ORBITAL ANOMALIES IN GODDARD SPACECRAFT

1982-1983

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Summary

This report presents data from Goddard spacecraft active in-orbit during the 18-month period between July 1, 1982, and December 31, 1983. This constitutes an update of data reported by Planning Research Corporation (PRC) under contract NAS 5-27279. During this period, there were 101 reported anomalies distributed among 16 different spacecraft. There were 11 spacecraft with no reported anomalies: these were invariably older spacecraft in standby or in very limited service. Appendix A contains lifetime data for 116 Goddard spacecraft.

Introduction

Orbital anomaly data has been collected at Goddard since the earliest days of the space program. The data has also been provided to a NASA-wide data base compiled over the years by PRC through a series of contracts primarily awarded by NASA Headquarters, Office of the Chief Engineer. Although the results of a variety of studies have been published, in the past the data was treated as sensitive and the actual data base either was not published, or was published in a coded format. Since there are a wide variety of potential applications for this data, ranging from developing hardware element meantime-to-failure statistics through studying potential on-orbit refurbishment requirements, this policy prevented the full value of the data from being realized.

This policy was changed in the contract for the most recent update of the PRC data base. The resultant report, "Analysis of Spacecraft On-Orbit Anomalies and Lifetimes" (Bloomquist and Graham, PRC R-3579, February 10, 1983,) contained complete descriptions of the anomalies occurring on 44 GSFC and JPL spacecraft over the 5-year period covered by the report, as well as summary charts for each spacecraft. This report has proved to be extremely popular, and has been the focus of a number of additional studies.

Since there is no systematic process for updating the PRC data base, it has been decided to publish the Goddard data in-house on a periodic basis. This report is the first of the proposed series. It covers the approximately 18 month time period from the cut-off time of the PRC report in mid-1982 through the end of calendar 1983. To put the individual anomaly data in perspective, summary descriptions of spacecraft condition and performance are also included. The report also contains an update of the complete log of Goddard spacecraft useful lifetimes originally published in TM 82178 "A Study of the Longevity and Operational Reliability of Goddard Spacecraft: 1960-1980" (Shockey, August 1981).

Scope

Twenty-seven Goddard spacecraft were active during 'he 18-month period covered by this report. This total includes 11 meteorological satellites built for NOAA and 16 NASA satellites. In addition to science and applications programs, for the first time in almost a decade the complement of NASA missions included a communications satellite; Tracking and Data Relay Satellite (TDRS-1). Of the 27 missions 23 were on-going missions and 4 were new launches: Landsat-4, NOAA-8, TDRS-1, and GOES-6. There were no unsuccessful launches or launch vehicle failures, although a malfuction of the Inertial Upper Stage (IUS) motor used to place the Shuttle-launched Tracking and Data Relay Satellite (TDRS-1) in synchronous orbit threatened to abort the mission. The mission was saved, however, by using the spacecraft's reaction control system thrusters to gradually circularize the orbit. Landsat-4 and NOAA-8 also experienced mission-threatening anomalies which are described later in this report.

The following missions were discontinued during the reporting period: NOAA-6, Landsat-2 and 3, Nimbus 5 and 6, and GOES-4. The latter failed catastrophically after 26-months of operation due to the loss of both encoders in the primary instrument (the VAS or Visible Infrared Spin Scan Radiometer Atmosphere Sounder). Termination of the others was essentially the result of normal degradation and wear-out.

Dynamics Explorer 2 (DE-2) which was in a planned high-drag orbit, re-entered, as expected, in February 1983.

Data Sources

While major orbital anomalies have invariably been documented and investigated and Project Offices and Control Centers have usually kept anomaly records for their own use, it was not until 1978 that any Project undertook to systematically record and evaluate in a permanent data base each and every anomaly throughout the life of the spacecraft. The change took place in October 1978, with the launch of TIROS-N, when the TIROS Project initiated the computerized TOAR (Tiros Orbital Anomaly Report) system. At the present time, the TOAR contains approximately 200 anomaly reports covering five different TIROS NOAA satellites.

Early in 1980, a similar system, known as the Spacecraft Orbital Anomaly Report, or SOAR, was established for projects under the cognizance of the Orbiting Satellites Project/Applications (OSP/A). This was soon extended to include the Orbiting Satellite Project/Science (OSP/S). This left GOES as the only active Goddard-managed project without provision for a computerized data base. GOES did, however, issue a formal monthly reports and an annual summary report, and when the new GOES series began with the launch of GOES-4 in September of 1980, the Project began to keep a formal (although not computerized) report known as the GOES Anomaly Report or GAR. Recently, the OSP/A Project was disbanded and its one remaining active satellite, Nimbus-7, turned over to OSP/S which was subsequently renamed simply Orbiting Satellites Project.

Two more recent Projects, Landsat-4/5 and TDRSS, while they fall under neither the Metsat Office nor OSP have agreed to use SOAR.

TOAR, SOAR, and GAR constitute the major sources for the data contained in this report. Information was also obtained by monitoring the regular status meeting of OSP, by personal interview with cognizant personnel, and by review of published reports.

Anomaly Data: Format and Classification

In the interest of continuity, the format for the anomaly summaries generally follows the format used in the referenced PRC report, with the exception that anomaly time is reported in days, rather than hours, which is considered too fine-grained to be meaningful. The anomalies on each spacecraft are indexed chronologically, and are contiguous with the PRC index numbers, where applicable. It should be noted that PRC did not follow this practice with respect to their previous report; i.e., Index 1 is not necessarily the first anomaly reported for a spacecraft if it was launched prior to the 1978 start date of the update.

Previous Goddard investigations divided the severity or "criticality" of the anomaly into four categories, while PRC has traditionally used five. The two schemes compare as follows:

Criticality or Mission Effect Classification

GSFC:

1. Catastrophic	(loss 90%)
2. Major loss	(50 – 90%)
3. Substantial loss	(10 – 50%)
4. Minor loss	(0 – 10%)

PRC:

1. Negligible	(0 - 5%)
2. Non-negligible but small	(5 – 33%)
3. 1/3 to 2/3 mission loss	(33 – 67%)
4. 2/3 to nearly total mission loss	(67 – 90%)
5. Essentially total mission loss	(90 – 100%)

Note that the numbering from least to most important is reversed. Since the difference between the two systems is otherwise moot**,** again in the interests of continuity with the previous report the PRC scheme has been used herein.

A slightly different approach was taken by B. Clark in a recent unpublished study of selected spacecraft. Clark developed the following categories:

1. Mission Loss or Close Call
2. Loss of Function
3. Degradation of Function
4. Others which should have/could have been caught
5. Unexpected flight environment

A sixth de facto category was anomalies considered "not a real problem" which were excluded from further study.

