

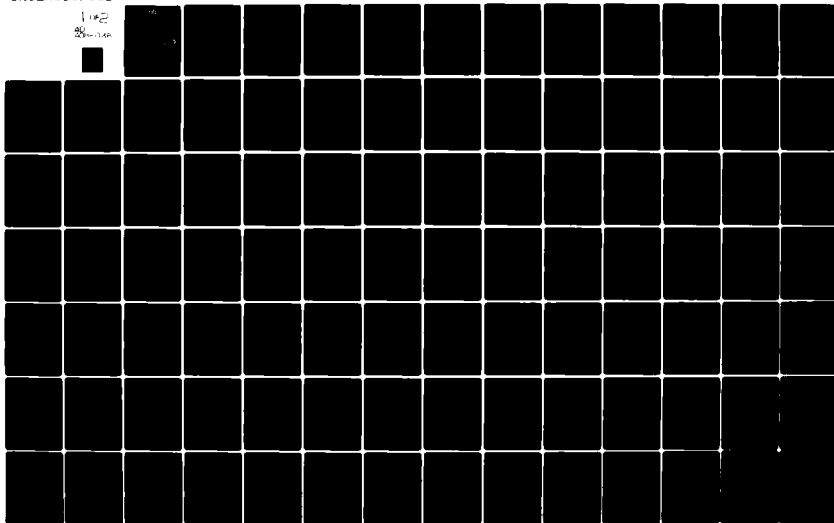
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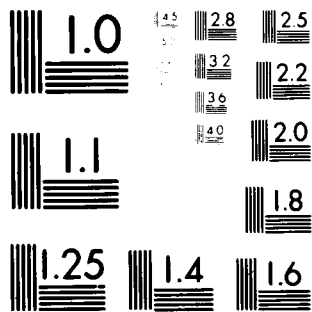
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MAY 80 G J BARBATO, R P MADERO, G A SEXTON F33615-78-C-3614
AFWAL-TR-80-3030-VOL-3 NL

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TANKER AVIONICS/AIRCREW COMPLEMENT EVALUATION (TAACE)
PHASE 0 - ANALYSIS AND MOCKUP

VOLUME III: MISSION SCENARIO

The Bunker Ramo Corporation
Electronic Systems Division
Westlake Village, California

May 1980

TECHNICAL REPORT AFWAL-TR-80-3030, VOLUME III
Final Report for Period June 1978 - May 1979

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This report has been reviewed by the Office of Public Affairs (ASD/PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.



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This report is presented in three volumes. Volume I describes the TAACE program and the mockup evaluation results. Volume II is a summary of the data resulting from the study, and Volume III is a detailed description of the mission scenario used during the evaluation.

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FOREWORD

This report documents the first phase of a two-phase effort called the Tanker Avionics/Aircrew Complement Evaluation (TAACE). The results obtained in an experimental cockpit mockup design effort concerned with developing the crew station avionics criteria to be met for a 3-man crew complement (pilot, copilot, boom operator) to complete all KC-135 mission requirements without compromise to either mission performance or aircraft operational safety are reported herein.

The program is being conducted under an Air Force Systems Command Memorandum of Understanding between the Aeronautical Systems Division, KC-135 Avionics Modernization Program Office (ASD/SD-28) managed by Mr. Tom Biggs, and the Flight Dynamics Laboratory (AFWAL/FIGR), Wright-Patterson AFB, Ohio. The Flight Dynamics Laboratory portion of the program is managed by Mr. Richard Moss, Program Manager, AFWAL/FIGR, and Lt Donald Seyler, Lead Engineer: Crew Systems Design Phase, AFWAL/FIGR.

The report was prepared in part by the on-site Human Factors Group, located at Wright-Patterson AFB, Ohio, Electronic Systems, Bunker Ramo Corporation, Westlake Village, California, under USAF Contract No. F33615-78C-3614, Project No. 23915100. Mr. Robert A. Bondurant, III (AFWAL/FIGR) is the contract monitor.

The authors wish to acknowledge the assistance from Lt Mark Hussey and Lt Tom Roberts, formerly of AFWAL/FIGR, for their essential contributions concerning the present study experimental design and set-up, testing, and report preparation. In addition, recognition is given to Mr. Tom Molnar (AFWAL/FIGR) for critical assistance in the development of the nav management system; Mr. John Kozina (Bunker Ramo) and Mr. Fritz Baker (Lear Siegler) for engineering assistance in experimental equipment integration; Mr. Rick Helton and Mr. Tom Pavton (AMFTD) for construction of the KC-135 mockup; Capt Steve Kolet (AFWAL/FIGR) for extensive consulting regarding KC-135 operations; and Cindy Gier and Sandy Dickey (Bunker Ramo) for untiring administrative support.

This research effort was performed between June 1978 and May 1979.

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TABLE OF CONTENTS

	PAGE
MISSION LEG 1: LORING TO U.K. FIGHTER DEPLOYMENT SUPPORT	1
MISSION LEG 2: MILDENHALL EWO MISSION	57
MISSION LEG 3: BODO CONTINGENCY MISSION	109

LIST OF ABBREVIATIONS

A/A	Air to Air
AC	Alternating Current
ADF	Automatic Direction Finding
ADI	Attitude Director Indicator
AFFDL	Air Force Flight Dynamics Laboratory
AHRS	Attitude Heading Reference System
APU	Auxiliary Power Unit
A/R	Air Refueling
ARA	Airborne Radar Approach
ARCP	Air Refueling Control Point
ARCT	Air Refueling Control Time
ARIP	Air Refueling Initial Point
ATC	Air Traffic Control
BAR	Begin Air Refueling
BDHI	Bearing Distance Heading Indicator
CADC	Central Air Data Computer
CAS	Calibrated Airspeed
C/D	Control/Display
CDU	Control/Display Unit
CG	Center of Gravity
CONUS	Continental United States
CRT	Cathode Ray Tube
DC	Direct Current
DF	Direction Finder
DME	Distance Measuring Equipment
DR	Dead Reckoning

LIST OF ABBREVIATIONS

(cont.)

EAR	End of Aerial Refueling
EGT	Exhaust Gas Temperature
EMP	Electromagnetic Pulse
EPR	Engine Pressure Ratio
FL	Flight Level
FM	Frequency Modulation
GA	Go Around
GCI	Ground Controlled Intercept
GMT	Greenwich Mean Time
GS	Groundspeed
HF	High Frequency
HSD	Horizontal Situation Display
HSI	Horizontal Situation Indicator
IAS	Indicated Airspeed
IFF	Identification, Friend or Foe
IFF/SIF	Identification, Friend or Foe/Selective Identification Feature
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
INS	Inertial Navigation System
JN	Jet Navigation
MPD	Multipurpose Display
MRT	Military Rated Thrust

LIST OF ABBREVIATIONS

(cont.)

NATO	North Atlantic Treaty Organization
NM	Nautical Miles
PPSN	Present Position
RGA	Rotate and Go Around
RMI	Radio Magnetic Indicator
RPM	Revolutions Per Minute
R/T	Receiver/Transmitter
RZ	Rendezvous
RZIP	Rendezvous Initial Point
SAC	Strategic Air Command
SELCAL	Selective Call
SKE	Station Keeping Equipment
TAACE	Tanker Avionics/Aircrew Complement Evaluation
TACAN	Tactical Air Navigation
TAS	True Airspeed
TOLD	Take-Off and Landing Data
TRT	Take-Off Rated Thrust
UHF	Ultra High Frequency
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VOR	VHF Omnidirectional Range
VVI	Vertical Velocity Indicator
WX	Weather

SUMMARY

This report documents a mockup cockpit design study which was the first phase of a two-phase effort currently being performed in support of the USAF KC-135 Avionics Modernization Program. The report is presented in three volumes: Volume I describes the experimental design and summary of results; Volume II presents the study data; and Volume III details the mission scenario.

To address the cockpit design issues relating to eliminating the navigator from the KC-135 tanker aircraft, a full scale mockup was designed and was "flown" by operational aircrews over a representative mission profile. The results of the study are presented in this paper. To develop the experimental design around answering the question of how to eliminate the navigator position from the aircraft, a mission analysis and composite mission scenario were constructed, and three candidate suites of available control/display avionics were identified and arranged in the full-size representative KC-135 cockpit mockup. Nine fully qualified Strategic Air Command tanker (KC-135) aircrews, consisting of two pilots and a boom operator, "flew" the composite mission scenario and the three candidate avionics suites. They thereby provided a subjective data base that formulates the results and conclusions of the present study.

The primary issues addressed during this study were the avionics control and display criteria to be met in the event of the reduction of the crew complement for the KC-135. The resultant data of the experiment suggested that subject crews were strongly supportive of a reduced crew complement only if certain present and useful KC-135 avionics hardware is relocated while other hardware that has become unacceptably outdated or has outlived its usefulness is significantly updated. The crew members were very much in favor of including as new hardware a navigation management system that could display at least six upcoming waypoints at a time with an almost infinite waypoint storage capacity. Additional capabilities of the system included fuel management/status update and display, automatic present position update in relation to flight plan, and the ability to calculate center of gravity and takeoff/landing computations. During refueling operations, holding and rendezvous patterns could also be preprogrammed into the system.

Another major modification to the cockpit design which was judged by the crews to be indispensable for mission accomplishment with a reduced crew size was the horizontal situation display. This device, which replaced the standard horizontal situation indicator, not only could display that standard information, but also allowed the selection of a moving map alone or with weather, ground mapping, or radar beacon overlays. In addition, certain

other flight parameters such as glide slope, groundspeed, course, and time and distance to the next waypoint were available on the perimeter and at the corners of the display itself.

Other changes to the current KC-135 avionics layout rated highly by the crew members were the use of vertical-scale engine instruments and the inclusion of a caution/warning annunciator panel. This panel consolidated all caution and warning indicators into one area of the front instrument panel directly in view of the pilot and copilot. The panel area was made available through the use of the vertical-scale instruments.

It should be noted that although the crew station reconfigurations presented in this report were analyzed in the context of a reduced crew complement (i.e., without a navigator), many of the findings about enhanced ability to accomplish the mission while, at the same time, reducing crew workload are applicable even without eliminating the navigator crew position. Given the rapidly increasing amount of information that must be assimilated by the pilot and copilot in a potentially expanding hostile environment, it becomes imperative that advanced technology in the form of multipurpose displays and computers be incorporated in crew systems designs to perform some of the paperwork/navigation computations which presently consume a significant amount of time and substantially contribute to aircrew workload.

Based on the results of this study, it can be stated that accomplishment of the aerial refueling mission is feasible with a two pilot, one boom operator flight crew by reallocating crew tasks and by utilizing 1980 state-of-the-art crew systems, including a navigation management system, electronic horizontal situation/multipurpose displays, and generally upgraded avionics systems.

TANKER AVIONICS/AIRCREW COMPLEMENT EVALUATION

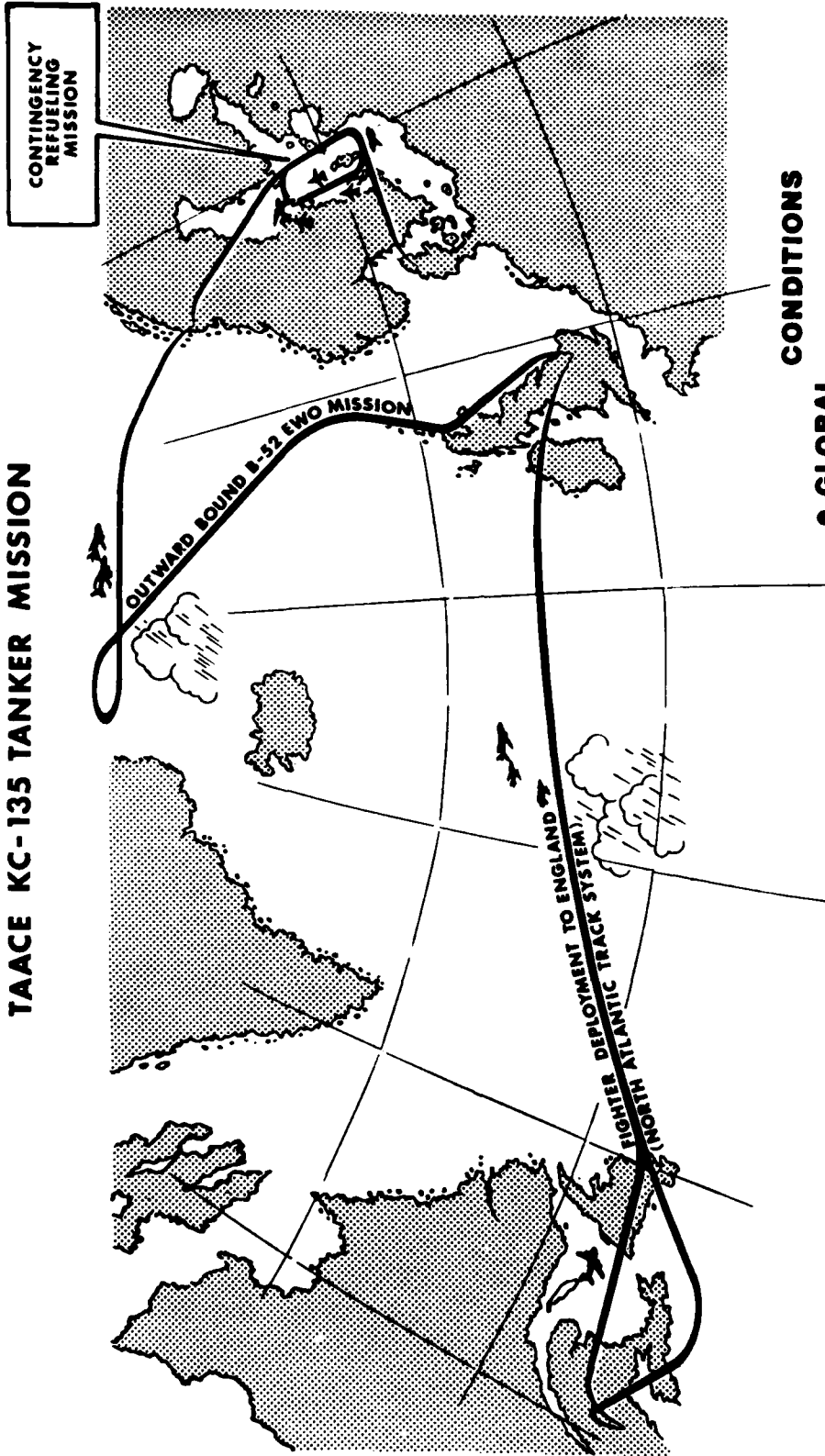
MOCKUP EVALUATION PHASE

VOLUME III: MISSION SCENARIO

1

This volume contains 1) a "ribbon-in-the-sky" depiction of the mission scenario used during the mockup exercise, 2) a narrative overview of each mission leg, 3) a mission profile graph depicting climbs and descents during the different mission segments, and 4) the mission scenario for each leg which outlines the specific tasks to be accomplished by the pilot, copilot, and boom operator during the mockup "flying" session.

TAACE KC-135 TANKER MISSION



CONDITIONS

- GLOBAL
- DAY - NIGHT
- VMC-IMC
- THREAT ENVIRONMENT
- DEGRADED MODE OPERATIONS

LORING TO U.K. FIGHTER DEPLOYMENT SUPPORT

The 3905 Strategic Aerial Refueling Wing, Loring AFB has been alerted for a Coronet mission to support an increased readiness posture in Europe. A deployment frag is dispatched which directs a five ship tanker force from Loring AFB to support an A-7 unit deployment from McGuire AFB to RAF Wittering. Proposed launch time is 1100Z which is three hours from now. The mission is identified as Coronet Eagle.

Eagle Tanker crews attend the deployment mission briefing which covers crew and aircraft assignment, spares, fuel loads (160,000 pounds), parking spots, navigation routing, procedures for marshaling, departure, formation, join-up, cruise, rendezvous, refueling, and recovery. Status of tanker force is identified as preflighted, but not cocked. Airborne command post (call sign, Head Dancer), Duckbutt, weather and alternate recovery procedures are also detailed. An intelligence briefing outlining the European political instability and prognosis of deterioration completes the mission briefing. Eagle crews receive mission kits, obtain a time hack and disburse to complete individual nav planning and pre-departure tasks. The following scenario describes the activities of the crew in the #2 ship (call sign, Esso 2) of the five ship cell (Esso Lead thru 5) who are supporting the Coronet Eagle deployment of 12 A-7 receivers (call sign, Hotel Sierra 1-12). Esso Lead and 2 will deploy to Mildenhall, while the other three tankers return to Loring after offloading fuel to the receivers.

Page 2
LORING TO U.K. FIGHTER
DEPLOYMENT SUPPORT

Prior to departing the briefing area, Esso Lead pilot conducts a pre-mission briefing with other cell aircrews covering communications, taxi, takeoff, climb, level off, join-up, formation tactics, offloads, and ARCTs - #1) 1200Z, #2) 1313Z, #3) 1504Z, #4) 1645Z. Weather and emergency procedures are also covered.

The boom operator departs to coordinate for inflight meals while the pilots review and complete flight planning forms, charts and maps. Subsequently, the crew of Esso 2 loads all required equipment on the crew bus and departs base ops at 0935Z. At 0940Z, the Coronet tanker crews arrive at their respective aircraft for preflight and final crew briefings. Taxi out is routine. Esso 2 experiences water failure on takeoff, aborts, returns to the hammerhead to check the system, resets circuit breaker and completes satisfactory check out.

