Building Sequence Database Files for the

Hopkins Ultraviolet Telescope

Version 2.0

June 1994

William P. Blair, and the HUT Team

Table of Contents

Comments on Versions of This Document

- Version 1.0, released November 1993.
- Version 2.0, released June 1994, contains minor corrections and additions to the original document and slightly revised figures. Appendix C modified to be more user friendly as a reference for target procedures. Distributed to entire HUT science team to support Astro-2 Final Timeline SDF development.

Please refer questions, changes, or corrections to Bill Blair (wpb@pha.jhu.edu).

1. Introduction and Overview

The purpose of this document is to provide a convenient reference for all persons involved in any aspect of building sequence files for use in setting up observations with the Hopkins Ultraviolet Telescope. Material has been assembled from diverse sources, including especially archival HUT memos from Astro-1, and updated where necessary for changes due to differing instrumental configuration or operational philosophy.

The process of "building sequence files" has many different facets, the combination of which results in a proper instrument set-up and ultimately a successful HUT observation. It is somewhat unfortunate that the nomenclature developed over the years causes some intrinsic confusion as to what one means when one refers to a "sequence file." Hence, we attempt to clarify some terminology first and we will use this terminology consistently below.

When a science plan (or SCIPLAN) of potential observations is generated in the mission planning process, one has a basic set of information about each potential observation — the length of the planned observing period, the day/night breakdown expected, a unique numerical identifier (or "sequence number"), etc. For each planned observation, HUT scientists must decide how to set-up the instrument and generate a *sequence object load* (also sometimes called an *MMU load* because they are loaded onto the Shuttle's Mass Memory Unit). This is an ascii file containing information in the proper formats and units to drive the HUT instrument into the proper configuration for an observation (when loaded into the HUT Dedicated Experiment Processor, or DEP, on orbit). The full ensemble of HUT sequence object loads forms a single MMU file called the HUT user file. Because the units of these parameters (as used by the DEP) are often not very user-friendly, we choose instead to have individual scientists work with *sequence database files*. These files contain a broad range of information on each target and/or each observation in a more user-friendly format.

Sequence database files, or SDFs, contain several different kinds of information from several sources. These include 1) information about the planned observation (coordinates, requested and scheduled times, etc.), 2) assorted reference information (magnitudes, fluxes, etc.), 3) information about potential guide stars for the HUT CCTV, and 4) information on the expected count rate and specific instrument configuration to be used. Items in category 1 come mainly from the SCIPLAN file, are entered automatically, and should not be changed by the user (i.e. they are placed in the file mainly for reference purposes). Items in category 2 are obtained from the literature or other sources and are entered into the file by the user. Guide star information is retrieved from the HST Guide Star Catalog (whenever possible) and entered automatically into the file, to provide a starting point for guide star selection. However, it is up to the user to actually decide which guide stars to use and edit the entries appropriately (see §3.2). Finally, items in category 4 arise from an analysis of the expected count rate (usually obtained from a reasonably high fidelity simulated spectrum) plus an input of scientific judgement about what is required from the observation. To assist with this process, a manila folder for each object is also kept on file; these folders, labelled with the 4-digit target ID number and the target's name, are used to store the guide star plots and overlays, reference information on each target, hard copies of your simulated spectra (if appropriate), and any other useful information or notes on the target.

Hence, as a user, you will see and be working with SDFs. But it is important to realize that these files are a "means to an end", which is the actual sequence load that drives each observation. Because of the importance of getting these files right (note: important for instrument safety as well as getting your observation!), we generally have a massive group review of each SDF followed by detailed checks of the generated sequence object loads before generating the actual HUT user file.

