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STS-9 National Space Transportation Systems Program Mission Report

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STS-9

NATIONAL SPACE TRANSPORTATION SYSTEMS PROGRAM

MISSION REPORT

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INTRODUCTION AND MISSION OBJECTIVES

The STS-9 National Space Transportation Systems Program Mission Report contains a summary of the major activities and accomplishments of this first Spacelab mission using Orbiter vehicle 102. The vehicle was last flown on the STS-5 mission. The significant configuration differences incorporated prior to STS-9 include the first use of the 3 substack fuel cells, the use of 5 cryo tanks sets and the addition of a galley and crew sleep stations. These differences combined with the Spacelab payload resulted in the heaviest landing weight yet flown. This report also summarizes the problems that occurred, as well as providing a problem tracking list of all significant anomalies that occurred during the mission.

The primary objective of this flight was to successfully conduct verification flight tests (VFT's) of Spacelab as an operational element of the Space Transportation System and within remaining timeline constraints to conduct normal scientific Spacelab operations.

The as-flown timeline for the STS-9 Spacelab flight is shown in figure 1 at the back of the report. The sequence of events for this STS-9 flight is shown in table I. The problem tracking lists for the launch vehicle, Orbiter, and Spacelab are contained in table II, also at the back of the report.

This report will contain only a brief summary of the scientific results with the George C. Marshall Space Flight Center publishing a more detailed evaluation of each experiment.

MISSION SUMMARY

The STS-9 flight, the first flight of the European-Space-Agency built Spacelab, was launched on November 28, 1983, at 15:59:59.991 G.m.t. (10:59:59.991 a.m. e.s.t.) from Kennedy Space Center, Florida, and landed at Edwards Air Force Base, California, on December 8, 1983, at 7:58 a.m. P.s.t. This flight was launched on the most northern inclination (57 deg.) of any U. S. manned flight. The 6-man crew for this Spacelab mission, the largest crew ever flown, was composed of four astronauts and two non-astronaut payload specialists, one of whom was the first foreign person to be launched by the U. S. Space Program. The crew members were John W. Young, Commander; Major Brewster H. Shaw, Jr., Pilot; Owen K. Garriott, Phd., and Robert A. Parker, Phd., Mission Specialists; and Byron K. Litchenberg, Phd., and Ulf Merbold, Phd., Payload Specialists. The six crew members were divided into two teams, red and blue, enabling two 12-hour work shifts each day and thereby maximizing the scientific data gathering from the 73 experiments on board Spacelab. This mode of operation was very successful as indicated by the vast amount of scientific data collected and the successful completion of all 94 planned flight test objectives.

No launch commit criteria were violated and only two minor problems occurred during the countdown; however, neither had any impact on launch operations. The ascent phase was nominal with the vehicle being inserted into a 135 nmi. circular orbit, as planned.

Spacelab activation was initiated on time and all experiment systems operated normally, thus causing no switchover to backup systems. One apparently temperature-related problem occurred in the remote acquisition unit (RAU) 21. This unit serves all NASA instruments on the pallet and the horizon sensor. Analysis during the mission suggested a correlation between the freon fluid temperature and the RAU 21 problem. Subsequent operations of RAU 21 with temperatures about 22° C resulted in problem-free operation.

TABLE I.- STS-9 SEQUENCE OF EVENTS

Event	Actual G.m.t.
APU activation (1)	332:15:55:07
(2)	332:15:55:08
(3)	332:15:55:09
SRB HPU activation command (4)	332:15:59:32.6
MPS start command sequence (engine 3)	332:15:59:53.4
SRB ignition command from GPC (lift-off)	332:15:59:59.991
MPS throttledown to 78-percent thrust (engine 3)	332:16:00:28.2
Maximum dynamic pressure	332:16:00:51.4
MPS throttleup to 104-percent thrust (engine 3)	332:16:01:02.3
SRB separation command	332:16:02:06.99
MPS throttledown for 3g acceleration (engine 3)	332:16:07:27.2
Main engine cutoff (MECO)	332:16:08:29.195
External tank separation	332:16:08:47
OMS-1 ignition	332:16:10:29.4
OMS-1 cutoff	332:16:11:33.2
APU deactivation (3)	332:16:13:12
OMS-2 ignition	332:16:40:37.4
OMS-2 cutoff	332:16:42:18.9
Spacelab activation complete	332:20:31
Verification flight test cold-attitude initialization	334:03:11
Verification flight test cold-attitude terminated	335:02:30
Verification flight instrumentation hot test began	339:18:25
Verification flight instrumentation hot test terminated	340:01:26
OPS-8 (flight control system) checkout	340:12:50:55
Spacelab deactivation complete	342:09:36
APU 1 activation	342:22:46:59.1
Deorbit maneuver ignition	342:22:52:00.2
Deorbit maneuver cutoff	342:22:54:36.5
APU 2 and 3 activation	342:23:02:33
Entry interface (400,000 ft)	342:23:16:00
End blackout	342:23:32:07
Terminal area energy management	342:23:40:57.5
Main landing gear contact	342:23:47:24
Nose landing gear contact	342:23:47:38
Wheels stop	342:23:48:17
APU 1 underspeed shutdown	342:23:54:14
APU 2 underspeed shutdown	342:23:58:38
APU 3 shutdown	342:23:59:18.7

Spacelab power requirements during experiment operations were about 1.0 to 1.5 kW below preflight predicted levels. Because of this lower usage, adequate consumables remained to extend the mission for one day and still have the necessary contingency reserves. Consequently, the Spacelab mission was extended from 9 to 10 days. During the 10-day flight, the crew performed 206 attitude maneuvers and 2 orbital trim maneuvers in support of Spacelab and its experiments.

Scientifically, the Spacelab 1 mission was a grand success. Investigators in each discipline have reported a high percentage achievement of their objectives. The preliminary evaluation of data indicates that significant new results were obtained from many of the experiments. Among the highlights of the mission were the successful on-orbit repair of several malfunctioning instruments, the excellent television coverage and voice communications, and the many opportunities for repeated or modified experiment operations. The following summary lists some of the major scientific results of the mission.

Significant findings in the astronomy and solar physics discipline included:

a. Measurement of ion emission from the Perseus cluster of galaxies and from Cygnus C-3;
b. Measurement of X-ray line emission from the supernova remnant Cassiopeia A;
c. Study of spectral variability from galactic X-ray sources (binary system/neutron star and black hole);
d. Absorption of certain spectral ranges of the solar spectrum caused by Shuttle outgassing: and
e. Uncertainties in data observations of the full solar spectrum caused by Shuttle contamination.

Significant findings in the space plasma physics discipline included:

a. Vehicle charge neutralization by magnetic plasma discharge (MPD) arcjet confirmed;
b. Beam plasma discharge phenomenon discovered;
c. Spreading of MPD argon plasma cloud observed;
d. Interaction of neutral gas plume with electron beam;
e. Wave emission and return electron spectra;
f. Significant diagnostic data in support of beam experiments;
g. Double layer of magnesium ions in the upper atmosphere detected;
h. Detailed high-resolution auroral electron distribution detected;
i. Electron distribution due to accelerator operations observed; and
j. Two supra-thermal electron populations relevant to understanding auroral particle acceleration detected.

Significant findings in the atmospheric physics and earth observations discipline included:

a. Successful dayglow imaging;
b. First use in space of intensified charge-coupled devices;
c. First broadband spectrum (300-12, 800 A) of dayglow at good spectral resolution;
d. Successful nightglow limb scans;
e. Successful collection of spectral data coincident with electron beam firings and neutral gas releases;
f. Successful collection of high resolution solar absorption spectra of the atmospheric limb;
g. First observation of carbon dioxide in the thermosphere and water vapor and methane in the mesosphere;
h. High resolution observations of other gases;
i. Discovery of deuterium in the upper atmosphere;
j. Determined atomic hydrogen vertical profile (80-250 km);
k. Observed proton aurorae on day side;
l. Observed interplanetary Lyman alpha emissions.

Significant life sciences findings included:

a. Indications of increased reliance upon vision for orientation in space;
b. Mildly provocative testing appears practical for study of space adaptation syndrome;
c. Early and significant adaptation for mass discrimination observed;
d. Fungus maintained circadian growth cycle in microgravity;
e. Interesting caloric nystagmus results; and
f. Successful performance of on-orbit phase of experiments dependent on postflight baseline data collection.

Significant materials science findings included:

a. Successful verification of material science double rack activities;
b. First silicon melt/crystal growth in space;
c. Confirmation of Marangoni convection effect in space; and
d. Suggestive results in fluid physics.

The Commander and Pilot, who spent their shifts on the flight deck supporting Spacelab operations, also exposed about 7000 frames of film in out-the-window photographic activities.

After the completion of planned and extended Spacelab activities, the Spacelab was deactivated and stowage preparations were begun for entry.

At 342:11:10:21 G.m.t., about 5 hours prior to the planned landing time, GPC (general purpose computer) -1 failed. About 6 minutes later, GPC-2 also failed. Attempts to bring GPC-1 back on line were unsuccessful and it was powered down for the rest of the mission. A ground review of the GPC-2 memory dump indicated that memory alterations had occurred, however, GPC-2 was reinitialized and was placed back in the the redundant set. Also, IMU (inertial measurement unit) -1 failed during this last day of the mission. Because of the GPC and IMU failures and analysis required, the landing time was delayed about 7 3/4 hours to 342:23:47:24 G.m.t. No activities were planned during this period of delay except to maintain the crew in a state of readiness for entry.

Final entry preparations were completed well ahead of the deorbit maneuver which was performed at 342:22:52:00 G.m.t. for a duration of 156 seconds. All scheduled PTI (programmed test input) maneuvers were performed except PTI 10, which was deleted due to the HAC (heading alignment circle) maneuver. The entry was nominal in all respects until about 4 1/2 minutes before landing when an APU (auxiliary power unit) -1 temperature measurement showed a rapid rise rate, and when the nose wheel touched the ground, GPC-2 failed. The crew successfully landed at Edwards Air Force Base at 342:23:47:24 G.m.t. The rollout required 8,456 feet.

About 6 1/2 minutes after landing, APU-1 prematurely shut down because of an underspeed condition. About 11 minutes after touchdown, APU-2 also prematurely shut down because of an underspeed condition. Postflight examination of the compartment where the APU's are located showed localized damage had occurred in the vicinity of both APU's. An investigation board has been formed and the complete evaluation of these two anomalies will be reported in a board report (JSC-19461).

SPACELAB EXPERIMENTS SUMMARY

The degree of achievement of scientific objectives is evidence of a successful payload integration. The scientific portion of the SL-1 mission shows a high degree of objectives accomplished. A "quick-look" assessment by the scientists indicate the following percent accomplishment; however, the scientific success can only be completely determined after all collected data are evaluated.

In the discipline of life sciences, 11 of 16 experiments were 100-percent successful, and the other five achieved 50 to 90 percent of their planned objectives.

The astronomy and solar physics experiments discipline indicate 100-percent success with four of six experiments and 95 percent with another. The sixth experiment, 1NA008, has not been assessed at this time.

The plasma physics discipline indicates 100-percent success with one experiment and 80 to 90 percent with the other four.

The atmospheric physics and earth observation discipline experienced 75 to 100-percent success with five experiments. The other one indicated limited success because of the launch slip to November 28, 1983.

Five materials processing experiments, including the tribology, had 100-percent successful accomplishment of objectives. The remaining were processed in 1ES300. Within that facility (materials science double rack), the gradient heating facility experiments and fluid physics module experiments were 100-percent successful, and the isothermal heating facility experiments and mirror heating facility experiments achieved 50 percent and 60 percent, respectively.

The ESA Facility 1ES300 (materials science double rack) started operations on day 2 and was very successful in operating the fluid physics module and the gradient heating facility; however, the isothermal heating facility and the mirror heating facility failed on day 3 due to power supply problems. The mirror heating facility was later restored to operation by crew action.

ESA experiments 1ES020 (passive unit) and 1ES022 (very wide field camera) were both successfully installed and operated from the scientific airlock on days 2 and 5, respectively.

ESA experiment 034 (microwave remote sensing) began operations on day 3 and operated successfully in a passive mode, but would not function in an active mode.

INS002 (SEPAC) operations began on day 0 and were successfully conducted throughout the mission except for the failure of the EBA (electron beam assembly) to operate in a high-power beam mode.

Even though experiment INS003 (AEPI) had to remain locked in position, Orbiter attitude pointing enabled 80 percent of the data collection objectives to be achieved.

VEHICLE ASSESSMENT

SOLID ROCKET BOOSTERS

The SRB (solid rocket booster) aft skirt shoe shims from all four north posts and from one south post were released during the early phases of lift-off. Improvement in bonding is being pursued.

The performance of the SRM's (solid rocket motors) was well within the specification limits. Quick-look evaluation shows that head pressures and propellant burn rates were very close to that predicted for both motors. SRM thrust imbalance between the two motors was within the allowed tolerance. Evaluation showed that the action times were about 2.1 and 0.3 seconds earlier than predicted for the left-hand and right-hand SRM's, respectively.

Available data shows that the SRB electronics and instrumentation systems functioned satisfactorily. All SRB power from the Orbiter was within specification, the rate gyro performance was as expected, and the IEA (instrumentation-electronics assembly) /APU controller functioned properly on both SRB's.

All four ignition PIC's (pyrotechnics initiator cartridges) charged and fired normally and all 24 PIC's associated with separation functions performed satisfactorily. The left-hand SRB thermal curtain became ineffective at about 286 seconds, and heat loads were similar to those seen on previous flights (table IIa). Recovery battery voltages, currents, and temperatures were normal.

The decelerator subsystems on both SRB's performed normally and all parachutes were recovered. One parachute had severe damage to two gores. Six of eight aft-booster-separation-motor-nozzle aero-heating-shield retainer rings were found missing (four on the left SRB and two on the right SRB) (table IIa). Physical evidence indicates that the ring fasteners failed during descent and that the rings were lost at water impact. The flashing lights and RF beacons performed normally.

EXTERNAL TANK

All prelaunch requirements were met with no LCC (launch commit criteria) violations. ET (external tank) separation and entry were as predicted and impact was within the footprint. The prelaunch thermal environment was as expected with only minor ice/frost buildup in areas that had approved waivers prior to flight. All OI (operational instrumentation) measurements performed satisfactorily with the exception of the nose-cone temperature measurements, both of which indicated off scale. Nose-cone purge was maintained applying STS-9 tanking test experience (table IIa).

SPACE SHUTTLE MAIN ENGINES

The SSME (Space Shuttle main engines) prestart, start, mainstage and cutoff performances were all good. The HPOTP (high pressure oxidizer turbo pump) and HPFTP (high pressure fuel turbo pump) turbine temperatures were close to predicted. The main engine 1 LPOTP (low pressure oxidizer turbo pump) discharge pressure channel B drifted upward to 600 psia at 330 seconds. This was probably an instrumentation error (table IIa).

Engine controller performance was very satisfactory during the prelaunch and launch mission phases with no hardware or software failures experienced. Closed-loop operation of all three engines was as expected. No unexpected oscillations occurred during steady-state operations, and no unexpected overshoots occurred during throttling operations.

MAIN PROPULSION SYSTEM

Liquid oxygen and liquid hydrogen propellant loading was completed satisfactorily. Purge requirements prior to and during loading were met. Aft compartment hazardous gas concentrations were well within limits. There was evidence of hydrogen leakage at the T-0 umbilical and the leakage was maintained below the redline limit by manual operation of the liquid hydrogen replenish valve (table IIa). Propellant preconditioning was satisfactory; all interface pressures and temperatures were met and all SSME prestart requirements were satisfied.

The engine start buildups and transitions to mainstage were normal. Engine operation and performance during mainstage appeared satisfactory. During steady-state performance, ET/ORB (Orbiter) pressures and temperatures, and ORB/SSME pressures and temperatures satisfied interface requirements. Quick-look mixture ratio and thrust values from the flight indicate repeatable engine performance. Power-level throttling operation appeared normal. Engine shutdown was satisfactory. MECO occurred approximately 1.0 second later than predicted.

The sticking closed of the gaseous hydrogen flow control valve no. 1, which failed to respond to 13 of 16 commands from T+10 to T+375 seconds remains under investigation (table IIa). However, satisfactory tank pressurization was maintained throughout the required time period.

The liquid oxygen ullage pressure slump at T+30 seconds to 17.5 psid (waiver limit is 18.3 psid) continues to be investigated. The problem can be reconstructed. A new waiver limit will be proposed for future flights (table IIa).

SPACELAB SYSTEM PERFORMANCE SUMMARY

The SL-1 (Spacelab-1 mission) was the first of two flights comprising the Spacelab VFT (Verification Flight Test) Program. The Spacelab-1 configuration consisted of an interconnected Spacelab transfer tunnel, long module, and single pallet. CPSE (common payload support equipment) included the SWAA (Spacelab window adapter assembly), SAL (scientific airlock), and an aft-end cone-mounted viewport assembly. The Spacelab-1 configuration, included experiment hardware in the module and on the pallet representing five broad areas of investigation. Also included throughout the configuration was hardware comprising the Spacelab-1 VFI (Verification Flight Instrumentation) system to provide for the acquisition of additional data required to accomplish the objectives of the VFT Program. The mission duration was extended an additional day because the expenditure of consumables was less than predicted, providing the opportunity for additional Spacelab verification and experiment activities.

All SL-1 VFT functional objectives are believed to have been performed in accordance with the timeline and flight procedures. A procedural error in the activation of the VFI orbit mode, and a real-time decision to cycle power to the VFI system during a 27-hour period of the flight did result in the loss of some VFI data (originally planned to be acquired throughout the orbital phase of the mission); however, no impact to VFT evaluation objectives is expected from this loss of data.

With the exception of a minor number of anomalies, the Spacelab system operated satisfactorily to support the secondary objective of the mission that was to obtain valuable scientific, applications, and technology data from the joint United States and European multidisciplinary payload and to demonstrate, to the user community, the broad capability of Spacelab for scientific research. Table IIb contains a compilation of Spacelab system problems during the Spacelab-1 flight. The problems are described in subsequent sections of this report.

Environmental Control System

The Spacelab ECLS (environmental control and life support)/thermal control system and payload interfaces function performed extremely well. No significant ECLS/thermal-related anomalies occurred in the mission.

Structural Subsystem

All low-frequency accelerometers were functional and yielding measurements within the predicted range. The lateral (Y) accelerations at launch were low, consistent with a symmetrical SRB thrust profiles. The frequency content, evaluated on the basis of shock spectrum comparison, was consistent with preflight predictions.

Vibration and acoustic measurements were well within the measurement range and within environmental predictions.

In general, the measured strain levels were low, and within the predicted ranges.

The SWAA was used extensively during the mission to support experiment 33 photographic operations. All these operations were conducted without incident.

The SAL performance during SL-1 was outstanding. The SAL supported both experiment 20 and experiment 22 operations in accordance with the mission timeline. The SAL was also operated during the cold test and the hot test as part of the VFT. All mechanisms were operated successfully.

The performance of both viewports (one in the SWAA and one in the aft-end cone) was nominal throughout the mission. The outer cover latch and rotation mechanisms operated without incident and the optical quality of the triple-layer glass was demonstrated by live TV downlink pictures of the pallet taken through the aft-end-cone viewport.

Command and Data Management System

Software Assessment: The Spacelab software in the experiment computer and subsystem computer functioned nominally with only minor problems during the mission. An ECOS (experiment computer operating system) crash was experienced; however, this crash only occurred as a result of a patch that was inserted to attempt to work around the RAU 21 problem and acquire data. Several other patches were made to the ECOS to help solve the RAU 21 problem and these patches worked successfully. All patches, including the patch that caused the ECOS crash, were verified at the MSFC Software Development Facility. The verification of the patch which caused the ECOS crash was limited by the inability to define the RAU 21 failure characteristics for all mission configurations in real-time.

An SCOS (subsystem computer operating system) error message is under investigation because the error theoretically should have been detected by STS ground or uplink systems. The SCOS reported receiving an "Invalid MDM Command." One patch was made to SCOS to downlink additional error-support data should SCOS report receiving another "Invalid MDM Command". SCOS did not report such an error during the remainder of the mission, and the problem remains under investigation.

Subsystem Hardware: As an integrated subsystem, the CDMS (command and data management subsystem) performed nominally. CCTV (closed circuit television) video was particularly outstanding. Two anomalies occurred, but in both cases operational workarounds were accomplished.

The HDRR (high data rate recorder) apparently experienced an electromechanical problem resulting in excessive drag in the tape drive, and the drag caused an overcurrent condition in the drive motor (table IIb). The condition was cleared by ground-developed real-time procedures. The anomaly did not recur.

The second anomaly was with RAU 21 (table IIb). The data acquisition functions of this RAU were lost when the freon loop coldplate temperature (on which the RAU was mounted) exceeded 22° C. The loss of these functions impacted NASA pallet-mounted experiments and mission-dependent equipment. Workarounds were implemented, including ECOS patches and power management to reduce heat induced into the freon loop, and experiment operations continued in a degraded mode.

Electrical Power Distribution System

The EPDS (electrical power distribution system) performed nominally throughout the mission. SL-1 power consumption was approximately 1.2 kW lower than predicted; however, Spacelab subsystem consumption was nearly at the level predicted. Partial explanations for the less-than-predicted power consumption are that some experiments were not operated as much as originally timelined and heater duty cycles were less than predicted during the cold test. On the other hand, some experiments as well as the VFI operated at less than predicted power levels.

Habitability

The Spacelab crew systems interfaces functioned well with no significant crew comments reported. The general architecture, color utilization and subsystem work stations appeared satisfactory.

The Orbiter foot restraints were quite effective. Handrail placement throughout the module was satisfactory.

The area lighting was very good. The light levels were reduced during a portion of the mission by turning off selected lights to help reduce freon loop heat load in support of RAU 21 workarounds. No significant impact on operations was noted.

Communications using the Spacelab intercom system and the wireless headsets were satisfactory. Background noise did not affect communications except when equipment that was known premission to be above specified noise values was operated. To improve operational efficiency, the flight crew has recommended revisions be made to the Spacelab intercommunications system. This revision would allow monitoring and operational flexibility. The recommendation would provide a functional capability similar to the present Orbiter system. The Spacelab Program is reviewing the recommendation.

Safety Assessment

All Spacelab caution and warning, and emergency parameters remained within their limits except for planned activities. During changeout of the LiOH canisters, the cabin fan differential pressure exceeded the lower limit. When manually controlling the atmosphere to obtain nitrogen regulator operation, the SL-1 oxygen and nitrogen flow rates were exceeded; also, the Orbiter cabin delta p/delta t measurement indication exceeded its limit during this operation.

Flight Instrumentation

The flight instrumentation subsystem performance was satisfactory. One anomaly was observed. The VFI tape recorder did not go into the record mode when commanded to do so via the RAU by a ground command. However, it did function normally via the control panel commands. There was no impact to VFT data acquisition requirements on orbit. During the descent phase, only the first 7 minutes of the required descent data were recorded. The cause and impact of the loss of these data is being assessed.

ORBITER/SPACELAB INTERFACES

The vehicle performance involving the Spacelab/Orbiter electrical, fluid, and mechanical interfaces was excellent with only one significant anomaly. On two occasions, the Spacelab SCOS (Subsystem Computer Operating System) rejected MCC uplinked HDRR (high data rate recorder) "standby" commands as invalid (table IIc).

ORBITER

The overall performance of the Orbiter was satisfactory. A discussion of the significant anomalies is contained in the following paragraphs. A complete list of the Orbiter flight anomalies are contained in table IIc.

Left-hand Orbital Maneuvering System Secondary Pitch Actuator

During prelaunch operations, the left-hand OMS (orbital maneuvering system) secondary (backup) pitch actuator failed to respond properly in the OMS profile test. Since sufficient redundancy existed within the primary actuator, the backup actuator was disabled for launch. After the OMS-1 maneuver, the secondary actuator was activated and the actuator again failed the OMS profile test. The backup actuator was disabled for the remainder of the mission and there was no impact.

Water Tank B Quantity Increase Greater Than Fuel Cell Water Output

Beginning at about 334:12:00 G.m.t., the flow rate from the fuel cells to water tank B was 20 cc/min greater than that calculated based on fuel-cell power output.

Analysis of the water dump profiles indicated that an excessive amount of gaseous hydrogen was entrained in the water output of the fuel cells. Successful management of the supply and potable water systems was implemented using crew procedures.

S-Band Antenna System Problem

Beginning at about 338:21:16 G.m.t., several S-Band reflected power peaks (up to 16W) occurred briefly (minutes) and randomly for the remainder of the mission. This occurred when the upper quad antennas were selected; however, the communications link was not significantly affected throughout the mission.

S-Band Power Amplifier 2 Failed

At 337:21:30 G.m.t., the S-Band/TDRSS link could not achieve two-way lock. Downlink data indicated that power amplifier 2 (PA 2) had failed. After switching to PA 1, the two-way lock was re-established and there was no further impact for the remainder of the mission.

APU-1 And APU-2 Failure

Shortly after landing at 342:23:54:14 G.m.t., APU-1 prematurely shut down because of an underspeed condition. At 342:23:58:38 G.m.t., APU-2 also shut down because of an underspeed. APU-3 was shut down nominally. Postflight inspection revealed extensive damage in the vicinity of these APU's. An investigation team has been organized to determine the cause of these failures.

GPC-1 And GPC-2 Failed

At 342:11:10:21 G.m.t., during computer reconfiguration for entry, GPC-1, (OPS 2) failed. Shortly thereafter at 342:11:16:45 G.m.t., GPC-2 (OPS 2) also failed. All attempts to bring GPC-1 back on line were unsuccessful.

A ground review of GPC-2 memory dump indicated some memory alterations had occurred. However, GPC-2 was reinitialized in OPS 3 and was used in the redundant set with GPC-3 and GPC-4 for entry and landing. At Orbiter nose wheel touchdown (342:11:16:45 G.m.t.) GPC-2 again failed.

Inertial Measurement Unit No. 1 Failed

At 342:16:42:31 G.m.t., and again at 342:17:03:46 G.m.t., fault messages were received which indicated that IMU-1 had failed. The BITE (built in test equipment) pin pointed the failure to the dc/dc no. 1 card in the IMU-1 power supply. IMU-1 was powered down and there was no mission impact.

Brake Damage

The initial Orbiter towing opeation from the Edwards Air Force Base runway was hampered by a locked right outboard brake. Field site inspection revealed that the carbon brake liner on the no. 3 rotor was damaged. All four brakes were removed and returned to the vendor for a detailed inspection and failure analysis.

Reaction Control System R3D Thruster Leaked

At 335:10:36:58 G.m.t., the reaction control system primary thruster R3D incurred an oxidizer leak and was deselected. After 113 hours, the leak had stopped; and, although the nozzle temperature rose above the hot-fire redline value of 65° F, the thruster was not reselected and there was no impact to the mission.

AERODYNAMICS

0.25 Hertz Oscillation During Entry

On all previous flights in the region between Mach 2 and 1, a small amplitude lateral/directional oscillatory motion has been present. One explanation of the cause was unsymmetrical flow separation in phase with the rudder inputs due to the large speedbrake angle. To test this theory on STS-9, a speedbrake reduction, which theoretically should have stopped the limit cycle was input manually. The STS-9 flight data showed that the levels of oscillation were as high or higher than those observed on previous flights. Also the elevon moved up 2° more than was predicted which thus reduced the aileron effectiveness. This reduction in aileron effectiveness due to elevon position, and the measured loss in aileron effectiveness during STS-1 through STS-8 flights is now believed to be the cause of the oscillation.

