspector: [NASA 89M stamp]

20.2.3 Signal Strength Test

RF	RSS	
-140	0.34	
-107	0.93	-140 to -107 delta = 0.59
-53	4.75	

21.2.2 Image Rejection (>60 dB)
71.0 dB

22.2.2 Near Carrier Spurious Rejection
Complies

22.2.3 Spurious Responses Calculated
Complies

23.2.2 AM Rejection
Complies

24.2.2 Adjacent Tone Channel Rejection
Complies

25.2.2 Tone Telemetry Voltage Levels

	Tone A	Tone B	Tone C
off	0.00	0.00	0.00
on	5.46	5.50	5.50

26.2.2 Command Leakage Current (<50uA)

MON	ARM	TERM	OPT
0.0E+0	0.0E+0	0.0E+0	0.0E+0

27.2.2 CMD & TLM Output Stability
Fail TONE C　mas TM output only

28.2.2 Power ON/OFF Stability
Complies

29.2.2 Command Load Test

MON	ARM	TERM	OPT
1.30Vdc	1.28Vdc	1.27Vdc	1.54Vdc

```
Part Name:      Command Receiver        Date/Time: 3/17/99  6:25 PM
Part Number:    LCP11004850-37          Environment: Port# 0, 28Vdc, +85C
Model Number:   FTR-915A                Technician:  mt
Serial Number: 360                      Inspector:

.RF Carrier Center Frequency: 421.000 MHz   IRIG Tones: A=1 B=2 C=7

10.2.2  Input Current
        Quiescent (No RF)
        27.99V   35.98V   21.99V
        0.185A   0.185A   0.183A
        5.18W    6.66W    4.02W
        Command (-40 dBm, TERM CMD)
        27.99V   35.98V   21.99V
        0.208A   0.210A   0.203A
        5.82W    7.56W    4.46W

11.2.2  Logic Sequence at -107 dBm (see Table 1)
        Complies

12.2.2  VSWR (<-10 dB)
        421.000 MHz     -20.47 dB
        422.000 MHz     -22.08 dB
        420.000 MHz     -19.52 dB

13.2.2  RF Sensitivity (-107 dBm to -117 dBm "Hold TERM")
        Loss of ARM     Hold ARM       Hold TERM
        -115.60         -115.00        -115.00

14.2.2  Dynamic Range & Operational Bandwidth (+/- 45 kHz) (see Table 2)
        FO         -107dBm -67dBm -27dBm 13dBm    Complies
        FO+45 kHz  -107dBm -67dBm -27dBm 13dBm    Complies
        FO-45 kHz  -107dBm -67dBm -27dBm 13dBm    Complies

15.2.2  Operational Bandwidth (Edges)
        Lower Edge  Upper Edge  FC          BW
        420.928     421.066     420.997     138
        Delta Lower    Delta Upper
        -72            66

16.2.2  CW Bandwidth (-3 dB)
        Lower Edge  Upper Edge  FC          BW
        420.898     421.104     421.001     206
        Delta Lower    Delta Upper
        -102           104

16.2.3  CW Bandwidth (-60 dB)
        Lower Edge  Upper Edge  FC          BW
        420.835     421.170     421.002     335
        Delta Lower    Delta Upper
        -165           170

17.2.2  CW Peak to Valley  (< +/- 3dB within Fo +/- 45kHz)
        Complies
```

Part Name: Command Receiver
Part Number: LCP11004850-37
Model Number: FTR-915A
Serial Number: 360

Date/Time: 3/17/99 6:25 PM
Environment: Port# 0, 28Vdc, +85C
Technician: mt
Inspector:

18.2.2 Tone Decoder Performance @ -80 dBm
Deviation Sensitivity (10-17 kHz)
2dB Bandwidth (> +/- 1%) 14dB Bandwidth (< +/- 3.5%)
2dB Center Frequency (< +/- 0.5%)

	Tone A	Tone B	Tone C
DevSens	11	11	12
Lower 2dB	7355	8297	15142
Lower 2dB%	-1.93	-1.93	-1.99
Upper 2dB	7685	8658	15772
Upper 2dB%	2.47	2.34	2.09
Lower 14dB	7330	8277	15088
Lower 14dB%	-2.27	-2.16	-2.35
Upper 14dB	7710	8683	15812
Upper 14dB%	2.80	2.64	2.35
2dB FC	7520	8478	15458
FC Delta%	0.27	0.21	0.05

19.2.2 Shortest Response Time (>4ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
6.7	7.1	4.9	6.3

19.2.3 Longest Response Time (<25ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
7.2	9.6	5.5	7.0

19.2.4 Avg. Response Time (<25ms)

ARM&C	ARM&A	TRM&B	OPT&B+C
7.0	8.3	5.2	6.6

20.2.2 Signal Strength Sweep

RF	RSS
-130	0.35
-125	0.35
-120	0.35
-115	0.40
-110	0.65
-105	1.04
-100	1.42
-95	1.84
-90	2.50
-85	3.22
-80	3.86
-75	4.30
-70	4.63
-65	4.80
-60	4.80
-55	4.80
-50	4.80
-45	4.80
-40	4.79
-35	4.79
-30	4.80
-25	4.80
-20	4.80

Slope Complies mtl

Model Number: FTR-915A
Serial Number: 360

Technician: mt
Inspector:

20.2.3 Signal Strength Test

RF	RSS	
-140	0.35	
-107	0.87	-140 to -107 delta = 0.52
-53	4.80	

21.2.2 Image Rejection (>60 dB)
75.0 dB

22.2.2 Near Carrier Spurious Rejection
Complies

22.2.3 Spurious Responses Calculated
Complies

23.2.2 AM Rejection
Complies

24.2.2 Adjacent Tone Channel Rejection
Complies

25.2.2 Tone Telemetry Voltage Levels

	Tone A	Tone B	Tone C
off	0.00	0.00	0.00
on	5.51	5.70	5.70

26.2.2 Command Leakage Current (<50uA)

MON	ARM	TERM	OPT
0.0E+0	59.8E-9	0.0E+0	0.0E+0

27.2.2 CMD & TLM Output Stability
Fail TONE A   MLJ TM OUTPUT ONLY

28.2.2 Power ON/OFF Stability
Complies

29.2.2 Command Load Test

MON	ARM	TERM	OPT
1.57Vdc	1.54Vdc	1.49Vdc	1.99Vdc

RECORD REPRODUCTION COVER SHEET

The attached records are:

Releasable to the Public ☑

Denied to the Public ☐

Subject:

1999 Global Hawk Accident Report

FOIA Control Number: 07-283 LK

Date Reproduced: 11 Oct 07

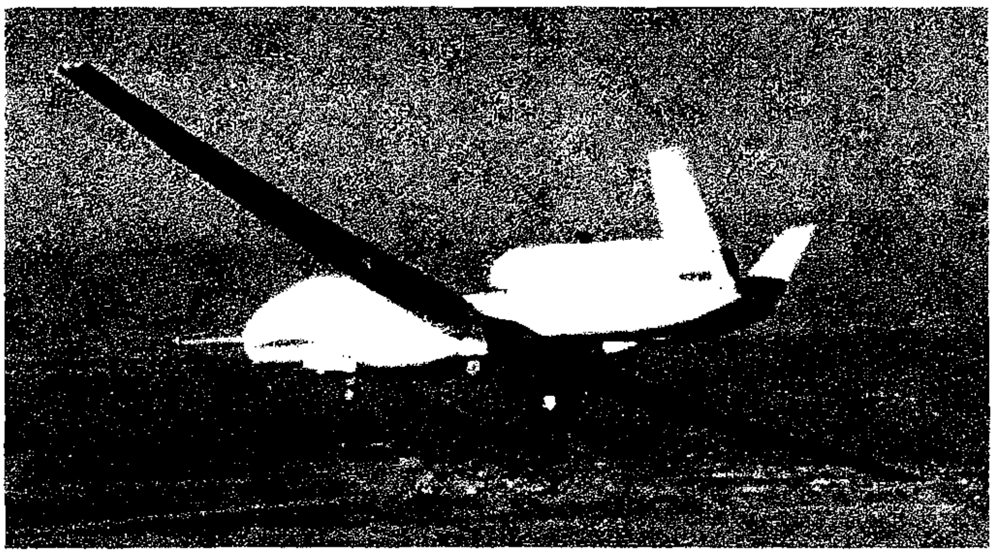
4 of 7

UNITED STATES AIR FORCE AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

Part 2 of 2

RQ-4A GLOBAL HAWK UAV, 95-2002

EDWARDS AFB, CA



Tab U

LOCATION: CHINA LAKE NAS, CA

DATE OF ACCIDENT: 29 MAR 99

BOARD PRESIDENT: COLONEL STEPHEN T. VIRGILIO

Conducted IAW Air Force Instruction 51-503

WITNESS TESTIMONY AND STATEMENTS

Tab V

TAB V

INDEX

ADVICE TO WITNESSES

1. The following individuals were interviewed by the Accident Investigation Boards:

Mr. Harry Brawley
Mr. Steve Cronk
Mr. Bob Ettinger
Mr. Christopher Faust
SSgt James Littlefield
Mr. John Marshal
Mr. Terrance Pelkey
Mr. Jim Rizzo
Mrs. Belinda J. Veracruz
Mr. Chester Wireman

IAW AFI 51-503 they were provided the following verbatim Script for Preparing Witnesses:

My name is Colonel Steve Virgilio. I am here investigating the Global Hawk accident that occurred 29 March 99, at China Lake NAS, California. This investigation is separate and apart from the safety investigation conducted under AFI 91-204. This investigation was convened to gather and preserve evidence for use in claims, litigation, disciplinary actions, adverse administrative proceedings, and for all other purposes except mishap prevention. A safety investigation is also being conducted on the accident for the sole purpose of mishap prevention. Your testimony to us may be used for any proper purpose. Additionally, your testimony can be released to the public. Do you understand the difference between the safety investigation and this accident investigation?

2. IAW AFI 51-503 all the witnesses listed in paragraph 1 above were also provided the following verbatim Oath of Swearing of Witnesses:

Do you solemnly swear that the testimony you are about to give in the matter that is now under investigation will be the truth the whole truth and nothing but the truth, so help you God?

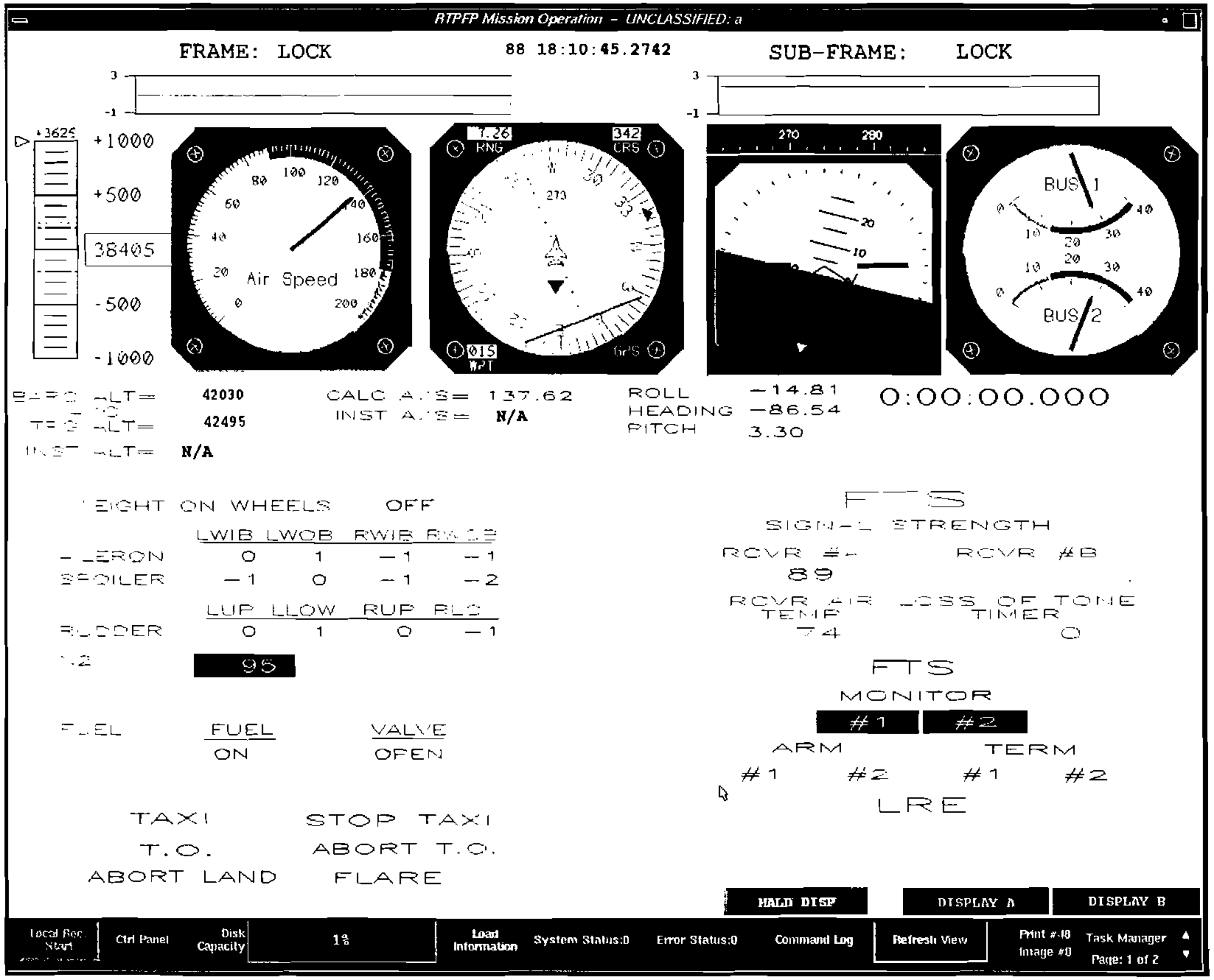
I, Belinda J. Veracruz, computer scientist, Air Force Flight Test Center, Edwards AFB, CA on 27 April 1999, provided copies of the RTPFP Mission Operation displays of the global hawk mission flown on 29 March 1999 at china lake naval air station, California. The displays were from 18:10:45Z through 18:11:10Z , 18:13:15Z through 18:13:41Z, 18:13:43Z through 18:14:01Z. The focus of attention on the displays was the status of the Flight Termination Signal (FTS), Strength and the FTS monitor, arm and terminate command activation display. The copies were made from the digital tape of UAV RQ-4A, tail # 2002, flight # 2-09 flown on 29 march 1999. The tape was received from the Global Hawk Accident Investigation Board on 26 April 1999.

Belinda J Veracruz
BELINDA J. VERACRUZ

Signed and sworn before me this 4TH day of May 1999

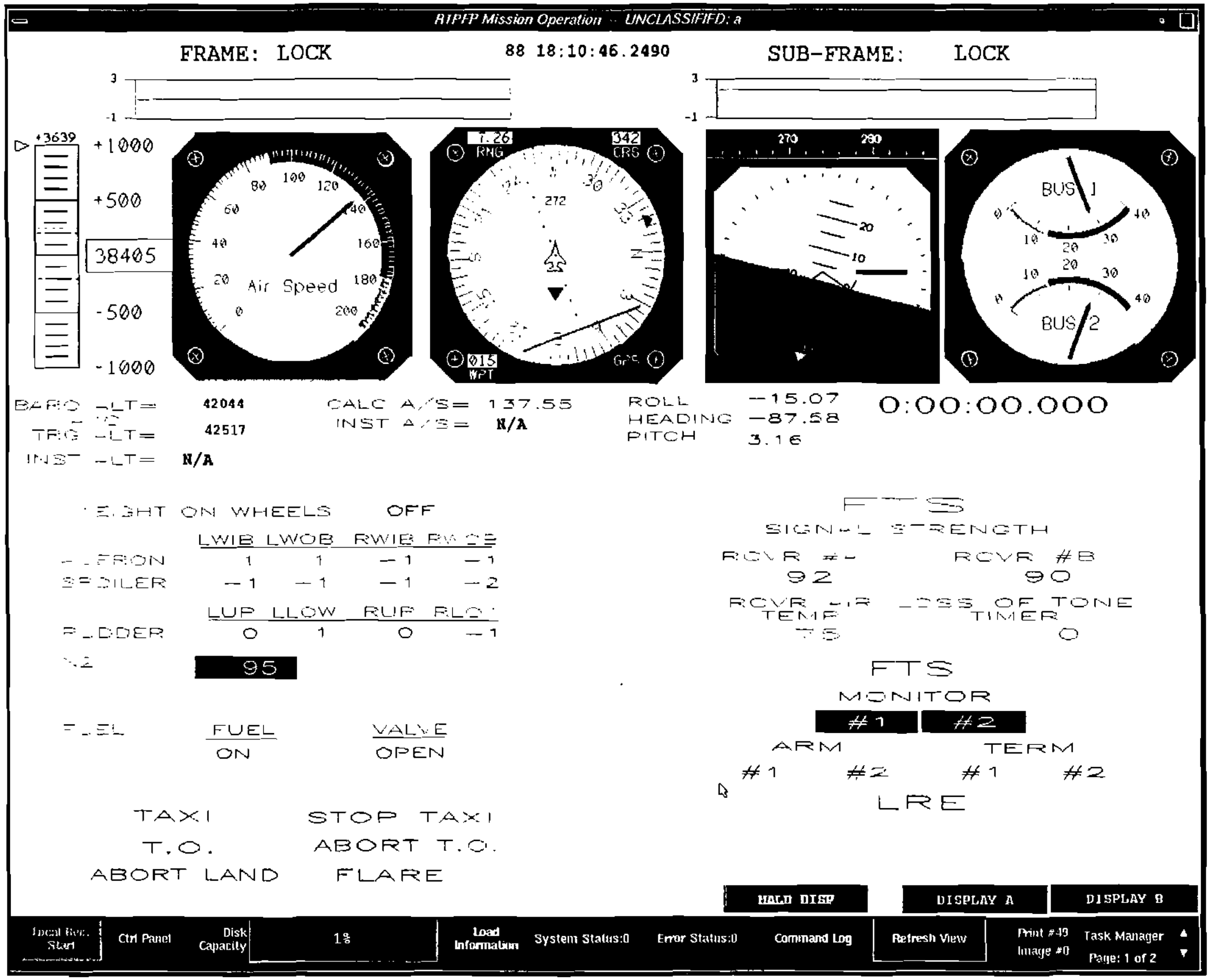
Steph T. Virgilio
STEPHEN T. VIRGILIO, Colonel, UASF
Global Hawk Accident Investigation Board President

Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65445296 Date: Tue Apr 27 07:38:41 1999

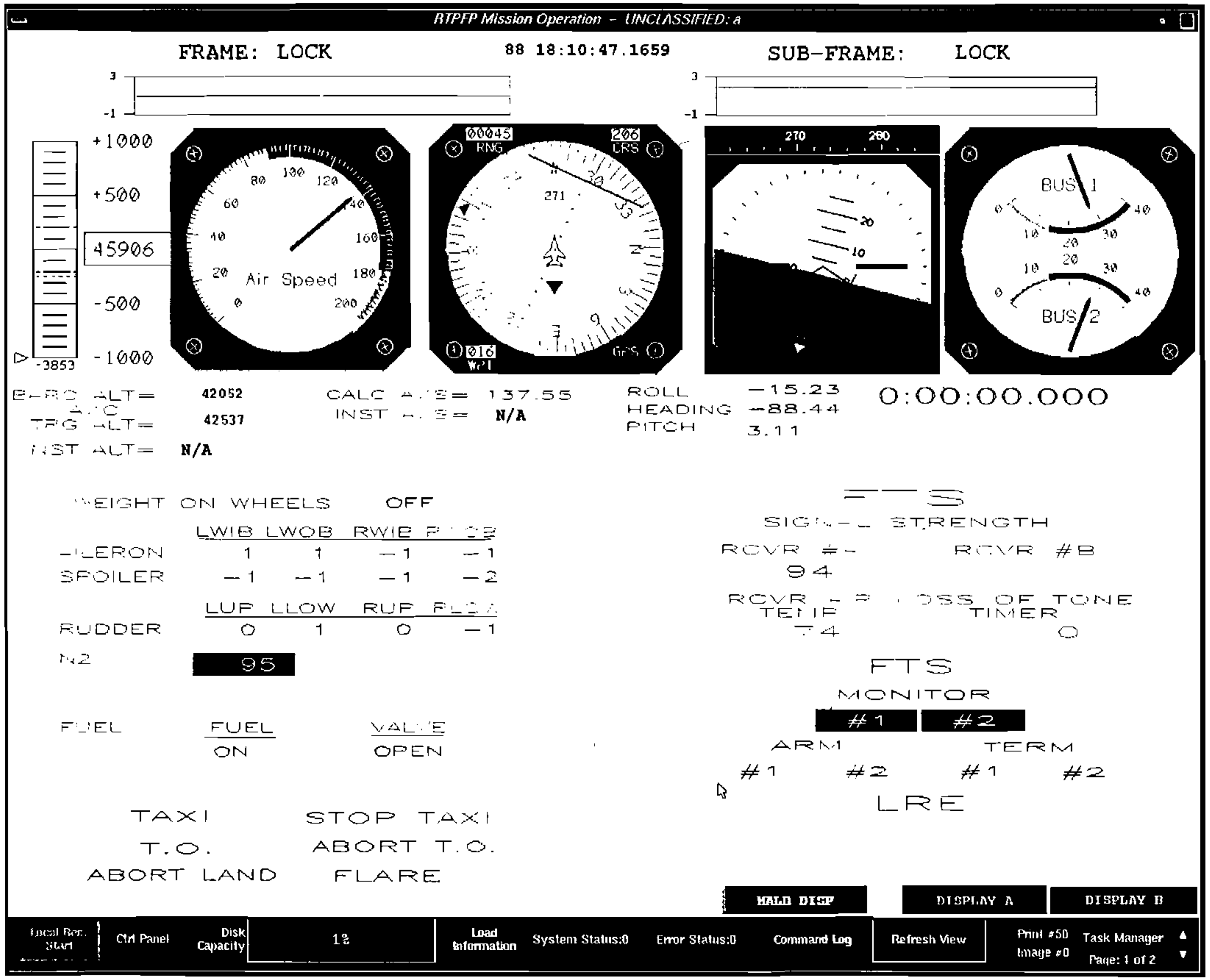
Project: a Operation: a Test: a Display: hawksafety.v
a



V-1.3

Global Hawk UAV, 95-2002, 19990329

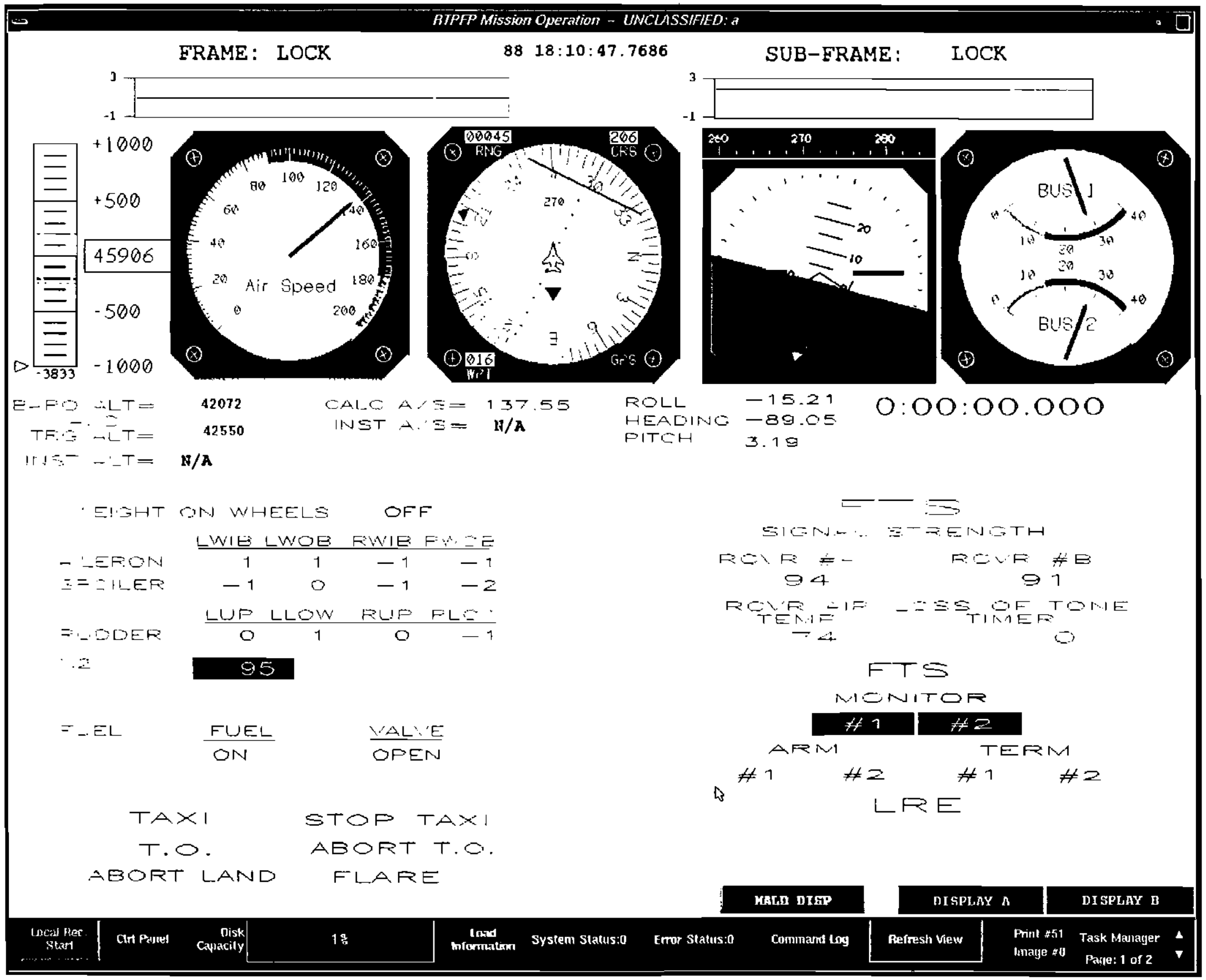
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65446254 Date: Tue Apr 27 07:38:45 1999



V-1.4

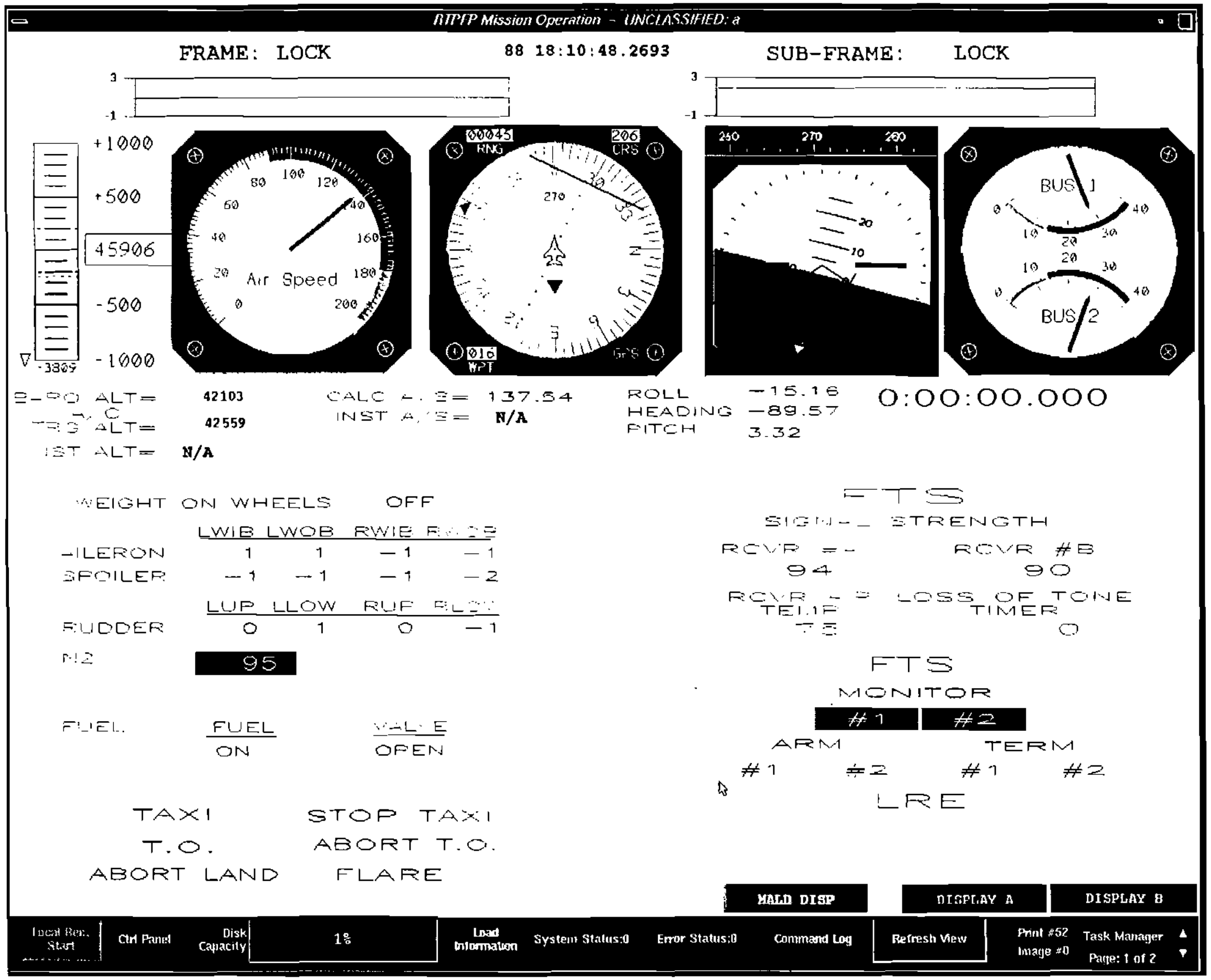
Global Hawk UAV, 95-2002, 19990329

Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65447782 Date: Tue Apr 27 07:38:51 1999

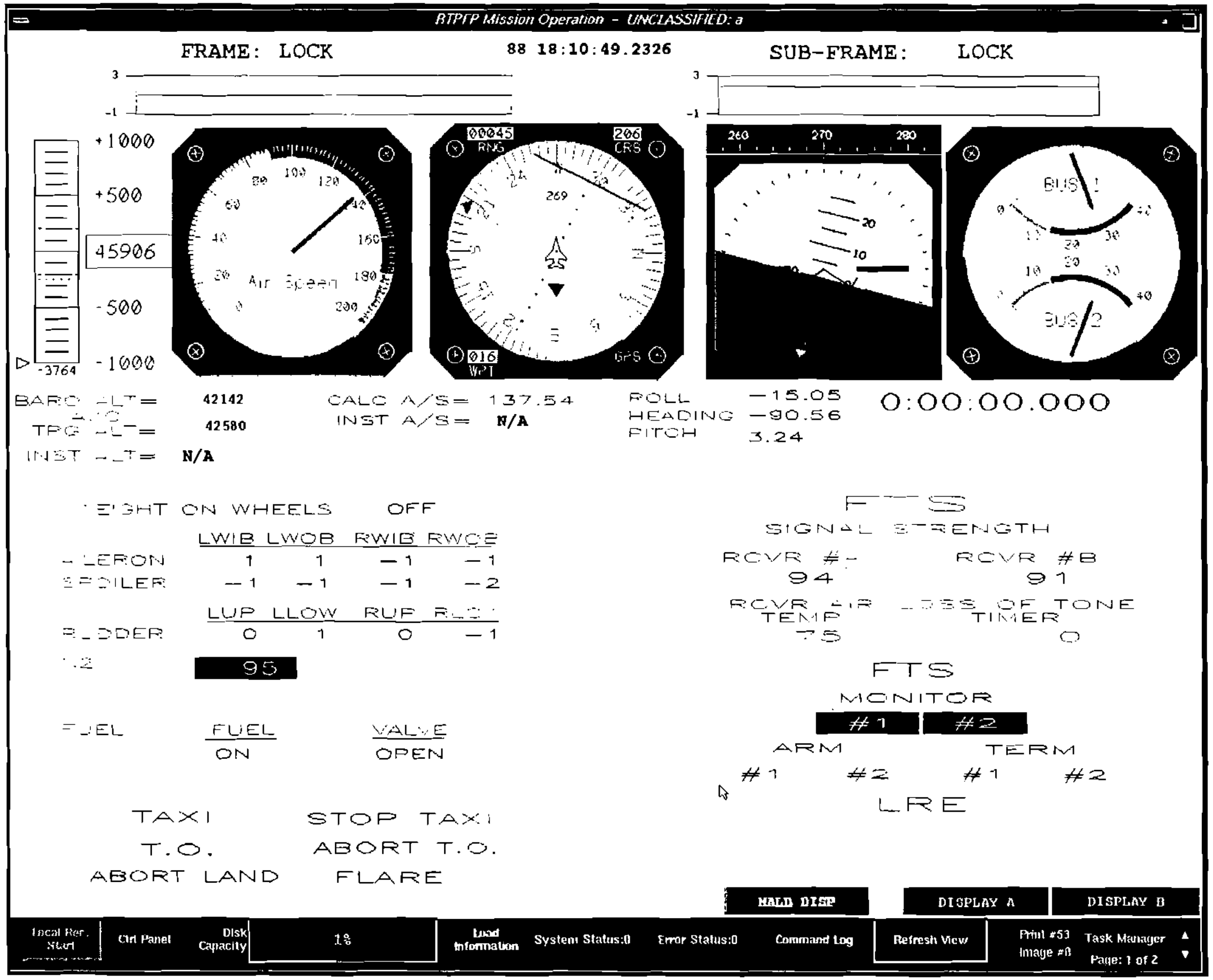
Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65448304 Date: Tue Apr 27 07:38:53 1999

Global Hawk UAV, 95-2002, 19990329

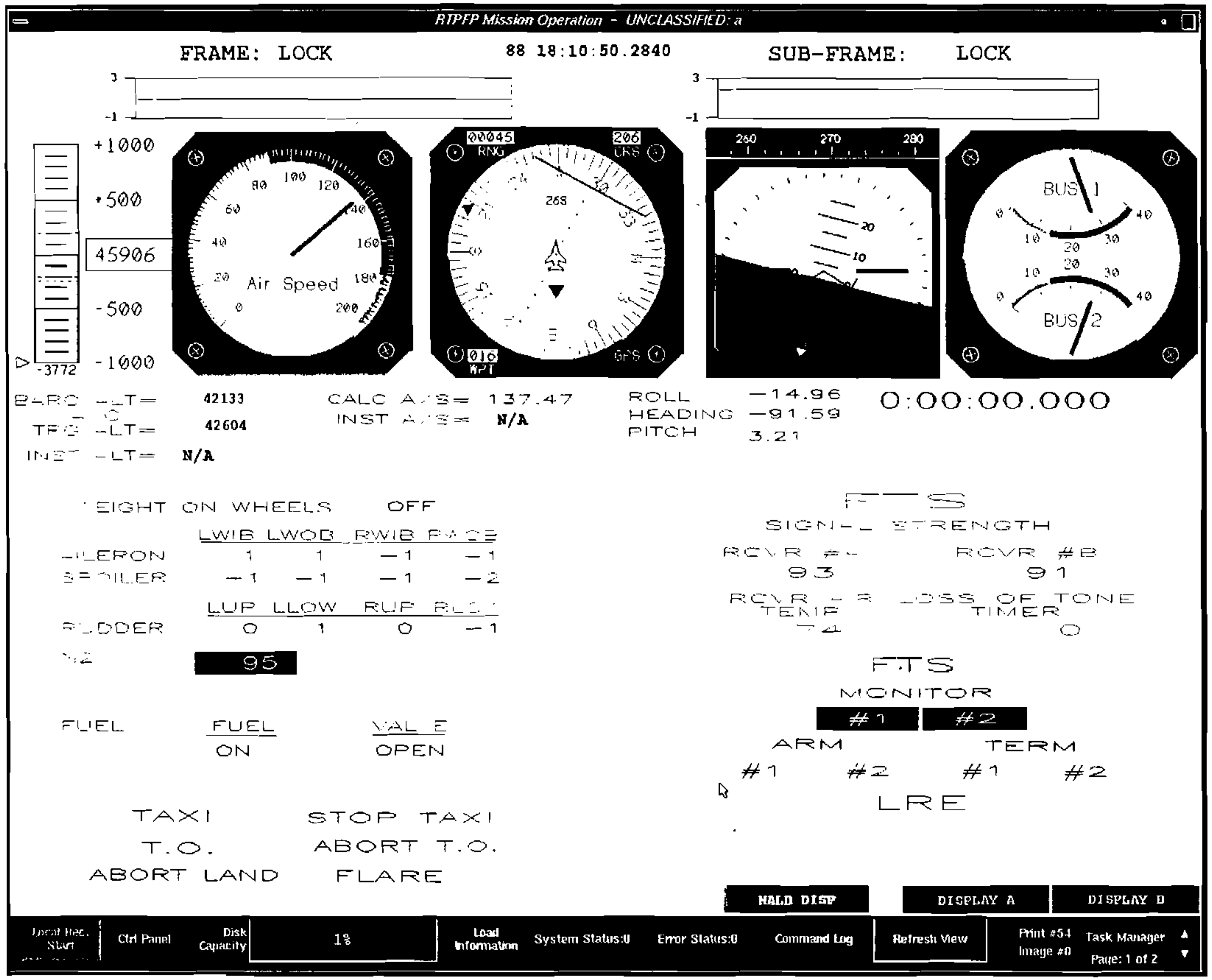
Project: a Operation: a Test: a Display: hawksafety.v
a



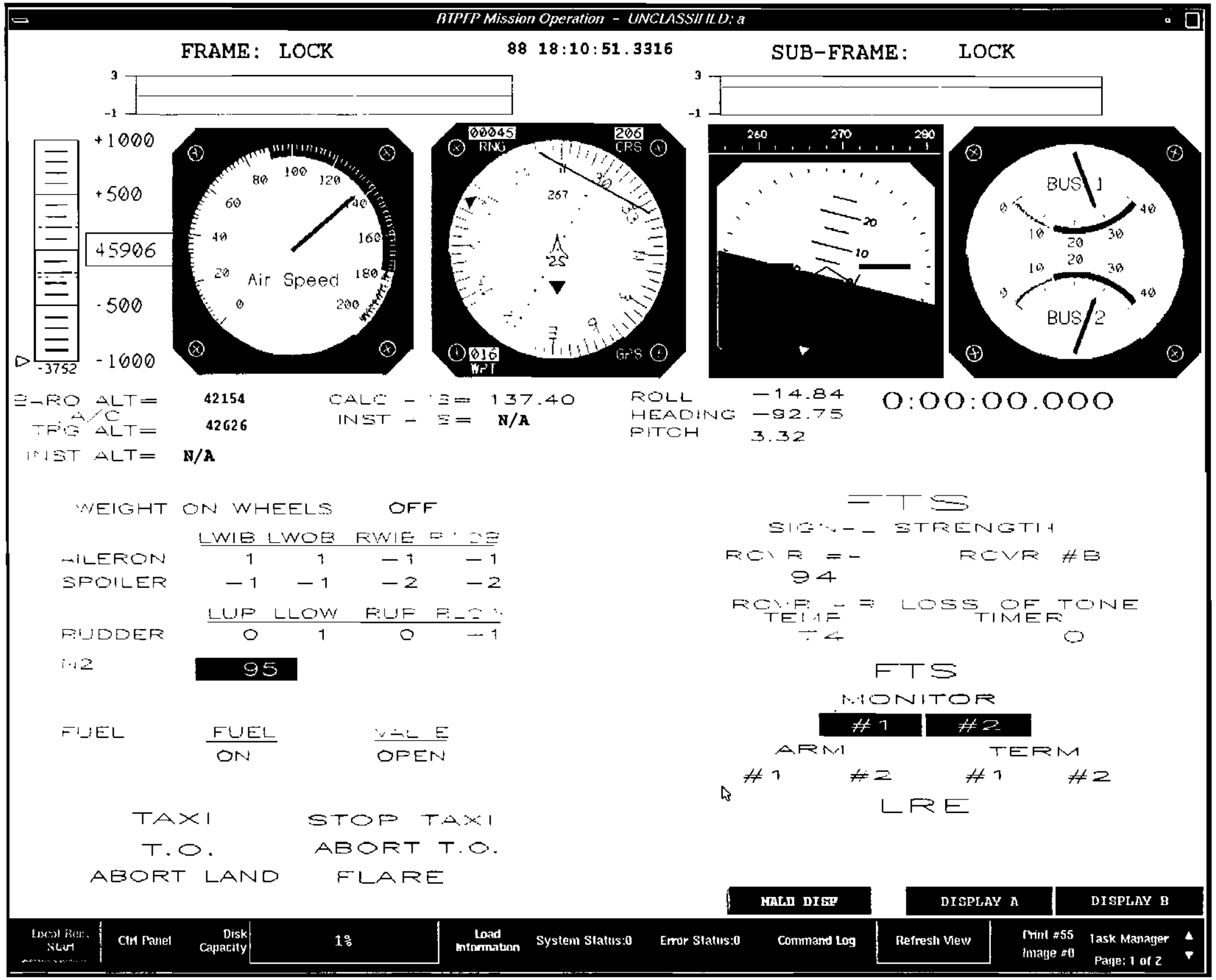
Global Hawk UAV, 95-2002, 19990329

a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65449238 Date: Tue Apr 27 07:38:57 1999

Project: a Operation: a Test: a Display: hawksafety.v
a



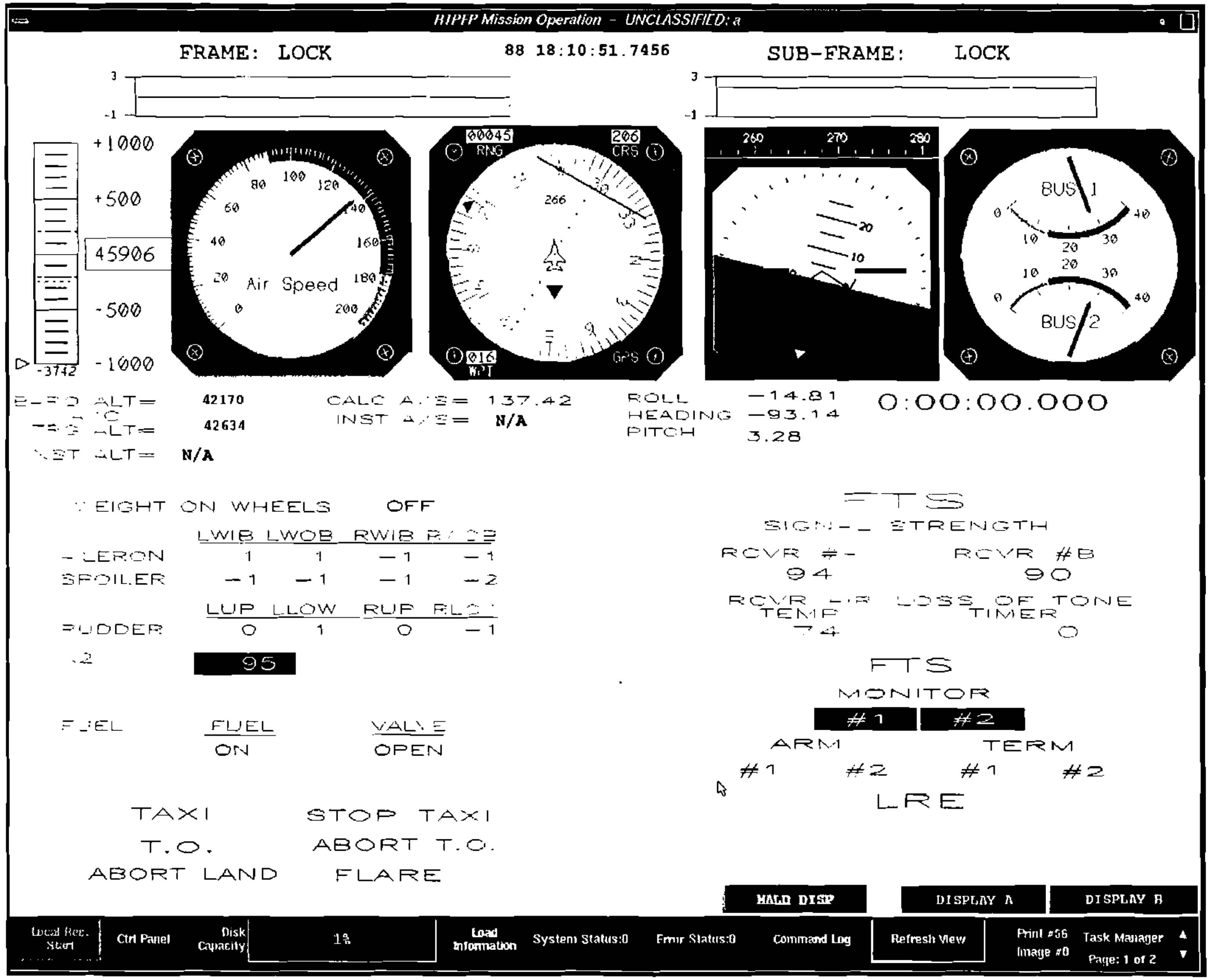
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65450297 Date: Tue Apr 27 07:39:01 1999



V-1.9

Global Hawk UAV, 95-2002, 19990329

Project: a Operation: a Test: a Display: hawksafety.v
a



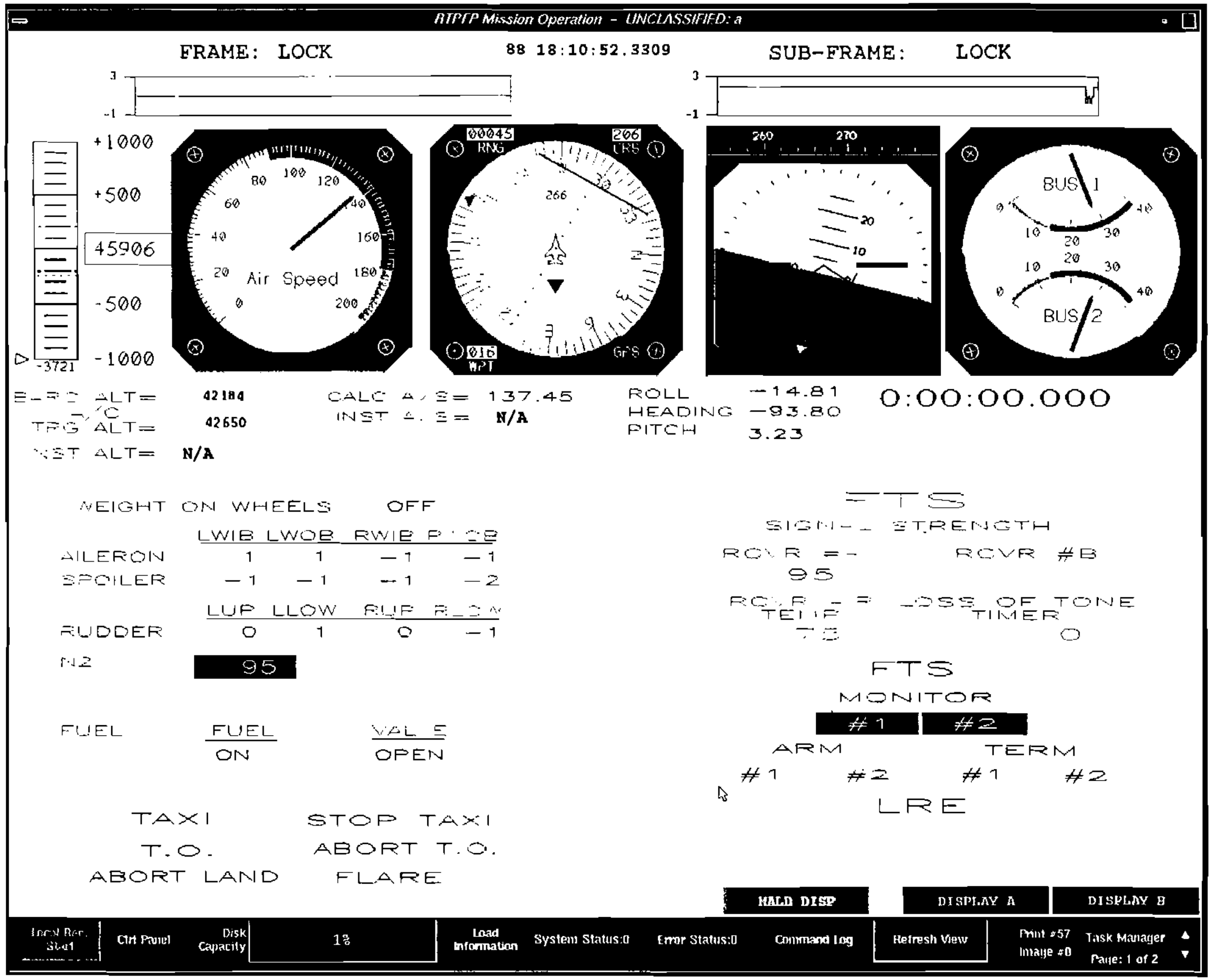
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65451757 Date: Tue Apr 27 07:39:07 1999

V-1.10

Global Hawk UAV, 95-2002, 19990329

Project: a Operation: a Test: a Display: hawksafety.v

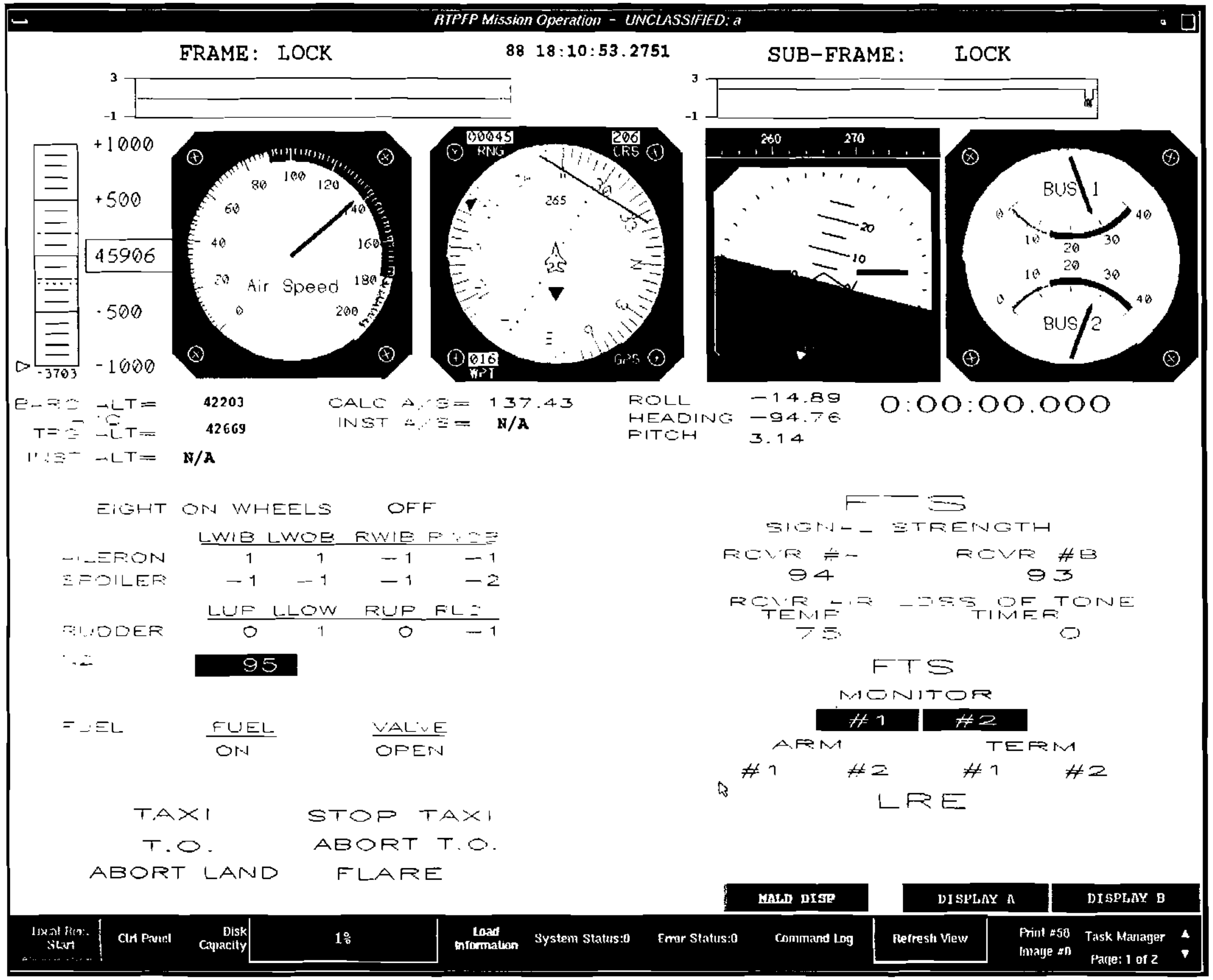
a



a

Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65452346 Date: Tue Apr 27 07:39:09 1999

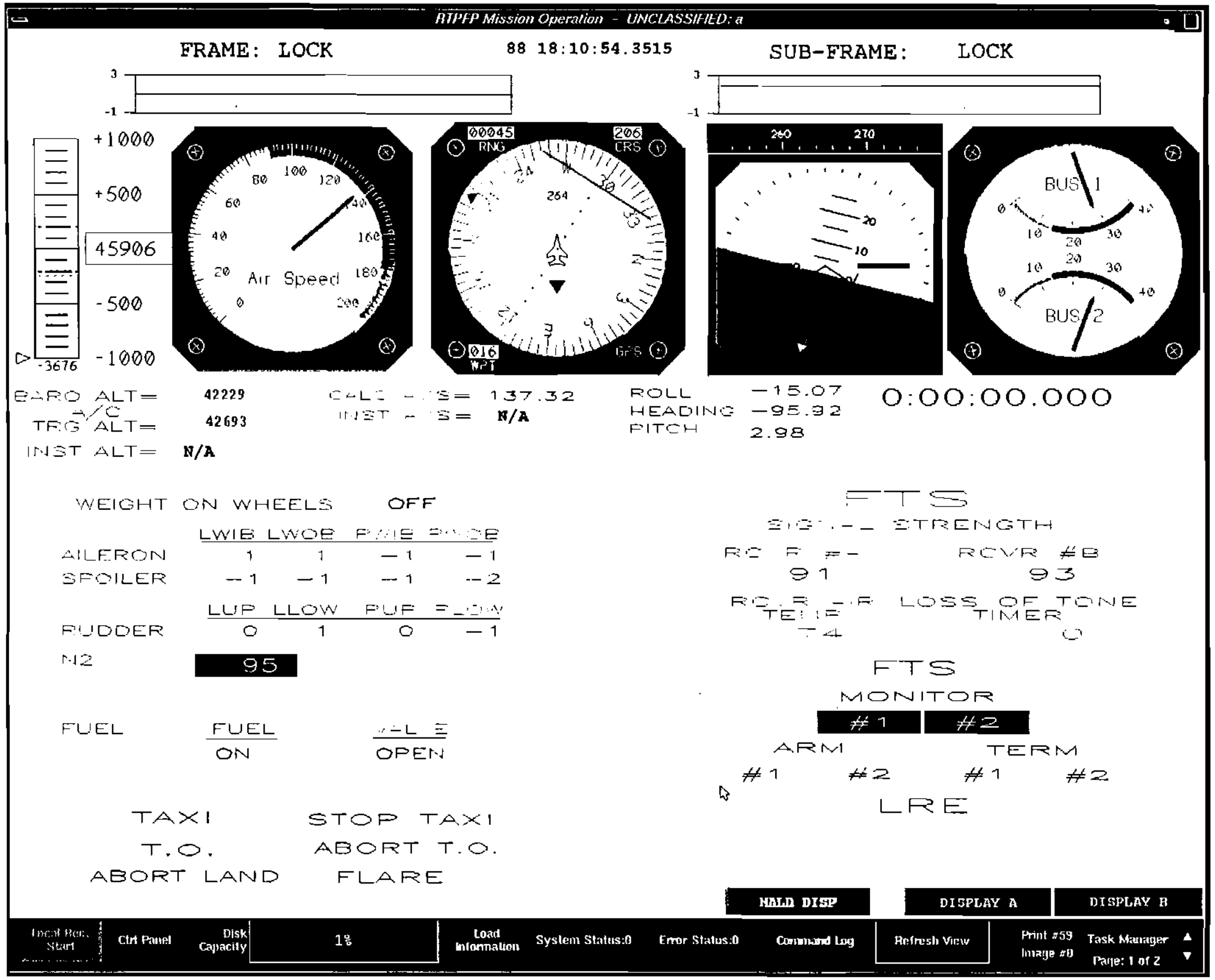
Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65453304 Date: Tue Apr 27 07:39:13 1999

Global Hawk UAV, 95-2002, 19990329

Project: a Operation: a Test: a Display: hawksafety.v
a

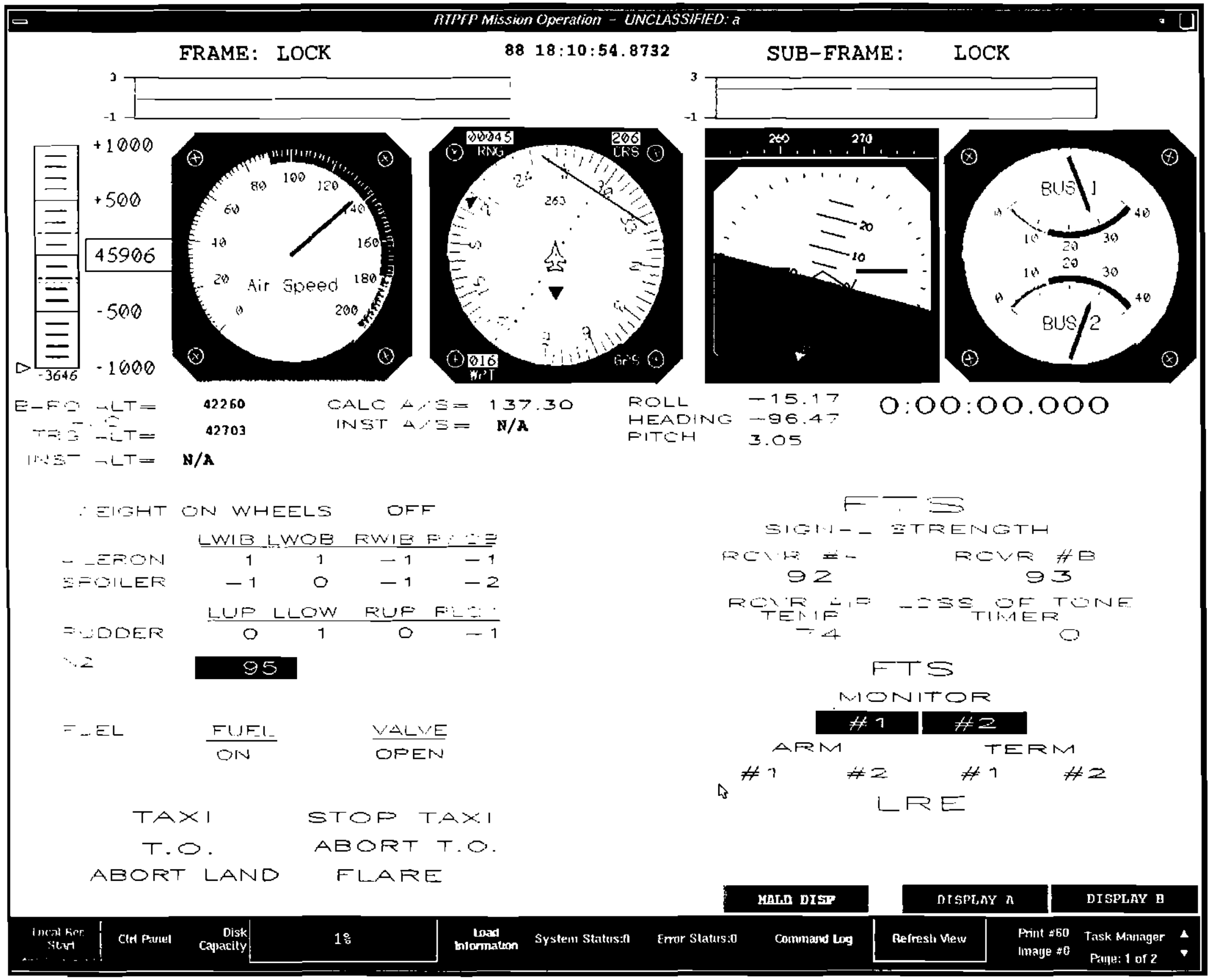


V-1.13

Global Hawk UAV, 95-2002, 19990329

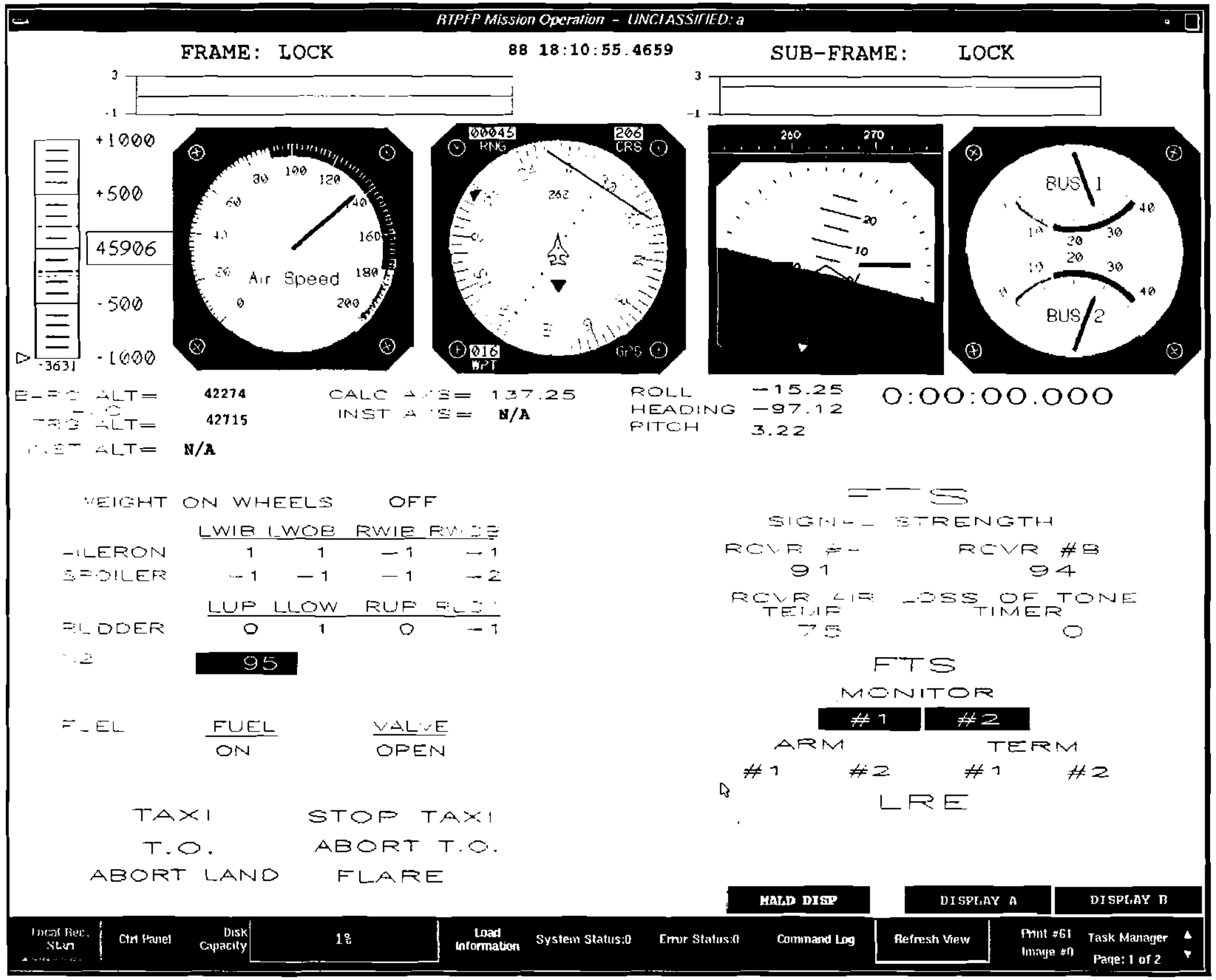
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65454355 Date: Tue Apr 27 07:39:17 1999

Project: a Operation: a Test: a Display: hawksafety.v
a



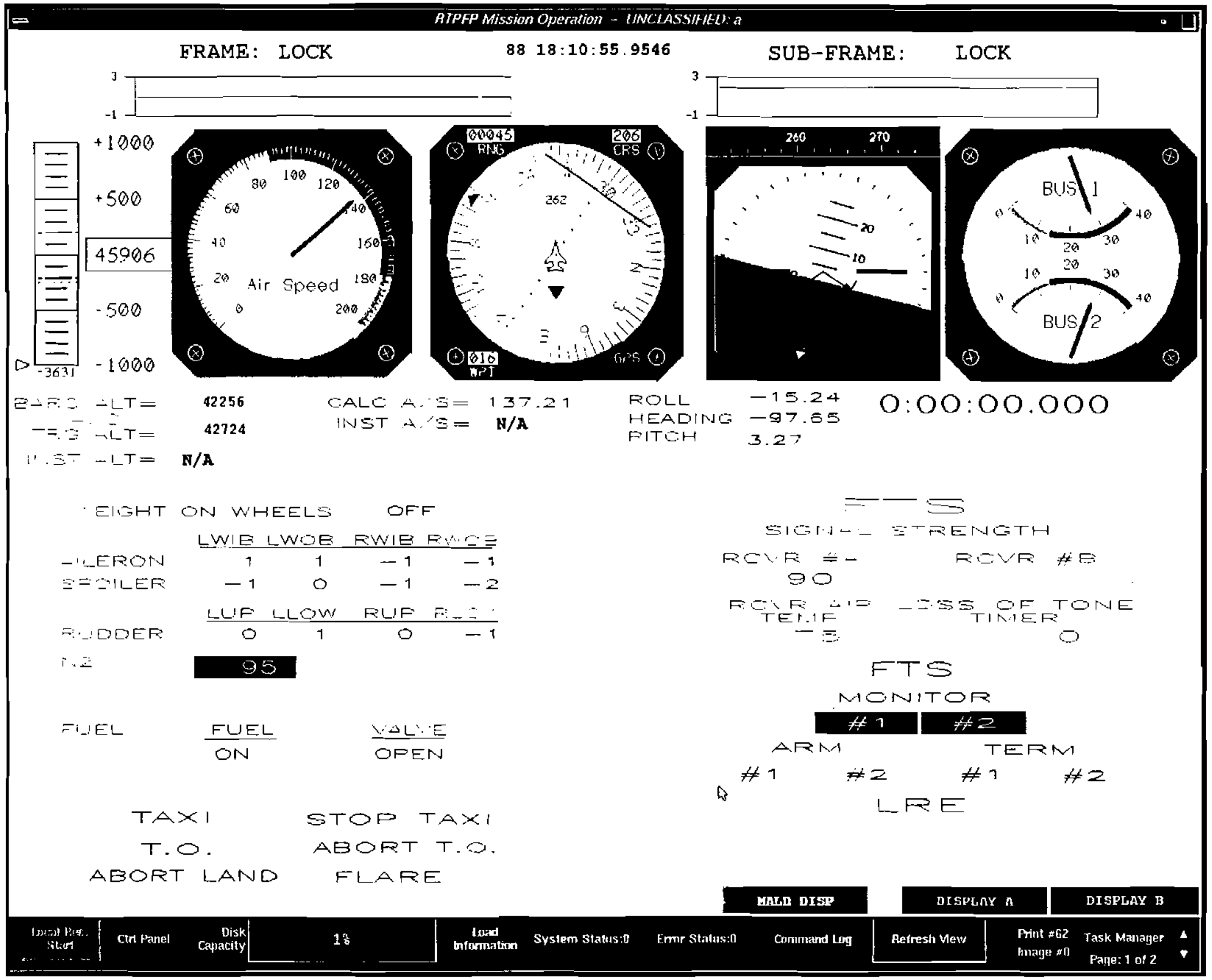
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65454882 Date: Tue Apr 27 07:39:20 1999

Project: a Operation: a Test: a Display: hawksafety.v
a



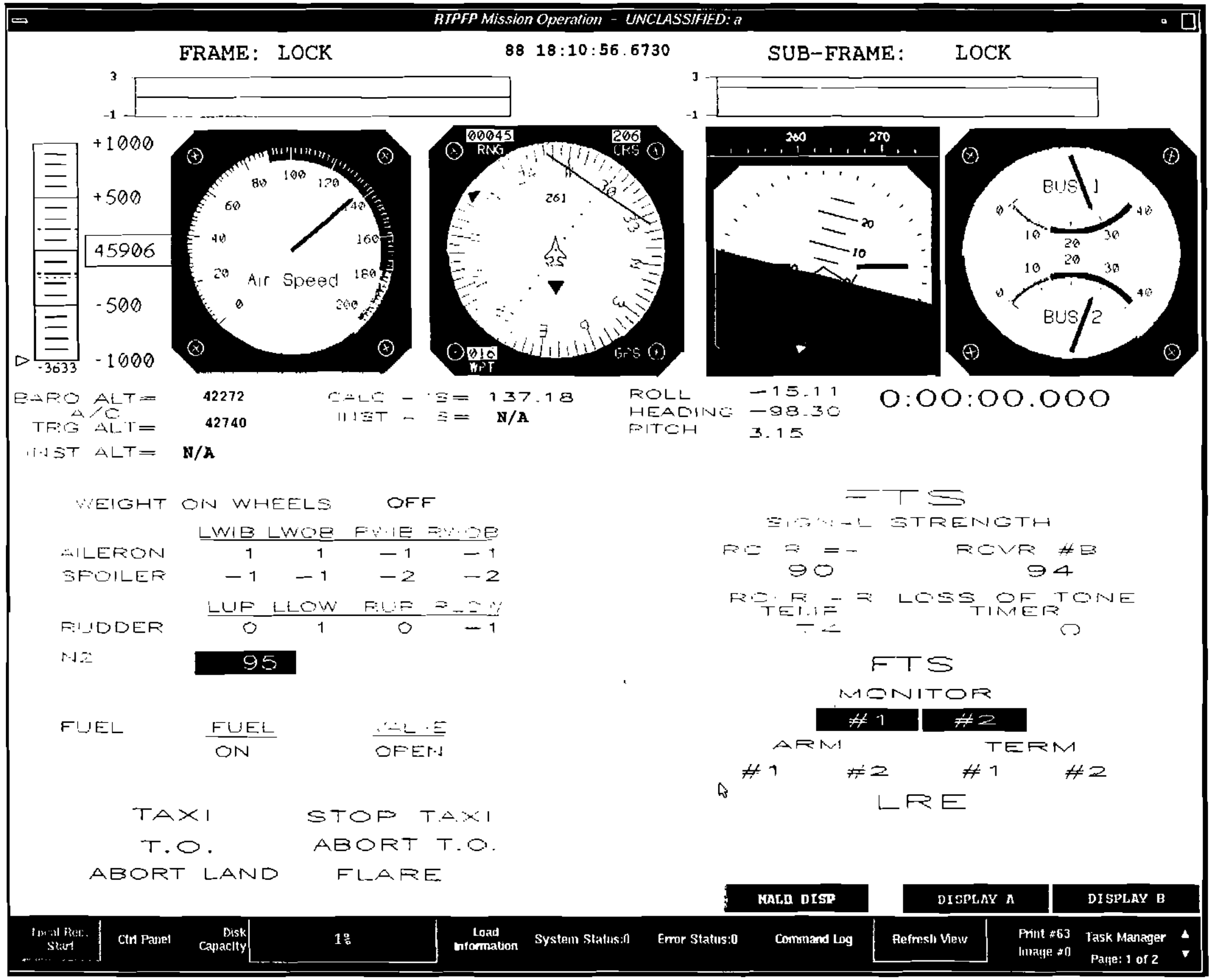
a
Workstation: wsl7rm266 User: wsl7 TPP: Range Time: 0 65455477 Date: Tue Apr 27 07:39:22 1999

Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65455975 Date: Tue Apr 27 07:39:24 1999

Project: a Operation: a Test: a Display: hawksafety.v
a

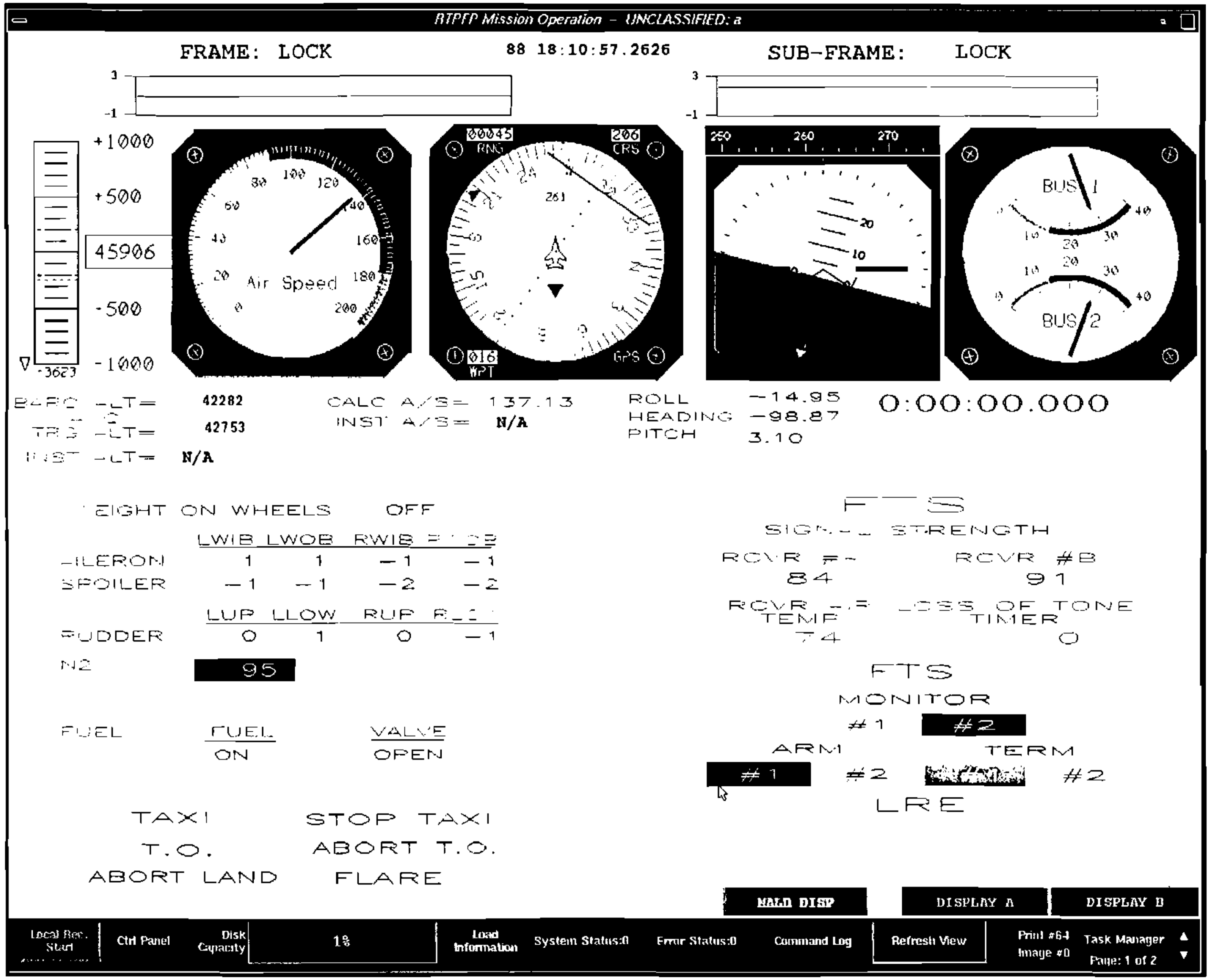


Global Hawk UAV, 95-2002, 19990329

V-1.17

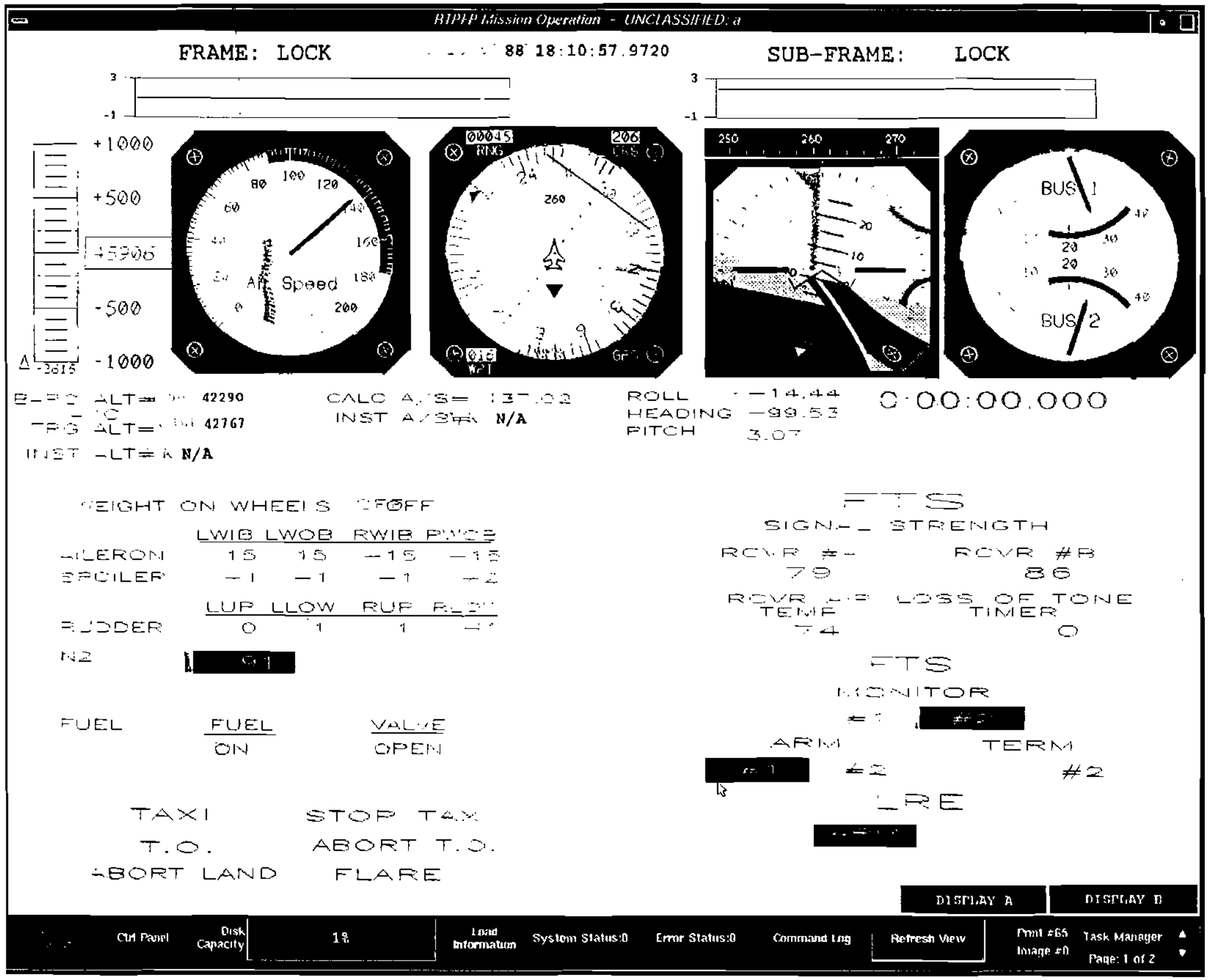
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65456678 Date: Tue Apr 27 07:39:27 1999

Project: a Operation: a Test: a Display: hawksafety.v
a

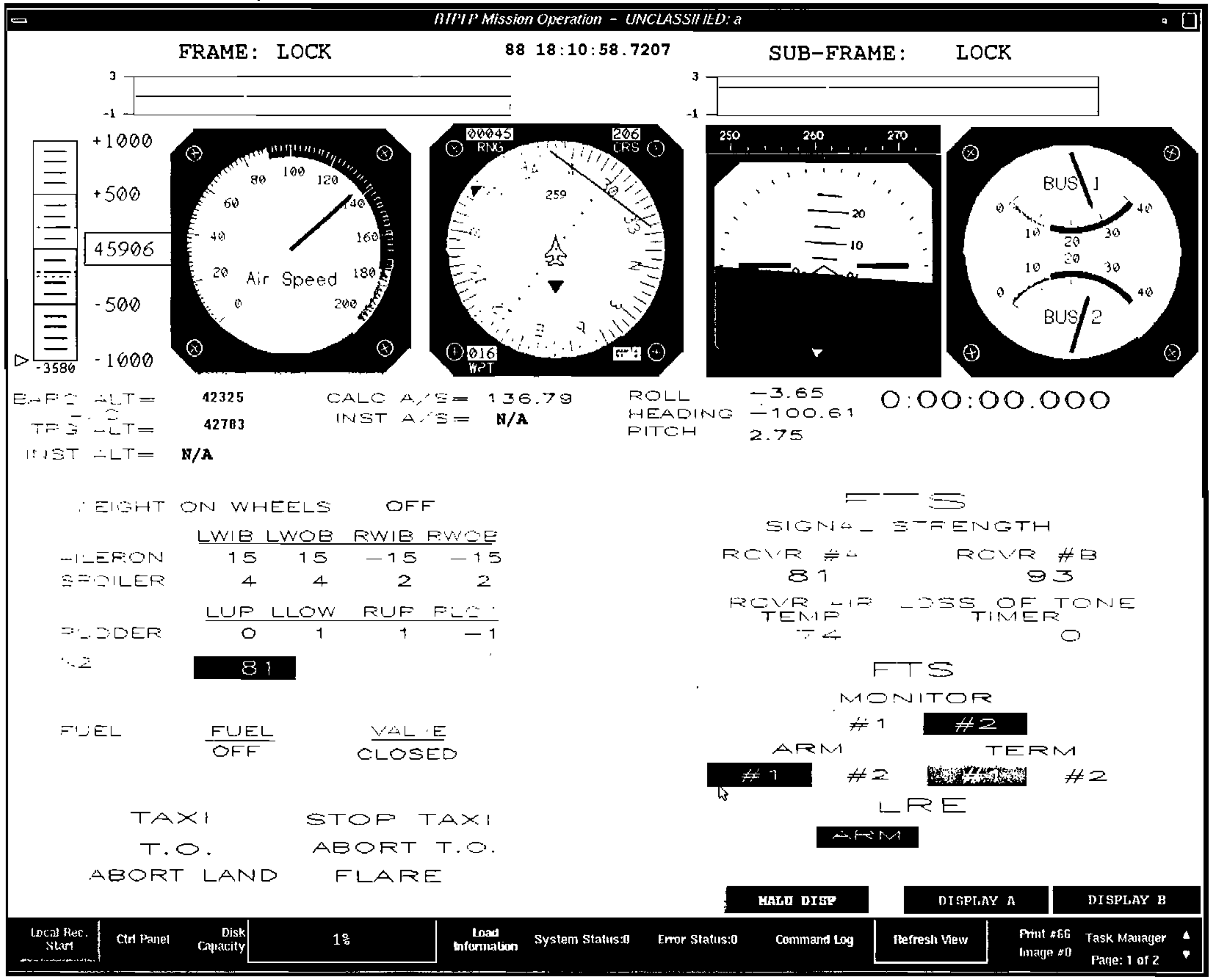


a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65457277 Date: Tue Apr 27 07:39:29 1999

Global Hawk UAV, 95-2002, 19990329

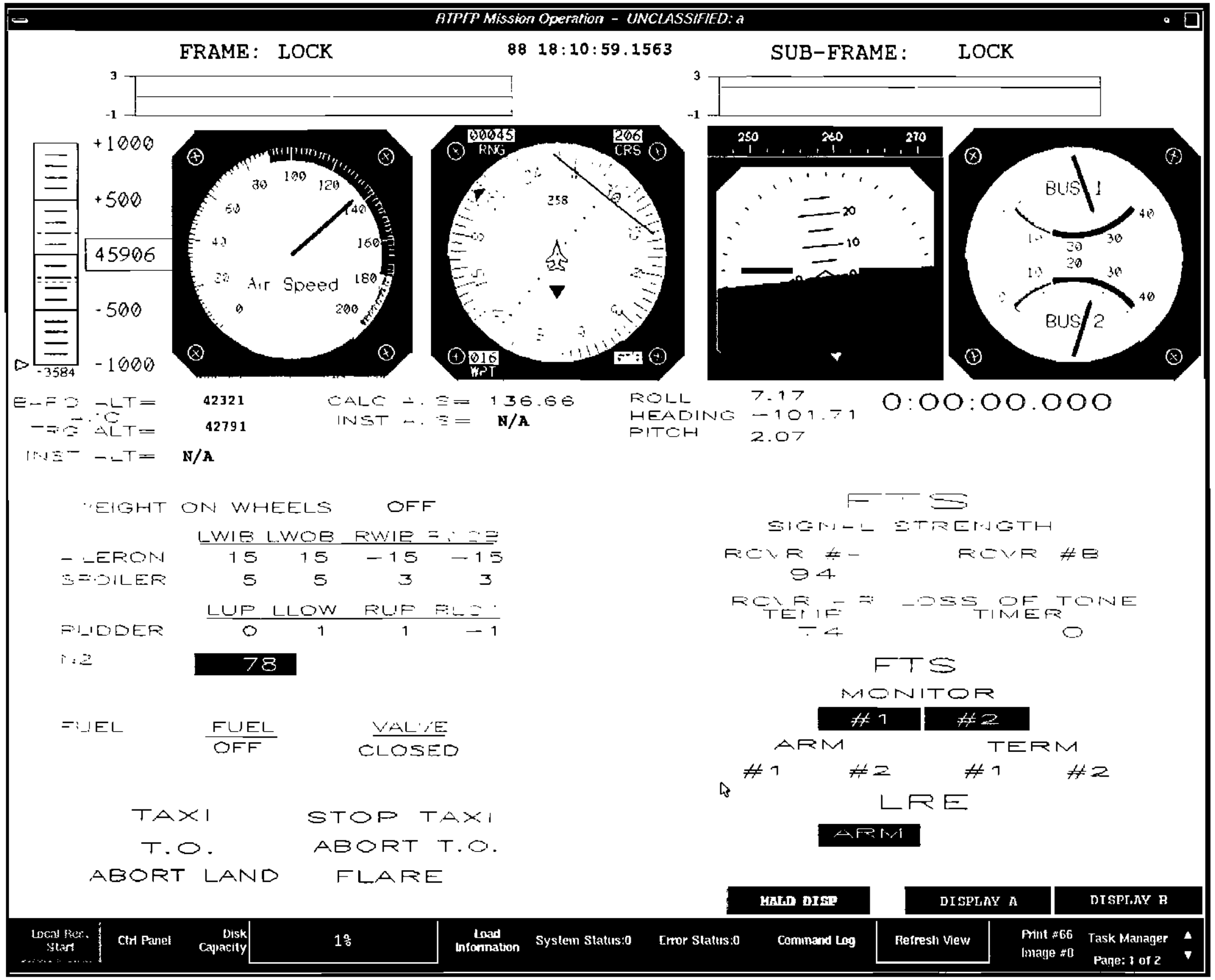

RTPFP Mission Operation - UNCLASSIFIED: a
FRAME: LOCK
88 18:10:57.9720
SUB-FRAME: LOCK
+1000
+500
-500
-1000
Air Speed
BUS 1
BUS 2
42290
42767
N/A
ROLL -14.44
HEADING -99.53
PITCH 3.07
0:00:00.000
FTS
SIGNAL STRENGTH
RCVR #B
79
86
LOSS OF TONE TIMER
74
0
FTS
MONITOR
ARM
TERM
#2
#2
LRE
LWIB LWOB RWIB
AILERON 15 15 -15 -15
SPOILER -1 -1 -1 -2
LUP LLOW RUP
RUDDER 0 1 1
N2
FUEL
FUEL
ON
VALVE
OPEN
TAXI
STOP TAXI
T.O.
ABORT T.O.
ABORT LAND
FLARE
DISPLAY A
DISPLAY B
Ctrl Panel
Disk Capacity
1%
Load Information
System Status:0
Error Status:0
Command Log
Refresh View
Task Manager
Page: 1 of 2

Project: a Operation: a Test: a Display: hawksafety.v
a



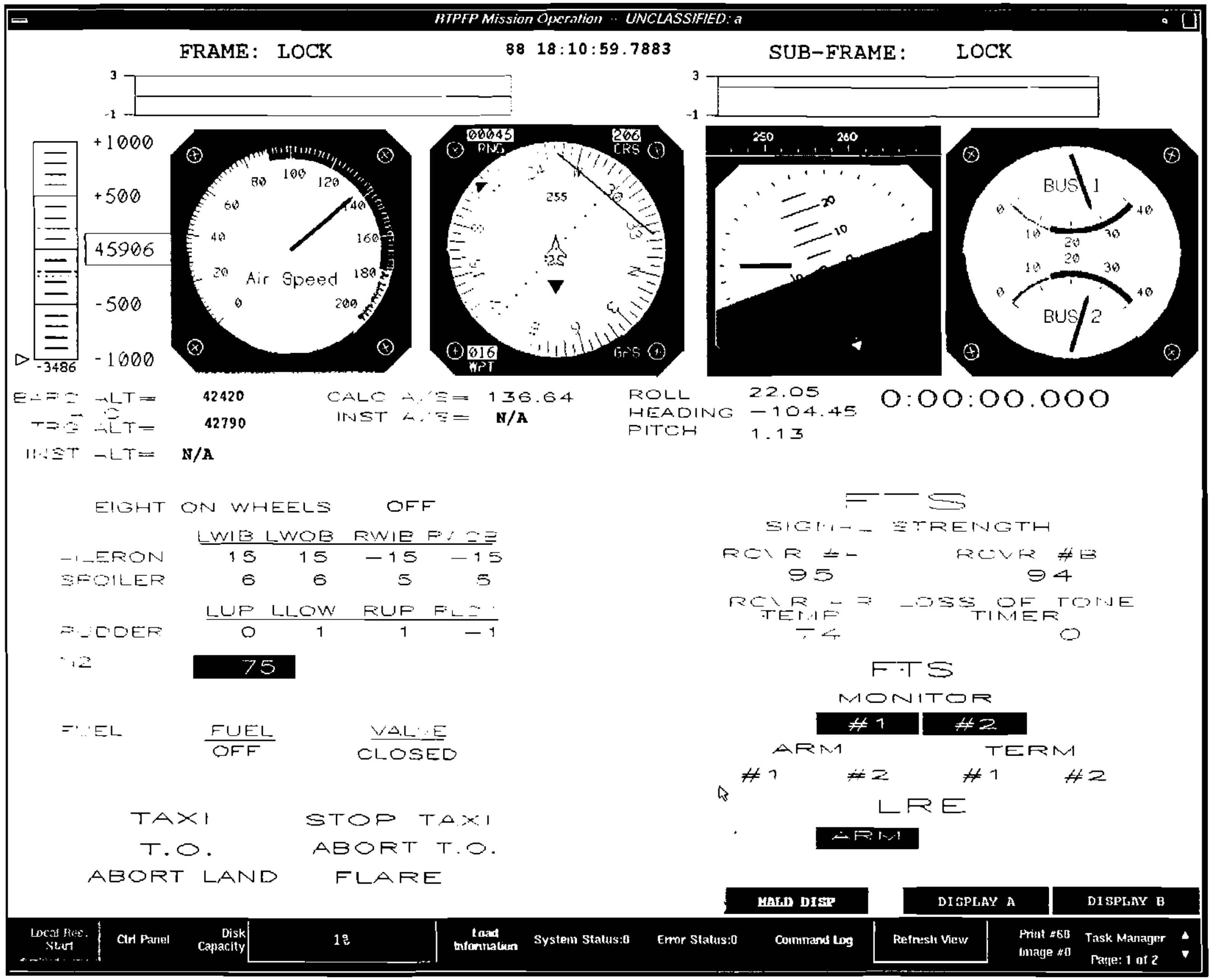
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65458747 Date: Tue Apr 27 07:39:35 1999

Project: a Operation: a Test: a Display: hawksafety.v
a



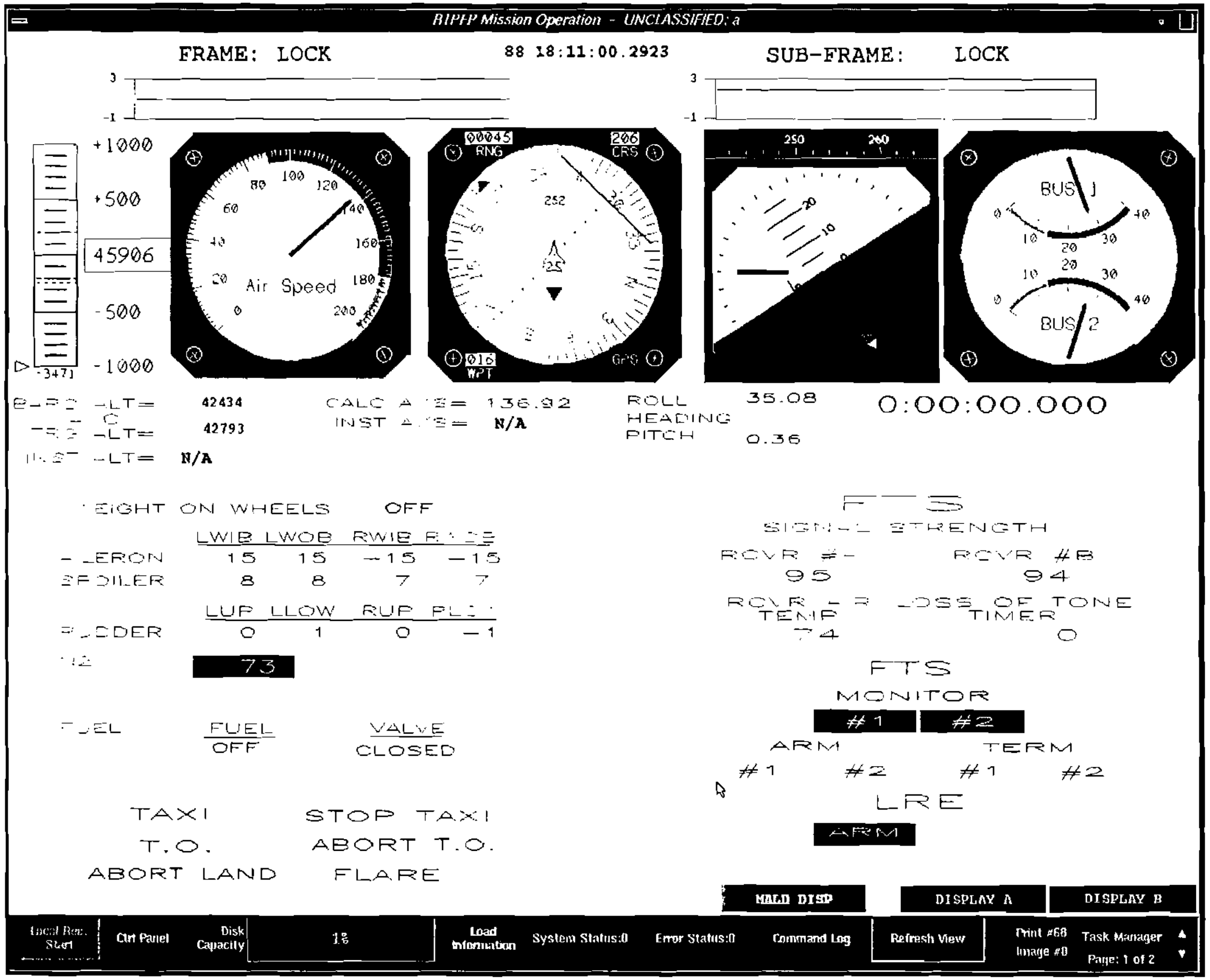
a
Workstation: wsl7rm266 User: wsl7 TPP: Range Time: 0 65459176 Date: Tue Apr 27 07:39:37 1999

Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65459792 Date: Tue Apr 27 07:39:39 1999

Project: a Operation: a Test: a Display: hawksafety.v
a

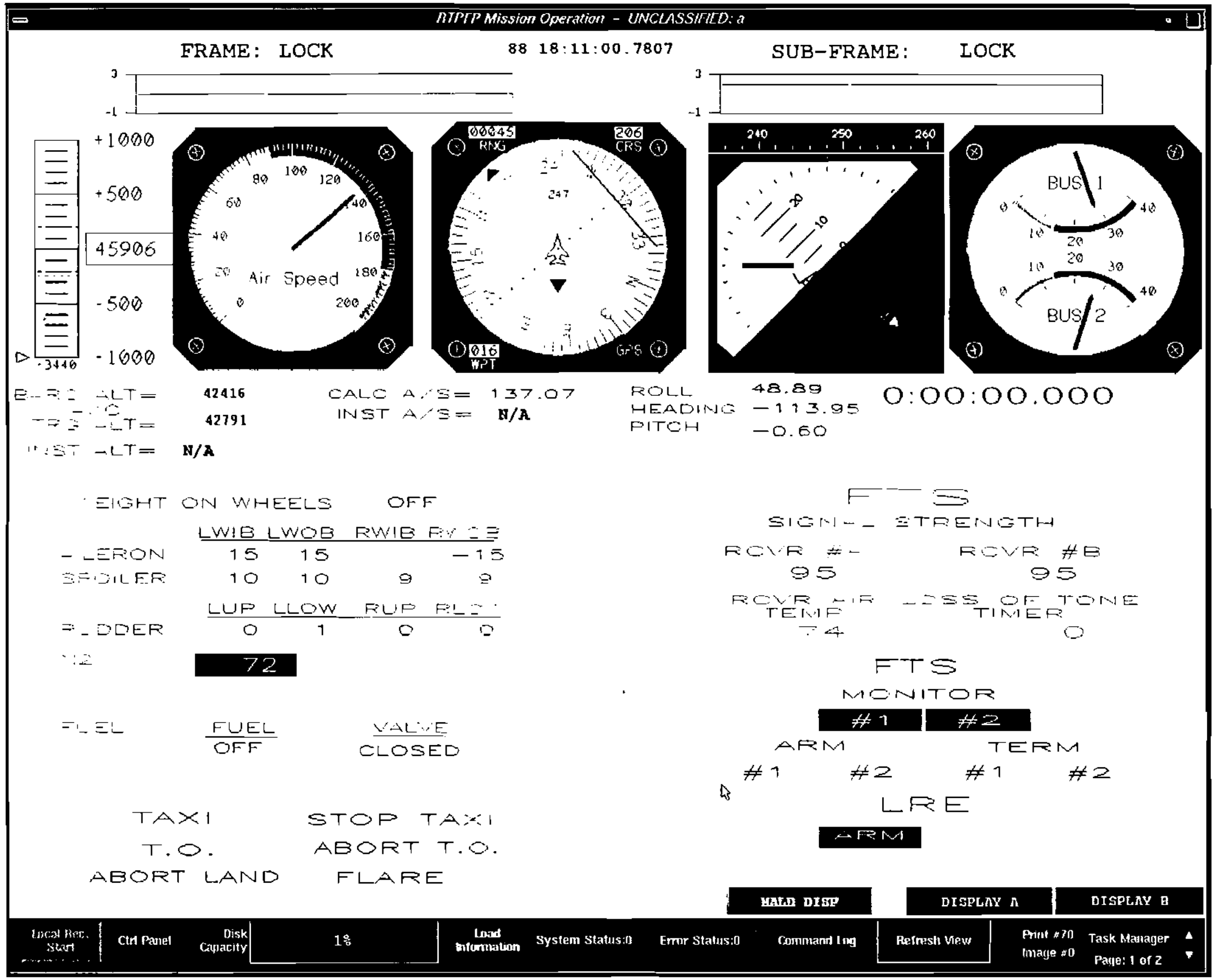


V-1.23

Global Hawk UAV, 95-2002, 19990329

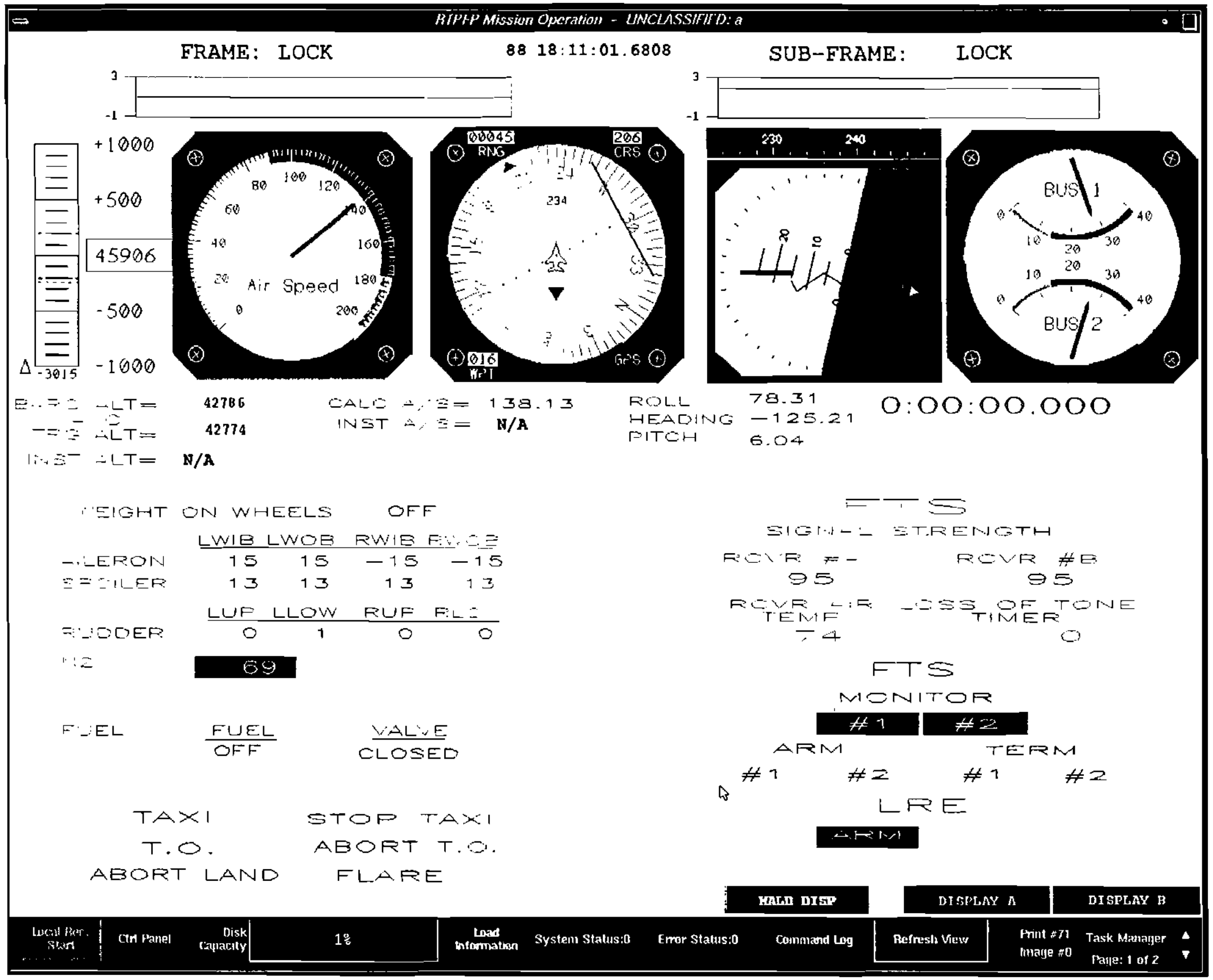
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65460304 Date: Tue Apr 27 07:39:41 1999

Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65460824 Date: Tue Apr 27 07:39:43 1999

Project: s a Operation: a Test: a Display: hawksafety.v

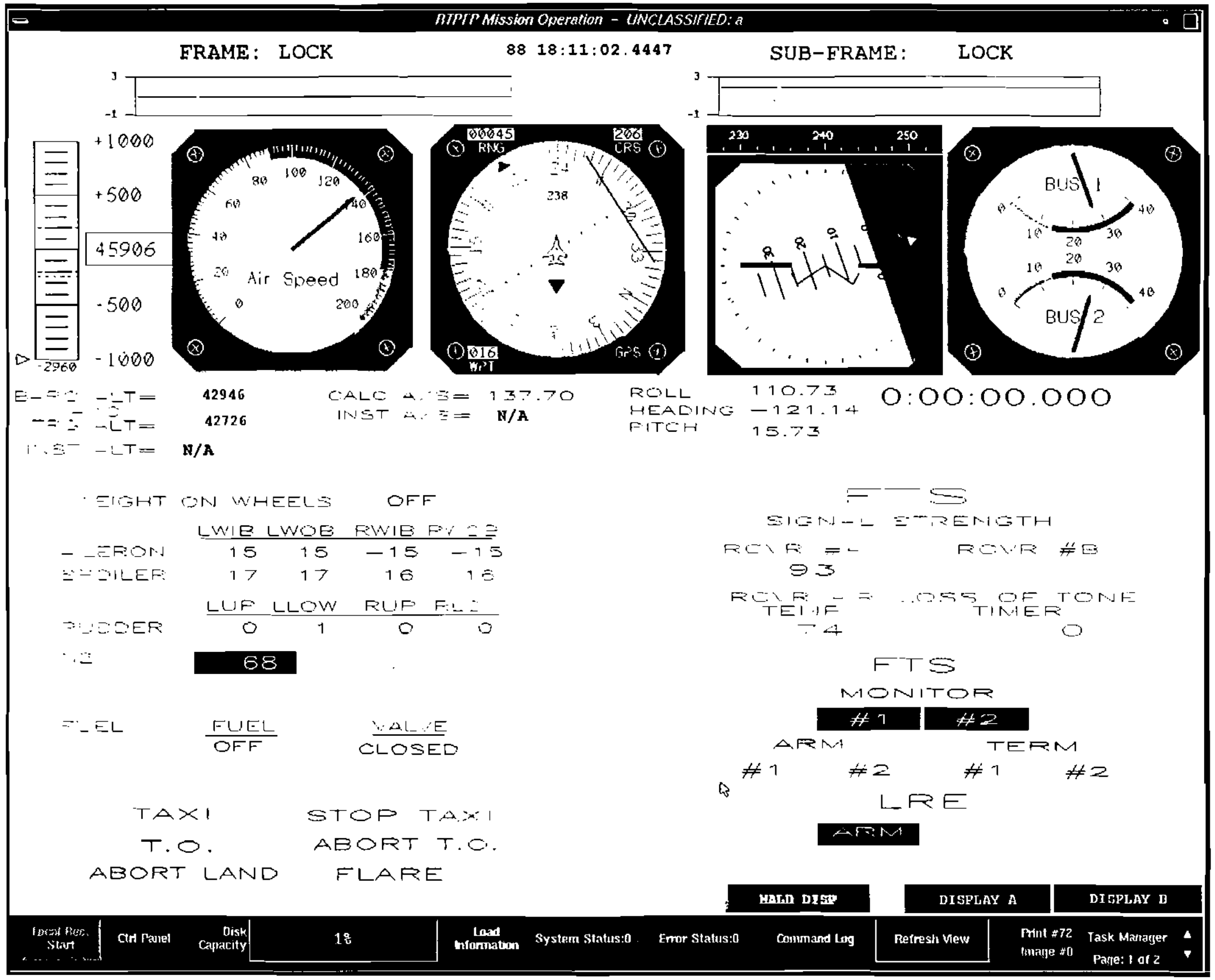


V-1.25

Global Hawk UAV, 95-2002, 19990329

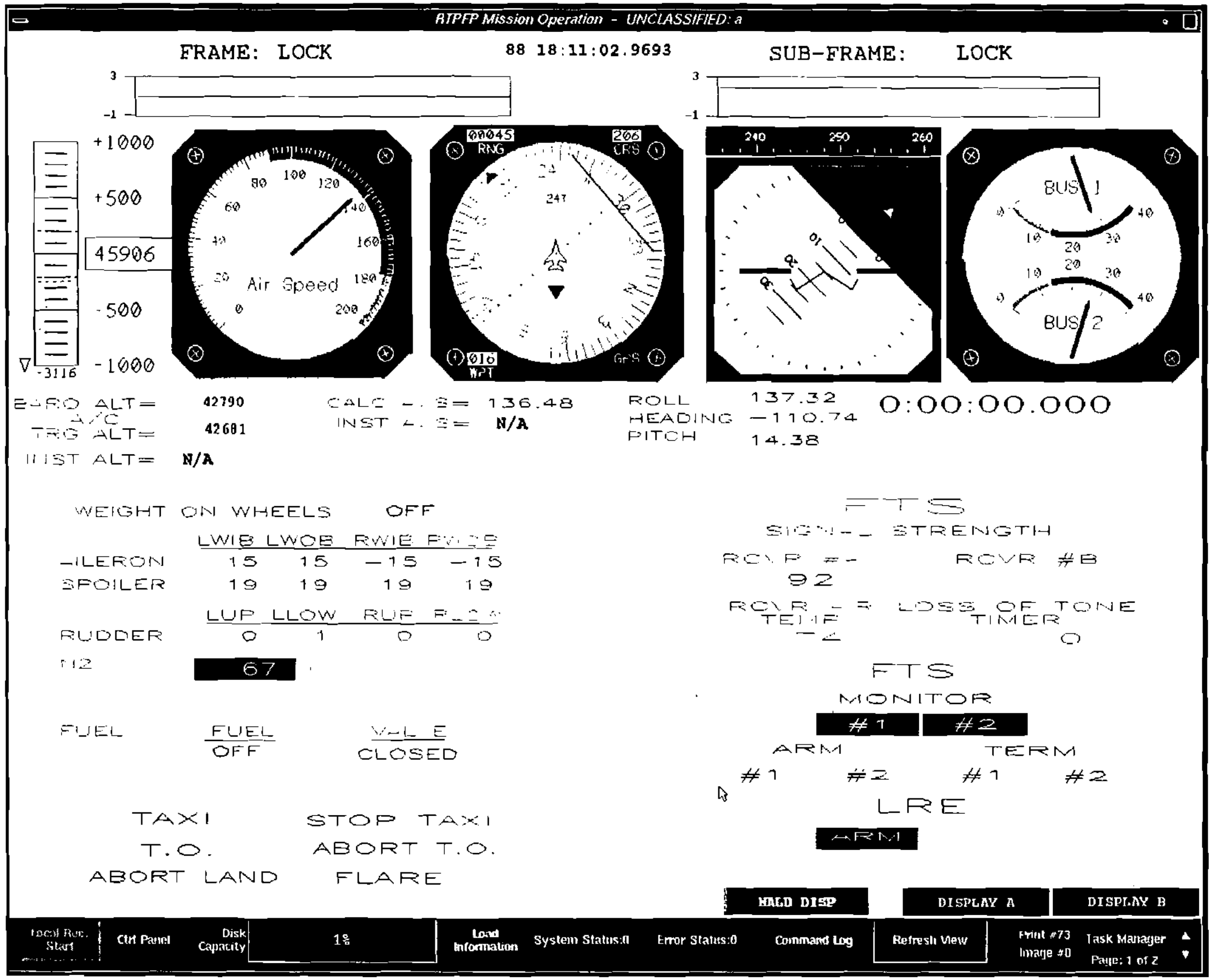
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65461693 Date: Tue Apr 27 07:39:47 1999

Project: a Operation: a Test: a Display: hawksafety.v
a



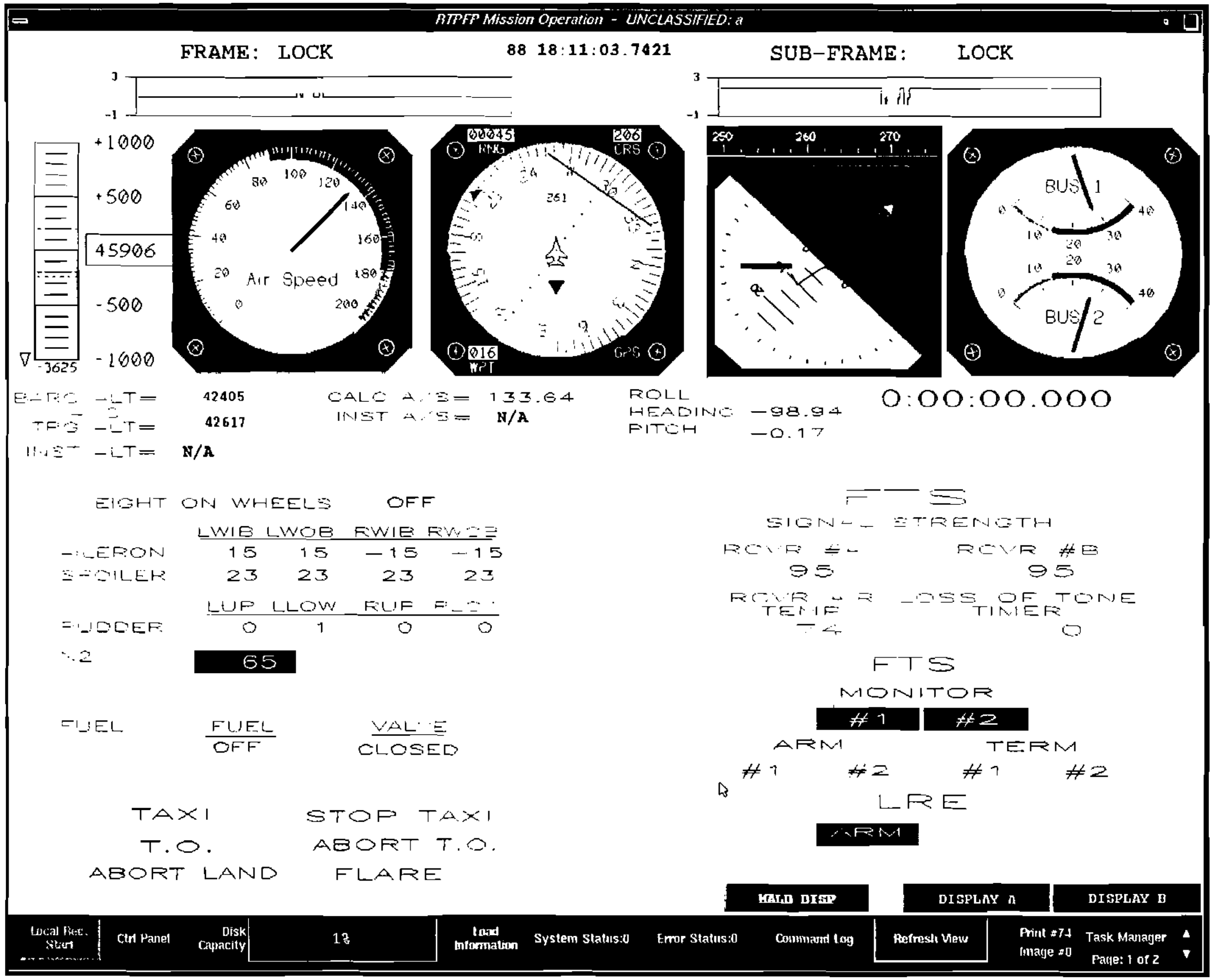
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65462462 Date: Tue Apr 27 07:39:50 1999

Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65462984 Date: Tue Apr 27 07:39:52 1999

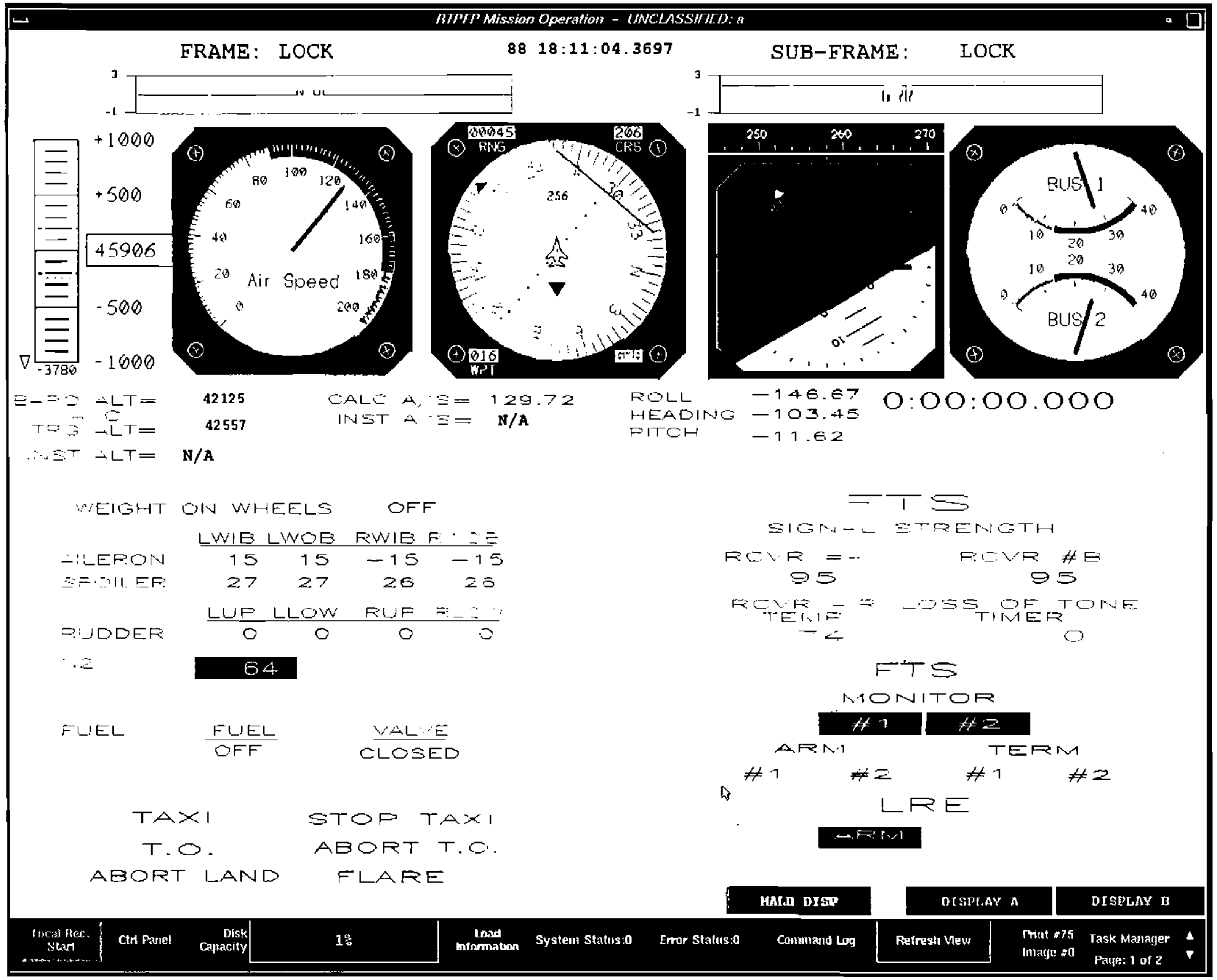
Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65463753 Date: Tue Apr 27 07:39:55 1999

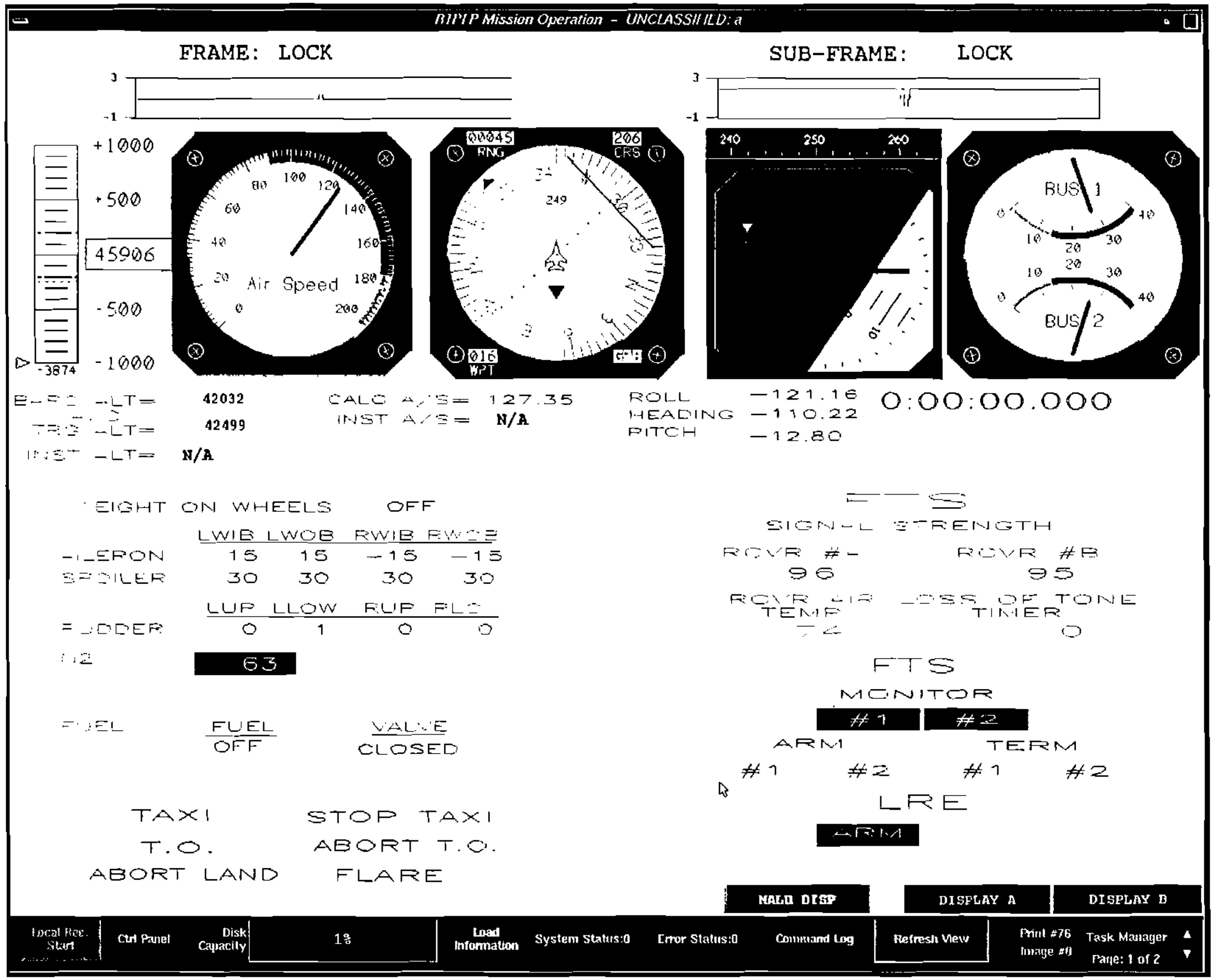
Global Hawk UAV, 95-2002, 19990329

Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65464376 Date: Tue Apr 27 07:39:57 1999

Project: a Operation: a Test: a Display: hawksafety.v
a

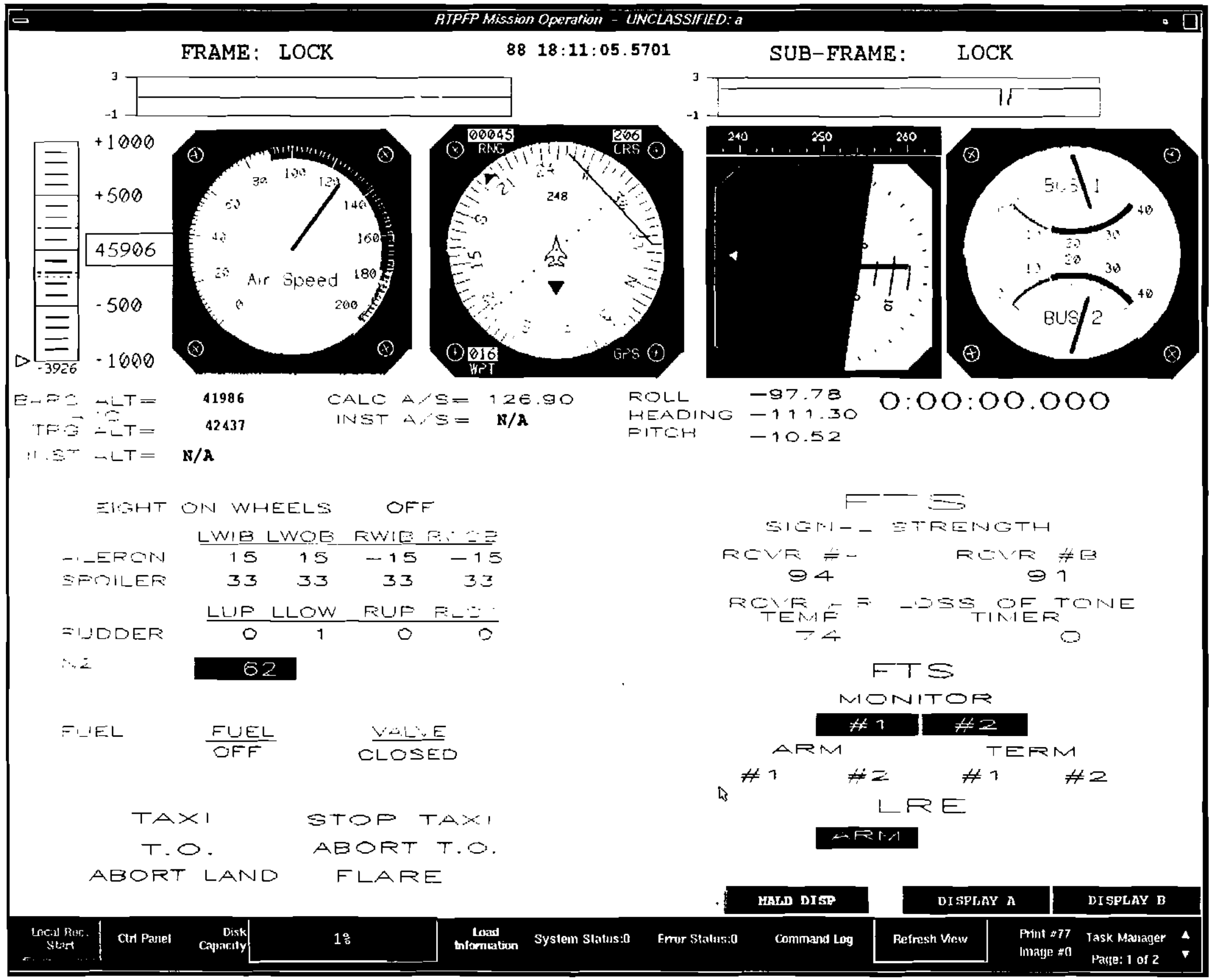


Global Hawk UAV, 95-2002, 1990329

V-1.30

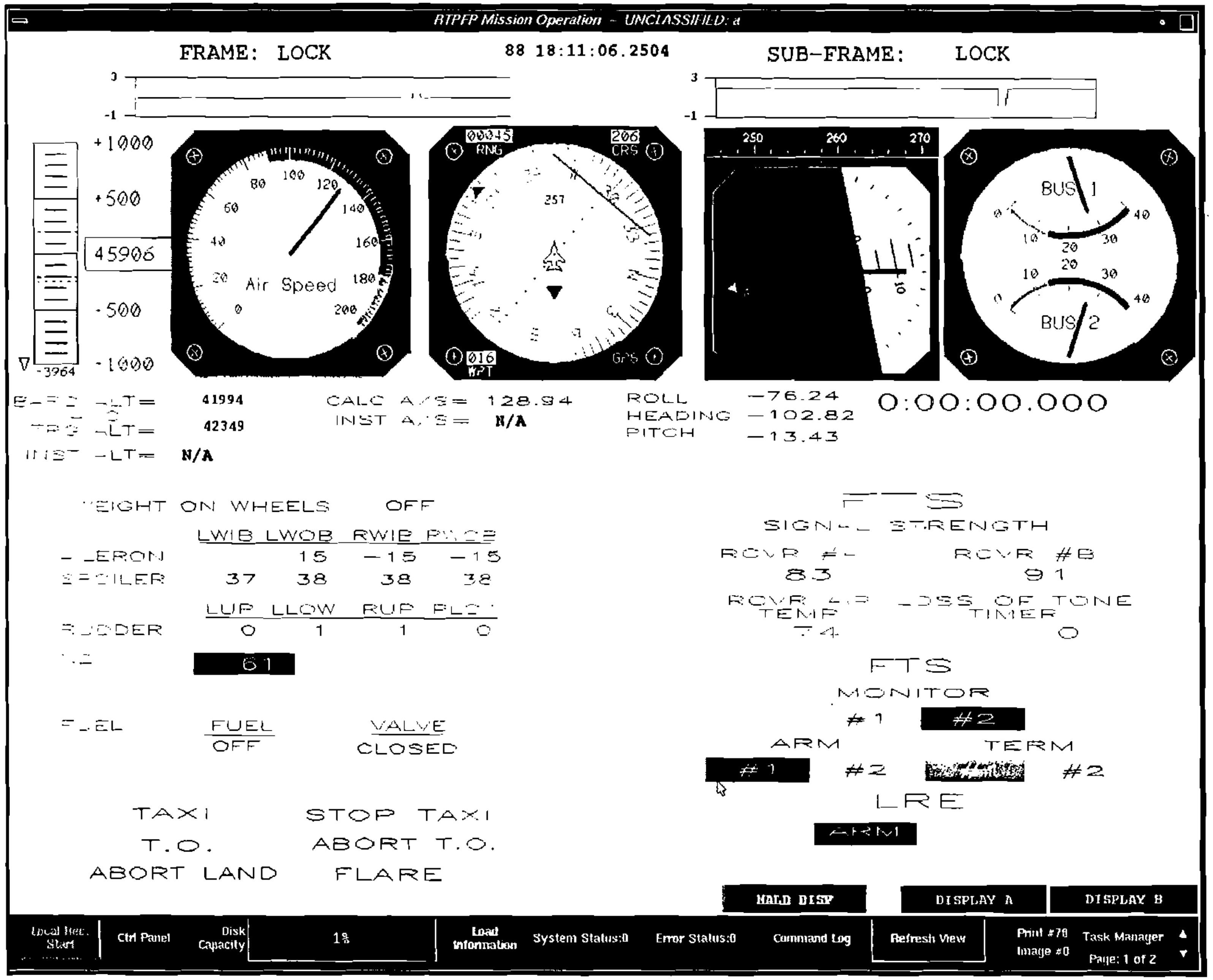
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65464957 Date: Tue Apr 27 07:40:00 1999

Project: a Operation: a Test: a Display: hawksafety.v
a



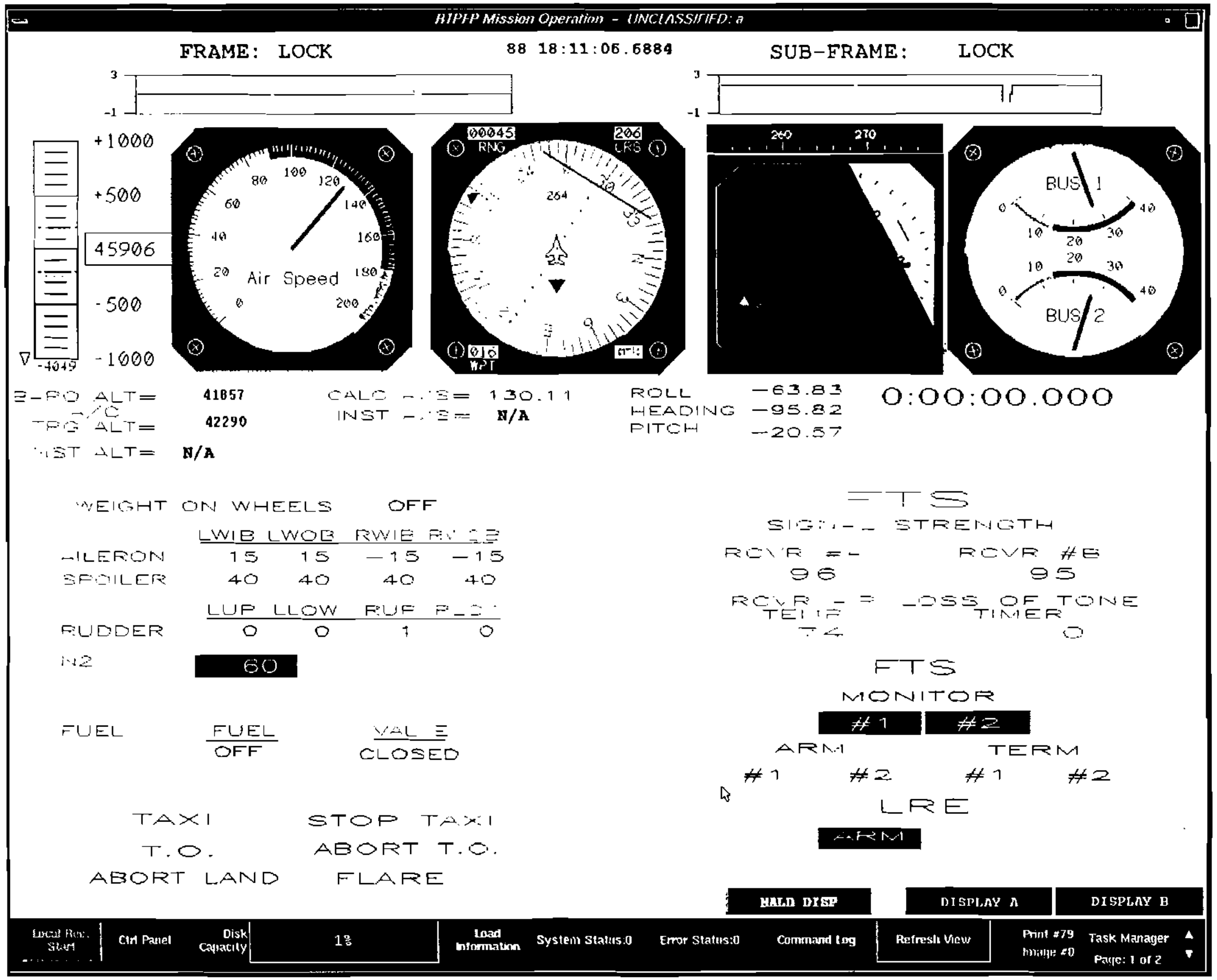
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65465582 Date: Tue Apr 27 07:40:02 1999

Project: a Operation: a Test: a Display: hawksafety.v
a



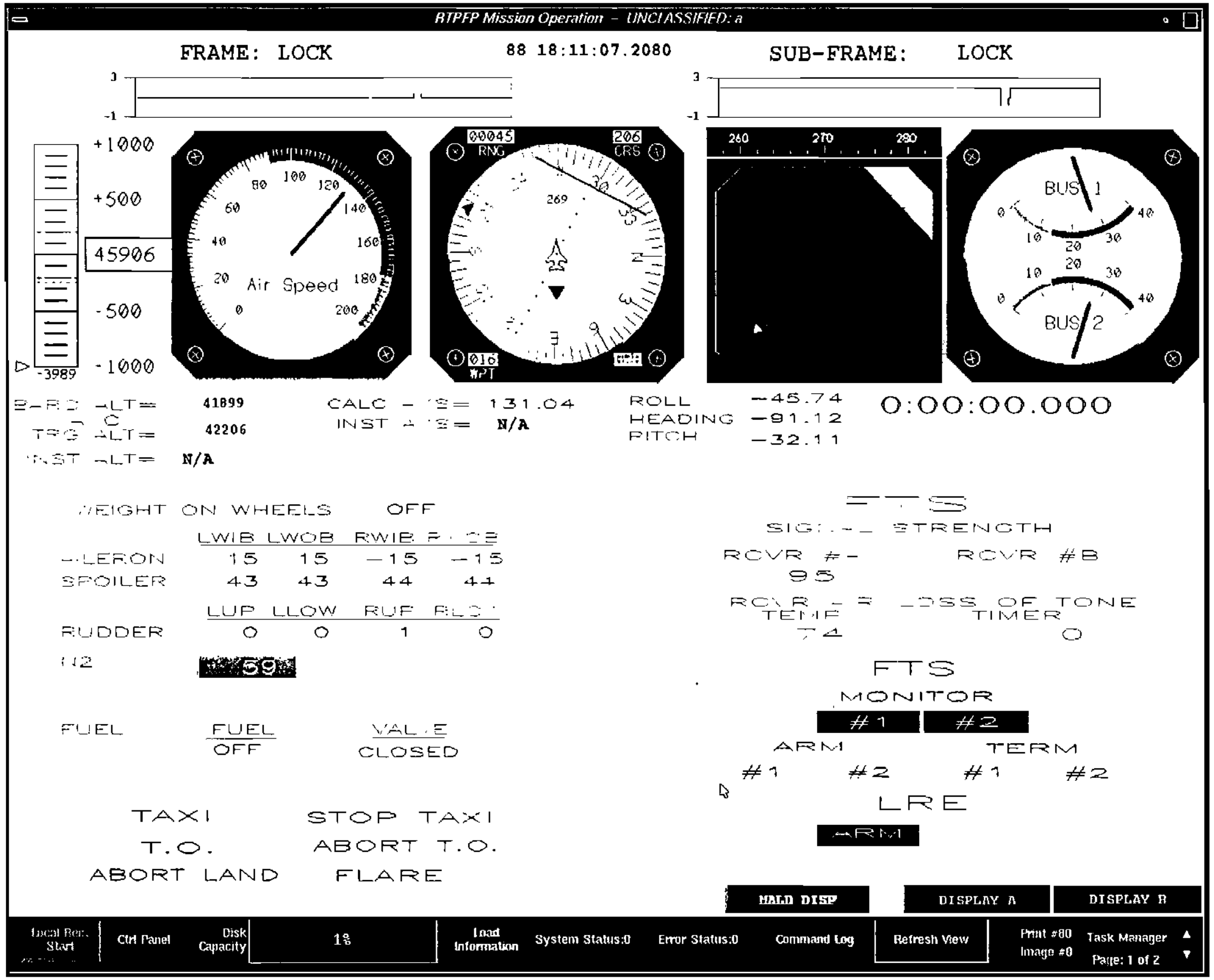
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65466268 Date: Tue Apr 27 07:40:05 1999

Project: a Operation: a Test: a Display: hawksafety.v
a



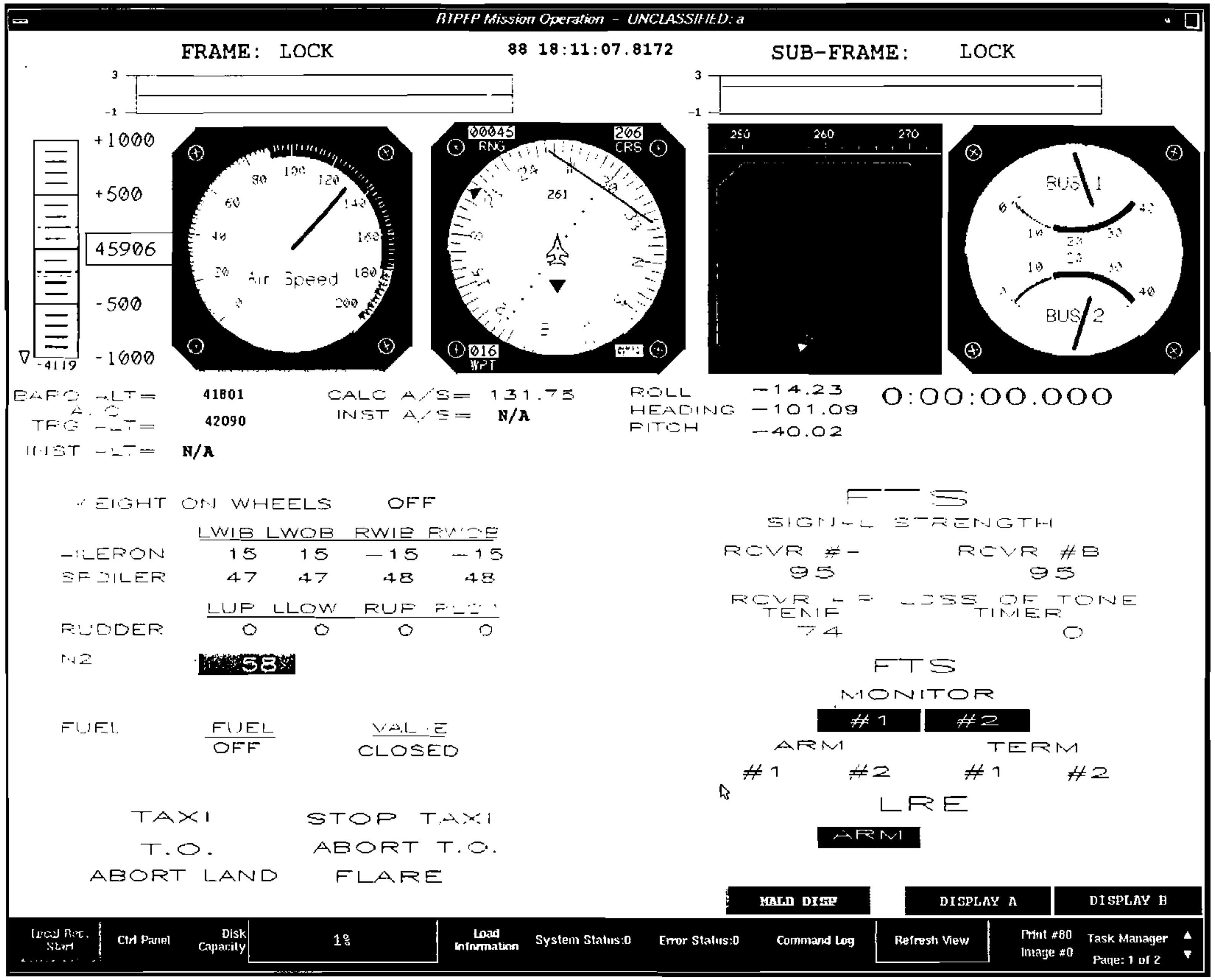
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65466707 Date: Tue Apr 27 07:40:07 1999

Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65467227 Date: Tue Apr 27 07:40:09 1999

Project: a Operation: a Test: a Display: hawksafety.v
a

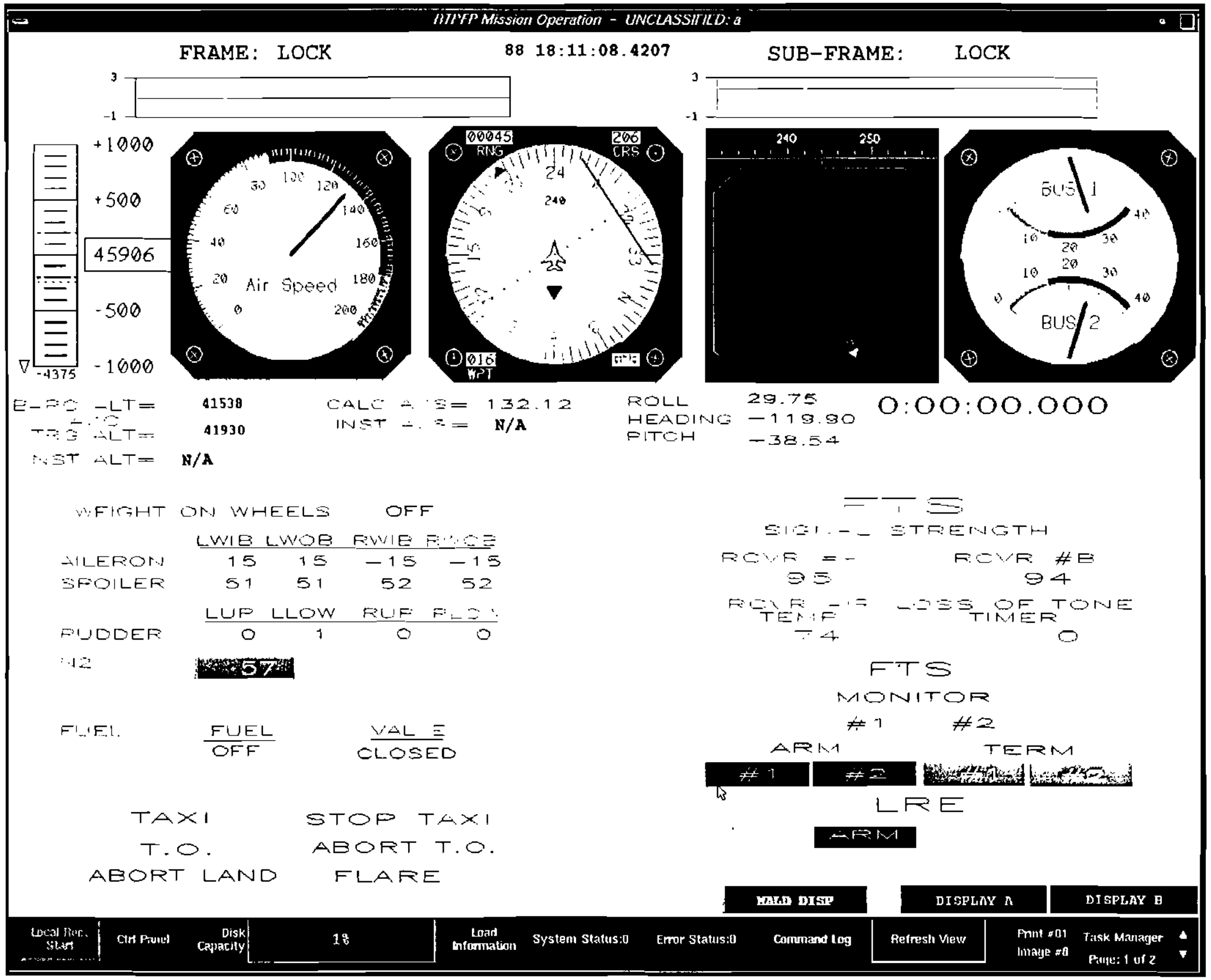


V-1.35

Global Hawk UAV, 95-2002, 19990329

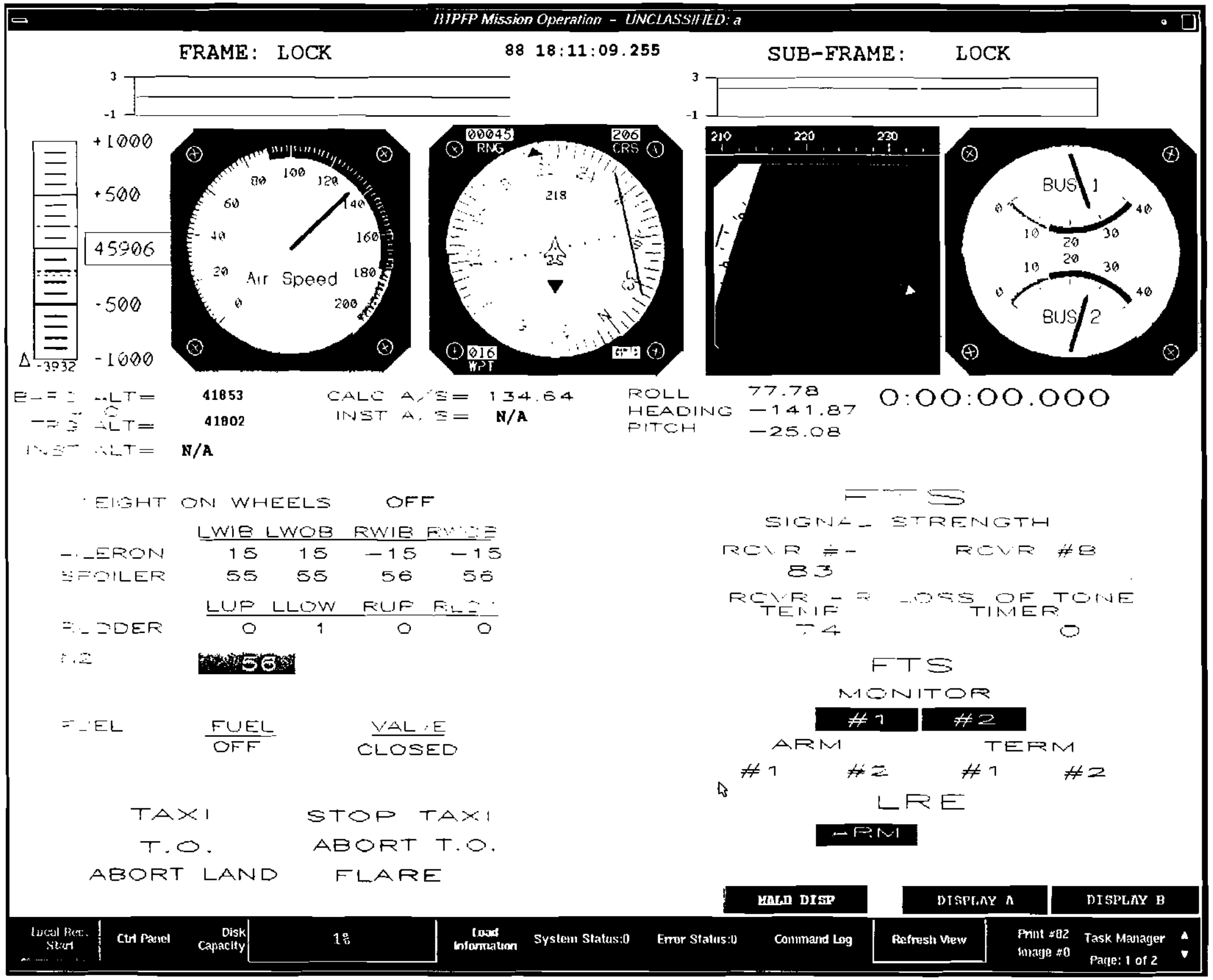
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65467832 Date: Tue Apr 27 07:40:11 1999

Project: a Operation: a Test: a Display: hawksafety.v
a

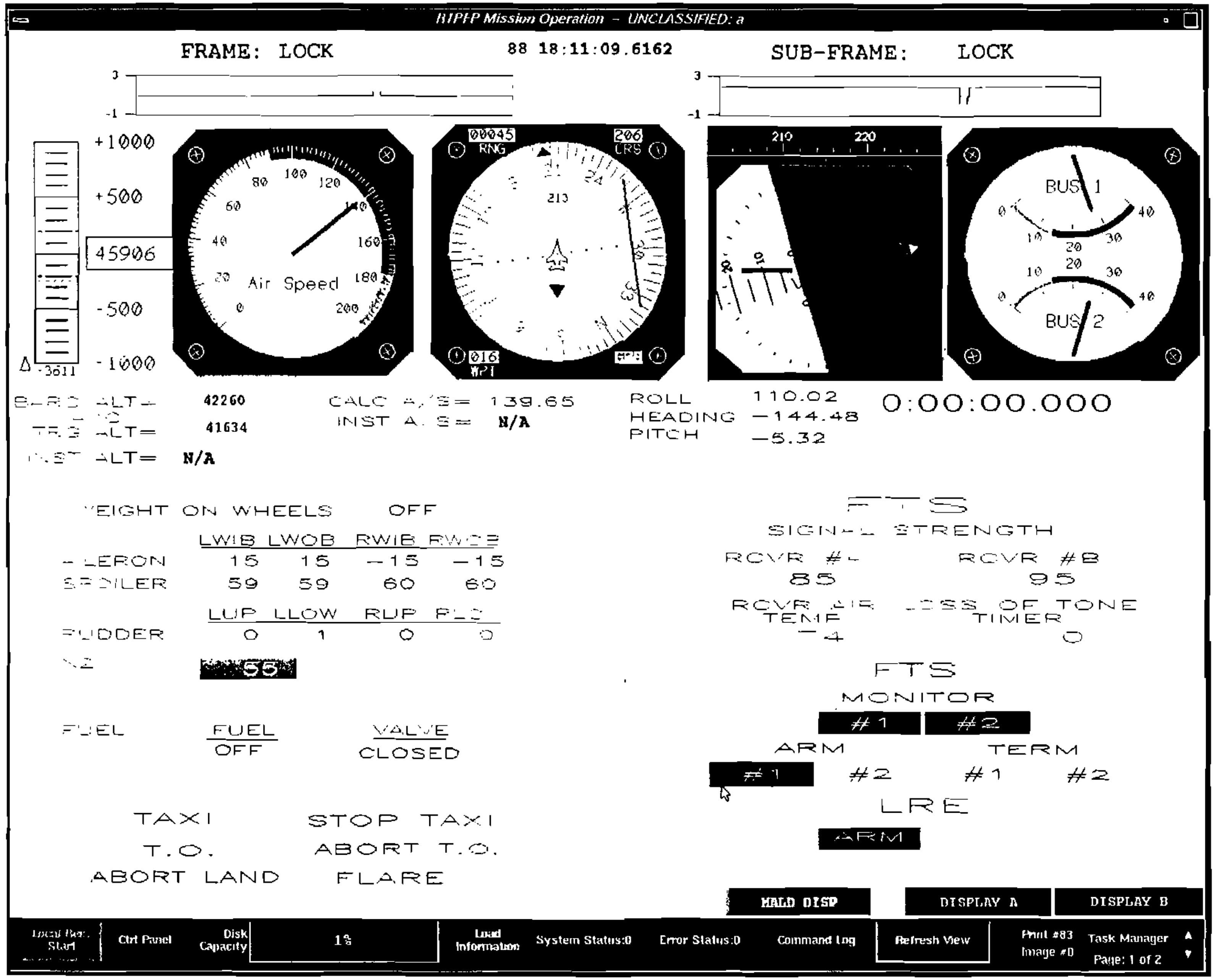


a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65468431 Date: Tue Apr 27 07:40:14 1999

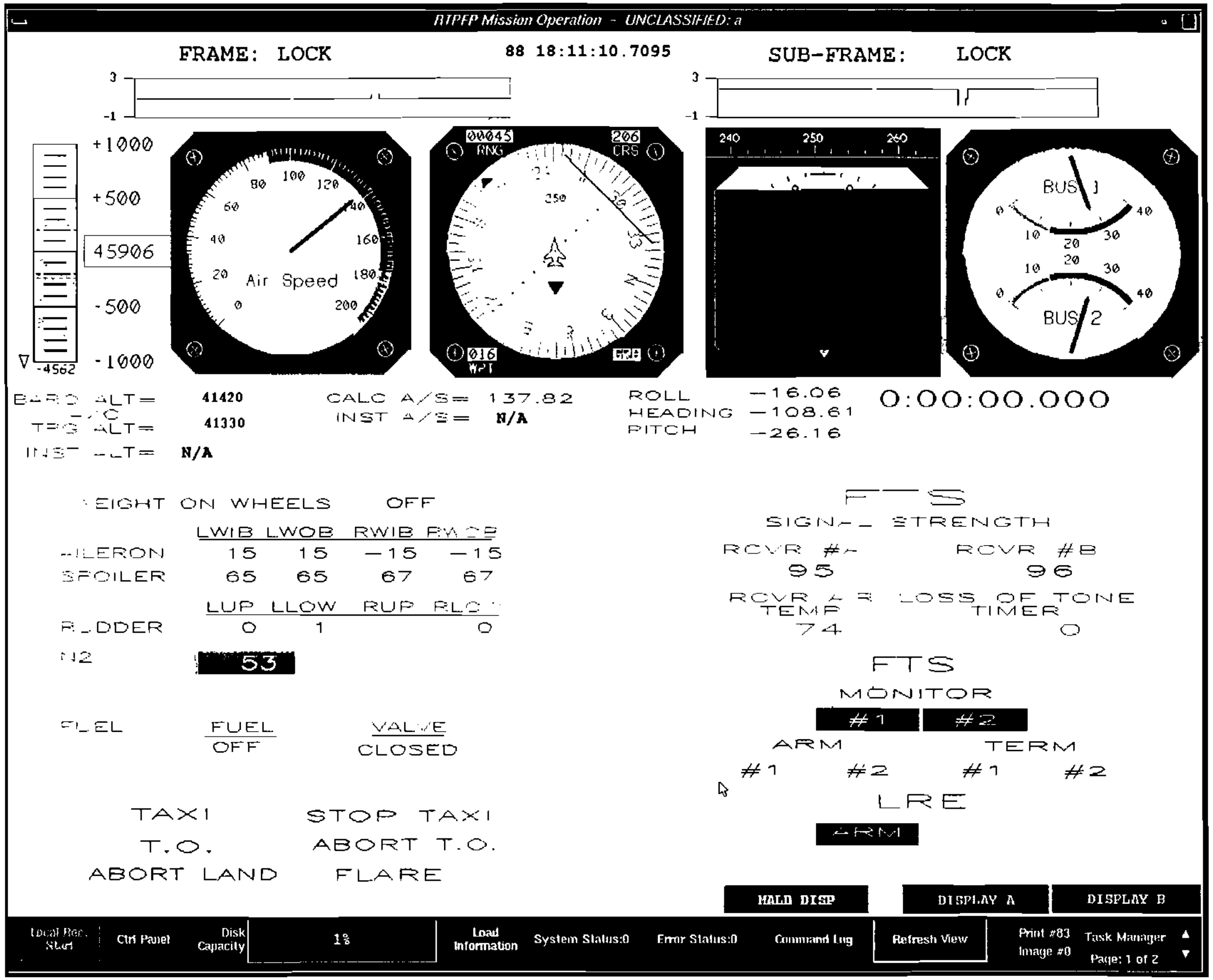
Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65469040 Date: Tue Apr 27 07:40:16 1999

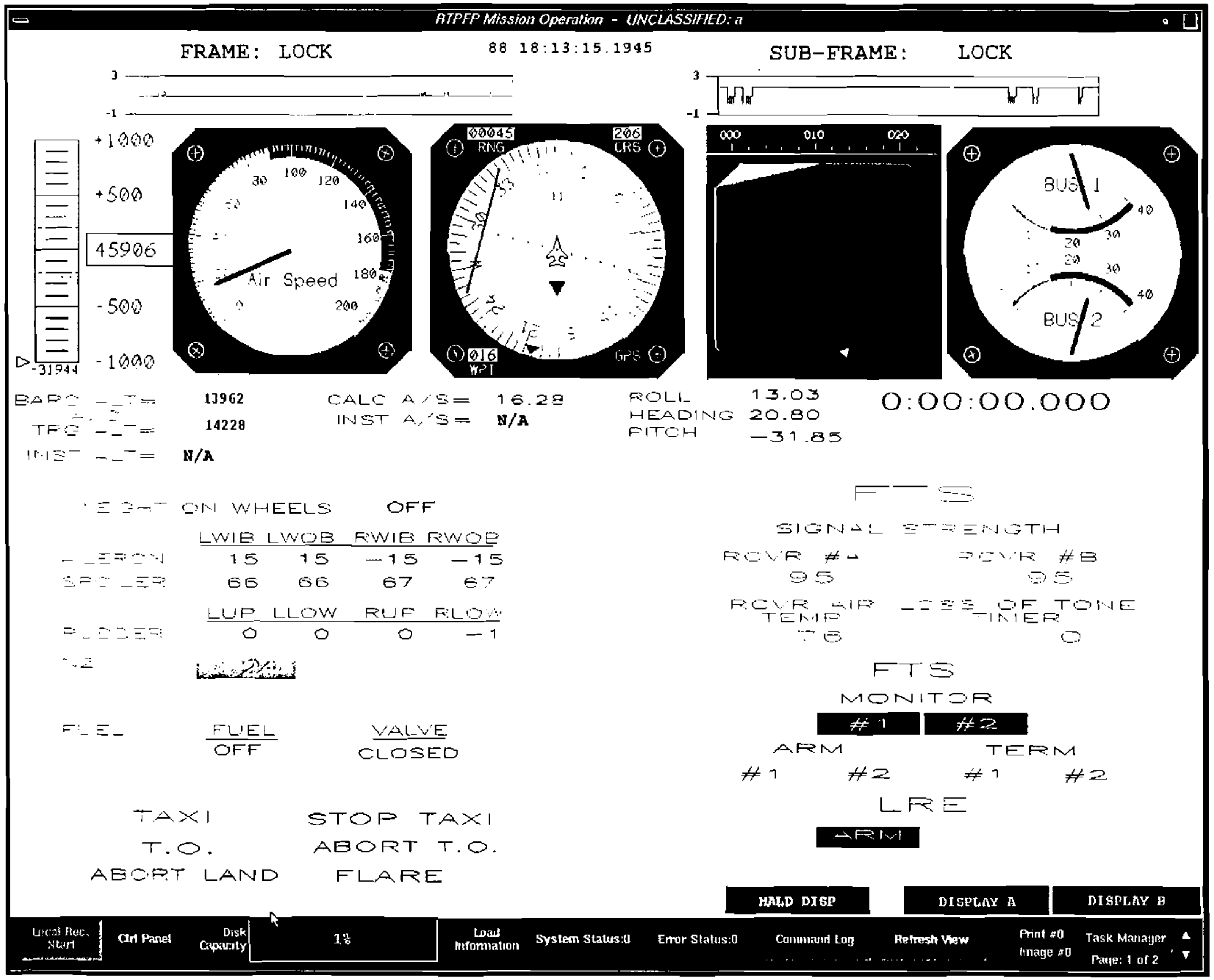

HTPFP Mission Operation - UNCLASSIFIED: a
FRAME: LOCK
88 18:11:09.6162
SUB-FRAME: LOCK
+1000
+500
45906
-500
-1000
Air Speed
BUS 1
BUS 2
42260
41634
CALC A/S= 139.65
INST A. S= N/A
ROLL 110.02
HEADING -144.48
PITCH -5.32
0:00:00.000
ALT= N/A
EIGHT ON WHEELS OFF
LWIB LWOB RWIB
LERON 15 15 -15 -15
59 59 60 60
LUP LLOW RUP
0 1 0 0
55
FTS
SIGNAL STRENGTH
RCVR #B
85
95
RCVR AIR TEMP
LOSS OF TONE TIMER
-4
0
FTS
MONITOR
#1 #2
ARM
TERM
#1 #2 #1 #2
LRE
ARM
FUEL
FUEL OFF
VALVE CLOSED
TAXI
STOP TAXI
T.O.
ABORT T.O.
ABORT LAND
FLARE
HALD DISP
DISPLAY A
DISPLAY B
Ctrl Panel
Disk Capacity
1%
Load Information
System Status:0
Error Status:0
Command Log
Refresh View
Task Manager
Page: 1 of 2

Project: a Operation: a Test: a Display: hawksafety.v
a



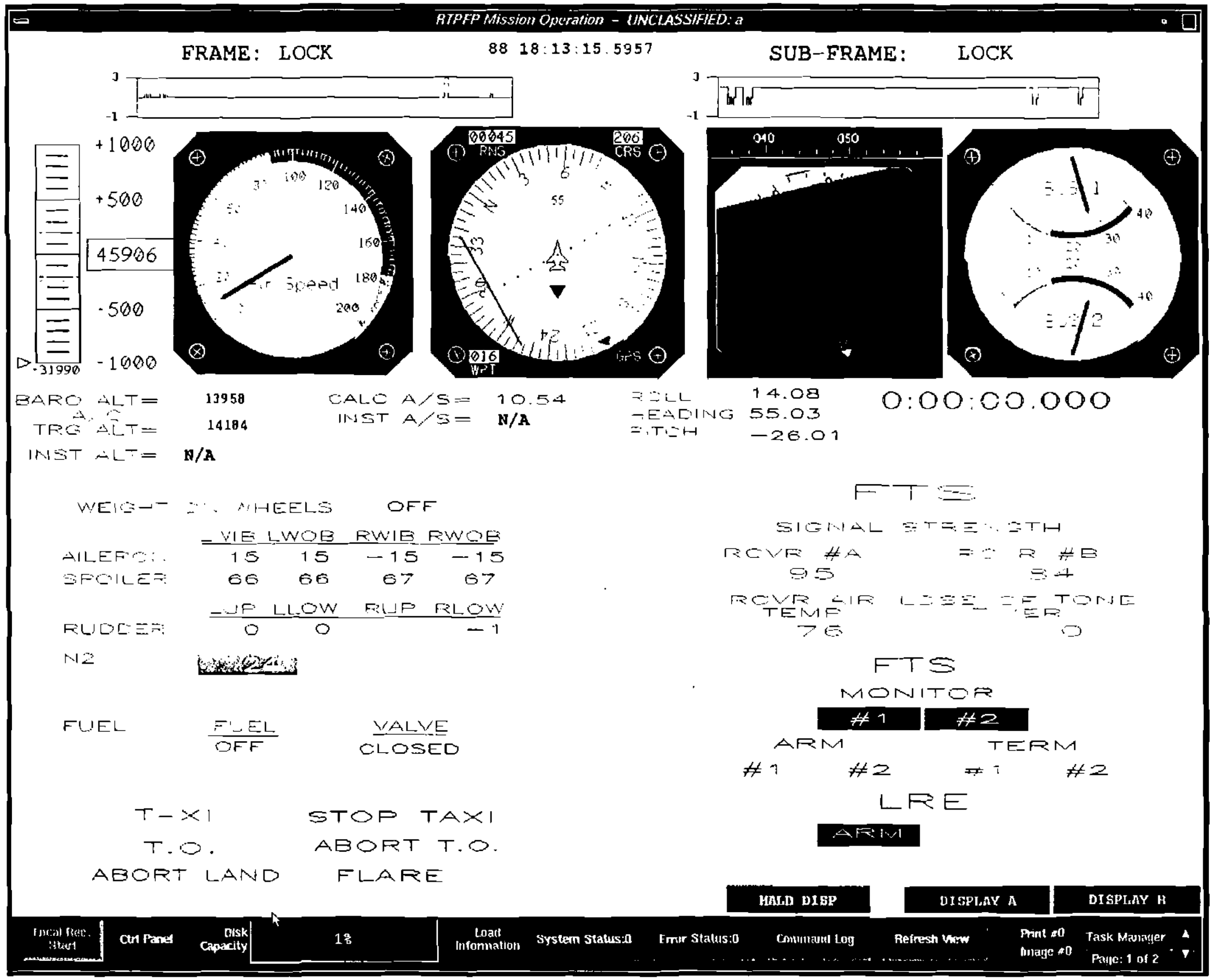
a
Workstation: ws17rm266 User: ws17 TPP: Range Time: 0 65470740 Date: Tue Apr 27 07:40:23 1999

Project: a Operation: a Test: a Display: hawksafety.v
a

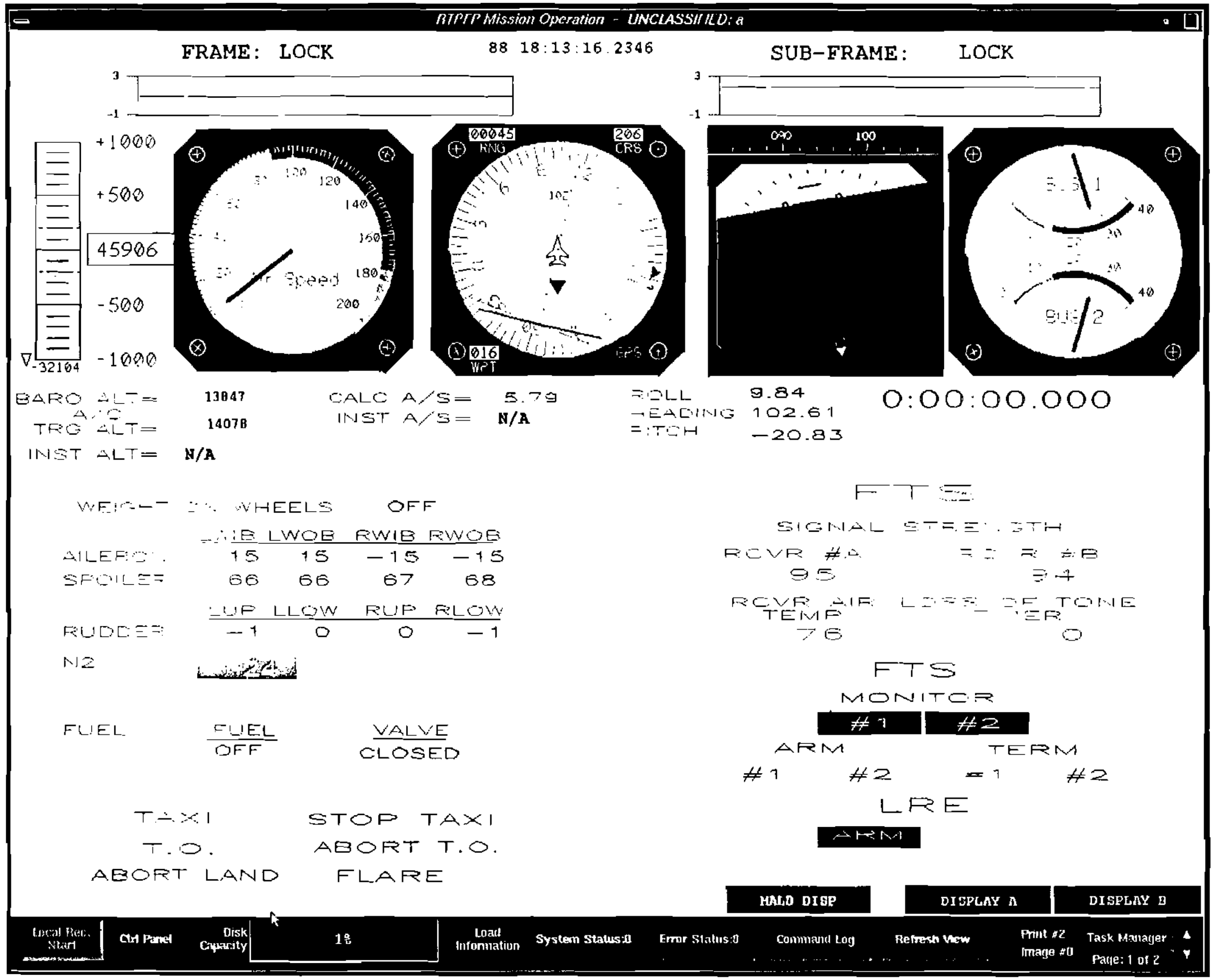


a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65595225 Date: Mon Apr 26 06:50:18

Project: a Operation: a Test: a Display: hawksafety.v
a



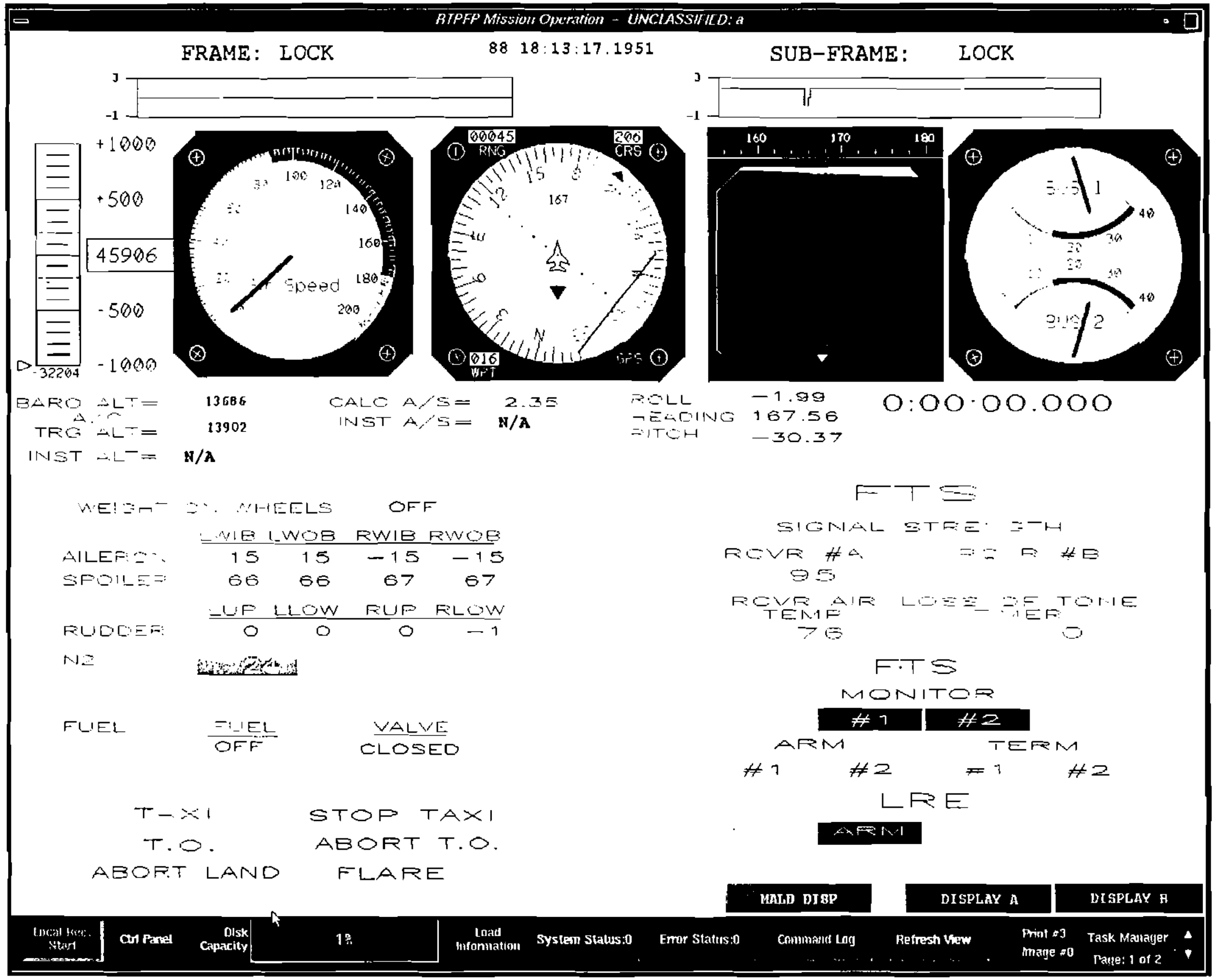
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65595637 Date: Mon Apr 26 06:50:19



V-1.42

Global Hawk UAV, 95-2002, 19990329

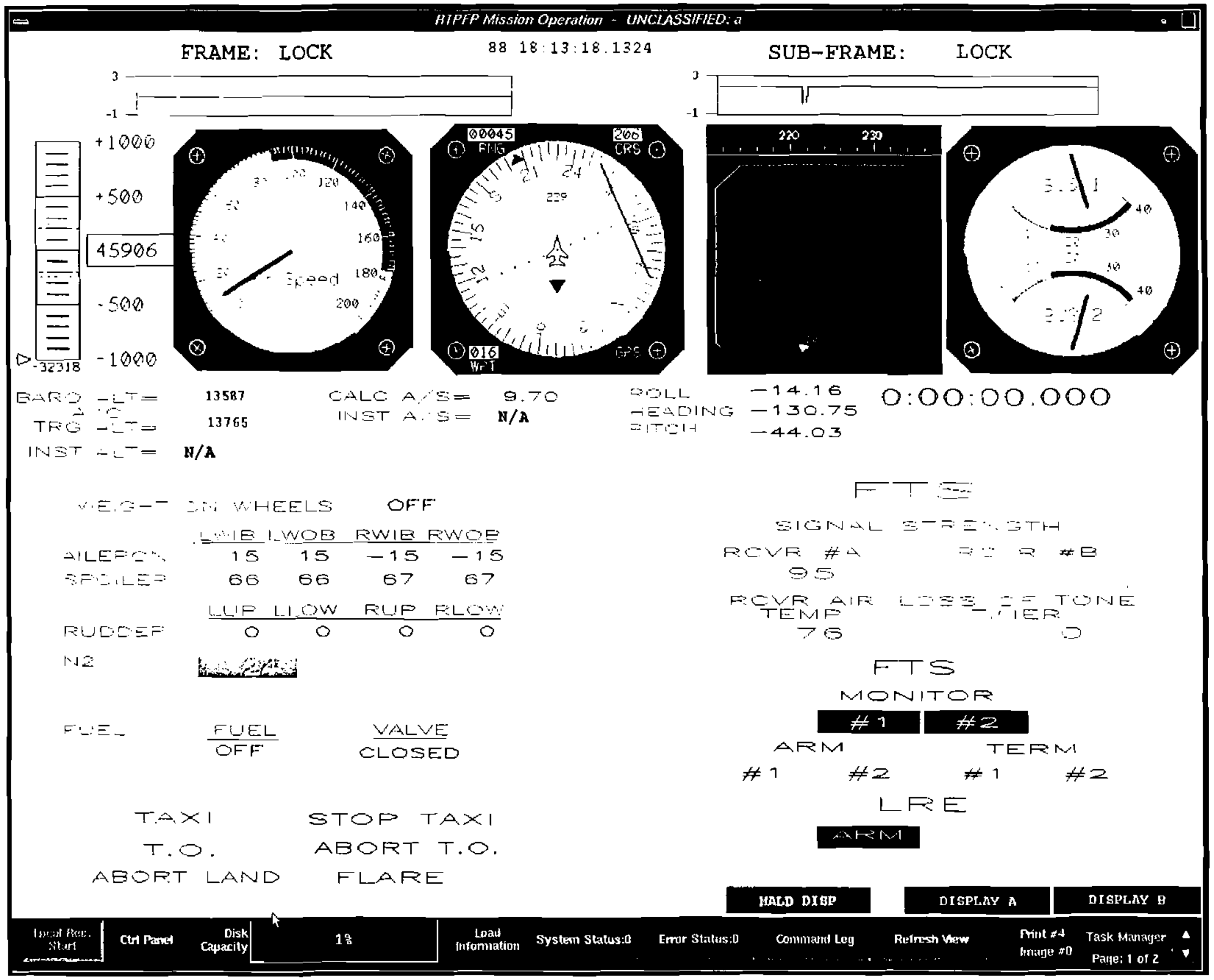
Project: a Operation: a Test: a Display: hawksafety.v
a



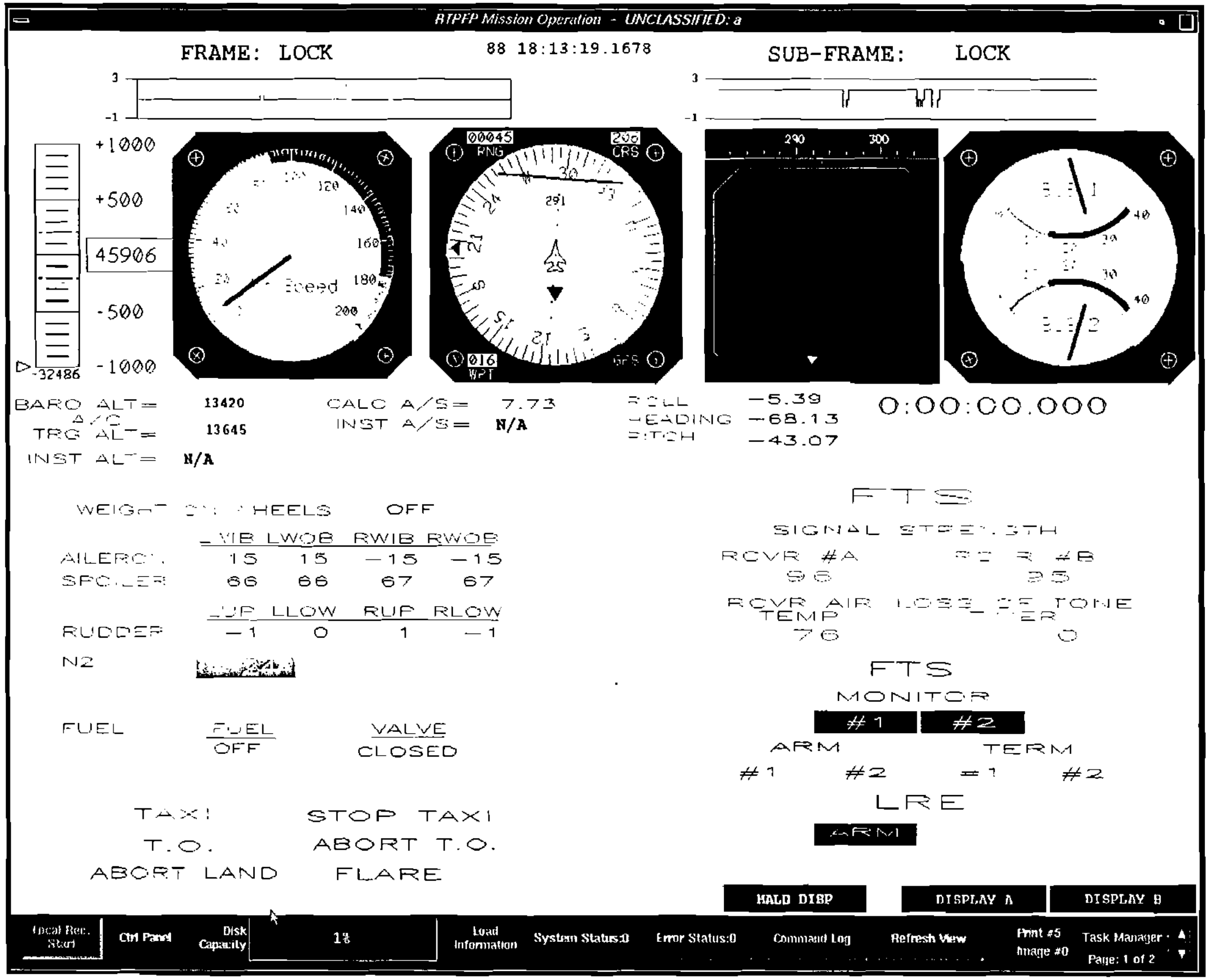
Global Hawk UAV, 95-2002, 19990329

a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65597214 Date: Mon Apr 26 06:50:26

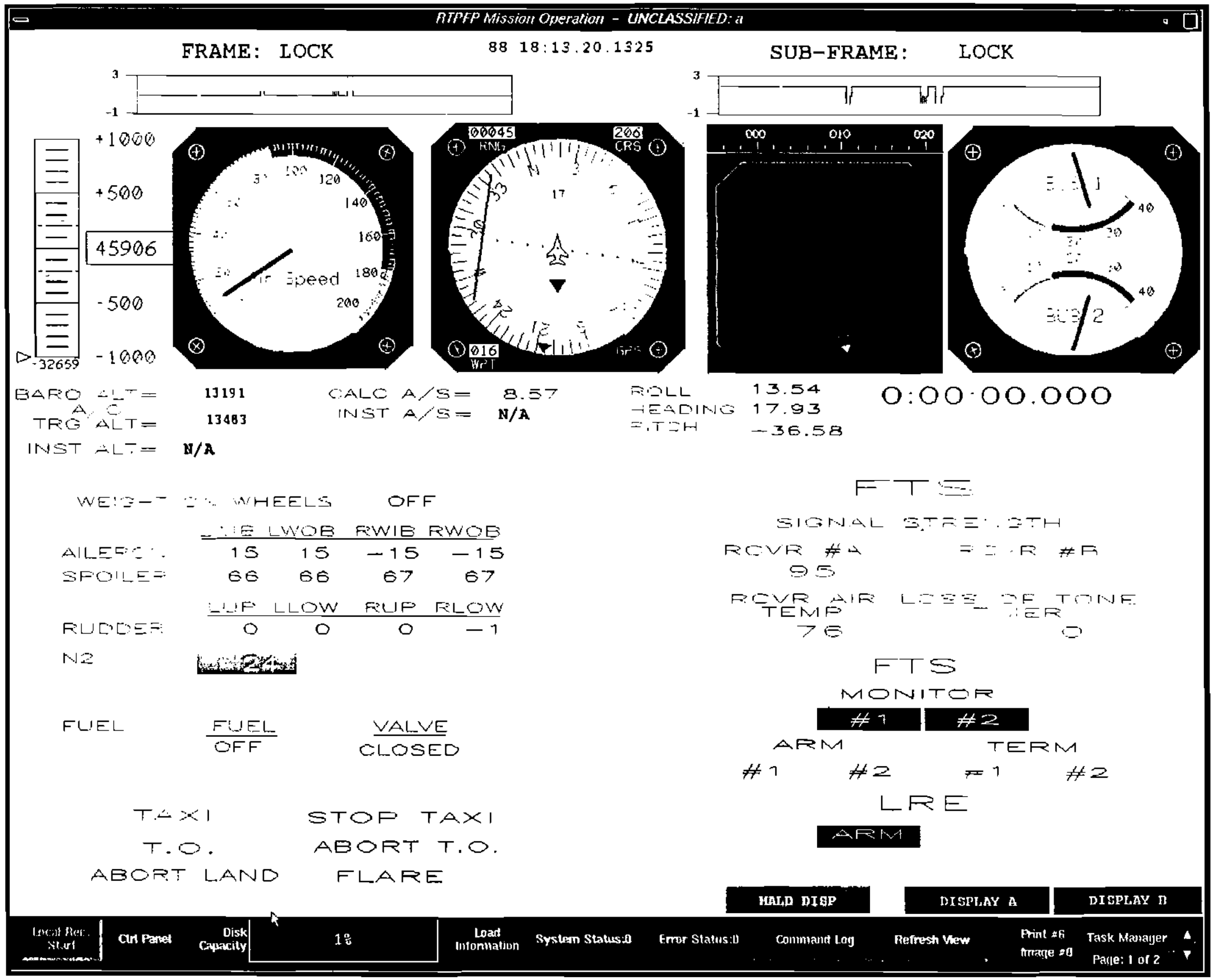
Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65598153 Date: Mon Apr 26 06:50:29

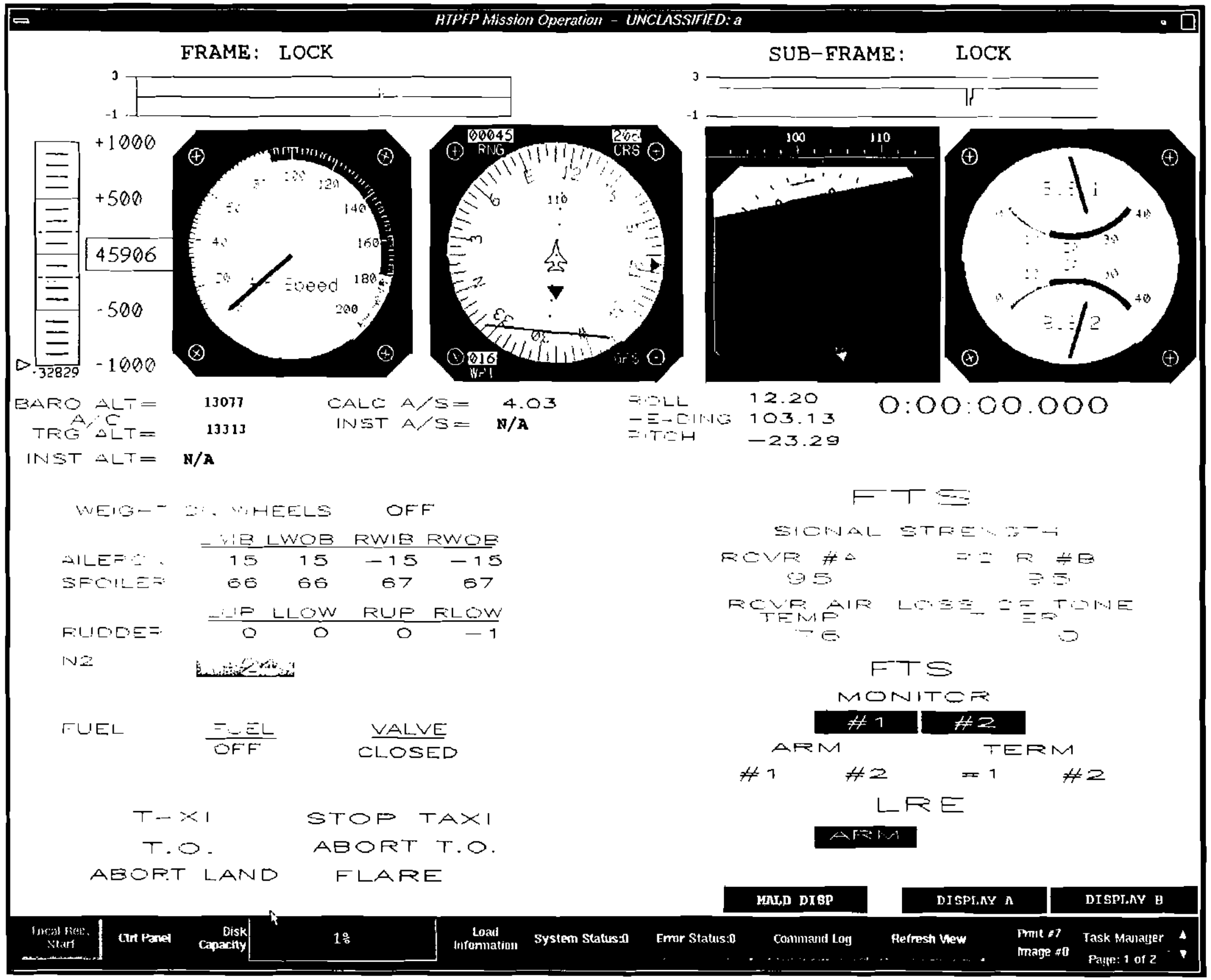

RTPFP Mission Operation - UNCLASSIFIED: a
FRAME: LOCK
88 18:13:19.1678
SUB-FRAME: LOCK
+1000
+500
45906
-500
-1000
-32486
00045 RNG
CRS
016 WPT
290
300
BARO ALT= 13420
A/C TRG ALT= 13645
INST ALT= N/A
CALC A/S= 7.73
INST A/S= N/A
ROLL -5.39
HEADING -68.13
PITCH -43.07
0:00:00.000
FTS
WEIGHT ON WHEELS OFF
LWIB LWOB RWIB RWOB
AILERON 15 15 -15 -15
SPOILER 66 66 67 67
LUP LLOW RUP RLOW
RUDDER -1 0 1 -1
N2
SIGNAL STRENGTH
RCVR #A 96
RCVR #B 95
RCVR AIR TEMP 76
LOSS OF TONE TIMER 0
FTS
MONITOR
#1 #2
ARM TERM
#1 #2 #1 #2
LRE
ARM
FUEL FUEL OFF VALVE CLOSED
TAXI STOP TAXI
T.O. ABORT T.O.
ABORT LAND FLARE
HALO DISP
DISPLAY A
DISPLAY B
Local Rec. Start
Ctrl Panel
Disk Capacity 1%
Load Information
System Status:0
Error Status:0
Command Log
Refresh View
Print #5 Image #0
Task Manager
Page: 1 of 2

Project: a Operation: a Test: a Display: hawksafety.v
a



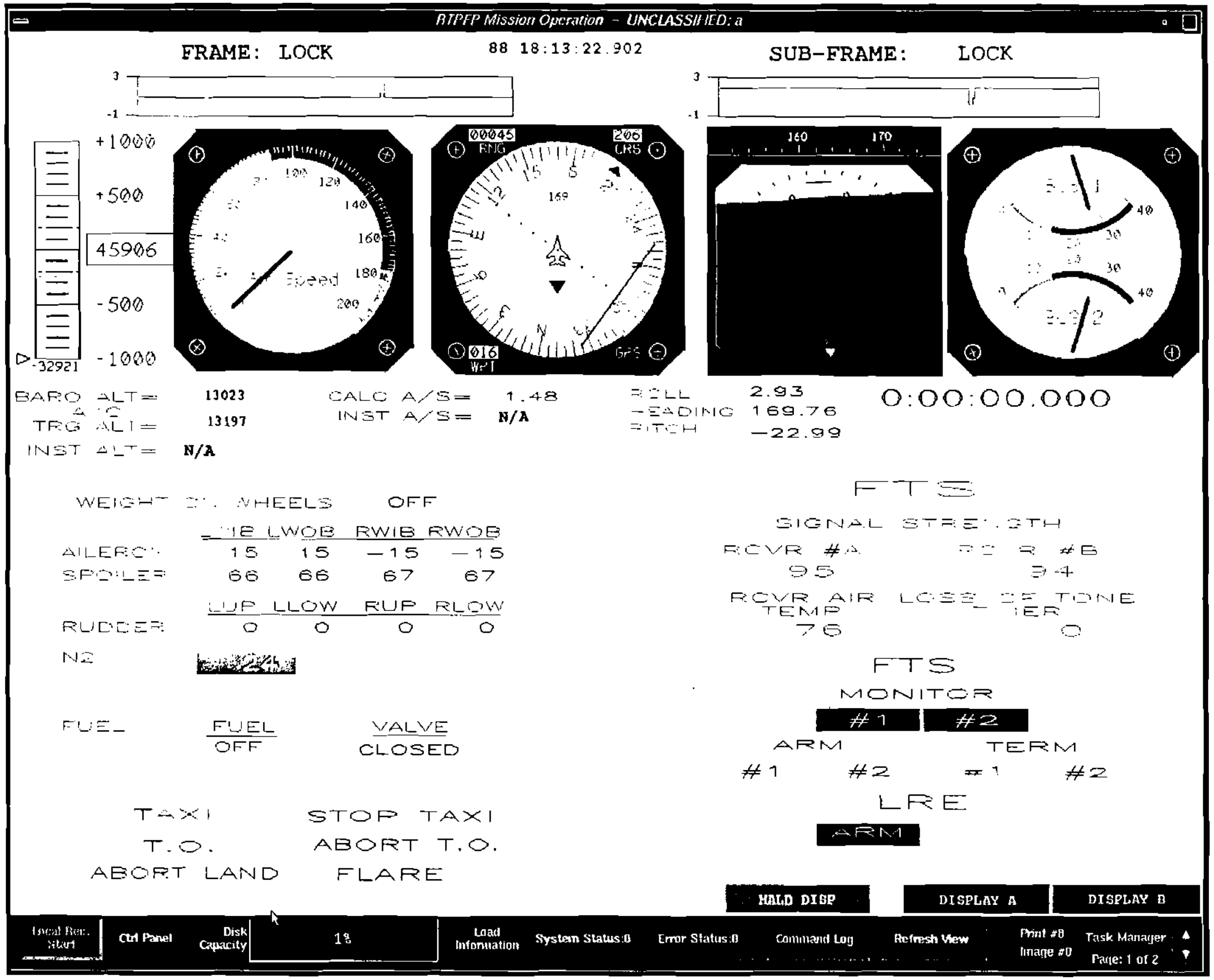
a
Workstation: wa15rm266 User: wa15 TPP: Range Time: 0 65600154 Date: Mon Apr 26 06:50:37

Project: a Operation: a Test: a Display: hawksafety.v
a

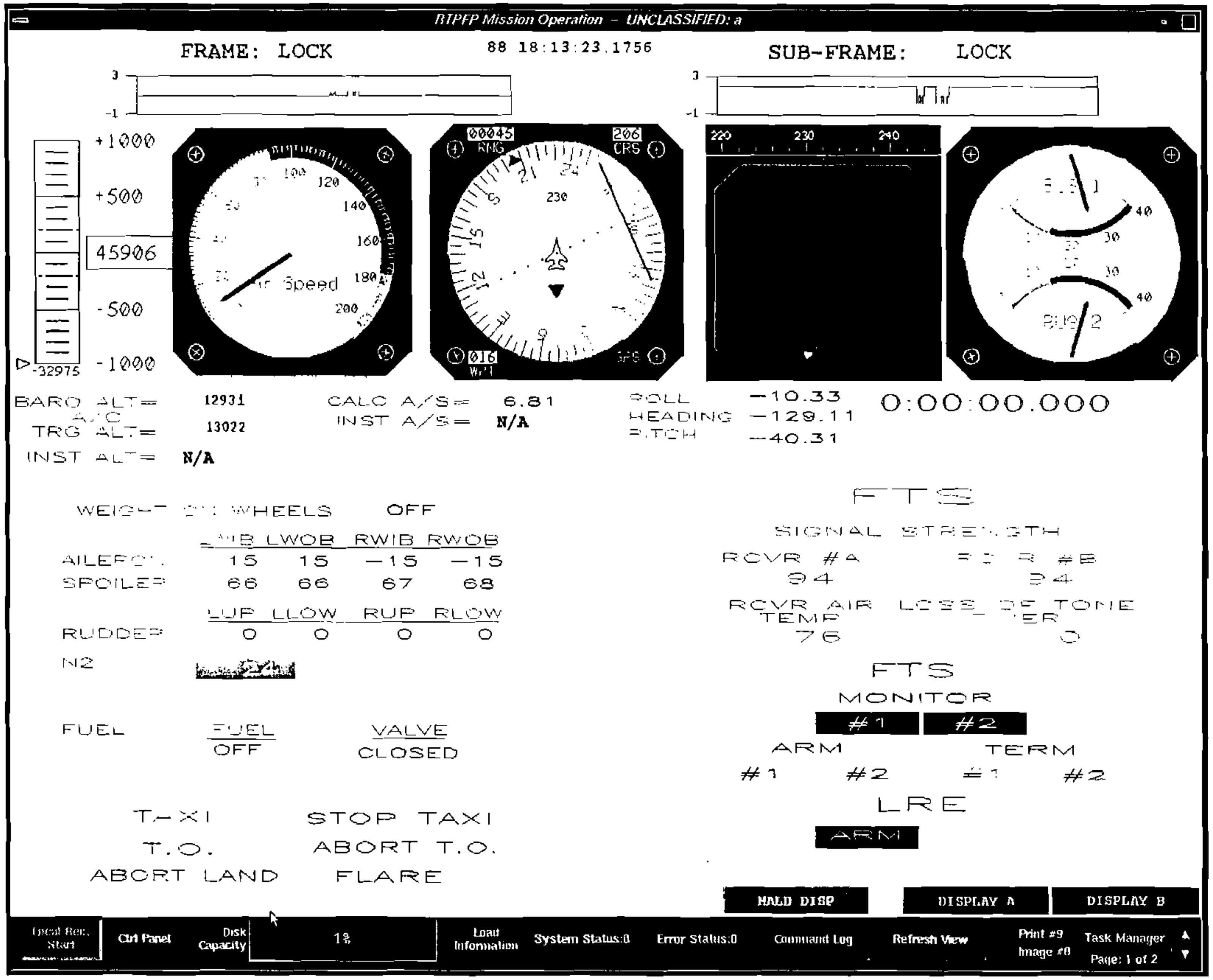


a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65601212 Date: Mon Apr 26 06:50:41

Global Hawk UAV, 95-2002, 19990329


RTPFP Mission Operation - UNCLASSIFIED: a
FRAME: LOCK
88 18:13:22.902
SUB-FRAME: LOCK
+1000
+500
45906
-500
-1000
-32921
BARO ALT= 13023
TRG ALT= 13197
INST ALT= N/A
CALC A/S= 1.48
INST A/S= N/A
ROLL 2.93
HEADING 169.76
PITCH -22.99
0:00:00.000
WEIGHT ON WHEELS OFF
LWIB LWOB RWIB RWOB
AILERON 15 15 -15 -15
SPOILER 66 66 67 67
LUP LLOW RUP RLOW
RUDDER 0 0 0 0
N2
FUEL FUEL OFF VALVE CLOSED
TAXI STOP TAXI
T.O. ABORT T.O.
ABORT LAND FLARE
FTS
SIGNAL STRENGTH
RCVR #A 95
RCVR #B 94
RCVR AIR TEMP 76
LOSS OF TONE TIMER 0
FTS
MONITOR
#1 #2
ARM TERM
#1 #2 #1 #2
LRE
ARM
HALD DISP
DISPLAY A
DISPLAY B
Local Rec. Start
Ctrl Panel
Disk Capacity
1%
Load Information
System Status:0
Error Status:0
Command Log
Refresh View
Print #0
Image #0
Task Manager
Page: 1 of 2

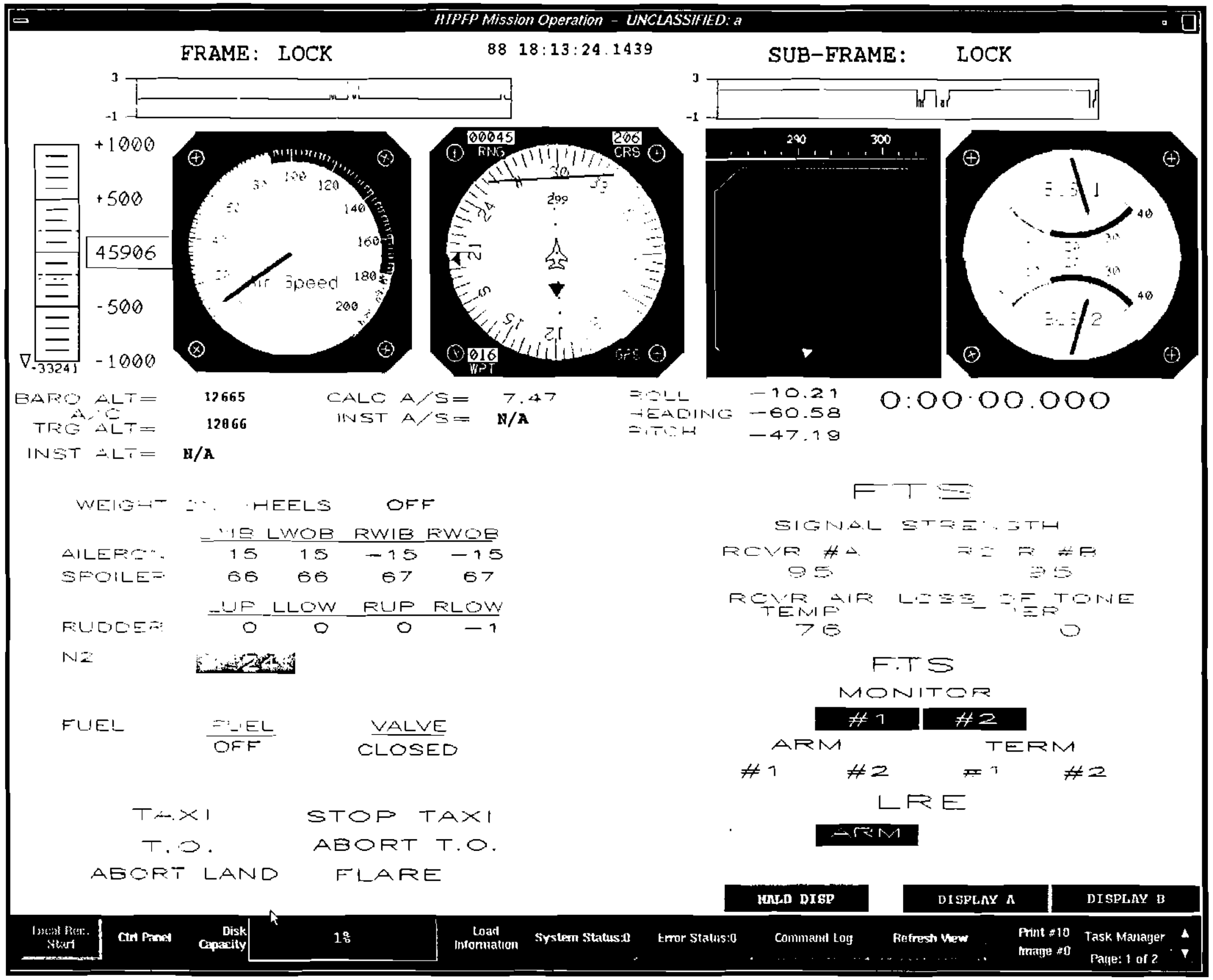
Project: a Operation: a Test: a Display: hawksafety.v
a



V-1.49

Global Hawk UAV, 95-2002, 19990329

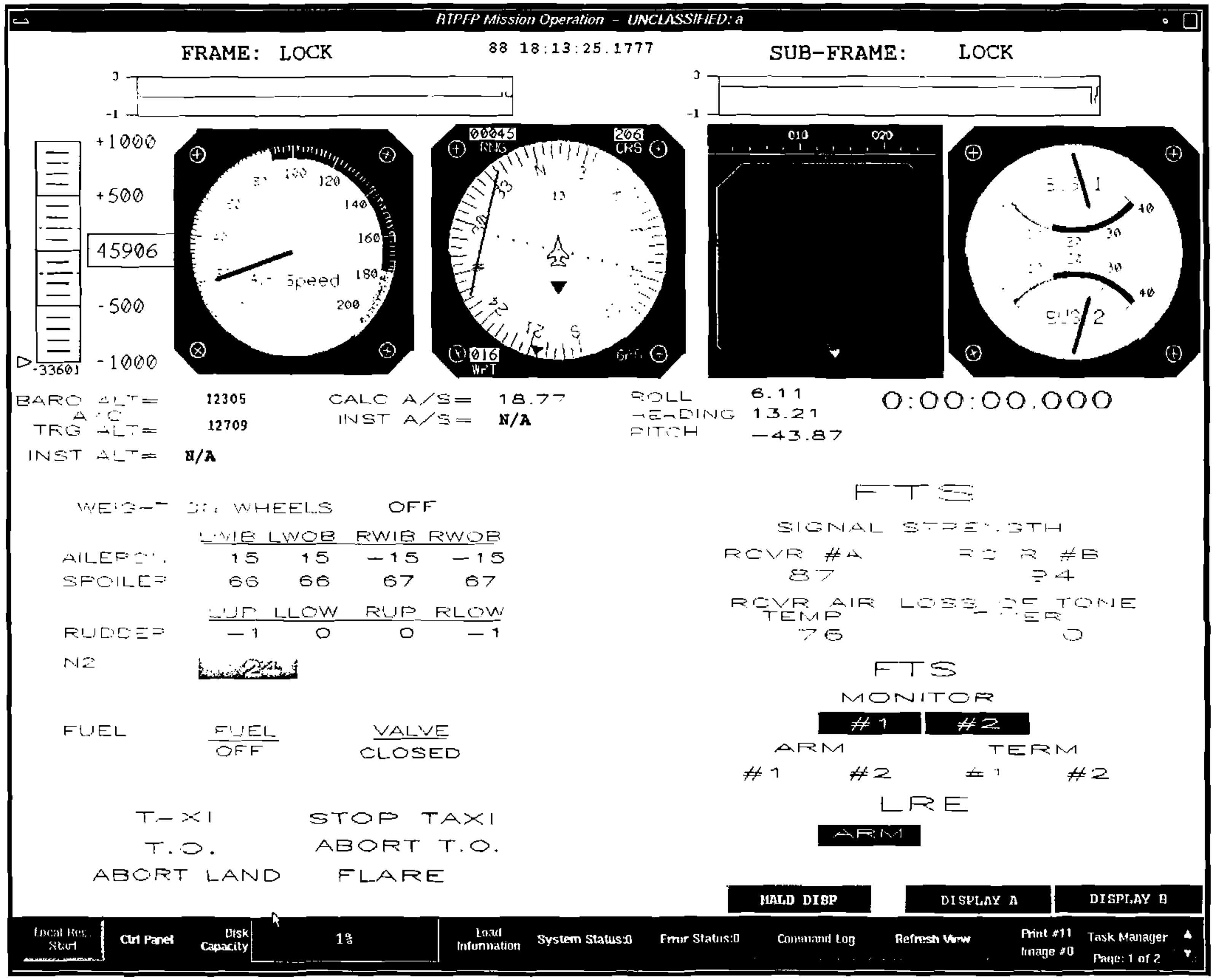
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65603204 Date: Mon Apr 26 06:50:49



