3. Operations highlight summary.

1978

January 26.
The International Ultraviolet Explorer was launched, at 17:36 UT, with an initial plan of revolving around the earth three times for a transfer orbit and then boosting to geosynchronous orbit.

January 27.
Due to high temperature, the apogee boost motor firing took place at 14:54 UT and placed IUE into geosynchronous orbit after the first intermediate revolution. This early transfer phase was flawless.

January 28.
The following events were carried out successfully,
- Despin.
- Solar array deployment.
- Sun acquisition and sun hold shortly.

The launch and early orbit phase was terminated at 12:36 UT.

January 29.
The PAS#1 failed due to a shift register malfunction. The redundant PAS was put into use.

January 30.
Camera and focus mechanism were checked out. Primary and secondary mirror heaters as well as camera deck heaters were switched on at 14:30 UT.
The telescope dust cover was ejected successfully at 16:20 UT.
The OBC began to indicate problems due to a violation of an operating constraint prohibiting a 16:1 multiplex ratio (1.25 kbps rate).

January 31.
The first major slew to the north ecliptic pole was initiated at 15:43 UT and ended at 16:25 UT.
AT 19:14 UT the spacecraft lost OBC control due to an unknown reason caused by OBC Worker-0, and the s/c attitude was lost.
LWR camera was switched on at 17:59 UT and configured in standby mode.

February 1.
SWR camera was switched on at 11:30 UT and configured in standby mode.
Initial switch on of FES#1 was conducted at 15:51 UT. The first FES image collected from IUE containing 1 star of approximately 11 magnitude.

February 3.
Calibration images were collected from the LWR and SWR cameras.

February 5.
The initial switch on of the LWP camera was performed.

February 9.
The first spectrograph image was received at VILSPA, containing the LWP high resolution spectrum of target "CAPELLA".
The Scientific Instrument was tested: camera check-out, in-flight camera reoptimization, photometric calibration and intensity transfer function (ITF) calibration.

February 13.
A malfunction of the LWP camera (the scan control logic anomaly) was detected. The scan beam did not sweep as expected during read mode.

February 19.
The SWR camera experienced some voltage drops.

February 21.
The FES#2 was declared the prime FES. By design FES#1 received 30% of the impinging stellar flux and FES#2 received the 70% portion.

March 27.
Solar array temperature sensors showed erroneous indications.

April 3.
The routine observations started. LWR and SWP were declared prime cameras.

July 24.
A 3 gyro software matrix was uplinked to the OBC. This was done to determine the feasibility of running on 3 gyros during IUE's second shadow season in order to save power.

September 23.
A malfunction of the SWR camera was detected in the GRID-1 voltage, which is a part of the camera read electronics.

1979

March 14.
Gyros 2, 4 and 6 were turned off as a part of shadow preparations. The OBC 8K memory was loaded with 1, 3 and 5 gyro matrix. It saved the spacecraft 17 watts of power, improving the power profile during shadow.

April 18.
Gyro 6 failed to start when the three gyros 2, 4 and 6 were turned on following shadow. Numerous attempts were made to restart the gyro 6 spin motor but all were unsuccessful.

May 29.
An OBC HIT protection was entered in the 4K memory back-up. An OBC hit was a specific type of corruption to hardware stored values in the OBC, which usually resulted in an OBC crash (see section 5.6.5.)

June 20.
Another unsuccessful attempt to restart Gyro 6 was made.

August 1.
The gyro 6 heater was set to high 5 hours prior to another attempt to turn on this gyro again. A command to turn on the gyro during a maneuver was sent when the ABG on the slewing axis was one degree. This permitted the maximum amount of oscillation and torque from the wheels during the 27 seconds that the gyro starting voltage was applied. This attempt to restart gyro 6 was unsuccessful.

October 25.
An intermittent change of aperture locations in the FES#2 was noted, when the expected drop of light did not take place while moving targets into the small apertures. It was assumed that the FES electrical characteristics changed or a mechanical shift of the aperture faceplate took place. This problem was called the FES reference point shift anomaly (see section 5.5.7.2).

November 8.
As a result of the information obtained from the last three OBC dumps acquired after crashes in previous months, the OBC software was patched in 33 locations.

1980

January 2.
The FES reference point shift anomaly was seen again. The problem was not found to be a mechanical shift, but was thought to be related to the FES electronics.

January 9.
The OBC was patched to collect data to study the HIT problem.

January 29.
The OBC was patched again. In this case, the NO-OP instruction in the idle task loop was changed to a HALT in order to save power and lower the OBC temperature.

March 31.
The NO-OP was reinstalled in the OBC. Evaluation of engineering data indicate no reduction in power and temperature with the new configuration. Since the NO-OP instruction greatly reduced bus noise, the decision was made to return to the previous one.

May 27.
The Command Decoder#1 was used as prime in order to investigate the cause of various command anomalies (see section 5.2.1.).