These categories differ from those described above in that they are aimed more at an engineering "cause-and-effect" impact than at statistical quantification. Clark's initial judgments were subjected to a review procedure within the Engineering Directorate, and the results were then subjected to a Delphi process to classify the root source of the problem and which "screens" could have or should have caught it. This sort of information would be an invaluable addition to the data reported herein, however, the study was made in support of a recent Projects Directorate effort and was limited to selected data of which only a portion of the Landsat-4 is part of this report. One of the recommendations of the study was that a permanent archive of anomaly data be established. Presumably, this would consist not only of anomaly reports such as SOAR and TOAR, but complete documentation of the anomaly including failure reports and anomaly committee reports, to the extent that they exist. Most importantly, the data would be

analyzed and classified by a committee of appropriate Center experts. In lieu of the implementation of this process, no attempt at further classification of the data has been attempted in this report.

Spacecraft Performance Summary

The following provides a summary of the condition and performance of the active spacecraft covered by this report:

ATS-I, III, V

These aged communications satellites continued to operate, although in very limited service, with no reported anomalies. ATS-V operations were discontinued and the spacecraft removed from synchronous orbit beginning March 20, 1084. All control gas was expended in this maneuver. With the partial shutdown of the GSTDN network in April 1984, control of ATS-I and ATS-III was turned over to the University of Hawaii and University of Miami, respectively.

DE-1

As the beginning of the reporting period, DE-1 was operating in a slightly degraded mode due to failure of the high voltage power supplv on the High Altitude Plasma Indicator (HAPI). Probably the next most significant anomaly was the effect of periodic radiation "hits" which caused periodic "glitches" in spacecraft operations. Operations continued in essentially the same conditions through the reporting period.

DE-2

Spacecraft operations had been somewhat degraded by the failure of the Z-axis antenna for the Vector Electric Field Instrument (VEFI) and failure of the high voltage power supply for the Low Altitude Plasma Instrument (LAPI) two of nine experiments on board the spacecraft. No additional significant anomalies had occurred at the time the spacecraft re-entered as expected on February 19, 1983.

Geostationary Operational Environmental Satellite (GOES)

The operational phase of the GOES project began on October 16, 1975, with the launch of GOES-1. This was a follow-on to two previous developmental synchronous meteorological satellites, SMS-1 (1974) and SMS-2 (1975), which continued to be used as part of the system. A total of eight SMS/GOES spacecraft have now been successfully launched and operated. GOES spacecraft, like TIROS/NOAA spacecraft, are procured, launched, and checked out by NASA before being turned over to NOAA for orbital operation.

The prime contractor changed beginning with GOES-4 from Philco-Ford (later Ford Aerospace) to Hughes Aircraft. At the same time, the primary instrument, built by Santa Barbara Research Corp., the Visible Spin-Scan Radiometer (VISSR) was upgraded to the VISSR Atmospheric Sounder (VAS).

This is a new type of instrument designed to measure temperature versus altitude cross section of the atmosphere to create three dimensional pictures for more accurate weather predictions.

During this reporting period, GOES-4 and GOES-5 were the primary operating satellites, operating as GOES West and GOES East, respectively, until the GOES-4 VAS failed on November 25, 1982. After this failure, GOES-1 was pressed into service as GOES West, although only visible (no infrared) data was available from it due to an earlier failure. GOES-6 went into service, replacing GOES-1 on June 1, 1983. GOES-2 served as the Central operational spacecraft during the year, providing central weather facsimile (WEFAX) SEM (Solar Electron Monitor) part of the year, and eclipse DCS (Data Collection System) support. GOES-3 was maintained as a standby spacecraft, and served part of the time as an S-Band transponder.

The useful life of GOES-5 ended on July 29, 1984, when the degraded redundant encoder failed, the primary unit having failed a week earlier. Both failures were attributed to fractures in the encoder lamp filaments.

ISEE-1

ISEE-1 operated in a somewhat degraded mode due to the loss of one experiment and partial loss of four others of the total complement of 13 experiments. The battery failed due to normal wear-out after 4 1/2 years of service; however, this did not curtail operations due to the spacecraft being in a full-sunlight orbit. There were no additional anomalies reported during this reporting period.

ISEE-3/ICE

Like ISEE-1, ISEE-3 had also lost one instrument and portions of 4 others by the beginning of this reporting period, and the battery had failed (after about 3.3 years). There have been no new anomalies. On June 10, 1982, after almost 4 years in orbit, flight controllers began moving ISEE-3, which was the first satellite to orbit a libration point, into a new trajectory with a new set of mission objectives. These were: 1) to study the earth's magnetotail through 1983, 2) to fly across the wake of comet Giacobini-Zimmer in September 1985, and 3) and to study the solar wind's effect on Halley's Comet during late 1985 and early 1986. The spacecraft , which has been renamed International Cometary Explorer ICE is currently on this mission.

IUE

This spacecraft continues to perform extremely well. None of the 24 recorded anomalies have had a significant effect on science or engineering performance, although there are no longer any redundant gyros. Gyros 3, 4, 5 are currently being used, gyros 1, 2, and 6 having failed. Each of the failures was unique: Gyro l's motor drive circuits failed, Gryo 2 apparently had a foreign particle jam in the rotor air-bearing, and Gyro 6 failed to spin up following an eclipse season, an anomaly which was attributed to a lubrication problem. Since in every case the gyros had exceeded their design lives by a wide margin, these failures may be classified generally as wearout. There were no reported anomalies during this reporting period.

Landsat-2

The useful lifetime of this spacecraft appeared to have ended in November of 1979 after 58 months of service when the yaw flywheel stopped. However, after repeated attempts, 6 months later, the flight controllers managed to restart the wheel, and operations were resumed. The yaw flywheel failed again on Feb. 8, 1982. Repeated attempts to restart again were unsuccessful. Attempts to develop procedures using magnetics to control yaw were terminated by the failure of the on-board computer and the spacecraft was permanently turned off July 27, 1983. There was only one minor anomaly during the reporting period.

Landsat-3

This was the last of a series of three first-generation Landsat (formerly ERTS) spacecraft. The series was plagued with a generic problem in the prime instrument, the Multi-Spectral Scanner (MSS), known as the line-start anomaly. The problem seemed to get more significant as the series went on, and was a particularly serious problem with Landsat-3, especially after the first 2 years in orbit. Other than this, the accumulated anomalies occurring in Landsat-3 prior to termination of the mission in September 1983 could be characterized as normal degradation.

Landsat-4

The first of the new Landsat series, based on the Multi-Modular Spacecraft (MMS) bus design, was launched July 16, 1982. During the first few months of flight, there were several serious anomalies. The first of these occurred on July 27, 1982 when the high gain Ku-band antenna was commanded to deploy but failed to do so. Many attempts were subsequently made to drive the antenna free, and success was finally achieved on August 15.

On October 29, 1982, the redundant central unit in the Spacecraft Command and Control Unit SC&CU failed.

