SPACE TRANSPORTATION SYSTEM
STS-14 (41-D)
OVERVIEW

HENRY W. HARTSFIELD
COMMANDER

MICHAEL COATS
PILOT

JUDITH A. RESNIK
MISSION SPECIALIST

STEVEN A. HAWLEY
MISSION SPECIALIST

RICHARD M. MULLANE
MISSION SPECIALIST

CHARLES D. WALKER
PAYLOAD SPECIALIST

National Aeronautics and
Space Administration

John F. Kennedy Space Center

NASA

KSC FORM 16-12 (REV. 8/76)

PREPARED BY:

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LOCKHEED SPACE OPERATIONS COMPANY
KENNEDY SPACE CENTER, FL

NOTE

THIS DOCUMENT WAS PREPARED BEFORE FINAL COUNTDOWN PLANNING WAS COMPLETED. LAUNCH OPERATIONS ARE INHERENTLY DYNAMIC AND ARE GREATLY AFFECTED BY UNFORESEEN HARDWARE PROBLEMS AND WEATHER. HOWEVER, THE TIMES CONTAINED WITHIN THIS DOCUMENT REPRESENT THE MOST UP-TO-DATE INFORMATION AVAILABLE AT THE TIME OF PUBLICATION AND WILL PROVIDE THE READER WITH AN OVERVIEW OF THE SEQUENCE OF EVENTS LEADING UP TO, AND INCLUDING, LAUNCH, FLIGHT AND LANDING.

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CREW INSIGNIA

THE OFFICIAL MISSION INSIGNIA FOR THE 41D SPACE SHUTTLE FLIGHT FEATURES THE DEBUT OF NASA'S NEWEST ORBITER, THE SPACESHIP "DISCOVERY" (SEE COVER). "DISCOVERY", LIKE ITS PREDECESSORS, WAS NAMED AFTER EXPLORING "SHIPS" OF HISTORY. THE PATCH DEPICTS THE ORBITER HEADING FOR NEW HORIZONS. SURNAMES FOR THE CREW MEMBERS OF NASA'S ELEVENTH SPACE SHUTTLE MISSION ENCIRCLE THE RED, WHITE AND BLUE SCENE. THEY ARE ASTRONAUTS HENRY W. HARTSFIELD JR., COMMANDER; MICHAEL L. COATS, PILOT; JUDITH A. RESNIK, STEVEN A. HAWLEY AND RICHARD M. (MIKE) MULLANE, ALL MISSION SPECIALISTS; AND CHARLES D. WALKER, PAYLOAD SPECIALIST.

DISCOVERY

FACTS AND FIGURES

STS 41D MARKS THE INITIAL FLIGHT OF THE SPACESHIP "DISCOVERY", NASA'S THIRD REUSABLE VEHICLE.

THE SPACECRAFT HAS TWO TASKS TO ACCOMPLISH. IT IS SCHEDULED FOR AT LEAST FOUR EARTH-ORBITING MISSIONS - ALL LAUNCHED FROM THE KENNEDY SPACE CENTER, FLORIDA. THE "DISCOVERY" WILL THEN BE TURNED OVER TO THE AIR FORCE FOR FLIGHT IN POLAR ORBIT LAUNCHED FROM THE VANDENBERG AIR FORCE BASE, CALIFORNIA.

THERE ARE NO MAJOR PHYSICAL DIMENSIONAL DIFFERENCES BETWEEN THE ORBITERS "DISCOVERY" AND "CHALLENGER". THEY EACH HAVE THE SAME MASSIVE 122 FOOT LONG STRUCTURE.

THERE IS, HOWEVER, A NOTICEABLE DIFFERENCE IN THE EXTERIOR OF THE "DISCOVERY". THE 8" X 8" WHITE-COLORED LOW TEMPERATURE TILES ALONG THE SPACECRAFT'S MID-FUSELAGE SIDES AND THE UPPER PORTION OF THE WING STRUCTURE HAVE BEEN REPLACED WITH A BLANKET MATERIAL KNOWN AS AFRSI (ADVANCED FLEXIBLE REUSABLE SURFACE INSULATION). THE BLANKET MATERIAL IS LOW DENSITY BATTING MADE FROM HIGH PURITY SILICA FIBERS.

IN ORDER TO PROTECT AGAINST RE-ENTRY FRICTION TEMPERATURES OF UP TO 1,200° F, APPROXIMATELY 5,000 OF THE LOW TEMPERATURE WHITE TILES WERE INITIALLY INSTALLED ON BOTH THE "COLUMBIA" AND THE "CHALLENGER". APPROXIMATELY 2,200 AFRSI BLANKETS ARE NOW USED TO PROTECT THE SPACECRAFT'S ALUMINUM STRUCTURES AGAINST THAT TEMPERATURE.

IN ADDITION, "DISCOVERY" HAS APPROXIMATELY 2,000 NEWLY DEVELOPED BLACK-COLORED HIGH TEMPERATURE REUSABLE SURFACE INSULATION TILES. KNOWN AS FRCI (FIBROUS REFRACTORY COMPOSITE INSULATION), EACH OF THESE NEW TILES HAVE A DENSITY OF 12 POUNDS PER CUBIC FOOT.

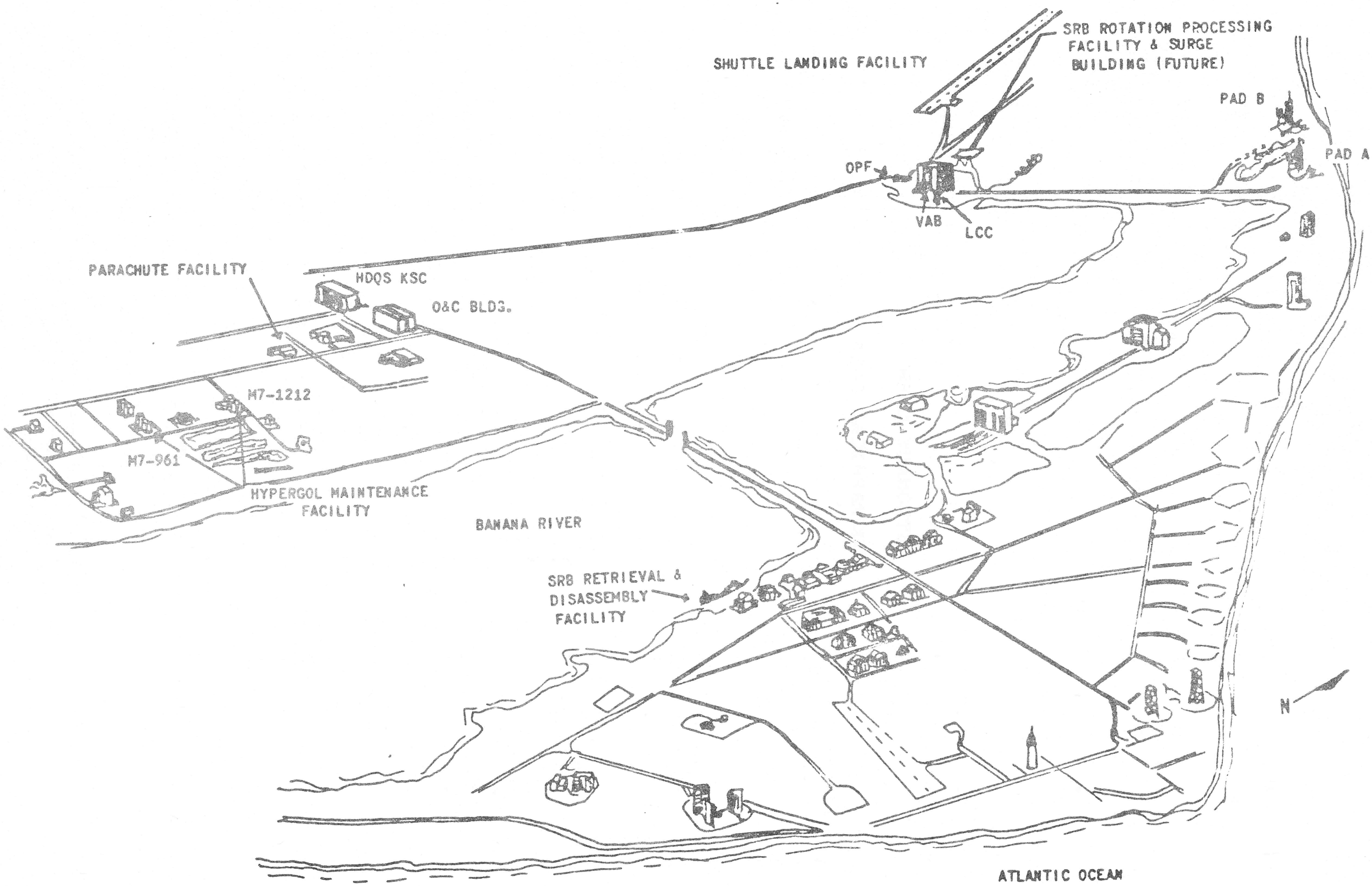
SIGNIFICANT PROGRESS HAS BEEN ACHIEVED IN THE AREA OF WEIGHT REDUCTION. DUE TO A MANUFACTURING WEIGHT SAVING PROGRAM (FIRST STARTED WITH "CHALLENGER") THE "DISCOVERY" IS APPROXIMATELY 1,000 POUNDS LIGHTER (TOTAL WEIGHT IS APPROXIMATELY 75,000 TONS). THIS HAS BEEN ACCOMPLISHED PRIMARILY BY THE USE OF THE THERMAL PROTECTION SYSTEM (TPS) BLANKETS RATHER THAN TILES AND IN THE USE OF COMPOSITE MATERIALS. UPGRADED ON-BOARD SYSTEMS AND ADDITIONAL STRUCTURAL SUPPORT FITTINGS HAVE ADDED SOME WEIGHT, WHICH SUBTRACTED FROM THE TOTAL TPS REDUCTION.

A GALLEY WAS ORIGINALLY INTENDED FOR INSTALLATION INTO "DISCOVERY" BUT WAS DELETED TO PERMIT INSTALLATION OF THE CONTINUOUS FLOW ELECTROPHORESIS SYSTEM (CFES) INTO THE SPACECRAFT'S MID-DECK.

ASTRONAUT CREW

BIOGRAPHICAL DATA

SHUTTLE TRANSPORTATION SYSTEM PROCESSING FACILITIES



COMMANDER

HENRY W. HARTSFIELD, JR.
(COLONEL, USAF - RETIRED)

BIRTHPLACE AND DATE: BORN IN BIRMINGHAM, ALABAMA, ON NOVEMBER 21, 1933.

PHYSICAL DESCRIPTION: BROWN HAIR; HAZEL EYES; HEIGHT: 5 FEET 10 INCHES; WEIGHT: 165 POUNDS.

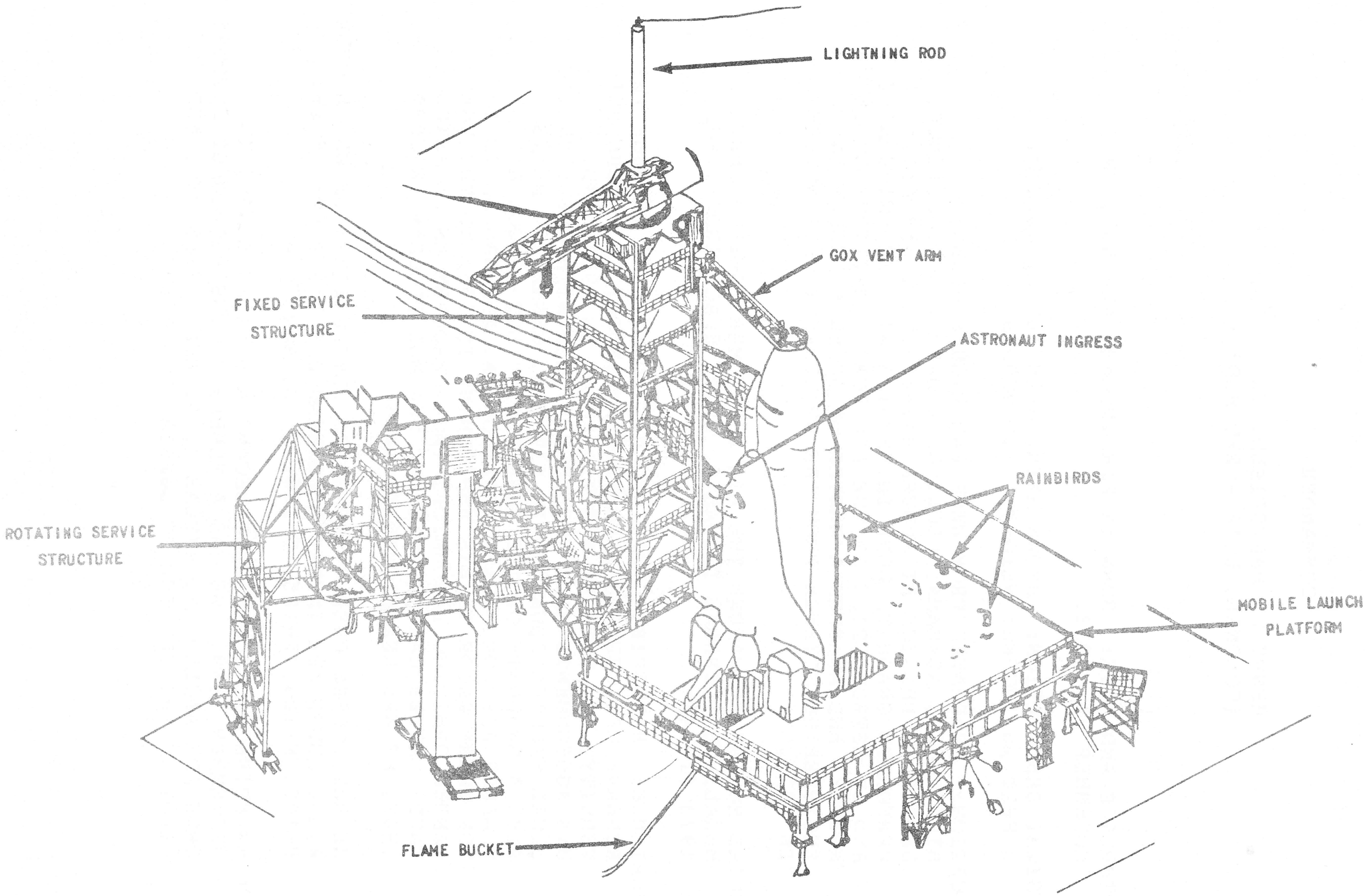
EDUCATION: GRADUATED FROM WEST END HIGH SCHOOL, BIRMINGHAM, ALABAMA; RECEIVED A BACHELOR OF SCIENCE DEGREE IN PHYSICS AT AUBURN UNIVERSITY IN 1954; PERFORMED GRADUATE WORK IN PHYSICS AT DUKE UNIVERSITY AND IN ASTRONAUTICS AT THE AIR FORCE INSTITUTE OF TECHNOLOGY; AND AWARDED A MASTER OF SCIENCE DEGREE IN ENGINEERING SCIENCE FROM THE UNIVERISTY OF TENNESSEE IN 1971.

SPECIAL HONORS: AWARDED THE AIR FORCE MERITORIOUS SERVICE MEDAL; THE GENERAL THOMAS D. WHITE SPACE TROPHY FOR 1973 (1974).

EXPERIENCE: HARTSFIELD RECEIVED HIS COMMISSION THROUGH THE RESERVE OFFICER TRAINING PROGRAM (ROTC) AT AUBURN UNIVERSITY. HE ENTERED THE AIR FORCE IN 1955, AND HIS ASSIGNMENTS HAVE INCLUDED A TOUR WITH THE 53RD TACTICAL FIGHTER SQUADRON IN BITBURG, GERMANY. HE IS ALSO A GRADUATE OF THE USAF TEST PILOT SCHOOL AT EDWARDS AIR FORCE BASE, CALIFORNIA, AND WAS AN INSTRUCTOR THERE PRIOR TO HIS ASSIGNMENT IN 1966 TO THE USAF MANNED ORBITING LABORATORY (MOL) PROGRAM AS AN ASTRONAUT. AFTER CANCELLATION OF THE MOL PROGRAM IN JUNE 1969, HE WAS REASSIGNED TO NASA.

HE HAS LOGGED OVER 4,750 HOURS FLYING TIME--OF WHICH OVER 4,400 HOURS ARE IN THE FOLLOWING JET AIRCRAFT: F-86, F-100, F-104, F-105, F-106, T-33, AND T-38.

NASA EXPERIENCE: HARTSFIELD BECAME A NASA ASTRONAUT IN SEPTEMBER 1969. HE WAS A MEMBER OF THE ASTRONAUT SUPPORT CREW FOR APOLLO 16, SKYLAB 2, 3, AND 4 MISSIONS, AND PILOT OF THE ORBITER "COLUMBIA" FOR STS-4.



SHUTTLE AT PAD 39A

PILOT

MICHAEL L. COATS
(COMMANDER, USN)

BIRTHPLACE AND DATE: BORN JANUARY 16, 1946, IN SACRAMENTO, CALIFORNIA, BUT CONSIDERS RIVERSIDE, CALIFORNIA, AS HIS HOMETOWN.

PHYSICAL DESCRIPTION: BROWN HAIR; BLUE EYES; HEIGHT: 6 FEET; WEIGHT: 185 POUNDS.

EDUCATION: GRADUATED FROM RAMONA HIGH SCHOOL, RIVERSIDE, CALIFORNIA, IN 1964; RECEIVED A BACHELOR OF SCIENCE DEGREE FROM THE UNITED STATES NAVAL ACADEMY IN 1968, A MASTER OF SCIENCE IN ADMINISTRATION OF SCIENCE AND TECHNOLOGY FROM GEORGE WASHINGTON UNIVERSITY IN 1977, AND MASTER OF SCIENCE IN AERONAUTICAL ENGINEERING FROM THE U.S. NAVAL POSTGRADUATE SCHOOL IN 1979.

RECREATIONAL INTERESTS: READING, RACQUETBALL, AND JOGGING.

SPECIAL HONORS: AWARDED 2 NAVY DISTINGUISHED FLYING CROSSES, 32 STRIKE FLIGHT AIR MEDALS, 3 INDIVIDUAL ACTION AIR MEDALS, AND 9 NAVY COMMENDATION MEDALS WITH COMBAT V.

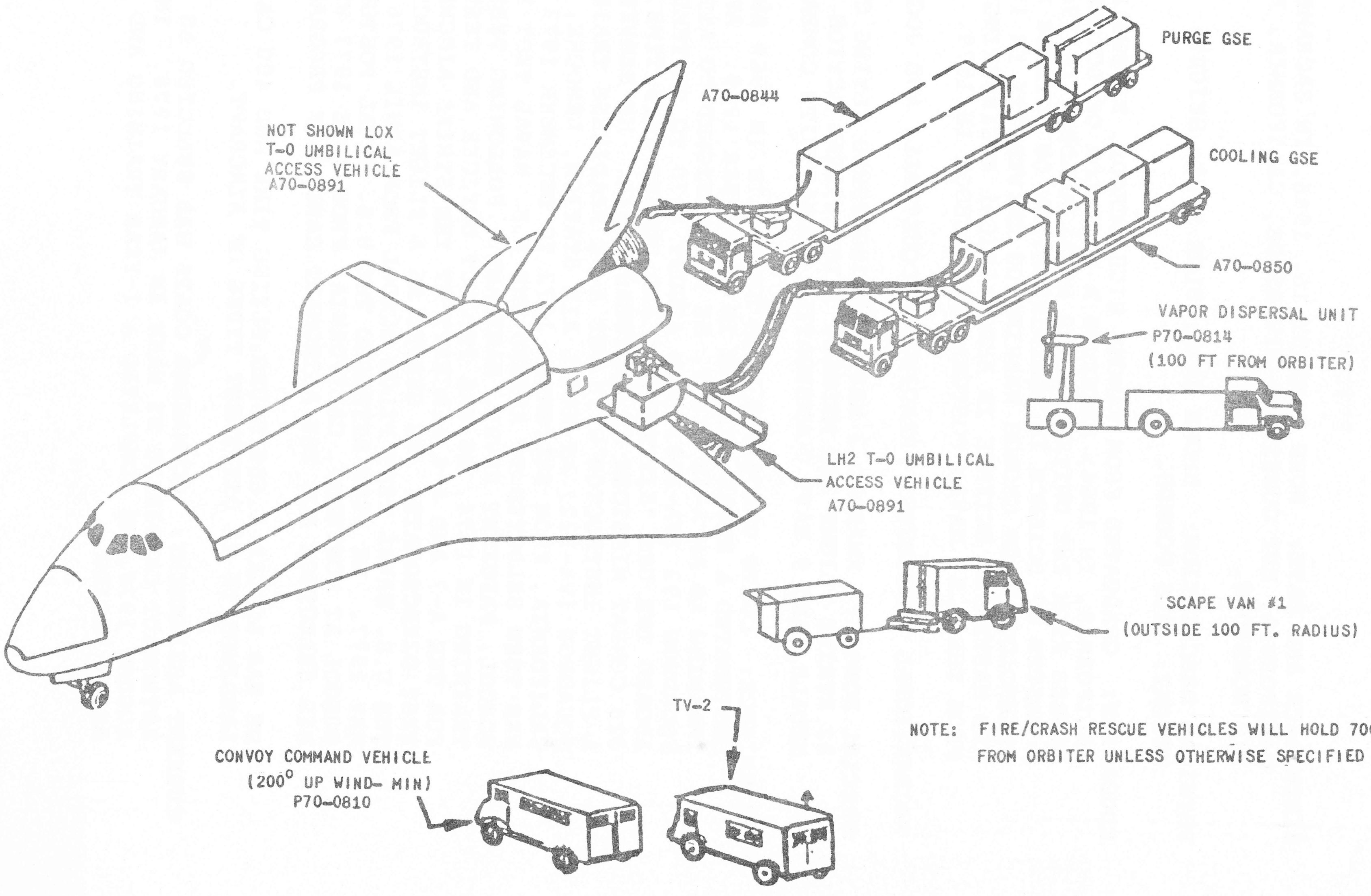
EXPERIENCE: COATS GRADUATED FROM ANNAPOLIS IN 1968 AND WAS DESIGNATED A NAVAL AVIATOR IN SEPTEMBER 1969. AFTER TRAINING AS AN A-7E PILOT, HE WAS ASSIGNED TO ATTACK SQUADRON 192 (VA-192) FROM AUGUST 1970 TO SEPTEMBER 1972, ABOARD THE USS "KITTYHAWK," AND DURING THIS TIME, FLEW 315 COMBAT MISSIONS IN SOUTHEAST ASIA. HE SERVED AS A FLIGHT INSTRUCTOR WITH THE A-7E READINESS TRAINING SQUADRON (VA-122) AT NAVAL AIR STATION, LEMOORE, CALIFORNIA, FROM SEPTEMBER 1972 TO DECEMBER 1973 AND WAS THEN SELECTED TO ATTEND THE U.S. NAVAL TEST PILOT SCHOOL, PATUXENT RIVER, MARYLAND. FOLLOWING TEST PILOT TRAINING IN 1974, HE WAS PROJECT OFFICER AND TEST PILOT FOR THE A-7 AND A-4 AIRCRAFT AT THE STRIKE AIRCRAFT TEST DIRECTORATE. HE SERVED AS A FLIGHT INSTRUCTOR AT THE U.S. NAVAL TEST PILOT SCHOOL FROM APRIL 1976 UNTIL MAY 1977. HE THEN ATTENDED THE U.S. NAVAL POSTGRADUATE SCHOOL AT MONTEREY, CALIFORNIA, FROM JUNE 1977 UNTIL HIS SELECTION FOR THE ASTRONAUT CANDIDATE PROGRAM.

HE HAS LOGGED 2,600 HOURS FLYING TIME AND 400 CARRIER LANDINGS IN 22 DIFFERENT TYPES OF AIRCRAFT.

CURRENT ASSIGNMENT: COMMANDER COATS WAS SELECTED AS AN ASTRONAUT CANDIDATE BY NASA IN JANUARY 1978. IN AUGUST 1979, HE COMPLETED A 1-YEAR TRAINING AND EVALUATION PERIOD.

CONVOY SCAPE OPERATIONS

INITIAL TASKS (PHASE I) - HAZARDOUS AREA



NOTE: FIRE/CRASH RESCUE VEHICLES WILL HOLD 700'
FROM ORBITER UNLESS OTHERWISE SPECIFIED

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MISSION SPECIALIST

STEVEN A. HAWLEY (PHD)

BIRTHPLACE AND DATE: BORN DECEMBER 12, 1951, IN OTTAWA, KANSAS, BUT CONSIDERS SALINA, KANSAS, TO BE HIS HOMETOWN.

PHYSICAL DESCRIPTION: BLOND HAIR; BLUE EYES; HEIGHT: 6 FEET; WEIGHT: 150 POUNDS.

EDUCATION: GRADUATED FROM SALINA (CENTRAL) HIGH SCHOOL, SALINA, KANSAS, IN 1969; RECEIVED BACHELOR OF ARTS DEGREES IN PHYSICS AND ASTRONOMY (GRADUATING WITH HIGHEST DISTINCTION) FROM THE UNIVERSITY OF KANSAS IN 1973 AND A DOCTOR OF PHILOSOPHY IN ASTRONOMY AND ASTROPHYSICS FROM THE UNIVERSITY OF CALIFORNIA IN 1977.

RECREATIONAL INTERESTS: BASKETBALL, SOFTBALL, TENNIS, RUNNING, PLAYING BRIDGE AND READING.

ORGANIZATIONS: MEMBER OF THE AMERICAN ASTRONOMICAL SOCIETY, THE ASTRONOMICAL SOCIETY OF THE PACIFIC, SIGMA PI SIGMA, PHI BETA KAPPA, AND THE UNIVERSITY OF KANSAS ALUMNI ASSOCIATION.

SPECIAL HONORS: EVANS FOUNDATION SCHOLARSHIP, 1970; UNIVERSITY OF KANSAS HONOR SCHOLARSHIP, 1970; SUMMERFIELD SCHOLARSHIP, 1970-1973; VETA B. LEAR AWARD, 1970; STRANATHAN AWARD, 1972; UNDERGRADUATE RESEARCH GRANT, 1971; OUTSTANDING PHYSICS MAJOR AWARD, 1973; UNIVERSITY OF CALIFORNIA REGENTS FELLOWSHIP, 1974.

EXPERIENCE: HAWLEY ATTENDED THE UNIVERSITY OF KANSAS, MAJORING IN PHYSICS AND ASTRONOMY, AND WAS EMPLOYED THERE DURING HIS TENURE AS AN UNDERGRADUATE BY THE DEPARTMENT OF PHYSICS AND ASTRONOMY AS A TEACHING ASSISTANT. IN 1971, HE WAS AWARDED AN UNDERGRADUATE RESEARCH GRANT FROM THE COLLEGE OF LIBERAL ARTS AND SCIENCES FOR AN INDEPENDENT STUDIES PROJECT ON STELLAR SPECTROSCOPY. HE SPENT THREE SUMMERS EMPLOYED AS A RESEARCH ASSISTANT: 1972 AT THE U.S. NAVAL OBSERVATORY IN WASHINGTON, D.C., AND 1973 AND 1974 AT THE NATIONAL RADIO ASTRONOMY OBSERVATORY IN GREEN BANK, WEST VIRGINIA. HE ATTENDED GRADUATE SCHOOL AT LICK OBSERVATORY, UNIVERSITY OF CALIFORNIA, SANTA CRUZ, AND WHILE THERE HELD A RESEARCH ASSISTANTSHIP FOR ALMOST 3 YEARS. HIS RESEARCH INVOLVED SPECTROPHOTOMETRY OF GASEOUS NEBULAE AND EMISSION-LINE GALAXIES WITH PARTICULAR EMPHASIS ON CHEMICAL ABUNDANCE DETERMINATIONS FOR THESE OBJECTS. THE RESULTS OF HIS RESEARCH HAVE BEEN PUBLISHED IN MAJOR ASTRONOMICAL JOURNALS.

PRIOR TO HIS SELECTION BY NASA IN 1978, DR. HAWLEY WAS A POSTDOCTORAL RESEARCH ASSOCIATE AT CERRO TOLOLO INTER-AMERICAN OBSERVATORY IN LA SERENA, CHILE.

CURRENT ASSIGNMENT: DR. HAWLEY WAS SELECTED AS AN ASTRONAUT CANDIDATE BY NASA IN JANUARY 1978. IN AUGUST 1979, HE COMPLETED A 1-YEAR TRAINING AND EVALUATION PERIOD.

MISSION ASSIGNMENT: HAWLEY WILL BE WORKING IN CONJUNCTION WITH MULLANE TO DEPLOY THE SYNCOM IV SATELLITE. IN ADDITION, HE WILL BE ONE OF THE OPERATORS OF THE LARGE FORMAT CAMERA AND THE IMAX CAMERA.

MISSION SPECIALIST

JUDITH A. RESNIK (PHD)

BIRTHPLACE AND DATE: BORN APRIL 5, 1949, IN AKRON, OHIO.

PHYSICAL DESCRIPTION: BLACK HAIR; BROWN EYES; HEIGHT: 5 FEET 4 INCHES; WEIGHT: 115 POUNDS.

EDUCATION: GRADUATED FROM FIRESTONE HIGH SCHOOL, AKRON, OHIO, IN 1966; RECEIVED A BACHELOR OF SCIENCE DEGREE IN ELECTRICAL ENGINEERING FROM CARNEGIE-MELLON UNIVERSITY IN 1970, AND A DOCTORATE IN ELECTRICAL ENGINEERING FROM THE UNIVERSITY OF MARYLAND IN 1977.

RECREATIONAL INTERESTS: SHE IS A CLASSICAL PIANIST AND ALSO ENJOYS BICYCLING, RUNNING, AND FLYING DURING HER FREE TIME.

ORGANIZATIONS: MEMBER OF THE INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS; AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE; IEEE COMMITTEE ON PROFESSIONAL OPPORTUNITIES FOR WOMEN; AMERICAN ASSOCIATION OF UNIVERSITY WOMEN; AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS; TAU BETA PI; ETA KAPPA NU; MORTARBOARD; CARNEGIE-MELLON UNIVERSITY ADMISSIONS COUNCIL; SENIOR MEMBER OF THE SOCIETY OF WOMEN ENGINEERS.

SPECIAL HONORS: GRADUATE STUDY PROGRAM AWARD, RCA, 1971; AMERICAN ASSOCIATION OF UNIVERSITY WOMEN FELLOW, 1975-1976.