TABLE II.- STS-9 ANOMALIES.

(a) ET, SSME, and SRB. DATE: JANUARY 4, 1984

NO.	TITLE	TIME, G.M.T	COMMENTS
1.	Nose cone temperature measurement failure	Prelaunch	Both nose cone temperature measurements failed off scale during prelaunch. Nose cone temperature was maintained using the STS-9 tanking test experience. Temperature sensors from the same lot have been successfully flown on four previous missions. Tests of the launch signal conditioners will be replaced for STS-11 and connector modifications will be incorporated to facilitate removal and replacement of the connector/cable section. Also a contingency procedure to control the nose cone temperature is being developed for STS-11.
2.	Aft BSM heat seal rings broken away	Postflight Inspection	Six of the eight aft BSM heat seal rings were broken away. The bolts were either broken at the head or near the threaded hole interface. There are indications of insufficient TPS bonding. M&P analysis indicates that high heat loads could fail the bolt after separation due to liquid metal stress cracking. Action is under way to provide bolts not affected by the heat loads.
3.	Main parachute canopy damage	Postflight Inspection	One main parachute canopy on the LH SRB had two areas of damage. The upper area had signs of frictional rubbing and the lower area had signs of tensile tearing. The deployment bag showed no signs of wear as seen on previous bags. Main parachute load data indicates that during first and second stages, the loads were slow in build up and 40 percent to 80 percent of normal loads. Third stage loading was nominal. Investigation concludes damage due primarily to frictional damage during parachute deployment from the bag. Engineering corrective actions are being evaluated. Retrofit options for STS-11 are not planned.

TABLE II.- STS-9 ANOMALIES (Continued).

(a) ET, SSME, and SRB (Concluded). DATE: JANUARY 4, 1984

NO.	TITLE	TIME, G.M.T	COMMENTS
4.	Aft skirt shoe shims ejected at liftoff (debris issue)	332:16:00	Pieces of the EPON shims from the north posts and one from the south posts were ejected from the aft skirt shoes. M&P laboratory has recommended an intensive scrubbing with a scouring cleanser and solvent wipe prior to bonding to the shoes.
5.	LPOT discharge pressure measurement failure	332:16:05	The ME-1 LPOT discharge pressure channel B measurement failed at T+325 seconds. This is the first failure of this type on this sensor design. Investigation is under way.
6.	Fuel bleed valve position indicator showed open during asce nt	332:16:00	The ME-3 fuel bleed valve indicator showed 50 percent open at T+4 seconds. Investigation is under way.
7.	HPFT discharge temperature measurement failure	332:16:03	The ME-3 HPFT discharge temperature measurement failed high at T+222.6 seconds. Investigation is under way.

TABLE II.- STS-9 ANOMALIES. (Continued)

(b) SPACELAB-1 ANOMALIES LIST

NO.	TITLE	TIME, G.M.T.	COMMENTS
1.	INVALID ORBITER MDM COMMANDS.	335:19:15 338:17:03	SCOS RECEIVED TWO INVALID UPLINK COMMANDS. INFORMATION RECEIVED FROM THE MCC INDICATES THE SAME COMMAND WAS ISSUED IN BOTH CASES (HDRR STBY). THIS COMMAND ISSUES SID #06AD. THE FIRST OCCURRENCE RESULTED IN MESSAGES 8D16 AND 8C21. THE SECOND OCCURRENCE RESULTED IN MESSAGES 8D15 AND 8C21, INDICATING THE SID NUMBER RECEIVED BY SCOS WAS NOT THE SAME IN THE TWO CASES. THIS PROBLEM APPEARS TO BE A SYSTEM PROBLEM INVOLVING ORBITER THAT CAN RESULT IN ISSUING AN INCORRECT COMMAND TO THE SPACELAB. THIS PROBLEM HAS BEEN TRANSFERRED TO THE JSC TRACKING LIST. SPACELAB WILL NO LONGER TRACK THIS PROBLEM.
2.	VFI TAPE RECORDER DID NOT RESPOND TO RECORD MODE COMMAND VIA RAU.	332:22:30	THE VFI TAPE RECORDER (T/R) DID NOT GO INTO THE RECORD MODE WHEN COMMANDED TO DO SO VIA THE RAU FROM A GROUND COMMAND. THE VFI T/R RECORD MODE DID FUNCTION NORMALLY VIA THE CONTROL PANEL COMMANDS. THE FLIGHT SEQUENCE OF COMMANDS HAS BEEN TESTED ON THE FLIGHT HARDWARE, LESS THE VFI T/R, AT KSC. PRELIMINARY RESULTS INDICATE PROPER COMMAND EXECUTION UP TO THE T/R INTERFACE. ADDITIONAL TESTING, INCLUDING THE VFI T/R, IS PLANNED.

TABLE II.- STS -9 ANOMALIES.

(b) SPACELAB-1 ANOMALIES LIST (continued).

NO.	TITLE	TIME, G.M.T.	COMMENTS
3.	RAU 21 SKIPS.	331:01:20	NUMEROUS INPUT/OUTPUT UNIT SKIPS OCCURRED DURING THE MISSION WITH THE ACQUISITION OF INPUT DATA FROM RAU 21. THE FIRST OCCURRENCE WAS AT MET 00:09:20:12. ALL SKIPS WERE TAGGED AS EITHER PROCEDURE OR TRANSMISSION ERRORS IN THE RAU TO I/O LINK. SKIPS OCCURRED FOR SERIAL PCM, ANALOG DATA, AND DISCRETE DATA ACQUISITIONS. RAU 21 SKIPS WERE UNIQUE WITH RESPECT TO OTHER RAU SKIPS IN THAT THEY SEEMED TO BE INFLUENCED BY THE OPERATING ENVIRONMENT. WHEN THE TEMPERATURE OF THE COLDPLATE SERVICING RAU 21 EXCEEDED 22 DEG C, SKIPS WERE VERY FREQUENT AND THE DATA ACQUISITION CYCLE VERY ERRATIC. WHEN THE TEMPERATURE WAS LESS THAN 22 DEG C, SKIPS WERE VERY INFREQUENT. SUBSYSTEM RAU H WAS ALSO MOUNTED ON THE SAME COLDPLATE WITH NO DETECTABLE ENVIRONMENTAL INFLUENCES. A POST-LANDING INSPECTION OF THE INSTALLATION OF RAU 21 WAS PERFORMED BY KSC AND FOUND TO BE CORRECT. THE MALFUNCTION CONDITION WAS RECREATED DURING BENCH TESTING USING HEAT LAMPS TO INCREASE THE TEMPERATURE. APPROXIMATELY 50 DEG C WAS THE TEMPERATURE REQUIRED TO RE-CREATE THE PROBLEM. THIS IS HIGHER THAN THE ON-ORBIT TEMPERATURE (22 DEG C) AT WHICH SKIPS OCCURRED. HOWEVER, THIS WAS ANTICIPATED DUE TO THE FACT THAT THE ON-ORBIT TEMPERATURE WAS MEASURED ON THE COLDPLATE AND A TEMPERATURE DIFFERENTIAL EXISTS BETWEEN THE COLDPLATE AND THE UNIT. DIFFERENCES ALSO OCCUR DUE TO VACUUM VERSUS ATMOSPHERIC CONDITIONS. AN EXACT THERMAL MODEL IS NOT AVAILABLE WHICH WOULD DEFINE THE EXACT DIFFERENCES TO BE EXPECTED IN FLIGHT VERSUS GROUND TESTING.

TABLE II.- STS-9 ANOMALIES. (Continued)

(b) SPACELAB-1 ANOMALIES LIST (concluded).

NO.	TITLE	TIME, G.M.T.	COMMENTS
			FOLLOW-UP ACTION IS IN PREPARATION. TENTATIVE PLANS INCLUDE: -CORRELATION OF RAU 21 ANOMALY WITH OTHER RAU TEMPERATURE PROBLEMS WHICH HAVE OCCURRED DURING GROUND TESTING. -SCREENING OF ADDITIONAL RAU'S VIA TEMPERATURE TESTS. -VACUUM/THERMAL TESTING OF RAU 21.
4.	HDRR MOTOR CURRENT ELEVATED DURING TAPE RECORDER OPERATION.	336:01:29	DURING DAY 3, THE HDRR TRANSPORT UNIT (TU) MOTOR CURRENT INCREASED ERRATICALLY FROM AN ACCEPTABLE 1-AMP RANGE TO NEAR 2 AMPS. DURING THE 30 SECONDS PRIOR TO HDRR POWER DOWN, THE INDICATED MOTOR CURRENT QUICKLY APPROACHED THE MAXIMUM 5-AMP SENSOR RANGE. FOLLOWING IN-FLIGHT MAINTENANCE (IFM), WHICH INCLUDED THE CREW ROTATING THE CAPSTAN DRIVE BY HAND AND A SEQUENCE OF HDRR OPERATING MODE CHANGES, THE HDRR TU MOTOR CURRENT RETURNED TO NOMINAL. THE ANOMALY DID NOT RECUR. THE T/R IS BEING REMOVED AND WILL BE SHIPPED TO ODETICS ON JANUARY 9 FOR INSPECTION AND TESTING. MSFC AND MDTSCO REPRESENTATIVES WILL MONITOR THE TESTING.
5.	VFI TAPE RECORDER RECORDED ONLY A PORTION OF DESCENT DATA.	342:07:15	THE FIRST 7 MINUTES OF DESCENT DATA (342:07:15 TO 342:07:22) WERE CAPTURED ON THE VFI T/R. THE SECOND PHASE (APPROACH AND LANDING) OF DESCENT DATA WAS NOT RECORDED; HOWEVER, THE RECORDER DID ADVANCE TO END-OF-TAPE. LAB TESTS BY MDTSCO AT MSFC INDICATE NORMAL FUNCTIONING OF THE VFI T/R (STANDALONE T/R TEST). KSC TESTING IS INCOMPLETE. RACK 3 TESTS ARE TO BE ACCOMPLISHED IN ABOUT 2 WEEKS.

TABLE II.- STS-9 ANOMALIES (Continued).

(c) JSC OV-102 STS-9 PROBLEM TRACKING LIST — JAN. 20, 1984

NO.	TITLE	TIME, G.M.T.	COMMENTS
1.	LH OMS SECONDARY PITCH ACTUATOR DID NOT RESPOND TO PRELAUNCH OMS PROFILE.	332:08:42	ACTUATOR RESPONDED TO PROFILE BUT HAD A WIGGLE AT 332:08:20. RERAN PROFILE. ACTUATOR MOVED ONLY ABOUT PLUS/MINUS 0.5 DEG. PROBLEM REPEATED IN POST OMS-1 CHECK. SUPPORT BEARING SEIZED.
2.	LH2 T-ZERO UMBILICAL LEAKAGE UP TO 3.4% CONCENTRATION.	332:11:00	UMBILICAL LEAK AT REDUCED REPLENISH RATE. LEAK RATE CONTROLLED BY LIMITING REPLENISH VALVE CLOSURE. WILL INCREASE BELLOWS COMPRESSION.
3.	INSTRUMENTATION FAILURES:		
A	HYDRAULIC SYSTEM [illegible] BODY FLAP RETURN LINE TEMPERATURE (V58T0388A) READING LOW.	332:16:15	SENSOR READING OVER 40 DEG F LOW COMPARED TO SYSTEM 2 BUT READ NORMAL SINCE DAY 2. KSC COULD NOT FIND PROBLEM. INSPECT INSULATION AT PALMDALE.
B	FES TOPPING DUCT AFT HEATER D TEMPERATURE (V63T1802A) FAILED.	332:17:17	SENSOR FAILED OFF-SCALE LOW AND CAME ON-SCALE DAY 2 BUT IT READ ALMOST 200 DEGREES LOW. KSC COULD NOT FIND PROBLEM. FLY AS IS.
C	MID FUSELAGE BONDLINE RIGHT TEMPERATURE (V34T1108A) ERRATIC.	335:05:06	TRANSDUCER WENT OFF SCALE HIGH, ABOVE 450 DEG F, FOR OVER 4 HOURS. AT 335:09:40 READ GOOD, RESPONDED PROPERLY ON DAYS 4 AND 5, WENT HIGH AGAIN ON DAY 6 FOR ABOUT 16 HOURS AND CONTINUED TO READ ERRATIC. KSC COULD NOT FIND PROBLEM. FLY AS IS.
D	LEFT MLG DOOR-CLOSE DISCRETE (V51X0116) INDICATED RELEASED.	332:16:01:00	RELEASE INDICATED FOR 12 SECONDS DURING MAX Q. RERIGGED PROXIMITY SWITCH AT KSC.
E	BODY FLAP SEAL CAVITY DRAIN LINE TEMP (V58T1650) READING LOW.	332:16:00	TEMP DROPPED TO 15 DEG F AT LIFTOFF, STAYED THERE ONE HOUR, THEN RETURNED NORMAL, ABOUT 45 DEG F. KSC COULD NOT FIND PROBLEM. INSPECT INSULATION AT PALMDALE.

T/S NOTE: T/S = TROUBLESHOOT

TABLE II.- STS-9 ANOMALIES (Continued).

(c) JSC OV-102 STS-9 PROBLEM TRACKING LIST (continued). JAN. 20, 1984

NO.	TITLE	TIME, G.M.T.	COMMENTS
F	FCL 2 PAYLOAD HEAT EXCHANGER FLOWRATE (V63R1303A) SHIFTED LOW.	341:23:55	FREON COOLANT LOOP 2 PL HX FLOWRATE DROPPED FROM 1100 LB/HR TO 600 LB/HR, CHECK OF TEMP READINGS SHOWED NO CORRELATED CHANGE. READ ABOUT 500 LB/HR LOWER THAN FCL 1. ISOLATED TO SENSOR. REPLACE WHEN LOOP IS DESERVICED.
G	HYDRAULIC RESERVIOR PRESSURE 1 TRANSDUCER (V58P0131A) FAILED.	POSTLANDING 342:23:52	ABOUT 5 MIN AFTER TOUCHDOWN WENT OFF-SCALE LOW. RESERVIOR QUANTITY AND HYD SYSTEMS PRESSURES WERE ALL NORMAL. APU WIRE DAMAGE. REPAIR AS PART OF APU REPAIRS.
H	MPS HE SUPPLY PRESSURE (V41P1600) DROPPED TO ZERO.	POSTLANDING 342:23:51:30	PRESSURE DROPPED SUDDENLY FROM 1000 PSIA TO ZERO, 4.5 MIN AFTER TOUCHDOWN. APU WIRE DAMAGE. REPAIR AS PART OF APU REPAIRS.
I	ET GH2 ULLAGE PRESSURE SIGNAL CONDITIONER NO. 3 MALFUNCTION (T41P1702C).		REVIEW OF DATA INDICATES VALVE COMMAND CIRCUIT OF SIGNAL CONDITIONER NO. 3 MAY NOT BE PERFORMING PROPERLY. KSC TESTS SHOW ORBITER SIGNAL CONDITIONER IS OK.
J	APU 3 TURBINE EXHAUST TEMP NO.1 (V46T0342) DROPPED 700 DEG, THEN RECOVERED.	343:00:10	DROPPED 300 DEG AT GMT 342:23:40 AND RECOVERED THEN DROPPED 700 DEG AND AGAIN RECOVERED. REPAIR AS PART OF APU REPAIRS.
4.	CABIN ADAPTER HATCH D LEAKED.	332:14:34	CABIN/SPACELAB HATCH D WAS LEAKING FROM ORBITER TO TUNNEL ABOUT 3.5 LB/HR AT 2 PSID. HAD 1.3 PSID AFTER LANDING. KSC TEST IN SPEC.
5.	LRCS 3/4/5A TANK ISOLATION VALVES SWITCH POSITION OPEN INDICATOR FAILED.	333:12:42	VALVE CYCLED TO CLOSED AND OPEN. ONBOARD T/B AND VALVE TM SHOWED OPERATION PROPER. ISOLATED TO MDM OA1 S/N 018 CARD 10 CHANNEL 2 BIT 2.
6.	WSB 3 LUBE OIL RETURN TEMPERATURE (V46T0350) OVERSHOOT BEFORE PULSING.	333:16:12	SHOULD HAVE CONTROLLED TO 253 DEG F, BUT HIT 287 DEG F BEFORE PULSING AND PROPERLY CONTROLLING. KSC TEST OPERATED PROPERLY. SUSPECT LOCALIZED FREEZING.

TABLE II.- STS-9 ANOMALIES (Continued).

(c) JSC OV-102 STS-9 PROBLEM TRACKING LIST (continued). JAN. 20, 1984

NO.	TITLE	TIME, G.M.T.	COMMENTS
7.	SSME 1 GH2 ULLAGE FLOW CONTROL VALVE MALFUNCTION.	333:16:10	VALVE FAILED TO RESPOND TO MAJORITY OF COMMANDS DURING BOOST. REMOVE AT KSC ASAP. EO FROM DOWNEY TO PLUG LINE. INSTALL REDESIGNED VALVES ON OV-099 AFTER STS-13, AND ON OV-102 BEFORE ITS NEXT FLIGHT. SSME 1 GH2 FCV CHANGED OUT ON OV-099 AFTER STS-6.
8.	PCMMU FORMAT 103 SM DATA LOST.	332:17:20	GROUND UNABLE TO PROPERLY PROCESS SM DOWNLIST IN FORMAT 103. EXPECT SAME PROBLEM IN FORMAT 104. CHANGED DECOM SOFTWARE. DATA PROCESSED SUCCESSFULLY 340:12:46.
9.	GPC STATE VECTOR TIME TAG TO SPACELAB INCREMENTED BY 1 DAY.	332:18:00	STATE VECTOR SENT BY SM GPC TO EXECUTIVE (EXC) AND SHUTTLE SYSTEMS (SSC) COMPUTERS IN SPACELAB WAS INCREMENTED BY SM GPC EXACTLY 1 DAY. IMPACTED 13 EXPERIMENTS. SOFTWARE PATCH IMPLEMENTED IN SM GPC TO CORRECT INPUT. VERIFY IN CITE.
10.	AIRLOCK HATCH A DIFFICULT TO OPEN.	332:20:00	CREW REQUIRED TO PUSH DOWN ON HATCH TO ALLOW LATCH TO CLEAR. EVALUATE PROCEDURES. DEBONDED GUIDE. REBOND AT KSC.
11.	SPACELAB TOTAL KW COMPUTATION READING ZERO.	332:22:30	READING ZERO ON BOARD AND ON GROUND. BOTH INPUT PARAMETERS IN SM GPC ARE VALID. NO ORBITER EXECUTION OF SPACELAB SPECIAL PROCESSES INCLUDING ANNUNCIATION OF RAU FAILURES. GMEM SM SOFTWARE PATCH PREPARED, VERIFIED AND IMPLEMENTED.
12.	KU BAND ANTENNA TWT FAILED TO COME ON WHEN COMMANDED.	334:15:49(1) 339:19:28(2) 341:11:26(3)	TWT ABOUT 22 DEG F AT COLD SOAK ATTITUDE(1). RECOVERED 334:17:20 AT 25 DEG F. PROCEDURE IMPLEMENTED TO MAINTAIN TWT TEMP. FAILED TO COME ON AGAIN AT 110 DEG F(2) AND 61 DEG F(3). RECOVERED BY CYCLING POWER. REMOVED AT KSC.

TABLE II.- STS-9 ANOMALIES (Continued).

(c) JSC OV-102 STS-9 PROBLEM TRACKING LIST (continued). JAN. 20, 1984

NO.	TITLE	TIME, G.M.T.	COMMENTS
13.	FUEL CELLS PRODUCED EXCESSIVE GH2.	334:12:00	WATER FLOW RATE INTO TANKS ABOUT 20 CC/MIN GREATER THAN CALCULATED BASED ON FUEL CELL POWER OUTPUT. EXCESSIVE GH2 LEAKAGE FROM FUEL CELLS. RATE WAS 2 CC/MIN ON DAY 5 THEN 16 TO 7 CC/MIN ON DAYS 6 THRU 8. DOWN TO ZERO CC/MIN ON DAY 10. T/S AT KSC. ADDITIONAL H2 SEPARATOR ON STS-11.
14.	RCS JET R3D OX VALVE LEAKAGE AND GAS BUBBLES IN L5L AND R5R.	335:10:36:58	LEAK OCCURRED AFTER FIRING AND THRUSTER WAS DESELECTED. L5L AND R5R FAILED "OFF" FROM BUBBLES AND EFFECTS ALSO SEEN IN L5D. R3D LEAK SLOWED DOWN ABOUT 335:22; BY 340:02 TEMP HAD STABILIZED AT 76 DEG F. READY FOR HOT FIRE AS REQUIRED. PROBABLE CONTAMINATION. R&R R3D AT AT KSC. BLANKING PLATE BY KSC.
15.	S BAND LOWER RIGHT QUAD AFT ANTENNA ACQUISITION INTERMITTENT.	333:02:21:25	RECEIVED SIGNAL LEVELS LOWER THAN ON OTHER QUADS. T/S AT KSC INCONCLUSIVE. R&R AT PALMDALE.
16.	S-BAND POWER AMPLIFIER NO. 2 FAILED.	337:21:30	S-BAND TDRS LINK WOULD NOT ACHIEVE 2-WAY LOCK. SWITCHED TO PA1 TO GAIN 2-WAY LOCK. TRIED PA2 AGAIN BUT IT FAILED AFTER 45 SECONDS OF OPERATION. USED PA1 REST OF MISSION. R&R AT KSC.
17.	R RCS OXIDIZER PRIMARY REGULATOR B INTERNAL LEAK.	336:05:29	ULLAGE PRESSURE INCREASED SLOWLY TO 266 PSIA AFTER SWITCH TO B LEG. DECR TO 250 PSIA WHEN OMS INTERCONNECT WAS TERMINATED AND FLOW FROM RCS TANKS WAS REESTABLISHED, OPERATING NORMALLY ON REG B PRIMARY STAGE AT 338:22. NORMAL P & S REG CHECK AT KSC. PROBABLE CONTAMINATION.
18.	S-BAND ANTENNA SYSTEM REFLECTED POWER INCREASED.	338:21:16	REFLECTED POWER WAS 15 WATTS THROUGHOUT REV 102 TDRS PASS, ABOUT 3 WATTS IS NORMAL. CONDITION RANDOM ON SUBSEQUENT PASSES USING UPPER RIGHT AND LEFT QUADS. S-BAND SWITCH ASSY IS SUSPECT. KSC COULD NOT REPEAT PROBLEM. R&R AT PALMDALE.
19.	GCIL SIMULTANEOUS ANTENNA MODES WITH KU BAND POWER IN STANDBY.	339:19:28	BOTH GPC & GPC DESIG MODE STATUS BITS PRESENT FOR ABOUT 6 MIN. TV & PL MAX PLUS OP RCDR & PL DIGITAL ALSO ON. PROBABLE SNEAK CIRCUIT WITH KU BAND IN STANDBY. PROCEDURE CHANGE.

TABLE II.- STS-9 ANOMALIES (Continued).

(c) JSC OV-102 STS-9 PROBLEM TRACKING LIST (continued). JAN. 20, 1984

NO.	TITLE	TIME, G.M.T.	COMMENTS
20.	NOISES AND OSCILLATIONS REPORTED BY CREW.	334:20:11(1) 338:20:25(2) 340:03:12(3) 340:04:41(4) 340:09:41(5) 342:02:44(6)	LOUD POP REPORTED FROM MID DECK (1). SPACECRAFT OSCILLATED LATERALLY 2 OR 3 cycles (2). GROANS AND CREAKS (3 & 4). SPACELAB FELT JOLT (5). AFTER 2 HRS AND 45 MIN IN TOP SUN NOISES REPORTED WITH ACIP RECORDER ON (6). INSPECT AT DRYDEN, KSC AND PALMDALE.
21.	KU BAND GYRO TEMPERATURE (V74T2967) HIGH.	341:05:35:18	EXCEEDED 154 DEG F MAX EXPECTED TEMPERATURE. AT 341:06:37:40 CREW PULLED CB FOR DEPLOYED ASSY HEATERS WITH MAX GYRO TEMP 250 DEG F. THERMO-STAT SUSPECT. HEATERS WERE TURNED BACK ON FOR ABOUT 30 MIN AND CONTROL WAS NORMAL. R&R AT KSC.
22.	O2 TANK 3 QUANTITY (V45Q1305A) RAPID DROP.	340:15:39	DROPPED FROM 58% TO 38% AND THEN HELD THERE ABOUT 3 HOURS BEFORE TURNING TANK 3 OFF. RE-SELECTED TANK 3 HEATERS A AT 341:06:48 AND GAUGE STAYED AT 38%. AT 341:22:30 READ NORMAL, ABOUT 28%. SUSPECT SIGNAL CONDITIONER. R&R AT KSC.
23.	GPC-1 FAILED REDUNDANT SET.	342:11:10:21	GPC-2 FAILED 6 MIN LATER. HARD FAILURE ON GPC-1, GPC-2 RE-IPL'D. BIT 13 ALTERED IN CORE EVERY EVEN ADDRESS THRU FIRST 8K OF MEMORY. FOUND A SOLDER SLIVER IN A MEMORY SENSE AMPLIFIER.
24.	IMU 1 BITE/T MESSAGE.	342:16:42:31	RM FAIL IMU MESSAGE AT 342:17:03:46, FOLLOWED BY BUS CONTROL ELEMENT STRING 1 IMU MESSAGE AT 342:17:06:11. ISOLATED TO IMU 1 DC/DC NO.1 POWER SUPPLY CARD. CAPACITOR NOT GROUNDED. R&R.
25.	GPC-2 FAILED AND MEMORY ALTERATED BEFORE DEORBIT, FAILED AGAIN AT NOSEGEAR TOUCHDOWN.	342:11:16:45A 342:23:47:37B	SEVERAL MEMORY LOCATIONS IN PROTECTED STORAGE WERE ALTERED (A). VOTED OUT OF REDUNDANT SET BY GPC-3 AND -4 (B). SEVERAL LOCATIONS ALTERED AGAIN. FOUND A GOLD-PLATED CARBONIZED FIBER IN A MEMORY SENSE AMPLIFIER.
26.	APU 1 & 2 UNDERSPEED SHUTDOWN.	342:23:54:10 342:23:58:41	UNCOMMANDED SHUTDOWN OF APU 1 & 2. SEVERAL MEASUREMENTS LOST ON BOTH APU'S. EXTENSIVE DAMAGE IN VICINITY OF APU 1 & 2. R&R AT KSC.

TABLE II.- STS-9 ANOMALIES (Concluded).