V-1.50

Global Hawk UAV, 95-2002, 19990329

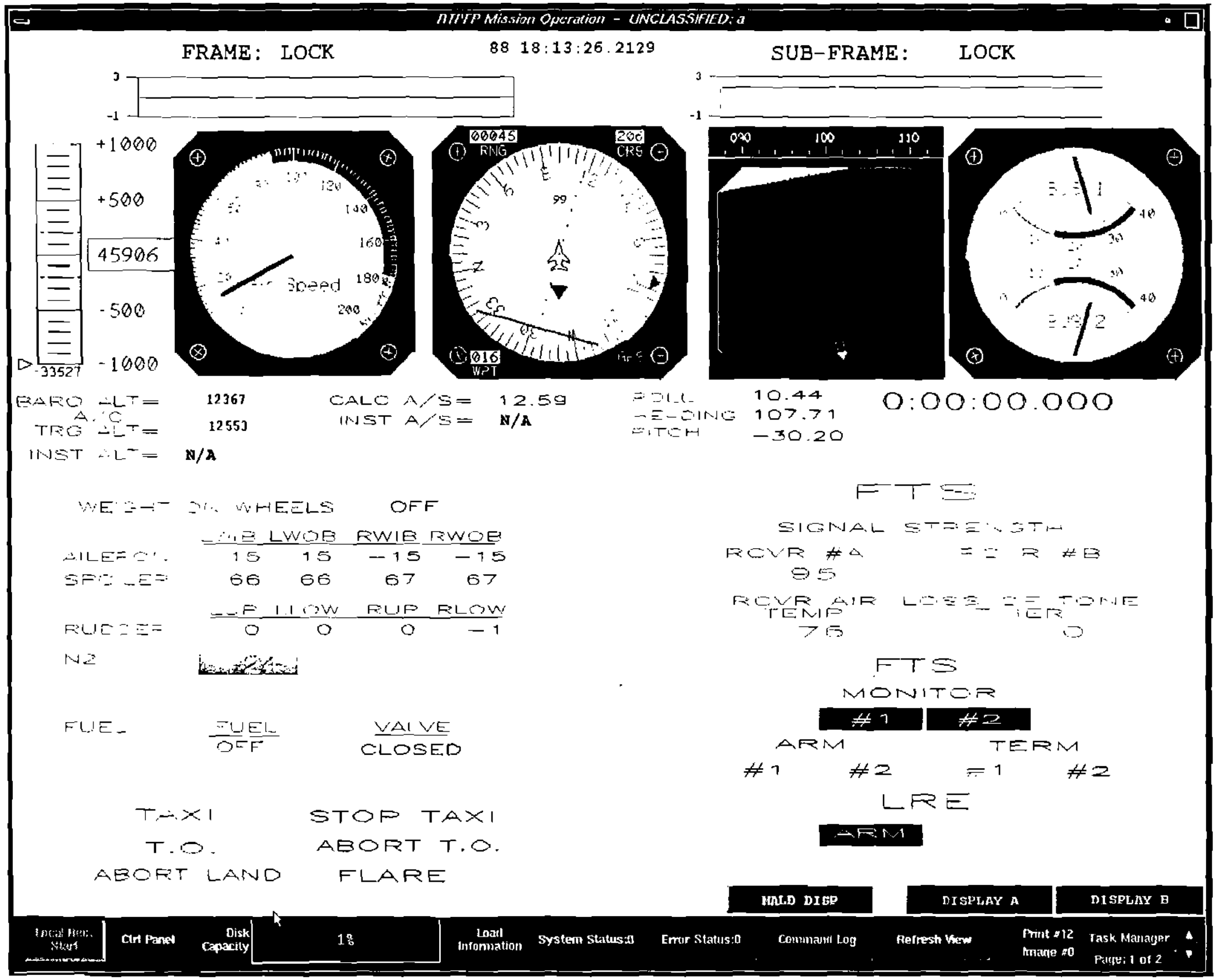
Project: a Operation: a Test: a Display: hawksafety.v
a



Global Hawk UAV, 95-2002, 19990329

V-1.51

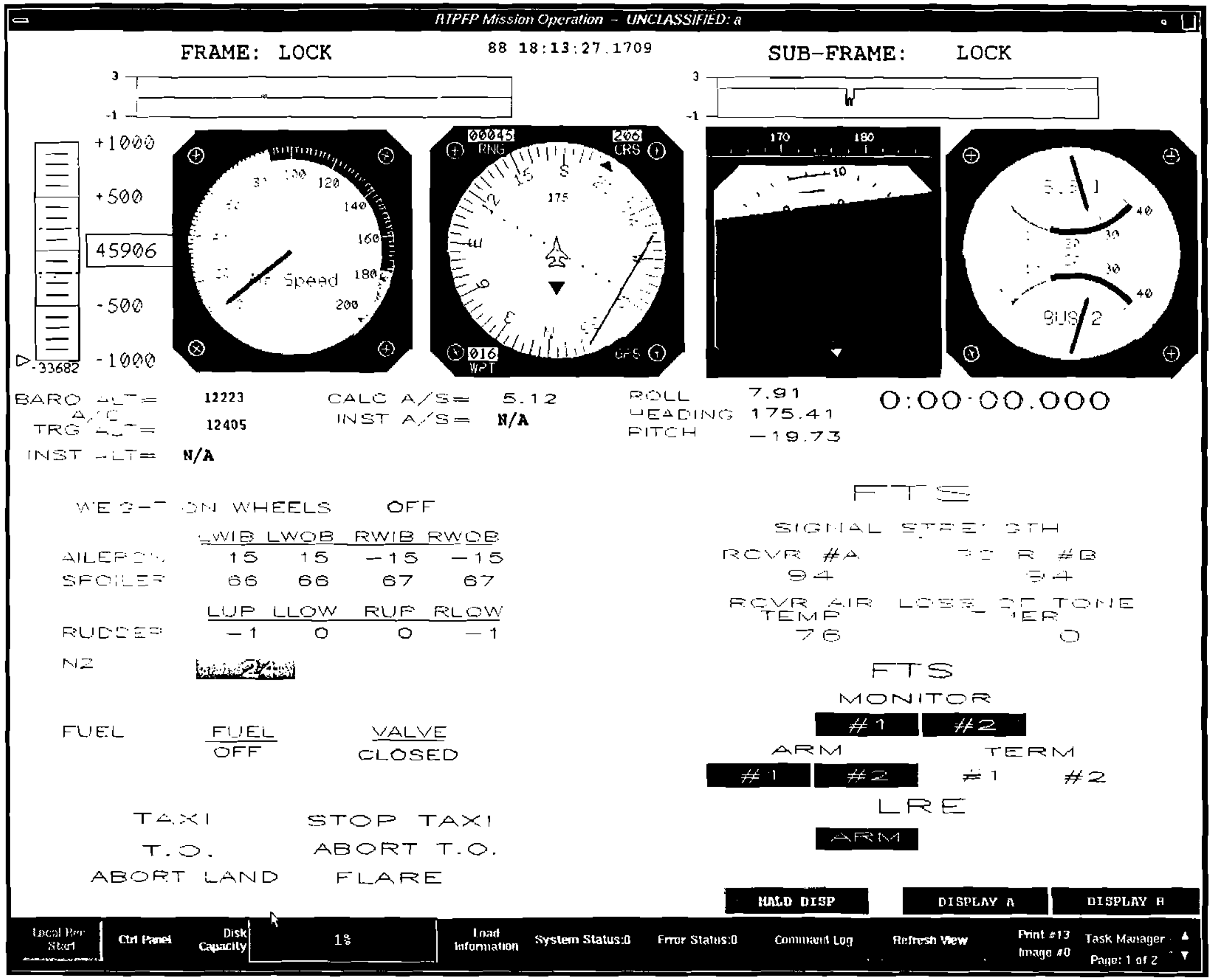
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65605185 Date: Mon Apr 26 06:50:57



V-1.52

Global Hawk UAV, 95-2002, 19990329

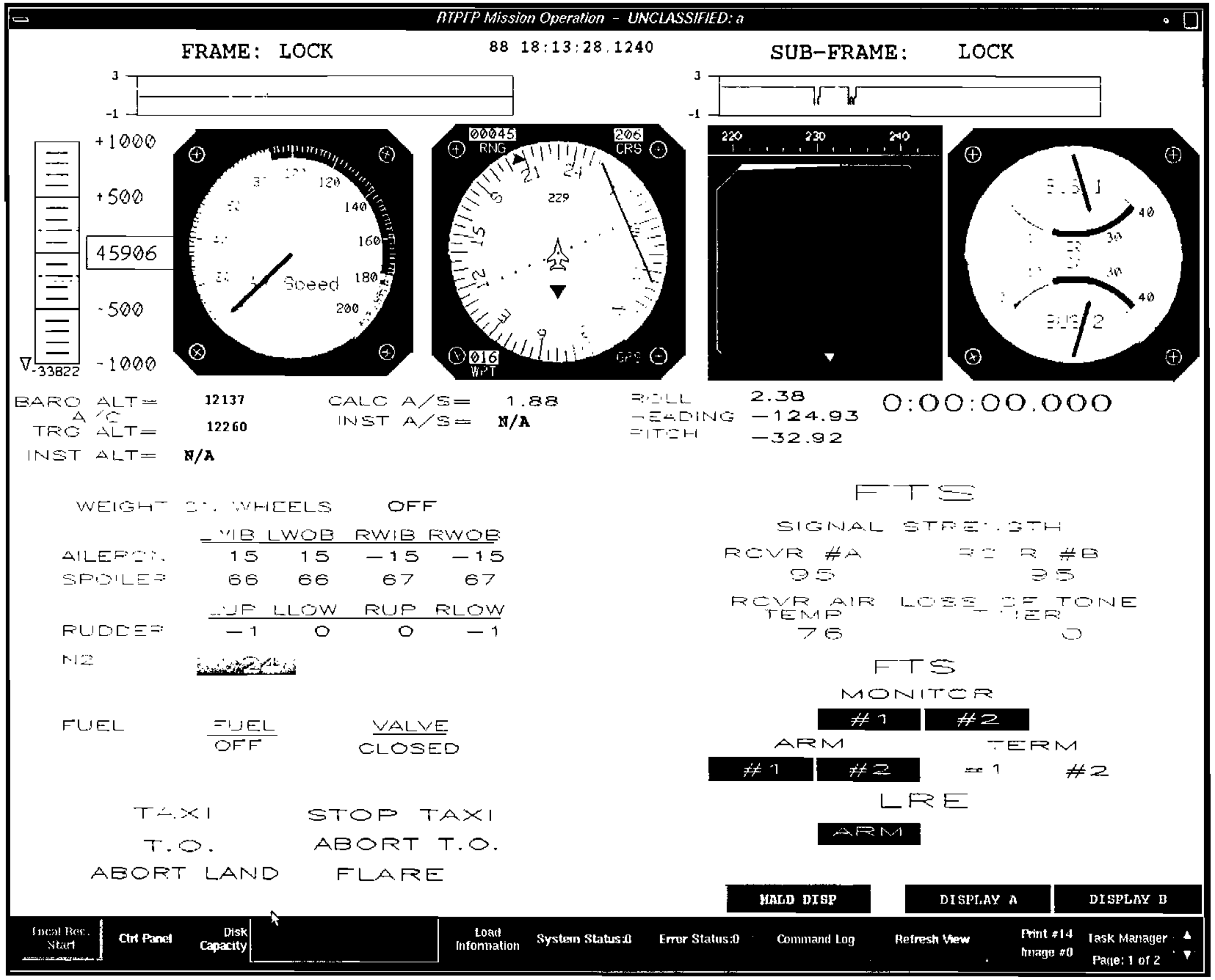
Project: a Operation: a Test: a Display: hawksafety.v
a



V-1.53

Global Hawk UAV, 95-2002, 19990329

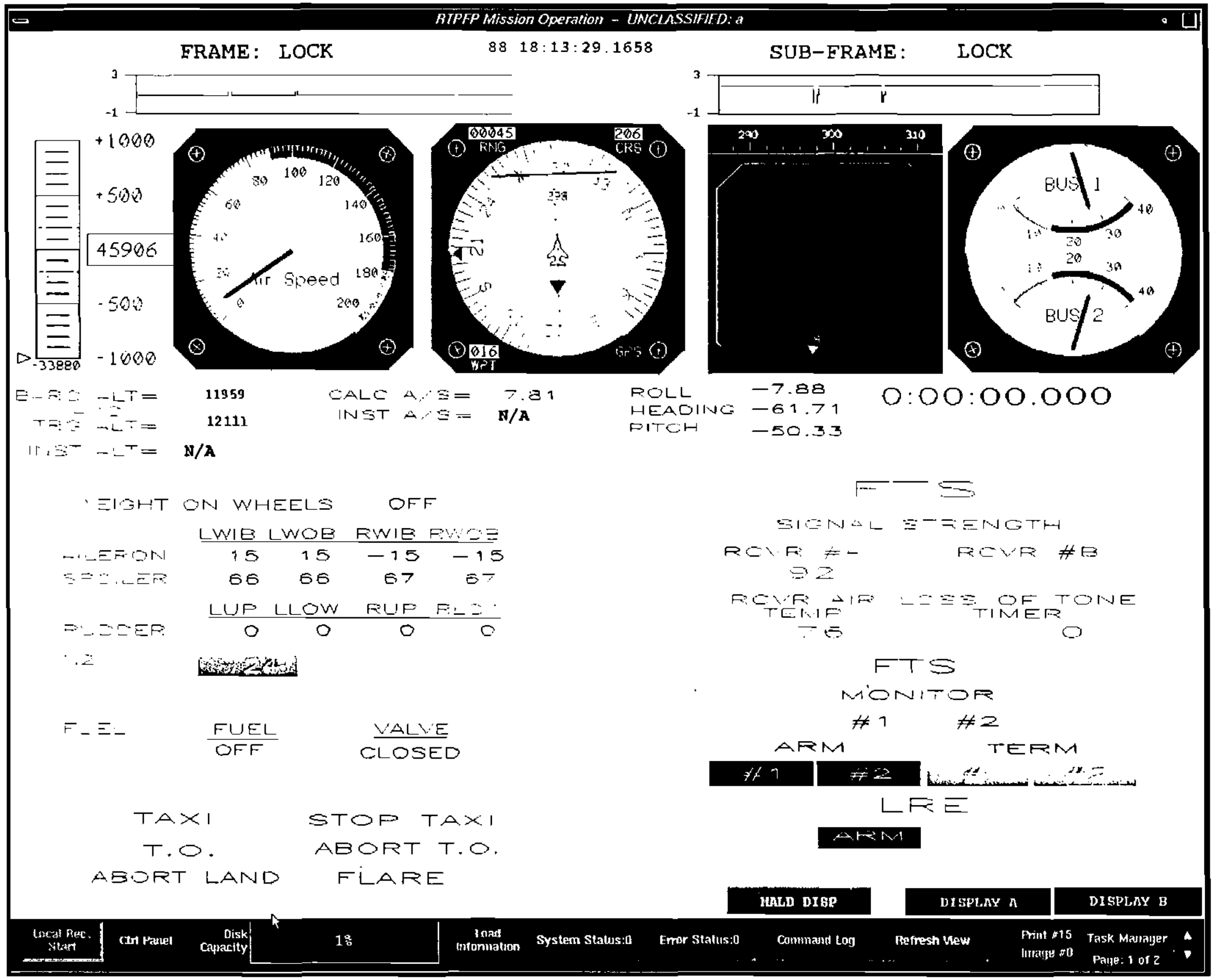
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65607187 Date: Mon Apr 26 06:51:05



V-1.54

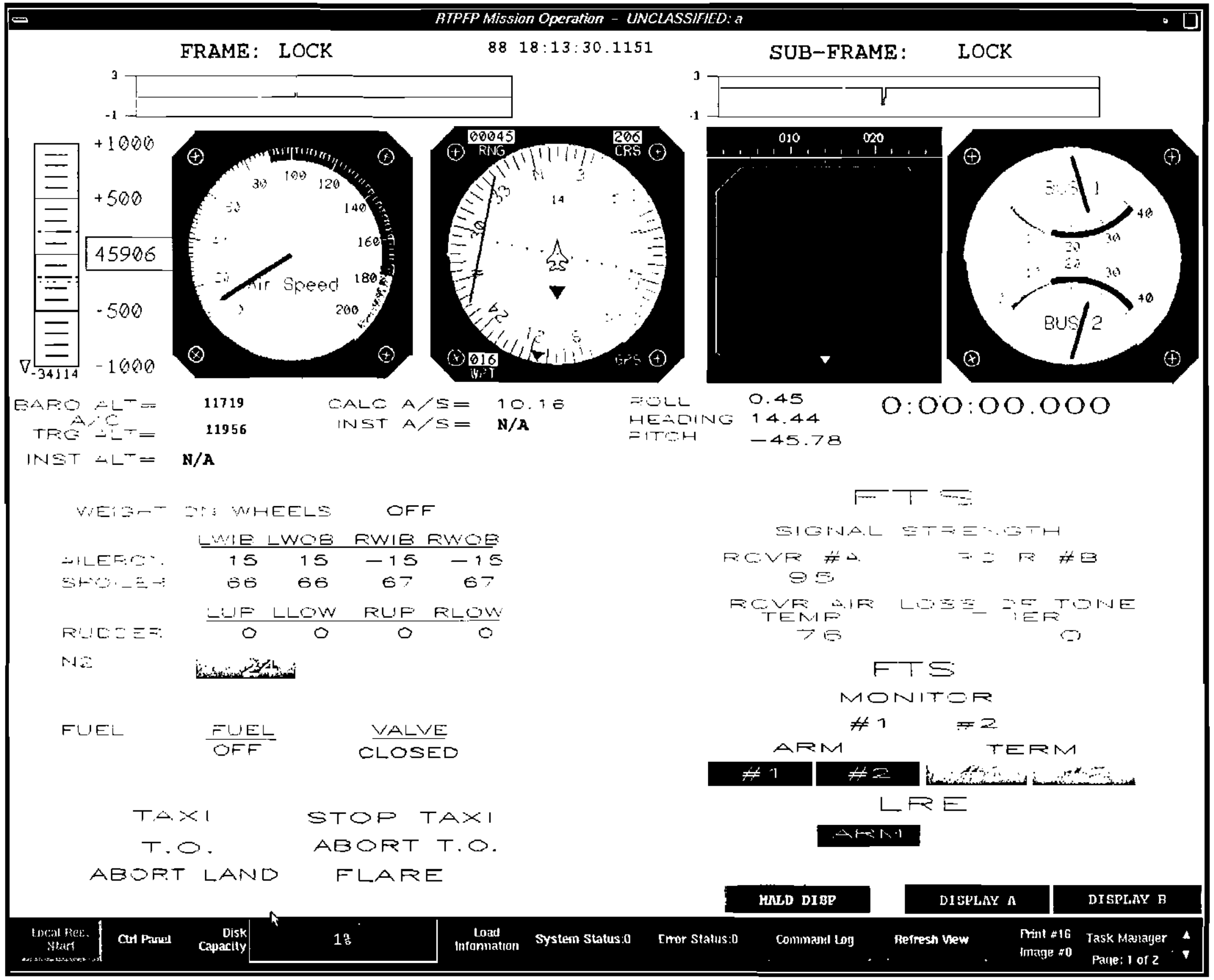
Global Hawk UAV, 95-2002, 19990329

Project: a Operation: a Test: a Display: hawksafety.v
a



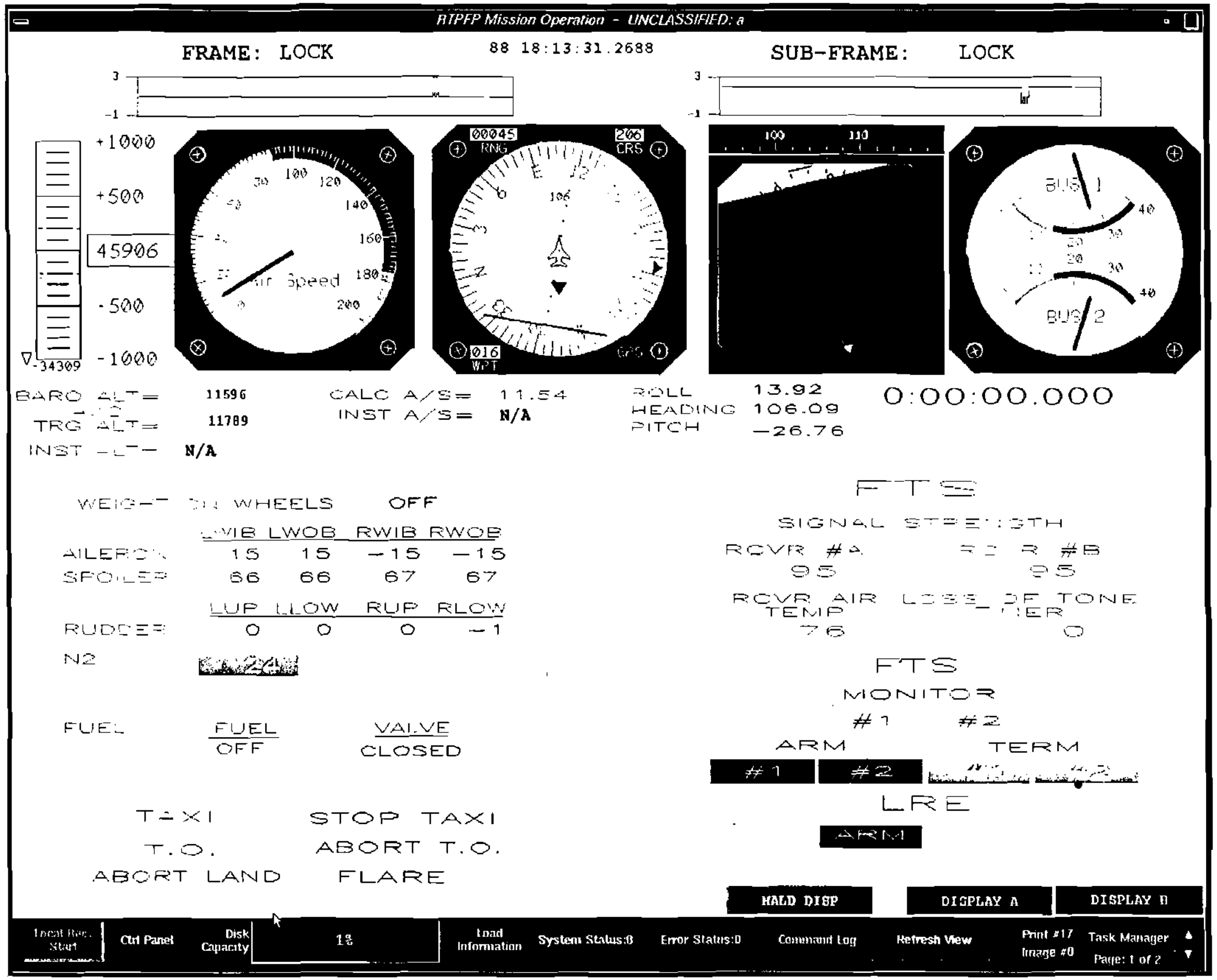
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65609184 Date: Mon Apr 26 06:51:13

Project: a Operation: a Test: a Display: hawksafety.v
a



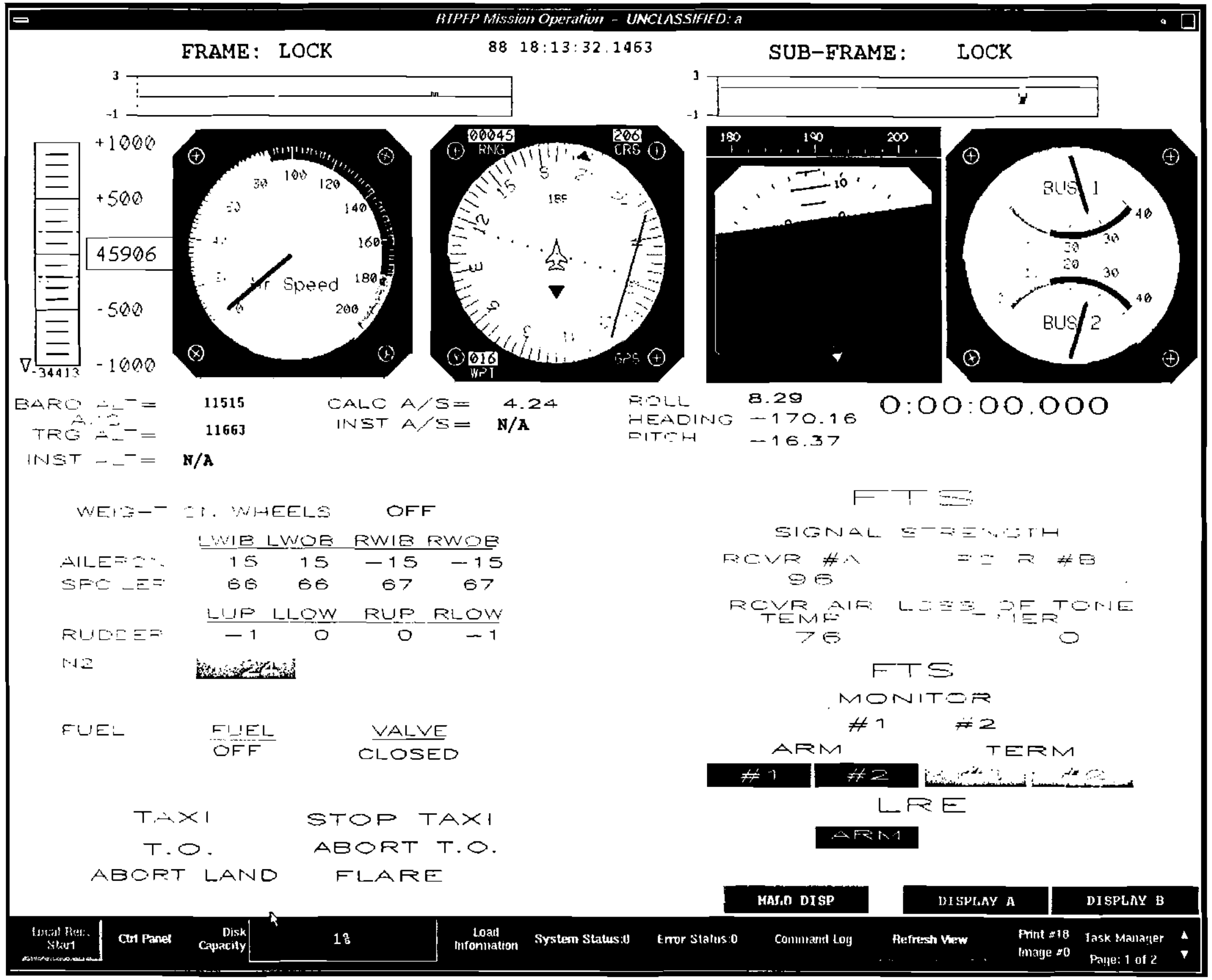
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65610131 Date: Mon Apr 26 06:51:17

Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65611285 Date: Mon Apr 26 06:51:22

Project: a Operation: a Test: a Display: hawksafety.v
a

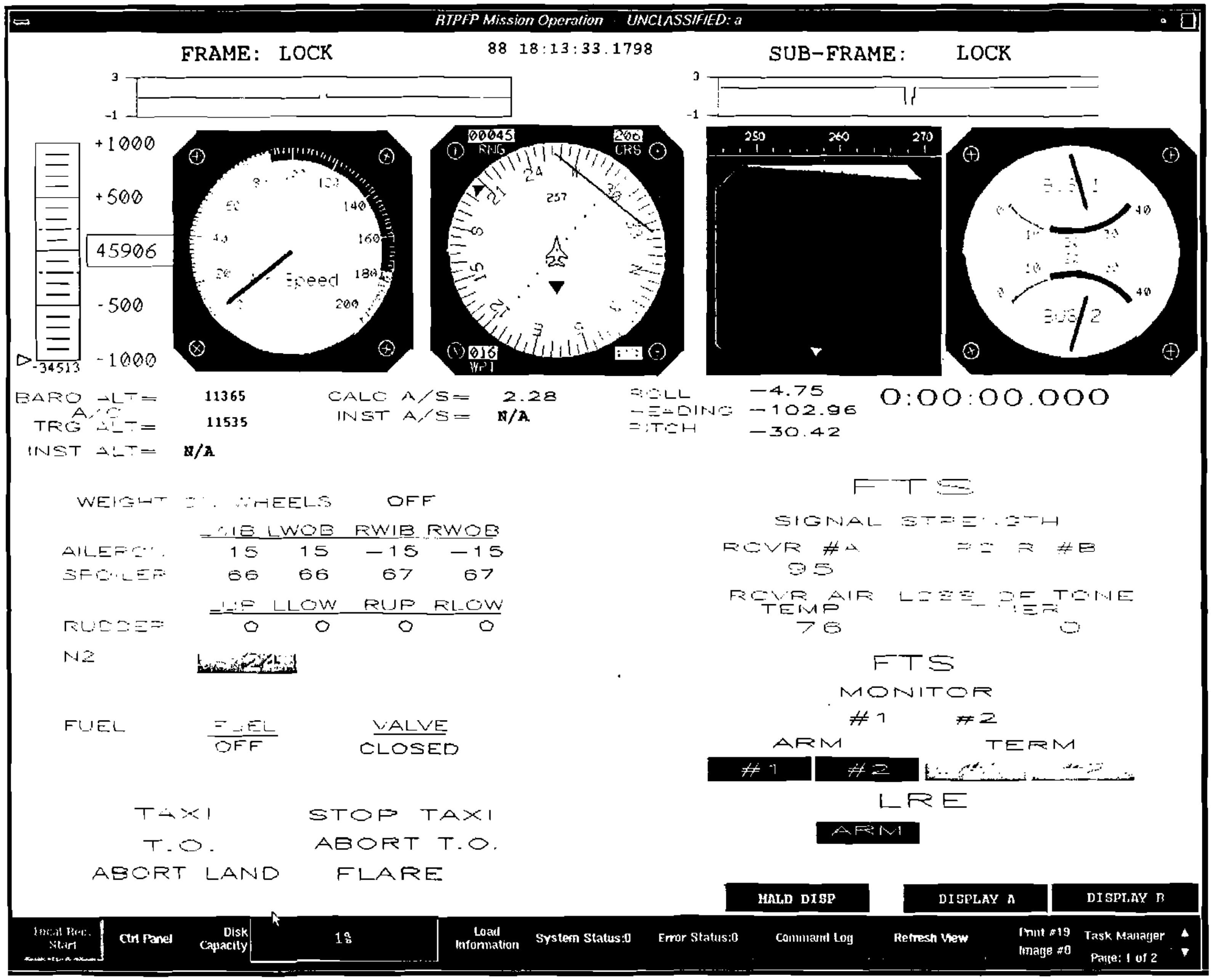


V-1.58

Global Hawk UAV, 95-2002, 19990329

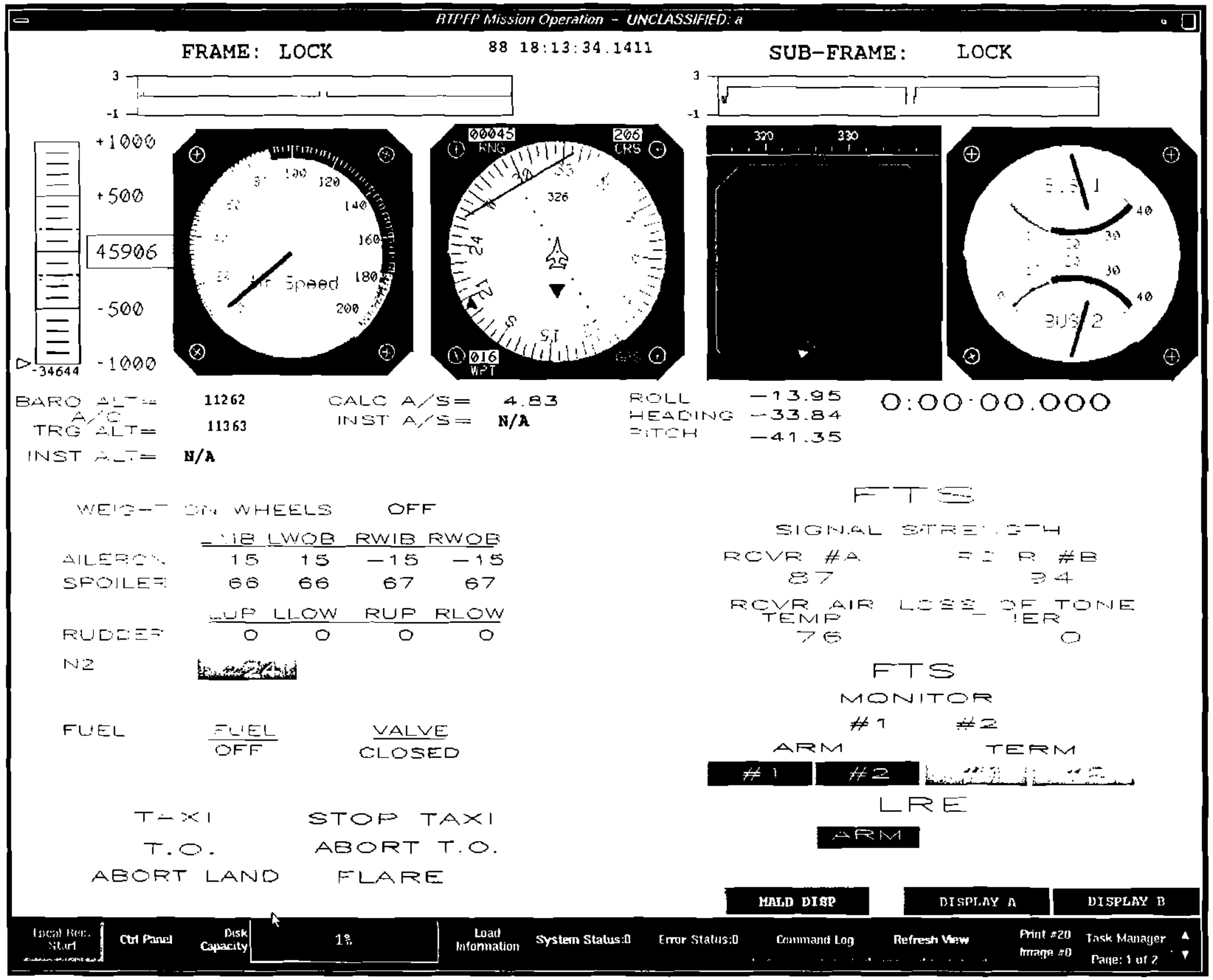
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65612162 Date: Mon Apr 26 06:51:25

Project: a Operation: a Test: a Display: hawksafety.v
a

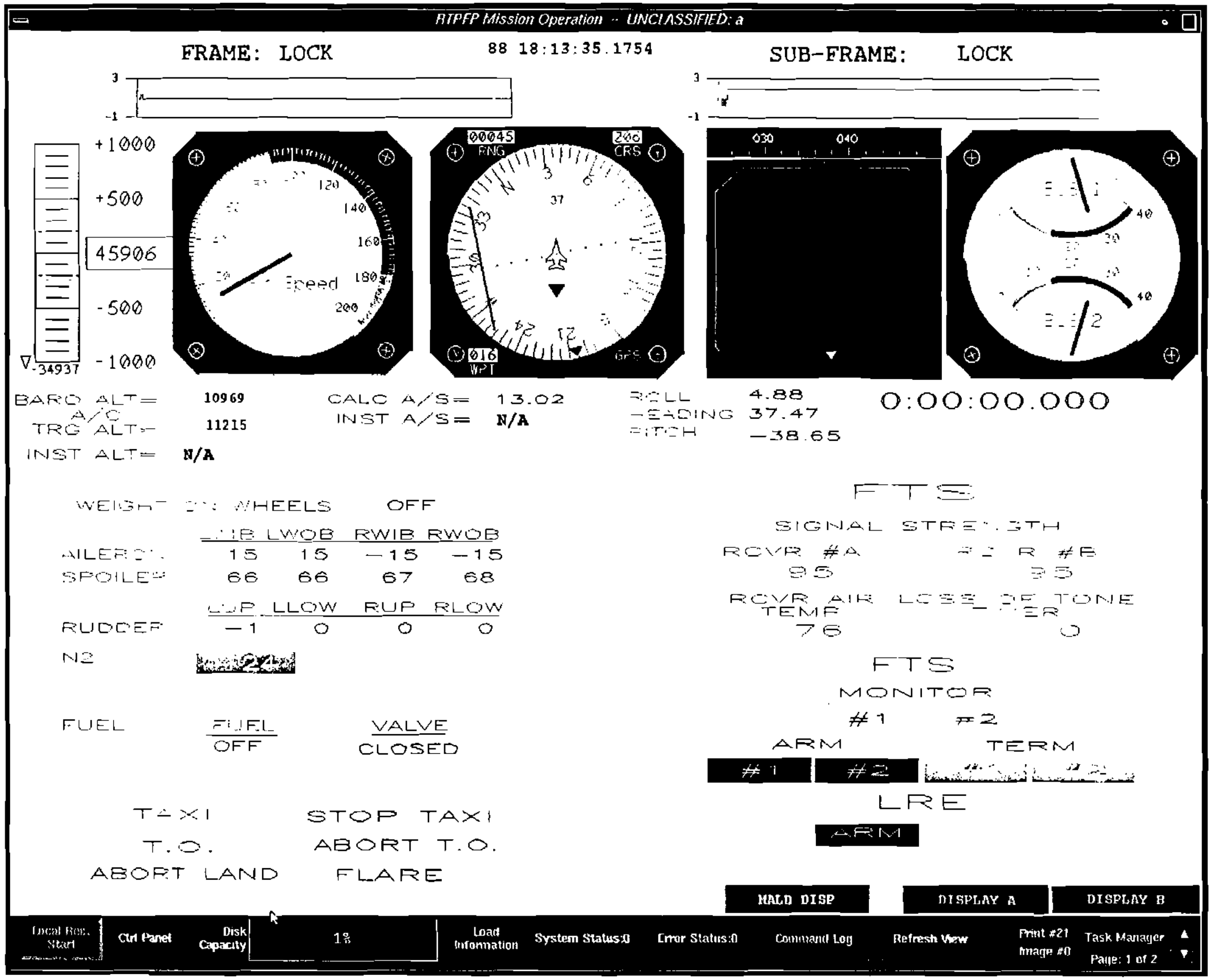


a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65613196 Date: Mon Apr 26 06:51:29

Project: a Operation: a Test: a Display: hawksafety.v
a



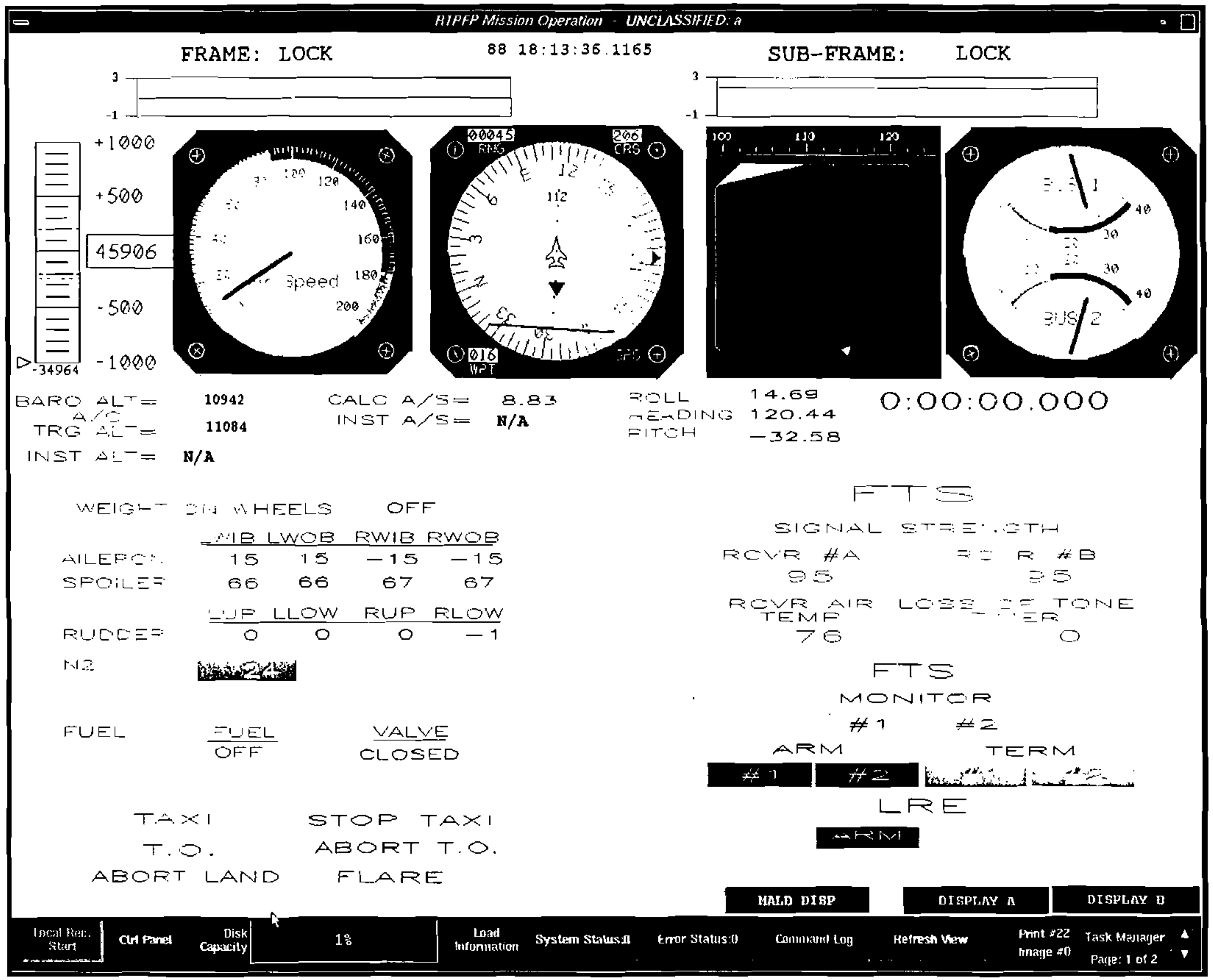
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65614157 Date: Mon Apr 26 06:51:33



Global Hawk UAV, 95-2002, 19990329

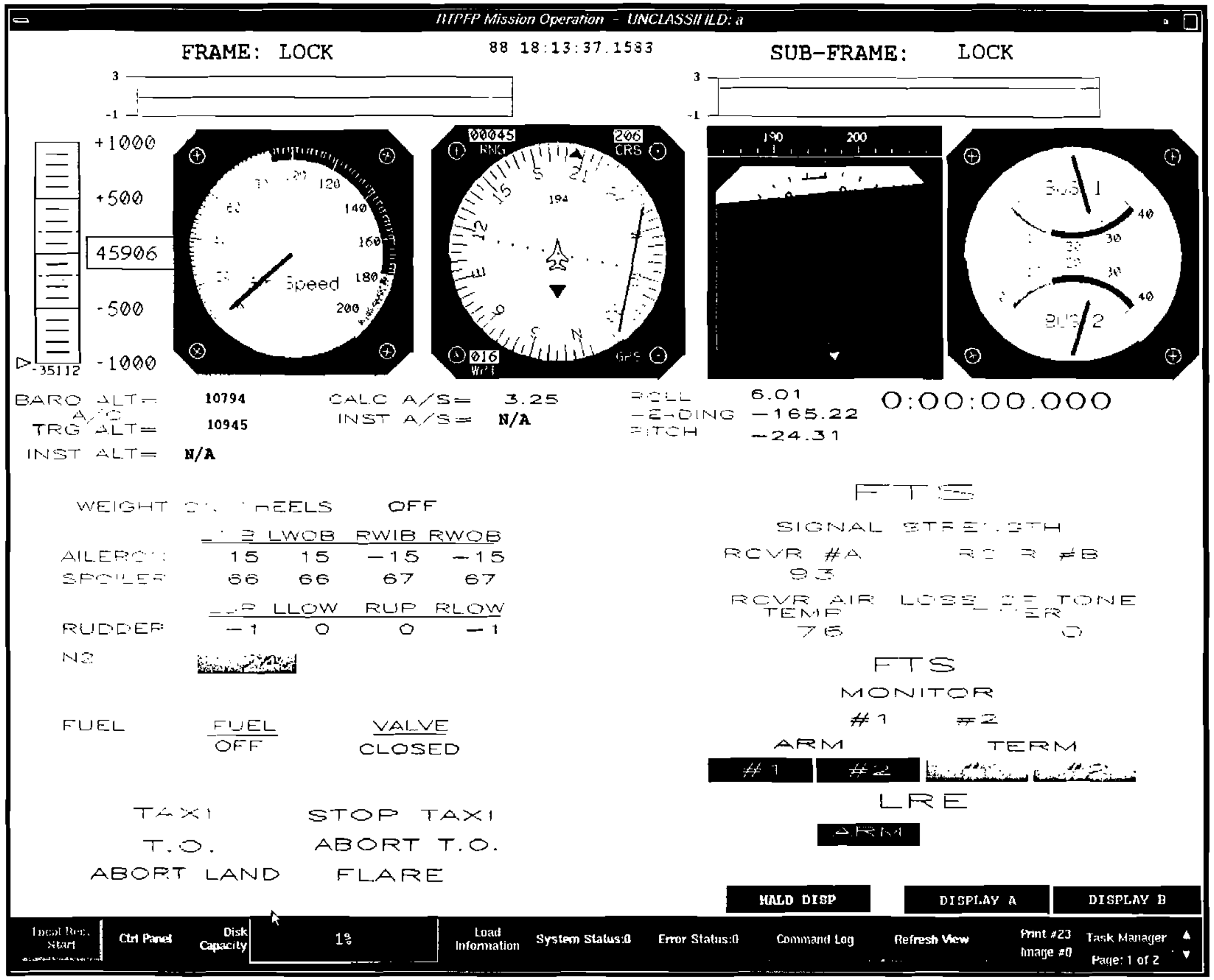
V-1.61

Project: a Operation: a Test: a Display: hawksafety.v
a



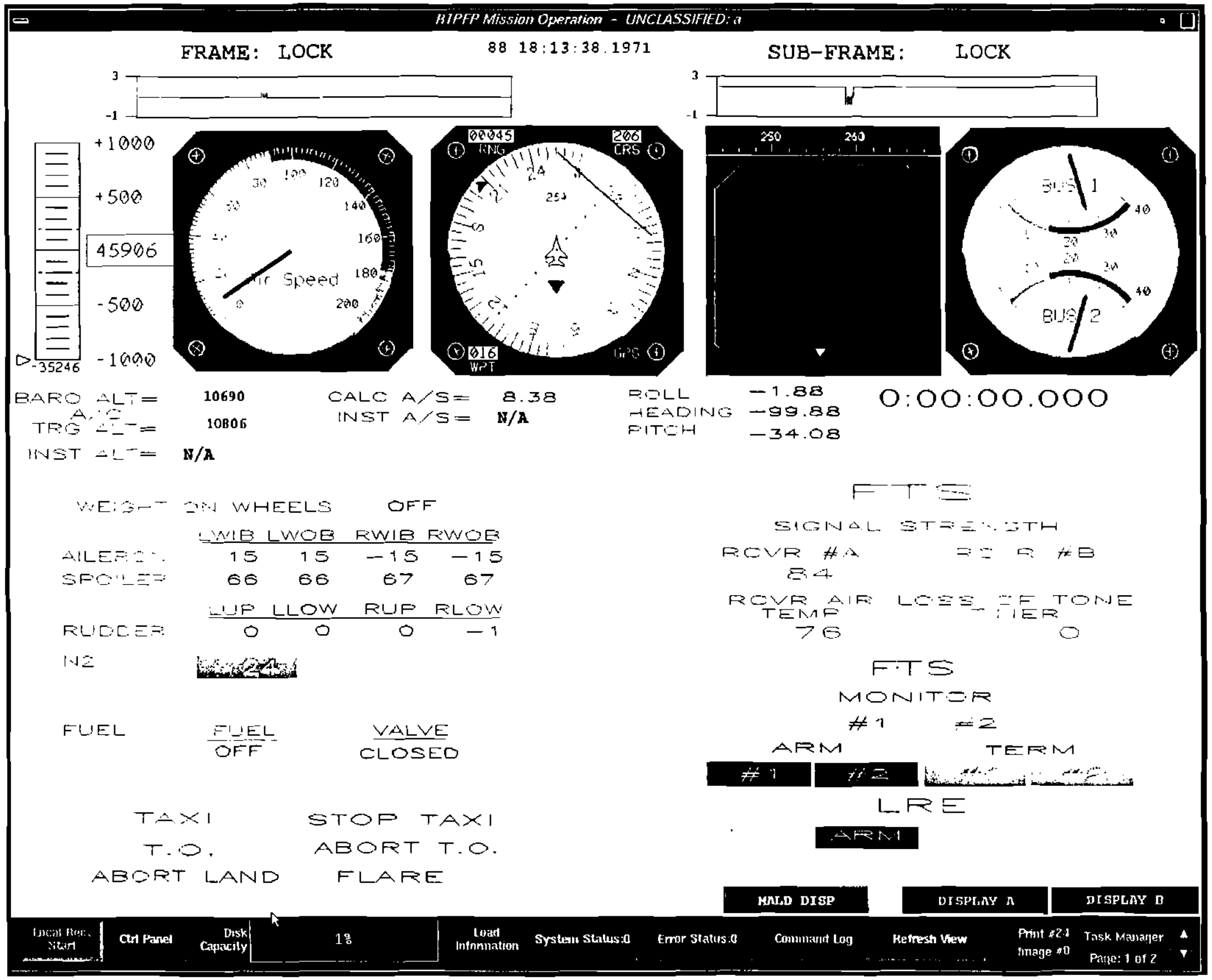
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65616134 Date: Mon Apr 26 06:51:41

Project: a Operation: a Test: a Display: hawksafety.v
a

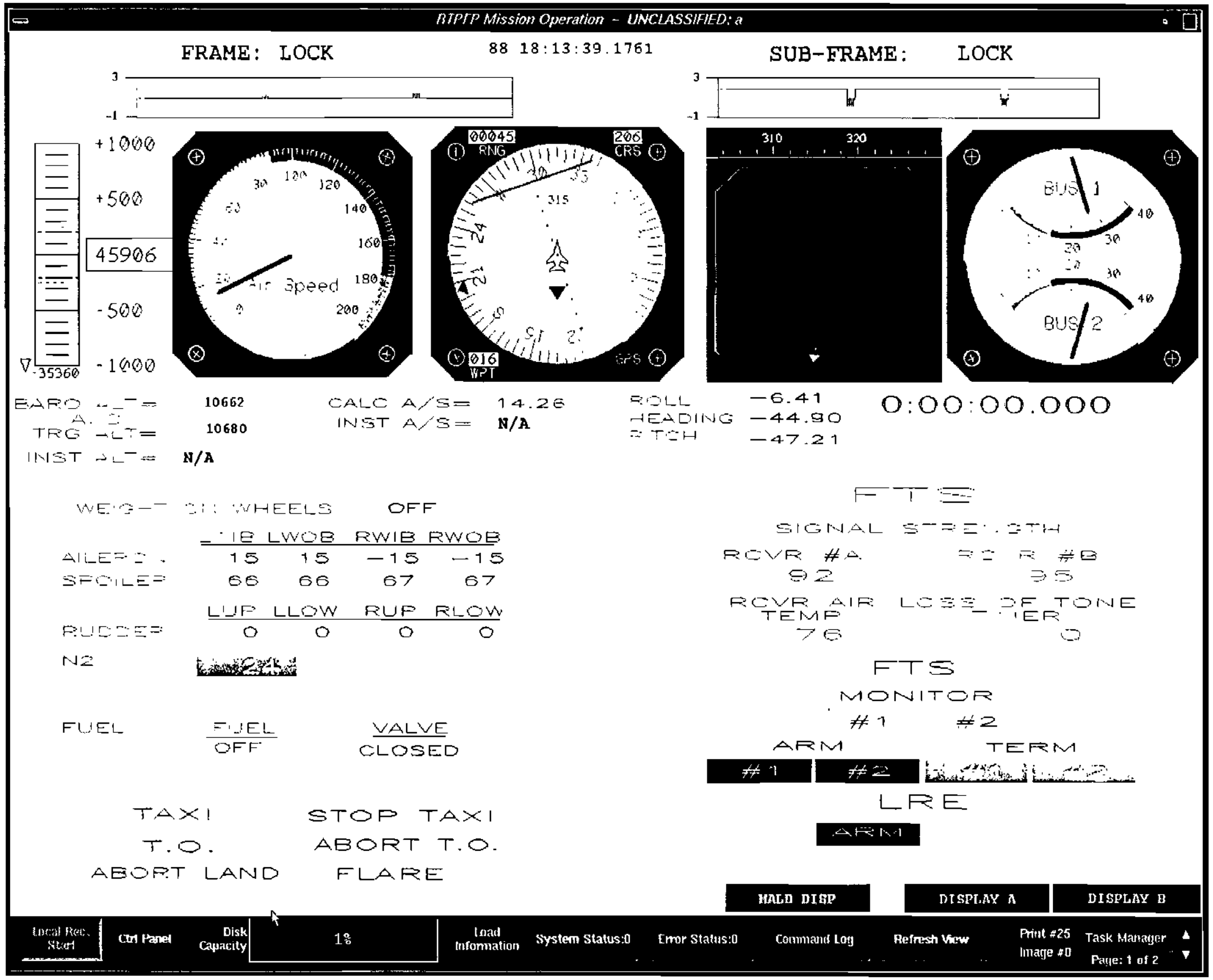


a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65617176 Date: Mon Apr 26 06:51:45

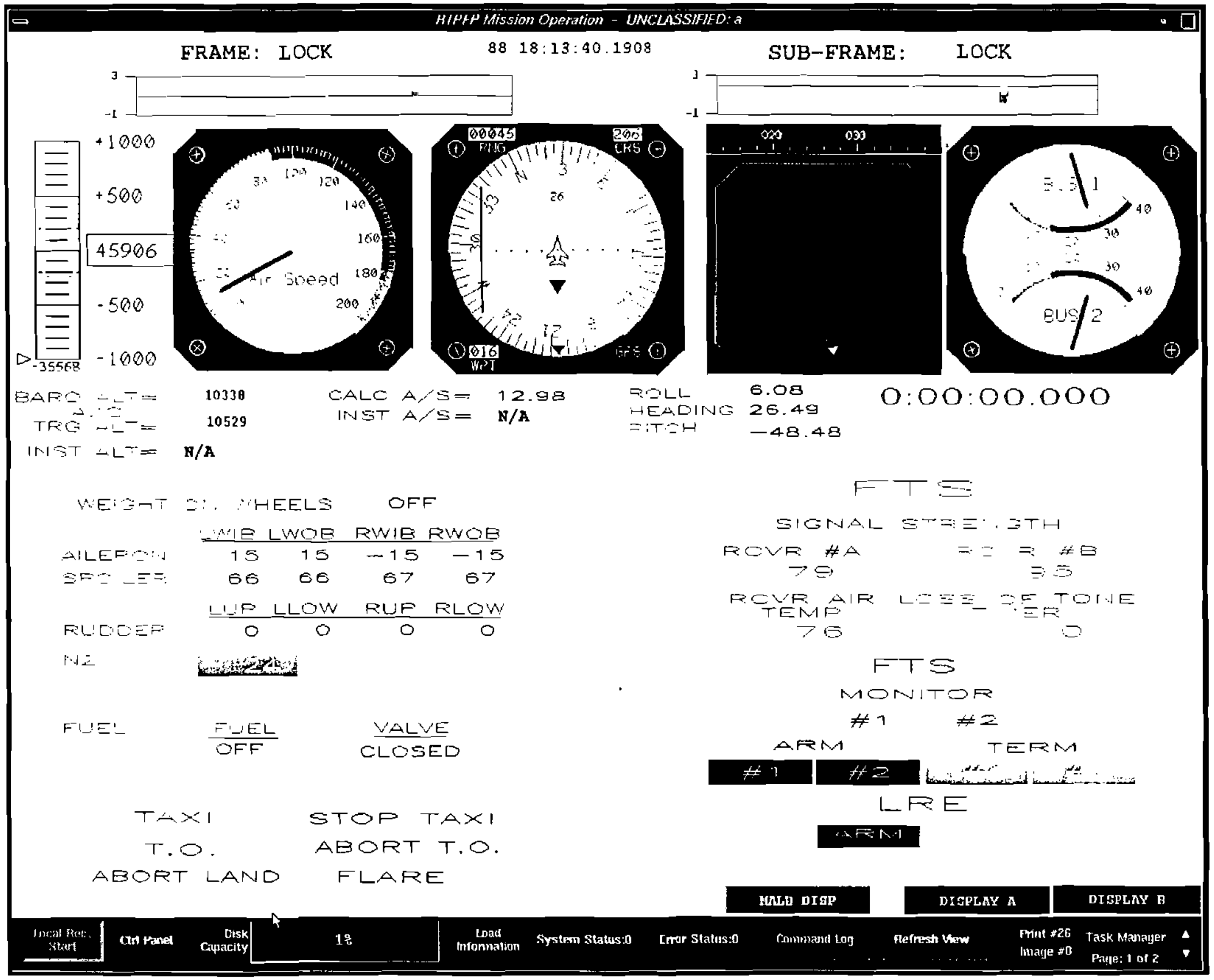
Project: a Operation: a Test: a Display: hawksafety.v
a



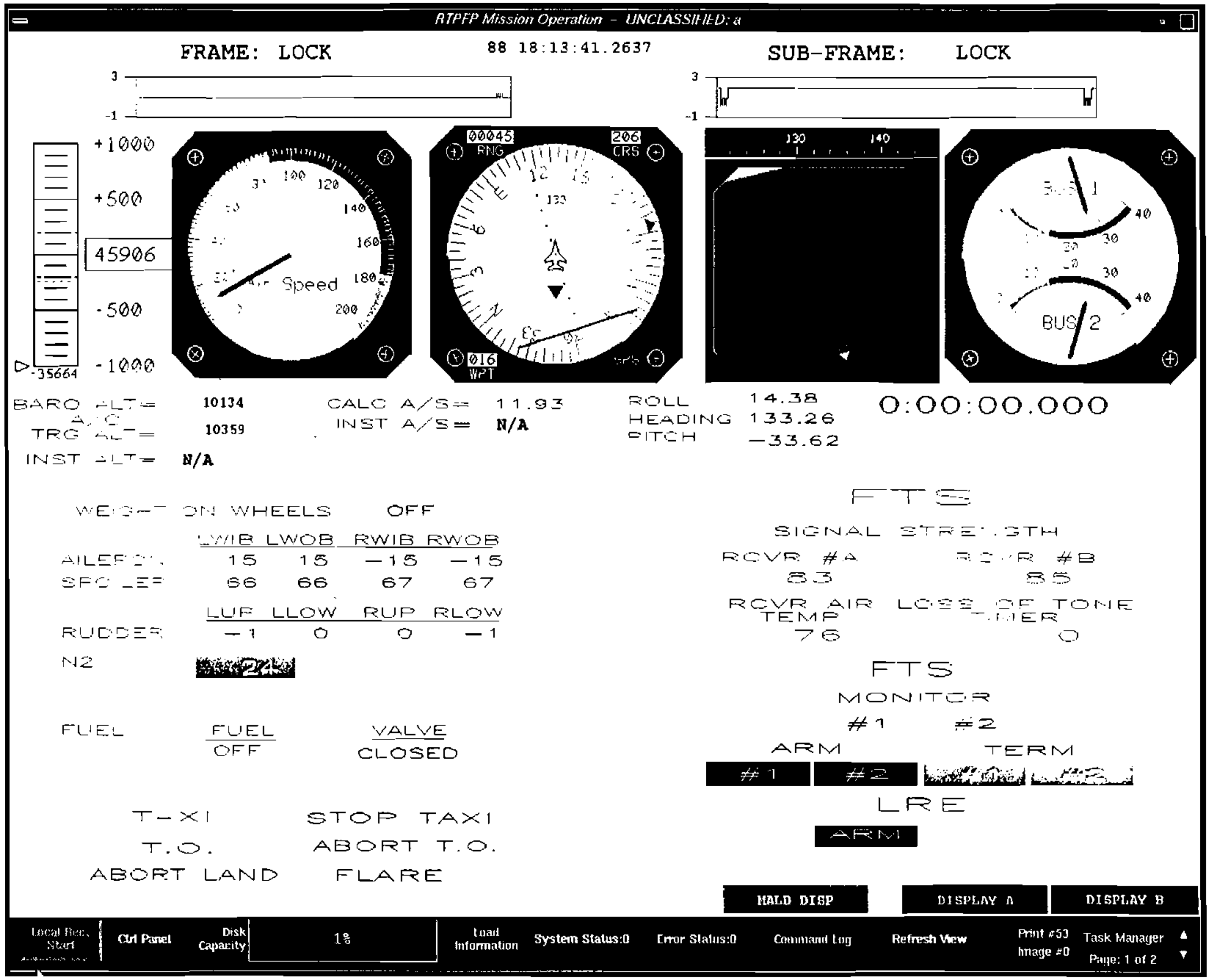
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65618216 Date: Mon Apr 26 06:51:49


RTPTP Mission Operation – UNCLASSIFIED: a
FRAME: LOCK
88 18:13:39.1761
SUB-FRAME: LOCK
+1000
+500
45906
-500
-1000
-35360
Air Speed
00045 RNG
206 CRS
016 WPT
BUS 1
BUS 2
10662
10680
TRG ALT=
INST ALT=
N/A
CALC A/S= 14.26
INST A/S= N/A
ROLL -6.41
HEADING -44.90
-47.21
0:00:00.000
WHEELS OFF
LWOB RWIB RWOB
15 15 -15 -15
66 66 67 67
LUP LLOW RUP RLOW
0 0 0 0
N2
FTS
SIGNAL
RCVR #A
92
RCVR AIR
TEMP
76
FTS
MONITOR
#1 #2
ARM
TERM
#1
#2
LRE
ARM
FUEL
OFF
VALVE
CLOSED
TAXI
STOP TAXI
T.O.
ABORT T.O.
ABORT LAND
FLARE
HALD DISP
DISPLAY A
DISPLAY B
Local Rec. Start
Ctrl Panel
Disk Capacity
1%
Load Information
System Status:0
Error Status:0
Command Log
Refresh View
Print #25
Image #0
Task Manager
Page: 1 of 2

Project: a Operation: a Test: a Display: hawksafety.v
a



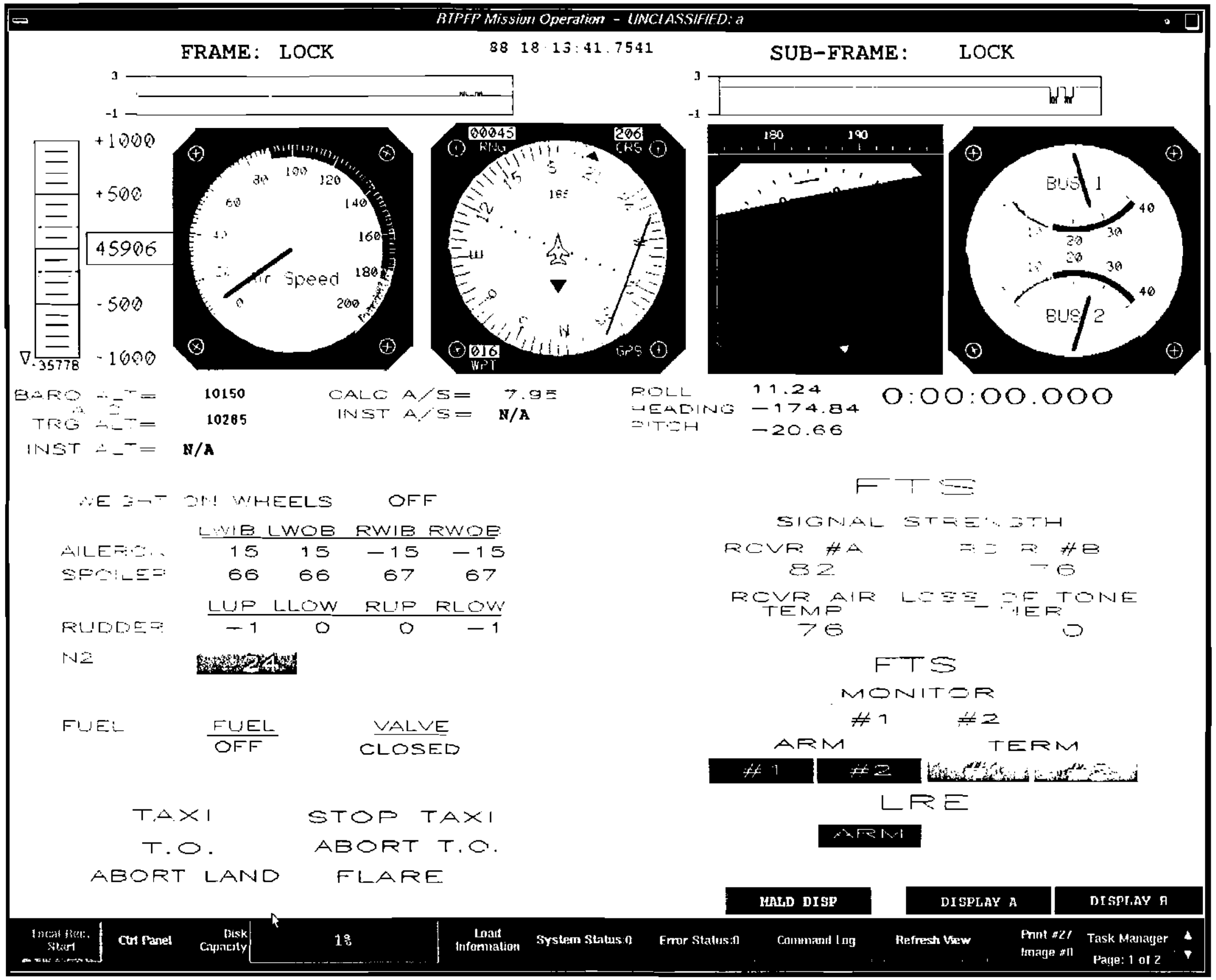
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65620206 Date: Mon Apr 26 06:51:57



Global Hawk UAV, 95-2002, 19990329

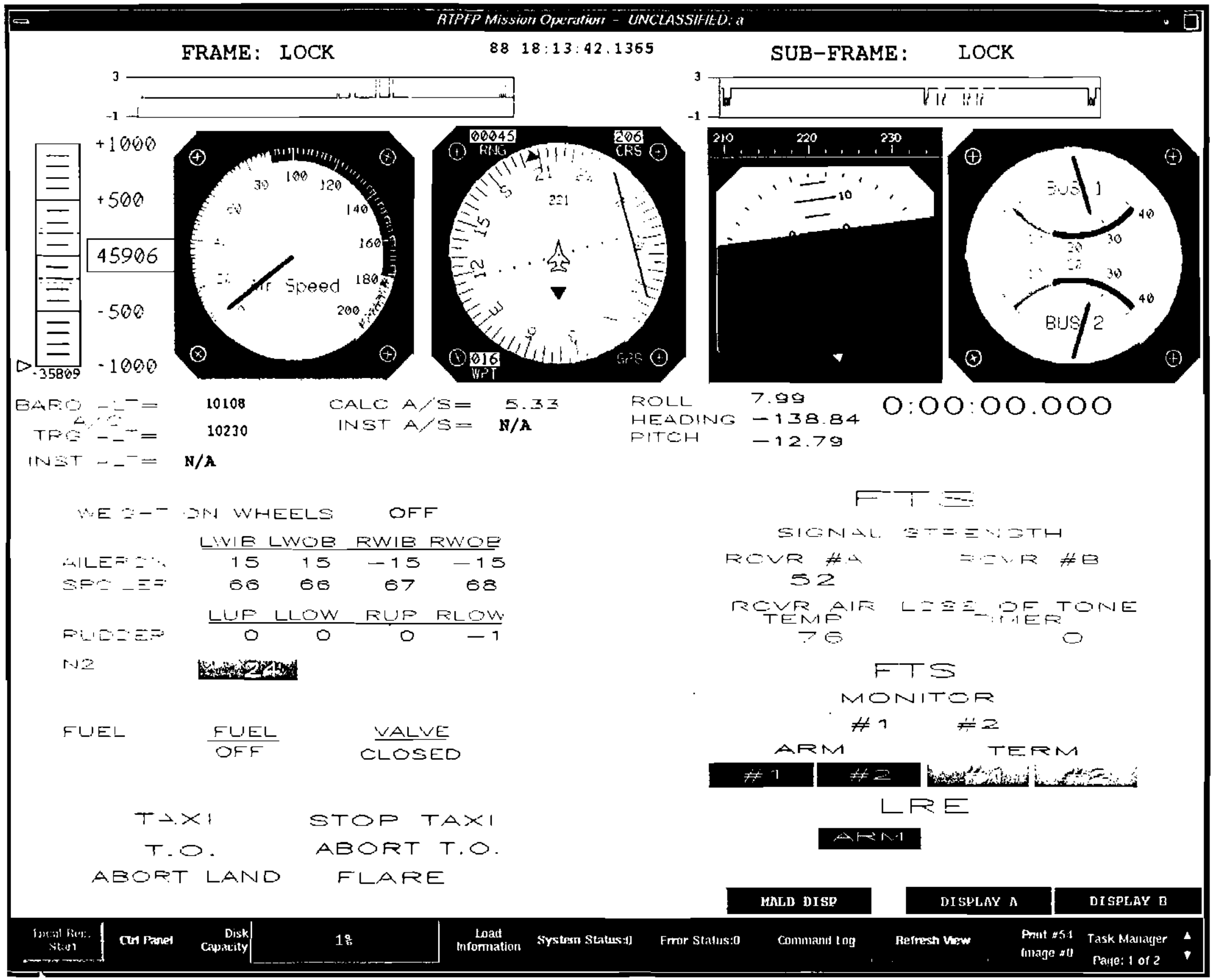
V-1.67

Project: a Operation: a Test: a Display: hawksafety.v
a



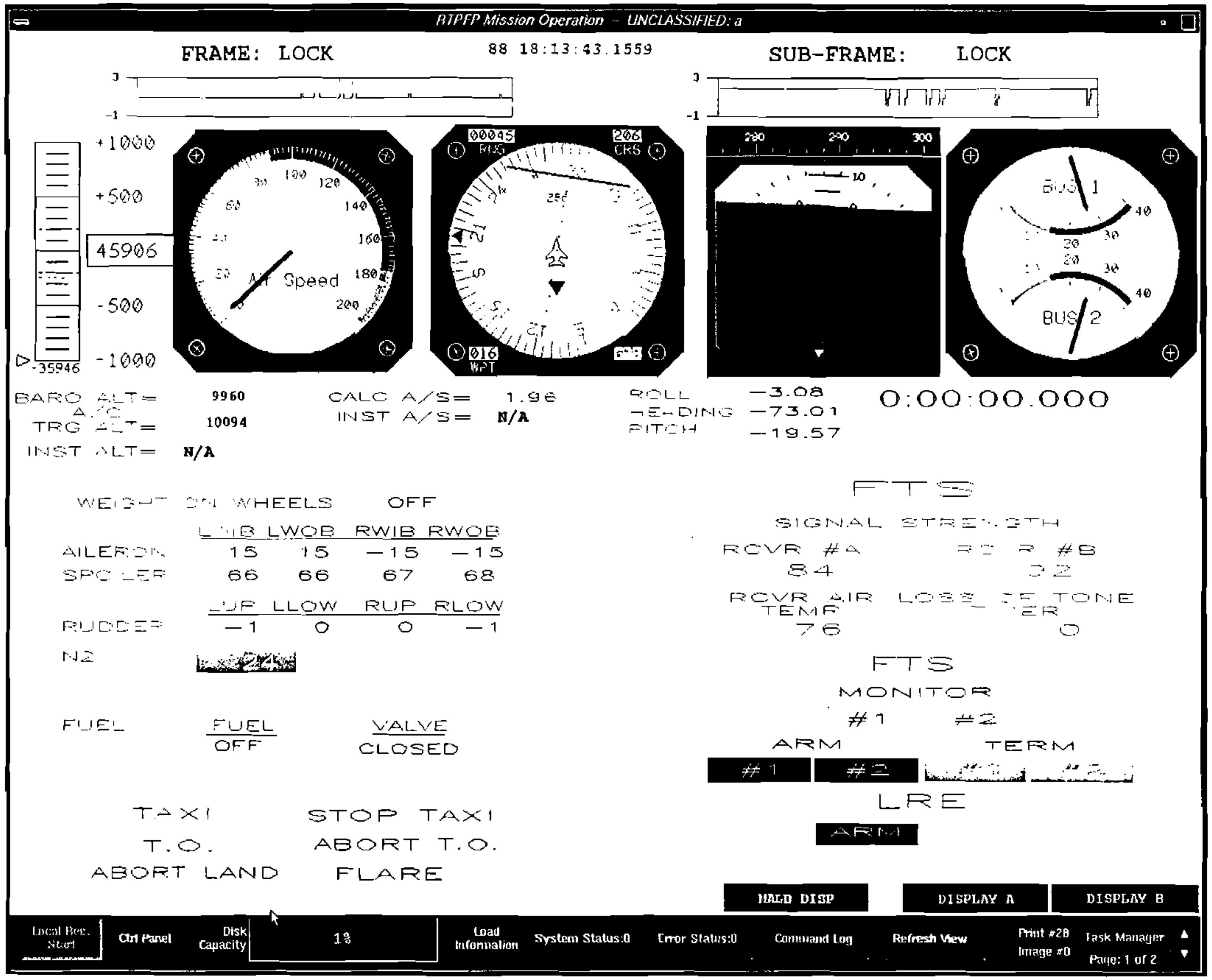
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65621762 Date: Mon Apr 26 06:52:03

Project: a Operation: a Test: a Display: hawksafety.v
a



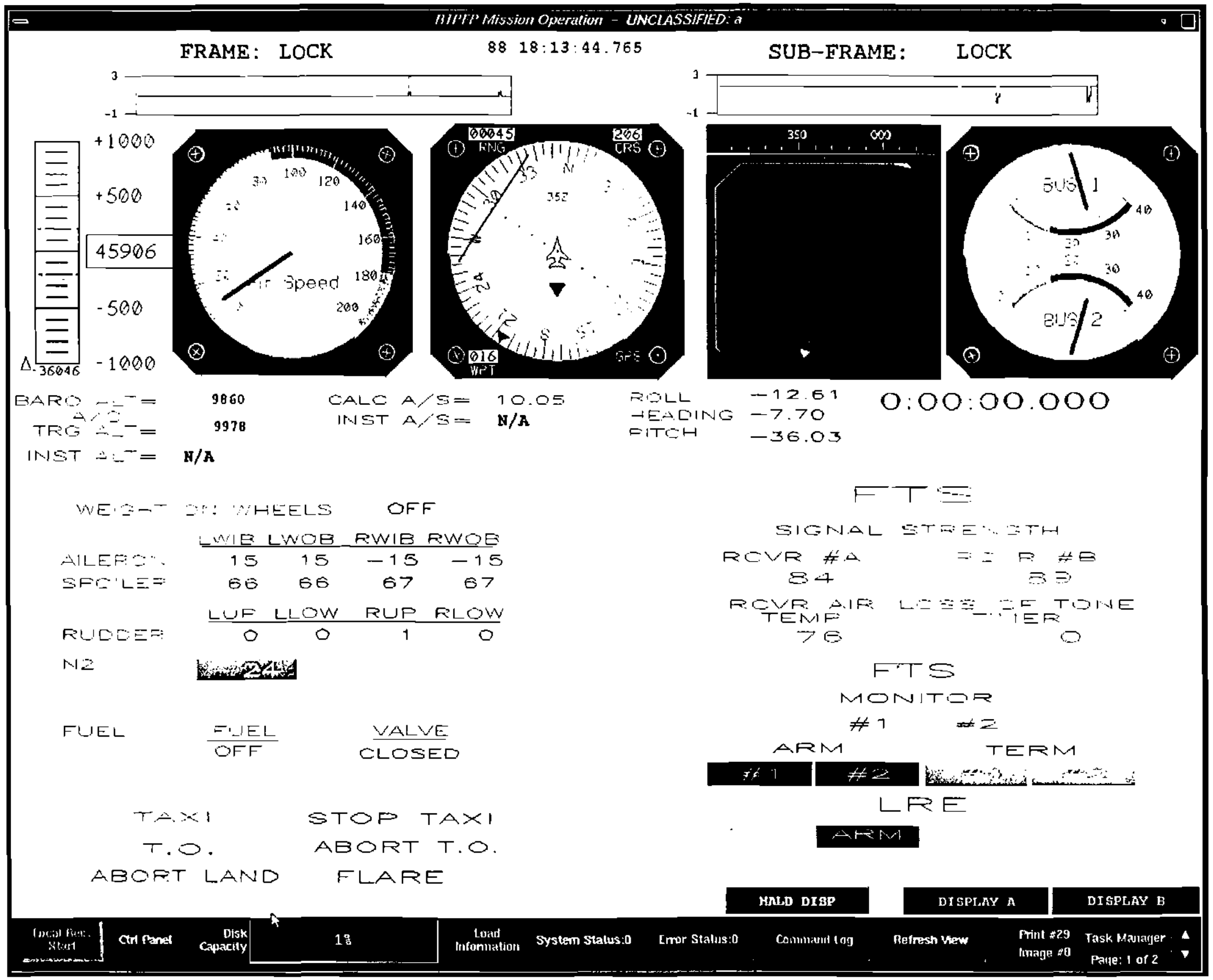
a
Workstation: wsl5rm266 User: wsl5 TPP: Range Time: 0 65622154 Date: Mon Apr 26 07:10:45

Project: a a Operation: a Test: a Display: hawksafety.v



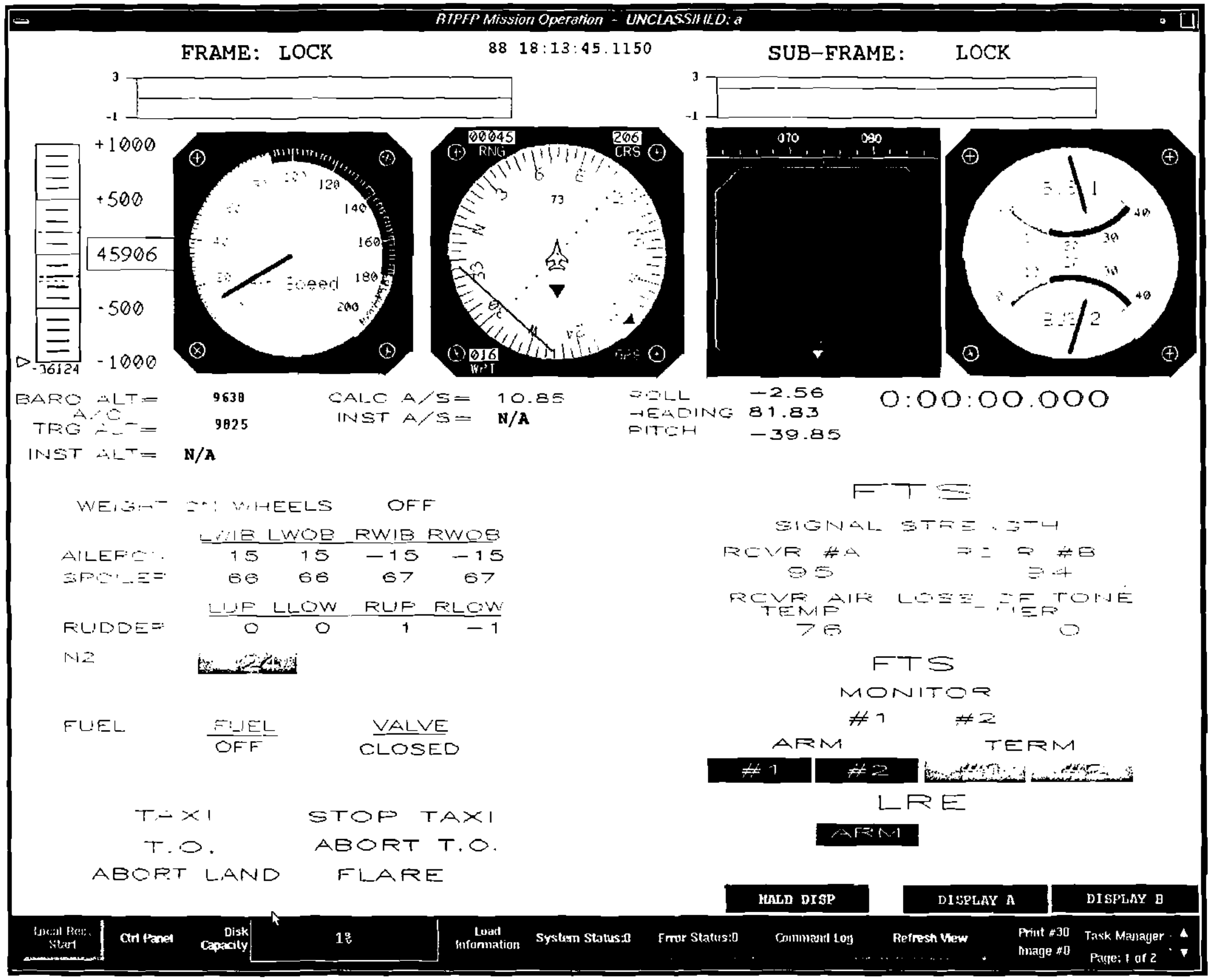
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65623163 Date: Mon Apr 26 06:52:09

Project: a Operation: a Test: a Display: hawksafety.v
a

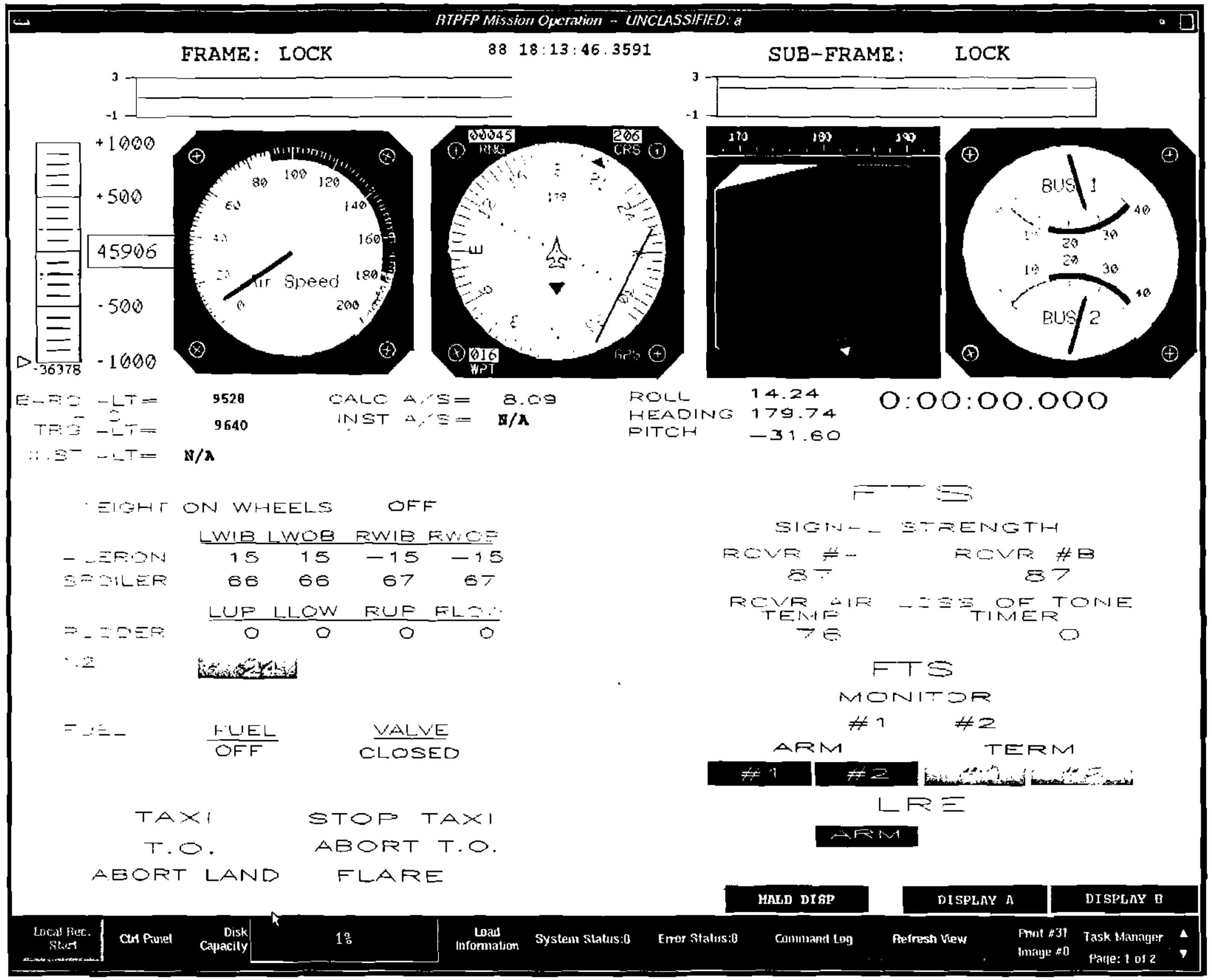


a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65624105 Date: Mon Apr 26 06:52:13

Global Hawk UAV, 95-2002, 19990329

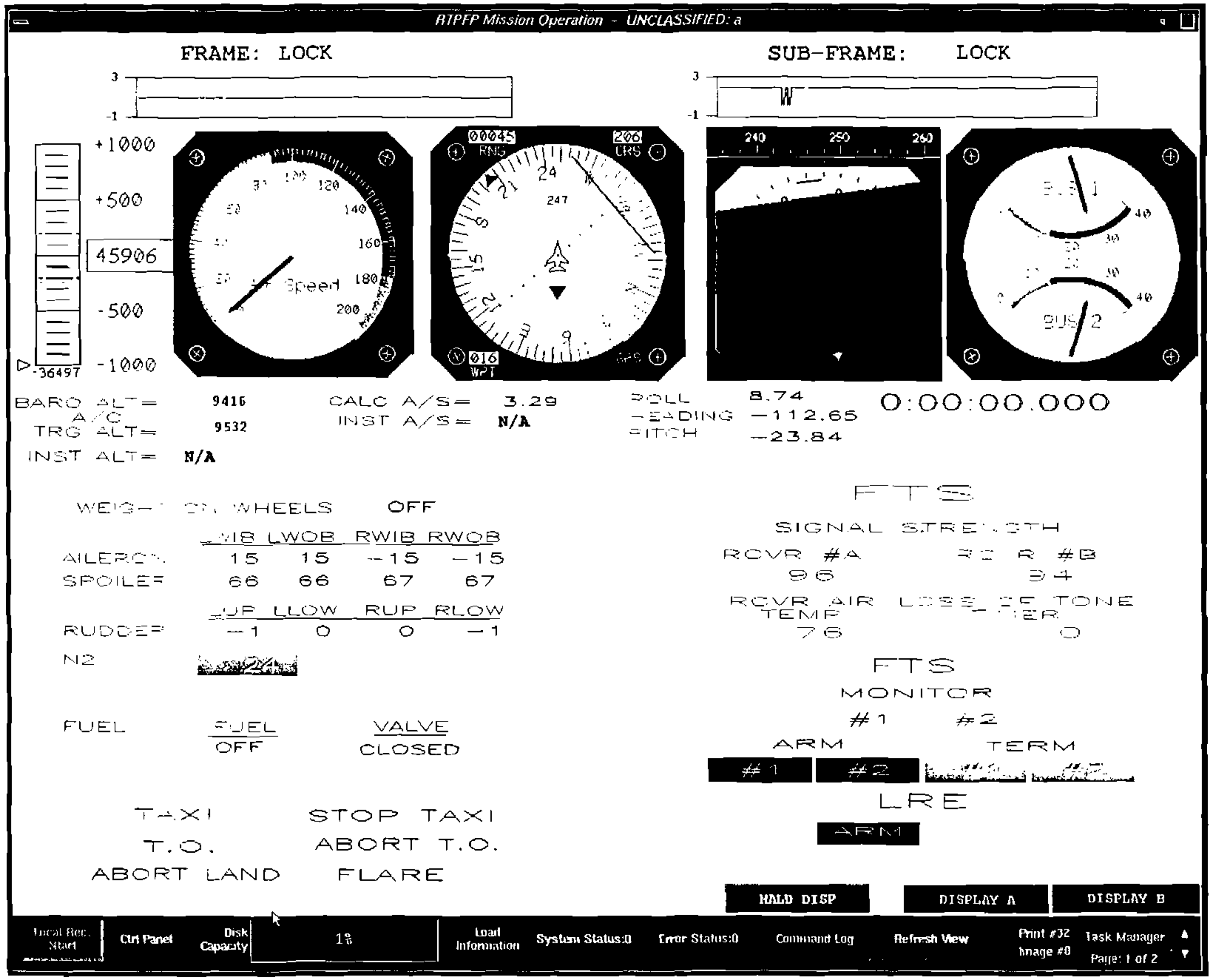

RTPFP Mission Operation - UNCLASSIFIED: a
FRAME: LOCK
88 18:13:45.1150
SUB-FRAME: LOCK
+1000
+500
45906
-500
-1000
BARO ALT= 9638
A/C TRG ALT= 9825
INST ALT= N/A
CALC A/S= 10.85
INST A/S= N/A
ROLL -2.56
HEADING 81.83
PITCH -39.85
0:00:00.000
WEIGHT ON WHEELS OFF
LWIB LWOB RWIB RWOB
AILERON 15 15 -15 -15
SPOILER 66 66 67 67
LUP LLOW RUP RLOW
RUDDER 0 0 1 -1
N2
FUEL
FUEL OFF
VALVE CLOSED
TAXI
STOP TAXI
T.O.
ABORT T.O.
ABORT LAND
FLARE
FTS
SIGNAL STRENGTH
RCVR #A
RCVR #B
95
94
RCVR AIR TEMP
LOSS OF TONE TIMER
76
0
FTS
MONITOR
#1 #2
ARM
TERM
LRE
ARM
HALD DISP
DISPLAY A
DISPLAY B
Ctrl Panel
Disk Capacity
1%
Load Information
System Status:0
Error Status:0
Command Log
Refresh View
Print #30
Image #0
Task Manager
Page: 1 of 2

Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65626364 Date: Mon Apr 26 06:52:22

Project: a Operation: a Test: a Display: hawksafety.v
a

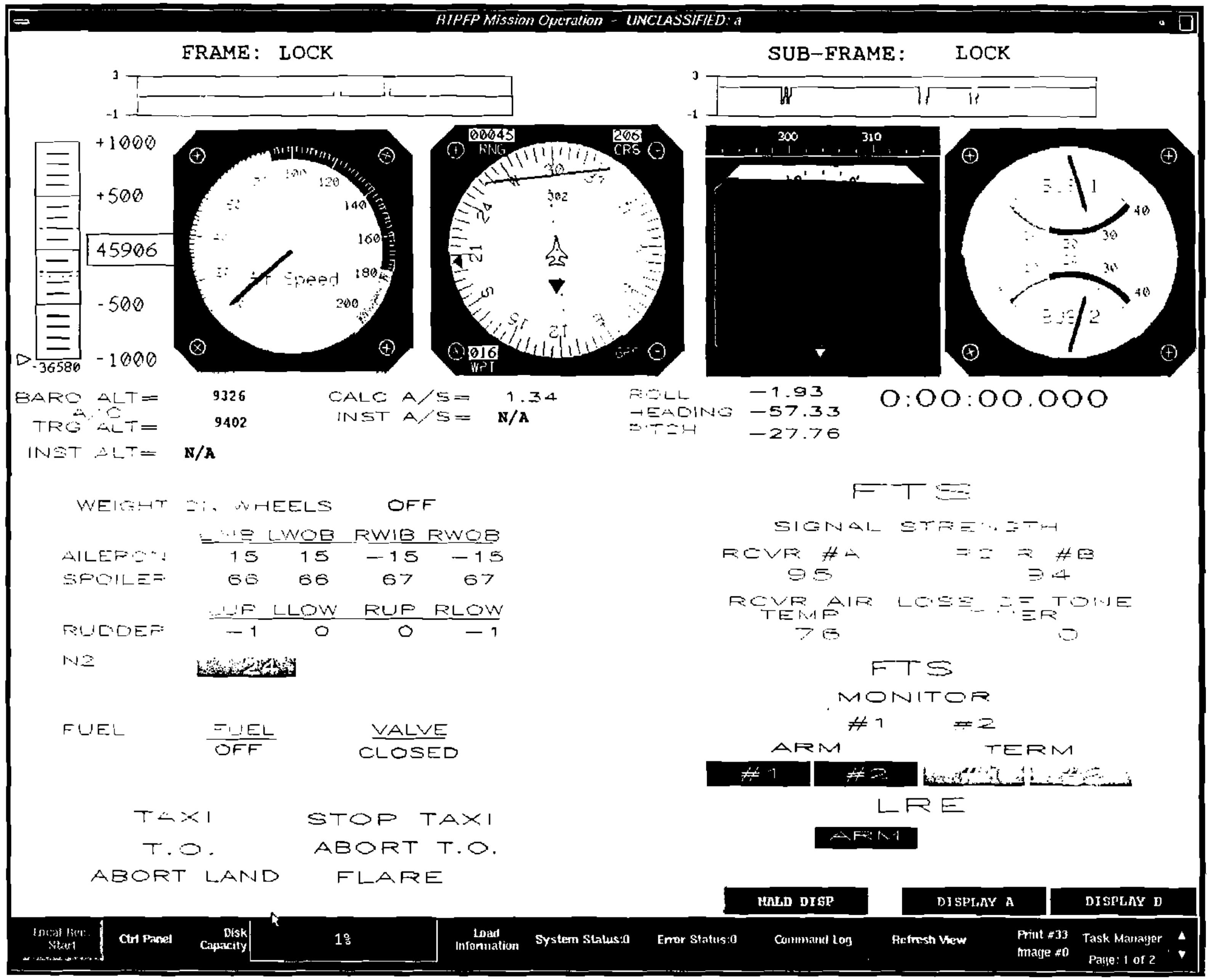


Global Hawk UAV, 95-2002, 19990329

V-1.74

a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65627227 Date: Mon Apr 26 06:52:25

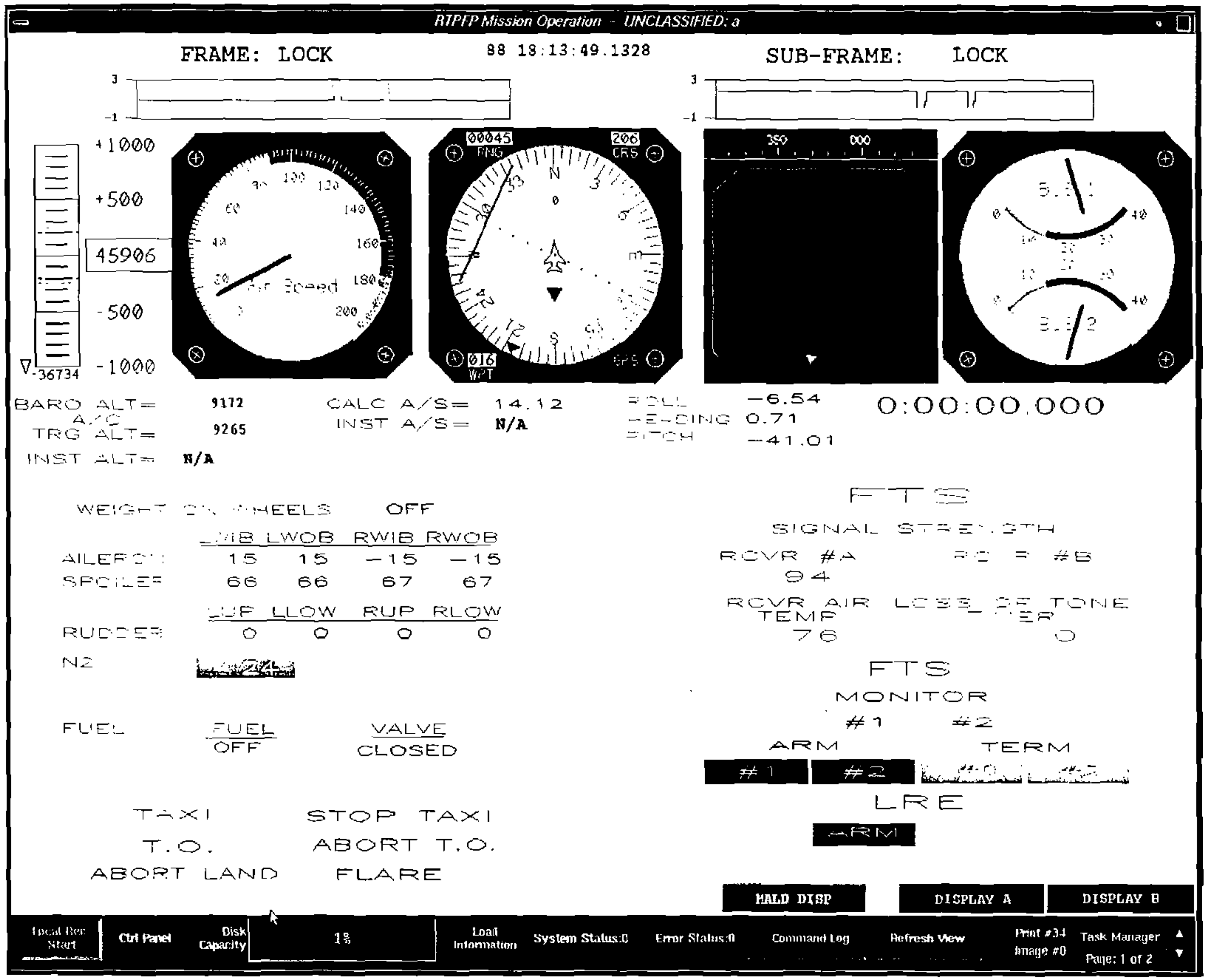
Project: a Operation: a Test: a Display: hawksafety.v
a



Global Hawk UAV, 95-2002, 19990329

a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65628200 Date: Mon Apr 26 06:52:29

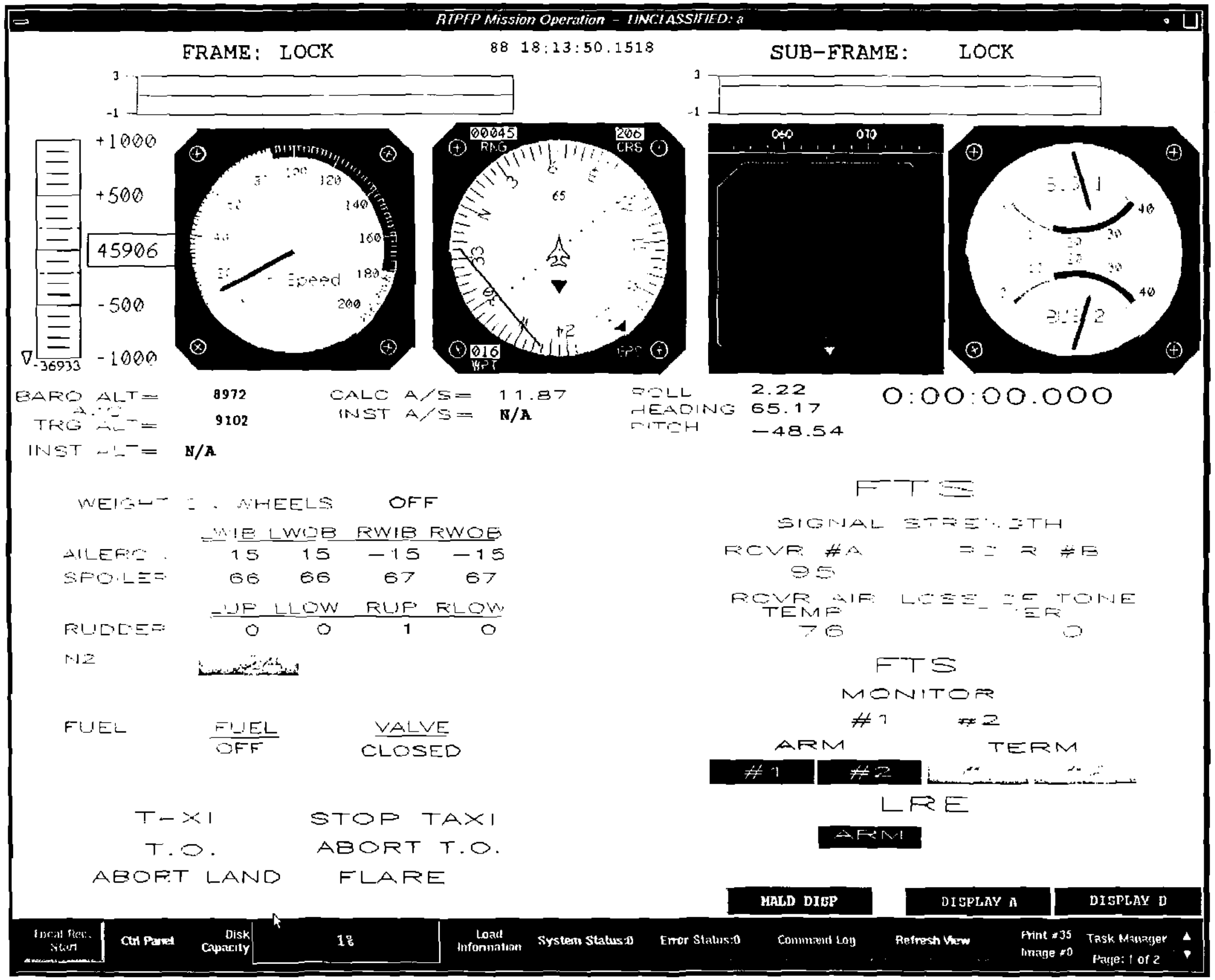
Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65629154 Date: Mon Apr 26 06:52:33