Both the primary and redundant X-Band transmitters, needed to communicate Thematic Mapper data to earth prior to launch of the Tracking and Data Satellite (TDRS), failed: the primary unit on September 22, 1982, and the redundant on February 15, 1983.

The most critical problem of all was the failure of the power cables on two of the four solar arrays. The problem began as an intermittent power loss in one of the four cables on March 18, 1983. By mid-May, one cable had failed and a second was intermittent. By this time, the cause of the problem had been attributed to stresses in the conductors due to thermal cycling. By June 5, 1983, the second array had failed. The spacecraft has since been operated at reduced power levels, and the array was reoriented from 40° lagging the sunline to 10° lagging. These actions seem to have prevented further degradation in the spacecraft's power system.

The launch of TDRS-1 enabled the Thematic Mapper to be placed back into service via Ku-band transmission.

Nimbus 5, 6, and 7

The 10-year old Nimbus-5 spacecraft was being used to supply data from its Electrically Scanned Microwave Radiometer (ESMR) to the Navy for Arctic and Antarctic ice mapping activity. After the failure of the second High Data Rate Storage System (HDRSS)) tape recorder on July 27, 1982, this activity was restricted to real-time operations only. The mission was terminated on March 31, 1983. Data of the Nimbus-5 type is now supplied to the Navy by Nimbus-7.

The 7-year old Nimbus-6 was being used only in support of the Drug Enforcement Agency. On August 14, 1982, the yaw flywheel stopped, causing a loss of power which caused the pitchwheel to also coast down to zero RPM. On August 18, the wheel was restarted after several attempts, but stopped again. The cause was believed to be high friction in the bearings. Operations continued until the mission was terminated September 21 1983.

Nimbus-7, the last of this highly successful series of meteorological satellites, continued in successful operation throughout this reporting period, the most serious problem being the anomalous behavior of the limb scan motor in the SAMS instrument, resulting in the instrument being turned off.

OSS-1

Although the flight of OSS-1, the first Goddard-managed attached shuttle payload, occurred during the period covered by the last PRC update, it was not reported therein and so will be discussed in detail here.

OSS-1 was launched as the payload of STS-3 at approximately 11:00 a.m. on March 22, 1982. Science payload turn on began at 3:00 p.m. the same day. After about 7 hours of operation, a tape recorder located in the aft flight deck failed due to what appeared to be a broken belt. A brief description of the flight, as reported by the Project in the Goddard Weekly Report is as follows: "The pallet contained the following payloads: Shuttle-Spacelab Induced Atmosphere Experiment (SSIA), Vehicle Charging and Potential Experiment (VCAP), Plasma Diagnostics Package (PDP), Microabrasion Foil Experiment (MFE), Contamination Monitor Package (CMP) Thermal Canister Experiment (TCE). Solar Flare X-Ray Polarimeter Experiment (SFXP), and a Solar Ultraviolet Spectral Irradiance Monitor (SUSIM), a total of 8 instruments.

The following failures were reported: The SUSIM wavelength drive mechanism failed, and it was therefore unable to operate at wavelengths other than 2700 angstroms. Investigation by NRL revealed one failed microcircuit, a TI series 54L. The circuit was replaced and an attempt made to drive the grating inchworm gear. This attempt was unsuccessful. Further investigations were to be made.

The Thermal Canister microprocessor reset itself periodically beginning on March 23. On March 24, after about 7 hours of operation, Tape Recorder-2, a redundant unit, failed due to a broken belt. Tape Recorder-1 operated satisfactorily throughout the mission.

The flight ended when the STS landed at about 11:00 a.m. March 30, 1982. Post flight inspections revealed that, on the PDP instrument, the aerodag-G coating on surfaces had deteriorated and in some areas was missing. No other anomalies were reported.

In addition to the OSS-1 pallet payload, a Get-Away Special Flight Verification Payload was flown, and returned in good condition. However, one of five tape recorders was found to contain loose parts due to their not having been adequately secured with GIyptol.

NOAA-8

The NOAA-8 spacecraft was launched from Vandenburg Air Force Base via an Atlas-F booster on March 28, 1983. This was the fifth launch of the current NOAA series of TIROS satellites (including the NOAA-B which due to a booster malfunction did not achieve orbit), and the first of the Advanced TIROS-N (ATN) configuration. This configuration is 19 inches longer and 650 pounds heavier than the previous version, and contains the Search and Rescue (SAR) instrument.

Performance was nominal through the boost, separation, coast, and pitch maneuver portions of the flights; however, when the apogee kick motor (AKM) was ignited at 812 seconds into the flight an oscillation occurred. This oscillation had sufficient magnitude to exceed the control system roll switch line which was in effect. This induced rapid alternate firings of the roll-axis thruster pairs, which in turn depleted the nitrogen control gas prematurely, and left the spacecraft unable to correct disturbances introduced by the deployment of the solar array, and the spacecraft began to tumble. A recovery effort was implemented using magnetic torquing and control was regained after a few weeks. The spacecraft is now stable and operating normally.

The anomaly was thoroughly reviewed by a committee chaired by Helen Neumann, and the cause was attributed to coupling between the control system and a structural resonance at about 18 Hz. The "fix" for follow-on missions is a software change to decouple the rate of reaction jet firing from the 18 Hz mode. The committee's final report "NOAA-E Ascent Phase Anomaly Report" is dated August 1, 1983.

Attitude control has been lost during ascent phase on three of the four successfully launched satellites of the TIROS-N series (all but NOAA-7), each for a different reason. There were no other serious anomalies on NOAA-8 through 1983. However, since July 1, 1984, attitude control has been lost due to an anomaly in the redundant crystal oscillator RXO , and recovery appears unlikely.

SMM

This spacecraft lost the ability to meet its major mission objectives when the loss of the third fuse controlling operations of the stabilizing gyros occurred on December 12, 1980, and the spacecraft was no longer able to maintain fine pointing control. The spacecraft was placed in a slow roll for stability, and continued in service, returning data from those instruments which did not require fine pointing. In April 1984, astronauts of Shuttle flight 41-C repaired the spacecraft by replacing the defective ACS module and the main electronics box of the CP instrument, which had also failed, and by placing a cover over the gas vent of the X-Ray Polychromator, and placing the spacecraft back in orbit.

TDRS-1

The first of the Tracking and Data Relay Satellites was deployed from Shuttle Mission 6 on April 4, 1983. The first stage of the Inertial Upper Stage (IUS) boost motor then fired correctly to place the spacecraft in a geosynchronous transfer orbit, but the second stage malfunctioned when it tried to

circularize the orbit, leaving the spacecraft tumbling out of control in an incorrect orbit and rapidly losing battery power. Controllers at the Air Force's IUS ground station in Sunnyvale, CA managed to override the IUS computer, allowing the separation event to occur. Once separated, the TDRSS controllers at White Sands Ground Terminal (WSGT) were able to slow the tumble rate from the initial 30 rpm until stabilization was finally achieved, separate it from the IUS, and stabilize it. Fortunately, the spacecraft carried a large supply (1,300 lb) of hydrazine propellant, about 850 lb of which was used to fire two 1 lb thrusters normally used for attitude control to gradually circularize the orbit. Proper orbit was finally achieved on June 29.