EXPERIENCE: UPON GRADUATING FROM CARNEGIE-MELLON UNIVERSITY IN 1970, DR. RESNIK WAS EMPLOYED BY RCA MISSILE AND SURFACE RADAR, LOCATED IN MOORESTOWN, NEW JERSEY; AND IN 1971, SHE TRANSFERRED TO THE RCA SERVICE COMPANY IN SPRINGFIELD, VIRGINIA. HER PROJECTS WHILE WITH RCA AS A DESIGN ENGINEER INCLUDED CIRCUIT DESIGN AND DEVELOPMENT OF CUSTOM INTEGRATED CIRCUITRY FOR PHASED-ARRAY RADAR CONTROL SYSTEMS; EQUIPMENT SPECIFICATION, PROJECT MANAGEMENT, AND PERFORMANCE EVALUATION FOR CONTROL SYSTEM EQUIPMENT; AND ENGINEERING SUPPORT FOR THE NASA SOUNDING ROCKET PROGRAM AND TELEMETRY SYSTEMS. DR. RESNIK AUTHORED A PAPER CONCERNING DESIGN PROCEDURES FOR SPECIAL-PURPOSE INTEGRATED CIRCUITRY.

DR. RESNIK WAS A BIOMEDICAL ENGINEER AND STAFF FELLOW IN THE LABORATORY OF NEUROPHYSIOLOGY AT THE NATIONAL INSTITUTES OF HEALTH IN BETHESDA, MARYLAND, FROM 1974 TO 1977, WHERE SHE PERFORMED BIOLOGICAL RESEARCH EXPERIMENTS CONCERNING THE PHYSIOLOGY OF VISUAL SYSTEMS. IMMEDIATELY PRECEDING HER SELECTION BY NASA IN 1978, SHE WAS A SENIOR SYSTEMS ENGINEER IN PRODUCT DEVELOPMENT WITH XEROX CORPORATION AT EL SEGUNDO, CALIFORNIA.

CURRENT ASSIGNMENT: DR. RESNIK WAS SELECTED AS AN ASTRONAUT CANDIDATE BY NASA IN JANUARY 1978. IN AUGUST 1979, SHE COMPLETED A 1-YEAR TRAINING AND EVALUATION PERIOD.

MISSION ASSIGNMENT: RESNIK WILL BE RESPONSIBLE FOR THE OAST-1 PAYLOAD CONSISTING OF THREE EXPERIMENTS: DYNAMIC AUG-MENTATION EXPERIMENT (DAE), SOLAR CELL CALIBRATION FACILITY (SCCF) AND THE SOLAR ARRAY EXPERIMENT (SAE). IN ADDITION SHE WILL BE THE BACKUP ON THE CONTINUOUS FLOW ELECTROPHORESIS SYSTEM (CFES) EXPERIMENT.

MISSION SPECIALIST

RICHARD M. MULLANE
(LT. COLONEL, USAF)

BIRTHPLACE AND DATE: BORN SEPTEMBER 10, 1945, IN WICHITA FALLS, TEXAS, BUT CONSIDERS ALBUQUERQUE, NEW MEXICO, TO BE HIS HOMETOWN.

PHYSICAL DESCRIPTION: BROWN HAIR; BROWN EYES; HEIGHT: 5 FEET 10 INCHES; WEIGHT: 146 POUNDS.

EDUCATION: GRADUATED FROM ST. PIUS X CATHOLIC HIGH SCHOOL, ALBUQUERQUE, NEW MEXICO, IN 1963; RECEIVED A BACHELOR OF SCIENCE DEGREE IN MILITARY ENGINEERING FROM THE UNITED STATES MILITARY ACADEMY IN 1967; AND AWARDED A MASTER OF SCIENCE DEGREE IN AERONAUTICAL ENGINEERING FROM THE AIR FORCE INSTITUTE OF TECHNOLOGY IN 1975.

RECREATIONAL INTERESTS: MICRO-COMPUTER SOFTWARE DESIGN, SKIING, SCUBA DIVING, AND RACQUETBALL.

ORGANIZATIONS: MEMBER OF THE AIR FORCE ASSOCIATION.

SPECIAL HONORS: AWARDED 6 AIR MEDALS, THE AIR FORCE DISTINGUISHED FLYING CROSS, MERITORIOUS SERVICE MEDAL, VIETNAM CAMPAIGN MEDAL, NATIONAL DEFENSE SERVICE MEDAL, VIETNAM SERVICE MEDAL, AND AIR FORCE COMMENDATION MEDAL; NAMED A DISTINGUISHED GRADUATE OF THE USAF NAVIGATOR TRAINING SCHOOL (AND RECIPIENT OF ITS COMMANDER'S TROPHY), THE USAF INSTITUTE OF TECHNOLOGY, AND THE USAF TEST PILOT SCHOOL; WINNER OF SECOND PLACE AWARD FOR TECHNICAL PAPERS AT THE 1975 AIAA MIDWEST REGIONAL CONFERENCE FOR PRESENTATION OF MASTER'S THESIS.

EXPERIENCE: MULLANE WAS GRADUATED FROM WEST POINT IN 1967. HE COMPLETED 150 COMBAT MISSIONS AS AN RF-4C WEAPON SYSTEM OPERATOR WHILE STATIONED AT TAN SON NHUT AIR BASE, VIETNAM, FROM JANUARY TO NOVEMBER 1969, AND A SUBSEQUENT 4-YEAR TOUR OF DUTY AT ROYAL AIR FORCE BASE, ALCONBURY, ENGLAND. IN JULY 1976, UPON COMPLETING THE USAF TEST PILOT SCHOOL'S FLIGHT TEST ENGINEER COURSE AT EDWARDS AIR FORCE BASE, CALIFORNIA, HE WAS ASSIGNED AS A FLIGHT TEST WEAPON SYSTEM OPERATOR TO THE 3246TH TEST WING AT EGLIN AIR FORCE BASE, FLORIDA.

CURRENT ASSIGNMENT: LT. COL. MULLANE WAS SELECTED AS AN ASTRONAUT CANDIDATE BY NASA IN JANUARY 1978. IN AUGUST 1979, HE COMPLETED A 1-YEAR TRAINING AND EVALUATION PERIOD.

MISSION ASSIGNMENT: MULLANE WILL BE WORKING IN CONJUNCTION WITH HAWLEY TO DEPLOY THE SYNCOM IV SATELLITE. IN ADDITION, HE WILL BE ONE OF THE OPERATORS OF THE LARGE FORMAT CAMERA AND THE IMAX CAMERA.

PAYLOAD SPECIALIST

CHARLES D. WALKER

BIRTHPLACE AND DATE: BORN IN BEDFORD, INDIANA, AUGUST 29, 1948.

PHYSICAL DESCRIPTION: BROWN HAIR; BLUE EYES; HEIGHT: 5 FEET 9 INCHES; WEIGHT: 145 POUNDS.

EDUCATION: GRADUATED FROM BEDFORD HIGH SCHOOL, BEDFORD, INDIANA, IN 1966; RECEIVED A BACHELOR OF SCIENCE DEGREE IN AERONAUTICAL AND ASTRONAUTICAL ENGINEERING FROM PURDUE UNIVERSITY IN 1971.

RECREATIONAL INTERESTS: PHOTOGRAPHY, RUNNING, HIKING, SCUBA DIVING, AND READING.

ORGANIZATIONS: HE IS A MEMBER OF THE AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, THE AMERICAN ASTRONAUTICAL SOCIETY, THE NATIONAL SPACE INSTITUTE, SPACE STUDIES INSTITUTE, THE NATURE CONSERVANCY, AND THE L-5 SOCIETY.

EXPERIENCE: HE IS CHIEF TEST ENGINEER FOR THE MCDONNELL DOUGLAS ELECTROPHORESIS OPERATIONS IN SPACE (EOS) PROJECT. HE JOINED THE EOS TEAM AS ONE OF ITS ORIGINAL MEMBERS. HIS CONTRIBUTIONS TO THE PROGRAM INCLUDE ENGINEERING PLANNING, DEVELOPMENT AND SPACE FLIGHT TEST AND EVALUATION OF THE EOS DEVICE. HE HAS BEEN INVOLVED WITH THE PROGRAM SUPPORT EFFORTS AT KENNEDY SPACE CENTER AND AT MISSION CONTROL CENTER, HOUSTON. HE HAS ALSO BEEN RESPONSIBLE FOR THE TRAINING OF THE ASTRONAUT CREWS IN THE OPERATION OF THE EOS PAYLOAD FOR ITS OPERATIONS ON STS-4, STS-6, STS-7, AND STS-8. WALKER SHARES A PATENT FOR THE CONTINUOUS FLOW ELECTROPHORESIS DEVICE.

WALKER JOINED MCDONNELL DOUGLAS AS A TEST ENGINEER ON THE AFT PROPULSION SUBSYSTEM FOR THE SPACE SHUTTLE ORBITERS.

PRIOR TO JOINING MCDONNELL DOUGLAS, WALKER WAS A DESIGN ENGINEER WITH BENDIX AEROSPACE COMPANY IN 1972 WHERE HE WORKED ON AERODYNAMIC ANALYSIS, MISSILE SUBSYSTEM DESIGN AND FLIGHT TESTING.

MISSION ASSIGNMENT: WALKER WILL BE RESPONSIBLE FOR CONDUCTING THE CONTINUOUS FLOW ELECTROPHORESIS SYSTEM (CFES) EXPERIMENT.

LAUNCH COUNTDOWN AND PROCEDURE OVERVIEW

IN ORDER TO SYSTEMATICALLY VERIFY ALL COMPONENTS AND SYSTEMS NECESSARY FOR A SUCCESSFUL LAUNCH, THE SPACE SHUTTLE LAUNCH TEAM HAS DEVELOPED A TEST PROCEDURE DOCUMENT TO INTEGRATE AND SEQUENCE ALL PREPARATIONS, TESTS, VERIFICATIONS AND CALIBRATIONS PERTAINING TO THE LAUNCH OF THE SPACE SHUTTLE.

THIS PROCEDURE IS KNOWN AS OPERATION AND MAINTENANCE INSTRUCTION (OMI) "S0007 - SHUTTLE LAUNCH COUNTDOWN". THIS OMI HAS BEEN SUB-DIVIDED INTO SEVERAL PHASES:

- PRETEST OPERATIONS
- CALL TO STATIONS
- SPACE SHUTTLE VEHICLE (SSV) POWER UP
- ORBITER POWER REACTANT STORAGE AND DISTRIBUTION (PRSD) AND GASEOUS NITROGEN (GN2) SERVICING OF THE ORBITAL MANEUVERING SYSTEM (OMS) ENGINES
- MAIN PROPULSION SYSTEM (MPS) HELIUM BOTTLE SERVICING
- SHUTTLE SYSTEM ACTIVATION AND CLOSEOUT
- SHUTTLE MAIN PROPELLANT TANKING
- FINAL LAUNCH COUNTDOWN

THESE PHASES CONTAIN SEQUENCES DEFINING ALL REQUIREMENTS AND DETAILING THE STEPS NECESSARY TO SATISFY THESE REQUIREMENTS FOR LAUNCH. AS THESE TESTS ARE PERFORMED, ENGINEERS MONITOR THEIR RESPECTIVE SYSTEMS THROUGH COMPUTER DATA PROVIDED THEM IN THE LAUNCH CONTROL CENTER (LCC) FIRING ROOM (FR) ON COLOR COMPUTER VIDEO DISPLAY TERMINALS (CRTs).

PRETEST OPERATIONS

THIS PHASE IS PRIOR TO THE COMMENCEMENT OF THE ACTUAL TESTING PHASES. IT IS DESIGNED TO ASSURE THAT ALL FEEDLINES, COMMUNICATION AND ELECTRICAL HOOK-UPS, AND MONITORING AND RECORDING CAMERAS ARE IN PROPER WORKING ORDER AND ARE CONFIGURED TO SUPPORT THE PRE-LAUNCH PHASES. THE COMPUTERS ARE CONFIGURED FOR THE LAUNCH PROCESS, AND ALL WARNING AND PAGING SYSTEMS ARE VERIFIED TO BE WORKING PROPERLY. THE PRETEST OPERATIONS PHASE GENERALLY ASSURES THAT ALL VEHICLE AND GROUND SUPPORT EQUIPMENT (GSE) ARE READY TO START THE COUNTDOWN PROCEDURE.

CALL TO STATION

PRETEST SETUPS ARE VERIFIED TO BE COMPLETE AND ALL SUPPORT PERSONNEL (TEST CONDUCTORS, ENGINEERS, TECHNICIANS, QUALITY, SAFETY, FIRE, RESCUE, MEDICAL AND SECURITY) ARE VERIFIED TO BE IN THEIR DESIGNATED POSITIONS AND READY TO SUPPORT THE LAUNCH COUNTDOWN. EMERGENCY PROCEDURES AND EMERGENCY POWER-DOWN PROCEDURES ARE REVIEWED OVER THE COMMUNICATIONS NET TO ENSURE THAT ALL PERSONNEL ARE FAMILIAR WITH THEIR RESPONSIBILITIES IN AN EMERGENCY SITUATION. WHEN ALL VERIFICATIONS HAVE BEEN CONFIRMED BY THE TEST DIRECTOR, HE GIVES THE "GO" TO PROCEED WITH THE LAUNCH COUNTDOWN.

SPACE SHUTTLE VEHICLE (SSV) POWER UP

THE ORBITER AND ITS EXTERNAL TANK ARE POWERED UP AND THE GROUND SUPPORT EQUIPMENT (GSE) IS CONFIGURED TO SUPPLY THE SPACE SHUTTLE WITH ALL NECESSARY SUPPORT (ELECTRICAL, COOLING, GASSES, FUEL, ETC.). THE ORBITER BACKUP FLIGHT CONTROL SYSTEM IS VERIFIED TO BE OPERATIONAL.

ORBITER PRSD AND GN2 SERVICING OF OMS ENGINES

THE PRSD SYSTEM, WHICH SUPPLIES REACTANTS TO THE ONBOARD FUEL CELLS, IS SERVICED AND LOADED WITH CRYOGENIC LIQUIDS (SUPER COLD LIQUID OXYGEN AND HYDROGEN). THE SERVICING OF THE PRSD SYSTEM INCLUDES PURGING THE SYSTEM OF INERTS, LEAK CHECKS, LOADING OF REACTANTS (CRYOGENICS), AND PRESSURIZING THE TANKS TO FLIGHT PRESSURE. NITROGEN GAS (GN2) WHICH IS USED AS THE CONTROL FLUID AND PROPELLANT TANK PRESSURIZATION MEDIUM FOR THE OMS ENGINES, IS ALSO LOADED.

MPS HELIUM BOTTLE SERVICING

THE TEN HELIUM FILLED PRESSURE BOTTLES, USED TO PURGE THE MAIN PROPULSION SYSTEM (MPS) DURING FLIGHT AND PROVIDE PRESSURE TO OPERATE THE MPS VALVES, ARE SERVICED AND BROUGHT UP TO PRE-TANKING PRESSURE (2000 PSI).

SHUTTLE SYSTEM ACTIVATION AND CLOSEOUT

AIR-TO-GROUND COMMUNICATIONS AND TRACKING SYSTEMS ARE ACTIVATED AND VERIFIED TO BE OPERATIONAL, AND PREPARATIONS ARE MADE TO LOAD CRYOGENIC LIQUIDS (OXYGEN AND HYDROGEN) INTO THE EXTERNAL TANK (ET). THE ORBITER FLIGHT CONTROL SYSTEM IS ACTIVATED AND TESTED. ORBITER AND ET INSTRUMENTATION SYSTEMS, ORBITER NAVAIDS (MSBLS, TACAN, RADAR ALTIMETER), GUIDANCE STAR TRACKER, AND AIR DATA CONTROL SYSTEMS ARE TESTED. A VERIFICATION OF ALL ORBITER SWITCH POSITIONS IS MADE WITH A BACKUP ASTRONAUT VERIFYING THE POSITIONS TO ENSURE THEIR CORRECTNESS.

THE SHUTTLE IS PREPARED FOR INDEPENDENT OPERATION. GROUND SUPPORT EQUIPMENT (GSE) IS DISCONNECTED AND THERMAL PROTECTION SYSTEM (TPS) PLUGS ARE INSERTED INTO THE CAVITIES. THESE PLUGS ARE SIMILAR IN COMPOSITION TO THE TPS TILE, HOWEVER, THEY ARE THREADED AND SCREW INTO THE CAVITY. THE ORBITER'S WINDOWS ARE CLEANED AND PROTECTIVE SOFT COVERS ARE INSTALLED UNTIL JUST PRIOR TO THE REMOVAL OF ACCESS PLATFORMS AND RETRACTION OF THE ROTATING SERVICE STRUCTURE (RSS). PROTECTIVE COVERS ARE REMOVED FROM THE ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEMS (ECLSS) AND THE RSS IS ROLLED AWAY FROM THE SHUTTLE VEHICLE TO THE LAUNCH POSITION. THE SOUND SUPPRESSION SYSTEM HAS A FINAL CHECKOUT AND IS FILLED. ENGINE COVERS ARE REMOVED FROM THE MAIN ENGINES AND SOLID ROCKET BOOSTERS (SRBs). FLAME DEFLECTORS ARE ALSO MOVED INTO POSITION AFTER THE RSS HAS BEEN ROLLED BACK. THE ONBOARD COMPUTERS ARE CONFIGURED AND FINAL PREPARATIONS ARE MADE FOR CREW BOARDING. THE SLIDEWIRE, WHICH THE CREW USES IN CASE ON AN EMERGENCY, IS PREPARED. THE SLIDEWIRE, WITH TWO MAN BUCKETS, CONNECTS THE FIXED SERVICE STRUCTURE (FSS) TO A BUNKER AREA 1200 FEET FROM THE BASE OF THE FSS. AT APPROXIMATELY T-8 HOURS, THE ORBITER PURGE SYSTEM IS TRANSFERRED FROM AIR TO GN2 IN SUPPORT OF MAIN PROPELLANT TANKING. THE PAD AREA IS CLEARED OF NONESSENTIAL PERSONNEL BY APPROXIMATELY T-8 HOURS IN PREPARATION FOR ET LOADING. FROM T-2 HOURS, ONLY ASTRONAUT PERSONNEL OPERATE ORBITER SWITCH POSITIONS.

SHUTTLE MAIN PROPELLANT TANKING

THE ORBITER COMPARTMENTS ARE VERIFIED TO BE INERTED AND THE HAZARDOUS GAS DETECTION SYSTEM AND THE LIQUID HYDROGEN (LH2) HAZARDOUS WARNING SYSTEM VERIFIED TO BE OPERATIONAL. THE EXTERNAL TANK (ET) AND THE GROUND SUPPORT EQUIPMENT USED TO LOAD THE ET ARE CHILLED DOWN FOR THERMAL CONDITIONING, AND THE ET IS FILLED WITH LIQUID OXYGEN (LOX OR LO2) AND LIQUID HYDROGEN (LH2). UPON COMPLETION OF THE TANKING OPERATION, A SPECIALIZED CREW MAKES A VISUAL INSPECTION OF THE ET TO EVALUATE FROST BUILDUP RESULTING FROM PROPELLANT TANKING.

FINAL LAUNCH COUNTDOWN PHASE

DURING THIS FINAL PHASE, THE FLIGHT CREW BOARDS THE ORBITER AT T-2 HOURS 05 MINUTES AND PERFORMS COMMUNICATIONS, GUIDANCE AND NAVIGATION CHECKS. THE CREW CONFIGURES SWITCHES IN THE ORBITER TO THE PROPER POSITION FOR LAUNCH. THE ORBITER HATCH IS CLOSED, LATCHED AND THE CABIN IS PRESSURIZED. THE MAIN PROPULSION SYSTEM HELIUM TANKS ARE BROUGHT TO FLIGHT PRESSURE, AS ARE THE ORBITAL MANEUVERING SYSTEM (OMS) AND THE REACTION CONTROL SYSTEM (RCS). THE FUEL CELLS ASSUME THE TOTAL ELECTRICAL LOAD FOR THE SHUTTLE SYSTEMS AND THE GROUND LAUNCH SEQUENCER (GLS) ASSUMES CONTROL OF THE LAUNCH COUNTDOWN AT T-9 MINUTES AND COUNTING.

THE GLS IS A SET OF AUTOMATED COMPUTER PROGRAMS WHICH PERFORM THE FINAL SERIES OF EVENTS IN A SPECIFIED SEQUENCE AND CAN AUTOMATICALLY STOP THE COUNTDOWN IF ANY OF THE LAUNCH COMMIT CRITERIA ARE OUT OF LIMITS OR A SYSTEM MALFUNCTION OCCURS. THE GLS CAN ALSO SAFE THE VEHICLE AND GROUND SYSTEMS. THE GLS STARTS THE FINAL AUTOMATED COUNTDOWN AT T-9 MINUTES. IT RETRACTS THE ORBITER ACCESS ARM (OAA), POSITIONS VALVES FOR FILLING TANKS, PRESSURIZES AND SEALS THE ET, AND ACTIVATES THE SOUND SUPPRESSION SYSTEM (SSS). THE SOUND SUPPRESSION SYSTEM CONSISTS OF A LARGE WATER SYSTEM WHICH SPRAYS 400,000 GALLONS/MINUTE OF WATER ON TOP OF THE MOBILE LAUNCH PLATFORM (MLP) DURING LIFTOFF TO LIMIT THE TREMENDOUS AMOUNT OF ACOUSTICAL VIBRATION GENERATED BY THE THREE MAIN ENGINES AND TWO SOLID ROCKET BOOSTERS. AT T-6.6 SEC. THE MAIN ENGINES ARE IGNITED AND UPON ACHIEVING 90% THRUST, THE SOLID ROCKET BOOSTERS (SRBs) ARE IGNITED, THE HOLDDOWN POSTS ARE RELEASED, AND LIFTOFF OCCURS. FOLLOWING TOWER CLEAR, RESPONSIBILITY FOR THE SPACE SHUTTLE INFLIGHT OPERATIONS IS TURNED OVER TO THE MISSION CONTROL CENTER, JOHNSON SPACE CENTER AT HOUSTON, TEXAS.

TERMINAL COUNTDOWN DETAILED DESCRIPTION

THIS SECTION GIVES A MORE DETAILED DESCRIPTION OF THE FINAL NINE HOURS OF THE COUNTDOWN. (H=HOURS, M=MINUTES, S=SECONDS)

T-8H40M ORBITER FUEL CELL ACTIVATION IS PERFORMED.

T-6H30M VERIFICATION OF THE LAUNCH COMMIT CRITERIA IS MADE AT THIS TIME.

T-6H00M THE LO2 AND LH2 SYSTEMS ARE CHILLED DOWN IN ORDER TO PRECONDITION THE GROUND LINES AND VALVES, AS WELL AS THE EXTERNAL TANK (ET), FOR CRYO LOADING.

T-5H50M LH2 SYSTEM CHILLDOWN IS COMPLETED AND LH2 LOADING BEGINS. THE LH2 LOADING STARTS WITH A "SLOW FILL" IN ORDER TO ACCLIMATE THE ET AND PREVENT BUCKLING. SLOW FILL CONTINUES UNTIL THE TANK IS 2% FULL.

T-5H30M THE LO2 SYSTEM CHILLDOWN IS COMPLETE AND AN LO2 "SLOW FILL" BEGINS AND CONTINUES UNTIL THE TANK IS 2% FULL.

T-5H20M THE LO2 AND LH2 SLOW FILLS ARE COMPLETE AND THE FAST FILLS BEGIN. THE FAST FILLS WILL CONTINUE UNTIL THE LO2 AND LH2 TANKS ARE 98% FULL.

T-4H00M THE MILA COMMUNICATION AND TRACKING SYSTEM ANTENNA, WHICH TRANSMITS AND RECEIVES COMMUNICATION, TELEMETRY AND RANGING INFORMATION, IS VERIFIED TO BE ALIGNED PROPERLY.

T-3H45M THE LH2 FAST FILL IS COMPLETE AND A SLOW TOPPING OFF PROCESS IS BEGUN.

T-3H25M THE LO2 FAST FILL IS COMPLETE AND TOPPING OFF STARTS.

T-3H15M THE LH2 TOPPING OFF IS COMPLETE AND A PERIODIC REPLENISHMENT IS BEGUN. THIS IS DONE TO ASSURE THAT THE ET REMAINS COMPLETELY FULL (AT FLIGHT MASS) EVEN AFTER VENTING OF THE LH2.

T-3H05M THE LO2 TOPPING OFF IS COMPLETE AND THE REPLENISHMENT PROCESS BEGINS.

T-3H00M THE LO2/LH2 FILL IS VERIFIED TO BE IN A STABLE REPLENISHMENT MODE. THE ORBITER CLOSEOUT CREW GOES TO THE PAD AND PREPARES THE CREW COMPARTMENT FOR CREW INGRESS.

T-3H00M (HOLDING) A PLANNED TWO HOUR HOLD BEGINS. THE INERTIAL MEASURING UNITS (IMU) PRE-FLIGHT CALIBRATION STARTS. THREE IMUs ARE USED BY THE ORBITER NAVIGATION SYSTEM TO DETERMINE THE POSITION OF THE ORBITER WHILE IN FLIGHT. AT THREE HOURS TWENTY MINUTES PRIOR TO LAUNCH (DURING THE HOLD), THERE WILL BE A TELEVISED WEATHER BRIEFING BY JSC TO THE CREW IN THEIR QUARTERS LOCATED IN THE OPERATION AND CHECKOUT (O&C) BUILDING. SIMULTANEOUSLY, THE FLIGHT CREW IS SUITING UP IN THEIR QUARTERS.

T-3H00M (COUNTING) THE PLANNED TWO HOUR HOLD ENDS.

T-2H30M THE CREW BEGINS THEIR TRIP FROM THE O&C BUILDING TO THE PAD.

T-2H05M THE TEST DIRECTOR GIVES A "GO FOR CREW INGRESS" UPON THEIR ARRIVAL AT THE PAD. THE LAUNCH COMMIT CRITERIA MONITORING COMPUTER PROGRAMS ARE ACTIVATED.

T-2H00M THE GROUND LAUNCH SEQUENCER (GLS) COMPUTER PROGRAMS ARE INITIALIZED. THE MAIN PROPULSION SYSTEM (MPS) HELIUM TANKS ARE BROUGHT TO FLIGHT PRESSURE (4400 PSI). ANOTHER WEATHER BRIEFING FOR SRB RETRIEVAL IS GIVEN. A FIRST MOTION SIMULATED SIGNAL IS SENT TO JSC, RANGE SAFETY, AND THE FIRING ROOM. THIS SIGNAL IS USED TO INDICATE LIFTOFF. THE SRB RATE GYRO ASSEMBLIES (RGAs) ARE TURNED ON. THE RGAs ARE USED BY THE ORBITER NAVIGATION SYSTEM TO DETERMINE RATES OF MOTION OF THE SRBs DURING STAGE ONE FLIGHT. THE SRB HYDRAULIC PUMPING UNITS GAS GENERATOR HEATERS ARE TURNED ON AND THE SRB AFT SKIRT GN2 PURGE STARTS.

T-1H55M THE CREW PROCEEDS TO THE WHITE ROOM AND CREW INGRESS BEGINS. THE CREW PERFORMS THEIR FINAL SUIT CONNECTIONS TO THE ORBITER LIFE SUPPORT AND COMMUNICATIONS SYSTEMS. AFTER THE CREW INGRESS CHECKLIST IS COMPLETE, THE ORBITER CREW MODULE HATCH IS CLOSED.

T-1H30M THE CREW BEGINS THEIR COMMUNICATION CHECKS WITH JSC AND THE KSC FIRING ROOM. THE SRB RATE GYRO ASSEMBLY TORQUE TEST BEGINS. THE EASTERN TEST RANGE (ETR) SHUTTLE RANGE SAFETY SYSTEM (SRSS) OPEN LOOP VALIDATION BEGINS.

T-1H20M CREW INGRESS IS COMPLETED AND THE HATCH IS CLOSED.

T-1H10M THE EASTERN TEST RANGE (ETR) RANGE SAFETY HOLD FIRE INDICATION CHECKS START. THIS VERIFIES THAT RANGE SAFETY PERSONNEL CAN STOP THE LAUNCH IF REQUIRED.

T-1H05M THE CABIN IS PRESSURIZED AND A 20 MINUTE LEAK CHECK IS PERFORMED.

T-1H01M FINAL IMU PRE-FLIGHT ALIGNMENT BEGINS.

T-1H00M THE SHUTTLE LANDING FACILITY (SLF) CONVOY IS VERIFIED TO BE IN POSITION FOR LAUNCH. PRESSURE READINGS ARE TAKEN FROM THE SRB CHAMBERS AND VERIFIED CORRECT TO ENSURE AN EVEN BURN. FIRE AND RESCUE SUPPORT ARE VERIFIED AT THE SHUTTLE LANDING FACILITY. THE EASTERN TEST RANGE (ETR) FINAL OPEN LOOP COMMAND NETWORK VERIFICATION IS STARTED.

T-50M00S THE CREW BEGINS THE WATER BOILER PRE-ACTIVATION. THE EASTERN TEST RANGE (ETR) SHUTTLE RANGE SAFETY SYSTEM (SRSS) TERMINAL COUNT CLOSED LOOP TEST IS PERFORMED.

T-45M00S THE S-BAND TELEMETRY SYSTEM IS SWITCHED TO HIGH POWER AND THE FM SYSTEM IS ACTIVATED. MILA ADJUSTS THE UPLINK COMMAND SIGNALS TO THE PROPER LEVEL. THE GROUND LAUNCH SEQUENCER MAINLINE COMPUTER PROGRAMS ARE ACTIVATED.

T-35M00S THE SHUTTLE TO GROUND TELEMETRY IS CONFIGURED TO SWITCH TO OPEN LOOP AT LIFTOFF, RATHER THAN HARDLINE. A READY FOR LAUNCH VERIFICATION IS MADE FOR THE LANDING SITES AND BOOSTER RETRIEVAL FORCES.

T-32M00S THE BACKUP FLIGHT SYSTEM (BFS) COMPUTER DATA TRANSFER PREPARATION IS PERFORMED.

T-31M00S THE CHASE PLANES ARE MANNED.

T-30M00S THE ORBITER MANEUVERING SYSTEM (OMS) ENGINES ARE PRESSURIZED FOR LAUNCH.

T-22M00S THE PRIMARY COMPUTER DATA (PASS) IS TRANSFERRED TO THE BACKUP COMPUTER (BFS) IN ORDER FOR BOTH SYSTEMS TO HAVE THE SAME DATA. IN CASE OF A PRIMARY COMPUTER SYSTEM FAILURE, THE BACKUP COMPUTER WILL TAKE OVER CONTROL OF THE SHUTTLE VEHICLE DURING FLIGHT.