The process of filling in the SDFs is an iterative one because all of the information is not available simultaneously. As soon as a SCIPLAN is finalized, "template" SDF files are created for each planned observation; these are placed in a sub-directory of the "rp" account on our "hut4" computer. These files are stuffed with the appropriate entries from the SCIPLAN for your reference. Also, sequence numbers are assigned to each observation (increasing sequentially through the planned timeline) and the HUT team member responsible for updating each file is assigned. This latter assignment is important because the permissions are set so that only the "responsible" party can edit a given SDF (except for times when a superuser stuffs additional information into the files — see below). As soon as these files are available, users can begin filling in any supporting information and checking coordinates, etc. In parallel, users can generate simulated spectra of their objects using our "HUTSIM2" program, both to determine the proper instrument set up to use (which slit, door state, etc.) and to assess the quality of the data to expect and the expected count rate. When the information on potential HUT guide stars is available, this will be placed into the SDFs by a superuser. Users then assess the guide star situation, select guide stars, and choose the "locate mode" for the observation. One can then fill in all SDF entries that drive the instrument set-up. Finally, when actual IPS roll angles are returned from MSFC, these are entered into the SDFs by a superuser. One can then do final checks on the availability of guide stars, whether roll angle conditions (if any) were met, and make any other adjustments. When all SDFs are finalized, a separate program is run to generate the HUT user file for the MMU.

It is important to have a SDF for each potential observation where the HUT instrument is expected to be active. This includes all WUPPE and UIT observations, as well as planning ahead for contingencies (such as dwarf novae or other variable targets that may need to have alternate SDFs available). Also, separate files are needed for multiple observations of the same target since each pointing could (potentially) be set-up in a different manner. Observation planning is a lot of work in the wonderful world of Astro, and this is one of the main activities where substantial help from Guest Investigators is required.

In the sections below, we describe observing configurations in detail, and provide the necessary information for filling in SDFs.

2. Summary of Observing Capabilities

For most situations, HUT observations can be specified in a straightforward manner by selecting a spectrograph aperture, door state, acquisition mode, observing mode, guide stars (if any), and by noting any special Target Procedures. (These items will be described in more detail below.) However, when necessary, HUT can be operated in several different ways that allow considerable flexibility. For instance, on certain observations, it may be desirable to change the observing mode part way through an observation (say from high time rate mode to histogram, or vise versa) or to switch from one spectrograph aperture to another (say on a planetary nebula, going from a circular aperture on the central star to a nebular aperture). Changes such as these are called *dithers* and can be specified with the SDF entries beginning with "Primary" and "Secondary" (e.g. Primary_slit and Secondary_slit). Likewise, you may decide that it is advantageous to offset from the initially specified position to a second position, or even a third or a fourth. Such offsets can be specified with the entries beginning with "Offset_n" (n = 1-3) in the SDFs. It is even possible to specify a raster pattern of positions, which use the SDF entries beginning with "Mirror".

However, these sorts of offsets are accomplished by moving the HUT primary mirror with one or more motors, and are only practical for offsets of up to about 2′ (both because of the optical performance of the telescope off axis, and because of the time it takes for the mirror motions to take place, roughly three minutes per arcmin). It is not practical in most cases, for instance, to use this capability to hop on and off an object repeatedly to try to measure airglow for removal in later data reductions (although in certain cases this may be an option). Because these modes of operation are used relatively infrequently, we will not describe them in detail here. However, please refer to Appendix A or check with one of the "experts" if you think one of these techniques might be useful for your observations.

3. Sequence Database Files

As discussed in §1, the SDFs provide a user-friendly interface for planning HUT observations. These files are the receptacles of basic planning information from the SCIPLAN and other files, reference information from the literature or other sources, and data that are used to make the actual sequence loads. An annotated example SDF is provided in Appendix B of this document, and should be used for quick reference on the formats and "legal" entries of the various parameters. In sub-sections below we discuss some of the major tasks involved in filling out the SDFs.

3.1. Information Checking

The SDF files allow a number of "sanity" checks to be made without having to search through numerous separate files for the necessary information. For instance, the 1950 coordinates of each target from the SCIPLAN file are the "official" coordinates used for making the observations. These entries should be double checked against the coordinate entries from the guide star work (e.g. Target_RA,GS_Program and Target_Dec,GS_Program) to verify that the object was correctly located by the Guide Star Program (GSP). Differences of a few arcsec are unimportant. Differences up to 10 arcsec could indicate proper motion of your target or that a nearby object was mistakenly identified as your target. Any coordinate errors larger than this should definitely be resolved, and corrected coordinates supplied to MSFC for future planning. (Note: the offsets for potential guide stars are referred to the GSP coordinates. Hence, any discrepancy between the GSP coordinates and those being used by MSFC will cause the guide star fiducials to appear in the wrong place on the HUT TV.) The GSP also checks whether the Target_V_Mag entered by the user is consistent with the value found from the HST GS Catalog, and flags discrepant values.