During orbital testing, problems were encountered with the Ku-Band Single Access (KSA) Forward Service link. TDRS contains two complete Ku-Band systems, each with primary and backup electronics. Between October 20, 1983, and November 18, 1983 the KSA-1A and KSA-2A TWTA's both failed, as well as the KSA-1 diplexer. KSA-2B TWTA was not activated pending an investigation of the failures. S-Band operations were essentially nominal.

The remaining KSA-Forward capability from KSA-28 has been satisfactorily checked out, but is being held in reserve for emergency usage. TDRS-1 was used to support the STS, Spacelab-1, Landsats 4 and 5, the revitalized SMM and other missions while in-orbit checkout continued. User support continued along with system performance testing until mid-May 1984. At that time, user support was reduced to a minimum in order to allow performance testing to proceed.

Data Table

The actual data is shown in the following table. The figure shown in parenthesis under date (days) is the time in days since the launch occurred, counting launch as day zero.

It has recently been learned that TDRS-1 experienced several anomalies prior to reaching synchronous orbit which had not been reported. SOAR's for these have not yet been written. This data will be included in the 1984 update. None of these anomalies a ear to have been serious.

INDEX	DATE/(DAYS)	SUBSYSTEM	CRITICALITY	DESCRIPTION	EFFECT/ACTION
				DE-1	
15	11/09/83 (976)	C&DH	1	Bit 6 of Location 543 in Command Telemetry Processor occasionally changes from a one to a zero. (SOAR No. A00387)	No significant effect. Stopped using that area
				DE-2	
12	7/12/82 (491)	POWER	1	Regulator #1 trips off during normal operations. (SOAR No. A00386)	None. Switched to redundant regulator.
				GOES-1	
				NOTE: BEGAN OPERATION AS GOES WEST (VISSR VISIBLE DATA ONLY) 11/29/82 AFTER FAILURES OF GOES-4 VISSR	
	4/7/83 (2730)	INST.	1	Primary encoder failed.	None. Redundant encoder used.
				OPERATION AS GOES-WEST TERMINATED (REPLACED BY GOES-6) JUNE 1983.	
				GOES-2	
				NO CHANGE: S/C IN STANDBY WIT14 FAILED VISSR	
				GOES-3	
				NO CHANGE: SEMI-OPERATIONAL AS TVM STRETCHED VAS TRANSPONDER. VISSR INOPERATIVE	

INDEX	DATE/(DAYS)	SUBSYSTEM	CRITICALITY	DESCRIPTION	EFFECT/ACTION
				GOES-4	
33	8/9/82 (699)	INST.	1	SEM: HP Fine sensor on magnetometer failed. (GAR 61)	Reduced SEM capability
34	10/23/82 (774)	INST.	1	SEM: X-ray went to calibrate mode uncommanded. (GAR 62)	None.
35	11/26/82 (808)	INST.	4	VAS SCAN Mirror stopped due to single point failure in electronic module (GAR 64)	Catastrophic loss of VAS data tantamount to loss of mission.
36	9/23/83 (1109)	POWER	1	VAS 29V Prereg uncommanded power off. Also occurred 4/11/83, 9/25/83, 11/19/83. (GAR 74)	None. VAS already inoperable.
				GOES-5	
18	7/26/82 (430)	TIIERMAL	1	Failed temp. sensor for VAS sunshade (GAR 59)	None
19	7/29/82 (433)	T&C	1	Lost PCM from CTU-2 (GAR 60)	None. Recovered when CTU-2 cycled on-off
20	10/31/82 (527)	VAS	1	Filter wheel temp. flagging high (GAR 63)	None. Improved heat sinking on GOES G&H
21	1/3/83 (591)	T&C	1	CTU-2 Single event upset failure. (GAR 65)	None. Corrected by appropriate commands
22	(1/20/83) (608)	INST.	1	VAS: Scan mirror line count erroneous at line 690 (GAR 66)	Minor. Corrected by increasing encoder lamp voltage
23	3/23/83 (670)	T&C	1	27 analog telemetry words increased by several counts. Recurred 3/24/83 (GAR 67)	None. Returned to normal in about 40 min.
24	6/16/83 (755)	INST.	1	VAS preregulator shut down due to excessive current. (GAR 69)	Loss of redundancy. Could not be isolated to a specific unit

INDEX	DATE/(DAYS)	SUBSYSTEM	CRITICALITY	DESCRIPTION	EFFECT/ACTION
25	9/1/83 (832)	COMM	1	Daily Intermittent loss of DCPR downlink at Wallops during a 1 hour period. (GAR 76)	Minor. Anomaly clear when UHF power is off.
26	11/5/83 (897)	INST.	2	SEM: Hepad failed. (GAR 73)	Partial loss of SEM capability.
				GOES-6	
1	6/10/83 (43)	C&DH	1	Command demodulator/decoder will not clear after execution of command (GAR 68)	None. Cleared up after a few days.
2	6/17/83 (50)	INST.	1	VAS: Erroneous line numbers in PCM and VDM telemetry at low lamp voltages. (GAR 70)	None. Attributed to design change from previous missions. Use higher voltages.
3	6/29/83 (62)	C&DH	1	Command data acquisition telemetry transmitter power decreased temporarily. Recurred October 2. (GAR 71)	None. Power still above link margin by several dB.
4	8/28/83 (122)	INST.	1	VAS photomultiplier tube 8 degraded about 20 percent (GAR 72)	None.
5	12/18/83 (234)	INST.	1	VAS filter wheel heater control circuit failed with heater "on." (GAR 77)	None. Heater was commanded off.
6	12/30/83 (246)	INST.	1	SEM X-ray position TLM did not respond to position commands. (GAR 78)	None. Responds to repeated commands.
				Landsat-2	
17	4/23/83 (3013)	C&OH	1	Spacecraft clock lost 2 min. and 34 sec. between orbits 42013 and 42018. Held this state until corrected. (SOAR No. A00474)	None. Did not recur.