T-20M00S (HOLDING) A 10 MINUTE PLANNED HOLD BEGINS. ALL COMPUTERS IN THE FIRING ROOM ARE CONFIGURED WITH THE PROPER PROGRAMS FOR THE FINAL COUNTDOWN. THE TEST TEAM IS BRIEFED ON THE RECYCLE OPTIONS IN CASE OF AN UNPLANNED HOLD AND ON EMERGENCY PROCEDURES IN CASE OF AN EMERGENCY. THE LANDING CONVOY STATUS IS AGAIN VERIFIED AND THE LANDING SITES ARE VERIFIED READY FOR LAUNCH. THE COUNTDOWN CLOCK IS SET TO PICK UP AT THE END OF THE 10 MIN. HOLD. TWO MIN. PRIOR TO COMING OUT OF THE HOLD, THE IMU PREFLIGHT ALIGNMENT IS VERIFIED COMPLETE. PREPARATIONS ARE MADE TO TRANSITION THE ONBOARD COMPUTERS TO MAJOR MODE 101 UPON COMING OUT OF THE HOLD, WHICH CONFIGURES THE COMPUTER MEMORY TO TERMINAL COUNTDOWN CONFIGURATION.

T-20M00S (COUNTING) THE 10 MINUTE PLANNED HOLD TERMINATES. THE COMPUTER TRANSITION TO MAJOR MODE 101 (TERMINAL COUNTDOWN CONFIGURATION) IS PERFORMED. UPON CONFIRMATION OF MAJOR MODE 101, THE PRIMARY COMPUTER IS DUMPED AND COMPARED TO VERIFY THE PROPER ONBOARD COMPUTER CONFIGURATION FOR LAUNCH.

T-19M00S THE CREW CONFIGURES THE BACKUP COMPUTER TO MAJOR MODE 101 AND THE TEST TEAM VERIFIES THE BACKUP COMPUTER IS TRACKING THE PRIMARY COMPUTER. THE CREW THEN CONFIGURES THEIR INSTRUMENTS FOR LAUNCH.

T-16M00S THE MAIN PROPULSION HELIUM SUBSYSTEM COCKPIT SWITCHES ARE CONFIGURED FOR LAUNCH AND THE HELIUM TANK ISOLATION VALVES ARE OPENED.

T-15M00S THE ORBITAL MANEUVERING SYSTEM (OMS) AND REACTION CONTROL SYSTEM (RCS) CROSSFEED VALVES ARE CONFIGURED FOR LAUNCH. THE CHASE AIRCRAFT ENGINES ARE STARTED.

T-12M00S THE COUNTDOWN CLOCK IS CONFIGURED FOR THE NEXT HOLD AT APPROXIMATELY T-9M00S. THE EXACT HOLD TIME IS DEPENDENT UPON THE LOX TERMINATE REPLENISHMENT FUNCTION OF THE EXTERNAL TANK. EMERGENCY AIRCRAFT AND PERSONNEL ARE VERIFIED ON STATION.

T-10M00S THE ONBOARD COMPUTER DUMP AND COMPARE IS VERIFIED COMPLETE AND SATISFACTORY.

T-9M00S (HOLDING) A 10 MINUTE PLANNED HOLD BEGINS. FINAL GROUND LAUNCH SEQUENCER CONFIGURATION IS COMPLETED. THE COUNTDOWN CLOCK IS SET TO START AT THE END OF THE HOLD. THE TEST DIRECTOR GETS A "GO FOR LAUNCH" VERIFICATION FROM THE LAUNCH TEAM.

T-9M00S (COUNTING) THE GLS AUTO SEQUENCE STARTS AND THE TERMINAL COUNT BEGINS. THE CHASE AIRCRAFT BEGIN THEIR TAKEOFF.

T-9M00S **GROUND LAUNCH SEQUENCER INITIATION**

FROM THIS POINT ON, ALL FUNCTIONS IN THE TERMINAL COUNT ARE UNDER COMPUTER CONTROL. THE GROUND LAUNCH SEQUENCER (GLS) IN THE FIRING ROOM INTEGRATION CONSOLE IS THE PRIMARY CONTROL COMPUTER FOR THE VEHICLE AND GROUND UNTIL T-0M31S WHEN THE FLIGHT COMPUTER REDUNDANT SET LAUNCH SEQUENCER TAKES OVER PRIMARY VEHICLE CONTROL.

T-7M30S **START ORBITER ACCESS ARM (OAA) RETRACT**

THE ARM CONNECTING THE ACCESS TOWER AND THE ORBITER HATCH IS RETRACTED. IF AN EMERGENCY ARISES REQUIRING CREW EVACUATION, THE ARM WILL BE EXTENDED EITHER MANUALLY OR BY COMPUTER CONTROL IN APPROXIMATELY 15 SECONDS.

T-5M30S **ORBITER OPERATIONAL INSTRUMENTATION RECORDERS ON**

JOHNSON SPACE CENTER (JSC) MISSION CONTROL CENTER (MCC) SENDS A COMMAND TO TURN THESE RECORDERS ON. THEY RECORD SHUTTLE SYSTEM PERFORMANCE DURING ASCENT, ON-ORBIT, AND DESCENT OPERATIONS. THE RECORDERS STORE THIS INFORMATION FOR PLAYBACK AFTER LANDING.

T-5M00S **AUXILIARY POWER UNIT (APU) POWER ON**

THE CREW ACTIVATES THE AUXILIARY POWER UNITS WHICH PROVIDE PRESSURE TO THE THREE ORBITER HYDRAULIC SYSTEMS. THESE SYSTEMS ARE USED TO MOVE THE ENGINE NOZZLES AND AEROSURFACES.

T-5M00S **SRB IGNITION AND SHUTTLE RANGE SAFETY SYSTEM (SRSS) ARM**

AT THIS POINT, THE FIRING CIRCUIT FOR THE SOLID ROCKET BOOSTER IGNITION AND DESTRUCT DEVICES IS MECHANICALLY ENABLED BY A MOTOR DRIVEN SWITCH CALLED A SAFE AND ARM DEVICE (S&A).

T-4M55S (APPROX) **TERMINATE ET LIQUID OXYGEN REPLENISH**

SINCE THE LIQUID OXYGEN TANKS WERE FILLED, SOME OF THE LIQUID OXYGEN HAS BEEN TURNING INTO A GAS. IN ORDER TO KEEP PRESSURE IN THE TANK LOW, THE GASEOUS O2 IS VENTED AND REPLACED BY MORE LIQUID OXYGEN. THIS LEVEL MAINTAINING OPERATION IS TERMINATED AND PREPARATIONS ARE MADE TO BRING THE FUEL TANKS TO FLIGHT PRESSURE.

T-4M30S **MAIN FUEL VALVE HEATERS OFF**

AS A PREPARATION FOR ENGINE START, THE MAIN FUEL VALVE HEATERS ARE TURNED OFF.

T-4M00S **SSME PURGE SEQUENCE 4 START**

THE FINAL HELIUM PURGE SEQUENCE ON THE SPACE SHUTTLE MAIN ENGINES (SSME) IS BEGUN IN PREPARATION FOR ENGINE START.

T-3M55S **AEROSURFACE PROFILE**

ALL OF THE ELEVONS, SPEEDBRAKE AND RUDDER ARE MOVED THROUGH A PRE-PROGRAMMED PATTERN. THIS IS TO ASSURE THEY WILL BE READY FOR USE IN FLIGHT AND TO PLACE THEM IN CORRECT POSITION FOR LAUNCH.

T-3M30S **GROUND POWER TRANSITION**

UP TO THIS POINT, POWER TO THE SPACE VEHICLE HAS BEEN SHARED BETWEEN GROUND POWER SUPPLIES AND THE ONBOARD FUEL CELLS. THE GROUND POWER IS DISCONNECTED AND THE VEHICLE SWITCHES TO INTERNAL POWER AT THIS TIME. IT WILL REMAIN ON INTERNAL POWER THROUGH THE REST OF THE MISSION.

T-3M25S **MAIN PROPULSION SYSTEM GIMBAL CHECK**

THE ENGINE NOZZLES ARE MOVED (GIMBALLED) THROUGH A PRE-PROGRAMMED PATTERN TO ASSURE THEY WILL BE READY FOR ASCENT FLIGHT CONTROL.

T-2M55S **EXTERNAL TANK (ET) LIQUID OXYGEN (LO2) PRE-PRESSURIZATION START**

THE LIQUID OXYGEN TANK FOR THE SHUTTLE MAIN ENGINES IS ENTERED INTO A PRESSURIZATION PROCESS TO BRING THE TANKS TO FLIGHT PRESSURE.

T-2M50S **START GOX ARM RETRACT**

THE CAP WHICH FITS OVER THE EXTERNAL TANK NOSE CONE TO PREVENT ICE BUILDUP ON THE OXYGEN VENTS IS RAISED OFF THE NOSE CONE AND RETRACTED.

T-2M35S **FUEL CELL GROUND SUPPLY OFF**

THE FUEL CELL GROUND (GASEOUS) OXYGEN AND HYDROGEN SUPPLIES, WHICH HAVE BEEN PROVIDING THE FUEL CELLS WITH REACTANTS TO ENSURE A FULL LOAD IN THE ONBOARD CRYO TANKS AT LIFTOFF, ARE TERMINATED AND THE FUEL CELLS BEGIN TO USE ONBOARD REACTANTS.

T-1M57S **ET LIQUID HYDROGEN REPLENISH TERMINATION AND PRE-PRESSURIZATION START**

SINCE THE LIQUID HYDROGEN TANKS WERE FILLED, SOME OF THE LIQUID HYDROGEN HAS BEEN TURNING INTO GAS. IN ORDER TO KEEP PRESSURE IN THE TANK LOW, THIS GAS WAS VENTED OFF AND PIPED OUT TO A BURN POND AND IGNITED. IN ORDER TO MAINTAIN FLIGHT LEVEL, LIQUID HYDROGEN HAS BEEN CONTINUOUSLY ADDED TO THE TANKS TO REPLACE THE VENTED HYDROGEN. THIS OPERATION TERMINATES, THE TANKS ARE BROUGHT UP TO FLIGHT PRESSURE AND THE SHUTTLE IS ISOLATED FROM GROUND LOADING EQUIPMENT.

T-0M40S **SRB FREQUENCY DE-MULTIPLEXER AUTOMATIC CALIBRATION COMMAND**

THIS COMMAND TELLS THE SRB DFI SYSTEM TO PERFORM AN AUTOMATIC CALIBRATION. THIS ASSURES ACCURATE DATA RECORDING THROUGH FLIGHT.

T-0M40S **EXTERNAL TANK HEATERS OFF**

UP TO THIS TIME, SEVERAL HEATERS ON EXTERNAL TANK STRUCTURAL MEMBERS HAVE BEEN ON IN ORDER TO PREVENT FROST BUILDUP. THESE ARE TURNED OFF IN PREPARATION FOR LIFTOFF.

T-0M40S **SRB FORWARD MULTIPLEXER/DE-MULTIPLEXER LOCKOUT**

THE SRB FORWARD CONTROL UNITS ARE ELECTRONICALLY LOCKED. THEY WILL NO LONGER PERFORM A COMMAND UNLESS IT IS PRECEDED BY AN UNLOCK COMMAND. THIS IS DONE AS A PROTECTION AGAINST INFLIGHT ELECTRONIC INTERFERENCE.

T-0M38S **VENT DOOR SEQUENCE START**

THE FLIGHT COMPUTERS POSITION THE ORBITER VENT DOORS TO THE LAUNCH CONFIGURATION.

T-0M31S **GO FOR REDUNDANT SET LAUNCH SEQUENCE START**

AT THIS POINT, THE FOUR PRIMARY FLIGHT COMPUTERS ARE GIVEN THE "GO" TO TAKE OVER VEHICLE CONTROL OF THE TERMINAL COUNT. ONLY ONE FURTHER COMMAND IS NEEDED FROM THE GROUND, "GO FOR MAIN ENGINE START," AT APPROXIMATELY T-0M6.6S. THE GROUND LAUNCH SEQUENCER (GLS) IN THE INTEGRATION CONSOLE IN THE LAUNCH CONTROL CENTER CONTINUES TO MONITOR SEVERAL HUNDRED LAUNCH COMMIT CRITERIA AND CAN CALL A CUTOFF IF A DISCREPANCY IS OBSERVED.

T-0M28S **START SRB HYDRAULIC POWER UNITS**

TWO HYDRAULIC POWER UNITS IN EACH SOLID ROCKET BOOSTER ARE STARTED BY THE GLS. THESE PROVIDE HYDRAULIC POWER FOR SOLID ROCKET BOOSTER NOZZLE GIMBALLING (THRUST VECTOR CONTROL - TVC) FOR ASCENT FLIGHT CONTROL.

T-0M16S **SRB GIMBAL PROFILE COMPLETE**

AS SOON AS HYDRAULIC POWER IS APPLIED TO THE SRBs, THE ENGINE NOZZLES ARE COMMANDED THROUGH A PRE-PROGRAMMED PATTERN TO ASSURE THAT THEY WILL BE READY FOR ASCENT FLIGHT CONTROL.

T-0M16S **PRE-LIFTOFF SOUND SUPPRESSION VENT VALVE OPEN**

THE GLS OPENS THE PRE-LIFTOFF GN2 VENT VALVES FOR THE SOUND SUPPRESSION WATER SYSTEM IN ORDER TO BEGIN WATER FLOW TO THE PAD AT T-0M13S.

T-0M16S **ARM T-ZERO UMBILICAL RELEASE**

THE FLIGHT COMPUTERS ARM THE EXPLOSIVE DEVICES THAT WILL SEPARATE THE T-ZERO UMBILICAL, WHICH IS THE FINAL ELECTRICAL CONNECTION BETWEEN THE GROUND AND THE SHUTTLE.

T-0M13S **SRB AFT MULTIPLEXER (MDM) LOCKOUT**
THE AFT MULTIPLEXER-DEMULTIPLEXER UNITS ARE LOCKED OUT. THIS IS TO PROTECT AGAINST ELECTRICAL INTERFERENCE DURING FLIGHT. THE ELECTRONIC LOCK REQUIRES AN UNLOCK COMMAND BEFORE IT WILL ACCEPT ANY OTHER COMMAND.

T-0M12S **TERMINATE MPS HELIUM FILL**
TOPPING OFF OF THE HELIUM BOTTLES ON THE ORBITER USED TO MAINTAIN CRITICAL PURGES ON THE MAIN PROPULSION SYSTEM DURING ASCENT AND ON ORBIT IS TERMINATED.

T-0M11S **SRB SHUTTLE RANGE SAFETY SYSTEM (SRSS) INHIBITS REMOVED**
THE SRB DESTRUCT SYSTEM IS NOW ACTIVE.

T-0M10S **GLS GO FOR MAIN ENGINE START**
THIS IS THE LAST REQUIRED GROUND COMMAND. THE GROUND COMPUTERS INFORM THE FLIGHT COMPUTERS THAT THEY HAVE A "GO FOR MAIN ENGINE START". THE GLS RETAINS CUTOFF CAPABILITY UNTIL JUST PRIOR TO SRB IGNITION.

T-0M10S **COMMAND DECODER POWER OFF**
THE COMMAND DECODERS ARE UNITS WHICH ALLOW GROUND CONTROL OF THE ORBITER IF THE PRIMARY FLIGHT COMPUTERS FAIL. THESE UNITS ARE NOT ACCESSIBLE DURING FLIGHT, AND ARE POWERED OFF AT THIS TIME.

T-0M10S **H2 BURNOFF**
IN PREPARATION FOR IGNITION, FLARES ARE IGNITED UNDER THE ENGINES. THIS BURNS AWAY ANY FREE GASEOUS HYDROGEN THAT MAY COLLECT UNDER THE ENGINES DURING PRESTART OPERATIONS.

T-0M09.5S **PREVALVES OPEN**
AS THE FLIGHT COMPUTERS ENTER INTO THE ENGINE START SEQUENCE, THE PREVALVES ARE OPENED. THESE VALVES ALLOW LIQUID HYDROGEN AND OXYGEN FLOW TO THE ENGINE'S TURBOPUMPS.

T-0M08S **LH2 RECIRCULATION PUMPS OFF**
THE RECIRCULATION PUMPS PROVIDE FOR FLOW OF FUEL THROUGH THE ENGINE COOLING SYSTEM DURING THE TERMINAL COUNT. THESE ARE SUPPLIED BY GROUND POWER, AND ARE POWERED OFF IN PREPARATION FOR ENGINE START.

T-0M08S **LH2 RECIRCULATION/HIGH POINT BLEED VALVE CLOSE**
THE LIQUID HYDROGEN FUEL RECIRCULATION FLOW VALVES AND LH2 MANIFOLD HIGH POINT BLEED VALVES ARE CLOSED.

T-0M08S **GROUND COOLANT UNIT STOP**

THE ORBITER GOES ON INTERNAL COOLING AT THIS TIME, AS THE GROUND COOLANT UNITS ARE POWERED OFF. THE ORBITER WILL REDISTRIBUTE HEAT WITHIN THE VEHICLE UNTIL IT REACHES 140,000 FEET AT WHICH TIME THE FLASH EVAPORATOR WILL BE TURNED ON.

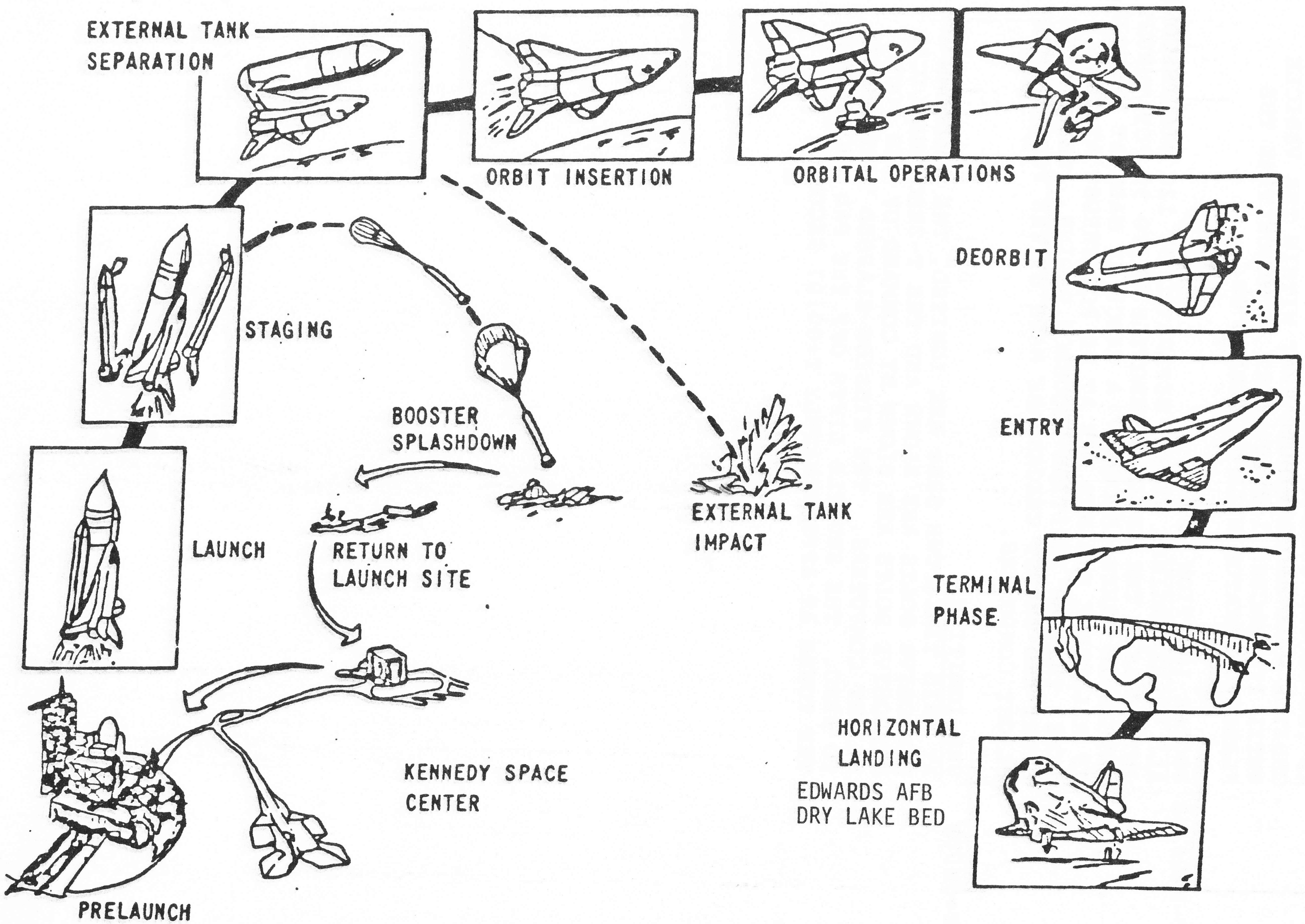
T-0M06.6S **ENGINE IGNITION**

ALL THREE ENGINES START, SEPARATED BY 120 MILLISECOND INTERVALS. THE ENGINES THROTTLE UP TO 90 PCT THRUST LEVELS IN THREE SECONDS. A CHECK IS MADE AT T-0M03S. IF ALL THREE ENGINES ARE AT 90 PCT THRUST AT THAT TIME, THE SRB IGNITION SEQUENCE BEGINS. THE ENGINE START AND THRUST CHECKS ARE MADE BY THE FOUR PRIMARY FLIGHT COMPUTERS.

T+0M00S **SRB IGNITION**

AT THIS TIME, THE SRBs ARE IGNITED, THE HOLDDOWN EXPLOSIVE BOLTS ARE BLOWN AND THE T-ZERO UMBILICAL EXPLOSIVE BOLTS ARE BLOWN BY COMMAND OF THE FOUR FLIGHT COMPUTERS. THE MISSION ELAPSED TIME RESETS TO ZERO. THE SHUTTLE LIFTS OFF THE PAD AND CLEARS THE TOWER AT APPROXIMATELY T+00:07 SECONDS.

MISSION PROFILE

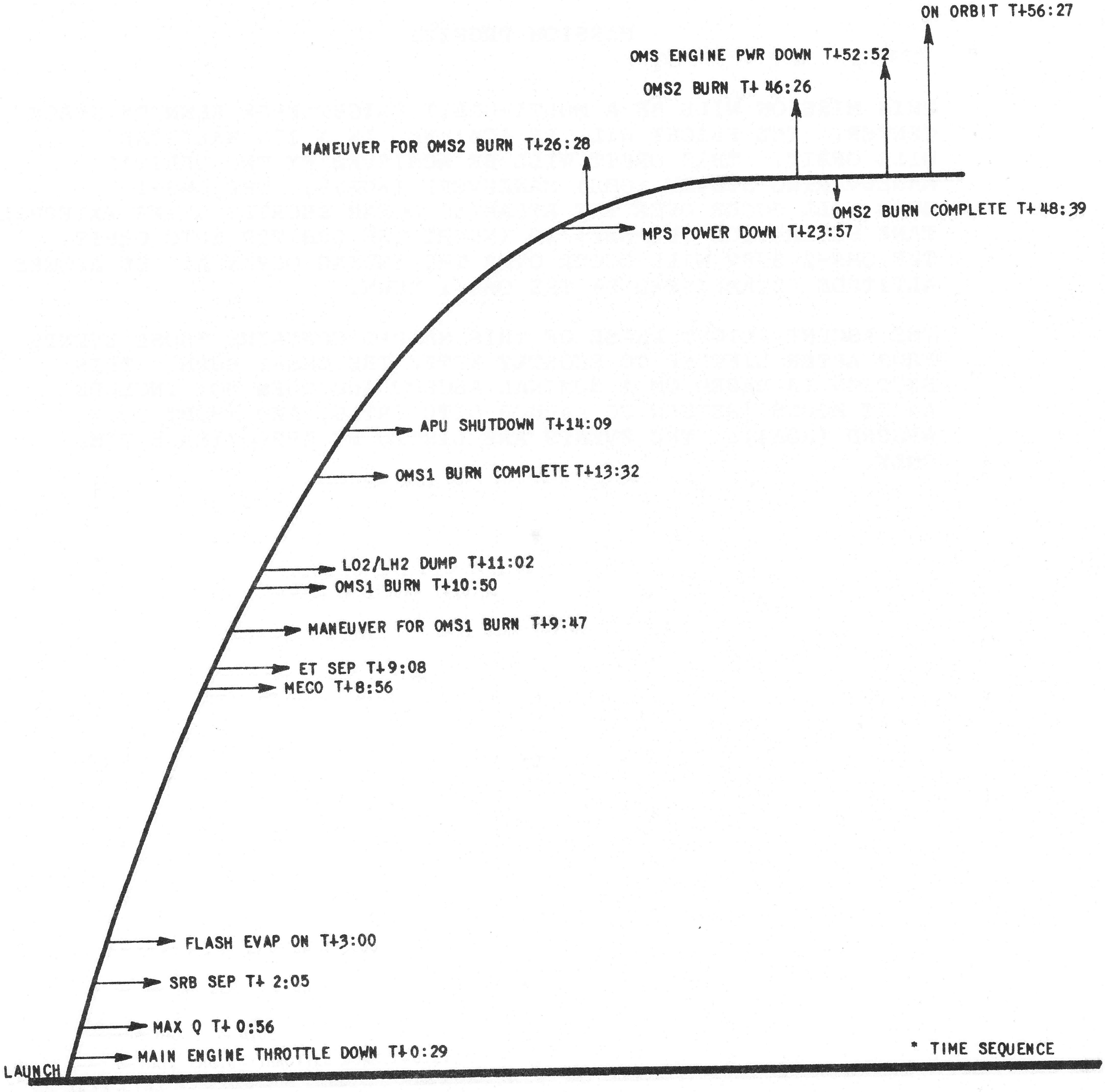


MISSION PROFILE

THIS MISSION WILL BE A MULTI-ORBIT FLIGHT FROM KENNEDY SPACE CENTER. THE FLIGHT WILL BE ACHIEVED IN A 173 NAUTICAL MILE ORBIT. THIS ORBIT WILL BE ACHIEVED BY TWO ORBITAL MANEUVERING SYSTEM (OMS) MANEUVERS (BURNS). THE OMS-1 BURN WILL OCCUR OVER THE ATLANTIC OCEAN SHORTLY AFTER EXTERNAL TANK SEPARATION (ET-SEP) TO INSERT THE ORBITER INTO ORBIT. THE OMS-2 BURN WILL OCCUR OVER THE INDIAN OCEAN AT THE APOGEE ALTITUDE ESTABLISHED BY THE OMS-1 BURN.

THE ASCENT FLIGHT PHASE OF THIS MANUAL CONTAINS THOSE EVENTS FROM AFTER LIFTOFF TO SHORTLY AFTER THE OMS-2 BURN. THIS SECTION IS BASED ON A NOMINAL ASCENT AND DOES NOT INCLUDE ABORT MODES [RETURN TO LAUNCH SITE (RTLS) AND ABORT ONCE AROUND (AOA)]. THE EVENTS ARE LISTED BY APPROXIMATE TIME ONLY.

ASCENT PROFILE



ASCENT FLIGHT PHASE - NOMINAL ASCENT

T+0M04S **CONFIRM MAJOR MODE 102**
AT LIFTOFF, THE ONBOARD COMPUTER MEMORY CONFIGURATION CHANGES TO MAJOR MODE 102 WHICH ENABLES THE STAGE 1 (SRB) OPEN LOOP GUIDANCE SYSTEM.

T+0M05S **STAGE 1 GUIDANCE ON**
THIS IS A CONFIRMATION THAT STAGE 1 GUIDANCE IS ON AND ONCE TOWER CLEAR HAS OCCURRED, THE VEHICLE IS READY FOR FIRST STAGE STEERING.

T+0M07S **TOWER CLEAR**
THIS EVENT CONFIRMS THE CURRENT SHUTTLE ALTITUDE IS ABOVE 275 FEET AND INCREASING.

T+0M07S **VELOCITY = 119 FT/S**
THIS EVENT CONFIRMS THE SHUTTLE VELOCITY IS GREATER THAN 119 FEET PER SECOND AND INCREASING.

T+0M08S **PITCHOVER**
WHEN THE RELATIVE VELOCITY REACHES 121 FEET PER SECOND, FIRST STAGE STEERING STARTS A PITCHOVER MANEUVER FOLLOWED BY A ROLL/YAW MANEUVER.

T+0M20S **ROLL/YAW MANEUVER COMPLETE**
AFTER THE VEHICLE PITCH ATTITUDE EQUALS 88 DEG, THE ROLL AND YAW ATTITUDE WILL START CHANGING. WHEN THIS MANEUVER IS COMPLETE, THE CREW WILL BE IN A "HEADS DOWN" ATTITUDE AND ALIGNED WITH THE LAUNCH AZIMUTH.

T+0M29S **MAIN ENGINE THROTTLE DOWN (MAX Q REGION)**
AS THE VEHICLE'S VELOCITY INCREASES, THE DYNAMIC PRESSURE INCREASES AND THE STRUCTURAL LOADS ON THE VEHICLE RISE. THE ONBOARD COMPUTERS WILL LIMIT THESE LOADS TO A SAFE VALUE WITH A POSSIBILITY OF FLYING SLIGHTLY OFF COURSE. TO HELP LIMIT THE DYNAMIC PRESSURE TO 671 POUNDS PER SQUARE FOOT, THE CREW WILL REDUCE THE MAIN ENGINE THROTTLE TO 75%.

T+1M01S **MAIN ENGINE THROTTLE UP TO 104%**
AT THIS TIME, THE MAXIMUM DYNAMIC PRESSURE (MAX Q) REGION IS PAST, DUE TO THE ALTITUDE. THE CREW WILL INCREASE THE THROTTLES BACK TO 104%.

T+2M02S **SRB CHAMBER PRESSURE LESS THAN 50 PSI**
WHEN THE SRB CHAMBER PRESSURE FOR BOTH SRBs DROPS BELOW 50 POUNDS PER SQUARE INCH, THE SRB STAGING SEQUENCE WILL START.

T+2M05S **SRB SEPARATION SEQUENCE ON**

THIS EVENT CONFIRMS THE SRB SEPARATION SEQUENCE HAS STARTED. AT THIS TIME, SRB SEPARATION PYROS ARE ARMED AND THE RANGE SAFETY SAFE AND ARM DEVICES ARE ROTATED TO THE SAFE POSITION. NEXT THE SRB RANGE SAFETY SYSTEM IS POWERED DOWN AND THE COMMAND FOR SRB SEPARATION IS ISSUED. THIS COMMAND FIRES THE SRB SEPARATION PYROS.

T+2M10S **INITIATE GUIDANCE FREEZE**

DURING THE SRB STAGING SEQUENCE, THE FIRST STAGE GUIDANCE IS FROZEN TO HOLD THE VEHICLE ATTITUDE CONSTANT.