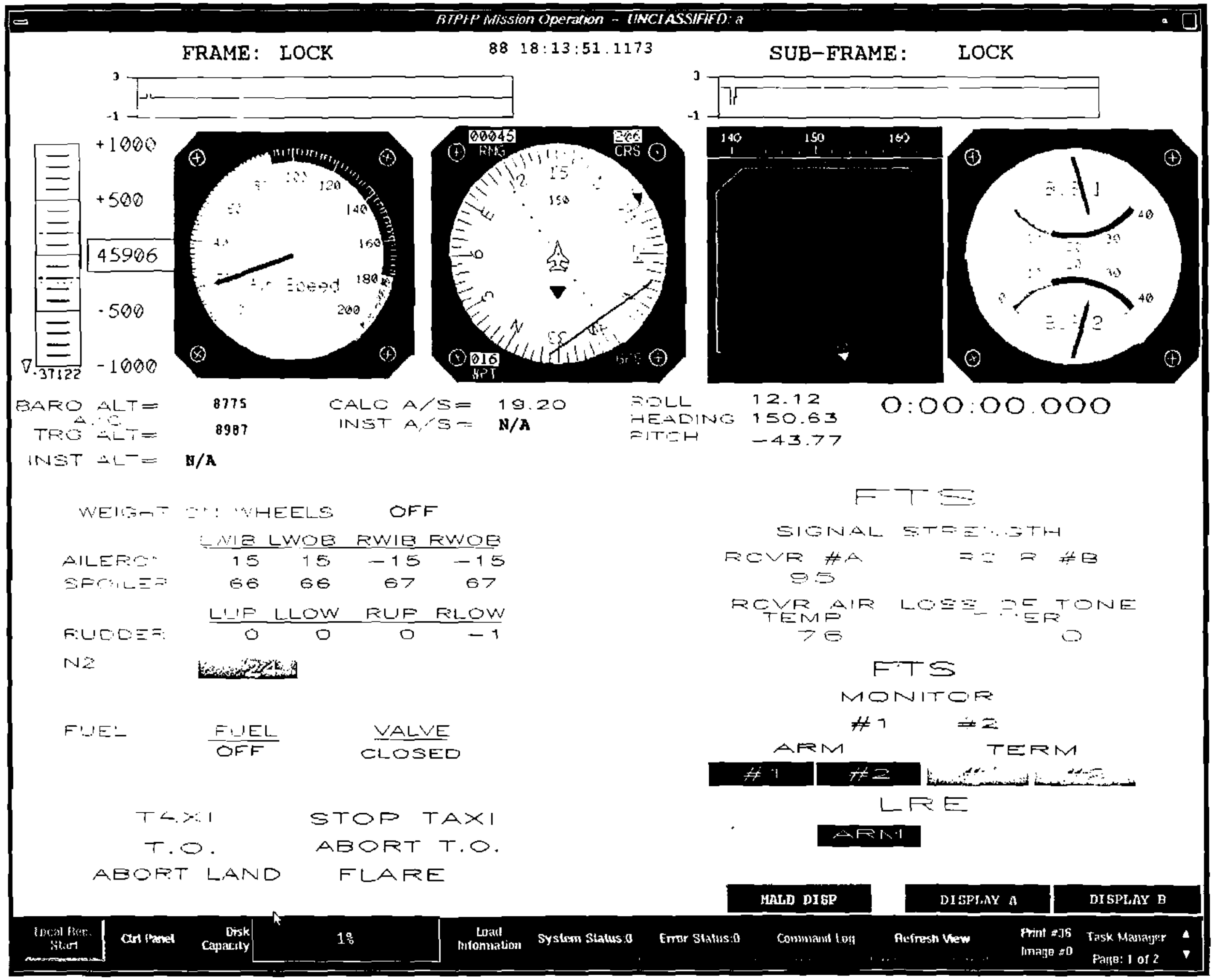
Global Hawk UAV, 95-2002, 19990329

Project: a Operation: a Test: a Display: hawksafety.v
a



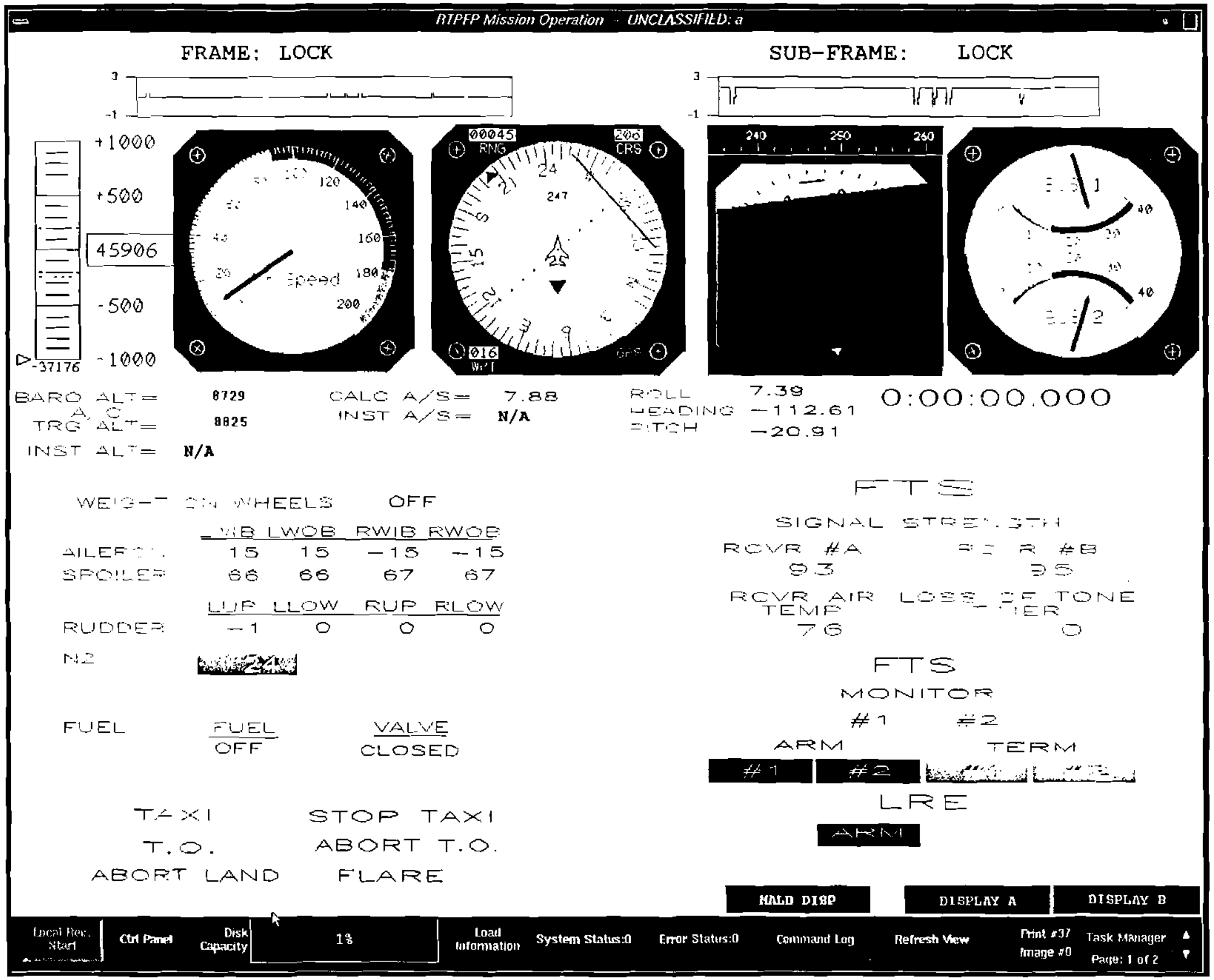
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65630180 Date: Mon Apr 26 06:52:37

Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65631136 Date: Mon Apr 26 06:52:41

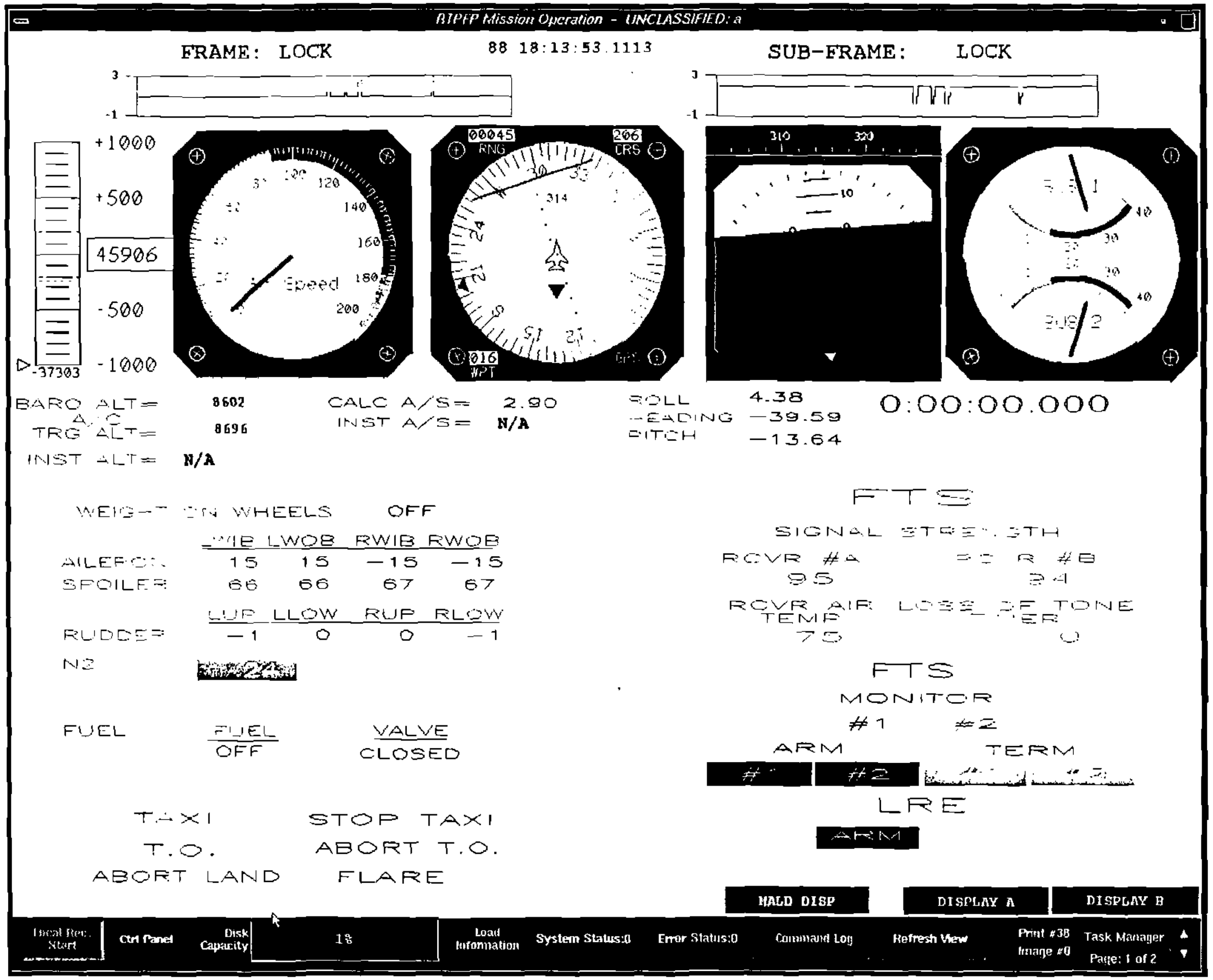
Project: a a Operation: a Test: a Display: hawksafety.v



a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65632188 Date: Mon Apr 26 06:52:45

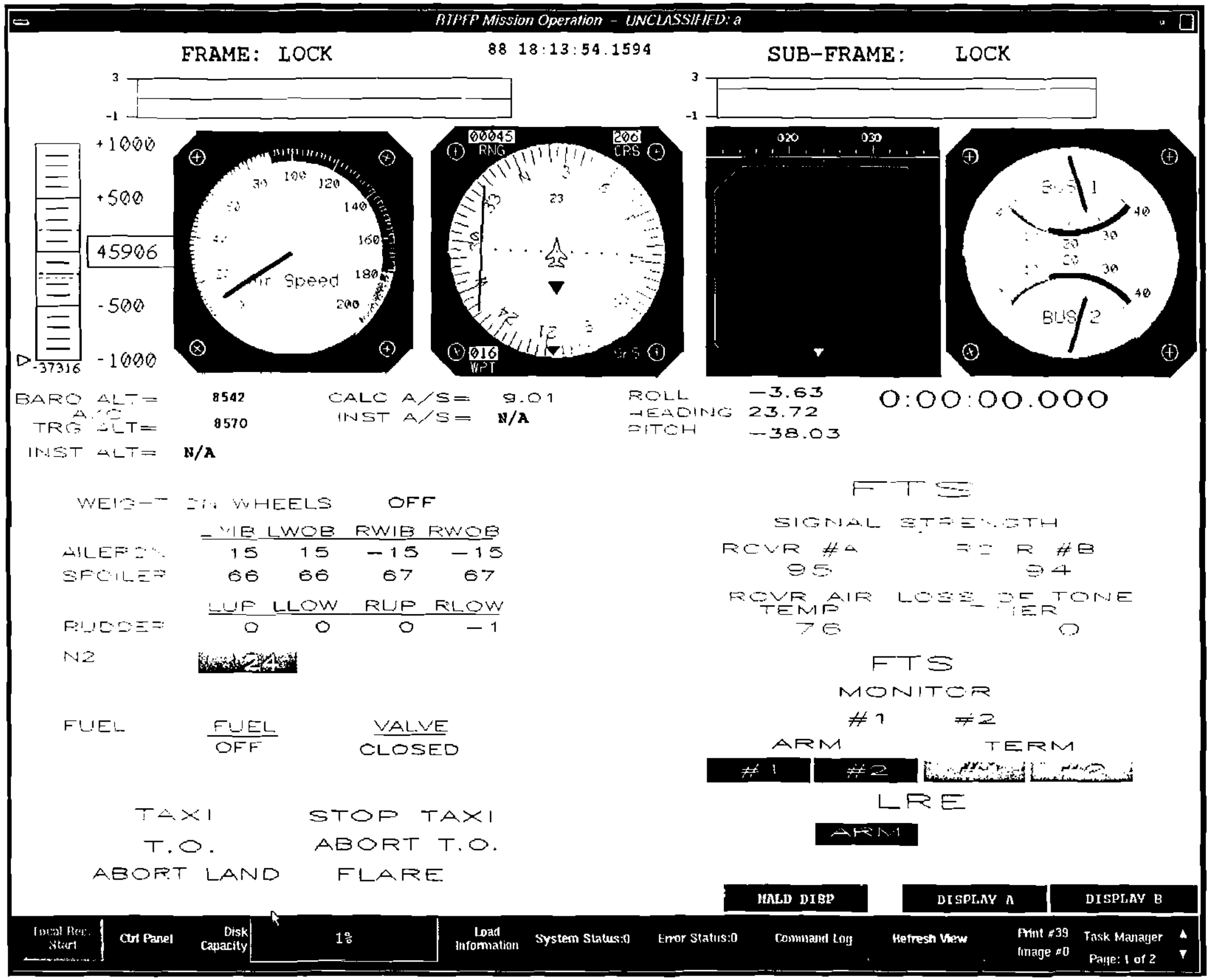
Global Hawk UAV, 95-2002, 19990329

Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65633135 Date: Mon Apr 26 06:52:49

Project: a Operation: a Test: a Display: hawksafety.v
a

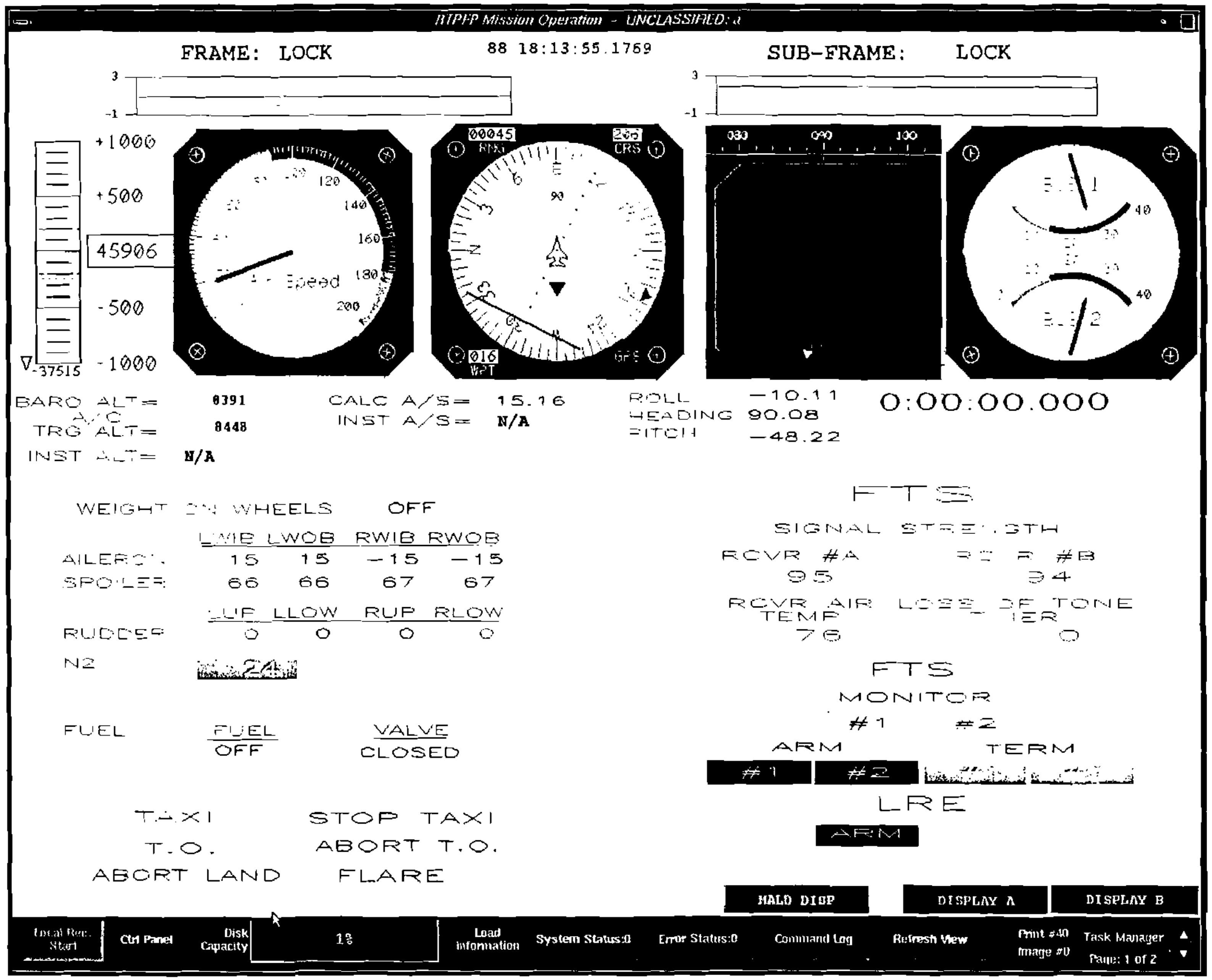


Global Hawk UAV, 95-2002, 19990329

V-1.81

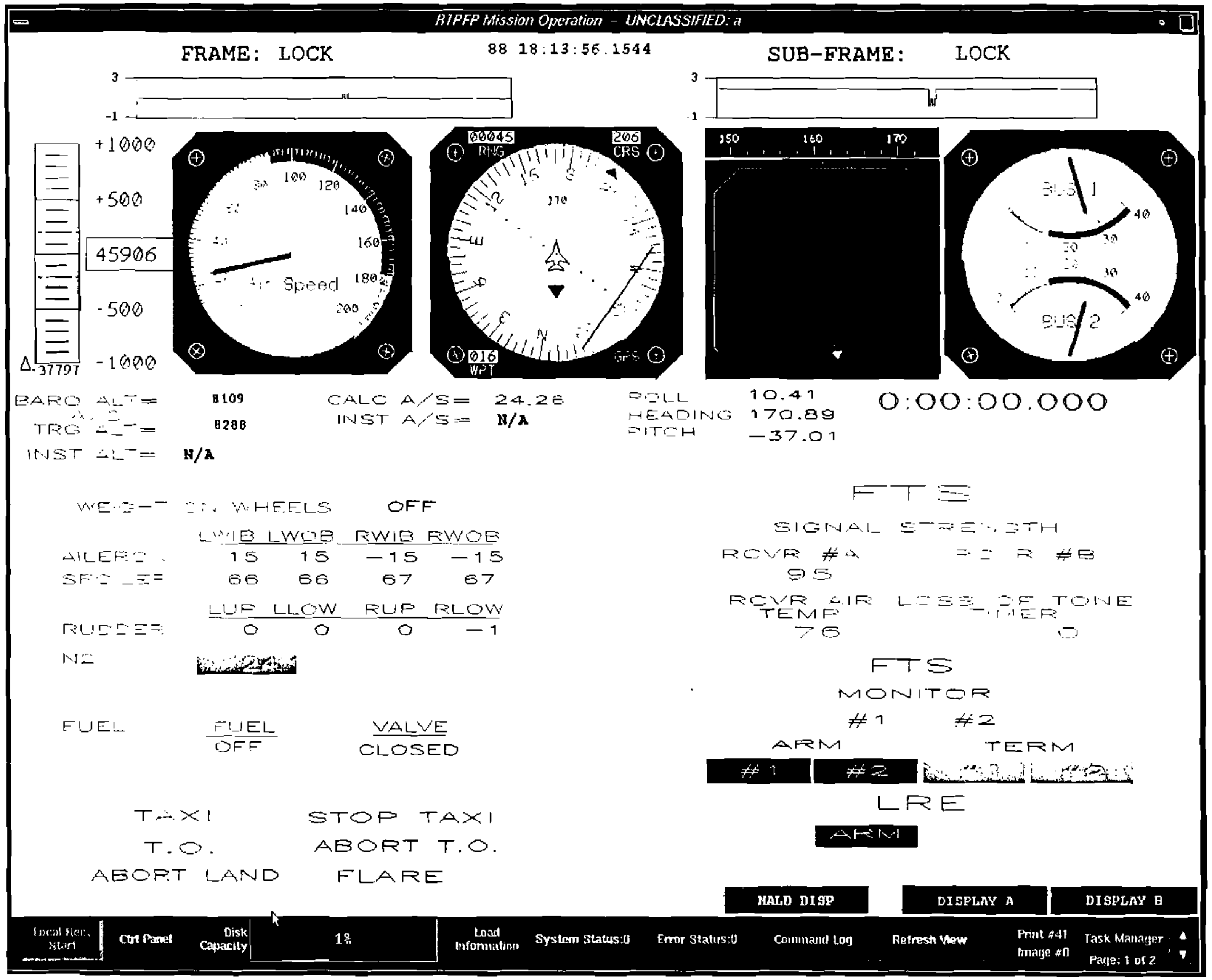
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65634165 Date: Mon Apr 26 06:52:53

Project: a Operation: a Test: a Display: hawksafety.v
a



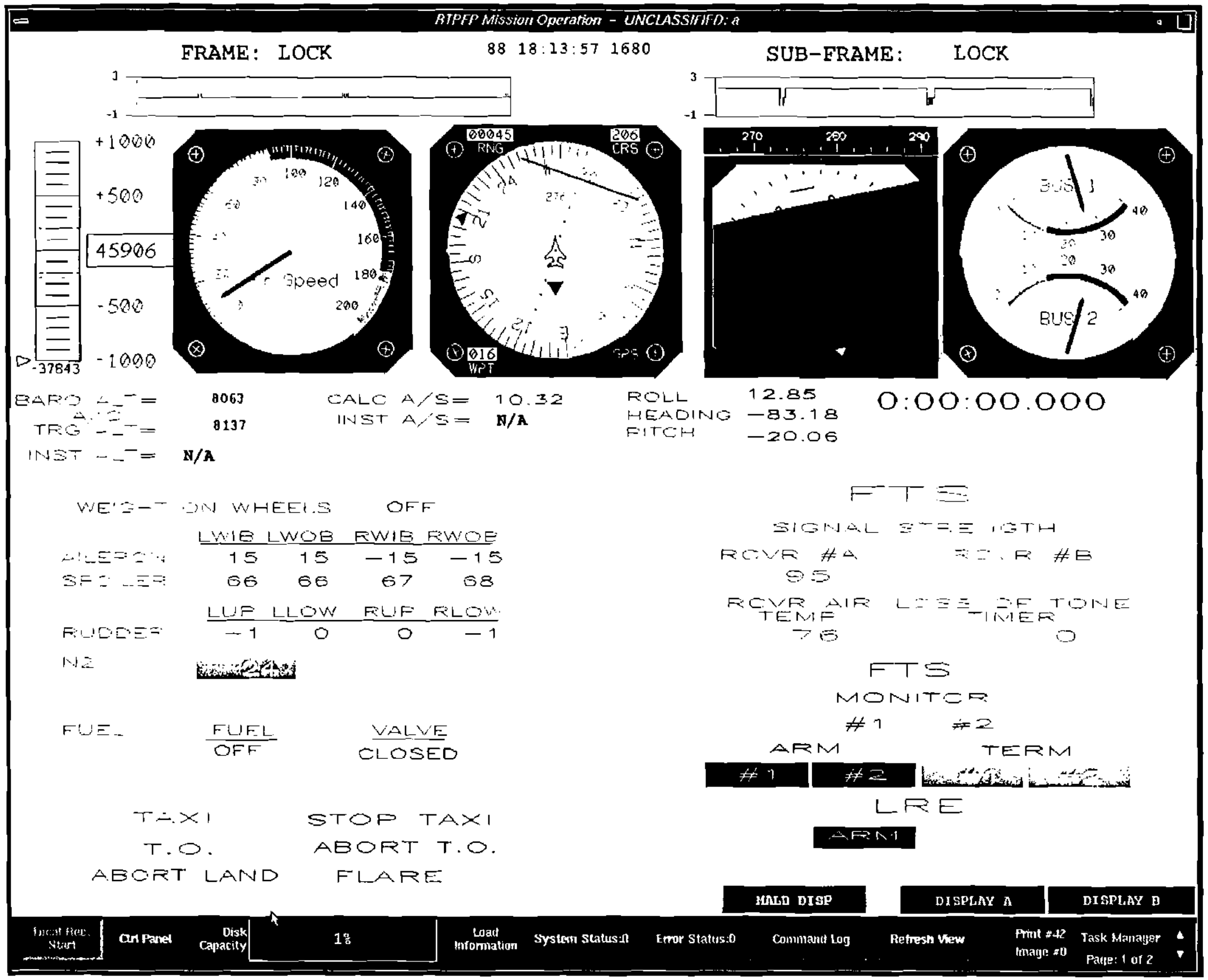
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65635207 Date: Mon Apr 26 06:52:57

Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65636170 Date: Mon Apr 26 06:53:01

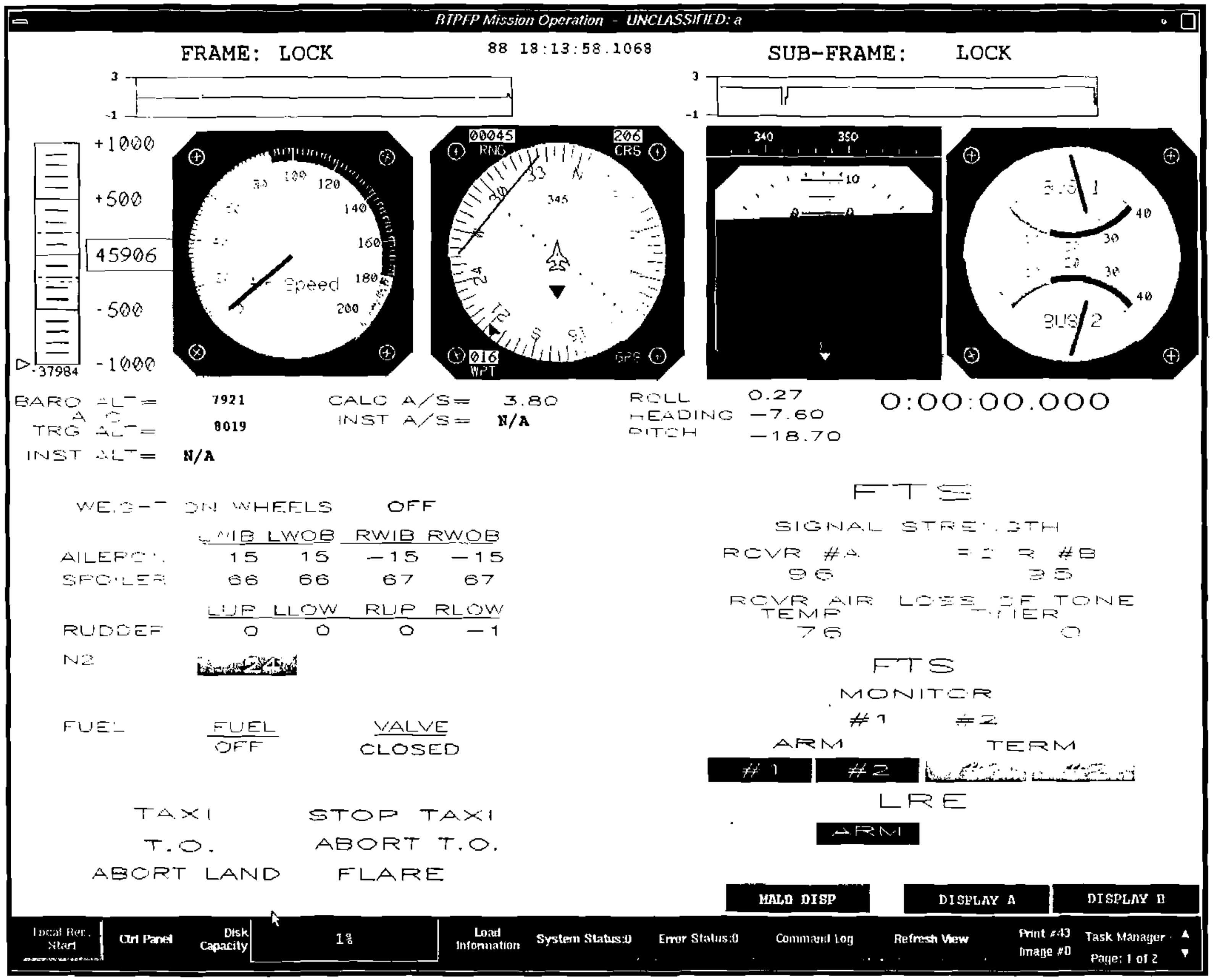
Project: a Operation: a Test: a Display: hawksafety.v
a



Global Hawk UAV, 95-2002, 1990329

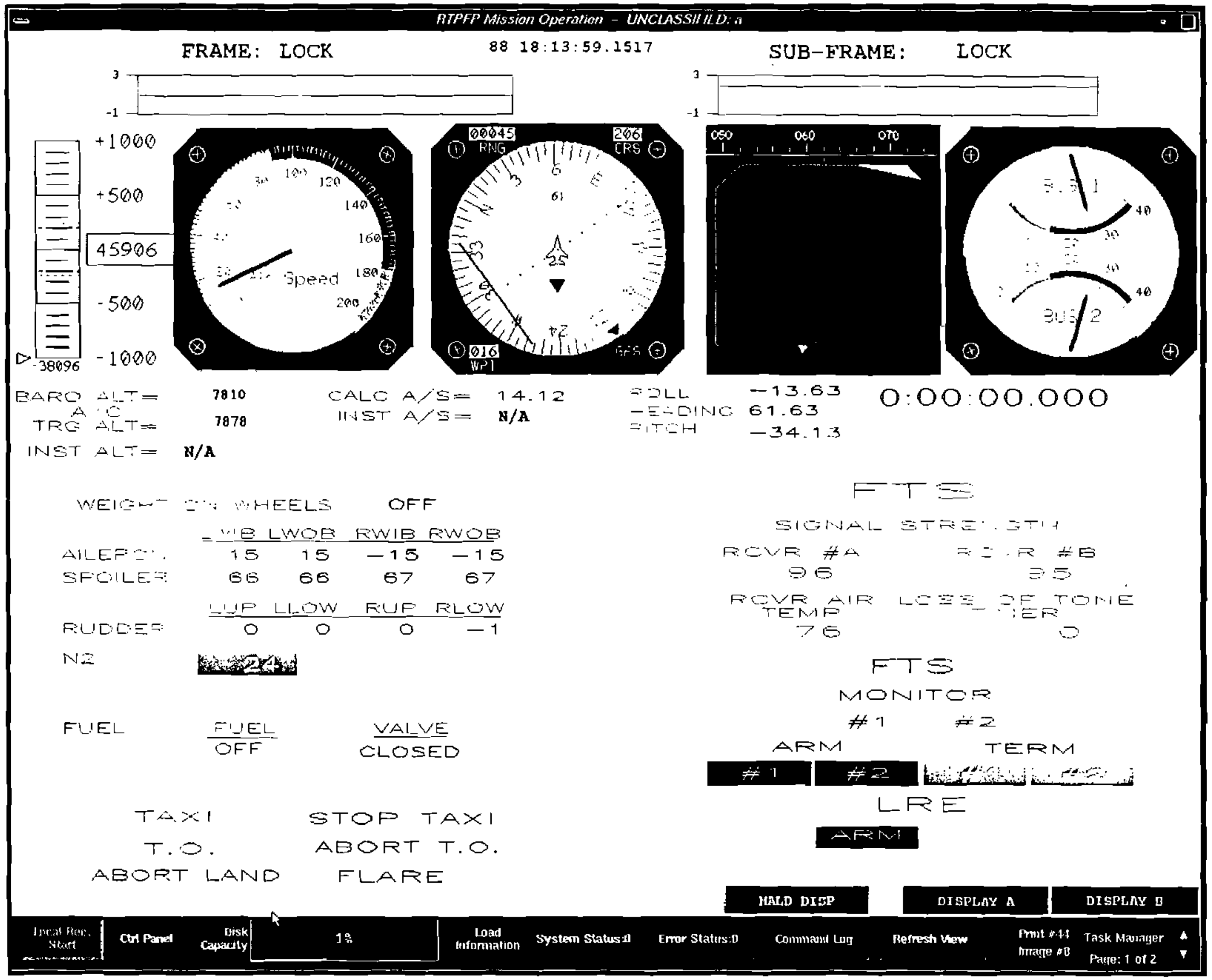
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65637187 Date: Mon Apr 26 06:53:05

Project: a Operation: a Test: a Display: hawksafety.v
a



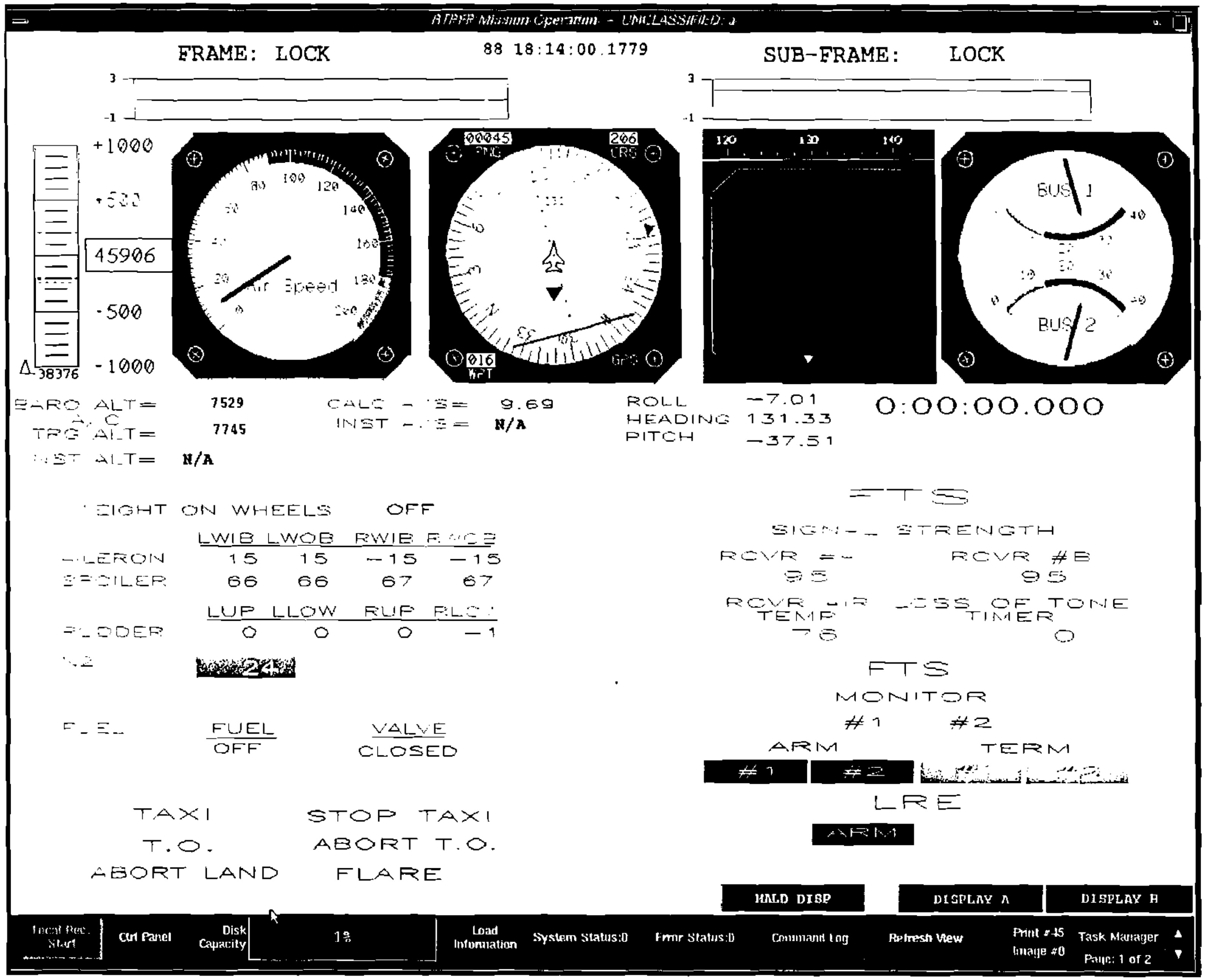
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65638133 Date: Mon Apr 26 06:53:09

Project: a Operation: a Test: a Display: hawksafety.v
a



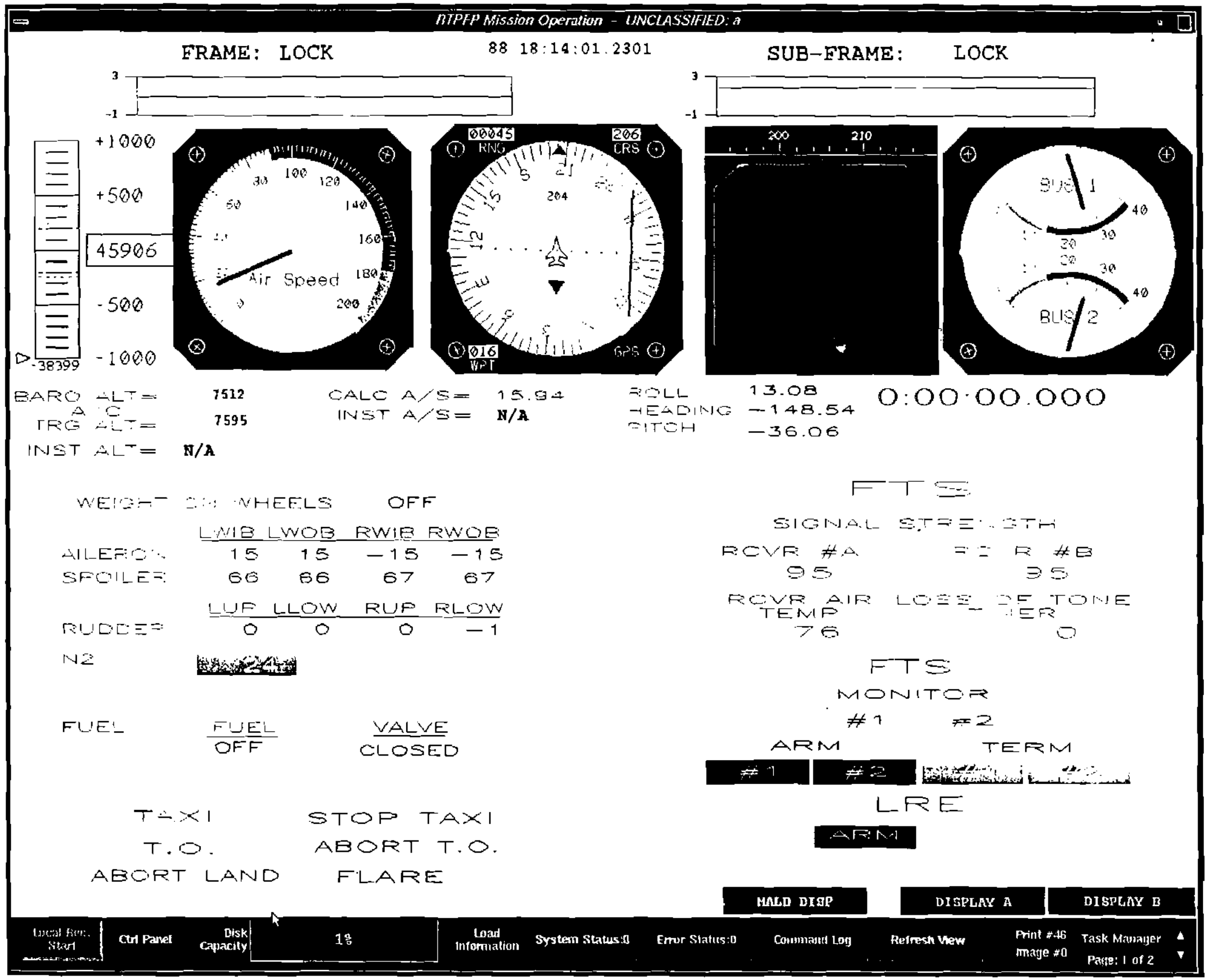
a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65639175 Date: Mon Apr 26 06:53:13

Project: a Operation: a Test: a Display: hawksafety.v
a



a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65640201 Date: Mon Apr 26 06:53:17

Project: a Operation: a Test: a Display: hawksafety.v
a



Global Hawk UAV, 95-2002, 19990329

a
Workstation: ws15rm266 User: ws15 TPP: Range Time: 0 65641248 Date: Mon Apr 26 06:53:21

RECORD REPRODUCTION COVER SHEET

The attached records are:

Releasable to the Public [✓]

Denied to the Public [ ]

Subject:

1999 Global Hawk Accident Report

FOIA Control Number: 07-283 LK

Date Reproduced: 11 Oct 07

5 of 7

VERBATIM TESTIMONY OF CHRISTOPHER JAMES FAUST

Q1: My name is Colonel Steven T. Virgilio. I am the investigating the Global Hawk accident that occurred on 29 March 99 at China Lake Naval Air Station, California. This investigation is separate and apart from the safety investigation conducted under AFI 91-204. This investigation was convened to gather and preserve evidence for use in claims, litigation, disciplinary action and adverse administrative procedures and for all other purposes except mishap prevention. The safety investigation is also being conducted on the accident for the sole purpose of mishap prevention. Your testimony to us may be used for any proper purpose. Additionally your testimony may be released to the public. Do you understand the difference between the safety investigation and this accident?

A1: Yes I do.

Q2: Do you understand what your testimony may be used for?

A2: Yes

Q3: Your testimony in this investigation will be under oath. At this time I will administer the oath so please raise your right hand. Do you solemly swear that the testimony you are about to give in the matter now under investigation shall be the truth, the whole truth and nothing but the truth so help you God?

A3: Yes

Q4: Today is 27 April 1999, the time is 11:47 local. This interview is being conducted in Building 2500, Edwards AFB, California. Person present at the Edwards AFB are presently now are Colonel Steven T. Virgilio, Major Ray Chamberland the Legal Advisor and the witness. The witness has been sworn. Please state your full name for the record sir.

A4: Christopher James Faust.

Q5: What is your present grade?

A5: Civilian.

Q6: Where are you assigned?

A6: Global Hawk, South Base.

Q7: What is your job title?

A7: Flight Test Instrumentation Engineer.

Q8: And your DSN number sir? Phone number?

A8: 275-8207

Q9: You are providing the board with some physical evidence. Will you please describe what you are provided and you are providing this upon my request earlier today.

A9: Six pages of information concerning signal strength, sensitivity specifications for the flight termination signal. And the displays that were used in the control during flight that indicated that signal strength.

Q10: Could you please state the name and the company you are working for?

A10: Teledyne Ryan Aeronautical.

Q11: Thank you. Are there other matters that we haven't covered that you believe may be important to our investigation?

A11: No.

Q12: You are reminded of the official nature of this interview sir, you may not discuss your testimony with anyone without my permission at any time before the report of this investigation is officially released to the public. This concludes the interview.

MEMORANDUM

TELEDYNE RYAN AERONAUTICAL
Tier II Plus Unit
An Allegheny Teledyne Company

Global Hawk UAV, 95-2002, 19990329

TO: Global Hawk UAV_02 Accident Investigation Board **DATE:** 4/27/99

FROM: Christopher J. Faust, Flight Test Instrumentation (FTI) Lead Engineer

SUBJECT: Locheed Martin Conic Model FTR-915A Flight Termination Receiver/Decoder (FTR) Signal Strength Telemetry Specification and Mission Control Room (MCR) Display Threshold Specification

---

The following information concerning the Locheed Martin Conic Model FTR-915A Flight Termination Receiver/Decoder (FTR) Signal Strength Telemetry Specification and Mission Control Room (MCR) Display Threshold Specification is presented to the Global Hawk UAV_02 Accident Investigation Board per their request on 04/27/99. Included with this memo is a copy of the Technical Bulletin provided by Locheed Martin for this product, as the source reference for the signal strength telemetry specification.

The signal strength telemetry signal used by the flight test instrumentation (FTI) system provides an output based in percentage relative to the detected RF input level at the front end of the FTR between the following levels:

- 0% - 0.000000Volts (0.00uV)
- 100% - 0.000500VVolts (500.0uV)

Sensitivity of the FTR with standard modulation (carrier and tones) is 0.000001Volts (1.00uV) with a dynamic range up to 1.00VoltsRMS (1.00Vrms) or –107dBm to +13 dBm.

In the Birk MCR the Test Director quadrant three (TD1Q3) display, the FTS RCVR #A (FTR #1) and FTS RCVR #B (FTR #2) Signal Strength displayed data values indicate the relative signal strengths as percentages between 0.00% to 100.00% with the following background color indicators:

- NO COLOR – 76.00% to 100.00%, nominal signal strength
- YELLOW - 40.00% to 75.99%, caution, critical signal strength
- RED - 00.00% to 39.99%, warning, unacceptable or no signal strength

The data update rate for these parameters is twenty-five samples per second (25Sps) with a screen refresh rate of one second (1Ups). It should be noted that the data and background displayed might not match at each refresh due to inherent delays in processing the background color information. This delay usually will last no longer than one (1) refresh cycle.

MEMORANDUM

Global Hawk UAV, 95-2002, 19990329

04/27/99

Christopher J. Faust, Flight Test Instrumentation Engineering Lead, TRA Global Hawk

Cc: R. C. Ettinger, TRA

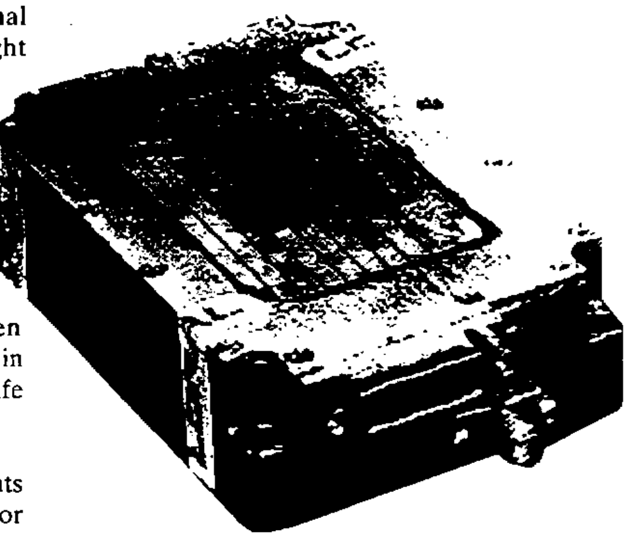
Technical Bulletin

MODEL FTR-915A

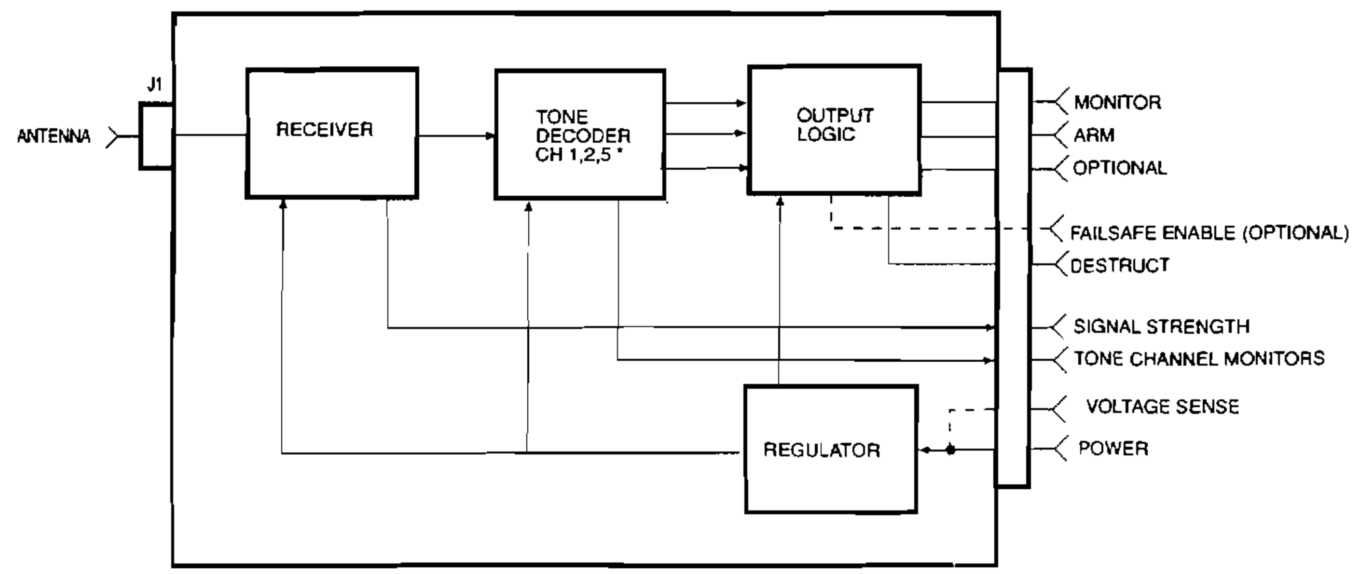
FLIGHT TERMINATION RECEIVER/DECODER

RX Products

The FTR-915A is a miniature state-of-the-art Flight Terminal Receiver/Decoder. Its small size (7.0 cubic inches) and light weight (approx. 7 ounces) is consistent with the requirements of today's missile programs, requiring smaller and lighter-weight components. This is accomplished by use of modern hybrid technology and packaging techniques while retaining the highly-reliable functional and environmental integrity of previous Loral designs. The FTR-915A is physically and electrically equivalent to the highly successful FTR-915 Receiver/Decoder which has been used on TSSAM, HARM, HARPOON, ITALD, SLAM (ER), ERINT, and THAAD. Production improvements have been integrated into the FTR-915A allowing greater customer choice in available tone channel combinations and the added option of failsafe circuitry.



The FTR-915A is qualified to the requirements of Range documents RCC 319-92 and RCC 313-94. The FTR-915A has been produced for the JDAM, ESSM, STD. Missile, PAC-3, TACAWS/Harpoon programs. The FTR-915A is one of the most fully range certified receivers in the industry.



*TYPICAL IRIG TONES

Figure 1. Functional Interface diagram

LOCKHEED MARTIN

Lockheed Martin Conic
9020 Balboa Avenue San Diego, California 92123-3507
Telephone: (619) 279-0411, 278-4100
Fax: (619) 279-0693, 292-1140

MODEL FTR-915A FLIGHT TERMINATION RECEIVER/DECODER

SPECIFICATIONS:

Receiver/Command Decoder:

Tuning Range: Designed to operate over the frequency range of 406 to 450 MHz. The center frequency is crystal-controlled ±0.005%.

Input Impedance: 50 ohms nominal with a maximum VSWR of 2:1.

Dynamic Range: With standard modulation, each unit has a minimum dynamic range from the nominal sensitivity of 1 μV to 1 Vrms (-107 to + 13 dBm).

Threshold Sensitivity: -116 dBm to -107 dBm with standard modulation of ±30 KHz per tone

Modulation: The unit demodulates up to 3 simultaneous tones at 30 kHz nominal peak frequency deviation.

Operating bandwidth: All command function operate at RF signal levels from 1 μV to 1 V rms over an operating bandwidth of ±45 kHz.

IF Bandwidth: Greater than 180 KHz for the 3 dB response and less than 360 KHz for the 60 dB response.

Image, Spurious Responses: All image and spurious responses are greater than 60 dB down from the unit's threshold sensitivity (-110 dBm typical) over the band of 10 MHz to 1.0 GHz.

Signal Strength Telemetry: With no RF input, the quiescent level is 0.5 ±0.25V, increasing to a value not to exceed 4.75 ±0.25V, at an RF level of 500μV. The slope is positive and does not change direction over the RF signal dynamic range.

Command Sequence:

TONE A	TONE B	TONE C
Ch 1 = 7500 Hz	Ch 2 = 8460	Ch 5 = 12140 Hz

Tone Sequence	Tones Applied	Command Output
Tone 5 on	5	Monitor
Tone 2 on	5, 2	Command, Optional
Tone 1 on	5, 2,1	Monitor, Optional, Arm
Tone 2 off	5,1	Monitor, Arm
Tone 5 off	1	Arm
Tone 2 on	1,2	Arm, Terminate

*Other combinations if IRIG tone channels are also available for the specified command functions (See Ordering Information).

Command Levels: The following indicates the maximum voltage drop at the solid-state command outputs relative to the applied DC input.:

Command Output	1A	2A	7.5A (10 ms)
Terminate	2V	3.5V	4V
Arm, Optional, Monitor	2V	3.5V	N/A

Command Response Time: The response time, after application of modulation to any command output, is less than 25 mS.

Decoder Channel Bandwidth: The 2 dB bandwidth of each decoder tone channel is a minimum of ±1% of the center frequency and a maximum of ±4% at the 20 dB bandwidth.

MODEL FTR-915A FLIGHT TERMINATION RECEIVER/DECODER

Decoder Deviation Sensitivity:	Command outputs are obtained from carrier deviations between 27 KHz and 33 KHz peak per tone. Tone decoder threshold settings are between 10 KHz and 18 KHz peak..
Noise Immunity:	The decoder noise margin is greater than 12 dB.
Single Point Mode Failure:	No Terminate Command is produced if any one component fails during unit operation.
Input Voltage:	All requirements are satisfied for an input voltage range of 24 to 36 Vdc.
Input Current:	The unit requires a maximum of 225 mA in the standby and command mode operation.
Isolation:	The unit has a maximum of 1 M ohms isolation resistance between: • Case and Primary Power (28V) Return • Case and Command Outputs • Case and Signal Strength Telemetry
Reverse Polarity Protection:	No damage or permanent deterioration of performance from indefinite application of reversed input power polarity.
Failsafe Option:	Terminate command output will be produced when the failsafe circuit is enabled under the following system conditions: • Loss of carrier/tone A for 8 ±2 seconds * • Power drops to 23 ±1 VDC Failsafe enable pulse 4.5 ±.5VDC for 18 millisecond minimum.

Environmental (Qualification Test Levels):

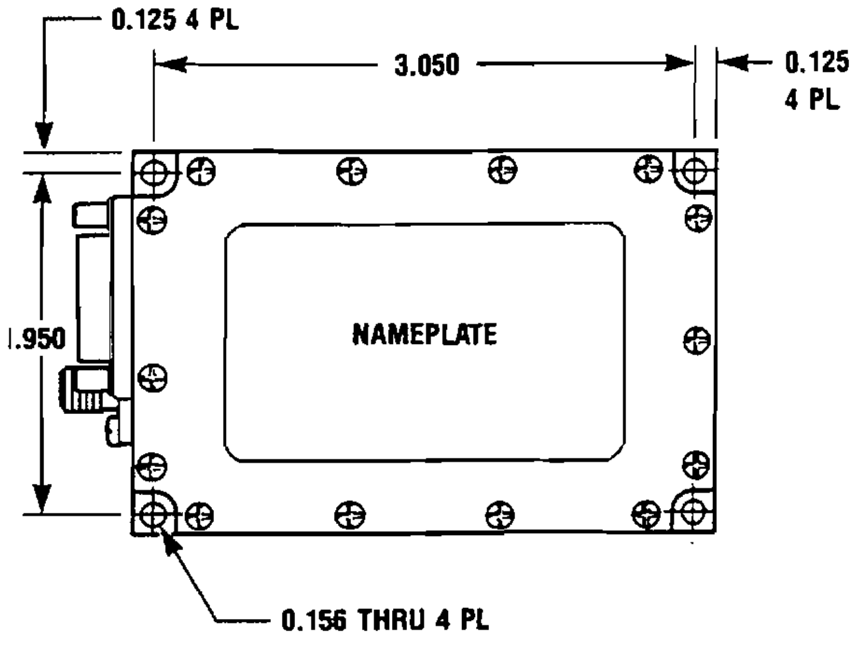
Electromagnetic interference:	The unit is designed to meet the requirements of MIL-STD-461C, for Class A equipment with the following changes: • CS04 Conducted susceptability: 10 MHz to 8.5 GHz, 60 dB minimum RF level • Specific Band Rejection >100 dB: 2.2 to 2.4, 5.4 to 5.9, 9.4 to 9.8 GHz.
Operating Temperature:	The unit meets all electrical requirements over a temperature range of -54°C to +85°C.
Humidity:	0 to 97% relative.
Shock:	80 g's rms half-sine, 5 mS. 20 g's rms saw tooth. 11 mS.
Random Vibration:	18.6 g's rms for one hour. 30 g's rms for 10 min., 3 axis.
Altitude/Temperature:	250,000 feet at -40° C.
Pressure:	30 lb/in^2 for 30 minutes.
Derating:	MIL-STD-975 is used as a guideline for derating of all components.

Mechanical:

Dimensions:	(See Figure 2).
Weight:	8 ounces, maximum.

*** Consult factory for other failsafe time durations**

MODEL FTR-915A FLIGHT TERMINATION RECEIVER/DECODER



J1 - RF Input (SMA Jack)

J2-Power & Commands (M83513)

PIN	FUNCTION STANDARD/FAILSAFE
1	+28 Vdc power
2	No connection
3	DC Return
4	DC Return
5	DC Return
6	DC Return/Failsafe Enable
7	No Connection
8	Terminate Command
9	No Connection
10	Optional Command
11	No Connection/Low Voltage Sense
12	Tone Monitor C
13	Case Ground
14	+28 Vdc Power
15	No connection
16	Tone Monitor B
17	Tone Monitor A
18	DC Return
19	No Connection
20	Terminate Command
21	No Connection
22	Monitor Command
23	Arm Command
24	Signal Strength
25	Signal Strength Return

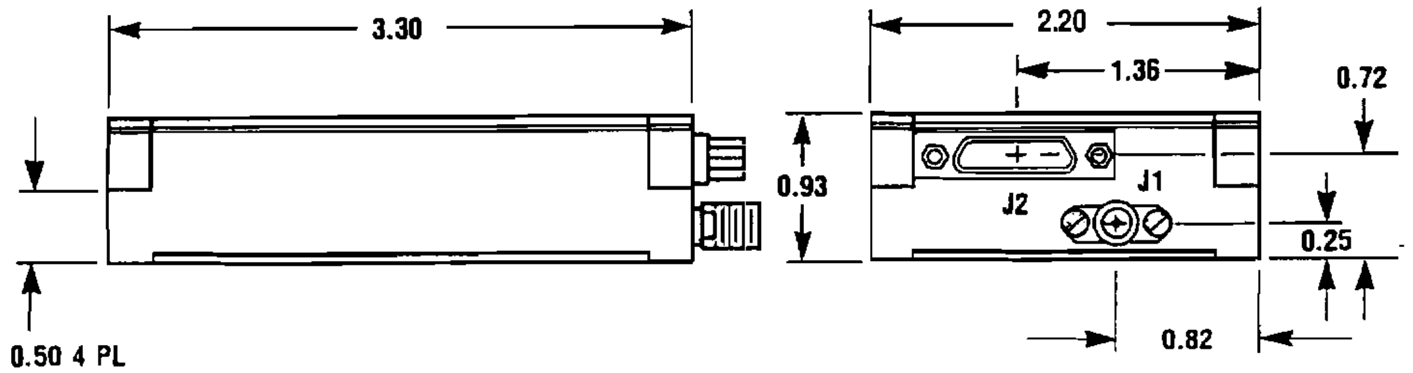


FIGURE 2. OUTLINE DRAWING/PIN FUNCTIONS

ORDERING INFORMATION:

Specify:
1. Center frequency
2. Part Number LCP 11004850-(xx) (xx) Tone channel combination dash number as shown at right:
3. Dash numbers may change subject to range safety or program requirement.

STANDARD:		FAILSAFE OPTION:	
Tone A, B, C		Tone A, B, C	
Ch. 1, 2, 5	-31	Ch. 1, 2, 3	-11
Ch. 1, 2, 4	-32	Ch. 1, 2, 4	-12
Ch. 1, 2, 3	-33	Ch. 1, 2, 4	-13
Ch. 3, 7, 6	-34	Ch. 1, 2, 6	-14
Ch. 4, 9, 8	-35	Ch. 1, 2, 7	-15
Ch. 1, 2, 6	-36	Ch. 1, 2, 8	-16
Ch. 1, 2, 7	-37		
Ch. 1, 2, 8	-38		

VERBATIM TESTIMONY OF JAMES THOMAS RIZZO

Q1: My name is Colonel Steven T. Virgilio, I am investigating the Global Hawk accident that occurred on 29 March 99 at China Lake Naval Air Station, California. This investigation is separate and apart from the safety investigation conducted under AFI 91-204. This investigation was convened to gather and preserve evidence for use in claims, litigation, disciplinary action and adverse administrative proceedings and for all other purposes except mishap prevention. The safety investigation is also being conducted on the accident for the sole purpose of mishap prevention. Your testimony to us may be used for any proper purpose. Additionally your testimony can be released to the public. Do you understand the difference between the safety investigation and this accident investigation sir?

A1: I think I do.

Q2: Okay, do you understand what your testimony may be used for?

A2: Yes

Q3: Your testimony in this investigation will be under oath. At this time I will administer the oath so please raise your right hand. Do you solemnly swear that the testimony you are about to give in the matter now under investigation shall be the truth, the whole truth and nothing but the truth so help you God?

A3: Yes

Q4: Today is 27 April 1999, the time is now 1545 local. This interview is being conducted in Building 2500, at Edwards AFB, California. Persons present at Edwards AFB are Colonel Steve Virgilio myself, Major Ray Chamberland the Legal Advisor, Lt. Delcampo and the witness. The witness has been sworn. Please sir for the record state your full name.

A4: James Thomas Rizzo.

Q5: What is your grade?

A5: A GS-12.

Q6: Where are you assigned?

A6: On 95 Communications Squadron Office Symbol is SCML.

Q7: What is your job title?

A7: I am the Chief of Frequency Management for the Flight Test Center.

Q8: And what is your DSN or phone number sir?

A8: It's DSN 527-8448.

Q9: Alright sir, I am going to ask you some questions and I would just ask you to expand on those and feel free to expand on to any length that you need to. First question sir, would you please explain how frequency management is applied to the flight test of UAV's on the Edwards Test Range complex?

A9: Frequency Management for UAV programs takes several forms. One is to secure and obtain legal license to radiate on the frequencies necessary for the vehicle to operate for the Global Hawk in this case there are a lot of frequencies: there are radar frequencies, there's a common data-link frequencies transmit and receive, there's a differential GPS frequencies, there are line sight communications frequencies there are SAT-COM frequencies there's a whole myriad of legal documents that had to be obtained prior to operation of the UAV in that does and does not include the flight termination frequencies for flight termination in particular the base has frequencies that we have legal license for and was not actually on the UAV program to ensure that we got clearance for the frequencies required for flight termination.

Q10: Alright, another question sir is why is there frequency management for flight test on the Edwards test range?

A10: Well that's a very generalized question. Frequency management is required for all radiation in the electro-magnetic spectrum regardless of whether it's a test vehicle or not a test vehicle. Frequency management is responsible for gaining the legal license necessary through DOD and federal regulation to actually radiate on any frequency. So when you say for flight test and at Edwards it really wouldn't make any difference where....

Q11: All right, all right. What frequencies are used or assigned to the flight terminations systems here at Edwards AFB?

A11: Well, we have more than some ranges do, we are good for 421, 425, 428, 429 and I think and this is just off the top of my head, if I really need to know I can go in a data base and look but there are 3 standard frequencies that we're good for, 421, 425 and 428 or 9, I don't remember exactly, but I can look them up out of the book I think it's 428.

Q12: All right, are these frequencies assigned to a particular receiver or just general?

A12: I'm not that familiar with exactly how the receivers are wired, I would assume though that the individual receivers because of their small size would be fixed tune frequency to one frequency and you'd have to actually change the receiver out to change the frequency. That's pretty typical for aircraft.

Q13: Okay, and then these frequencies sir, how are they coordinated for use?

A13: All flight termination is scheduled for this area, all flight termination frequencies are scheduled, de-conflicted within just the Edwards complex and then de-conflicted with the other ranges under the area frequency coordinator down at Point Magu, the western area frequency coordinator's office. They de-conflict the use of those frequencies throughout the range to include China Lake, Point Magu, Vandenberg, Fort Irwin, Mojave anything that's going up down at Point Magu and probably with any of the other civil users like Mojave or Long Beach.

Q14: Are these the western area region?

A14: That's the western area region but the region should not be defined as the ranges like Point Magu or China Lake or Edwards. The western frequency coordinator's responsibilities are within 200 nautical miles of Point Magu and south of I want to say the 36th parallel, whatever the top end of the range is, it's one degree past that. It's either 36 or 38, I don't remember but it's, to say it's within 200 nautical miles of Point Magu and then anything that falls in that range that's on any of the flight termination frequencies have to be coordinated with Point Magu, or I should say de-conflicted not coordinated. Coordinated has takes on a different role.

Q15: All right, thank you. Can changes be made to these frequencies?

A15: Yes, I am assuming that you are asking about the schedule, the daily schedule?

Q15: If I am scheduled for 425 for a test can I change to another frequency to 421 or 428?

A15: Not without changing the schedule. So once the mission is on the schedule for a particular frequency and it doesn't have to be flight termination it could be telemetry or anything else that goes along with the aircraft, once if you want to change frequencies you have to de-conflict those frequencies through the scheduling process which de-conflicts it through the entire range.

Q16: Okay, so in other words if you make a change to your frequency you must then make that change into the schedule so it works through the procedure, the de-confliction.

A16: Right and that could take an hour, it all depends. If you were in conflict it would be very, if you, if the frequencies open it's very easy to change, so if you want to change from 421 to 425 and 425 is open that's an easy change, a couple of phone calls should fix it but if somebody else was on and you wanted to de-conflict that, with the other programming it could take hours, because you actually have to call them, get in touch with them, you have to work it out between the programs to find out whose not going to fly and whose--------

Q17: You're leading into the next question we were concerned with and that is what's the procedure of coordination on the changes, now could you kind of walk us through if we made a change to the frequency what, how would that come to you, how it would be coordinated?

A17: It wouldn't actually come to us, we really don't get involved in the data base frequency schedule unless there's a problem that can't be resolved through the regular frequency scheduling process. But if you were going to make a change to the schedule there would be two cases, one where the flight, the frequency was open and one where it would not be open. So if we were here at Edwards and we wanted to change from 421 to 425 we would call the range scheduling office and tell the range scheduling office that we would want to make a change the range scheduling office would then either call or electronically send the change to the schedule down to the area frequency coordinator's office down at Point Magu if there is nobody on that frequency then they would either tell us over the phone or you'd see it come up in the schedule that we were changed to that frequency. On the other hand now, if the frequency was being used by somebody else either the and this would probably depend on the workload of the frequency schedulers here and down at Point Magu. If the frequency was already scheduled they could just say no, you can't use that frequency, you're in standby, you'll have to wait till later or you'll have to schedule a mission for another day or we may get involved if you wouldn't take that for an answer, then say well, no, we really have to do our mission, call the frequency guys then you would call us and we would try and find out who it was on the other end that was in conflict and then we'd try to make a determination whether, either the two missions could go at the same time or whether we could get them to slip for half an hour or whether we could slip for half an hour and try to work it out to try and find out how we could resolve the problem by time. We would look at geographic you know, are you flying north and we're flying south type of thing or we would try and get you guys to slip or we would try to get the other mission to slip.

Q18: All right. Can you tell me in your opinion how often a flight termination system frequency change is made on average? Is that a normal---------

A18: No that's not a normal thing at all. Like and like I said, I'm not in on the frequency schedule on a day to day basis, but usually programs are set on a particular frequency and we can usually tell which program it is by the frequencies that are being scheduled, my frequency scheduling guy Kevin can look at the schedule and look at the frequencies that are on the schedule and tell you what aircraft they are and where they are going to be flying. So a change to the frequency on a vehicle like this to me would be very rare and very odd. I don't know why you would want to change frequencies at the last minute.

Q19: The frequency schedulers you mentioned just a few seconds ago, who do they work for here at Edwards?

A19: They work for the OSS Squadron.

Q20: Okay, is that within the Test Wing?

A20: It's in the Test Wing.

Q21: Can the frequency changes be made in less than 24 hours? Prior to the flight now?

A21: Yes, but it starts to become a very difficult process, I mean it all depends on how much there is on the schedule. If the schedule is packed, and you're going to change frequencies you're assuming that your gonna move to a frequency that's open. If there isn't a frequency that's open it could be very difficult. Back when we were doing a lot of B2 missions we were having B2's fly over to Vandenberg and Vandenberg didn't settle their schedule out over there until late in the afternoon or in the evening. So we would have to try to change frequencies for a B2 mission which ended up to be a lot of trouble a lot of times we would lose a mission or there was just too many people in the coordination process so you'd have to call scheduling, scheduling would call down to Point Magu, Point Magu would call over to Vandenberg, the Vandenberg guys were in and then okay you got the change with Vandenberg, now you have to call China Lake, now you have to call everybody else and make sure that everybody else knows what frequencies you're going to be on, so it becomes very difficult. Even in 24 hours it would be tough, but the schedule is actually put, I don't want to say it's put in stone. It's written in jello at like 3:00 in the afternoon or 1:00 in the afternoon today for tomorrow. So that's when really the last changes are allowed to be made to the schedule. You can add on or change frequencies but that's handled on a case by case basis, assuming that the frequency that you're moving into is open.

Q22: So when there are conflicts in this, who is the on frequencies now for the flight termination frequencies let's say in particular how is the conflict or who resolves that conflict?

A22: Well---

Q22: Is it all done via the schedulers?

A22: Well the, only through a certain point, okay. The current guy over at Point Magu who is George __________(?) he's a western area frequency coordinator, his policy is frequency management does not make any decisions on who gets to fly and who doesn't get to fly. That's not our call. What we will do is, we will connect the programs together and allow the programs to decide whose gonna go and whose not gonna go and then it's up to the program manager whether he wants to take the risk of either causing interference to the other guy or receiving interference from the other guy, it's up to them to decide.

Q23: So then the program managers are supposed to be put in contact with each other?

A23: Right.

Q24: And they resolve the issues and get whose---

A24: Get the scheduling people Paul Christ down at Point Magu or our person over here at our scheduling office tell them what they decide.

Q25: Now is this for conflicts within maybe tests that were being done at Edwards, or let's say it was tests between Edwards and China Lake.

A25: Between like Edwards and China Lake. Once upon a time as our anecdote for this incident, I was, we were in conflict with China Lake, we were using a range called Mojave B where we go out we shoot tow targets with, and our F-16 commander really wanted to go out there and fly, was a short thing about half an hour, forty-five minutes. We were in conflict with China Lake; China Lake was on an illegal frequency that they didn't even have a frequency assignment for. I was 100% in the right, I pinned my counterpart out at China Lake to back off and say okay, you guys can go ahead and fly, we'll back off. His commander, their commander called me and said okay, we'll stand down on our mission, but you guys have been using Mojave B range for free for 500 years. We'll stand down for you this time but next time you want to fly Mojave B you'll have to pay for it. Then I called over to the F-16 commander and the F-16 commander said well we're not going to pay Mojave B and I said okay, well are you going to back off and then he backed off. So, a lot of times it gets into a political battle over who has, who has control over which area. We don't really fly a lot of missions over Edwards. We fly a lot of missions at China Lake and in that area. Whose ever range you're flying at has control over their own airspace, so if you're flying out at Point Magu and you've got a one dash one priority, and Point Magu wants to fly a five dash zero out, out at a with a sesnot (?) and fly around and just burn gas, they're going to take priority over your mission because it's their range, they own the range.

Q26: Tell me, is that written--- No.--- in any type of guidance or that is just ---

A26: Actually, it goes down to DOD priority. Whose got the DOD assigned priority is whose should have the range but that's not written down anywhere and it would be very difficult for the Air Force to kick the Navy out of their own range.

Q27: So there is an established priority system? In the DOD guidance?

A27: In the DOD guidance there is. All programs get a DOD priority assigned to them and when you do conflict this frequency stuff the DOD priority should be the deciding factor on who gets to fly and who doesn't get to fly, but it isn't.

Q28: Okay, thank you. Does the flying altitude of the UAV make a difference to the flight termination system receivers?

A28: That's a good question. Yes, okay I'll just say yes it does. It doesn't make a difference to the receiver per say, but it does make a difference to the number of signals you would have to de conflict to ensure that the system didn't get interference.

Q29: Does that increase with altitude or decrease---------

A29: It would decrease with altitude.

Q30: So if altitude increases for the vehicle you have more, it's more susceptible to other, other transmitters to reach out and touch?

A30: Yes, yes. This goes with a path analysis equation that determines how much signal there is in a receiver from a given transmitter which varies with r squared with the distance squared so the distance the transmitter is not really the deciding factor on how much signal level there is in the receiver, it's how high is the airplane to see the receivers. So it's the line of sight distance really that's the long pole in the tent so to speak.

Q31: Before the other UAV's I'm assuming we have flown at other UAV's here at Edwards, and we've flown them in various altitudes, are we at a different thresh hold of normally flying now with this program, Global Hawk than we have in other UAV programs?

A31: Yeah, yeah, absolutely. The Global Hawk can fly higher and go farther than any other UAV than we've ever tested here. I think maybe the only one that I can think of is maybe one of the NASA high-flyers. I know that NASA maybe has one or two other vehicles that can kinda, that can fly this high. Yeah, this is a new generation for us and frequency management, I don't think that we, I don't think that frequency management as a corporate entity has thought through the frequency deconfliction process for high-flying UAV's. We've been, we've had, I've had several meetings here at Edwards discussing the possibility of getting interference on one of the UAV's but uh, as of yet we haven't had any movement on changing our frequency management procedures to accommodate that.

Q32: Could you kind of give me a quick summary on UHF, for definition, if someone says what is UHF radio waves, and put it into some simplistic terms of it's, compare it to something or some analogy to it or is it a very easy frequency to reach out and touch or receive or transmit on?

A32: Well the band designations UHF, VHF, SHF were kind of arbitrarily placed on different frequency bands back in the 1950's and 1940's as a way to um, as a way to uh make it more difficult to figure out what bands of frequencies we were using because back when radio and radars were first being developed you didn't want the bad guys to know what band you were in, so you made up these bogus band designations so that stuck for all these years, so to a laymen I can understand how it can be very confusing, it's supposed to be confusing so whatever they did back, obviously it's working well. The UHF band is, is just an arbitrary band designation and when you say UHF to a frequency guy, you're, you're talking about something between 200 and 800 megahertz. If you say VHF then you're talking about something below 200 but above 100, and then if you say HF you're talking below 100 megahertz, so it's just a band break for convenience um, if I wanted to relate it to something um, your TV at home has a VHF and UHF bands on it. The VHF are low bands and the UHF are higher bands. So there are more channels, for us in the military there's the radios and the airplanes are VHF, VHF you use to talk to civil air traffic, UHF you use to talk to military air traffic.

Q33: All right then on flight termination systems are they all to a spec of UHF type transmission?

A33: UHF is the normal, although I do know other vehicles that don't have range data requirements for flight termination that can actually terminate your vehicle via other means, through satellite likes or through their up link, down link or their common data link those are in different bands, C-band, X-band, but UHF is the standard range flight termination system.

Q34: In the flight termination system under UHF you, is there a capability of those to be encrypted and non-encrypted?

A34: There are encrypted systems but range requirements do not require encrypted flight termination systems.

Q35: Can the organization you're in, in the frequency area, monitor all frequencies and determine if there was any external interference to a flight termination system of a UAV?

A35: Well, monitor all frequencies is, that's a, nobody can monitor all frequencies in....

Q35: All right, maybe I should say UHF.

A35: Well, you could say flight termination. Can we monitor all the known flight termination frequencies? Yeah, we can monitor all the flight termination frequencies, um that is something that we would like to do or we would like to have the, we have all the gear and everything that we need we just don't have the personnel to sit down for every flight termination mission unless somebody actually asks us to do it, we don't. If frequency management as a whole, say all frequency managers at test ranges had to monitor flight termination, we could definitely monitor, especially here in the R-25 range complex. All my counterparts in this area have equipment that can monitor flight termination frequencies over a very large geographic area like this, if we had a mission here at Edwards and we were all monitoring flight termination, we would know immediately if somebody came on and interfered with out flight termination frequencies. It would be very apparent. We already have the gear we have the people that know how to do it, but our personnel and frequency management has been run down to the minimum over the last five or six years. We just flat don't have the personnel necessary to do this.

Q36: Is it part of a normal test program in your experience where someone may ask us to do this or is it again, depends if the owner of the system wants it done?

A36: If the owner of the system wants it done then we'll do it, but then they usually pay us. I mean, they um, our office for example is on a reimbursable charge. If they want to pay us for it then we'll go ahead and we'll monitor their flight termination frequencies but if the program says well we don't care, then there's no reason for us to be spending our manpower doing something. Obviously in this case if we were monitoring it would have been a great aid to know what was going on. We may have even been able to prevent this, our systems are very sophisticated and if the signal came up we would have immediately known and we could have started calling around and trying to find out who it was that was on and we may have been able to prevent.

Q37: Were you asked at all to monitor the Global Hawk flight termination system for any type of interference, external?

A37: Not for this mission we didn't, or we weren't. But we, in the, in the beginning of the program for probably the first five to seven flights we were paid by the Global Hawk program to come in and monitor all their frequencies not just flight termination. Their command or satellite frequencies, their line of sight and stuff. Everything was monitored at our office to ensure that they weren't getting any interference. During that time we didn't find any interference but we did find some problems with the way that the Global Hawk was doing business. Once they had refined their own processes and they resolved those problems then they, they didn't ask us to come in and monitor for them.

Q38: In the flight termination system side of the house are you talking, or are you just talking in the---

A38: No, they were having some problems with sat-com, they were having some problems, the only real problem I can really recall is they were having some problems with their sat-com, where they would try to control the vehicle via satellite and they were having some problems with that. We helped them try to resolve some of the issues with that, but once they had gotten into a group so to speak they didn't ask us to come in and monitor---

Q39: So you're not aware or you don't remember any flight termination system problems that they had?

A39: Well, don't, that's a different issue. They did have some flight termination problems in the beginning of the program where the vehicle had been terminated on several occasions while it was in the hangar. They were doing ground checks in the hangar and did not schedule their flight termination requirements and other people on the range that were either testing their flight termination transmitters or were working with other programs inadvertedly terminated the Global Hawk while it was in the hangar. So, but that wasn't a problem that was a scheduling issue where the program didn't want to schedule their flight termination requirements while they were doing ground checks because it was hampering their operations or for whatever reason, they just didn't want to schedule their flight termination for ground checks and as such they ended up getting terminated.

Q40: In other words they weren't scheduling it through the scheduling process that they were going to be doing flight termination ground checks---

A40: Where they were just powering the vehicle up with the flight termination receiver on---

Q41: On, okay, all right, and thus somebody transmitted on there, someone else could have radiated on their flight termination receiver's frequency and thus made the vehicle terminate. So it wasn't something that was planned.

A41: Right.

Q42: I'm going to give you or I've got some Global Hawk flight termination frequency strength percentage data for the flight on the 29th of March, would you be able to take this data and possibly pinpoint locations for possible transmitters that could have interfered or kind of, could have gone out and touched the Global Hawk vehicle during it's flight?

A42: We should be able to back-calculate, if we know what the signal level received of the vehicle was we should be able to back-calculate where standard transmitters were that could have made that power appear on the vehicle---

Q43: All right, in what area of frequency coordinator do you come under?

A43: The western area frequency coordinator's office.

Q44: Are there any areas east of our range included in the western range for example Nellis, or New Mexico?

A44: Okay, are there any areas east of our range included in the western area, I, ---

Q44: In the western area range.

A44: In the western area range, well the only ranges that are east of Edwards that are under the area frequency coordinator's office would be 29 Palms, um China Lake, Echo Range and Fort Irwin. Those are under the western area frequency coordinator's hat. They're in our carpel so to speak. The Nellis ranges are under a different area frequency coordinator's are under the Nellis area frequency coordinator's office. They take care of the Nellis ranges, UTTR and I think Falon and a couple of other areas, other than that east of us I don't think there's anything directly east of us, there is Yuma and Fort Wachuka which are under a different area frequency coordinator also and White Sands which is also under a different area frequency coordinators, so, um not I guess the answer is no to that question. There are no other ranges east that are part of the WAFC.

Q45: Alright, I'm going to ask you if some of the data I give you, could you, could you plot the transmitters that are on, currently on the Edwards range.

A45: On the Edwards range? There's two, to my knowledge there's only two flight termination transmitters on the Edwards range. There's one at 5790 and one out at NASA, that's on Edwards. There are other flight termination transmitters within the range complex, but we could plot on a map.

Q46: That's what I would ask you to do for me.

A47: That's not a problem.

Q48: Then uh, can you plot any commercial transmitters that would be outside the range complex that could fall under the, that you're aware of that are registered through FCC or whatever that could actually maybe reach out---

A48: Absolutely, absolutely. We can do that.

Q49: Alright, and then understanding what the UHF discussion we had with the vehicle sitting in around forty-one thousand five, uh you could then take that height and do a radius type of summary out there and say these transmitters which we've just plotted are transmitters that possibly could have reached out and touched the vehicle line of sight, touched the vehicle during this flight.

A49: As long as we know what the aircraft altitude is we can do that.

Q50: Okay, we know you've been involved with, in the accident since it happened and done some discussion analysis, have you done, have you formed any opinion on where you think the FTS signal originated from or actually came from during it's flight?

A50: Yeah, there are, there are, in our opinion there are two possibilities. One is either it came from the Nellis ranges which we, I think we know about there actually admitting that their transmitter was on, or it came from the China Lake area where they had a mission scheduled that normally requires flight termination that was not on the schedule for 425, those would be the only two areas but I think if we look at the signal level beta as received at the aircraft it should be very apparent as to which one was a possibility and which one wasn't. If the China Lake guys came one we should see a huge increase in the amount of power as seen by the, at the vehicle. If it was the guys out as Nellis we may or may not see any change in the receive signal level---

Q51: So we would need obviously any type of transmitting time frame and uh, what level from China Lake to be able to get into that type of analysis.

A51: Right, they'd smoke right in there, I mean they'd saturate the receiver from where their transmit site is, it's only about three miles away from where it crashed. It's right there.

Q52: If Nellis was transmitting on the frequency on the FTS frequency that we were flying would they have coordinated with us prior to?

A52: Well, there's no actual requirement for the Nellis guys to, to coordinate their use of flight termination with us because they fall under the Nellis area frequency coordinator's office, but um we did get a call from Nellis to coordinate use of the flight, their flight termination system on the day of the crash and they were using the flight termination system. We coordinated with them on it, um I shouldn't say it that way, they called us to tell us that they were going to use flight termination that day and we checked our schedule to make sure that we weren't doing anything that that's, that is beyond the requirements of the current process. They're not required to do that.

Q53: How about them for China Lake?

A53: China Lake would have to. They couldn't schedule without going through the de-confliction process.

Q54: Because they are again under the range complex of Edwards.

A54: Right, right they're within the western area frequency coordinator's office and they have to schedule with us.

Q55: Do you know why we didn't know there was a conflict with Nellis?

A55: Umm, that is a fault in the scheduling process. Um, Nellis is not required to schedule through our office so if they do have operations they're not required to put them into the de-confliction system.

Q56: When you say de-confliction system because they are in another region---

A56: They're in another region so they're not required to come under our de-confliction system and that's really the reason why we didn't know that there was a conflict. Although they had called us and we had talked to it, talked about it we checked the schedule from the data that we had when they talked to us on Friday it was uh, nothing on the schedule, there was nothing that was going to be on the schedule um, especially in the case of the Global Hawk uh, for the Global Hawk we're, we require that Global Hawk to give us three day notice on any missions so the Global Hawk was not going to be on, that would probably be the only thing that we would be flying out of Edwards that could be affected by flight or something that was going on out at Nellis, um when they, when Nellis called us on the Friday prior our schedule was clear, the schedule that was down at Point Magu was clear. We told them it was fine with us, wasn't a problem with anything that we were doing at Edwards, but then behind us uh, the Global Hawk program added on, we didn't get coordinated with, through Global Hawk, we're not really required to be coordinated with through the scheduling process. It was added on and we had two, two items on at the same time.

Q57: Okay. The uh, since you stated earlier that Nellis was transmitting on the same frequency as the Global Hawk flight termination system on at that time?

A57: Right, well no, when they coordinated with us they were going on 425 and the Global Hawk was normally on 421 so there really wasn't a conflict even if the Global Hawk was going to be flying on that Monday. Which per our requirement with the Global Hawk was---they weren't going to fly.

Q58: Is Global Hawk required to coordinate with you when they make changes to their flight termination system.

A58: Well not, not when they're, not so much from with their flight termination system, but Global Hawk is required to notify us three days prior to a flight to coordinate use of the radar with the FAA. They have some issues with the radar that requires a three day heads up to the FAA western region down at Los Angeles, so we get a schedule from the Global Hawk, usually four or five days prior to their flight that shows where the vehicle is going to be, where it's going to be flown, all of the information that we need to coordinate the radar. For this particular flight it was a flight schedule that was, had a back up for Friday that cancelled on Friday that they backed up to Monday but they did not coordinate that with us. So, when we checked our schedule there was nothing on it.

Q59: But their coordination process with you, if it was done would not address changes to the flight termination system frequency even if there was or was not one?

A59: Right. Our coordination process for the Global Hawk and our requirement for the three days head up is to notify us when their flying so that we can de-conflict the radar, but like I said, um in this particular case if we would have gotten a schedule from the Global Hawk that said hey, we cancelled on Friday we're backing up to Monday, that would have rang a bell with us and we would have called out and made sure that we weren't on the same time as the guys up at Nellis were. Um, but, because we didn't get that coordination, we, we didn't that there was a Global Hawk flying until, until we got called because of the crash.

Q60: Now, earlier we had said we have data here that shows that Nellis was radiating at the termination frequency during the Global Hawk mission. Would the altitude we had discussed earlier and the strength do you think that the vehicle could have picked up a termination sequence from the Nellis range or transmitter?

A60: That's the question of the hour. Or the question of the century. It's not inconceivable that it couldn't happen, I mean it could happen, but you'd really have to stack a lot of ifs on top of it to make, to make that work. Okay, um, from the technical standpoint the radiation pattern of the aircraft is an unknown. It probably looks like a butterfly, and, and the antenna pattern probably looks something like a butterfly with probably four main lobes, maybe five, uh maybe some small lobes off of the wing tips and the tail. So, being the antenna pattern is very scalloped there, you could possibly get the aircraft into an attitude where you would null out the signal, intentional signal being radiated from Edwards to pick up the unintentional signal that was radiated from Nellis. But usually the lobes, those, those wings, those butterfly wings are very narrow and very short in duration as you make altitude change and the ratio between the aircraft and the air, and the ground stations are usually very short duration, so yes I could imagine in my mind a way I could get the aircraft to the configuration where it would have more gain on the signal ports, it would to the aircraft, or to the transmitter here at Edwards where they could actually capture the receiver but, you're saying at that instant in time is when the termination sequence was transmitted and received at the aircraft to cause it to terminate and that's where I, I have problems I mean, okay it's possible but it would be very, very difficult. I would think that the two signals could probably be on at the same time and be received at the aircraft for a great, long period of time before you could actually get that circumstance to happen, that's the lightening bolt in the whole equation. I guess I would have to see the data from the aircraft and look at the transmission times and try to wind things up that way.

Q61: All right. Alright sir, you're reminded of the official nature of this interview, you may not discuss your testimony with anyone without my permission at any time before the report of this investigation is officially released to the public.

A61: Okay.

Q62: Do you have anything you would like to add before we conclude the interview sir?

A62: Well, not at this time um, this is, was a very unfortunate incident, I really think if we would, frequency management could have prevented this incident, I mean we've been working on trying to find solutions to the UAV problems over the last year, um we've had several meetings at my office where I've brought in all the UAV programs and tried to lay this exact problem out we were gonna have a problem either with interference on a command data link or interference on a flight termination transmitter, um because there are just too many UAV's operating in the area all at the same time, um we, I've done it there, I've done it at the frequency management group meeting with all the ranges and tried to get some um, movement on resolving the scheduling issues associated with the UAV's but it is a long and drawn out process and we have not been able to get anything moving on it.

Q63: Let me ask one other question sir, for you and you can either answer yes or no or expand on it. The present scheduling system from how it's been explained to me when we do the scheduling for frequency does not have any type of interference analysis uh, that is done to it to ensure as you just, eluded to that there would be a frequency overlap from one range complex to another.

A63: Well, no it doesn't. Right now the current scheduling process is expert system operated by experts. Then you have experts here at Edwards, you have experts down at Point Magu, and their expert opinion is what makes the frequency schedule work as well as it does right now. If you were gonna do this process the right way you would do uh, interference analysis on each one of the different missions in correlation to the all the other missions, to make sure that you could operate interference-free. There is just not the manpower to be able to do that right now and it would probably take, it would probably take you a two or three days to de-conflict the schedule if you had, actually had to do the engineering analysis on each one of the missions by the area of operation. There is a new scheduling system um, coming on line or trying to come on line shortly that will do that analysis in an automated fashion will take all of the receiver transmitters that are in the complex including the airborne transmitter and receive sight and perform the interference analysis on a mission by mission basis, but it's underfunded , it's over budget and it's behind in implementation.

Q64: Now this interfere analysis then would identify a signal conflict even if it was a source off this complex, range complex or a commercial location or even another adjacent range complex.

A64: It could, we haven't looked at the commercial side from the FCC standpoint, I guess we're all assuming that the FCC and the amateur's are staying off of our frequencies, but it is being looked at from an intra-range or intra-AFC de-confliction, um we've briefed it at the frequency management group meetings which is all of the range frequency managers from all the areas to try to get them all involved with this new scheduling process and I've briefed it to my counterpart at Patch River and he wants to use it, or we'll use it if we put it on line which I mean we are never gonna have any interference problems between us and Patch River, but he's looking at a way to be able to do this for his own missions so he wants to, he wants to become of it also.

Q65: Alright sir, and then are you aware of any other frequency monitor either aircraft or ground that may have picked up on the location or direction of the termination, uh terminal? Termination signal center?

A65: Yes I am but we couldn't discuss them under this one, we would have to, we'd have to talk about them under a different guys---

Q66: A different form?

A66: Yeah, and even at that I don't know, I would have to get permission from the organization.

Q67: Understand. All right sir. All right sir, I appreciate your time and this concludes the interview.

I, Harry Brawley, center scheduler, 412th Center Scheduling, Air Force Flight Test Center, Edwards AFB, CA , was notified at 1545L, 26 March 1999 that an add on mission for the UAV global hawk was needed for 29 March 1999. I met all requirements of Air Force Flight Test Center Instruction 11-15, (Scheduling Procedures for Aircraft and Air/Ground Support), dated 1 March 1999. There were no conflicts in the Edwards Scheduling System for the mission on the 29th March 1999, the Flight Termination System frequency was identified as 421 megahertz. Additionally, the Western Area Frequency Coordinator, Pt Magu, California was advised of the flight termination system frequency of 421 megahertz and no conflicts were identified for the global hawk flight scheduled for the 29th March 1999.There were no conflicts in scheduling process or support to the global hawk mission that needed resolution at the end of my duty day 26 March 1999.

Harry D Brawley
HARRY BRAWLEY

Signed and sworn before me this 4TH day of May 1999.

Steph T Virgilio
STEPHEN T. VIRGILIO, Colonel, USAF
Global Hawk Accident Investigation Board President

I, Chester Wireman, center scheduler, 412th Center Scheduling, Air Force Flight Test Center, Edwards AFB, CA, was notified by the Range Control Officer at 0615L, 29th March 1999 that a Flight Termination System Frequency change was needed for the global hawk mission scheduled to fly 29 March 1999. I met all requirements of Air Force Flight Test Center Instruction 11-15, (Scheduling Procedures for Aircraft and Air/Ground Support), dated 1 March 1999. The new Flight Termination System Frequency request (425 megahertz) was input to the Edwards Scheduling System and there were no conflicts. Additionally, the Western Area Frequency Coordinator, Pt Magu, California was advised of the flight termination system frequency change at 0730L 29 March 1999, and no conflicts were identified for the global hawk flight on the 29th March 1999.

CHESTER WIREMAN

Signed and sworn before me this 7th day of May 1999.

STEPHEN. T. VIRGILIO, Colonel, USAF
Global Hawk Accident Investigation Board President

VERBATIM TESTIMONY OF ROBERT C. ETTINGER

Q1: My name is Colonel Steven T. Virgilio. I am the investigating the Global Hawk accident that occurred on 29 March 1999 at China Lake Naval Air Station, California. This investigation is separate and apart from the safety investigation conducted under AFI 91-204. This investigation was convened to gather and preserve evidence for use in claims, litigation, disciplinary actions and adverse administrative proceedings and for all other purposes except mishap prevention. The safety investigation is also being conducted on the accident for the sole purpose of mishap prevention. Your testimony today sir to us may be used for any proper purpose. Additionally your testimony can be released to the public. Do you understand the difference between the safety investigation and the accident investigation?

A1: I do.

Q2: Do you understand what your testimony may be used for?

A2: Yes I do.

Q3: Your testimony in this investigation will be under oath. At this time I will administer the oath, please raise your right hand. Do you solemnly swear that the testimony you are about to give in the matter now under investigation shall be the truth, the whole truth and nothing but the truth so help you God?

A3: I do.

Q4: Thank you sir. Today is 28 April 1999; the time is now 1036 local. This interview is being conducted in Building 2500, at Edwards AFB, California. Persons present at Edwards AFB Colonel Steve Virgilio myself, Major Ray Chamberland the Legal Advisor, Lt. Delcampo who is the admin POC and the witness. The witness has been sworn. Sir for the record would you please state your full name?

A4: It's Robert C. Ettinger.

Q5: What is your grade sir?

A5: Civilian.

Q6: Where are you assigned?

A6: I work for Teledyne Ryan Aeronautical ---

Q7: And your job title?

A7: In San Diego and I'm the manager of flight test and I spend 90% of my time here at Edwards in the B2 facility over on South Base.

Q8: And your job title sir?

A8: I'm the manager of flight test for Teledyne Ryan's tier 2 plus, and uh, that's the Global Hawk. I run the flight test program on the Global Hawk.

Q9: All right sir, and your DSN number or your phone number?

A9: Phone number is area code (616) 275-8196.

Q10: All right sir, thank you what we'll get into now sir is just some of the questions. Do you test the flight termination system on the Global Hawk UAD prior to every launch?

A10: Uh, yes. I personally don't test it but my team does, yes.

Q11: Did the Global Hawk pass all flight termination system checks prior to the launch on 29 March 1999?

A11: Yes it did.

Q12: Have ah, I say you but I understand the generics in this. Have you have any inadvertent Global Hawk flight termination system activation's on the ground in hangars etc. prior to the launch on 29 March 1999?

A12: Well, when we first got here and we were first starting to check out the system and occasionally we would have our airplane doing ground checks when we had not reserved the frequency for the flight termination system. These are kind of like hangar checks that were being done, they were not on the main schedule and we did have some inadvertent shut downs. At those times we believe somebody else legitimately using the frequency caused our vehicle to shut down we believe the fault was not getting on the schedule and leaving those things hooked up. This has only occurred in hangar or engine run operations adjacent to the hangar. It has not occurred when we had an intent to fly or obviously it hadn't occurred in flight. There was once or twice when we, when intending that day to fly and we got out there before the range safety guys did the check of their system, and we had power on the airplane and we were inadvertently shut down but ah ---

Q13: You mean you came up on the aircraft before the range safety were able to test their internal transmitter procedures?

A13: Right.

Q14: And one time, twice?

A14: Oh I believe that happened at least twice, I'd have to go back and check the records, uh, we finally did work the coordination a little better so they came in earlier and got their checks out of the way before we were starting to do things. And it's been mostly; I view that as a procedural problem.

Q15: All right, the instances you just talked to me about on saying that you have had some in the hangar activations, problems with scheduling possibly to frequencies. Do you have documentation on that, is that something off a record or that is ---

A15: Nope, nope. Ah, we could go pull the guys that were actually doing the work and they might give you better numbers but ah, at the time we recognized there was a certain risk in doing these sorts of tests without reserving the frequency and the, what meant was whoops, the airplane may suddenly shut down and we have to go start it up again. It interrupts our test but there are no consequences other than that.

Q16: In the outbound, umm, when you did this corrective action you felt that solved the one time incident of this inadvertent with the scheduling issue you just mentioned? Did you feel that was your corrective action because you were not scheduling the powering up or the --- UAV

A16: When we're having trouble with the range safety guys?

Q17: No, speaking about the time it inadvertently went off in the hangar ---

A17: Yeah, there were two or three times that happened, it was definitely more than once and what we did was recognize the problem, either schedule hard the requirement or accept the risk of an inadvertent shut down and having to re-do the test. If, sometimes it was simpler just to take the chance, okay. Because the ah, all it caused was that our airplane would, if an engine was running and we shut it off if the computers were up and we didn't have the engine running they would shut off. We also did sometimes where we disconnected the flight termination receivers so that we could do the test without fear of having somebody shut it down.

Q18: All right. I don't know if this question is applicable now to be honest with you because the corrections you made had nothing to do with the validation of the flight termination system design or positive control so you had no problem in that area you just had problems on (talking at the same time).

A18: We wouldn't be putting this in the airplane unless we thought it worked.

Q19: Understand. Do you know has the Air Force Global Hawk program manager ever evaluated the option or has evaluated the option of using the secure flight termination system for Global Hawk?

A19: Uh, no. That, to my knowledge that was never discussed. I'm aware that there are such devices, I've been led to believe they were relatively expensive and uh, and that we're not considered for this program.

Q20: So I'll take the same question and say to you then as the contractor ever evaluated the prime contractor (talking at the same time).

A20: No, I don't believe so. We just kinda accepted the premise that the Air Force wanted us to use the flight termination system and they provided us these receivers and we used them.

Q21: So the Air Force directed it, okay. In the program.

A21: It's, it's you know you have to be a little bit careful saying that the program office back in Dayton directed those, these specific things. The flight test center said we want you to use these and we said okay.

Q22: Now I understand that but what I'm looking for or what I'm trying to ask and maybe I didn't verb it right is, from a contractor point of view was secure flight, was a secure type of flight termination system never, either proposed or ever be evaluated internal in the company.

A22: Uh, to my knowledge no.

Q23: All right. On ah, did the mission control element on 29 March 1999, the date of the accident, uh ever implement the flight termination system on the Global Hawk?

A23: No. I can say that with almost complete assurance recognizing that I'm at Edwards and they're in San Diego. Uh, the, you know the instrument display in the control panel did not show the, the, a, either the LRE or the MCE causing a flight termination.

Q24: All right sir. On the 26th of March 1999 an additional Global Hawk mission was scheduled for the day of 29 March, the following Monday. Do you know what time that you all, did, that that decision was made and who made that decision?

A24: Uh, I made that decision in ah, call with my boss on the telephone, and he was in San Diego.

Q25: Do you know what time?

A25: Uh, I'm gonna guess that was about noon.

Q26: Local time, right?

A26: Right. It was before we landed, it was about an hour before we landed, so we could figure it out, okay? (Sure, that's fine I just need approximate) At this moment I can't um, tell you much ---

Q27: In, what was your rational for picking then Monday the 29th for the next flight?

A27: We had a flight scheduled uh, for our first exercise (?) on the Thursday of that week and that was to be the 1st of April, and that was, you know our starting deal into the military utility phase and we really wanted to make that flight, take off on time and all that sort of thing. So, my boss and I discussed whether it would be better to fly on Sunday or Monday or Tuesday and I led the parade to say that we should fly on Monday. There's a lot of problems in trying to coordinate activities for the weekend with no lead time in the middle of Friday and I felt we made it later in the morning than early and all that sort of thing and I felt that we had the time enough to, ensure the airplane was ready and the equipment on the airplane was ready and yet still allow the range guys the opportunity to plan ahead, get ready. Instead of our normal you know 6:30 takeoff on ah, Monday we had a takeoff plan more like 8:00.

Q28: Okay, now once you made that decision then sir, help me out, how do you schedule that add on, coordinate it or how do you start your coordination process for that add on for the following Monday?

A28: Right, my, the guy who normally does our scheduling was monitoring the mission, which was airborne over at the FAA facility okay, so he was helping coordinate the mission with them. So I went to our range control officer, is a Mr. Terry Pelkey and asked him if he could add us on to the schedule.

Q29: What was the gentleman's name again?

A29: Terry Pelkey ---

Q29: Okay, all right I understand the name, right.

A29: I think it's P i l k e. He is very familiar with the schedule and the scheduling process and all those sorts of things so I felt he was a good person to help us with us and he ah, gladly took the ball and did a good job of getting us back on the schedule.

Q30: So, this Terry Pelkey then, your notification is strictly to Terry Pelkey and then Terry Pelkey in return does all the coordination procedures, requirements, etc.

A30: Yes, I believe he does that by entering things into a computer and it comes up on a master ---

Q31: Is there any other coordination support you do like that you have to do, or do do, when you add on like that?

A31: Uh, no I don't think so. Uh ---

Q32: Does Terry come back to you on a validation?

A32: Uh, usually not. He attended the, you know he monitored the flight with us and he attended the de-briefing of the flight which he usually does. At that time I believe he verified with my number one test director that we had the right frequencies all added on for Monday, okay. I would guess this is about 2 o'clock in the afternoon but I don't remember, okay. Don Murray is the name of my number one test director, okay. He's the, my test director and most experienced guy. So, I've been led to believe that Terry started the process and then at some time after the flight talked directly to Murray and said let's make sure we're on all the right frequencies for all of these things, okay and he had three or four frequencies that they discussed.

Q33: What was the gentleman's name again, what Murray?

A33: Don Murray

Q34: And he's your number one test ---

A34: Test director.

Q35: Test director. All right, when, so was the new mission profile then published for this additional flight coming up, this add on for Monday?

A35: Ah, I believe it was entered into the flight test centers scheduling system, okay, and then we had a briefing on Monday morning and we put together some run cards that were essentially a repeat of what we intended to do on Friday. Don Murray led the charge in getting those new cards together.

Q36: Could you explain to me just for my edification where you, went you say test cards what does that mean?

A36: Well every time we fly we have a packet of papers maybe as much as thirty sheets and it tells you everything as you ever want to know about that flight test mission. It tells you the day, the date, the time, the frequencies, the players, uh the support and all of those sorts of things. Chase airplanes, chase pilots call signs and then it actually has step by step procedures, numbered that we are going to accomplish. They include with the pre-flight you know the pre-start thing the start and each element of the test mission is delineated on this card, okay.

Q37: This goes to telemetry data, this goes down to routes and everything like that then sir?

A37: Ah yes, the routes are a little bit different in that there's a book that goes around along with it that tells you actually where the airplane is flying in the big things but in this card it will say on leg such and so between way point such and so and such and so we intend to do this, this, this ---

Q38: So these cards then would have your flight termination sequence frequency on it ---

A38: Ah yes, yes, ah they would have ah and they would have the steps that we do to verify the flight termination system as working properly before we take off ---

Q39: Understand, now maybe I'm not, in every mission I've been able to see and the data has been provided to me there has always published a mission profile for the flight and it spells out ---

A39: I guess I don't know what you mean by a profile ---

Q39: Well, the profile basically addresses a number of the things like where it's going, what, where it's way points are this is the launch time, this is the takeoff time those type of approaches we're going to test ---

A39: We must be talking about the same thing but what we call those things are test cards or run cards ---

Q40: Okay and we maybe then talking about the same thing okay, but there's one that's published for every flight. Correct? (Right, right, right) All right, I think we're on the same, I think we're in vital agreement here. (Okay) (laughing)

A40: If we have a disagreement it's in the terminal ---

Q41: Yes sir, okay. Can you help me out on just a few other areas here? Who selected the flight termination system antennae that is used on the Global Hawk?

A41: I don't know the answer to that question. I believe that antennae is a standard flight termination that is used on a lot of different other airplanes and stuff. I've flown other unmanned vehicles here at the flight test center and at NASA and it seems to me they all have the same type of antennae ---

Q42: What I'm looking for I don't know if it was a directed type use this type of antennae, or directed that these are types of antennas available, pick the one you want to use ---

A42: I don't know the answer to that question that was kind of before my time ---

Q43: Yes sir, all right. Then how about on the location of where this antenna is put on the Global Hawk vehicle?