(c) JSC OV-102 STS-9 PROBLEM TRACKING LIST (concluded). JAN. 20, 1984

NO.	TITLE	TIME, G.M.T.	COMMENTS
27.	RIGHT OUTBOARD BRAKES DAMAGED.	LANDING	RH OB BRAKE LOCKED DURING TOW. FOUND 14 WASHERS MISSING AND 6 LOOSE. DAMAGED CARBON ON RH OB NO. 4 ROTOR AND NO. 3 STATOR.
28.	R OMS GN2 REGULATOR SHIFTED DOWN DURING BURNS.	332:16:10:29 332:16:40:37 332:22:52:00	10 PSI SHIFT DOWN DURING OMS-1, OMS-2, AND DEORBIT BURNS. NO ENGINE OPERATIONAL PROBLEM. NORMAL REG CHECK AT KSC AFTER MOD AT PALMDALE. PROBALBE CONTAMINATION.
29.	ATVC-3 ME ACTUATOR FCS CHANNEL 3 FAIL INDICATION.	342:23:47	ATVC-3 OUTPUTS WERE ERRATIC, INTERMITTENT OUTPUT POWER TO THE ME ACTUATORS. R&R AT KSC. DUPLICATED AT KSC AND AT VENDOR.
30.	WSB 1 BYPASS VALVE INDICATION MALFUNCTION.	342:23:32:27	INDICATED VALVE IN BYPASS POSITION BUT TEMPERATURE DATA SHOWED WSB PROVIDED SOME COOLING. KSC NOT ABLE TO REPEAT PROBLEM.
31.	WCS DOOR OPENED DURING ENTRY.	DURING ENTRY	CREW REPORTED AT DEBRIEFING THAT WCS DOOR CAME OPEN DURING ENTRY. EO AND MCR FOR STS-11. ADDED A BLOCKING PLATE TO HOLD BOLT.
32.	LH OMS POD TPS DAMAGE.	ASCENT AND ENTRY	KSC INSPECTION SHOWED CHARRED HONEYCOMB, BLISTERED INNER LINER & BURN DAMAGE TO BLANKET. R&R AT KSC.
33.	INVALID UPLINK COMMANDS FROM ORBITER MDM TO SPACELAB.	335:19:15 338:17:03	TWO INVALID HDRR STANDBY COMMANDS WERE UPLINKED TO SCOS. THE FIRST RESULTED IN ERROR MESSAGES 8D16 AND 8C21, THE SECOND IN 8D15 AND 8C21, INDICATING THE SID NUMBER WAS NOT THE SAME. PROBABLE SERIAL I/O PROCESSING PROBLEM.
34.	INADVERTANT FLIGHT CONTROL CHANNEL 2 SHUTDOWN.	342:23:47	FCS CHANNEL 2 INADVERTANTLY SHUT DOWN INSTEAD OF CHANNEL 1 AFTER SECOND GPC-2 FAILURE AT TOUCHDOWN. PROCEDURE PROBLEM.

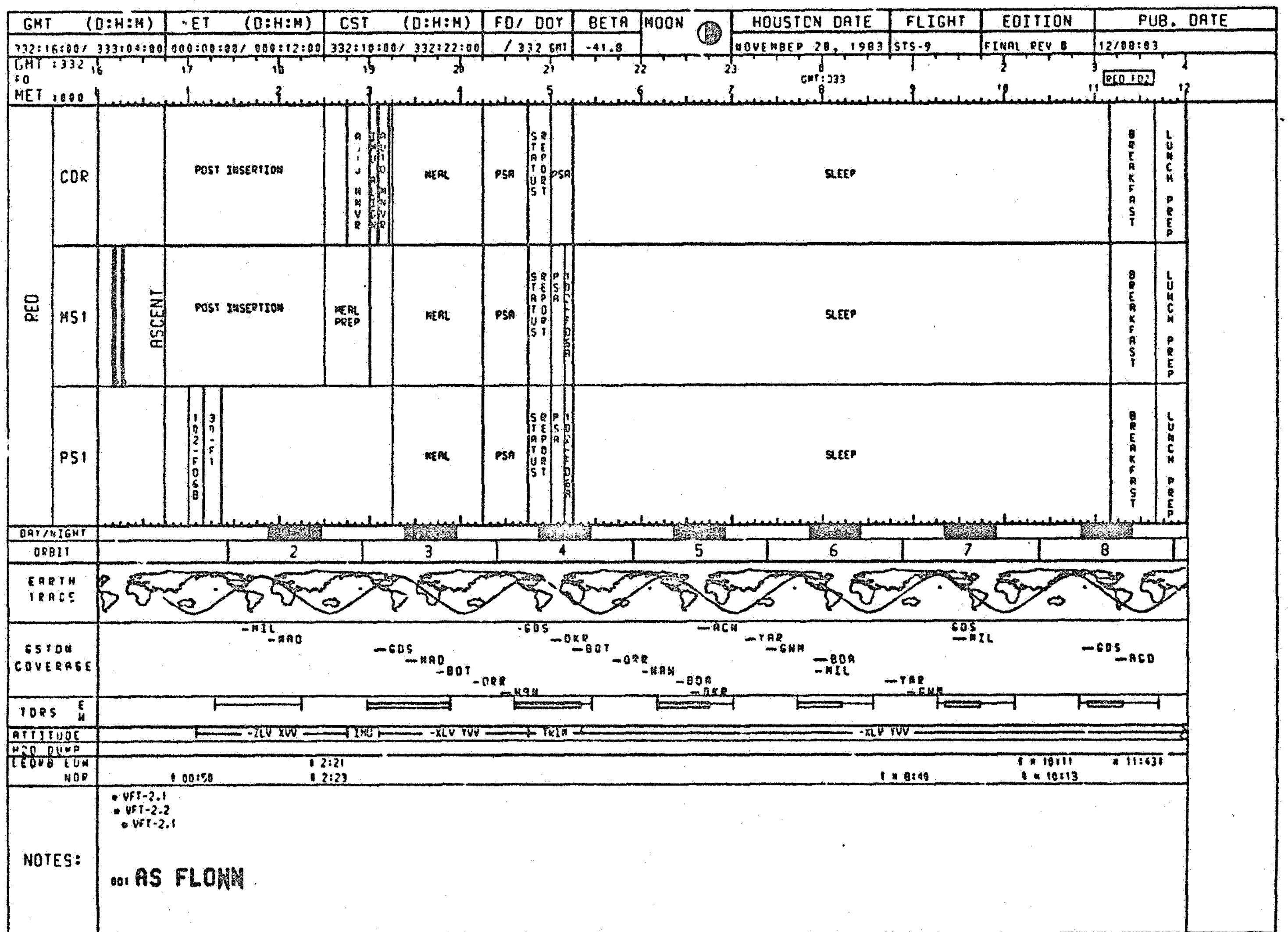

Figure 1.- As-flown crew activity plan.

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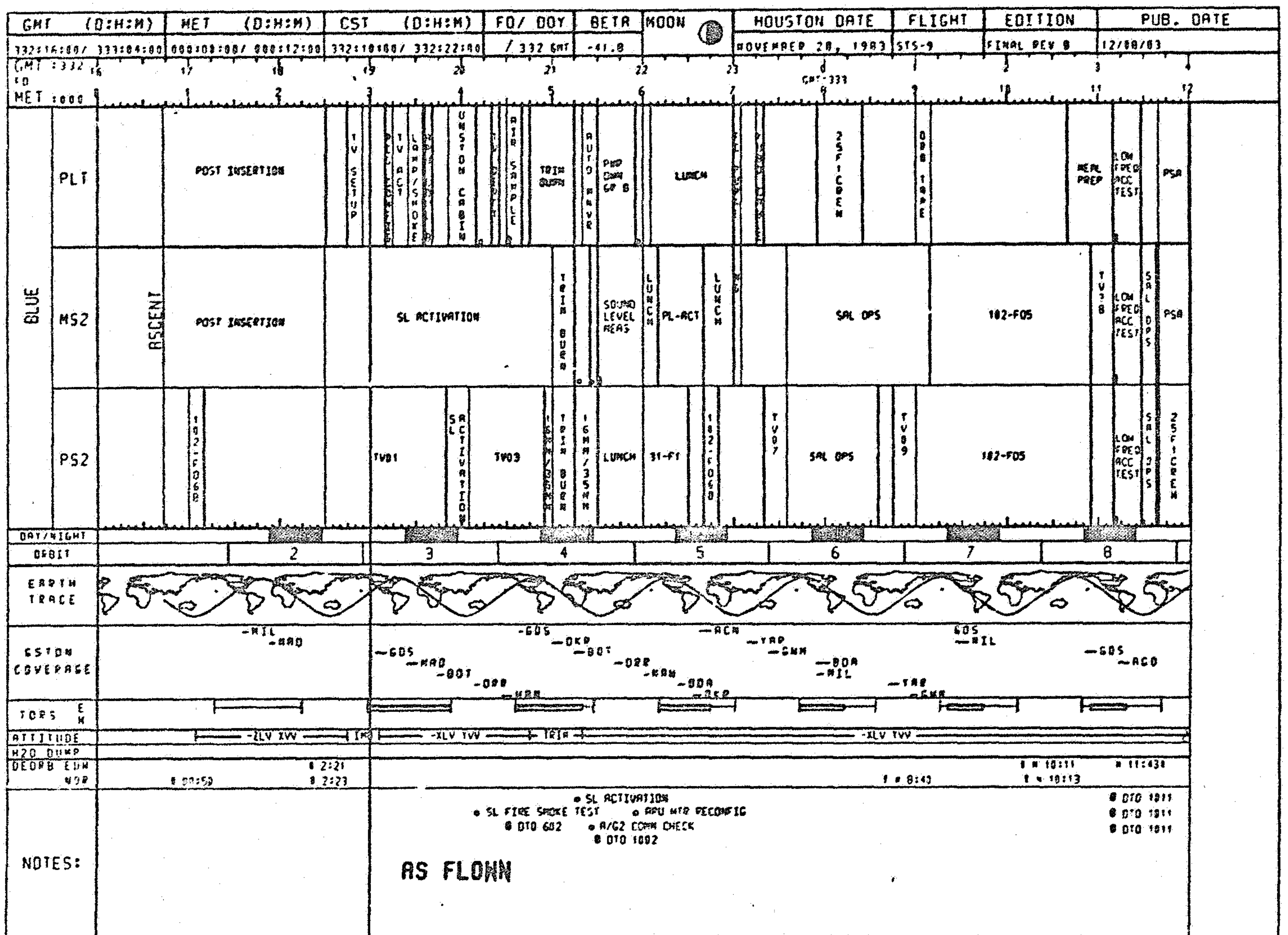

Figure 1.- As-flown crew activity plan (continued).

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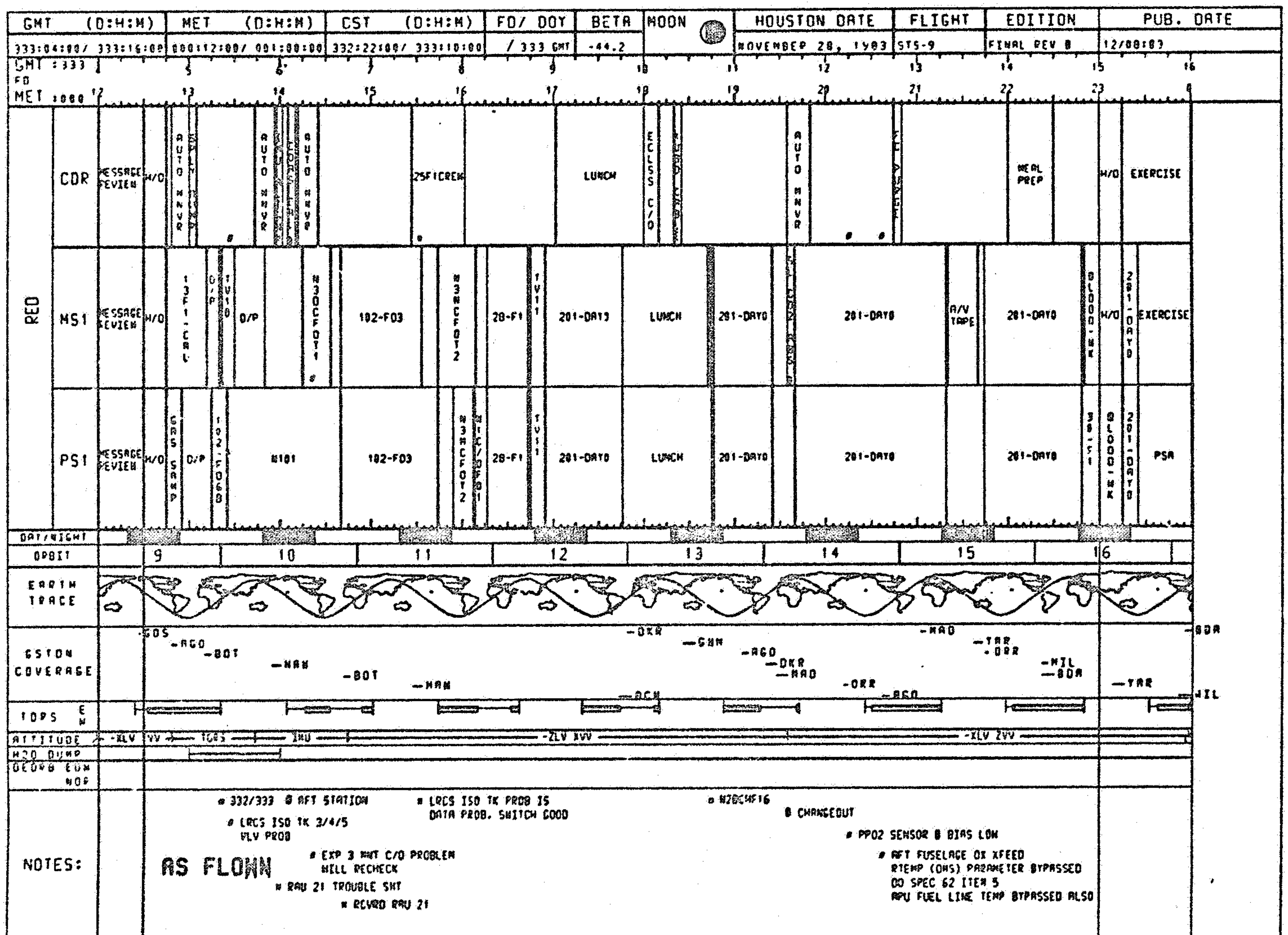

Figure 1.- As-flown crew activity plan (continued).

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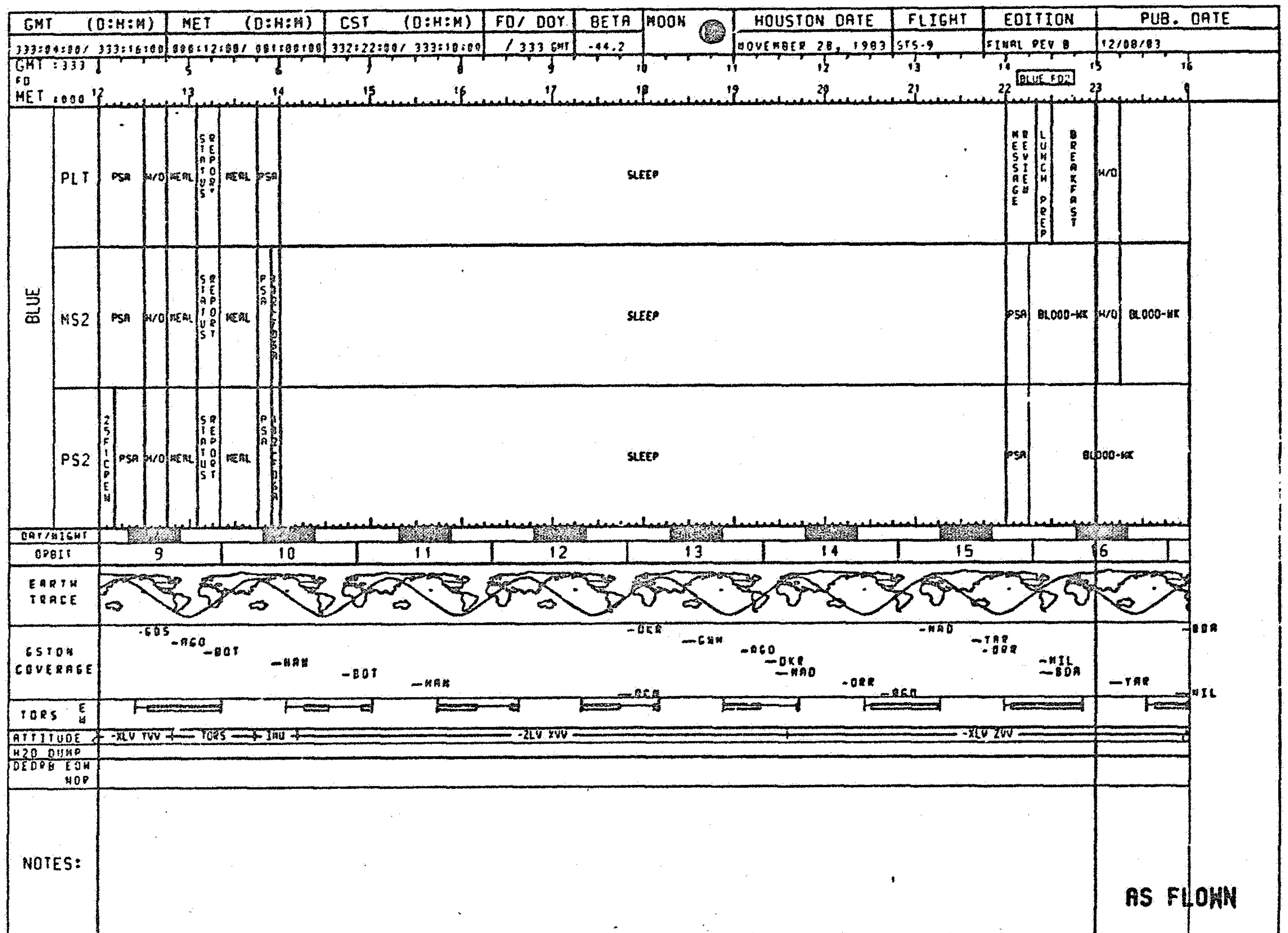

Figure 1.- As-flown crew activity plan (continued).

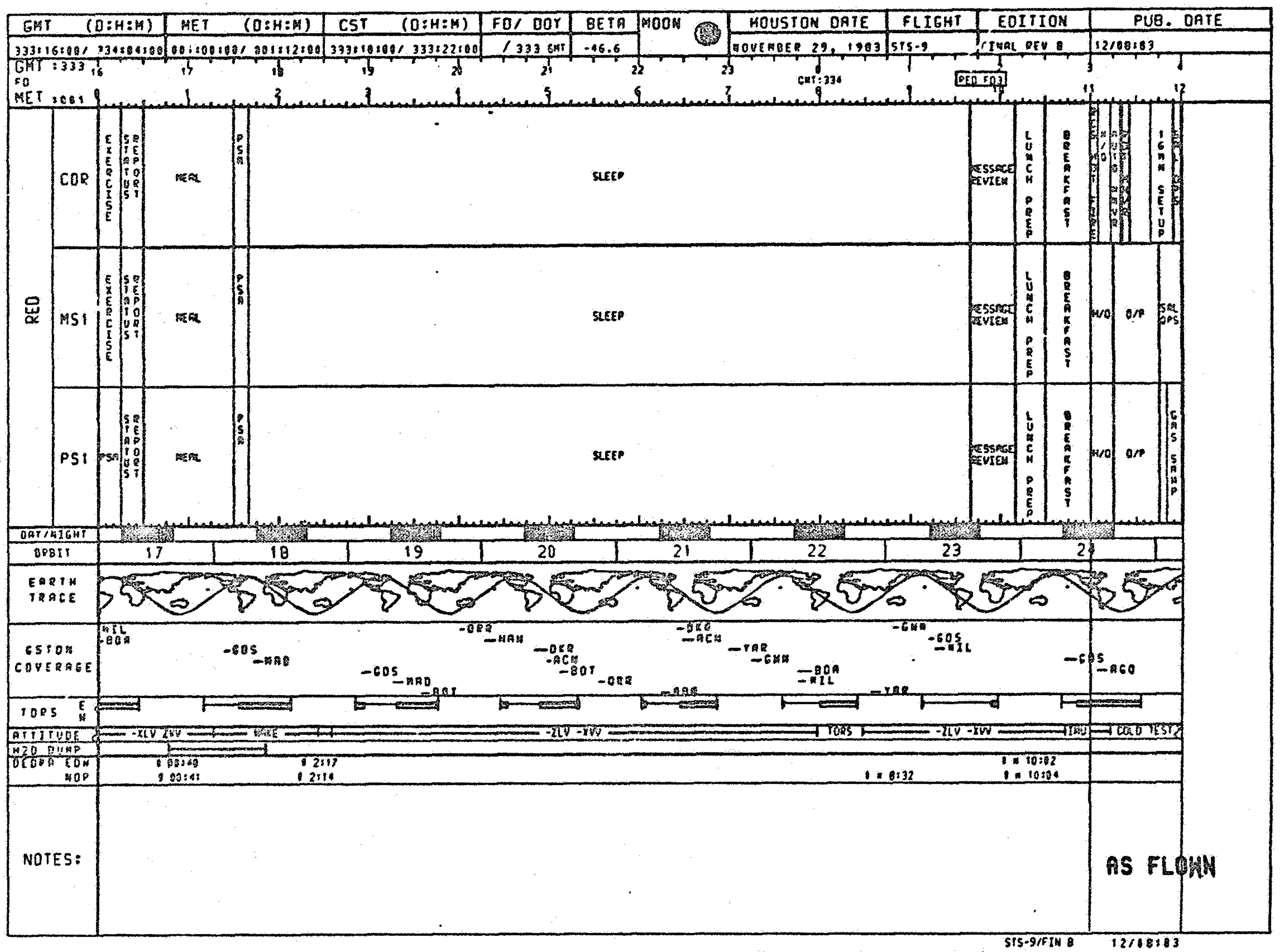

Figure 1.- As-flown crew activity plan (continued).

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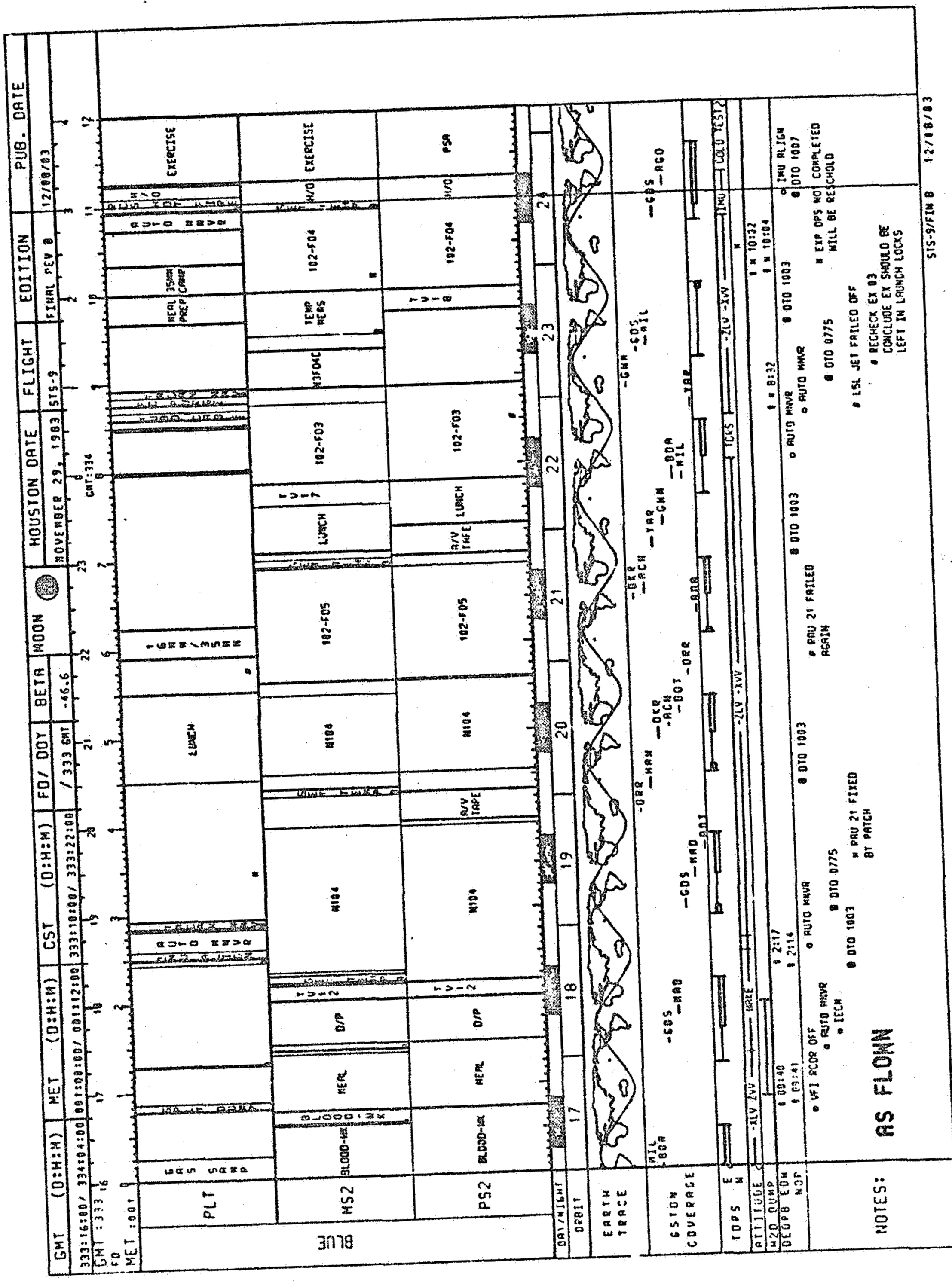

Figure 1.- As-flown crew activity plan (continued).