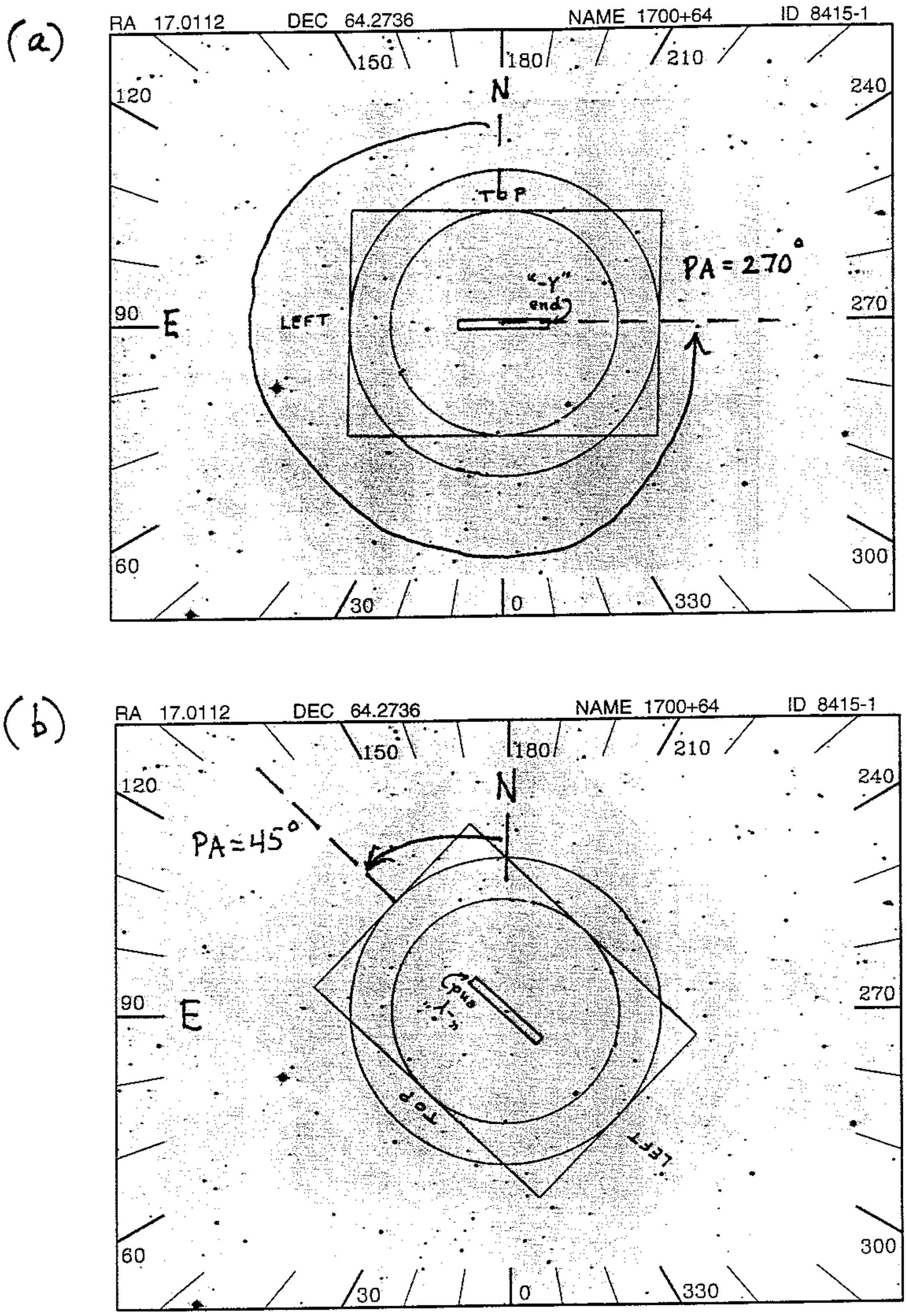


Figure 1: Position Angle Definition Examples Relative to the HUT TV View. Panel (a) shows an example of the HUT TV field of view projected on the sky. For this example, the PI_roll_angle was 270°. Panel (b) shows the situation for a PI-roll angle of 45° for comparison.

Another check that can be made is whether the roll angle requested for a specific observation agrees with the actual roll angle selected by the MSFC planners when they searched for IPS guide stars. The SDF entry called "HUT_roll_angle" refers to any requested roll angle that was made with the official SCIPLAN submission to MSFC. (Note: "-99.99" indicates no angle was requested. A flag can be set that indicates whether the roll must be met exactly as given or whether ±180° is ok; usually ±180° has no impact.) The entry "PI_roll_angle" is entered into the SDF automatically when a file returns to us from MSFC with the actual planned roll angle for the observation. (This angle has the ±180° ambiguity removed.) Hence, the user can check whether the requested roll angle was satisfied or not. Note that these angles are simply astronomical "position angles" (degrees East of North=0°) of the "-Y_{HUT}" end of the HUT aperture. Figure 1 shows a picture of the HUT TV field projected onto the sky with two examples. Our experience has been that requested roll angles can readily be accommodated by the IPS, but occasionally fields at high galactic latitude are limited in the choice of actual roll angles.

3.2. Selecting HUT Guide Stars

As mentioned above, information on potential guide stars for use with each observation will be retrieved by HUT personnel and entered into each SDF automatically. These data will include positional information relative to the target, the HST GS magnitude, and the guide star ID number. When the digital image data are available, a hard copy of the field will be produced and placed into the numbered manila folder for each object. Our software will also produce a plot of the field to the same scale as the image, with guide star identifications cross-referenced to the SDF entries. Clear overlays of this plot can be placed on the image to assist in identifying which guide stars to use for a given target.

There are rules for choosing guide stars which are based on operational or safety issues, but there is also an element of "art" involved. Below we present these rules, and then discuss some additional guidelines that should prove helpful.