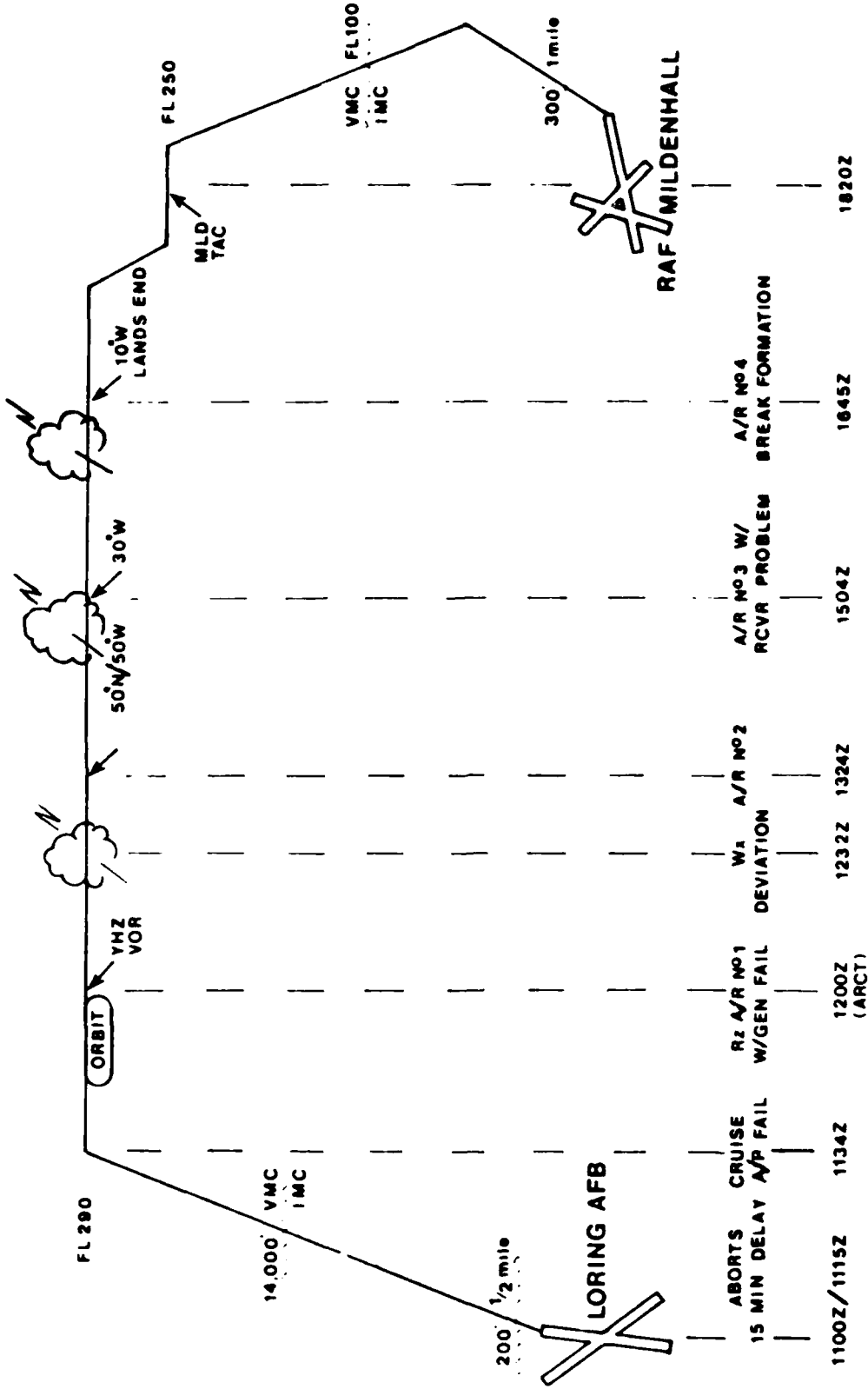
The remainder of the formation departs on schedule and Esso 2 departs 15 minutes behind the leader. A routine IMC departure is made with weather at 200' and 1/2 mile. After airborne a change of flight plan is requested to shorten the route so as to rendezvous with the tanker cell over the ARCP at Halifax (YHZ) at 1152Z prior to the scheduled rendezvous with the receivers. During level off at FL290 the aileron axis of the autopilot fails and cannot be revived. Due to their late departure, Esso 2 joins the cell in the Esso 5 position. During tanker join-up at Halifax, Esso 5 experiences a generator failure which is resolved. During AR #1, Esso Lead and 5 refueling systems

Page 3
LORING TO U.K. FIGHTER
DEPLOYMENT SUPPORT

are checked by providing a token offload. After the non-deploying tankers have twice refueled the fighters, they return to Loring and Esso 5 moves into the #2 position. Esso Lead radar becomes inoperative so Esso 2 assumes responsibility for formation station-keeping and weather avoidance through an extended area where numerous diversions around weather cells are required. At 30° W, halfway across the Atlantic, a third A/R is accomplished except for Hotel Sierra 12. After several unsuccessful attempts to refuel and tow, Hotel Sierra 12, accompanied by Hotel Sierra 11, heads for the closest landfall/airport - Shannon, Ireland with a projected flame out 40 miles short of the airfield. Esso 2 coordinates the problem with Head Dancer and rescue and proceeds with the remainder of the Coronet Eagle contingent to the U.K. The fighters top off near Lands End and subsequently break away from the tanker cell to recover at RAF Wittering. The disabled receiver and escort are assisted to Shannon by Head Dancer and Duckbutt. Esso 2 accomplishes a minimum weather recovery at RAF Mildenhall at 1820Z.

The following detailed time line and task mission description starts with the crew of Esso 2 arriving at their aircraft.

FIGHTER DEPLOYMENT SUPPORT-LORING TANKER FORCE



ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:00	0940	Arrives at aircraft.	Arrives at aircraft.	Arrives at aircraft.
00:01	0941	Receives aircraft status from ground crew.	On-loads equipment.	On-loads equipment.
00:07 (PREFLIGHT)	0947	Exterior Inspection. Checks aircraft forms and general condition of aircraft exterior. Enters noted discrepancies in AFTO 781 and briefs ground crew as required. Enters aircraft and assists copilot in nav management system and crew position set up.	Interior Inspection. Checks and sets comm and nav systems and aircraft subsystems as directed by checklist. Aligns INS with present location, enters current time and loads flight plan into nav management system. Sets appropriate modes and codes in the IFF and ciphony. Sets up charts, documents and mission forms for departure.	Cabin Preflight. Checks equipments and secures baggage. Checks refueling stations as outlined by checklist. Checks general conditions of cargo compartment. Weight and balance (C.G.) is computer verified. Take off data is computed and recorded for pilot use (extracted from computer).
00:35	1015	Crew assembles. Accomplishes crew briefing of mission	Checks equipment and continues Interior Inspection.	Briefs crew on emergency procedures, location of O ₂ bottles

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:35 (cont.)	1015	profile. Directs crew to complete Interior Inspection checklist.		and evacuation procedures. Checks equipment and completes boom operator Interior Inspection.
00:37	1017	Climbs into pilot seat. Assists in completion of Interior Inspection.	Climbs into copilot seat. Responds to checklist.	Reads Interior Inspection checklist for pilots (from jump seat position).
00:41	1021	Sets up maps and charts. Reviews departure and flight plan. Responds to lead aircraft in the formation for comm check and start status on UHF 1 (command post frequency).	Command Post check-in. Copies ground control on UHF 2 for altimeter setting and fire guard information.	Completes Interior Inspection. Authenticates and copies launch message. Informs pilot Inspection complete.
00:46	1026	Advises Lead that 2 is ready for start. Calls for Starting Engines and Before Taxi checklist.	Responds to checklist. Advises Esso Lead that 2 is starting engines.	Reads checklist.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:47	1027	Starts engines. Responds to checklist.	Assists in engine start. Responds to checklist.	Reads checklist. (Crew chief boards aircraft and secures ladder.)
00:55 (TAXI)	1035	Receives clear to taxi visual signal from ground crew.	Copies taxi instructions from ground control. Checks in and advises Lead that 2 is ready to taxi. Checks VHF comm radio.	Completes Starting Engines and Before Taxi checklist and informs pilot checklist complete. Departs flight deck.
00:56	1036	Calls for Taxiing aircraft while taxiing aircraft.	Reads and responds to checklist while clearing for obstructions.	Secures cabin during last chance check. Returns to jump seat during taxi.
01:03	1043	Parks aircraft in holding area at the end of the runway.	Clears for obstructions. Checks TACAN, VOR, altimeter, and nav management alignment for position display information.	Completes Taxiing checklist and clears for obstructions. Informs pilot Taxiing checklist complete. Checks HF comm radio.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
01:04	1044	Calls for Before Takeoff checklist.	Responds to checklist.	Reads checklist.
01:06	1046	Copies ATC and departure clearance. Responds to guard check with Esso Lead and ground control.	Copies call from ground control with clearance. Copies ATC and departure clearance.	Copies ATC/departure clearance.
01:08	1048	Changes to Metro frequency and checks in with Esso Lead. Copies Metro for final weather check. Confirms (with Lead) Bangor International as takeoff alternate.	Copies weather. Selects navigation aid (VOR) guidance on navigation mode selector for pilot and copilot. Verifies all heading systems reference magnetic north.	Copies weather. Sets up navigation station with JN chart and backup navigation control units.
01:11	1051	Copies takeoff briefing including ATC clearance, radar departure, emergencies on departure and emergency IMC return.	Copies briefing. Verifies communication and navigation set up for departure and emergency IMC return. Calls in "ready for takeoff". Switches to tower frequency	Acknowledges briefing. Completes Before Takeoff checklist and informs pilot checklist complete.

ELAPSED TIME HR-MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
01:11 (cont.)	1051	Responds to Esso Lead request to go to command post frequency and checks in.	as requested. Sets up weather radar for takeoff. Verifies takeoff data.	
01:19	1059	Taxis aircraft into position and hold.	Receives clearance from tower "into position and hold, runway one."	Verifies aircraft secure and ready for takeoff.
01:20	1100	Calls for Takeoff checklist. Responds to checklist.	Receives clearance from tower for takeoff. Responds to checklist.	Reads Takeoff checklist.
01:20 (TAKEOFF)	1100	Advances power for takeoff, maintains directional control and assumes yoke control. Maintains visual runway alignment.	Stabilizes yoke forward, backs up throttle control, monitors engine instruments and airspeed. Calls "abort" due to water low pressure warning light on outboard engines.	Monitors water run time.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
01:21	1101	Cuts throttles, extends speed brakes, checks hydraulic pressures and uses brakes as required. Uses nosewheel steering to taxi clear of runway.	Provides backup to pilot in keeping aircraft stabilized and maintains outside scan. Advises tower of status.	Maintains outside scan.
01:22	1102	Calls for After Landing checklist. Advises Esso Lead of problem. Taxies back toward takeoff position. Stops aircraft for maintenance team to perform hot brake check.	Responds to After Landing checklist. Maintains outside watch. Checks in with Command Post who advises no spare aircraft is available. Checks in with ground control for taxi back and ATC clearance requirements. Responds to maintenance call that main wheels check ok.	Reads After Landing checklist. Maintains outside watch. Checks circuit breakers on bulk head and finds a "popped" circuit breaker for outboard engines water boost pump. Resets circuit breaker.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
01:24	1104	Continues to maneuver aircraft to holding area at takeoff end of runway.	Maintains outside scan. Notifies Command Post of circuit breaker and receives instructions to static check the water system.	Checks cabin and main gear wheels for signs of overheating or tire damage.
01:25	1105	Calls for Taxiing checklist while taxiing aircraft.	Reads and responds to checklist while clearing for obstructions.	Returns to jump seat.
01:26	1106	Copies Esso Lead's message that Esso flight aircraft will compress (move their position up one) and that 2 will become 5. Responds to Esso Lead's suggestion that 5 now request direct routing from Loring AFB to Halifax in order to catch up with cell.	Checks TACAN, VOR, altimeter, and nav management alignment for position display information. Requests ATC clearance change as suggested by Lead.	Completes Taxiing checklist and clears for obstructions. Informs pilot Taxiing checklist complete.

ELAPSED
TIME
HR:MIN

GMT

PILOT

COPILLOT

BOOM OPERATOR

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
01:29	1109	Parks aircraft in holding area at the end of the runway and calls for Before Takeoff checklist. Performs static water check. Checks ok.	Responds to checklist. Clears with ground control for static water check. Notifies Command Post and Lead that water checks ok.	Reads checklist. Instructs crew chief to monitor engines and jet blast area during water check.
01:30	1110	Copies original ATC and departure clearance.	Copies call from ground control with clearance. Copies ATC and departure clearance and acknowledges direct routing may be obtained from departure control.	Copies ATC/departure clearance.
01:31	1111	Obtains final weather check. Verifies comm and nav set up for departure and emergency IMC return. Verifies takeoff data.	Copies weather. Selects nav aid (VOR) guidance on nav mode selector for pilot and copilot. Verifies all heading systems reference magnetic north. Sets up weather radar for takeoff.	Completes Before Takeoff checklist and informs pilot that checklist is complete. Rechecks JN charts and backup navigation units.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
01:34	1114	Taxis aircraft into position and holds.	Receives clearance from tower "into position and hold, runway one".	Verifies aircraft secure and ready for takeoff.
01:35	1115	Calls for Takeoff checklist. Responds to checklist.	Receives clearance from tower for takeoff. Responds to checklist.	Reads Takeoff checklist.
01:35 (TAKEOFF)	1115	Advances power for takeoff, maintains directional control and assumes yoke control. Maintains visual runway alignment.	Stabilizes yoke forward, backs up throttle control, monitors engine instruments and airspeed. Calls S-1 and rotate. Maintains outside scan.	Monitors water run time.
01:36	1116	Rotates aircraft and lifts off. Calls "gear up". Maintains instrument and visual attitude reference until IMC.	Monitors instruments, RGA rotation speed and altitude. Retracts gear on pilot command.	Monitors fire warning and other annunciators.