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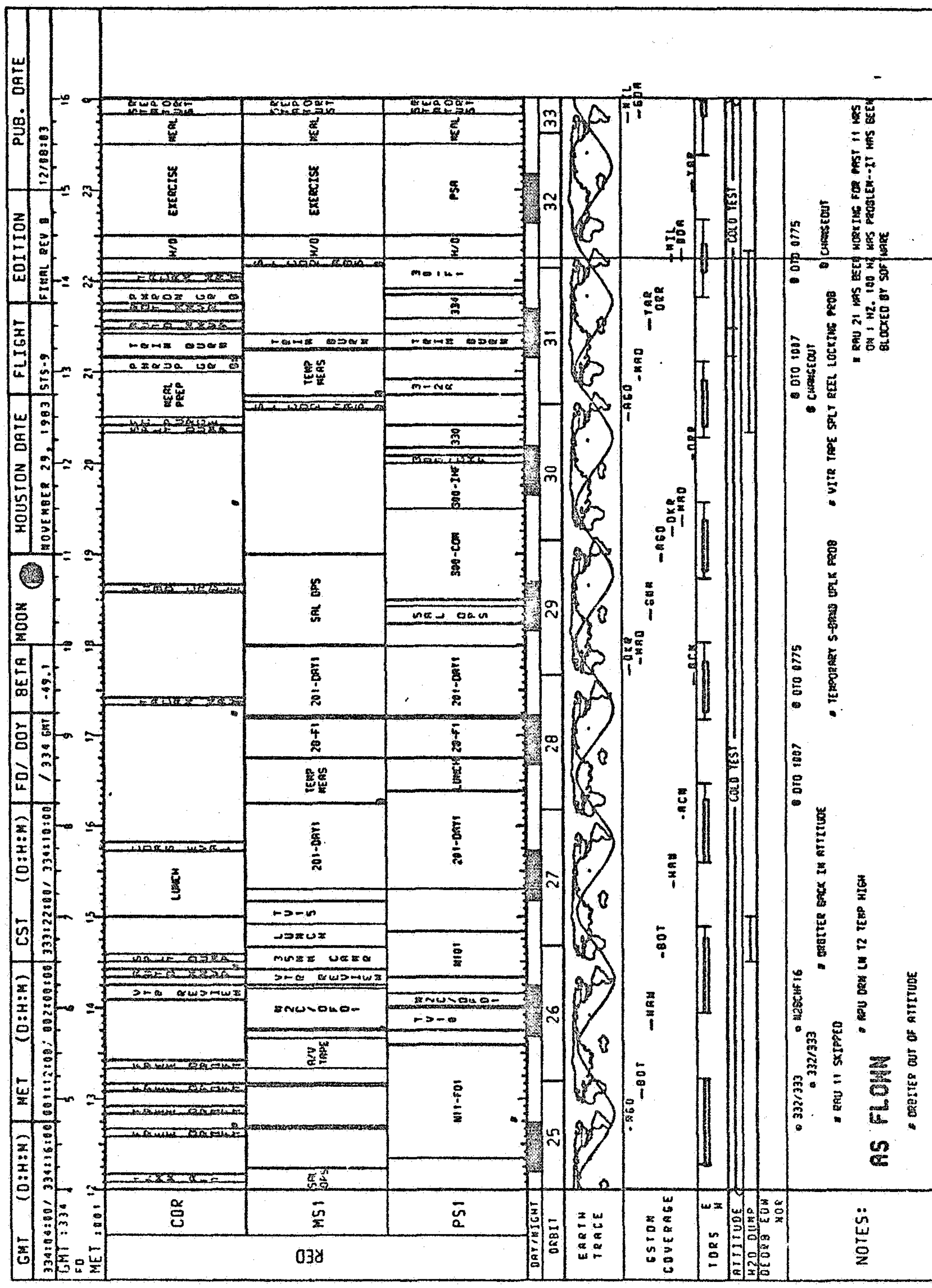

Figure 1.- As-flown crew activity plan (continued).

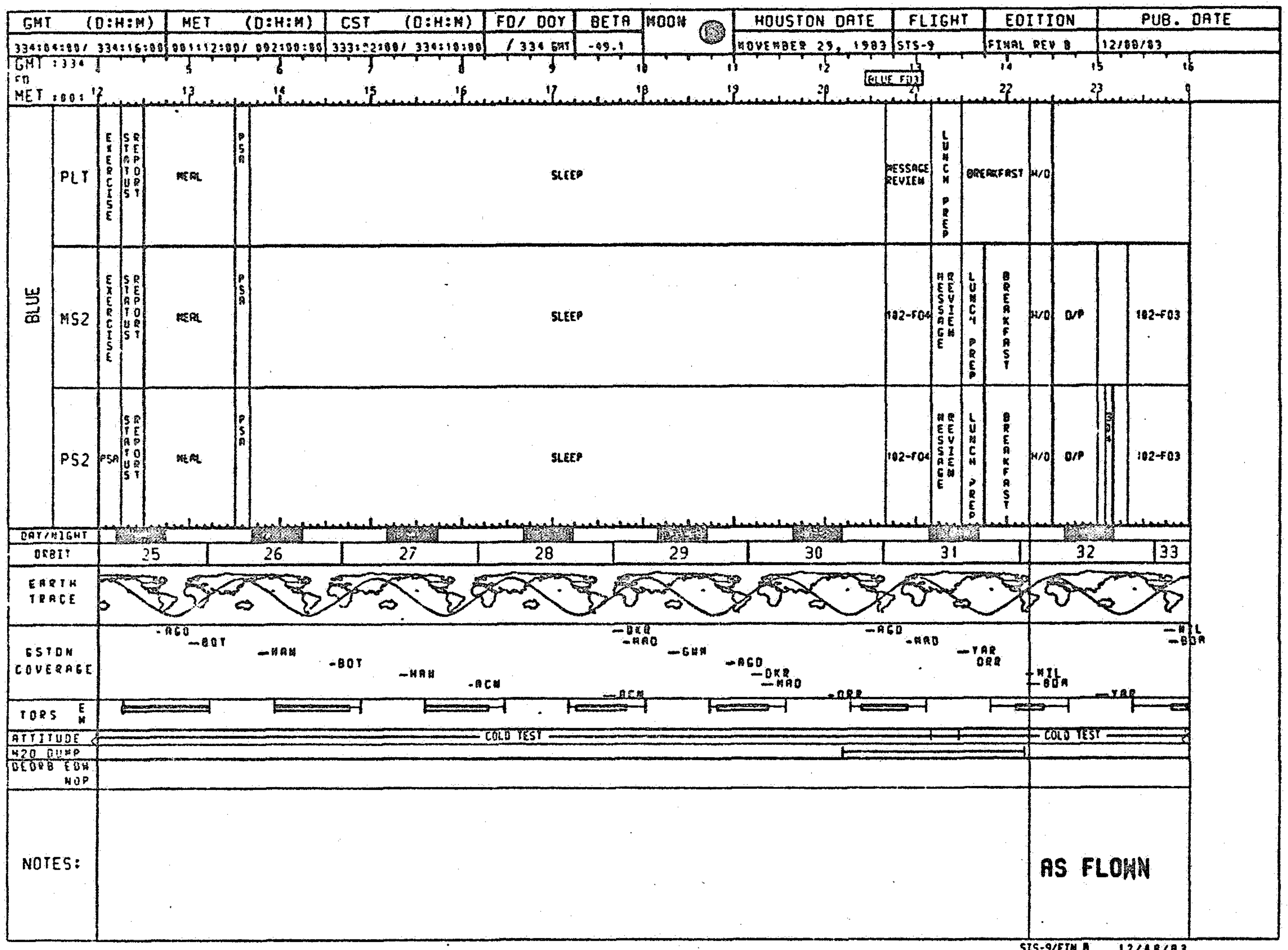

Figure 1.- As-flown crew activity plan (continued).

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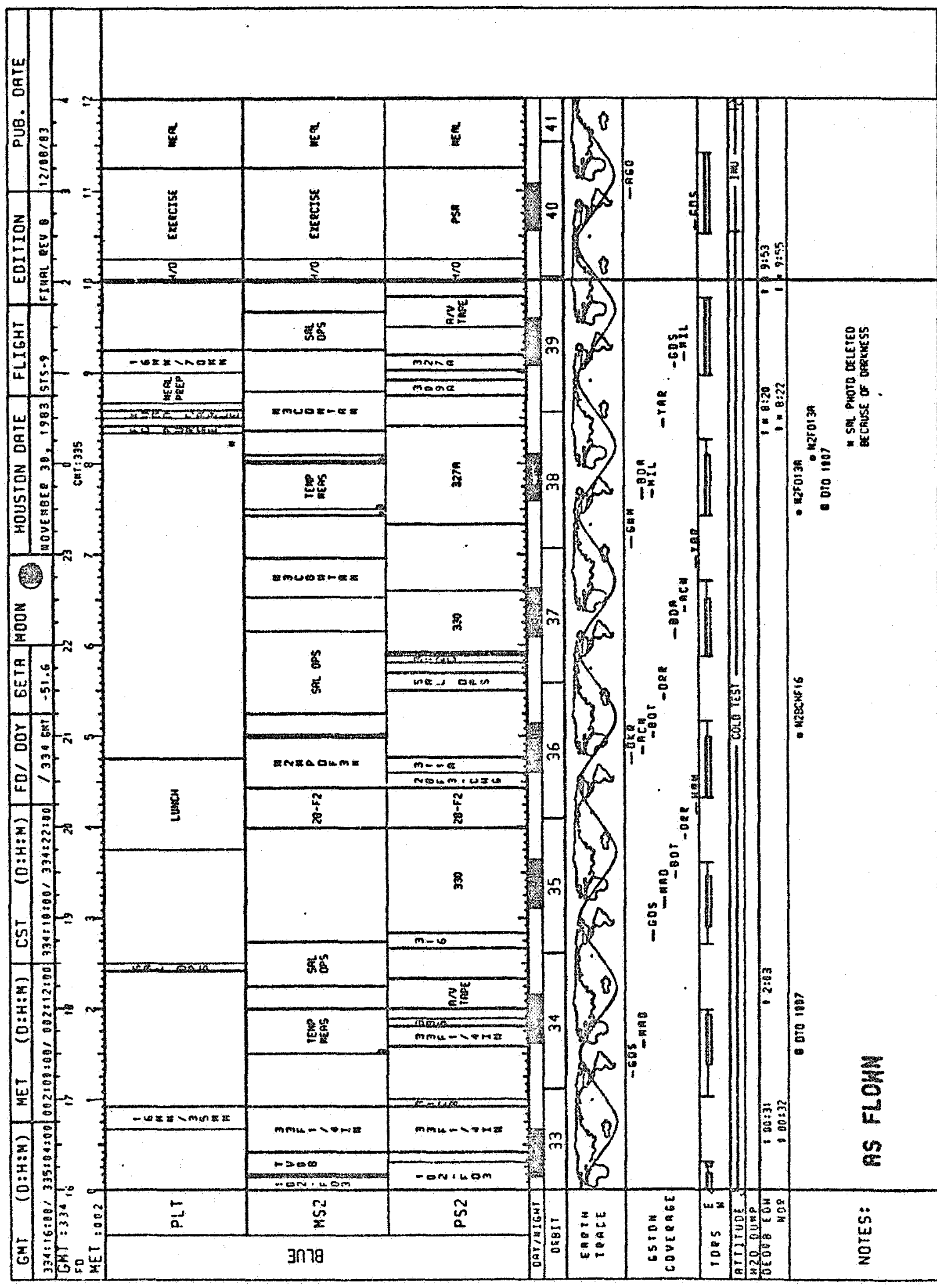

Figure 1.- As-flown crew activity plan (continued).

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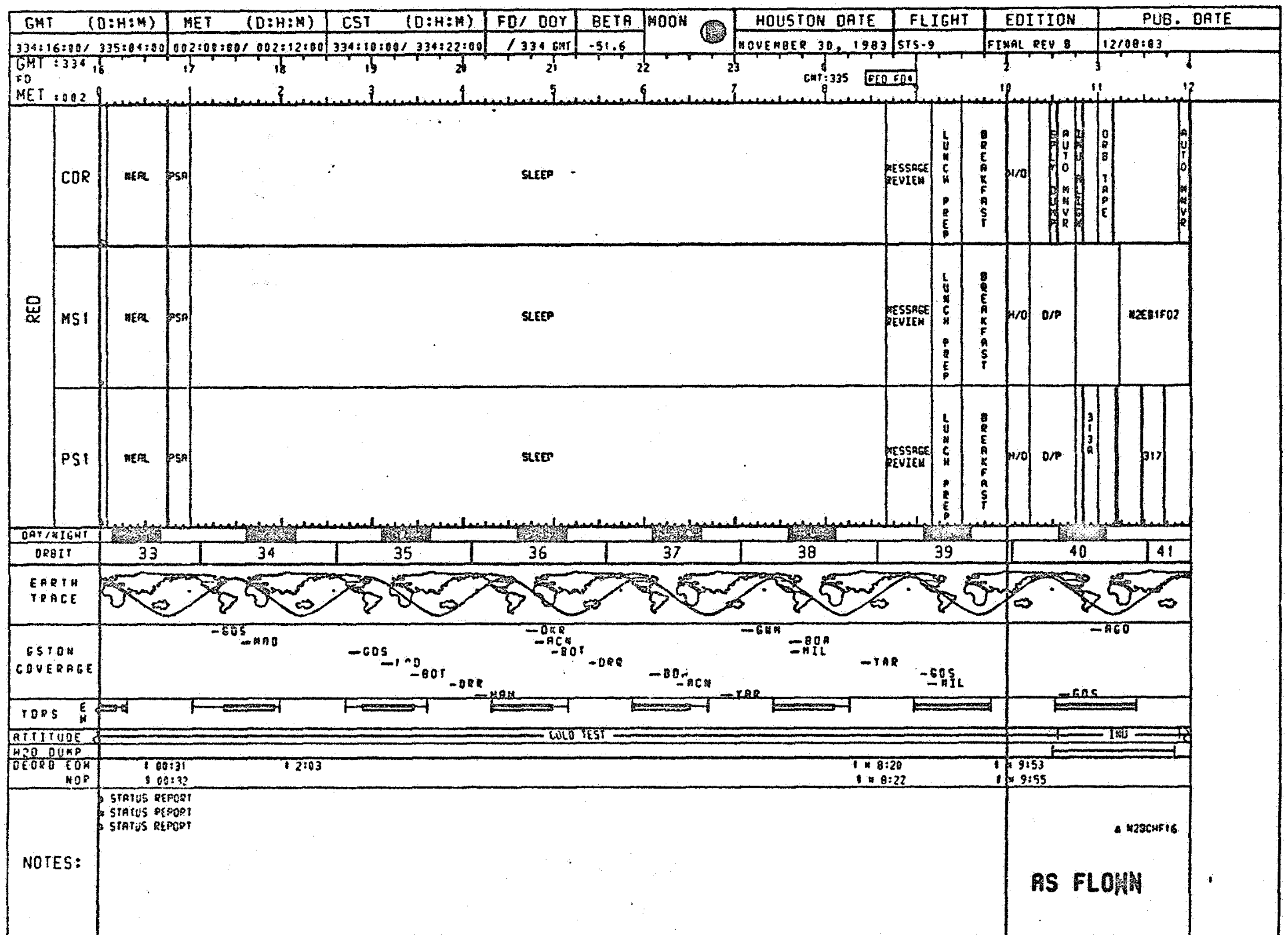

Figure 1.- As-flown crew activity plan (continued).

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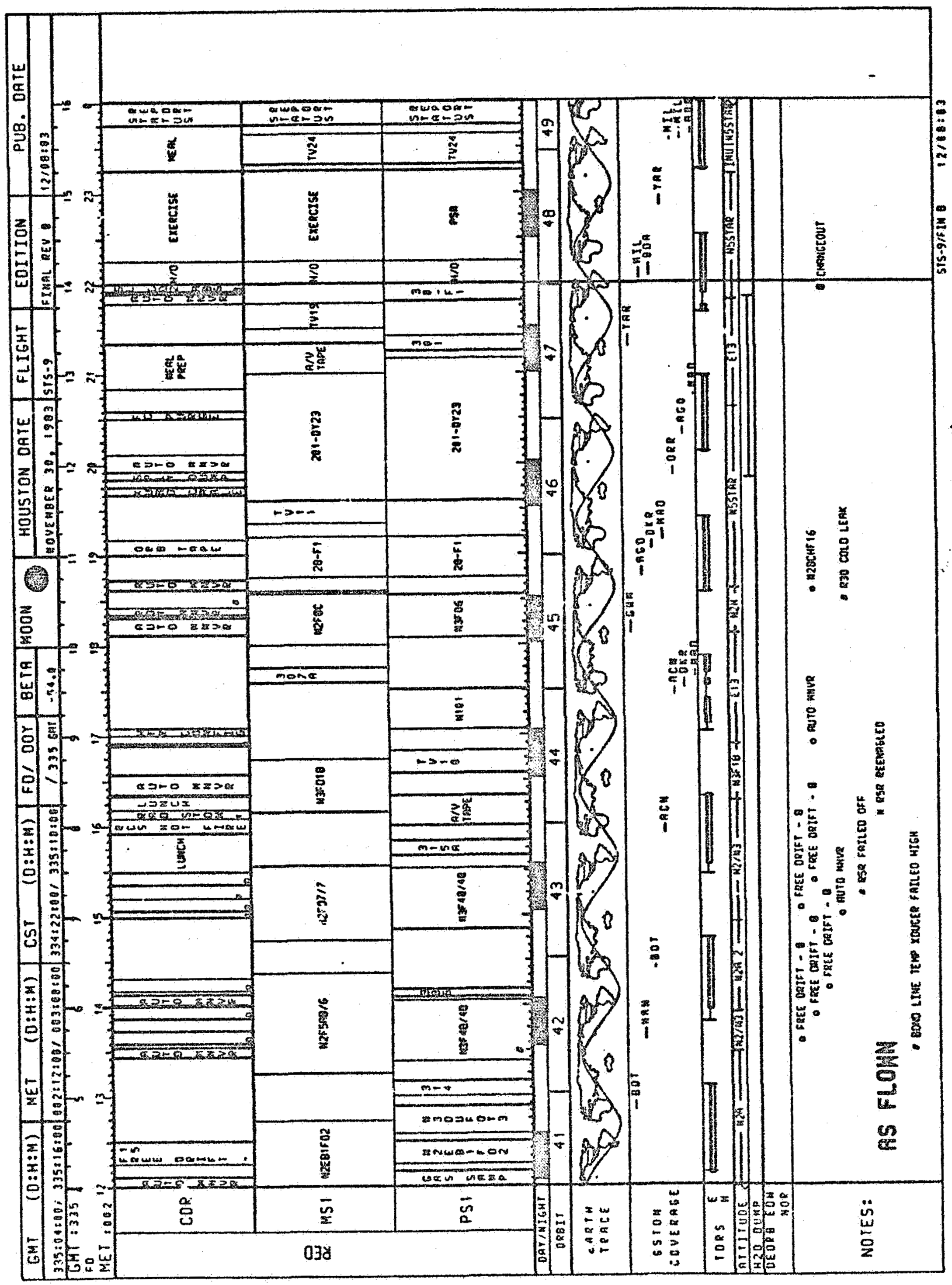

Figure 1.- As-flown crew activity plan (continued).

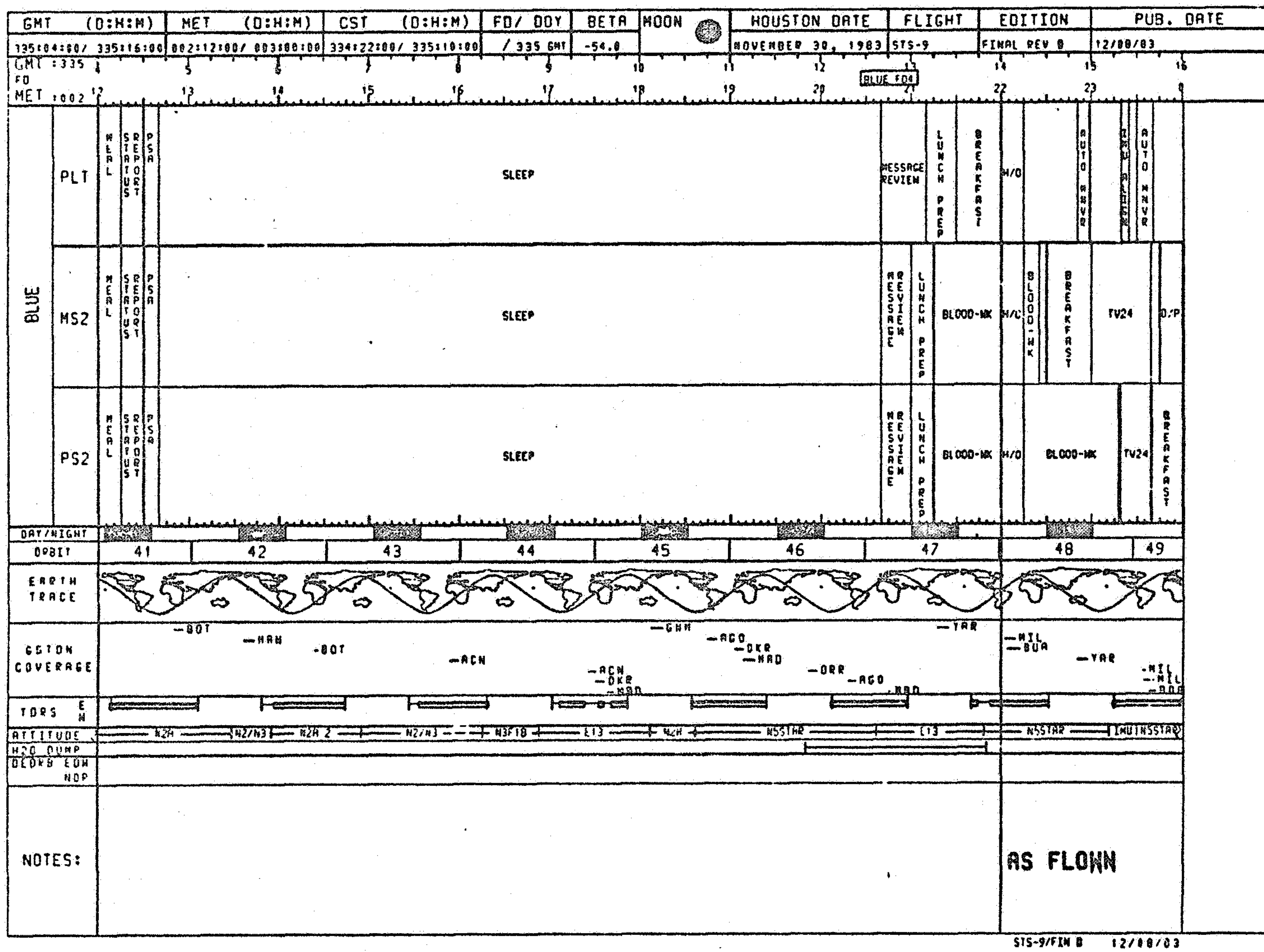

Figure 1.- As-flown crew activity plan (continued).

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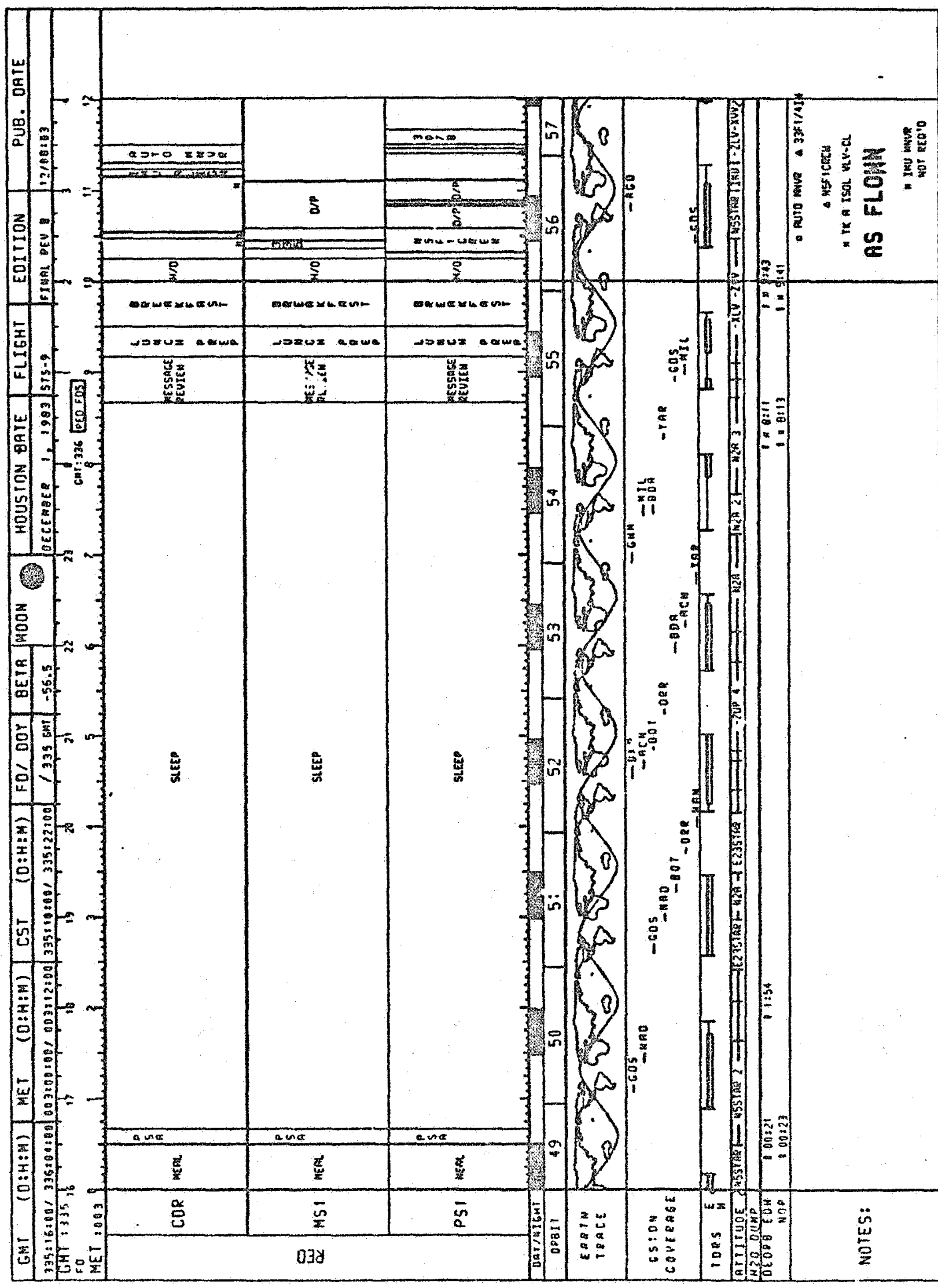

Figure 1.- As-flown crew activity plan (continued).