1. **Guide stars may not be closer than 30" to the edge of the TV field, or closer than ~1′ to the target.**

To acquire a star, the HUT DEP searches a 1′ region centered at the expected guide star position. This yields an effective field of 8′ 20" by 11′ 40" centered on the object position. Two circles representing these extremes are produced on the field plots mentioned above.

Hint: Choosing guide stars inside the smaller circle means that they will be available at any roll angle, while guide stars in the annulus between the two circles may or may not be available, depending on the IPS roll angle (and hence, the orientation of the TV on the sky). When the final roll angle is selected by MSFC, a value will be entered in the SDF entry called "PI_roll_angle." This angle is the astronomical position angle (degrees eastward from north=0°) of the long axis of the HUT TV field. (This is also the long dimension of the rectangular HUT apertures. For choosing guide stars, it is not necessary to break the 180° ambiguity. However, for completeness, the PA refers to the "-Y" end of the HUT slit.) Hence, once the PI_roll_angle is known, one can make a final guide star selection.

2. **Selected guide stars should not span a nominal range greater than 2.5 magnitudes** because the dynamic range of the HUT TV camera is limited to only four bits.

Guideline: If possible, choose guide stars within this range of the target magnitude so that both the target and the guide stars will be visible during the set up procedure. (Of course, nature does not always cooperate in this regard.)

3. **For camera safety considerations, the camera cannot be set more than 5 magnitudes fainter than the brightest object in the field.**

Hence, if one had a 12th magnitude object (normally an easy target for the HUT TV), but it unfortunately had a 5th magnitude star within a few arcmin, one would have to set the camera for the brighter object, and use a "guide star locate" to blindly place the object in the slit. On the other hand, if a field contained a 9th magnitude star, and the object and/or several potential guide stars in the 13-14th magnitude range, one could set up for the fainter targets. (In this case, the bright star would "bloom" somewhat on the camera, and could not be chosen as a guide star because it would be saturated, but it would not cause a "camera safety" concern.)