ELAPSED
TIME
HR:MIN

PILOT

COPILOT

BOOM OPERATOR

01:37	1117	Calls "flaps up" at flap retract altitude and accelerates to enroute climb speed. Monitors flight instruments.	Monitors airspeed and altitude. Retracts flaps on pilot command. Monitors aircraft systems and weather radar.	Logs takeoff time and continues to monitor annunciators.
01:38	1118	Turns towards departure route. Selects flight director for heading. Monitors flight instrument guidance. Pilot directs copilot to set water out EPR.	Responds to tower's comm frequency change. Sets flight director to capture departure route. Water runs out. Sets water out EPR. Reaches enroute climb IAS.	
01:39	1119	Responds to departure control heading and altitude direction. Maintains flight instrument reference. Calls for After Takeoff-Climb checklist.	Responds to calls from departure control. Responds to checklist.	Reads After Takeoff-Climb checklist. Makes nav log entry for departure.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
01:40	1120	Flies departure vector to avoid Presque Isle traffic enroute to Houlton VOR, maintaining flight instrument reference.	Responds to IFF squawk from departure control Receives clearance to climb to cruise altitude, to cross Houlton VOR at or below FL200. Requests direct routing to Halifax VOR.	Continues After Takeoff-Climb checklist. Departs flight deck to check cabin and scan the wings. Returns with coffee and continues checklist.
01:43	1123	Turns aircraft right to 150°. Checks weather on radar. Selects flight director for nav guidance.	Acknowledges departure control's directive to turn right to 150 and squawk ident. Maintains outside scan.	Monitors systems annunciators.
01:45	1125	Engages autopilot to capture desired headings. Advises Esso Lead of position. Is directed by Esso Lead to maintain interplane frequency. Note: Pilot monitors the	Responds to departure control VHF frequency change directive to contact Moncton Centre for clearance direct to Halifax VOR. Verifies clearance to Halifax VOR via present position direct to	Notes position on chart.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
01:45 (cont.)	1125	flight instruments, comm radios except HF and outside watch during entire flight unless otherwise noted.	Grand Lake intersection, HL 578A to maintain FL250. Identifies new route on chart and enters new route into nav management system.	
01:48	1128	Resets altimeter to 29.92	Reset altimeter to 29.92	
01:49	1129	Calls passing 20,000'. Responds to call from Esso Lead for position and Halifax ETA. Engages autopilot to maintain desired climb and nav signal guidance. Monitors flight instrument reference and outside watch.	Responds to IFF change from Moncton and acknowledges request for present altitude and passing FL200. Note: Copilot monitors nav management system, aircraft systems radar and comm radios except HF during entire flight unless otherwise noted.	Calls After Takeoff-Climb checklist complete. Note: Boom operator maintains outside visual scan and monitors aircraft system annunciators for entire flight unless otherwise noted. Boom operator also maintains a continuous listening watch on HF (including decoding messages) and other radios as directed by pilot while on flight deck.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
01:53	1133	Monitors outside watch. Notes instability in aileron axis of the auto- pilot.	Confirms with Moncton Centre that the flight is passing Grand Lake.	Maintains outside watch. Notes position on JN chart.
01:54	1134	Turns off aileron axis of autopilot. Monitors flight instruments and outside watch. Manually flies ailerons.	Responds to VHF frequency change to Moncton Centre.	Maintains outside watch. Monitors aircraft system annunciators.
01:55	1135	Checks wind speed and drift versus forecast. Monitors weather radar, flight instru- ments and outside watch. Receives a call from Esso Lead to acknowledge when 5 paints his beacon.	Responds to IFF ident. Checks Halifax weather with airborne radar.	Maintains outside watch. Notes time and position on JN map at nav station. Updates fuel log.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
01:56 (PARC)	1136	Monitors aircraft control, flight instruments, map display position and outside watch.	Calls radar contact on Lead. Acknowledges passing Parc intersection.	Continues outside watch.
01:57 (LEVEL OFF FL250)	1137	Accomplishes level off at FL250. Advises Esso Lead prior to level off and at level off. Monitors flight instruments and outside watch.	Reports level at 250. Updates flight plan. Checks nav management for Halifax ETA of 1155Z. Passes Halifax ETA to boom operator. Monitors aircraft systems (HEFO check). Acknowledges Moncton request to climb to FL270.	Monitors outside watch and system annunciators.
01:58	1138	Begins climb departing FL250 to FL270. Monitors flight instruments and outside watch.	Checks nav management present position lat/long.	Notes time and position on JN map. Continues outside watch. Updates fuel log.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:00	1140	Maintains outside scan. Monitors flight instruments and nav position. Calls for Preparation For Contact checklist.	Notes discrepancy between present position, lat/long, nav aid and radar information. Identifies present position from nav aids while freezing nav system present position lat/long. Converts nav aids position to lat/long, enters new lat/long into nav system present position and releases nav system freeze. Doppler is also updated. Calls passing FL260. Reads and performs checklist.	Notes updated position and time on JN chart. Accepts coffee order from crew. Satisfies coffee order. Proceeds to boom station to perform checklist.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:01	1141	Monitors flight instruments and outside watch. Checks in with boom operator in intercom.	Calls level FL270. Verifies A/A TACAN is on and beacon code set and on. Relays DME and bearing from ARCP to Esso Lead.	Performs checklist. Checks intercom with pilot.
02:02	1142	Monitors course, winds, GS and Halifax ETA. Monitors map display position, flight instruments, and outside watch. Starts climb to FL310.	Checks ground map position with flight plan map position for INS update. Monitors HF radio. Monitors aircraft systems and weather radar. Requests and receives FL315. Calls departing FL270.	Coordinates boom exercise with pilot.
02:05 (PARRSBORO)	1145	Maintains outside watch. Monitors flight instruments.	Calls passing Parrsboro and passing FL300. Coordinates RZ with Esso Lead.	Completes Preparation For Contact checklist.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:06	1146	Monitors flight instruments and maintains outside watch. Levels FL315. Notes position on map display and notes weather radar.	Responds to Moncton's request to change to frequency 368.5. Completes Preparation For Contact checklist. Calls level FL315. Monitors aircraft systems. Monitors Lead's beacon and calls out distance.	Returns to flight deck and maintains outside watch.
02:07	1147	Monitors flight instruments and outside watch. Checks nav management system GS, wind, drift, TAS and Halifax ETA. Asks Esso Lead to hold down for DF.	Inserts orbit function in nav management system for Halifax ARCP. Copies Hotel Sierra altitude. Continues Rz with beacon. Copies Hotel Sierra (HS) position over Yarmouth VOR (ARIP) and beacon contact with Esso. Maintains outside watch. Updates fuel log entry. Copies HS A/A TACAN check and range lock-on.	Maintains outside watch.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
02:10	1150	Monitors flight instruments and weather radar. Confirms tally ho on Lead. Maneuvers for join up. Descends to FL310.	Acknowledges Moncton position information. Informs Lead and Moncton of tally ho.	Calls tally ho on Esso Lead. Updates position on JN chart.
02:11	1151	Acknowledges Esso Lead crossing ARCP. Confirms Esso Lead at 5's twelve o'clock, approximately 5 mi.	Acknowledges Moncton's clearance to join Esso flight.	Maintain outside watch. Copies HF message.
02:12	1152	Notes generator failure light on #1 generator. Calls for Dash 1 reference for loss of generator. Moves generator control switch to "close". Checks voltage with paralleling selectors. Notes normal	Continues to scan radar. Notes generator problem. Assumes aircraft control. Advises Head Dancer of generator problem. Acknowledges Head Dancer advice to follow Dash 1 and keep them posted.	Notes generator fail light on #1 generator. Locates generator emergency procedure in Dash 1. Reads emergency procedure as directed by pilot.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:12 (cont.)	1152	voltage. Directs copilot to control aircraft. Informs Esso Lead of problem.		
02:14	1154	Responds to generator out procedures. Notes breaker circuit light on - Resets breaker switch "close". #1 breaker circuit open light remains on. Trips generator control switch. #1 bus is carried by remaining generators.	Monitors aircraft control, outside watch and HS position. Maintains position on 4.	Reads generator out procedures. Copies HS call at 60 miles.
02:15	1155	Assumes aircraft control. Maintains position on 4.	Monitors position and Rz. Advises Head Dancer and Esso Lead that generator problem is resolved.	Copies HS position, 50 miles.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:16	1156	Notes position on backside of orbit.	Monitors HS Rz and outside watch. Acknowledges Lead coordination of token offload with HS and Esso 5.	Copies HS position, 40 miles.
02:17	1157	Maintains position on 4.	Monitors HS position.	Acknowledges HS position, 30 miles. Returns to boom station.
02:18	1158	Copies center call HS at 23 NM separation. Begins turn onto Rz A/R heading and increases visual scan. Copies Lead call of final turn maneuver and standing by to "push it up". Clears boom operator for AR comm.	Monitors position halfway through the turn.	Rechecks boom station. Radio check with token offload receiver (HS 9).
02:20 (ARCT #1)	1200	Monitors position on 4.	Monitors position on nav management display. Checks and sets fuel panel for token offload.	Clears Sierra 9 to observation position.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:21	1201	Maintains heading and air-speed. Selects map display with weather. Copies Esso Lead airspeed.	Maintains outside scan. Selects map display with beacon.	Calls visual contact with Sierra 9. Clears Sierra 9 to pre-contact position.
02:22	1202	Maintains steady platform for AR contact.	Maintains position on 4 and nav location.	Clears Sierra 9 to contact.
02:23	1203	Flies aircraft and maintains visual separation in cell.	Acknowledges contact. Initiates AR pumps. Calls taking fuel.	Calls contact and taking fuel. Accomplishes token offload.
02:24 (DEPART HALIFAX)	1204	Copies Sierra 9 disconnect and clear of boom. Confirms auto update on nav management system over Halifax. Copies Lead turn to new heading/course. Calls for Post AR checklist. Monitors outside scan.	Copies Sierra 9 disconnect. Secures fuel panel. Updates nav management lat/long. Receives and records HF coded message. Updates position on JN chart. Completes Post AR checklist.	Calls Sierra 9 disconnect and clear of boom. Completes Post AR checklist.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:24 (cont.)	1204	Monitors slight course adjustment. Acknowledges Esso Lead on A/R airspeed. Sets power to maintain position on 4.	Monitors position on map display. Informs pilot of head in cockpit work.	Returns to flight deck with coffee order.
02:25	1205	Monitors heading control. Monitors map display position and weather.	Notes Esso 2, 3, 4 start A/R of Hotel Sierra. Monitors number 4 position.	Copies HF message.
02:26	1206	Monitors heading and altitude position. Confirms Sydney ETA at 1221Z.	Acknowledges Moncton request for IFF ident and traffic information.	Decodes HF message. Makes entry in comm log.
02:31	1211	Accomplishes slight course correction. Checks wind and drift on nav management display. Maintains position on 4.	Copies Esso 2, 3, 4 A/R progress.	Makes fuel log entry.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:40	1220	Monitors map display position. Notes fuel state.	Monitors Sydney ETA and weather radar.	Maintains outside visual watch.
02:41 (SYDNEY VOR)	1221	Notes Sydney station passage. Copies Esso Lead turn on course.	Copies Sydney VOR passage. Copies Esso 2, 3, 4 A/R progress.	Updates position on JN chart. Makes entry on fuel log.
02:42	1222	Monitors ETA to Ramea, GS, TAS, winds, drift and present position. Monitors weather radar.	Acknowledges Moncton traffic and IFF code change. Monitors fuel state. Departs flight deck to utilize relief facilities and returns.	Maintains outside visual scan.
02:43	1223	Monitors position.	Monitors nav management system and outside watch. Updates nav management system with radar cursor.	Notes lat/long present position and makes entry on JN chart.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
02:44	1224	Monitors position. Maintains outside visual scan.	Copies VHF frequency change and IFF change from Moncton to Gander. Responds to Esso Lead to frequency change.	Continues outside visual scan.
02:45 (A/R #1 COMPLETE)	1225	Copies call from Esso Lead that Hotel Sierra flight has completed A/R and is in cell position.	Copies check in with Gander Centre.	Continues outside visual scan. Performs HEFO check. Departs flight deck for copilot flight lunch and returns.
02:46	1226	Maintains position on 4. Notes nav location.	Checks nav system for winds, position and Ramea ETA.	Updates JN chart and fuel log for A/R activities.
02:47	1227	Monitors map display position and weather. Receives route weather update from Gander which indicates heavy weather from 40 miles west Gander VOR to 20 NM south of Ramea NDB.	Monitors weather radar and confirms weather location.	Monitors and records Esso 2, 3, 4 A/R report to Head Dancer on HF. Continues outside scan.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:48	1228	Copies Lead deviation south of Ramea to avoid weather. Confirms best route with weather radar.	Acknowledges Esso Lead weather deviation and location. Copies Lead's deviation with Gander Centre.	Logs weather location on JN chart at nav station.
02:49	1229	Monitors weather radar.	Enters new waypoint into navigation management system and selects guidance for present position direct to new waypoint south of weather.	Plots waypoint south of Ramea and gives to copilot. Plots new course on JN chart.
02:50	1230	Acknowledges Esso Lead turn maneuver preparation.	Updates navigation management lat/long.	Updates aircraft location on JN chart.
02:51	1231	Turns toward new waypoint, maintaining position on 4.	Monitors weather and number 4.	Informs Head Dancer of deviation on HF.
02:52 (WEATHER DEVIATION)	1232	Monitors weather and course on radar and map display.	Copies Gander traffic and IFF squawk. Monitors weather on radar.	Continues outside visual scan.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:58	1238	Acknowledges Esso Lead turn maneuver over deviation waypoint.	Monitors position and wind information on nav management system.	Maintains outside scan. Notifies pilot of visual location of Gander traffic.
02:59	1239	Accomplishes turn over deviation waypoint. Departs flight deck to utilize relief facilities and returns.	Copies message to Gander Center that Esso flight will proceed direct to Gander VOR. Copies Gander's consent and IFF request. Assumes aircraft control until pilot returns.	Updates aircraft position on JN chart.
03:18 (GANDER VOR)	1258	Copies Esso Lead call over Gander VOR. Weather check shows no immediate concern. Acknowledges 30 minutes prior to AR #2 from Esso Lead. Acknowledges Lead's maneuver call and ETA for 50N/50W. Maintains position on 4 and monitors map position.	Obtains radar fix for nav update. Selects INS guidance on nav mode selector. Verifies flight director/HSI is referencing true north and RMIs referencing magnetic north.	Checks coast out lat/long with copilot. Updates aircraft position on JN chart.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:24	1304	Maintains formation position. Directs copilot to confirm next ETA.	Monitors weather, beacon, and map display. Confirms ETA to 50N/50W 1324Z.	
03:39	1319	Assumes echelon for A/R 2 as directed by Esso Lead. Monitors position and weather radar.	Copies message that 50N/50W ETA for top off is in seven minutes. Acknowledges echelon call from Lead. Monitors 50/50 ETA and present position on nav system.	Continues outside watch.
03:43	1323	Acknowledges ready for turn maneuver. Copies Esso 2, 3, 4 ready for A/R top off.	Monitors nav management system.	Continues outside watch.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:44 (A/R #2)	1324	Notes crossing 50/50 inter-section. Maintains position in turn on course. Copies 50/40 ETA. Monitors radar and position on map display. Notes fuel status.	Monitors auto update of nav system. Verifies nav system accuracy at present position. Copies 50/40 ETA (1416Z). Checks position on map display.	Updates fuel log. Updates position on JN chart over 50W.
03:53	1333	Copies Esso 4 report that HS 12 is not taking fuel.	Copies Esso 4 report that HS 12 is not taking fuel.	Updates JN chart position noting A/R problem. Maintains outside scan.
03:55	1335	Copies Esso 4 that HS 12 problem has been resolved.	Monitors forecast wind with actual winds.	Advises pilot of visual traffic. Copies Esso message to Head Dancer concerning AR problem.
04:00 (E A/R #2)	1340	Copies Esso 2, 3, 4 call that refueling is completed.	Monitors weather on map overlay.	Monitors and copies Post Air Refueling report from Esso 2, 3, 4 to Head Dancer. Updates JN chart with A/R data.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
04:00 (cont.)	1340			Updates fuel log. Performs HEFO check.
04:02	1342	Monitors position on map display. Checks ETAs and wind. Request flight lunch from boom operator.	Monitors Mac Dill with clearance for Esso 2, 3, 4 to return to Loring AFB.	Maintains outside visual scan. Departs flight deck for flight lunches.
04:03	1343	Copies Esso 2, 3, 4 clearing from cell for return flight. Acknowledges call from Esso Lead to clear 2, 3, and 4, descend to FL295 and close it up. Esso 5 now becomes Esso 2. Acknowledges HS flight in position on Esso Lead and 2.	Provides Esso Lead with nav data to update his nav system. Checks 40 west ETA (1416Z).	Delivers box lunch. Updates position on JN chart. Maintains outside visual scan. Consumes box lunch.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:10	1350	Acknowledges Esso Lead has lost radar. Assumes responsibility for flight. Esso 1 will navigate and make HF calls while Esso 2 monitors weather and flies formation.	Coordinates Lead radar problems with HS flight.	
04:14	1354	Relays to Esso Lead suggested vectors around heavy weather cells at twelve o'clock.	Maintains outside scan. Systems monitoring.	Maintains visual scan.
04:36 (40 W)	1416	Checks fuel log and position information. Checks in with HS for fuel state. Copies Esso 1 50N/40W position.	Monitors weather radar and present position on map display. Copies Esso 1 report to Mac Dill airways of 50N/40W position with 30 W ETA of 1504Z.	Copies traffic and weather and advises pilot of visual traffic.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:54 (30 MINUTES PRIOR TO A/R #3)	1434	Calls for Preparation For Contact checklist. Alerts flight of 30 minutes prior to A/R.	Reads and responds to check- list. Call checklist com- plete. Accepts JN chart and fuel log from boom operator.	Departs flight deck for boom station. Checks in on inter- com and proceeds with checklist.
05:14	1454	Alerts flight of A/R ETA in 10 minutes. Monitors performance and position on map display.	Monitors weather radar. Checks nav position against ETA.	Completes Preparation For Contact checklist. Advises pilot.
05:22	1502	Directs boom operator to clear HS 7-12 in for A/R.	Rechecks fuel load and pro- posed offloads. Checks posi- tion and 30 W ETA.	Reports refueling station ready for A/R. Clears HS 7-12 in for A/R.
05:23	1503	Calls for 1/2 Mile A/R checklist. Continues visual scan. Notes weather on AR track.	Reads and completes 1/2 Mile A/R checklist.	Alerts pilot, exercises and positions boom. Scans for HS 7. Completes radio check with HS 7. Calls HS 7 in sight. Clears HS 7 to pre- contact.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
05:24 (30 W A/R #3)	1504	Notes passage of 30 west. Checks fuel and position. Monitors map display and outside scan. Provides Esso Lead with vectors to avoid weather cells.	Copies Esso 1 call to Mac Dill airways for 30 west position and ETA to 20 W (1554Z). Notes auto update of nav management system. Acknowledges Esso 1 frequency change to Croughton Airways. Makes entry on JN chart.	Acknowledges pre-contact position from HS 7. Clears to contact position. Gives directions toward boom.
05:25	1505	Maintains outside scan.	Sets A/R switches. Notifies boom operator "receiver taking fuel".	Calls contact. Acknowledges HS contact call.
05:29	1509	Monitors position. Main- tains outside scan.	Turns off A/R pumps. Notifies boom operator that receiver has taken on briefed fuel load and records fuel load for HS 7 receiver.	Gives receiver "Disconnect Now" call. Calls disconnect. Notifies receiver clear of boom.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
05:30	1510	Monitors trim. Monitors weather location and position on Lead.	Checks position on navigation management system. Monitors contact with Croughton Airways - no contact.	Clears next receiver into pre-contact position from observation position.
05:32	1512	Monitors A/R and aircraft control.	Turns on A/R pumps. Monitors A/R. Monitors Croughton position report and 20 W ETA. Croughton assumes primary guard. Acknowledges contact. Advises boom operator "receiver taking fuel".	Clears second receiver into contact position. Guides receiver into contact. Calls contact.
05:36	1516	Maintains aircraft control and monitors position on nav map display.	Continues monitor A/R for HS 8-11 receivers.	Continues A/R for HS 8-11 receivers.
05:50	1530	Continues monitor of position and outside watch.	Monitors nav position and radar.	Clears last receiver (HS 12) into pre-contact from observation position.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
05:52	1532	Monitors aircraft control and position.	Monitors A/R.	Clears HS 12 into contact position. Guides receiver into contact. Calls contact.
05:53	1533	Acknowledges A/R problem. Directs repeat contact.	Turns A/R pumps on with contact call and indicator. Notifies boom no fuel flow. Checks nearest airfield location - Identifies Shannon. Checks lat/long and enters into nav system.	Acknowledges a no fuel indication from receiver and no fuel flow call from copilot. Clears receiver to disconnect, recycle system and try again.

ELAPSED
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BOOM OPERATOR

05:55	1535	Coordinates proposed action with HS Lead and HS 12 and Esso 1. Directs manual override. Requests fuel state from receiver. Acknowledges one hour, twelve minutes. Continues to provide Lead with vectors to clear weather cells.	Continues to operate fuel panel and notifies boom of no fuel at each contact attempt. Notifies Head Dancer of A/R problem; passes position and receiver fuel state. Notifies Head Dancer of emergency action taken. Acknowledges advice from Head Dancer. Acknowledges nearest airfield data request from HS Lead and copies maximum range IAS for A-7.	After several normal contacts, coordinates manual override attempt. Acknowledges no fuel flow with manual override.
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ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
05:57 (E A/R #3)	1538	Directs emergency boom latch. Requests Head Dancer coordinate problem with Duckbutt.	Notifies boom operator prior to turning A/R pumps on. Notifies receiver of little fuel flow. Stops A/R pumps as excess spill is reported. Records nav system data (course, distance and time) for A-7 to Shannon.	Briefs receiver on emergency boom latch procedure. Clears receiver for contact. Calls contact. Acknowledges contact. Reports excess fuel spill on receiver. Boom directs receiver disconnect.
06:02	1543	Directs termination of A/R attempt. Directs boom operator to try emergency boom latch for tow hook up.	Passes nearest suitable airport data (Shannon) to receiver. Coordinates final efforts with Head Dancer.	Attempts tow hook up with receiver. Acknowledges receiver manual latch inoperative. Advises HS 12 termination of tow attempt.
06:06	1547	Acknowledges HS lead and Head Dancer coordination of escort for HS 12 by HS 11 to Shannon. Coordinates with HS lead that Esso 2 proposes to continue flight plan to U.K. with HS 1-10. with present winds, he should	Checks time, distance and course to Shannon from nav management system. Applies A-7 max range performance and passes data to HS. Advises HS 12 that	Runs Post A/R checklist.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
06:06 (cont.)	1547	Confirms Esce present position with Head Dancer and plan of action. Acknowledges Duckbutt location and proposed Rz with disabled receiver at 18 west enroute to Shannon. Calls for Post A/R checklist.	make landfall, approximately 40 miles short of Shannon. Also passes course and distance from Shannon to RAF Wittering. Runs Post A/R checklist and calls complete.	
06:11 (20 WEST)	1551	Acknowledges UHF contact between HS 11 and Head Dancer. Confirms Head Dancer will assume comm and nav cover for HS 11 and HS 12 and will coordinate with Duckbutt and Croughton Airways as HS 11 and HS 12 break formation. Directs boom operator to attempt phone patch with MLD. Acknowledges	Acknowledges call from Duckbutt at 18 west. Confirms situation with Duckbutt. Acknowledges Duckbutt comm link with Head Dancer and HS 11. Acknowledges Esso 1 cannot contact Croughton with 20 west position. Directs boom to pass position to MLD.	Advises pilot that A/R system checks ok and Post A/R checklist is complete. Departs A/R station for flight deck. Attempts phone patch with MLD for coordination. MLD occurs to continue with HS 1-10 flight plan route. Requests position of 20 west be passed to Croughton Airways at 1554Z.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
06:11 (cont.)	1551	MLD information and passes to HS Lead and Head Dancer. Directs HS Lead thru 5 form on Esso 1; HS 6 thru 10 on Esso 2.		
06:22	1602	Checks present position on map display, nav system position data and fuel status.	Notes nav system present position and fuel status.	Assumes flight deck position at nav station. Starts updating JN chart and fuel log. Completes HEFO check.
06:29	1609	Rechecks fuel status and continues outside watch.	Checks 10 west ETA (1645). Passes position information to the rest of the flight.	Continues to update charts and logs. Moves to jump seat and begins outside visual scan.
06:34	1614	Checks winds and aircraft performance on nav management system. Starts vectoring Lead around final weather cells.	Checks in with Head Dancer on HF concerning HS 12 status.	Notes aircraft position on JN chart.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
06:35 (30 MINUTES PRIOR TO A/R #4)	1615	Copies HS 11 and HS 12 status from Head Dancer. Monitors position on map display. Alerts flight of 30 minutes prior to A/R	Checks ETA to next A/R at 10 W. Acknowledges HS 11 and HS 12 Rz with Duckbutt at 18 west.	Continues outside scan. Acknowledges next A/R ETA of 1645Z. Copies HF coded message. Decodes message.
06:37	1617	Monitors position. Continues outside scan.	Confirms 10 W ETA to flight along with nav position and winds data.	Continues outside visual scan. Brings logs up to date.
06:55	1635	Calls for Preparation For Contact checklist.	Updates flight on A/R ETA. Starts A/R checklist. Accepts charts and logs from boom operator.	Departs flight deck for A/R station.
07:00	1640	Acknowledges A/R checklist from copilot and boom operator.	Completes checklist up to the 1/2 mile check. Updates fuel log. Alerts flight 5 minutes prior to refuel.	Checks in with pilot. Starts A/R checklist. Informs pilot boom coming down.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
07:01	1641	Monitors position, airspeed, and outside watch. Clears boom operator to command radio.	Acknowledges flight ready for A/R. Maintains outside watch. Confirms projected onload with HS 6.	Checks in with HS 6 for radio check. Completes A/R checklist. Notifies pilot ready for A/R.
07:02	1642	Clears boom operator to begin A/R. Checks airspeed steady for A/R.		Clears HS 6 into pre-contact position.
07:03	1643	Acknowledges pre-contact call from boom operator.	Completes 1/2 mile position A/R checklist. Notifies pilot, checklist complete.	Calls visual on 6 in pre-contact. Alerts pilot and lowers boom into A/R position.
07:04	1644	Monitors airspeed, position and outside watch.	Rechecks A/R panel ready and notifies boom operator.	Clears 6 to contact position. Starts verbal guidance toward boom.
07:05 (A/R #4, 10 WEST)	1645	Monitors aircraft control and outside watch. Completes weather vectors for Esso Lead.	Sets A/R pumps to transfer fuel. Advises boom that receiver is taking fuel. Makes JN chart log entry. Monitors Esso 1 position	Calls contact and acknowledges receiver contact call. Confirms fuel flow to receiver.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
07:05 (cont.)	1645		report of 10 west to Croughton Airways. ETA 8 W (1655).	
07:10	1650	Monitors aircraft control and outside watch. Checks weather radar.	Sets A/R switches to stop fuel transfer. Monitors position and AR.	Notifies receiver of full load. Acknowledges confir- mation from receiver. Clears receiver to "disconnect now".
07:11	1651	Checks fuel status, monitors aircraft control and outside watch.	Checks nav system position.	Guides receiver clear of boom.
07:12	1652	Monitors aircraft control and outside watch.	Checks A/R panel. Acknowledges call from Croughton Airways to contact London Control on VHF and set up IFF.	Clears next receiver from observation position to pre-contact position.
07:13	1653	Monitors aircraft control and outside watch.	Calls London Control with flight position. Acknowledges IFF ident. Acknowledges contact and receiver taking fuel.	Guides receiver to A/R contact. Calls contact and acknowledges receiver contact call.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
07:15	1655	Acknowledges call from Duckbutt that HS 12 has flamed out 50 miles west of Shannon and has decided to attempt a glide to the airport from 40,000 ft. Weather at Shannon is scattered to broken. HS 11 is on wing and will assist into Shannon. Duckbutt will maintain cover into Shannon.	Copies Duckbutt message and relays to HS flight. Continues A/R procedures. Monitors Esso 1 calls of 8 W to London Control. ETA Lands End 1707Z. Secures Croughton HF radio frequency.	Continues A/R.
07:27	1707	Coordinates A/R. Maintains outside watch and monitors aircraft control. Copies Esso 1 position and turn maneuver. Monitors nav system update. Turns aircraft. Selects radio nav mode and verifies change to magnetic north reference.	Monitors and operates A/R system. Maintains logs and comm with boom operator. Maintains outside watch. Monitors Esso 1 calls to London with Lands End position. Notes radar contact. Notes Brize Norton ETA of 1731Z. Updates INS with radar at coast in.	Repeats A/R procedures to top off all HS receivers.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
07:30	1710	Monitors aircraft control and outside watch. Checks fuel status, position and progress on map display. Checks Brize Norton ETA of 1731Z. Acknowledges boom operator EAR.	Calls London Control with request for Hotel Sierra flight clearance from present position to RAF Wittering. Checks Wittering weather and passes to HS flight.	Reports EAR to pilot.
07:31	1711	Calls for Post A/R checklist.	Performs Post A/R checklist. Notifies flight of present position and RAF Wittering ETA.	Performs Post A/R checklist.
07:33	1713	Acknowledges copilot and boom operator calls.	Notifies pilot that checklist is complete.	Notifies pilot that checklist is complete and departing A/R station for flight deck.
07:34	1714	Copies clearance from London Control. Monitors aircraft control and position.	Acknowledges clearance from London Control for HS flight to RAF Wittering.	Checks cabin for security. Draws a cup of coffee.
07:35	1715	Monitors position on map display.	Passes clearance to HS lead. Checks position on map display.	Assumes position in jump seat. Updates fuel log and JN chart