T+2M16S **SRB SEPARATION**

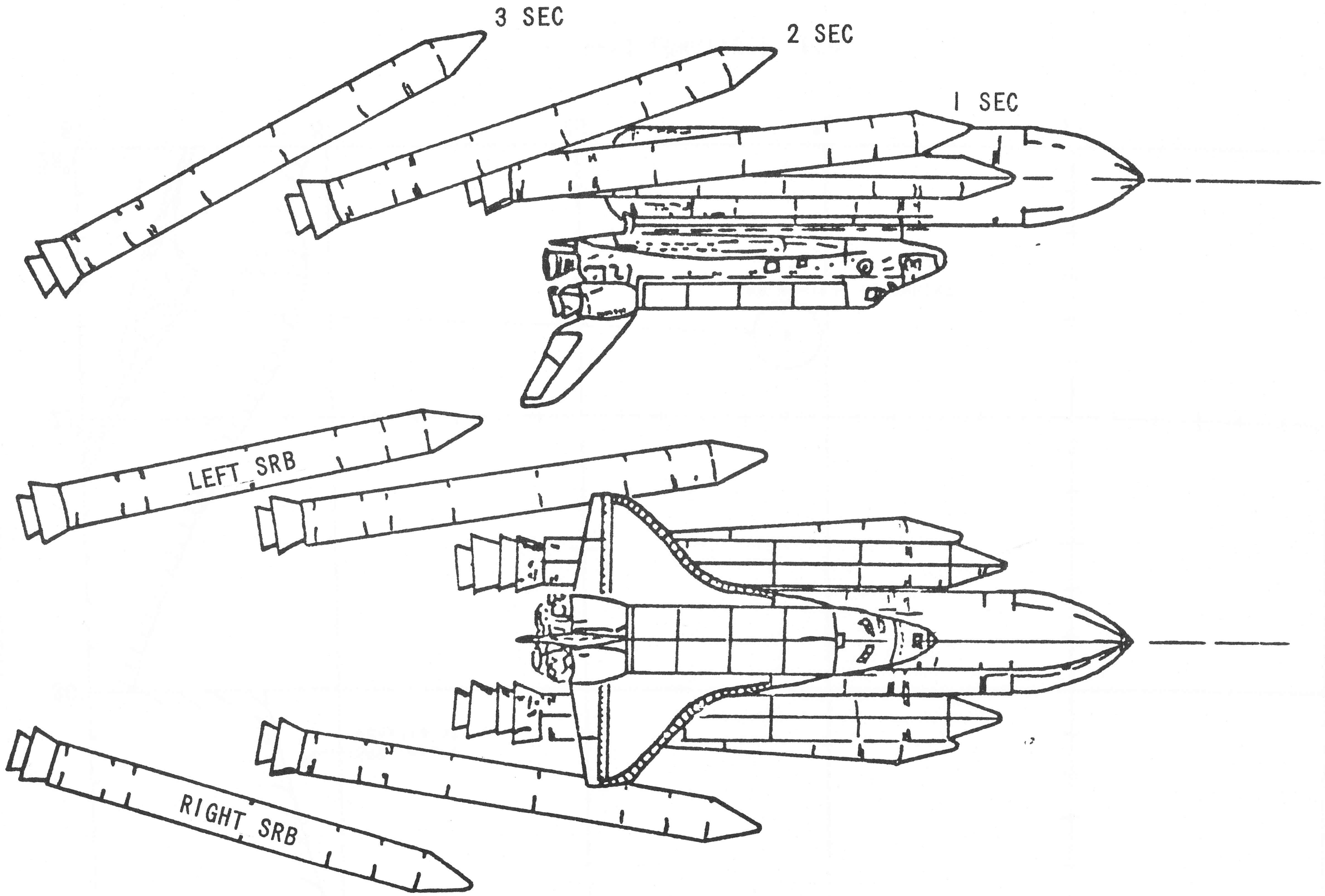
THE SRBs SEPARATE FROM THE EXTERNAL TANK AT AN ALTITUDE OF 25 NM AND 25 NM FROM THE LAUNCH SITE. THE LEFT AND RIGHT SRBs ARE JETTISONED AFTER BURN-OUT ON A TUMBLING FREE FALL TRAJECTORY. AT 78.5 SEC AFTER SEPARATION, THE NOZZLE EXTENSION ON EACH SRB IS JETTISONED. DURING THE DESCENDING PORTION OF THE TRAJECTORY, THE SRBs ACHIEVE A NOSE-UP TRIM CONDITION. AT AN ALTITUDE OF 17,000 FEET, THE NOSECAP ON EACH SRB IS JETTISONED, BEGINNING THE PARACHUTE DEPLOYMENT SEQUENCE. THIS CULMINATES AT 7,000 FEET WITH THE DEPLOYMENT OF THREE MAIN PARACHUTES ON EACH SRB. SRB IMPACT IN THE ATLANTIC OCEAN OCCURS 311 SECONDS AFTER SEPARATION, 138 NM FROM THE LAUNCH SITE. AT THIS TIME, THE SRB RETRIEVAL CREW WILL RECOVER THE SRBs AND RETURN THEM TO KENNEDY SPACE CENTER FOR DISASSEMBLY AND REFURBISHMENT.

T+2M16S **TRANSITION TO MAJOR MODE 103**

FOLLOWING SRB SEPARATION, THE ONBOARD COMPUTER MEMORY CONFIGURATION CHANGES TO A NON-SRB MAJOR MODE 103 WHICH CONTAINS THE STAGE-2 (SSME ONLY) OPEN LOOP GUIDANCE SYSTEM.

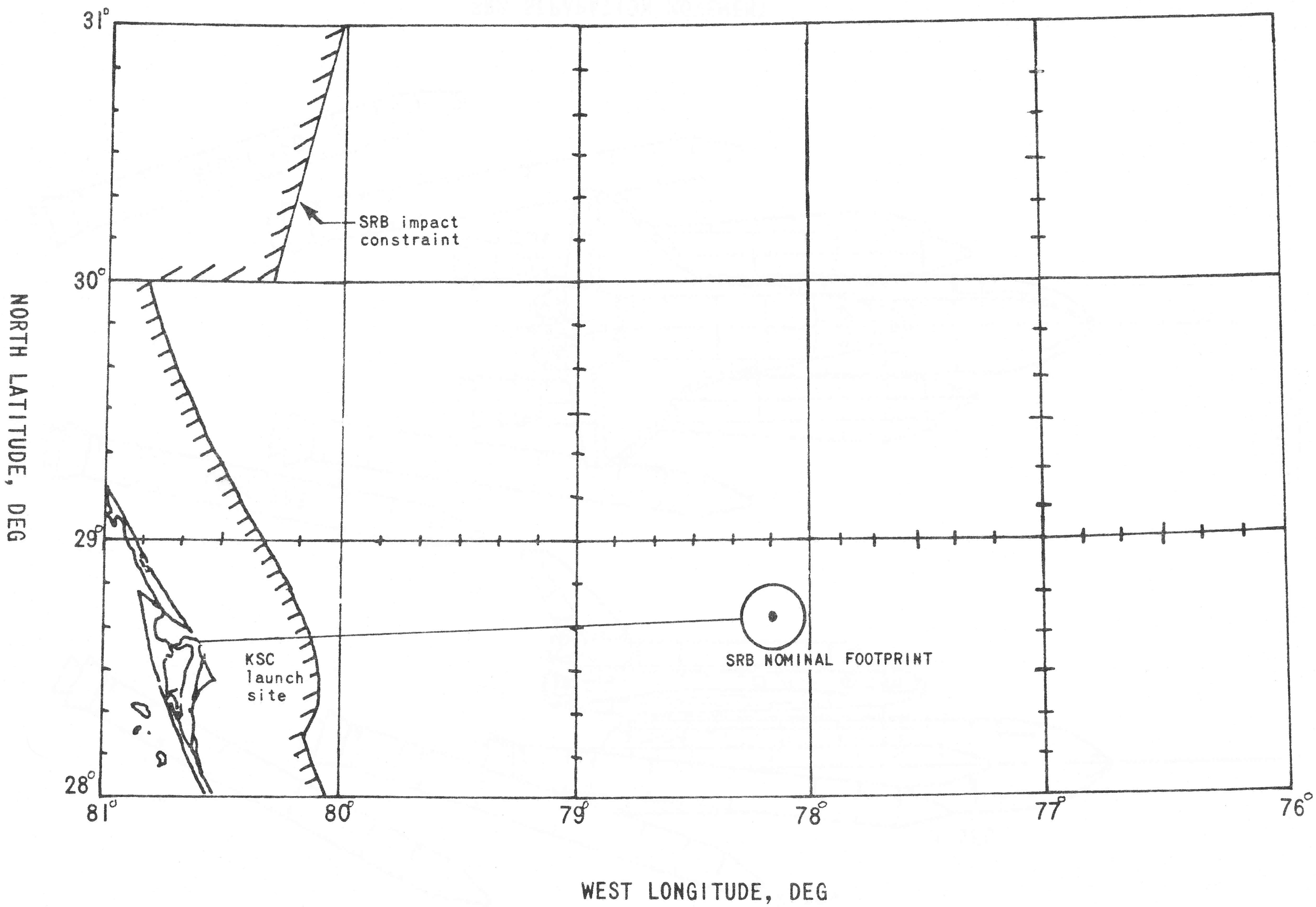
T+2M16S **SECOND STAGE GUIDANCE INITIATE**

THIS EVENT VERIFIES GUIDANCE IS READY, STAGE 2 STEERING IS ON, FREEZE BODY COMMAND IS OFF, AND STAGE 1 GUIDANCE IS OFF. AT THE BEGINNING OF STAGE 2 GUIDANCE, THE ONBOARD COMPUTERS ARE PROGRAMMED TO ASSUME AN ENGINE FAIL WILL OCCUR IN ORDER TO GET THE EARLIEST POSSIBLE PRESS-TO-MECO CAPABILITY. THIS LOFTS THE TRAJECTORY UNTIL GUIDANCE STARTS, ASSUMING NO ENGINE FAILURES. AT THIS TIME (T+4M00S) THE VEHICLE WILL PITCH DOWN 25 DEGREES.



SRB SEPARATION MOVEMENT

SRB NOMINAL IMPACT FOOTPRINT



T+3M00S **FLASH EVAP HTR ACTIVATION**

BELOW 140,000 FEET THERE HAS BEEN NO WAY TO REMOVE EXCESS HEAT GENERATED INSIDE THE ORBITER. AT THIS TIME, THE CREW WILL VERIFY THE FLASH EVAPORATORS ARE WORKING AND WILL TURN ON THE FLASH EVAPORATOR DUCT AND NOZZLE HEATERS TO PREVENT THE WATER FROM FREEZING.

T+7M25S **ME THROTTLE DOWN (3G LIMIT)**

WHEN THE ACCELERATION LEVEL REACHES 3GS, THE MAIN ENGINES WILL BE THROTTLED BACK TO MAINTAIN AN ACCELERATION OF 3GS UNTIL 6 SECONDS PRIOR TO MAIN ENGINE CUTOFF (MECO).

T+8M27S **ME THROTTLE DOWN TO 65% (MECO PREP)**

SIX SECONDS PRIOR TO MECO THE MAIN ENGINES ARE THROTTLED DOWN TO 65% TO PREPARE THEM FOR SHUTDOWN. AS THE MECO TARGET IS APPROACHED, GUIDANCE GIVES UP CONTROL OF THE MECO POSITION PARAMETERS. FIVE SECONDS BEFORE MECO, A FINE CUTOFF MODE IS ENTERED AND GUIDANCE CONTROLS ONLY FOR THE INERTIAL VELOCITY OF MECO.

T+8M56S **MECO**

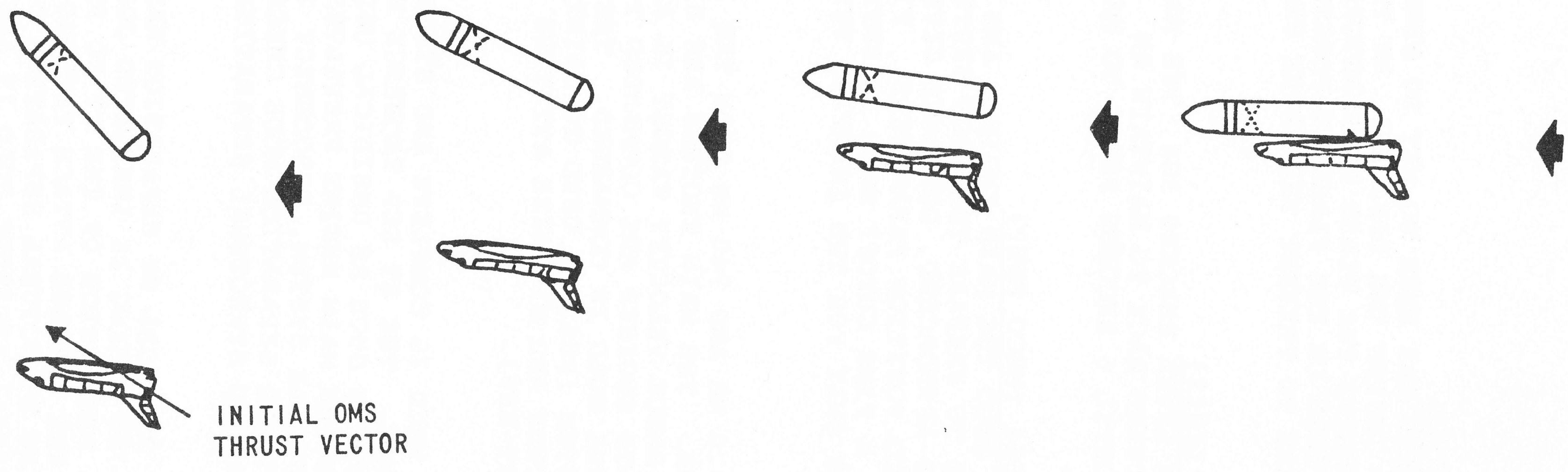
AT AN ALTITUDE OF 60.0 NM AND 740 NM FROM THE LAUNCH SITE, MECO WILL OCCUR. THE MAIN ENGINES ARE HELD AT 65% UNTIL THE GUIDANCE VELOCITY TARGET IS REACHED. AT THIS TIME, THE MAIN ENGINES ARE COMMANDED TO CUTOFF AND AN ATTITUDE HOLD IS COMMANDED. THE REACTION CONTROL SYSTEM (RCS) IS USED TO MAINTAIN THE ORBITER/ET ATTITUDE AND MINIMIZE ATTITUDE RATES FOR ET SEPARATION (ET-SEP).

T+8M35S **MECO CONFIRMED**

THIS EVENT CONFIRMS MECO IS COMPLETE AND STARTS THE ET SEPARATION SEQUENCE. THE ET SEP SEQUENCE WILL THEN PERFORM MAJOR TASKS SUCH AS UMBILICAL UNLATCH AND RETRACT, COMMAND THE MAIN ENGINE PREVALVES CLOSED, ARM THE ET TUMBLE SYSTEM, DISCONNECT THE ELECTRONICS, INHIBIT AND SEPARATION MODE CHECKS, AND FINALLY WILL COMMAND STRUCTURAL SEPARATION.

T+9M08S **ET SEPARATION**

THIS EVENT VERIFIES PHYSICAL ET SEPARATION HAS OCCURRED. THE RCS JET FIRING IS INHIBITED JUST PRIOR TO STRUCTURAL SEPARATION OF THE ET TO PREVENT POSSIBLE DAMAGE AT THE FORWARD ATTACH FITTING. IMMEDIATELY FOLLOWING STRUCTURAL SEPARATION OF THE ORBITER AND ET, INERTIAL ATTITUDE HOLD IS INHIBITED AND THE ORBITER PERFORMS A HIGH MODE RCS -Z TRANSLATION MANEUVER, ASSURING ORBITER CLEARANCE FROM THE ARC OF THE ROTATING ET AND ALLOWS THE CREW TO OBSERVE THE ET PRIOR TO PERFORMING THE OMS-1 BURN.



OMS-I BURN

- OMS ORBIT INSERTION BURN

RCS TRANSLATION

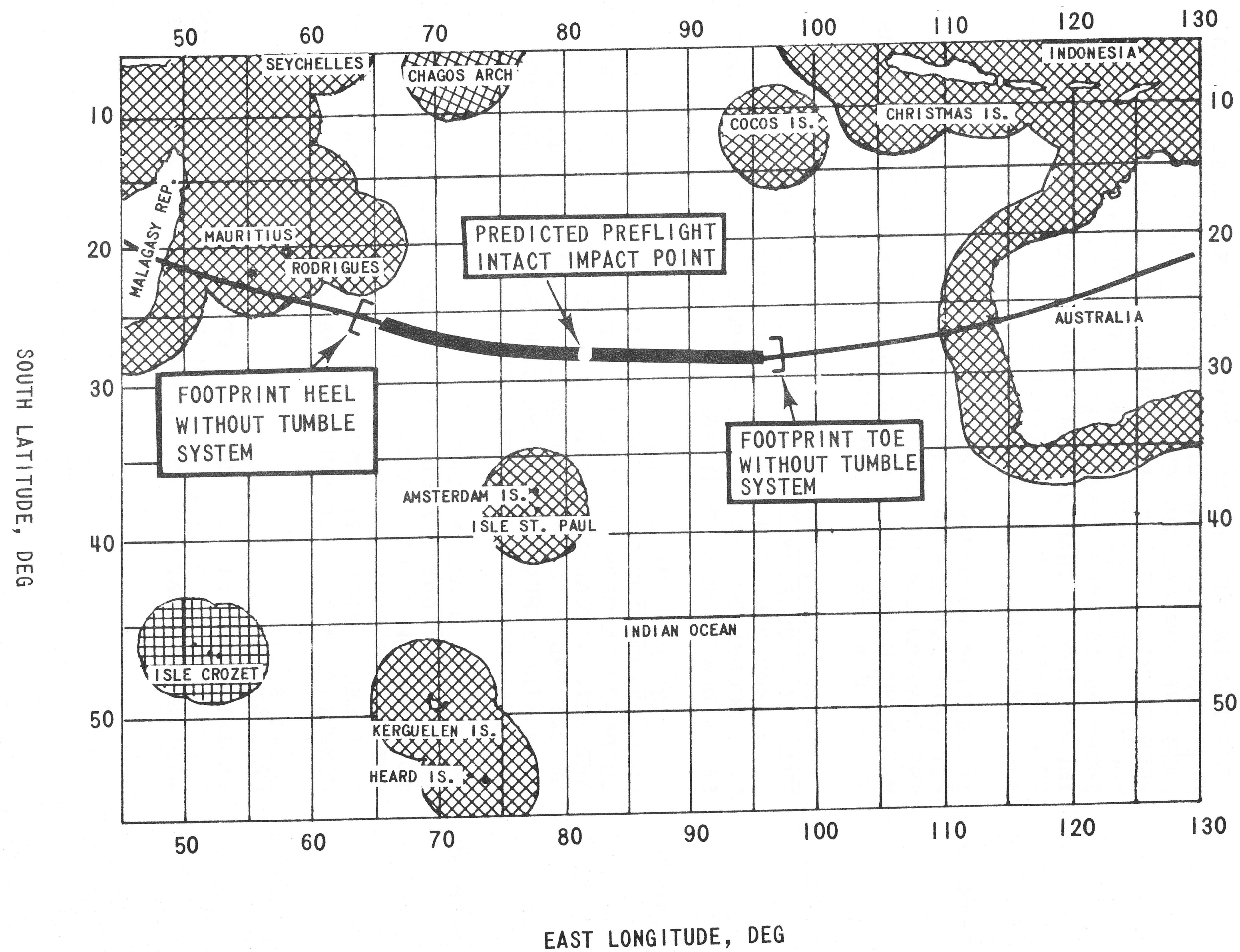
- STRUCTURAL RELEASE
- CONSTANT ATTITUDE TRANSLATION

MECO

- SSME SHUTDOWN
- UMBILICAL DISCONNECT
- ISOLATION VALVE CLOSURE VERIFICATION

NOMINAL ET SEPARATION MANEUVER SEQUENCE

NOMINAL ET FOOTPRINT



T+9M08S (CONT.) SEVEN SECONDS AFTER THE MECO COMMAND, THE ET TUMBLE SYSTEM IS ACTIVATED TO JETTISON THE ET ON A SUBORBITAL TRAJECTORY THAT RESULTS IN AN IMPACT LOCATION IN THE INDIAN OCEAN. THE ET IMPACT POINT FOOTPRINT IS 1059 NM UPRANGE AND 745 NM DOWNRANGE FROM THE NOMINAL IMPACT POINT. THERE IS ALSO A PLUS OR MINUS 29 NM CROSS RANGE DEVIATION FROM THE NOMINAL IMPACT POINT. THE ET BREAKUP OCCURS DURING ENTRY AT 195,000 FEET. THE ET FOOTPRINT DOES NOT IMPACT CLOSER THAN 200 NM FROM A LAND MASS. FOLLOWING ET SEPARATION, THE ORBITER HAS AN APOGEE OF 248.3 NM AND A PERIGEE OF 31.9 NM.

T+9M02S <u>TRANSITION TO MAJOR MODE 104</u>
FOLLOWING ET SEP AND THE -Z TRANSLATION MANEUVER, THE ONBOARD COMPUTER MEMORY CONFIGURATION CHANGES TO MAJOR MODE 104 WHICH CONTAINS THE GUIDANCE PROGRAMS NEEDED FOR THE FIRST OMS BURN.

T+9M02S <u>SSMEs POSITIONED FOR AUTO DUMP</u>
THIS IS A CONFIRMATION THAT THE MAIN ENGINE BELLS HAVE BEEN POSITIONED FOR THE LO2 AND LH2 DUMPING THAT OCCURS DURING THE OMS-1 BURN. THIS POSITIONING BEGAN DURING THE ET SEPARATION SEQUENCE.

T+9M47S <u>MANEUVER FOR OMS-1 BURN</u>
UPON TRANSITION TO MAJOR MODE 104, THE PREDETERMINED GUIDANCE TARGETS AND REQUIRED POSITION OF THE ORBITER ARE AUTOMATICALLY LOADED INTO THE ONBOARD COMPUTER'S MEMORY AND IS DISPLAYED ON THE ONBOARD CRTs. THE CREW WILL CONFIRM THE TARGETING RESULTS, AND THEN MANEUVER TO THE BURN ATTITUDE INDICATED.

T+9M49S <u>ATTITUDE FOR OMS-1 BURN</u>
THIS EVENT CONFIRMS THE ORBITER HAS BEEN MANEUVERED TO THE PROPER OMS-1 ATTITUDE. A TIMER ON THE ORBITER'S CRT COUNTS DOWN THE TIME TO IGNITION (TIG). AT T-15 SEC BEFORE TIG, THE CREW GIVES THE ONBOARD COMPUTERS A "GO FOR BURN" COMMAND.

T+10M50S <u>OMS-1 BURN</u>
WHEN THE TIME TO IGNITION REACHES ZERO, THE OMS ENGINES WILL FIRE. THE ORBITER WILL BE OVER BERMUDA AT THIS TIME. DURING THE BURN, THE VEHICLE WILL BE APPROACHING THE DESIRED VELOCITY AND APOGEE.

T+11M02S MPS LO2/LH2 DUMP INITIATE

OVERBOARD DUMPING OF RESIDUAL PROPELLANTS IS REQUIRED AFTER EXTERNAL TANK SEPARATION. THERE ARE APPROXIMATELY 5400 POUNDS OF PROPELLANT TRAPPED IN THE ORBITER. TRAPPED LH2 POSES A HAZARD DURING ENTRY SINCE IT MAY COMBINE WITH ATMOSPHERIC OXYGEN TO FORM A POTENTIALLY EXPLOSIVE MIXTURE. IN ADDITION, IF NOT DUMPED, THE PROPELLANTS WILL OUTGAS, CAUSING LOW-LEVEL ACCELERATIONS NOT SENSED BY GUIDANCE, AND THUS CREATING NAVIGATION ERRORS. FINALLY, IF THE PRESSURE RELIEF VALVES SHOULD HANG UP, THESE PROPELLANTS MAY RUPTURE THE LINES CAUSING SERIOUS DAMAGE. TO AVOID THIS POSSIBILITY, THE MAIN PROPELLANT SYSTEM DUMP WILL BE PERFORMED WITH THE OMS-1 BURN. LO2 AND LH2 TRAPPED IN THE FEEDLINE MANIFOLD WILL BE EXPELLED UNDER PRESSURE SUPPLIED BY THE HELIUM SUBSYSTEM.

T+13M32S OMS-1 CUTOFF

AFTER AN OMS-1 BURN OF APPROXIMATELY 2.5 MIN THE BURN WILL TERMINATE AND THE OMS ENGINES WILL AUTOMATICALLY PURGE THEMSELVES. FOLLOWING THE OMS-1 BURN, THE ORBITER WILL BE AT AN ALTITUDE OF 119 NM AND 1,635 NM FROM THE LAUNCH SITE IN AN EGG-SHAPED ORBIT.

T+13M09S SSMEs STOWED

AFTER THE LH2 DUMP IS COMPLETE, THE ONBOARD COMPUTERS WILL AUTOMATICALLY POSITION THE MAIN ENGINE BELLS TO THE PROPER POSITION FOR DEORBIT AND ENTRY.

T+14M09S APU POWER DOWN

WITH MAIN ENGINE STOWAGE, HYDRAULIC PRESSURE REQUIREMENTS TERMINATE. THE CREW WILL TURN OFF THE AUXILIARY POWER UNITS (APUs) WHICH SUPPLY HYDRAULIC PRESSURE. THE APU FUEL ON BOARD MUST BE CONSERVED FOR RE-ENTRY.

T+15M00S FLASH EVAPORATOR FEEDLINE ON

THE FLASH EVAPORATOR FEEDLINE HEATERS ARE TURNED ON TO PREVENT WATER, FLOWING TO THE FLASH EVAPORATOR COOLING SYSTEM, FROM FREEZING.

T+15M00S CRYO TANK HEATERS ON

THE CRYO TANK HEATERS ARE TURNED ON TO MAINTAIN A CONSTANT PRESSURE ON THE OXYGEN AND HYDROGEN TANKS USED BY FUEL CELLS SUPPLYING ELECTRICAL POWER TO THE ORBITER SYSTEMS. BY TURNING THESE TANK HEATERS ON, HEAT ENERGY IS ADDED TO THE LIQUID GASSES, THUS INCREASING TANK PRESSURE.

T+22M52S TRANSITION TO MAJOR MODE 105
FOLLOWING THE APU POWER DOWN, THE ONBOARD COMPUTERS' MEMORY CONFIGURATION CHANGES TO MAJOR MODE 105, WHICH CONTAINS THE GUIDANCE PROGRAMS NEEDED FOR THE OMS-2 BURN.

T+23M57S MPS POWER DOWN
AFTER COMPLETION OF THE MPS DUMP, THE MPS SYSTEM IS POWERED DOWN.

T+23M57S MPS VACUUM INERT START
AFTER THE MPS POWER DOWN, THE MPS WILL BE VACUUM INERTED BY THE PILOT. VACUUM INERTING ALLOWS ANY TRACES OF LO2 AND LH2, LEFT OVER AFTER THE PROPELLANT DUMP, TO BE VENTED INTO SPACE. BOTH THE LO2 AND LH2 LINES WILL BE INERTED SIMULTANEOUSLY.

T+24M00S H2 PRESS LINE VENT CLOSED
PRIOR TO CLOSING THE ET UMBILICAL DOORS AND AFTER THE MPS VACUUM INERTING HAS STARTED, THE CREW OPENS THE MPS H2 PRESSURE LINE VENT TO EXPEL ANY HYDROGEN IN THE LINE THROUGH THE UMBILICAL DOOR OPENING. THIS VENTING WILL LAST ONE MINUTE.

T+25M00S ET UMBILICAL DOORS CLOSED
THE ET UMBILICAL DOORS ON THE ORBITER MUST BE CLOSED PRIOR TO RE-ENTRY. THE UMBILICAL DOORS ARE NOT CLOSED UNTIL THE H2 PRESSURE LINE VENTING IS COMPLETE TO AVOID TRAPPING ANY HYDROGEN IN THE ET DOOR WELLS.

T+26M28S MANEUVER FOR OMS-2 BURN
ONCE MAJOR MODE 105 IS VERIFIED, THE CREW LOADS AND VERIFIES THE PROPER GUIDANCE PARAMETERS ON THE ONBOARD COMPUTERS. THE OMS ENGINES ARE THEN POSITIONED FOR THE OMS-2 BURN.

T+26M30S ATTITUDE FOR OMS-2 BURN
AFTER THE PROPER OMS-2 GUIDANCE INFORMATION HAS BEEN SET UP AND VERIFIED BY THE MISSION CONTROL CENTER, THE PILOT CONFIGURES THE OMS/RCS SWITCHES FOR THE BURN AND THE COMMANDER MANEUVERS THE VEHICLE TO THE BURN ATTITUDE.

T+40M20S MPS VACUUM INERT COMPLETE
THIS EVENT VERIFIES THE MPS VACUUM INERTING IS COMPLETE. THE INERTING WILL NORMALLY BE COMPLETE APPROXIMATELY 5 MIN. BEFORE THE OMS-2 BURN.

T+46M26S OMS-2 BURN

THE OMS-2 BURN OCCURS WHEN THE ORBITER HAS REACHED ITS APOGEE (253 NM) OVER THE INDIAN OCEAN. THE OMS-2 BURN IS IDENTICAL TO THE OMS-1 BURN EXCEPT THE PURPOSE OF THE OMS-2 BURN IS TO ESTABLISH A CIRCULAR ORBIT, WHEREAS THE OMS-1 BURN ESTABLISHED ORBIT INSERTION.

T+48M39S OMS-2 CUTOFF

AT THE TIME OF OMS-2 CUTOFF, THE ORBITER WILL BE AT AN ALTITUDE OF 253 NM AND 9,681 NM FROM THE LAUNCH SITE. THE ORBITER IS NOW IN A CIRCULAR (253 NM BY 253 NM) ORBIT.

T+52M52S OMS ENGINE POWER DOWN

FOLLOWING THE OMS-2 BURN, THE OMS ENGINES ARE NO LONGER REQUIRED FOR ON-ORBIT OPERATIONS AND ARE POWERED DOWN.