4. **The guide star magnitude in the SDF may not be set more than three magnitudes fainter than the target magnitude.**

This is to protect the TV in the event that a bright object pops out of the slit during the course of an observation and becomes visible on the TV. We choose to be particularly careful with the region of the TV directly adjacent to the slit so as not to compromise our general acquisition capabilities. Hence, if an 8th magnitude target has 12th magnitude potential guide stars nearby, there are no suitable guide stars.

A couple of other general guidelines are worth keeping in mind: when possible, choose guide stars spread azimuthally around the target. Also, it is better to choose stars closer to the target (within limits) rather than near the edge of the field. Both of these guidelines arise because there are small but discernible distortions in the HUT TV. These distortions are more pronounced near the edge of the field, but occur everywhere at a small level. Again, nature often conspires against these guidelines, but use them when you can!

When you have selected 1 to 3 guide stars, edit the SDF and change the "no" to "yes" beside each of the selected stars, using the HST guide star ID number as a cross reference. You may find it useful to mark the selected stars on the clear overlay with a viewgraph marker for future reference. All materials should be returned to the target folders when you are finished. The information you enter on the guide stars will be used in the observation set-up to produce fiducial marks on the HUT TV at the expected positions of guide stars. (This information is also used by our s/w that produces the Target Book pages to mark the guide stars on the field image — see §4.)

The BUILDSEQ program also uses magnitude information to set the TV camera settings appropriately for locating the object and for guiding. Because most targets are stellar and continuum sources, BUILDSEQ uses Target_V_Mag (rounded down to the next fainter integer magnitude) to calculate the TV settings for locating the object. Likewise, the program averages the guide star magnitudes, and chooses the next lower integer magnitude for calculating the TV settings for guiding. In certain instances, it will be advantageous to override these default calculations and specify directly the magnitudes you want BUILDSEQ to use. For instance, emission line objects or extended nebulae may not have appropriate V magnitude information. In these cases, you should enter the optional line "TV_target_mag" into your SDF and fill in an appropriate V magnitude (presumably the desired guide star magnitude so that the guide stars will be visible during the set-up). There may also be cases where the average magnitude calculation from the guide stars needs to be overridden; this can be done with the optional parameter "TV_guide_star_mag". Let's say you had a situation with two relatively bright guide stars (V=11.8 and 12.1) that weren't very close to the object, and one fainter guide star (V=14.3) that was well placed near the object; you decide you want to make sure the fainter star is visible for the set-up. Left to its own devices, BUILDSEQ will choose V=13 for the set-up. You could specify "TV_guide_star_mag" to be 14 in order to skew the set-up toward the fainter star.

3.3. Estimating Count Rates and Setting the Door States

In order to set up the instrument properly and to ensure its safety, it is important to have a reasonable estimate of the expected count rate. This information is provided to the Payload Specialists during the observation set up so they know what to expect.

Count rates are most readily determined by running the program "HUTSIM2" which we have made into an IRAF task. It has a detailed on-line 'help' file, and is described in more detail in the HUT Handbook. This flexible program can receive or calculate input spectra in a variety of formats, incorporate the effects of reddening, and basically do just about anything one needs to do to estimate an expected count rate. For an assumed aperture size, count rates are calculated (both with and without airglow emissions) and output for each run of the program, along with IRAF-format and/or ascii output files of the input and output spectra. (You may wish to save the final HUTSIM parameters and ascii counts output files for use with the target book. See §4.) By consensus, we enter the count rate *without airglow* into the SDF parameter 'Initial_expected_rate.' Airglow counts get added to the sequence load automatically by the BUILDSEQ program.

