Holm

March 21, 1977

# THE SCIENTIFIC COMMISSIONING PLAN FOR IUE

## INTRODUCTION

The following plan for the scientific commissioning of IUE is the result of a series of technical meetings held on March 4, 7, 8 and 9, 1977. The principal contributors to this plan have been A. Boggess, D. Evans, P. Gondalekar, D. Klinglesmith, F. Macchetto, B. Stewart, D. West and R. Wilson.

The process of commissioning the IUE after it is placed in orbit has as its purpose several fundamental objectives:

1. The turn-on and engineering test of spacecraft systems.
2. The turn-on and engineering test of the scientific instrument.
3. Scientific evaluations of the performance of the SI.
4. Observations of a restricted number of high priority objects.

The present document deals primarily with the third and fourth of these objectives. It lists the principal tasks to be performed and develops a rationale for the order in which they should be carried out. It also establishes a mechanism for integrating the scientific commissioning activities of the three participating agencies, NASA, ESA and SRC, into a single, unified effort and establishes a mechanism for staffing the IUE Observatory with experienced observers and analysts during the commissioning period.

The work to be accomplished during the commissioning period will be the minimum necessary to begin routine scheduled operations with guest observers. One consequence of this approach is that some aspects of instrument performance and data reduction will remain unstudied at the end of the commissioning period, but these will be matters that are not essential to the first observations and that can be investigated most successfully by observers who need the additional information in order to interpret their own data.

Even during the limited commissioning period the most effective way of evaluating the instrument performance characteristics will be to entrust experienced observers with the task of studying real spectra and learning enough about the instrumental characteristics to understand their data. These real spectra must include a number of known, well-studied sources, where the results are predictable, and also a number of unknown sources that will test the research potential of the scientific instrument.

It is proposed that the scientific staff that will be necessary during commissioning be acquired by assembling an international team of experts experienced in the various aspects of the IUE observatory. This team will be named the IUE Science Commissioning Team and would be given the responsibility for ensuring the scientific commissioning of the IUE observatory system. The team would need to establish the performance characteristics of the instrument and conduct the necessary optimization and calibration procedures. Further, it would need to define a set of high priority observations to be carried out at a very early stage, prior to optimization and calibration, as a precaution against premature failure of the satellite. The team would be expected to make early publications describing the performance, characteristics and calibration together with any preliminary analysis of the observational data.

The following sections describe the plan for scientific commissioning, the nature of the observing list of high priority objects, and the organization and charter of the IUE Science Commissioning Team.

## THE TIME LINE FOR THE IUE COMMISSIONING PHASE

1.0 The sequence of events between launch and the ejection of the telescope cover is summarized in Table I. Checkout of the Scientific Instrument begins after cover eject. Table 1 is on page 12.

Table II is shown on pages 13 and 14.

2.0 The time line in Table II covers the period between telescope cover eject and the beginning of regularly scheduled guest observers. There are nine major parts to the time line. These nine parts will be described first in the broad terms of what each event is and then, in the next sections, each major part will be broken down into a description of what is happening during each event in three areas: the telescope, which includes the pointing system; the spectrograph, which includes the TV cameras; and the data processing tasks.

This time line begins 7 to 12 days after launch with the ejection of the telescope cover. The SI then goes through a two day vacuum soak during which the spacecraft is positioned at different angles and thermal time constants and thermal equilibrium values are determined. Next the engineering checkout of the SI begins with turning on the Fine Error Sensors. For both the FES and TV camera we have adopted the policy of turning on the redundant unit first so that if any procedural fault occurs the prime unit would not be damaged.