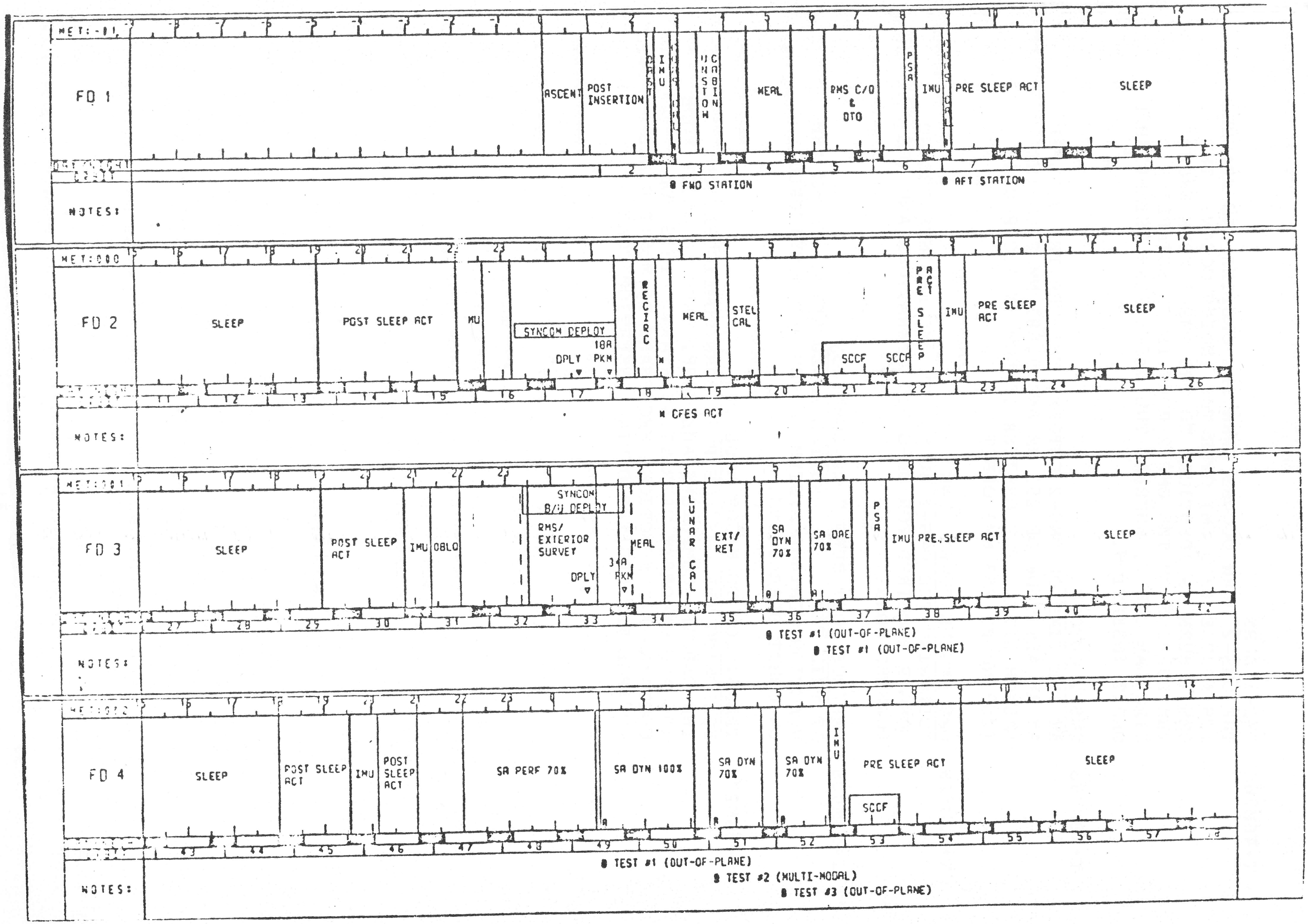
T+54M00S OMS/RCS POST BURN CONFIGURATION

AT THIS TIME, THE ORBITAL MANEUVERING SYSTEM AND REACTION CONTROL SYSTEM VALVES ARE CONFIGURED FOR ON-ORBIT OPERATIONS.

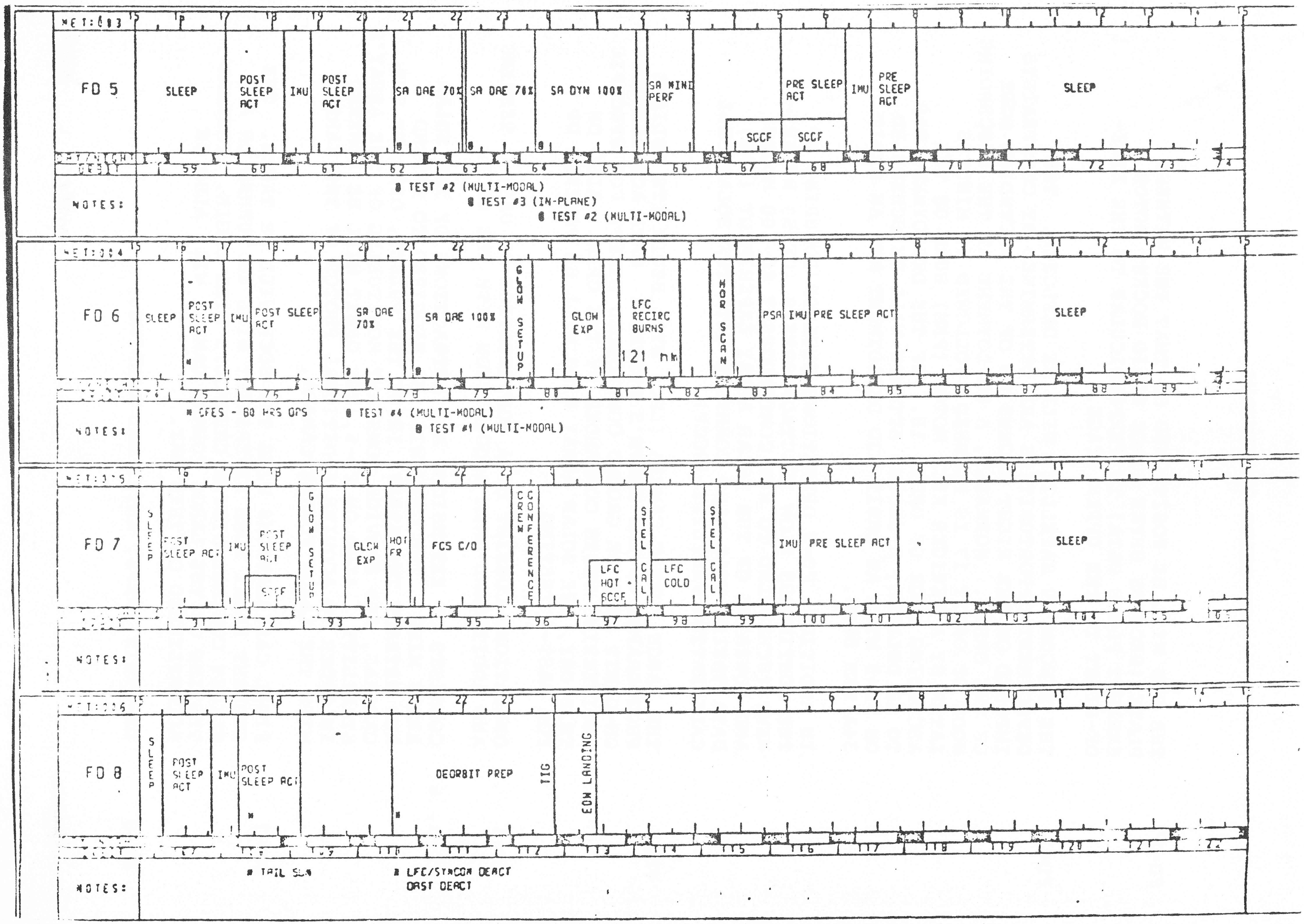
T+56M27S TRANSITION TO MAJOR MODE 106

FOLLOWING THE OMS/RCS POST BURN CONFIGURATION, THE ONBOARD COMPUTERS ARE CONFIGURED TO MAJOR MODE 106 AND ON-ORBIT OPERATIONS START. THIS MODE CONTAINS ALL FUNCTIONS NECESSARY TO MONITOR AND CONTROL THE ORBITER DURING INSERTION COAST.

MISSION EVENT TIMELINE



MISSION EVENT TIMELINE (CONTINUED)



ON-ORBIT OPERATIONS

FD-1 THE RMS WILL BE POSITIONED SO THAT THE WITNESS PLATE (RECORDS UPPER STAGE SOLID ROCKET MOTOR EXHAUST PLUME DATA) IS PERPENDICULAR TO THE LINE-OF-SIGHT TO THE UPPER STAGE.

FD-2 THE SYNCOM IV SATELLITE WILL BE DEPLOYED. THE DEPLOYMENT OPPORTUNITIES ARE DETERMINED BY CONSTRAINTS IMPOSED ON THE RIGHT ASCENSION OF THE ASCENDING NODE OF THE ORBIT. NORMALLY, A DEPLOYMENT AT THE DESCENDING NODE OF ORBIT 17 IS PLANNED, FOLLOWED 45 MINUTES LATER BY A PERIGEE KICK MOTOR (PKM) BURN ON THE ASCENDING NODE OF ORBIT 18. IF THE DEPLOYMENT HAS TO BE DELAYED, A SECOND ATTEMPT WILL BE SCHEDULED ON FD-3 WITH AN ORBIT 33D DEPLOYMENT AND AN ORBIT 34A PKM BURN.

IN ADDITION, FD-2 OPERATIONS INCLUDE POWERING UP THE CONTINUOUS FLOW ELECTROPHORESIS (CFES) EXPERIMENT (SCHEDULED TO RUN CONTINUOUSLY 80-100 HOURS) AND POWERING UP THE SOLAR ARRAY EXPERIMENT (SAE). DATA TAKING WILL ALSO COMMENCE WITH THE SOLAR CELL CALIBRATION FACILITY (SCCF).

FD-3 THE LARGE FORMAT CAMERA (LFC) WILL BEGIN ITS OBLIQUE PHOTOGRAPHY OF THE EARTH'S SURFACE. DATA ACQUISITION ON-ORBIT WILL BE GROUND CONTROLLED EXCEPT FOR SPECIFIC ENGINEERING TESTS COMMANDED BY THE CREW. ALSO ON THIS DAY, THE SOLAR ARRAY WING WILL BE POWERED UP FOR OAST-1 TESTING.

FD-4 OPERATIONS CONSIST OF A CONTINUATION OF OAST-1 TESTING AND ADDITIONAL DATA ACQUISITION WITH THE SCCF.

FD-5, 6 CONSISTS OF EXTENSIONS AND RETRACTIONS OF THE SOLAR ARRAY WING. THE CREW WILL BE REQUIRED TO EXTEND AND RETRACT THE ARRAY, INPUT THE PULSES, OPERATE THE CAMERAS, AND PROVIDE CONSTANT MONITORING OF THE ARRAY'S STABILITY. ALSO ON FD-6, THE ORBIT WILL BE LOWERED IN ORDER TO ACQUIRE ADDITIONAL PHOTOS OF THE EARTH WITH THE LARGE FORMAT CAMERA.

FD-7 FINAL CALIBRATIONS WITH THE SCCF WILL BE TAKEN. THE STUDENT FLOAT ZONE EXPERIMENT WILL BE TURNED ON AND FLIGHT CONTROL SYSTEM CHECKOUTS WILL BEGIN. THERMAL TESTING OF THE LARGE FORMAT CAMERA WILL ALSO BE ACCOMPLISHED ON THIS DAY.

FD-8 DE-ORBIT PREPS, ENTRY AND LANDING.

THE CARGO

THE STS 41D MANIFEST INCLUDES THREE PAYLOAD BAY PAYLOADS, TWO GETAWAY SPECIAL (GAS) CANISTERS, TWO RMS EXPERIMENTS, AND FOUR MID-DECK EXPERIMENTS:

PAYLOAD BAY

SYNCOM IV
LFC
OAST 1
CINEMA 360 (GAS CAN)
UTAH STATE GAS CAN
GLO EXPERIMENT (RMS)
WITNESS PLATE EXPERIMENT (RMS)

MID-DECK PAYLOADS

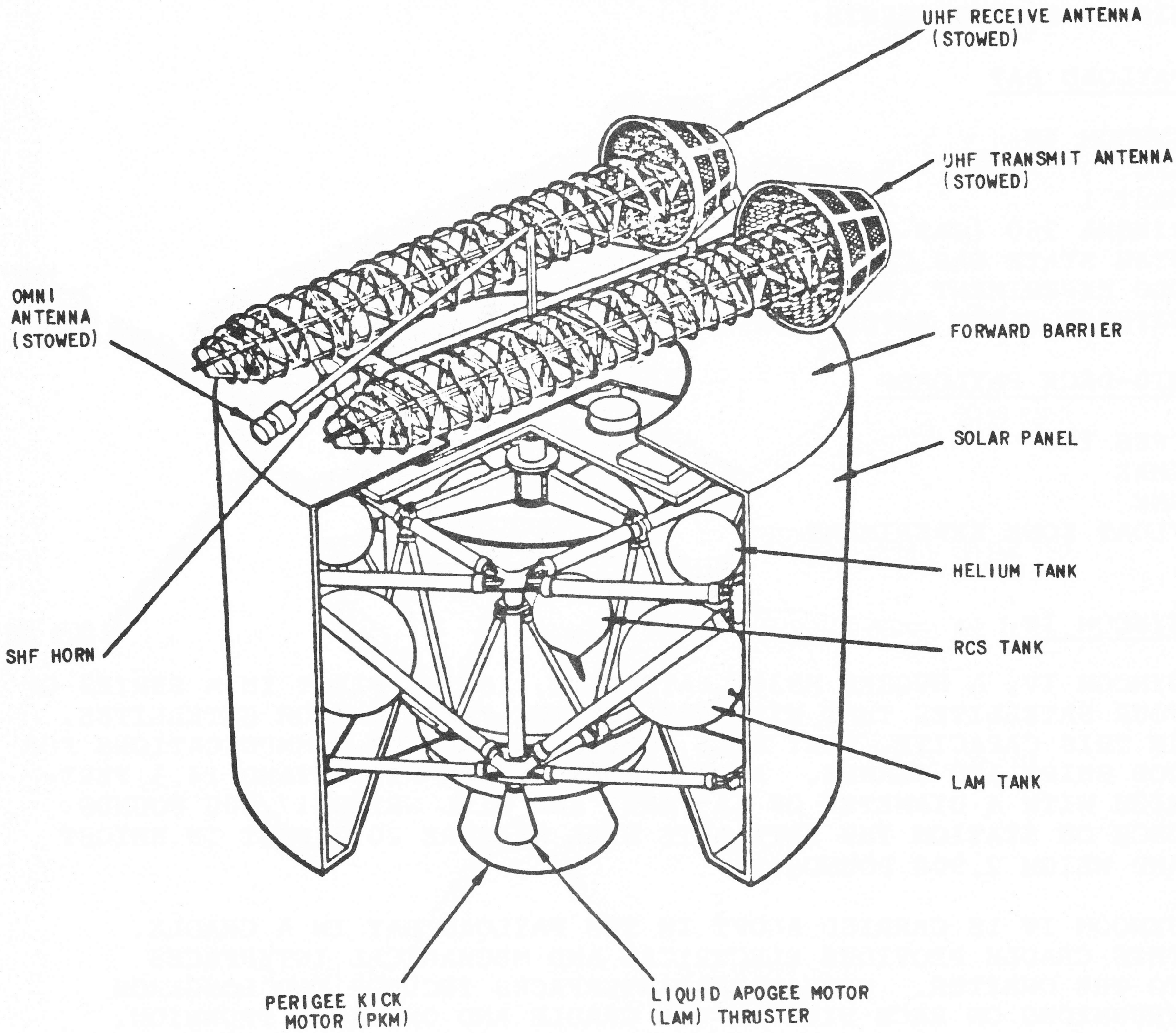
CFES III
IMAX
RME
FLOAT ZONE EXPERIMENT

SYNCOM IV

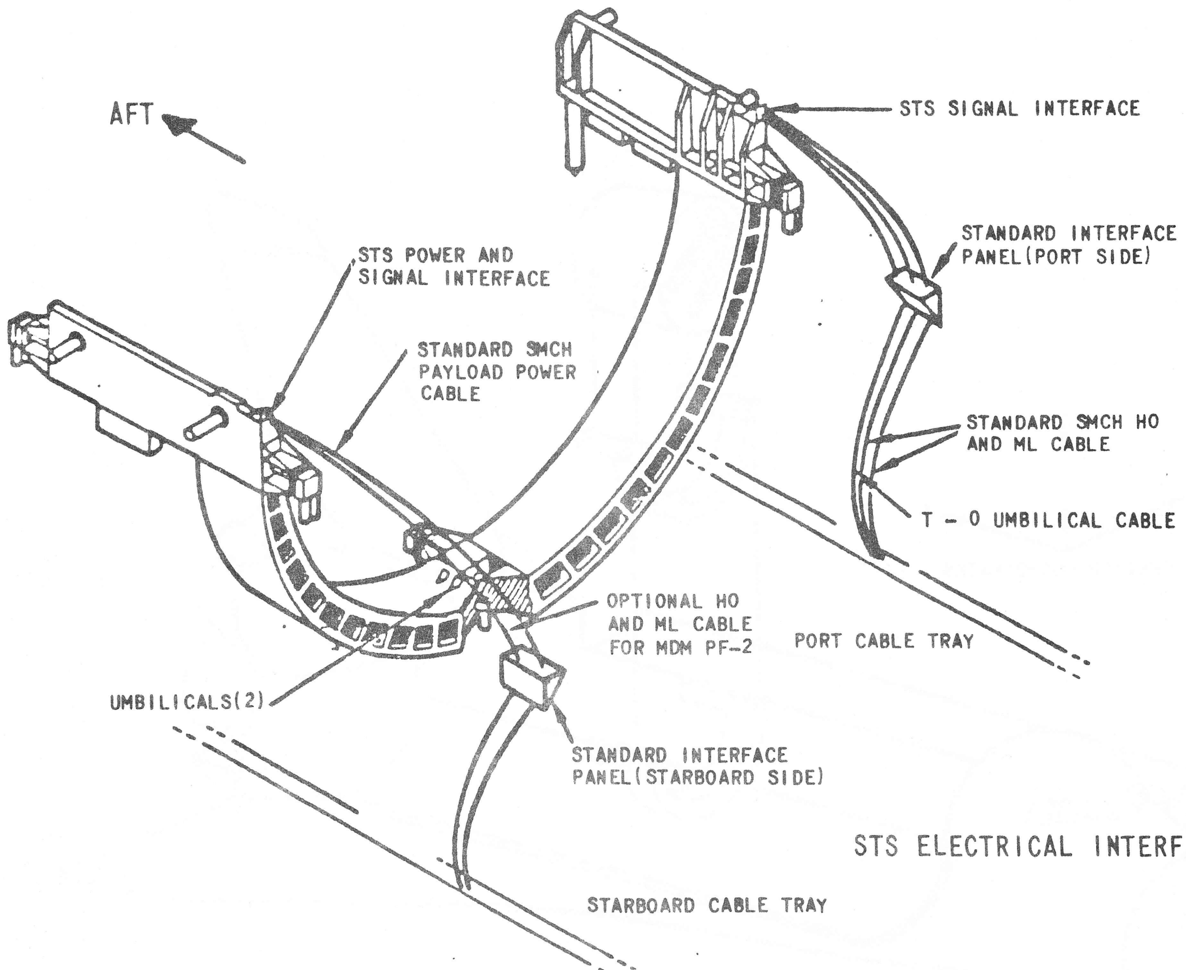
SYNCOM IV, A HUGHES HS381 SATELLITE, IS THE FIRST IN A SERIES OF FOUR SATELLITES THAT WILL REPLACE THE FLEET SATCOM SATELLITES. IN THIS CAPACITY, THEY WILL PROVIDE WORLDWIDE COMMUNICATIONS FOR DOD SHIPS AND PLANES. AT LIFT-OFF SYNCOM WILL STAND 14.1 FEET HIGH WITH A DIAMETER OF 14 FEET, AND WILL WEIGH 17,500 POUNDS. ONCE ON STATION THE SATELLITE WILL MEASURE 20.3 FEET IN HEIGHT AND WEIGH 2,900 POUNDS.

SYNCOM IV IS CARRIED ALOFT IN THE PAYLOAD BAY IN A CRADLE. THIS CRADLE PROVIDES ELECTRICAL AND MECHANICAL INTERFACES TO THE ORBITER. MECHANICAL INTERFACES INCLUDE TWO LONGERON TRUNNIONS ON EACH SIDE OF THE CRADLE AND ONE KEEL TRUNNION. THE FORWARD TRUNNIONS ARE THE LOAD CARRYING TRUNNIONS, WHILE THE AFT TRUNNIONS PROVIDE STABILIZATION. ALTHOUGH NO ACTIVE LATCHES ARE REQUIRED FOR ON ORBIT OPERATIONS, TWO ACTIVE LATCHES ARE USED ON THE PORT SIDE TO AVOID ACCESS PROBLEMS WITH RMS DURING GROUND INSTALLATION.

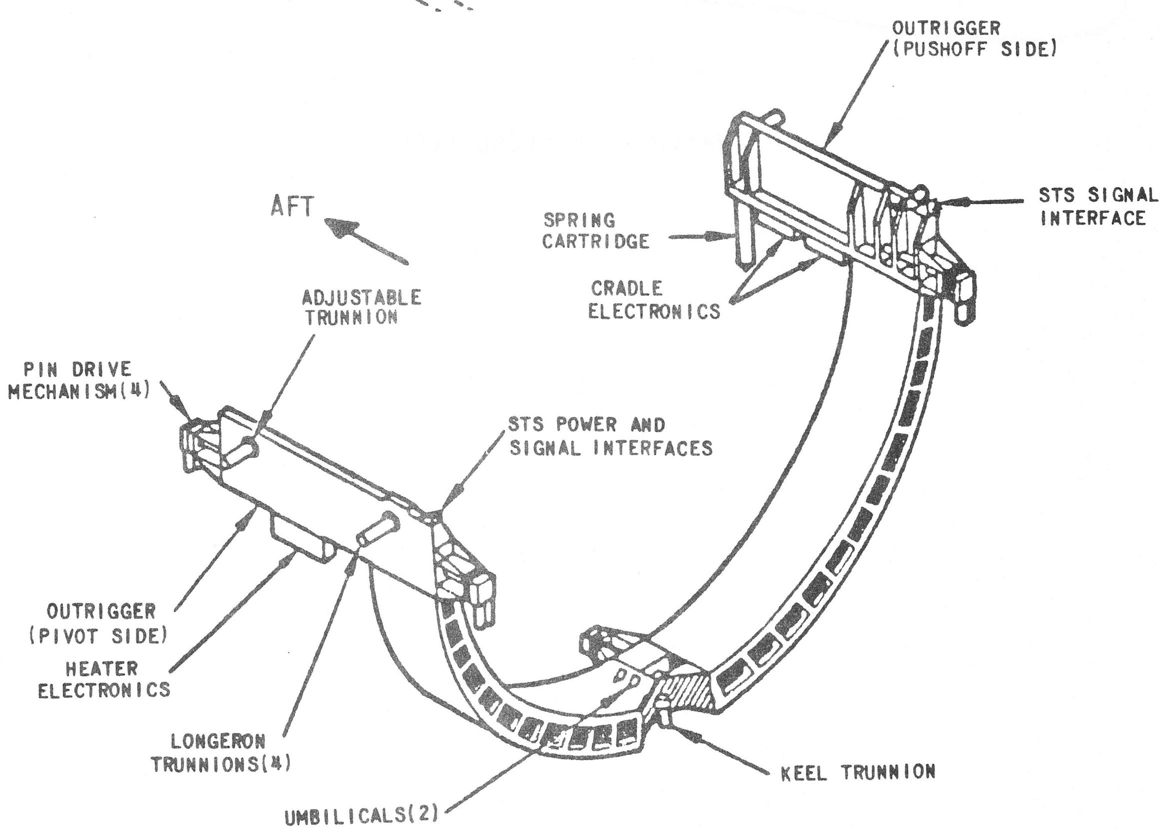
ELECTRICAL INTERFACES ON THE CRADLE PROVIDE ORBITER ELECTRIC POWER TO THE CRADLE AND SATELLITE VIA A CONNECTOR ON THE PORT SIDE OF THE CRADLE NEAR THE PORT STABILIZING TRUNNION. SIGNAL INTERFACES ARE PROVIDED ON EITHER SIDE OF THE CRADLE NEAR THE STABILIZING TRUNNIONS. THESE ALLOW DATA TRANSFERRAL THROUGH MDM PF-1 AND THROUGH THE T-O UMBILICAL ON THE GROUND. AN OPTIONAL LINK TO MDM PF-2 IS ALSO PROVIDED.



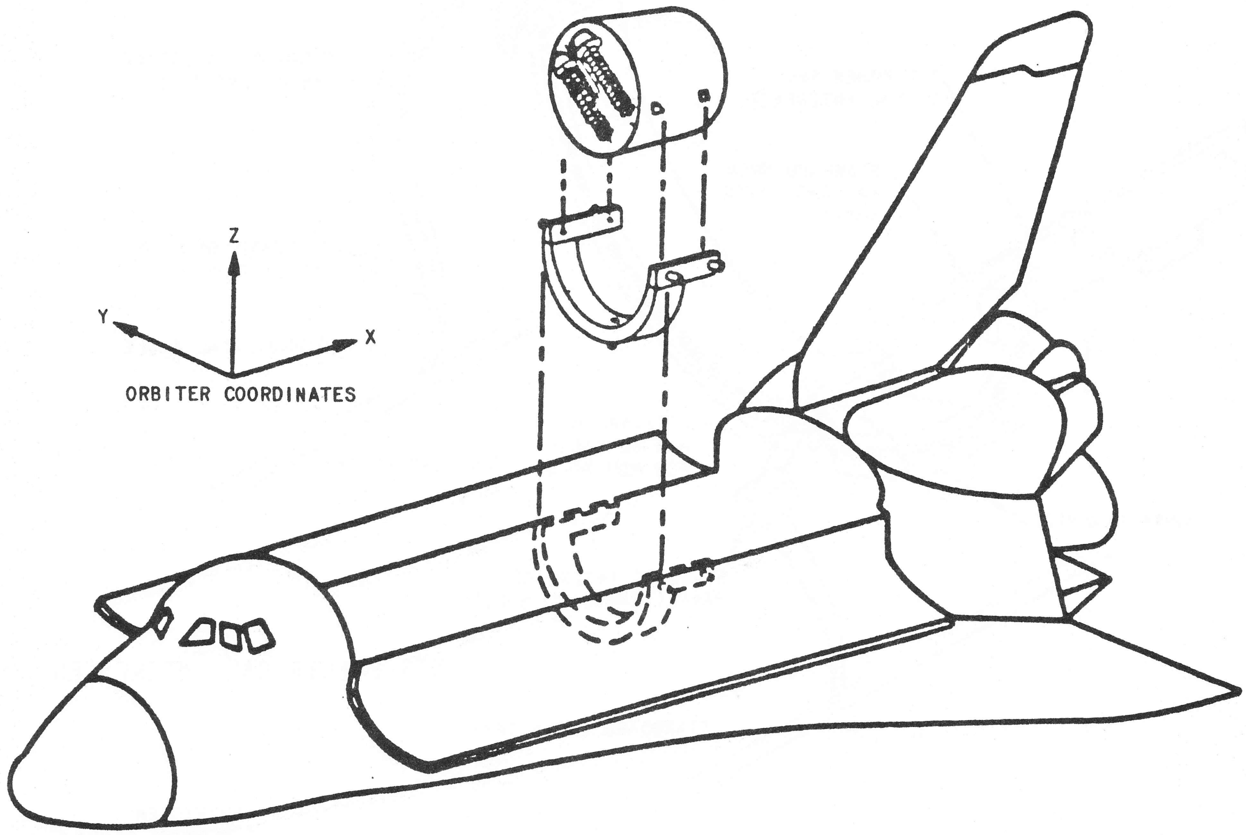
SYNCOM IV SPACECRAFT



STS ELECTRICAL INTERFACES



SYNCOM IV CRADLE

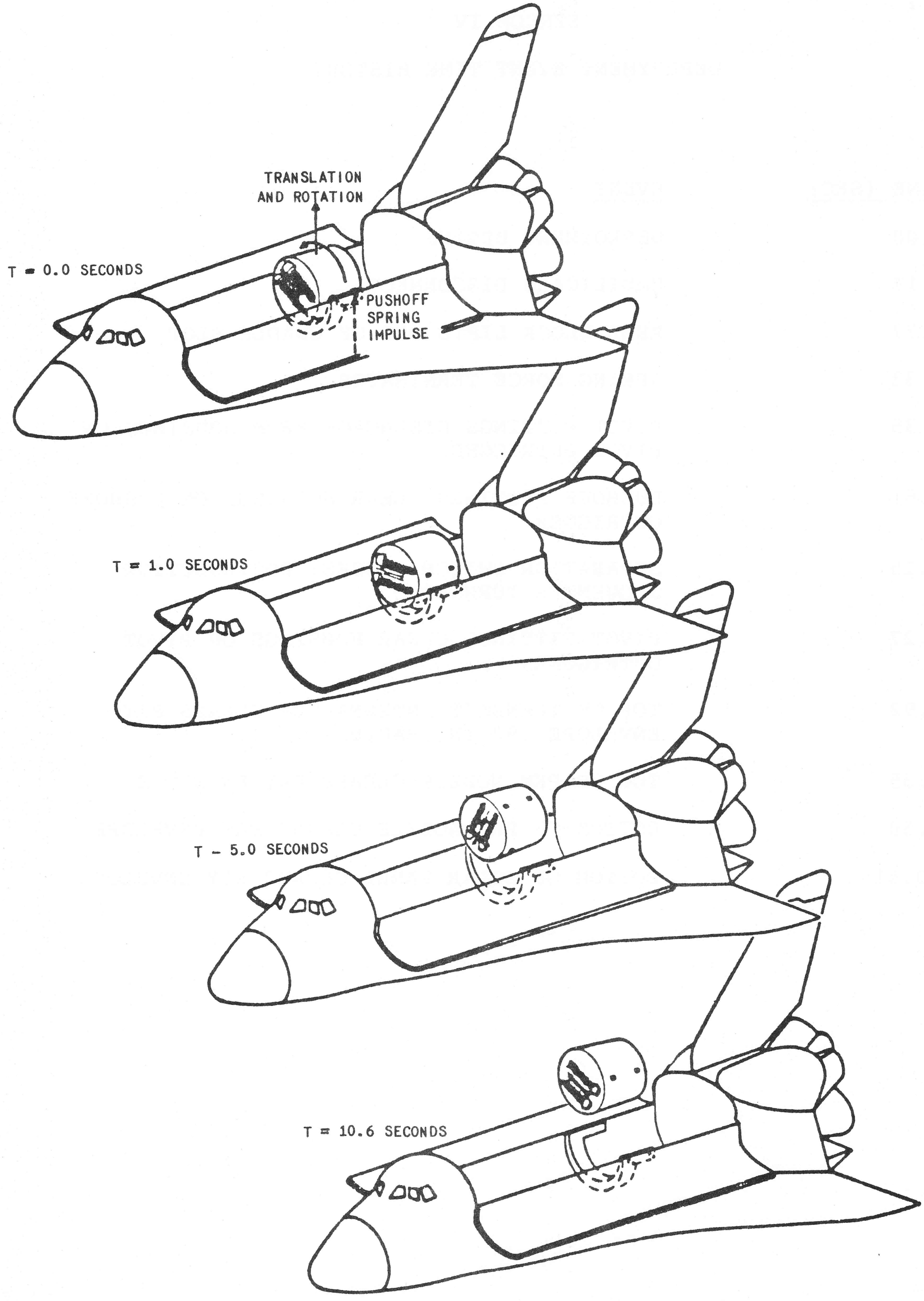


SYNCOM IV PAYLOAD ELEMENTS

SYNCOM IV

DEPLOYMENT EVENT TIME HISTORY

TIME (SEC)	EVENT
0.00	DEPLOYMENT BEGINS
0.17	UMBILICALS DISCONNECT
0.27	KEEL BLOCK LIFTS OUT OF CRADLE SLOT
0.33	SPRING FORCE TERMINATES
0.35	PIVOT FITTINGS DISENGAGE FROM HOUSINGS ON PIVOT OUTRIGGER
0.51	PUSHOFF FITTINGS CLEAR HOUSINGS ON PUSHOFF OUTRIGGER
1.15	SEPARATION SWITCH CLOSES; POSTEJECTION SEQUENCER TURNS ON
1.27	PIVOT FITTINGS CLEAR HOUSINGS ON PIVOT OUTRIGGER
1.92	TOP OF TRANSMIT ANTENNA CUP CLEARS BAY ENVELOPE (90 IN. RADIUS)
4.35	TOP OF PKM NOZZLE CLEARS BAY ENVELOPE
6.50	BOTTOM OF PKM NOZZLE CLEARS BAY ENVELOPE
10.61	BOTTOM OF SOLAR PANEL CLEARS BAY ENVELOPE



SYNCOM IV DEPLOYMENT TIME HISTORY

DEPLOYMENT OF THE SYNCOM IV BEGINS WITH A "FRISBEE" EJECTION FROM THE PAYLOAD BAY. AS THE SATELLITE IS RELEASED A SPRING ON THE PORT SIDE OF THE CRADLE KICKS THE SATELLITE OUT OF THE PAYLOAD BAY CAUSING BOTH TRANSLATION AND ROTATION OF THE PAYLOAD. FORTY-FIVE MINUTES AFTER EJECTION A PERIGEE KICK MOTOR FIRES, PLACING SYNCOM IV IN AN ELLIPTICAL TRANSFER ORBIT. APOGEE ALTITUDE IS INCREASED THROUGH SEVERAL FIRINGS OF THE LIQUID APOGEE MOTOR. WHEN APOGEE ALTITUDE REACHES 19,300 NM THE APOGEE MOTOR FIRES AGAIN TO CIRCULARIZE THE FINAL GEO-SYNC ORBIT.