As described in the HUT Handbook, we impose both a total count rate limit across the array (5000 cts/s) and a peak count rate limit for emission lines (40 cts/s/pixel) for detector safety reasons. In addition, objects with expected count rates below 500 cts/s can be observed in "high time rate" mode (where each photon is "time tagged") as opposed to "histogram" mode (data saved every two seconds). HUTSIM outputs should be checked for consistency with these limits. If the anticipated count rate is too high, one can attenuate the count rate by selecting another spectrograph aperture (for extended sources) or by choosing alternate aperture door states, as described in the HUT Handbook. Attenuations of a factor of 2, ~100, and ~1250 are available. The appropriate coded entries for the 'Primary_slit' and 'Door_config_#' are entered in the SDF.

In addition, for Astro-2 the capability for "partial door states" has been added. This procedure opens the main aperture doors by an amount specifiable by the user to optimize the expected count rate. Users should be aware that calibration of partial door states may be somewhat less accurate than the discrete door states, although current plans call for calibration of one or two specific partial door states, depending on demand. If you want to use a partial door state, set the 'Door_config_#' parameter to 2, set the optional parameter

'Partial_door_opening' to be the desired fraction of full aperture, and use one of the 'PT_DOOR#' target procedures provided in Appendix C. Partial door states should only be used in those cases where the simulated spectrum is high enough fidelity to provide an accurate expected count rate.

3.4. Setting Other Instrument Parameters

The majority of HUT observations are simple, fixed pointings at targets of interest (Obs_type=0), and can be specified by filling out the following entries in the SDF: Obs_type, Door_config_#, Locate_mode, Primary_SP_mode, and Primary_slit. (Possible entries for all of these parameters are summarized in Appendix B.) All other entries beginning with "Primary," "Secondary," "Offset,", and "Mirror" can be left blank for simple observations. (In particular, "Primary_obs_interval" *should be left BLANK* unless a dither is specifically desired. See also § 2.) Obs_type = 1 or 2 can be used in conjunction with these other parameters to specify HUT mirror offsets or rasters, as described in § 2 and Appendix B.

The "Locate_mode" parameter is used to specify how a given object is to be acquired. Whenever an object is bright enough to be seen on the HUT TV (basically V < 15), one should use "source locate." Some complex fields may require more detailed attention by the operator and the use of "manual locate" mode. For faint objects or extended nebulosity one has to position the slit blindly relative to your guide stars, and so "guide star locate" mode is used. Finally, "none locate" is used occasionally when another team's source is so faint for us that it doesn't make sense for the HUT TV to even acquire anything.

The SP_mode parameters are used to specify the mode by which the spectra will be read out. Normal usage modes include histogram (1) for count rates above 500 cts/s, and "high time" mode (4) where each photon is time-tagged (<500 cts/s). (Other modes are mostly used for calibration or instrument testing.)

A selection of five slit sizes is available for Astro-2 (see Appendix B). The 20" circular slit is the nominal slit to use for point sources, although 12" and 32" circular slits are also available. If IPS pointing is particularly good, we may switch to the 12" slit to cut down airglow (both intensity and line widths) for point sources, and if IPS pointing is very bad, the larger slit is available. Also, for diffuse sources two rectangular apertures are available (10" × 56", and 19" × 197"). Again, the narrow slit gives the best performance in airglow rejection. A 32" circular aperture with an Al filter is also available for rejecting the first order and observing in the 425 - 700 Å range (although the sensitivity in this mode is very low — see the HUT Handbook).

3.5. Choosing Special Target Procedures

Target Procedures (which for historical reasons are sometimes called ALTs; here we will call them TPs) are special instructions needed to modify the normal set up or observing procedure. TPs are needed for handling contingencies that might occur (e.g. a cataclysmic variable star that may be found in its high state,), for instrument safety (e.g. door states or changes), or calibration activities. Also, if predicted count rates are close to the maximum allowed for a given SP mode, TPs are available to instruct the operators to change the SP to the proper mode, based on the measured count rate. Likewise, acquisition procedures might have to be changed on selected targets for a variety of reasons. Because of the numerous potential reasons for needing TPs, we will not go into detail here. The reader is instead referred to Appendix C for a listing of the current TPs available, including descriptive material on when each TP might be used. Users should read through this appendix before finalizing their SFD entries.