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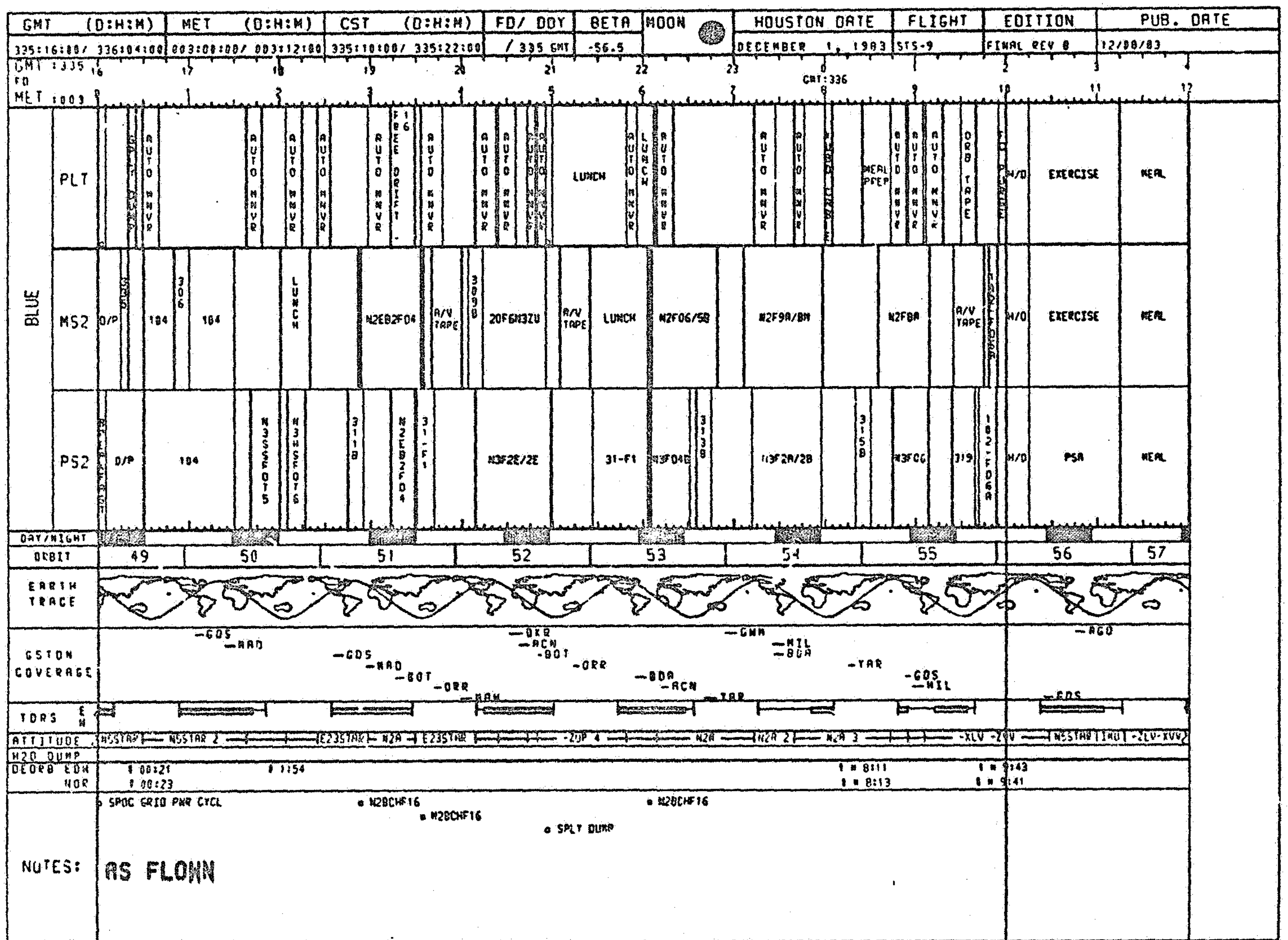

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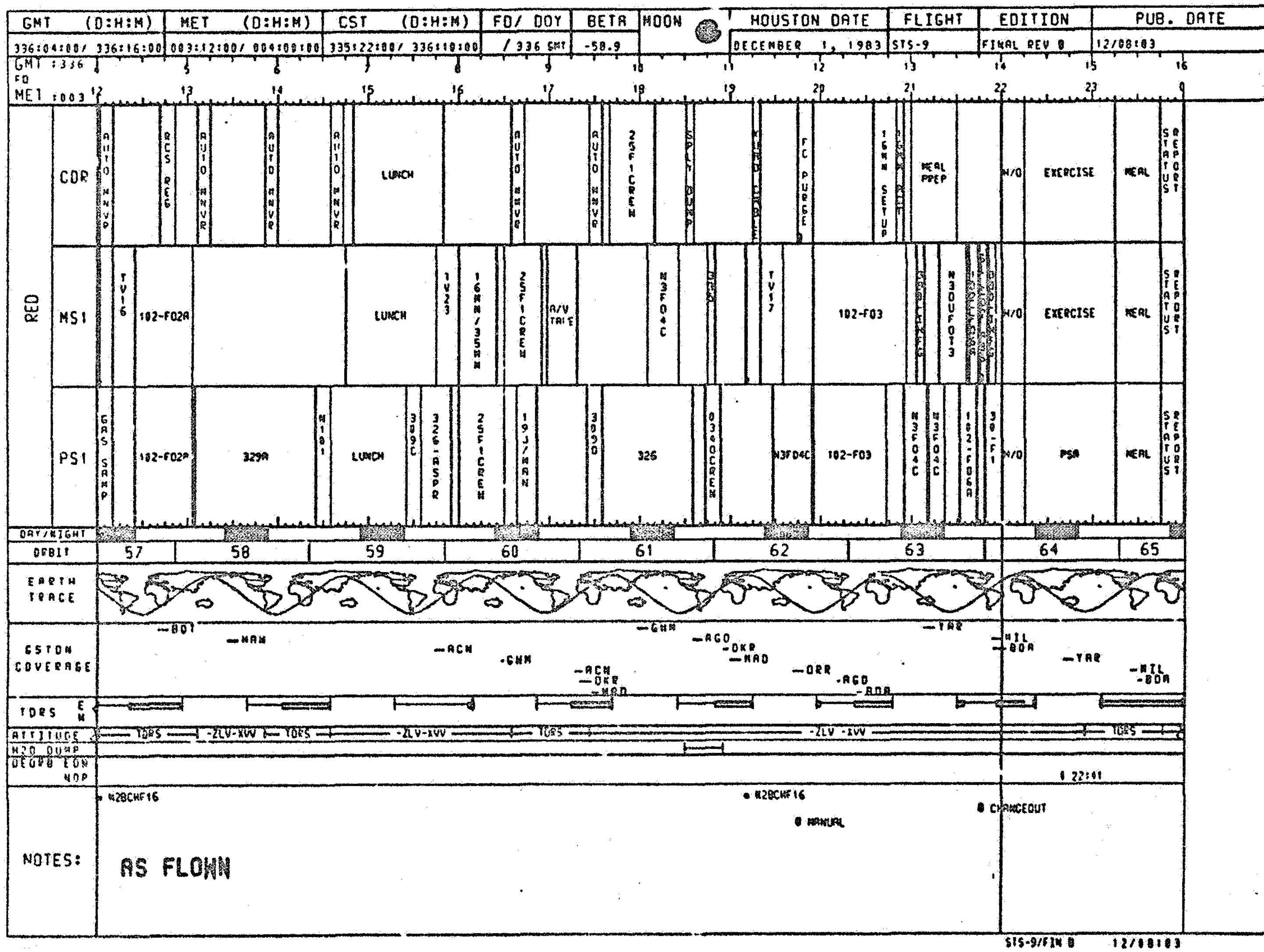

Figure 1.- As-flown crew activity plan (continued).

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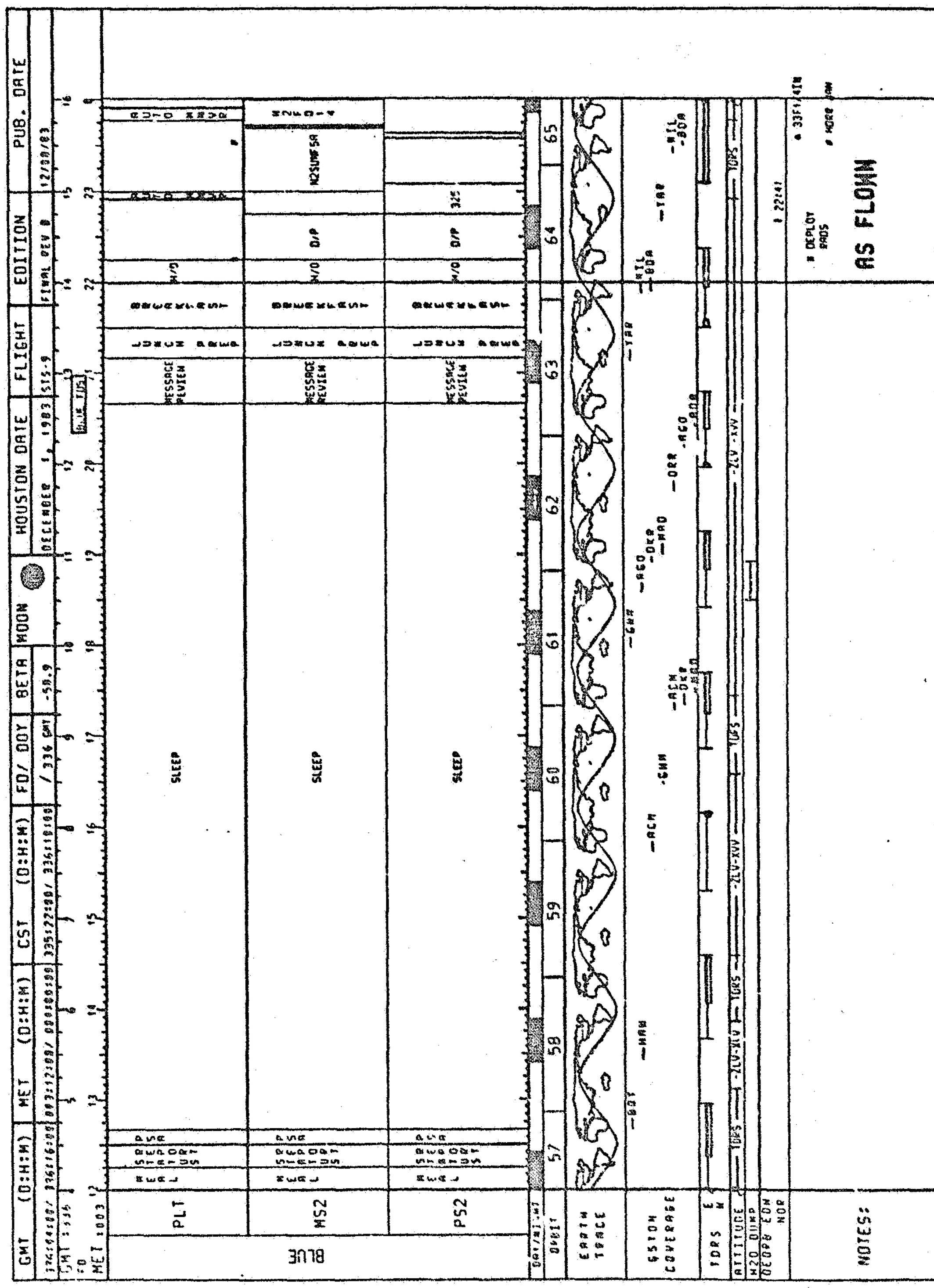

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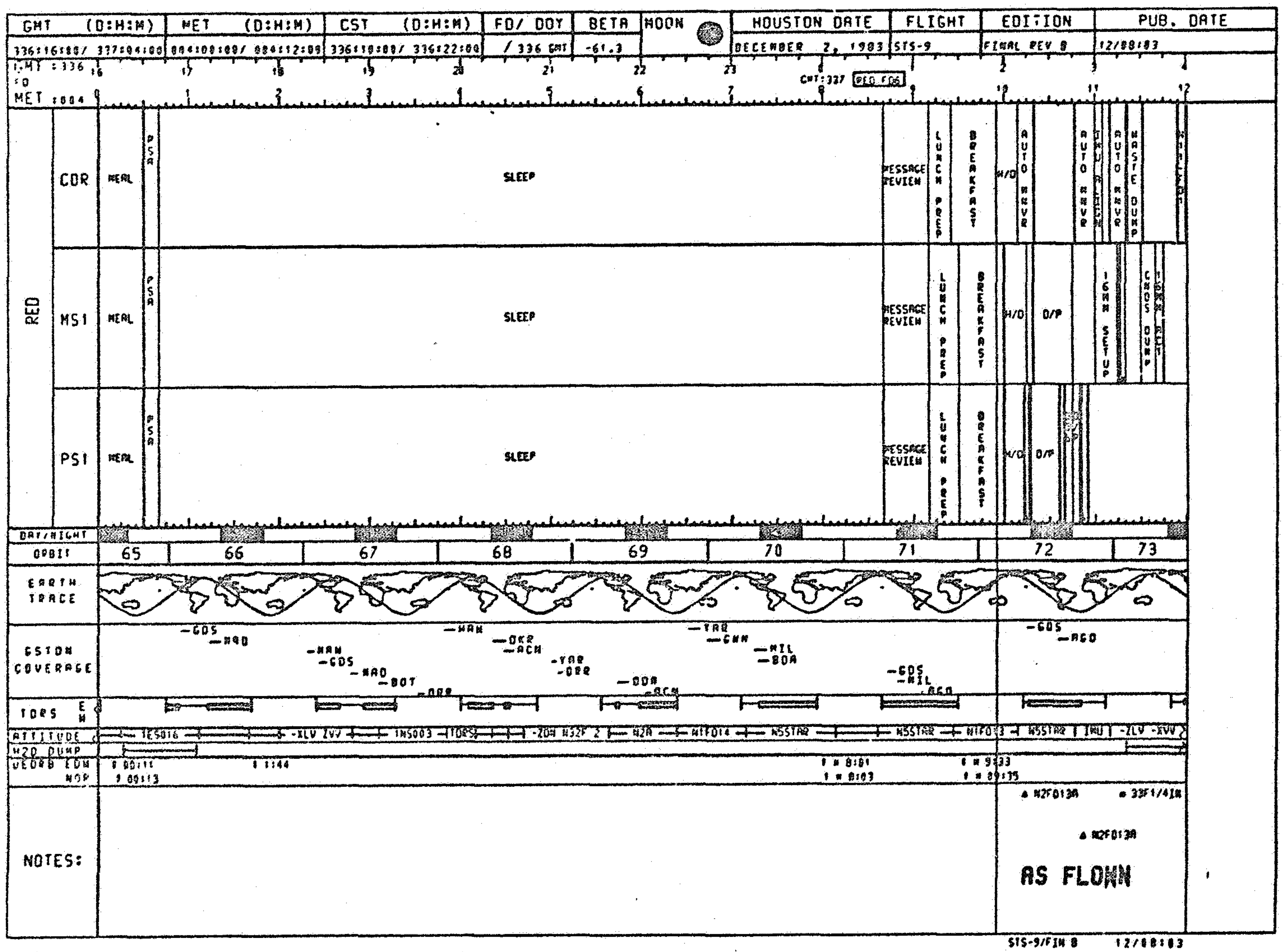

Figure 1.- As-flown crew activity plan (continued).

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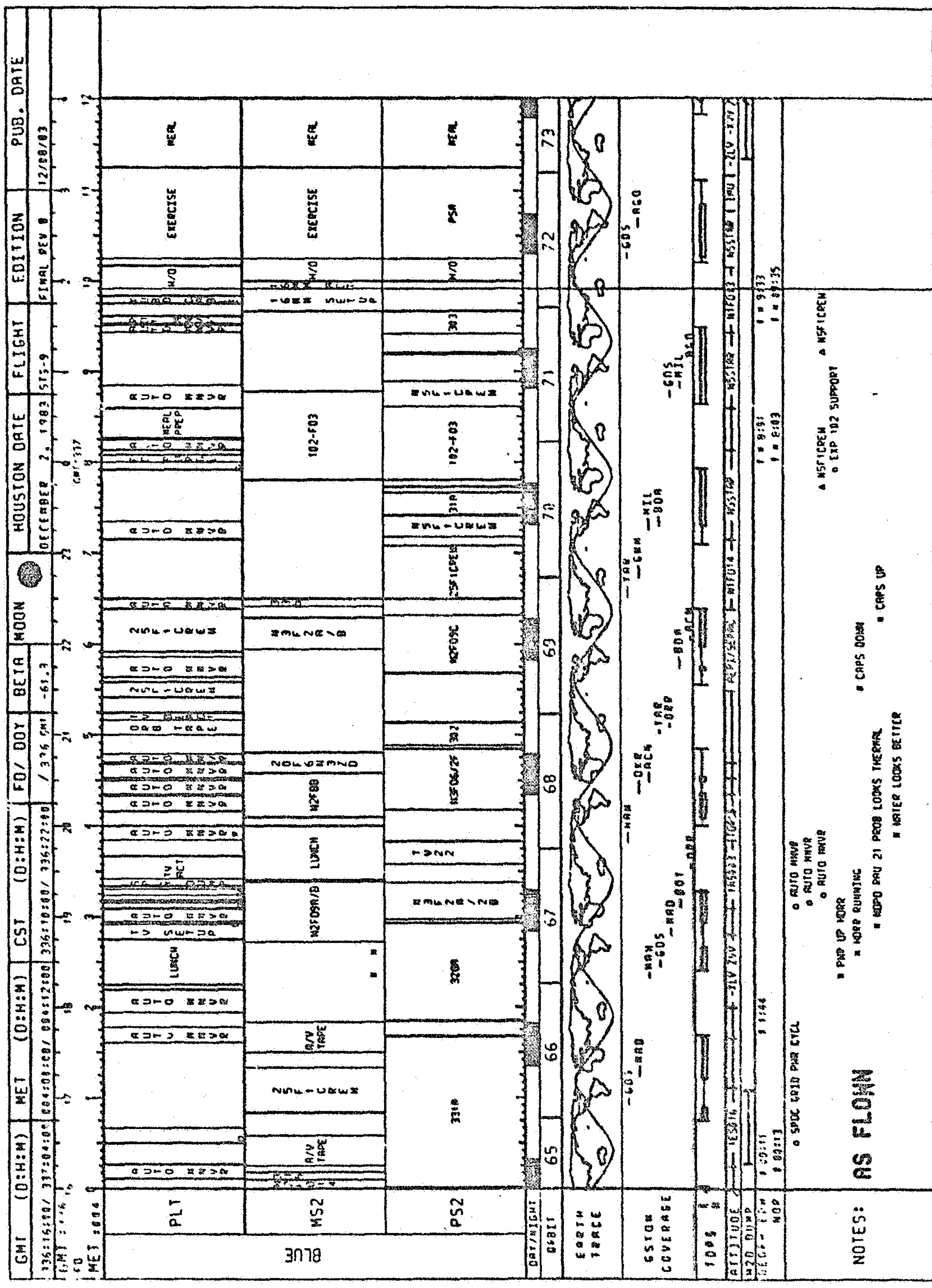

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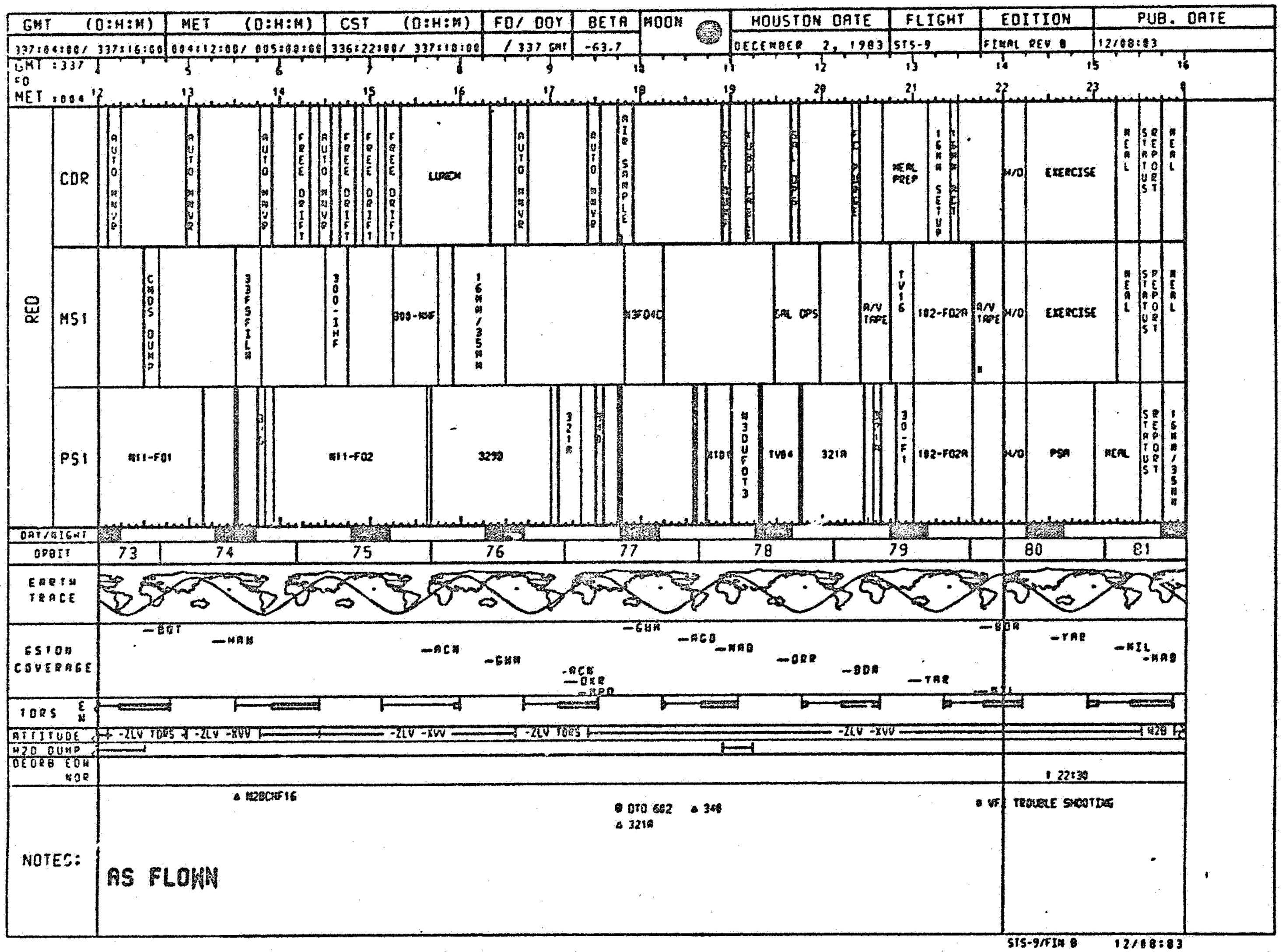

Figure 1.- As-flown crew activity plan (continued).

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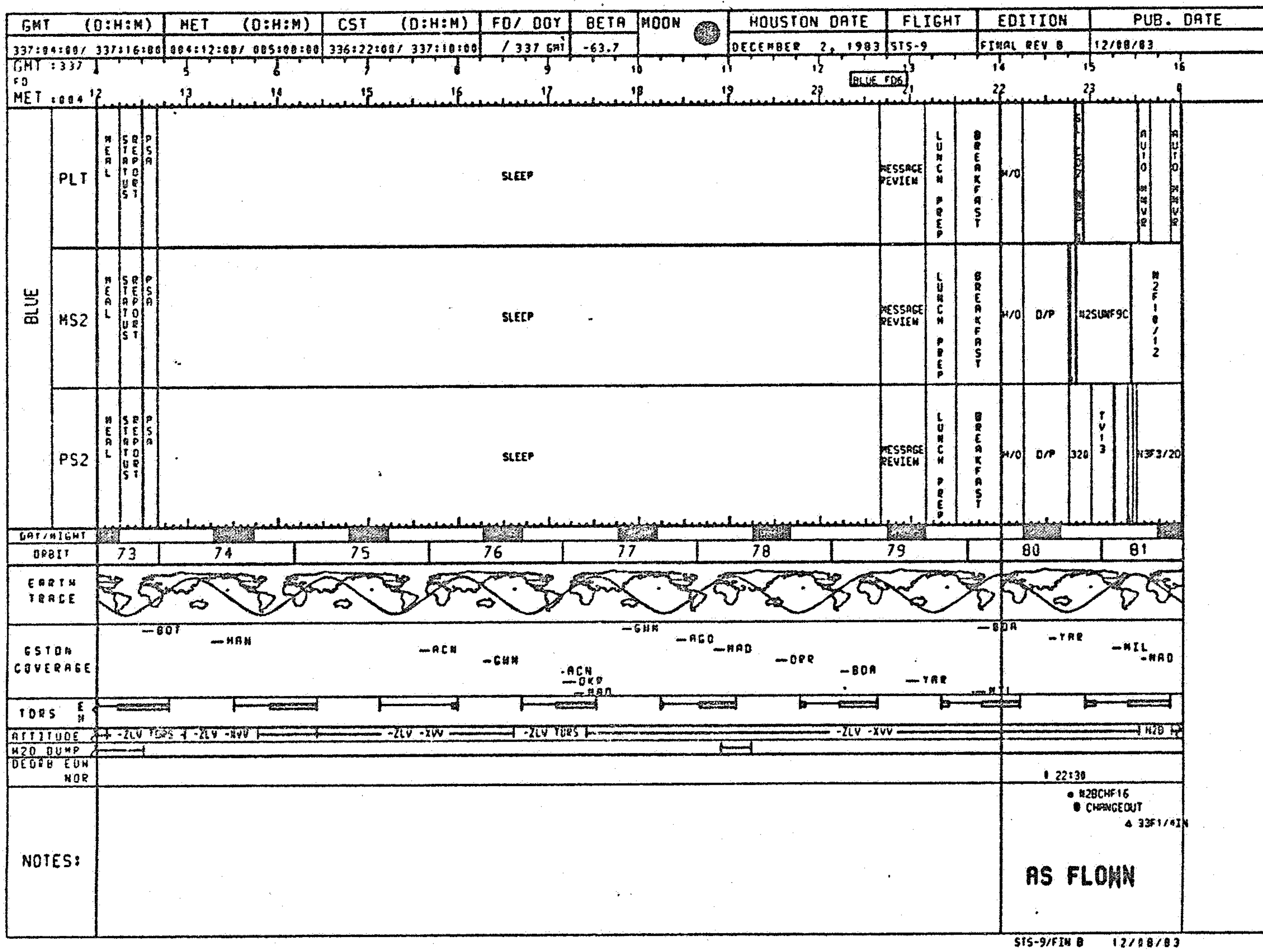

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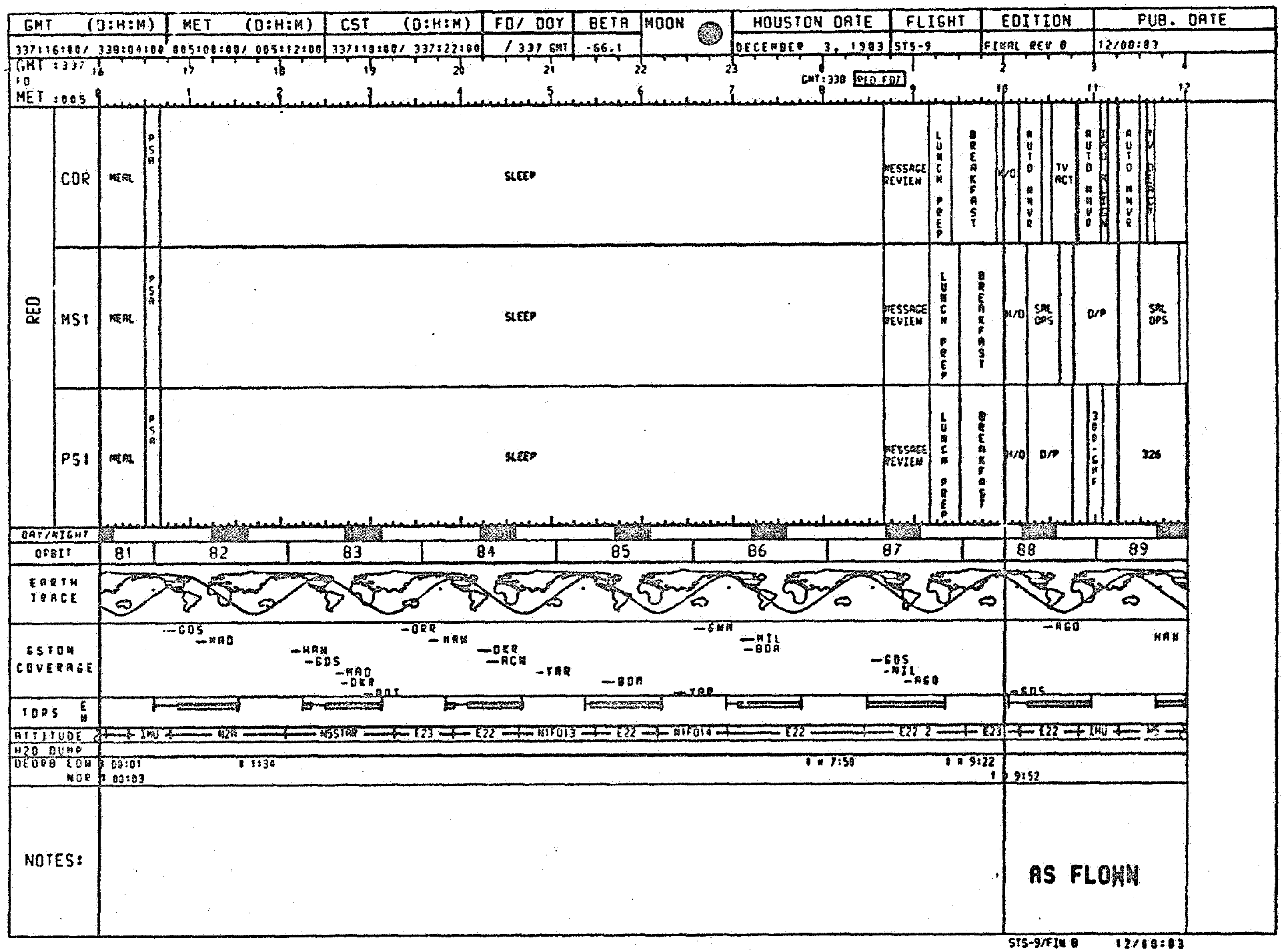

Figure 1.- As-flown crew activity plan (continued).