The initial evaluation of the SI capabilities begins with stellar acquisition and the turning on of the redundant TV cameras in each spectrograph. Spectra of the first stellar object are obtained along with flat fields and wavelength comparison spectra. The data reduction programs used in reduction of these spectra are summarized in Appendix A. After obtaining the first spectra, the high priority target list is begun. These high priority spectra will be processed with the existing groundbased calibrations. After these observations are completed, a post-launch calibration phase begins, in which the cameras are re-optimized and calibrated, and ends with the approval of the data reduction system. As these activities cannot be scheduled with great accuracy, a short contingency time will be included before scheduled guest observations begin.

2.1 Cover Eject

The event will happen between 7 and 12 days after launch. It must be 2 days after ABM firing. The spacecraft must be stabilized so that the 3-axis drift rates are less than 2 arcsec/minute. The SI is off, the sun-shutter will be closed, and the SI heaters will be set to provide proper thermal control during the period before SI electronics are turned on.

2.2 Vacuum Soak

During this two day period the spacecraft and SI will be allowed to outgas and come to thermal equilibrium. It will be possible to point the system to various angles so that thermal time constants can be obtained.

2.3 Engineering Checkout of the SI

The SI can now be turned on. First the redundant FES is turned on slowly along with the lamp power supplies and fiducial lamps. The FES is checked functionally and the remaining part of the orbit is used for radiation background measurements. No acquisition is attempted. After 24 hours the redundant FES is turned off and the prime unit is turned on in a similar manner. During the first or second day the calibration of the SI analogue to digital converters can be checked with the built-in ramp function.

2.4 Initial Turn-on of the SI Capabilities

The rationale for this activity is to obtain as early as possible well exposed spectra which can be used for initial evaluation of the data reduction software, so that ample time is allowed to refine the software package. For this purpose the target star should have been observed by Copernicus so that its spectrum is already known, and it should be located near the Ecliptic Pole so that there are no scheduling time constraints on the initial observations. This phase begins with acquisition of this star by the FES, after which the IUE will be stabilized.

The redundant TV cameras can now be turned on. The turn-on procedure takes about 7 hours and is detailed in Appendix B. Notice that since the redundant cameras are in use the camera select mirror is in the optical path. Also the low dispersion flip mirror is out of the optical path because this first star will be a bright one.

After the turn-on is completed, a series of six or seven images are obtained in each spectrograph in the following order:

null image
flat field (uv flood)
wavelength calibration lamp
stellar spectra - more than one needed to obtain good S/N over 1000Å
wavelength calibration lamp
flat field

These images will provide the first opportunity to go through the complete data reduction system. The flat fields are used to measure the geometrical distortion. The wavelength calibration lamp images measure shifts in spectral format suffered during launch and provide the dispersion constants for the stellar spectra. The stellar spectrum is used to checkout the basic data reduction system. It will be compared to the known data for that star so that an initial evaluation of the system efficiency can be obtained.

This procedure will be repeated for the two prime cameras. The total effort will take two days.

2.5 FES Tests

The telescope and FES will begin acquisition studies in rich fields and tests of its ability to resolve and acquire close binaries. Also a planned reacquisition and repointing procedure will be tested here. One day is allowed for these activities. During this day, radiation background measurements will also be obtained by making repeated background exposures with both prime cameras at various locations in the orbit.

2.6 High Priority Target Observing

At the beginning of the eighth day the system should be checked out sufficiently so that the high priority observing program can begin. These objects are deemed important enough to observe even before the whole system has been optimized and calibrated in flight.

While this high priority program is being carried out, much information concerning telescope scattered light and telescope PSF can be obtained. At the time of launch, very conservative pointing constraints will be imposed upon the observers. These constraints will be relaxed gradually as the result of experince obtained during the high priority observing program. The information to be gathered includes scattered light levels as functions of earth, sun and moon position.

The data reduction of the spectra of the high priority objects will be done with the groundbased calibrations, with some attempt to remove the radiation induced backgrounds.

## 2.7 Post-launch Calibration and Evaluation

The post-launch calibration and evaluation is divided into nine parts.