INDEX	DATE/(DAYS)	SUBSYSTEM	CRITICALITY	DESCRIPTION	EFFECT/ACTION
				Landsat-3	
34	4/23/83 (1681)	POWER	1	5-string circuit of 465 solar cells on main solar panel shorts out for 8 min, every orbit after night-day transition. (SOAR No, A00409)	None, System has sufficient margin,
35	11/04/82 (1705)	INST,	3	Scan monitor In multi-spectral scanner (MSS-D) of 3 pulses continued to decline: mid-scan ceased 10/78, start-line ceased 9/80; end line practically ceased 11/82. (SOAR No. A00472)	Degraded performance of MSS-D. Scan monitor turned off,
36	3/3/83 (1824)	INST,	1	MSS: Unvarying output in 4 discrete segments of scene radiance: only lowest level transmitted. Previously occurred from 12/17/80 to 3/19/81. (SOAR No. A00411)	None.
37	3/5/83 (1826)	INST,	1	All video data near black level in RBV. (SOAR No. A00472)	None. Recovery effected using redundant relays for power input.
				Landsat-4	
11	9/3/82 (49)	THERMAL	1	Solar array panel #2 temperature readings intermittently erroneous. (SOAR No. A00428)	None. Infer temp. from panels 1, 2, 4.
12	9/19/82 (65)	C&DH	1	C&DH S-band RF not present from central unit-A. Switched to CU-B. CU-A later retested okay. (SOAR No. A00429).	None.
13	9/22/82 (69)	C&DH	1	WBCS: Prime x-band transmitter failed. (SOAR No. A00430)	None.
14	9/27/82 (73)	C&DH	1	On-board processor does not process GPS file 7 data due to a failed write attempt to OBC common area. (SOAR No. A00444)	None. File 7 not used.

INDEX	DATE/(DAYS)	SUBSYSTEM	CRITICALITY	DESCRIPTION	EFFECT/ACTION
15	10/18/82 (94)	C&DH	1	OBC executive status report indicated a storage protect error. (SOAR NO. A00431)	None. Status report was zeroed. Error apparently did not recur.
16	10/25/82 (101)	THERMAL	3	Solar array panel #1 temperature readings intermittently erroneous (similar to index 11) (SOAR No. A00440)	None. Infer temp. from panels 2 and 4.
17	10/29/82 (105)	C&DH	1	Central Unit (CU)-B failed. (SOAR No. A00433)	None. Switched back to CU-A. Design mod. for follow-on S/C.
18	11/6/82 (113)	C&DH	1	WBCS: High gain antenna movements to check software stops caused a high rate transient disturbance which saturated the IRU. S/C lost stars. (SOAR No. A00437)	Attrib. to error in original analysis. Reduce slew rate to 1.4° per second.
19	11/16/82 (123)	THERMAL	1	Temp. sensor on solar panel #4 failed (similar to failures on panels 1 & 3). (SOAR No. A00441)	None. Temp. data not critical, can be inferred from solar panel #2.
20	11/21/82 (128)	ACS	1	S/C lost star track in orbit 01857. Also occurred in orbits 465 & 1934. (SOAR No. A00439)	Attrib. to FHST misalignment (350-ARC-SEC vs. 100 ARC-SEC spec). Loaded new alignment factors.
21	11/30/82 (137)	ACS	1	S/C lost star track again in orbit 1994 & orbit 2124. (SOAR No. A00442)	Same as above, Index 20.
22	12/11/82 (148)	INST.	1	On orbit 2159 OBC time skipped 512 ms. update. (SOAR No. A00438)	None. Resynch'ed DPU and OBC clocks. Flight executive modified to correct the cause of time Jumps.
23	12/14/82 (151)	INST.	1	Due to a set failure in the GPS receiver processor, navigation attempted in RCVR mode 1, 2, 4. (SOAR No. A00443)	None. Returned to RCV mode 2,2,4 and resumed operations.
24	2/15/83 (214)	C&DH	2	WBCS: Back-up x-band transmitter failed. (SOAR No. A00531)	Loss of x-band capability. T/M data no longer possible until TDRS-A launched.

INDEX	DATE/(DAYS)	SUBSYSTEM	CRITICALITY	DESCRIPTION	EFFECT/ACTION
25	3/18/83 (245)	POWER	2	Solar array began exhibiting intermittent and unpredictable dropout of 1 to 2 of its 4 panels. (Both later failed entirely.) Attrlb. to failure of flat ribbon cable connectors due to large temperature excursions. Cable assy redesigned for follow-on S/C (SOAR No. A00532)	Significant loss of performance capability. Array offset angles reduced to reduce thermal excursions to prevent further damage.
26	3/21/83 (248)	THERMAL	1	Solar array panel #2 temp. sensor became briefly intermittent and then returned to normal. (SOAR No. A00533)	None. Frequency of occurrence reduced by changing solar array offset. Set index 25.
27	4/3/83 (261)	C&DH	1	Narrow band tape recorder #1 had large serve errors during playback. (SOAR No. A00534)	Slight loss of data. Increase overlap time between the 2 recorders
28	9/22/83 (133)	C&DH	1	OBC Flt SW time experienced 5 Jumps of 512 MS each during day 265 (see index 22) (SOAR No. A00535)	None, Jumps were automatically reset
				NIMBUS-5	
9	7/27/82 (3514)	C&DH	1	HDRSS-B (tape recorder) failed, Probably broken tape or belt, (SOAR No. A00253)	Loss of recording playback capability
10	11/20/82 (3630)	C&DH	3	HDRSS-A (tape recorder) failed. Attributed to failure of playback motor brake to engage, (SOAR No. A00450)	Loss of recording capability: real time only operation. No corrective action possible
				NIMBUS-6	
9	8/14/82 ((2620)	ACS	2	Yaw reaction wheel stopped with motor drivers at 100%. Attrib. To high bearing friction. (SOAR No. A00406)	S/C emergency.
10	8/15/82 (2621)	ACS	3	Pitch wheel stopped due to low power after yaw wheel failures. (SOAR No. A00407)	Loss of pitch control.

INDEX	DATE/(DAYS)	SUBSYSTEM	CRITICALITY	DESCRIPTION	EFFECT/ACTION
11	9/4/82 (2641)	C&DH	1	Analog-to-digital converter failed. (SOAR No. A00408)	Some loss of data. Switched to redundant unit.
				NIMBUS-7	
18	10/16/82 (1453)	INST.	2	SAMS mirror scan abnormal. Placed to standby mode pending investigation. . (SOAR No. A00447)	Loss of SAMS data.
19	10/19/82 (1456)	POWER	1	Solar array drive motor voltage TLM indicated sporadic increase. (SOAR No. A00448)	None.
20	11/29/82 (1497)	C&DH	1	Tape recorder #1 (GSTR) had area of noisy data. Cleared up later. (SOAR No. A00449)	None.
21	5/01/83 (1650)	C&DH	1	TOMS command stored in comstor failed to execute properly, (SOAR Not A00451)	None, Comstor reloaded, subsequent operations okay.
22	6/13/83 (1693)	INST.	2	SAM inst, behavior anomalous, (SOAR No, A00453)	SAMS inst. turned off,
23	7/5/83 (1115)	INST.	1	CZCS electronics tripped off due to high current, (SOAR No, A00454)	None. 50% duty cycle on motor heater corrects problem.
24	7/10/83 (1720)	ACS	1	Left COS POT TLM showed increasing drop at midnight position. (SOAR No. A00455)	None. Anomaly disappeared.
25	11/16/83 (1849)	C&DH	2	Tape recorder #2 (GSTR) data noisy. (SOAR No. A00456)	Loss of recorder. TR-2 OPS terminated.
				NOAA-6	
24	7/18/82 (1117)	ACS	1	Bias shifts in x-gyro caused yaw updates between 0.2 and 1.0°. (TOAR 167)	None. Effect of gyro bias instability on yaw updates is understood.