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
07:35	1715			from copilot information.
(cont.)				Performs HEFO checklist.
07:36	1716	Clears HS flight to terminate cell and proceed with London Control.	Relays from nav management system to HS flight, the time distance and course to RAF Wittering. Clears HS flight to change frequency for London Control.	Continues outside watch and chart update.
07:37	1717	Monitors position and progress. Checks winds and groundspeed. Checks ETA to Brize Norton. Monitors weather radar and outside watch.	Acknowledges call from Head Dancer that HS 11 and HS 12 had just landed at Shannon. Acknowledges request to pass message to HS flight that HS 11 and HS 12 will refuel and rejoin at RAF Wittering.	Updates fuel log and continues outside watch.
07:38	1718	Monitors aircraft control, position and progress.	Calls HS on UHF and passes message from Head Dancer.	Monitors outside watch.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
07:41	1721	Checks station passage at Yeovilton. Notes auto update on nav system. Monitors progress on map display. Monitors weather radar. Request Esso 1 set power for inflight engine data check. Request copilot coordinate cell termination with Esso 1.	Notes passing Yeovilton. Acknowledges frequency change to London Military. Monitors aircraft systems. Coordinates with Esso 1 and London for cell termination. Acknowledges London vectors Esso 1 out of cell.	Enters position on JN chart. Monitors outside watch.
07:49	1729	Continues aircraft control monitor and outside watch.	Checks in with London Military and acknowledges ident squawk.	Records data for inflight engine check. Continues outside watch.
07:51	1731	Monitors auto nav update, aircraft control and aircraft systems. Verifies ETA to MLD IAF 1749Z.	Calls passing Brize Norton to London Military.	Updates JN chart.
07:52	1732	Calls Mildenhall Metro for local weather and forecast. Monitors aircraft control	Copies MLD weather. Calls MLD command post with A/R report, fuel status, maintenance status	Monitors outside watch. Acknowledges weather. Monitors command post as directed.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
07:52 (cont.)	1732	and position. Acknowledges weather of 300'/1 mile, winds, light and variable. Best alternate is RAF Wittering with 1000'/2 miles. Forecast no change.	and ETA of 1800Z. Acknowledges weather alert. Directs boom operator to monitor command post on UHF for remainder of flight. Passes pilot report to Metro.	
08:02	1742	Requests copilot to ask for descent to FL250. Also requests HI TACAN/GCA Rw 29. Calls for Descent checklist.	Calls London Military with request. Frequency change to Eastern radar is acknowledged. Checks in with Eastern radar with request. Acknowledges IFF ident. Responds to checklist.	Maintains outside watch. Reads checklist. Verifies landing data from nav management system.
08:03	1743	Starts descent with power adjustment. Enters new altitude for MLD IAF.	Acknowledges clearance to FL250 to HI TACAN Rw 29 IAF with ILS final. GCA is temporarily out of service. Calls departing FL290.	Monitors outside watch.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
08:05	1745	Monitors descent and map display position. Monitors weather radar.	Enters IAF holding pattern guidance into nav management system.	Monitors outside watch. Advises pilot of visual traffic.
08:07	1747	Levels off at FL250. Directs copilot to request immediate approach. Adjusts power to attain penetration speed.	Calls Eastern radar with level altitude report at FL250. Request immediate approach. Acknowledges hold with expected approach time of 1752Z.	Monitors outside watch.
08:08	1748	Adjusts power to attain holding speed of 220 KTS. Monitors aircraft control and position.	Studies approach plate and reviews approach with crew. Selects radio nav mode and verifies magnetic reference.	Posts landing data for pilot. Reviews altitudes for approach.
08:09 (MLD IAF)	1749	Monitors entry into holding pattern.	Continues Descent checklist. Calls Eastern Radar entering holding at IAF. Acknowledges IFF change. Verifies TACAN approach waypoints in nav management system.	Reads Descent checklist. Calls complete up to penetration.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
08:12	1752	Acknowledges approach clearance. Calls departing IAF and FL250. Throttles idle, calls gear down, sets speed brakes 60°.	Acknowledges clearance for approach. Calls departing IAF and FL250. Acknowledges frequency change to Honington control. Lowers gear.	Monitors approach.
08:14	1754	Continues approach. Monitors position on map display.	Monitors weather radar. Monitors altitude and course. Checks in with Honington approach control.	Calls departing FL200 for 3500'.
08:16	1756	Monitors approach and air-speed. Checks temperature for anti-ice and de-ice requirements.	Monitors altitude, course and DME. Checks weather radar.	Calls departing FL150 for 3500'.
08:18	1758	Checks position, altitude and airspeed. Checks map display progress.	Checks weather radar, altitude, airspeed and location. Notes entering tops at FL100.	Calls departing FL100 for 3500'.
08:20	1800	Starts turn to final at 21 DME. Monitors altitude and	Checks weather radar. Monitors altitude and airspeed. Checks	Calls departing FL5.5 for 3500'.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
08:20 (cont.)	1800	<p>airspeed. Requests copilot to nav management system for proper verify set up for ILS intercept. ILS set up. Acknowledges request from Honington to call turning final. Selects ILS</p> <p>Selects ILS map.</p>		
08:21	1801	<p>Captures final course.</p> <p>Monitors descent altitude and airspeed. Notes 210 KTS. Retracts speed brakes and calls for flaps 30°. Resets altimeter at FL40. Calls for Before Landing checklist.</p>	<p>Calls Honington at 21 DME.</p> <p>Lowers flaps to 30° at pilot command. Acknowledges altimeter setting and clearance for ILS Rw 29. Resets altimeter at FL40. Responds to Before Landing checklist.</p>	<p>Calls departing FL4.5 for 3500'. Calls Descent checklist complete. Reads Before Landing checklist.</p>
08:22	1802	<p>Confirms with copilot that they are cleared for ILS. Checks altitude, airspeed and map display position.</p>	<p>Checks altitude, airspeed and on course. Monitors weather radar. Checks position on map display.</p>	<p>Calls departing 3500' for 2500'.</p>
08:23	1803	<p>Monitors position and altitude level off. Selects localizer and accomplishes capture.</p>	<p>Acknowledges approach clearance, winds and weather at 300'/1 mile.</p>	<p>Calls departing 2600' for 2500'.</p>

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
08:24	1804	Descends to 2200'. Accomplishes descent. Monitors airspeed and position.	Monitors weather radar, position, altitude and airspeed. Acknowledges Honington request for FAF call.	Calls out of 2300' for 2200'.
08:25	1805	Continues to monitor descent to 1500'. Selects ILS auto couple to glideslope and notes autopilot capture glideslope. Continues to fly localizer manually. Calls for Before Landing checklist. Establishes final approach configuration and airspeed.	Calls FAF departing 1500'. Monitors weather radar, altitude and airspeed. Monitors position on map display.	Calls departing 1600' for 1500'. Calls Before Landing checklist complete. Monitors weather radar.
08:26	1806	Monitors glideslope and localizer displacement. Monitors altitude, airspeed and position on map display.	Continues to monitor weather radar, altitude and airspeed. Checks progress on map display.	Monitors approach.
08:27	1807	Searches for runway while monitoring flight instruments. Acknowledges middle marker	Calls middle marker and lights in sight. Monitors altitude, airspeed and attitude. Calls	Calls 100' above DH.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
08:27 (cont.)	1807	passage. Acknowledges lights in sight and calls lights in sight.	field in sight to Honington approach. Acknowledges frequency change to tower.	
08:28	1808	Flares aircraft slightly and reduces power for touch- down. Lowers nose and extends speed brakes.	Monitors altitude, airspeed and attitude. Holds yoke for- ward as briefed. Responds to tower request for pilot report.	Notes touchdown time.
08:28	1808	Maintains directional con- trol with rudder and decelerates with brakes	Maintains forward yoke pres- sure. Maintains outside watch. Responds to frequency change from tower to ground control.	Monitors systems/communications.
08:29	1809	Uses nosewheel steering to taxi clear of runway. Calls for After Landing checklist.	Responds to After Landing checklist. Maintains outside watch. Checks in with ground control.	Reads After Landing checklist. Maintains outside watch.
08:30	1810	Taxis to ramp, parks air- craft as directed by ground	Responds to After Landing checklist. Maintains outside	Completes After Landing checklist. Maintains outside

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
08:30	1810	crew and calls for Engine watch. Checks in with command watch.		
(cont.)		Shutdown checklist. post.		
08:31	1811	Responds to Engine Shutdown checklist. Completes paperwork. Extracts nav log, fuel log and engine log memory recordings from interface system.	Reads and responds to Engine Shutdown checklist. Completes paperwork. Extracts	Departs flight deck for cabin duties.
08:40	1820	Offloads equipment and deplanes.	Offloads equipment and deplanes.	Offloads equipment and deplanes.

MILDENHALL EWO MISSION

After arrival at RAF Mildenhall, the KC-135 crew has completed their crew rest and are now on alert in the alert facility. Nuclear war appears imminent. The following is a mission scenario for KC-135A, call sign Filip 66. The mission kit shows this aircraft as number 2 in a two ship cell of KC-135s. The takeoff will be from RAF Mildenhall to a rendezvous with two B-52s coming easterly from the United States. The rendezvous point is in a high latitude area at N73° 00' W001° 00'. The ARCT will be 0130Z.

The fuel offload will be 130,000 pounds per each KC-135 with a recovery in northern Norway. The lead KC-135, Filip 61, will be responsible for the navigation and communication enroute. Filip 66 will follow in formation using airborne radar to keep his relative position (station keeping) from the lead aircraft. The crew will navigate and monitor communications as a backup. The crew has studied the mission and completed the necessary flight planning. The aircraft is cocked. The proposed flight plan and the aircraft's position on the alert pad have been stored in the navigation management system.

As an overview to this portion of the mission scenario, hostilities have broken out between Communist block countries and friendly nations. As a result, the SAC alert force has launched and is proceeding toward target areas. The two ship cell of KC-135s depart RAF Mildenhall at 2200Z,

Page 2
MILDENHALL EMO MISSION

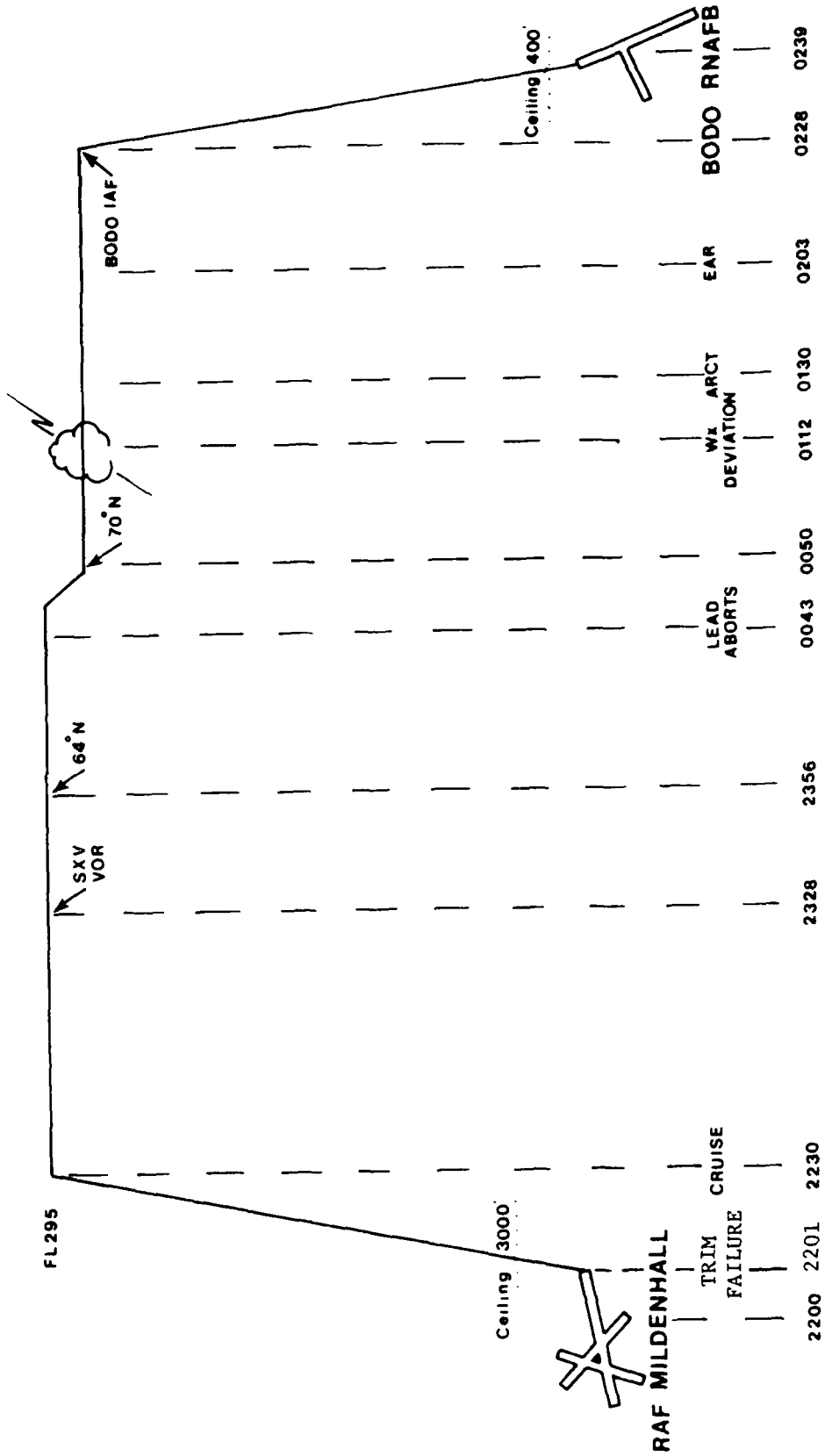
nighttime, with a 3,000 foot ceiling and 7 nautical miles visibility. They climb to FL290 and FL295 respectively, and proceed in IMC conditions by normal navigation and station keeping procedures direct to an overwater, high latitude rendezvous with their two B-52s receivers. Approximately four hundred miles prior to the ARCP, the lead KC-135 experiences an uncontrollable engine fire. That aircraft leaves the formation and sets course toward an emergency recovery base, while Filip 66 proceeds. When approaching the ARCP, several severe thunderstorms with tops estimated at above FL400 are detected in the planned refueling track by Filip 66 and the two B-52 receivers, Bozo 21 and Bozo 24. A new refueling track clear of the thunderstorms is plotted and coordinated between aircraft. Authentications are completed and a diversion is made to the new refueling track. A modified point parallel rendezvous is completed. Filip 66 refuels both Bozo 21 and 24, since the other tanker was not available. Filip 66, with only emergency fuel, recovers at the nearest airfield, Bodo, Norway. Ground navigation aids have been shut down or jammed so an airborne radar approach (ARA) is made with only enough fuel for one approach. The weather at Bodo is a 400 foot ceiling and 1 NM visibility in nighttime conditions. The mission is further complicated by a stabilizer trim failure on departure, the tankers rendezvous beacon being inoperative, smoke and fumes from the air conditioning system being detected during the

Page 3
MILDENHALL EWO MISSION

aerial refueling of the B-52s and two engines flaming out from fuel starvation on final approach to landing. The detailed description of the mission scenario begins at the sound of the Klaxson horn and terminates with recovery at Bodo, Norway.

NOTE: The boom operator will read all checklists except when coded messages must be copied and decoded or when he is in the boom pod, at which times the copilot will read the checklists.