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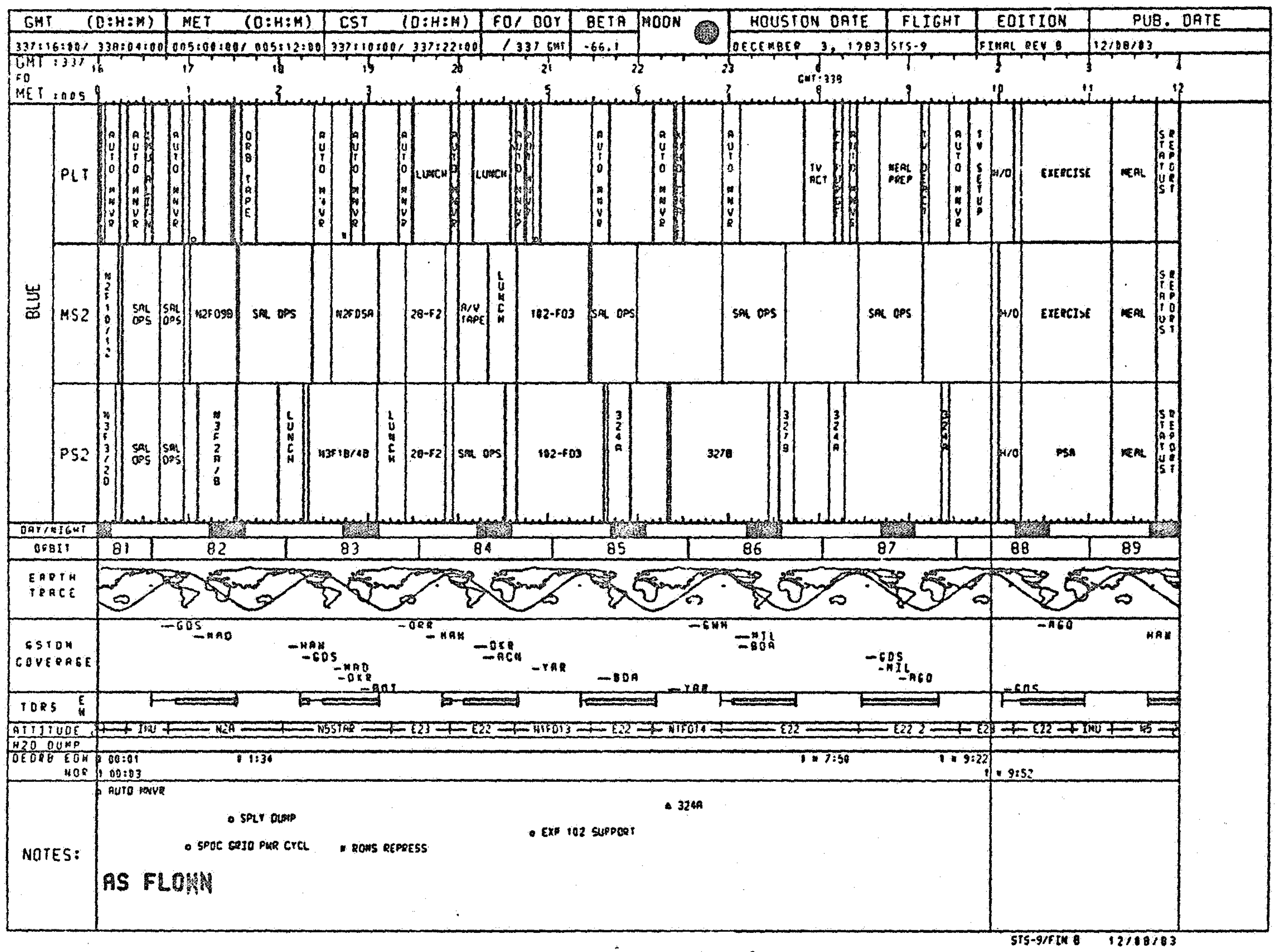

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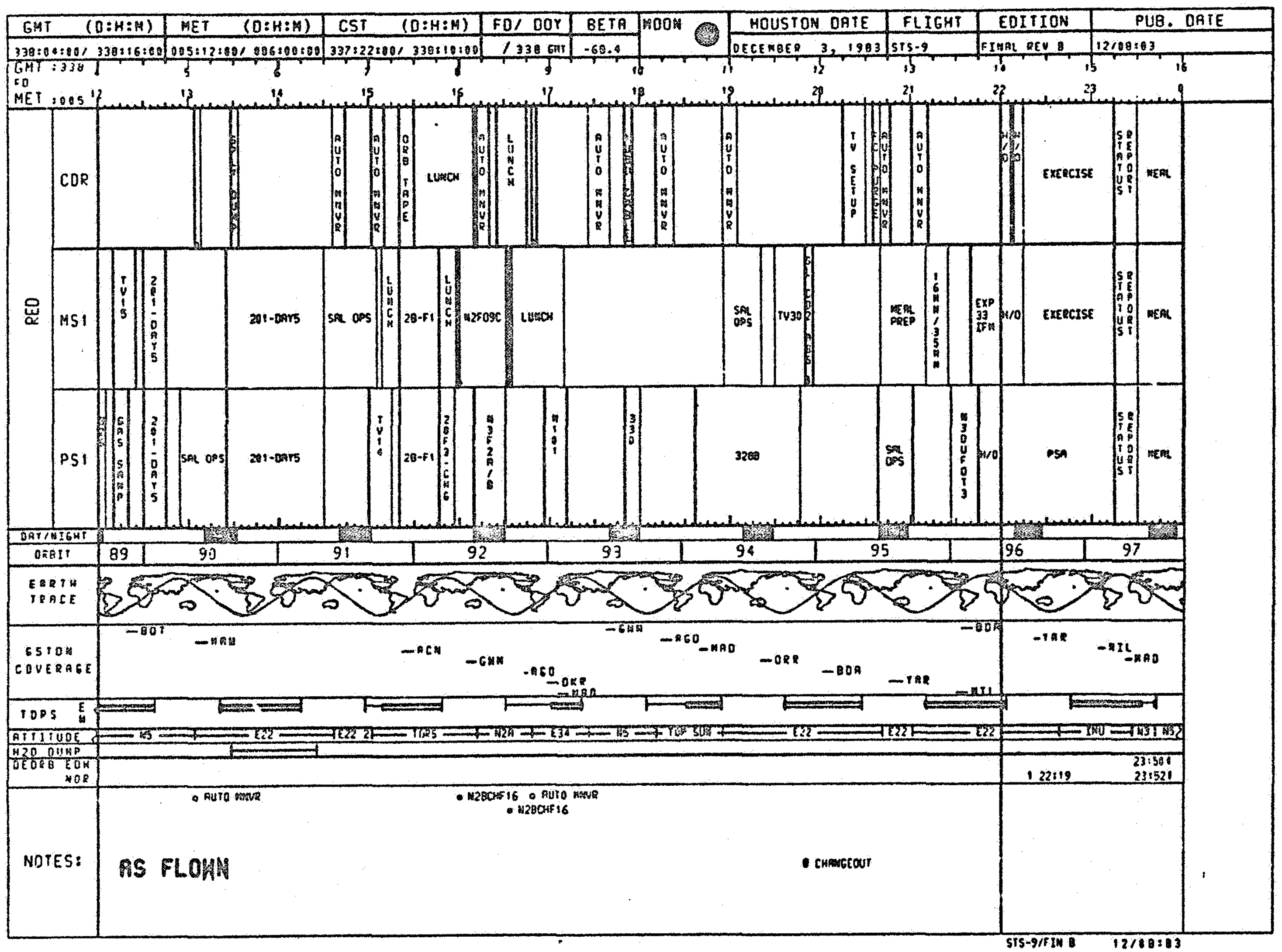

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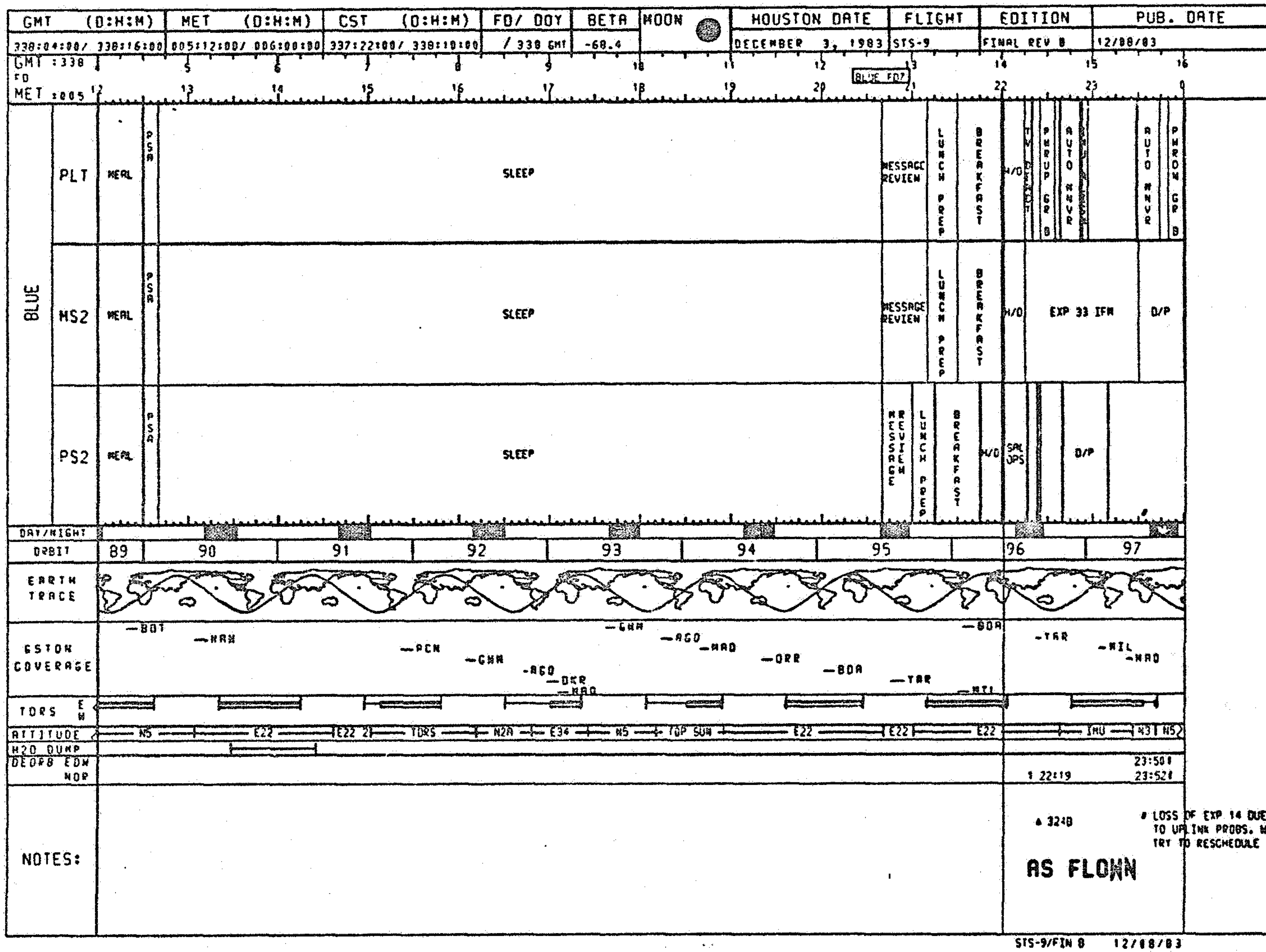

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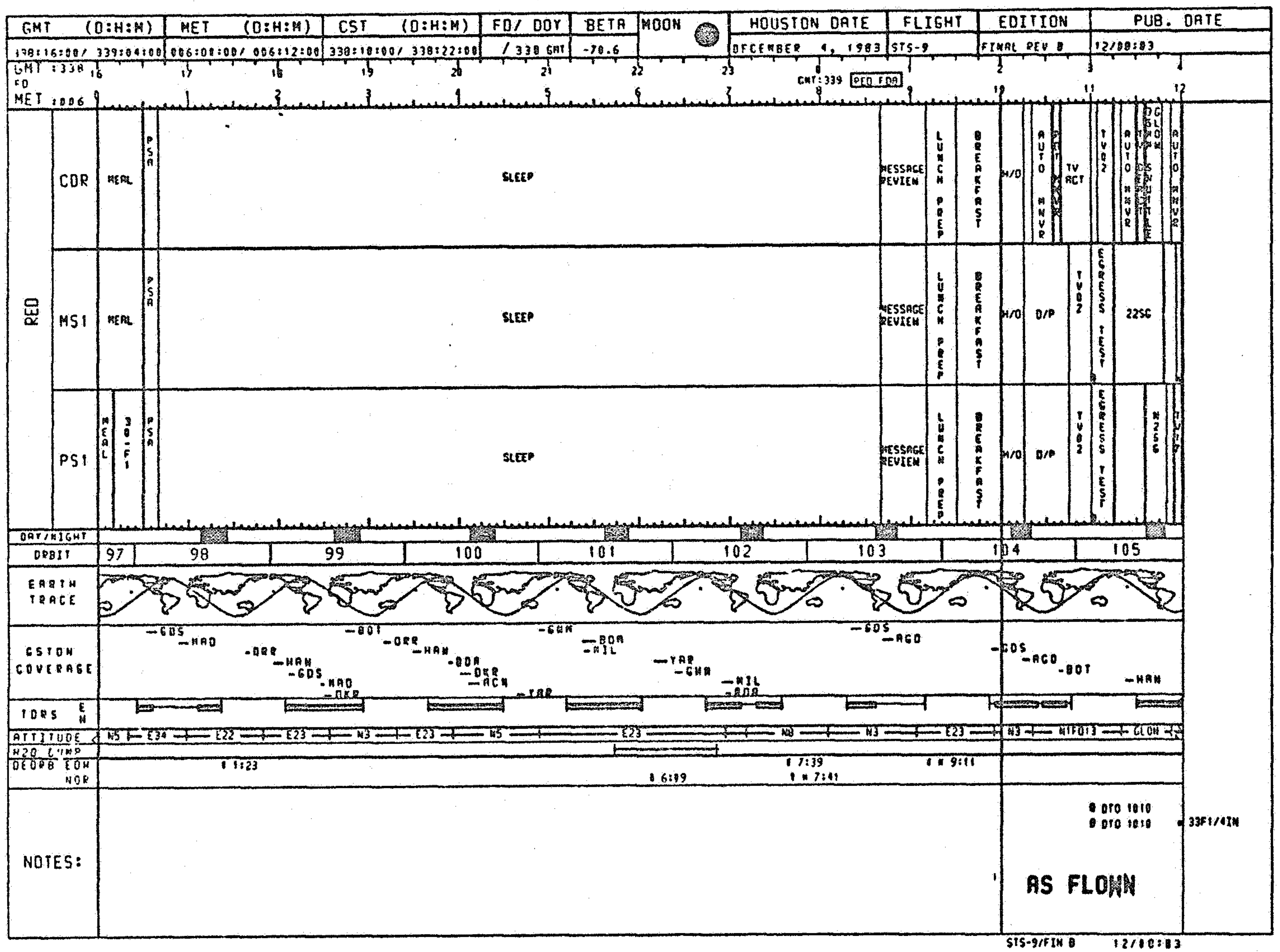

Figure 1.- As-flown crew activity plan (continued).

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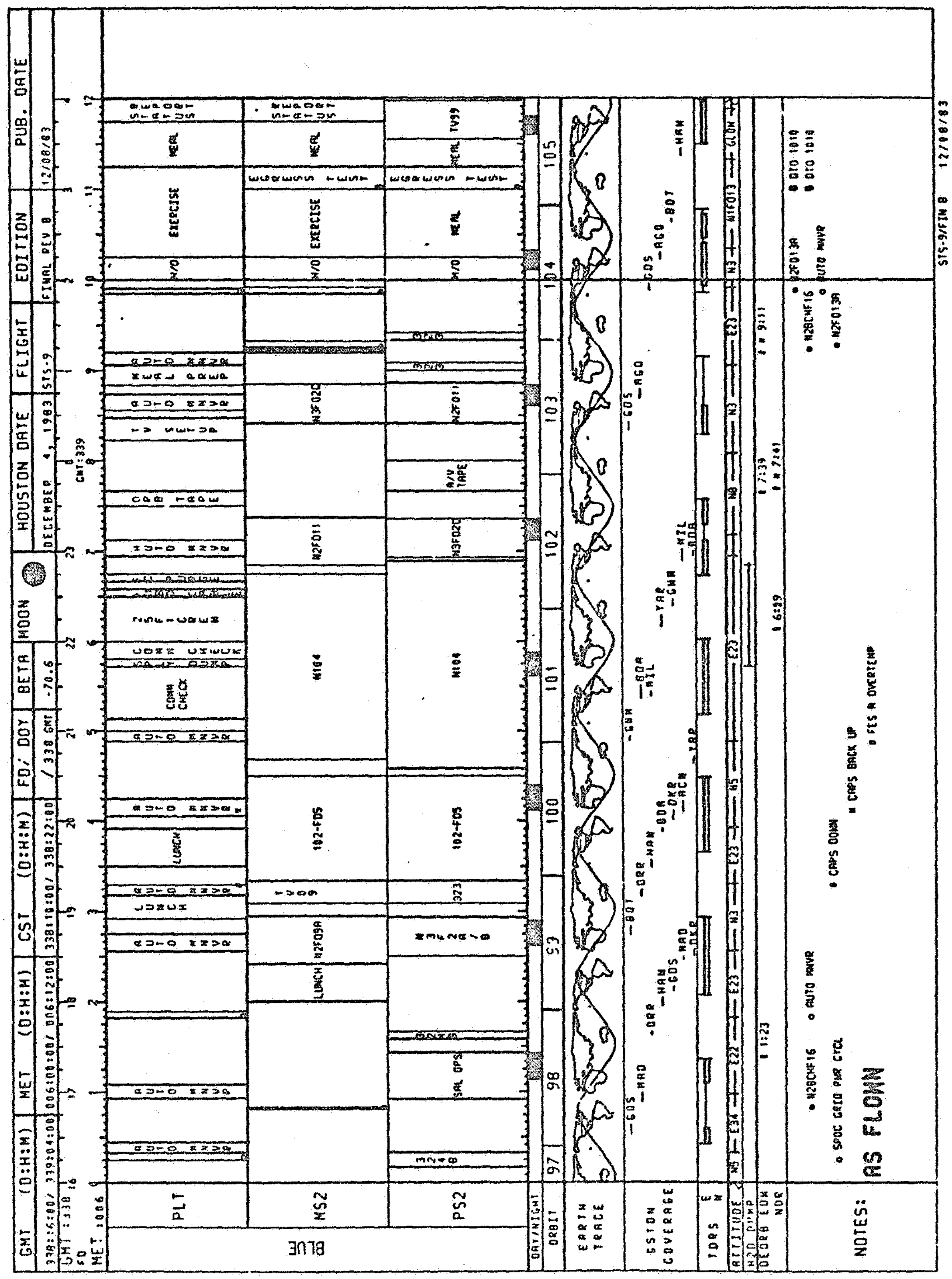

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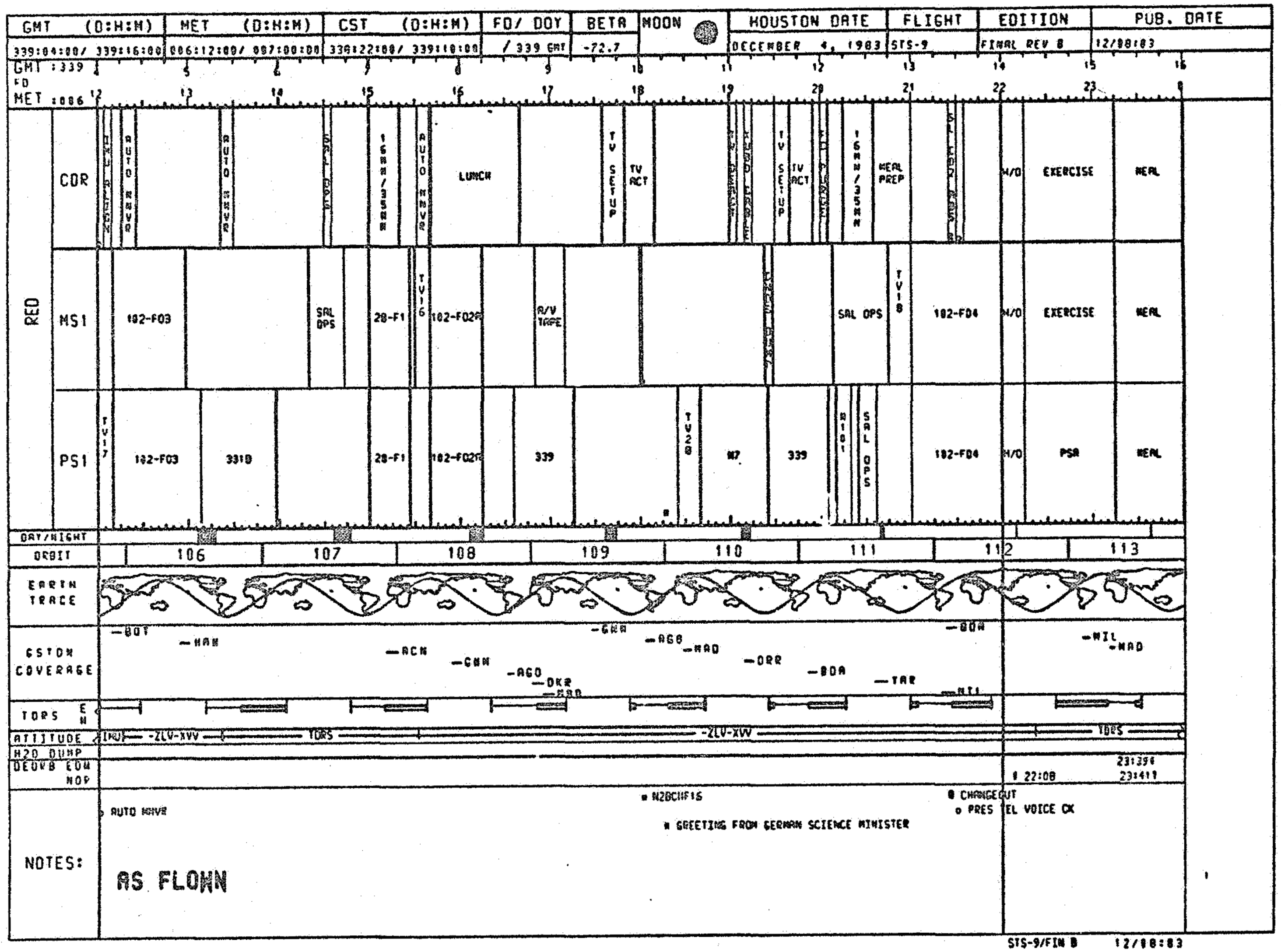

Figure 1.- As-flown crew activity plan (continued).