INDEX	DATE/(DAYS)	SUBSYSTEM	CRITICALITY	DESCRIPTION	EFFECT/ACTION
25	8/3/82 (1133)	C&DH	1	TIP time jumped –0.5 sec. (This recurrent phenomenon is now well understood.) TOAR (168, 169, 174, 175)	None, Reset TIP.
26	9/2/82 (1163)	ACS	1	After 15CCP1 command, S/C switched to YGC for no apparent reason. (TOAR 170)	No permanent effect.
27	12/4/82 (1256)	INST.	1	HIRS 2 noise increased on CH 1-12. Increase reached approx. 95% by 12/21; started to decrease on 12/26. (TOAR 176)	No permanent effect. A one-time phenomenon.
28	5/8/83 (1411)	ACS	1	ADACS control mode changed from nominal to YGC. (TOAR 180)	Due to anomalous behavior of the x-gyros commanded back to nominal.
29	5/15/83 (1418)	INST.	1	Excessive TIP parity errors occurring in MRPT & GAC. HRTP images unaffected. Tip parity errors not present in STIP data. (TOAR 185)	
30	6/l/83 (1435)	C&DH	1	Tape recorder DTRSTB STIP recordings showing high parity errors and noise. (TOAR 186) NOTE: S/C put in "park" mode 6/20/83	
31	9/19/83 (1545)	INST.	2	HIRS filter wheel stopped rotating. Motor apparently failed. Attempts to restart (Oct. 6) failed. (TOAR 188)	Loss of HIRS inst. No action possible.
32	9/27/83 (1553)	C&DH	1	TIP frame synch pattern in MIRP GAC data is toggling at 1 second rate. (TOAR 189)	
				NOAA-7	
12	7/14/82 (386)	ACS	1	Earth sensor #1 incurred 0.4° attitude error on the roll axis. (TOAR 166)	Sun-moon effects. Barnes under study contract to investigate
13	11/3/82 (498)	C&DH	1	Temp. of DTR 5B has gradually trended upward to 9° higher than DTRS 1, 2, 3. (TOAR 172)	None. Attributed to faulty thermistor circuit.

INDEX	DATE/(DAYS)	SUBSYSTEM	CRITICALITY	DESCRIPTION	EFFECT/ACTION
14	12/5/82 (530)	INST.	1	SEM-TED high voltages changed levels. Mechanism not understood. (TOAR 173; also see 151, 153, 154)	Little loss of data if timely correction made.
15	1/27/83 (583)	C&DH	1	TIP time gained 1/2 sec. after 24 hr. ETCUP. (TOAR 177; also see 144, 168, 169, 174, 175)	None. Software to be changed for NOAA-F and following S/C.
16	11/5/83 (865)	C&DH	1	DTR5A STIP data at Lannion is noisy. GAC & LAC data show no problems at this time. (TOAR 191)	Not serious.
				NOAA-8	
1	3/28/83 (0)	ACS/ STRUCTURE	1	Interaction between control system and structure depleted N_2 gas thru excessive firing of roll jets causing loss of attitude control during ascent phase. (TOAR 184)	No permanent effect. Control regained thru magnetic torquing.
2	5/3/83 (36)	INST.	1	Search-and-Rescue: Receiver-A anomaly (apparently error in command data base) (TOAR 183)	All SOCC computers loaded with gold-tape, better config. Control of CMD data base.
3	5/5/83 (38)	C&DH	1	DTR5B shows approx. 8 min. dropout following BOT. Has occurred since day 110. (TOAR 179)	Power off/on relay of data input differential line receiver (internally intermittent U73) First part type failure
4	5/13/83 (46)	C&DH	1	DTR5A LAC playback provides only 14% of expected data. DTR5B playback subsequently showing no modulation. (TOAR 181)	None. Use redundant units.
5	5/16/83 (49)	POWER	1	Battery 2 charge cannot be controlled in same way as battery 1 & 3. (TOAR 182)	No problem now, S/C needs only 2 batteries for full operation, but potential future problems with premature aging.

INDEX	DATE/(DAYS)	SUBSYSTEM	CRITICALITY	DESCRIPTION	EFFECT/ACTION
6	9/17/83 (173)	C&DH	1	Redundant crystal oscillator BU oven temp. increased several degrees over limit. (TOAR 187)	None. Redundant. Probably TM problem. RCA to review parts pedigree.
7	10/1/83 (187)	INST.	1	DCS: DRU-3 reported to be not processing data, (TOAR 190)	Probable part failure: Low power TTL device. DCS operating normally with 3 DRU's with no noticeable degradation.
8	11/13/83 (230)	INST.	1	Noise pattern on GAC video. (TOAR 193)	Vertical stripes on left edge of global images from all channels of AVHRR. Intermittent. Not in LAC nor confirmed by HRPT or APT users.
9	11/11/83 (231)	C&DH	1	DTR-3: Did not respond to commands. (TOAR 192)	Intermittent, Not serious due to redundancy.
				TDRS-1	
1	4/5/83 (1)	C&DH	1	Single event upsets (RAM hits) on OBC have been occurring intermittently since launch. (SOAR No. A00626)	Minimal. Dump computer RAM, find mis-compare & uplink fix.
2	7/17/83 (104)	ACS	1	Gyro 1/2 failed due to excessive drift. Attrib. To wearout caused by S/C rescue mission. (SOAR No. A00651)	None. Gyro unusable.
3	8/15/83 (133)	C&DH	1	Unable to lock Rcvr B at S-band with S-Band payload on. Attributed to improper procedure. (SOAR No. A00652)	None. Procedure corrected.
4	9/21/83 (170)	POWER	1	Solar arrays stopped clocking. Suspected due to 2-bit slip in antenna pointing command. (SOAR No. A00653)	None. Expected to occasionally recur.