MILDENHALL EWO MISSION



ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:00 (KLAXSON)	2150	Hears Klaxson. Grabs flight jacket and runs to the alert aircraft.	Hears Klaxson. Grabs flight jacket and runs to the alert aircraft.	Hears Klaxson. Grabs flight jacket, two apples and a banana and runs to the alert aircraft.
00:03	2153	Arrives at aircraft. Observes boom operator and crew chief pulling wheel chocks and engine plugs from the engines and throwing them clear of the aircraft. Runs to the crew ladder and ascends to the cockpit.	Arrives at aircraft. Runs immediately up the crew ladder. Turns battery switch to EMERGENCY. Adjusts seat, fastens seat belt, dons headset and observes UHF radio is warmed up.	Arrives at aircraft. Assists in pulling wheel chocks and engine plugs. Runs to the crew ladder and ascends to the cockpit.
00:03	2153	Calls for Starting Engines and Before Taxiing checklist. Adjusts seat. Fastens seat belt. Sets parking brakes. Checks reserve brake pressure and observes crew chief giving thumbs up signal indicating that the aircraft is ready to start.	Reads bold face items on Starting Engines and Before Taxiing checklist.	Occupies nav station. Copies coded message being transmitted on UHF.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:04	2154	Moves all four starter switches to GROUND START. Pulls the start selector switch to the CRT START position. Observes RPM on all tachometers. Releases the start selector switch to OFF at 12 percent rpm. Moves the throttles to START and observes rise in EGT. Moves throttles to idle position when engines reach 30 percent rpm. Checks EGT, fuel flow and oil pressure lights. Places starter switches OFF. Checks that hydraulic pump inoperative lights are extinguished. Checks hydraulic quantity for four gallons minimum.	Monitors engine START and accomplishes checklist. Moves generated breaker switches to CLOSE. Sets INS system to ALIGN. Sets doppler system to ALIGN. Turns nav management system ON. Checks and confirms doppler sent position display agrees with present position of aircraft. Turns doppler to operate.	Decodes message. Informs pilot of valid launch message.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:07	2157	Resets altimeter. Acknowledges start taxi from Filip 61.	Resets altimeter. Checks the alarm bell, calls for Taxi Report and states "Alarm bell checked. Ready to taxi." Calls Starting Engines and Before Taxiing checklist complete.	Observes crew chief coming through hatch, stowing ladder and closing crew entry door. States, "Alarm bell checked. Ready to taxi."
00:08	2158	Observes aircraft clear of obstructions. Calls for Taxi checklist. Advances throttles. Releases parking brakes and begins taxiing. Checks brakes and nosewheel steering. Checks flight instruments.	Observes Filip 61 taxiing onto the Christmas tree ahead and informs pilot. Reads Taxi checklist. Clears the aircraft of ground obstructions to the right. Calls "Filip 66 taxiing" on UHF. Checks flight instruments. Calls Taxi checklist complete.	Clears aircraft of obstructions on both left and right sides. Copies coded message on UHF. Decodes message.
00:09	2159	Calls for Before Takeoff checklist. Checks stabilizer, aileron and rudder trim set for takeoff. Checks speed brakes set to 0°.	Reads Before Takeoff checklist. Checks electrical panel. Checks stabilizer, aileron and rudder trim Set For Takeoff. Sets flaps	Informs pilot of message content.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
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00:09 (cont.)	2159	Checks flaps set for takeoff. Checks rudder power ON. Briefs takeoff data. Closes the sliding window. Sets window heat to Normal. Sets the pilot's pitot heat and Q-inlet flight director mode selector switch to RGA. Sets takeoff climb selector switch to MAX. Checks warning indicators, flags and annunciators for correct indications. Continues to taxi onto the runway behind Filip 61.	Rechecks takeoff data. Sets window heat to Normal. Turns pitot heat and Q-inlet heat ON. Sets FD mode selector switch to RGA. Sets takeoff climb selector switch to MAX. Checks warning indicators, flags and annunciators for correct indications. Calls Before Takeoff checklist completed.	
00:09	2159	Calls for Takeoff checklist. Confirms with the boom operator that the launch message has been received and decoded. Observes Filip 61 starting a rolling takeoff. Starts aircraft hack clock. Sets	Turns radar on the BEACON MODE. Displays flight plan on the navigation management system. Turns water boost pumps ON. Notifies pilot and boomer of water flow. Guards throttles and makes final power adjustments.	Reads Takeoff checklist. Confirms launch message to pilots. Starts timing of water flow.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:09 (cont.)	2159	<p>starter switches to Flight</p> <p>Start. Calls for water boost pumps ON. Advances throttles to wet TRT, observes the EPR while lining up on the runway center line for a rolling takeoff.</p>		
00:10 TAKEOFF	2200	<p>Maintains directional control with nosewheel steering, then rudders. Checks airspeed indicator. Crosschecks copilot's call of "S1" speed. Crosschecks copilot's call of rotation speed. Rotates the nosewheel off the runway and obtains an 8 to 9 degree nose high pitch attitude.</p>	<p>Checks engine instruments. Holds control column forward. Checks flight instruments. Calls S1 speed. Calls rotation speed.</p>	<p>Notes takeoff time. Monitors engine instruments. Monitors aircraft subsystems indications. Monitors outside the aircraft for runway obstacles. Monitors HF radio.</p>
00:11	2201	<p>Flies the aircraft off the runway. Adjusts pitch attitude</p>	<p>Notes liftoff at runway over-run. Raises landing gear</p>	<p>Monitors aircraft performance and monitors lead aircraft</p>

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
00:11 (cont.)	2201	to flight director indication. Observes acceleration to best climb speed. Observes positive rate of climb. Calls landing gear UP and observes copilot raise the gear handle. Detects hard pitch up in control column. Exerts forward force on control column to stabilize pitch, holding wings level and stops trim wheel with leg force. Directs copilot to select cutout position on stab trim switch. Retrims manually and directs boom operator to read procedures from dash one.	handle. Sets the flight director mode selector to HDG. Adjusts manual pitch command knob. Selects stab trim switch to cutout position.	on radar beacon mode display. Checks dash one. Reads stab trim emergency procedures to the pilot.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
00:12	2202	Observes water burn out at approximately 125 seconds. Calls for water out EPR. Maintains four engine climb speed. Adjusts attitude on the flight director. Continues climbing straight ahead until reaching maximum flaps cleanup height. Calls flaps UP and observes flaps retracting. Sets flight director mode selector to HDG. Adjusts the manual pitch command knob. Accelerates to	Sets water out EPR. Sets MRT. Drains water. Accomplishes After Takeoff Climb checklist. Sets fuel panel valves and pump switches. Turns RGA power switch OFF.	Notifies pilot of water burn out time. Reads After Takeoff Climb checklist.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:12 (cont.)	2202	enroute climb speed. Requests MRT and After Takeoff-Climb checklist.		
00:13	2203	Calls for anti-ice ON. Directs crew chief to check cargo compartment secured and to scan the wings and engines.	Adjusts radar to observe Filip 61's beacon. Informs the pilot of Filip 61's location and calls "Filip 66 in position" to Filip 61. Turns on anti-ice and resets MRT.	Acknowledges cargo compartment and wing scan report from crew chief. Continues to monitor engine instruments and aircraft subsystems.
00:14	2204	Engages autopilot. Observes Filip 61 turning left on cockpit radar display. Starts left turn to obtain formation position in trail. Begins installation of ther- mal radiation curtains.	Crosschecks flight instruments and radar display. Begins installation of thermal radia- tion curtains.	Assists pilot and copilot in installation of thermal radiation curtains.
00:15	2205	Rolls out of turn in trail	Crosschecks flight instruments	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:15 (cont.)	2205	with Filip 61 at 1 1/2 miles in the twelve o'clock position.	and radar beacon display. Checks doppler readout for wind indication.	
00:17	2207	Sets altimeters to 29.92 passing transition altitude of 4,000 feet. Monitors position of Filip 61 on radar display. Maintains position on Filip 61. Completes installation of thermal radiation curtains.	Sets altimeter to 29.92. Selects present position display on nav management system. Completes installation of thermal radiation curtains.	Crosschecks desired position on JN chart. Copies and decodes HF message. Makes entry in communication log.
00:18	2208	Continues to fly aircraft in trail with Filip 61. Continues to monitor Filip 61 on UHF 1. Monitors GCI on UHF 2.	Tunes TACAN and VOR. Checks reception. Determines that nav aids signals are not being received. Checks present position in latitude/longitude from doppler system on nav management CDU. Passes	Continues to monitor mission control on HF. Makes entries on column log. Monitors aircraft engine instruments and aircraft subsystems indications.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:18 (cont.)	2208		present position lat/long to boomer. Continues to monitor all comm radio frequencies.	
00:22	2212	Continues to fly aircraft through 10,000 feet MSL. Rechecks oxygen regulator to 100% and ON. Continues to monitor radar display for formation position.	Rechecks oxygen regulator to 100% and ON. Checks anti-icing systems for proper operation.	Rechecks oxygen regulator to 100% and ON. Confirms with copilot the aircraft position on JN chart. Calls After Takeoff-Climb checklist complete.
00:23	2213	Notes position of Filip 61 at twelve o'clock, one mile.	Crosschecks present position with GCI and Filip 61 (radar position). Places radar in search mode for skin paint.	Plots position on JN chart.
00:28	2218		Notes Filip 61's termination of communications with ground control radar (GCI). Monitors present position. Monitors radar display for relative	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:28 (cont.)	2218		position to Filip 61 and con- firms with pilot that his position is now twelve o'clock, 1 1/4 miles.	
00:30	2220	Notes nav system INS ready light illuminated.	Selects align position to update nav system. Identifies position with radar and cur- sor. Enters aligned position on both INS systems. Selects NAV/INS position.	Selects INS #2 NAV position to backup pilots nav on INS #1.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
00:40	2230	<p>Levels aircraft at flight level 295. Adjusts power to maintain position and 430 K TAS. Maintains airspeed and altitude. Observes radar display showing Filip 61 at twelve o'clock, 1 1/2 miles.</p>	<p>Requests present position coordinates of the lead aircraft on UHF. Places INS control in Operate mode. Selects "INS" position on nav mode selector switch.</p> <p><u>NOTE:</u> When "INS" position is selected on nav mode selector switch, the horizontal situation display (HSI/HSD) receives information from the inertial navigation system and the aircraft heading reference for the HSI/HSD displays true heading/true course information. The RMIs and the standby</p>	<p>Makes entry in fuel log. Makes HEFO check.</p>

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:40 (cont.)	2230		<p>magnetic compass continues to display magnetic heading information. When the nav mode selector switch is positioned to either VOR/ILS or TACAN, the HSI/HSD heading reference displays magnetic heading information.</p>	
00:41	2231		<p>Receives present position coordinates of lead aircraft. Places INS readout in HOLD. Updates and inserts present lat/long position in INS system. Takes INS readout out of HOLD. Informs pilot that air alignment of INS has been completed. Informs boom operator of present lat/long position.</p>	Plots the present lat/long position on the JN chart.

ELAPSED
TIME
HR:MIN

PILOT

COPILOT

BOOM OPERATOR

00:43	2233	Continues to fly aircraft. Observes Filip 61 at twelve o'clock, one mile on the radar display. Confirms with copilot and requests copilot to inform Filip 61.	Confirms relative position of two aircraft . Notifies Filip 61 on UHF. Turns map display ON. Aligns map display to reflect aircraft position. Crosschecks JN chart position with map display position. Informs pilot that map display is operational.	Copies and decodes coded message. Informs pilot.
00:45	2235	Receives change of airspeed from Filip 61. Adjusts power to maintain 450 KTAS.	Acknowledges change of TAS to Filip 61. Selects true air-speed display on the nav management system.	
00:50	2240	Observes 450 KTAS. Reduces power to maintain airspeed, heading and altitude at one mile in trail with Filip 61.	Requests confirmation of pre-sent position from Filip 61 to crosscheck alignment of INS and map display.	Assists copilot in cross-checking alignment of INS and map display against JN chart position.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:53	2243	ST ABBS	Observes Filip 61 in a right turn on the radar display. Confirms with copilot. Notes new course on nav management system. Slews heading bug. Turns aircraft to new course.	Records position on JN chart. Gives copilot the paperwork. Checks off headset to go to boom pod to check out boom operation. Leaves flight deck.
00:54	2244		Acknowledges boomer.	Checks in on intercom from the boom pod. Performs operational check of the boom.
01:04	2254		Acknowledges boomer. Requests cup of water from boomer enroute back.	Reports boom operational check completed. Checks off interphone to return to cockpit.
01:07	2256	ABERDEEN	Takes cup of water from boomer. Observes Filip 61 in right turn on radar display. Confirms with copilot. Observes course change on nav management system.	Returns to cockpit with cup of water for the pilot. Checks back in on interphone. Receives paperwork back from copilot.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
01:07 (cont.)	2256	Slews heading bug. Turns aircraft to remain in trail with Filip 61.	position on JN chart.	
01:29	2319	Observes waypoint passage. Turns to fly new course.	Observes waypoint passage. Informs boom operator.	Plots position on JN chart.
01:33	2323	Continues to fly 1 NM in trail with Filip 61 maintaining altitude and airspeed as required. Continues to monitor UHF 1, (interplane) and VHF (emergency) radios. Continues to monitor aircraft position on map display. Directs copilot to update INS passing Saxa Vord (SXV).	Continues to monitor aircraft position through navigation system and map display. Provides boom operator with coordinates for crosschecking against JN chart. Continues to monitor UHF 1 (interplane), UHF 2 (company) and HF (mission control) radios. Confirms latitude, longitude and map location of SXV. In preparation for update, selects present position information on nav	Continues to monitor UHF 1 (interplane) and HF (mission control) radios. Plots positions on JN chart provided by copilot. Continues to make fuel log entries (level off, hourly, pre A/R, post A/R and descent), and comm log entries as required.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
01:33 (cont.)	2323			
			management system. Selects ground mapping mode on radar. Determines crosstrack error passing SXV and types latitude and longitude of the projected abeam position into the scratch pad. Alternately switches from ground mapping mode to search (skin paint) mode to maintain a relative position with Filip 61 and to observe projected track.	
01:38 (SAXA VORD)	2328	Observes waypoint passage (SXV) on nav management system. Confirms relative position of Filip 61 and relative position to SXV on radar display.	Determines relative position from SXV as the lat/long typed in the scratch pad. Presses appropriate adjacent line key to update INS system from ground mapping radar. Informs pilot that INS is updated.	Plots updated position on JN chart.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
01:38 (cont.)	2328		Informs boom operator of present position.	
01:53	2343	Reviews preflight planned rendezvous and refueling information, airspeeds, altitude, fuel offload and recovery point. Confirms receiver authentication and communication information with crew.		Reviews fuel offload and fuel tank management information and procedures with pilots.
02:06 64° N	2356	Observes waypoint passage. Continues to fly aircraft.	Notes waypoint passage. Noti- fies boomer. Continues to crosscheck navigation.	Plots position on JN chart. Continues to monitor engine instruments and aircraft subsystems, and update JN chart.
02:33 67° N	0023	Observes waypoint passage.	Notes waypoint passage. Informs boom operator.	Plots position on JN chart.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:48	0038	Observes closure on Filip 61 on radar display, reduces power, notes the true airspeed decreasing.		Makes fuel log entry and updates JN chart.
02:49	0039	Continues to reduce power to maintain space. Asks Filip 61 for indicated airspeed check.	Acknowledges call on UHF from Filip 61 that his number one engine is on fire. Offers assistance. Directs boom operator to research Dash 1 procedures.	Researches Dash 1, Section III for engine fire procedures.
02:51	0041	Stabilizes aircraft in position.	Acknowledges message from Filip 61 that fire on the number one engine is still uncontrolled. Obtains Dash 1 procedure for engine fire from boom operator. Offers assistance to Filip 61.	Refers to Dash 1.
02:53	0043	Acknowledges Filip 61 message		Observes JN chart to determine

LEAD ABORTS

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:53 (cont.)	0043	that fire is uncontrollable and that he is aborting his mission and returning south-bound. Directs copilot to provide Filip 61 with vector to nearest recovery field.		emergency airfields in the area.
02:54	0044		Determines present position from nav management system. Confirms with boom operator location of nearest emergency field. Determines heading and distance to the emergency field through the nav management system. Relays information on UHF to Filip 61.	Draws course line from present position to emergency recovery field. Confirms information provided by copilot.
02:55	0045	Informs crew that they are now lead aircraft. Directs copilot to take over naviga-	Notifies boomer of present position from nav management system. Checks groundspeed	Makes notations on JN chart of Filip 61 turnaround position for search and rescue purposes.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:55 (cont.)	0045	tion functions. Directs boomer to continue plotting known positions on JN chart. Changes radar display mode from search mode to WX. Descends to FL290. Adjusts power to maintain 450 KTAS.	and ETA to next waypoint.	
03:00 70° N	0050	Observes waypoint passage and nav system update. Scans radar display for weather cells.	Checks cross track error on nav management system. Checks groundspeed and ETA to next waypoint (ARCP at 73 N). Informs pilot that ARCP ETA is on schedule.	Notes time of waypoint passage on JN chart passing 70 N. Copies and decodes HF message.
03:03	0053	Hears transmission on guard channel from Filip 61 that he is losing control and ditching is imminent.	Hears transmission from Filip 61 and notes coordinates of Filip 61.	Plots position of Filip 61's coordinates on JN chart.
03:04	0054	Directs boom operator to broadcast	Confirms Filip 66 present	Makes entry in communications

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:04 (cont.)	0054	in the blind on emergency frequency 8364 that a KC-135 is ditching at the last known position of Filip 61.	position.	log. Tunes HF radio to frequency 8364. Transmits emergency message in the blind.
03:05	0055	Directs boom operator to broadcast Filip 61 emergency message to mission control on appropriate frequency.	Detects weather along route.	Tunes HF radio. Broadcasts Filip 61 emergency message to mission control in the blind.
03:08	0058	Observes weather cells at the twelve o'clock to two o'clock position at 150 miles. Confirms with copilot.	Confirms position of weather cells. Crosschecks position of weather against refueling route. Informs pilot that thunderstorms are lying within the intended refueling route.	Asks copilot for position of thunderstorms. Plots thunderstorms on JN chart.
03:11	0101	Directs copilot to plot a possible new refueling route clear of thunderstorms.	Interprets weather radar display and map display to determine alternate refueling course.	Plots new ARCP and refueling track on JN chart. Provides copilot with new latitude and

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
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03:11 (cont.)	0101		Approximates location of new ARCP and new refueling course clear of the weather. Provides this information to the boomer.	Longitude of ARCP and end of refueling track (EAR).
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03:13	0103	Calls for Preparation For	Responds to checklist.	Reads checklist.
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PREPARATION FOR Contact checklist. Briefs

CONTACT CHECKLIST crew on probable new rendezvous and A/R procedures. Expect IMC conditions for this night refueling. Modified point parallel procedure since change of ARCP will not provide sufficient lead time for planned ETA to new orbit point. The new ARCP, if accepted by receivers, will be only 8-10 minutes before ARCT. Range calls will be provided each 10 NM from