A43: Well, we do that pretty carefully and we do that making sure that the ah, all of the different radiating, or antennas are all balanced and not interfering with each other and there's a tremendous effort in doing that and a gentleman named John Marshall in San Diego is the primary, our primary expert on that. We even change some of our, two of our antennae positions as a result of flight test results. We were finding that on ---

Q44: The FTS antennas now or just other antennas ---

A44: No, no, no, other antennas, but they all have to be kind of played in concert with each other. We want the flight test ah the flight termination antennas to have wide area of coverage and they're set in a certain polarity you know so they are mounted this way to receive signals coming from ground places this way rather than putting them this way to receive ah signals from other polarities and stuff, all that's considered and ah our flight termination antennas are on the, after the airplane, underneath the diagonal tails and there's one on the inside of the airplane.

Q45: Understand, now from the data I've been able to review and I think you're aware of it too that the flight termination system frequency was changed on that morning of the 29th, or was that decision made earlier?

A45: Yeah, we actually made the decision to change that on Friday in fact we had made the decision before that, uh we knew that we could only use that particular flight termination receivers and that particular frequency only on a Friday. We had, normally our frequency is 425 megahertz, we had changed to 421 for the Friday flight. We had borrowed those receivers from another program at Teledyne Ryan called mald and that we were obligated to return those right after the Friday flight so they could get ready for a Wednesday flight. So, going into this situation I knew I had to take those out of the airplane after the flight and send them back to San Diego.

Q46: So they were actually borrowed from what was the program?

A46: The mald program ---

Q47: Can you help me spell it?

A47: M, it's a miniature air launch decoy. M a l d.

Q48: So the decision if I, let me see if I can then verb this right, the decision, the reason you changed the frequency was because the receiver frequencies that you were using, or the receivers that you were using because their FTS frequency for another flight had to be returned back to the mald program and so thus you had to turn to a different (right) receiver from on this flight.

A48: He turned on, that Friday was the only time in the nineteen, or the eighteen flights that we've been here that we've been on other than 425. 425 has been our primary frequency but we were told about Monday or Tuesday of that week by, uh the range safety community that there was a conflict with something going on at uh, Point Magu.

Q49: For what day?

A49: For Friday. They said if you want to fly on Friday you have to find another FTS frequency and I said okay, I found it.

Q50: Then the frequency you flew out on Friday was then what?

A50: 421. That's the only time we'd flown with 421.

Q51: All right and so then the frequency decision to fly on 425 was known on Friday.

A51: Yes.

Q52: Okay, and then the notification that's part of the add on mission that was done the frequency is part of that notification, the change (yes) to the frequency is part (yes) of that notification.

A52: Yes, yes and that should have been in the system on Friday sometime between noon when I started the process and the close of business on Friday. It was known to me, it was known to Don Murray that we intended to fly on Monday on 425. I don't know what actually made it into the scheduling system. I have physically looked at a piece of paper that says 425 on it but it's which is reported to be a printout of the scheduling system and it's kind of like an add on that fits on the back of the schedule piece of paper and I'm clear in my mind what date it was actually submitted into the process.

Q53: In one final note sir, I'd ask you if you could to bring some data with you and I'm going to make you have it available ---

A53: I have it here ---

Q54: Okay, just tell us what you've brought ---

A54: Okay, I have a cover letter which says the attached reports contain the initial summary for each flight of the Global Hawk UAV test program. Each report with one exception contains a Global Hawk system description for that flight, a chronological summary of the flight activities, discrepancies noted and comments from the Ryan principal engineers directly involved in the flight. The one exception is the last flight and this flight a system description and chronological summary are only included ---

Q55: Understand, and these sir are the quick look ah ---

A55: These are what we call a quick look report, which is issued 24 hours or so after the flight.

Q56: All right I appreciate that. All right, anything else then sir or is that it?

A56: Nope that's it for me.

Q57: Okay. Are there any other matters that we, you'd been, you have, obviously the accident happened the 29th. Have you come to any of your own opinions of what you think caused the accident?

A57: Uh, yeah. Would you like me to state ---

Q57: Sir, if you would like to (talking at same time) --- you don't have to if you don't want to ---

A57: From my observations and my familiarity with the program and my uh, sitting in the control room and watching the displays real time and then subsequently stepping into the control room to assist the SIB and watching it replayed eight to ten times and then assisting you guys walking in there and watching it again, my conclusion has not changed and that is that some other agency was uh, sending a flight termination system check, was doing a flight termination system check and sending a proper sequenced series of tones on our frequency. Those somehow interfered with our frequency and caused a flight termination signal to get into the airplane, and the airplane behaved as it's designed. When it receives that sort of a flight termination system it did exactly what it was supposed to do. It was a perfect test of the flight termination system, a test you really don't want to do.

Q58: Understand. If I could ask you just a few more questions. There was some planning being done for Global Hawk to be flown in Green Flag correct?

A58: Right.

Q59: When would that mission tentatively planned that you would actually transition the airframe from the Edwards test range over to the Nellis test range for the green ---

A59: That was the same mission I was speaking of our first exercise sortie which was to take place on the first of April. So we were flying the airplane on Friday the 26th I believe, yeah, that's Friday the 26th and that's the day we saw that some of the sensors weren't working, we decided then to cut that flight short, fix the sensors over the weekend and fly again a short flight on Monday to check it out.

Q60: For the Green Flag mission do you recall or do you recall the flight termination system frequency you would be flying on while you're in the Nellis range, under the Nellis range control?

A60: We had assumed that we would be on our same standard frequency of ah, 425 ---

Q61: All right, okay but the mission was coming up then on that following Thursday, so you would have flown from everything you had published in the coordination process you were planning to fly that on 425?

A61: Right on.

Q62: All right. All right sir, are there any other matters that we haven't covered that you believe may be important to our investigation?

A62: Okay, ah, you know initially we had considered that we would just deactivate the flight termination system to fly in these exercises. In the process and late in the game, uh, of doing this safety review for the first two exercises, Green Flag and then another one called EOB Colonel Blitz. The Green Flag is done at Nellis and the EOB Blitz, Colonel Blitz is done down by Camp Pendleton and that it was decided that it would be safer to include the flight termination system in those two exercises.

Q63: Due to, do you know the specifics behind that when you say ---

A63: Well, you know I sat in the safety review board process and all that sort of thing and uh, it just kind of came out as a mutual conclusion of the whole, the whole board. Part of the reasoning was that we had not implemented a device to override the automatic abort which results from the airplane not receiving this carrier tone or monitor tone. So anyway it was decided between the government and the safety review guys and us, the range safety officers and the safety review board and Teledyne Ryan that we would use this range safety system in Green Flag and in this EOB Colonel Blitz, in order to do that we had to get some supplemental coverage for flight termination and in the Nellis area where Green Flag is performed there is a test organization that works for General Reynolds here at the base uh and uh they had such a facility. So we asked them to crank up their flight termination antennae, check it out and be ready to support us on the 1st of April. Similarly we asked the people at Point Magu to crank up their flight termination system and get it ready to support us in this EOB Colonel Blitz exercise. They have a very powerful antennae and it gives good coverage down in the Camp Pendleton area.

Q64: All right. So the, what frequency manager then for the area here would have reached out for you to Point Magu and to Camp Pendleton and Nellis or is that something you were doing internal in the contract(?) ---

A64: Well, ah, for Point Magu and the other China Lake and Edwards and several other people ah, they belong to a they're part of a --- there is a western test frequency coordination outfit that's located at Point Magu and they are charged with keeping all these frequencies de-conflicted and ah, they handle both com frequencies and ah flight termination frequencies. Ah the way we do that is put down our frequencies on the schedule then we send a copy of our schedule over to them and they do all the shuffling over there. They come back and identify when there are conflicts. For instance, the planned conflict for Friday was identified and passed back through that process to us saying you better do something different on Friday, okay? So that process I believe took place. I've, subsequent to the accident I've been told verbally can't verify this. I've been told that the people at Nellis do not belong to that frequency coordinating committee but you need to find that out for yourself.

Q65: All right, thank you sir. Sir, just to close this out for you, you are reminded of the official nature of this interview, you may not discuss your testimony with anyone without my permission at any time before the report of this investigation is officially released to the public. Sir, this concludes the interview.

I, Steven Cronk, Chief, Range Safety, Air Force Flight Test Center, Edwards AFB, CA on 28 April 1999, provided written statements and data and procedure guidance for range safety flight operations for an unmanned aerial vehicle flight in the Edwards test range complex. The Range Mission Control Center, Range Safety Officer can terminate a UAV flight on the range when one of any four criteria are met: the UAV's position or track becomes unknown, the UAV is in violation of the range boundary/limits and control of the UAV is lost, the UAV departs from controlled flight, and finally the judgement of the range safety officer. Flight termination systems are required for all UAV's flown on United States ranges and must meet the standards of RCC standard 319-92. The global hawk UAV was required to have a flight termination system and it met RCC standard 319-92.

Prior to the launch of the UAV global hawk on 29 March 1999, a premission functional test of the Air Force Flight Test Center flight termination system command transmitter on 421 megahertz, without the UAV was conducted. The test was successful. Prior to the next test of the system with the UAV, the range mission control center and the range safety officer was notified by global hawk project personnel that the flight termination system frequency had been changed to 425 megahertz. The range safety officer then conducted another premission functional test of the flight termination command transmitter on the new frequency of 425 megahertz, without the UAV. The test was successful. Prior to UAV launch a prelaunch functional test of the flight termination system is done with the UAV to verify the system is operational. This test was conducted on the new frequency of 425 megahertz. This test was successful.

On 29 March 1999, approximately 20 minutes into the UAV global hawk flight, the Edwards range safety Officer (Mr. Sharpe), observed the vehicle had rolled inverted and entered into a flat spin. Once notified I immediately went to the control room. I looked at the tracking display noting that the impact predictor and the vehicle present position were coincidental indicating the vehicle was going straight down. This was also confirmed by telemetry. Based on the facts that the aircraft had departed from controlled flight, its position was on the edge of the echo range keep-out area and would soon go outside of line of sight of our FTS transmitter, I instructed Mr Sharpe to terminate the vehicle. As the vehicle passed through approximately 10,000 feet Mr. Sharpe sent the terminate commands to the vehicle. I observed the telemetry display and saw the arm and terminate commands appear in the proper sequence. No change in vehicle flight path was noted after the termination sequence was sent. The vehicle impacted at approximately 10:14 A.M.

I noted that the UAV global hawk program was also planning a mission in support of green flag at the Nellis test range complex for 1 April 1999. The mission was to be flown from the Edwards test range complex and "handed off" and flown into the Nellis range complex then to the Edwards test range complex. The UAV global hawk flight termination system receivers to be used for this flight were to be at 425 megahertz. The

Range Safety Officers at each respective test range are required to have positive control of the UAV flight termination system while the UAV is flying in their range complex, thus the use of 425 megahertz was planned to be used for the mission on 1 April 1999.

I provided a written statement on my observations of the data playbacks of the 29 March 1999 global hawk flight, which I watched on 2 and 26 April 1999, see attached. I concluded that the global hawk flight termination system was activated from a source outside of Edwards AFB, causing the loss of the aircraft. The source of the activation command appears to have been a valid termination sequence having been sent to the flight termination receivers and integrated mission management computer. The flight termination receivers are highly reliable, single fault tolerant and post incident examination indicates they were in proper working order. The receivers were removed from the wreckage and I personally took them to Vandenberg AFB for testing. The receivers passed all certification testing. It is my opinion a receiver malfunction is not a likely cause of this accident. Also, while not impossible, it is highly unlikely that the proper tone sequence could be generated by a random noise event. I believe that the vehicle received a programmed arm and terminate command sequence from a source outside of Edwards AFB having sufficient RF power/signal strength to capture the flight termination receivers.

I have provided written documentation (attached), in the form of: memorandum dated 28 April 99, subject-statement of observations during a data playbacks on 2 and 26 April 1999 (2 pages), a memorandum dated 27 April 99, subject-statement of facts regarding the RQ-4A Accident on 29 March 99, (3 pages), a memorandum dated 24 March 99, subject-global hawk range safety support requirements, (2 pages) and copies of various e-mail messages dated 26 Mar 99 to 29 Mar 99 (4 pages).

STEVEN CRONK

Signed and sworn before me this 11 day of May 1999

STEPHEN T. VIRGILIO, Colonel, USAF
Global Hawk Accident Investigation Board President

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 412TH TEST WING (AFMC)
EDWARDS AIR FORCE BASE, CALIFORNIA

24 March 99

MEMORANDUM FOR: J.D. Dainels

FROM : 412 TW/TSRO
306 East Popson Avenue
Edwards AFB CA, 93524-6680

SUBJECT: Global Hawk Range Safety Support Requirements

1. The following are the Range Safety support requirements for Global Hawk during the upcoming Green Flag exercise:

a. Flight Termination System (FTS): During flights outside of the direct line of site of the AFFTC FTS it will be necessary to have the range FTS up and operational to close the FTS logic loop in the test aircraft. Failure to maintain constant carrier and monitor tone will result in the aircraft invoking a contingency 2 maneuver which will result in a return to base (Edwards) once the 20 second FTS timer expires. The aircraft FTS is configured in the following manner:

Frequency: 425 MHz

Monitor Tone: May be tone 5 or 7 depending on which FTRs are installed for the mission. I will provide this information prior to the mission. The monitor tone must remain active (up) at all times during normal flight or the vehicles FTS timer will trip causing an RTB.

ARM: Tone 5/7 remains up and add tone 1.

TERMINATE: Tone 1 remains up, remove tone 5/7, add tone 2

b. Communications: During the exercise the test aircraft will transition between the range and R-2508 as required. During these transitions it will be necessary to transfer FTS control of the vehicle between the Range Safety Officers (RSO). To effect this handoff direct voice communications between the RSOs is required. This can be via telephone or direct voice net if available.

c. Radar/Tracking: Continuous tracking of the vehicle by two independent tracking sources is required while on range. These sources may be instrumentation radar (minimum of 1 desired) and search radar with mode 3C transponder. A background trace with the vehicles nominal ground track is desired. I will provide this data in electronic and tabular format prior to the mission.

d. Range Safety Officer: It is highly recommended that an AFFTC RSO familiar with the Global Hawk system be on station at the range to coordinate support and act as an advisor to range personnel during the mission. If deemed appropriate by range management I will act as the AFFTC RSO on station. My security data can be verified by range security. The following is my personnel information:

Name: Steven G. Cronk
SSAN:
Clearance: TS/SCI

2. Request you provide a statement of capability outlining your cost for this support. Please forward the SC to 412th TW/RMJ. POC is Mr. Dan Goddard.

3. In the event you have any questions regarding this matter please contact me at DSN 527-3224.

Steven G. Cronk
Chief, Range Safety

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 412TH TEST WING (AFMC)
EDWARDS AIR FORCE BASE, CALIFORNIA

27 April 99

MEMORANDUM FOR AFFTC/JA

FROM 412 TW/TSRO
306 East Popson Avenue
Edwards AFB CA, 93524-6680

SUBJECT: Statement of facts regarding the RQ-4A Accident on 29 March 99

The following statement outlines my recollection of the events leading up to the accident on 29 Mar.

In preparation of the upcoming Global Hawk participation in the Green Flag exercise the AFFTC Range Safety Office began a dialog regarding support requirements with the Nellis Range Safety personnel approximately 13 March. Initial activities involved the transmission of flight path data and information regarding the upcoming AFFTC Safety Review Board (SRB). The SRB was convened on 17 March with findings briefed to AFFTC/CC on 23 March. Nellis personnel attended this SRB.

On 23 March additional discussions took place between myself and Nellis Range personnel outlining the technical requirements (Range Safety) for the missions to include flight termination, tracking requirements, Range Safety Officer support, etc. As a result of this discussion I prepared a formal support request to the range (Atch 1) detailing our requirements to which the range could prepare a cost estimate. One issue which came to light was that the local FTS had not been used in some time and that it was currently set up for 425Mhz tones 1,2 & 5 and that it was not known at this point if tone 7 could be supported.

On 24 March I completed the requirements letter which was hand carried to the Nellis Range by range personnel who were on station at Edwards. I believe it to be later this same day that I was contacted by Mr. Bob Ettinger of TRA who advised me that the Global Hawk mission which was scheduled for Thursday 25 March was currently in stand-by for a B-2 Mission and for the 425Mhz FTS frequency due to a mission at Point Mugu NAS. Further that FTS missions at Point Mugu were also scheduled for Friday the 26th and Saturday the 28th. I informed Mr. Ettinger that TRA had in their possession in San Diego 2 Flight Termination Receivers on 421 MHz which belonged to the MALD program and that if a loan could be arranged between the projects range safety would authorize the change. It was later that day I was notified that the receiver change was in work and the A/C would fly on Friday the 26th on FTS frequency 421Mhz.

On 25 March Mr. Len Roen the Chief of Range Operations and myself were TDY to Point Mugu NAS for the purpose of arranging support for the Global Hawk participation in the Kernel Blitz and Extended Littoral Battlefield exercises. During our visit to Point Mugu NAS I was paged by

Mr. Ettinger who advised that the 421 MHz receivers had been installed and that TRA was in need of a test set to check the receivers. I informed him that my office had a test set and instructed him to contact Mr. Michael Young to schedule a time for the testing. In the course of Mr. Roen's and my discussions with Point Mugu Range Safety it came to light that there was the potential for FTS frequency conflicts during the over water exercises. Several Missile launches were scheduled and that 425 MHz would be the FTS frequency in use. After further discussions I called Mr. Ettinger and informed him of potential conflict and recommended that plans be made to have the A/C set up for 421Mhz for the over water exercises. Mr. Roen and I returned to the Edwards local area that afternoon and contacted my office to check the schedule for the following day's Global Hawk Mission and assign work schedules. Mr. Michael Young and myself would handle the takeoff and first half of the mission with Mr. Sharpe and Mr. Puckett scheduled in at 1400 to relive us.

On 26 March Mr. Michael Young and myself arrived at Edwards AFB approximately 0400 to support the Global Hawk Mission. Mr. Young conducted pre-mission FTS checks on 421 MHz and I departed to South Base as the Range Safety Outside Observer at the A/C. The takeoff was delayed until approximately 0930 due to A/C problems but was normal other that the A/C tracking well right of centerline during takeoff roll. At this point I returned to my office at Ridley Mission Control Center and alternated Range Safety Officer duties with Mr. Young. While in between RSO shifts in the A.M. I contacted Nellis Range personnel to discuss the progress of our planning activities. During this discussion I was informed that Nellis FTS could support 425Mhz tones 5 & 7. It was after this I informed Nellis that the A/C configuration had been changed to 421Mhz due to a scheduling conflict. Nellis advised me that they were sending me an e-mail with some additional questions regarding the operation (Atch 2) to which I replied that I would respond ASAP but that I was tied up with the mission at the present time. At approximately 1230 hours Mr. Young departed the facility on personal business and I took over RSO duties for the remainder of the mission. During the course of the mission I was informed that the A/C was going to return to base early due to sensor problems and that the project intended to add-on for Monday morning. At this point I contacted Mr. Puckett and Mr. Sharpe to advise them to not come in due to the early return and to plan to be in early Monday to support the add-on mission. I also called my Nellis POC and advised him of the add-on mission and extended the offer to observe the flight from the range safety console as a way to become familiar with the operation and the aircraft characteristics. My POC declined due to workload and the logistics in setting up travel late on a Friday. The A/C landed at approximately 1530 and I departed the area.

On 29 March I arrived at work approximately 0700 and went to the range safety console to check the status of the mission. Mr. Sharpe was at the RSO position and Mr. Puckett was at the A/C as the outside observer. Mr. Sharpe advised that FTS checks were complete and that their had been an FTS frequency change to 425. He went on to explain that the change come from the South Base, Range Control Officer after he had completed pre-mission checks on 421. He went on to say that he did re-accomplish the checks on 425 and that everything was ready for support. At this time the takeoff had been delayed due to control room problems at south base so I requested Mr. Sharpe to return to the office and send me an electronic copy of the Global Hawk Range Safety Operational Plan so that I could forward it to Nellis. Which he did while I assumed RSO responsibilities. Upon his return I went to my office to forward the document to Nellis and to answer the e-mail which I had received from Nellis on Friday (Atch 3). In the e-mail from Nellis was a note that they were able to configure their system to 421 MHz to which I responded that the A/C had been reconfigured to 425 MHz. My response was transmitted to Nellis at 0803 A.M. I also forwarded a copy to Mr. Ettinger at 0805 A.M. (Atch 4). I then returned to the control room and assisted Mr. Sharpe as the Telemetry Observer for the takeoff and initial climb through FL200. At this point the A/C was performing nominally all systems were green so I returned to my office to continue working support issues for the upcoming Green Flag. When I got to my desk I turned on the UHF radio in my work area to the Global hawk mission frequency and began working until I heard a radio call saying the "aircraft was going straight down". At this point I ran to the control room (30 seconds) to see the nose camera video showing the vehicle in a spin. I then looked at the tracking display noting that the impact predictor and the aircraft present position were coincidental indicating the aircraft was going straight down. This was also confirmed by telemetry. I noted that the position of the aircraft was on the edge of the Echo Range keep-out area and instructed Mr. Sharpe to terminate the vehicle. He advised that control had requested that we not terminate the vehicle at this time and that chase indicated the vehicle was falling in a clear area. After checking the position again, confirming the proximity to the Echo Range area and having a concern that the vehicle would soon go outside of line of sight to our FTS transmitter I instructed Mr. Sharpe to terminate the vehicle which he did. I observed telemetry and saw the arm and terminate commands appear in the proper sequence. No change in vehicle flight path was noted after the termination sequence was sent. We continued to monitor the vehicle and I instructed the range operations duty officer to notify command post that the Global Hawk was coming down approximately 5NM south of Echo Range and to call China Lake. The aircraft impacted at approximately 10:14 A.M. We then began to secure and impound all mission data. I then called the Safety Office and told Mr. Doug Wada to please notify the appropriate personnel in safety of the situation.

In the event you have any questions regarding this matter I may be reached at 7-3224.

Steven G. Cronk
Chief, Range Safety

vehicle and its associated antenna patterns (peaks and nulls) relative to the transmitters could further amplify this situation.

Turn Southbound (playback): As the aircraft began a left turn over the southern end of R-2524 I observed the monitor tone on both flight termination receivers drop in and out and the signal strength on receiver "A" drop momentarily to 72% then return to the 90% range. This event was immediately followed by a quick series of arm and terminate commands appearing on the display for receiver "B". Within a very few seconds the aircraft rolled right through inverted and entered what I would describe as steep spiral or spin like maneuver. Checking the vehicles flight control positions and engine status showed spoilers at approximately 65° and ailerons deflected to 15° pro right roll and N^2 at about 15%. This condition is consistent with activation of the vehicles flight termination system. As the vehicle continued to spiral down I observed the monitor tones on both receivers drop in and out of lock. However after the initial sequence of arm and terminate commands I do not recall seeing any further activation of these commands. Throughout this entire series of events the AFFTC command transmitter system appeared stable transmitting a continuous tone 5, further indicating interference from an external source. I also noted the LRE arm command was illuminated indicating the vehicles IMMC's had detected a valid arm. During repeated playbacks I was able to refresh the real-time display and noted an LRE Terminate indication that would confirm (in my opinion) the IMMC's had received a valid termination sequence. After passing 10,000' the AFFTC Range Safety Officer sent arm and terminate functions through the AFFTC command transmitter system. As these functions were transmitted they appeared in the proper sequence on the range safety telemetry display. No change in vehicle condition was noted after the transmission of functions by the AFFTC RSO which would further indicate the vehicle was already in the terminate mode. Terminate functions were held by AFFTC Range Safety to impact. During this time I did not observe any further unexplained dropouts.

Conclusions: Given the sequence of events described above I must conclude that the Global Hawk flight termination system was activated causing the loss of the aircraft. The source of the activation command appears to have been a valid termination sequence having been sent from the flight termination receivers to the IMMC's. The flight termination receivers are highly reliable, single fault tolerant and post incident examination indicates they are in proper working order. It is my opinion a receiver malfunction is not a likely cause of this accident. Also while not impossible it is highly unlikely that the proper tone sequence could be generated by a random noise event. I believe that the vehicle received a programmed arm and terminate command sequence from an outside source having sufficient RF power/signal strength to capture the flight termination receivers from the AFFTC command transmitter system.

In the event you have any questions regarding this matter I may be reached at 7-3224.

Steven G. Cronk
Chief, Range Safety

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 412TH TEST WING (AFMC)
EDWARDS AIR FORCE BASE, CALIFORNIA

28 April 99

MEMORANDUM FOR AFFTC/JA

FROM 412 TW/TSRO
306 East Popson Avenue
Edwards AFB CA, 93524-6680

SUBJECT: Statement of observations regarding the RQ-4A Accident on 29 March 99

The following statement outlines my observations during a data playbacks on 2 and 26 April 1999.

Takeoff and Initial climb: Based on the data I observed during real-time and playback, it appears all aircraft and range systems were operating normally during pre-flight, taxi, takeoff and initial climb. I did not note any indications which were not consistent with those observed during previous RQ-4A operations. In particular FTS status and health were nominal, AGC/Signal strength was in the 94% range and telemetry was of excellent quality with minimal dropouts.

Climb Eastbound (playback): Climbing through approximately 20,000' on the eastbound leg I observed a momentary dropout of the FTS monitor tone (tone 5) on receiver "A". This in its self is not an abnormal indication during periods of poor telemetry reception or low FTS signal strength. However this particular loss of tone could not be correlated to any degradation in telemetry or signal strength nor could it be attributed to problems in the command transmitter system as only one receiver lost tone. This is not an indication I have observed on other RQ-4A missions or any other UAV operations. In my opinion this could be caused by one of the following conditions:

a. An intermittent failure in the flight termination receiver.
b. Defective installation of the flight termination receiver (lose connectors, etc.)
c. Interference from and external RF source.

Climb Northbound (playback): Climbing through approximately 35,000' I recall noticing momentary loss of monitor tone this time on both flight termination receivers. Again this event could not be correlated to any observable telemetry dropouts, FTS signal strength remained high (90-94%) and monitoring of the AFFTC command transmitter system showed no drop in transmitted signal strength or change in modulation (tone 5). Given the loss of tone on both receivers I feel the most probable cause for this and the earlier event would be the capture of the receivers by an an external RF source. I feel the intermittent nature of the interference could be attributed to both the AFFTC command transmitter and the unknown source have very close relative signal strengths causing the receivers to "hunt" for the best signal. Movement of the

Global Hawk UAV, 95-2002, 19990329

From: Steven Cronk
To: "sholkovic@ew.elan.af.mil"@EDW.GWIAB
Date: 3/29/99 8:03 AM
Subject: Re: GH issues/questions

Steve,

I have sent you a copy of the Range Safety Requirements Doc under separate cover.

The FTS has already been changed back to 425 tones 1,2,7. We plan to leave the A/C on this set-up unless you need us to change.

I should have an electronic copy of the waypoints tomorrow that also contains the contingency routes as well. When I come out for the mission I will have the A/C operators manual which contains the emergency procedures and fault codes etc.

I will pass on the info on the other landing sites to Bob Ettinger at Ryan though I believe it is too late to change.

I plan to have a draft hand-off procedure to you by noon today.

I should be at my desk all day so give me a call if you need anything.

Steven G. Cronk
Chief, Range Safety
Air Force Flight Test Center
(661) 277-3224
DSN 527-3224

>>> "Steve Holkovic" <sholkovic@ew.elan.af.mil> 3/26/99 >>>
Steve,

Please send anything you have on GLOBAL HAWK operations/contingency procedures ASAP. I spoke with our tower folks and yes there was a visit by some GH folks, but the exchange of information was limited to "we're the UAV guys and here is the contingency checklist"...not thorough enough. Also, I do not know if the fire department was advised, but they will have to be up to speed as far as crash recovery and fire suppression & safety.

We started thinking and came up with some potentially better alternatives for alternate landing sites away from population centers and high value assets. I think this deserves some thought because if this happens, there is somthing serious wrong and the probability for the situation to get worse escalates. Therefore, there is a remote landing field (may be too rough) at Mellan (approx 8 miles SE of TTR) or even better, is Mud Lakebed in the very NW corner of the airspace. The lakebed is very large, flat, and hard and is mostly within resricted land. Another potential probelm with TTR is Sandia National Labs, They need to be aware of this contingency since they own the airspace above the airfield and have sensitive hardware at their locations. They need to be coordinated with...I can supply a POC.

Our FTS guys have been able to configure our control system for 421MHz with tones 1,2,7. You may maintain your current configuration, but if it does change, we need a day's notice.

I have the flight profile in hardcopy format. Could you send me the Lat/long of the action points and turn

Global Hawk UAV, 95-2002, 19990329

radius (or speed and bank angle). With this I can build an overlay for our graphics system.

That's all for now, Thanks----SteveH

From: Steven Cronk
To: Bob Ettinger
Date: 3/29/99 8:05 AM
Subject: Fwd: Re: GH issues/questions

Bob FYI

Steve

From: "Steve Holkovic" <sholkovic@ew.elan.af.mil>
To: EDW.PO1A(Cronk Steven)
Date: 3/26/99 2:28 PM
Subject: GH issues/questions

Steve,

Please send anything you have on GLOBAL HAWK operations/contingency procedures ASAP. I spoke with our tower folks and yes there was a visit by some GH folks, but the exchange of information was limited to "we're the UAV guys and here is the contingency checklist"...not thorough enough. Also, I do not know if the fire department was advised, but they will have to be up to speed as far as crash recovery and fire suppression & safety.

We started thinking and came up with some potentially better alternatives for alternate landing sites away from population centers and high value assets. I think this deserves some thought because if this happens, there is somthing serious wrong and the probability for the situation to get worse escalates. Therefore, there is a remote landing field (may be too rough) at Mellan (approx 8 miles SE of TTR) or even better, is Mud Lakebed in the very NW corner of the airspace. The lakebed is very large, flat, and hard and is mostly within resricted land. Another potential probelm with TTR is Sandia National Labs, They need to be aware of this contingency since they own the airspace above the airfield and have sensitive hardware at their locations. They need to be coordinated with...I can supply a POC.

Our FTS guys have been able to configure our control system for 421MHz with tones 1,2,7. You may maintain your current configuration, but if it does change, we need a day's notice.

I have the flight profile in hardcopy format. Could you send me the Lat/long of the action points and turn radius (or speed and bank angle). With this I can build an overlay for our graphics system.

That's all for now, Thanks----SteveH

VERBATIM TESTIMONY OF JAMES RUSSELL LITTLEFIELD

Q1: My name is Colonel Steven T. Virgilio. I am the investigating the Global Hawk accident that occurred on 29 March 99 at China Lake Naval Air Station, California. This investigation is separate and apart from the safety investigation conducted under AFI 91-204. This investigation was convened to gather and preserve evidence for us in claims, litigation, disciplinary action and adverse administrative proceedings and for all other purposes except mishap prevention. The safety investigation is also being conducted on the accident for the sole purpose of mishap prevention. Your testimony to us may be used for any proper purpose. Additionally your testimony can be released to the public. Do you understand the difference between the safety investigation and this accident investigation sir?

A1: Yes

Q2: Do you understand what your testimony may be used for?

A2: Yes

Q3: Your testimony in this investigation will be under oath. At this time I will administer the oath, please raise your right hand. Do you solemnly swear that the testimony you are about to give in the matter now under investigation shall be the truth, the whole truth and nothing but the truth so help you God?

A3: Yes

Q4: Today is 30 April 1999, the time is 1135 local. This interview is being conducted in Building 2500, Edwards AFB, California. Persons present at Edwards AFB are Colonel Steve Virgilio-Myself, Major Ray Chamberland the Legal Advisor and the witness. The witness has been sworn. Please state your full name for the record sir.

A4: James Russell Littlefield.

Q5: And what is your grade?

A5: Staff Sergeant.

Q6: Where are you assigned?

A6: Las Vegas.

Q7: What is your job title?

A7: I am the Spectrum Manager for the Electronic Warfare Range.

Q8: And what is your DSN number?

A8: It is 525-8400 extension 55104.

Q9: Thank you sir. Sir are you responsible for frequency management for the entire Nellis Range complex?

A9: No I am not.

Q10: Do you know who is responsible for the Nellis Range complex?

A10: Yes, it is the DOD AFC, Nellis Frequency Management Office.

Q11: Is there a name that goes with that by chance, would you know?

A11: Yes, it's Dennis, who is brand new, and his advisor has been Tech Sergeant John Jordan.

Q12: Jordan?

A12: Yes.

Q13: All right, thank you. Are you able to transmit flight termination frequencies, there at Nellis Range, your area?

A13: Yes, yes.

Q14: O.K. do you know what frequencies your able to transmit on?

A14: Yes, 421, 425, and 434.

Q15: All right, and how do you de-conflict the use of these FTS frequencies, if there is any conflict?

A15: Uh, we, I will get a call from the testing people, mainly Will Raymond.

Q16: Testing people on?

A16: On the electronic warfare range, the, the people that are gonna actually transmit on that frequency.

Q17: Now are we talking within, are we talking Nellis Range complex?

A17: Yes

Q18: Oh, ok go ahead, I'm sorry.

A18: They will call me up and then they will tell me what frequency they want to use, what's their highest elevation they'll be at max power, then I will call the Nellis frequency office and inform them that I need to transmit and will pass on the information I was given and then I will, as a courtesy, call the Edwards frequency management office and let them know what we're doing and to see if there's any conflicts.

Q19: You said you call the Edwards frequency management office, out of a courtesy, is that something that's been going on for months, years, weeks?

A19: We started it probably within the last six months to a year.

Q20: And why do you call them out of courtesy?

A20: Uh, even though we have a mileage difference in the ranges now, but the altitudes we're flying on both sides that we have to, uh, that uh, we feel that we need to.

Q21: All right, now does the Edwards frequency management office call you also when they are transmitting, as a courtesy?

A21: Uh, no. Oh, well, they haven't been until this incident. Uh, that's what I want to say.

Q22: All right, I understand. So you're talking the incident of the Global Hawk crash on the 29th of March?

A22: Correct.

Q23: All right. And at least for the last six to twelve months you've courtesy called into the Edwards frequency management office?

A23: Yes I do.

Q24: Now are you under a different range of control? From what I understand when I look at the, the management spectrum that talks about there's two different regions, are you under a different region?

A24: Yes I am.

Q25: What region are you all under?

A25: I am under the DOD AFC Nellis.

Q26: DOD AFC Nellis region?

A26: Region.

Q27: All right, In the planning for the Green Flag operation, or exercise that was coming up in the Nellis Range, the Global Hawk UAV was going to be flown onto the Nellis Range complex from the Edwards Test Range complex. How were you, or were you in the planning process, or were you planning to maintain an FTS control on that vehicle when it went into your range complex?

A27: Yes.

Q28: And do you know on what frequency it would have been on?

A28: 425.

Q29: Prior to the Green Flag exercise, you were going to test your transmitter at the planned frequency here you just mentioned, of 425 for the Global Hawk mission, were you planning on testing that I should say? To test your transmitter, is it a requirement to test your transmitter to insure it's working at 425 prior to the Global Hawk mission coming to you?

A29: Yes

Q30: O.K. Do you know when those tests were scheduled for?

A30: They believe it was the, the first mission was supposed to be the Thursday after the incident.

Q31: If I look at the calendar, the incident was on the 29th of March, bear with us a minute, here we go, looking at a calendar here, the 29th of March was a Monday.

A31: Correct, and we were supposed to fly our first mission on the 1st of April.

Q32: O.K. So when were you going to test your transmitter?

A32: It was that Monday.

Q33: O.K. So you were going to test it on?

A33: The 29th of March for Thursday the 1st.

Q34: And that, that test, was scheduled for the 29th of March. Do you know what time it was scheduled for?

A34: Uh, the times that I requested were from 0900 to I believe 1200, I am not real sure but it was...

Q35: 1200 Local?

A35: Yes, oh, yeah right, 0900 to about 1200 local.

Q36: And when you coordinate that as you mentioned in an earlier question, when you coordinated that time your, your coordinating that in the frequency with your Nellis, as you mentioned it, with your Nellis frequency management?

A36: Correct.

Q37: Region control right?

A37: Yes.

Q38: Did you also then, would you coordinate that with the Edwards on your courtesy call?

A38: Yes, I did.

Q39: O.K., so you did notify the Edwards?

A39: Right, and they looked on their schedule to ensure that it wasn't scheduled.

Q40: That no conflicts, or that it was scheduled?

A40: That there were no conflicts and that that frequency itself was not scheduled on their schedule. They have, they have their own scheduling, frequency scheduling program that they use.

Q41: Yeah, the Edwards scheduling system I think is what it's called. So you notify, I mean, I don't want to put words in your mouth, but let me make sure I understood. When you were going to do your transmitter test on Monday from somewhere between 0900 and 1200 planned, you had called Edwards and told them you're going to do this test?

A41: Correct, I called them Friday morning.

Q42: Friday?

A42: And they looked at their schedule at the time.

Q43: Do you know who you talked to?

A43: Uh, I talked to Jim Rizzo.

Q44: All right. On, that would be then the 26th of March?

A44: Correct.

Q45: O.K. And then did you conduct your test as scheduled between 0900 and 1200?

A45: Yes.

Q46: And did Jim Rizzo give you a confirmation that was, that was a verbal confirmation, or written confirmation?

A46: A verbal confirmation.

Q47: That it was a good, good frequency at 425 and a good test?

A47: Correct.

Q48: Here is some data that we have been providing, regarding flight termination system test on frequency 425 done on 29 March. Do you recognize that?

A48: Yes.

Q49: And, does it correspond to the test you ran that day?

A49: Yes.

Q50: All right. Now do you take, could a signal send a, a flight termination signal sent from your transmitter have reached the Global Hawk flight on the Edwards test range on the 29th of March?

A50: It would be, I'd have to look at, uh, lets see, what their receiver signal would have been. Because I'm not, I'm a frequency manager and not a engineer and I understand a little bit, and I would need certain information from my standpoint and then I would have to do a study itself to do it. But like I said, that would be from a frequency manager's point and not a engineers standpoint.

Q51: Understand, o.k. All right sir, are their any other matters, that we haven't covered, that you believe may be important in our investigation?

A51: No.

Q52: All right. You're reminded then of the official nature of this interview, you may not discuss your testimony with anyone, without my permission, at any time before the report of this investigation is officially released to the public. And you'll be notified when that happens. This then concludes the interview.

VERBATIM TESTIMONY OF JOHN W. MARSHALL

Q1: My name is Colonel Steven T. Virgilio. I am investigating the Global Hawk accident that occurred on 29 March 1999 at China Lake Naval Air Station, California. This investigation is separate and apart from the safety investigation conducted under AFI 91-204. This investigation was convened to gather and preserve evidence for use in claims, litigation, disciplinary actions and adverse administrative proceedings and for all other purposes except mishap prevention. The safety investigation is also being conducted on the accident for the sole purpose of mishap prevention. Your testimony to us, Sir, may be used for any proper purpose. Additionally your testimony can be released to the public. Do you understand the difference between the safety investigation and this accident investigation?

A1: Yes.

Q2: Do you understand what your testimony may be used for?

A2: Yes.

Q3: Your testimony in this investigation will be under oath. At this time I will administer the oath, so Sir, please raise your right hand. Do you solemnly swear that the testimony you are about to give in the matter now under investigation shall be the truth, the whole truth and nothing but the truth, so help you God?

A3: I do.

Q4: Thank you. Sir to day is 30 April 99, time is 1333 local. This interview is being conducted in Building 2500, at Edwards AFB, California. Persons present at Edwards AFB are Colonel Steve Virgilio Board President Myself, Major Ray Chamberland the Legal Advisor, the witness. And, Sir, I need you to state your name and position for me.

A4: I'm Mark Aspenwall, Region General Council for Allegheny Telematic Incorporated.

Q5: Thank you, Sir. The witness has been sworn. Sir, will you please state your full name for the record?

A5: John W. Marshall.

Q6: You present grade?

A6: I'm civilian.

Q7: Where are you assigned?

A7: Teledyne Ryan Aeronautical, in San Diego.

Q8: And what is your job title?

A8: I am an engineer specialist, you want responsibility with that?

Q9: Sure.

A9: I have the EMI/EMC responsibility on the Global Hawk program, as well as, antenna placement, uh ______ among other duties, those are primary.

Q10: Sir, could you spell out or tell us what EMI and EMC stands for?

A10: EMI is electromagnetic interference, EMC is electromagnetic compatibility.

Q11: All right, thank you Sir. All right, Sir, I'm going to get into some questions. Do you, Sir, know who or what directed the selection of the FTS antenna type presently used for Global Hawk?

A11: Umm, what directed the selection was it's used on other programs. Other programs that we have had as well as we have done some qualification test on that particular antenna on another program, and we're familiar with its aspects and how it works.

Q12: Do you know if it was part of the contractual requirements or was it just part of the contractor's requirements to meet the contractual request?

A12: It was part of the system that meets the contractual request.

Q13: All right. And so this antenna system that was used, was something you've used before with other systems in your company?

A13: Correct.

Q14: Do you know who or what selected or designed the location of the FTS antenna on the Global Hawk UAV?

A14: I selected the location for it on the UAV.

Q15: All right. Was there any testing, Sir, done on the present location of the FTS antenna location on the UAV Global Hawk for antenna strength or reception anomalies?

A15: Hmm. We have run some uh, testing the course of the vehicle checkout if that's what you mean.

Q16: I guess what I'm asking is, you did do testing on the location of the antenna in its ability to fit in to the system requirements of the vehicle? In other words, did it cause, if it caused interference from another antenna, another antenna had interference, did you do some type of testing with either through computer simulation, modeling or actual hard test to, to pick the location that you're using the antenna on right now?

A16: The antenna was placed at its location with a computer simulation, is where it started.

Q17: Was the computer simulation something from a model that your company developed or is it something that a subcontractor developed for you?

A17: It's a application that we acquired from the Joint Spectrum Center.

Q18: Oh, help me on that now, Joint Spectrum Center?

A18: They used to be called ECAC (sp?), it's a Government office in Washington DC. Well, I guess they're, are they Government? They do work for the Government in Washington DC.

Q19: They work for the Government, they're not a Government Agency, you just said that?

A19: Well, I think it's an Agency.

Q20: Could you tell me the name of that again?

A20: Joint Spectrum Center.

Q21: Joint Spectrum Center. And then they give you the computer simulation, that then you're able to, or that you're able then to run, to run the, for better choice of words, the requirements or the specifications that the antennas on? Does that make sense?

A21: No, Sir.

Q22: O.K. When you ran the computer simulation that you received from them, and ran this through it, ran this antenna or whatever through it, did you get hard data from that, did you get some type of data that said good, bad, indifferent?

A22: Yes, you do get data, umm, you have to interpret that data with respect to the, the rest of the antennas on the aircraft.

Q23: Do you have that data available to you?

A23: I don't have it with me.

Q24: O.K., but you, you can, are you able to get that data? That you used for the interpretation?

A24: Yes.

Q25: And then the results of the interpretation? You're able to get that data as well?

A25: It's a uh, yes.

Q26: And is that interpretation done by you; or your office; or some part of your branch; or shop or division?

A26: Mainly done by me, with concurrence of, in this case, Range safety.

Q27: I would like you, if you could for the record, can you, you may not have it with you now, and I would like you to try to provide that data, if you could. In other words, the results of it, the hard data, the results of it, and any interpretation that was made, if you could. Who in range safety then were you working with when you said that range safety?

A27: We had, uh, meetings and uh, with the safety representatives present, as I recall Steve Cronk was...

Q28: We're talking Edwards?

A28: Edwards Range Safety.

Q29: All right. All right Sir. Where did this, the data you're referring to might be better answer to this next question. Is there an antenna termination pattern data available for the Global Hawk, cause I think we had talked about a little bit on the phone?

A29: We have the vender pattern.

Q30: Do you have that available with you?

A30: Yes.

Q31: This is the vender pattern?

A31: Yes.

Q32: And again this is the specs?

A32: That's the spec on the antenna, and the, uh, what was the rest of the question?

Q33: I just, I was, what do you do? Help me out, just in the layman's terms. When you get the venders data on this, on these, what do you do with this in applying it to what you were doing with the location of the antenna and that you were going to use on Global Hawk, or you plan to use this on Global Hawk? Did you overlay this on some other type of model?

A33: You have to take, uh, the software application is somewhat limited in that you're in, in the amount of points in the pattern that you can put into it. So you look at that pattern and you pick what best that you can put into the application and make your evaluation. Does that answer your question?

Q34: But, there, you don't roll, you roll this into this model that you, this computer simulation?

A34: Yes, correct, in some respects. But you have to also use the antenna itself, it's a hemispherical antenna, if you understand that term?

Q35: Yes, I do. So there is, I don't want a yes or no answer, but you take this and roll this into some type of a simulation, but there is no antenna termination pattern per say? In other words would not, you know what an antenna pattern looks like?

A35: Yes.

Q36: Is there something like that, that was actually ever done for Global Hawk with this antenna?

A36: Uh, um, no.

Q37: In your experience is there a blind spot or a null area on the aircraft where the antenna won't receive an FTS signal?

A37: No.

Q38: Are you aware of any blind spots or nulls on the Global Hawk for FTS?

A38: Not for FTS. Could you explain what you mean blind spot?

Q39: A blind spot to where you might get a, in the orientation of the UAV, to where for whatever timeframe small/minute, would have an area where the signal strength for FTS would drop off?

A39: Now you're saying drop off to?

Q40: Well, drop off out of limitations? Get below, below it's minimums for signal strength, for an FTS, for an FTS system specification requirement? There is a standard you must meet for FTS, as you know, as you're aware of probably?

A40: Right.

Q41: And, is there any nulls or blind spots where that standard could not be met on the Global Hawk? Are you aware of any of that?

A41: To the best of my knowledge no.

Q42: O.K. Now with this, by the application of this antenna on it?

A42: Yes.

Q43: O.K. Maybe I didn't word that right to you. You look a little confused; maybe I didn't say it right?

A43: Yeah, you have... I have some of the, you know, the range safety stuff that I brought with me, and there's some guidelines in there.

Q44: These are the RCC standards?

A44: Yeah, they're goals, and of mitigating and minimizing things. And this antenna, and its placement and its performance in my opinion complies with that. Your term drop off has other connotations.

Q45: Yes, Sir, as I said that, I saw your look, I realized I probably need to be a little more specific than the other night. I couldn't really get into the level of detail you have sitting in front of you there.

A45: I don't know where you are in the standing, so...

Q46: Well, I understand...

A46: I know that it's confused sometimes in trying to....

Q47: I'm not an electrical engineer, I guarantee. There's been some evidence presented to the Board that the armed/terminate signal sent from Nellis AFB, possibly captured the Global Hawk receivers and caused it to terminate flight. In your opinion, do you think this could have happened?

A47: It's possible.

Q48: And since you say it's possible, do you, do you know what circumstances you would think would have to occur to allow this to happen?

A48: You'd have to have the two frequencies, the two, uh, sources let me put it that way, at the same frequency, with a similar tone set. Do you understand that?

Q49: Yes, I understand that Sir. All right, Sir, are there any other matters that we haven't covered that you believe need be important to our investigation?

A49: Uh, no I don't think so.

Q50: All right Sir, thank you. You're reminded of the official nature of this interview. You may not discuss your testimony with anyone without my permission at any time before the report of this investigation is officially released to the public, O.K. Sir? And this concludes the interview.

RECORD REPRODUCTION COVER SHEET

The attached records are:

Releasable to the Public ☑

Denied to the Public ☐

Subject: 1999 Global Hawk Accident Report

FOIA Control Number: 07-283 LK

Date Reproduced: 11 Oct 07

6 of 7

MEMORANDUM

TELEDYNE RYAN AERONAUTICAL
Tier II Plus Unit
An Allegheny Teledyne Company

TO: Accident Investigation Board, Global Hawk **DATE:** 5/6/99

FROM: John W. Marshall , EMI/EMC Engineer

SUBJECT: Flight Termination Receiver Test

Attached please find the data presenting the results of tests performed on the Model FTR-915A Flight Termination Receiver. These data are copies made from a strip chart recording.

The tests consisted of two signals at 425 MHz applied to the receiver RF input through a combiner. The tests are a variation from the IRIG Std 313-94 in that both signals were modulated with the exception of one test.

The attached data presents the following tests and the results when both signals are within ≤ 2 dB:

1. Signal Generator #1 modulated with Tone 5
   Signal Generator #2 modulated with Tone 5 and offset low by 10 Hz for effects on the Signal Strength indication.

   Data shows Tone 5 Toggling On and Off and variations in the Signal Strength Telemetry output

2. Signal Generator #1 modulated with Tone 5
   Signal Generator #2 modulated with Tone 5 and offset high by 10 Hz for effects on the Signal Strength indication.

   Data shows Tone 5 Toggling On and Off and variations in the Signal Strength Telemetry output

3. Signal Generator #1 modulated with Tone 5.
   Signal Generator #2 modulated with Tone s 1 and 2.

   Data shows Tone 5 Toggling On and Off as the signal level of Signal #1 converges with Signal #2. The receiver outputs an Arm and Terminate command.

4. Signal Generator #1 modulated with Tone 5.
   Signal Generator #2 modulated with Tone s 5, 1 and 2.

   Data shows Tone 5 Toggling Off, Tone 5 toggles On, remains On, Arm toggles On/Off/On, then remains On. Terminate command On when tone 5 is removed from Signal #2.

5. Signal Generator #1 modulated with Tone 5.
Signal Generator #2 modulated with Tone 7.

Data shows Tone 5 Toggling Off and remains Off.

6. Signal Generator #1 modulated with Tone 5.
Signal Generator #2 modulated with Tone s 7, 1 and 2.

Data shows Tone 5 Toggling Off .

7. Signal Generator #1 unmodulated.
Signal Generator #2 unmodulated.

Data shows variation in the Signal Strength Telemetry output.

8. Signal Generator #1 modulated with Tone 5.
Signal Generator #2 modulated with Tone 5.
Higher signal level test

Data shows Tone 5 Toggling On/Off between Signals #1 and #2 and variation in the telemetry Signal Strength Ouput.

9. Signal Generator #1 modulated with Tone 5.
Signal Generator #2 modulated with Tone s 1 and 2.
Higher signal level test.

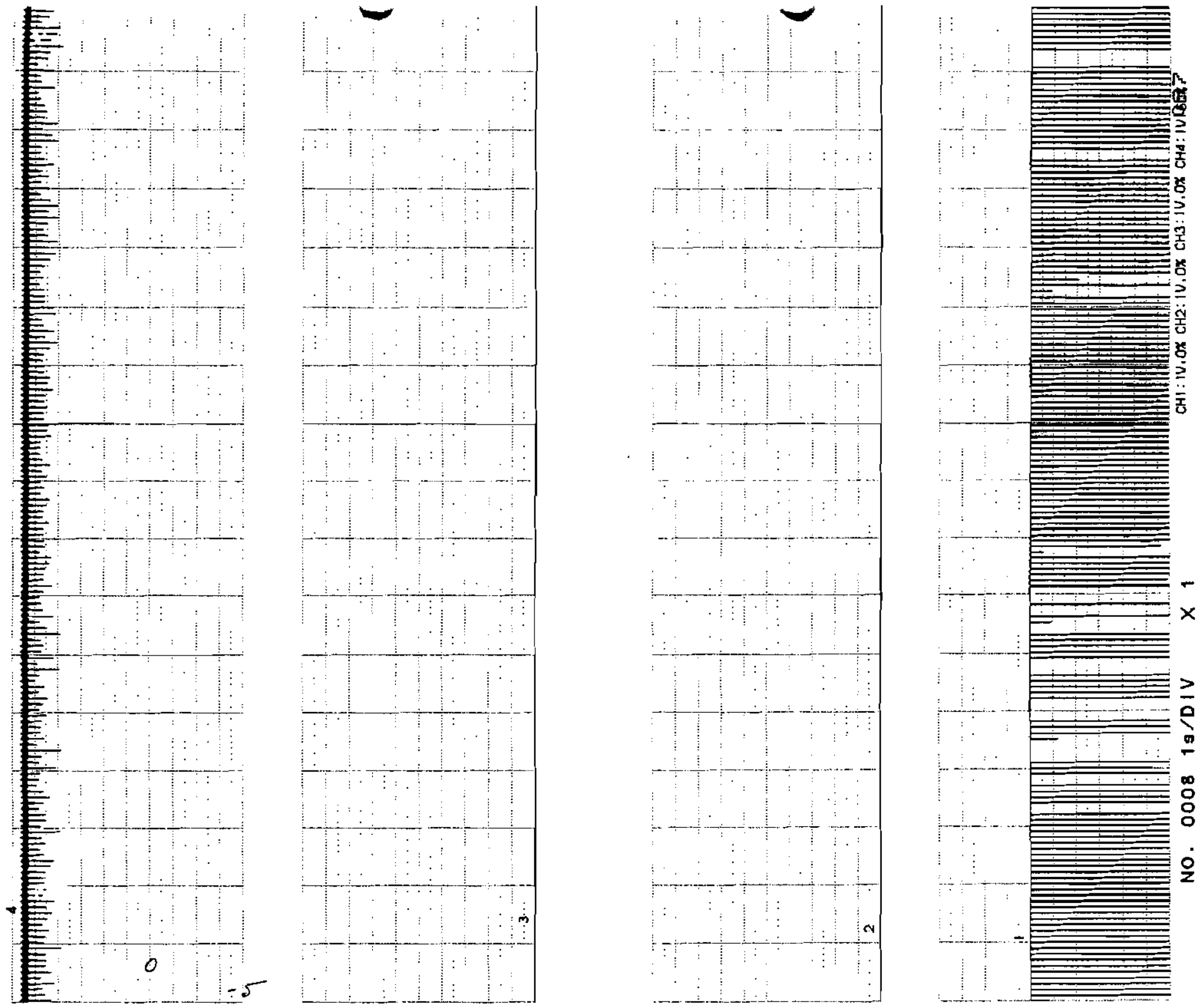
Data shows Tone 5 Toggling On and Off as the signal level of Signal #1 converges with Signal #2. The receiver outputs an Arm and Terminate command when the level from Signal #1 is reduced .2 dB below Signal #2.

10. Signal Generator #1 modulated with Tone 5.
Signal Generator #2 modulated with Tones 5, 1 and 2.
Higher signal level test.

Data shows Tone 5 Toggling On and Off with both signals equal. Arm toggles On/Off as the level of Signal #1 is reduced. Tone 5 toggles On and then remains On, Arm continues to toggle On/Off. When the level from Signal #1 is reduced .5 dB below Signal #2 Arm continues to toggle On/Off. Arm and Terminate commands occur when Tone 5 is removed from Signal #2.

These tests were performed at L3 Communications-Conic Division with the assistance of L3 personnel and directed by the undersigned.

John W. Marshall
John W. Marshall

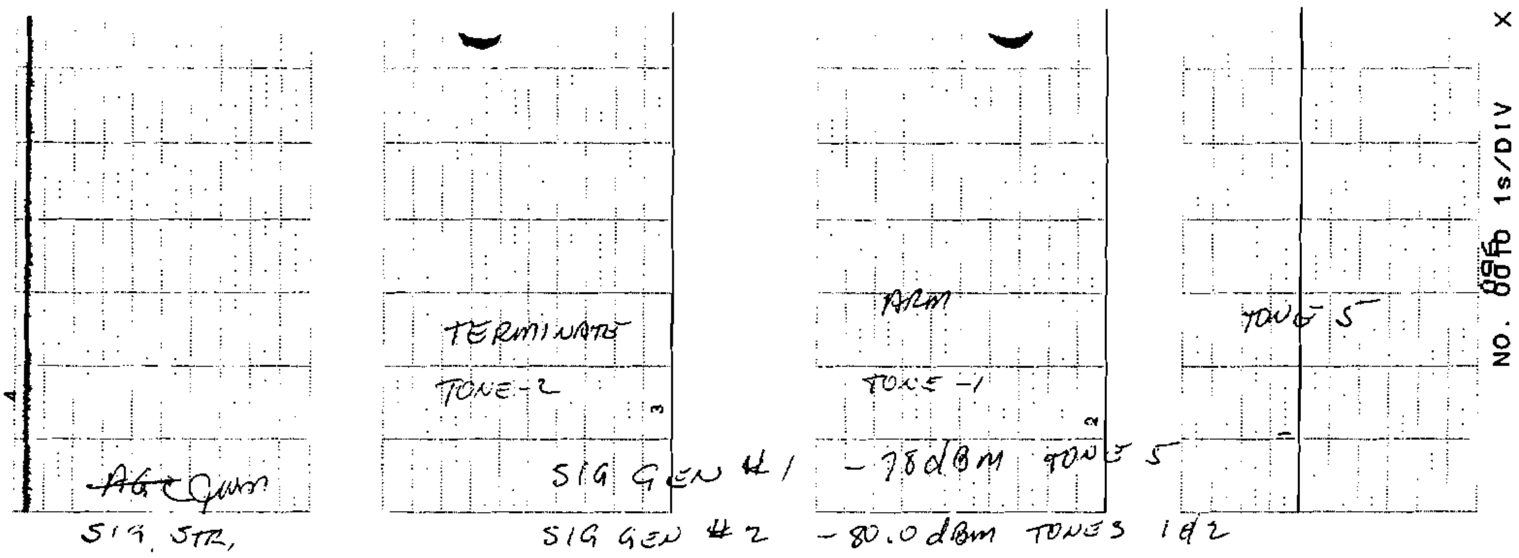


~~AGC~~ ~~~~ SIG. STR.

TONE - 2

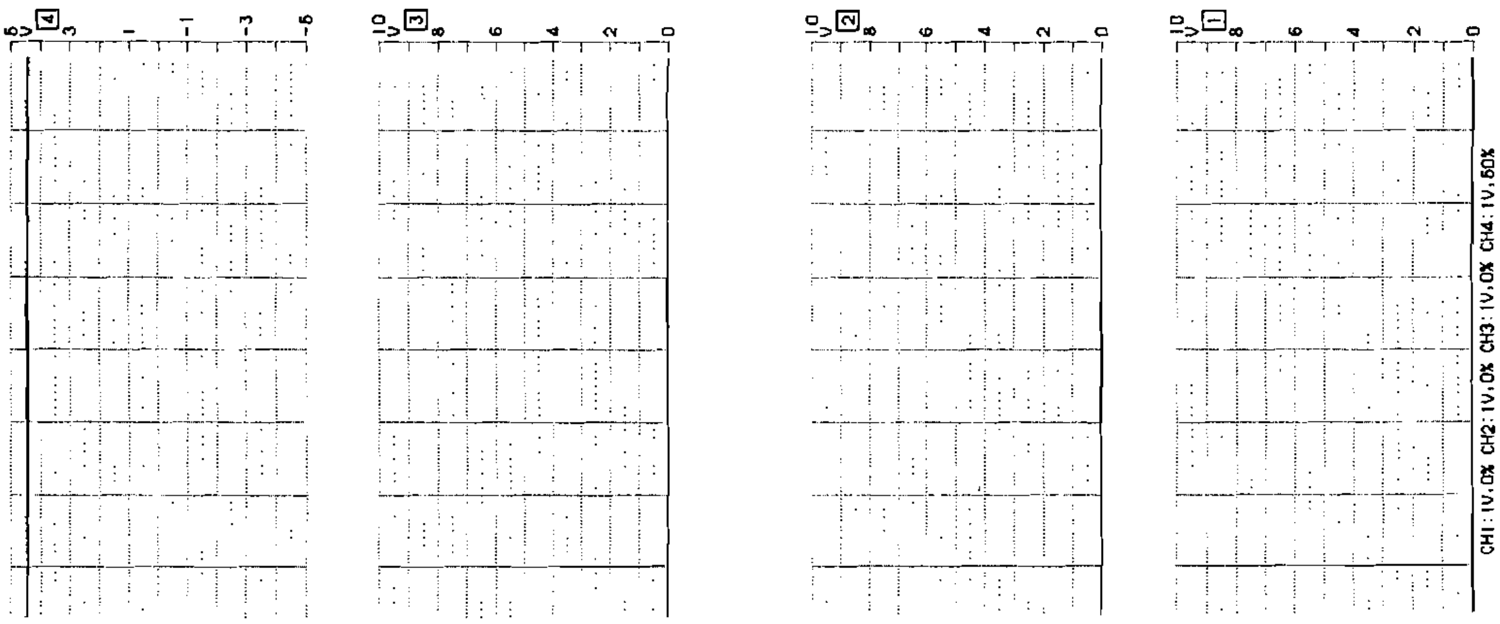
TONE - 1

TONE - 5

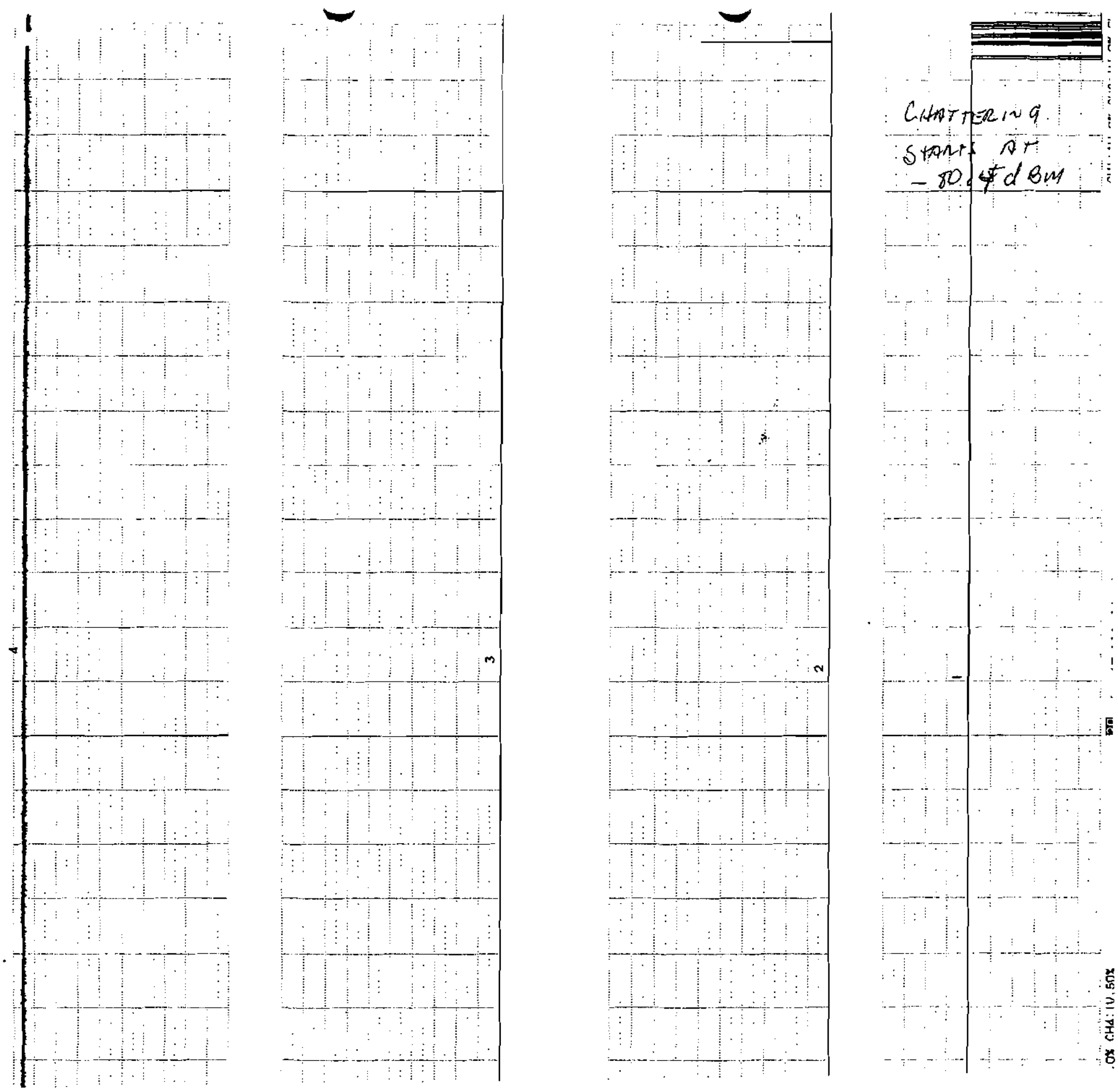


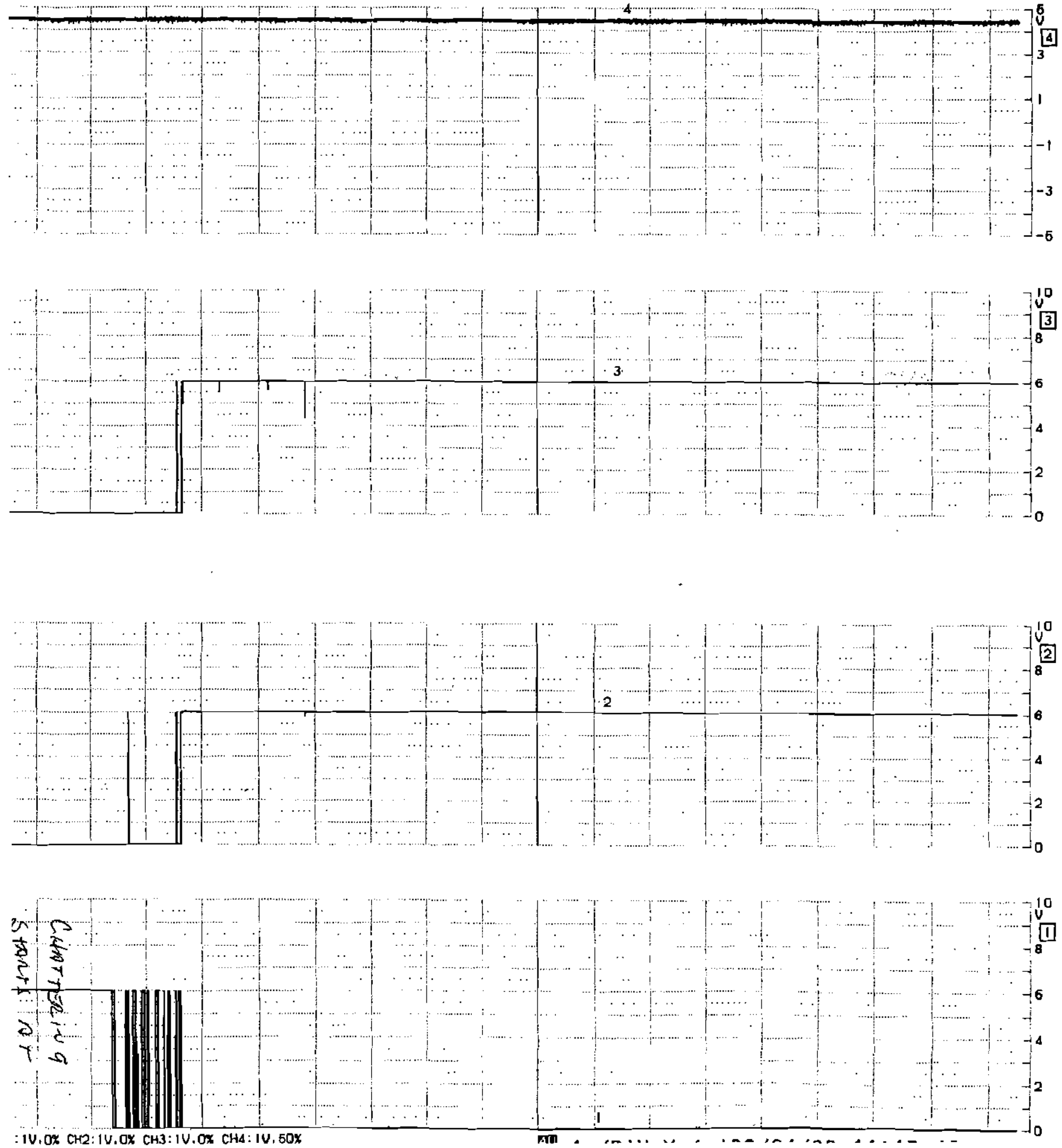
NO. 0095 1s/DIV
AGC Gain
SIG. STR.
TERMINATE
TONE-2
ARM
TONE -1
TONE 5
SIG GEN #1 -78dBm TONE 5
SIG GEN #2 -80.0dBm TONES 1&2

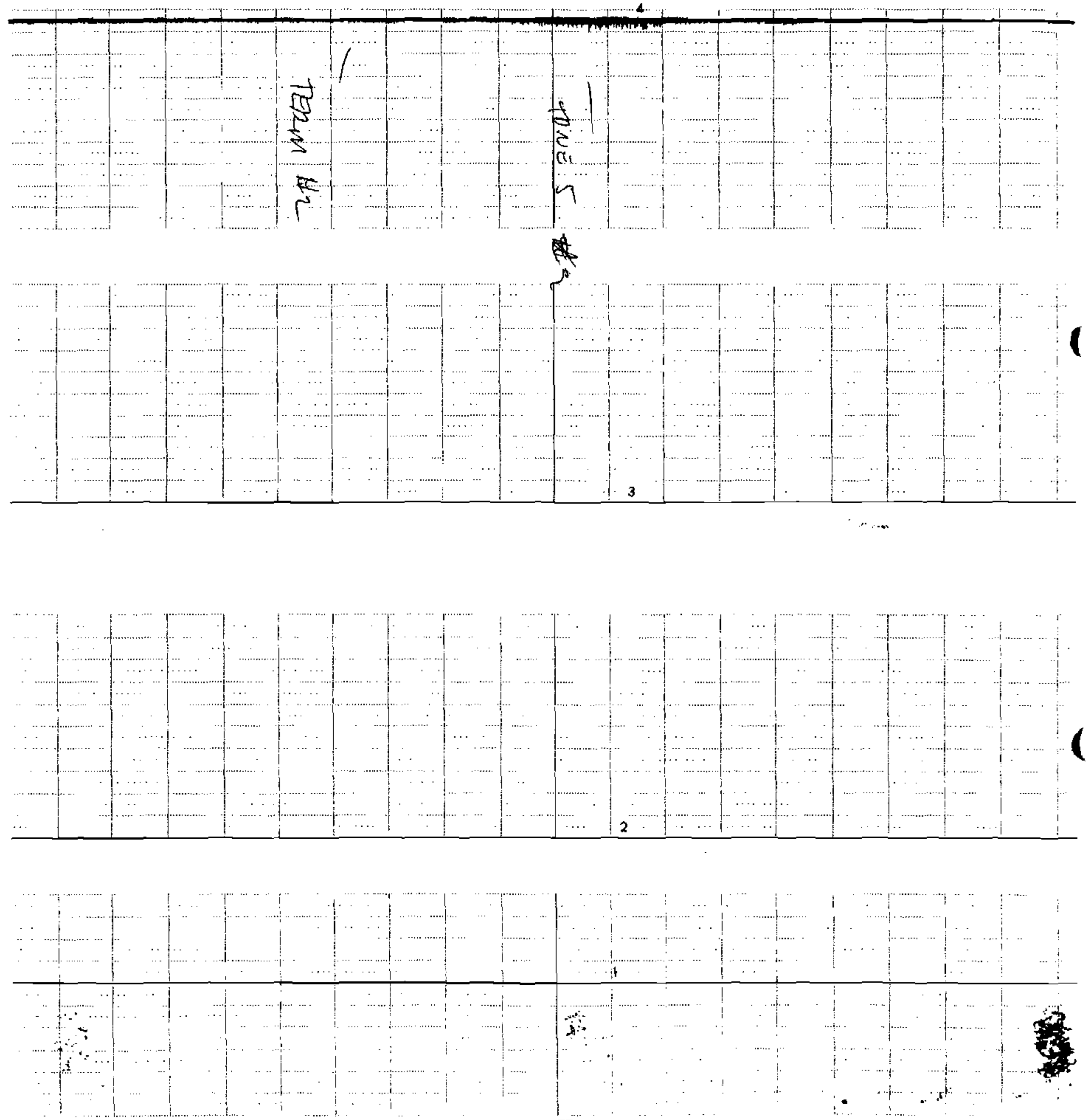
Rcvr



CH1:1V,0% CH2:1V,0% CH3:1V,0% CH4:1V,50%

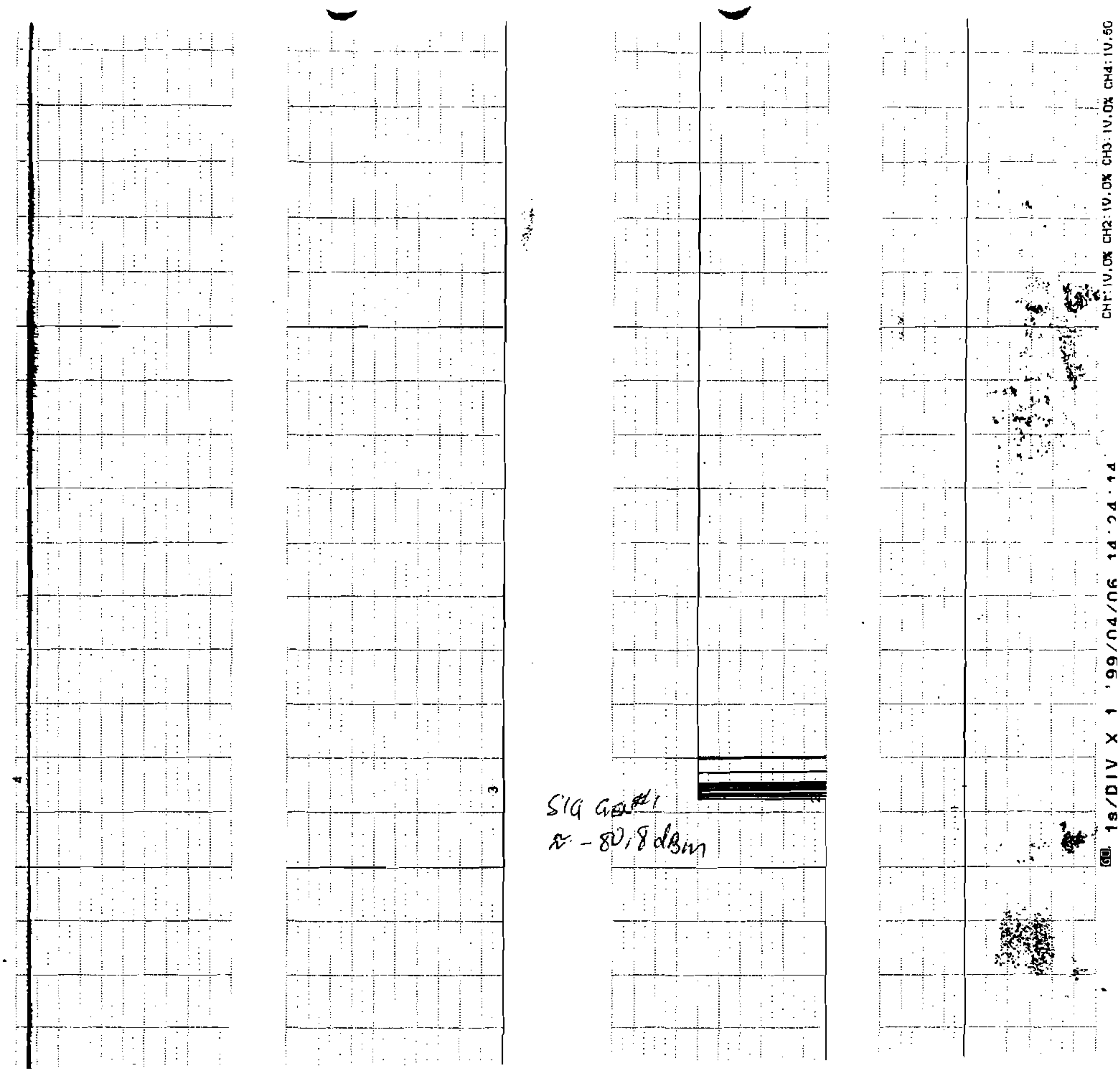

CHATTERING
STARTS AT
-80.4 dBm

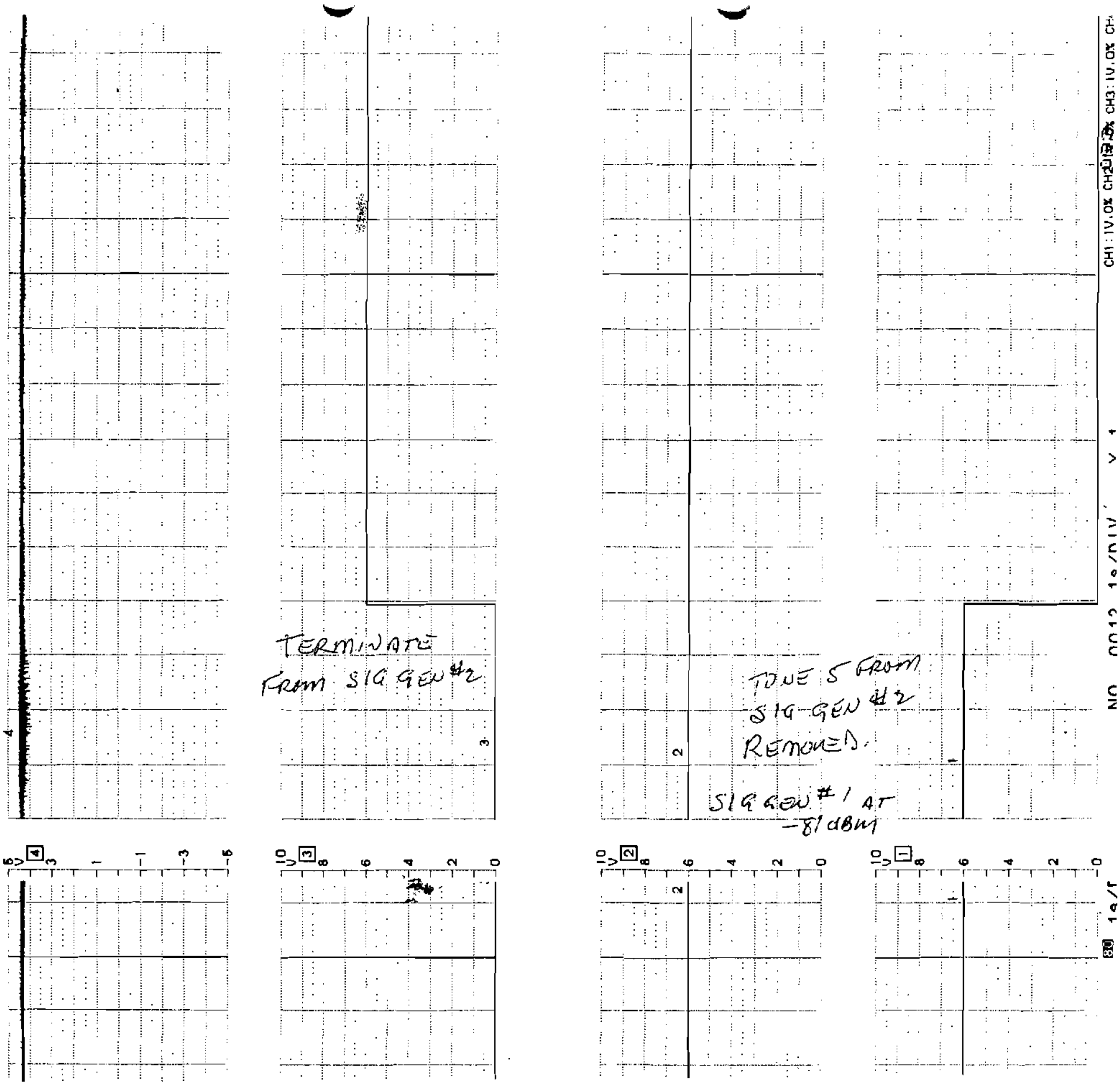

CHATTERING
STARTS AT
:1V,0% CH2:1V,0% CH3:1V,0% CH4:1V,50%

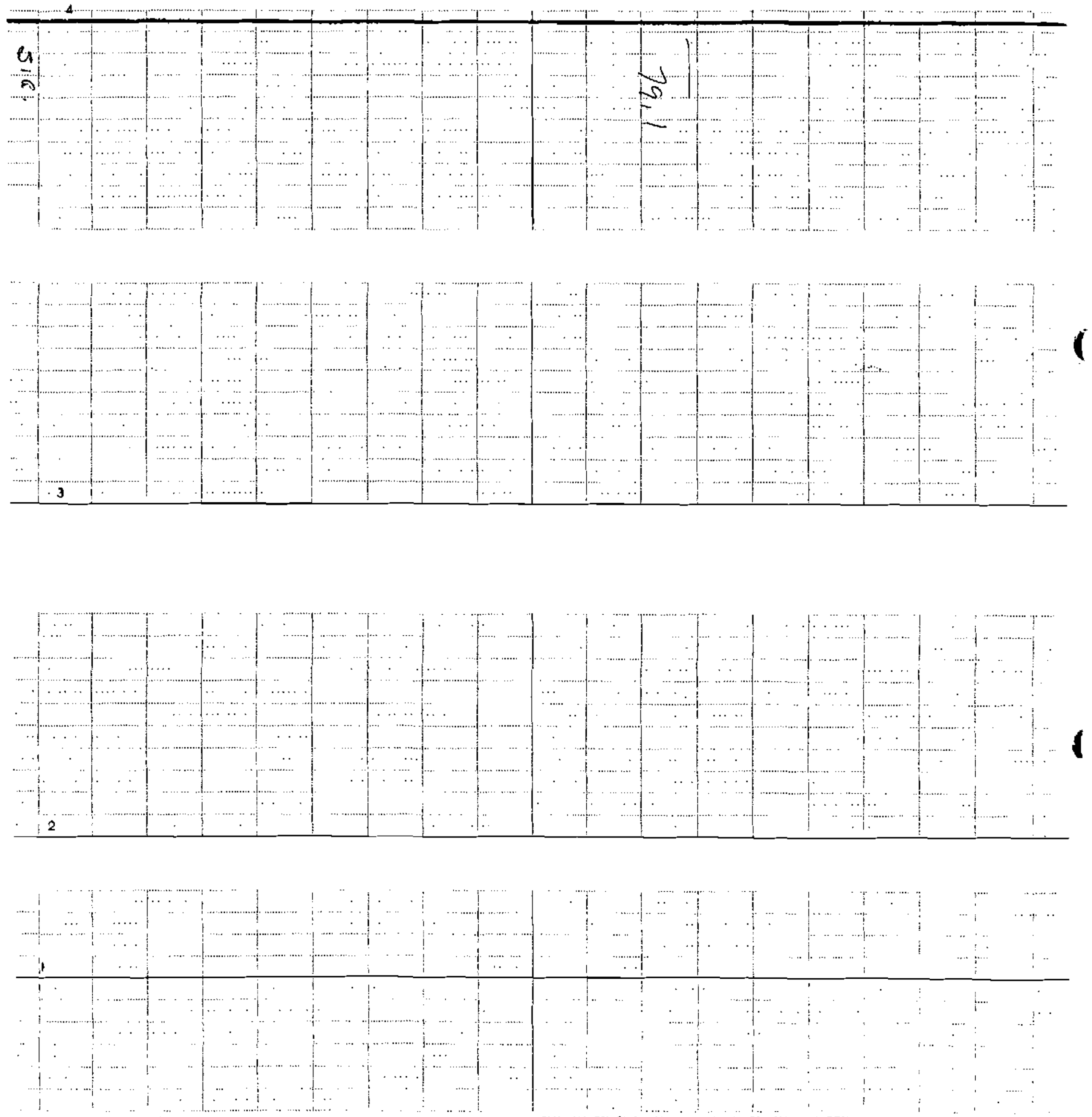


CH1:1V,0% CH2:1V,0% CH3:1V,0% CH4:1V,50%

20 1s/DIV X 1 '99/04/06 14:23:34

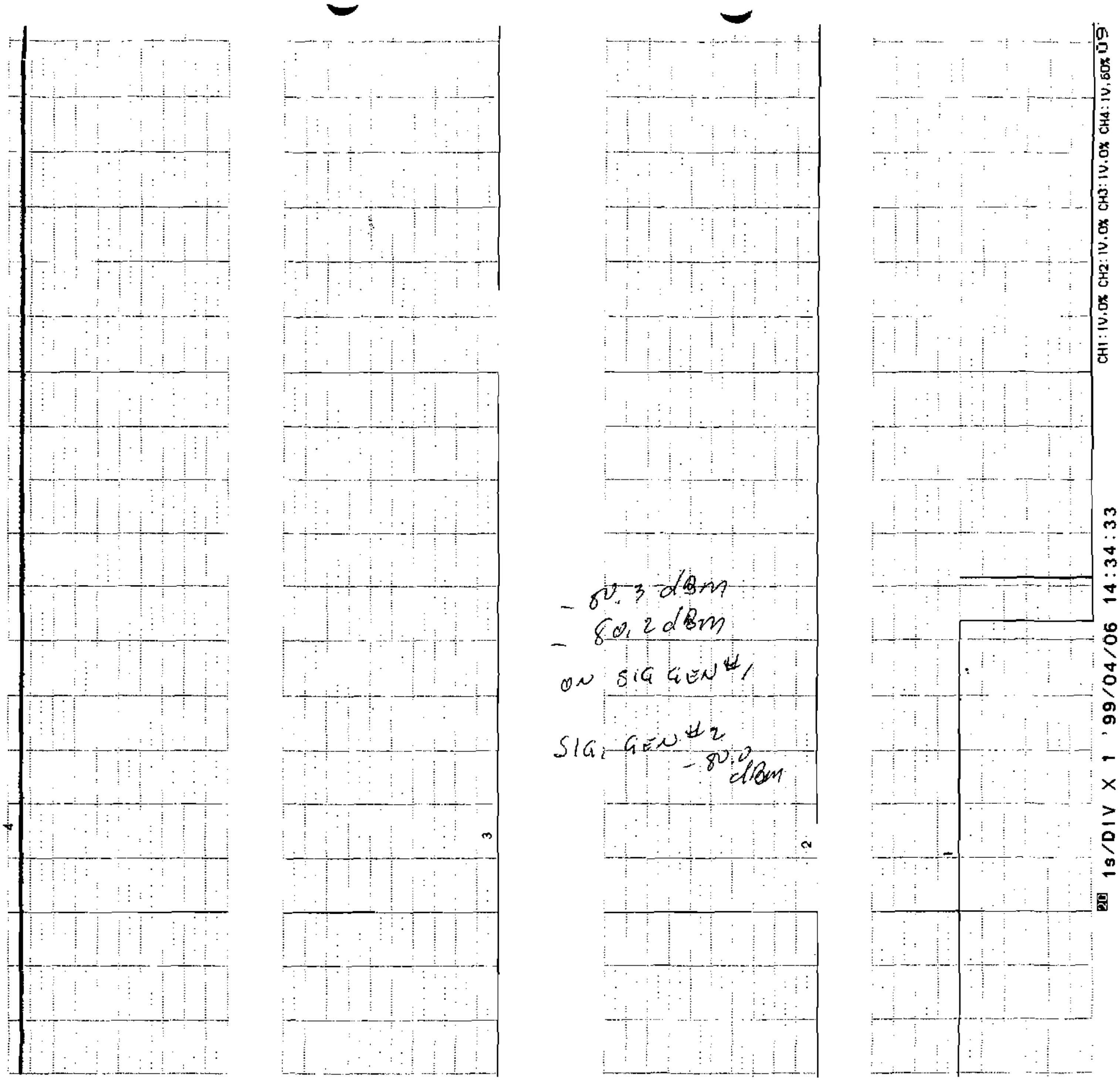

1s/DIV X 1 '99/04/06 14:24:14
CH1:1V,0% CH2:1V,0% CH3:1V,0% CH4:1V,50
SIG GEN #1
≈ -80,8 dBm


TERMINATE FROM SIG GEN #2
TONE 5 FROM SIG GEN #2 REMOVED.
SIG GEN #1 AT -81 dBm

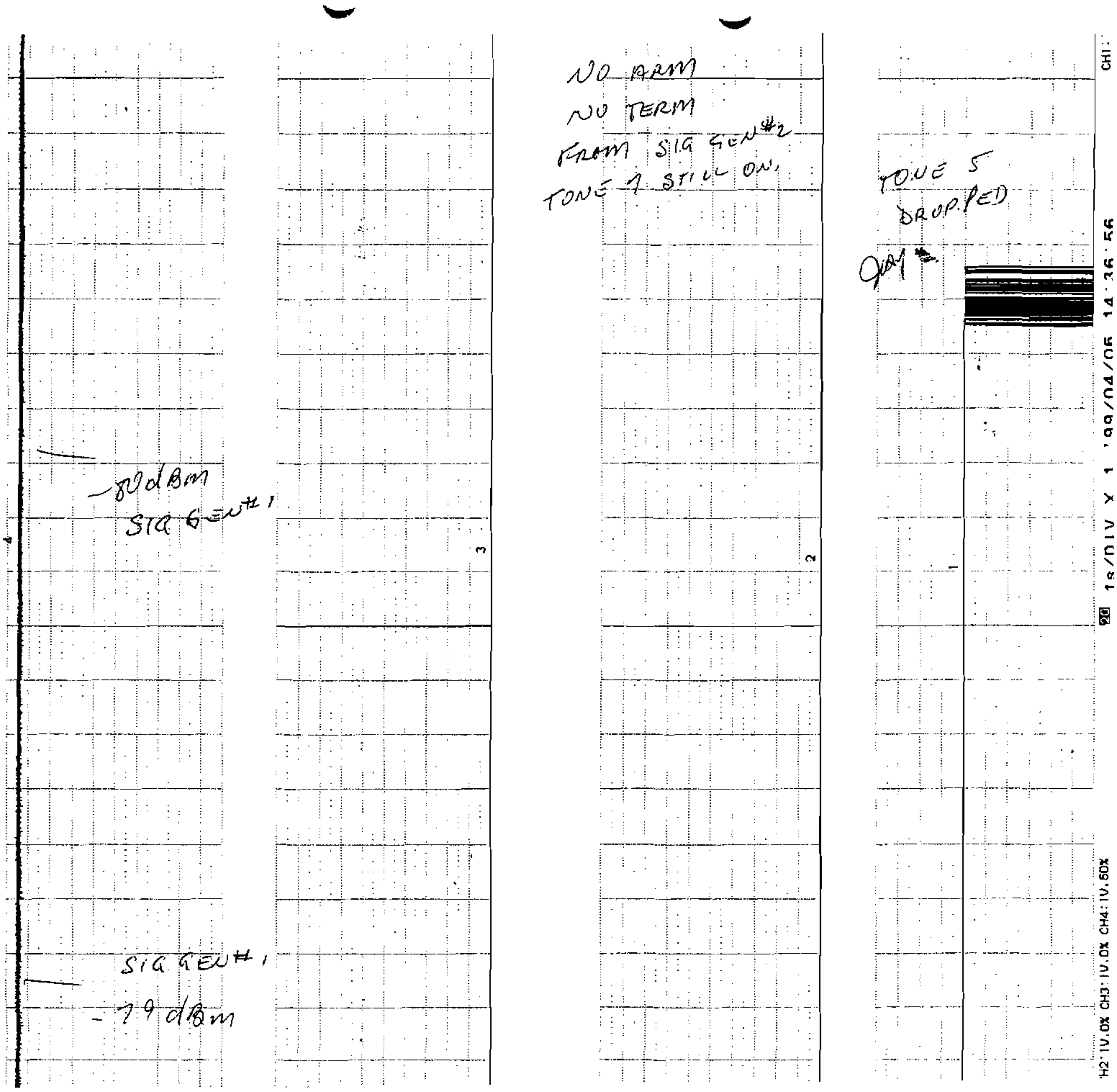


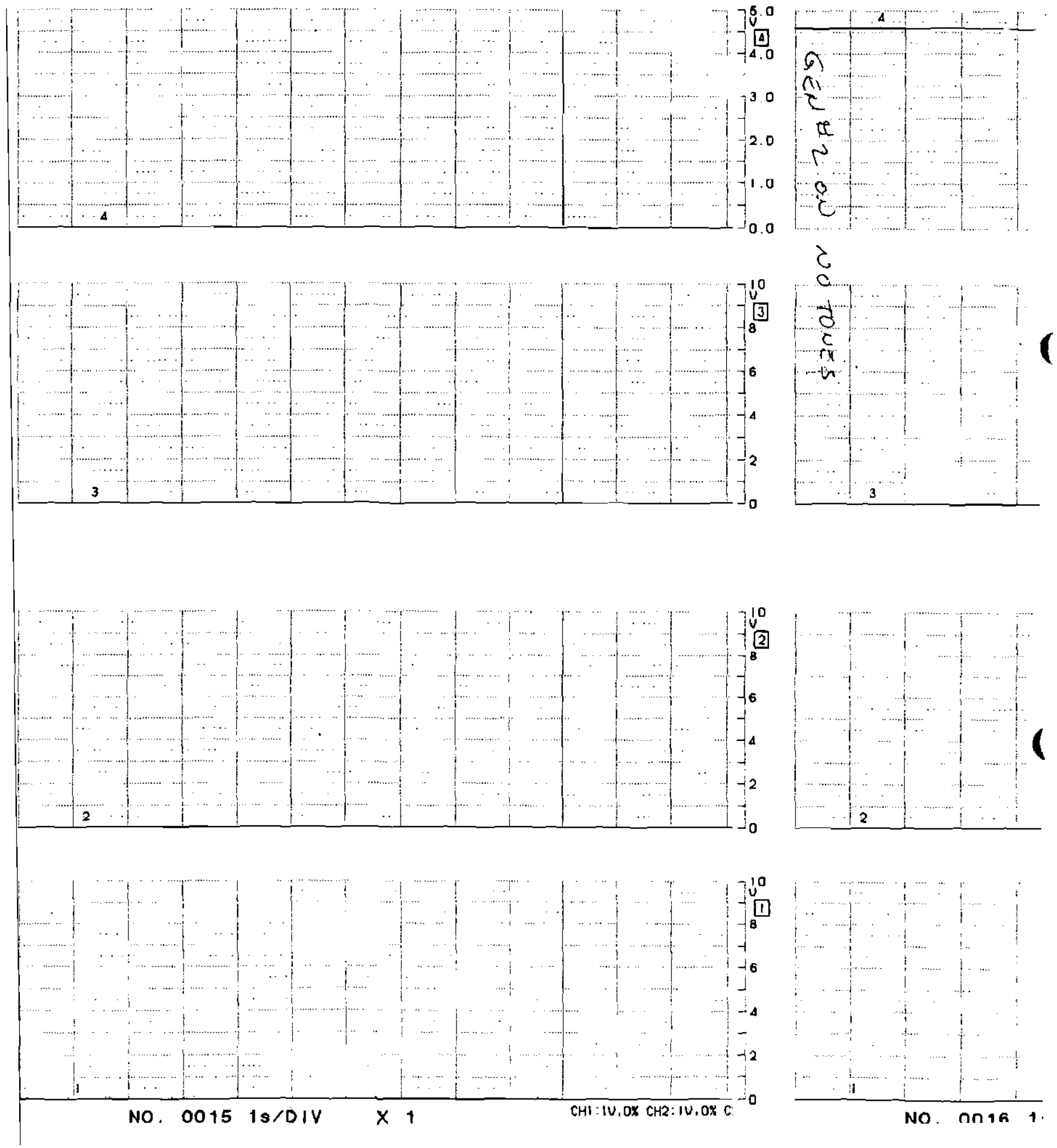
NO. 0013 1s/DIV X 1

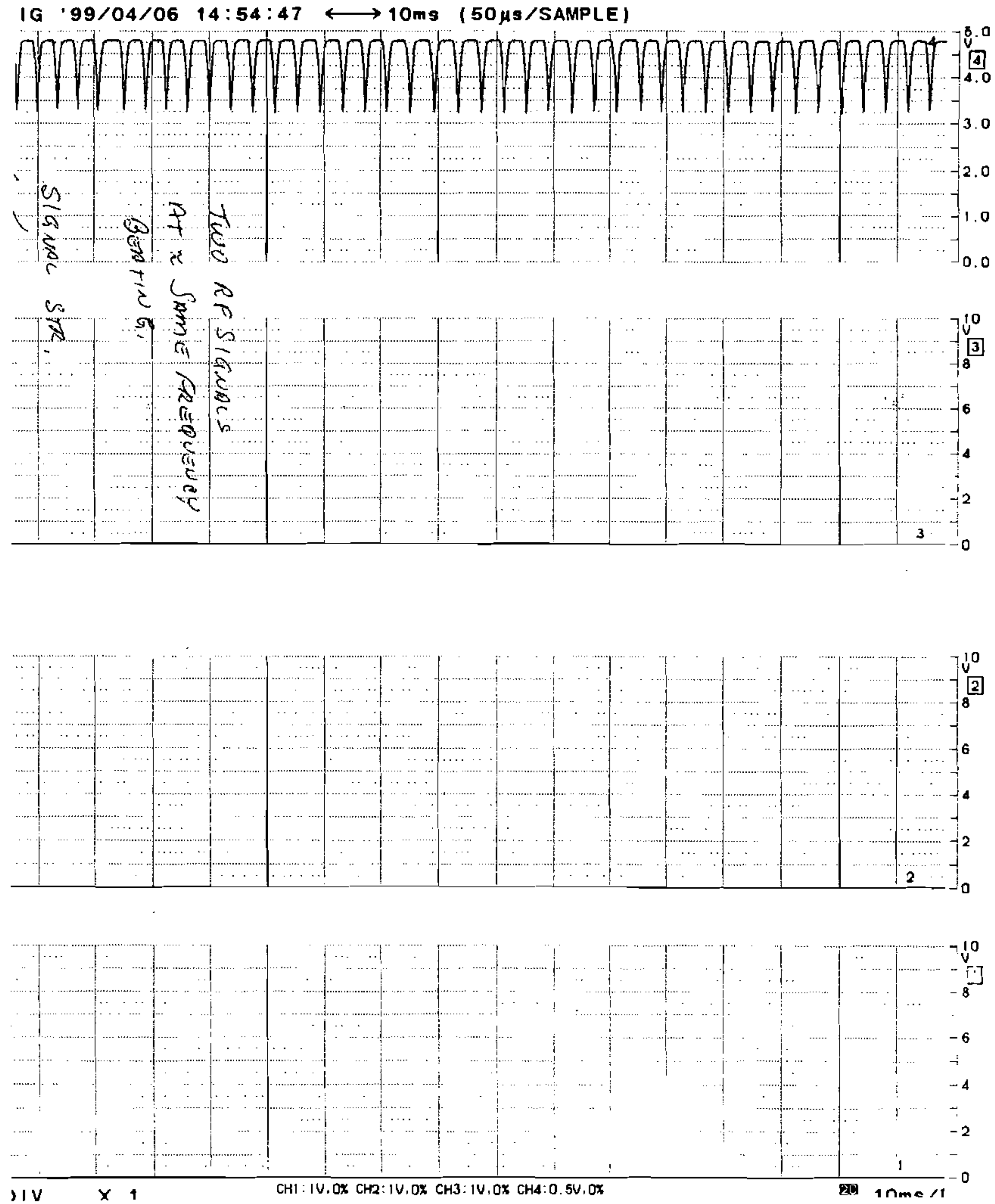
CH1:1V,0% CH2:1V,0% CH3:1V,0% CH4:1V,50%



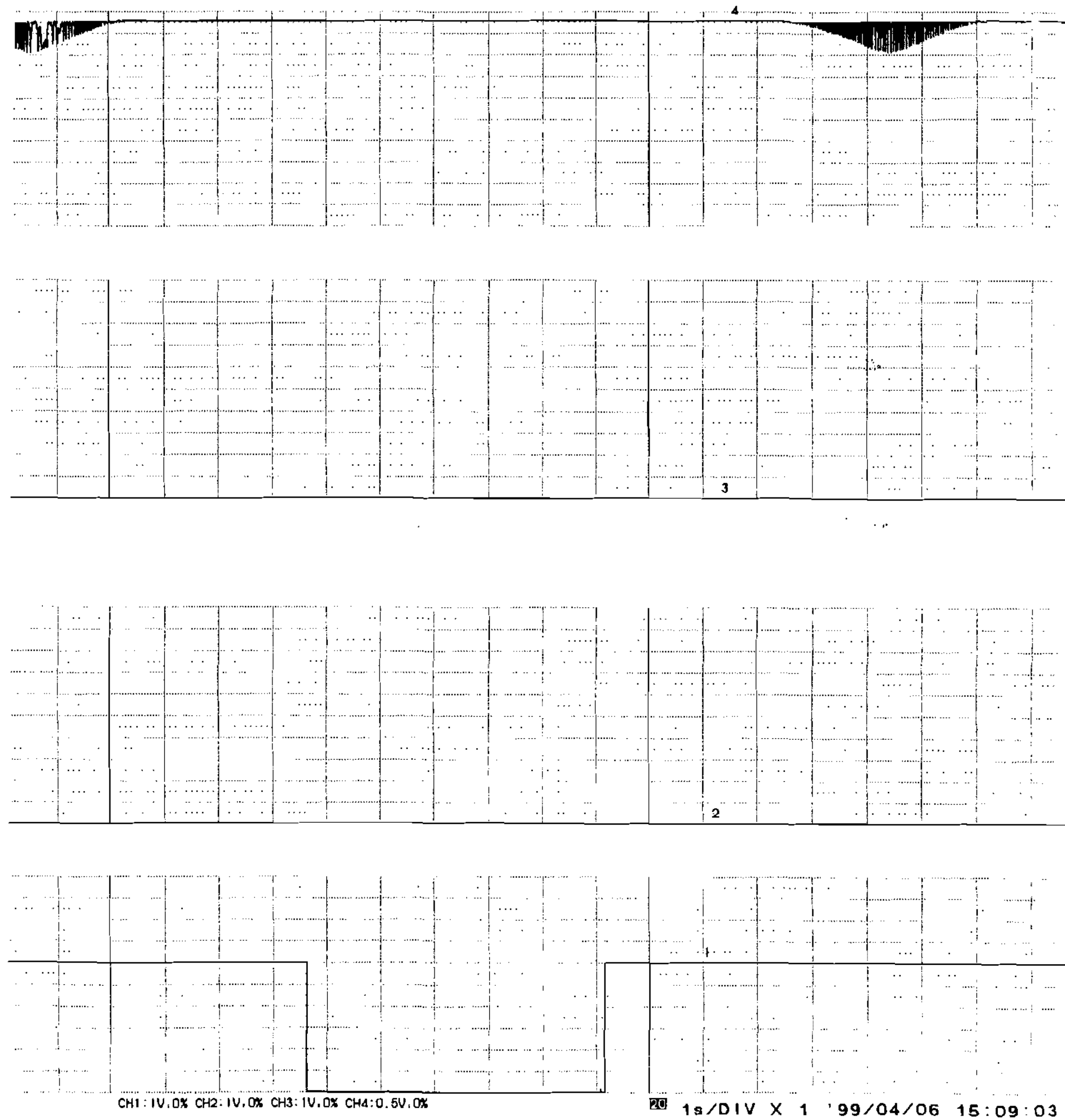
1s/DIV X 1 '99/04/06 14:34:33
CH1:1V.0% CH2:1V.0% CH3:1V.0% CH4:1V.60%
4
3
2
1
- 80.3 dBm
- 80.2 dBm
on SIG GEN #1
SIG. GEN #2
-80.0 dBm