INDEX	DATE/(DAYS)	SUBSYSTEM	CRITICALITY	DESCRIPTION	EFFECT/ACTION
5	10/11/83 (190)	ACS	1	RCS thermal control heater failed. Attrib. To contamination in relay. (SOAR No. A00656)	None. Anomaly disappeared 10/25/83 and heater will be left on.
6	10/20/83 (199)	C&DH	1	Ku-band single access (KSA-1 Forward) prime TWT shows 12-18dB loss of signal power. (SOAR No. A00657)	None. Switch to redundant KSA.
7	11/02/83 (212)	C&DH	1	KSA-2 Forward power dropped. (SOAR No. A00658)	
8	11/10/83 (220)	C&DH	1	S/C failed to execute 2 commands. Re-transmitted commands were successfully executed. (SOAR No. A00659).	None. Attrib. to operator error.
9	11/18/83 (228)	ACS	1	Attitude diverged .25° in pitch, then returned. Reaction wheels showed wild fluctuations. (SOAR No. A00660).	None. Spacecraft stabilized within 3 minutes.
10	11/23/83 (233)	ACS	1	No spacecraft motion from firing –Z1B thruster attrib. To N_2 bubbles in feed lines caused by catalyst bed heaters being continually on. (SOAR No. A00661).	None. Used redundant thrusters. Thruster fired to clear bubbles. Now okay.
11	11/27/83 (237)	ACS	1	Indication of loss of efficiency while unloading momentum with +Z 2B and +Z 4B thrusters. (SOAR No. A00662).	None. Same as above.

APPENDIX A

SPACECRAFT LIFETIME DATA

Note: In the following table, the term "useful life" refers to the time during which the major mission objectives were met. Active life is the total lifetime during which the satellite remained in service. A blank space means the information was not available. Data is through 1983; see text for update.

SPACECRAFT LIFETIMES

SPACECRAFT	LAUNCH DATE	DESIGN LIFE (YRS)	USEFUL LIFE (YRS)	ACTIVE LIFE (YRS)	REMARKS
TIROS	4/1/60	0.25	.24	.24	TV system useful for 77 days
Explorer VIII (S-30)	11/3/60	0.25	.15	.15	Last transmission 12/28/60
TIROS-II	11/23/60		.63	1.03	TV data useful to 7/12/61
Explorer XI (S-15)	4/27/61		.61	.61	Last transmission 12/7/61
TIROS-III	7/12/61	.25	.40	.63	TV data useful to 12/4/61. Lost tape recorders.
Explorer XII (S-3)	8/15/61	1.0	.31	.31	Transmission ceased abruptly
TIROS-IV	2/8/62	0.25	.36	.44	TV useful to 6/9/62. Lost tape recorders.
OSO-I	3/7/62	0.5	1.40	1.40	Lost tape recorder @ 2 mos. starfish incident degraded power system.
Ariel-I (S-51)	4/26/62	1.0	0.88		Degraded by starfish incident of 7/9/62.
TIROS-V	6/19/62	0.5	0.88	0.88	TV useful to 5/4/63. Camera filaments failed.
TIROS-VI	9/18/62	0.5	1.06	1.06	TV useful to 10/11/63. Filaments and focus out.
Explorer XIV (S-3a)	10/2/62		0.85	1.20	Last transmission 2/17/64
Explorer XV (S-3b)	10/27/62	0.17	0.26	0.55	Despin system failed. Last transmission 5/19/63.
Relay I	12/13/62	2.0	2.53	2.53	
Syncom I	2/14/63	2.0	0	0	Lost power, mission failure.
Explorer XVII (S-6)	4/3/63	0.25	.27	.27	Batteries degraded. No solar array.
TIROS-VII	6/19/63	0.5	4.33	4.96	Deactivated. Camera focus out 12/65.
Syncom II	7/26/63	2.0	N/A	N/A	
IMP-A	11/26/63	1.0	0.82		
TIROS-VIII	12/21/63	0.5	3.53	3.53	Deactivated.
Relay-II	1/21/64	1.0	1.68	3.50	
Ariel-II (S-52)	3/27/64	1.0	0.53		Had spin rate and attitude control problems.
Syncom III	8/19/64	3.0	N/A	N/A	
Explorer XX (S-48)	8/25/64		1.60	1.60	Based on last transmission 3/30/66.
Nimbus-I	8/28/64	0.5	0.07	0.07	Solar array drive failed.
OGO-1(A)	9/4/64	1.0	5.23	5.23	Mission failure. 3-axis stabilization not achieved.
IMP-B	10/3/64	1.0	0.50	1.25	Reentered. Placed in wrong orbit.
Explorer XXVI (S-3c)	12/21/64	1.0	2.10	2.10	Last transmission 1/21/67.
TIROS-IX	1/22/65	0.5	2.73	3.4	Deactivated. Camera contrast out 10/66.
OSO-II	2/3/65	0.5	0.75	0.75	Used up control gas.
IMP-1(C)	5/29/65	1.0	1.92	1.92	Reentered.

SPACECRAFT LIFETIMES

SPACECRAFT	LAUNCH DATE	DESIGN LIFE (YRS)	USEFUL LIFE (YRS)	ACTIVE LIFE (YRS)	REMARKS
TIROS-X	7/2/65	1.0	1.16	2.00	Deactivated.
OGO-2(C)	10/14/65	1.0	3.48		Mission failure: Horizon scanners did not maintain earth lock.
ESSA-I	2/3/66	1.0	2.36	2.36	Deactivated.
ESSA-II	2/28/66	1.0	4.64	4.64	Deactivated.
OAO-I	4/8/66	1.0	0	0	Mission failure: Lost power
Nimbus-II	5/16/66	0.5	2.67	2.67	ACS scanner failed.
AE-B	5/25/66	0.5	0.82		Higher than planned orbit. Two sensors did not work.
OGO-3(B)	6/6/66	1.0	2.04	3.5	Boom oscillation problem.
AIMP-2(D)	7/1/66	0.5	4.92		Failed to achieve lunar orbit.
ESSA-III	10/2/66	1.0	2.02	2.02	Deactivated. Cameras failed
ATS-I	12/6/66	3.0		ACTIVE	Gas expended. Limited service
ESSA-IV	1/26/67	1.0	0.41	1.27	Deactivated. One camera failed, one degraded.
OSO-III	3/8/67	0.5	3.0	3.0	Tape recorder failure at 18 mos. ACS controlled manually.
ESSA-V	4/20/67	1.0	2.83	2.83	Deactivated. IR failed, cameras gradually degraded.
IMP-3(F)	5/24/67	1.0	1.95	1.95	Reentered.
AIMP-4(E)	7/19/67		3.50	3.50	Lunar orbit. Subsequent period of intermittent operation.
OGO-4(D)	7/28/67	1.0	2.24	2.75	Thermal bending of antenna caused stabilization control problem.
OSO-IV	10/18/67	0.5	0.90		Tape recorder failure at 6 mos.
ATS-III	11/5/67	3.0		ACTIVE	Instruments no longer in use
ESSA-VI	11/10/67	1.0	2.09	2.09	Deactivated Cameras degraded
OGO-5(E)	3/4/68	1.0	3.60	3.60	Deactivated. Data glut
RAE-A	7/4/68	1.0	4.50	4.50	Deactivated. Data quality had become marginal.
ESSA-VII	8/16/68	1.0	0.92	1.56	Deactivated. Early camera and tape recorder failures
OAO-II	12/7/68	1.0	4.20	4.20	Prime instrument (WEP) failed.
ESSA-VIII	12/15/68	1.0	4.95	6.75	Deactivated. Camera problems
OSO-V	1/22/69	0.5	3.9	3.9	
ESSA-IX	2/26/69		4.1	4.1	Deactivated. Standby after 4/71.
Nimbus-3	4/19/69	0.5	2.67		ACS Scanner failed 1/72.
OGO-6 (F)	6/5/69	1.0	2.06	2.25	Deactivated. Data glut