AD-A088 036

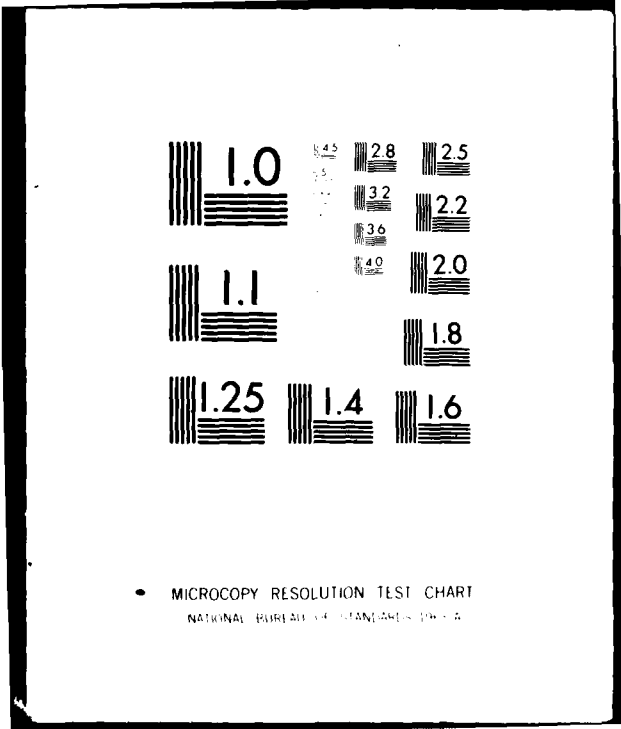
BUNKER-RAMO CORP WESTLAKE VILLAGE CALIF ELECTRONIC --ETC F/G 1/2
TANKER AVIONICS/AIRCREW COMPLEMENT EVALUATION (TAACE), PHASE 0.--ETC(U)
MAY 80 G J BARBATO, R P MADERO, G A SEXTON F33615-78-C-3614
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• MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:13 (cont.)	0103	100 to 30; each 5 NM from 30 to 25; each 1 NM there- after until the tanker starts turn onto refueling track. Bozo 21 Flight should begin descent at 80 NM range to FL280, and will climb back to FL290 after visual con- tact with Filip 66. Offload will be down to emergency fuel level for Filip 66 and distributed as requested between Bozo 21 and Bozo 24. Communications should be kept to a minimum. A/R frequency is 255.50.		
03:17	0107			Acknowledges rendezvous brief- ing. Briefs pilot on navigation to new ARCP if agreed by Bozo 21 Flight. 84

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:19	0109	Observes aircraft beacons at ten o'clock, 195 miles. Confirms with copilot.	Observes aircraft beacons. Confirms with pilot.	
03:20	0110	Calls Bozo 21 Flight on UHF. Establishes radio contact. Directs copilot to require authentication for Bozo 21 Flight.	Choose authentication code from appropriate document. Requests and receives authentication from Bozo 21 on UHF refueling frequency.	Updates JN chart.
03:21	0111	Advises Bozo 21 that Filip 61 is not available. Acknowledges message from Bozo 21 that Filip 66 beacon is not being received. Directs boomer to recycle the beacon and check circuit breakers. Suggests new refueling track clear of thunderstorms.		Recycles beacon from OPERATE to STANDBY to OPERATE. Checks circuit breakers.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:22	0112	Receives approval for new refueling track from Bozo 21.	Computes bearing and distance from old ARCP to new ARCP.	
WX DIVERSION		Directs copilot to compute bearing and distance from old ARCP to new ARCP, and old end of refueling to new end of refueling.	<p>Informs pilot. Inform's pilot that EAR remains the same.</p>	
03:23	0113	<p>Inform's Bozo 21 that new ARCP is 040° at 35 NM from old ARCP to preclude necessity from broadcasting new coordinates in the clear. EAR and ARCT remain the same (0130Z).</p> <p>Acknowledges request for authentication from Bozo 21.</p>	<p>Types and inserts lat/long of new ARCP into the navigation management system. Determines course and ETA to ARCP. Determines new refueling course. Directs boom operator to plot new ARCP and refueling course on JN chart.</p> <p>Exchanges A/R information with Bozo 21 on UHF.</p>	<p>Updates JN chart. Determines authentication and transmits to Bozo 21.</p>

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:25	0115	Observes Bozo 21 flight at 1030, 125 miles on radar display.	Acknowledges call from Bozo 21 to turn ON air to air TACAN. Turns TACAN set ON. Selects prebriefed channel.	
03:26	0116		Responds to Bozo 21 call to key microphone on refueling frequency for five seconds for DF steer. Observes A/A TACAN reading of 112 NM.	
03:27	0117	Calls relative position to Bozo 21 as 11 o'clock, 100 miles. Acknowledges that Filip 66 beacon is still inoperative and advises that the tanker will con- duct the rendezvous.	Scans weather radar for thun- derstorm cells. Calls 90 miles.	
03:28	0118		Calls 80 miles.	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:29	0119	Notices passage abeam old ARCP. Turns 30° right for new course. Instructs copilot to pass position to Bozo 21.	Calls Bozo 21 with position at 11 o'clock, 70 miles.	
03:30	0120	Calls Bozo 21 at 60 miles.	Computes fuel from end of refueling track to recovery point at Bodo, Norway. Informs pilot. Assures fuel panel set for maximum offload. Computes total offload possible to receivers with enough remaining to make Bodo, Norway. Informs pilot and the boomer.	Updates fuel log. Copies and decodes HF message. Informs pilot.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:31	0121	<p>03:31 Informs Bozo 21 that his position at 9 o'clock, 52 miles. Informs him of total fuel offload available. Adjusts airspeed to 325 KIAS.</p>	<p>Determines orbiting procedure at new ARCP. Inserts procedure into nav management system. Informs boom that they are 5-6 minutes from ARCT. In-sufficient time to orbit so offset will be established and tanker will proceed on reciprocal of receiver's inbound track to affect rendezvous.</p>	<p>Updates fuel log and gives copilot paperwork. Checks off headset to go to the boom pod.</p>
03:32	0122	<p>03:32 Observes passing ARCP. Starts left turn to reciprocal of receiver's inbound track.</p>	<p>Informs Bozo 21 Flight that Filip 66 is in their one o'clock position, 40 miles (from radar display). Responds to Bozo 21 request for UHF tone for DF. Calls Bozo at 30, 25, 24, 23, and 22 miles.</p>	

ELAPSED TIME HR.:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:33	0124	Starts left turn to 145° (FL290) and adjusts to 255 KIAS.	Informs Bozo 21 that they are at 11 o'clock, 21 miles start- ing a left turn to the refuel- ing track.	
03:35	0125	Acknowledges boomer's check- in on intercom.	Calls that they are halfway through turn and informs Bozo 21 that he is at 9 miles.	Checks in on intercom from boom pod. Informs pilot that boom is coming down.
03:36	0126	Rolls out of left turn on 145° heading. Advises Bozo 21 that Filip 66 is rolling out on heading.	Crosschecks DME readout.	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:37	0127	Notes passing ARCP on course, on time, on altitude, and advises Bozo 21 that they are on A/R airspeed.	Bozo 21 that he is at 2 miles on DME. Acknowledges Bozo 21 call that he is skin painting Filip 66 at twelve o'clock, 2 miles.	
03:38	0128	Dons oxygen mask (as part of checklist).	Dons oxygen mask (as part of checklist).	
03:39	0129	Calls for continuation of Preparation For Contact checklist. Acknowledges Bozo 21 that visual contact has been made at twelve o'clock, 1/2 mile and that Bozo 21 is climbing to AR altitude.	Turns position lights to steady and dim. Turns rendezvous beacon light to upper ON. Turns strobe lights OFF. Completes fuel quantity check. Sets air refueling panel. Air refueling manifold to engine manifold valve Closed. Air refueling line valve Open. Calls Preparation For Contact checklist complete.	Informs pilot and Bozo 21 that he has Bozo 21's lights at six o'clock, 1/2 mile. Coordinates refueling order with Bozo 21 and directs receivers into position.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:40	0130	Maintains heading, airspeed, and altitude.	Turns air refueling pumps ON when amber light illuminates and boom operator and Bozo 21 call "Contact". Advises boomer that receiver is taking fuel.	Calls contact. Acknowledges that Bozo 21 is taking fuel.
03:41	0131	Continues aircraft control. Observes thunderstorms on weather radar at two o'clock, 40 miles.	Monitors fuel quantities, pumps and valves positions. Monitors aircraft position.	
03:43	0133		Acknowledges Bozo 21's query requesting maximum amount of fuel available for offload, with sufficient fuel remaining for Filip 66 recovery at nearest suitable airdrome. Response 100,000 pounds.	
03:44	0134		Acknowledges Bozo 21's request to stop fuel offload at 70,000	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:44 (cont.)	0134		for Bozo 21 with remainder to go to Bozo 24. Informs boomer.	
03:45	0135	Monitors aircraft heading, air-speed, and altitude while on autopilot. Observes weather cells in three o'clock position, 20 miles on weather radar display.	Monitors fuel control panel. Rechecks ETA and fuel requirements for Bodo recovery.	
03:56 #1 RECEIVER A/R COMPLETED	0146		Turns OFF air refueling pumps and informs boom operator that 70,000 pounds have been off-loaded.	Calls disconnect and receives Bozo 21's acknowledgement. Informs pilot that Bozo 21 is clearing.
03:57	0147		Acknowledges boomer's call that Bozo 21 has broken contact and is moving back to the left and up.	Clears Bozo 24 into pre-contact position.
03:59	0149	Continues to fly the aircraft on autopilot.	Continues to monitor navigation and weather radar. Updates JN chart.	Calls Bozo 24 lights in sight at six o'clock, 3/4 mile.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:60	0150			Observes Bozo 24 in pre-contact position and clears him in.
03:61	0151		Observes refueling light ON. Starts refueling pumps when boom and Bozo 24 call "Contact". Advises boom that Bozo 24 is taking fuel.	Calls contact. Tells Bozo 24 he is taking fuel.
03:62	0152	Continues to fly aircraft.	Monitors fuel controls, engine instruments and navigation.	
04:03	0153	Detects smoke and fumes in the cockpit coming through the air conditioning system. Directs crew to go to 100% oxygen. Directs boomer to give Bozo 24 a disconnect signal.	Goes to 100% oxygen.	Gives Bozo 24 disconnect signal. After clear, dons oxygen mask and selects 100% oxygen.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:04	0154	Directs copilot to read emergency checklist. Advises boom to continue air refueling. Acknowledges report from crew chief that smoke and fumes are still evident.	Refers to pilot's checklist, emergency section, then to Section III of the Dash 1. Turns air conditioning master switch OFF. Turns left alternator pressurization switch OFF. Turns right alternator pressurization switch to INCREASE. Directs crew chief to check air conditioning ducts in cabin for smoke and fumes.	Clears Bozo 24 into contact position.
04:05	0155	Continues to fly aircraft and navigate. Observes refueling lights ON. Starts refueling pump when boom and Bozo 24 call contact. Advises boom that Bozo 24 is taking fuel. Acknowledges crew chief's	Turns right alternator pressurization switch to DECREASE. Turns engine bleed switches to CLOSE. Turns air conditioning master switch to COND AIR. Opens engine bleed switches one at a time. Checks for smoke	Calls "Contact".

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:05 (cont.)	0155	report that smoke and fumes are continuing.	and fumes. Directs crew chief to check for smoke and fumes.	
04:06	0156	Acknowledges that smoke and fumes are no longer coming from the air conditioning system.	Closes air conditioning cross-over switch. Opens engine bleed switches. Checks for fumes and directs crew chief to check for smoke and fumes.	
04:07	0157	Advises crew that Emergency checklist is complete.	Determines that the cause of smoke and fumes was engine bleed valve #1. Allows air conditioning system to ventilate the aircraft. Advises the pilot that the difficulty has been found and that the mission can continue.	Acknowledges Emergency checklist is complete.
04:08	0158		Stows Dash 1. Copies and decodes HF message. Makes entry	Removes and stows oxygen mask.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:08	0158		into comm log.	
(cont.)				
04:10	0200	Directs copilot to recompute fuel required from present position to Bodo recovery.	Computes fuel required for present position to Bodo (7,000 pounds). Advises pilot.	
04:11	0201	Directs refueling pumps be turned off when minimum fuel (7,000 pounds) is reached.		
04:13	0203		Observes fuel reaching minimum required. Turns OFF refueling pumps. Directs boomer to give disconnect signal to Bozo 24.	Signals Bozo 24 to disconnect, refueling completed.
EAR				
04:14	0204	Gives Bozo 24 his offload report and wishes him good luck. Calls for Post A/R checklist. Acknowledges boomer.	Reads Post A/R checklist. Makes entry in fuel log. Resets navigation chart. Resets navigation management system for direct flight to destination.	Accomplishes checklist. Secures boom pod. Checks off intercom to come forward to the cockpit.

EALPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:15	0205	Turns to set course directly to destination. Requests ETA and fuel remaining.	Obtains ETA from nav management system. Checks fuel remaining (7,000 pounds). Advises pilot that they will be overhead Bodo at 0228, and if they remain at flight level 290, will have 1,500 pounds fuel remaining.	Enters cockpit. Dons headset. Checks back in on intercom. Updates fuel log and JN chart.
04:17	0207	Directs boom operator to enter maintenance discrepancy on engine bleed valve and AFTO 781. Dictates discrepancy.		Makes write-up in AFTO 781.
04:18	0208	Directs boom operator to send coded message to mission control that mission is complete on HF.		Determines coded message from appropriate documents. Transmits coded HF message in the blind.
04:19	0209	Scans radar display. Observes no weather cells on 200 mile range. Calls for Descent	Accomplishes Descent checklist. Reviews radar approach chart for Bodo. Notes elevations,	Reads Descent checklist. Makes entry in fuel log. Computes weight and balance, CG, and

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:19 (cont.)	0209	checklist.	runway orientation, obstructions, and points that may make good radar returns.	landing data with the nav management system.
04:20	0210	Obtains Bodo airfield radar map picture and instrument approach plate and studies approach information. Briefs crew on Bodo approach procedures assuming airborne radar approach with no nav aids available. Copilot to supply directions from ground mapping radar. Approach minimums discussed as 400 feet, one mile and the probability of not enough fuel for a go-around.		
04:21	0211	Briefs plan to arrive over Bodo at flight level 290. Approimate a HI-TACAN approach using INS	Acknowledges approach briefing.	Acknowledges approach briefing. Calls "Descent check complete with altimeters and altitude

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:21 (cont.)	0211	navigation and descending so as to cross TACAN approach fixes at desired altitudes. The copilot to provide radar heading and altitude direc- tions on the final approach segment, to be crosschecked against INS information. The boomer to monitor engines, fuel and navigation information.		calls."
04:23	0213	Directs copilot to attempt contact with any Bodo facility to obtain weather.	Tunes VHF to 119.7. Tunes UHF to 365.1. Attempts contact with Bodo approach control on those frequencies. Receives no response.	
04:24	0214		Tunes VHF to 118.1 and UHF 270.1. Attempts contact with Bodo tower. Receives no response.	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:25	0215	Flies the aircraft. Directs copilot to compute estimated time required for briefed instrument approach and fuel required for approach.	Computes time for instrument approach. Approximating the Hi-TACAN approach. Ten minutes will be required if airspeed is kept at computed speed on final.	
04:27	0217	Directs copilot to compute maximum glide distance with four engines inoperative and best glide speed for present weight.	Computes present weight, best glide speed and maximum glide distance.	
04:28	0218	Observes land mass at twelve o'clock, 25 miles on radar display.	Crosschecks nav management system. Informs pilot that observed land is approximately 50 miles short of Bodo.	Identifies island on JN chart in approximate position described by pilot.
04:29	0219		Takes radar fix and updates nav management system.	Updates JN chart.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:31	0221	Observes island passing directly under aircraft on radar display. Confirms with copilot.	Confirms passing island coastline.	Informs pilot that all tanks are empty except #2 and #3 main.
04:32	0222	Observes landmass at twelve o'clock, approximately 50 miles on radar display. Confirms with copilot.	Observes landmass. Checks navigation management system. Confirms coastline near Bodo.	
04:33	0223	Attempts to contact Bodo approach control on UHF, without response. Tunes VHF to approach control frequency and attempts contact, but no response. Directs copilot to attempt contact with tower.	Attempts contact with Bodo tower on UHF with no response. Changes VHF to tower frequency. Attempts contact and receives background noise and static.	
04:34	0224		Rechecks fuel quantity and ETA to Bodo. Confirms with boomer	Checks fuel quantity, fuel consumption and confirms 14 minutes

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:34 (cont.)	0224		that fuel remaining is approxi- mately 14 minutes. Informs pilot.	remaining at this time.
04:35	0225	Scans weather display, air- craft subsystems displays and flies aircraft.	Attempts contact with Bodo tower to VHF. Receives broken reply. Reattempts contact and requests Bodo weather.	
04:36	0226	Directs removal of pilot's and copilot's forward rad- iation curtains. Removes radiation curtains.	Receives broken and garbled message from Bodo tower giving weather as 400 feet and one mile. Removes rad- iation curtains.	Assists in removal of thermal radiation curtains.
04:37	0227	Sets radio altimeter at 379 feet. Leaves autopilot on. Checks hydraulic system.	Requests altimeter setting from Bodo tower. Receives response as 29.84. Sets radar altimeter to 2,000 feet. Checks window heat, anti-ice, pitot heat, Q-Inlet heat all	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:37	0227		ON. Checks electrical power systems indicators. Sets cabin pressure controller.	
(cont.)				
04:38	0228	Observes station passage over BODO IAF	Monitors navigation and the flight instruments.	Monitors engine instruments and aircraft subsystems.
		Turns aircraft to 244°. Reduces power. Starts descent at 4,000 feet per minute from FL290.		
04:39	0229	Establishes 244° track on INS. Descends at 4,000 feet per minute, 250 KIAS.	Observes passing 8 miles on waypoint distance readout on the nav management system.	Monitors approach and makes appropriate altitude calls throughout approach. (Each 5,000' until 2,000' above level off, 1,000' above and level off.)
04:40	0230	Briefs copilot to hold low-ering of landing gear until airfield is in sight.	Observes passing 16 miles distance and flight level 220.	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:41	0231	Upon reaching 20 miles, begins right standard rate turn to intersect inbound track of 084. Sets altimeter 29.84.	Notifies pilot when passing 20 miles from Bodo. Observes starting turn passing flight level 180. Sets altimeter 29.84.	
04:42	0232	Continues turn toward inbound course of 084. Observes altitude passing flight level 140.	Adjusts radar for final approach course monitoring.	
04:43	0233	Observes 084 inbound bearing to Bodo on horizontal situation display. Rolls out of turn. Observes distance at 18 miles and altitude of 10,000 feet. Calls for Before Landing checklist.	Observes aircraft rolled out on extended centerline at approximately 18 miles. Informs pilot. Accomplishes Before Landing checklist.	Reads Before Landing checklist.
04:44	0234	Checks INS distance at 10 miles. Observes altitude, 7,000 feet. Corrects	Informs pilot he is crossing 10 mile range marker, turn left to 079°. Completes	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:44 (cont.)	0234	aircraft heading, 5° left at copilot's direction. Instructs copilot to use 0° flaps and hold the gear until field is in sight, but to turn landing lights ON.	designated checklist items after confirmation with pilot.	
04:45	0235	Observes nav management dis- tance of six miles, altitude 4,000 feet, 2,500 feet higher than published. Turns right to 082°.	Informs pilot he is at FAF, 6 miles out, on course, to turn back right to 082°.	
04:46 #1 AND #2 ENGINE FAILURE	0236	Observes three miles on nav management display, 1,500 feet above the ground. Observes extreme yaw to the left. Observes EPR and RPM dropping off on #1 and #2	Informs pilot he is passing 3 nautical miles and is moving rapidly left of course. Directs right turn to 090°.	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:46 (Cont.)	0236	engines. Observes low fuel pressure light illuminate. Calls #1 and #2 engine flamed out. Disconnects autopilot. Trims aircraft. Increases power on #3 and #4 engines.		
04:47	0237	Corrects to 090°. Slows aircraft to 180 knots. Observes runway and boomer's call of runway in sight. Calls for gear and wing flaps - 50°.	Provides final heading corrections and altitude advisories until field is in sight. Lowers landing gear and wing flaps. Completes Before Landing checklist.	Pulls anti-skid circuit breaker and advises pilot. Watches outside for indication of runway. Calls runway in sight at 1230 and about one mile. Calls Before Landing checklist complete.
04:48 TOUCHDOWN	0238	Lands aircraft. Reduces power on #3 and #4 engines. Breaks aircraft to 94 knots.		