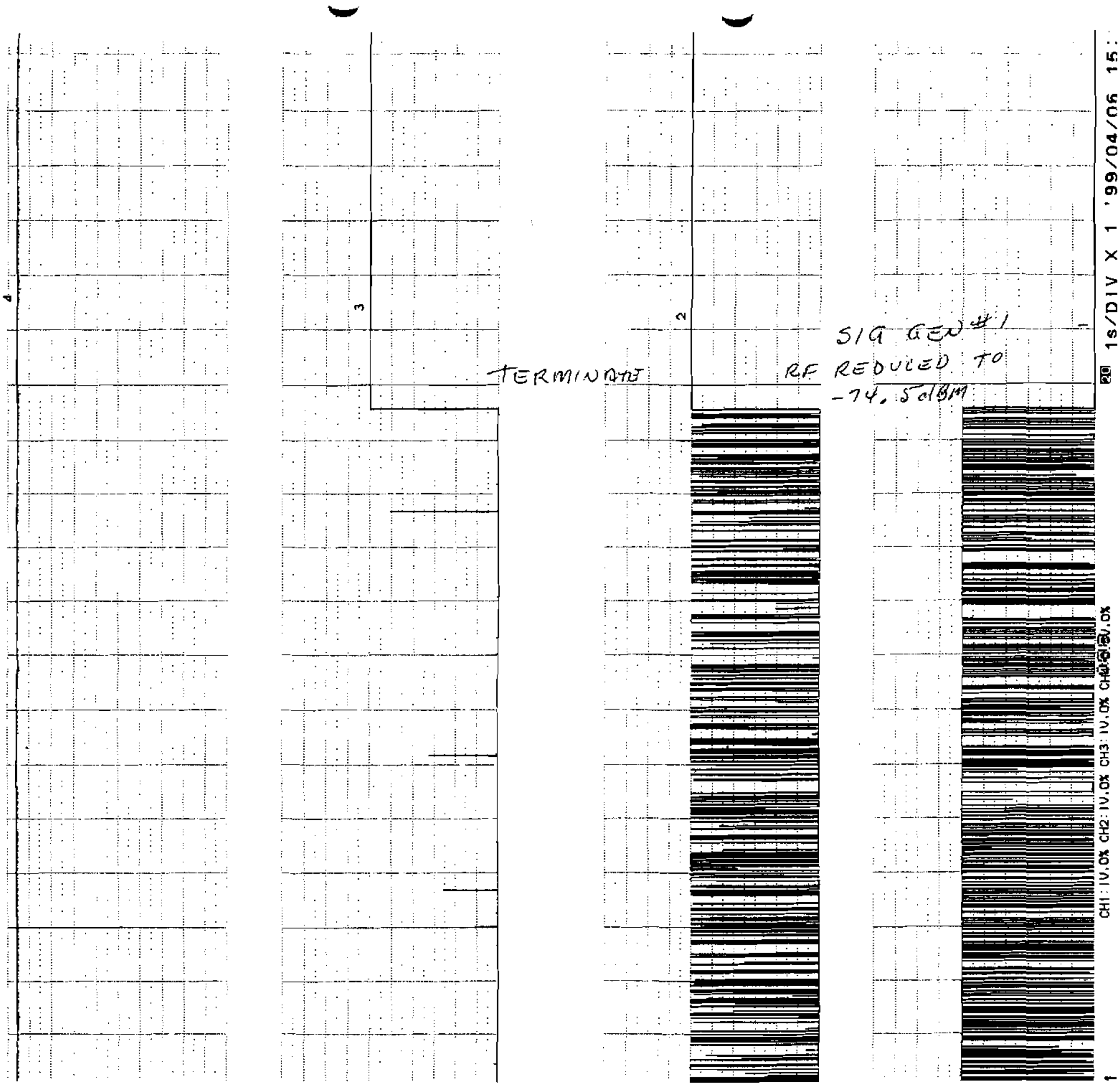

NO ARM
NO TERM
FROM SIG GEN#2
TONE 7 STILL ON,
TONE 5
DROPPED
-80dBm
SIG GEN#1
SIG GEN#1
-79 dBm
CH1:
1s/DIV X 1 '99/04/06 14:36:56
CH2:1V.0X CH3:1V.0X CH4:1V.50X


GEN #2 ON NO TONES
NO. 0015 1s/DIV X 1
CH1:1V,0% CH2:1V,0% C
NO. 0016 1

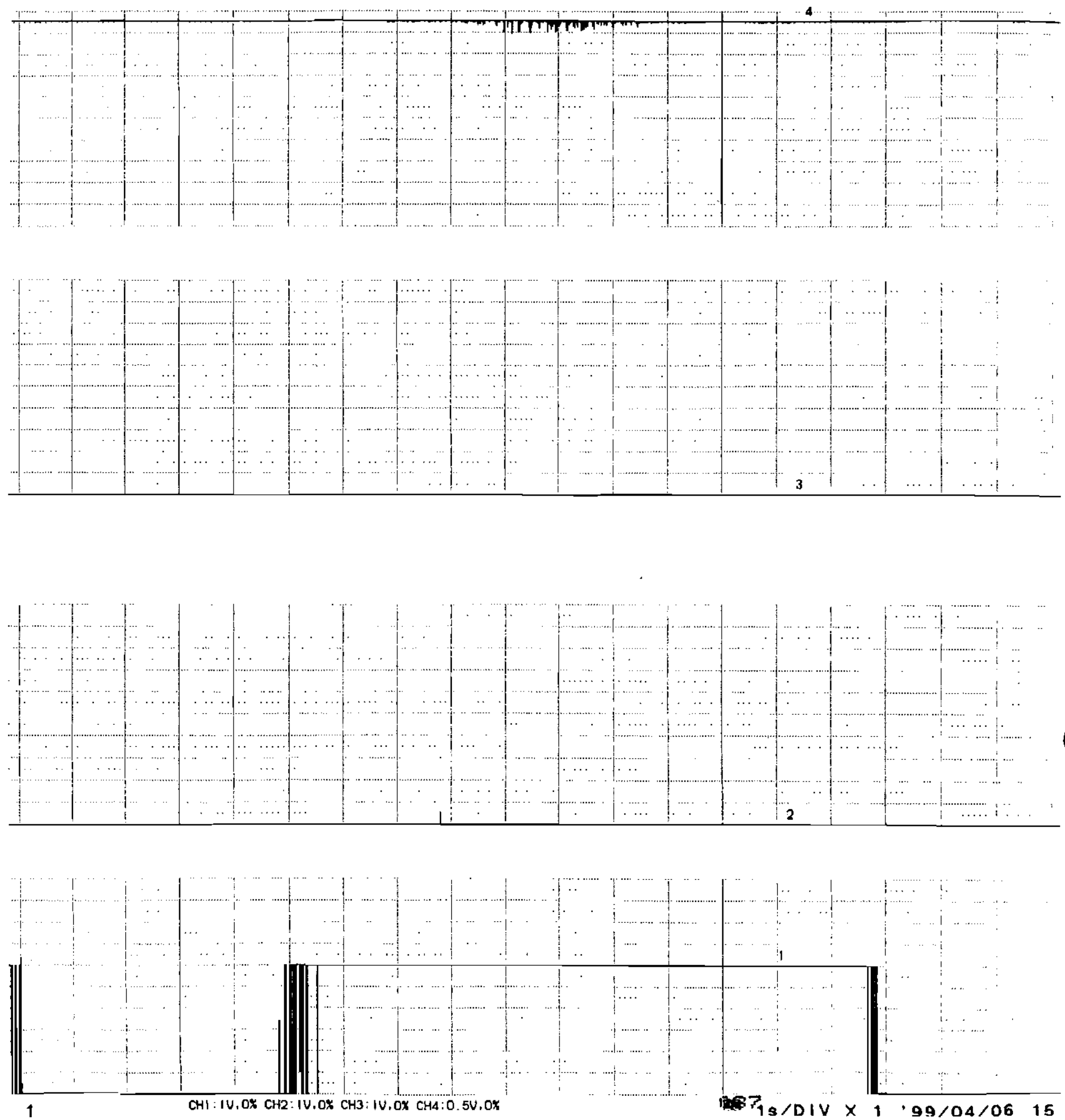


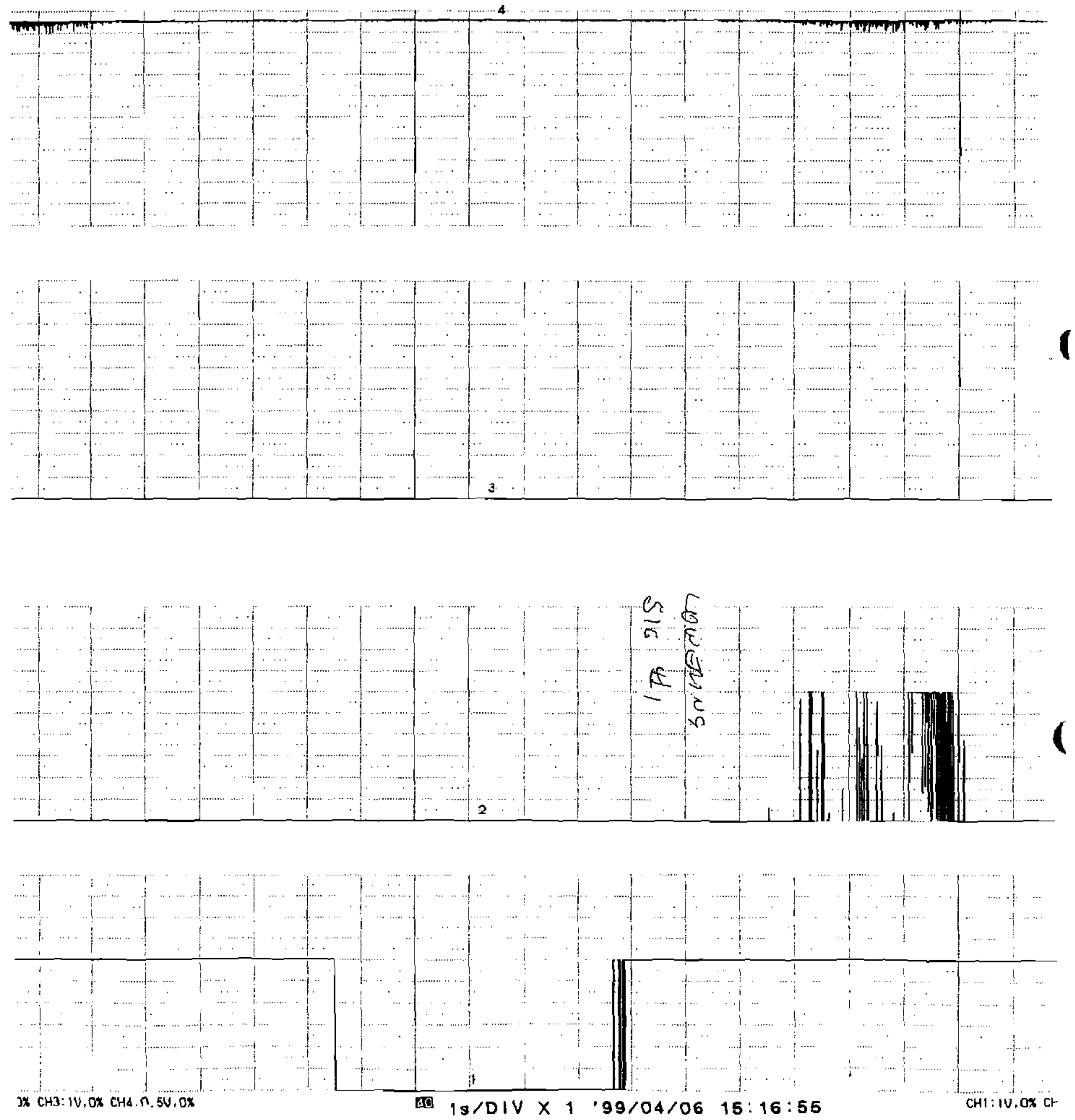
IG '99/04/06 14:54:47 ⟷ 10ms (50µs/SAMPLE)
5.0 V 4 4.0 3.0 2.0 1.0 0.0
10 V 3 8 6 4 2 0
10 V 2 8 6 4 2 0
10 V 1 8 6 4 2 0
X 1
CH1:1V,0% CH2:1V,0% CH3:1V,0% CH4:0.5V,0%
10ms/

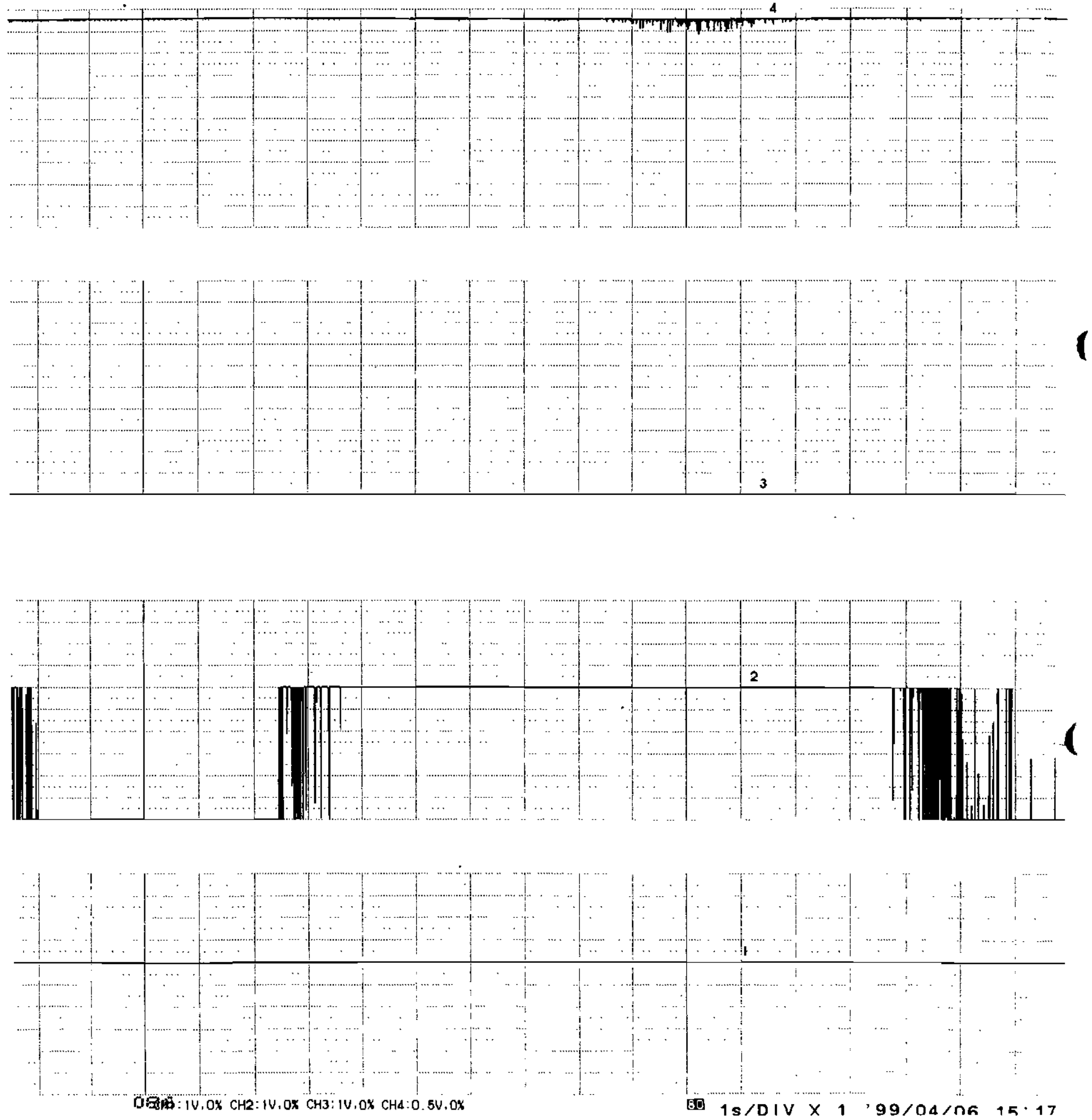

4
3
2
1
CH1:1V,0% CH2:1V,0% CH3:1V,0% CH4:0.5V,0%
20 1s/DIV X 1 '99/04/06 15:09:03

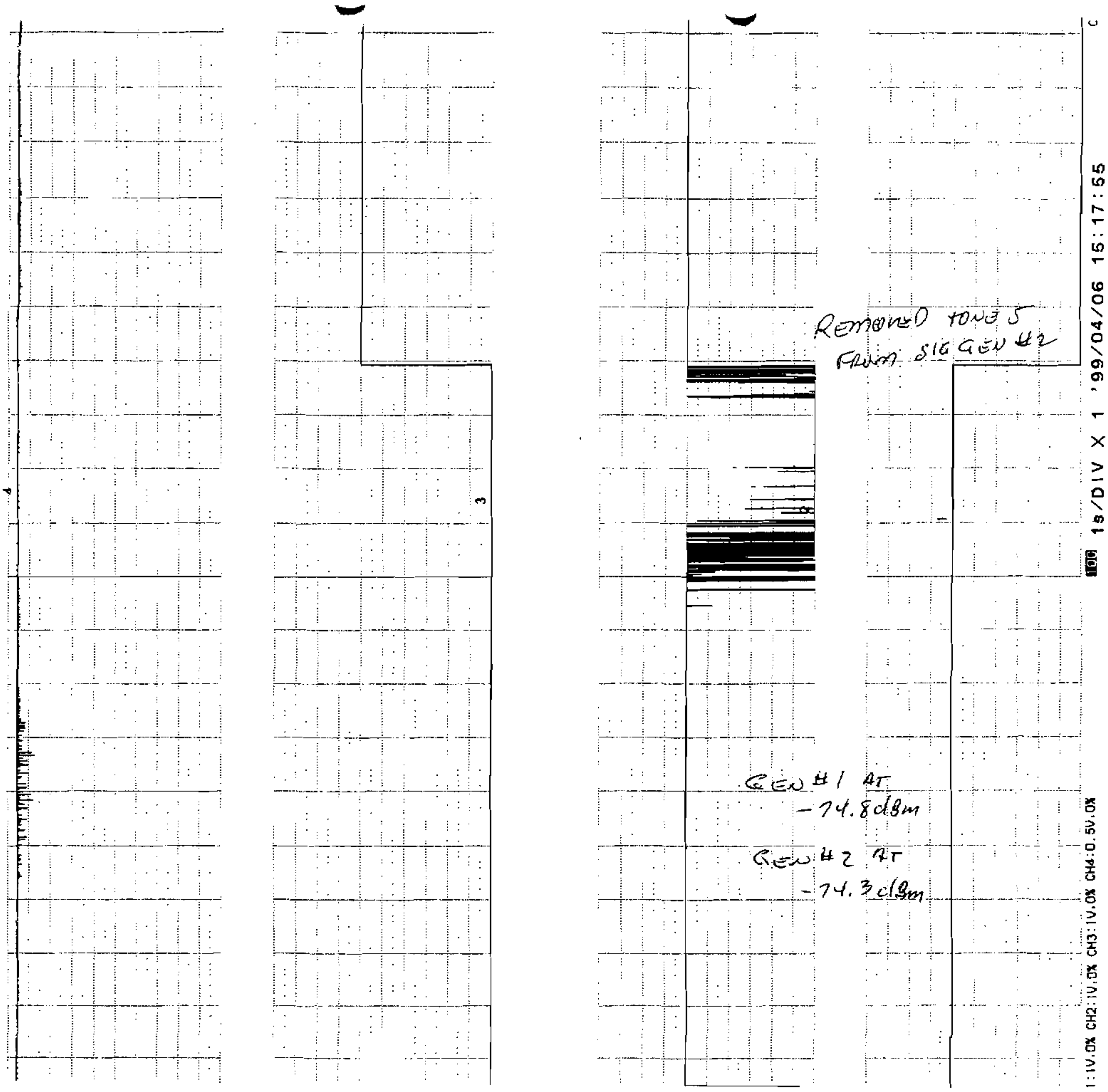


1s/DIV X 1 '99/04/06 15:
CH1: 1V.0% CH2: 1V.0% CH3: 1V.0%
TERMINATE
SIG GEN #1
RF REDUCED TO
-74.5dBM


4
3
2
1
CH1:1V,0% CH2:1V,0% CH3:1V,0% CH4:0.5V,0%
1s/DIV X 1 '99/04/06 15


4
3
2
1
LOWERING
SIG #1
)% CH3:1V,0% CH4:0.5V,0%
1s/DIV X 1 '99/04/06 15:16:55
CH1:1V,0% CH

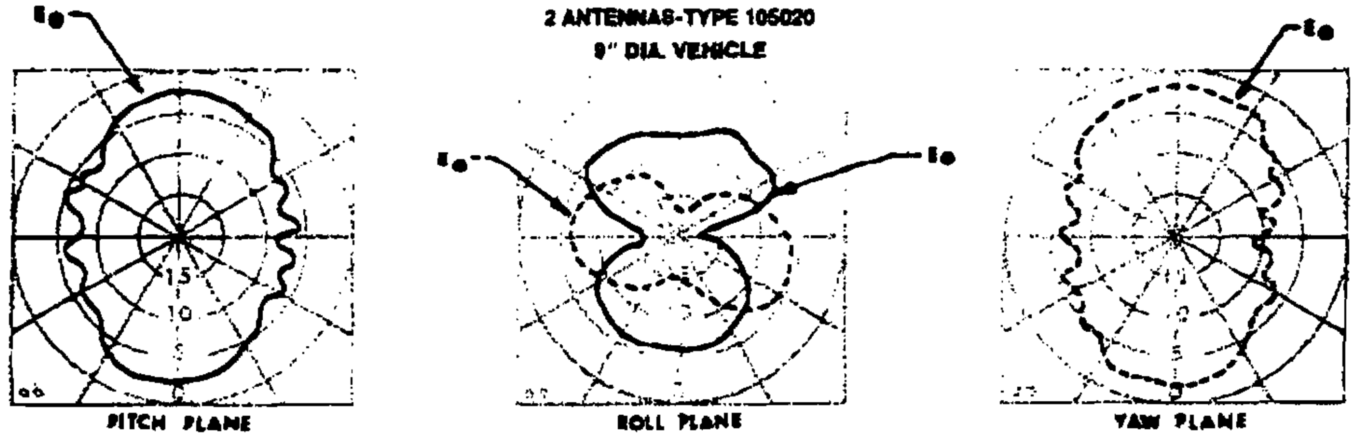

4
3
2
CH1:1V,0% CH2:1V,0% CH3:1V,0% CH4:0.5V,0%
1s/DIV X 1 '99/04/06 15:17



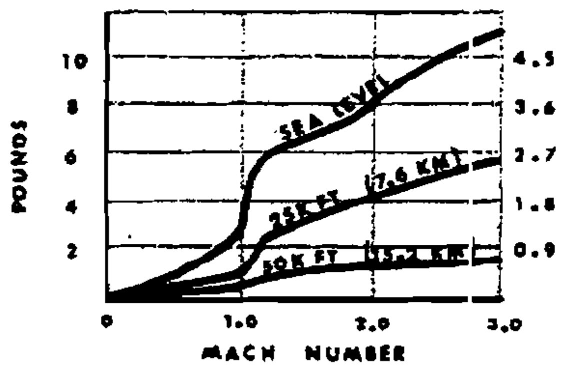
REMOVED TONE 5
FROM SIG GEN #2
GEN #1 AT
-74.8dBm
GEN #2 AT
-74.3dBm
1s/DIV X 1 '99/04/06 15:17:55
1:1V.0% CH2:1V.0% CH3:1V.0% CH4:0.5V.0%

PERFORMANCE CURVES

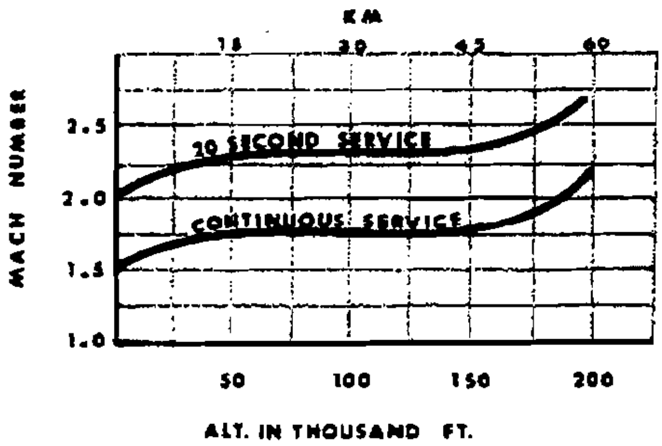
TYPICAL RADIATION PATTERNS
2 ANTENNAS-TYPE 105020
9" DIA. VEHICLE



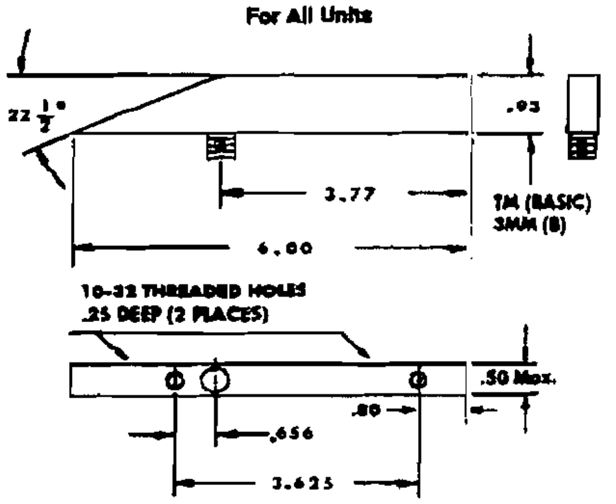
DRAG IN POUNDS/Kg
ALL TYPES



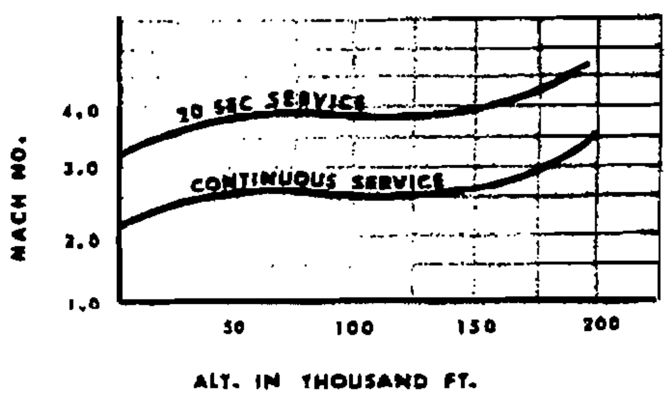
SPEED/ALTITUDE REGIME
NORMAL TEMP. TYPES



For All Units



SPEED/ALTITUDE REGIME
EXTREME TEMP. TYPES

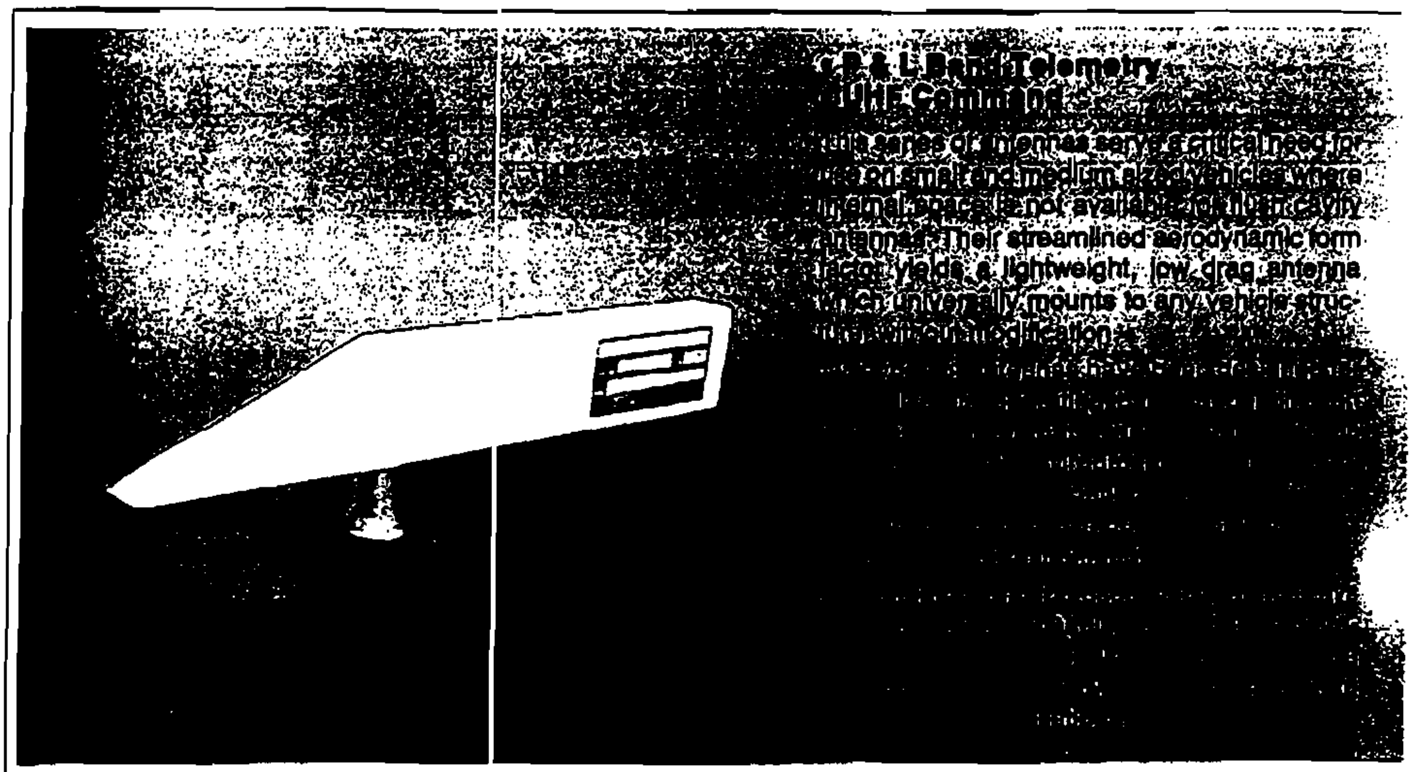


Global Hawk UAV, 95-2002/19990529

ECOM

INDUSTRIES INC.

A Tech-Sym Company



ELECTRICAL PERFORMANCE SPECIFICATIONS

NORMAL THERMAL ENVIRONMENT

BAND	P	UHF	L			
TYPE NO.	103003	105002	109001	Weight oz/gm	3.0	85
FUNCTION	Telemetry	Command	Telemetry	Temp. Cont. °F-°C	400	205
FREQ. RANGE (MHz)	215-260	406-550	790-850	Temp. 20 sec. °F-°C	600	315

EXTREME THERMAL ENVIRONMENT

BAND	P	UHF	L			
TYPE NO.	103013	105020	109002	Weight oz/gm	6.0	170
FUNCTION	Telemetry	Command	Telemetry	Temp. Cont. °F-°C	800	425
FREQ. RANGE (MHz)	215-260	406-550	790-850	Temp. 20 sec. °F-°C	1100	600

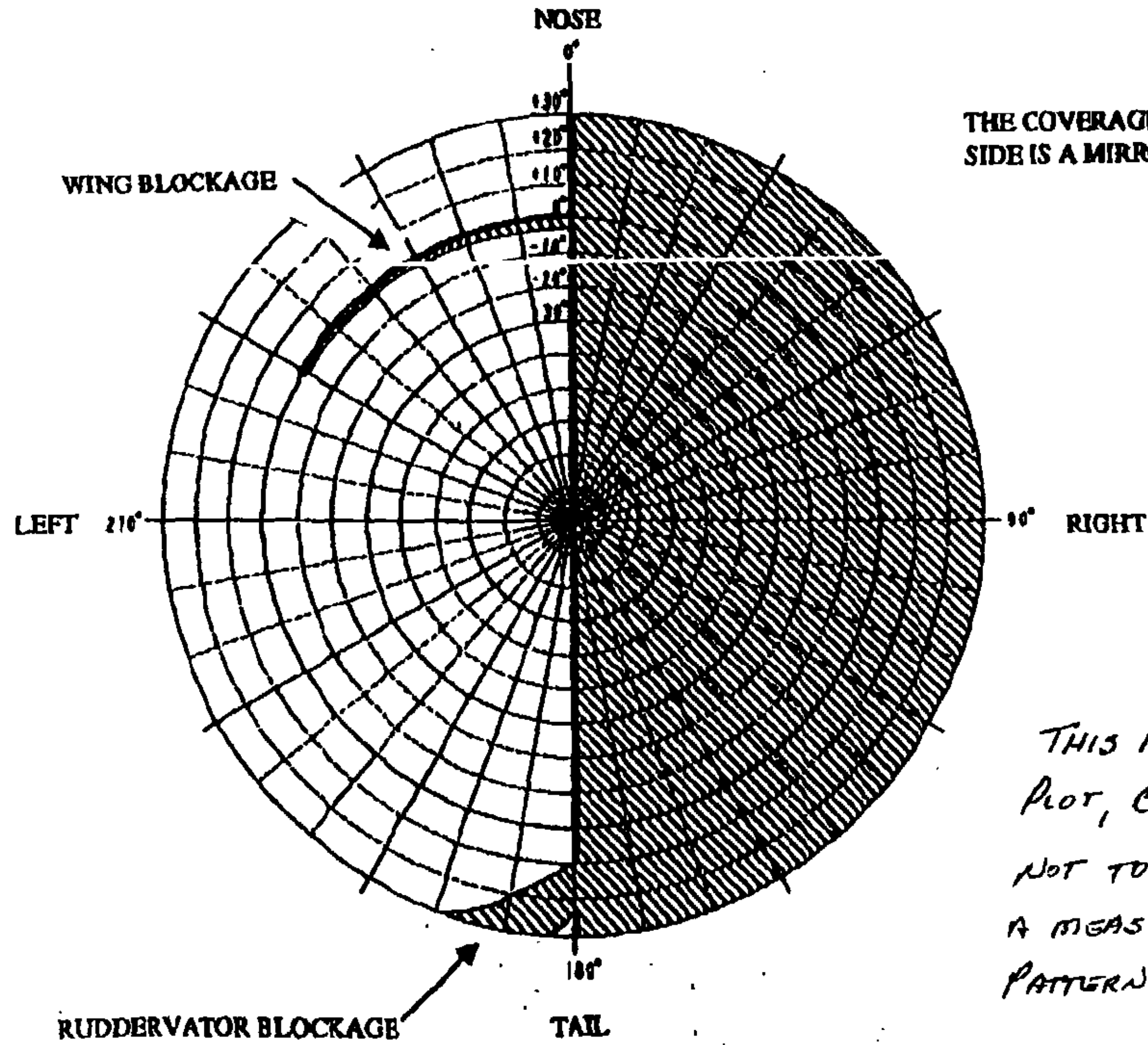
COMMON

PWR. HANDLING (watts)	2.0*	IMPEDANCE (OHMS)	50	VSWR	1.5:1**
POLARIZATION: LINEAR		RADIATION PATTERN: HEMISPHERICAL			

*At critical altitude for voltage breakdown (10 watts average at sea level to 75 K ft.).

**At tuned frequency and over bandwidth of 103003, typically ±0.3 MHz
105002, typically ±0.5 MHz
109001, typically ±0.5 MHz

TIER II Plus FTR Antenna Coverage - LH Side



THE COVERAGE ON THE RIGHT HAND SIDE IS A MIRROR IMAGE OF THIS.

VERBATIM TESTIMONY OF TERRANCE MICHAEL PELKEY

Q1: My name is Colonel Steven T. Virgilio. I am the investigating the Global Hawk accident that occurred on 29 March 99 at China Lake Naval Air Station, California. This investigation is separate and apart from the safety investigation conducted under AFI 91-204. This investigation was convened to gather and preserve evidence for use in claims, litigation, disciplinary actions and adverse administrative proceedings and for all other purposes except mishap prevention. The safety investigation is also being conducted on the accident for the sole purpose of mishap prevention. Your testimony to us Sir may be used for any proper purpose. Additionally your testimony can be released to the public. Do you understand the difference between the safety investigation and this accident investigation?

A1: Yes I do.

Q2: Do you understand what your testimony may be used for?

A2 Yes.

Q3: Your testimony in this investigation will be under oath. At this time I will administer the oath. Would you raise your right hand? Do you solemnly swear that the Testimony you are about to give in the matter now under investigation shall be the truth, the whole truth and nothing but the truth so help you God?

A3: I do.

Q4: Today is 5 May, the time is now 1536 local. This interview is being conducted in Building 2500, at Edwards AFB, California. Persons present at Edwards AFB is myself Colonel Steven T. Virgilio, Board President, Major Ray Chamberland the Legal Advisor, Mr. Joe Harrington, our Technical Advisor, and Lt. Delcampo is our Administrative Assistant and the witness. The witness has been sworn. Sir would you please state your full name for the record?

A4: Terrance Michael Pelkey.

Q5: What is your grade sir.

A5: Ah...GS-12.

Q6: And where are you assigned?

A6: 412 Test Wing Range Control.

Q7: At Edwards AFB?

A7: At Edwards AFB.

Q8: And what is your job title?

A8: Range Control Specialist.

Q9: And your phone number sir.

A9: Ah... 5-8043 or 275-8043.

Q10: All right, thank you sir.

Q11: Sir, can you tell me, when you were notified of the add on Global Hawk mission for the 29th of March 1999?

A11: Well actually, I don't remember specifically what time, but it was in the afternoon, on the Friday, a proceeding Friday.

Q12: Ah...Mid afternoon?...Early afternoon?... After lunch?

A12: About after lunch. It would of probably been after 3:00. I don't really remember.

Q13: All right. Do you know who notified you? Do you remember or recalled who notified you sir?

A13: I believe ah...Mr. Bob Ettinger notified me.

Q14: All right. And when..ah...you were notified of the mission. Do you know what the mission profile was for the 29th, for the Global Hawk flight?

A14: It was the same as on that Friday, except...it would of taken off later, I think. I can't really remember for sure.

Q15: So...Ok...So same profile. Do you know in that profile, was the flight termination frequencies set up for the 29th the same as the one on the 26th of March for the UAV?

A15: At that time I thought it was the same because that was the receiver they had on the aircraft was 421.

Q16: All right. When your notified, like you said, Mr. Ettinger notified you sir, then what is your procedures? What do you do from there?

A16: Well normally they have a OPs Engineer who would have a.....scheduled the mission in general, and he would of been on to the flight ops and scheduled it there, but he wasn't there.

Q17: This is an Engineer from what Organization?

A17: 419th.

Q18: Ok. Keep going.

A18: Ok.......He wasn't there so we didn't do it that way. You want to know how I actually did it?

Q19: I need to:...I need to know both, if you don't mind? How you actually should do it and then how maybe you did it in this or how you did it in this situation?

A19: Well I knew he wasn't there, I new where he was, he was at Joshua Approach Control or High Dessert Tracon, from that facility so he couldn't do what he normally would do so...I went to the OPS desk and I scheduled what he normally would of scheduled, but there are parts that he wouldn't normally schedule anyway that I would of done, and I did those too, and those are the a....scheduling the restricted areas 2505, R2505 and R2524, and I called the a....specific agencies at China Lake that scheduled those, and scheduled those up, otherwise we couldn't go into those kind of mission. And also, I think that I personally called current OPS and scheduled the a...........flight termination frequencies 421, because that's what I thought was on the aircraft. I believe I did that, I'm...I'm reasonably sure I did but I don't have any notes.

Q20: So that's good. All right. So I understand you are normally. Should the....Mr. Ettinger....By Mr. Ettinger calling you, is that the normal procedure, or he should of called someone else?

A20: No. No....we were all in the same room running the mission and I wouldn't normally get the notification from Mr. Ettinger.

Q21: You normally wouldn't?

A21: I would normally of gotten the notification probably from Don Murray who is a test conductor.

Q22: For Teledyne?

A22: From Teledyne. Right. But Mr. Ettinger is also from Teledyne and so he is just further up, and when he told me to add a mission add it on, I add a mission add it on.

Q23: I understand. This notification to current Ops for the FTS frequencies 421, that's something normally you would of done in your responsibilities no matter who notified you.

A23: Normally because that's a TM frequency, normally we would of handled that.

Q24: Do you recall what time you finished all these required procedures that you were doing? I mean not to the exact minute.

A24: Probably somewhere around 4:00 and then we went to a debrief. But I'm not sure of the time there.

Q25: 1600 local?

A25: Yes. 1600.

Q26: And I think we already went through your standard procedures? All right.

Q27: Do you remember the words that Mr. Ettinger actually used when he asked you to add on the mission?

A27: No. I don't remember any words at all.

Q28: Who did you talk to at Current Ops?

A28: That day I really don't know. Now, we did have a problem with the frequency as I found out when I went over to the debrief. Cause when I found out they took those receivers out, then they had 425's, there not the 421's I'm sure you know that by now but, they had taken those receivers out and put in different receivers, that's the first I knew that we were having problems with this and I had to go back and try to reschedule.

Q29: Now, when you said they took the receivers out, so.....

A29: Teledyne Ryan took the receivers out, I do not remember who at Teledyne Ryan told me they changed the receivers.

Q30: So at the 1600 meeting they had already changed the receivers to 425?

A30: Yes. They told me they had already taken them out. I may of misunderstand. I don't even remember who told me that.

Q31: All right. So when you now know that you have 425's, do you have to go back to Current Ops?

A31: Yes. But by the time I called Current Ops, it was probably after 1630, I'm not really sure, but whatever time it was, nobody answered. I called them several times and no one answered there, so I was stuck trying to coordinate this on Monday morning.

Q32: How about through China Lake? Did you recall them again then to the 425 frequency?

A32: No. I don't think China Lake would particularly care what, how the current Ops would be.

Q33: I'm sorry, you said you called Point Magu. Earlier you said................

A33: No. No, that's Current Ops here. I do not..... I never have called Point Magu, straight through Point Magu.

Q34: Ok. You never called China Lake or anything like that?

A34: Not for that. I called China Lake for air space.

Q35: I'm sorry...Ok...Misunderstood you......

A35: For the TM frequencies I only call Current Ops. I hear that.

Q36: Now were you the person......Were you the first one in the morning on the 29th?

A36: Oh yes!

Q37: Ok. So that's when you would reach out to the change the frequency to 425. Is that when you did it?

A37: Yes.

Q38: Who did you notify then?

A38: First, person at that time.........

Q39: About what time?

A39: Probably, probably they weren't there until about 6:30. At Current Ops. I think that's about the time I talked with them. I think that....that was Mr. Wireman first. And Mr. Wireman just took the information and told me either to call back later or he had another person call me back...that I don't remember exactly how that works. But I did talk later on to another person, which was Mr. Dickson, at that same office. Mr. Dickson gave me the go ahead for the 425.

Q40: All right sir. So all your procedures for notification were done then approximately somewhere around 6:30 in the morning 7:00 maybe on the 29th for the mission?

A40: Yes.

Q41: Ok sir. Are there any other matters that we haven't covered that you believe may be important to our investigation?

A41: Not that I'm aware of.

Q42: Sir, you are reminded of the official nature of this interview. You may not discuss your testimony with any one without my permission, at anytime before the report of this investigation is officially released to the public. So this sir, this then concludes our interview.

WEATHER OBSERVATIONS

Tab W

TAB W

INDEX

SEE TAB K-5

STATEMENTS OF INJURY

Tab X

TAB X

INDEX

THIS TAB NOT USED

DOCUMENTS APPOINTING
THE AIB MEMBERS

Tab Y

TAB Y

INDEX

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE MATERIEL COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

19 APR 99

MEMORANDUM FOR WR-ALC/LJP (COL STEPHEN T. VIRGILIO)

FROM: AFMC/CC
4375 Chidlaw Road, Suite 1
Wright-Patterson AFB OH 45433-5001

SUBJECT: Convening of AFI 51-503 Accident Investigation Board (AIB), Class A, Global Hawk Unmanned Aerial Vehicle (UAV) Mishap, 29 Mar 99, Edwards AFB CA

1. An accident investigation board is hereby convened under the provisions of AFI 51-503 to investigate subject mishap. This appointment letter is your authority to interview witnesses, take sworn testimony, and review all documents, files, and wreckage relevant to your investigation. Upon receipt of Part I of the Safety Investigation Board (SIB) Report, detailed board members are relieved of all other duties until the AIB Report is completed. The following personnel are detailed to serve on the AIB:

Col Stephen L. Virgilio, WR-ALC/LJP	President
Maj Raymond Chamberland III, AFFTC/JA	Legal Advisor

2. Your investigation will be conducted IAW the provisions of AFI 51-503. HQ AFMC/JA will advise you on preliminary administrative matters, as required. Your legal advisor is required to be present during all witness interviews and must review all evidence, documents, transcripts, and statements prior to inclusion in your report. Your report will include an Executive Summary, Summary of Facts, and Statement of Opinion as required by AFI 51-503. All witnesses, documents, records, and other evidence within the control of the Air Force will be made available to you, other than privileged safety information. All witnesses who testify must do so under oath or affirmation. Your report shall be releasable to the public and may not contain any privileged safety or Privacy Act-protected information.

3. Your Statement of Opinion must be supported by clear and convincing evidence contained in your report. Your legal advisor will assist you in evaluating evidence. Do not include recommendations for corrective or disciplinary action in your report.

4. You and the other AIB members are not authorized to disclose board findings or opinions, except to members of my staff, prior to my approval of the AIB Report. Travel and billeting will be funded by WR-ALC. Travel orders should be issued locally and authorize variations in travel for all members of the AIB. All travel costs needed for witness interviews outside the Edwards AFB area should be coordinated with HQ AFMC/JA in advance. (See AFI 51-503, paragraph 2.8 and AFI 65-601V1, paragraph 7.14 regarding funding authority.)

5. IAW AFI 51-503, Edwards AFB will assist you with logistical and administrative support. A Host Base Liaison Officer will be appointed by AFFTC/CC to assist with arranging billeting, vehicles (if available), facilities, administrative support, reproduction services, and access to witnesses. Make contact with the Host Base Liaison Officer through the office of the AFFTC/CC. Your investigation should begin as soon as possible and be completed within 30 days from receipt of the completed Part I of the Safety Investigation Board (SIB) Report. Submit any requests for extensions, additional advisors, or other matters to me through HQ AFMC/JA. Submit your final report to HQ AFMC/JA, and they will forward it to me for approval.

6. The HQ AFMC/JA point of contact for any questions is Maj Craig G. Miller, DSN 787-4172, DSN fax 787-0537, e-mail CRAIG.MILLER@wpafb.af.mil.

GEORGE T. BABBITT
General, USAF
Commander

cc: Maj Raymond Chamberland III
AFFTC/CC
AFFTC/JA
WR-ALC/CC
WR-ALC/LJ

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE MATERIEL COMMAND
WRIGHT-PATTERSON AIR FORCE BASE OHIO

04 MAY 1999

MEMORANDUM FOR WR-ALC/LJP (COL STEPHEN L. VIRGILIO)

FROM: AFMC/CC
4375 Chidlaw Road, Suite 1
Wright-Patterson AFB OH 45433-5001

SUBJECT: Appointment of Technical Advisor for Global Hawk Unmanned Aerial Vehicle (UAV), AFI 51-503 Aircraft Accident Investigation Board

1. Pursuant to my authority under AFI 51-503, paragraph 2.1, I convened an aircraft Accident Investigation Board (AIB) to investigate the circumstances surrounding the 29 Mar 99 Class A mishap involving a Global Hawk UAV at or near Edwards AFB CA. Detailed as members were Col Stephen Virgilio, President, and Maj Raymond Chamberland, Legal Advisor.

2. The AIB has requested the assistance of a qualified technical advisor to advise on operational aspects of the Global Hawk UAV, including radio frequency and control issues. Joseph P. Harrington, ASC/RAE WPAFB OH, has been identified as possessing the requisite technical expertise. Accordingly, pursuant to AFI 51-503, paragraphs 2.2 and 4.4, Joseph P. Harrington is hereby detailed to serve on the AIB as Technical Advisor to the AIB. As Technical Advisor, he will advise and assist the AIB on all matters within his technical expertise, including formulating questions for witnesses, examining documents, and evaluating testimony, if necessary. This appointment shall remain in force until the final report has been submitted.

George T. Babbitt

GEORGE T. BABBITT
General, USAF
Commander

PHOTOGRAPHS
(NOT INCLUDED IN TAB S)

TAB Z

INDEX

THIS TAB NOT USED

FLIGHT DOCUMENTS

TAB AA

INDEX

THIS TAB NOT USED

GOVERNMENT DOCUMENTS AND REGULATIONS

TAB BB

INDEX

GLOBAL HAWK
AV 2 – 10 PL
GREEN FLAG

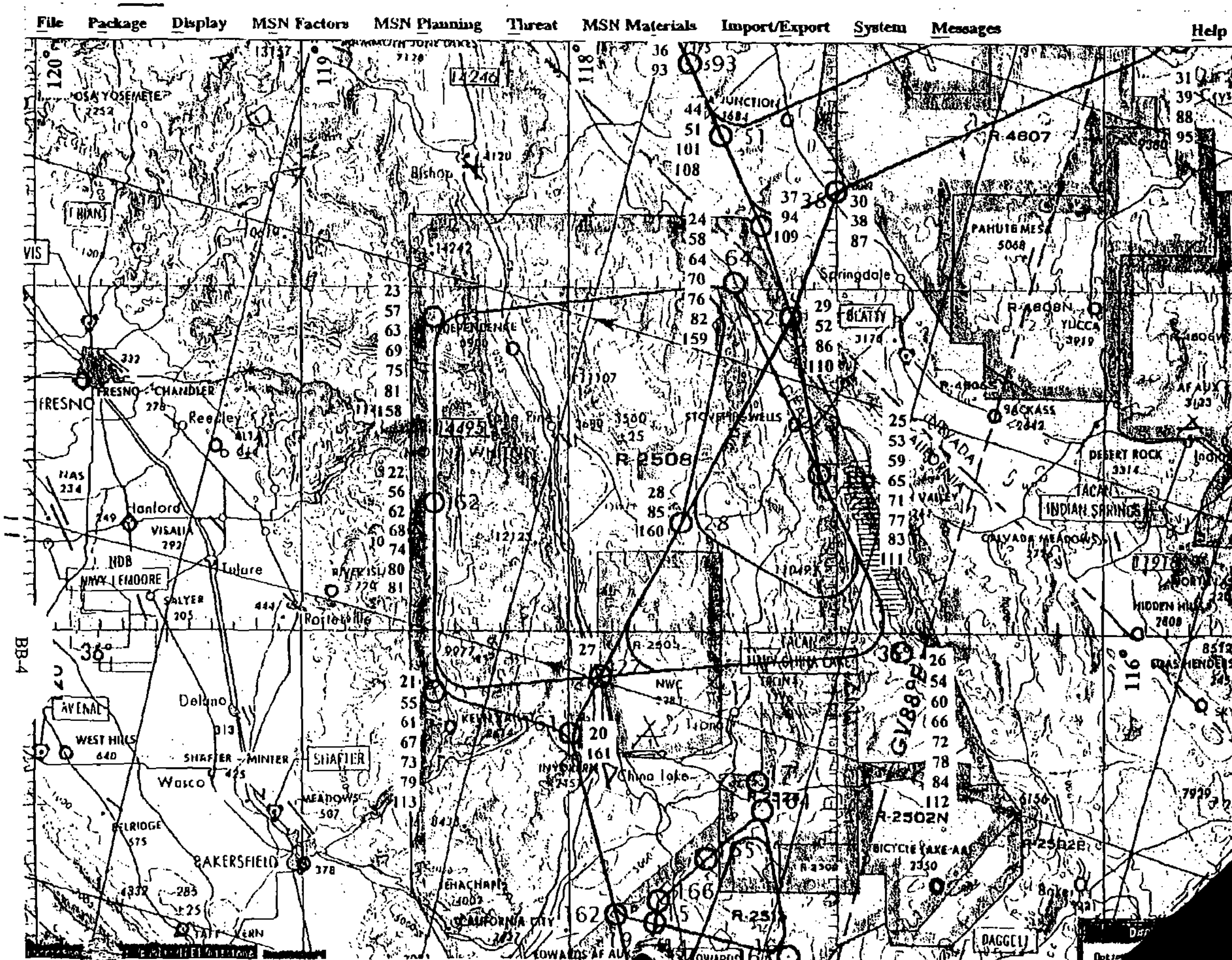
MISSION PLAN

GLOBAL HAWK PROGRAM DATA

UNCLASSIFIED

```
DTD:    15  00:08:11  00:08:11 (GMT)
            N35-10.61  W117-40.81  75000 ft
            IN FLIGHT  TURN SHORT     144 kts CAS
            Fuel to next:  186 lbs  Fuel remaining:  13340 lbs
            Next:     16  C1:   405  C2:   370  C3:   144  C4:    15

AP:    759  00:08:11  00:08:11 (GMT)  (COMM)
            @       0 ft  Always   Configure Ku SatCom

DTD:    16  00:14:28  00:14:28 (GMT)
            N35-05.00  W117-11.00  75000 ft
            IN FLIGHT  TURN SHORT     132 kts CAS
            Fuel to next:  76 lbs  Fuel remaining:  13154 lbs
            Next:     17  C1:   403  C2:   368  C3:   193  C4:    16

AP:    760  00:09:55  00:09:55 (GMT)  (COLL)
            @  112940 ft  Always   Set Sensor AC Power ON

DTD:    17  00:18:05  00:18:05 (GMT)
            N35-34.70  W117-17.80  75000 ft
            IN FLIGHT  TURN SHORT     152 kts CAS
            Fuel to next:  188 lbs  Fuel remaining:  13078 lbs
            Next:     18  C1:   401  C2:   378  C3:   193  C4:    17

DTD:    18  00:30:25  00:30:25 (GMT)
            N34-45.78  W117-41.48  75000 ft
            IN FLIGHT  TURN SHORT     100 kts CAS
            Fuel to next:  34 lbs  Fuel remaining:  12890 lbs
            Next:     19  C1:   403  C2:   368  C3:   193  C4:    18

AP:    775  00:20:47  00:20:47 (GMT)  (COMM)
            @  219400 ft  Always   Control Recorder

DTD:    19  00:33:09  00:33:09 (GMT)
            N35-11.94  W117-49.61  75000 ft
            IN FLIGHT  NON TURN       131 kts CAS
            Fuel to next:  50 lbs  Fuel remaining:  12856 lbs
            Next:     20  C1:   403  C2:   368  C3:   193  C4:    19

AP:    776  00:32:51  00:32:51 (GMT)  (COMM)
            @   13000 ft  Always   Control Recorder

DTD:    20  00:37:31  00:37:31 (GMT)
            N35-42.80  W117-59.60  75000 ft
            IN FLIGHT  TURN SHORT     149 kts CAS
            Fuel to next:  45 lbs  Fuel remaining:  12805 lbs
            Next:     21  C1:   352  C2:   395  C3:   192  C4:    20

SC:      1  00:33:37  00:33:37 (GMT)  (COLL)
            EO    SPOT          1:1    Pty: 50
SC:      2  00:34:25  00:34:25 (GMT)  (COLL)
```

UNCLASSIFIED


File
Package
Display
MSN Factors
MSN Planning
Threat
MSN Materials
Import/Export
System
Messages
Help
Bishop
FRESNO
Reedley
Hanford
VISALIA
Tulare
NAVY LEMOORE
Porterville
Delano
Wasco
BAKERSFIELD
SHAFTER
WEST HILLS
AVENAL
R-2508
R-4807
PAHUTE MESA
Springdale
BEATTY
R-4808N
YUCCA
DESERT ROCK
INDIAN SPRINGS
CHINA LAKE
China Lake
R-2502N
BICYCLE LAKE AAF
CALIFORNIA CITY
DAGGETT
Baker
37°
36°
119°
118°
116°

Range Commanders Council

RANGE SAFETY GROUP

DOCUMENT 306-93

FLIGHT TERMINATION RECEIVER CATALOG

WHITE SANDS MISSILE RANGE
KWAJALEIN MISSILE RANGE
YUMA PROVING GROUND
DUGWAY PROVING GROUND
ELECTRONIC PROVING GROUND

ATLANTIC FLEET WEAPONS TRAINING FACILITY
NAVAL AIR WARFARE CENTER WEAPONS DIVISION
NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
NAVAL UNDERSEA WARFARE CENTER DIVISION NEWPORT

30TH SPACE WING
45TH SPACE WING
AIR FORCE FLIGHT TEST CENTER
AIR FORCE DEVELOPMENT TEST CENTER
AIR FORCE WEAPONS AND TACTICS CENTER
DETACHMENT 2, SPACE AND MISSILE SYSTEMS CENTER

LORAL CONIC

FLIGHT TERMINATION RECEIVER

MODEL FTR-915

1. GENERAL DESCRIPTION

The Loral Conic Model FTR-915 Flight Termination Receiver is specifically designed for todays missile range safety usage on programs requiring smaller and lightweight components with stringent environmental requirements. The FTR-915 is a miniature, state-of-the-art Flight Termination Receiver/Decoder.

2. BACKGROUND

The Model FTR-915 uses modern hybrid technology and packaging techniques while retaining the highly reliable functional and environmental integrity of Loral designs is fully qualified.

3. TECHNICAL SPECIFICATIONS

3.1 RF SECTION

3.1.1	Frequency Range (Tuneable)	405 to 486 MHz
3.1.2	Threshold Sensitivity (Command Output)	2 μV
3.1.3	Maximum Useable RF Input	1 Vrms
3.1.4	Operating Bandwidth	±45 kHz
3.1.5	Antenna Impedance	50 ohms (nominal)
3.1.6	VSWR	2:1 maximum
3.1.7	Local Oscillator Stability	±0.005 percent
3.1.8	Tuning Accuracy	±0.005 percent
3.1.9	Tuning Method	Fixed frequency, crystal-controlled

3.2	IF SECTION (DUAL CONVERSION)	
3.2.1	IF Frequency	24 MHz
3.2.2	Selectivity, 60 dB	±180 kHz maximum ±375 kHz maximum/with audio
3.2.3	Capture Ratio	<1 dB
3.3	AUDIO SECTION	
3.3.1	Audio Amplifier Response	500 Hz to 20 kHz
3.3.2	Audio Amplifier Distortion	<3 percent
3.3.3	Audio Output	1 Vp-p at 10 kHz peak deviation
3.3.4	Frequency Deviation	30 ±6 kHz peak per tone
3.4	DECODER SECTION	
3.4.1	Number of Decoder Channels	3
3.4.2	Number of Simultaneous Useable Tones	3
3.4.3	Tone Channel Bandwidth	>±1 percent at 2 dB
3.4.4	Adjacent Channel Rejection	80 dB
3.4.5	Decoder Threshold Deviation	15 kHz (nominal)
3.5	OUTPUT	
3.5.1	Types of Output	Solid-state
3.5.2	Output Current Capability	2 A; 7.5 A peak 10 ms
3.5.3	Output Leakage	50 μA

3.5.4	Logic Circuit	Tone 1, Tone 3 ON = Arm Tone 1 ON, Tone 3 OFF, Tone 2 ON = Destruct Other sequences available
3.5.5	Response Time for Commands	25 ms maximum
3.5.6	Transition Time Between Commands	<3 ms
3.5.7	Output Isolation	Power and command returns isolated from chassis (can be connected)
3.5.8	Noise Immunity	12 dB minimum noise margin on decoder channels for unquieted noise
3.5.9	Telemetry Outputs	
3.5.9.1	Signal Strength	No RF: 0.50 ±0.25 Vdc -101 dBm: 0.25 Vdc above no RF reading -30 dBm: 4.75 ±0.25 Vdc
3.5.9.2	Tone Monitors	Monitors Tone Channel Status

	Present	Absent
Tone 1	"1"	"0"
Tone 2	"1"	"0"
Tone 3	"1"	"0"

Logic "1" = Vcc ±3 Vdc
Logic "0" = 0.0 to 0.5 Vdc

3.6	POWER SUPPLY	
3.6.1	Supply Voltage	22 to 35 Vdc
3.6.2	Power Requirements	200 mA
3.6.3	Power Supply Isolation	Return isolated by from case
3.6.4	Turn-On Power Control for Receiver	None
3.6.5	Other Controls	N/A

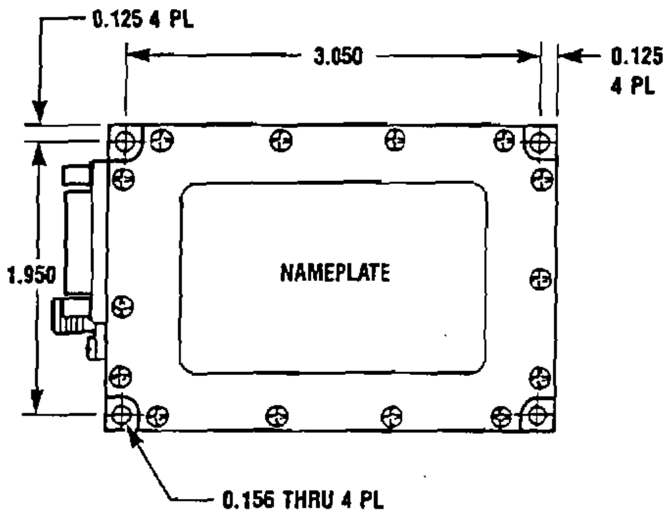
3.7	ELECTROMAGNETIC INTERFERENCE	
3.7.1	RFI Suppression	Meets MIL-STD-461, CS04 A and B - 60 dB
3.7.2	Pulse Rejection	Immune to E-, G-, and I-Band applied to antenna port +27 dBm
3.7.3	AM Rejection	AM carriers will not cause command output
3.7.4	Image Rejection	60 dB minimum
3.8	ENVIRONMENTAL CHARACTERISTICS	
3.8.1	Operating Temperature Range (Continuous)	-54°C to +85°C
3.8.2	Nondestructive Temperatures (Shelf Storage)	-65°C to +125°C
3.8.3	Humidity	97 percent
3.8.4	Altitude	250,000 feet minimum at -40°C
3.8.5	Shock	50 g, 11 ms half sine 20 g, 11 ms sawtooth 1,100 g, 0.5 ms pulse
3.8.6	Acceleration	100 g, each axis
3.8.7	Vibration	14.2 g rms, random
3.8.8	Acoustics	Not measured
3.8.9	Pressurization	30 lb/in^2, 30 minutes
3.8.10	Operating Life	MTBF = 8,500 hours minimum
3.8.11	Shelf Life	5 years

3.9	PHYSICAL CHARACTERISTICS	
3.9.1	Volume	5.5-in^3
3.9.2	Dimensions	See Outline Drawing
3.9.3	Weight	8 ounces
3.9.4	Mounting Attitude	Any
3.9.5	External Adjustments	None
3.9.6	Connector Types	RF Input (J1): SMA Power, Command (J2): M83513/04-D11N

MODEL FTR-915 FLIGHT TERMINATION RECEIVER/DECODER

J1 – RF Input (SMA Jack)

J2 – Power & Commands (M83513)	
PIN	Function
1	+28 Vdc Power
2	No Connection
3	Power Return
4	Terminate Return
5	Monitor Return
6	Arm Return
7	No Connection
8	Terminate Command
9	No Connection
10	Optional Command
11	Auxiliary Audio/NC
12	Auxiliary Audio Return
13	Case Ground
14	+28 VDC Power
15	No Connection
16	Power Return
17	Terminate Return
18	Optional Return
19	No Connection
20	Terminate Command
21	No Connection
22	Monitor Command
23	Arm Command
24	Signal Strength
25	Signal Strength Return



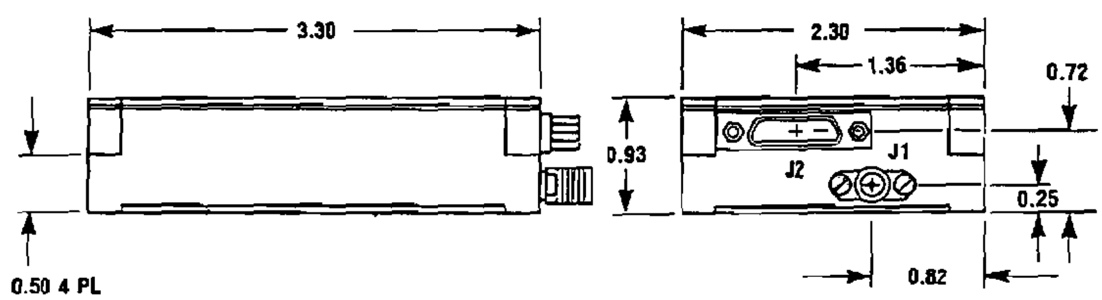


Figure 4-11. Outline drawing of LC Model FTR-915 Flight Termination Receiver.

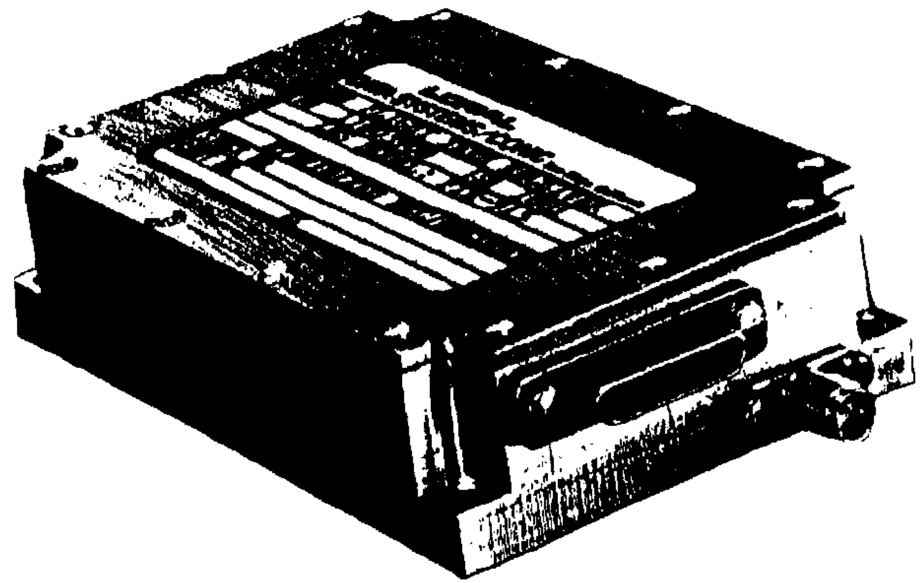


Figure 4-12. LC Model FTR-915 Flight Termination Receiver.

LORAL CONIC

FLIGHT TERMINATION RECEIVER

MODEL CCR-200

1. GENERAL DESCRIPTION

The Loral Conic Model CCR-200 series solid state FM command receiver/decoder is designed to meet the severe environmental and stringent reliability requirements of missiles and spacecraft. The unit is well suited, however, for other applications requiring ruggedized, lightweight miniature construction, high performance and/or high reliability and long trouble-free service life. The unit is available with three to 11 relay channels operating in IRIG command channels 1 through 20 with high adjacent subcarrier channel rejection and freedom from false triggering by white noise or power supply voltage transients.

2. BACKGROUND

The Model CCR-200 is used on special military program, foreign and domestic.

3. TECHNICAL SPECIFICATIONS

3.1	RF SECTION	
3.1.1	Frequency Range (Tuneable)	220 to 550 MHz
3.1.2	Threshold Sensitivity (Command Output)	3 µV
3.1.3	Maximum Useable RF Input	2 Vrms
3.1.4	Operating Bandwidth	±20 kHz minimum
3.1.5	Antenna Impedance	50 ohms (nominal)
3.1.6	VSWR	2:1 maximum
3.1.7	Local Oscillator Stability	±0.005 percent
3.1.8	Tuning Accuracy	±0.005 percent
3.1.9	Tuning Method	Single frequency, crystal-controlled

Range Commanders Council
RANGE SAFETY GROUP

IRIG STANDARD 313-94

DESIGN, PERFORMANCE, AND TEST STANDARDS FOR FLIGHT TERMINATION RECEIVERS/DECODERS

VOLUME 1

DESIGN AND PERFORMANCE REQUIREMENTS

WHITE SANDS MISSILE RANGE
KWAJALEIN MISSILE RANGE
YUMA PROVING GROUND
DUGWAY PROVING GROUND
ELECTRONIC PROVING GROUND
COMBAT SYSTEMS TEST ACTIVITY

ATLANTIC FLEET WEAPONS TRAINING FACILITY
NAVAL AIR WARFARE CENTER WEAPONS DIVISION
NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
NAVAL UNDERSEA WARFARE CENTER DIVISION NEWPORT

30TH SPACE WING
45TH SPACE WING
AIR FORCE FLIGHT TEST CENTER
AIR FORCE DEVELOPMENT TEST CENTER
AIR FORCE WEAPONS AND TACTICS CENTER
SPACE TEST AND EXPERIMENTATION PROGRAM OFFICE
SPACE AND MISSILE SYSTEMS CENTER

IRIG STANDARD 313-94

DESIGN, PERFORMANCE, AND TEST STANDARDS FOR FLIGHT TERMINATION RECEIVERS/DECODERS

VOLUME 1

DESIGN AND PERFORMANCE REQUIREMENTS

FEBRUARY 1994

Prepared by

FLIGHT TERMINATION SYSTEM COMMITTEE
RANGE SAFETY GROUP
RANGE COMMANDERS COUNCIL

Published by

Secretariat
Range Commanders Council
U.S. Army White Sands Missile Range,
New Mexico 88002-5110

3.2 Receiver Specifications

These receiver specifications apply to all FTRs whether its associated decoder uses standard or secure logic.

3.2.1 Operating-Frequency Band. The receiver shall be designed to be tunable over the frequency range 406–450 MHz. Programs desiring to operate at more than one range, except at Kwajalein Missile Range (KMR), must use one of the assigned common frequencies: 421, 425, or 428 MHz. Programs expecting to launch to or from KMR must coordinate an assigned frequency that is compatible with KMR. The FTR must center at the assigned radio frequency (RF) center frequency within ±0.005 percent. Usage of 421, 425, and 428 MHz at the 45th Space Wing (45 SW) must be precoordinated.

3.2.2 Voltage Standing Wave Ratio (VSWR) and Impedance. The FTR RF input VSWR shall be 2:1 or less with respect to 50 ohms across the specified bandwidth of the assigned operating frequency.

3.2.3 RF Sensitivity. The receiver shall respond to properly modulated RF signals of from –107 to –116 dBm across a 50-ohm impedance. The measured-threshold sensitivity is the minimum level at which an FTR meets all specifications. The measured-threshold sensitivity shall not be more sensitive than –116 dBm.

NOTE

Once an FTR measured threshold sensitivity has been established during the acceptance test procedure (ATP), all subsequent sensitivity bench test results shall be within ±3 dB of the ATP results.

3.2.4 Maximum Usable RF Input. The receiver shall be capable of operating within its specification limits during and after the application of RF signal levels between the measured threshold sensitivity and +13 dBm.

3.2.5 Operational Bandwidth. The receiver shall initiate and sustain all command functions over a continuous range of ±45 kHz from the assigned RF center frequency when subjected to command tones having deviations of plus and minus 30 ±3 kHz peak per tone at the specified sensitivity level.

3.2.6 Continuous-Wave (CW) Bandwidth. The receiver shall provide an intermediate frequency (IF) bandwidth of 180 kHz minimum at the 3-dB point and 360 kHz maximum at the 60-dB point, centered on the assigned RF center frequency.

3.2.7 Spurious-Response Rejection. The receiver shall provide at least 60 dB of rejection from 10 to 1000 MHz, excluding the frequency band within the 60-dB bandwidth at the assigned center frequency referenced to response at center frequency.

3.2.8 Noise Margin. The noise required to produce a command output shall be at least 12 dB above the highest noise level that would normally be found in the receiver when an RF signal is not applied to the receiver RF input.

3.2.9 Noise Immunity. The FTR shall not produce a command output when the FTR is subjected to white noise (at an amplitude of 12 dB higher than the measured threshold sensitivity level) at the RF input connector.

3.2.10 Quieting. If the FTR contains automatic-gain control (AGC) circuitry, the AGC shall provide a minimum of 10 dB of receiver quieting at an RF input level that is not greater than 3 dB above the measured receiver threshold sensitivity.

3.2.11 CW Peak-to-Valley Ratio. The IF filter CW peak-to-valley ratio shall not exceed 3 dB within ±45 kHz of the assigned operating frequency.

3.2.12 Capture Ratio. The application of an unmodulated RF signal shall not capture the receiver or interfere with the desired signal at the assigned frequency at levels up to 80 percent (-2 dB) of the desired modulated RF carrier signal (see figure 1-1).

3.2.13 Signal Strength Telemetry Output (SSTO) Monitor. The receiver's SSTO voltage, while operating into a 10,000-ohm load, shall be in accordance with the following requirements:

3.2.13.1 The quiescent (no RF signal) condition shall be 0.5 ±0.25 Vdc.

3.2.13.2 The measured command threshold sensitivity input condition shall be 0.1 Vdc minimum above the quiescent value.

3.2.13.3 The SSTO output level shall reach a maximum (4.75 ±0.25 Vdc) with no less than -53 dBm (500 microvolts) of RF input.

3.2.13.4 The shape of the transfer function shall not exceed approximately 1-Vdc change in voltage for each 13-dB change in RF input signal over the range between threshold and saturation.

3.2.13.5 The maximum SSTO voltage shall not exceed 5 Vdc under all conditions.

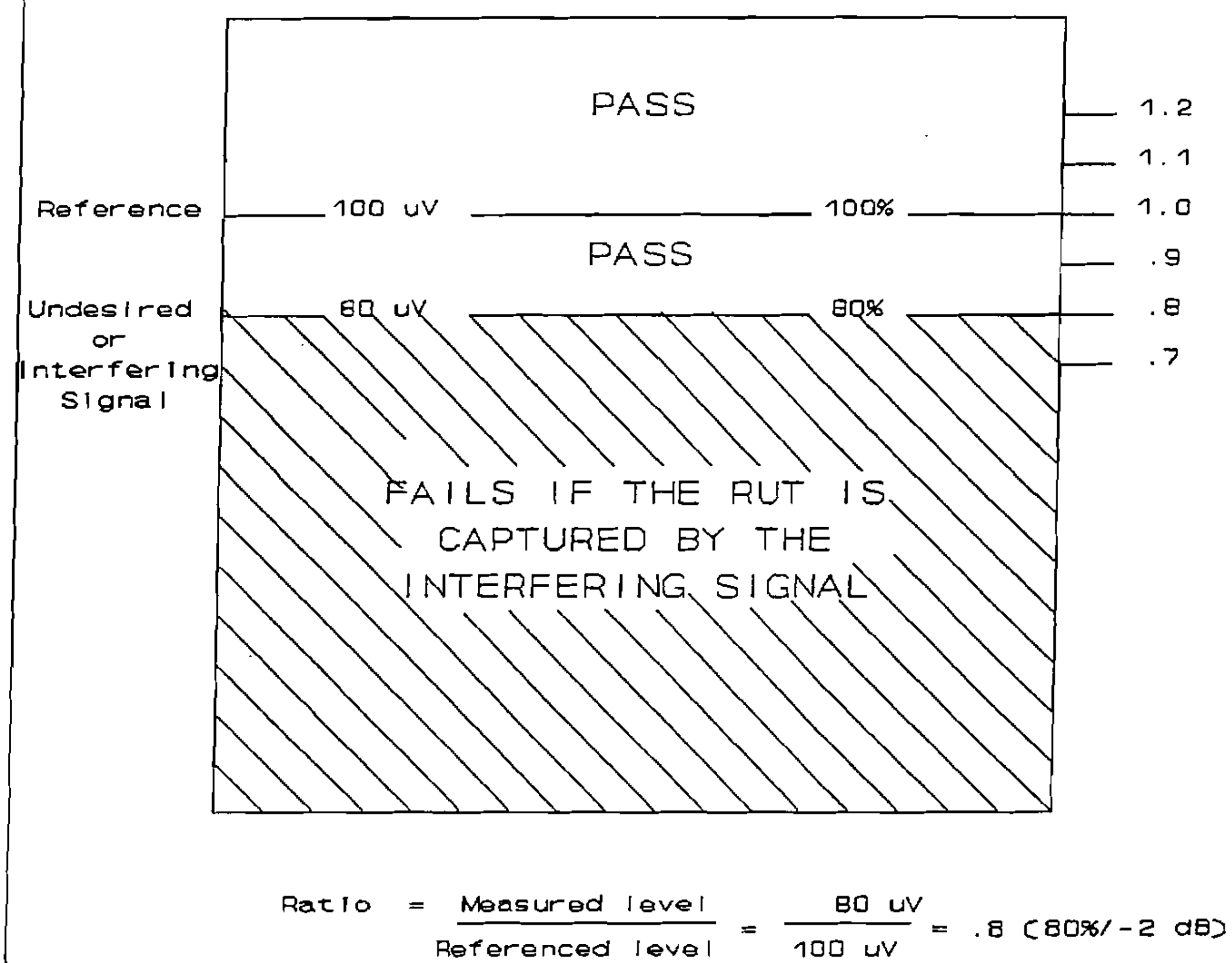


Figure 1-1. Capture ratio.

3.2.13.6 The slope of the SSTO voltage shall not change polarity from measured threshold to a +13-dBm level. (The slope shall be monotonic.)

3.2.13.7 The SSTO voltage shall not be used as a command output monitor.

3.2.14 Amplitude-Modulation (AM) Rejection

3.2.14.1 50 Percent. An RF input signal shall not produce an output from any decoder channel at the assigned RF center frequency of -90.1 dBm (7 microvolts) ±10 percent with 50 percent amplitude modulation by the assigned RCC tone frequencies and then a -85.4 dBm (12 microvolt) ±10 percent signal with 50 percent amplitude modulation at any modulation frequency.

3.2.14.2 100 Percent. An RF input signal shall not produce an output from any decoder channel at the assigned RF center frequency of -67 dBm (100 microvolts) ±10 percent with 100 percent peak amplitude noise modulation at low-pass filter (LPF) 3-dB frequencies of 3.5 or 7 kHz. When the input signal is properly modulated to produce an output from a decoder channel, the 100 percent peak amplitude noise modulation at LPF 3-dB frequencies of 3.5 to 7 kHz shall not inhibit that decoder output function.

3.2.15 Input-Voltage Range. The FTR input-voltage range shall be specified, and the current in the commanded and uncommanded state shall be noted in the FTR procurement specification. The FTR shall meet the requirements of this document at any voltage level between the minimum and maximum specified in the FTR procurement specification. The receiver shall be protected for 45 volts or the OCV of the power source whichever is greater. The receiver shall not produce an output or be damaged because of low or fluctuating input voltage.

3.2.16 Reverse-Polarity Protection. The receiver shall not be damaged by reverse-polarity voltage applied at its input for a period of not less than 1 hour.

3.2.17 Dynamic Stability. The FTR shall not produce false output or provide unstable desired output as a result of changing input VSWR including open and short RF transmission circuits.

3.2.18 Warmup Time. The FTR shall meet all operational requirements within 3 minutes after application of dc power.

3.2.19 Self-Test Capability. If the FTR employs a microprocessor, it shall have the capability to perform a self test (error detection) and output the results via telemetry. The self test shall be capable of initiation by both "power on" and on receiving a special test command. The failure of the self-test shall not intentionally disable the receiver. The execution of a self test shall not inhibit the processing of a command or cause a command output to change state.

3.2.20 Image Rejection. The FTR shall provide at least 60 dB of RF rejection at harmonics of the assigned frequency.

3.3 Standard Decoder Specifications

The minimum number of channels the decoder is required to output simultaneously is two: ARM and TERMINATE. On those ranges that require the use of CHECK CHANNEL, this requirement is for three channels.

3.3.1 Minimum RCC Audio Tones. The minimum number of RCC audio tone inputs that the receiver must process simultaneously is four. Any additional RCC audio tone input/decoder channel output requirements beyond those specified here shall not interfere with the minimum requirements of paragraph 3.3.

3.3.2 Tone Frequency. See table 1-1 for RCC standard decoder tones.

3.3.3 Standard Logic Sequence. Unless otherwise specified and approved by the Lead Range Safety Officer, the decoder shall **NOT** produce a command output under any condition or set of conditions except as specified in tables 1-2 and 1-3.

TABLE 1-1. RCC STANDARD DECODER TONES

RCC TONE	FREQUENCY (kHz)
1	7.50
2	8.46
3	9.54
4	10.76 (CHECK CHANNEL)
5	12.14
6	13.70
7	15.45 (SECURE PILOT TONE)
8	17.43
9	19.66
10	22.17
11	25.01
12	28.21
13	31.83
14	35.90
15	40.49
16	45.68
17	51.52
18	58.12
19	65.56
20	73.95

Tolerances: Frequency ±0.1 percent
Amplitude ±1 dB
Distortion 2 percent maximum total harmonic distortion

TABLE 1-2. STANDARD TONE LOGIC	
LOGIC SEQUENCE	DECODER OUTPUT
TONES 1 AND 5 ON	ARM
TONES 1 AND 5 ON FOLLOWED BY TONE 5 OFF THEN TONE 2 ON	ARM AND TERMINATE
TONE 2 AND 5 ON	OPTIONAL
TONE 4 ON	CHECK CHANNEL

TABLE 1-3. RCC STANDARD TONE COMBINATIONS				
VEHICLE	ARM	TERMINATE	CHECK CHANNEL	OPTIONAL
A	1&5	1&2	4	2&5
B	1&3	1&2	4	2&3
C	1&6	1&2	4	2&6
D	1&7	1&2	4	2&7
E	1&8	1&2	4	2&8

NOTE

Vehicle A is the standard tone combination to be used for single missile operations.

3.3.3.1 ARM Command. Apply RCC tones 1 and 5. Removal of tone 5 during ARM to TERMINATE switching shall not cause loss of ARM output.

NOTE
This tone combination is for vehicle A; other vehicles would apply different tone combinations.

3.3.3.2 Flight Termination Command. With RCC tones 1 and 5 on (ARM), remove tone 5 and apply tone 2. There may be a tone overlap during transition; that is, tone 2 applied before tone 5 is removed. If overlap occurs, neither the ARM nor the TERMINATE shall be lost or inhibited.

NOTE
This tone combination is for vehicle A; other vehicles would apply different tone combinations.

3.3.3.3 Optional Command. This command is not a range safety requirement. It is optional and may be used by range users to execute mission-peculiar functions such as safing the flight termination system or shutting down a specific engine. The OPTIONAL command shall not inhibit a TERMINATE command sequence including operation with a shorted load on the OPTIONAL command output channel.

3.3.3.4 Check Channel Command. With RCC tone 4 applied, the decoder shall be capable of outputting a minimum of 2 watts of power to the external load. The presence or absence of tone 4 shall not affect the performance or function of the other decoder channels.

3.3.3.5 Other Coding Techniques. Other sequential coding techniques may be used if within the capability of the range's transmitting system and if approved by the Lead Range Safety Officer.

3.3.4 Channel Deviation Threshold Range. The RF deviation threshold design goal for each channel shall be between ±10 and ±15 kHz. The decoder shall not provide any output at deviation levels of less than ±10 kHz per tone (see figure 1-2). The FTR shall meet all specifications when the input RF carrier is deviated over the range of ±27 to ±33 kHz per tone.

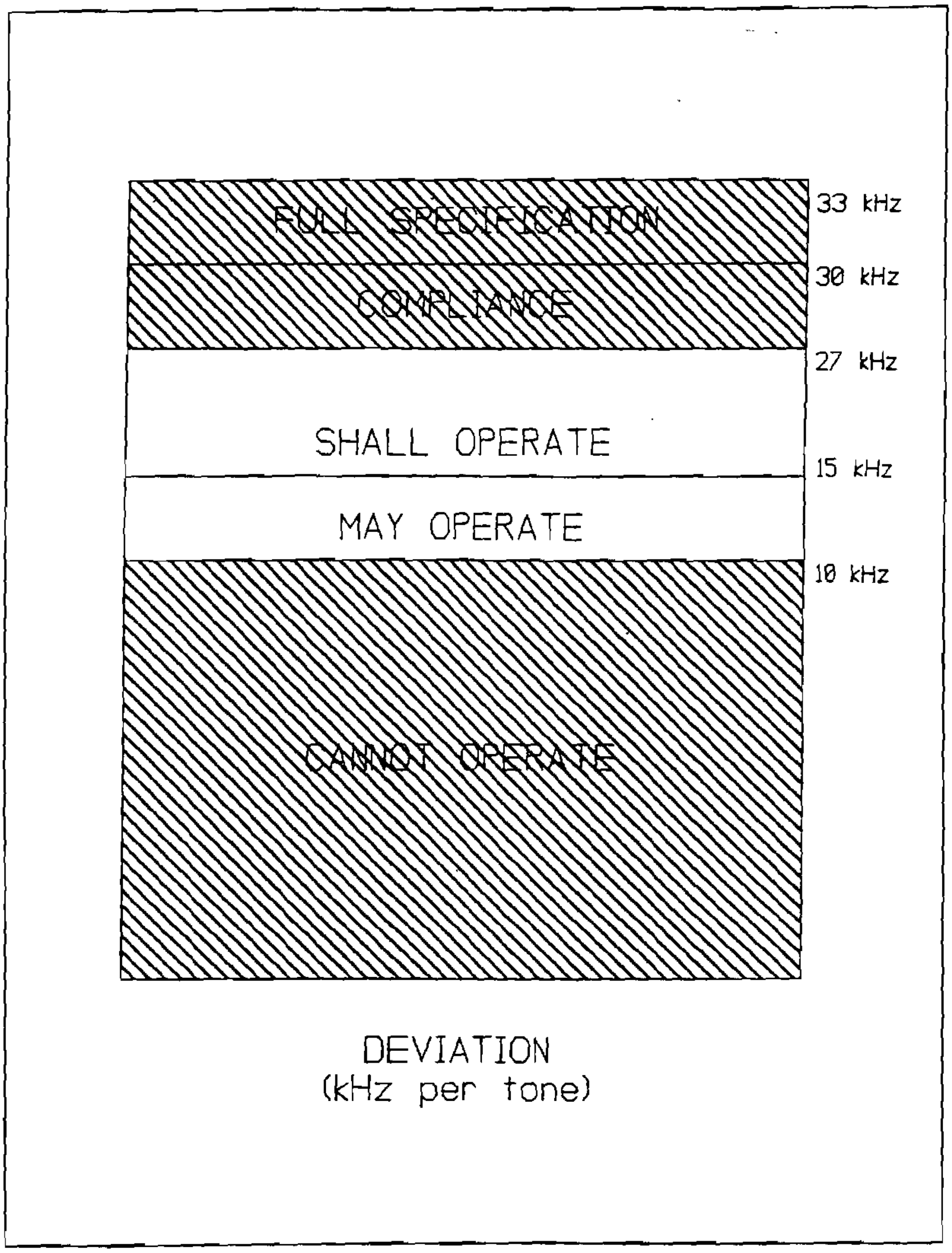


Figure 1-2. Deviation (kHz per tone).

RECORD REPRODUCTION COVER SHEET

The attached records are:

Releasable to the Public ☑

Denied to the Public ☐

Subject:

1999 Global Hawk Accident Report

FOIA Control Number: 07-283 LK

Date Reproduced: 11 Oct 07

7 of 7

Range Commanders Council
RANGE SAFETY GROUP

STANDARD 319-92

FLIGHT TERMINATION SYSTEMS COMMONALITY STANDARD

WHITE SANDS MISSILE RANGE
KWAJALEIN MISSILE RANGE
YUMA PROVING GROUND
ELECTRONIC PROVING GROUND
DUGWAY PROVING GROUND

NAVAL AIR WARFARE CENTER - WEAPONS DIVISION
ATLANTIC FLEET WEAPONS TRAINING FACILITY
NAVAL AIR WARFARE CENTER - AIRCRAFT DIVISION
NAVAL UNDERSEA WARFARE CENTER DIVISION, NEWPORT

45TH SPACE WING
AIR FORCE DEVELOPMENT TEST CENTER
30TH SPACE WING
CONSOLIDATED SPACE TEST CENTER
AIR FORCE FLIGHT TEST CENTER
AIR FORCE TACTICAL FIGHTER WEAPONS CENTER

CHAPTER 1

INTRODUCTION

1.1 Range users operating at more than one range have had difficulty because of a lack of commonality between the various ranges' requirements for the Flight Termination System (FTS). For purposes of this document, an FTS provides the necessary action to end the flight of a vehicle. A Flight Safety System (FSS) provides the capability to control the flight in a safe manner. A diagram of a generic FSS is shown in figure 1-1. To eliminate such problems, the FTS committee has defined commonly acceptable FTS requirements for such systems in the various classes of unmanned flight vehicles. Requirements in this document specify certain design features, documentation, system monitoring criteria, testing and in some cases, test methodology for FTSs only. Application of these standards presupposes a determination that an FTS is required.

1.2 This document is intended to provide technical specifications for the design, documentation, and test of all new and modified airborne FTSs or vehicles (including new programs) which will be acceptable for use on a specific flight vehicle at any Major Range and Test Facility Base (MRTFB). In this document, the MRTFB includes NASA launch facilities.

1.3 Users are cautioned that ground and flight operational constraints may vary from range to range; consequently, what is an acceptable operation on one range may not be permitted on another. Adherence to the design requirements stated in this document, plus testing in the specified manner, will produce a hardware design which can be flown at any MRTFB without modification or retest, provided the flight vehicle and environment are essentially identical to those used for the initial qualification. If modification is made to the qualified flight vehicle or FTS/FSS design, a review by the Range Safety Office of each subsequent launching range is mandatory and will determine whether additional testing or FTS/FSS design modification is required prior to any flight of the modified vehicle.

1.4 Any requirement of this document that is waived, exempted, or deviated from by an individual range for use on that range, invalidates the common approval concept for use on all other ranges. The user must submit adequate justification for waivers and deviations to that range.

1.5 Users are cautioned to make provision for the mandatory system testing and monitoring functions as specified here. Users are strongly urged to coordinate with the ranges' safety offices as early as practical to ensure proper recognition and interpretation of these requirements.

1.6 Because of differing requirements between classes of flight vehicles, this document defines the following five major categories.

1.6.1 **Tactical Missiles**

Usually referred to as the smaller, suborbital missiles and rockets that are ground, sea, or air launched such as Patriot, Standard Missile, and Advanced Medium Range Air-to-Air Missile (AMRAAM).

1.6.2 **Cruise Missiles, Remotely Piloted Vehicles, and Subscale Aerial Targets**

Air-breathing engine-powered, unmanned airborne vehicles, usually used for jamming, interrogation, harassment, reconnaissance, targets, or tactical attack missions such as Tomahawk and BQM-34.

1.6.3 **Full-Scale Aerial Targets**

Man-rated aircraft with proven control systems that are converted to remote control unmanned vehicles for use as remote control targets, for example, QF-4, QUH-1, and QF-100.

1.6.4 **Sounding Rockets**

Suborbital space vehicles used primarily in support of space and earth sciences research, single or multiple stage rockets, or missile systems whose maximum velocity does not exceed 13,000 feet/second, for example, Black Brant, Talos Aries, and Aries.

1.6.5 **Expendable Launch Vehicles/Ballistic Missiles (includes experimental vehicles not falling in other categories)**

Single or multiple stage missiles made up of individual or a combination of solid and liquid stages capable of delivering a payload or warhead such as Delta, Atlas/Centaur, Titan, Pegasus, Minuteman, Trident, and Scout.

1.7 Each major category uniquely addresses antennas, flight termination receiver/decoders, ordnance, power supplies, wiring harnesses, telemetry, and monitoring requirements. Operational constraints at some ranges may also require tracking aids. Many requirements are the same, but some differ between categories. For vehicles not classified in the above categories or those which could be classified in two or more categories, the Lead Range Safety Office will evaluate and identify the category to use for design purposes.

1.8 Conformance with the design requirements of this document does not relieve the range user of the responsibility for compliance with flight certification requirements prior to operations at any range; for example, flight hardware must be within its certification period.

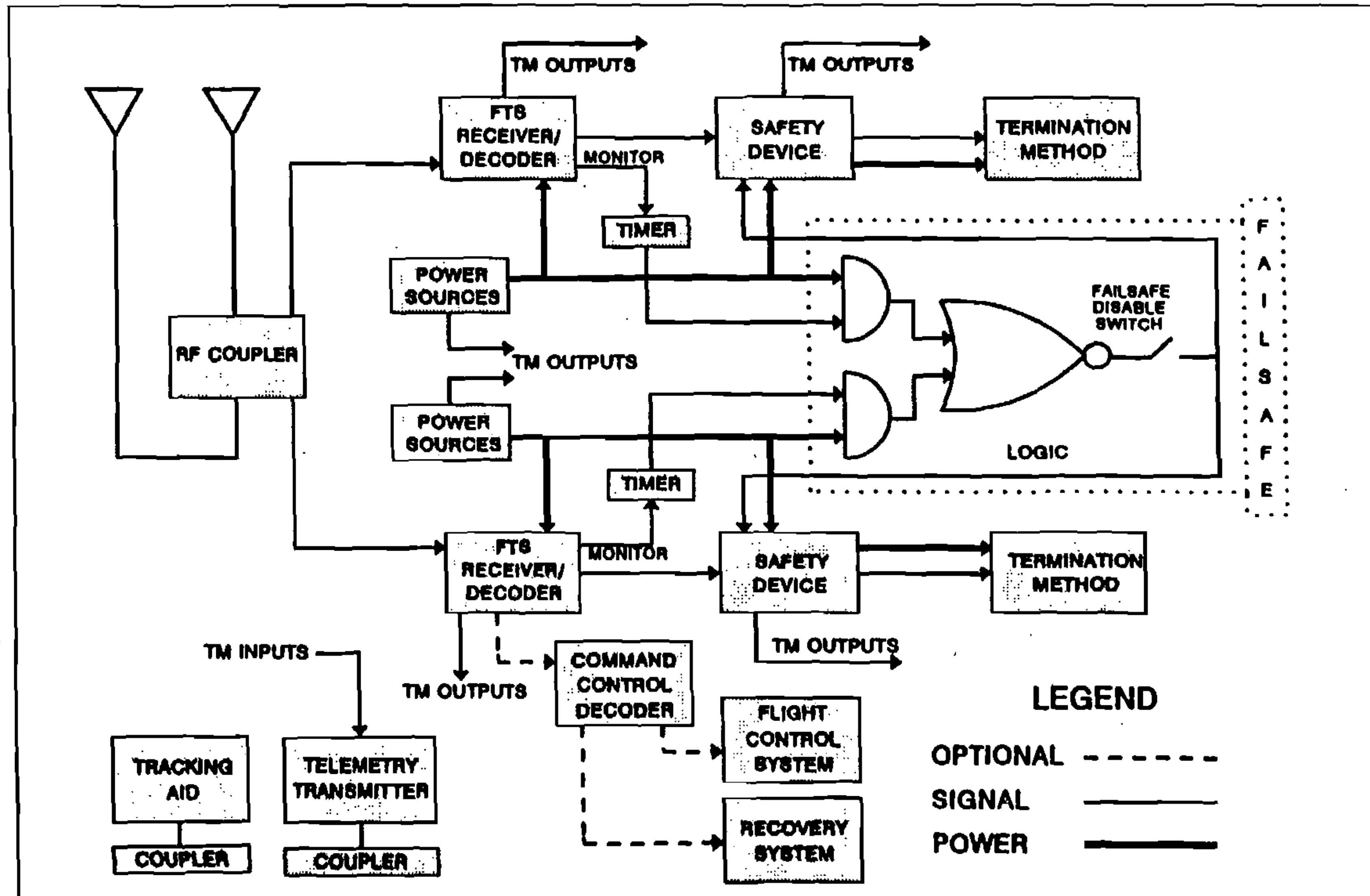


Figure 1-1. Generic flight safety system.

CHAPTER 2

GENERAL

2.1 The following discussion applies to all FTSs

For design requirements, users are referred to the details in the specific vehicle category section. The FTS design must be approved by the Lead Range Safety Office before range safety launch approval will be granted. The approved FTS design shall be under configuration control. After FTS design approval, no modifications may be made without prior approval by the Lead Range Safety Office. Modification without safety approval will result in the revocation of the approved status of the system. The range user must maintain appropriate configuration documentation, revising it to reflect approved modifications to the FTS, and shall provide copies of these documents as specified in approved configuration control procedures.

2.2 Procurement Specifications

Procurement specifications for FTS components shall include the requirements of this document and will be approved by the Lead Range Safety Office.

2.3 Effectiveness

The FTSs must be effective throughout that portion of flight in which the Range Safety Office has safety responsibility. All unmanned flight vehicles (except unguided sounding rockets) determined to need an FTS by the Range Safety Office shall contain redundant FTS components. This redundancy will be structural, mechanical, and electrical with maximum practical physical separation between the redundant components. The only exceptions to this requirement that will be considered by the Range Safety Office are FTS antenna/RF transmission systems and terminal charges, provided the destruct charge is initiated by at least two structurally and functionally independent detonators.

2.4 Reliability

The FTS shall be designed to eliminate the possibility of a single-point failure inhibiting the function of the system or causing an undesired output of the system (single-fault tolerant).

2.4.1 The overall system reliability design goal is 0.999 at 95 percent confidence.

2.4.2 Reliability testing of components shall include a quantity approved by the Lead Range Safety Office. The quantity will be based on economic feasibility, historical use, and analyses.

2.4.3 Each FTS component shall have its shelf, service, and operating life specified.

2.5 Action

The FTS must be capable of imposing a condition of zero lift, zero yaw, and zero thrust when termination is effected. Where termination causes a decaying thrust condition, as in the puncturing of a motor case, the thrust resulting from the termination action must cause tumbling. In vehicles using lifting surfaces to control attitude or stability, the FTS must be capable of imposing a condition of zero lift to minimize range to impact. When termination is initiated, it shall be irrevocable.

2.6 Multi-Staged Missiles

A method of terminating thrust must be provided for each propulsive stage of a multi-stage missile capable of hazarding a protected area. To limit the effects of premature separation, breakup, or self-abort, all propulsive stages not containing a command FTS shall be disabled or thrust terminated automatically when such an event occurs.

2.7 Range Required Flight Termination Receivers

The qualification test units shall be delivered to the Lead Range. Additionally, when multiple ranges are involved, two additional receivers for each range involved will be required for their continued and peculiar usage.

2.8 Monitors

Real-time remote monitoring of critical FTS functions is required. See telemetry and monitoring requirements for details.

CHAPTER 3

RELIABILITY SPECIFICATION

3.1 Reliability Program Guidance

Guidance for establishing or implementing a reliability program can be found in Military Standard 785, *Reliability Program for Systems and Equipment, Development and Production*.

3.2 Single-Fault Tolerant

The FTS will be designed in such a manner as to eliminate the possibility of a single-point failure inhibiting the function of the system or causing an undesired actuation or output of the system. Construction shall use high reliability components with an equally reliable quality control during the buildup, installation, and checkout of these systems. The number of components shall be kept to a minimum.

3.3 System

Airborne FTS modules shall have a design goal of 0.999 reliability with 95 percent confidence. System reliability shall be verified by test or analysis in accordance with the Part Stress Analysis of Military Handbook 217, *Reliability Prediction of Electronic Equipment*, using the missile launch (ML) environmental factor or others as appropriate to the program's flight vehicle. Mission time used in calculations shall include preflight checkout time as required plus a minimum of 30 minutes for hang-fire waiting periods plus 150 percent of the predicted maximum time of hazardous flight.

3.4 Subsystem

The design of major FTS subassemblies or components (black boxes) shall demonstrate, by analytical prediction, reliability values not less than those assigned in the system reliability budget. For certain articles selected by the Lead Range Safety Office, based on design maturity, prior flight use and failure history, additional functional testing will be required in the amount of 298 mission cycles. Test quantity for single-use devices will be 298 tests. Duration of testing for other devices will be determined by multiplying the mission time by a factor of 298. Test results, failure analyses, and corrective actions shall be reported to the Lead Range Safety Office. Test data from Qualification and Acceptance Testing may be used, as applicable. The occurrence of any failure during the above testing may, at Lead Range Safety Office direction, require additional testing.

3.5 Reliability Data

Not later than 6 months prior to FTS component or system testing, the user shall submit the Reliability Requirement Analysis and Reliability Test Plan to the cognizant Lead Range Safety Office for review and approval. The analysis must be performed for the worst-case flight environment.

CHAPTER 4

DESIGN REQUIREMENTS

4.1 General

4.1.1 All missiles and unmanned air vehicles (except unguided sounding rockets) must have a fully redundant command FTS between the antenna and the terminal charge. The two FTSs shall be physically and electrically independent throughout. A fail-safe system does not fulfill the redundancy requirement.

4.1.2 Except for Sounding Rockets and Expendable Launch Vehicles (ELVs), a fail-safe system with bypass capability is required. The fail-safe system must respond to "loss of tone" and "loss of power." Time duration for the loss of tone fail-safe timer will be based on vehicle performance characteristics. Loss of power fail-safe will be the minimum guaranteed operating voltage of the FTS. Capability to enable/disable fail-safe prior to and after launch must be provided. Bypass capability shall be accomplished with a plug or jumper cable which will deactivate the system.

4.1.3 The FTS must produce zero lift, zero yaw, and zero thrust, achieved by any method that does not degrade overall FTS reliability below 0.999 at 95 percent confidence. It shall be designed in a manner to eliminate the possibility of a single-point failure inhibiting the function of the system or causing an undesired output from the system (single-fault tolerant). The vehicle must be destabilized or severed into the minimum number of pieces required to produce tumbling.

4.1.4 The source effecting flight termination must be independent of all other vehicle systems.

4.1.5 A flight terminate action must terminate flight in all stages.

4.1.5.1 When more than one powered stage contains an FTS, the system design must be such that destruct action of one stage will not prevent destruct action of other stages.

4.1.5.2 When required by the Range Safety Office, a fully redundant automatic FTS shall be installed on each powered stage not containing a command FTS. The automatic FTS shall be designed to be activated by vehicle breakup or premature separation and will terminate any separated stage not containing a command FTS.

4.1.6 Design should accommodate easy replacement of FTS components where such is likely to be required. Design should allow for post-replacement verification of component connections integrity through built-in test points without breaking into flight connectors.

4.1.7 All ordnance items must be assigned the appropriate DOD Hazard Classification and Storage Compatibility Group in accordance with DOD 6055.9, *Ammunition and Explosive Safety Standard*. Items which have not previously been classified and cannot be classified based on similarity with previously classified items will be tested and classified in accordance with AFTO 11A-1-47, NAVSEAINST 8020.8A, and TB700-2, *DOD Explosives Hazard Classification Procedures*. The range user is responsible for having the tests conducted and submitting the results to the Lead Range Safety Office for verification and concurrence. The Lead Range Safety Office must also verify the test procedures prior to conducting the tests.

4.1.8 The FTS command system shall be installed in the last propulsive stage capable of hazarding a protected area. Redundant systems shall be configured to avoid fratricide and physically separated from each other by the maximum possible distance. Physical separation shall be maintained between the redundant systems when placing explosives and routing explosive transfer or electrical lines to other stages.

4.1.9 The FTS shall be designed to function properly under dynamic environmental and mechanical factors equal to or greater than those which would result in structural in-flight breakup of the vehicle. It shall also survive without degrading all factors encountered prior to free flight including storage, transportation, prelaunch processing, and checkout (captive) flights. To provide a design factor of safety or margin, all components of the FTS, including methods of attaching or installing the system components, shall be designed to function within performance specifications when exposed to environmental levels that exceed the maximum levels predicted or known during its service life (ground transportation, checkout, and launch through the end of the Range Safety Office's responsibility).

4.1.9.1 Unless otherwise agreed to by the Lead Range Safety Office, FTS components shall be designed and qualified to the following minimum limits:

TEMPERATURE: 10 °C higher and lower than the maximum predicted flight environment. The minimum thermal range, however, shall be -54 to 71 °C. The design must allow for a minimum of 32 thermal cycles.

SHOCK: 6 dB above maximum flight predicted for a minimum of 20 msec or predicted duration, whichever is greater.

ACCELERATION: A factor of 2 for predicted launch or ejection acceleration for a minimum of 5 minutes or 150 percent of predicted duration, whichever is greater.

VIBRATION: 10 dB above maximum predicted or 6 dB above known levels for both sine and random vibration environments. The minimum duration shall be at least 3 minutes per axis or 3 times the flight exposure, whichever is greater. For systems/components which will have long captive carry and/or flight times, test duration will be determined by the Lead Range Safety Office.