### 2.7.1 Re-optimize the Cameras

Re-optimization will be necessary because of the schedule constraints that will prevent the project from doing a complete optimization on the flight cameras before launch. The procedure to do the re-optimization will be determined only after the flight cameras have been delivered to GSFC. Basically, there is a four step iteration of adjustment of parameters. First, the GI-on voltage is adjusted to provide enough beam current to readout the target. Then the alignment currents are adjusted so that the read beam lands equally well at all parts of the image. Next, the G3 voltage (focus voltage) is adjusted to give best focus of the read beam at all parts of the image. Finally, the prepare sequence is adjusted so that a uniform pedestal remains on the target. This cycle is repeated until a convergence is obtained.

This process should take 2 days for each camera and it will be done on only the prime cameras, since there is no point in optimizing the redundant cameras until they are actually needed. Hence, four days are used for re-optimization. The data analysis tasks include averaging, contouring, reseaux location and depth analysis, and S/N ratio determination.

### 2.7.2 Intensity Transfer Function

This phase will produce ITF curves for the optimized cameras. Twelve images are needed per ITF curve. It shall be repeated at least 4 times in order to minimize possible fluctuations in brightness of the uv floodlamps. With an average exposure time of 10 minutes plus 20 minutes of preparation and readout this will amount to 24 hours of image collection per camera. Hence, a two day period is needed.

The data reduction and analysis tasks are reseaux location and removal, averaging and generating of the final ITF curves.

During this period the acquisition tests may continue if needed.

2.7.3 Radiation Background Limits

This phase is concerned with determining the radiation induced background with the re-optimization cameras as a function of position in the orbit. It will consist of a series of 1 and 2 hour exposures in each prime camera for one complete orbit. Hence, one day will be needed.

The data reduction tasks are averaging, S/N determination and image contouring.

2.7.4 Wavelength Calibration

The phase determines the initial set of dispersion constants for each spectrograph and each dispersion. The images needed will include flat fields (for reseaux location) and Pt lamp exposures for the actual dispersion constants. Between 2 and 7 images will be needed in each dispersion and spectrograph. The image collection can be done in 8 hours or less for both spectrographs.

The data reduction tasks include reseaux location, emission line feature location, least squares analysis to determine the dispersion constants.

2.7.5 Telescope Focus

The telescope can be focussed on the aperture plate, or the total system can be focussed for best spectral image quality. Assuming that the telescope has been focussed on the aperture plate at the beginning of the acquisition phase (day 4), the resolution of the entire system can be checked by looking at the depths of narrow unsaturated absorption lines in stellar spectra. A set of images with 3 images inside and 3 images outside of nominal telescope focus will be obtained. This procedure should take less than eight hours for both spectrographs. The focus must be checked for each spectrograph at each dispersion.

The data reduction needs are the complete data reduction scheme and analysis of line depths.

2.7.6 Photometry (System Efficiency)

This phase will determine the overall system efficiency. It is here that the wavelength dependent effects are to be measured.

A series of 5 images of a photometric standard star selected from candidates recommended by the AWG Standards Committee will be taken so that optimal S/N ratios are obtained at all wavelengths. These observations need to be made with both spectrographs and with both dispersions. However, for the low dispersions a much fainter standard star will be selected. The image collection time will be about 10 hours for the four spectrograph-dispersion combinations.

2.7.7 Interorder Overlap

This phase is mainly analysis of spectra previously obtained in section 2.7.6. To augument those spectra, highly overexposed Pt lamp images will be used to measure the extent of the wings of the PSF. A total image collection time of 3 hours is needed for this effort.

The data reduction tasks will include the complete data system plus contours of emission line profiles to determine the extent of the wings of the PSF.

2.7.8 Scattered Light Analysis

This phase will need images of late type objects in which there are steep gradients in the wavelength range covered by each spectrograph. The images will be long exposures, as they need to be well exposed at the short wavelength end. These exposures will show the effect of large angle scattering. The exposure time needed for the late type objects will be of the order of 8 hours.