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:48 (cont.)	0238	Directs max braking by copilot. Observes #3 and #4 engine flame out as turn off runway is completed. Requests After Landing and Engine Shutdown check- list.	Applies max brakes. Slows aircraft and turns off runway. Completes After Landing checklist.	Reads After Landing check- list.
04:51	0239	Deplanes and requests crew chief to clean up the cockpit.		

BODO CONTINGENCY MISSION

The KC-135 has been towed off the taxiway at Bodo, maintenance discrepancies have been corrected, and it has been refueled with 120,000 pounds of fuel. A thru-flight inspection has been performed by the crew chief. The pilots proceeded to operations where they contacted their operation center through NATO land line communications. They reported Filip 61's emergency, his unknown disposition and the amount of fuel offloaded to each of Bozo 21 and 24. They were directed by their operation center to relaunch as Lead in a two ship cell with TACO 33, another KC-135 which recovered at Bodo. TACO 33 has an inoperative navigation management system, but an operable radar. They are to proceed to an anchor point over the Baltic Sea at N58°40", E19°40" to refuel multiple flights of friendly fighters striking targets in Western Eurasia. The air refueling control time (ARCT) is 0845Z. The tankers' altitudes in the anchor will be FL290 and FL300. The receivers will be authenticated and vectored by GCI Control. Filip 66 and TACO 33 are to remain in the refueling track until they have only enough fuel remaining to safely recover at Aalborg Royal Danish Air Force Base, Denmark.

The crew obtains an intelligence briefing from NATO Ops. NATO is involved in a limited war with the Soviet block nations. Aircraft are operating on tactical clearances without air traffic control clearances. Some control towers and military radars are operating. All navigation aids have been shut down, and jamming and interference is taking place on all communication radios. Nuclear detonations

Page 2
BODO CONTINGENCY MISSION

are possible. Crews are advised to wear gold goggles. Enemy fighter aircraft have been reported infringing upon free airspace from both ground bases and aircraft carriers.

Mission and crew briefings are completed. The crew inserts the proposed flight plan into the nav management system. The INS systems are aligned prior to taxiing. As Lead, Filip 66 makes a two ship, day, IMC departure with ceiling at 400 feet and visibility at 1 NM. The aircraft climb to FL290 and FL295 respectively, and proceed to the anchor point, where the pattern is established prior to the control time. TACO 33 climbs to FL300. Enroute to the ARCP, an electrical system malfunction occurs and subsequently the pilot's nav management system control/display unit (CDU) becomes inoperative, requiring all further navigation interface to be conducted through the copilot's CDU. GCI assistance is not available until after the aircraft are in the anchor.

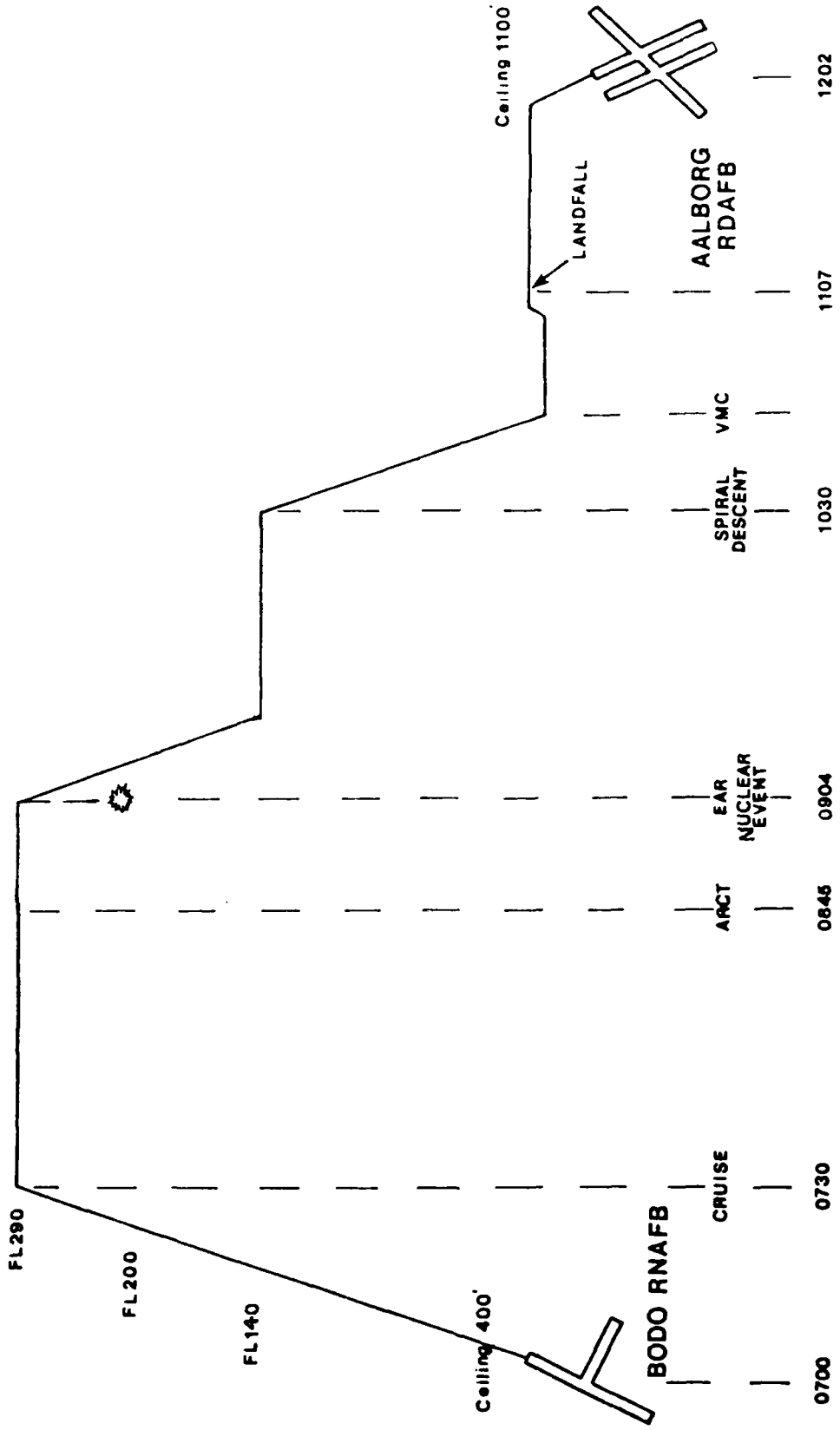
GCI vectors numerous F-15, F-16, A-7, and F-4 aircraft, formations and single ships, in for refueling from both tankers. Fighters are both inbound to and outbound from target areas. Some are required to hold out while others are on the tanker. Some are extremely low on fuel, requiring coordination for priority treatment. In one case Filip 66 is required to cut short the anchor and proceed toward a point in the anchor pattern closer to an emergency fuel fighter. The pattern is also complicated by several weather cells which must be circumnavigated along one side of the anchor.

Page 3
BODO CONTINGENCY MISSION

After approximately 1 1/2 hours in the pattern, enemy fighters attack the refueling formation. A nuclear device is detonated and Filip 66 is subject to an electro-magnetic pulse (EMP). The loss of all non-hardened avionics systems ensues, leaving Filip 66 without communications and with only limited flight instruments and navigational capability. Most electrically operated controls and indicators are inoperative. The boom operator, in the boom pod without his goggles, is blinded by the flash. Filip 66, unable to see or communicate with TACO 33, turns southwestward and descends to FL140 to maintain terrain clearance. He continues to dead reckon to a position believed to be over the North Sea just west of Denmark and makes a slow spiraling descent to VMC conditions over the water. He then turns northeast and proceeds until landfall on the northeast coast of Denmark. Using dead reckoning he proceeds visually to Aalborg Royal Danish Air Force Base. A visual approach is made to Aalborg with the ceiling at 1,100 feet and the visibility at 3 miles. The landing gear and wing flaps are extended normally and a successful landing concludes this portion of the mission.

The following time line and crew task definition begins with the Before Takeoff checklist.

BODO CONTINGENCY MISSION



ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:00	0655	Requests Before Takeoff checklist.		Reads checklist. Monitors HF radio.
00:01	0656	Accomplishes Before Takeoff checklist.	Accomplishes Before Takeoff checklist.	Accomplishes Before Takeoff checklist. Calls checklist complete.
00:03	0658	Acknowledges TACO 33 ready for takeoff.	Acknowledges clearance for takeoff from Bodo Tower.	
00:04	0659	Calls for Takeoff check- list. Holds brakes. Advances throttles to TRT dry. Checks engine instruments. Releases brakes.	Accomplishes Takeoff check- list. Advises Bodo Tower that Filip 66 is rolling. Receives acknowledgment. Guards throt- tles for pilot. Scans engine instruments.	Reads Takeoff checklist. Scans engine instruments and aircraft subsystems indications.
00:05	0700	Maintains directional con- trol with nosewheel steering	Checks engine instruments. Checks flight instruments.	Notes takeoff time. Monitors engine instruments. Monitors

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
00:05 (cont.)	0700	then rudders. Checks air-speed indicator. Crosschecks copilot's call of S1 speed. Crosschecks copilot's call of rotation speed. Rotates the nosewheel off the runway and obtains climb attitude.	Calls S1 speed. Calls rotation speed.	aircraft subsystems indications. Monitors outside the aircraft for runway obstacles.
00:06	0701	Flies aircraft off the runway.	Observes lift-off and scans flight instruments.	Monitors warning panel and outside watch.
00:07	0702	Calls for landing gear UP.	Places gear handle in UP position.	
00:08	0703	Calls for flaps up at 1,000 AGL. Accelerates toward best climb speed. Starts left turn on course (183°). Calls for After Takeoff-Climb checklist and MRT.	Places wing flap control in UP position. Completes other items in the After Takeoff-Climb checklist.	Reads After Takeoff-Climb checklist.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:10	0705	Stabilizes at enroute climb speed. Adjusts pitch attitude for climb. Engages autopilot for climb.	Crosschecks flight instruments and radar display. Acknowledges TACO 33 in turn cutoff.	Obtains wing scan report and cargo compartment check from crew chief. Continues to monitor engine instruments and aircraft subsystems.
00:11	0706	Installs thermal radiation curtains.	Takes JN chart from boom operator for course reference. Continues to navigate using nav management system.	Assists pilot and copilot to install thermal radiation curtains.
00:12	0707	Rolls out on course continuing climb. Continues monitoring all comm radios.	Crosschecks flight instruments. Monitors engine instruments. Checks doppler readout for wind indication. Monitors weather radar display. Continues to monitor all communications radios except HF. Installs	Monitors engine instruments. Monitors aircraft subsystems. Monitors HF communications radio.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:12 (cont.)	0707		thermal radiation curtains.	
00:15	0710	Sets altimeter to 29.92 passing transition altitude. (5,000 MSL) Continues climb. Sets radio altimeter for 2,000 feet.	Sets altimeter to 29.92. Checks present position on nav management system display and crosschecks against JN chart. Sets radio altimeter for 2,000 feet.	Copies and decodes HF message. Makes entry in communication log.
00:19	0714	Continues to fly aircraft through 10,000 feet MSL. Rechecks oxygen regulator to ON and 100%. Acknowledges TACO 33 in position.	Rechecks oxygen regulator to ON and 100%. Monitors weather radar for returns.	Rechecks oxygen regulator to ON and 100%. Calls After Takeoff-Climb checklist com- plete.
00:35 LEVEL OFF	0730	Levels aircraft at FL290. Adjusts power to maintain 440 KTAS.	Monitors present position on nav management system and crosschecks against JN chart. Provides pilot with IAS, TAS,	Makes entry in fuel log. Moni- tors engine instruments. Updates JN chart. Completes HEFO check.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:35 (cont.)	0730		and GS information.	
00:36	0731	Directs boomer to code a message for mission control. Acknowledges TACO 33 request for nav position information.	Transmits nav position to TACO 33.	Codes message and transmits coded message stating departure information in the blind on mission control HF frequency.
00:39	0734	Flies the aircraft maintaining planned altitude, airspeed and course.	Navigates with nav management system. Monitors position, progress and ETA to anchor point (0830).	Monitors engine instruments and aircraft subsystems. Records maintenance discrepancies in AFTO 781.
00:44 WPT #1	0739	Observes passing waypoint #1 (ESPC), update of navigation system and information update for waypoint #2. Turns	Notes present position over first waypoint. Confirms course to waypoint #2. Informs TACO 33 of position.	Makes entry on JN chart. Monitors HF comm. Monitors outside watch.

ELAPSED TIME HR: MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:44 (cont.)	0739	aircraft to intercept 150° course.		
00:45	0740	Reacts to boom operator's information of electrical malfunction. Requests AC Power System Emergency procedure.	Attempts contact with GCI (Blackball). Acknowledges GCI is saturated with higher priority traffic.	Observes #1 bus tie breaker light illuminate. Notifies pilot.
00:46	0741	Monitors boom operator and copilot troubleshooting and corrective action.	Troubleshoots malfunction.	Refers to Section III of the Dash 1 and reads AC Power System Emergency Procedure for the appropriate malfunction.
00:47	0742	Acknowledges copilot and agrees. Monitors CRT map and radar display.	Advises pilot to operate #1 bus from #2 and #3 generators to prevent possible unneces- sary loss of electrical equip- ment.	

ELAPSED TIME HR: MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:48	0743	Observes pilot nav management system CDU inoperative and keyboard unuseable. Requests appropriate malfunction procedure.		Researches appropriate procedure in Dash 1. Reads procedures to copilot.
00:49	0744	Monitors copilot's and boom operator's troubleshooting procedures. Selects copilot's HSD to repeat on pilot's HSD.	Unsuccessfully troubleshoots pilot nav management CDU. Turns system off. Advises pilot that further navigation management must be accomplished on copilot CDU.	Reads malfunction procedures for nav management CDU malfunction. Assists copilot in troubleshooting.
00:50	0745	Discusses new operating procedures with crew. Reiterates necessity for boom operator to provide backup monitoring of INS display information from the boom operator's backup control head.	Confirms information requirements from the boom operator.	Reviews operation of INS backup control head. Checks backup INS CDU for proper operation and information. Reports to the pilot and copilot.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
00:52	0747	Flies the aircraft. Monitors engine instruments. Monitors aircraft subsystems.	Checks INS and doppler control heads for proper flight plan storage. Re-enters data as necessary. Reviews boom operator actions required for monitoring position on backup INS.	Observes operation of the INS control head. Confirms understanding of operational requirements.
01:04	0759	Observes passage of waypoint #2 (ESCL). Turns right to intercept course of 163°. Scans weather radar display on nav heading.	Observes waypoint passage and informs TACO 33. Requests present position readout from the boom operator. Crosschecks lat/long position against radar.	Provides copilot with coordinates of present position. Copies and decodes HF message. Makes entry in communication log. Plots position on JN chart.
01:05	0800	Continues to fly aircraft. Requests the boom operator to provide information on TAS, GS, and ETA to the anchor point.	Monitors engine instruments and aircraft subsystems. Using ground mapping radar, identifies eastern shoreline of Sweden. Advises boom	Obtains TAS, GS, and ETA to the anchor point (0829) and relays it to the pilots.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
01:05 (cont.)	0800		operator to be prepared to update the INS if required.	
01:09	0804		Projects expected position when passing waypoint #3. Determines coordinates of that position. Executes INS update procedures.	
01:19 WPT #3 (Stockholm)	0814	Observes passage of waypoint #3. Corrects aircraft heading for 136° course to the anchor point.	Confirms present position and coordinates through ground mapping radar.	Logs station passage and monitors outside watch.
01:20	0815	Reviews anchor entry proce- dures with crew. A turn into the anchor track will be made prior to the anchor point. This turn will be made onto the downwind side of the		

ELAPSED TIME HR:MIN	PILOT	COPILOT	BOOM OPERATOR
01:20	0815 anchor. GCI should be contacted ASAP. TACO 33 will be reminded of downwind turn.		
01:21	0816 Calls for "Preparation for Contact" checklist.	Acknowledges briefing. Starts reading checklist.	Acknowledges briefing. Proceeds to the boom station.
01:22	0817 Responds to checklist. Monitors weather radar.	Reads checklist, responds to checklist and calls GCI control (Blackball). Acknowledges TACO 33 on frequency.	Runs Preparation for Contact checklist.
01:23	0818 Continues checklist. Monitors anchor information by selecting anchor display.	Contacts GCI with position and anchor entry intentions. Requests and receives authentication of GCI.	Continues checklist.

ELAPSED
TIME
HR:MIN

PILOT

COPILOT

BOOM OPERATOR

01:25	0820	Acknowledges checklist complete.	Announces Preparation for Contact checklist complete.	
01:30	0825	Acknowledges boom operator checklist complete. Monitors distance to anchor point.	Checks ground radar for INS update. Acknowledges GCI with receivers inbound to anchor.	Calls Preparation for Contact checklist complete.
01:31	0826	At 50 miles prior to anchor point, turns right to 215° to intercept downwind leg of anchor as displayed on HSD.	Confirms position intercepting downwind leg of anchor. Confirms position with GCI. Advises TACO 33 of position and turn maneuver. Acknowledges GCI receiver traffic 120 miles SE of anchor.	
01:35	0830	Continues to fly aircraft and monitors all communications radios.	Scans weather radar display for returns. Selects ground mapping radar and observes	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
01:35 (cont.)	0830		island landmass in ten o'clock position at 35 miles. Cross-checks against JN chart. Determines position in reference to Gotland Island.	
01:36	0831	Obtains EIA to the anchor point from the INS system (0845).	Suggests to pilot that during rendezvous and refueling that the crew chief occupy the jump seat to be available to furnish navigation information from backup control heads if required. Additionally to monitor fuel panel and engine instruments.	
01:37	0832		Receives approval. Briefs crew chief on his duties.	
			Monitors flight instruments.	
			Checks time. Confirms with pilot.	
			Notes relative position on JN	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
01:37	0832		chart from Gotland Island using ground mapping radar.	
(cont.)			Turns A/A TACAN ON. Selects prebriefed channel. Performs checklist.	
01:38	0833	Notifies TACO 33 of position at the end of the anchor downwind leg and of intended turn. Starts left turn toward final refueling track (035°).	Notifies GCI of turn at downwind end of anchor. Acknowledges refueling traffic position 70 miles from anchor point, number and type of aircraft, call sign and requested fuel load.	
01:39	0834	Monitors aircraft control through turn. Checks weather and ARCT.	Requests GCI bring receivers up on common frequency.	Acknowledges receiver information.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
01:40	0835	Rolls out on final refueling track. Verifies receiver location with copilot.	Establishes contact with receiver, 6 A-7s - call sign Vixon.	
01:41	0836	Monitors weather developing in anchor pattern. Notifies TACO 33 of weather and air-speed reduction to satisfy ARCT.	Verifies Vixon's required fuel and armament check. Coordinates with Vixon and TACO 33 for assignment of receivers to tankers.	Acknowledges Vixon requirement with copilot.
01:45	0840	Monitors anchor display and weather.	Acknowledges receiver location from GCI.	
01:47	0842	Scans outside for receiver contrails.	Acknowledges weather information from GCI.	Completes radio check with receiver.
01:49	0844	Calls tally-ho on receivers.	Acknowledges call from GCI to start turn to downwind anchor track. Acknowledges receiver hand off from GCI.	Starts scan for receivers.
ARCT		Acknowledges TACO 33 tally-ho call. Starts turn at GCI request.		