Only two TPs can be specified for each observation. Occasionally more than two TPs are needed. This has been handled by creating some TPs that are really just combinations of two others. If you see the need to do this for other TPs, or think additional TPs may be necessary for your program, contact a HUT PI team member immediately for additional help.

4. Target Book Support

One of the mission planning products produced for an Astro mission is a document called the "Target Book." This product is used by the astronauts (or ground personnel) to verify the field and expected guide stars to be used, and to communicate other basic information about a given target. The structure and contents of this document have been revised from Astro-1; it now contains a page for each target, with a digital image of the field on the top of each page, and two sections at the bottom for comments, plots, etc., from the HUT and WUPPE teams. (Observation-specific information has been removed into a separate document, called the Joint Observation Target Procedures book, or JOTP book.) Although the Crew Procedures Engineer (CPE) at MSFC maintains the official responsibility for the target book, for Astro-2 it will basically be produced by the HUT team and turned over to the CPE for reproduction and distribution. An example target book page is provided in Figure 2.

The target book images will generally come from the digitized sky survey plate material available from the STScI (i.e. the same plates used to generate the HST Guide Star Catalog). We have developed a program to properly align and scale these images to a standard size field and produce a 'postscript' output of the image with the appropriate bells and whistles for the target book. For a few targets (e.g. nearby galaxies, bright nebulae, H II regions, etc.) the digital data will not be of use and special plate material will need to be located and incorporated separately. An image scanner is available is a suitable image can be located for such special targets.

HUT scientists support the production of the target book in two significant ways. Selection of HUT guide stars in the SDFs is actually supporting the target book as well as the sequence loads, since our target book program reads the information on the selected guide stars and marks both the object position and the guide stars on the digital image for each target book page. The other support activity involves producing a HUTSIM2 output file of the simulated counts spectrum for each object (see above), with an accompanying short text file of descriptive material that may be of use to the Payload Specialist or ground personnel who are setting up an observation. A "template" file is provided for the text inputs. A program run by HUT personnel converts these ascii inputs (including information from the WUPPE team as well) into the 'postscript' output files. The postscript files are then printed on a high quality 600 dpi laser printer to produce the hard copy used in the target book.