The small angle scattering can be obtained from images taken in section 2.7.6 and 2.7.4.

The data reduction tasks include the full data reduction system plus differences of spectra.

2.7.9 Repeatability

Several images of flat fields, Pt spectra, and stellar spectra need to be repeated so that the stability of the system can be determined. One day should be sufficient for the image collection. These tests will provide the early baseline data for studies of long term trends.

2.8 Completion of the Commissioning Phase

If, following the previous activities, any contingency time is left, it will be used for additional observations of high priority objects. Based on the reports of the calibration activities and on the evaluation of the IUE scientific instrument performance and data reduction software by the IUE Science Commissioning Team and Project personnel, a formal review by the three agencies will be held to determine that the IUE is commissioned and ready for guest observing.

## 2.9 First Scheduled Guest Observer Sessions

Having completed the commissioning phase, regularly scheduled guest observers can begin their programs. These routine operations will start about 30 days after cover eject and about 40 days after launch.

TABLE I

IUE ORBITAL OPERATIONS

INITIAL TIME CONSTRAINTS

| LAUNCH | TIME(T, DAYS) | COMMENT |
|---|---|---|
| Launch | 0 | |
| Mission Orbit | 1 to 3 | Earliest & latest dates to achieve synchronous orbit |
| V < 250 | 4 | No high voltage until 72 hours after launch |
| Despin | --- | |
| Deploy Arrays | --- | |
| Sun Hold, $\beta = 67^{\circ}$ | 1 to 3 | Analog acquisition/Jets |
| Control to Wheels | --- | |
| ACS Checkout, $\beta = 90^{\circ}$ | 2 to 4 | ($\Delta$ = 1d) drifting to station |
| Drift to Station (on station) | 4 to 50 | ABM burn timing<br>GSFC 60-100% (24 hrs.)<br>Vilfra 0-100%(10 hrs.) |
| S/C Systems Checkout<br>$\beta$ = 0, 45, 115, 137, etc. | 4 to 8 | ($\Delta$ = 2-4d) 'Long Form Test Comparison', Vilfra Command Test |
| G/S Antenna Checkout | 5 to 10 | ($\Delta$ = 1-2d) S Band Antenna Patterns |
| S/W Constraint Checks | 6 to 11 | ($\Delta$ = 1d) Test Interlocks |
| Cover Eject | 7 to 12 | Constraints:<br>ABM + 2 days;<br>Constraints Check;<br>2 days before S/I HV "ON" |

3 axis Rates << 2 arcsec/minute

TABLE II

IUE COMMISSIONING PHASE

| TIME (DAYS) | EVENT | TELESCOPE | SPECTROGRAPH | DATA PROCESSING |
|---|---|---|---|---|
| 0 | cover eject | | | |
| 0-2 | vacuum soak | | | |
| 3 | engineer checkout of telescope | FES #2 ON | | |
| 4 | | FES #1 ON | | |
| 5 | initial evaluation of SI capabilities | acquire first star<br>focus checks | turn on redundant cameras<br>take first set of spectra | first run thru IUE Spectral Processing System (IUESIPS) |
| 6-7 | | acquisition studies, rich fields,<br>binaries, reacquisition test | Turn on Prime cameras<br>background studies with prime cameras | averages, differences contouring |
| 8-14 | high priority targets | telescope scattered light & PSF<br>bright earth observing constraint tests | high priority target list spectra | complete run thru of IUESIPS with ground calibration |
| 15-23 | post-launch calibration | | re-optimize ITF<br>background wave-length calibration | averages, SN, contour<br>averages, create cal. file<br>averages, contours<br>reseaux location, feature location, DC library |