4.1.9.2 The maximum flight-predicted levels shall be verified and adjusted as necessary by actual flight data. Significant deltas between predicted and actual may warrant further analyses and qualification testing. The monitoring sample rates on actual data will be such that the data from 20 to 3000 Hz is definable.

4.1.10 Flight termination components and complete systems shall be designed to accommodate all test requirements identified in chapter 5 of this document.

4.1.11 Any FTS component employing a microprocessor shall have the capability to perform a self test (error detection) and output the results via telemetry. The self test shall be capable of initiation by "power on" or upon the reception of a special test command. The execution of a self test shall not inhibit the processing of the units' intended functions or cause any outputs to change state.

4.1.12 A mechanical stress analysis of hardware mounting shall be performed to support the design of the proposed FTS. This analysis should include major components, associated bracketry, and attaching hardware. The resulting margin of safety or safety factors shall be calculated and documented.

4.2 Tactical Missiles

4.2.1 Flight Termination Receiver/Decoder

4.2.1.1 Redundancy. The Flight Termination System shall contain two flight termination receivers (FTR) which are physically and electrically independent of each other and of the missile system.

4.2.1.1.1 The FTR shall operate within the frequency range of 406-450 MHz except at Kwajalein Missile Range (KMR).

4.2.1.1.2 Programs desiring to launch at more than one range (except KMR) must use one of the assigned common frequencies: 421, 425, or 428 MHz. Programs expecting to launch to or from KMR must coordinate an assigned frequency that is compatible with KMR.

4.2.1.1.3 The FTR deviation shall be ±30 kHz per tone.

4.2.1.1.4 The FTRs shall be capable of operating within specification limits during and after application of radio signals of ±13 dBm at its RF input.

4.2.1.1.5 The operating bandwidth of the FTR shall be ±45 kHz at nominal sensitivity.

4.2.1.1.6 The FTR output power requirements and load characteristics shall be specified.

4.2.1.1.7 The FTR shall be designed and qualified in accordance with RCC Document 313-89, *Design, Performance and Test Standards for Flight Termination Receiver/Decoders, Volume I, Design and Performance Requirements* and the requirements of this document.

4.2.1.2 Sensitivity Range. The sensitivity range of the FTR must be between -107 and -116 dBm. The minimum threshold sensitivity is the minimum level at which an FTR meets all specifications. The measured threshold sensitivity shall not be more sensitive than -116 dBm. Subsequent sensitivity tests shall be within 3 dB of the original acceptance test measurements.

4.2.1.3 Intermediate Frequency (IF) Output. If the FTR has an IF output intended to be used for command and control, it must meet the specifications described next.

4.2.1.3.1 The amplitude must be specified in the procurement document but shall be no less than 1 volt root-mean-square (Vrms).

4.2.1.3.2 The output impedance of the circuit shall be 50 ohm or as specified in the procurement document.

4.2.1.3.3 The IF bandwidth shall be as specified in the procurement document but shall be no less than 210 kHz at the 3 dB point and 350 kHz at the 60 dB point.

4.2.1.3.4 The IF output distortion shall not exceed 5 percent.

4.2.1.3.5 If the IF output is not intended for use on command and control, then its output characteristics must be specified and it must be stated that it will not be used for such.

4.2.1.4 <u>RCC Tone Channels</u>. The number of simultaneous usable channels required is three. If a fourth tone is applied, it will neither cause the loss of the arm output or prevent the acceptance of the terminate command. For decoder tones and tone combinations, see tables 4-1 and 4-2.

TABLE 4-1. RCC STANDARD DECODER TONES

RCC TONE	FREQUENCY (kHz)
1	7.50
2	8.46
3	9.54
4	10.76
5	12.14
6	13.70
7	15.45
8	17.43
9	19.66
10	22.17
11	25.01
12	28.21
13	31.83
14	35.90
15	40.49
16	45.68
17	51.52
18	58.12
19	65.56
20	73.95

Tolerances: Frequency ±0.1 percent
Amplitude ±1.0 dB
Distortion < 2 percent total harmonic distortion

TABLE 4-2. RCC STANDARD TONE COMBINATIONS			
Missile	ARM	TERMINATE	OPTIONAL
A	1&5	1&2	2&5
B	1&3	1&2	2&3
C	1&6	1&2	2&6
D	1&7	1&2	2&7
E	1&8	1&2	2&8

NOTE: Missile A is the standard tone combination to be used for single missile operations.

4.2.2 Antenna

4.2.2.1 Radio-Command Coverage. The FTS antenna system shall have adequate radio coverage over 95 percent of the radiation sphere. To have adequate coverage, the FTS shall be capable of reliable operation with signals having electromagnetic field intensity 12 dB below the intensity provided by the range at any point along the vehicle trajectory where the range retains safety responsibility for the flight vehicle. Deep nulls in the pattern shall be minimized both as to the number of nulls and angular width. The FTS antenna systems for spinning vehicles shall also minimize the fluctuation of the received signals as the vehicle rolls. To ensure adequate coverage, the entire command FTS (ground and airborne) shall have an RF link analysis conducted which must show a minimum of 12 dB margin. This analysis must include path loss, plume or flame attenuation, aspect angle, vehicle trajectory, and ground system RF characteristics. For use in RF link analysis, antenna patterns shall be provided as described in the current edition of RCC Document 253-XX, *IRIG Standard Coordinate System and Data Formats for Antenna Patterns*.

4.2.2.2 Voltage Standing Wave Ratio (VSWR). Unless otherwise specified, FTS antenna system components shall be designed for a nominal 50 ohm impedance, and the antenna system shall have a VSWR of 2:1 or less across the specified bandwidth and over the operating environments.

4.2.2.3 Characteristics. With the FTS antenna system mounted by its normal means, the performance characteristics specified in this document shall be met under any combination or all of minimum/maximum environmental levels predicted during its service life, (that is, storage, transportation, prelaunch processing and checkout, and launch through the end of the Range Safety Office's responsibility) plus margin. If power splitters, combiners, hybrids, coaxial cables, or other passive devices are used to connect the antenna to the FTR, these shall then be considered as part of the FTS antenna system.

4.2.2.3.1 Antennas. If more than one antenna element is used in the FTS antenna system, the RF signal shall be equally divided (assuming in-phase RF input signal) between the FTRs. A hybrid coupler using an unequal wavelength between the coupled output ports will not satisfy this requirement. If a dedicated independent FTS antenna system is used for each FTR, each antenna system shall meet the requirements specified in this document. For programs desiring to launch on more than one range, the FTS antenna system shall be designed to operate on the assigned frequency.

4.2.2.3.2 Bandwidth. The bandwidth of the FTS antenna system shall be adequate to pass the operating bandwidth of the radio command signal.

4.2.2.3.3 Insertion Loss. The insertion loss shall have a design goal of no greater than 4 dB loss from the output port of any antenna to the input port of any FTR.

4.2.2.4 Ground-System RF Characteristics. The FTS antenna system shall be fully compatible with the ground command transmitters and their left-hand circular polarized antennas.

4.2.3 Ordnance

Safe and arm (S&A) devices; arm and fire (A&F) units; safe, arm, fire (SAF) units; initiators; detonators; energy-transfer devices; boosters; explosive manifolds; and termination charges.

4.2.3.1 Redundant electromechanical S&A devices are required on all explosive systems incorporating sensitive initiators (primary explosives).

4.2.3.2 Redundant Exploding Bridge Wires (EBW)/Laser Firing Units (LFU)/Electronic S&A may be used in lieu of electromechanical S&A for explosive systems incorporating non-sensitive initiators (secondary explosives).

4.2.3.3 Electrical inhibit circuits, other than electronic S&As, may be used only on systems which employ low-energy termination devices such as fuel shutoff valves and parachutes.

4.2.3.4 No arming device may produce a terminate output as the result of a single component failure.

4.3 Cruise Missiles, Remotely Piloted Vehicles, and Subscale Targets

4.3.1 Flight Termination Receiver/Decoder

4.3.1.1 Redundancy. The Flight Termination System shall contain two FTRs, physically and electrically independent of each other and of the vehicle system.

4.3.1.1.1 The FTR shall operate within the frequency range of 406-450 MHz except at KMR.

4.3.1.1.2 Programs desiring to launch at more than one range (except KMR) must use one of the assigned common frequencies: 421, 425, or 428 MHz. Programs expecting to launch to or from KMR must coordinate an assigned frequency that is compatible with KMR.

4.3.1.1.3 The FTR deviation shall be ±30 kHz per tone.

4.3.1.1.4 The FTRs shall be capable of operating within specification limits during and after application of radio signals of +13 dBm at its RF input.

4.3.1.1.5 The operating bandwidth of the FTR shall be ±45 kHz at nominal sensitivity.

4.3.1.1.6 The FTR output power requirements and load characteristics shall be specified.

4.3.1.1.7 The FTR shall be designed and qualified in accordance with RCC Document 313-89, *Design, Performance and Test Standards for Flight Termination Receiver/Decoders, Volume I, Design and Performance Requirements* and additionally, shall meet the requirements of this document.

4.3.1.2 Sensitivity Range. The FTR sensitivity range must be between -107 and -116 dBm. The minimum threshold sensitivity is the minimum level at which an FTR meets all specifications. The measured threshold sensitivity shall not be more sensitive than -116 dBm. Subsequent sensitivity tests results shall be within 3 dB of original acceptance test measurements.

4.3.1.3 Intermediate Frequency Output. If the FTR has an IF output intended to be used for command and/or control, it must meet the following specifications.

4.3.1.3.1 The amplitude must be specified in the procurement document but shall be no less than 1 Vrms.

Missile	ARM	TERMINATE	OPTIONAL
A	1&5	1&2	2&5
B	1&3	1&2	2&3
C	1&6	1&2	2&6
D	1&7	1&2	2&7
E	1&8	1&2	2&8

TABLE 4-2. RCC STANDARD TONE COMBINATIONS

NOTE: Missile A is the standard tone combination to be used for single missile operations.

4.3.2 Antenna

4.3.2.1 Radio Command Coverage. The FTS antenna system shall have adequate radio coverage over 95 percent of the radiation sphere. To have adequate coverage, the FTS shall be capable of reliable operation with signals having electromagnetic field intensity which is 12 dB below the intensity provided by the range at any point along the vehicle trajectory where the range retains safety responsibility for the flight vehicle. Deep nulls in the pattern shall be minimized both as to the number of nulls and angular width. The FTS antenna systems for spinning vehicles shall also minimize the fluctuation of the received signals as the vehicle rolls. To ensure adequate coverage, the entire command FTS (ground and airborne) shall have an RF link analysis conducted which must show a minimum of 12 dB margin. This analysis must include path loss, flame attenuation plume, aspect angle, vehicle trajectory, and ground system RF characteristics. For use in the RF link analysis, antenna patterns shall be provided as described in the current edition of RCC Document 253-XX, *IRIG Standard Coordinate System and Data Formats For Antenna Patterns*.

4.3.2.2 Voltage Standing Wave Ratio. Unless otherwise specified, the FTS antenna system components shall be designed for a nominal 50 ohm impedance and the antenna system shall have a VSWR of 2:1 or less across the specified bandwidth and over the operating environments.

4.3.2.3 Characteristics. With the FTS antenna system mounted by its normal means, the performance characteristics specified here shall be met under any combination or all of minimum/maximum environmental levels predicted during its service life (that is, storage, transportation, prelaunch processing and checkout, and launch through the end of the Range Safety Office's responsibility) plus margin. If power splitters, combiners, hybrids, coaxial cables, or other passive devices are used to connect the antenna to the FTR, these devices shall then be considered as part of the FTS antenna system.

4.3.2.3.1 Antennas. If more than one antenna element is used in the FTS antenna system, the RF signal shall be equally divided (assuming in-phase RF input signal) between the FTRs. A hybrid coupler using an unequal wavelength between the coupled output ports will not satisfy this requirement. If a dedicated independent FTS antenna system is used for each FTR, each antenna system shall meet the requirements specified here. For programs desiring to launch on more than one range, the FTS antenna system shall be designed to operate on the assigned frequency.

4.3.2.3.2 Bandwidth. The bandwidth of the FTS antenna system shall be adequate to pass the operating bandwidth of the radio command signal.

4.3.2.3.3 Insertion Loss. The insertion loss shall have a design goal of no greater than 4 dB loss from the output port of any antenna to the input port of any FTR.

4.3.2.4 Ground-System RF Characteristics. The FTS antenna system shall be fully compatible with the ground command transmitters and their left-hand circular polarized antennas.

4.3.3 Ordnance

Safe and arm (S&A) devices; safe, arm, fire (SAF) units; arm and fire (A&F) units; initiators; detonators; energy-transfer devices; boosters; explosive manifolds; and termination charges.

4.3.3.1 Redundant electromechanical S&A devices are required on all explosive systems incorporating sensitive initiators (primary explosives).

4.3.3.2 Redundant Exploding Bridge Wires/Laser Firing Units/Electronic S&As may be used in lieu of electromechanical S&As for explosive systems incorporating non-sensitive initiators (secondary explosives).

4.3.3.3 Electrical inhibit circuits except electronic S&As may be used only on systems which employ low energy termination devices such as fuel shutoff valves and parachutes.

4.3.3.4 No arming device may produce a terminate output as the result of a single component failure.

4.6.1.7.2 Prelaunch FTS Safing. Redundant capability to remotely safe the FTS arming devices shall be provided. For surface launch vehicles, at least one of the ground-safing systems shall be routed to the vehicle via hardline.

4.6.1.8 Design Life. Each FTS component shall have its operating life and storage life specified. The Range Safety Office must be notified if an FTS components' operating or storage life expires prior to launch. The Range Safety Office will then determine if retesting is required.

4.6.1.9 Ground-Support Equipment. All ground-support equipment required to test the FTS and components at the range must be provided by the range user. This equipment must be approved by the Range Safety Office.

4.6.1.10 FTS Fratricide. System design shall be such that flight termination action of a stage will not sever inter-connecting flight termination system circuitry or ordnance to other stages until the other stages have been destroyed. Analysis verifying compliance with this requirement may be required by the Range Safety Office.

4.6.1.11 Environmental Monitoring. Environmental monitoring shall be required on all flights until the flight environment is established. The function to be monitored will be determined on a case-by-case basis.

4.6.1.12 FTS Isolation. Such flight-termination system components as electrical wiring, power systems, and initiators shall be isolated from other vehicle components to the extent that normal or abnormal functioning of the other vehicle components does not inhibit or activate the FTS components.

4.6.1.13 Receipt-Through-Launch Testing Requirements. The FTS and associated ground-support design shall provide the capability to perform receipt-through-launch testing.

4.6.2 FTS Receiver Requirements

This section contains minimum acceptable requirements for FTS receivers. Where the state-of-the-art permits a desirable improvement over these requirements, such improvements may be incorporated provided the Range Safety Office has given approval. Two flight termination receivers which are physically and electrically independent of each other shall be provided for each stage having a command flight termination system requirement. In this document, the word "receiver" is used to include the combined receiver/decoder. In addition to the requirements specified in the following subparagraphs, information on FTS receiver design and testing requirements may be found in Range

Commanders Council Document 313-89, *Design, Performance, and Test Standard for Flight-Termination Receiver/Decoders*. In case of conflicts between this document and document 313-89, this document will take precedence.

4.6.2.1 General Specifications

4.6.2.1.1 Connectors

4.6.2.1.1.1 Arm, terminate, and optional commands shall be routed through a separate connector from input power, monitor circuits, and RF inputs.

4.6.2.1.1.2 The RF inputs shall be routed through a dedicated connector, separate from input power and monitor circuits.

4.6.2.1.2 Single-Fault Tolerant. Failure of any one component within the receiver shall not cause a command output.

4.6.2.1.3 Performance. After being adjusted initially, the receiver shall perform in accordance with the requirements of this document without subsequent adjustment.

4.6.2.1.4 Interference Protection. The receiver shall be designed to meet the requirements of MIL-STD 461, *Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference*, methods CE03, CE06, CE07, CS01, CS02, CS03, CS04, CS05, CS06, CS10, CS11, RE02, RS02, RS03 and RS05. Limits of MIL-STD 461, method RS03, are changed to 60 dB above threshold sensitivity at center frequency. In addition, RS03 shall be at least 0 dBm throughout the following frequency ranges: 2200–2400, 5400–5900, and 9200–9600 MHz.

4.6.2.1.5 Radiation Analysis. An analysis of the emitted radiations and the susceptibility of the FTR to interference shall be performed at the system level to establish that the interference characteristics identified and profiled in testing are compatible with the environment of the vehicle in which the FTR is to be used.

4.6.2.1.6 Transient Response. The tolerance to transient voltages shall be specified for each connector pin. Amplitude, polarity, and duration shall be identified. The receiver must meet the "no output during transient" requirement and its performance requirements after the application of the specified transient.

4.6.2.1.7 Continuity and Isolation. The resistance from each pin to common return, and also case ground, shall be specified. Measurements that are polarity sensitive such as those containing diodes shall be identified. In addition, significant pin-to-pin measurements shall be included where their inclusion will provide meaningful data relative to the reliability of the receiver. The isolation of the command output pin to the dc input and case ground shall not be less than 2 megohms.

4.6.2.1.8 FTR Damage by Output Voltage. The receiver shall not be damaged by the application of up to 45 Vdc or the open circuit voltage (OCV) of the power source, whichever is greater, to any of the output ports (arm, terminate, and optional) for up to 5 minutes. This requirement shall be met by the FTR in both the powered up and powered-down mode.

4.6.2.1.9 Power Transfer Switch. If a range user has a mandatory need for incorporating the power transfer capabilities into the flight termination receiver, it must be approved by the Lead Range Safety Office. If approved, the following design requirements apply.

4.6.2.1.9.1 If the FTR uses an on/off switch, the "off" position must be used for external power.

4.6.2.1.9.2 The FTR shall not change power source selection as a result of loss of the power source.

4.6.2.2 Nonsecure Receiver Specifications

4.6.2.2.1 Operating-Frequency Band. The receiver shall be designed to be tunable over the frequency range 406-450 MHz. Programs desiring to operate at more than one range except at KMR must use one of the assigned common frequencies: 421, 425, or 428 MHz. Programs expecting to launch to or from KMR must coordinate an assigned frequency that is compatible with KMR. The FTR RF input VSWR shall be 2:1 or less. The FTR must center at the assigned RF center frequency within ±0.005 percent.

4.6.2.2.2 RF Sensitivity. The receiver shall respond to properly modulated RF signals of from -107 to -116 dBm across a 50 ohm impedance. The minimum threshold sensitivity is the minimum level at which an FTR meets all specifications. The measured minimum threshold sensitivity shall not be more sensitive than -116 dBm. Subsequent sensitivity test results shall be within 3 dB of original acceptance test measurements.

4.6.2.2.3 Maximum Usable RF Input. The receiver shall be capable of operating within its specification limits during and after the application of RF signal levels between the threshold sensitivity and +13 dBm.

4.6.2.2.4 Operational Bandwidth. The receiver shall initiate and sustain all command functions over a continuous range of ±45 kHz from the assigned RF center frequency when subjected to command tones having deviations of plus and minus 30 ±3 kHz peak per tone.

4.6.2.2.5 Continuous-Wave (CW) Bandwidth. The receiver shall provide an IF bandwidth of 180 kHz minimum at the 3 dB point and 360 kHz maximum at the 60 dB point, centered on the assigned RF center frequency. All spurious responses outside this bandwidth shall be at least 60 dB down.

4.6.2.2.6 Noise Margin. The noise required to produce an unwanted output shall be at least 12 dB above the highest noise level that would normally be found in the receiver when an RF signal is not applied to the receiver RF input.

4.6.2.2.7 Noise Immunity. The FTR shall not produce unwanted outputs when the FTR is subjected to white noise (at an amplitude of 12 dB higher than the measured threshold sensitivity level) at the RF input connector.

4.6.2.2.8 CW Peak-to-Valley Ratio. The IF filter peak-to-valley ratio shall not exceed 3 dB within ±45 kHz of the assigned operating frequency.

4.6.2.2.9 Capture Ratio. The application of an unmodulated RF signal at the assigned frequency at up to 80 percent of the desired/modulated RF carrier signal shall not capture the receiver.

4.6.2.2.10 Signal Strength Telemetry Output Monitor. The receiver's SSTO voltage, while operating into a 10k ohm load, shall be in accordance with the following requirements.

4.6.2.2.10.1 Quiescent (no RF signal) condition: 0.5 ±0.25 Vdc.

4.6.2.2.10.2 Measured command threshold sensitivity input condition: 0.1 Vdc minimum above the quiescent value.

4.6.2.2.10.3 Minus 53 dBm RF input condition: 4.75 ±0.25 Vdc.

4.6.2.2.10.4 The shape of the transfer function shall not exceed approximately 1 Vdc change in voltage for each 13 dB change in RF input signal over the range between threshold and saturation.

4.6.2.2.10.5 The maximum SSTO voltage shall not exceed 5 Vdc under all conditions.

4.6.2.2.10.6 The slope of the SSTO voltage shall not change polarity from measured threshold to a +13 dBm level (the slope shall be monotonic).

4.6.2.2.10.7 The SSTO voltage shall not be used as a command output monitor.

4.6.2.2.11 Amplitude-Modulation (AM) Rejection

4.6.2.2.11.1 An RF input signal of 7 microvolts ±10 percent with 30 percent AM modulation at the assigned center frequency and a 12 microvolt ±10 percent signal with 50 percent AM modulation at any modulation frequency shall not produce an output from any decoder channel.

4.6.2.2.11.2 An RF input signal at the assigned center frequency of 100 microvolts ±10 percent with 100 percent peak AM noise modulation at low-pass filter (LPF) 3 dB frequencies of 3.5 or 7.0 kHz, shall not produce an output from any decoder channel. When the input signal is properly modulated to produce an output from a decoder channel, the 100 percent peak AM noise modulation at LPF 3 dB frequencies of 3.5 to 7.0 kHz shall not inhibit that decoder output function.

4.6.2.2.12 Input-Voltage Range. The FTR input voltage range shall be specified, and the current in the commanded and uncommanded state shall be noted in the FTR specification. The FTR shall meet the requirements of this document at any voltage level between the minimum and maximum specified.

4.6.2.2.13 Reverse-Polarity Protection. The receiver shall not be damaged by reverse polarity voltage applied at its input for a period of not less than 1 hour. The receiver shall be protected for 45 volts or OCV of the power source whichever is greater. The receiver shall not produce an output or be damaged because of low or fluctuating input voltage.

4.6.2.2.14 Discernible Threshold. The following definitions describe discernible threshold. No RF signal line shall be projected to the right on the SSTO graph until it intersects with a line drawn tangent to the increasing SSTO curve; the smaller angle formed by the intersection of these two lines shall be bisected; and the intersection of this line with the SSTO curve will be called the discernible threshold point. The discernible threshold shall be between 0.1 and 0.7 V.

4.6.2.2.15 Dynamic Stability. The FTR shall not produce false output or provide unstable desired output as a result of changing input VSWR including open and short.

4.6.2.2.16 Warm-Up Time. The FTR shall meet all operational requirements within 3 minutes after application of dc power.

4.6.2.2.17 Out-Of-Band Rejection. The FTR shall be immune to all out-of-band frequencies. Special emphasis shall be given to those signals originating from 2.2 to 2.4 gigahertz and from 5.4 to 5.9 gigahertz (pulsed). Out-of-band rejection shall be a minimum of 80 dB above measured threshold sensitivity.

4.6.2.2.18 Intermediate Frequency (IF) Output. If the FTR has an IF output intended to be used for command and/or control, it shall meet the following specifications.

4.6.2.2.18.1 The amplitude must be specified in the procurement document but shall be no less than 1 Vrms.

4.6.2.2.18.2 The output impedance of the circuit shall be 50 ohm or as specified in the procurement document.

4.6.2.2.18.3 The IF bandwidth shall be as specified in the procurement document but shall be no less than 180 kHz at the 3 dB point and 360 kHz at the 60 dB point.

4.6.2.2.18.4 The IF output distortion shall not exceed 5 percent.

4.6.2.2.19 Self-Test Capability. If the receiver employs a microprocessor, it shall have the capability to perform a self test (error detection) and output the results via telemetry. The self test shall be capable of initiation by both "power on" or on the reception of a special test command. The execution of a self test shall not inhibit the processing of a command or cause a command output to change state.

4.6.2.2.20 Image Rejection. The FTR shall provide at least 60 dB of rejection of RF at harmonics of the assigned frequency.

4.6.2.3 Nonsecure Decoder Specifications

4.6.2.3.1 Minimum Decoder Output Channels. The number of channels the decoder is required to output simultaneously is three: arm, terminate, and check channel.

4.6.2.3.2 Minimum RCC Audio Tones. The minimum number of RCC audio tone inputs that the receiver must process simultaneously is four. Any additional RCC audio tone input/decoder channel output shall not interfere with the minimum requirements of subparagraph 4.6.2.3.1 and this paragraph.

4.6.2.3.3 Tone Frequency. See tables 4-1 and 4-2 for RCC decoder tones and tone combinations which are standard for the nonsecure mode.

4.6.2.3.4 Standard Logic Sequence. Unless otherwise specified and approved by the Range Safety Office, the decoder shall not produce a command output under any condition or set of conditions except as follows:

Logic Sequence	Decoder Output
Tones 1 and 5	Arm
Tones 1 and 5 followed by tone 2 with tone 5 removed	Terminate
Tone 2 and 5	Optional
Tone 4	Check Channel

TABLE 4-1. RCC STANDARD DECODER TONES

RCC TONE	FREQUENCY (kHz)	
1	7.50	
2	8.46	
3	9.54	
4	10.76	(Check Channel)
5	12.14	
6	13.70	
7	15.45	
8	17.43	
9	19.66	
10	22.17	
11	25.01	
12	28.21	
13	31.83	
14	35.90	
15	40.49	
16	45.68	
17	51.52	
18	58.12	
19	65.56	
20	73.95	

Tolerances:		
	Frequency	±0.1 percent
	Amplitude	±1 dB
	Distortion	±2 percent total harmonic distortion

TABLE 4-2. RCC STANDARD TONE COMBINATIONS				
TARGET	ARM	TERMINATE	CHECK CHANNEL	OPTIONAL
A	1&5	1&2	4	2&5
B	1&3	1&2	4	2&3
C	1&6	1&2	4	2&6
D	1&7	1&2	4	2&7
E	1&8	1&2	4	2&8

NOTE: Target A is the standard tone combination to be used for single missile operations.

4.6.2.3.4.1 Arm/Engine-Shutdown Command. Apply RCC tones 1 and 5. Removal of tone 5 during arm to terminate switching shall not cause loss of arm/engine shutdown output.

4.6.2.3.4.2 Flight-Termination Command. With RCC tones 1 and 5 on (arm), remove tone 5, and apply tone 2. There may be a tone overlap during transition; that is, tone 2 applied before tone 5 is removed. If overlap occurs, neither the arm nor the terminate shall be lost or inhibited.

4.6.2.3.4.3 Optional Command. Apply RCC tones 2 and 5. This command is not a range requirement. It is optional and may be used by range users to execute mission-peculiar functions such as safing the flight termination system or shutting down a specific engine. The optional command shall not inhibit a terminate command sequence including a shorted load on the optional command output channel.

4.6.2.3.4.4 Check Channel Command. With RCC tone 4 applied, the decoder shall be capable of outputting a minimum of 2 watts of power to the external load. The presence or absence of tone 4 shall not affect the performance or function of the other decoder channels.

4.6.2.3.4.5 Other Coding Techniques. Other sequential coding techniques may be used if within the capability of the range's transmitting system and if approved by the Range Safety Office.

4.6.2.3.5 Channel Deviation Threshold and Range

4.6.2.3.5.1 The RF deviation threshold for each channel shall be between ±10 and ±15 kHz. The decoder shall not provide any output at deviation levels of less than ±10 kHz per tone.

4.6.2.3.5.2 The FTR shall meet all specifications when the input RF carrier is deviated over the range of ±27 to ±33 kHz per tone.

4.6.2.3.6 Channel Bandwidth. The channel bandwidth required for the generation of a tone detected output over the operating temperature range shall be

2 dB ± 1 percent of the assigned tone frequency, minimum (at board/box level).

20 dB ±4 percent of the assigned tone frequency, maximum (at the decoder board level).

14 dB ±4 percent of the assigned tone frequency, maximum (at the box level)

The channel filters must be centered about the RCC tone center frequency within ±0.5 percent.

4.6.2.3.7 Adjacent-Channel Rejection. The decoder shall not produce an output on unkeyed channels or cause a keyed channel to drop out in the presence of adjacent channel interference resulting from any combination of simultaneous tones with carrier deviation set at ±50 kHz.

4.6.2.3.8 Response Time. The response time of each function shall be between 4 and 25 milliseconds.

4.6.2.3.9 Transition Time (arm to terminate). The transition time from arm to terminate shall be equal to or less than 10 milliseconds plus normal response time and shall not be inhibited by the simultaneous application of tones.

4.6.2.3.10 Output-Power Capability. The decoder shall be capable of delivering the required energy to the specified load at each output at any power voltage level between the minimum and maximum specified within 0.5 V. The output load impedance characteristics must be defined in the procurement specification, and all output load testing must be conducted under the specified load characteristics. The FTR must be capable of providing a command output while the applicable telemetry monitor output is shorted.

4.6.2.3.11 Leakage Current. The leakage current with no RF applied must be specified in the procurement specification and is expected to be 50 microamperes maximum (nominal).

4.6.2.3.12 Output-Pulse. The rise and fall time of the output terminate voltage shall be specified to ensure compatibility with the loaded circuits and input from the flight battery.

4.6.2.4 <u>Secure Flight-Termination Receiver</u>. Secure receivers are designed to prevent inadvertent flight termination outputs caused by unauthorized or accidental radio transmissions. Secure FTRs are not a range safety requirement. If a user proposes a secure FTR, the secure receiver design shall meet the requirements of subparagraph 4.6.2.1 and the following subparagraphs.

4.6.2.4.1 <u>Secure-Receiver Specifications</u>. The design and performance requirements for the receiver on a secure receiver/decoder are the same as those required for a nonsecure receiver (subparagraph 4.6.2.2).

4.6.2.4.2 <u>Secure-Decoder Specifications</u>. The decoder design must be approved by the Range Safety Office. The ranges will consider any design that satisfies the security requirements of the manager, National Telecommunications and Automated Information Systems Security (NTAISS) while maintaining range safety reliability requirements. Secure decoder designs shall, however, be compatible with existing secure flight termination transmitting equipment. Designs that result in the redesign of range flight termination transmitting equipment require long-range planning and extensive coordination and approval efforts. The following requirements reflect the existing secure decoder specifications.

4.6.2.4.2.1 <u>Minimum Decoder Output Channels</u>. The number of channels the decoder is required to output is three: arm, terminate, and pilot tone. Any additional decoder output channel shall not interfere with the minimum required channels.

4.6.2.4.2.2 <u>Tone Frequency</u>. See table 4-3 for tones and tolerances used in the secure mode (These are not standard RCC audio tones).

TABLE 4-3. TONES AND TOLERANCES

SECURE TONE	FREQUENCY (kHz)
1	7.35
2	8.40
3	9.45
4	10.50
5	11.55
6	12.60
7	13.65
Pilot	15.45

Tolerances:	Frequency	±0.1 percent
	Amplitude	±1.0 dB
	Distortion	±2.0 percent total harmonic distortion

4.6.2.4.2.13 Output Power Capability. The decoder shall be capable of delivering the required energy to the specified load at each output at any power-voltage level between the minimum and maximum specified within 0.5 V. The output load impedance characteristics shall be defined in the procurement specification and all output load testing shall be conducted under the specified load characteristics. The FTR shall be capable of providing a command output while the applicable telemetry monitor output is shorted.

4.6.3 **Antenna**

4.6.3.1 Radio Command Coverage. The FTS antenna system shall have adequate radio coverage over 95 percent of the radiation sphere. To have adequate coverage, the FTS shall be capable of reliable operation with signals having electromagnetic field intensity which is 12 dB below the intensity provided by the range at any point along the vehicle trajectory where the range retains safety responsibility for the flight vehicle. Deep nulls in the pattern shall be minimized both as to the number of nulls and angular width. The FTS antenna systems for spinning vehicles shall also minimize the fluctuation of the received signals as the vehicle rolls. To ensure adequate coverage, the entire command FTS (ground and airborne) shall be subjected to an RF link analysis which must show a minimum of 12 dB margin. This analysis must include path losses because of plume or flame attenuation, aspect angle, vehicle trajectory, and ground system RF characteristics. Antenna patterns shall be provided as described in the current edition of RCC Document 253-XX, *IRIG Standard Coordinate System and Data Formats For Antenna Patterns* and shall be used in the RF link analysis.

4.6.3.2 Voltage-Standing-Wave Ratio. The FTS antenna system components shall be designed for a nominal 50 ohm impedance and the antenna system shall have a VSWR of 2:1 or less across the specified bandwidth and over the operating environments.

4.6.3.3 Antenna-System Characteristics. If power splitters, combiners, hybrids, coaxial cables, or other passive devices are used to connect the antenna to the FTR, these devices will then be considered as part of the FTS antenna system.

4.6.3.3.1 Multiple Antennas. If more than one antenna is used in the FTS antenna system, the RF signal shall be equally divided (assuming in-phase RF input signal) between the FTRs. A hybrid coupler using an unequal wavelength between the coupled output ports will not satisfy this requirement. If a dedicated, independent FTS antenna system is used for each FTR, each antenna system shall meet the requirements specified here. For programs desiring to launch on more than one range, the FTS antenna system shall be designed to operate on an assigned interrange frequency.

4.6.3.3.2 Bandwidth. The bandwidth of the FTS antenna system shall be ±45 kHz, minimum.

4.6.3.3.3 Insertion Loss. The insertion loss shall have a design goal of no greater than 4 dB from the output port of any antenna to the input port of any FTR.

4.6.3.4 Ground-System RF Characteristics. The FTS antenna system shall be fully compatible with the ground command transmitters and their left-hand circular polarized antennas.

4.6.4 Ordnance

S&As, initiators, detonators, energy-transfer lines, boosters, explosive manifolds, and termination charges.

4.6.4.1 Flight-Termination System Arming Devices

4.6.4.1.1 Firing circuit arming devices are required on all flight termination systems. Arming devices typically used on flight termination systems are electromechanical safe and arm devices or electronic exploding bridge wire-firing units. Redundant and physically separated S&A devices or EBW-FUs shall be provided.

4.6.4.1.2 All FTS arming-device designs shall be compatible with the system arming and safing requirements contained in paragraphs 4.6.1.6 and 4.6.1.7.

4.6.4.1.3 A remote status indicator shall be provided on all arming devices to show the armed or safed condition. The device shall also indicate its arm or safe status by simple visual inspection. There shall be easy access to this visual indication throughout vehicle and payload ground-processing.

4.6.4.1.4 The device shall be capable of being remotely armed and disarmed electrically and disarmed mechanically in the event of a malfunction or abort.

4.6.4.1.5 No arming device shall produce a terminate output as the result of a single component failure.

4.6.4.1.6 Flight-termination system arming devices shall not require adjustment throughout their service life.

4.6.4.1.7 Each arming device shall be designed for a service life of at least 10 years after passing its acceptance test.

CHAPTER 6

DOCUMENTATION

6.1 Documentation Requirements for Flight Termination Systems

This section defines the documentation requirements imposed on range users seeking safety approval of FTSs to be used at multiple ranges. It covers the conceptual design, design finalization, qualification, acceptance, and preflight testing phases plus failure reporting. It further defines the organization, quantity, and schedule of the required data. This documentation and data will allow an independent technical review of the FTS design by the appropriate range safety personnel.

6.1.1 Coordination

Range users are advised to coordinate with the lead range as early as possible in the design phase of their program. The concept of the FTS design should be discussed with safety personnel prior to the start of the design effort and reviewed as described in the following subparagraphs.

6.1.1.1 Safety-Design Concept Review. A presentation to the lead range given by the range user defining the concept, which will be followed in designing the FTS. This review should occur early in the design phase prior to the start of any fabrication, release of specifications, or procurement of hardware. Its purpose is to correct any design deficiencies or inadequacies before costs are incurred as a result of changes.

6.1.1.2 Preliminary-Design Review (PDR). A detailed presentation to the lead range of the FTS design details, identifying major components and operational concepts, must be held prior to beginning of engineering fabrication. The presentation shall be documented and provided 14 days prior to the start of the PDR.

6.1.1.3 Critical-Design Review (CDR). A review of the design, design drawings, and documentation as delivered. The FTS shall be under configuration control following approval of the CDR design. Any changes thereafter require Range Safety Office approval. The presentation shall be documented and provided 14 days prior to the start of the CDR.

6.2.4.5.1 Maximum predicted flight loads (per axis for three axes) for all anticipated environmental forces (for example, shock, vibration, acceleration, and thermal) for each component/system. A summary of the analyses or measurements used to derive the vehicle maximum predicted environment shall be included.

6.2.4.5.2 A matrix of the actual qualification and acceptance test levels used for each component/system in each test versus the predicted flight levels for each environment.

6.2.4.5.3 A clear identification of those components qualified by similarity, analysis, or a combination of analysis and test.

6.2.4.5.4 A history of testing and installation of all components.

6.2.4.5.5 A compliance checklist of all test requirements from the appropriate sections of this document. The checklist shall indicate compliance (Yes/No) and indicate the range user documentation that verifies compliance.

6.2.4.6 Telemetry Design Data. The following data shall be included.

6.2.4.6.1 A complete and detailed description of the FTS telemetry system and how it functions, including general specifications and schematics.

6.2.4.6.1.1 A listing of typical telemetry calibration data for each safety channel.

6.2.4.6.1.2 A tabulation of measurement accuracy, sample rate, and time delay for each telemetry measurement used for safety purposes.

6.2.4.6.1.3 A set of single-thread wiring diagrams showing the end-to-end schematic for each safety monitoring channel from pickoff point to telemetry input, ground support equipment, or safety console readout. The schematic shall identify all connectors and pin numbers, components, and wire sizes.

6.2.4.6.2 A compliance checklist of all FTS telemetry requirements (ground and airborne), as defined in the Telemetry Section of the design requirements in this document, indicating compliance (Yes/No) and identifying the range user documentation that verifies compliance.

6.2.4.7 Range Safety Requirement Noncompliance Data. A description of all FTS noncompliance with the requirements of this document; both those that meet "intent" and those requiring a formal Range Safety Office waiver. As a minimum, the description shall include a detailed technical rationale justifying each noncompliance, and if applicable, the scheduled correction date.

6.2.4.8 Compliance Checklist Documents. All documentation referenced in the FTS data package as compliance documents shall be provided as part of or annexes to the data package.

6.2.4.9 Test Plans and Procedures. Development, qualification, acceptance, and prelaunch test plans and procedures shall be submitted to the Lead Range Safety Office for review and approval at least 30 days prior to the need date. Submitted copies shall become a part of the data package. Schedules of required testing must be submitted to the Lead Range Safety Office with sufficient lead time to allow safety monitoring.

6.2.4.10 Test Data. The results (test reports) of required testing shall be submitted to the Lead Range Safety Office for approval. Range Safety Office approval of test results is a prerequisite for FTS approval.

6.2.4.11 RF Command Coverage and Link Analysis. The entire FTS command system, both ground and airborne, shall be subjected to RF link analysis in accordance with the design requirements for radio command coverage in this document. Range Safety Office approval of the analysis is a prerequisite for FTS approval.

6.2.4.12 Manuals. Operating manuals for all FTS components and ground-test equipment, including termination initiator simulators shall be provided.

6.2.4.13 Reliability Data. A reliability analysis containing the following data shall be submitted for review and approval.

6.2.4.13.1 Data showing compliance with the reliability requirements of paragraph 3.1 of this document.

6.2.4.13.2 Identification of the reliability model and budget.

6.2.4.13.3 Computations of reliability predictions for all range safety systems and subsystems.

6.2.4.13.4 A description of the effects on component reliability resulting from storage, transportation, handling, and maintenance.

6.2.4.13.5 A listing of all components which have a critical lifetime, including expiration dates.

6.2.4.14 Failure Mode Effects and Criticality Analysis (FMECA). An FMECA performed in accordance with MIL-STD 1543, *Reliability Program Requirements for Space and Launch Vehicles*. Any tailoring must be approved in advance by the Range Safety Office. The application of the FMECA shall be consistent with ensuring the successful execution of the FTS functions rather than user mission success objectives. Submittal is required prior to CDR.

BY ORDER OF THE SECRETARY OF THE AIR FORCE

AIR FORCE INSTRUCTION 33-118

1 AUGUST 1997

Communications and Information

RADIO FREQUENCY SPECTRUM MANAGEMENT

NOTICE: This publication is available digitally on the SAF/AAD WWW site at: http://afpubs.hq.af.mil. If you lack access, contact your Publishing Distribution Office (PDO).

OPR: AFFMC/SCX CMSgt Copeland
Supersedes AFI 33-118, 1 October 1995.

Certified by: HQ USAF/SCXX Col Brian D. Miller
Pages: 28
Distribution: F

This instruction implements Department of Defense (DoD) Directive 4650.1, *Management and Use of the Radio Frequency Spectrum*, June 24, 1987; Department of Commerce (DoC), National Telecommunications and Information Administration (NTIA) *Manual of Regulations and Procedures for Federal Radio Frequency Management* (NTIA Manual); Air Force Policy Directive (AFPD) 33-1, *Command, Control, Communications, and Computer (C4) Systems*; Air Force Manual (AFMAN) 33-120, *Radio Frequency (RF) Spectrum Management*; and the procedures established by the United States Military Communications-Electronics Board (USMCEB). It identifies responsibilities for Air Force management of the radio frequency (RF) spectrum and provides procedures for implementing its use.

Refer technical questions on the content of this instruction to the Air Force Frequency Management Agency (AFFMA/SCX), 4040 N. Fairfax Drive, Suite 204, Arlington VA 22203-1613. Refer recommended changes and conflicts between this and other publications on an AF Form 847, **Recommendation for Change of Publication**, through channels, to Headquarters Air Force Communications Agency (HQ AFCA/XPPD), 203 W. Losey Street., Room 1065, Scott AFB IL 62225-5224. See Attachment 1 for a listing of references, abbreviations, acronyms, and terms.

SUMMARY OF REVISIONS

This document has been substantially revised and must be completely reviewed for changes.

Section A—Managing the Radio Frequency Spectrum

1. Managing Frequencies. The International Telecommunications Union (ITU) radio regulations govern international management and use of the RF spectrum, including specific uses by individual countries.

2. Managing United States Frequencies. *The Communications Act of 1934*established separate control of federal and non-federal (civilian) use of the RF spectrum. Under this act, the only government agencies that assign and control the use of frequencies in the United States are:

2.1. The NTIA for all federal use.

2.2. The Federal Communications Commission (FCC) for all non-federal use.

3. Managing Federal Frequencies. The *NTIA Manual* governs all federal (including military) use of the RF spectrum within the United States and its Possessions (US&P).

4. Managing Department of Defense Frequencies. The Under Secretary of Defense (Acquisition)(USD[A]) sets policy for getting systems that use the RF spectrum and ensures compliance with RF spectrum support procedures. The Assistant Secretary of Defense (Command, Control, Communications, and Intelligence) (ASD[C3I]) develops overall DoD policy for managing and using the RF spectrum. The primary DoD activities involved in frequency management (Figure 1) are:

4.1. USMCEB:

4.1.1. Develops joint policy.

4.1.2. Gives direction in military communications-electronics matters, including RF spectrum management.

4.2. Frequency Panel (FP). Makes frequency assignments for United States military operations in foreign countries and supports certain NTIA-approved joint operations in the US&P.

4.3. Joint Spectrum Center (JSC). Serves as the DoD focal point for electromagnetic compatibility (EMC) analysis matters in support of the unified commands and DoD agencies.

4.4. DoD Area Frequency Coordinator (AFC). Promotes frequency coordination within, and near, a selected geographical area of responsibility (AOR). Activities must coordinate military frequency use within a DoD AFC AOR with the DoD AFC before start of operations. AFMAN 33-120 provides DoD AFC addresses and phone numbers.

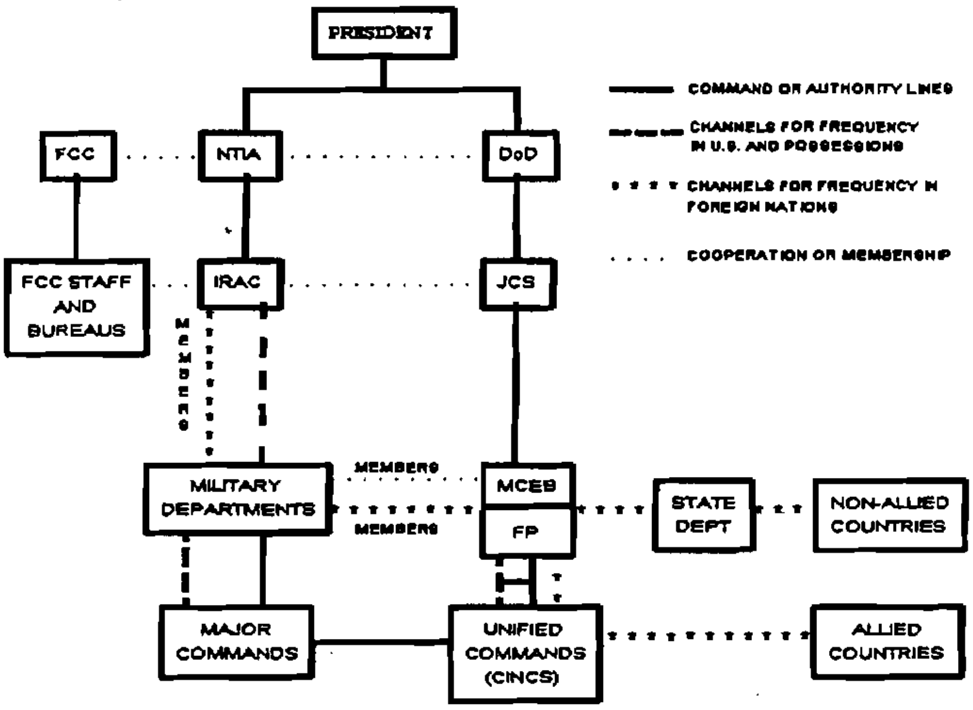
4.5. Defense Information Systems Agency. Maintains frequency records, analyzes frequency use, and requests frequency assignments for the Defense Communications System.

4.6. Headquarters United States Air Force, Director, Communications and Information (HQ USAF/SC). The Air Force senior officer responsible for RF spectrum management and who sets policy for managing RF spectrum use to support the Air Force mission.

4.6.1. The HQ USAF/SC exercises control over the frequency management process through HQ Air Force Communiations Information Center (AFCIC), a DRU, and its FOA (HQ AFFMA).

4.7. AFFMA. Carries out Air Force policies and develops procedures to efficiently satisfy the RF spectrum needs of the Air Force mission.

Figure 1. DoD Frequency Management Channels.



Section B—Air Force Radio Frequency Spectrum Management

5. Managing Air Force Radio Frequency Spectrum. Commanders and organizations that use, plan to use, or plan to get equipment that uses the RF spectrum must:

5.1. Have a valid, correct frequency authorization (to include location, time, type of service, and operating parameters) before using equipment that intentionally radiates in the RF spectrum.

5.2. Have RF spectrum support assured before obligating funds to acquire, develop, modify, or install equipment that uses the RF spectrum.

5.3. Consider impact of RF emitters (intentional or unintentional) on other authorized uses of the RF spectrum, including passive receivers.

5.4. Request only the minimum number of frequencies necessary to complete the mission.

5.5. Meet authorized limitations and tolerances for using equipment that radiates RF energy.

5.6. Minimize the impact of equipment that radiates RF energy on other users of the RF spectrum.

5.7. Review frequency assignments, at least once every 5 years, for accuracy and validity.

6. Responsibilities:

6.1. Major Commands (MAJCOM):

6.1.1. Carry out Air Force policy, practices, and procedures for managing use of the RF spectrum.

6.1.2. Make sure the spectrum manager is an active member of the communications and information planning staff who will coordinate and obtain frequency assignments to support the MAJCOM wartime mission.

6.1.3. Make sure wartime and contingency spectrum management procedures are incorporated into the appropriate operation plan (OPLAN)/concept plan appendices.

6.1.4. Have valid, correct frequency assignments before letting activities use RF-radiating equipment.

6.1.5. Make efficient RF spectrum use an ongoing concern of the MAJCOM acquisition, logistics, intelligence, operations, and communications planning staffs.

6.1.6. Manage RF spectrum use in the concept, planning, deployment, operation, and evaluation phases of MAJCOM-supported exercises and operations.

6.1.7. Refrain from degrading friendly systems or operations during command, control, and communications countermeasures training activities.

6.1.8. Process and obtain frequency assignments for spectrum-dependent systems in support of operational requirements.

6.1.9. Get guidance on using the RF spectrum from the USMCEB, through AFFMA, early in the concept, exploration, demonstration, and validation phases of the acquisition process.

6.1.10. Get USMCEB guidance through AFFMA before assuming contractual obligations for the full-scale development, production, or procurement of these systems.

6.1.11. Follow the requirements of Office of Management and Budget (OMB) Circular A-11, *Preparation and Submission of Budget Estimates*, paragraph 12.4 (e): "Estimates for the development or procurement of major communications-electronics systems (including all systems employing space satellite techniques) will be submitted only after certification by the DoC NTIA, that the RF required for such systems is available."

6.1.12. Get host-nation coordination from the USMCEB, through AFFMA, before contracting for full-scale development, production, or procurement of systems for use in another nation.

6.1.13. Plan for present and future RF spectrum needs.

6.1.14. Consider RF spectrum EMC and interoperability aspects of new or modified equipment in its intended RF environment, including nondevelopmental items (NDI) purchased according to Office of the Deputy Under Secretary of Defense (Industrial Affairs & Installations) (ODUSD[IA&I]) Publication, *Buying NDI (Nondevelopmental Items)*.

6.1.15. Review all new or changed USMCEB J-12 working group (J/F-12) frequency allocations (see **Section C** for impact on RF spectrum use by the MAJCOM and provide comments to AFFMA when appropriate.

6.1.16. Review the MAJCOM and subordinate unit RF spectrum management programs and do staff assistance visits as required.

6.2. AFFMA:

6.2.1. Carries out Air Force RF spectrum management policy.

6.2.2. Evaluates Air Force plans for needed RF spectrum support.

6.2.3. Represents and defends Air Force RF spectrum technical interests in committees, groups, and organizations that address RF spectrum management matters.

6.2.4. Negotiates at the departmental, national, and international levels to get frequency allocations and assignments to satisfy Air Force and MAJCOM exercise, crisis, contingency, wartime, and day-to-day RF requirements for use of the RF spectrum.

6.2.5. Gives functional guidance to Air Force-sponsored DoD AFCs.

6.2.6. Resolves interference problems with Air Force-assigned frequencies.

6.2.7. Gives help to MAJCOMs in carrying out their RF spectrum management programs.

6.2.8. Gives guidance on using the RF spectrum to developers of Air Force communications and information (C-I); electronic warfare; intelligence; weapons; and air traffic control systems that rely on the RF spectrum.

6.2.9. Determines impact of development of non-Air Force RF spectrum-dependent systems on Air Force's current or planned operational use of the RF spectrum.

6.2.10. Provides assistance to Air Force activities requiring JSC services.

6.2.11. Helps Air Force activities get frequency engineering and high frequency propagation services.

6.2.12. Provides curriculum input and support to the Interservice Radio Frequency Management School under the Air Education and Training Command.

6.3. HQ AFCA. Confirms the frequency needs of the Global Command and Control System, the Military Affiliate Radio System, and other HQ AFCA-controlled systems (see Air Force Instruction [AFI] 33-106, *Managing High Frequency Radios, Land Mobile Radios, Cellular Telephones, and the Military Affiliate Radio System*).

6.4. Installation Commander. Responsible for all electromagnetic radiation emanating from the installation and from those outlying activities hosted by the installation. The installation C-I systems officer appoints a primary and an alternate installation spectrum manager for the installation commander.

6.5. Installation Spectrum Manager:

6.5.1. Makes sure using activities understand the parameters of their assigned frequencies.

6.5.2. Keeps the current radio frequency authorization (RFA).

6.5.3. Sets up a frequency management education program.

6.5.4. Processes frequency action proposals and makes sure they are submitted through the appropriate command channels.

6.5.5. Gives frequency management help and guidance to host installation and tenant activities.

6.5.6. Reviews installation OPLANs and C-I requirements documents, and obtains frequency support through command channels.

6.5.7. Makes sure contractor activities using Air Force frequencies to support Air Force requirements follow Air Force policies for RF spectrum use.

6.6. Using Activity. Each organization that operates an Air Force transmitter or receiver will:

6.6.1. Get a frequency assignment before using devices that intentionally emit RF energy or require protection of receive-only frequencies from interference.

6.6.2. Coordinate frequency actions, in advance, with the installation spectrum manager.

6.6.3. Request the minimum number of frequencies necessary to accomplish the mission.

6.6.4. Request minimum transmitter power and antenna gain or height necessary to ensure adequate coverage.

6.6.5. Maintain a frequency authorization document for each frequency used.

6.6.6. Make sure electromagnetic radiating equipment operations comply with authorized parameters.

6.6.7. Make sure current Air Force RF spectrum management instructions are available and followed.

6.6.8. Act promptly to resolve and report incidents of interference in accordance with AFI 10-707, *Spectrum Interference Resolution Program.*

6.6.9. Use radiation-suppression devices (dummy loads) as much as possible when tuning, testing, or experimenting.

6.6.10. Make sure proper radio procedures are used when transmitting.

6.6.11. Make sure transmissions on all RF emitters are for official government business.

6.6.12. Provide, in writing to the installation spectrum manager, the name and phone number of a point of contact for frequency matters.

6.6.13. Advise the installation spectrum manager immediately when frequencies are no longer required.

7. Air Force-Sponsored Department of Defense Area Frequency Coordinator:

7.1. Command and control of range frequency resources are the range or area commander's responsibility. Air Force-sponsored DoD AFCs manage, coordinate, and schedule the use of frequencies for the range commanders according to Allied Communications Publication (ACP) 190, U.S. Supplement (USSUP) 1, *Guide to Frequency Planning.* They also:

7.1.1. Promote the DoD EMC program.

7.1.2. Make temporary frequency assignments supporting range operations within the scope of national regulations.

7.1.3. Review new or changed J/F-12 frequency allocations for impact on range RF spectrum use and provide comments to the AFFMA, when appropriate.

7.1.4. Advise the range or area commander, and all other participating organizations, of RF interference that may result from scheduled operations and tests, and recommend solutions. Commanders concerned will resolve conflicts.

7.1.5. Evaluate frequency requests on future operations for expected compatibility. Recommend parameters change to allow for the proposed operation.

7.1.6. Refer unresolved problems on RF spectrum management practices, technical comments, or recommended operating conditions through Air Force command channels to AFFMA for resolution.

7.2. The Air Force, through the responsible MAJCOMs, will provide DoD AFC services at the following locations:

7.2.1. Air Force Materiel Command (AFMC). DoD Gulf AFC, located at Eglin AFB FL, in the area bounded by 27 degrees North latitude, 33 degrees 30 minutes North latitude, 83 degrees West longitude, and 90 degrees West longitude.

7.2.2. Air Force Space Command. DoD Eastern AFC, located at Patrick AFB FL, in the area bounded by 24 degrees North latitude, 31 degrees 30 minutes North latitude, 77 degrees West longitude, and 83 degrees West longitude.

7.2.3. Air Combat Command. DoD Nellis AFC, located at Nellis AFB NV, for all of Nevada, all of Utah west of longitude 111 degrees West, and all of Idaho south of latitude 44 degrees North.

Section C—Radio Frequency Spectrum Support for Equipment

8. United States Military Communications-Electronics Board Frequency Guidance. USMCEB procedures ensure:

8.1. Radio frequencies are available to support radiating devices in their intended environment without causing harmful interference to existing frequency uses.

8.2. New, modified, or additional equipment meets applicable national and international frequency regulations.

9. Frequency Allocation:

9.1. International Frequency Allocation. The *ITU Allocation Table* gives ITU allocations for frequency bands on specific radio services (functions). In this table, the ITU divides the world into three geographic regions and lists frequency allocations by region for specific services. Types of services may remain the same in each region (such as certain broadcast bands) or they may vary between regions through international agreement.

9.2. United States National Frequency Allocation. Frequency bands selected for United States Government, civil, and shared use make up the *National Table of Frequency Allocations*. It is a planning guide, not an authority to operate on any frequency.

10. Electromagnetic Compatibility Standards and Frequency Criteria. Air Force agencies developing, procuring, or modifying equipment using the RF spectrum must meet applicable military, government, national, host-nation, and international EMC standards and frequency criteria as outlined below:

10.1. EMC Standards:

10.1.1. Define and control the parameters of emissions and set standards for receivers.

10.1.2. Enable planning for efficient use of the RF spectrum by identifying considerations such as power, bandwidth, types of modulation, types of emission, stability, and levels of spurious and harmonic emission.

10.1.3. Classify emissions according to the type of modulation of the main carrier, nature of signals modulating the main carrier, and type of information transmitted. (AFMAN 33-120 explains emission designators.)

22.1.1. AFFMA notifies the continental United States MAJCOMs of completed frequency assignment actions and, if applicable, sends a copy to the DoD AFC for the geographical area in which the frequency will be used. Notification is by:

22.1.1.1. A FRRS message.

22.1.1.2. An AFFMA temporary frequency assignment message or memorandum.

22.2. Outside US&P. Determined by theater policies and procedures.

22.3. FP:

22.3.1. The FP tells the CINC of the unified or specified command of completed FP frequency assignment actions.

22.3.2. These actions are subject to approval by the CINC of the unified or specified command before entry into the FRRS.

22.4. MAJCOM:

22.4.1. Use an Automatic Digital Network or e-mail message or memorandum to notify requesters of assignments made under their own assignment authority.

22.4.2. Send a copy to the using activity, the host MAJCOM (if appropriate), the installation spectrum manager, and to the applicable DoD AFC.

23. Five-Year Review and Renewal of Frequency Assignments. Review Air Force frequency assignments at least once every five years to make sure the need for the frequency and all supporting data is accurate. This process does not relieve the using activity from updating its frequency assignments when making changes to its use or operating parameters.

23.1. US&P and FP Assignments. According to IRAC policy, using activities must review each assignment at least one month before the fifth anniversary of the original assignment date or the date of the latest modification, whichever is later.

23.2. Assignments Outside the US&P. Follow theater policy, however, review Air Force assignments at least once every 5 years, regardless of the assignment authority.

23.3. Air Force 5-Year Review Program:

23.3.1. The review notice is sent to the MAJCOM, installation spectrum manager, and using activity (as applicable). It contains all SFAF items, results of computer checks of data items, any other problems, and brief instructions on how to review the assignment.

23.3.2. The installation spectrum manager, together with the using activity, reviews the records; verifies and updates the need for the assignment and all SFAF items, including those identified by the computer checks; and sends an assignment renewal, deletion, or modification.

24. Major Command Processing of Electronic Countermeasures Training Frequency Clearance Requests.

24.1. In the US&P and Canada, process ECM training frequency clearance requests according to AFMAN 33-120 and this AFI.

24.2. Refer to theater policies and procedures for ECM training frequency clearances outside the US&P and Canada.

Attachment 1

GLOSSARY OF REFERENCES, ABBREVIATIONS, ACRONYMS, AND TERMS

References

DoC NTIA, *Manual of Regulations and Procedures for Federal Radio Frequency Management ("NTIA Manual")*

DoDD 3222.3, *Department of Defense Electromagnetic Compatibility Program (EMCP)*, August 20, 1990

DoDM 4120.3, *Defense Standardization Program (DSP) Policies and Procedures*, July 1993

DoDD 4650.1, *Management and Use of the Radio Frequency Spectrum*, June 24, 1987

DoDR 5200.1, *Information Security Program Regulation*, June 1986, with Changes 1 and 2

AFPD 16-2, *Disclosure of Military Information to Foreign Governments and International Organizations*

AFPD 31-6, *Industrial Security*

AFPD 33-1, *Command, Control, Communications, and Computer (C4) Systems*

AFPD 61-2, *Management of Scientific and Technical Information*

AFI 10-707, *Spectrum Interference Resolution Program*

AFI 31-401, *Managing the Information Security Program*

AFI 33-106, *Managing High Frequency Radios, Land Mobile Radios, Cellular Telephones, and the Military Affiliate Radio System*

AFMAN 33-120, *Radio Frequency (RF) Spectrum Management*

ACP 190, *Guide to Frequency Planning*

ACP 190USSUP1, *Guide to Frequency Planning*

ACP 190USSUP2, (C) *Coordination and Registration of frequencies Used by Military Forces on Foreign Soil* (U)

Allied Radio Frequency Agency (ARFA) Handbook

The Communications Act of 1934

International Civil Aviation Organization (ICAO) Handbook

ODUSD (IA&I) Publication, *Buying NDI (Nondevelopmental Items)*

OMB Circular A-11, *Preparation and Submission of Budget Estimates*

Abbreviations and Acronyms

ACP—Allied Communications Publication

AFC—Area Frequency Coordinator

AFCA—Air Force Communications Agency

AFCIC—Air Force Communications and Information Center

AFFMA—Air Force Frequency Management Agency

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFMC—Air Force Materiel Command

AFPD—Air Force Policy Directive

AOR—Area of Responsibility

ARFA—Allied Radio Frequency Agency

C4—Command, Control, Communications, and Computers

CCEB—Combined Communications-Electronics Board

C-I—Communications-Information

CINC—Commander in Chief

CSO—Communications-Information Systems Officer

DoC—Department of Commerce

DoD—Department of Defense

DoDD—Department of Defense Directive

DODM—Department of Defense Manual

ECM—Electronic Countermeasures

EMC—Electromagnetic Compatibility

EMI—Electromagnetic Interference

E3—Electromagnetic Environmental Effects

FCC—Federal Communications Commission

FDO—Field Disclosure Office

FP—Frequency Panel

FRRS—Frequency Resource Records System

GHz—Gigahertz

HQ USAF—Headquarters United States Air Force

IFRB—International Frequency Registration Board

IRAC—Interdepartment Radio Advisory Committee

ISM—Industrial, Scientific, and Medical

ITU—International Telecommunications Union

J/F-12—USMCEB J-12 Working Group

JSC—Joint Spectrum Center

kHz—Kilohertz

LMR—Land Mobile Radio

MAJCOM—Major Command

MHz—Megahertz

NDI—Nondevelopmental Item

NTIA—National Telecommunications and Information Administration

OMB—Office of Management and Budget

OPLAN—Operation Plan

RF—Radio Frequency

RFA—Radio Frequency Authorization

RR—ITU Radio Regulations

SAF—Secretary of the Air Force

SFAF—Standard Frequency Action Format

SPS—Spectrum Planning Subcommittee

STINFO—Scientific and Technical Information

USD(A)—Under Secretary of Defense (Acquisition)

US&P—United States and its Possessions

USMCEB—United States Military Communications-Electronics Board

Terms

NOTE:

The following definitions of frequency management terms were extracted from international, national, and DoD regulations and directives. Where appropriate, the source is given in parentheses following each definition: **(RR)**--*International Telecommunications Union Radio Regulations*, **(NTIA)**--*National Telecommunications and Information Administration Manual of Regulations and Procedures for Federal Radio Frequency Management.*

Allocation— (of a frequency band) Entry in the *Table of Frequency Allocations* of a given frequency band for its use by one or more (terrestrial or space) radio communication services or the radio astronomy service under specified conditions. This term also applies to the frequency band concerned. **(RR)**

Assignment— (of a radio frequency or radio frequency channel) Authorization given by an administration for a radio station to use a RF or RF channel under specified conditions. **(RR)**

Channeling Plan— The plan by which the frequencies within a frequency band are to be assigned.

Electromagnetic Compatibility (EMC)— The condition that prevails when telecommunications equipment is performing its individually designed function in a common electromagnetic environment without causing or suffering unacceptable degradation due to unintentional electromagnetic interference (EMI) to or from other equipment in the same environment. **(NTIA)**

Electromagnetic Interference (EMI)—: 1. DoD: The ability of systems, equipment, and devices that utilize the electromagnetic spectrum to operate in their intended operational environments without suffering unacceptable degradation or causing unintentional degradation because of electromagnetic radiation or response. It involves the application of sound electromagnetic spectrum management; system, equipment, and device design configuration that ensures interference-free operation; and clear concepts and doctrines that maximize operational effectiveness. Also called "**Electromagnetic Compatibility**". See also electromagnetic spectrum,; electronic warfare; spectrum management. **(JP 1-02)** 2. Any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics or electrical equipment. It can be induced intentionally, as in some forms of electronic warfare, or unintentionally, as a result of spurious emissions and responses, intermodulation products, and the like.

Frequency Assignment —See **Assignment** (of a radio frequency or radio frequency channel).

Frequency Assignment, Group —Frequencies assigned to a MAJCOM to satisfy short-term requirements throughout the US&P. Group assignments are not assigned exclusively to a single MAJCOM.

Frequency Assignment, Temporary— An assignment effective for 90 days or less.

Harmful Interference —Interference that endangers the functioning of a radio navigation service or other safety services, or that seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the radio regulations. **(RR)**

Industrial, Scientific, and Medical (ISM) Applications— (of radio frequency energy) Operation of equipment or appliances designed to generate and use local radio-frequency energy for industrial, scientific, medical, domestic, or similar purposes, excluding applications in the field of telecommunications. **(RR)**

Interference— The effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radio communication system, manifested by any performance degradation, misinterpretation, or loss of information that could be extracted in the absence of such unwanted energy. **(RR)**

Low-Power Communication Device— A restricted radiation device, exclusive of those employing conducted or guided RF techniques, used for the transmission of signs, signals (including control signals), writing, images and sounds or intelligence of any nature by radiation of electromagnetic energy. Examples: Wireless microphone, phonograph oscillator, radio-controlled garage door opener, and radio-controlled models. **(NTIA)**

NTIA Manual— DoC NTIA manual of regulations and procedures for federal RF management.

Radio Frequency Spectrum— The RF spectrum includes the frequencies from 3.0 kHz to 400 GHz. The presently allocated spectrum is from 9 kHz to 381 GHz.

Radio Location— Radio determination used for purposes other than those of radio navigation. **(RR)**

Range Commander— In this publication, the commander of an Air Force test or tactical range.

Restricted Radiation Device— A device in which the generation of RF energy is intentionally incorporated into the design, and in which the RF energy is conducted along wires or is radiated, exclusive of transmitters for which provisions are made under those parts of Chapter 7 of the *NTIA Manual* other than Part 7.9, and exclusive of ISM equipment. **(NTIA)**

Spurious Emission— Emission on a frequency or frequencies that are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions. **(RR)**

Telecommunication— Any transmission, emission, or reception of signs, signals, writings, images, and sounds or information of any nature by wire, radio, visual or other electromagnetic systems. **(RR)**

Attachment 2

FREQUENCY ASSIGNMENT CLASSIFICATION GUIDE

A2.1. Security Classification. Determine security classification of DoD and Federal Government frequency assignments and the information in them primarily by the association with the function they support. Mark classification of individual data items according to DoDR 5200.1 and AFI 31-401.

A2.2. Individual Air Force Frequency Assignments.

A2.2.1. The following frequency assignment information, standing alone or in combination with other assignment information, is unclassified:

A2.2.1.1. Overall classification of the frequency assignment (SFAF Item 005).

A2.2.1.2. Security classification modification (SFAF Item 006).

A2.2.1.3. Type of action (SFAF Item 010).

A2.2.1.4. Agency serial number (SFAF Item 102).

A2.2.1.5. IRAC docket number (SFAF Item 103).

A2.2.1.6. Assignment authority (SFAF Item 104).

A2.2.1.7. List serial number (SFAF Item 105).

A2.2.1.8. Serial replaced, delete date (SFAF Item 106).

A2.2.1.9. Docket numbers of older authorizations (SFAF Item 108).

A2.2.1.10. Operating frequency or frequency band and excluded frequency or frequency band (SFAF Items 110 and 111).

A2.2.1.11. Agency (SFAF Item 200).

A2.2.1.12. Command (SFAF Item 204).

A2.2.1.13. IRAC notes (SFAF Item 500).

A2.2.1.14. Frequency action officer (SFAF Item 701).

A2.2.1.15. Control/request number (SFAF Item 702).

A2.2.2. Other assignment information, standing alone or in combination with other information (including that in A2.2.1), is classified according to DoDR 5200.1 and AFI 31-401 by the appropriate classification authority. Include the appropriate classification marking with the corresponding SFAF item.

A2.3. Lists of Air Force Frequency Assignments.

A2.3.1. Although most individual frequency assignment records in the Air Force RFA list are individually unclassified, the entire RFA list is classified according to the highest level of classification of the assignments it contains. Lists (two or more frequencies) of unclassified frequency assignment records in a given range of frequencies, or in a given geographic area, may need to be classified, because they may provide information leading to the disclosure of military- or national security-related operations, and scientific and technological matters relating to national security. These lists can indicate the overall strategic telecommunications capabilities of the United States, and their disclosure could cause damage to national security. The continued protection of this information is essential to national security because it pertains to communications security and reveals vulnerabilities and capabilities. Unauthorized disclosure can result in nullifying the effectiveness of telecommunications networks and capability of the United States.

A2.3.2. The *USMCEB Security Classification Guide for Frequency Assignment Records* gives guidance on classifying compilations of frequency assignment records. Based on this guidance:

A2.3.2.1. Classify a RFA list at the highest level of frequency assignment it contains.

A2.3.2.2. When a RFA list contains only unclassified DoD frequency assignments, it is unclassified. This type of listing contains only assignments of one agency (DoD) and was requested by DoD, meeting the criteria of both paragraphs 4.2 and 7.1.2 of the USMCEB security classification guide.

A2.3.2.3. When a RFA list contains DoD unclassified frequency assignments and unclassified assignments of one or more federal (non-DoD) agencies, classify the list CONFIDENTIAL according to paragraph 4.2 of the *USMCEB Security Classification Guide,* unless it meets the criteria of any one of the exemptions of the *USMCEB Security Classification Guide.*. Mark RFA lists classified under this guidance according to DoDR 5200.1 and AFI 31-401: **Classified by: USMCEB Security Classification Guide for Frequency Assignment Records, dated 15 Mar 83. Declassified: OADR.**

A2.3.2.4. An appropriate MAJCOM classification authority can classify an RFA list containing compilations of its own unclassified assignments at a higher level. In such cases, the MAJCOM must notify JSC of the appropriate classifications of such RFA lists. Mark the RFA list according to DoDR 5200.1, AFI 31-401, and MAJCOM instructions.

BY ORDER OF THE
SECRETARY OF THE AIR FORCE

AIR FORCE MANUAL 33-120

1 JUNE 1997

Communications and Information

RADIO FREQUENCY (RF) SPECTRUM MANAGEMENT

NOTICE: This publication is available digitally on the SAF/AAD WWW site at: http://afpubs.hq.af.mil. If you lack access, contact your Publishing Distribution Office (PDO).

OPR: HQ AFFMA/SCX
(CMSgt William G. Copeland)

Certified by: HQ USAF/SCXX
(Col Brian D. Miller)

Pages: 177
Distribution: F

This Air Force manual (AFMAN) implements Department of Defense (DoD) Directive (DoDD) 4650.1, *Management and Use of the Radio Frequency Spectrum*, June 24, 1987; Department of Commerce (DoC) National Telecommunications and Information Administration (NTIA) *Manual of Regulations and Procedures for Federal Radio Frequency Management* (*NTIA Manual*); United States Military Communications-Electronics Board (USMCEB) procedures; Air Force Policy Directive (AFPD) 33-1, *Command, Control, Communications, and Computers (C4) Systems*; and Air Force Instruction (AFI) 33-118, *Radio Frequency Spectrum Management*. It details responsibilities and provides guidance and procedures for Air Force management of the radio frequency (RF) spectrum. It assists in system planning, tells how to obtain frequency support for new systems, and lists detailed procedures for frequency allocations and assignments. It applies to all Air Force activities using the RF spectrum, including Air Force Reserve (AFRES), Air National Guard (ANG), and Civil Air Patrol (CAP) units and members. The term "major command" (MAJCOM), as used in this manual, includes field operating agencies (FOA) and direct reporting units (DRU). Names of specific commercial products, commodities, or services included in this publication are for information only and do not imply endorsement by the Air Force. Refer technical questions on the content of this manual to the Air Force Frequency Management Agency, (AFFMA/SCX), 4040 N. Fairfax Drive, Suite 204, Arlington VA 22203-1613. Refer recommended changes and conflicts between this and other publications on an AF Form 847, **Recommendation for Change of Publication**, through channels, to Headquarters (HQ) Air Force Communications Agency, (HQ AFCA/XPPD), 203 W. Losey Street, Room 1065, Scott AFB IL 62225-5224. MAJCOMs, FOAs, and DRUs send one copy of their supplement to HQ AFCA/XPPD.

Chapter 1

INTRODUCTION TO RADIO FREQUENCY SPECTRUM MANAGEMENT

1.1. Terms Explained. Attachment 1 is a glossary of spectrum management references, abbreviations, acronyms, and terms used in this manual.

1.2. Introduction. The RF spectrum is a finite natural resource with many nations and activities competing for its use. As a result, most portions of the RF spectrum are extremely congested, making strict practices and procedures necessary to ensure all valid needs are satisfied. Because RF energy does not respect political or physical boundaries, these practices and procedures are established at the international and national levels to ensure equitable use of the RF spectrum.

1.3. International Frequency Management. The International Telecommunications Union (ITU) is a United Nations organization in which the nations of the world cooperate to improve the use of telecommunications. The International Frequency Registration Board (IFRB) is a permanent part of the ITU charged with documenting frequencies used internationally to provide a degree of protection to users and to aid decisions in conferences. The International Radio Consultative Committee (CCIR) of the ITU studies technical and operating questions relating to radio communications and issues recommendations on them.

1.4. National Frequency Management. *The Communications Act of 1934* established separate control of federal and nonfederal (civil) use of the RF spectrum. Under this act, the only government agencies that assign and control use of frequencies in the United States are:

1.4.1. The NTIA. NTIA, a DoC agency, develops and implements policy for use of the RF spectrum by US Government (federal) radio stations (including DoD stations), and for assigning frequencies to those stations that are within the United States and its Possessions (US&P). NTIA publishes the *NTIA Manual* that governs frequency use within the US&P. The Interdepartment Radio Advisory Committee (IRAC) of the NTIA helps the NTIA Office of Spectrum Management develop and execute policies, programs, procedures and criteria for allocating, managing and using the RF spectrum.

1.4.2. The Federal Communications Commission (FCC). The FCC, which reports to the Congress, regulates frequencies assigned to nonfederal government stations, including those of state and local governments. FCC-regulated frequencies are available to US Government (federal) stations on a case-by-case basis when agreed to by the FCC.

1.5. Department of Defense Frequency Management. The Under Secretary of Defense (Acquisition) (USD[A]) is responsible for establishing policy for acquiring systems that use the RF spectrum and for ensuring compliance with RF spectrum supportability procedures. The Assistant Secretary of Defense (Command, Control, Communications, and Intelligence) (ASD[C3I]) provides overall policy for managing and using the RF spectrum. The main DoD activities involved in frequency management are:

1.5.1. USMCEB. The USMCEB formulates policy and provides direction in military communications-electronics (C-E) matters, including RF spectrum management. The Air Force member of the USMCEB is the Director, Communications and Information (Headquarters United States Air Force [HQ USAF]/SC). The USMCEB Frequency Panel (FP) deals with frequency matters and makes frequency assignments for United States military operations in foreign countries and to support certain NTIA-approved joint operations in the US&P.

1.5.2. The Joint Spectrum Center (JSC). The JSC serves as the DoD focal point for electromagnetic compatibility (EMC) analysis matters in support of the unified commands and Defense agencies.

1.5.3. DoD Area Frequency Coordinator (AFC). The USMCEB set up the DoD AFC system to ensure compatible operation of C-E systems at national service test and training ranges. Each DoD AFC promotes frequency coordination within, and adjacent to, a designated geographical area. The military must coordinate frequency use within a DoD AFC area of responsibility (AOR) (see Attachment 4) with the DoD AFC before start of actual operations.

1.5.4. The Defense Information Systems Agency (DISA). DISA maintains frequency records, analyzes frequency use, and requests assignment of frequencies needed by the Defense Communications System (DCS).

1.5.5. Military Departments. Each service has a senior officer responsible for RF spectrum management. In the United States Army (USA) it is the Director of Information Systems for Command, Control, Communications, and Computers; in the United States Navy (USN) it is the Director for Command, Control, Communications, and Computers; and in the USAF, it is HQ USAF/SC.

1.5.6. HQ USAF. HQ USAF/SC establishes Air Force policy for managing use of the RF spectrum to support the Air Force mission. The AFFMA, a FOA reporting directly to HQ USAF/SC, implements these policies and develops procedures to effectively and efficiently satisfy RF spectrum needs of the Air Force.

1.5.6.1. MAJCOM and using activities responsibilities for management of the RF spectrum are contained in AFI 33-118. You must know and understand Air Force policy, responsibility, and guidance contained in AFI 33-118 before you can effectively apply the procedures contained in this manual.

Chapter 3

UNITED STATES AND POSSESSIONS FREQUENCY ACTIONS

3.1. General Procedures.

3.1.1. Frequency Request and Approval Channels. AFI 33-118 explains the command channels used for frequency actions. Send US&P frequency actions through the appropriate MAJCOM to AFFMA as follows:

3.1.1.1. The installation spectrum manager sends:

3.1.1.1.1. Host installation unit actions to the host MAJCOM.

3.1.1.1.2. Tenant unit actions that support the host installation mission to the host MAJCOM, even if the tenant is the sole user of the frequency, with a copy to the tenant unit's MAJCOM.

3.1.1.1.3. Tenant unit actions not in support of the host installation mission to the supported unit's MAJCOM with a copy to the host and tenant unit MAJCOMs. For example:

- Send a frequency action for an Air Combat Command (ACC) maintenance expediter net on a Air Mobility Command (AMC) installation to ACC with a copy to AMC.
- Send a frequency action for an Air Force Materiel Command (AFMC) unit in support of ACC on an AMC installation to ACC with a copy to AFMC and AMC.

3.1.1.2. CONUS MAJCOMs send frequency actions in Standard Frequency Action Format (SFAF) for their units deploying outside the US&P to the Air Force component of the theater unified command. For example, ACC sends frequency actions to the Pacific Air Forces (PACAF) for a fighter wing deploying to the Pacific Area (Commander-in-Chief, Pacific Command [CINCPAC]). PACAF, in turn, processes these actions according to theater procedures.

3.1.1.3. CONUS MAJCOM units in an overseas area send actions according to theater policy.

3.1.1.4. Send frequency actions to support operations for the Commander-in-Chief, Special Operations Command (CINCSOC), Commander-in-Chief, Space Command (CINCSPACE), Commander-in-Chief, Transportation Command (CINCTRANS), or Commander-in-Chief, Strategic Command (CINCSTRAT), through the appropriate MAJCOM to the AFFMA for coordination with the USMCEB FP.

3.1.1.5. Send frequency actions for these worldwide operations through the MAJCOM to AFFMA for coordination through the appropriate theater CINC and assignment by the host nation:

3.1.1.5.1. Space systems (excluding in-theater tactical assets).

3.1.1.5.2. Down-range missile tests.

3.1.1.5.3. MYSTIC STAR/White House Communications Agency.

3.1.1.5.4. Worldwide airborne national command posts.

3.1.1.5.5. Military Affiliate Radio System(MARS) (for circuits terminating in US&P).

3.1.1.5.6. Global Command and Control System (GCCS) HF stations.

3.1.1.6. ANG, AFRES, and CAP units:

3.1.1.6.1. Submit actions to support all day-to-day operations, training requirements, fixed ATC and NAVAIDS at operating bases and permanent training sites, through appropriate channels to the ANG Readiness Center (ANGRC), HQ AFRES, or HQ CAP, for forwarding to AFFMA.

3.1.1.6.2. Submit requests in support of training, exercise, or readiness inspections, through the tasking agency to AFFMA.

3.1.1.6.3. ANG units submit actions to support state-levied mission taskings through appropriate channels to The Adjutant General (TAG). TAG sends them according to state directives to the FCC Safety and Special Radio Services Bureau.

3.1.1.7. USAF MARS activities:

3.1.1.7.1. Submit actions for MARS VHF nets on a military installation or on outlying locations hosted by an installation through the host-installation spectrum manager to the host MAJCOM. MAJCOMs coordinate with the Chief, USAF MARS (HQ AFCA/SYXR) to ensure the net has been authorized before sending the action to AFFMA.

3.1.1.7.2. Civilian affiliate stations send frequency actions to the state MARS director. The state MARS director sends actions to the region communications manager, who, in turn, sends it to the Chief, USAF MARS. If the net is approved, the Chief, USAF MARS will send the frequency action to AFFMA.

3.1.1.7.3. The Chief, USAF MARS and AFFMA coordinate HF actions. HF assignments are made on a regional basis and authority for station operation is AFI 33-106, *Managing High Frequency Radios, Land Mobile Radios, Cellular Telephones, and the Military Affiliate Radio System*. No formal action is required.

3.1.1.8. Civil Air Patrol (CAP). The CAP is a civilian organization supported by the Air Force according to AFI 36-5001, *Organization and Function of the Civil Air Patrol*. CAP units send frequency actions that support Air Force operations and training, whether in whole or in part, through HQ Air Education and Training Command (AETC) to AFFMA. In addition, by agreement between HQ CAP and USAF MARS, CAP and USAF MARS share certain VHF repeater frequencies.

3.1.1.8.1. AFFMA may assign CAP frequencies for Air Force units to communicate with the CAP during training activities and SAR operations.

3.1.1.8.2. Air Force units may allow CAP to use their assigned frequencies to communicate with other Air Force units during SAR missions.

3.1.1.8.3. CAP units give the installation spectrum manager a list of frequencies used on the installation.

3.1.2. Frequency Coordination. Coordinate frequency actions as follows:

3.1.2.1. Aerospace and Flight Test Radio Coordinating Council (AFTRCC). Coordinate requests for frequencies in the 1435-1535 and 2310-2390 MHz bands with the appropriate DoD AFC (see Attachment 4). The AFC coordinates with the AFTRCC.

3.1.2.2. FAA. Coordinate frequency actions for the frequencies and bands listed in Table 3.1 with the appropriate FAA regional frequency management office (FMO):

Table 3.1. Federal Aviation Administration Frequencies and Bands.

190-285 kHz	1030 MHz/1090 MHz
325-415 kHz	1031-1087 MHz
75 MHz	1104-1146 MHz
108-121.975 MHz	1156.5-1213.5 MHz
123.575-128.825 MHz	1215-1400 MHz
132.015-136 MHz	2700-2900 MHz
328.55-335.45 MHz	5000-5250 MHz
977.5-1020.5 MHz	9000-9200 MHz

3.1.2.2.1. The FAA nominates a frequency for ATC (and PRR for radar or radar beacon[RACON]). They coordinate on the service volume, flight level, and desired-to-undesired signal protection (in dBs); and they nominate channels for ILS, VOR, and TACAN.

3.1.2.2.2. An agency coordination serial number is provided by the FAA regional FMO and entered in SFAF Item 504.

3.1.2.2.3. Special coordination procedures for air-to-air TACAN requirements are in paragraph 3.2.7.

3.1.2.2.4. Air Force installations having an ATC support agreement with a FAA facility for local control of civil aircraft will be assigned suitable VHF frequencies for control of these aircraft.

3.1.2.3. DoD AFCs. Each DoD AFC is responsible for frequency coordination within a designated geographical AOR.

3.1.2.3.1. Applicants requesting frequencies for use within a DoD AFC's AOR coordinate specific frequencies, if known, with that DoD AFC in advance (refer to Attachment 4 for exact area information and addresses).

3.1.2.3.2. If the assigned frequency is different from the frequency requested and coordinated, the agency making the assignment must coordinate the new frequency with the appropriate AFC.

3.1.2.4. Terrestrial and Space Systems within Shared Bands. The following information applies to those bands between 1 GHz and 50 GHz equally shared by space and terrestrial services:

3.1.2.4.1. AFFMA determines whether a proposed fixed or mobile station in these bands will be within the normal coordination distance of an Earth station listed in the *NTIA Manual.*

3.1.2.4.2. If the location is within the coordination distance, AFFMA coordinates the request with the agency operating the Earth station.

3.1.2.4.3. Begin coordinating Earth stations during the system review using procedures outlined in paragraphs 8.3.12 and 8.3.13 of the *NTIA Manual.* Indicate on applications for frequency assignments the status of coordination with agencies that have terrestrial operations in the same band and within the coordination area of the Earth stations.

3.1.2.4.4. AFFMA does not take final assignment action until national-level coordination is complete.

Attachment 1

GLOSSARY OF REFERENCES, ABBREVIATIONS, ACRONYMS, AND TERMS

References

AFDIR 37-135, *Air Force Address Directory* (will be converted to AFDIR 33-335)

AFI 10-707, *Spectrum Interference Resolution Program*

AFI 31-401, Managing the Information Security Program

AFI 33-106, *Managing High Frequency Radios, Land Mobile Radios, Cellular Telephones, and the Military Affiliate Radio System*

AFI 33-111, *Telephone Systems Management*

AFI 33-118, *Radio Frequency Spectrum Management*

AFI 36-5001, *Organization and Function of the Civil Air Patrol*

AFPD 33-1, *Command, Control, Communications, and Computer (C4)* Systems

DoC NTIA, *Manual of Regulations and Procedures for Federal Radio Frequency Management(NTIA Manual)*

DoDD 4650.1, *Management and Use of the Radio Frequency Spectrum,* June 24, *1987*

DoDR 5200.1, *Information Security Program Regulation,* June 1986, with Changes 1 and 2

Executive Order 12958, *Classified National Security Information*

Federal Communications Commission Rules and Regulations, Part 95, Subpart D

The Communications Act of 1934

Abbreviations and Acronyms

AAG—Aeronautical Assignment Group

ACC—Air Combat Command

ACMI—Aircraft Maneuvering Instrumentation

AETC—Air Education and Training Command

AFC—Area Frequency Coordinator

AFCA—Air Force Communications Agency

AFDIR—Air Force Directory

AFFMA—Air Force Frequency Management Agency

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFMC—Air Force Materiel Command

AFPD—Air Force Policy Directive

AFRES—Air Force Reserve

AFTRCC—Aerospace and Flight Test Radio Coordinating Council

AM—Amplitude Modulation

AMC—Air Mobility Command

ANG—Air National Guard

ANGRC—Air National Guard Readiness Center

AOR—Area of Responsibility

APF—Automated Processing Format

ARFA—Allied Radio Frequency Agency

ASCII—American Standard Code for Information Interchange

ASD(C3I)—Assistant Secretary of Defense (Command, Control, Communications, and Intelligence)

ASR—Airport Surveillance Radar

ATC—Air Traffic Control

ATCRBS—Air Traffic Control Radar Beacon System

AUTODIN—Automatic Digital Network

BER—Bit Error Rate

C4—Command, Control, Communications, and Computers

CB—Citizen Band

CCF—Consolidated Computer Facility

CCIR—International Radio Consultative Committee

C-E—Communications-Electronics

CINC—Commander in Chief

CINCEUR—Commander-in-Chief, European Command

CINCLANT—Commander-in-Chief, Atlantic Command

CINCPAC—Commander-in-Chief, Pacific Command

CINCSOC—Commander-in-Chief, Special Operations Command

CINCSPACE—Commander-in-Chief, Space Command

CINCSTRAT—Commander-in-Chief, Strategic Command

CINCTRANS—Commander-in-Chief, Transportation Command

CINCUSACOM—Commander-in-Chief, United States Atlantic Command

COMSAT—Communications Satellite (Corporation)

CONUS—Continental United States

CW—Continuous Wave

dB—Decibel

dBm—dB referred to 1 milliwatt

DCS—Defense Communications System

DDN—Defense Data Network

DISA—Defense Information Systems Agency

DISN—Defense Information System Network

DME—Distance Measuring Equipment

DoC—Department of Commerce

DoD—Department of Defense

DoE—Department of Energy

DoI—Department of Interior

DSN—Defense Switched Network

ECM—Electronic Countermeasures

EMC—Electromagnetic Compatibility

EMI—Electromagnetic Interference

EPIRB—Emergency Position-Indicating Radio Beacon

ERP—Effective Radiated Power

ESMC—Eastern Space and Missile Center

ESC—Electronic Systems Center

EUCOM—European Command

EW—Electronic Warfare

FAA—Federal Aviation Administration

FAS—Frequency Assignment Subcommittee

FB—Base Station

FCC—Federal Communications Commission

FM—Frequency Modulation

FMO—Frequency Management Office

FOA—Field Operating Agency

FP—Frequency Panel (USMCEB)

FRRS—Frequency Resource Records System

FSS—Flight Service Station

GCA—Ground Control Approach

GCCS—Global Command and Control System

GHz—Gigahertz

GMF—Government Master File

GMT—Greenwich Mean Time

GW—Gigawatt

HF—High Frequency

Hz—Hertz

ICAO—International Civil Aviation Organization

ID—Identification

IF—Intermediate Frequency

IFF—Identification, Friend or Foe

IFRB—International Frequency Registration Board

ILS—Instrument Landing System

INMARSAT—International Maritime Satellite

IRAC—Interdepartment Radio Advisory Committee

ISM—Industrial, Scientific, and Medical

ITU—International Telecommunications Union

JCS—Joint Chiefs of Staff

JETDS—Joint Electronics Type Designation System

J/F-12—USMCEB J-12 Working Group

JFMO—Joint Frequency Management Office

JSC—Joint Spectrum Center

JTIDS—Joint Tactical Information Distribution System

kHz—Kilohertz

kW—Kilowatt

LAN—Local Area Network

LF—Low Frequency

LMR—Land Mobile Radio

LORAN—Long Range Aid to Navigation

LOS—Line of Sight

LRR—Long Range Radar

MAG—Military Advisory Group
MAJCOM—Major Command
MARS—Military Affiliate Radio System
MF—Medium Frequency
MHz—Megahertz
MLS—Microwave Landing System
MM—Maritime Mobile
M Notes—Minute Notes
MRFL—Master Radio Frequency List
MSL—Mean Sea Level
MW—Megawatt
mW—Milliwatt
NASA—National Aeronautics and Space Administration
NATO—North Atlantic Treaty Organization
NAVAID—Navigational Aids
NBS—National Bureau of Standards
NEXRAD—Next Generation Radar
NIB—Noninterference Basis
NTIA—National Telecommunications and Information Administration
OCONUS—Outside the Continental United States
OPLAN—Operation Plan
OUS&P—Outside United States and Possessions
PACAF—Pacific Air Forces
PACOM—Pacific Command
PAR—Precision Approach Radar
PC—Personal Computer
PD—Pulse Duration
PEP—Peak Envelope Power
PPS—Pulses Per Second
PRR—Pulse Repetition Rate
RACES—Radio Amateur Civil Emergency Services
RACON—Radar Beacon

RADAR—Radio Detection and Ranging

RADHAZ—Radiation Hazard

RDT&E—Research, Development, Test, and Evaluation

RF—Radio Frequency

RFA—Radio Frequency Authorization

RFI—Radio Frequency Interference

RR—ITU Radio Regulations

RSEC—Radar Spectrum Engineering Criteria

SAR—Search and Rescue

SD—Space Division

SDI—Strategic Defense Initiative

SFAF—Standard Frequency Action Format

SGLS—Space Ground Link Subsystem

SIF—Selective Identification Feature

SINAD—Signal-to-Interference plus Noise-and-Distortion

S/N—Signal-to-Noise Ratio

SPS—Spectrum Planning Subcommittee

SSB—Single-Sideband

STU-III—Secure Telephone Unit-III

TACAN—Tactical Air Navigation

TAG—The Adjutant General

TFMS—Tactical Frequency Management System

THz—Terahertz

TRSB—Time-Referenced Scanning Beams

UAV—Unmanned Aerial Vehicle

UGT—Universal Greenwich Time

UHF—Ultra High Frequency

USAF—United States Air Force

USD(A)—Under Secretary of Defense (Acquisition)

USN—United States Navy

USMCEB—United States Military Communications-Electronics Board

US&P—United States and Possessions

VHF—Very High Frequency

VLF—Very Low Frequency

VOR—VHF Omnidirectional Range

VORTAC—VOR Tactical Air Navigation

W—Watt

WAFC—Western Area Frequency Coordinator

WSMC—Western Space and Missile Center

WSMR—White Sands Missile Range

Terms

NOTE:

The following are definitions of frequency management terms extracted from international, national, and DoD regulations and directives. Where appropriate, the source is given in parentheses following each definition: **(RR)**--International Telecommunications Union Radio Regulations, **(NTIA)**–National Telecommunications and Information Administration Manual of Regulations and procedures for Federal Radio Frequency Managment.

Allocation (of a frequency band)—Entry in the Table of Frequency Allocations of a given frequency band for its use by one or more (terrestrial or space) radio communication services or the radio astronomy service under specified conditions. This term shall also be applied to the frequency band concerned. **(RR)**

Allotment (of a radio frequency or radio frequency channel)—Entry of a designated frequency channel in an agreed plan, adopted by a component conference, for use by one or more administrations for a (terrestrial or space) radiocommunications service in one or more identified countries or geographical areas and under specified conditions. **(RR)**

Amateur Service—A radiocommunication service of self-training, intercommunication, and technical investigation carried out by amateurs (i.e., duly authorized persons interested in radio techniques solely with a personal aim and without pecuniary interest). **(RR)**

Assigned Frequency—The center of the frequency band assigned to a station. **(NTIA)**

Assigned Frequency Band—The frequency band within which the emission of a station is authorized; the width of the band equals the necessary bandwidth plus twice the absolute value of the frequency tolerance. Where space stations are concerned, the assigned frequency band includes twice the maximum Doppler shift that may occur in relation to any point of the Earth's surface. **(RR)**

Assignment (of a radio frequency or radio frequency channel)—Authorization given by an administration for a radio station to use a RF or RF channel under specified conditions. **(RR)**

Authorized Bandwidth—The necessary bandwidth required for transmission and reception of intelligence (does not include allowance for transmitter drift or Doppler shift). **(NTIA)**

Broadcasting Service—A radiocommunication service in which the transmissions are intended for direct reception by the general public. This service may include sound, television, or other types of transmissions. **(RR)**

Channeling Plan—The plan by which the frequencies within a frequency band are to be assigned.

Characteristic Frequency—A frequency easily identified and measured in a given emission. A carrier frequency may, for example, be designated as the characteristic frequency. **(RR)** (see also **Reference Frequency**).

Coordination Distance—Distance on a given azimuth from an Earth station beyond which a terrestrial station, sharing the same frequency band, neither causes nor is subject to interference emissions greater than a permissible level. **(RR)**

Earth Station—A station located either on the Earth's surface or within the major portion of the Earth's atmosphere and intended for communication with one or more space stations, or with one or more stations of the same kind by means of one or more reflecting satellites or other objects in space. **(RR)**

Electromagnetic Compatibility (EMC)—(1) The ability of systems, equipment, and devices that utilize the electromagnetic spectrum to operate in their intended operational environments without suffering unacceptable degradation or causing unintentional degradation because of electromagnetic radiation or response. It involves the application of sound electromagnetic spectrum management; system, equipment, and device design configuration that ensures interference-free operation; and clear concepts and doctrines that maximize operational effectiveness (JP 1-02.) (2) The condition that prevails when telecommunications equipment is performing its individually designed function in a common electromagnetic environment without causing or suffering unacceptable degradation due to unintentional electromagnetic interference (EMI) to or from other equipment in the same environment. **(RR)**

Electromagnetic Interference (EMI)—Any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronic or electrical equipment. It is induced intentionally, as in some forms of electronic warfare (EW), or unintentionally, as a result of spurious emissions and responses, intermodulation products, and the like.

Electromagnetic Spectrum—(1) The range of frequencies of electromagnetic radiation from zero to infinity. It is divided into 26 alphabetically designated bands. (**JP 1-02**)

Fixed Service—A radiocommunication service between specified fixed points. **(RR)**

Frequency Allocation—See Allocation (of a frequency band).

Frequency Allotment—See Allotment (of a frequency or radio frequency channel).

Frequency Assignment—See Assignment (of a radio frequency or radio frequency channel).

Frequency Assignment, Group—Frequencies assigned to a MAJCOM to satisfy short-term requirements throughout the US&P. Group assignments are not assigned exclusively to a single MAJCOM.

Frequency Assignment, Temporary—An assignment effective for 90 days or less.

Frequency Tolerance—The maximum permissible departure by the center frequency of the frequency band occupied by an emission from the assigned frequency, or by the characteristic frequency of an emission from the reference frequency expressed in part 106 or hertz (Hz). **(RR)**

Harmful Interference—Interference that endangers the functioning of a radio navigation service or other safety services, or that seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the radio regulations. **(RR)**

Hertz (Hz)—A unit of frequency equal to one cycle per second. (NTIA)

Industrial, Scientific, and Medical (ISM) Applications (of radio frequency—energy) Operation of equipment or appliances designed to generate and use local radio-frequency energy for industrial, scientific, medical, domestic, or similar purposes, excluding applications in the field of telecommunications. **(RR)**

Instrument Landing System (ILS)—A system of radio navigation intended to assist aircraft in landing which provides lateral and vertical guidance, which may include indications of distance from the optimum point of landing (JP 1-02.) A radionavigation system that provides aircraft with horizontal and vertical guidance just before and during landing and , at certain fixed points, indicates the distance to the reference point of landing. **(RR)**

Instrument Landing System Glide Path—A system of vertical guidance embodied in the ILS that indicates the vertical deviation of the aircraft from its optimum path of descent. **(RR)**

Instrument Landing System Localizer—A system of horizontal guidance embodies in the ILS that indicates the horizontal deviation of the aircraft from its optimum path of descent along the axis of the runway. **(RR)**

Interference—The effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radio communication system, manifested by any performance degradation, misinterpretation, or loss of information that is extracted in the absence of such unwanted energy. **(RR)**

Ionospheric Sounder—A device that transmits signals for the purpose of determining ionospheric conditions. (NTIA)

Land Station—A station in the mobile service not intended to be used while in motion. **(RR)**

Low-Power Communication Device—A restricted radiation device, exclusive of those employing conducted or guided RF techniques, used for the transmission of signs, signals (including control signals), writing, images and sounds or intelligence of any nature by radiation of electromagnetic energy. Examples: Wireless microphone, phonograph oscillator, radio-controlled garage door opener, and radio-controlled models. **(RR)**

Marker Beacon—A transmitter in the aeronautical radionavigation service that vertically radiates a distinctive pattern to provide position information to aircraft. **(RR)**

Mean Power (of a radio transmitter)—The average power supplied to the antenna transmission line by a transmitter during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation taken under normal operating conditions. **(RR)**

Meteorological Aids Service—A radiocommunication service used for meteorological, hydrological observations and exploration. **(RR)**

Microwave Landing System (MLS)—A radionavigation system that provides the same information as an ILS but operates in the 5000-5250 MHz band.

Mobile Service—A radiocommunication service between mobile and land stations, or between mobile stations. **(RR)**

Mobile Station—A station in the mobile service intended to be used while in motion or during halts at unspecified points. **(RR)**

Necessary Bandwidth—For a given class of emission, the width of the frequency band which is minimally sufficient to ensure the transmission of information at the rate, and with the quality, required under specified conditions. **(RR)**

Nominal Coordination Distance—The maximum coordination distance for flat terrain on an overland path or, if applicable, on an over-water path. It does not take into account the effects of possible terrain shielding.

Peak Envelope Power (PEP) (of a radio transmitter)—The average power supplied to the antenna transmission line by a transmitter during one RF cycle at the crest of the modulation envelope taken under normal operating conditions. **(RR)**

Perimeter Protection System—A field disturbance sensor that uses buried cables installed around a facility to detect any unauthorized entry or exit.

Radiation Hazard (RADHAZ)—RADHAZs are of three types. One deals with the effects on the human body of nonionizing radiation caused by exposure to high-power transmitters or electronic equipment which produces x rays. The other types deal with the danger of RF transmissions accidentally detonating explosive devices or igniting fuels.

Radio Astronomy—Astronomy based on the reception of radio waves of cosmic origin. **(RR)**

Radio Frequency (RF) Spectrum—The RF spectrum includes the frequencies from 3.0 kHz to 400 GHz. The presently allocated spectrum is from 9 kHz to 381 GHz.

Radiolocation—Radiodetermination used for purposes other than those of radionavigation. **(RR)**

Range Commander—In this publication, the commander of an Air Force test or tactical range.

Reference Frequency—A frequency having a fixed and specific position with respect to the assigned frequency. The displacement of this frequency with respect to the assigned frequency has the same absolute value and sign that the displacement of the characteristic frequency has with respect to the center of the frequency band occupied by the emission. **(RR)** (See also **Characteristic Frequency.**)

Restricted Radiation Device—A device in which the generation of RF energy is intentionally incorporated into the design, and in which the RF energy is conducted along wires or is radiated, exclusive of transmitter for which provisions are made under those parts of Chapter 7 of the *NTIA Manual* other than part 7.9, and exclusive of ISM equipment. (NTIA)

Space Operation Service—A radiocommunication service concerned exclusively with the operation of spacecraft, particularly space tracking, space telemetry, and space telecommand. These functions will normally be provided within the service in which the space station is operating. **(RR)**

Space Station—A station located on an object which is beyond, is intended to go beyond, or has been beyond, the major portion of the Earth's atmosphere. **(RR)**

Space Telemetry—The use of telemetry for the transmission from a space station of results of measurements made in a spacecraft, including those relating to the functioning of spacecraft. **(RR)**

Spurious Emission—Emission on a frequency or frequencies that are outside the necessary bandwidth and the level of which is reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions. **(RR)**

Standard Frequency and Time Signal Service—A radio communication service for scientific, technical and other purposes, providing the transmission of specified frequencies, time signals, or both, of stated high precision, intended for general reception. **(RR)**

Telecommunication—Any transmission, emission, or reception of signs, signals, writing, images, and sounds or intelligence of any nature by wire, radio, optical, or other electromagnetic systems. **(RR)**

Telemetry—The use of telecommunication for automatically indicating or recording measurements at a distance from the measuring instrument. **(RR)**

United States and Possessions (US&P)—The term "United States and Possessions" includes the 50 States, the District of Columbia, the Commonwealth of Puerto Rico, and the territories and possessions (but less the Canal Zone).

Attachment 4

OFFICES OF INTEREST

A4.1. Department of Defense Area Frequency Coordinators.

OFFICE	AREA
Western Area Frequency Coordinator Pt. Mugu, CA 93042-5001 Telephone: (805) 989-7983/7981 Fax: (805) 989-4854 DSN: 351-4854 Message Address: WAFC PT MUGU CA//AFMO//	California south of 37o30'N, including all offshore islands.
Area Frequency Coordinator State of Arizona ATTN: SFIS-FAC-SH Ft. Huachuca, AZ 85613-5000 Telephone: (520) 538-6423 DSN: 879-6423 Fax: (520) 538-8528 DSN: 879-8528 Message Address: DOD AFC AZ FT HUACHUCA AZ// SFIS-FAC-SH//	Arizona.
DoD Area Frequency Coordinator 99CS/SCXF 5870 Devlin Drive, Suite 102 Nellis AFB, NV 89191-7075 Telephone: (702) 652-3417 DSN: 682-3417 Fax: (702) 652-7354 DSN: 682-7354 Message Address: DOD AFC NELLIS AFB NV	Nevada; Utah west of 111oW; Idaho south of 44oN.
DoD Area Frequency Coordinator White Sands Missile Range, NM 88002-5526 Telephone: (505) 678-5417 DSN: 258-5281 Fax: (505) 678-5281 DSN: 258-5281 Message Address: DOD AFC WSMR NM//DOD AFC//	Colorado west of 108oW; New Mexico; Texas west of 104oW
Gulf Area Frequency Coordinator 96CCSG/SCZ 102 North Second Avenue, Suite 106 Eglin AFB, FL 32542-6837 Telephone: (904) 882-4416 DSN: 872-4416 Fax: (904) 882-8494 DSN: 872-8494 Message Address: DOD GAFC EGLIN AFB FL	Alabama south of 33o30'N; Georgia west of 83oW, south of 33o30'N; Louisiana east of 90oW; Mississippi east of 90oW, south of 33o33'N.