June 12.
The OBC and radiation monitor were powered down as a result of a failure in Command Decoder#1 and the spacecraft attitude was lost. Decoders were switched again putting Decoder#2

in use.

December 15.
HAPS heater group number 1 failed to warm up after it was switched on, the redundant one (HAPS heater group number 2) was used.

1981

January 21.
The OBC was reset following an OBC crash. Upon start up the OBC automatically selected the Command Decoder#1 to receive the OBC commands (see section 5.2.).

January 23.
A restart of gyro 6 was attempted though cycling the gyro on and off every 25 seconds. This procedure had worked for two gyros on the HEAO-3 spacecraft. The turn on was unsuccessful for IUE.

February 1.
The OBC worker 7 was switched on to provide additional information for troubleshooting in case OBC hardware errors were detected.

August 9.
The temperatures of gyros 1 and 3 had been decreasing since July 1.

August 18.
The gyro 6 heater was powered up to heat the area, but as gyro 2 temperature and current rose abnormally, the gyro 6 heater was turned off in order to return the gyro 2 to the normal state.

September 8.
Gyros 1 and 3 temperatures dropped again and maneuver accuracy continued to decline. A new OBC matrix without Gyro 1, which was considered the primary source of error, was uplinked.

September 22.
A new set of scaling factors for gyros 1, 2, 3, 4 and 5 was uplinked to the OBC.

November 21.
A new set of scaling factors for gyros 2, 3, 4 and 5 was uplinked to the OBC. The large errors observed after coarse maneuver termination were improved.

1982

February 23.
Numerous OBC crashes were caused by Interrupt 14 during the last year (see Appendix C). So, a patch was uplinked to the OBC to protect against this problem.

March 2.
A new malfunction of gyro 1 was observed when the torque rebalance loop indicated saturation. Gyro 1 was considered as being lost.

April 26.
A gradual increment of the temperature of gyro 5 was measured. An improved gyro scale factor had to be uplinked.

May 25.
A badly decoded and executed command placed the SWP camera in an incorrect configuration (see section 5.2.1.).

July 27.
The gyro 2 motor current increased from a nominal 60 mA to 214 mA in 9 seconds. Turning the gyro off and on was tried but nothing happened. The gyro 2 had stalled.
Gyros 3, 4 and 5 were used in the control matrix while a new system using 2 gyros and FSS began to be developed.

December 4.
A new set of scaling factors for gyro 3 and 4 was uplinked in order to reduce the maneuver errors.

1983

January 9.
New scale factors for gyros 3 and 5 were uplinked.

March 30.
A reoccurring flare was seen on the LWR camera images (see section 5.7.3.).

March 31.
The 2 Gyro + FSS was successfully tested with the spacecraft.

April 13.
A test with gyro 1 was performed because its stability appeared to have improved. The test showed the gyro to still have excessive noise in its output signal.

August 31.
The undervoltage detectors on both batteries were turned off. This action was taken as a precaution because if only one cell failed, an entire spacecraft shutdown might occur.

October 16.
The LWP camera was declared the prime long wavelength camera. This was due to the LWR anomaly.

December 11.
Gyro 1 stopped spinning leaving gyros 3, 4 and 5 as the three remaining operational gyros.

1984

March 16.
New scale factors were uplinked for gyros 3 and 5.

July 16.
The spacecraft experienced a sudden unexpected change in momentum. The attitude control system was able to control the motion, but it could not be attributed to an onboard system.

July 23.
The scan control logic of the SWP camera skipped two pixels of video data during a read.

August 31.
The telescope sun shutter unexpectedly closed (see section 5.7.).

September 24.
S-Band antenna 4 began to show large fluctuations in its output power, which were directly associated with fluctuations in the power drawn by the power amplifier.

September 26.
The telescope sun shutter unexpectedly closed again.

1985

April 15.
FES#2 demonstrated anomalous behaviour. When tracking on a star of known brightness, the magnitude count fluctuated erratically (see section 5.5.7.3.).

April 30.
Both PASs were turned off.

May 15.
New scale factors were uplinked for gyros 3, 4 and 5 to improve the maneuvering accuracy.

June 16.
FES#2 star magnitude count variation were observed again when the fine error sensor was configured in fast track underlap mode.

July 17.
New scale factors were uplinked for gyros 3, 4 and 5.

August 17.
Gyro 3 failed at approximately 05:00 UT. The spacecraft had to be placed in sunbath and scientific operations were suspended.
Attempts to restart gyros 3 and 6 were unsuccessful.

August 18.
The 2-Gyro FSS back-up control system was loaded into the 8K OBC and testing began.

August 28.
PAS#2 was tested and found that it no longer worked.

September 30.
The observing program was restarted.

October 4.
FES#2 counts fluctuated erratically.

October 9.
Sun shutter closed without being commanded shut.

November 26.
The sun shutter was commanded closed but remained in the 'slew' mode. It was reopened and closed successfully.

1986

January 9.
FES#2 displayed more anomalous behaviour.