TABLE II (continued)

| TIME (days) | EVENT | TELESCOPE | SPECTROGRAPH | DATA PROCESSING |
|---|---|---|---|---|
| 15-23 (continued) | | | system focus | absorption line depth |
| | | | photometry | system efficiency curves |
| | | | order overlap | line plate, contours |
| | | | scattering, repeat-ability | IUESIPS averaging, differences |
| 24-30 | completion of commissioning list | observations as needed | observations as needed | IUESIPS OBSERVER HANDBOOK PREP. |
| 31 | first scheduled guest observer | | | |

## HIGH PRIORITY TARGETS FOR IUE

A list of high priority targets for IUE will be compiled by the Science Commission Team to form the basis of an abbreviated observing program to be carried out during the commissioning phase of IUE mission. The observations will be conducted when no in-orbit calibration will be available for IUE SI, and will be taken when the observational techniques are not fully developed. The observations will have to be repeated during the guest observing phase. The high priority targets have been defined as objects for which even low quality uv spectra would lead to a major advance in astronomy. The high priority target list will reflect the interests and thinking of the astronomical user community and will involve a high degree of international collaboration. As a guideline, seven days have been allocated for observation of high priority targets. In order to simplify their selection, they may be categorized within the following six areas.

i. Hot OBA stars, e.g.
   Subluminous stars, planetary nebulae, hot emission line objects, NOVA, dwarf novae, symbiotic stars

ii. Cool stars, e.g.
   stellar chromospheric lines, T Tauri stars, variables

iii. Interstellar medium, e.g.
   heavily reddened objects, supernovae remnants

iv. x-ray objects

v. Extragalactic objects, e.g.
   normal galaxies, QSO's, Seyfert's and Markarian galaxies, BL Lac objects

vi. Solar System objects

Based on current estimates of IUE sensitivity and camera preparation and read times, it should be possible to make about 100 observations in the seven days proposed for high priority observations. Two sample high priority lists have been generated so far. One list has been compiled from recommendations by the NASA users and AWG. A second list has been compiled at UCL. These lists may serve as a basis for the deliberations of the Scientific Commissioning Team.

## IUE SCIENCE COMMISSIONING TEAM

### INTRODUCTION

The purpose of this section is to describe the nature, responsibilities, and working relationship of the IUE Science Commissioning Team and to define its role during the commissioning phase of IUE.

The in-orbit scientific commissioning of the IUE requires an engineering checkout of the SI, including the FES, telescope, spectrographs and cameras as well as the total scientific operations system on the ground, including, science planning, realtime target acquisition, SI operations, quick-look and production data processing.

Following these hardware and software checkout activities, there will begin the important and critical tasks of scientific calibration, the observing of high priority objects, the evaluation of the scientific performance of the IUE and the scientific interpretation of the high priority observations. In order to accomplish this critical phase of the IUE commissioning, NASA, ESA and UK plan to set up an IUE Scientific Commissioning Team charged with the responsibility for the Commissioning Phase. The selected members would carry out their responsibilities at the IUE Operations Centers during the first weeks of IUE Scientific Operations.

### Team Membership

The team will consist of about 15 scientists. The membership will be divided among the three agencies in approximate proportion to their respective observing allocation. Each agency will nominate scientists as members to the commissioning team, the final membership selection to be made jointly by the Project Scientists of the three agencies.

The team should include scientists from within project who are expert in different aspects of IUE operation, as well as other scientists who are experienced in observing and reducing data for research programs close to the scientific goals of IUE. Specific areas of experience should include

SEC cameras
IUE Hardware
IUE Software
Operational experience with astronomical satellites
OBA Stars
Cool Stars
Interstellar medium
Extragalactic objects
X-ray objects
Solar System objects

It is expected that the first meeting of the IUE Commissioning Team should occur in July, 1977.