Eastern Area Frequency Coordinator 45CS/SCXF 1225 Jupiter Street Patrick AFB, Fl 32925-3341 Telephone: (407) 494-5838 DSN: 854-5838 Fax: (406) 494-4541 DSN: 854-4541 Message Address: DOD EAFC PATRICK AFB FL	Florida east of 83oW; Georgia east of 83oW south of 31o33'N.
Area Frequency Coordinator Atlantic Fleet Weapons Training Facility (AFWTF) Box 3023 PSC 1008 Code 017 FPO AA 34051-9000 Telephone: (809) 865-5227 DSN: 831-5227 Fax: (809) 865-5212 DSN: 831-5212 Message Address: DOD AFC PR ROOSEVELT ROADS PR	200-mile radius of Roosevelt Roads, Puerto Rico

A4.2. Army and Navy Frequency Coordinators.

OFFICE	AREA
Army Frequency Management Office CONUS AFC 2390 Liscum Road Ft. Sam Houston, TX 78234-5000 Telephone: (210) 221-2820/2050 DSN: 471-2820 Fax: (210) 221-2844 DSN: 471-2844 Message Address: AFMO CONUS FT SAM HOUSTON TX//SFIS-FAC-SC//	All CONUS except those areas serviced by DoD. Arizona and DoD White Sands Missile Range
Mid-Atlantic Area Frequency Coordinator Naval Air Warfare Center Aircraft Division 22953 Cedar Point Road Patuxent River, MD 20670-5304 Telephone: (301) 342-1532/1194 DSN: 342-1194/1532 Fax: (301) 342-1200 DSN: 342-1200 Message Address: AREA FREQCOORD MIDLANT PATUXENT RIVER MD//5.1.4A/RD66//	That area of the eastern United States and the Atlantic Ocean south of 41ON; east of a line starting at the intersection of 41ON and 75O30'W running to the intersection of 33O30'N and 83OW; north of 31O30'N; west of 68O40'W.
Navy Frequency Coordinator Eastern US Director JFMO LANT USACOM/J642 1562 Mitscher Ave, Suite 200 Norfolk, VA 23551-2488 Telephone: (804) 444-3241 DSN: 564-3241 Fax: (804) 445-9267 DSN: 565-9267 Message Address: JFMO LANT NORFOLK VA	Minnesota, Iowa, Kansas, Oklahoma, Texas, and all states east of these states.

Navy Frequency Coordinator Western US Code 521J00E Pt. Mugu, CA 93042-5001 Telephone: (805) 989-4854 DSN: 351-4854 Message Address: NAVFRCOORD WESTERN US PT MUGU CA//AFMO//	North Dakota, South Dakota, Nebraska, Colorado, New Mexico, and all states west of these states.

A4.3. Federal Aviation Administration Frequency Coordinators.

OFFICE	**AREA**
Federal Aviation Administration NW Mountain Region Frequency Management Officer ANM-472 1601 Lind Avenue, SW Renton, WA 98055-4056 Telephone: (206) 227-2328/2637 Fax: (206) 227-1460	Colorado; Idaho; Montana; Oregon; Utah; Washington; Wyoming.
Federal Aviation Administration Western Pacific Region Frequency Management Officer AWP-475 PO Box 92007 Worldway Postal Center Los Angeles, CA 90009-2007 Telephone: (310) 725-3475 Fax: (310) 297-0181	Arizona, California, including all off-shore islands; Nevada
Federal Aviation Administration Central Region Frequency Management Officer ACE-473 601 E. 12th Street Kansas City, MO 64106-2894 Telephone: (816) 426-5647 Fax: (816) 426-3038	Iowa; Kansas; Missouri; Nebraska.
Federal Aviation Administration Southwest Region Frequency Management Officer ASW-473 2601 Meacham Boulevard Fort Worth, TX 76193-0783 Telephone: (817) 222-4730 Fax: (817) 222-5977	Arkansas; Louisiana; New Mexico; Oklahoma; Texas.
Federal Aviation Administration Great Lakes Region Spectrum Management Office AGL-472B 2300 East Devon Avenue Des Plaines, IL 60018 Telephone: (847) 294-8472 Fax: (847) 294-7470	Illinois; Indiana; Michigan; Minnesota; North Dakota; South Dakota; Ohio; Wisconsin.

Rome, NY 13441-4505
Telephone: (315) 330-2259 DSN: 587-2405

RF Spectrum Management Section
88CG/SCXM
Area B, Building 676
3810 Communications Boulevard
Wright-Patterson AFB OH 45433-5706
Telephone: (513) 255-2181/DSN: 785-2181
Fax: (513) 255-1851/DSN: 785-1851

Electronic Systems Center(ESC/SCXC)
50 Griffiss Street
Hanscom AFB, MA 01731-1621
Telephone: (617) 377-7511 DSN: 478-7516
Fax: (617) 377-7516 DSN: 478-7516

99CS/SCXF
5870 Devlin Drive, Suite 102
Nellis AFB, NV 89191-7075
Telephone: (702) 652-3417 DSN: 682-3417
Fax: (702) 652-7354 DSN: 682-7354

Phillips Laboratory Geophysics Directorate
Phillips Lab/Technical Services
29 Randolph Road
Hanscom AFB, MA 01731-3010
Telephone: (617) 377-4761 DSN: 478-4761
Fax: (617) 377-4498 DSN: 478-4498

30 Space Wing
826 13th Street, Suite 402
Vandenberg AFB, CA 93437-5212
Telephone: (805) 734-8232, Ext 6695 DSN: 276-6695
Fax: (805) 734-5695 DSN: 276-9572

Arnold Engineering Development Center
350 First Street
Arnold AFB, TN 37389-3300
Telephone: (615) 454-5978 DSN: 340-5978
Fax: (615) 454-3997 DSN: 340-3997

A4.6. Military Test Ranges.

ACTIVITY	AREA OF COGNIZANCE	SERVICE
Air Warfare Center Nellis AFB NV	Entire State of Nevada, Utah west of 111oW, and Idaho south of 44oN	Air Force

Eastern Range Patrick AFB, FL	Area bounded by 24oN, 31o30'N,77oW, and 88oW	Air Force
Air Force Development and Test Center Eglin AFB, FL	Area bounded by 27oN, 33o30'N,83oW, and 90oW	Air Force
Pacific Missile Test Center Pt. Mugu, CA	Area enclosed within a 200-mile radius of the HQ Building, PMR, and the area of California south of 37o30'N	Navy
Army Electronic Proving Ft. Huachuca, AZ	Entire State of Arizona	Army
Military Ranges within the State of Hawaii	Area enclosed by 200 mile radius of Honolulu, Hawaii	CINCPAC
Atlantic Fleet Weapons Training Facility Roosevelt Roads, PR	Area within 200 nautical miles of HQ Building, AFWTF	Navy
White Sands Missile Range Las Cruces, NM	Entire State of New Mexico and other US territory within a 150-mile radius of HQ Building, WSMR, plus the area of Utah and Colorado that lies south of 41oN and between 108o and 111oW	Army

A4.7. Electromagnetic Compatibility Services. Joint Spectrum Center
120 Worthington Basin
Annapolis, MD 21402-5064
Telephone: (410) 293-2452/9815 DSN: 281-2452/9815
Fax: (410) 293-3763 DSN: 281-3763

738 Engineering Installation Squadron/EEEX
801 Vandenburg Avenue, Suite 201
Keesler AFB, MS 39534-2634
Telephone: (601) 377-3920 DSN: 597-3920
Fax: (601) 377-3956 DSN: 597-3956

BY ORDER OF THE COMMANDER
Air Force Flight Test Center (AFMC)
Edwards Air Force Base CA 93524

AFFTC INSTRUCTION 11-15
1 March 1999

Flying Operations

SCHEDULING PROCEDURES FOR AIRCRAFT AND AIR/GROUND SUPPORT

COMPLIANCE WITH THIS INSTUCTION IS MANDATORY

Supersedes AFFTC 55-15 Dated 18 Jun 91 — Editor: Nancy Smith
No of printed pages: 21 — Distribution: F, E, X
OPR: 412 OSS/OSCS (Terry Lawton, DSN 527-4367) — HQ AFMC/DOV........1
Approved by: 412 TW/CC (Col Robinson)

This instruction establishes the Air Force Flight Test Center (AFFTC) procedures for scheduling aircraft, air/ground support, and/or resources at AFFTC, Edwards AFB. It prescribes policies and functional responsibilities and applies to all personnel authorized to use AFFTC resources.

SUMMARY OF REVISIONS: Revises/updates user responsibilities concerning changes, add-ons and deletions/ cancellations (para 2); adds guidance on ground test operations (GTOs) (para 3); changes the airfield operation during non-duty hours notification (para 2.7); alters procedures for overtime and weekend support (para 2.8); further defines the hazardous test designation on the printed schedule (para 2.10); adds duty officer situation code assessment responsibilities (para 5.2.7); updates Center Scheduling operations, including Daily Scheduling timelines(para 3 through 5); changes monthly scheduling requirements (para 6); deletes the AFSC/AFFTC Form 17 requirement (para 7.3 and atch 6); changes the Cost Recovery Decision Chart (atch 2); changes and updates the weekly and daily scheduling process/timelines attachments (atch 3 and 4); adds a situation code listing (atch 6.)

1. RESPONSIBILITIES:

1.1. The 412th Test Wing Commander (412 TW/CC) will establish and maintain a Center Scheduling Office authorized to coordinate and schedule AFFTC resources required to conduct all ground/flight tests, test support, and operational flying at Edwards AFB.

1.2. Center Scheduling (412 OSS/OSCS) is divided into three functional areas. Their responsibilities are:
1.2.1. Forecast (Weekly) Scheduling provides long-range planning, coordination, and scheduling of AFFTC resources required to conduct ground/flight tests, test support, and operational flying at Edwards AFB IAW guidelines set in this instruction; and finalizes the weekly schedule.
1.2.2. Daily Scheduling provides confirmation of missions on the weekly schedule one workday prior to the mission, and accepts add-ons, changes, and mission deletions. They are responsible for deconflicting telemetry/communication frequencies, designated low level training routes, IR/VR routes, and spin test areas. They also provide printouts of the daily schedule.
1.2.3. Real Time Scheduling (Current Operations) is responsible for coordinating Realtime changes, flight extensions, mission support deletions, and mission cancellations/aborts on the daily schedule. They are also responsible for Realtime deconfliction of telemetry/communication frequencies, designated low level training routes, IR/VR routes, and spin test areas. Current Operations, using the radio call sign CONFORM on 304.0 MHz provides flight following between 0600-1700 on workdays, and on an as-needed basis at other times. At all other times, CONFORM is manned by the Command Post on a limited basis.

1.3. AFFTC Command Post (95 ABW/CP): Will provide aircraft flight following when Current Ops is not manned. Will provide information concerning mission cancellations and changes to Current Ops when relieved of flight-following responsibilities.

1.4. SPORT Radar Control Facility (RCF) (412 OSS/OSAR): SPORT RCF provides multiple services to AFFTC flight test aircraft using Restricted Area 2515; the Barstow East and West and Buckhorn Military Operation Areas (MOAs); and Air Traffic Control Assigned Airspace. SPORT is responsible for providing both Air Traffic Control services for aircraft arriving and departing Edwards AFB, and provides test mission support to include traffic advisories, safety and boundary advisories, and airspace coordination. SPORT conducts range weapon/stores releases and confirms accurate footprint data is available (when necessary) to ensure the safety of both air and ground crews during air-to-ground weapons/stores deliveries. Normal hours of SPORT operations are 0600 to 2000 local Monday through Friday. After-hour support must be coordinated with SPORT 72 hours in advance to ensure personnel will be available to support the mission.

1.5. The Range Squadron (412 TW/TSR) will provide:
1.5.1. A Range Scheduling Office (412 TW/TSRO). The Range Scheduling Office is organized into Forecast, Daily, and Realtime Range Scheduling and is responsible for scheduling range assets.
1.5.2. Through the Range Scheduling Office - range support, to include Precision Impact Range Area (PIRA), Radar Fidelity and Geometric (RADFAG) Range Control, bombing targets with scoring, a range safety officer or representative for radar-controlled drops, Dual Air-to-Ground Range (DAGRAG) and targets, gunnery scoring, aerial delivery systems recovery, electronic countermeasure and avionics functional check facility (MUTES/MOTES), takeoff and landing photographic optical facilities, photographic resolution range, instrumentation radar and optical tracking system, and arresting barrier facility as scheduled.
1.5.3. Telemetric services including north, west, China Lake, and local Data Acquisition and Transmission Service (DATS), microwave data/communication links, telemetry/communication/video receive/record/display, and mission control facilities as scheduled.
1.5.4. Telemetry post-flight services as scheduled.
1.5.5. Operations Duty Officer (ODO)/Range Control Officer (RCO). ODOs and RCOs from the 412 TW/TSROC are responsible for implementing Realtime changes of range assets to the daily and Realtime schedules. RCOs are assigned as primary representatives to specific programs to ensure proper support and coordination of range resources. The ODO and RCO positions are manned between 0600-1700 on workdays, and on an as-needed basis at other times.
1.5.6. Data Production Analyst (DPA) (412 TW/TSRPD). DPAs are assigned to specific programs to ensure proper support and coordination of data products.
1.5.7. A Range Budget Analyst (412 TW/TSRB), who will process applicable range asset cancellation charges IAW AFFTCI 65-5, *Reimbursement Policy*.

1.6. The Commander, 412th Logistics Group (412 LG/CC) will provide aircraft, gun harmonization range, and airborne test instrumentation pre- or post-flight services as scheduled. Logistics Management Flight (412 LG/LGLXXR) will process applicable aircraft cancellation charges IAW AFFTCI 65-5. 412th Equipment Maintenance Squadron (412 EMS/LGMSM) will provide munitions storage for testing/operating agencies when scheduled.

1.7. The Director of Technical Support (412 TW/TS) will provide weight and balance facilities and thrust stands, television display, and videotaping services as scheduled.

1.8. 95th Medical Group (95 MG/SG) will provide medical standby alert as scheduled.

1.9. 95th Civil Engineering Group (95 CEG/CC) will provide standby fire fighting services as scheduled.

2. USER RESPONSIBILITIES AND PROCEDURES:

2.1. Agencies Based at Edwards. All agencies utilizing AFFTC flight test resources/airspace/airfield facilities will:
2.1.1. Request and coordinate all activities, whether air or ground, involving AFFTC assets through Center Scheduling, including test and non-test flight, ground test activity, add-on requests, mission/resource deletions/cancellations, flight extensions, and mission aborts. This includes Ground Test Operations (GTO). (See paragraph 3.1 for definition of GTO information.) Submit all support requirements for each mission. When more than one resource will satisfy the requirements, indicate all alternatives on the request. Center Scheduling will

consider only those projects having AFFTC approval and supplemented by sufficiently detailed plans for proper scheduling. Project documentation must be in the hands of all support and control agencies in advance of scheduling the mission. Timelines for submission of requests are outlined in paragraph 5.

2.1.1.1. Requesting agencies that have access to an Edwards Scheduling System (ESS) terminal will submit their weekly requirements by 0800 Tuesday prior to the forecast week. Adds will not be accepted after 0800 Tuesday. Detailed guidance for operation of ESS is provided in the AFFTC/ESS Users Manual. Center Scheduling will provide ESS training as needed.

2.1.1.2. Requesting agencies that do not have access to ESS will submit weekly requirements by 1200 Monday prior to the forecast week. Requests will be submitted IAW Attachments 1 on AFFTC Form 5016, **Weekly Aircraft and Air/Ground Support Requirements Schedule**. Forms will not be accepted unless properly prepared. Requests will not be accepted after 1200 Monday. When a Monday holiday occurs, the deadline will move forward accordingly.

2.1.1.3. Agencies requesting classified mission support will submit requirements by 0800 Tuesday prior to the forecast week. Adds will not be accepted after 0800 on Tuesday. They will submit mission support requirements on AFFTC Form 5016 with the appropriate classification markings (an approved computer printout may be used in lieu of AFFTC Forms 5016)

2.1.2. To ensure a conflict-free schedule is built, each requesting agency must ensure their requests are conflict-free within their own organization, **PRIOR** to submitting to Center Scheduling. This includes telemetry/communication frequencies, aircraft capabilities, airspace, and range utilization.

2.2. Outside Agency Requests. Requests for AFFTC resources/support facilities by other than agencies based at Edwards AFB, will be the responsibility of the designated project officer and will be accomplished through Center Scheduling.

2.3. Telemetry Support/Requests. When telemetry resources are required to support a flight/ground activity, the request and coordination of those assets will be scheduled through Center Scheduling.

2.4. Precision Impact Range Area (PIRA). Project officers will provide all release profiles, parameters, and ballistics data for missions involving weapons/parachute testing in the PIRA to the 412th Range Division Range Safety Officer (RSO) or designated representative (7-3224) NLT 1200, the day before the scheduled mission.

2.5. Overflight Restrictions of Detachment 7, Air Force Research Laboratory and/or PIRA. Missions requiring overflight restrictions of Air Force Research Laboratory or the PIRA will be coordinated with Center Scheduling and published on the weekly schedule. Scheduled Air Force Research Laboratory missions will be re-coordinated on the daily schedule, and all realtime changes or cancellations will be coordinated with Current Operations.

2.6. Closure of On-Base Highways.

2.6.1. If a mission may be a hazard to traffic on any highway, notify Center Scheduling/Current Ops of the location, time, and road to be closed in order for the test mission to be completed. Missions that would close any road between 0600-0800 or 1530-1700 will not be scheduled other than for exceptional circumstances. Such circumstances will require 412 OG/CC approval and coordination with Detachment 7, Air Force Research Laboratory.

2.6.2. Center Scheduling will notify the 412th Range Division, Base Operations, Fire Department, Air Force Research Laboratory, the 95th Security Forces Squadron, and Maintenance Operations Center of road closures.

2.7. Airfield Operation During Non-Duty Hours. Normal duty hours for Base Operations and the Control Tower are listed in the IFR Supplement.

2.7.1. The airfield is normally in operation 24 hours each day. However, during certain periods, operations occurring between 2200L - 0600L Monday through Friday, weekends, or federal holidays requests for airfield operations support (Control Tower/Base Operations) must be coordinated with the Airfield Operations Flight (AOF) Commander at least 72 hours prior to the planned event.

2.7.1.1. Any changes or cancellations to planned operations during the times and days referred to in paragraph 2.7.1 must be coordinated though AOF commander as soon as possible but not later than 24 hours prior to the event.

2.8. Missions Requiring Overtime Support. Requests for weekend support after the weekly schedule has been printed must be submitted to Center Scheduling NLT 1200 Wednesday prior to the desired weekend.

2.9. Range Support Release (RSR). Test agencies or their representatives can release all scheduled resources or portions of scheduled resources based on changes to test objectives.

2.9.1. Day Prior. Test agencies will provide RSR information to Center Scheduling NLT 1000 the day prior to the mission. Any mission RSR'd after 1200 may be charged to the project concerned if those resources are not utilized by subsequent add-on/standby missions.

2.9.2. Realtime. Test agencies will provide RSR information to Current Ops on the day of the mission. Current Ops will relay this information to Range Operations Duty Officer (ODO). When release occurs after range setup has occurred, the project concerned may be charged for the full range time scheduled, if the range assets are not utilized by add-on/standby missions.

2.10. Hazardous Tests. Test missions that have been designated as Hazardous, either Medium or High Risk, must be identified in the mission title on the printed schedule. For add-on missions users will indicate to Center Scheduling if the mission is hazardous. The proper input/designation will be entered as **"HAZ TST XX-XXX,"** where the X indicates the safety package number.

2.11. Airshow Practice Procedures.

2.11.1. Unit Responsibilities. Individual units will request airshow practices through Center Scheduling and ESS. Airshow practices over the airfield will be scheduled in ESS as **"Airshow Practice"** in the mission title with airfield closure time in the remarks. Airshow practices in the area should be scheduled as proficiency missions with **"Airshow Practice"** in the remarks.

2.11.1.1. Airshow practice over the field will normally be scheduled after 1600 to minimize the effect on USAF Test Pilot School (TPS) launches and recoveries. A minimum of 15 minutes between airfield closures will be allotted to launch and recover the aircraft.

2.11.1.2. To ensure all flying units are aware of approved airshow practices, the unit sponsoring the practice will notify by telephone all other flying units, Airfield Operations Flight (AOF) Commander, SPORT, and NASA, of the airfield closure time, normally by 1500 the day prior.

2.11.1.3. Advise the AOF Commander if the airshow practice will be requested over the North Base or South Base runways. Coordination must be made with the facility managers in those areas before the airshow practice can be conducted.

2.11.2. Delays/Changes. Center Scheduling will be responsible for deconfliction of airshow practices. If a flight is delayed and cannot be completed within the designated time block, it will either be rescheduled or canceled. Squadrons must obtain 412 OG/CC approval to reschedule or add-on. After the change is approved, the squadron will confirm the change with Current Ops who will then coordinate with the AOF commander, tower, and SPORT. The squadron will then notify all other units.

2.11.3. Aircrew Responsibilities. The coordination of airshow-specific resources necessary to conduct an airshow practice is the responsibility of the aircrew. If the airshow is over the Main Base, North Base, or South Base runways, the aircraft commander/flight leader will brief the Edwards Control Tower Chief Controller to include beginning time, practice duration, minimum altitude, and discrete radio frequency for tower, safety observer, and airshow. The aircraft commander/flight leader will notify tower and CONFORM of any delays as soon as possible.

2.12. Requests for Off-Base Range Support. In order to ensure all supporting activities are informed of changes, Center Scheduling will coordinate all off-base support requirements. Organizations requiring China Lake, Vandenburg, or Pt Mugu support will provide information to Center Scheduling by 0900 Tuesday prior to the forecast week. Center Scheduling will review the requirements and forward to the appropriate supporting organization. If the requested support has not been confirmed prior to the OG/LG scheduling meeting, then the weekly scheduler will notify the requesting organization by phone of any changes. Other range support (within the R2508 complex) such as Mojave B Range, or Superior Valley will be requested through the normal scheduling process.

2.13. Airspace Scheduling

2.13.1. The following procedures are to be used for cross country, out-and-back, or for flights conducted in part outside of R-2508 (round robins) requiring use of DD Form 175, **Military Flight Plan**. This process will clarify airspace scheduling procedures upon departure or RTB.

2.13.2. Aircraft from Edwards AFB or Air Force Plant 42 departing or arriving on a DD Form 175, not requiring special use airspace (SUA), will only list DD Form 175 in ESS as the sole resource. No airspace needs to be scheduled.

2.13.3. If you require SUA on departure or RTB, list airspace requirements with associated altitude and time within the ESS (do not list DD Form 175).

2.14. The scheduling process outlined above is required for either weekdays, weekends, or holidays. This ensures airspace requirements are in place when you depart or arrive at the airspace boundary. The TRACON maintains airspace requirements for 30 minutes prior and up to 90 minutes after your ETA. If you have experienced a delay outside this time frame, contact Current Operations or CONFORM to update your ETA with TRACON.

3. GROUND TEST OPERATIONS / MAINTENANCE GUIDELINES:

3.1. Ground Test Operations (GTO). When AFFTC aircraft are utilized for non-flying missions, they will be scheduled through the normal weekly/daily process and assigned a mission number (ground test operations associated with a flying mission may be conducted under the mission number of the flight). A GTO is defined as a scheduled test of an aircraft or its systems that are performed on the ground. The event must be in support of an approved test program. The pre-test and post-test actions are included in the GTO.

3.2. Class II Mod Schedules. Particular attention will be paid to early notification of potential modifications and preliminary package briefing to the Configuration Control Board. Project officers will coordinate with Center Scheduling (412 OSS/OSCS), Maintenance Wing Scheduling (412 LSS/LGLOS), and the Class II Mod Branch (412 LG/LGQD) to assure that schedules are adjusted to meet test program requirements with minimum delay. Project officers will keep the Maintenance Operations Center (412 LSS/LGLOM) and 412th Test Wing advised when project or instrumentation work, other than Class II modification, is forecast or being accomplished by project personnel.

3.3. Functional Check Flights (FCF). When FCFs are required, Maintenance Quality Assurance (412 LG/LGQ) will coordinate with the appropriate flying unit for aircrew availability. FCF crews will be requested when the aircraft is crew-ready and all maintenance forms have been reviewed. The flying unit will then schedule the FCF through Current Ops on the fly day. FCFs will not be combined with other mission requirements. An FCF that requires flight parameters not listed in the specific aircraft FCF technical order must have prior approval of the 412 OG/CC. If it becomes necessary to fly a weekend FCF, notify the appropriate flying unit and Current Ops prior to 1500 Friday so aircrews can be notified. For Center Scheduling purposes, FCFs will be incorporated into the Realtime Schedule and, when flown, counted as scheduled and flown sorties.

3.4. Weight and Balance/Thrust Stand/Stores, Weight and Inertia System (SWIS) Facilities. Organizations subordinate to 412 LG/CC will coordinate all pre-planned utilization of the Weight and Balance/Thrust Stand/SWIS Facilities through Wing Scheduling (412 LSS/LGLOS) for input to the weekly/monthly OG/LG sortie plan. Requests for same day utilization of these facilities will be submitted through the Maintenance Operations Center 412 LSS/LGLOM. They will, in turn, coordinate priorities directly with the Weight and Balance scheduler (412 TW/TSIM).

4. CENTER SCHEDULING GUIDELINES:

4.1. Priority. Projects will be supported in accordance with the current AFFTC Job Order Register priority listing. Support requirements will be adjusted to ensure maximum utilization of resources. Scheduling conflicts that cannot be resolved by Center Scheduling will be referred to 412 OG/CC.

4.2. Mission Numbers. A five-character number identifies missions on the schedule. The first digit is an alpha character identifying the month (A thru M, excluding I, for January through December, respectively), and the remaining four digits are random generated numbers. Multiple sorties within a given mission package will be further identified by an alpha character suffix. The five-character mission number will be printed in the schedule prefixed with an "X," which is used as the Job Order Number (JON) for non-proficiency sorties. Mission numbers, which are generated and distributed to users monthly, are invalid at the end of the month unless a mission is loaded in ESS against a respective mission number. With the exception of not-available aircraft (N/A), once a mission number is published or added to the approved daily schedule the mission is accountable as either flown, canceled, or completed.

4.3. Add-ons. Normal requests for add-ons will be accepted by the daily scheduler between 0700 and 1000 on the workday prior to the mission and will be assigned a 99 priority. Add-ons will be considered first-come, first-served, and scheduled on a strictly non-interference basis with the hard scheduled missions and will not be accepted between 1000 and 1400 on the workday prior to the mission. However, resources requiring long lead-time may be added-on as soon as requirements are identified. The following add-ons require parent CTF Top 3 (coordination) approval:
4.3.1. Schedule approval moves to Current Operations and the Maintenance Operations Center (MOC) and assumes Realtime "day of" scheduling after 1400 each day. All add-ons, cancels, and changes require parent CTF Top 3 approval. CTF/TPS will obtain Top 3 approval prior to contacting Current Operations and MOC. Test support aircraft released/canceled may be added after approval by CTF Top 3. Changes or add-ons which would add tail numbers, not previously planned for that day, require CTF Top 3, OG, and LG approval. Add ons will be given a 99 priority. Specific OG approval is needed to retain overall mission priority. Cancels and deletions of resources are subject to cancellation charges (see paragraph 4.9.)
4.3.2. Cross countries and out-and-backs requested after the weekly schedule is approved.
4.3.3. Any request for Edwards AFB facilities during non-duty hours or when the airfield is closed by NOTAM.

4.4. Not Available Aircraft (N/A). Weekly N/As that are filled on the day prior to the mission will be considered an add-on with a 99 priority.

4.5. Standby Status. Support requests that exceed resource availability will be put in "standby" (SB) status. Missions in SB status will be hard-scheduled when resources become available.

4.6. Backup Missions. Backup sorties are not authorized at AFFTC. All missions will be scheduled as primary missions.

4.7. Cancels. A cancellation is scored if an aircraft fails to launch within 3 hours of its scheduled takeoff time (as printed on the daily schedule at 1400 the day prior) or when determined by the aircrew, whichever occurs first. All cancellations, mission deletions or changes should be reported promptly to Center Scheduling to allow maximum opportunity to coordinate and reschedule resources. Center Scheduling/Maintenance Operations Center will provide a summary of the previous week's cancellations at the weekly OG/LG scheduling meeting.

4.8. Mission Deletion. A mission deletion is any mission deleted prior to 1300 Wednesday, the week prior. Mission deletions will not be accepted after 1300 Wednesday.

4.9. Reimbursement Policy for Schedule Cancellations. Funding provisions for cancellations are contained in DODD 3200.11, Major Range and Test Facility Base (MRTFB); and AFFTCI 65-5, Reimbursement Policy. In general, they provide for charging to the project those costs associated with test and test support mission cancellations. These charges may include the ongoing costs of assets and people standing idle as a result of cancellations. Reimbursable support may include incremental contractor costs, support aircraft preparation costs, and charges for other assets tied up the day before the scheduled mission in preparation for the mission. Liability could extend to the full cost of non-expendables for the canceled mission depending upon when the mission is canceled and the extent of assets tied up.
4.9.1. In general, if a cancellation is caused by a decision made by the test requester, or the non-availability of a resource provided by the test requester, the test is charged for the mission costs. Conversely, if the test mission was

canceled because of a decision made by someone other than the requester, or if resources were not available, the Test Wing will absorb the cost.

4.9.1.1. The Cost Recovery Decision Chart (CRDC) at Attachment 2 will be used to establish who will pay for the mission cancellation. Sympathetic cancellations will be given the same CRDC code as the mission causing the cancellation.

4.9.1.2. Users may be liable for costs incurred for test/test support mission cancellations and aborts after 1200 the workday prior to the scheduled mission.

4.9.2. The liability will not usually exceed the direct costs incurred except for special purpose facilities scheduled in advance for a specific period. In this case, liability may also include lost reimbursements, unless the test and evaluation activity is able to schedule a substitute workload. Contractor-owned/maintained aircraft will not normally be assessed preparation cancellation charges which are rescheduled and flown within 3 hours of the original mission takeoff time will not incur an preparation cancellation charge. However, this may not necessarily apply to range asset charges. Specific cancellation charges are listed in the AFFTC PIN Rate Catalog.

4.9.3. On the next workday following each test or test support mission cancellation (Mission Symbols 0-4, 0-5, and 0-6 reimbursable), Center Scheduling will ascertain the primary reason for the cancellation and assign a cancellation code from the Cost Recovery Decision Chart. Range Scheduling will determine which primary range assets were affected by each cancellation. A test mission cancellation report will be generated daily to record each determination, and to charge for cancellation costs that have been incurred by the test project. After 0900 on the second workday following the mission, users may review applicable portions of a report on ESS. Any disputed reasons for cancellation that cannot be resolved by 412 OSS/OSCS or 412 TW/TSRO will be referred to 412 OG/CC. Cancellation reports from the previous week will be transferred on Wednesdays to 412 LSS/LGLXXR and 412 TW/TSRB who will process applicable cancellation charges.

4.10. Classified Mission Scheduling.

4.10.1. Forecast (Weekly) Schedule. Classified missions will be requested IAW paragraph 2.1.1.3. Center Scheduling will distribute requests to Maintenance Wing Scheduling (412 LSS/LGLOS) who will further disseminate requests to applicable offices and assign support based on current priorities. Center Scheduling will provide the proposed classified schedule to the OG and LG during the Weekly OG/LG scheduling meeting.

4.10.2. Daily Schedule/Realtime Operations. All telephonic coordination on the classified schedule will be accomplished by secure means. Between 0700-1000 on the workday prior to the scheduled operation, the requesting user will call Center Scheduling to confirm or make necessary changes to the scheduled mission. Center Scheduling will then:

4.10.2.1. Coordinate changes with the supporting organization(s).

4.10.2.2. Inform base operations and the control tower of any takeoff or landing during non-duty hours.

4.10.2.3. Utilizing STU-III telephones, coordinate the classified schedule with the Command Post. The Command Post controller will brief the applicable Supervisor of Flying.

4.10.2.4. Perform Realtime flight following.

4.10.3. Airspace Briefing. The Range Control Officer for classified missions will provide a face-to-face briefing to the Central Coordinating Facility (CCF) coordinator on airspace requirements for each mission. When the use of R2515 is required to support the mission, SPORT also requires a face-to-face briefing. Following the briefing, the RCO will notify Current Operations of the mission's assigned mission number using secure means. From that time until termination of the mission, Current Operations will relay to CCF, and SPORT if R2515 airspace is required, all changes affecting airspace or call signs.

4.11. Off-base aircraft. All off-base aircraft requesting the use of R2515 will be inputted into the ESS. This will allow a more accurate count of aircraft that utilized the airspace.

5. CENTER SCHEDULING OPERATIONS:

5.1. Forecast (Weekly) Schedule Operations. Weekly schedule timelines are summarized at Attachment 3.

5.1.1. Initial Input. The initial input to the flying schedule is accomplished by users at the squadrons or agencies needing AFFTC resources. Their schedules can be submitted on AFFTC Form 5016 or entered into ESS terminals as far in advance as they choose, but the usual guideline is 2 weeks prior to the forecast week. Requests will be submitted IAW timelines established in paragraph 2.1.1.1/2/3. Users may not enter changes after those times.

5.1.2. Preliminary Weekly Schedule. The preliminary weekly schedule will be available to Center Scheduling, Range Scheduling, and Maintenance Wing Scheduling by 0800 Tuesday prior to the forecast week. At 0830 Wednesday, Range Scheduling, Center Scheduling, Maintenance Wing Scheduling and selected squadron representatives will meet face-to-face to deconflict and resolve OG/LG sortie plan, range, aircraft assignment, and priority issues. Center Scheduling with concurrence of Maintenance Wing Scheduling and Range Scheduling is authorized to move mission take-off times/dates to obtain necessary support. (Exceptions: Missions restricted to specific time/date must indicate this on their schedule requests in ESS under the field " Maintenance Notes."
5.1.3. Weekly Schedule. The Weekly Schedule will be completed by 1300 on Wednesday prior to the forecast week.
5.1.4. Weekly Scheduling Meeting. The weekly OG/LG scheduling meeting will convene each Thursday at 1300 to review and approve the weekly schedule, to review the previous week's accomplishments/deviations, and to review/approve monthly sortie requirements. Representatives from range scheduling, maintenance and all user organizations that have made requests for the following week/month WILL attend this meeting.

5.2. Daily Schedule Operations. Daily schedule timelines are summarized at Attachment 5.
5.2.1. Mission Confirmation Procedures. Missions on the printed weekly schedule must be confirmed by the requesting agency with the Daily Scheduler between 0700 and 1000 on the workday prior to the scheduled operation. Requests for add-ons, changes, and mission deletions will be accepted at this time, with priority restrictions as outlined in paragraphs 2.1.1.1, .2, and .3, respectively. Failure to accomplish confirmation may result in mission deletion. To allow adequate time for scheduling/maintenance/range to reallocate aircraft and resources prior to printing a daily schedule, no project-generated coordination will be accepted between 1000 and 1400, except for mission deletions and mission support requirement deletions, which will be accepted until 1200. Any project generated mission deletion occurring after 1200 is subject to cancellation charges as outlined in paragraph 4.9. Between 1200 and 1300 cancels and deletions may be made to the schedule but are subject to cancellation charges.
5.2.2. Situation Code Mission Recap. Each operation duty officer or their designated representative will review the Operations Group Mission Recap web page no later than 1000 the day after the mission, for accuracy and acceptance of situation/deviation codes. All situation codes are also distributed each day by Maintenance Operations Center through the E-mail system to each squadron/TPS, in case of network failures or computer problems. All situation codes are assumed acceptable at 1000, for the previous day's data.
5.2.3. Mission Utilization Recap. Logistics Test Flights (LTFs) will provide a daily mission utilization recap sheet to Maintenance Wing Scheduling NLT 1000 the day following the mission, which has been reviewed/approved by LTF/CTF. CTF/LTF operations and maintenance representatives will deconflict ESS and CAMS prior to submitting recaps to Maintenance Wing Scheduling.
5.2.4. Add-ons, cancels, changes from CTFs/TPS to Current Operations resumes at 1400, after receiving approval of parent CTF Top 3. Test support aircraft released/canceled may be added after approval by parent CTF Top 3. Changes or add-ons, which would add tail numbers, not previously planned for that day, require parent CTF Top 3, 412 OG/CC, and 412 LG/CC approval. Furthermore, these add-ons must be in support of a test mission, approved ground test operation or a reimbursable sortie. All add-ons receive a 99 priority. Cancels/resource deletions are subject to cancellation charges. Current Operations will pass all add-ons to the 412 Range Division ODO. The ODO will pass all add-ons to SPORT.
5.2.5. Daily Scheduler Coordination Procedures.
5.2.5.1. 1000-1200. The Daily Scheduler will coordinate the next day's missions with Maintenance Wing Scheduling, Range Scheduling and other agencies. Missions in N/A or Standby status will be reaffirmed by 1400 and passed to users.
5.2.5.2. 1400. The Daily schedule will be printed and transferred to Current Operations (Realtime Scheduling), the day prior. Users will input call signs into ESS NLT 1600. Maintenance Wing Scheduling will transfer the daily schedule to maintenance supervisors at 1400 the day prior.
5.2.5.3. After 1600 no add-ons to the next day's schedule will be accepted by Current Operations. No major configuration changes may be made including tanks, weapons, fuel loads, etc. Maintenance Operations Center will determine what constitutes a major configuration change. Cancellations will be accepted at any time.
5.2.5.4. After 1600 no major range changes will be accepted by Current Operations. Range Scheduling will determine what constitutes a major range change.

5.3. Current Operations:

5.3.1. Realtime Operations. Current Operations is responsible for coordinating realtime changes to the daily schedule. Current Ops will be the central point for notification of any and all changes to missions or resources affecting the conduct and on-time completion of missions.

5.3.2. CONFORM. Current Operations, using the radio call sign CONFORM on 304.0 MHz, provides flight following and is manned from 0600-1700, Monday through Friday and on an as-needed basis. When Current Operations is unmanned, the Command Post will assume flight following and other limited services.

6. MONTHLY SORTIE PLAN REQUIREMENTS: The ability of maintenance to meet operational requirements is accomplished through negotiated schedules. Monthly planning specifies broad objectives for flights in terms of sortie/flying hours and known or predictable maintenance needs. Monthly planning will be developed utilizing the Test Wing Yearly Flying Program information.

7. **FORM PRESCRIBED:** AFFTC Form 5016, **Weekly Aircraft and Air/Ground Support Requirements Schedule**

8. **FORM UTILIZED:** AFMC Form 244, **Class II Modification Configuration Control Board Directive**

OFFICIAL

RICHARD V. R[illegible]DS, Brigadier General, USAF
Commander

6 Attachments
1. AFFTC Form 5016
2. Cost Recovery Decision Chart
3. Weekly Scheduling Process/Timelines
4. Daily Scheduling Process/Timelines
5. Situation Code Listing
6. Abbreviations and Acronyms Listing

Attachment 1

Instructions for Preparation of AFFTC Form 5016, Weekly Aircraft and Air/Ground Support Requirement Schedule (Expanded Schedule).

1. Form will be typed. Each mission must be requested on separate form.

2. Header Data:
   a. OPS NO. Leave blank. This will be assigned by the computer.
   b. MRS No. Four digit number representing a model of the mission on file in the computer. If no model has been established, leave blank. This form may be used to establish a model and the assignment of MRS number.
   c. JON/PRI. Enter Job Order Number and priority.
   d. DUR. Enter mission duration
   e. TIME/DATE. Enter start time and date of mission
   f. ALT. Enter mission altitude. Example: "0 to 30K"
   g. MSN Title. Enter short title from Job Control Register. Hazard test will be identified in block letters above the mission title with the control number from the AFFTC Form 5028. Example: Hazardous Test 72-89
   h. Remarks. Enter other information

3. Aircraft Data
   a. Code. Enter aircraft resource code
   b. TMS. Enter aircraft type, model, series
   c. ETD. Estimated time of departure. If date is different than Header date, enter date
   d. ETE. Estimated time enroute
   e. Fuel. Enter fuel load. Example: "full/TKS"
   f. Brief/LOC. Enter mission brief time and location. If date is different than Header date, enter date. Example: 17/0800/1881
   g. POS. Enter position such as A for primary aircraft and B, C, etc., for second and third aircraft
   h. T.O. location. Enter three letter symbol for aircraft take off location. If EAFB - leave blank
   i. A/S. Enter aircraft airspeed. Example: ".4 - .9"
   j. Call sign. Enter first two letters and the pilot's assigned number. Example: For RICK 20 enter RI-20
   k. MSN Title. Enter title if different than Header title. Enter mission title of chase aircraft.

4. Resource Data
   a. Code: Enter resource code from resource file
   b. Mult. Enter the number of like resource code required
   c. Name resource code title. Example: "FPS16"
   d. Meet User. This is the time the resource support is required. Leave blank if the time is the same as Header time. This will be minutes plus or minus Header time.
   e. Support Time. Leave blank if same as Header duration. Enter support duration in minutes.

AFFFTC Form 5016, Jul 98 (Reverse)

Attachment 2

COST RECOVERY DECISION CHART

CODE	DESCRIPTION	DEFINITION
AFFTC Absorbs Cost if Mission is Canceled for –		
A1	Weather	Adverse weather on or off-station
A2	Range	On or off-site range resources (e.g., range, radar, control room, telemetry frequency, microwave relay, etc.) not available, malfunctioning, or otherwise unable to support mission.
A3	Operations	Support aircrew/aircraft not available, higher priority mission (HPM), quite hours, static display, airfield closure, etc.
A4	Supply	Parts provided by Air force supply system not available.
A5		Special Instrumentation Failure of required special instrumentation (SI) internal or external to the aircraft.
A6	Maintenance	Aircraft system/test item malfunction on EH-coded aircraft.
Test User Pays if Canceled for –		
B1	Project	Test requirements change, aircraft reconfiguration, test completed, data study/reduction, safety coordination not complete, software malfunction for software test, etc.
B2	Modification	Aircraft/SI modification not complete.
B3	Operations	Test project aircrew not available, project scheduling decision, etc.
B4	Supply	Project test item not available (e.g. test engine, project pod, etc.)
B5 project-	Special Instrumentation	E.g., project history files not current, owned diagnostic pods inoperative, etc.
B6	Maintenance	Aircraft system/test item malfunction on other (Project/Contractor) than EH-coded aircraft

Attachment 3

WEEKLY SCHEDULING PROCESS/TIMELINES

MONDAY

1200
-Users w/out ESS must submit requirements on AFFTC 5016

TUESDAY

By 0800
-Users with ESS will submit requests.
-Classified requests will also be made to receive full AFFTC priority.
-Prioritized requirements available to Center Scheduling, Range Scheduling, and Wing Scheduling (PS&D).

NOTE: Only reimbursable missions will be flown on weekends/holidays. Furthermore, aircraft returning from off station on Sunday/holidays will not be scheduled the following day. Exceptions require LG/CC and OG/CC approval.

0900
-Users will submit Inter-range Support Requests.

WEDNESDAY

0830
-Range Scheduling, Center Scheduling, Wing Scheduling, and CTF representatives meet face-to-face to de-conflict and resolve OG/LG sortie plan, range, aircraft assignment and priority issues.

-Center Scheduling, with concurrence of Wing Scheduling (PS&D), and Range Scheduling, is authorized to move missions as necessary to obtain support. (Exceptions: Missions restricted to specific time/date must indicate this on their schedule requests in maintenance notes.)

- No cancels/changes after 1300 Wednesday to 0700 Friday. Cancel/changes after 0700 Friday will be considered day prior.

NOTE: SCHEDULE ADDS OR PROJECT-GENERATED CHANGES WILL NOT BE ACCEPTED AT THE 0830 MEETING.

1300
-Weekly inputs ready for user review.

THURSDAY

1300
- OG/LG weekly meeting with users.
--OG/LG Sortie Plan reviewed for next week*.

*All attempts should be made to project the next week's weekend flying in the weekly process. Requests after this time fall under the day-prior process and will require CTF Top 3, OG, and LG approval.

NOTE: NO PROJECT GENERATED ADD-ONS OR CHANGES ACCEPTED AT THE OG/LG WEEKLY MEETING.

Attachment 3 (con't)

1630
-Input from scheduling meeting complete.
-Reports generated.
-Major changes that will affect other units already scheduled in the weekly process receive a 99 priority. Moreover, all adds receive a 99 priority.

FRIDAY

0700
-Weekly schedule moves to daily.
- Daily scheduling process begins.

Attachment 4

SCHEDULING DAILY PROCESS RECAP

(DAY PRIOR)

0700-1000
- CTF/TPS changes/add-ons accepted by Center Scheduling.
- Changes/Add-ons that do not impact the weekly schedule receive a priority 99.

(NO ADDS ACCEPTED 1000-1400.)

1000-1200
- 1030 - Coordination process takes place between Center and Range Scheduling.
- 1030-1130 - Wing Scheduling (PS&D) and parent CTFs coordinate.
- 1130-1200 - Coordination process takes places between Center Scheduling and Wing Scheduling (PS&D).
- Resources are reallocated.

NLT 1200
- Last chance to cancel missions and delete resources without incurring cancellation charges. No project generated changes accepted until 14:00.

1200
- Cost Recovery/Cancellation Charge Process begins.

1200-1300
- Center Scheduling pre-coordinates with TPS to see if they can use canceled sorties.
- Cancels/Deletions accepted. (Subject to cancellation charges.)

1300-1330
- **Final coordination occurs with CTFs and TPS.**

1400
- Schedule moves to Maintenance Operations Center (MOC) and Current Operations and assumes Realtime (day of) status.
- Add-ons, cancels, changes from CTFs/TPS to Current Operations resumes after approval by CTF Top 3*. Test support aircraft released/canceled may be added after approved by CTF Top 3. Changes or add-ons, which would add tail numbers, not previously planned for that day, require CTF Top 3, OG and LG approval. The Maintenance Officer or Maintenance Superintendent will notify MOC of their approval. Furthermore, these add-ons must be in support of a test mission or an approved ground test operation, or a proficiency sortie with a reimbursable JON. (Add-ons receive a 99 priority. Cancels/deletes are subject to cancellation charges.)

*CTF TOP 3 DEFINED AS: MAINTENANCE OFFICER, OPERATIONS OFFICER AND SQUADRON COMMANDER (OR THEIR DESIGNEES.)

1400-1500
- No changes from Current Operations accepted by MOC.

1500
- Electronic (useable) schedule sent to Logistics Test Flights (LTFs) and OG users.
- Coordination between Current Operations and MOC resumes.

Attachment 4 (Cont)

1600

- NO ADD-ONS TO THE NEXT DAY'S SCHEDULE ACCEPTED UNTIL 0700 THE FOLLOWING DAY. HOWEVER, CANCELS WILL BE ACCEPTED AT ANYTIME. NO MAJOR CONFIGURATION CHANGES. (MAJOR CONFIGURATION CHANGE INCLUDES TANKS, WEAPONS, FUEL LOADS, ETC.) MOC WILL DETERMINE WHAT CONSTITUTES A MAJOR CONFIGURATION CHANGE.

- NO MAJOR RANGE CHANGES ACCEPTED FROM CTFs/TPS. RANGE SCHEDULING WILL DETERMINE WHAT CONSTITUTES A MAJOR RANGE CHANGE.

Attachment 5 **SITUATION CODE LISTING**

LVL-1	SITUATION CODES	DEFINITION
AA	AIR ABORT	Non Completion of Mission After Takeoff, Any Reason
AD	ADD	Any Mission Added After Weekly Cut-Off Including Add/Cx Due to 3-Hr Rule
CF	CONFIGURATION CHANGE	Any Major Aircraft Capability Change
CR	CREW READY	Any Occurrence of Aircraft Not Being Available to OPS Within Prescribed Time Prior To Takeoff For MDS
CX	CANCEL	Cancellation of Mission
ET	EARLY TAKEOFF	Aircraft Which Departs More Than 30 Minutes Prior To Scheduled Takeoff Time On Daily Schedule
FE	IN FLIGHT EMERGENCY	In Flight Emergency
GA	GROUND ABORT	Non-Completion of Mission After Acceptance/Release to Aircrew
LL	LATE LANDING	Any Aircraft Which Lands More Than 30 Minutes From Published Time Of Arrival On Daily Schedule
LT	LATE TAKEOFF	Any Aircraft Which Departs More Than 30 Minutes From Published Time Of Departure On Daily Schedule
MC	MISSION CHANGE	Other than 3 hour time change and JON change - R-NR
NA	NOT AVAILABLE	Lack of Resources To Fill Mission Request
NE	NOT EFFECTIVE	Mission Not Effective As Determined By Aircraft Commander
NS	NOT SCHEDULED	No Requirement For Resource
TS	TAIL NUMBER SWAP	Change of Aircraft For Mission As Published On Daily Schedule

LVL-2		RESPONSIBLE ORG/CATEGORY
00	NO REQUIREMENT	No Requirement Scheduled
01	MAINTENANCE	Maintenance - Including Air Force and Contractor
02	SUPPLY	Supply - Including MICAP
03	OPERATIONS	Associated with Aircrew
04	PROJECT	CTF/Project Related
05	SPECIAL INSTR	SI - External to Aircraft System
06	RANGE	Range - Local or Off-Base
07	WEATHER	Weather - On or Off Station
08	MODIFICATION	Any Modification to Aircraft/Aircraft Sub-System
09	HIGHER HDQUARTERS	Higher Headquarters - Above AFFTC Command
10	AIR TRAFFIC CONTROL	Airspace or Airfield
11	OTHER	All Situation/Deviation Codes That do not fit Specific Categories
12	CONTRACTOR	Contractor Maintained

Attachment 5 (con't)

LVL 2	LVL 3	DESCRIPTION - ALL LEVEL THREE CODES MAY BE USED WITH ANY LEVEL 2 ORG
00	**000**	NO REQUIREMENT
01 / 02	**03X**	INSPECTION
01 / 02	**04L**	LOGISTIC TEST
01 / 02	**04G**	GROUND TEST
01 / 02	**04S**	STATIC DISPLAY
01 / 02	**04M**	MODIFICATION TEST
01 / 02	**11X**	STRUCTURAL SYSTEMS
01 / 02	**12X**	EQUIPMENT/FURNISHINGS
01 / 02	**13X**	LANDING GEAR SYSTEMS
01 / 02	**14X**	FLIGHT CONTROL SYSTEMS
01 / 02	**15X**	ARIA SPECIFIC AIRFRAME
01 / 02	**16X**	CREW ESCAPE
01 / 02	**19X**	ENGINE STARTING SYSTEMS
01 / 02	**22X**	TURBOPROP POWERPLANT
01 / 02	**23X**	PROPULSION SYSTEM
01 / 02	**24X**	AUX POWER SYSTEMS
01 / 02	**26X**	ROTARY WING DRIVE SYSTEM
01 / 02	**27X**	GEAR BOX ASSY
01 / 02	**32X**	HYDRAULIC PROP SYSTEM
01 / 02	**39X**	ICE/RAIN PROTECTION
01 / 02	**41X**	ECS - ENVIRONMENTAL CONTROL SYS
01 / 02	**42X**	ELECTRICAL POWER SYSTEMS
01 / 02	**44X**	LIGHTING SYSTEMS
01 / 02	**45X**	HYDRAULIC AND PNEUMATIC SYSTEMS
01 / 02	**46X**	FUEL SYSTEMS
01 / 02	**47X**	OXYGEN SYSTEM
01 / 02	**48X**	INDICATING & RECORDING SYSTEMS
01 / 02	**49X**	FIRE PROTECTION SYSTEMS
01 / 02	**51X**	FLIGHT INSTRUMENTS
01 / 02	**52X**	AUTOPILOT SYSTEMS
01 / 02	**54X**	ARIA RF SYSTEM
01 / 02	**55X**	MALFCT ANLYS R
01 / 02	**56X**	ALL WEATHER LANDING SYSTEM
01 / 02	**57X**	INTERACTIVE GUIDANCE & CONTROL SYSTEM
01 / 02	**59X**	CREW COMMUNICATIONS SYSTEMS
01 / 02	**60X**	AIRBORNE COMMUNICATIONS SYSTEMS
01 / 02	**61X**	HF COMMUNICATION
01 / 02	**62X**	VHF COMMUNICATION
01 / 02	**63X**	UHF COMMUNICATION
01 / 02	**64X**	INTERPHONE SYSTEMS
01 / 02	**65X**	IFF SYSTEM
01 / 02	**66X**	EMERGENCY COMMUNICATION SYSTEM
01 / 02	**68X**	SATELLITE COMMUNICATION SYSTEM
01 / 02	**69X**	COMMUNICATIONS SYSTEMS
01 / 02	**71X**	RADIO NAVIGATION
01 / 02	**72X**	RADAR SYSTEMS
01 / 02	**73X**	NAVIGATION SYSTEMS
01 / 02	**74X**	FIRE CONTROL SYSTEMS

Attachment 5 (con't)

LVL 2	LVL 3	DESCRIPTION - ALL LEVEL THREE CODES MAY BE USED WITH ANY LEVEL 2 ORG
01 / 02	75X	WEAPONS SYSTEMS
01 / 02	76X	ELECTRONIC WARFARE SYSTEMS
01 / 02	77X	PHOTOGRAPHIC EQUIP
01 / 02	79X	GLOBAL POSITIONING SYSTEM
01 / 02	82X	COMPUTER AND DATA SYSTEMS
01 / 02	89X	AIRBORNE COMMAND & CONTROL SYSTEMS
01 / 02	90X	ANTENNA SECTION
01 / 02	91X	EMERGENCY EQUIPMENT
01 / 02	92X	TOW TARGET EQUIPMENT
01 / 02	93X	DRAG CHUTE EQUIPMENT
01 / 02	95X	SMOKE GENERATOR SCR
01 / 02	96X	PERSONNEL EQUIPMENT
01 / 02	98A	ATMOSPHERIC RESEARCH EQUIPMENT
01 / 02	98X	LOW OBSERVABLE EQUIPMENT
01 / 02	99X	SPECIAL MOD/INST SYSTEMS
01 / 02	ALT	ALERT DUTY
01 / 02	SPR	SPARE
LVL 2	**LVL 3**	**DESCRIPTION**
01 / 02	CMP	TIME OFF
01 / 02	DTL	DETAIL - SQUADRON OR BASE
01 / 02	PDM	DEPOT MAINTENANCE
01 / 02	FCF	ACFT AWAITING FUNCTIONAL/OPERATIONAL CHECK FLIGHT
01 / 02	FOD	FOREIGN OBJECT
01 / 02	LCR	LATE CREW READY
01 / 02	LVE	LEAVE
01 / 02	DFO	DROPPED FOREIGN OBJECT
01 / 02	MXC	MAINTENANCE CONVENIENCE
01 / 02	NAA	NO AIRCRAFT AVAILABLE - UNDER CONTRACT
01 / 02	NLR	NO LONGER REQUIRED
01 / 02	NTT	NOT ENOUGH TURN TIME
01 / 02	OTC	OVER TAIL NUMBER COMMITMENT
01 / 02	OTH	OTHER
01 / 02	POL	FUEL TRUCKS
01 / 02	SCM	SCHEDULED MAINTENANCE
01 / 02	SYM	SYMPATHY
01 / 02	TRN	MAINTENANCE TRAINING
01 / 02	USM	UNSCHEDULED MAINTENANCE
01 / 02	UTC	UNDER TAIL NUMBER COMMITMENT
01 / 02	DIS	(-6) INSPECTON
03	O01	AIRCREW AVAILABILITY
03	O02	
03	O03	SCHEDULING ERRORS
03	O04	AIRCREW LATE STEP
03	O05	AIRCREW DNIF
03	O07	CREW REST
03	O08	HIGHER PRIORITY MISSION
03	O09	AIRCREW ERROR

03	**O10**	STUDENT AVIALABILITY
03	**O11**	AIRCREW CURENCY/QUALIFICATION
04	**P01**	TEST REQUIREMENT CHANGE
04	**P02**	AIRCRAFT CONFIGURATION
04	**P03**	PROJECT SOFTWARE MALF
04	**P04**	TEST COMPLETED
04	**P05**	DATA STUDY/REDUCTION/REVIEW
04	**P06**	SAFETY COORDINATION/PACKAGE NOT COMPLETE
04	**P07**	
04	**P08**	TEST ITEM AVAILABILITY
04	**P09**	SPECIAL INSTRUMENTATION
04	**P10**	SUPPORT AIRCRAFT AVAILABILITY
04	**P11**	PROJECT PERSONNEL AVAILABILITY
04	**P12**	JON CHANGE
04	**P13**	MAIMUM AIRCRAFT CAPABILITY
04	**P14**	CTF DOWN DAY
04	**P15**	CONTINUATION OF PREVIOUS MSN
04	**P16**	TEST AIRCRAFT AVAILABILITY
04	**P17**	EXTERNAL CUSTOMER
04	**PNR**	PROJECT NOT RELEASED
04	**OBR**	OFF BASE RANGE
05	**SI1**	TELEMETRY MALFUNCTION
05	**SI2**	CALIBRATION
05	**SI3**	EXTERNAL EQUIPMENT
05	**SI4**	NO RESOURCES
06	**ACQ**	ACQGEN
06	**ADP**	ADAPS
06	**ANT**	TELEMETRY ANTENNA
06	**COM**	COMMUNICATIONS SWITCH
06	**DAT**	WEST DATS/SAT DATS
06	**DFL**	DOWNFALL
06	**DLS**	GPS DATALINK SYSTEM
06	**GRR**	GPS REFERENCE RECEIVER
06	**IFD**	IFDAPS
LVL2	**LVL3**	**DESCRIPTION**
06	**LAN**	CINE-T (CONTRAVES)
06	**LTE**	DISTRIBUTION SWITCH
06	**MAP**	MANPOWER
06	**MCR**	MISSION CONTROL ROOM
06	**MER**	MERCURY BOULEVARD
06	**MSC**	MASSCOMP
06	**PAD**	DPAD
06	**PBL**	PIBALL
06	**POD**	ARDS POD
06	**RDR**	RADAR (FPS-16)
06	**REC**	RECOVERY
06	**RNG**	PIRA
06	**SCR**	STRIP CHARTS
06	**TEC**	TECCS
06	**TOL**	TAKE OFF & LANDING TOWERS

06	**TRK**	TRACKER
06	**TRP**	GPS TSPI PROCESSING
06	**VAN**	TELEMETRY VAN/RIDLEY MOBILE
06	**VBS**	VIDEO BOMB SCORING
07	**WXE**	EN ROUTE / DESTINATION WEATHER
07	**WXL**	LIGHTNING
07	**WXN**	NO WEATHER
07	**WXP**	PREVIOUS WEATHER
07	**WXR**	PRECIPITATION
07	**WXT**	TEMPERATURE
07	**WXV**	VISIBILITY
07	**WXW**	WINDS
08	**MDC**	MODIFICATION CCB
08	**MDD**	MODIFICATION DOCUMENTATION
08	**MDM**	MODIFICAITON MAINTENANCE
08	**MDP**	MODIFICATION PROJECT
08	**MDR**	MODIFICATION RESOURCE AVAILABILITY
08	**MDS**	MODIFICATION SAFETY
08	**MDY**	MODIFICATION SUPPLY
09	**HH1**	SPECIAL INSPECTION
09	**HH2**	INCENTIVE
09	**HH3**	EXERCISES
09	**HH4**	VIP
10	**ATA**	AIRSPACE
10	**ATF**	AIRFIELD
10	**ATS**	SHUTTLE
11	**AFF**	AIRCRAFT FERRY FLIGHT

Attachment 6

A.6.1. Abbreviations and Acronyms

AFFTC	Air Force Flight Test Center
AOF	Airfield Operations Flight
CCF	Central Coordinating Facility
CONFORM	Call Sign Current Operations/Command Post
CTF	Combined Test Force
DAGRAG	Dual Air-to-Ground Range
DATS	Data Acquisition and Transmission Service
DPA	Data Producing Analysis
ESS	Edwards Scheduling System
ETA	Estimated Time of Arrival
FCF	Functional Check Flight
GTO	Ground Test Operations
IAW	In Accordance With
JON	Job Order Number
LTF	Logistics Test Flight
MOA	Military Operations Area
MOC	Maintenance Operations Center
MUTES/MOTES	Electronic Counter Measure and Avionics Functional Check Facility
N/A	Not Available Aircraft
NLT	No Later Than
ODO	Operations Duty Officer
PIN	Product Identification Number
PIRA	Precision Impact Area
RADFAG	Radar Fidelity and Geometric
RCF	Radar Control Facility
RCO	Range Control Officer
RSO	Range Safety Officer
RSR	Range Support Release
RTB	Return to Base
SB	Standby
SPORT	Callsign AFFTC Radar Control Facility
SUA	Special Use Airspace
SWIS	Stores, Weight and Inertia System
TPS	United States Air Force Test Pilot School
TRACON	Terminal Radar Approach Control

TAB CC

INDEX

GLOBAL HAWK
FLIGHT TEST SUMMARY
MISSION PL-3
FLIGHT 2-09
29 March 1999

TEST OBJECTIVES :

Sensor Payload System Objectives: Verify SAR fixes and CAMA LSM card changes correct sensor and data link deficiencies, respectively, noted during flight 2-08

- Green Flag-ready sensor performance determination
  SAR Spot/WAS image quality
- SAR performance in WAS and Spot mode.
- EO performance in WAS and Spot modes.
- IR performance in WAS and Spot modes.
- Imagery, health and status, sensor payload command, Ku SATCOM & CDL LOS communications system performance.
- Evaluation of imagery quality, quantity and processing capability of the entire Global Hawk Imagery collection system.

General:

- Continue functional checkout of all aircraft systems through initial cruise altitudes.
- LRE command and control RF data link; UHF LOS (primary), UHF SATCOM (secondary), and CDL via remote link at EAFB (tertiary).
- MCE command and control RF data link; Ku SATCOM (primary), UHF SATCOM (secondary), and CDL (tertiary)
- UAV response to non-critical CCO commands from LRE and MCE.
- Demonstrate ATC voice link, Ku SATCOM (primary) and UHF SATCOM (secondary).
- "C" and "S" band telemetered data quality evaluation.
- Evaluate Ku pointing and link quality via imagery data from the UAV.
- Evaluate AFMSS mission plan's ability to accommodate sensor tasking.
- Evaluate CDL pointing and link quality via imagery data from the UAV using a CDL station co-located with the MCE; and link quality via a remote link to the LRE (if available).
- Demonstrate LRE/MCE hand-off procedures.
- Demonstrate multi-band width switching capability.
- LRE/MCE/UAV state identification and health status monitoring.
- LRE/MCE flight crew situation awareness and crew coordination.

TEST ARTICLE CONFIGURATION

Aircraft: UAV 95-2002
Gross weight: 21,616 lbs (engine start)
C.G.: 30.5% mac
Fuel load: 9,631 lbs

Deviations from Dwg 3671000A100-1 baseline: See Configuration Summary and Flight Release Form dated 29 Mar 99.

Software configuration: Global Hawk UAV, 95-2002, 19990329

Air Vehicle

IMMC:	6.3.1.3
VTC	1.141/1.140
TDMC	1.14
FADEC	A307H05A
Flight Test CSV	CF02005A
Mission plan	PALOD8A_01

LRE:

Software baseline:	3.11N_11/3.11M_11
UHF LOS:	381.175 Mhz.
UHF SATCOM	308.050 Mhz up/267.050 mhz down/267.050 mhz order wire
DGPS:	113.95 Mhz.

TEST SUMMARY :

Take-off was delayed from 0800 until 0954 (PST) due to LN-100 real-time parameter display problems and Mission Control Room data system re-boot. Take-off was made from South Base runway 06 under UHF LOS control , which was much improved over flight 2-08. The UHF SATCOM link was also improved. ISS DC and AC power were applied as briefed. Climb-out to orbit 'A' was initiated with a good turn-short at waypoint #14. Satisfactory CDL checks were accomplished between waypoints #13 and #14. Both LN211s were disabled before waypoint #14 due to excessive cross-track error and degraded nav quality. ISS boot-up and control hand-off to the MCE were accomplished prior to the turn start at waypoint #15. The air vehicle was climbing through FL410 as it entered the turn. During the turn (1010 local) the MCE CCO reported momentary 'FTS red' faults and MCC observers noticed intermittent 'arm/terminate' indications. Approximately 45 seconds after the CCO call, the chase pilot called the air vehicle rolling inverted, concurrent with MCC indications the vehicle was responding to a 'vehicle terminate' command. Neither LRE, MCE nor EAFB Range Safety had initiated such a command.

MCC real-time data and LRE/MCE all indicated the air vehicle was responding with the expected terminate sequence:

Engine shut-down
Spoilers Deployed
Flight controls commanded and held full right aileron

The vehicle, as described by the chase and from the nose video, transitioned from the roll inverted into a right vertical roll. Initial turns were nose-low with fuel observed streaming from both outer wing panels. Midway during the descent the fuel streaming ceased. The air vehicle remained intact throughout the descent. Pitch attitude gradually decreased to approximately 45° nose low at impact

The air vehicle impacted approximately 35 Nmi. NE of Edwards AFB, south of Searles Dry Lake, on the Naval Weapons Center 'Echo' Range at 1014 hrs. local. The wreckage was contained within an area approximately one wing span in diameter and there was no post-impact fire. An interim investigation board was immediately formed with a final report expected by the end of April, 1999.

Objective Met: CAMA fix verified. No other objectives were met.

Discrepancies: Vehicle was a total loss.

Global Hawk UAV, 95-2002, 19990329

United States Air Force

Air Force Flight Test Center, Edwards AFB, Calif., 93524, (661) 277-4127

NEWS RELEASE

Release 990303
March 29, 1999

FOR IMMEDIATE RELEASE

FOR MORE INFORMATION CONTACT
John Haire at 661-277-4127

UAV ACCIDENT

EDWARDS AIR FORCE BASE, CALIF.- - A Global Hawk Uninhabited Aerial Vehicle crashed today at 10:14 a.m. Pacific Standard Time South of Searles Lake, on China Lake Naval Air Station's Echo Range.

The aircraft was on an avionics developmental flight test that had originated here.

There were no injuries or property damage on the ground. The aircraft had been flying 20 minutes. The cause of the accident is not known. A board of officers will investigate the accident.

The Global Hawk is being developed by Teledyne Ryan Aeronautical in San Diego for the USAF to provide high altitude long-endurance battlefield reconnaissance imagery. When operational, Global Hawk aircraft can autonomously fly at altitudes greater than 60,000 feet and remain on station in excess of 24 hours.

Additional details will be provided as soon as they become available.

- 30 -

Global Hawk UAV, 95-2002, 19990329

3 May 99

MEMORANDUM FOR COL VIRGILIO (President AIB)

FROM: EWR/Director

1. The Nellis Test and Training Range (NTTR) has only one Command Destruct Radio (CDR). It is operated by my organization, the 412TW/EWR.

2. Sometime during the week of the 15 March 1999, the Range Management Office on NTTR was contacted about Global Hawk participating in conjunction with a training exercise during the last 2 weeks of Green Flag, 10-24 April 1999. As a rest of this request, we scheduled a ground test of our CDR link to occur on 29 Mar 99 from 17:30 Zulu to 18:45 Zulu.

3. On the date of the ground test, tone data with relevant time correlation was collected and has subsequently been authenticated and provided to your office. My POC for interpreting this data is Mr Walter Raymond. He can be reached at DSN 525-8400, extension 54370.

4. If I may be of any further assistance, please feel free to call mc and I will be more than happy to provide it. I can be reached at DSN 525-8400, extension 52400.

Anthony P. Marsh
ANTHONY P. MARSH, GM-14, DAF
Director, Electronic Warfare Range

DEPARTMENT OF THE NAVY
NAVAL AIR WARFARE CENTER WEAPONS DIVISION
1 ADMINISTRATION CIRCLE CHINA LAKE, CA 93555-6100
521 9TH STREET POINT MUGU, CA 93042-5001

IN REPLY REFER TO:

5102
52B000D/005
3 May 99

MEMORANDUM

From: Commander, Naval Air Warfare Center Weapons Division
To: President, UAV Global Hawk, Accident Investigation Board (Attn: Colonel Stephen T. Virgilio, United States Air Force), Edwards Air Force Base, CA 93523

Subj: DATA FOR GLOBAL HAWK INVESTIGATION

Ref: (a) Fax memo, President, UAV Global Hawk, Accident Investigation of 29 April 1999

1. Reference (a) requested documentation of any flight termination transmissions emitting from any Point Mugu, China Lake, and Electronic Combat Range transmitters between 1700Z and 1900Z on 29 March 1999, plus a list of test missions conducted.

2. The Frequency Management Office for the China Lake Ranges and the Point Mugu Sea Ranges checked for any use of the flight termination transmitters at all Naval Air Warfare Center Weapons Division sites immediately following the accident. The Range Offices at both sites verified that there were no emissions at 425MHz during the requested time at either China Lake or Point Mugu. No maintenance or testing was being done on the command destruct system at either site.

3. The Land Range at China Lake had the Global Hawk mission scheduled and a flight of the F/A-18 F2 in the R2508 complex. The F/A-18 flight had only telemetry frequencies of 1359.0, 1388.0, 1370.0, 2231.5, 2258.5 scheduled. The Electronic Combat Range was conducting a radar calibration test against a tethered balloon during the time period and had nine of their radars participating; however, no frequency was near the command destruct frequency. The Sea Range at Point Mugu had no operation underway during that time period.

4. Point of contact for this and any other information is Larry E. Thompson, Head, Range Safety Branch, Code 521300D. He can be reached at DSN 437-6810, or commercial (760) 939-6810.

A. K. Rogers
A. K. ROGERS
By direction

Copy to:
00A000E
520000D
52B000D
521000E

National Aeronautics and
Space Administration

Dryden Flight Research Center
P.O. Box 273
Edwards, California 93523-5000

Global Hawk UAV, 95-2002, 19990329

Reply to Attn of RF

May 3, 1999

Stephen T. Virgilio, Col, USAF
President, UAV Global Hawk Accident Investigation Board

Subject: DFRC Flight Termination Transmissions

Col. Virgilio:

This letter is written in response to the request for documentation of any flight termination transmissions emitting from any NASA Dryden Flight Research Center transmitters. There is no documentation available because there were no flight termination transmissions emitting from any NASA Dryden Flight Research Center transmitters between 17:00 and 19:00 Zulu on March 29, 1999.

Maria Tobin

Maria Tobin
Chief, FTS Office

FAX COVER SHEET

FROM: [redacted] **DATE:** April 27, 1999

NAME: Mr. Walt Raymond **OFFICE:** RDOSF **EXT:** 5-4370

TO: 805-258-5206 / Edwards AFB, CA.
(PHONE NUMBER/COMPANY/CITY/STATE)

ATTN: Colonel Steve Vergilio

MESSAGE:

As per your request, the following information is provided in support of the Global Hawk Accident Investigation. This data is true and valid. Events were collected on the morning of 29 March 99. Should you require any further information, you may contact me at Edwards ext. 5-8400 then enter 5-4370.

Walter J. Raymond

CHARLES E JULIAN
TYPED/PRINTED NAME OF RELEASING OFFICIAL

RELEASING OFFICIAL/SIGNATURE

6
NUMBER OF PAGES (INCLUDING COVER)

Digital Data Logger File 8822.TXT

Date: March 29, 1999

Time Span: 14:35:48 to 21:01:07 GMT

1999	088:14:35:48.334	Recorder Started
1999	088:14:35:48.417	Rcvr 1 Tone 1 Off
1999	088:14:35:48.417	Rcvr 1 Tone 2 Off
1999	088:14:35:48.417	Rcvr 1 Tone 3 Off
1999	088:14:35:48.417	Rcvr 1 Tone 4 Off
1999	088:14:35:48.417	Rcvr 1 Tone 5 Off
1999	088:14:35:48.417	Rcvr 1 Tone 6 Off
1999	088:14:35:48.417	Rcvr 1 Tone 7 Off
1999	088:14:35:48.417	Rcvr 1 Tone 8 Off
1999	088:14:35:48.417	Rcvr 1 Tone 9 Off
1999	088:14:35:48.417	Rcvr 1 Tone 10 Off
1999	088:14:35:48.417	Rcvr 1 Tone 11 Off
1999	088:14:35:48.417	Rcvr 1 Tone 12 Off
1999	088:14:35:48.417	Rcvr 1 Tone 13 Off
1999	088:14:35:48.417	Rcvr 1 Tone 14 Off
1999	088:14:35:48.417	Rcvr 1 Tone 15 Off
1999	088:14:35:48.417	Rcvr 1 Tone 16 Off
1999	088:14:35:48.417	Rcvr 1 Tone 17 Off
1999	088:14:35:48.417	Rcvr 1 Tone 18 Off
1999	088:14:35:48.417	Rcvr 1 Tone 19 Off
1999	088:14:35:48.417	Rcvr 1 Tone 20 Off
1999	088:14:35:48.417	Rcvr 1 Tone 21 Off
1999	088:14:35:48.417	Rcvr 2 Tone 1 Off
1999	088:14:35:48.417	Rcvr 2 Tone 2 Off
1999	088:14:35:48.417	Rcvr 2 Tone 3 Off
1999	088:14:35:48.417	Rcvr 2 Tone 4 Off
1999	088:14:35:48.417	Rcvr 2 Tone 5 Off
1999	088:14:35:48.417	Rcvr 2 Tone 6 Off
1999	088:14:35:48.417	Rcvr 2 Tone 7 Off
1999	088:14:35:48.417	Rcvr 2 Tone 8 Off
1999	088:14:35:48.417	Rcvr 2 Tone 9 Off
1999	088:14:35:48.417	Rcvr 2 Tone 10 Off
1999	088:14:35:48.417	Rcvr 2 Tone 11 Off
1999	088:14:35:48.417	Rcvr 2 Tone 12 Off
1999	088:14:35:48.417	Rcvr 2 Tone 13 Off
1999	088:14:35:48.417	Rcvr 2 Tone 14 Off
1999	088:14:35:48.417	Rcvr 2 Tone 15 Off
1999	088:14:35:48.417	Rcvr 2 Tone 16 Off
1999	088:14:35:48.417	Rcvr 2 Tone 17 Off
1999	088:14:35:48.417	Rcvr 2 Tone 18 Off
1999	088:14:35:48.417	Rcvr 2 Tone 19 Off
1999	088:14:35:48.417	Rcvr 2 Tone 20 Off
1999	088:14:35:48.417	Rcvr 2 Tone 21 Off
1999	088:14:35:48.417	Rcvr 3 Tone 1 Off
1999	088:14:35:48.417	Rcvr 3 Tone 2 Off
1999	088:14:35:48.417	Rcvr 3 Tone 3 Off
1999	088:14:35:48.417	Rcvr 3 Tone 4 Off
1999	088:14:35:48.417	Rcvr 3 Tone 5 Off
1999	088:14:35:48.417	Rcvr 3 Tone 6 Off
1999	088:14:35:48.417	Rcvr 3 Tone 7 Off
1999	088:14:35:48.417	Rcvr 3 Tone 8 Off
1999	088:14:35:48.417	Rcvr 3 Tone 9 Off
1999	088:14:35:48.417	Rcvr 3 Tone 10 Off
1999	088:14:35:48.417	Rcvr 3 Tone 11 Off
1999	088:14:35:48.417	Rcvr 3 Tone 12 Off
1999	088:14:35:48.417	Rcvr 3 Tone 13 Off
1999	088:14:35:48.417	Rcvr 3 Tone 14 Off
1999	088:14:35:48.417	Rcvr 3 Tone 15 Off
1999	088:14:35:48.417	Rcvr 3 Tone 16 Off
1999	088:14:35:48.417	Rcvr 3 Tone 17 Off
1999	088:14:35:48.417	Rcvr 3 Tone 18 Off
1999	088:14:35:48.417	Rcvr 3 Tone 19 Off
1999	088:14:35:48.417	Rcvr 3 Tone 20 Off
1999	088:14:35:48.417	Rcvr 3 Tone 21 Off
1999	088:14:35:48.417	Rcvr 4 Tone 1 Off
1999	088:14:35:48.417	Rcvr 4 Tone 2 Off
1999	088:14:35:48.417	Rcvr 4 Tone 3 Off
1999	088:14:35:48.417	Rcvr 4 Tone 4 Off
1999	088:14:35:48.417	Rcvr 4 Tone 5 Off
1999	088:14:35:48.417	Rcvr 4 Tone 6 Off
1999	088:14:35:48.417	Rcvr 4 Tone 7 Off
1999	088:14:35:48.417	Rcvr 4 Tone 8 Off
1999	088:14:35:48.417	Rcvr 4 Tone 9 Off
1999	088:14:35:48.417	Rcvr 4 Tone 10 Off
1999	088:14:35:48.417	Rcvr 4 Tone 11 Off
1999	088:14:35:48.417	Rcvr 4 Tone 12 Off
1999	088:14:35:48.417	Rcvr 4 Tone 13 Off
1999	088:14:35:48.417	Rcvr 4 Tone 14 Off
1999	088:14:35:48.417	Rcvr 4 Tone 15 Off
1999	088:14:35:48.417	Rcvr 4 Tone 16 Off
1999	088:14:35:48.417	Rcvr 4 Tone 17 Off
1999	088:14:35:48.417	Rcvr 4 Tone 18 Off
1999	088:14:35:48.417	Rcvr 4 Tone 19 Off
1999	088:14:35:48.417	Rcvr 4 Tone 20 Off
1999	088:14:35:48.417	Rcvr 4 Tone 21 Off
1999	088:14:49:15.865	Rcvr 3 Tone 21 On
1999	088:14:49:16.190	Rcvr 3 Tone 21 Off
1999	088:14:56:42.786	Rcvr 3 Tone 21 On
1999	088:14:56:43.109	Rcvr 3 Tone 21 Off
1999	088:16:21:47.550	Rcvr 3 Tone 7 On
1999	088:16:21:47.550	Rcvr 3 Tone 21 On
1999	088:16:21:48.138	Rcvr 4 Tone 7 On
1999	088:16:21:48.138	Rcvr 4 Tone 21 On
1999	088:16:21:48.674	Rcvr 3 Tone 7 Off
1999	088:16:21:48.674	Rcvr 3 Tone 21 Off
1999	088:16:21:48.674	Rcvr 4 Tone 7 Off
1999	088:16:21:48.674	Rcvr 4 Tone 21 Off
1999	088:16:21:55.206	Rcvr 3 Tone 7 On

1999 088:16:21:55.206 Rcvr 3 Tone 21 On
1999 088:16:21:55.741 Rcvr 4 Tone 7 On
1999 088:16:21:55.741 Rcvr 4 Tone 21 On
1999 088:16:21:56.323 Rcvr 3 Tone 7 Off
1999 088:16:21:56.323 Rcvr 3 Tone 21 Off
1999 088:16:21:56.323 Rcvr 4 Tone 7 Off
1999 088:16:21:56.323 Rcvr 4 Tone 21 Off
1999 088:16:35:02.559 Rcvr 3 Tone 21 On
1999 088:16:35:02.829 Rcvr 3 Tone 7 On
1999 088:16:35:02.829 Rcvr 4 Tone 7 On
1999 088:16:35:02.829 Rcvr 4 Tone 21 On
1999 088:16:35:03.671 Rcvr 3 Tone 7 Off
1999 088:16:35:03.671 Rcvr 3 Tone 21 Off
1999 088:16:35:03.671 Rcvr 4 Tone 7 Off
1999 088:16:35:03.671 Rcvr 4 Tone 21 Off
1999 088:16:35:32.629 Rcvr 3 Tone 21 On
1999 088:16:35:32.903 Rcvr 3 Tone 7 On
1999 088:16:35:32.903 Rcvr 4 Tone 7 On
1999 088:16:35:32.903 Rcvr 4 Tone 21 On
1999 088:16:35:34.771 Rcvr 4 Tone 7 Off
1999 088:16:35:35.089 Rcvr 3 Tone 7 Off
1999 088:16:35:35.089 Rcvr 3 Tone 21 Off
1999 088:16:35:35.089 Rcvr 4 Tone 21 Off
1999 088:17:42:05.153 Rcvr 3 Tone 21 On
1999 088:17:42:05.430 Rcvr 4 Tone 21 On
1999 088:17:43:35.248 Rcvr 3 Tone 21 Off
1999 088:17:43:35.524 Rcvr 4 Tone 21 Off
1999 088:17:43:41.546 Rcvr 3 Tone 7 On
1999 088:17:43:41.546 Rcvr 3 Tone 21 On
1999 088:17:43:42.134 Rcvr 4 Tone 7 On
1999 088:17:43:42.134 Rcvr 4 Tone 21 On
1999 088:17:54:26.283 Rcvr 3 Tone 7 Off
1999 088:17:54:26.283 Rcvr 4 Tone 7 Off
1999 088:17:54:26.818 Rcvr 3 Tone 7 On
1999 088:17:54:26.818 Rcvr 4 Tone 7 On
1999 088:17:55:30.298 Rcvr 4 Tone 7 Off
1999 088:17:55:32.395 Rcvr 3 Tone 7 Off
1999 088:17:55:36.730 Rcvr 3 Tone 7 On
1999 088:17:55:37.540 Rcvr 4 Tone 7 On
1999 088:17:55:52.276 Rcvr 4 Tone 7 Off
1999 088:17:55:52.544 Rcvr 3 Tone 7 Off
1999 088:17:56:36.612 Rcvr 3 Tone 21 Off
1999 088:17:56:36.883 Rcvr 3 Tone 7 On
1999 088:17:56:36.883 Rcvr 3 Tone 21 On
1999 088:17:56:36.883 Rcvr 4 Tone 7 On
1999 088:17:57:40.156 Rcvr 4 Tone 7 Off
1999 088:17:57:45.640 Rcvr 4 Tone 7 On
1999 088:18:01:34.106 Rcvr 3 Tone 7 Off
1999 088:18:01:34.106 Rcvr 4 Tone 7 Off
1999 088:18:06:14.394 Rcvr 3 Tone 7 On
1999 088:18:06:14.665 Rcvr 4 Tone 7 On
1999 088:18:07:54.004 Rcvr 4 Tone 7 Off
1999 088:18:07:54.275 Rcvr 3 Tone 7 Off
1999 088:18:07:56.870 Rcvr 3 Tone 7 On
1999 088:18:07:57.190 Rcvr 4 Tone 7 On
1999 088:18:08:18.091 Rcvr 4 Tone 7 Off
1999 088:18:08:19.618 Rcvr 3 Tone 7 Off
1999 088:18:08:33.474 Rcvr 3 Tone 7 On
1999 088:18:08:34.114 Rcvr 4 Tone 7 On
1999 088:18:10:27.535 Rcvr 3 Tone 1 On
1999 088:18:10:27.535 Rcvr 4 Tone 1 On
1999 088:18:10:54.854 Rcvr 3 Tone 7 Off
1999 088:18:10:54.854 Rcvr 4 Tone 7 Off
1999 088:18:10:55.434 Rcvr 4 Tone 2 On
1999 088:18:11:11.784 Rcvr 4 Tone 1 Off
1999 088:18:11:21.445 Rcvr 3 Tone 1 Off
1999 088:18:11:23.024 Rcvr 3 Tone 1 On
1999 088:18:11:32.054 Rcvr 4 Tone 2 Off
1999 088:18:11:32.326 Rcvr 3 Tone 7 On
1999 088:18:11:43.656 Rcvr 3 Tone 1 Off
1999 088:18:12:22.577 Rcvr 4 Tone 7 On
1999 088:18:12:34.387 Rcvr 4 Tone 7 Off
1999 088:18:12:35.615 Rcvr 3 Tone 7 Off
1999 088:18:12:54.269 Rcvr 3 Tone 7 On
1999 088:18:12:54.537 Rcvr 4 Tone 7 On
1999 088:18:15:35.595 Rcvr 3 Tone 7 Off
1999 088:18:15:35.595 Rcvr 4 Tone 7 Off
1999 088:18:15:54.635 Rcvr 3 Tone 1 On
1999 088:18:15:54.635 Rcvr 4 Tone 1 On
1999 088:18:16:09.388 Rcvr 4 Tone 1 Off
1999 088:18:16:09.678 Rcvr 3 Tone 1 Off
1999 088:18:16:24.156 Rcvr 3 Tone 1 On
1999 088:18:16:27.903 Rcvr 3 Tone 1 Off
1999 088:18:16:39.061 Rcvr 3 Tone 1 On
1999 088:18:16:41.498 Rcvr 4 Tone 1 On
1999 088:18:17:24.237 Rcvr 4 Tone 1 Off
1999 088:18:17:24.508 Rcvr 3 Tone 1 Off
1999 088:18:17:27.396 Rcvr 3 Tone 1 On
1999 088:18:17:28.020 Rcvr 4 Tone 1 On
1999 088:18:17:36.914 Rcvr 4 Tone 1 Off
1999 088:18:17:37.230 Rcvr 3 Tone 1 Off
1999 088:18:17:39.913 Rcvr 3 Tone 1 On
1999 088:18:18:03.727 Rcvr 3 Tone 1 Off
1999 088:18:18:04.042 Rcvr 3 Tone 1 On
1999 088:18:18:04.042 Rcvr 4 Tone 1 On
1999 088:18:19:57.785 Rcvr 3 Tone 1 Off
1999 088:18:19:57.785 Rcvr 4 Tone 1 Off
1999 088:18:20:13.699 Rcvr 3 Tone 1 On
1999 088:18:20:13.699 Rcvr 4 Tone 1 On
1999 088:18:21:00.525 Rcvr 4 Tone 1 Off
1999 088:18:21:01.617 Rcvr 4 Tone 1 On
1999 088:18:22:05.174 Rcvr 3 Tone 1 Off
1999 088:18:22:05.174 Rcvr 4 Tone 1 Off
1999 088:18:22:17.658 Rcvr 3 Tone 1 On
1999 088:18:22:18.243 Rcvr 4 Tone 1 On
1999 088:18:22:26.041 Rcvr 4 Tone 1 Off
1999 088:18:22:29.552 Rcvr 3 Tone 1 Off
1999 088:18:22:32.911 Rcvr 3 Tone 1 On

1999 088:18:22:33.514 Rcvr 4 Tone 1 On
1999 088:18:23:04.437 Rcvr 4 Tone 1 Off
1999 088:18:23:04.706 Rcvr 3 Tone 1 Off
1999 088:18:23:15.681 Rcvr 3 Tone 1 On
1999 088:18:23:15.681 Rcvr 4 Tone 1 On
1999 088:18:23:48.856 Rcvr 4 Tone 1 Off
1999 088:18:23:49.172 Rcvr 3 Tone 1 Off
1999 088:18:24:03.505 Rcvr 3 Tone 1 On
1999 088:18:24:09.654 Rcvr 3 Tone 1 Off
1999 088:18:24:37.730 Rcvr 3 Tone 1 On
1999 088:18:24:38.047 Rcvr 4 Tone 1 On
1999 088:18:24:58.692 Rcvr 3 Tone 1 Off
1999 088:18:24:58.692 Rcvr 4 Tone 1 Off
1999 088:18:24:59.272 Rcvr 3 Tone 1 On
1999 088:18:24:59.272 Rcvr 4 Tone 1 On
1999 088:18:25:17.628 Rcvr 3 Tone 1 Off
1999 088:18:25:17.628 Rcvr 4 Tone 1 Off
1999 088:18:25:18.208 Rcvr 3 Tone 1 On
1999 088:18:25:18.208 Rcvr 4 Tone 1 On
1999 088:18:26:20.931 Rcvr 3 Tone 1 Off
1999 088:18:26:20.931 Rcvr 4 Tone 1 Off
1999 088:18:26:21.506 Rcvr 3 Tone 1 On
1999 088:18:26:21.506 Rcvr 4 Tone 1 On
1999 088:18:27:30.503 Rcvr 3 Tone 1 Off
1999 088:18:27:30.503 Rcvr 4 Tone 1 Off
1999 088:18:27:31.078 Rcvr 3 Tone 1 On
1999 088:18:27:31.078 Rcvr 4 Tone 1 On
1999 088:18:28:09.743 Rcvr 4 Tone 2 On
1999 088:18:28:10.058 Rcvr 3 Tone 2 On
1999 088:18:28:15.855 Rcvr 3 Tone 1 Off
1999 088:18:28:15.855 Rcvr 3 Tone 2 Off
1999 088:18:28:15.855 Rcvr 4 Tone 1 Off
1999 088:18:28:15.855 Rcvr 4 Tone 2 Off
1999 088:18:28:16.436 Rcvr 3 Tone 1 On
1999 088:18:28:16.436 Rcvr 3 Tone 2 On
1999 088:18:28:16.436 Rcvr 4 Tone 1 On
1999 088:18:28:16.436 Rcvr 4 Tone 2 On
1999 088:18:28:30.455 Rcvr 3 Tone 2 Off
1999 088:18:28:30.455 Rcvr 4 Tone 2 Off
1999 088:18:28:36.683 Rcvr 3 Tone 1 Off
1999 088:18:28:36.683 Rcvr 4 Tone 1 Off
1999 088:18:28:56.559 Rcvr 3 Tone 7 On
1999 088:18:28:56.559 Rcvr 4 Tone 7 On
1999 088:18:29:14.645 Rcvr 3 Tone 7 Off
1999 088:18:29:14.645 Rcvr 4 Tone 7 Off
1999 088:18:29:15.229 Rcvr 3 Tone 7 On
1999 088:18:29:15.229 Rcvr 4 Tone 7 On
1999 088:18:29:40.313 Rcvr 3 Tone 1 On
1999 088:18:29:40.313 Rcvr 4 Tone 1 On
1999 088:18:29:54.195 Rcvr 3 Tone 1 Off
1999 088:18:29:54.195 Rcvr 3 Tone 7 Off
1999 088:18:29:54.195 Rcvr 4 Tone 1 Off
1999 088:18:29:54.195 Rcvr 4 Tone 7 Off
1999 088:18:29:54.726 Rcvr 3 Tone 1 On
1999 088:18:29:54.726 Rcvr 3 Tone 7 On
1999 088:18:29:54.726 Rcvr 4 Tone 1 On
1999 088:18:29:54.726 Rcvr 4 Tone 7 On
1999 088:18:30:06.787 Rcvr 3 Tone 2 On
1999 088:18:30:06.787 Rcvr 4 Tone 2 On
1999 088:18:30:12.194 Rcvr 3 Tone 1 Off
1999 088:18:30:12.194 Rcvr 4 Tone 1 Off
1999 088:18:30:21.334 Rcvr 3 Tone 2 Off
1999 088:18:30:21.334 Rcvr 3 Tone 7 Off
1999 088:18:30:21.334 Rcvr 4 Tone 2 Off
1999 088:18:30:21.334 Rcvr 4 Tone 7 Off
1999 088:18:30:21.871 Rcvr 3 Tone 2 On
1999 088:18:30:21.871 Rcvr 3 Tone 7 On
1999 088:18:30:21.871 Rcvr 4 Tone 2 On
1999 088:18:30:21.871 Rcvr 4 Tone 7 On
1999 088:18:30:41.710 Rcvr 3 Tone 2 Off
1999 088:18:30:41.710 Rcvr 4 Tone 2 Off
1999 088:18:31:14.887 Rcvr 3 Tone 7 Off
1999 088:18:31:14.887 Rcvr 4 Tone 7 Off
1999 088:18:31:22.941 Rcvr 3 Tone 7 On
1999 088:18:31:22.941 Rcvr 4 Tone 7 On
1999 088:18:32:34.538 Rcvr 4 Tone 7 Off
1999 088:18:32:34.808 Rcvr 3 Tone 7 Off
1999 088:18:32:34.808 Rcvr 3 Tone 21 Off
1999 088:18:32:34.808 Rcvr 4 Tone 21 Off
1999 088:18:33:18.045 Rcvr 3 Tone 21 On
1999 088:18:33:18.319 Rcvr 3 Tone 7 On
1999 088:18:33:18.319 Rcvr 4 Tone 7 On
1999 088:18:33:18.319 Rcvr 4 Tone 21 On
1999 088:18:33:27.724 Rcvr 3 Tone 7 Off
1999 088:18:33:27.724 Rcvr 4 Tone 7 Off
1999 088:18:33:28.312 Rcvr 3 Tone 7 On
1999 088:18:33:28.312 Rcvr 4 Tone 7 On
1999 088:18:34:04.369 Rcvr 3 Tone 2 On
1999 088:18:34:04.369 Rcvr 4 Tone 2 On
1999 088:18:36:06.122 Rcvr 3 Tone 2 Off
1999 088:18:36:06.394 Rcvr 4 Tone 2 Off
1999 088:18:37:06.830 Rcvr 4 Tone 7 Off
1999 088:18:37:07.149 Rcvr 3 Tone 7 Off
1999 088:18:37:08.826 Rcvr 3 Tone 7 On
1999 088:18:37:09.145 Rcvr 4 Tone 7 On
1999 088:18:37:30.767 Rcvr 3 Tone 1 On
1999 088:18:37:31.085 Rcvr 4 Tone 1 On
1999 088:18:37:53.467 Rcvr 3 Tone 1 Off
1999 088:18:37:53.467 Rcvr 3 Tone 7 Off
1999 088:18:37:53.467 Rcvr 4 Tone 1 Off
1999 088:18:37:53.467 Rcvr 4 Tone 7 Off
1999 088:18:37:54.049 Rcvr 3 Tone 1 On
1999 088:18:37:54.049 Rcvr 3 Tone 7 On
1999 088:18:37:54.049 Rcvr 4 Tone 1 On
1999 088:18:37:54.049 Rcvr 4 Tone 7 On
1999 088:18:38:39.204 Rcvr 4 Tone 1 Off
1999 088:18:38:40.927 Rcvr 4 Tone 1 On
1999 088:18:38:53.878 Rcvr 3 Tone 1 Off

1999	088:18:38:53.878	Rcvr 4 Tone	1 Off
1999	088:18:39:29.454	Rcvr 3 Tone	7 Off
1999	088:18:39:29.454	Rcvr 4 Tone	7 Off
1999	088:18:39:30.037	Rcvr 3 Tone	7 On
1999	088:18:39:30.037	Rcvr 4 Tone	7 On
1999	088:18:39:39.035	Rcvr 3 Tone	1 On
1999	088:18:39:39.035	Rcvr 4 Tone	1 On
1999	088:18:39:59.244	Rcvr 3 Tone	1 Off
1999	088:18:39:59.244	Rcvr 4 Tone	1 Off
1999	088:18:40:18.721	Rcvr 3 Tone	1 On
1999	088:18:40:19.038	Rcvr 4 Tone	1 On
1999	088:18:40:26.255	Rcvr 3 Tone	1 Off
1999	088:18:40:26.255	Rcvr 3 Tone	7 Off
1999	088:18:40:26.255	Rcvr 4 Tone	1 Off
1999	088:18:40:26.255	Rcvr 4 Tone	7 Off
1999	088:18:40:26.791	Rcvr 3 Tone	1 On
1999	088:18:40:26.791	Rcvr 3 Tone	7 On
1999	088:18:40:26.791	Rcvr 4 Tone	7 On
1999	088:18:40:34.173	Rcvr 4 Tone	7 Off
1999	088:18:40:34.444	Rcvr 3 Tone	1 Off
1999	088:18:40:36.634	Rcvr 3 Tone	1 On
1999	088:18:40:36.905	Rcvr 4 Tone	7 On
1999	088:18:40:37.681	Rcvr 4 Tone	1 On
1999	088:18:41:40.188	Rcvr 3 Tone	1 Off
1999	088:18:41:40.188	Rcvr 3 Tone	7 Off
1999	088:18:41:40.188	Rcvr 4 Tone	1 Off
1999	088:18:41:40.188	Rcvr 4 Tone	7 Off
1999	088:18:41:40.728	Rcvr 3 Tone	1 On
1999	088:18:41:40.728	Rcvr 3 Tone	7 On
1999	088:18:41:40.728	Rcvr 4 Tone	1 On
1999	088:18:41:40.728	Rcvr 4 Tone	7 On
1999	088:18:42:24.719	Rcvr 3 Tone	1 Off
1999	088:18:42:24.719	Rcvr 3 Tone	7 Off
1999	088:18:42:24.719	Rcvr 4 Tone	1 Off
1999	088:18:42:24.719	Rcvr 4 Tone	7 Off
1999	088:18:42:25.297	Rcvr 3 Tone	1 On
1999	088:18:42:25.297	Rcvr 3 Tone	7 On
1999	088:18:42:25.297	Rcvr 4 Tone	1 On
1999	088:18:42:25.297	Rcvr 4 Tone	7 On
1999	088:18:42:51.784	Rcvr 4 Tone	1 Off
1999	088:18:42:53.571	Rcvr 4 Tone	1 On
1999	088:18:43:01.083	Rcvr 3 Tone	1 Off
1999	088:18:43:01.083	Rcvr 4 Tone	1 Off
1999	088:18:43:22.529	Rcvr 3 Tone	7 Off
1999	088:18:43:22.529	Rcvr 4 Tone	7 Off
1999	088:18:43:23.105	Rcvr 3 Tone	7 On
1999	088:18:43:23.105	Rcvr 4 Tone	7 On
1999	088:18:43:31.906	Rcvr 3 Tone	1 On
1999	088:18:43:31.906	Rcvr 4 Tone	1 On
1999	088:18:43:38.721	Rcvr 3 Tone	1 Off
1999	088:18:43:38.721	Rcvr 4 Tone	1 Off
1999	088:18:44:20.283	Rcvr 3 Tone	7 Off
1999	088:18:44:20.283	Rcvr 4 Tone	7 Off
1999	088:18:44:20.817	Rcvr 3 Tone	7 On
1999	088:18:44:20.817	Rcvr 4 Tone	7 On
1999	088:18:44:27.150	Rcvr 3 Tone	7 Off
1999	088:18:44:27.150	Rcvr 4 Tone	7 Off
1999	088:18:44:27.685	Rcvr 3 Tone	7 On
1999	088:18:44:27.685	Rcvr 4 Tone	7 On
1999	088:18:44:45.443	Rcvr 3 Tone	1 On
1999	088:18:44:45.443	Rcvr 4 Tone	1 On
1999	088:18:44:50.560	Rcvr 3 Tone	1 Off
1999	088:18:44:50.560	Rcvr 3 Tone	7 Off
1999	088:18:44:50.560	Rcvr 4 Tone	1 Off
1999	088:18:44:50.560	Rcvr 4 Tone	7 Off
1999	088:18:44:51.147	Rcvr 3 Tone	1 On
1999	088:18:44:51.147	Rcvr 3 Tone	7 On
1999	088:18:44:51.147	Rcvr 4 Tone	1 On
1999	088:18:44:51.147	Rcvr 4 Tone	7 On
1999	088:18:44:56.782	Rcvr 3 Tone	1 Off
1999	088:18:44:56.782	Rcvr 4 Tone	1 Off
1999	088:18:45:20.766	Rcvr 3 Tone	7 Off
1999	088:18:45:20.766	Rcvr 4 Tone	7 Off
1999	088:18:45:21.345	Rcvr 3 Tone	21 Off
1999	088:18:45:21.345	Rcvr 4 Tone	21 Off
1999	088:18:45:49.214	Rcvr 3 Tone	21 On
1999	088:18:45:49.486	Rcvr 4 Tone	21 On
1999	088:18:45:54.302	Rcvr 3 Tone	21 Off
1999	088:18:45:54.577	Rcvr 4 Tone	21 Off
1999	088:18:51:05.182	Rcvr 4 Tone	21 On
1999	088:18:51:05.458	Rcvr 4 Tone	21 Off
1999	088:20:37:38.117	Rcvr 3 Tone	21 On
1999	088:20:37:38.393	Rcvr 4 Tone	21 On
1999	088:20:37:39.806	Rcvr 3 Tone	21 Off
1999	088:20:37:40.131	Rcvr 3 Tone	21 On
1999	088:20:37:40.406	Rcvr 3 Tone	21 Off
1999	088:20:37:40.406	Rcvr 4 Tone	21 Off
1999	088:21:01:07.870	Recorder Stopped	

Excerpt from FTS Data Logger During Ground Test on March 29, 1999

(18:00 to 18:16 GMT)

1999 088:17:57:45.640 Rcvr 4 Tone 7 On
1999 088:18:01:34.106 Rcvr 3 Tone 7 Off
1999 088:18:01:34.106 Rcvr 4 Tone 7 Off
1999 088:18:06:14.394 Rcvr 3 Tone 7 On
1999 088:18:06:14.665 Rcvr 4 Tone 7 On
1999 088:18:07:54.004 Rcvr 4 Tone 7 Off
1999 088:18:07:54.275 Rcvr 3 Tone 7 Off

On the following line we see Tone 7 ON. (Monitor)

1999 088:18:07:56.870 Rcvr 3 Tone 7 On
1999 088:18:07:57.190 Rcvr 4 Tone 7 On
1999 088:18:08:18.091 Rcvr 4 Tone 7 Off
1999 088:18:08:19.618 Rcvr 3 Tone 7 Off

On the following lines we see Tones 7 and 1 ON. (ARM)

1999 088:18:08:33.474 Rcvr 3 Tone 7 On
1999 088:18:08:34.114 Rcvr 4 Tone 7 On
1999 088:18:10:27.535 Rcvr 3 Tone 1 On
1999 088:18:10:27.535 Rcvr 4 Tone 1 On

On the following lines we see Tone 7 go OFF

1999 088:18:10:54.854 Rcvr 3 Tone 7 Off
1999 088:18:10:54.854 Rcvr 4 Tone 7 Off

On the following lines we see Tone 2 go ON. We now have a TERMINATE condition. Tone 7 is OFF and both Tones 1 and 2 are ON for 16 seconds until Tone 1 goes OFF.

1999 088:18:10:55.434 Rcvr 4 Tone 2 On
1999 088:18:11:11.784 Rcvr 4 Tone 1 Off
1999 088:18:11:21.445 Rcvr 3 Tone 1 Off

On the following lines we see Tone 1 go back ON. We now have a second TERMINATE condition with Tone 7 OFF and both Tones 1 and 2 ON for 9 seconds until Tone 2 goes OFF.

1999 088:18:11:23.024 Rcvr 3 Tone 1 On
1999 088:18:11:32.054 Rcvr 4 Tone 2 Off
1999 088:18:11:32.326 Rcvr 3 Tone 7 On
1999 088:18:11:43.656 Rcvr 3 Tone 1 Off
1999 088:18:12:22.577 Rcvr 4 Tone 7 On
1999 088:18:12:34.387 Rcvr 4 Tone 7 Off
1999 088:18:12:35.615 Rcvr 3 Tone 7 Off
1999 088:18:12:54.269 Rcvr 3 Tone 7 On
1999 088:18:12:54.537 Rcvr 4 Tone 7 On
1999 088:18:15:35.595 Rcvr 3 Tone 7 Off
1999 088:18:15:35.595 Rcvr 4 Tone 7 Off
1999 088:18:15:54.635 Rcvr 3 Tone 1 On
1999 088:18:15:54.635 Rcvr 4 Tone 1 On
1999 088:18:16:09.388 Rcvr 4 Tone 1 Off
1999 088:18:16:09.678 Rcvr 3 Tone 1 Off
1999 088:18:16:24.156 Rcvr 3 Tone 1 On
1999 088:18:16:27.903 Rcvr 3 Tone 1 Off
1999 088:18:16:39.061 Rcvr 3 Tone 1 On
1999 088:18:16:41.498 Rcvr 4 Tone 1 On