SPACECRAFT LIFETIMES

SPACECRAFT	LAUNCH DATE	DESIGN LIFE (YRS)	USEFUL LIFE (YRS)	ACTIVE LIFE (YRS)	REMARKS
IMP-5(G)	6/21/69		3.51	3.51	Reentered.
OSO-VI	8/9/69	0.5	3.30	3.30	
ATS V	8/12/69	3.0	14.84	14.84	Mission officially unsuccessful: Stabilization not achieved. Deorbited 3/20/84
TIROS-M	1/23/70	1.0	1.40	1.40	Momentum wheel assembly failed.
Nimbus-4	4/8/70	1.0	10.00	10.00	Deactivated.
NOAA-1 (ITOS-A)	12/11/70	1.0	.56	0.75	Deactivated. Momentum wheel assembly problems.
SAS-A	12/12/70	0.5	4.00	4.00	Transmitter failure terminated mission.
IMP-6(I)	3/13/71	1.0	3.56	3.56	Reentered.
OSO-VII	9/29/71	0.5	3.17	3.17	Reentered due to bad orbit
SSS-A	11/15/71	1.0	2.87	2.87	Deactivated. Battery unusable, as expected after 1 year.
Landsat-1 (ERTS-A)	7/23/72	1.0	5.58	5.58	Deactivated: Funding withdrawn
OAO-C	8/21/72	1.0	8.50	8.50	Deactivated: Funding withdrawn
IMP-7(H)	9/22/72	2.0	6.10	6.10	Power system failed.
NOAA-2 (ITOS-D)	10/15/72	1.0	2.25	2.40	Standby after 3/74. Some experiments failed.
SAS-B	11/16/72	0.5	.54	.54	Experiment low voltage power supply failed.
Nimbus-5	12/12/72	1.0	10.30	10.30	Deactivated 3/31/83. Second HDRSS failed 7/27/82.
RAE-B	6/10/73	1.0	3.75	3.75	Deactivated. Mission objectives achieved.
IMP-8(J)	10/25/73	2.0	ACTIVE	ACTIVE	All instruments operating.
NOAA-3 (ITOS-F)	11/6/73	1.0	2.84	2.84	Deactivated. Radiometer, VTPR, VHRR out
AE-C	12/16/73	1.0	5.00	5.00	Reentered.
SMS-1	5/17/74	2.0	1.60	6.70	Standby after 1/76. Deactivated 1/31/81.
ATS-6(F)	5/30/74	5.0	5.17	5.17	Deactivated.
NOAA-4 (ITOS-G)	11/15/74	1.0	4.00	4.00	Deactivated. Radiometer, VHRR's out.
Landsat-2	1/22/75	1.0	8.51	8.51	Yaw flywheel stopped 11/79, recovered 5/80. Permanently turned off July 27, 1983.
SMS-2(B)	2/6/75	2.0	6.50	7.50	Second encoder failed on 8/5/81.
SAS-C	5/7/75	1.0	4.92	4.92	Reentered.
Nimbus-6(F)	6/12/75	1.0	ACTIVE	ACTIVE	Tape recorders have failed.
OSO-8(I)	6/21/75	1.0	3.40	3.40	Funding withdrawn
AE-D	10/6/75	1.0	0.42	0.42	Shorted diode in power supply electronics.

SPACECRAFT LIFETIMES

SPACECRAFT	LAUNCH DATE	DESIGN LIFE (YRS)	USEFUL LIFE (YRS)	ACTIVE LIFE (YRS)	REMARKS
GOES-1(A)	10/16/75	3.0	ACTIVE	ACTIVE	VISSR degraded 3/79.
AE-E	11/20/75	1.0	5.56	5.56	Reentered 6/10/81
NOAA-5 (ITOS-H)	7/29/76	1.0	2.96	2.96	Failed 7/79
GOES-2 (B)	6/16/77	3.0	1.55	1.55	VISSR failed 1/79
ISEE-1(A)	10/22/77	2.0	ACTIVE	ACTIVE	Some instrument losses
IUE	1/26/78	3.0	ACTIVE	ACTIVE	Fully operational. Some problems w/ computer "HALTS"
Landsat-3(C)	3/5/78	3.0	5.07	5.51	Problems with MSS instrument
AEM-A (HCMM)	4/26/78	1.0	2.40	2.40	Deactivated. Battery degraded 9/14/80.
GOES-3(C)	6/16/78	3.0	2.21	ACTIVE	VISSR degraded 9/80. Failed 5/6/81.
ISEE-3(C) [ICE]	8/12/78	2.0	ACTIVE	ACTIVE	Some instrument losses.
TIROS-N	10/13/78	2.0	2.38	2.38	ACS failed 2/27/81.
Nimbus-7(G)	10/24/78	1.0	ACTIVE	ACTIVE	Solar array power and some instruments degraded.
AEM-B (SAGE)	2/18/79	1.0	2.75	2.75	Battery degraded. Failed 11/18/81.
NOAA-6(A)	6/27/79	2.0	ACTIVE	ACTIVE	AVHRR degraded.
Magsat	10/30/79	0.4	.61	.61	Reentered as planned 6/11/80
SMM	2/14/80	2.0	0.83*	ACTIVE	Lost fine pointing control 12/12/80.
GOES-4(D)	9/9/80	7.0	2.21	2.21	VAS failed 11/25/82.
GOES-5(E)	5/22/81	7.0	ACTIVE	ACTIVE	
NOAA-7(C)	6/23/81	2.0	ACTIVE	ACTIVE	
DE-1(A)	8/3/81	1.0	ACTIVE	ACTIVE	
DE-2(B)	8/3/81	1.0	1.54	1.54	Reentered as expected 2/19/83.
OSS-1	3/22/82	--	--	--	Shuttle attached payload mission.
Landsat-4(D)	7/16/82	3.0	ACTIVE	ACTIVE	
NOAA-8(E)	3/28/83	2.0	ACTIVE	ACTIVE	
TDRS-1(A)	4/4/83	**	ACTIVE	ACTIVE	
GOES-6(F)	4/28/83	7.0	ACTIVE	ACTIVE	
Landsat-5(D')	3/1/84	3.0	ACTIVE	ACTIVE	

* Repaired by crew of shuttle flight 41-C on April 12, 1984.
** Complex warranty provisions call essentially for 10-year service from TDRSS system.