ONCE ON ORBIT THE SYNCOM IV SATELLITE DEPLOYS ITS UHF ANTENNAS AND OMNI ANTENNA TO PERFORM ITS COMMUNICATIONS FUNCTIONS. POWER IS PROVIDED BY A CYLINDRICAL SOLAR ARRAY. HYPERGOLIC RCS JETS PROVIDE STATIONKEEPING FOR THE SATELLITE.

LARGE FORMAT CAMERA (LFC)

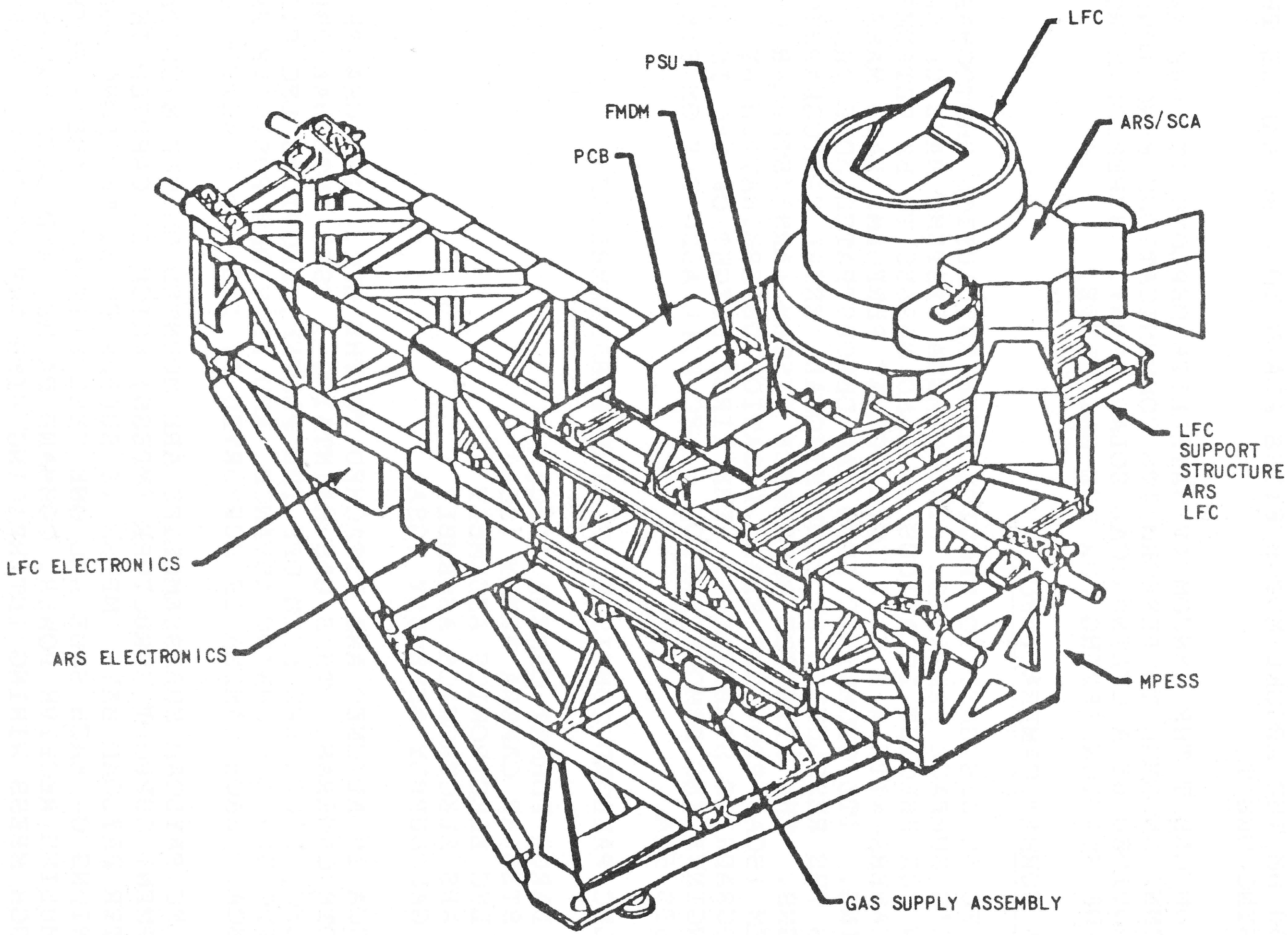
THE LFC IS DESIGNED TO PROVIDE HIGH RESOLUTION PHOTOGRAPHS OF THE EARTH'S SURFACE FEATURES. TWO CAMERA SYSTEMS MAKE UP LFC AND ALLOW FOR PRECISE LOCATIONS OF LAND MASSES TO BE DETERMINED. THE LFC CAMERA WITH A 9 X 18 INCH FORMAT PERFORMS LAND MASS IMAGING. ITS GEOMETRIC LENS HAS DEMONSTRATED MORE THAN THREE TIMES THE RESOLUTION OF CONVENTIONAL AERIAL CARTOGRAPHIC LENS DESIGNS. THE ATTITUDE REFERENCE SYSTEM (ARS)/STELLAR CAMERA SYSTEM (SCA) PROVIDES EXACT LOCATION DETERMINATION BY PHOTOGRAPHING STARFIELDS. THE FIRST FLIGHT OF LFC IS INTENDED AS AN ENGINEERING DEMONSTRATION. LFC WILL ALSO FLY ON STS 41G AND STS 51A.

THE LFC PAYLOAD CONSISTS OF FIVE SUBASSEMBLIES:

A. LARGE FORMAT CAMERA (LFC)
B. STELLAR CAMERA ARRAY (SCA)
C. LFC ELECTRONICS ASSEMBLY
D. ARS ELECTRONICS ASSEMBLY
E. GAS SUPPLY ASSEMBLY (GSA)

THE SCA IS ALIGNED AND ATTACHED TO THE LFC. THE GSA PROVIDES GN2 TO BOTH CAMERAS. THIS GAS MAINTAINS 2 PSIG INTERNAL PRESSURE IN THE LFC, LIFTS LFC FILM OFF THE PLATEN, PROVIDES LFC FILM WITH A BEARING SURFACE DURING ADVANCE, AND PROVIDES POSITIVE PRESSURE TO THE SCA. EACH CAMERA IS SUPPORTED BY ITS OWN ELECTRONICS.

ALL LFC PAYLOAD SUBASSEMBLIES ARE MOUNTED ON THE MISSION PECULIAR EQUIPMENT SUPPORT STRUCTURE (MPESS) WHICH IS CARRIED IN THE ORBITER PAYLOAD BAY. MPESS IS SUPPORTED BY TWO LONGERON TRUNNIONS ON EACH SIDE AND ONE KEEL FITTING. THE ELECTRONICS ASSEMBLIES RECEIVE POWER, COMMAND PATHS, AND DATA PATHS THROUGH MPESS WIRING INTERFACING WITH THE ORBITER. ALL CABLING IS ROUTED FROM STANDARD INTERFACE PANELS (SIPS) THROUGH THE MPESS CIRCUIT BREAKERS AND FROM THERE EITHER TO THE POWER CONTROL BOX (PCB) OR THE FLEXIBLE MULTIPLEXER/DEMULTIPLEXER (FMDM). THE FMDM, PCB AND PCV ARE ALL MOUNTED ON THE MPESS.



LARGE FORMAT CAMERA PAYLOAD

OAST-1

OAST-1 CONSISTS OF THREE RELATED EXPERIMENTS MOUNTED ON A MISSION PECULIAR EQUIPMENT SUPPORT STRUCTURE (MPESS). EACH OF THE THREE EXPERIMENTS, THOUGH RELATED, HAS AN INDEPENDENT OBJECTIVE. THE SOLAR ARRAY EXPERIMENT (SAE) WILL EVALUATE THE EXTENSION AND RETRACTION OF A LARGE SOLAR ARRAY. THE SOLAR CELL CALIBRATION FACILITY (SCCF) WILL CALIBRATE SOLAR CELLS MOUNTED ON THE SAE IN A TRUE SPACE ENVIRONMENT. THE DYNAMIC AUGMENTATION EXPERIMENT (DAE) MEASURES THE DYNAMIC RESPONSE OF THE EXTENDED SOLAR ARRAY STRUCTURE TO KNOWN IMPULSE LOADS.

SAE

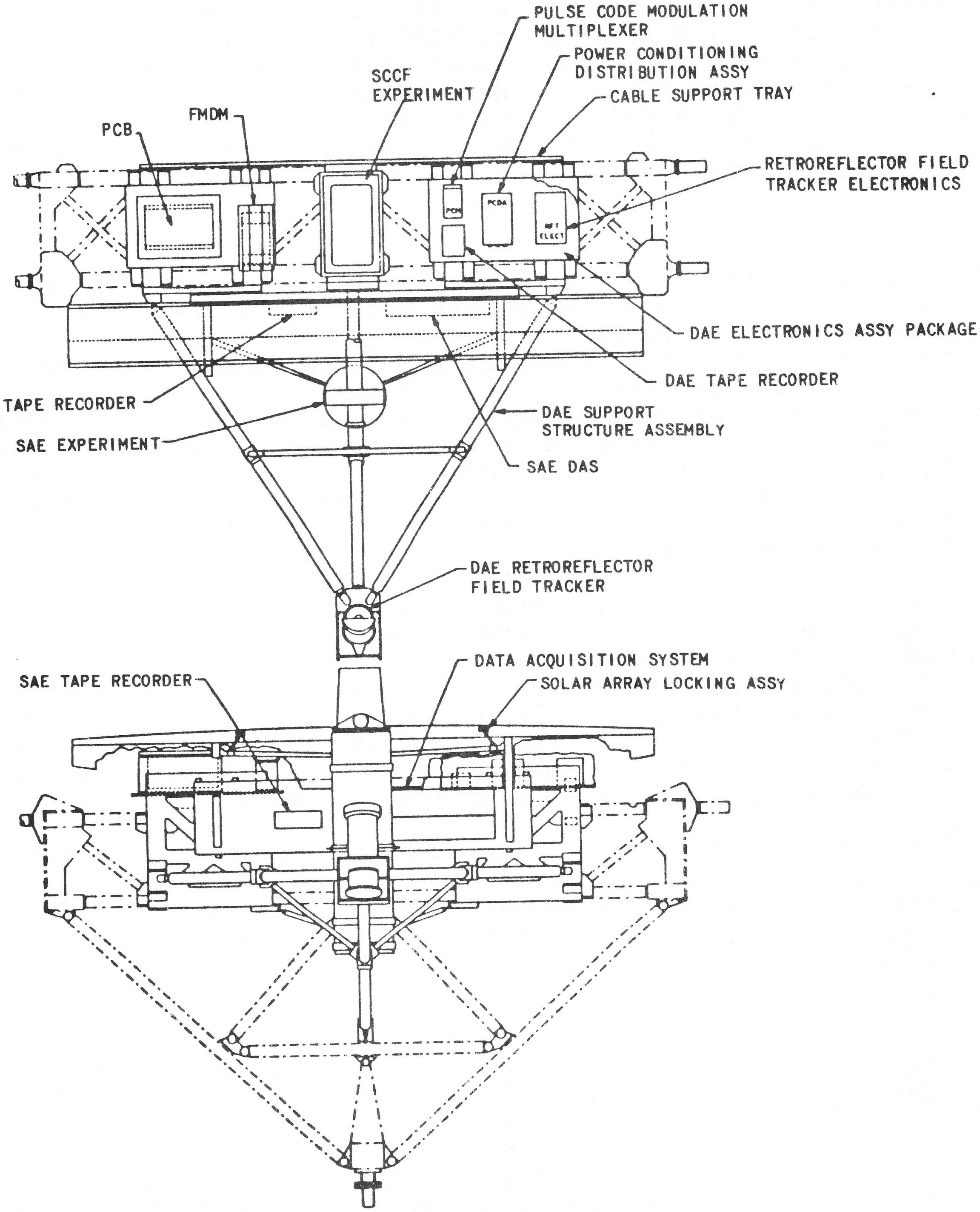
THE SAE CONSISTS OF THE EQUIPMENT REQUIRED TO EXTEND AND RETRACT THE SOLAR ARRAY WING AND GATHER DATA ON ITS ELECTRICAL, STRUCTURAL/ MECHANICAL, AND THERMAL PERFORMANCE. THIS EQUIPMENT IS LOCATED ON THE MPESS IN THE CARGO BAY AND IS CONTROLLED FROM THE AFT FLIGHT DECK (AFD) THROUGH A STANDARD DISPLAY SYSTEM (MCDS), AND THE DEPLOYMENT/POINTING PANEL (DPP). A CREWMAN OPERATES THE SAE EXPERIMENT AND MONITORS ITS STATUS. FOUR ORBITER CLOSED CIRCUIT TELEVISION (CCTV) CAMERAS IN THE CARGO BAY AND STS-PROVIDED VIDEO TAPE RECORDERS (VTR'S) IN THE AFD ARE USED FOR RECORDING EXPERIMENT OPERATIONS. VIDEO RECORDING IS ACCOMPLISHED FROM THE AFD.

THE SAE EXPERIMENT ASSEMBLY CONTAINS PYROTECHNIC DEVICES TO ALLOW SEPARATION OF THE WING ASSEMBLY AND THE CANISTER ASSEMBLY FROM THE SUPPORT STRUCTURE IN CASE OF A MALFUNCTION THAT PRECLUDES STOWAGE AND LOCKING OF THE SOLAR ARRAY WING. THE SEPARATION OF THESE ASSEMBLIES IS INITIATED THROUGH THE USE OF PYROTECHNIC-ACTUATED PIN PULLERS. THE PYROTECHNIC SYSTEMS, BOTH PRIMARY AND SECONDARY, ARE ACTIVATED THROUGH THE DDP WITH CONFIRMATION OF ARMING AND CLAMP OPENING DISPLAYED ON THE SSP.

TESTING OF THE SAE WILL FALL INTO FOUR CATEGORIES: ARRAY WING OPERATION, EXTENDED ARRAY DYNAMICS, MAST TEMPERATURE GRADIENT, AND ELECTRICAL MODULE AND WING THERMAL PERFORMANCE TESTS. THE FOLLOWING PARAGRAPHS DESCRIBE FUNCTIONAL OBJECTIVES OF EACH AREA OF TESTING.

ARRAY WING OPERATION

THE OBJECTIVE OF THE ARRAY WING OPERATION TESTS IS TO DEMONSTRATE THAT THE SOLAR ARRAY CAN BE DEPLOYED, RETRACTED AND AUTOMATICALLY DESTOWED IN AN EARTH ORBITAL ENVIRONMENT. THIS TEST REQUIRES THAT THE ORBITER BE MANEUVERED TO AN ATTITUDE THAT WILL ALLOW THE SUNLIGHT TO ILLUMINATE THE SOLAR ARRAY IN ORDER TO OBTAIN VISUAL DATA AND ALLOW THE CREW TO MONITOR THE OPERATION ON CLOSED CIRCUIT TV (CCTV). ALL EXTENSION AND RETRACTION OPERATIONS SHALL BE DOCUMENTED VIA CCTV WITH THE VIDEO RECORDED ONBOARD AND THE TAPES RETURNED FOR POSTFLIGHT CCTV. PERFORMANCE DATA WILL BE COLLECTED AND RECORDED BY THE SAE TAPE RECORDER. DURING THESE TESTS, WHENEVER THE ARRAY IS UNSTOWED, THE PRIMARY ORBITER REACTION CONTROL SYSTEM (RCS) FIRINGS MUST BE INHIBITED TO PRECLUDE DISTURBING THE SOLAR ARRAY IN EXCESS OF THE 0.003 G'S ACCELERATION ALLOWS. THIS TEST WILL BE PERFORMED FIVE TIMES.



OAST-1 EXPERIMENTS (SAE, DAE, SCCF)

EXTENDED ARRAY DYNAMICS

THE OBJECTIVE OF THE EXTENDED ARRAY DYNAMICS TEST IS TO MEASURE THE MULTIMODAL AND OUT-OF-PLANE BENDING OF THE SOLAR ARRAY WING WHEN PREPLANNED, CONTROLLED IMPULSES OF KNOWN MAGNITUDE AND DIRECTION ARE IMPARTED TO THE ORBITER BY THE RCS. TEN TESTS ARE TO BE PERFORMED: SIX TESTS IN WHICH THE SOLAR ARRAY IS PARTLY EXTENDED AND FOUR TESTS IN WHICH THE SOLAR ARRAY IS FULLY EXTENDED. TWO OF THE PARTIAL EXTENSION TESTS ARE TO BE PERFORMED IN DARKNESS.

TWO FORWARD BULKHEAD CCTV CAMERAS AND TWO AFT BULKHEAD CCTV CAMERAS WILL BE USED SIMULTANEOUSLY DURING THE DAYLIGHT TESTS TO VIEW DIFFERENT AREAS OF THE ARRAY WITH THE SPECIFIC CAMERA FIELDS-OF-VIEW TO BE DEFINED IN THE PAYLOAD INTEGRATION PLAN FLIGHT PLANNING ANNEX. THE DAYLIGHT OPERATIONS REQUIRE THAT THE ORBITER BE MANEUVERED TO AN ATTITUDE THAT WILL ALLOW OPTIMUM ILLUMINATION OF THE ARRAY TO ACCOMMODATE CCTV VIEWING. ARTIFICIAL ILLUMINATION MAY BE REQUIRED ON THE DARK SIDE OF THE ARRAY FOR CCTV VIEWING. THE TWO TESTS PERFORMED IN DARKNESS DO NOT REQUIRE CCTV COVERAGE ALTHOUGH USE OF THE CCTV MAY BE OPTED BY THE STS FOR CREW-MONITORING. THE TESTS IN DARKNESS MAY BE PERFORMED IN ANY STABILIZED VEHICLE ATTITUDE.

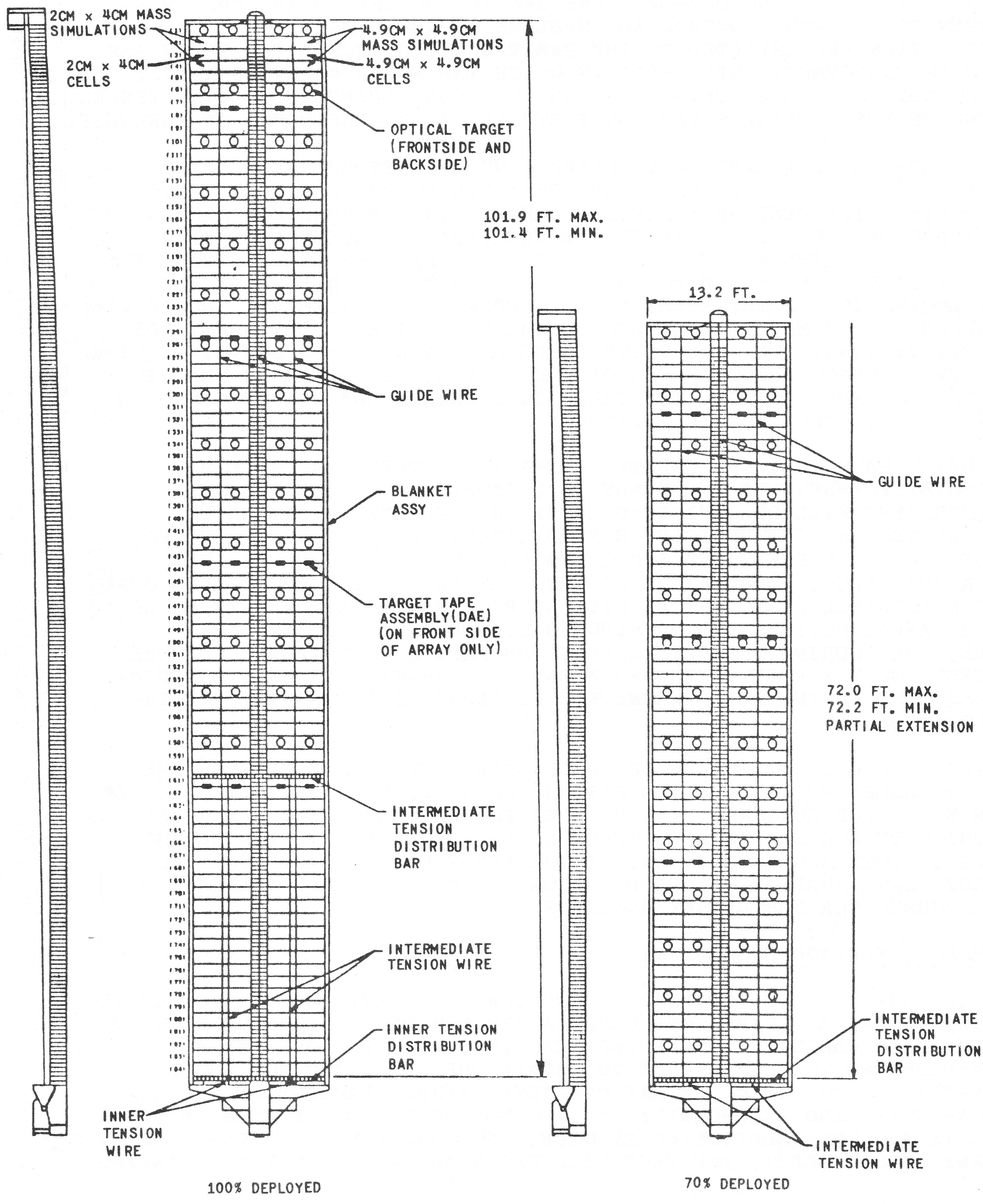
DURING EACH TEST THE ORBITER PRIMARY RCS THRUSTERS WILL BE INHIBITED WHENEVER THE ARRAY IS UNSTOWED. THE ORBITER RCS THRUSTERS WILL BE INHIBITED AFTER THE SELECTED ATTITUDE IS ACHIEVED AND THE VEHICLE IS STABILIZED, AND WILL BE ACTIVATED ONLY FOR PREDETERMINED AND CONTROLLED FIRINGS TO EXCITE THE ARRAY. ALSO, CONSTRAINTS ON CREW MOTIONS, WATER DUMPS, AND OTHER CONTROLLABLE DISTURBANCES WILL BE REQUIRED TO ALLOW DAMPING OF THE ARRAY MOTIONS FOR 20 MINUTES BEFORE EACH TEST AND ARE REQUIRED DURING THE DATA COLLECTION PART OF THE TEST. FOR THE TESTS OF THE FULLY EXTENDED ARRAY, THE VERNIER AS WELL AS PRIMARY RCS MUST BE INHIBITED WHENEVER THE ARRAY IS BEYOND THE PARTIAL POSITION.

THE DATA COLLECTION PERIOD SHALL START BEFORE THE TIME OF THE CONTROLLED RCS EXCITATION FIRING AND SHALL BE A MINIMUM OF THREE MINUTES FOR CCTV AND FIVE MINUTES FOR SAE DATA-RECORDER OPERATION. THE CCTV AND SAE DATA RECORDER SHALL ALSO ACQUIRE DATA DURING EXTENSIONS AND RETRACTIONS OF THE ARRAY FOR THESE TESTS. ALL CCTV DATA SHALL BE RECORDED ONBOARD, AND THE TAPES SHALL BE RETURNED FOR POSTLFIGHT ANALYSIS.

MAST TEMPERATURE GRADIENT

THE OBJECTIVE OF THE MAST TEMPERATURE GRADIENT TEST IS TO OBTAIN DATA ON ARRAY OPERATIONS UNDER A MAXIMUM TEMPERATURE GRADIENT ON THE MAST CANISTER. THIS TEST REQUIRES THAT THE ORBITER BE MANEUVERED TO AN ATTITUDE TO OBTAIN THE SUN-INCIDENCE ANGLE PREDICTED TO YIELD THE MAXIMUM TEMPERATURE GRADIENT ON THE MAST CANISTER, AND SECONDARILY, TO ACCOMODATE THE COLLECTION OF VISUAL DATA AND CREW MONITORING BY CCTV. AT FOUR MINUTES AFTER SUNRISE OF ANY CHOSEN ORBIT, THE TEST WILL BEGIN AND WILL CONSIST OF TAKING

SOLAR ARRAY EXPERIMENT (SAE)



PERFORMANCE DATA MEASUREMENTS WHILE THE ARRAY IS RETRACTED FROM THE PARTIAL POSITION FOR 1 MINUTE AND THEN REEXTENDED TO THE PARTIAL POSITION FOR 1 MINUTE. DURING THIS TEST, THE PRIMARY RCS MUST BE INHIBITED TO PRECLUDE DISTURBING THE ARRAY IN EXCESS OF THE 0.003 G'S ACCELERATION LIMIT. ONLY ONE PERFORMANCE OF THIS TEST IS REQUIRED. CCTV DATA CAMERAS SHALL BE OBTAINED FOR THIS TEST. THE DATA SHALL BE RECORDED ONBOARD, AND THE TAPES SHALL BE RETURNED FOR POSTFLIGHT ANALYSIS.

ELECTRICAL MODULE PERFORMANCE AND WING THERMAL PERFORMANCE

THE OBJECTIVE OF THIS TEST IS TO OBTAIN AND RECORD CURRENT, VOLTAGE, AND TEMPERATURE DATA ON THE ELECTRICAL MODULES AND TEMPERATURE DATA ON THE WING AT VARIOUS SUN-INCIDENCE ANGLES. THIS TEST IS TO BE PERFORMED THREE TIMES DURING BOTH DAYLIGHT AND DARKNESS. DURING DARKNESS PERFORMANCE DATA WILL BE RECORDED ONLY FIVE MINUTES OF EACH 25 MINUTES OF TEST (AT 20 PERCENT SAE RECORDER DUTY CYCLE). DURING THESE TESTS THE PRIMARY RCS FIRINGS MUST BE INHIBITED TO PRECLUDE DISTURBING THE SOLAR ARRAY IN EXCESS OF THE 0.003 G'S ACCELERATION LIMIT. A TOTAL OF APPROXIMATELY FOUR HOURS IS REQUIRED FOR THESE TESTS.

SOLAR CELL CALIBRATION FACILITY

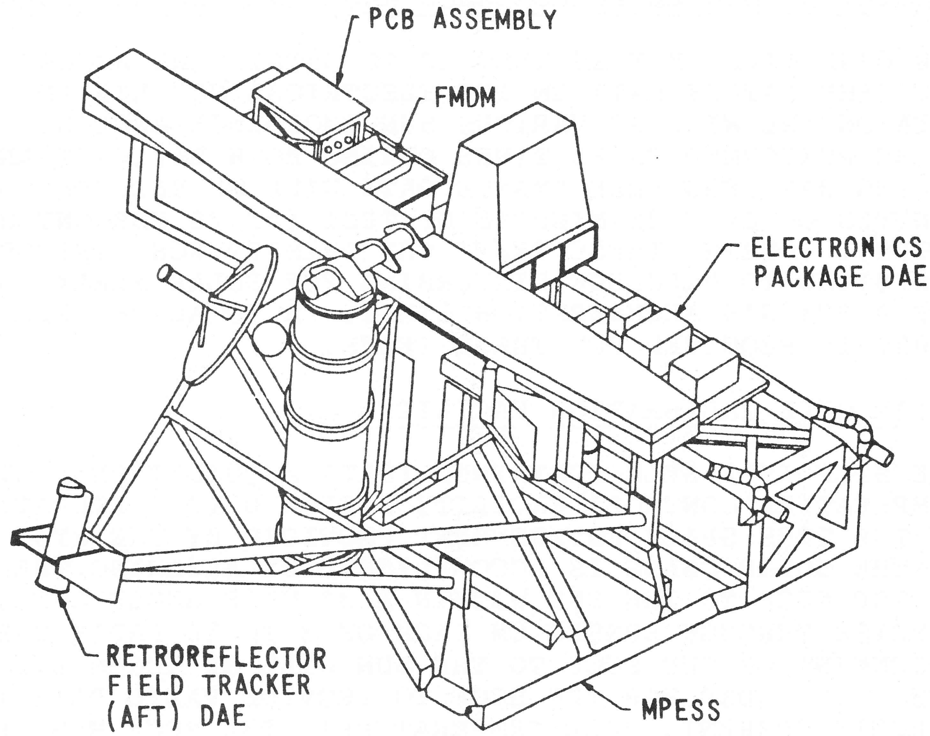
THE SCCF IS A SELF-CONTAINED (DATA ACQUISITION, DATA STORAGE TEMPERATURE CONTROL) FACILITY DESIGNED TO CALIBRATE SOLAR CELLS IN THE TRUE SPACE ENVIRONMENT PROVIDED BY THE STS. CALIBRATION OF THE SOLAR CELLS IS ACCOMPLISHED BY ALIGNING THE +Z AXIS OF THE SCCF TO THE SUN WITHIN A 3° HALF-ANGLE CONE, FROM SUNRISE THROUGH SUNSET ON EACH OF 8 TO 10 EARTH ORBITS. ALIGNMENT OF THE SCCF TO THE SUN WILL BE ACCOMPLISHED BY THE STS. IN ORDER FOR THE SCCF TO PROVIDE VALID DATA (CELL SHORT CIRCUIT CURRENT, CELL TEMPERATURE), THE SCCF MUST BE ALIGNED TO THE SUN FROM BEGINNING OF SUNRISE TO END OF SUNSET ON EACH SCCF DATA ORBIT.