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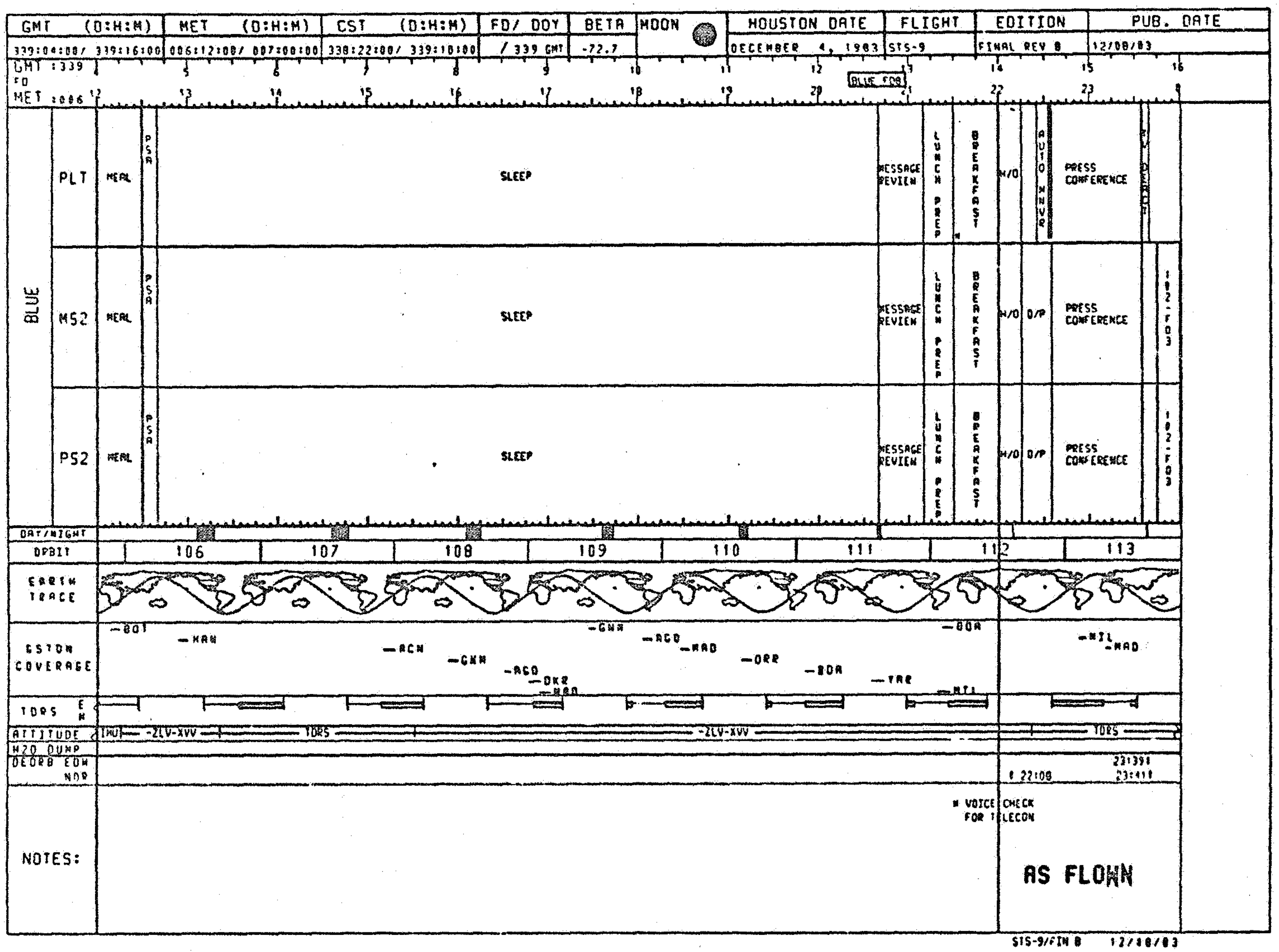

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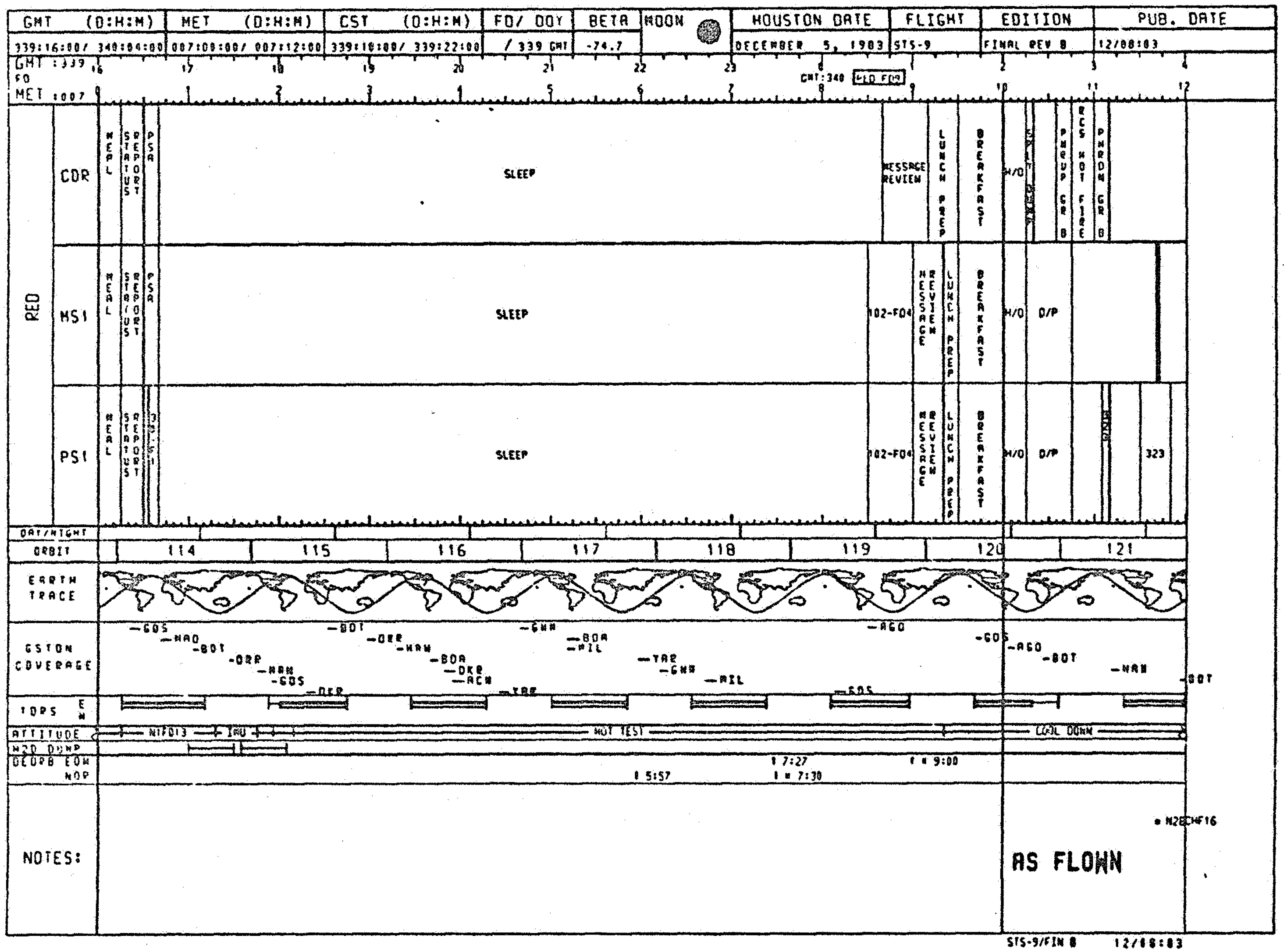

Figure 1.- As-flown crew activity plan (continued).

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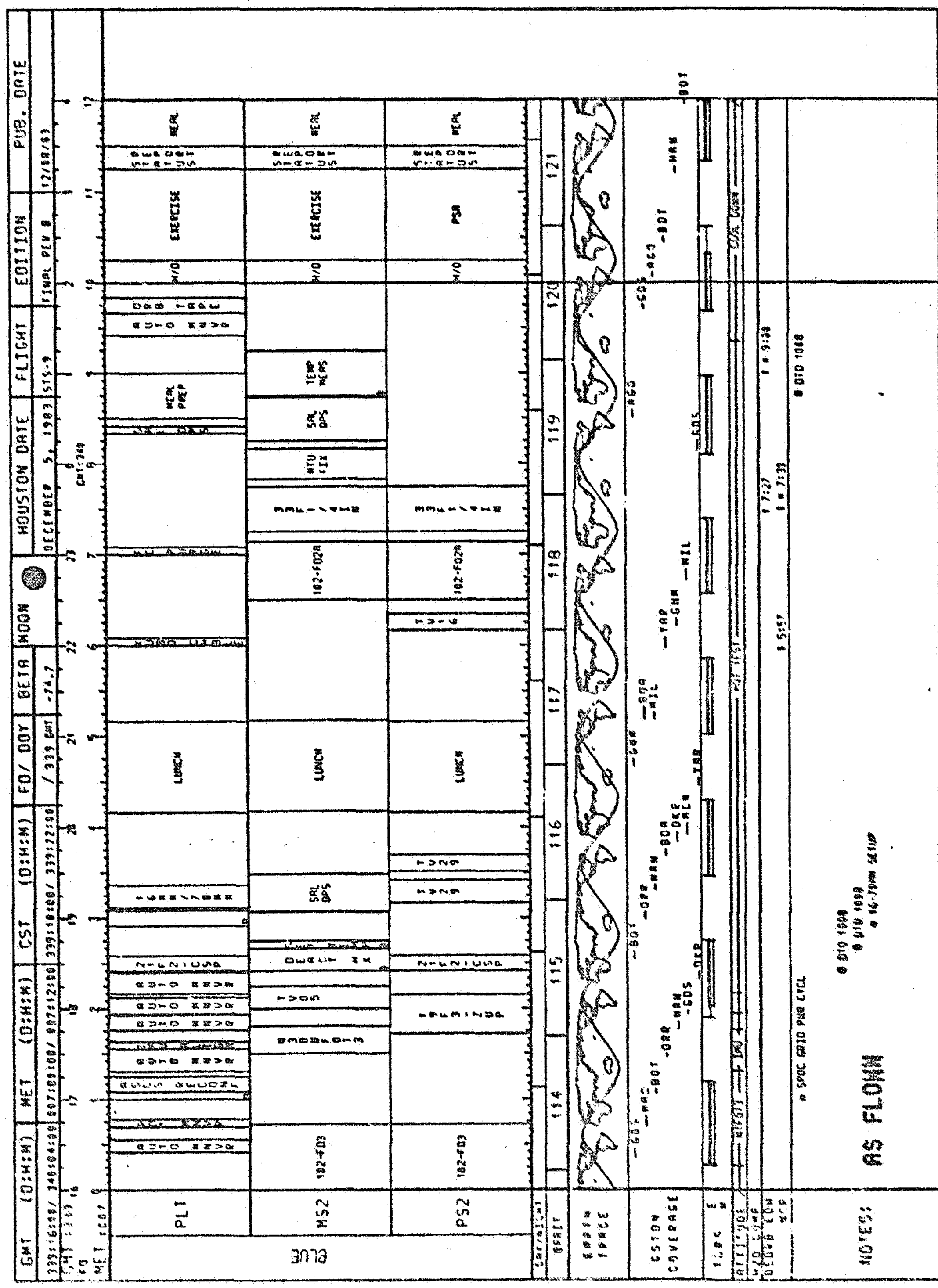

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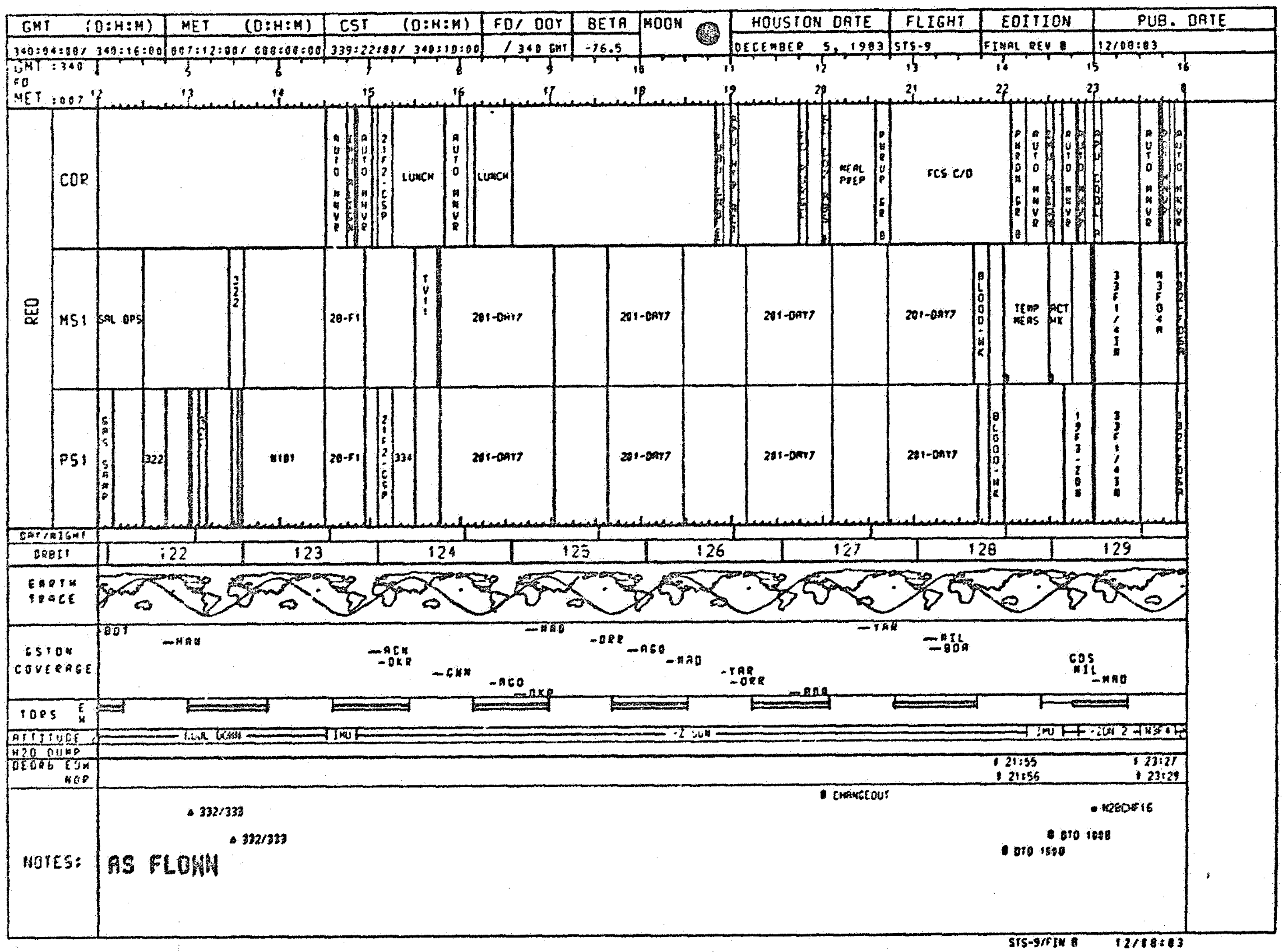

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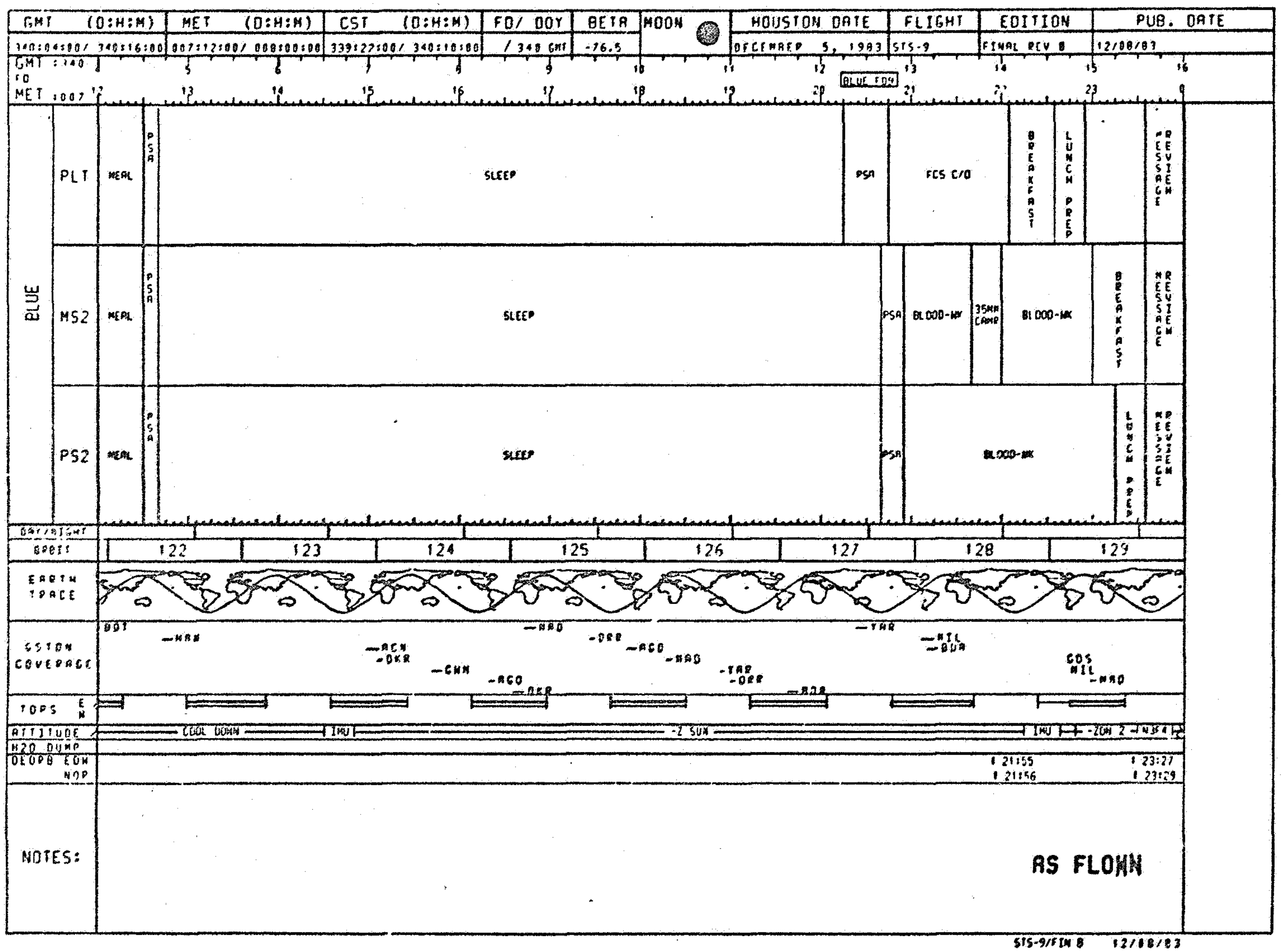

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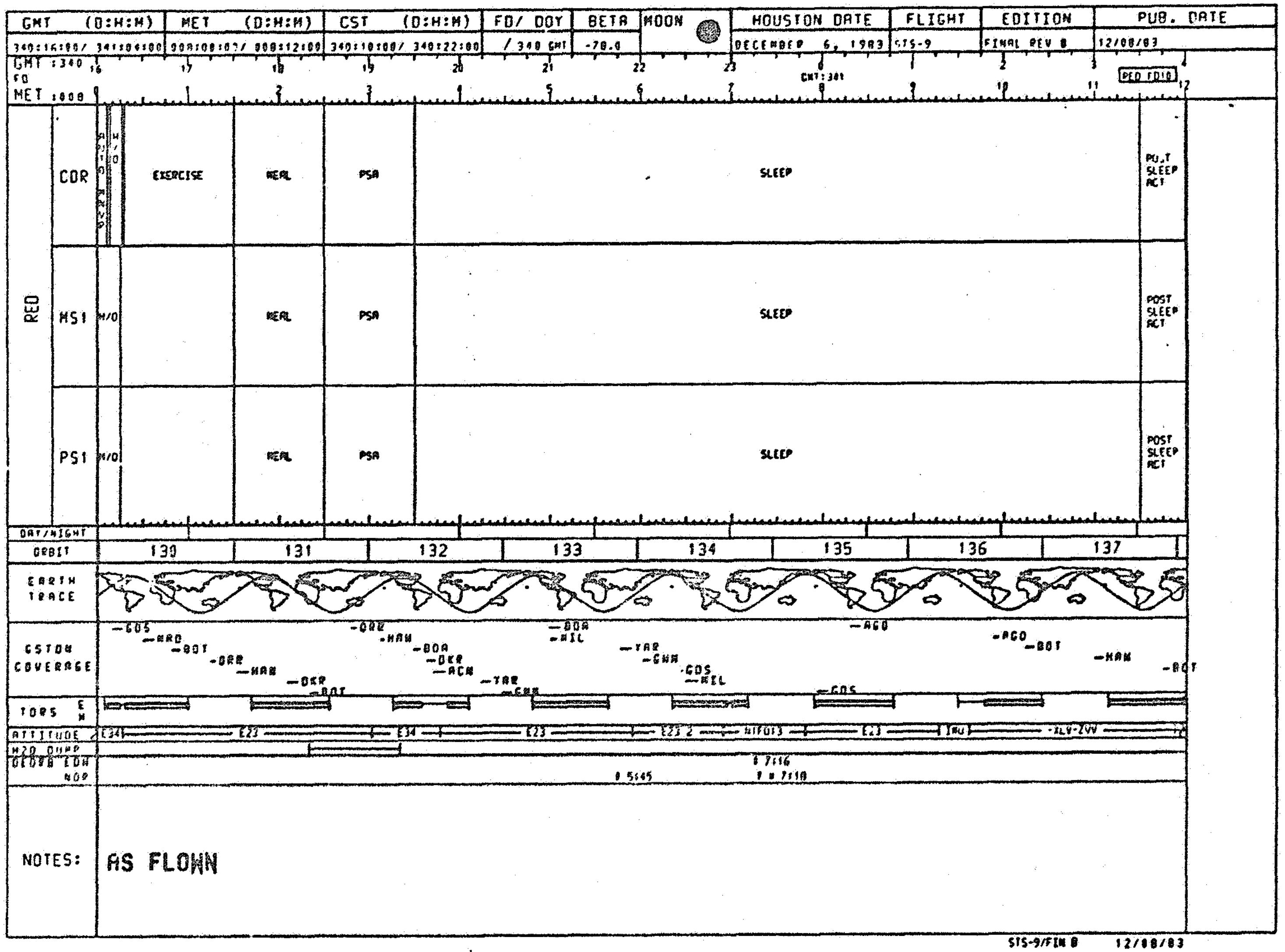

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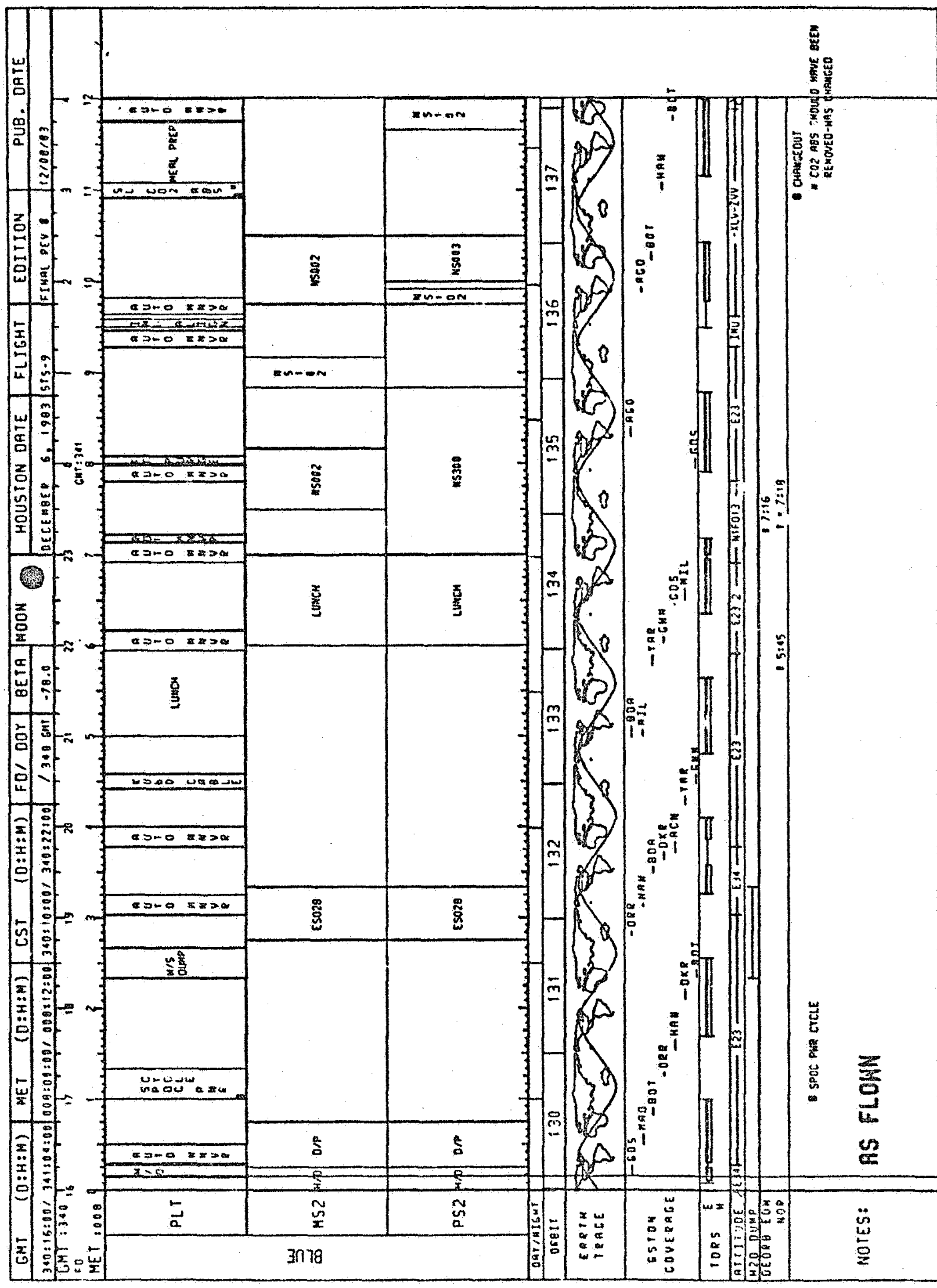

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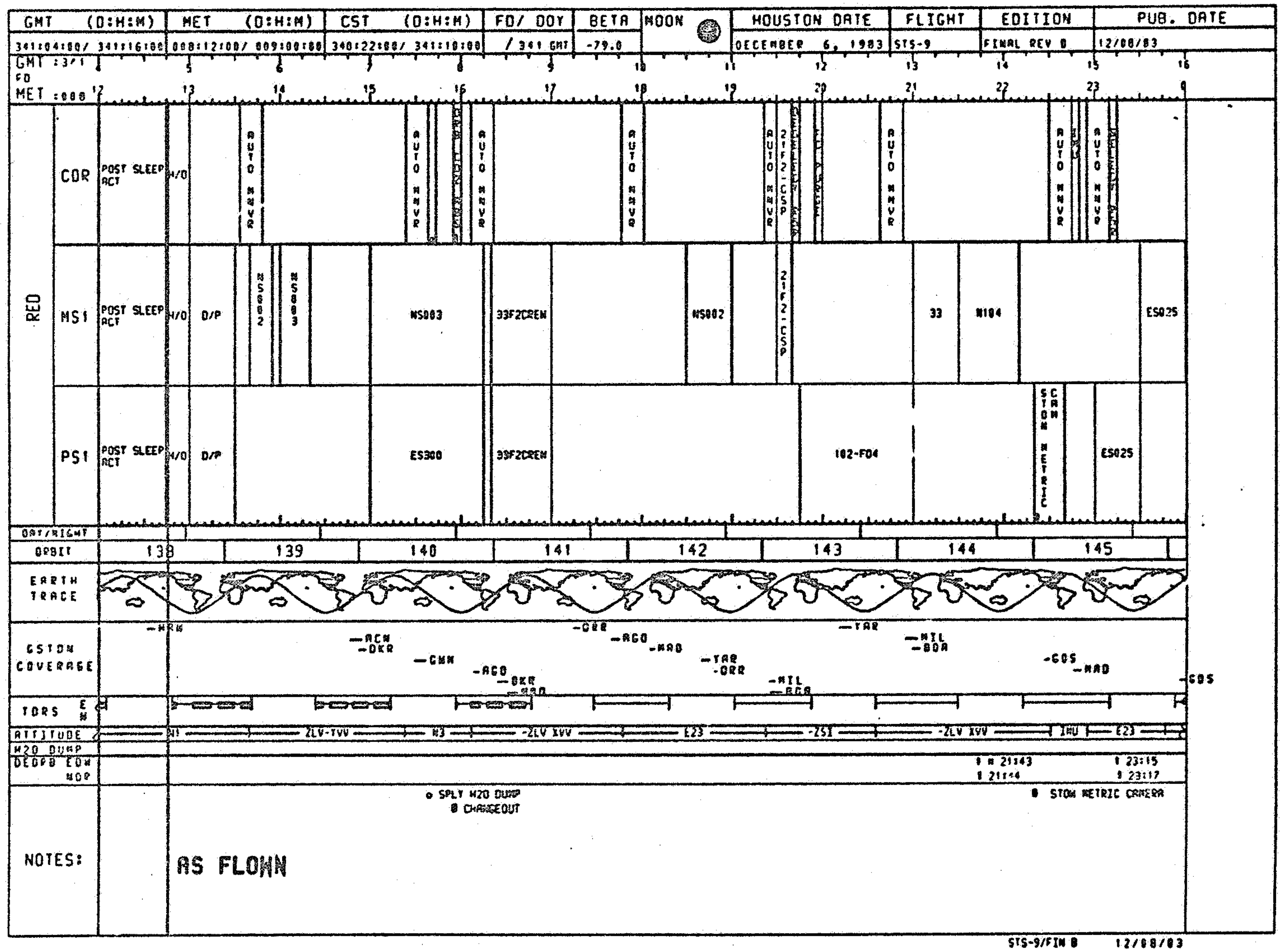