May 14.
A patch was made to the OBC in an attempt to keep the roll axis in a fine control mode as well as to reduce power consumption when the OBC uses the FSS to control that axis.

August 31.
Sun shutter closed without being commanded.

October 7.
A new control system (the 1-Gyro/FSS control system) was developed to be used in case of another gyro failure.

1987

January 20.
Battery#1 raised suspicion on its performance. Tests were carried out and batteries proved to be operational. The battery#1 third electrode was giving an anomalous signal so it was a bad charge indicator.
It was recommended that charge/discharge operations be done without using third electrode voltages as full charge indicators or to provide charge control.

April 28.
A bad scan was detected on the LWP camera, it was a known camera malfunction. The ground system software was prepared to detect and correct this condition automatically.

November 30.
Another bad scan was detected on the LWP camera.

1988

March 9.
FSS gave corrupt data while the spacecraft was slewing. The attitude control was lost.
A study was made as to the viability of switching to the backup heads on each FSS system, but the collected data showed this configuration to be as bad as the prime one (see section 5.5.2.1.).

July 29.
During an attempt to promote discharge of the batteries, both PASs were commanded on, but only PAS#1 responded by drawing current. Analysis of the data suggested a relay failure.

November 28.
The spacecraft attitude control degraded into oscillations as a result of the beta 75° crossover point of the FSS. The problem corrected itself when the dangerous region was left (see section 5.6.5.).

December 1.
Worker 3 was uplinked to the spacecraft. Tests of the new code showed it to work but it was not used because cycling the cameras so rapidly could damage them.

1989

September 5.
FSS gave corrupt data while the spacecraft was slewing. The maneuver had to be stopped by ground command.

October 2.
A new wheel unload program was used to reduce the frequency of required Delta-Vs, by selecting the most favourable momentum-wheel unload jet firings to counteract the westward drift of the spacecraft.

1990

February 22.
The third electrode on Battery#1 was turned off.

March 10.
The Gyro 5's drift rate changed abruptly.

March 19.
The thrid electrode on Battery#2 was turned off (see section 5.1.2.).

May 25.
A new configuration was used in the power system due to the Battery#1 degradation and third electrode malfunction: Battery#1 Main Charger ON, Battery#2 Low Trickle Charger only and both batteries 3rd electrode OFF (see section 5.1.2.1.).

August 26.
"Top-off"s were performed on a weekly basis on Battery#1 to ensure a full charge on this battery (see section 5.1.2.).

October 17.
The engineering testing of the 1-Gyro attitude control system was completed. A spacecraft test was performed successfully.

November 1.
Sun shutter closed without being commanded shut.

December 9.
FSS gave corrupt data while the spacecraft was slewing. The maneuver had to be stopped by ground command.

December 18.
The OBC had to be restarted due to a synchronization problem with the data received from the DMU.

1991

January 27.
Several FES images of different stellar fields showed a large background event. This problem was called the FES Scattered light anomaly (see section 5.5.7.4.).

February 5.
The current reading coming from Gyro 5 dropped to 0 amps and remained there. However Gyro 5 continued to work properly.

May 14.
The FPM began to produce erratic data.

July 24.
The flux level in a LWP camera image was about 25% below expected for unknown reasons. This problem was named the LWP flux anomaly (see section 5.7.3.).

July 30.
Appreciable scattered light in the FES camera at approximately 13 magnitude level was seen again.

1992

May 23.
The Gyro 5 drift rate increased abruptly.

September 14.
The FES level of contaminated light experienced a strong increase. The behaviour of this problem was different than the previous light in several aspects. It was called the FES Streak light anomaly (see section 5.5.7.5.).

1993

April 26.
Some special maneuvers about the roll axis were performed to evaluate the cause of the FES Streak Light problem. It did not produce any solution.

1994

October 4.
The Gyro 5's drift rate changed abruptly.

October 24.
Raw values of some telemetry points changed to a fixed value (159) during periods of high OBC temperature and while the spacecraft was in 1B format. This was called the DMU anomaly (see section 5.4.1.).

1995

January 1.
The raw values of some other telemetry points changed to 63.

January 8.
The corrupted number 159 began to appear in the spectrograph images.

August 5.
A sudden drop of -10 dBm in S-Band PA#4 down-link signal strength was observed.

1996

March 6.
Gyro 5 was switched off by a conflictive command and could not be restarted. Several attempts to restart the Gyro 6 were also unsuccessful.
The spacecraft had to be placed into Sunbath mode and the scientific operations were suspended.

March 11.
The 1-Gyro system was loaded into the OBC. The spacecraft came back under the OBC control with only one remaining gyro.

April 4.
The observing program was restarted.

May 10.
FSS corrupt data produced a brief loss of attitude control and a loss of attitude several times, due to the new control law not being able to recover from the corrupted data condition (see section 5.5.2.1.).

September 30.
All remaining hydrazine was vented. The batteries were discharged and switched off when their voltages reached 17 volts. The radio frequency transmitter was turned off at 18:44 UT.