DYNAMIC AUGMENTATION EXPERIMENT

THE DAE CONSISTS OF A RETROREFLECTOR FIELD TRACKER (RFT) AND ITS ASSOCIATED POWER CONTROL BOX. THIS EQUIPMENT IS LOCATED ON THE MPESS AND CONTROLLED FROM THE AFD THROUGH GENERAL PURPOSE COMPUTER (GPC) KEYBOARD ENTRY. THE DAE WILL MEASURE AND RECORD SOLAR ARRAY REFLECTIONS THROUGH ANALYSIS OF LASER LIGHT REFLECTED BY TARGETS MOUNTED ON THE SOLAR ARRAY BLANKET. THE OBJECTIVE OF THE EXTENDED ARRAY DYNAMICS TESTS IS TO MEASURE THE MULTIMODAL AND OUT-OF-PLANE BENDING OF THE SOLAR ARRAY WING WHEN PREPLANNED, CONTROLLED IMPULSES OF KNOWN MAGNITUDE AND DIRECTION ARE IMPARTED TO THE ORBITER BY THE RCS. THIS FUNCTIONAL OBJECTIVE IS PERFORMED AT 70 PERCENT SOLAR ARRAY DEPLOYMENT IN DARKNESS AND 100 PERCENT DEPLOYMENT IN SUNLIGHT.

GETAWAY SPECIAL CANISTERS (GAS CANS)

TWO GAS CANS ARE FLYING IN THE PAYLOAD BAY ON THIS FLIGHT: A UTAH STATE UNIVERISTY GAS CAN AND THE CINEMA 360.



DAE EXPERIMENT ASSEMBLIES

UTAH STATE UNIVERSITY GAS CAN

THIS 2.5 CUBIC FOOT GAS CAN WILL PERFORM FOUR EXPERIMENTS. THE FIRST EXPERIMENT IS THE CAPILLARY WAVE EXPERIMENT WHICH WILL PHOTOGRAPH WAVE ACTION ON A WATER SURFACE IN A ZERO G ENVIRONMENT. A SOLDERING EXPERIMENT WILL STUDY SOLDER FLUX SEPARATION. THE HEAT PIPE EXPERIMENT WILL STUDY HEAT TRANSFER THROUGH WATER INTO PARAFFIN. THE FOURTH EXPERIMENT WILL DOCUMENT SURFACE TENSION CONVECTION. IN THIS EXPERIMENT PARAFFIN IMPREGNATED WITH CARBON WILL BE PHOTOGRAPHED AS IT MELTS AND FLOWS WITHIN A CYLINDER.

CINEMA 360

THE CINEMA 360 PAYLOAD WILL PRODUCE A COLOR MOTION PICTURE FILM OF SHUTTLE FLIGHT OPERATIONS. THIS IS A JOINT VENTURE BY NASA AND CINEMA 360 INCORPORATED. ONE 35MM MOTION PICTURE CAMERA IS MOUNTED IN A HEATED, PRESSURIZED GAS CAN THAT IS MOUNTED ON THE PORT SIDE OF THE PAYLOAD. THE FILM EXPOSED THROUGH THE CINEMA 360 FISHEYE LENS WILL BE PROCESSED FOR PROJECTION IN PLANETARIUMS.

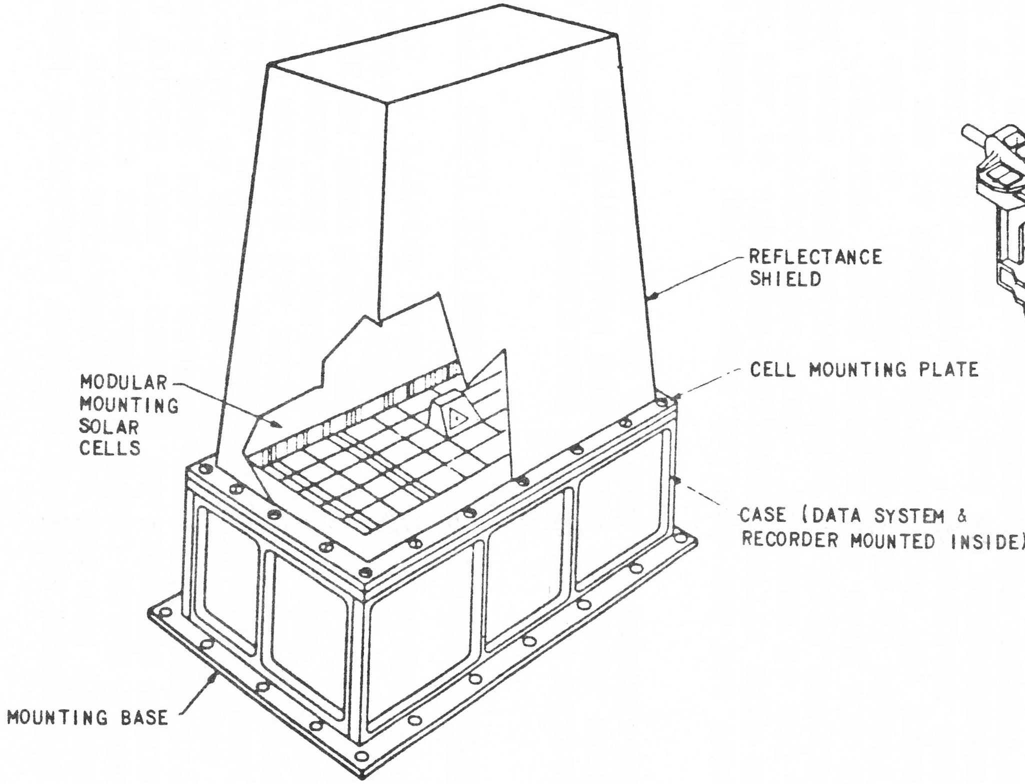
RMS EXPERIMENTS

THE SHUTTLE'S REMOTE MANIPULATOR SYSTEM (RMS) IS BEING USED TO PERFORM TWO EXPERIMENTS ON STS 41D. THE FIRST IS A STUDY OF THE SYNCOM IV PLUME ENVIRONMENT. A WITNESS PLATE ASSEMBLY ATTACHED TO THE RMS LOWER ARM BOOM WILL BE EXPOSED TO THE PLUME ENVIRONMENT AS THE SYNCOM IV KICK MOTOR IGNITES. THE RMS WILL BE STOWED IN THE PLB WITH THE WITNESS PLATE ATTACHED. THE WITNESS PLATE WILL PROVIDE DATA ON PLUME ENVIRONMENT THAT WOULD OTHERWISE BE LOST DUE TO REENTRY. THIS DATA COLLECTED FROM THE WITNESS PLATE SAMPLES WILL ALLOW NUMERICAL ANALYSIS OF THE PLUME AND DAMAGE CRITIERA FOR THE ORBITER WINDOWS AND THERMAL PROTECTION SYSTEM.

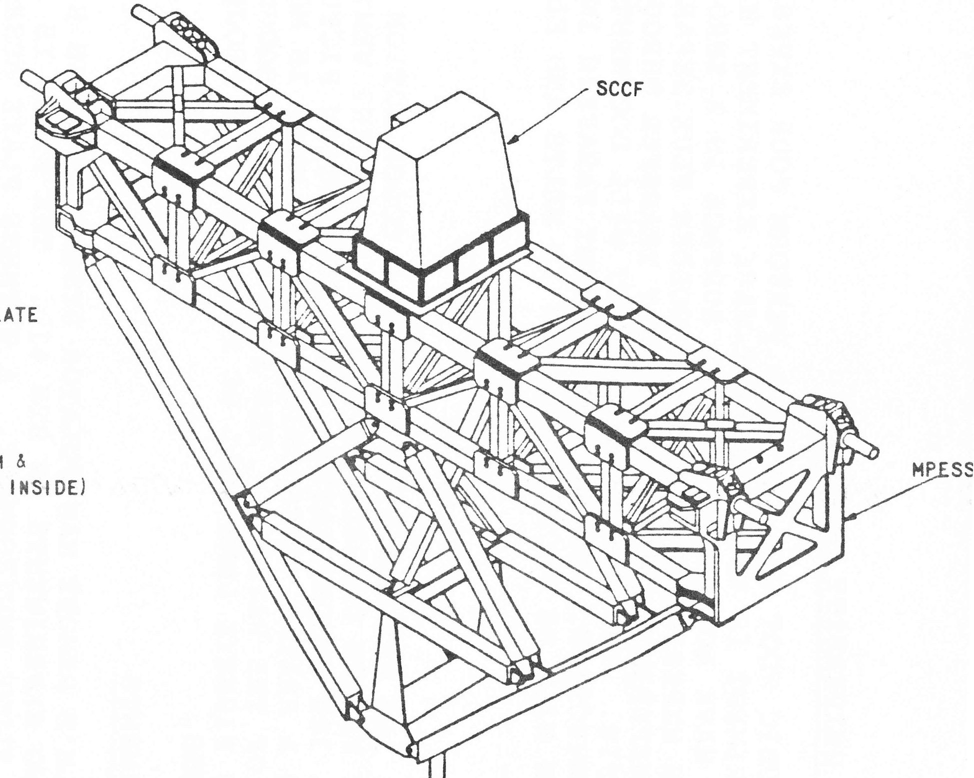
THE SECOND EXPERIMENT ON THE RMS IS THE GLO EXPERIMENT. IN THIS EXPERIMENT NINE TAPES OF DIFFERENT MATERIALS ARE ADDED TO RMS TO STUDY THE EFFECTS OF THE SPACE ENVIRONMENT ON THESE VARIOUS MATERIALS.

CONTINUOUS FLOW ELECTROPHORESIS SYTEM III (CFES III)

CFES III IS AN ELECTROCHEMICAL SYSTEM CAPABLE OF SEGREGATING PARTICLES WITHIN A BIOLOGICAL SAMPLE. THIS IS THE FIFTH FLIGHT OF CFES, WHICH IS A JOINT VENTURE AMONG ORTH PHARMACEUTICALS, MCDONNELL DOUGLAS ASTRONAUTICS COMPANY, AND NASA. CFES III WILL RUN CONTINUALLY FOR 80-HOURS DURING THE MISSION AND WILL INCLUDE AN ENZYME LINKED IMMUNOSORBENT ASSAY (ELISA) EXPERIMENT. LOCATED IN THE CREW MODULE MID-DECK, CFES CONSISTS OF THREE MODULES. THE FLUIDS SYSTEMS MODULE IS LOCATED ON THE PORT SIDE WHERE THE GALLEY WOULD NORMALLY BE LOCATED. THIS MODULE IS COOLED BY THE ORBITER'S WATER COOLANT LOOPS. THE EXPERIMENT CONTROL AND MONITORING MODULE AND THE PUMP ACCUMULATOR MODULE ARE MOUNTED ON AV BAY 1. ALL THREE MODULES RECEIVE ELECTRICAL POWER FROM THE ORBITER.



SCCF EXPERIMENT



SCCF MOUNTED ON MPESS

SOLAR CELL CALIBRATION FACILITY (SCCF)

IMAX

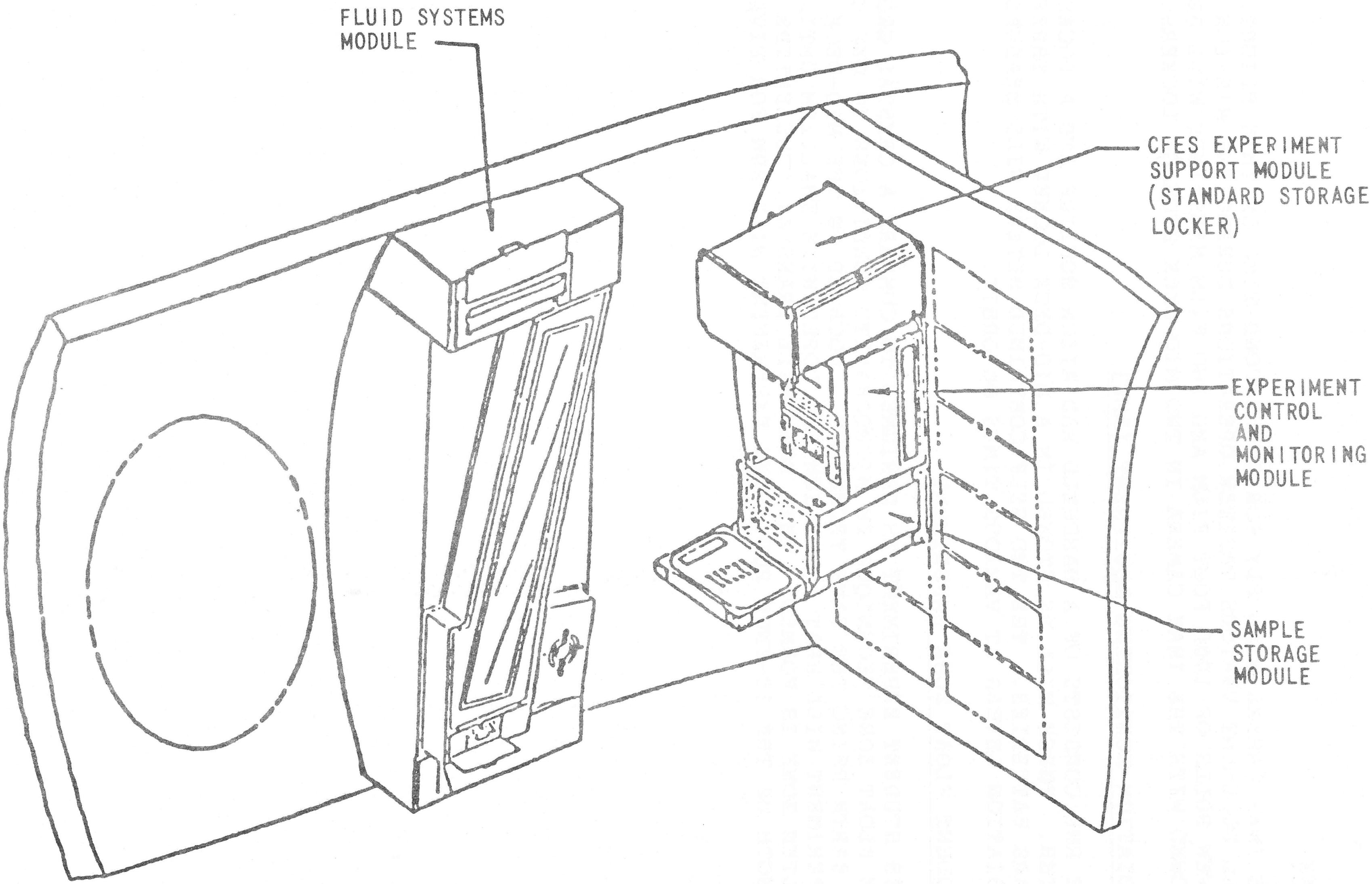
THE IMAX CAMERA WILL FLY FOR ITS SECOND TIME ON THIS FLIGHT. IT WILL DOCUMENT VARIOUS ORBITER OPERATIONS DURING THE MISSION. SEVEN ROLLS OF 1000 FOOT FILM AND TWO FILM MAGAZINES WILL BE STOWED WITH THE IMAX CAMERA IN TWO MID-DECK STOWAGE LOCKERS.

RADIATION MONITORING EQUIPMENT (RME)

THE RME CONSISTS OF A HANDHELD RADIATION MONITOR AND A POCKET METER. THESE WILL BE STOWED IN A MID-DECK LOCKER WITH THREE SPARE BATTERIES. THE TWO SELF-CONTAINED METERS WILL MEASURE RADIATION LEVELS AT VARIOUS TIMES ON ORBIT.

STUDENT FLOAT ZONE EXPERIMENT

THIS STUDENT EXPERIMENT IS DESIGNED TO COMPARE A CRYSTAL GROWN BY THE FLOAT ZONE TECHNIQUE IN MICROGRAVITY CONDITIONS TO ONE GROWN ON EARTH USING THE SAME TECHNIQUE. LOCATED ON THE MID-DECK THIS EXPERIMENT WILL HEAT A GALLIUM ROD DOPED WITH THALLIUM UNTIL A MOLTEN ZONE IS FORMED. THIS ZONE WILL TRANSLATE THE ENTIRE LENGTH OF THE 10-INCH ROD. THE EXPERIMENT WILL RUN FOR FIVE HOURS.



CFES (MIDDECK GALLEY LOCATION, BLOCK I CONFIGURATION)

DE-ORBIT

ON ENTRY DAY, THE CREW FIRES THE OMS ENGINES TO DECELERATE FOR ORBITER RE-ENTRY. PRIOR TO THE OMS BURN, THE APUs ARE POWERED UP TO SUPPLY HYDRAULIC PRESSURE TO THE ORBITER'S AEROSURFACES AND LANDING GEAR. DURING RE-ENTRY, THE ORBITER LOSES COMMUNICATION CONTACT WITH THE GROUND, DUE TO THE IONIZATION OF AIR PARTICLES SURROUNDING THE ORBITER WHICH IS CAUSED BY THE FRICTION (AND RESULTING HEAT) OF RE-ENTRY. THE ORBITER IS PROTECTED FROM THIS HEAT BY THE THERMAL PROTECTION SYSTEM (TPS). DURING THE TERMINAL PHASE OF THE ORBITER'S DESCENT, IT WILL APPROACH ITS PRIMARY LANDING SITE, EDWARDS AFB, CALIFORNIA, FROM THE WEST. THE ORBITER RAPIDLY DECELERATES, USING ITS RUDDER/ SPEEDBRAKE AND VEHICLE NOSE UP ATTITUDE. WHEN THE ORBITER HAS DESCENDED TO AN ALTITUDE OF 300 FEET, THE CREW LOWERS THE LANDING GEAR AND LANDS THE ORBITER SIMILAR TO AN AIRPLANE. THE PRIMARY DIFFERENCE BETWEEN AN AIRPLANE APPROACH AND LANDING AND AN ORBITER APPROACH AND LANDING IS THAT THE ORBITER LANDS WITH NO PROPULSIVE POWER, AS ITS MAIN ENGINES ARE NOT UTILIZED.

POST LANDING ACTIVITIES

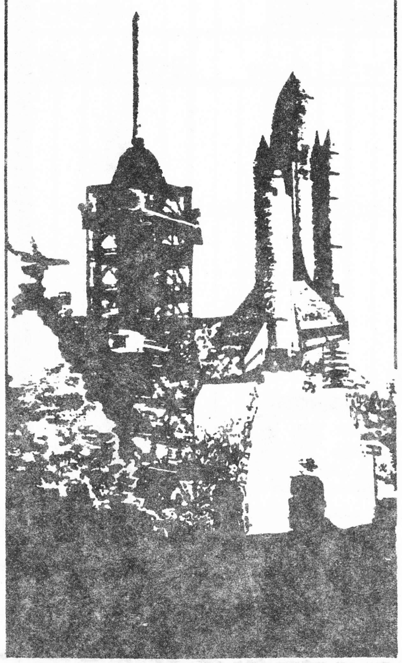
ONE HOUR AFTER THE DE-ORBIT BURN, THE ORBITER WILL LAND AT A SPEED OF APPROXIMATELY 185 MPH. AT WHEELS STOP, THE ORBITER IS MET BY A CONVOY OF GROUND SUPPORT VEHICLES. A VISUAL INSPECTION FOR OBVIOUS ANOMALIES IS PERFORMED. A TEAM OF SAFETY PERSONNEL IN SCAPE SUITS PERFORM CHECKS FOR TOXIC AND EXPLOSIVE/FLAMMABLE GASSES AND WHEN THE AREA IS DECLARED SAFE, THE COOLING AND PURGE GROUND SUPPORT EQUIPMENT IS BROUGHT UP TO THE ORBITER, CONNECTED, AND ACTIVATED. THE LANDING GEAR IS PREPARED FOR TOWING AND THE TOW VEHICLE AND TOW BAR ARE ATTACHED TO THE ORBITER.

AS THIS OCCURS, THE CREW REMOVES THEIR HELMETS, SAFE THEIR SEATS, GO THROUGH A POST LANDING SWITCH CONFIGURATION, AND PREPARE TO EGRESS THE ORBITER. THE GROUND CREW POSITIONS AN ACCESS VEHICLE BESIDE THE ORBITER UNDER THE CREW ACCESS HATCH. MOUNTED ON THIS VEHICLE IS A "MINI" WHITE ROOM, WHICH WILL BE POSITIONED NEXT TO THE ORBITER. THE ASTRONAUT SUPPORT CREW AND A FLIGHT SURGEON ENTERS THE ORBITER AFTER THE SIDE HATCH IS OPENED. AFTER THE ASTRONAUTS HAVE BEEN EXAMINED BY THE FLIGHT SURGEON, THEY EGRESS THE ORBITER AND DEPART THE RUNWAY IN THE ASTRONAUT TRANSPORT VAN. THE ASTRONAUT SUPPORT CREW REMAINS IN THE ORBITER TO PERFORM POST LANDING PROCEDURES AND SUPPORT TOWING OPERATIONS.

AFTER FIVE DAYS OF DESERVICING AND PREMATING OPERATIONS PERFORMED BY THE KSC RECOVERY TEAM, THE ORBITER IS TOWED INTO POSITION AND IS MATED ON TOP OF THE SHUTTLE CARRIER AIRCRAFT (SCA) FOR FERRY BACK TO KENNEDY SPACE CENTER. IN THESE ACTIVITIES, THE HYPERGOLIC SYSTEMS WILL BE SAFED, THE ORBITER ENGINES AND AEROSURFACES MOVED TO FERRY POSITIONS, AND THE ORBITER ELECTRICAL AND COOLING SYSTEMS WILL BE CONFIGURED TO SUPPORT FERRY. A SPECIAL TAILCONE WILL BE INSTALLED ON THE ORBITER TO DECREASE BUFFETTING AND AERODYNAMIC DRAG. AT KSC, "DISCOVERY" WILL BE DEMATED FROM THE SCA IN THE MATE-DEMATE DEVICE AND TOWED TO THE ORBITER PROCESSING FACILITY (OPF). AT THE OPF, THE ORBITER IS DESERVICED, CHECKED OUT, SERVICED, AND MADE READY FOR ITS NEXT FLIGHT.

41D

S0007 Launch Countdown



OMI Revisions

Volume I - G
Volume II - K
Volume III - G
Volume IV - G

NOTE:

All proposed changes to the barchart will be submitted to the NTD for his approval via the appropriate Test Team signees. The NTD will redline his master copy and advise affected parties. If a barchart revision is required, all new concurrence signatures will be obtained prior to issue.

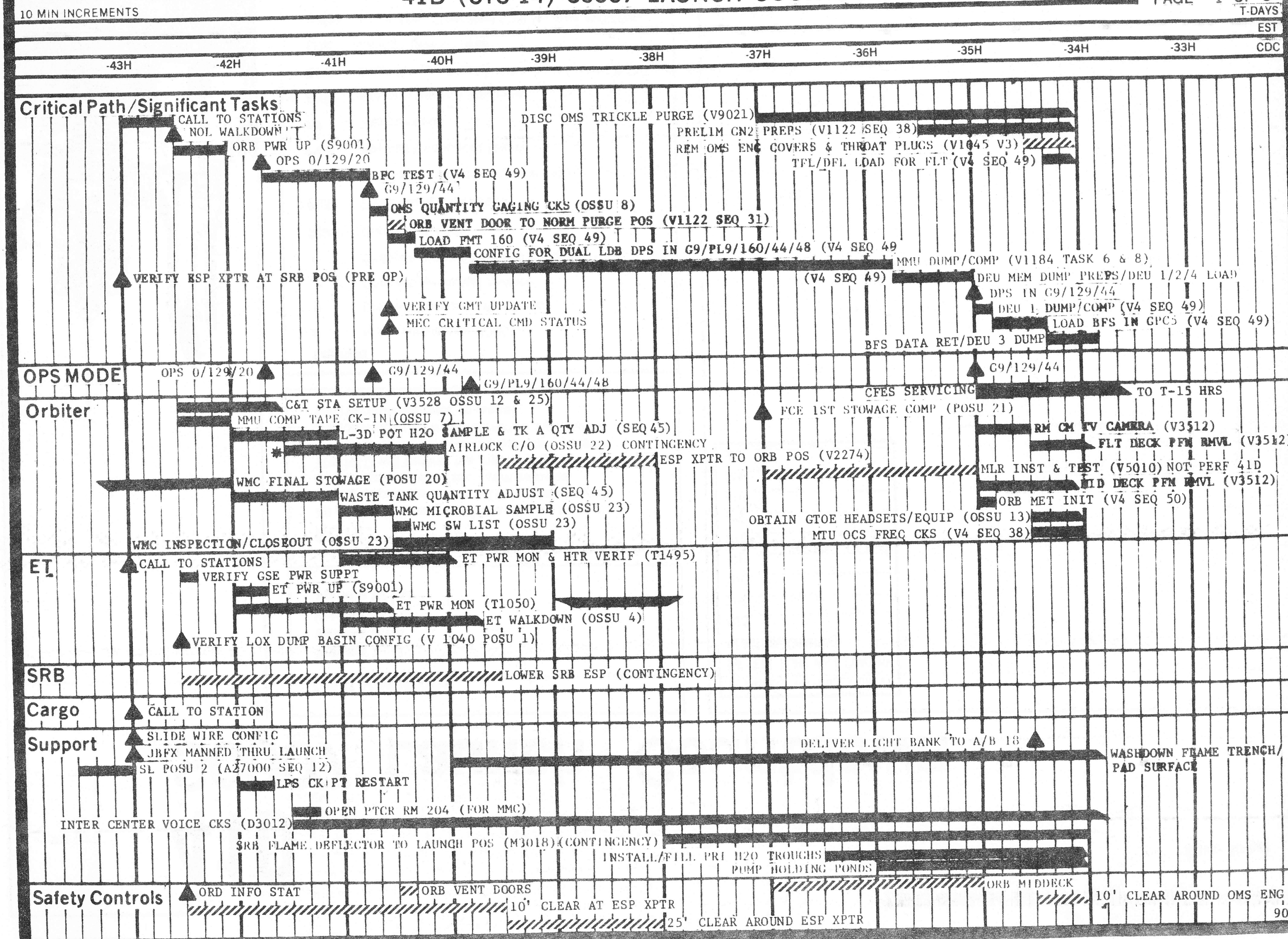
Legend

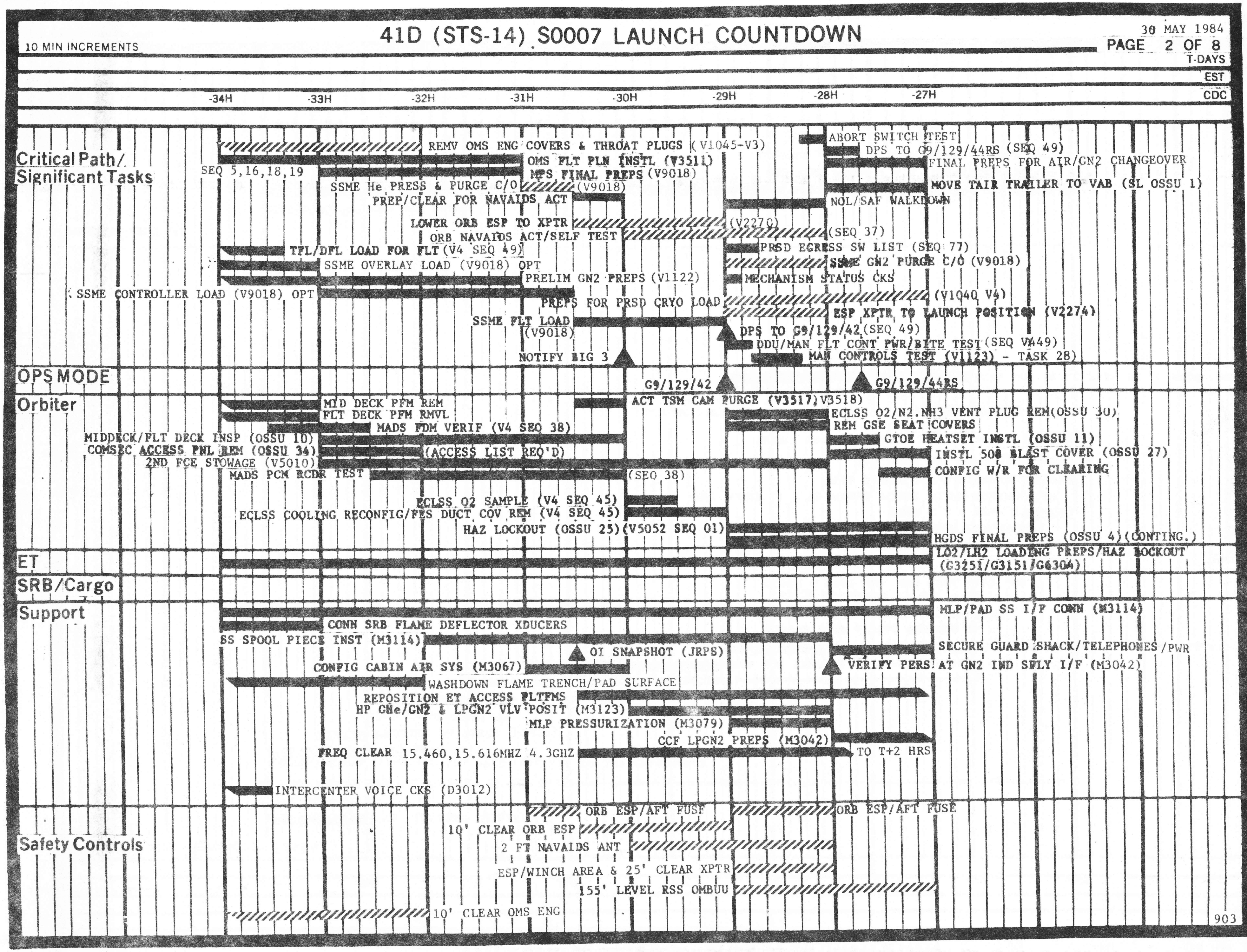
●	Not controlled by S0007
✱	Unless Previously Performed
✓	Changes since last revision
★	Changes since OMI basic release
▬	Completed work
FSS	Fixed Service Structure
PA	Pad Apron and above (slope incl)
PCR	Payload Changeout Room
PP	Pad perimeter
RSS	Rotating Service Structure
BDA	Blast Danger Area
LDA	Launch Danger Area
//////	Local Area Clear (see OMI for area definition).
▚▚▚	Major Area Clear (see OMI for area definition).