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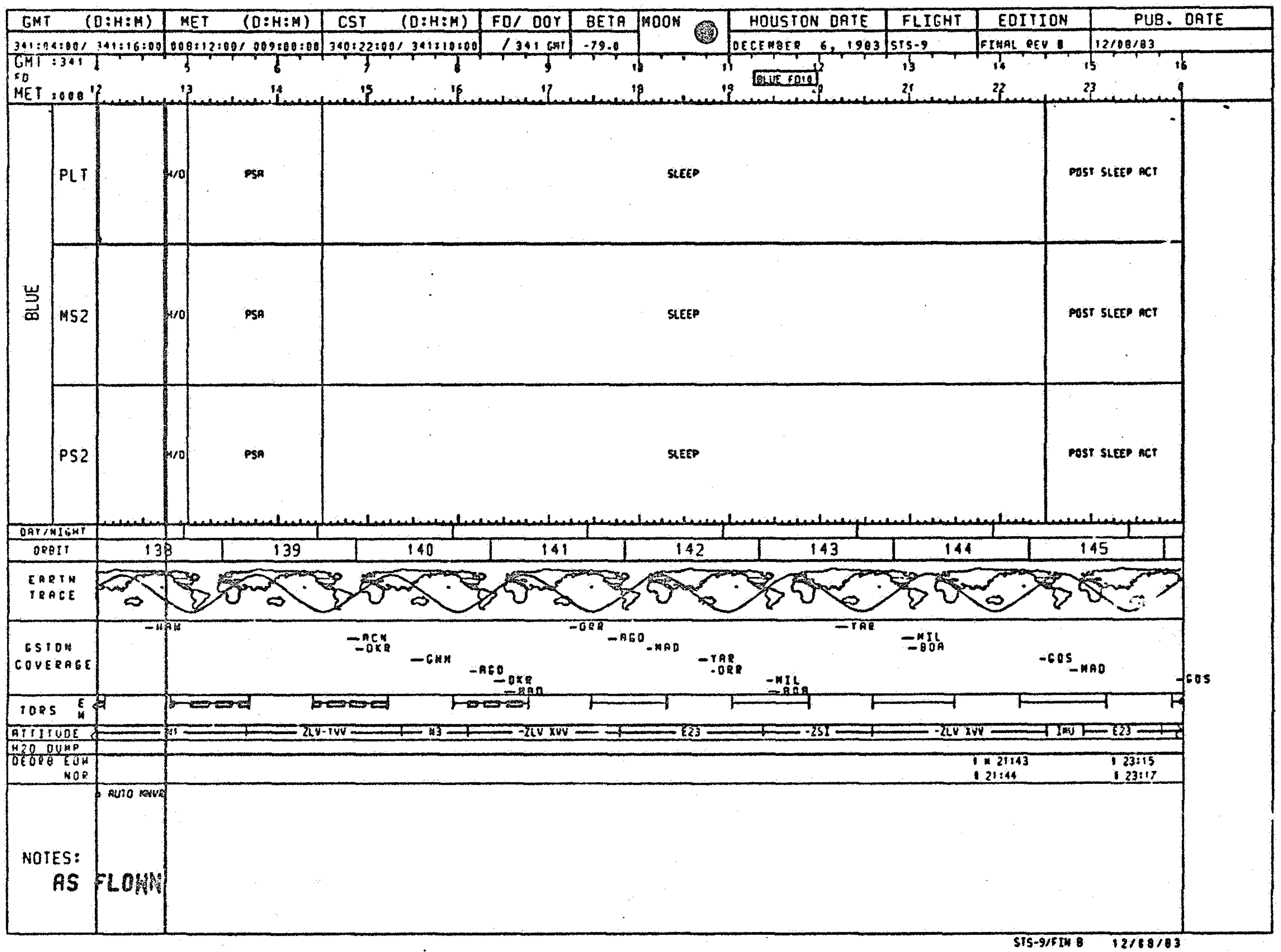

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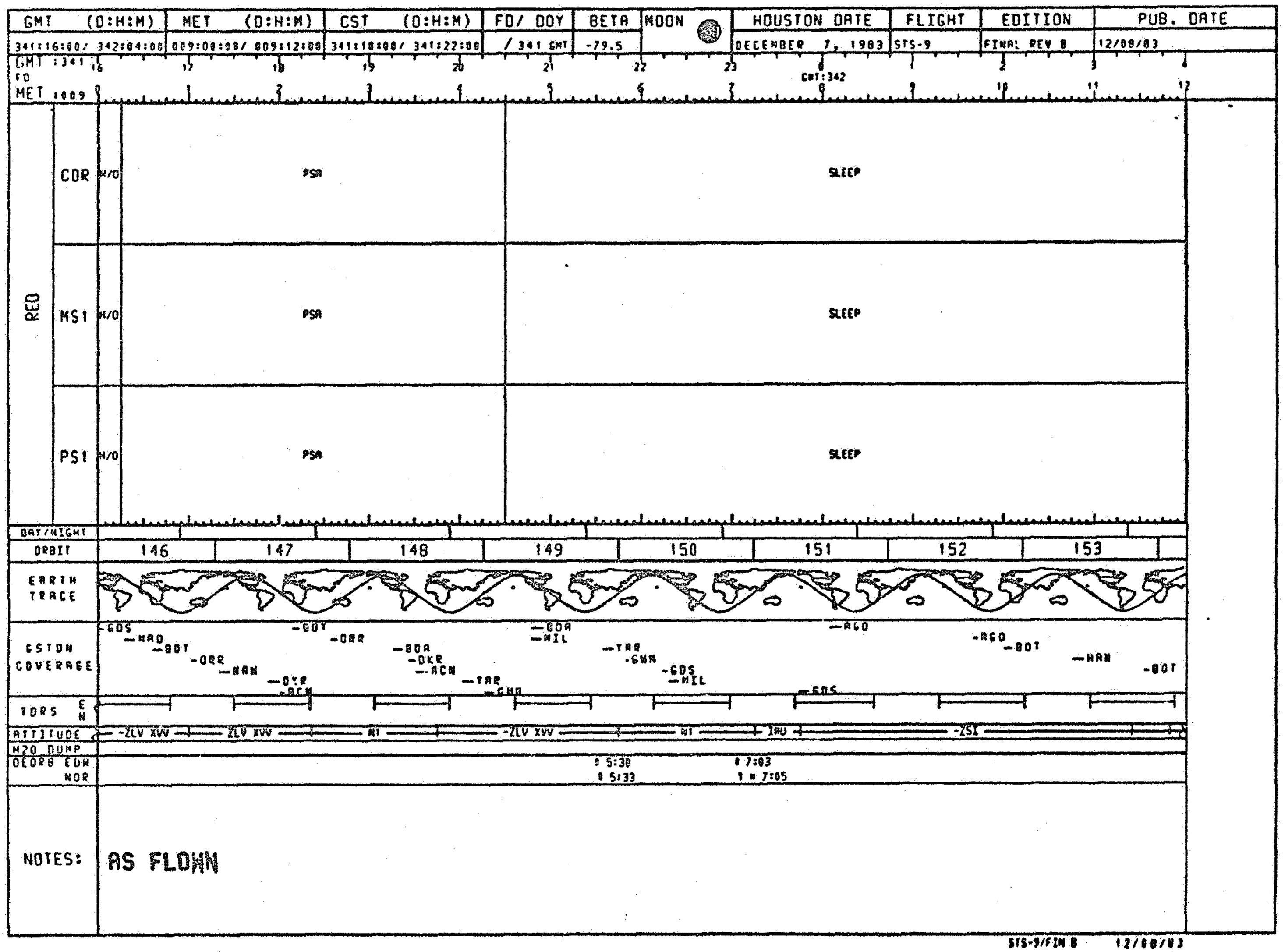

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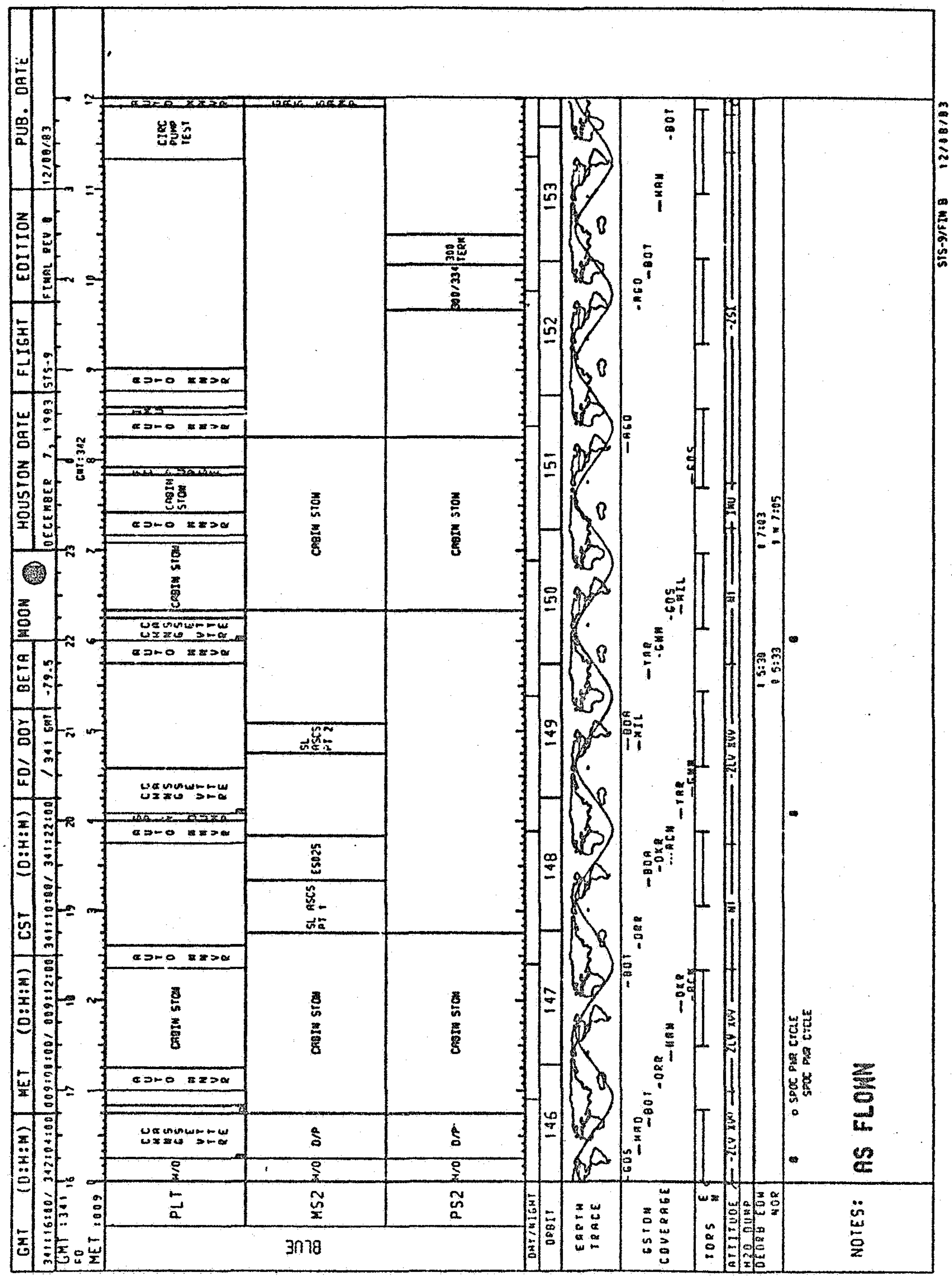

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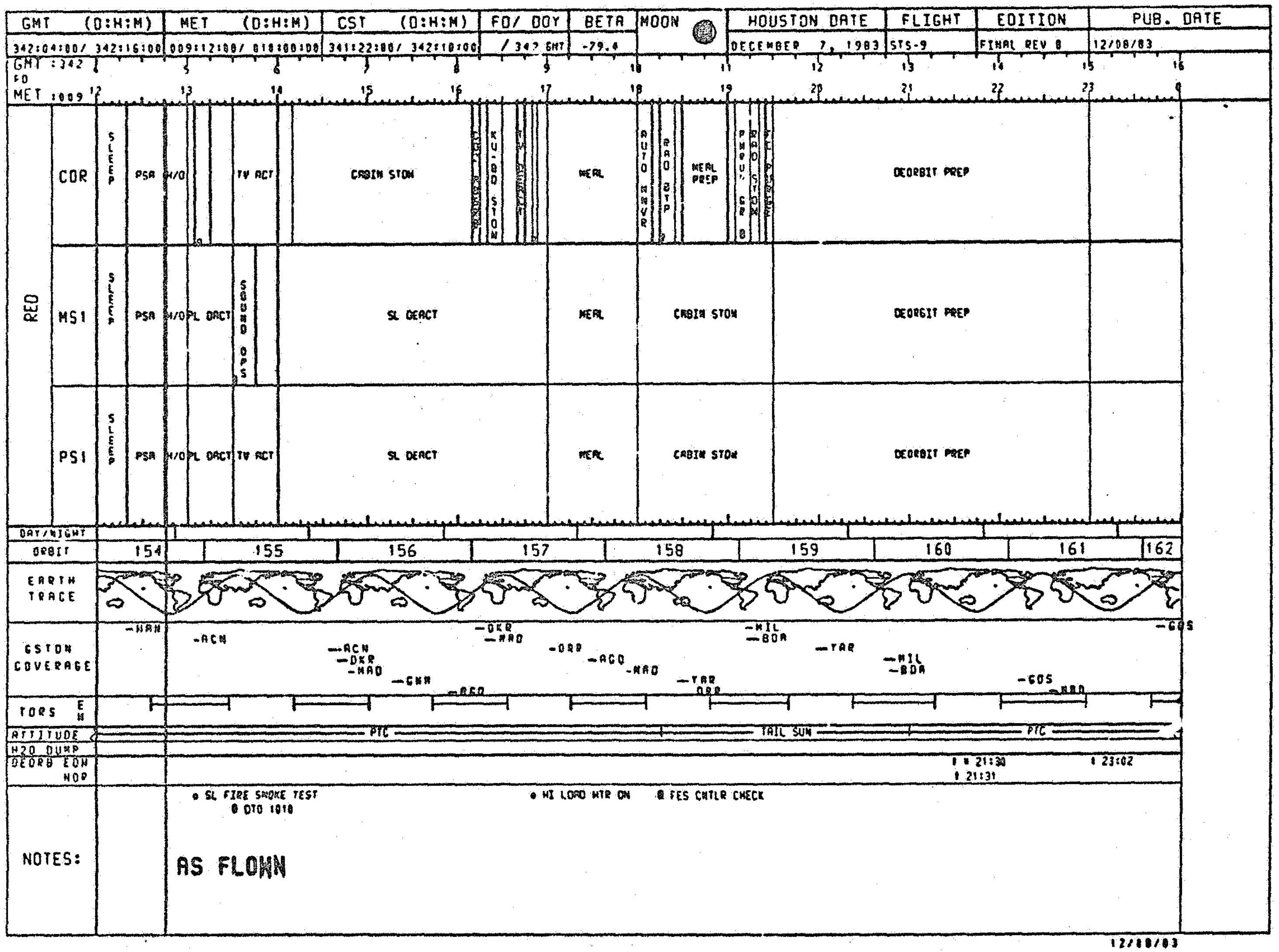

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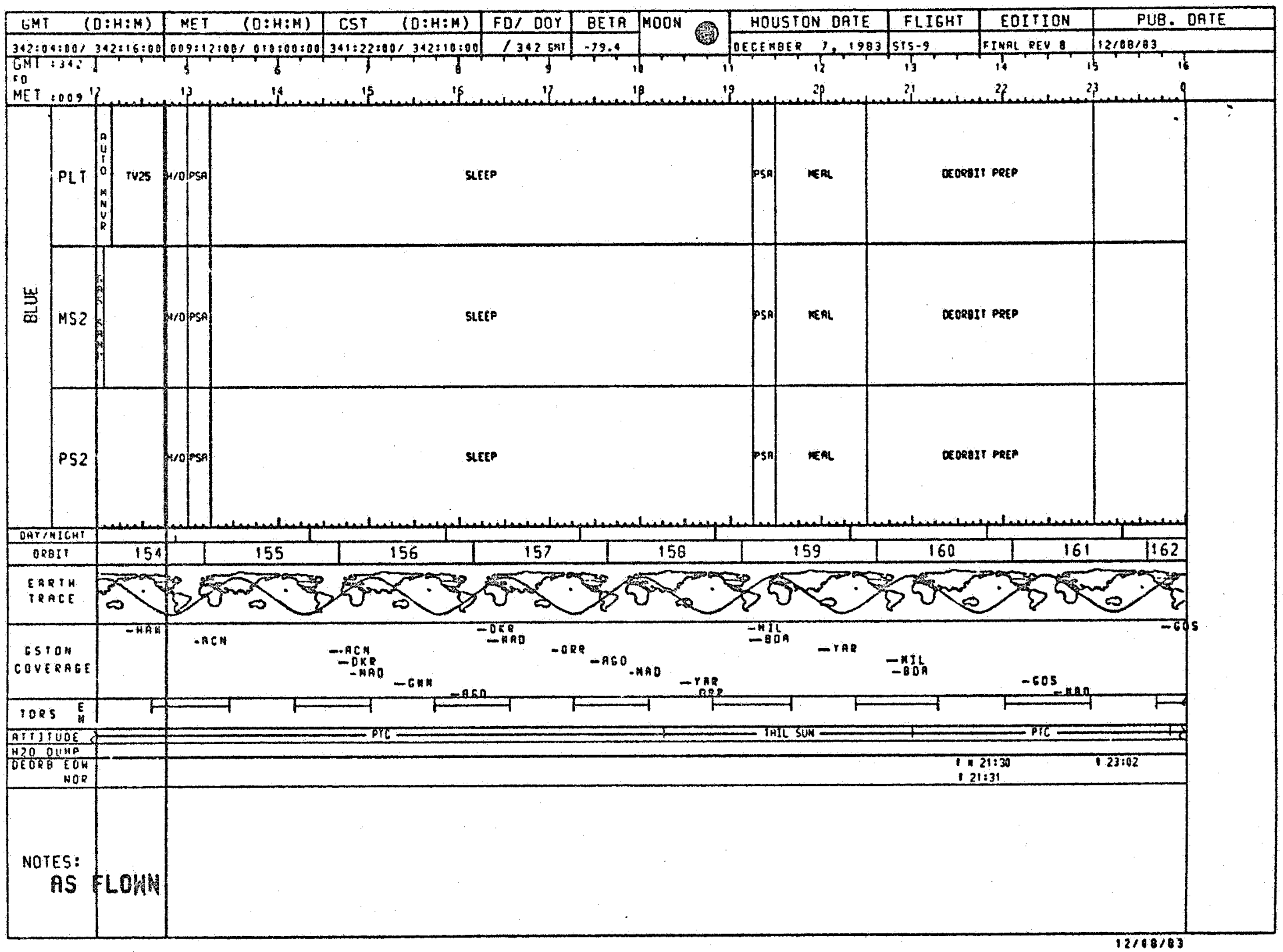

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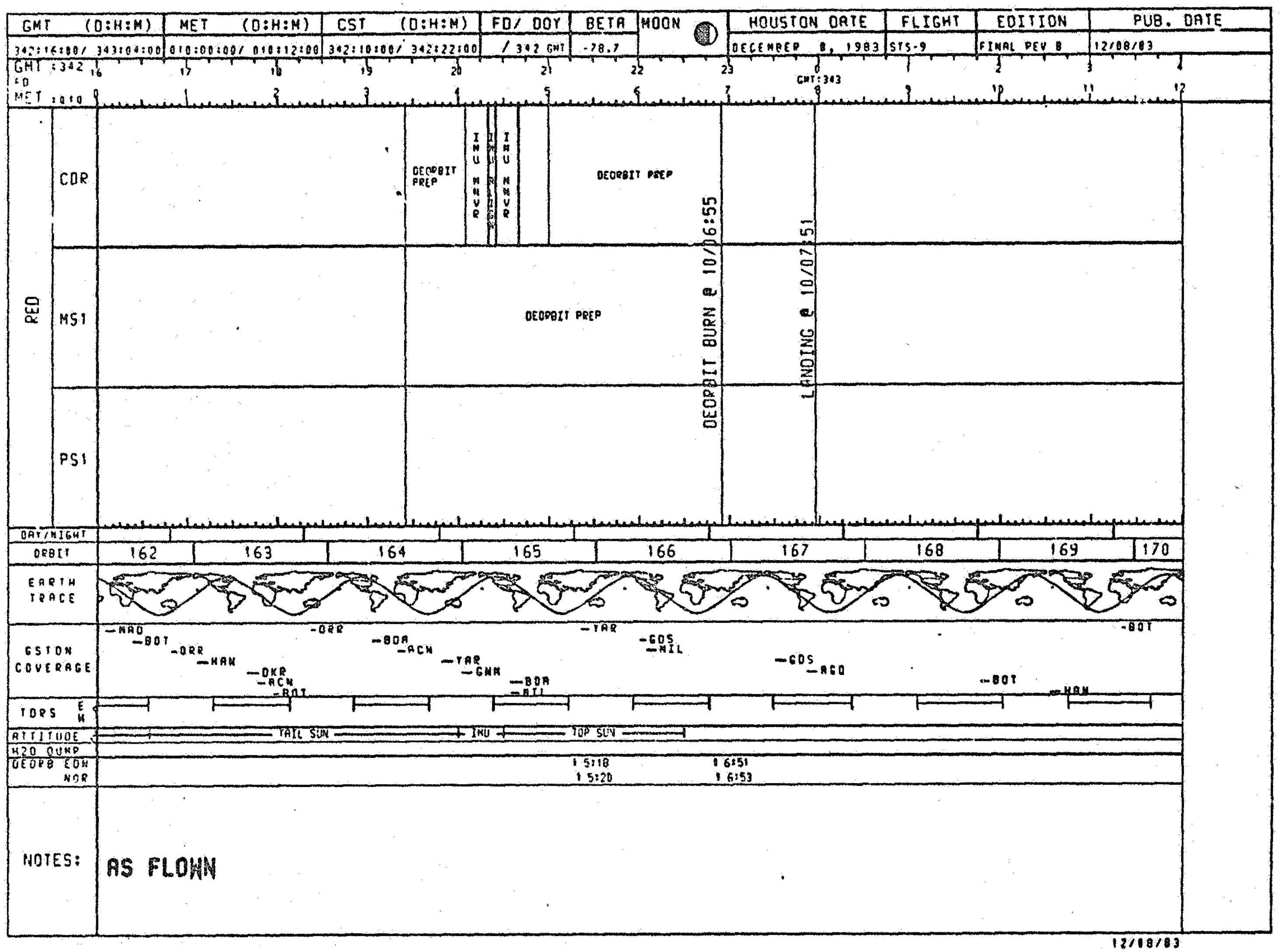

Figure 1.- As-flown crew activity plan (continued).

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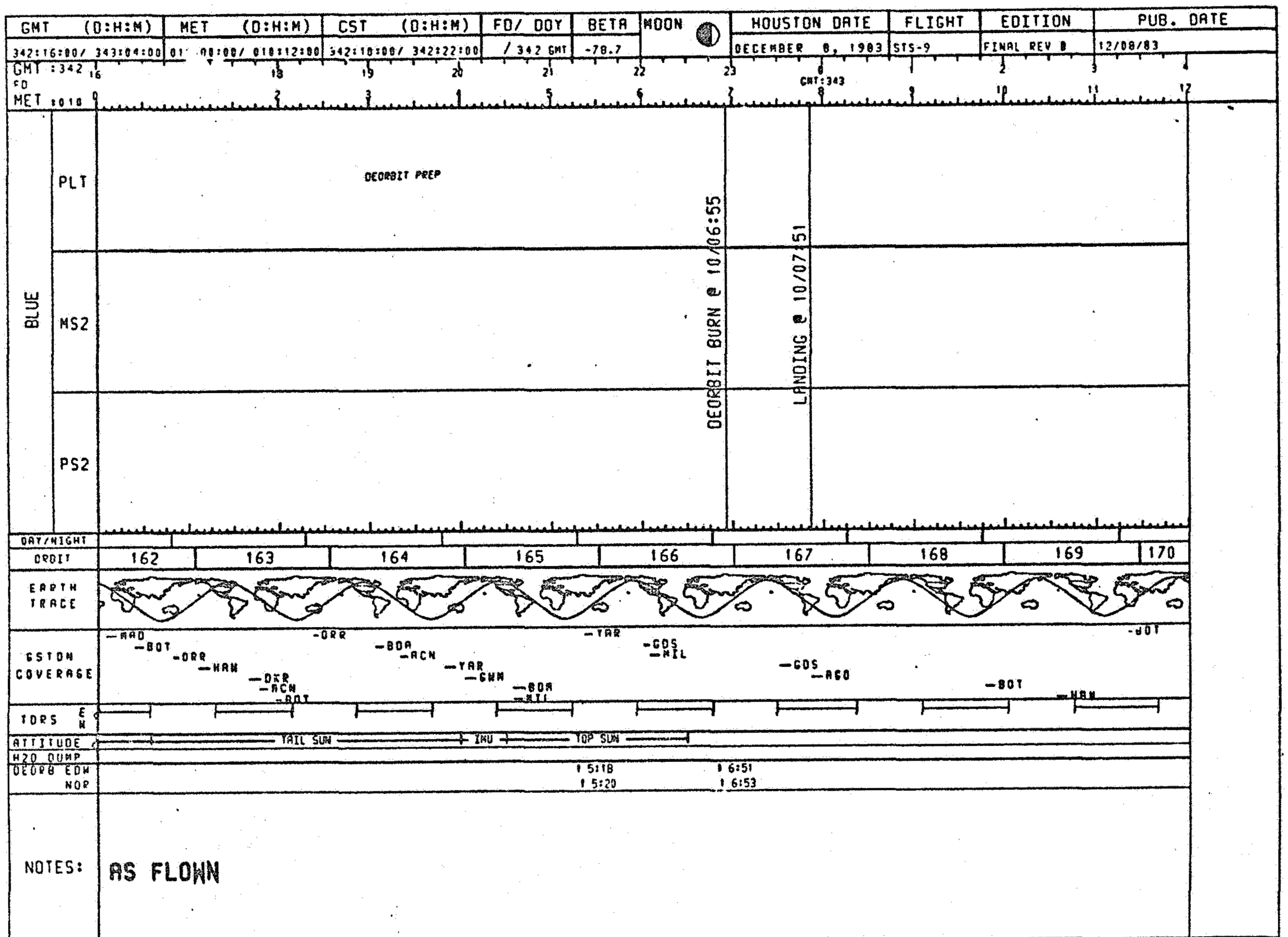

Figure 1.- As-flown crew activity plan (concluded).