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
01:51	0846	Rolls out on downwind track. Calls out new heading to avoid weather. Clears boom operator for primary comm with receiver.	Notifies GCI, TACO 33 and Vixon flight of new heading to avoid weather buildup in anchor track.	Calls tally-ho on receivers. Acknowledges comm hand off of receivers from pilot.
01:52	0847	Monitors anchor and weather. Calls airspeed change to TACO 33.	Checks fuel panel for proper distribution.	Clears Vixon flight to observation position.
01:54	0849	Maintains proper airspeed (305 IAS) and avoids weather in anchor pattern.	Monitors fuel offloads, location in anchor pattern and weather.	Begins aerial refueling.
01:59	0854	Starts turn at end of downwind leg. Acknowledges F-16 receivers with minimum fuel. Coordinates with TACO 33.	Acknowledges GCI call with four F-16s, two with minimum fuel. Position is 50 miles from tanker.	Continues fuel offload.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:01	0856	Rolls out on final refueling track. Acknowledges Venom flight information. Checks with boom operator on status of Vixon refueling. Starts scan for Venom flight.	Acknowledges location of new receiver at 30 miles, call sign Venom. Establishes radio contact with Venom flight and receives number of aircraft, fuel requirements, minimum fuel status, altitude and armament check.	Continues fuel offload. Notifies pilot that one more Vixon aircraft needs fuel. Acknowledges Venom flight information and continues fuel offload to Vixon.
02:03	0858	Calls tally-ho on Venom flight, 2 o'clock at 12 miles. Notifies Vixon flight of Venom inbound. Acknowledges TACO 33 tally-ho of Venom.	Confirms with GCI that visual contact has been made with Venom but refueling is not yet complete with the final Vixon chic. Acknowledges handoff of Venom flight from GCI.	Continues offload of fuel to final Vixon chic.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
02:04	0859	Clears Vixon flight from tanker area. Clears boom operator to contact Venom flight as soon as he finishes Vixon. Coordinates airspeed change to 315 IAS with TACO 33.	Coordinates line up with boom operator and TACO 33.	Clears last Vixon chic from boom. Establishes radio check with Venom. Calls tally-ho on Venom and clears minimum fuel chic to pre-contact position.
02:06	0901	Monitors position in anchor and weather location.	Notifies GCI of Venom BAR. Acknowledges a Venom flight single is inbound with emergency fuel - needs vector away from anchor track.	Starts offload of fuel to Venom flight.
02:07	0902	Approves GCI vectors to pick up Venom with emergency fuel. Starts turn south. Coordinates with TACO 33 to stay with Filip 66 until Venom's minimum fuel chics have	Coordinates with GCI for vector to Venom 5 who is 100 miles south of the anchor point. Copies urgency of Venom 5 fuel emergency.	Continues fuel offload to Venom flight.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:07	0902	required fuel. TACO 33 will then return to anchor pattern with Venom 1-4 while Filip 66 continues south to Rz with Venom 5. Filip 66 will then return to anchor to join TACO 33.		
2:09	0904	Coordinates cell termination with TACO 33 and shift of all Venom (1-4) over to TACO 33. Advances power to obtain max allowable airspeed. Directs copilot to attempt contact with Venom 5. Acknowledges GCI call that Venom 5 is throttled back to max endurance.	Coordinates cell termination with GCI and confirms that GCI understands TACO 33 navigation problems and Filip 66 intentions of returning to anchor after Rz with Venom 5.	Notifies pilot that minimum fuel chic has completed AR. Standing by for emergency fuel chic.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:15	0910	Monitors position and weather. Starts a 180° turn to the north as instructed by GCI. Acknowledges Venom 5 is near fuel exhaustion.	Acknowledges GCI with Venom 5 position and instructions to turn for Rz. Contacts Venom 5 and copies altitude, armament, fuel state and fuel requirements.	
02:16	0911	Continues turn. Directs boom operator to be prepared for immediate hook up with Venom 5. Clears boom operator to contact Venom 5.	Calls tally ho in mid turn. Checks fuel panel ready for fuel offload.	Confirms with pilot that he is ready to offload fuel. Contacts Venom 5 with radio check.
02:17	0912	Rolls out of turn and sets course toward anchor point. Monitors weather and adjusts speed for AR with Venom (315 IAS).	Checks position and weather. Requests TACO 33 beacon for Rz in the anchor pattern. Acknowledges TACO 33 position and status of other Venom chics.	Scans for receiver.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:18	0913	Acknowledges message from GCI on inbound F-4. Directs copilot to accept orbit request after Venom 5 is stable taking fuel.	Coordinates with GCI for another receiver inbound from the southeast, call sign Vampire 3. Acknowledges request for orbit at present position to Rz with Vampire.	Calls visual on Venom 5 and clears him to pre-contact and then to contact. Acknowledges Venom 5 sucking fumes.
02:19	0914	Coordinates orbit with Venom 5. Directs copilot to coordinate next receiver, Vixon 7 to receive fuel from TACO 33.	Coordinates with TACO 33 and GCI for Vampire 3. GCI has another A-7 receiver, Vixon 7, inbound.	Starts AR for Venom 5.
02:20	0915	Starts left orbit with Venom 5 on the boom. Verifies Filip 66 position 40 miles south of anchor pattern. Acknowledges status of Vampire 3.	Contacts Vampire 3 with fuel status, altitude, armament check and fuel requirements. Also acknowledges Vampire 3 is disabled from an aerial encounter and is loosing fuel.	Continues AR for Venom 5. Copies Vampire chic inbound.

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:25	0920	Rolls out of orbit heading north toward anchor. Verifies position 25 miles south-east of Gotland island. Acknowledges message from boom operator that Venom 5 has completed AR.	Acknowledges tally ho from Vampire 3. Also acknowledges 2 Bogies inbound from the east.	Completes AR for Venom 5.
02:27	0922	Requests update on Bogy information from GCI. Requests fighter assistance with Bogies after finding that Vampire 3 is unable to assist due to damage and weapons configuration (Recce bird).	Acknowledges GCI information that Bogies are closing fast. Copies coded HF message directing immediate tanker recall at Aalborg, Denmark. Informs pilot.	Starts AR for Vampire 3.

ELAPSED TIME HR.:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:29	0924	Acknowledges GCI that friendly fighters are inbound to assist with Bogies. Instructs TACO 33 to recover Aalborg. Detects explosion and loss of electronic avionics. Notes autopilot disconnect. Attempts contact with TACO 33. No contact.	Calls tally-ho on Bogies at 15 miles. Notifies boom operator to secure boom and come forward. Detects explosion and loss of electronic avionics. Attempts contact with boom operator. No contact.	Vampire 3 breaks off for landing at Visby, Gotland. Acknowledges copilot direction to secure boom. Starts to secure boom and detects explosion and blinding flash. Attempt contact with flight deck. No contact. Unable to see, starts toward flight deck, aided by crew chief.
02:30	0925	Makes descending left turn toward the west.		
02:31	0926	Continues turn and descent. Directs copilot to determine damage to avionics. Directs	Begins appraisal of damage to avionics. Checks comm systems, nav systems, flight director	

ELAPSED
TIME
HR:MIN

PILOT

COPILOT

BOOM OPERATOR

ELAPSED TIME HR:MIN	PILOT	COPILOT	BOOM OPERATOR
02:31 (cont.)	0926 crew chief to inspect the cabin, wings, and engines. Notes intercom is inop and quietness on communication radios. Selects Battery to Emergency and notes no change.	and autopilot.	
02:32	0927 Removes thermal radiation curtains. Levels aircraft at FL140. Levels wings and stabilizes airspeed. Checks compass systems against magnetic standby compass. Flies heading of 255°. He is informed by crew chief that no visible damage appears in cabin or aircraft exterior, but boom is not stowed.	Reports to pilot that all communications systems are inoperative. VOR and TACAN inoperative or all stations shut down. INS and doppler systems giving unreliable readings. Navigation input to flight director unreliable. Requests pilot, connect and check autopilot.	Enters cockpit with aid of crew chief. Informs pilot that he has lost his vision from flash blindness, is seated in observer's seat and seatbelt fastened by crew chief.

ELAPSED
TIME
HR:MIN

PILOT

COPILOT

BOOM OPERATOR

02:33	0928	Determines that autopilot is inoperative, disconnects, and hand flies aircraft. Directs crew chief to attempt to stow boom. Advises copilot that manual trim will be used during remainder of flight.	Removes thermal radiation curtains. Observes undercast at approximately 10,000 ft. and another layer with bases at approximately 20,000 ft. Informs pilot that radar is inoperative on all modes. Air-speed indicators, altimeters, and inclinometers appear to be operating normally. All electro-mechanical type instruments and equipment appear to be malfunctioning. Direct reading gages on aircraft engine instruments and subsystems are operating properly. All electrical type indicators are inoperative or unreliable.	
02:34	0929	Flies aircraft west-southwesterly	Monitors flight instruments, engines	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:34 (cont.)	0929	at FL140. Receives information from crew chief that boom is still in trail and will not stow. Directs crew chief into jump seat to monitor remaining engine instruments and systems indications and to assist in the See and Avoid of other aircraft by looking outside the cockpit.	instruments and subsystems. Keeps watch outside for other aircraft.	
02:36	0931	Receives final estimate of damage from the copilot and crew chief. Discusses options for recovery of aircraft.	Completes assessment of damage. Informs pilot. Refers to JN chart to compute a D/R from last known position.	
02:38	0933	Briefs plan to continue west-southwest bound until over		

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:38 (cont.)	0933	the North Sea on the western side of Denmark, orbit slowly down until VMC beneath the clouds, then proceed back northeast to the Danish coast. Locate position on coast. Navigate along coast to an inland lake. Overfly the inland lake to Aalborg Airfield, and make VMC landing. If airfield can not be found or if ceiling and visibilities are too low to become VMC, then ditching will be considered to keep the crew together.		
02:41	0936	Requests ETE and ETA to the west coast of Denmark. Requests estimate of fuel	Estimates present position as abeam Boda, Sweden. Estimates west coast of Denmark to be	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:41 (cont.)	0936	remaining based upon last information available.	300 miles or 0 + 45 minutes. Estimates total of 60,000 pounds of fuel remaining, with 30,000 pounds useable due to electrical malfunc- tions.	
02:42	0937	Directs copilot and crew chief to attempt emer- gency boom hoist to stow boom.	Reviews Emergency Boom Hoist procedures in Dash 1. Dis- cusses with crew chief. Directs crew chief to boom pod to complete checklist items. Departs to cargo compartment.	
02:43	0938	Maintains FL140 and cruise airspeed.	Completes Emergency Boom Hoist checklist in coordination with the crew chief. Observes that the electrical pumps and valves are not operational. Manual	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:43 (cont.)	0938		valves are operated. Copilot operates manual hand pump. Goes forward to request pilot to slow airspeed to allow boom stowage, then returns to cabin.	
02:45	0940	Slows aircraft to 200 KIAS.	Continues to operate boom hoist hand pump, while crew chief latches boom lever from the boom pod. When boom is latched, turns boom hoist manual bypass shutoff valve to NORMAL. Waves crew chief forward. Goes forward. Informs pilot that boom is stowed.	
02:46	0941	Increases speed to 300 KIAS. Directs copilot to try one last attempt to reset	Returns to copilot's seat. Observes crew chief enter cabin and occupy jump seat.	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
02:46 (cont.)	0941	generators.	Confirms to pilot that all electrical power has been lost after final attempt to reset generators.	
02:48	0943	Requests recheck of estimate of fuel remaining in tanks which were selected at the time of the explosion.	Researches fuel log. Consults with crew chief and pilot on their recollection of fuel remaining in selected tanks. Estimates between 2 1/2 and 3 hours fuel remaining at present altitude. Reconfirms to pilot.	
03:00	0945	Continues to fly 265° on whiskey compass. Crosschecks other compass systems. Maintains FL140 and 300 KIAS. Observes solid cloud decks at FL100 below and FL200 above.	Estimates TAS at 370 from outside air temp gage and pilot's computer. Estimates winds and computes estimated GS at 400. Notes time and plots estimated position on JN chart.	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
03:20	1015	Continues to fly aircraft.	Continues to monitor remaining operational instruments. Informs pilot that position is estimated as over west coast of Denmark. Updates nav chart with assumed position.	
03:35	1030	Reduces power. Reduces air-speed. Lowers nose and starts 1/2 standard rate, left, descending turn at 1,000 FPM. Requests Descent checklist. Sets altimeter.	Estimates position at 100 NM west of the coast of Denmark. Updates nav chart. Informs pilot that highest terrain within 100 miles is less than 600 feet MSL. Sets altimeter. Completes Descent checklist. Calls Descent checklist complete. Observes entry into clouds at 9,500 ft.	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
03:47	1042	Observes altimeter passing through 2,000 ft. Continues left spiraling turn. Decreases rate of descent to 500 FPM	Crosschecks flight instruments. Calls out altitudes, each 1,000 ft. Watches outside for indication of VMC.	
03:49	1044	Rolls out of turn on northeasterly heading. Notes altitude at 1,000 ft. Slows descent to 200 FPM.	Observes water directly below aircraft. Forward visibility still 0.	
03:50	1045	Confirms visual conditions under clouds. Observes altitude at estimated 800 feet MSL.	Informs pilot when forward visibility improves to VMC and aircraft is below all clouds.	
03:52	1047	Increases power to 310 KIAS. Requests desired heading from copilot	Refers to navchart and projected flight path. Estimates course 075°. Informs pilot. Updates navchart with assumed DR position.	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILLOT	BOOM OPERATOR
03:53	1048	Stabilizes aircraft on 075° heading, airspeed at 310 KIAS, altitude at 800 feet.	Estimates TAS as 310. Estimates winds as calm. Estimates coast to be 80 NM and ETE to coast to be 16 minutes. Estimates fuel remaining at 1 1/2 to 2 hours.	
04:00	1055	Directs copilot to fly aircraft. Studies nav chart and Aalborg approach plate.	Flies aircraft. Monitors outside for terrain clearance. Crosschecks instruments inside.	
04:05	1100	Discusses procedure upon reaching coast. Turn northbound until a landmark can be identified. Proceed from that point direct to Aalborg. An inland lake and a railroad may be helpful identifiers. The pilot will monitor inside the cockpit indicators. The copilot will watch		

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:05	1100	outside the cockpit.		
(cont.)				
04:10	1105	Takes control of aircraft. Detects slightly higher ceiling. Climbs to 1,000 feet MSL remaining VMC.	Takes primary watch outside aircraft. Continues to plot DR positions on nav chart.	
04:12	1107		Detects landmass at twelve o'clock, 5 miles. Informs pilot.	
LANDFALL				
04:13	1108	Reduces power to maintain 240 KIAS. Turns northbound to parallel coast.	Notes time. Plots estimated DR position on nav chart. Navigates through map reading to identify position.	
04:17	1112		Tentatively identifies posi- tion off coast abeam a narrow bay. Informs pilot to turn to approximately 075°.	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:18	1113	Turns right to 075°. Observes narrow bay as coast-line is passed. Quickly crosschecks nav chart.	Plots tentative position on nav chart. Identifies next prospective checkpoint.	
04:20	1115		Identifies second checkpoint crossing railroad track. Informs pilot of positive identification of position. Plots position on nav chart. Notes time.	
04:21	1116	Requests heading to Aalborg. Requests ETA to Aalborg. Calls for Emergency Gear and Flap Extension checklist and Landing Without Brake System Pressure procedure from Dash 1.	Calculates distance to Aalborg as 55 NM. Calculates ETA as 1130Z, ETE 0 + 14. Informs pilot. Begins research of checklists and Dash 1 for emergency procedures.	
04:25	1120	Flies aircraft. Crosschecks nav chart. Makes corrections	Navigates by map reading. Provides course corrections	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
04:25	1120	provided by copilot.	to pilot as necessary. Con-	
(cont.)			tinues Dash 1 research.	
04:30	1125		Observes runway complex to	
OVER AALBORG			northside of inland waterway.	
			Crosschecks runway layout	
			against approach chart des-	
			cription of Aalborg Royal	
			Danish Air Force Base. Des-	
			criptions match. Informs	
			pilot that Aalborg is at	
			eleven o'clock, 2 miles.	
04:31	1126	Observes runways. Directs	Assists crew chief in manually	
MANUAL EXTENSION		copilot and crew chief to	extending landing gear and	
GEAR AND FLAPS		manually extend landing	wing flaps 30°-40° (500-600	
		gear and flaps to 30°-40°.	turns on crank).	
		Flies aircraft in left		
		hand orbit around the field.		

ELAPSED TIME HR:MIN GMT PILOT COPILOT BOOM OPERATOR

05:00	1155	Slows to 160 KIAS for pattern and approach speeds. Turns left to fly abeam runway complex. Observes wind tee indicating wind from the northeast.	Returns to seat. Calls Emergency checklist complete.	
05:01	1156	Turns left to a heading of 270 to a downwind position. Requests Before Landing checklist, applicable items.	Reads Before Landing checklist.	
05:02	1157	Checks speed brakes at 0°. Checks landing gear lever DOWN. Confirms the remainder of the Before Landing checklist that is not applicable because of power failure.	Checks landing gear lever in DOWN position. Determines remainder of the Before Landing checklist is not applicable due to power failure.	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
05:03	1158	Briefs copilot that landing will be made assuming 30° wing flaps. Approach and touchdown speeds will be increased for rudder power inoperative. Directs copilot to estimate approach and landing speeds for 30° flaps.	Recomputes approach and landing speeds based upon 30° flaps. Informs pilot.	
05:04	1159	Turns left to southerly heading for base leg. Begins descent.	Observes terrain clearance visually. Monitors flight and engine instruments.	
05:05	1200	Turns left to 090° for final approach. Adjusts power.	Calls out altitudes and airspeeds.	
05:06	1201	Establishes landing attitude. Reduces power. Flies aircraft to the runway.	Calls altitudes and airspeeds.	

ELAPSED TIME HR:MIN	GMT	PILOT	COPILOT	BOOM OPERATOR
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05:07	1202	Feels main gear touch runway. Lowers nosewheel to the runway. Reduces power. Maintains directional control with rudders. Slows aircraft with wheel brakes.		
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TOUCHDOWN

05:08	1203	Turns left off runway near the end. Brings aircraft to a stop on the hammerhead. Sets parking brakes. Calls for After Landing checklist and Engine Shutdown checklist. Shuts down engines. Deplanes to the ramp.	Reads and completes After Landing and Engine Shutdown checklist. Calls checklists complete. Helps crew chief assist boom operator to the ramp. Deplanes to the ramp.	
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**DAT
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