Responsibilities of the IUE Science Commissioning Team

The Team will have the responsibility for ensuring the scientific commissioning of the IUE. This responsibility includes the following tasks:

1. Provide a detailed commissioning plan;
2. Provide commissioning and high priority observing lists and the observation specifications and data processing requirements;
3. Review the operations and data processing schemes;
4. Execute the observing program and improve observing techniques;
5. Provide analysis of scientific instrument performance;
6. Evaluate and improve the data processing system;
7. Provide a report describing instrument performance and observing and data reduction techniques;
8. Preliminary analysis and early publication of high priority observations;
9. Consider fostering international cooperation into the guest observer phase.

# APPENDIX A

To be supplied by D. Klinglesmith

APPENDIX B

## SUMMARY OF PROCEDURE FOR INITIAL CAMERA TURN ON

M. C. W. Sandford

1. Starting assumptions (Camera Turn-on Constraints)

| | | |
|---|---|---|
| SI adequately outgasses) | | |
| Pressure less than $10^{-5}$ Torr for 24 hours | ) partially ) confirmed ) by operati[on] ) of FES? | |
| SI dark | ) | |

Checkout of the following completed: Command up link
Telemetry down link
EEA
Lamp Controls

2. Detailed procedure for engineering checkout of camera after launch

This procedure covers the initial turn-on of a camera in orbit and establishes that it can be operated safely in all modes. The procedure should be rehearsed before launch and comparative data will be available.

NOTE: Status checks are performed after each command and the image inspected after each read.

2.1 EEA on, Camera off, Lamps off

2.2 Standby

2.3 Warm

2.4 Read with VG1 biased off, high gain (502 test A and allows status to check scanning) beam current check

2.5 One fast wipe VG1 on (Allows status to check VG1 on)

2.6 Read (VG1 on)

2.7 Expose 1/2 min. EHT: SEC $V_3$, CONV 0 i.e. ($V_3$, 0) minimum voltage

2.8 Read

2.9 Expose 1/2 min. ($V_2$, 0) (checks EHT status)

2.10 Read

2.11 Expose 1/2 min ($V_1$, 0) (checks EHT status)

2.12 Read

2.13 Expose 1/2 min. ($V_3$, $V_2$) (checks for EHT status, and background)

2.14 Read

2.15 Expose 10 min. ($V_3$, $V_2$) (Checks for background)

2.16 Read

2.17 Expose 20% tungsten flood lamp ($V_3$, $V_2$)

2.18 Read . (establishes flood intensity is approximately correct)

2.19 Prepare ($V_3$, $V_2$)

2.20 Read (First proper null exposure test)

2.21 Prepare ($V_3$,$V_2$), Expose 10 mins. ($V_2$, $V_2$), Read)

2.22 Prepare ($V_3$,$V_2$), Expose 10 mins. ($V_1$, $V_2$), Read) (Background exposures looking for Corona problems)

2.23 Prepare ($V_3$,$V_2$), Expose 30 mins. ($V_1$, $V_3$), Read)

2.24 Prepare at ($V_1$,$V_1$), Expose flood lamp for 100% ($V_1$,$V_1$), Read (checks flood lamp exposure accurately)

2.25 Prepare at ($V_1$,$V_1$), Read high gain (Checks out high/low gain)

2.26 Prepare at ($V_1$,$V_1$), Read low gain

2.27 Prepare at ($V_1$,$V_1$), Expose UV flood lamp 10%, Read (Establishes correct illumination from UV lamp)

2.28 Camera can now be safely operated in any mode subject to usual status checks. wrong hardware only

| | | | |
|---|---|---|---|
| Total No. of Reads | 15 | Time = | 1/2 hr. |
| Total No. of Preps | 8 | Time = | 1/2 hr. |
| Total Expose Time | | = | 1 hr. |

Time to analyze data say 5 mins. per step = 2-1/2 hr.