PLANNING PURPOSES ONLY.
FR TEST TEAM WILL CONTROL
REALTIME CHANGES.

NTD: ____________
SPE: ____________
OTC: ____________
TTC: ____________
BTC: ____________
CTC: ____________
CTD: ____________
STM: ____________
SAF: ____________

41D (STS-14) S0007 LAUNCH COUNTDOWN

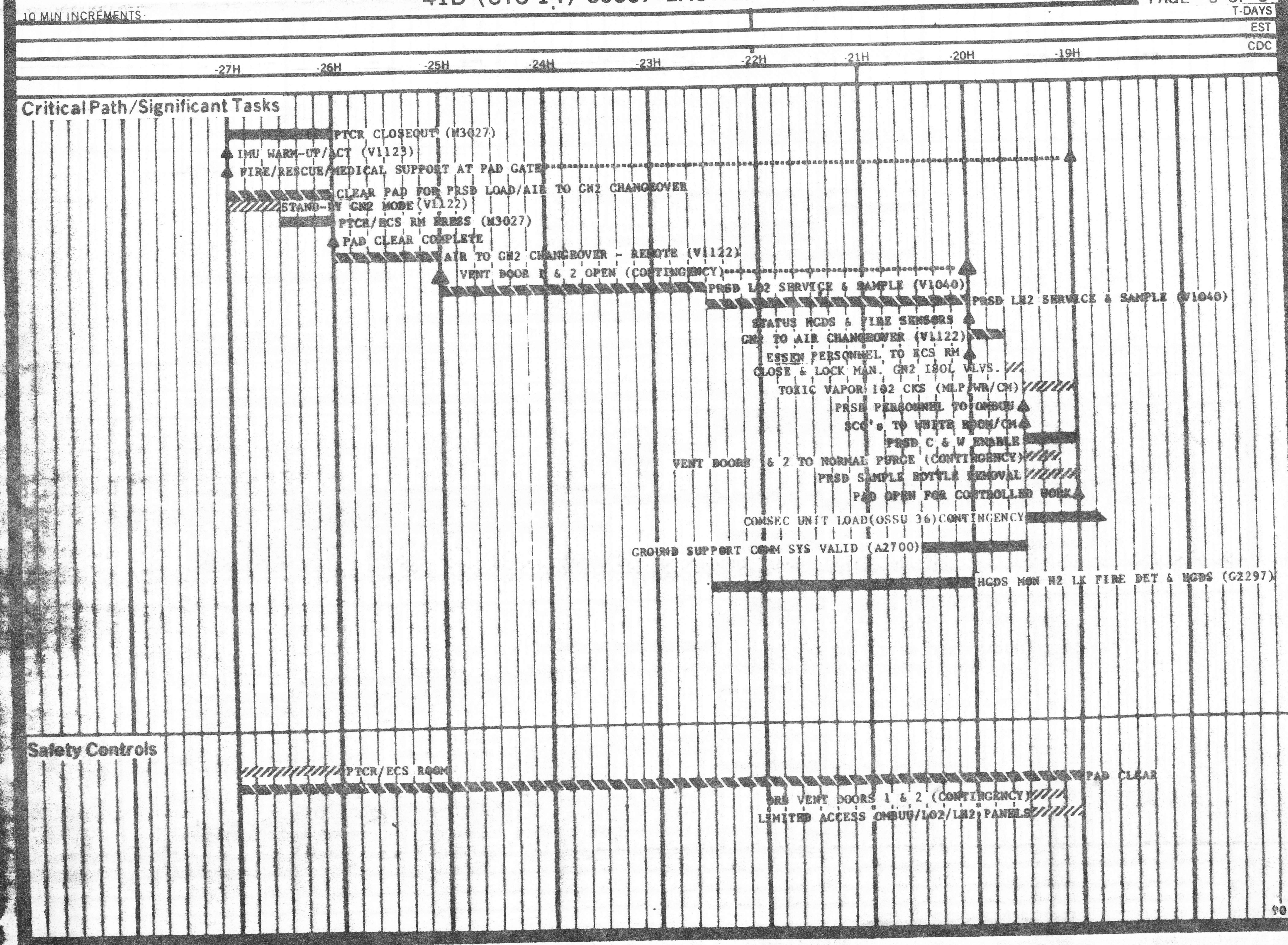




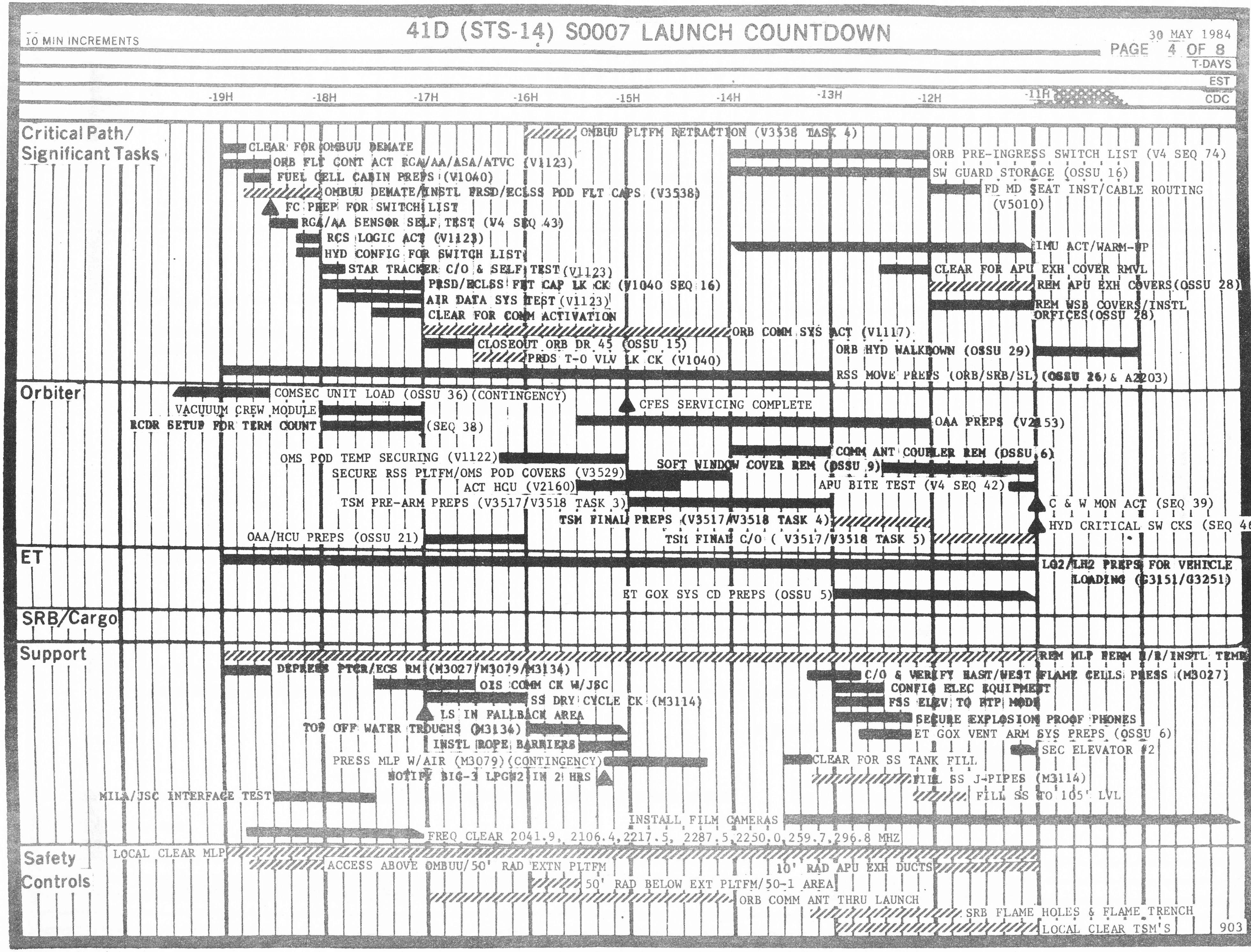
KSC FORM 4-447 (8/81)

41D (STS-14) S0007 LAUNCH COUNTDOWN

30 MAY 1984



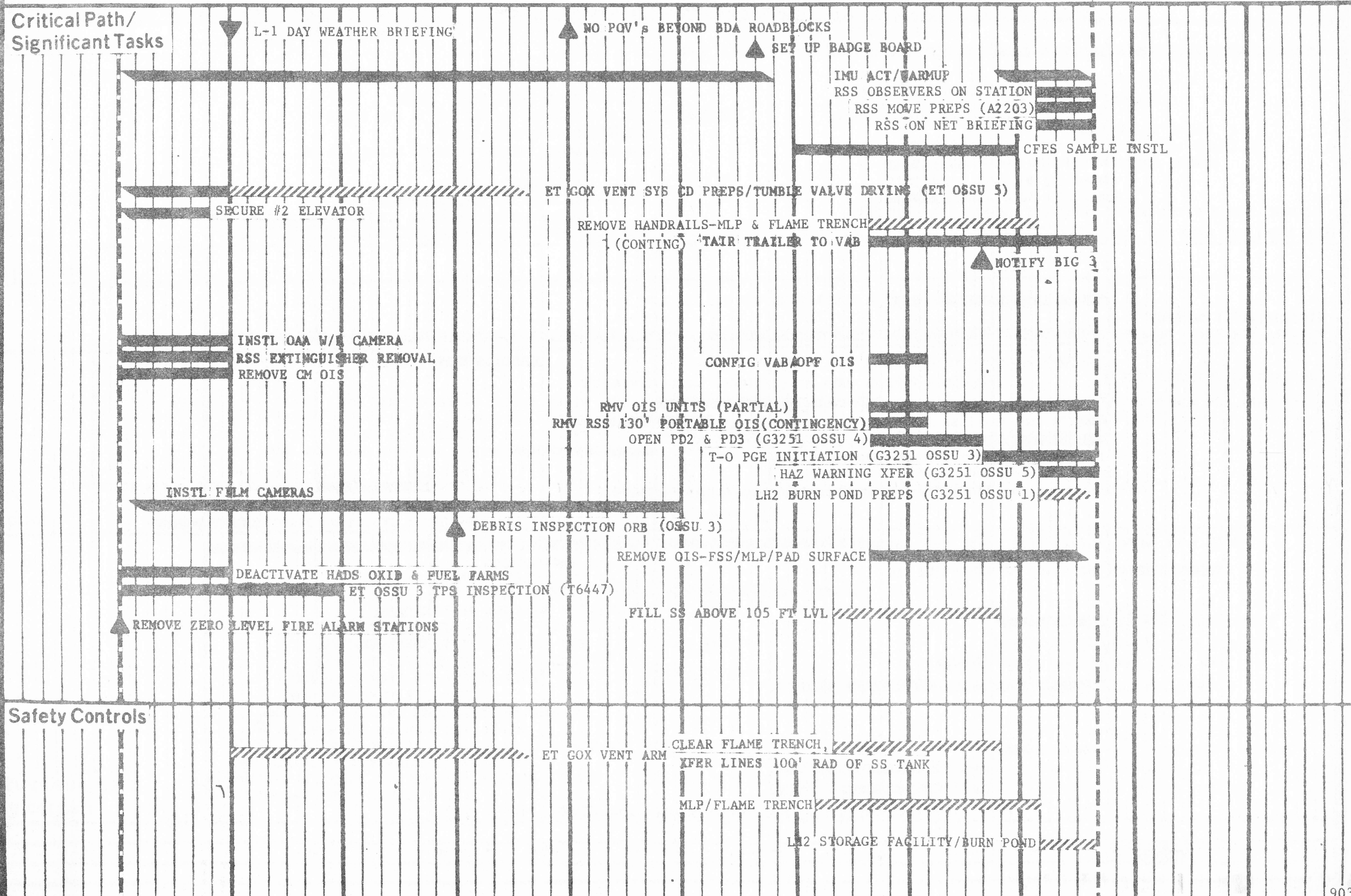
KSC FORM 4-447 (8/81)



KSC FORM 4-447 (8/81)

41D (STS-14) S0007 LAUNCH COUNTDOWN

T-DAYS
EST
-11H -11H CDC

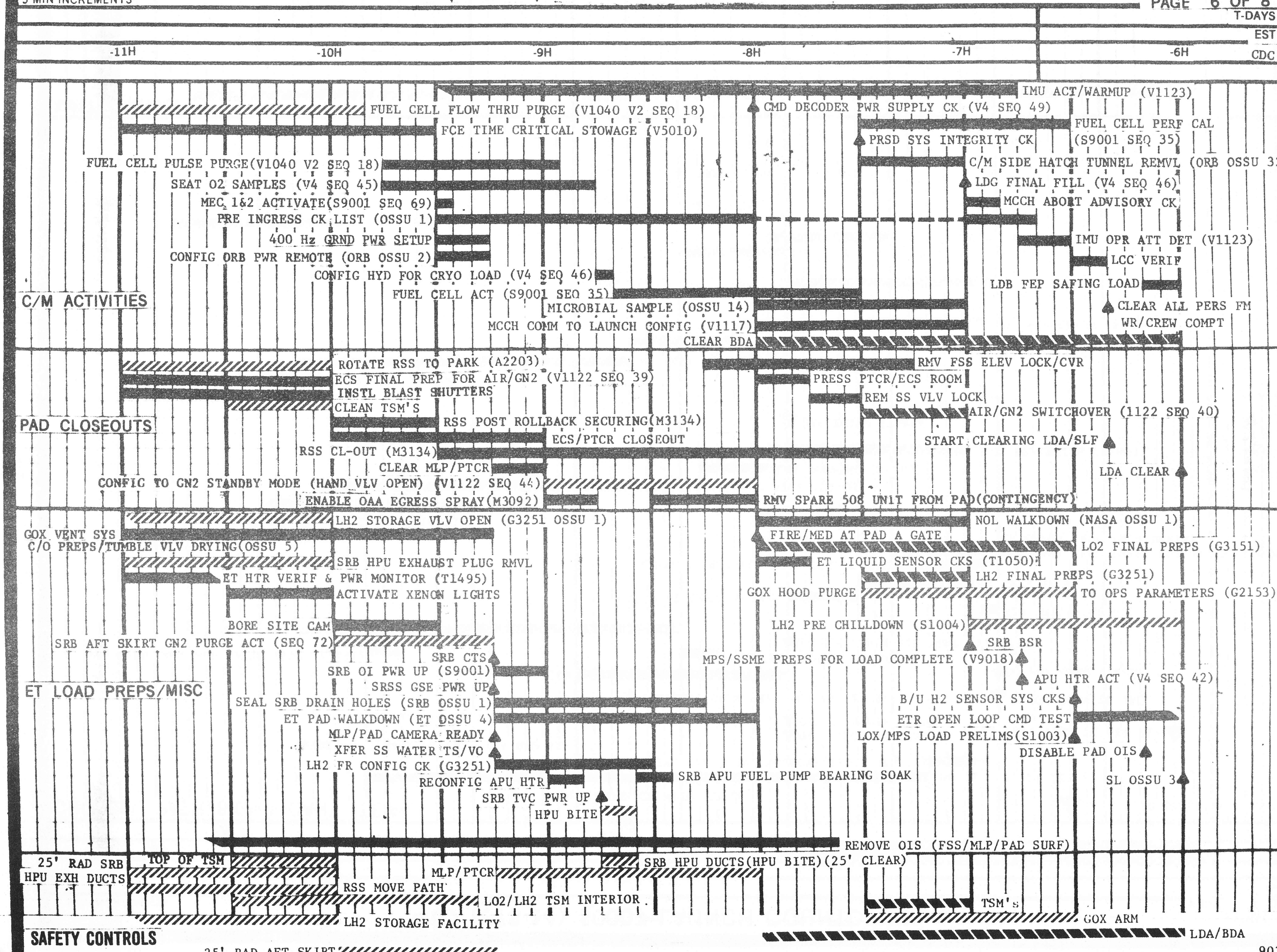


70

41D (STS-14) S0007 LAUNCH COUNTDOWN

5 MIN INCREMENTS

30 MAY 1984



903

41D (STS-14) S0007 LAUNCH COUNTDOWN

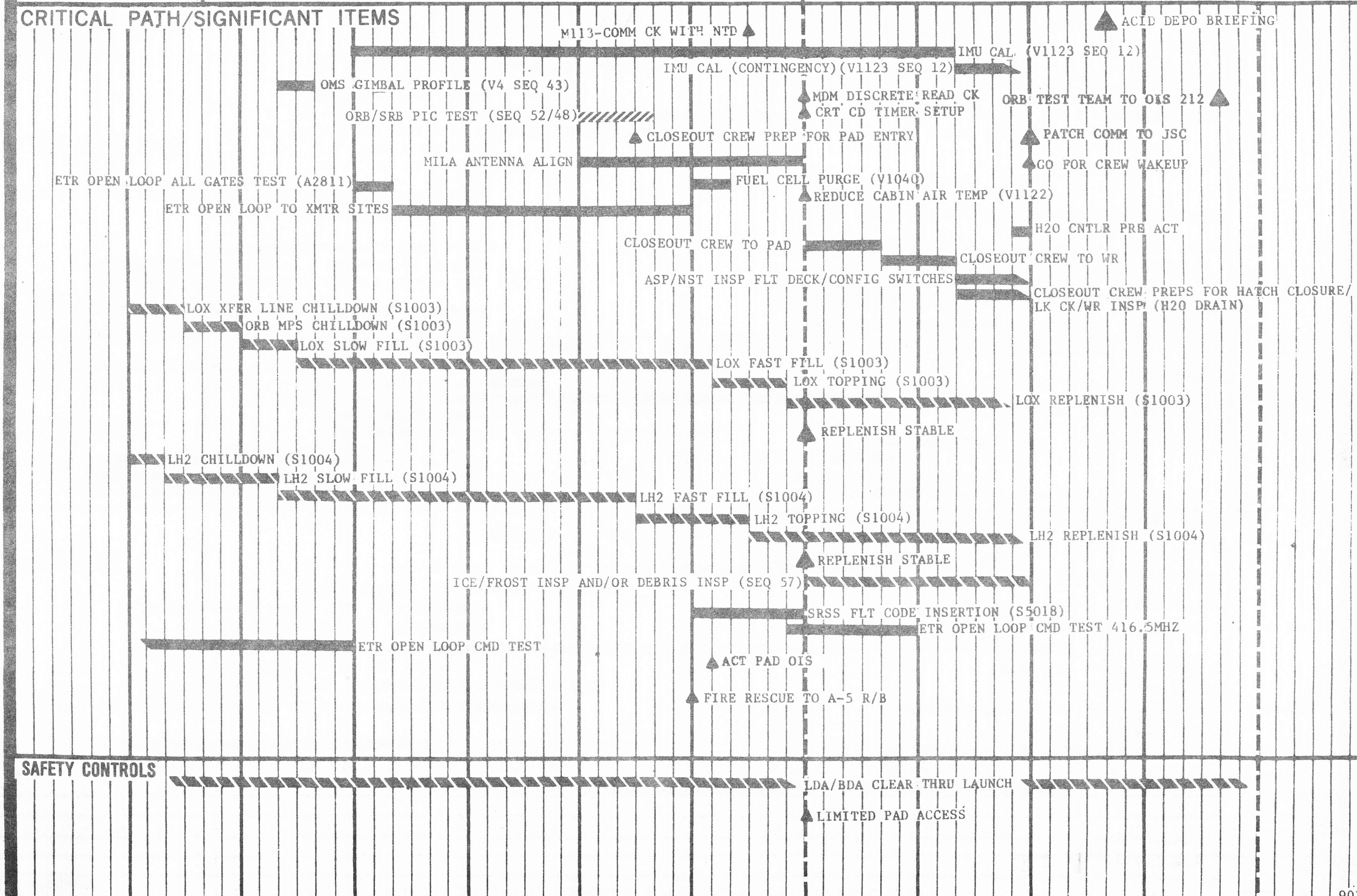
5 MIN INCREMENTS

30 MAY 1984

T-DAYS

EST

CDC: -6H | -5H | -4H | -3H | 2 HOUR BUILT IN HOLD | -3H

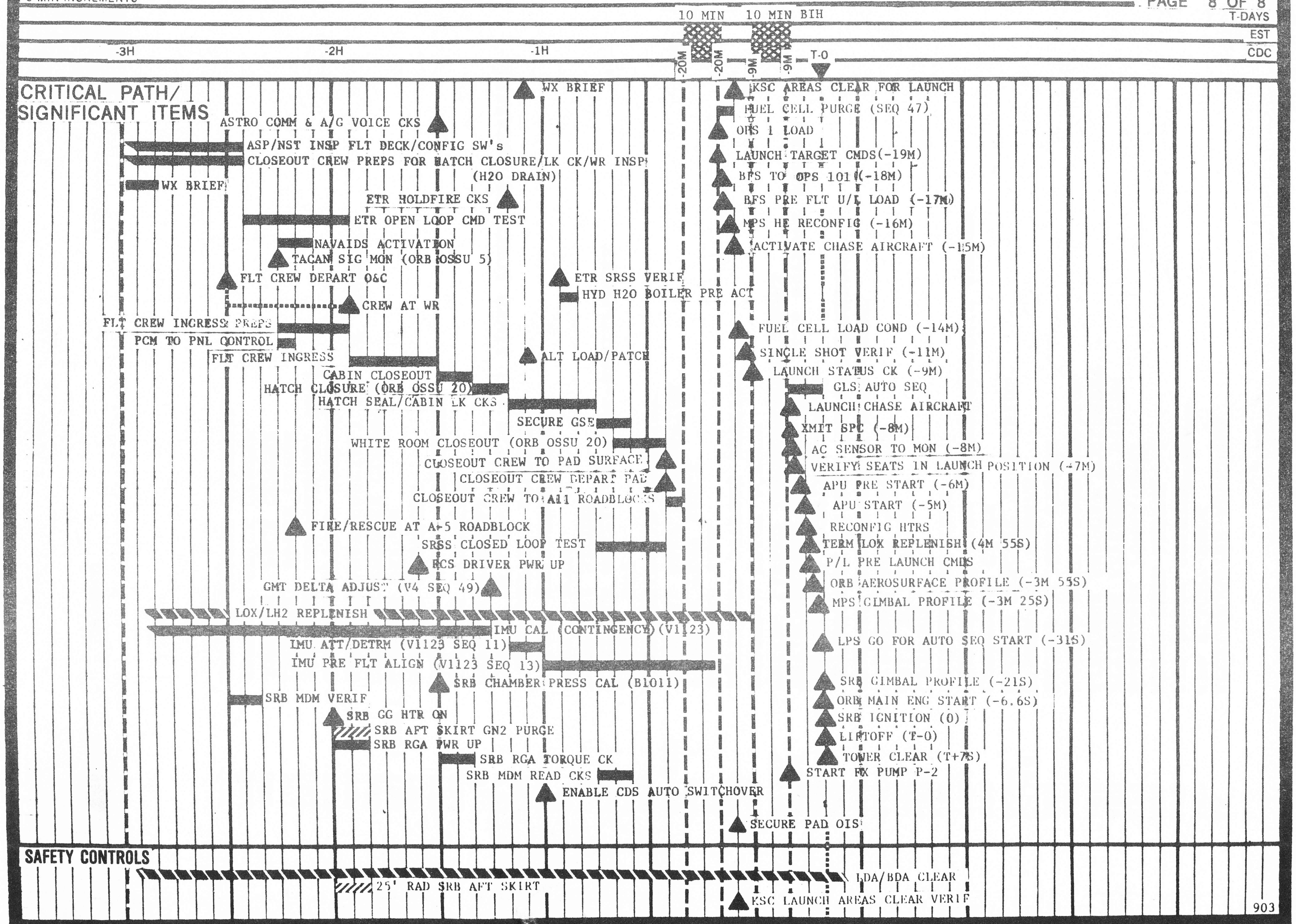


903

KSC FORM 4-447 (8/81)

41D (STS-14) S0007 LAUNCH COUNTDOWN

30 MAY 1984



KSC FORM 4-447 (8/81)

ACRONYMS & ABBREVIATIONS

AA	ACCELEROMETER ASSEMBLY
AFD	AFT FLIGHT DECK
AFS	AIR FORCE STATION
AOA	ABORT ONCE AROUND
APU	AUXILIARY POWER UNIT
ARS	ATTITUDE REFERENCE SYSTEM
ASE	AIRBORNE SUPPORT EQUIPMENT
ASTP	APOLLO-SOYUZ TEST PROJECT
BFS	BACKUP FLIGHT SYSTEM
C-360	CINEMA-360 CAMERA
CCTV	CLOSED CIRCUIT TELEVISION
CDC	COUNTDOWN CLOCK
CFES	CONTINUOUS FLOW ELECTROPHORESIS SYSTEM
CRT	CATHODE RAY TUBE
CRYO	CRYOGENIC
CTS	CALL TO STATION
D&C	DISPLAYS AND CONTROLS
DAE	DYNAMIC AUGMENTATION EXPERIMENT
DFI	DEVELOPMENT FLIGHT INSTRUMENTATION
DPP	DEPLOYMENT/POINTING PANEL
ECLSS	ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM
ELISA	ENZYME LINKED IMMUNOSORBENT ASSAY
ESA	EUROPEAN SPACE AGENCY
ESS	EQUIPMENT SUPPORT SECTION
ET	EXTERNAL TANK
ETR	EASTERN TEST RANGE
ET-SEP	EXTERNAL TANK SEPARATION
EVA	EXTRAVEHICULAR ACTIVITY
FD	FLIGHT DAY
FMDM	FLEXIBLE MULTIPLEXER/DE-MULTIPLEXER
FPS	FEET PER SECOND
FR	FIRING ROOM
FRF	FLIGHT READINESS FIRING
FSS	FIXED SERVICE STRUCTURE
G	FORCES OF GRAVITY (3G = 3 TIMES FORCE OF GRAVITY)
GAS	GETAWAY SPECIAL
GH2	GASEOUS HYDROGEN
GLS	GROUND LAUNCH SEQUENCER
GN2	GASEOUS NITROGEN
GO2 (GOX)	GASEOUS OXYGEN
GPC	GENERAL PURPOSE COMPUTER
GSA	GAS (GETAWAY SPECIAL) SUPPLY ASSEMBLY
GSE	GROUND SUPPORT EQUIPMENT
IMU	INERTIAL MEASUREMENT UNIT
IUS	INERTIAL UPPER STAGE
JSC	JOHNSON SPACE CENTER
KSC	KENNEDY SPACE CENTER
LCC	LAUNCH COMMIT CRITERIA

LCC	LAUNCH CONTROL CENTER
LFC	LARGE FORMAT CAMERA
LH2	LIQUID HYDROGEN
LO2 (LOX)	LIQUID OXYGEN
MAX Q	MAXIMUM DYNAMIC PRESSURE
MCC	MISSION CONTROL CENTER
MDD	MATE-DEMATE DEVICE
MDM	MULTIPLEXER/DE-MULTIPLEXER
ME	MAIN ENGINE
MECO	MAIN ENGINE CUTOFF
MET	MISSION ELAPSED TIME
MILA	MERRITT ISLAND LAUNCH AREA
MLP	MOBILE LAUNCH PLATFORM
MLR	MONODISPERSE LATEX REACTOR
MMU	MASS MEMORY UNIT
MPESS	MISSION PECULIAR EQUIPMENT SUPPORT STRUCTURE
MPS	MAIN PROPULSION SYSTEM
MSBLS	MICROWAVE SCANNING BEAM LANDING SYSTEM
NASA	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
NM	NAUTICAL MILES
O2	OXYGEN
OAA	ORBITER ACCESS ARM
OAST	OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
O&C	OPERATIONS AND CHECKOUT BUILDING
OFT	ORBITAL FLIGHT TEST
OMI	OPERATIONS AND MAINTENANCE INSTRUCTIONS
OMS	ORBITAL MANEUVERING SYSTEM
OPF	ORBITER PROCESSING FACILITY
OSTA	OFFICE OF SPACE AND TERRESTRIAL APPLICATIONS
PAM	PAYLOAD ASSIST MODULE
PASS	PRIMARY ASCENT SYSTEM
PCB	POWER CONTROL BOX
PRSD	POWER REACTANT STORAGE AND DISTRIBUTION
PSI	POUNDS PER SQUARE INCH
RCS	REACTION CONTROL SYSTEM
RFT	RETROREFLECTOR FIELD TRACKER
RGA	RATE GYRO ASSEMBLY
RME	RADIATION MONITORING EQUIPMENT
RMS	REMOTE MANIPULATOR SYSTEM
RPM	ROTATIONS PER MINUTES
RSS	ROTATING SERVICE STRUCTURE
RTLS	RETURN TO LAUNCH SITE
S&A	SAFE AND ARM DEVICE
SAE	SOLAR ARRAY EXPERIMENT
SCA	SHUTTLE CARRIER AIRCRAFT
SCA	STELLAR CAMERA ARRAY
SCCF	SOLAR CELL CALIBRATION FACILITY
SIP	STANDARD INTERFACE PANEL
SLF	SHUTTLE LANDING FACILITY
SRB	SOLID ROCKET BOOSTER
SRM	SOLID ROCKET MOTOR
SRSS	SHUTTLE RANGE SAFETY SYSTEM

SSME	SPACE SHUTTLE MAIN ENGINE
SSS	SOUND SUPPRESSION SYSTEM
SSV	SPACE SHUTTLE VEHICLE
STS	SPACE TRANSPORTATION SYSTEM
TACAN	TACTICAL AIR NAVIGATION
T-	TIME PRE-IGNITION
T+	TIME POST-IGNITION
TIG	TIME TO IGNITION
TPS	THERMAL PROTECTION SYSTEM
TVC	THRUST VECTOR CONTROL
UV	ULTRAVIOLET
VAB	VEHICLE ASSEMBLY BUILDING
VTR	VIDEO TAPE RECORDER
WSB	WATER SPRAY BOILER
ZERO-G	ZERO GRAVITY
ZLV	Z-AXIS LOCAL VERTICAL