Total time for camera checkout 4-1/2 hrs. 10 hrs

# VOB TEST PLAN - Evans

| VOB test Procedures | | # of Images | Completeness |
|---|---|---|---|
| 1.0 | Safety Check | 4 | ✓ |
| 2.0 | Mini ITF - TF1 | 36 | ✓ |
| 3.0 | System Noise Test | 12 | ✓ |
| 4.0 | Uniformity of TF1 Lamps | 12 | ✓ |
| 5.0 | Modified '502' on FU7 | 14 | ✓ Acceptance test |
| 6.0 | Mini ITF, UVF & Uniformity | 24 | ✓ |
| 7.0 | UVF-ITF λ 2537 | 13 | ✓ |
| 8.0 | WLC Lamp Exposure Test | 16 | ✓ |
| 9.0 | Spectrograph Focus Check | 4 | ✓ |
| 10.0 | Spectrograph Focus Test - FDM | 40 | ✓ |
| 11.0 | Echelle Order Overlap & Ripple | 31 | ✓ |
| 12.0 | Absolute Photometry (LW) | 3 | |
| 13.0 | Grating Uniformity | 5 | ✓ |
| 14.0 | Pre/Vacuum Short Form Test | 8 | ✓ |
| 15.0 | System Noise Test - Vacuum | 8 | ✓ |
| 16.0 | WLC Lamp Exposure Test | 9 | ✓ |
| 17.0 | Vacuum UVF - ITF | 13 | ✓ |
| 18.0 | Spectrograph Focus Check | 4 | ✓ |
| 19.0 | Spectrograph Focus Test - FDM | 14 | ✓ |
| 20.0 | Grating Scattering | 30 | |
| 21.0 | Vacuum Short Form Test | 4 | ✓ |
| 22.0 | Focus Verification | 14 | --- |
| 23.0 | Echelle Order Overlap & Ripple | 33 | ✓ |
| 24.0 | Grating Scattering | 10 | |
| 25.0 | Absolute Photometry | 3 | |

# VOB TEST PLAN

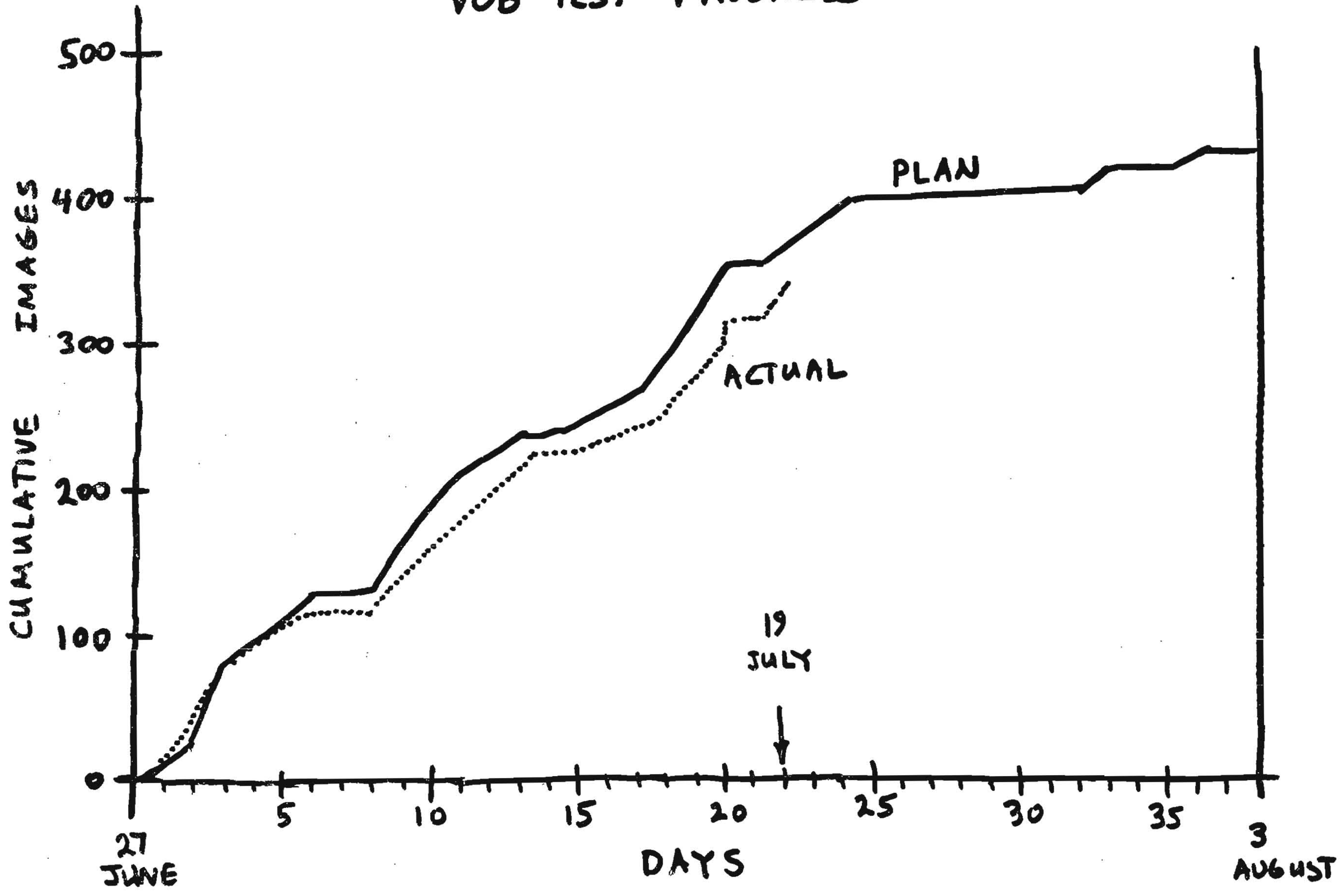
| | | |
|---|---|---|
| 26.0 | Pixel Bias - Vacuum | 6 |
| 27.0 | WLC Exposure Matrix | 14 |
| 28.0 | Vacuum UVF ITF | 39 |
| 29.0 | TF2 - Short ITF | 20 ✓ |
| 30.0 | Pixel Bias - Air | 6 |
| 31.0 | WLC Exposure - Matrix | 14 |
| 32.0 | Phosphor Decay Test | 20 |
| 33.0 | Backwards ITF | 13 |
| 34.0 | Spectrograph Cover Evaluation | 8 |
| | | 502 |

Image Categories

| | | |
|---|---|---|
| I - | Essential | 390 |
| II - | Essential, but possible in T/V | 71 |
| III - | Desirable, but not mission critical | 41 |

✓ Complete as of 19 JULY 1977

# VOB TEST PROGRESS



# KEY MILESTONES

- LTOF SPECTROGRAPH ALIGNMENT
  SPECTROGRAPH FOCUS (2MM SHIM)
  TELESCOPE FOCUS
    a) SENSE
    b) RANGE
    c) QUALITY (RATIO: SMALL/LARGE)

| | |
|---|---|
| Diffraction Limit | .82 |
| +20°C | .65 |
| +5°C | .60 |
| −10°C | .55 |

  LONG WAVELENGTH EFFICIENCY RATIO
  $\frac{LW}{SW}$ from .12 to .77 {improvement due to installation of 2 coated mirrors

- VOB SPECTROGRAPH ALIGNMENT
  TELESCOPE FOCUS PROCEDURE
  SPECTROGRAPH FOCUS (1/2 MM)
  FES PERFORMANCE
  ($12^{th}$ $m_V$ & $6^{th}$ $m_V$ − 15 sec)

PROBLEMS
- STAR MAGNITUDE (factor of 50 → 5)
- ORDER SEPARATION
  LW-Marginal-May be acceptable
  SW-Marginal-? uncertain ?
- S/G ALIGNMENT
- HARDWARE CAM 07 (04, 05)
  FES 02, 03