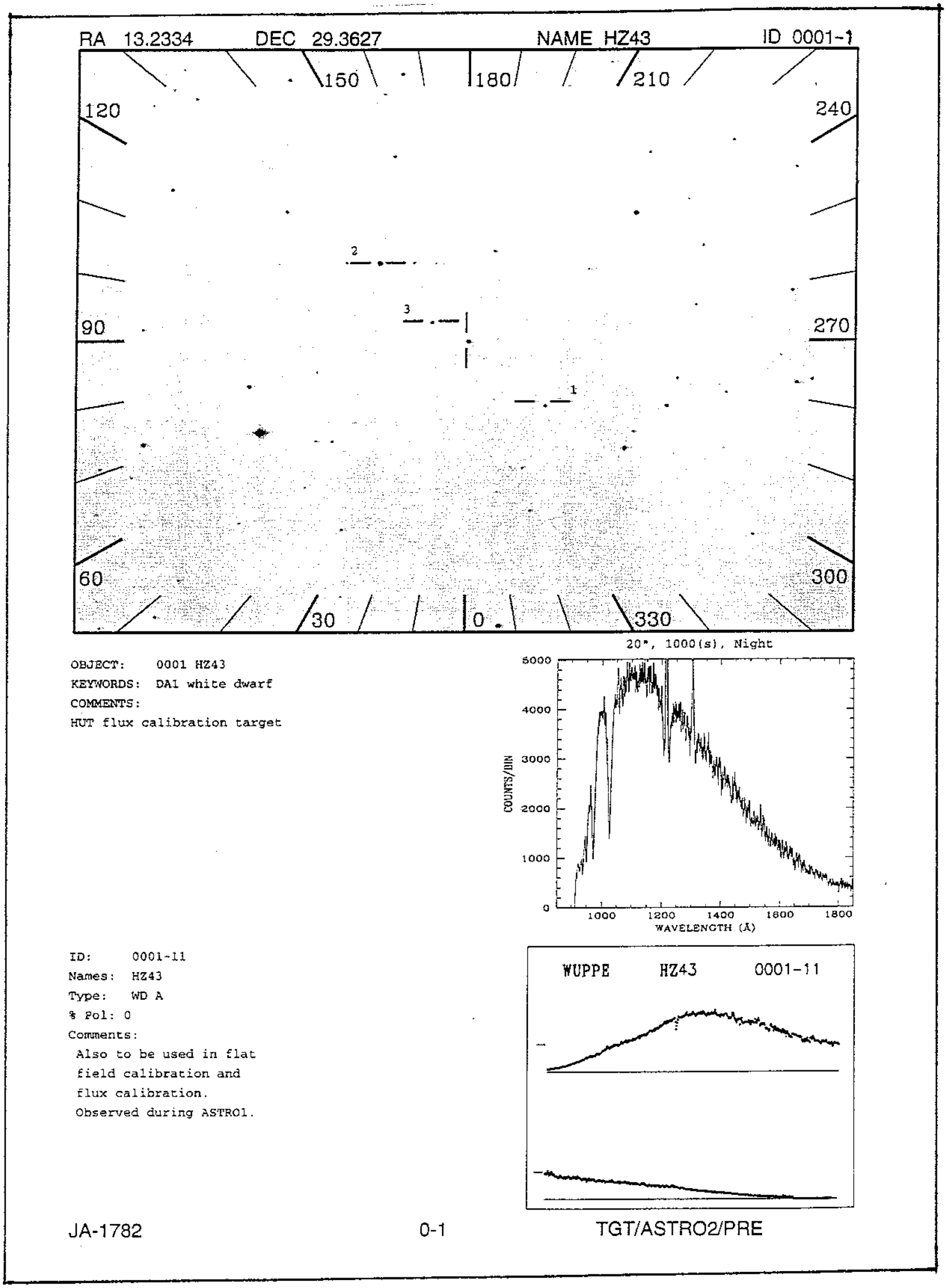


Figure 2: An example Target Book page. The image portion is digitized data from STScI. Our software generates the tick marks and other markings around the border. Inputs from HUT and WUPPE are then incorporated into the postscript files for the bottom sections.

5. The BUILDSEQ Program

The program that reads information from the SDFs and creates the sequence loads is called BUILDSEQ. This program converts units for some parameters and calculates entries for others, based on information it reads from the SDFs. Although users do not need to know the details of how this program works (it will be run collectively on the entire database of SDFs by a HUT team member), the output files from the program will need to be checked for accuracy. In Appendix D we provide an annotated output file from BUILDSEQ to assist in this review process.

6. Real-time Update Capability

Despite the best efforts of pre-mission planners, real-time conditions may make it necessary to change some of the observational parameters. These changes will be accomplished by editing the SDFs (which will be available on our ground support computers at the POCC in Huntsville), re-running the BUILDSEQ program, and uplinking revised sequence loads to the MMU on the Shuttle. In general, these changes will be made by HUT Instrument Team members specifically trained for this activity, in consultation with the person assigned responsibility for filling out each SDF in the first place.

Appendix A -- HUT Mirror Motions

HUT primary mirror motions are used to focus the telescope, and can also be used for offsetting or performing a raster pattern of motions. Three motors (one on each of the support arms of the primary) are used to move the mirror: all three are moved in the same direction and at the same speed to accomplish focus activities, while various combinations are used to perform offset or raster motions.

The time necessary to move the mirror for various activities can be estimated with the following approximate formulae:

$$T_{req} = 3.2\ \Delta\theta \text{ sec} \quad \text{[for angular offsets]}$$

$$T_{req} = 2.5\ |\Delta X| \text{ sec} \quad \text{[for focus motions]}$$

where $\Delta\theta$ is a desired angular offset in arcsec, and $|\Delta X|$ is a focus motion in μm.

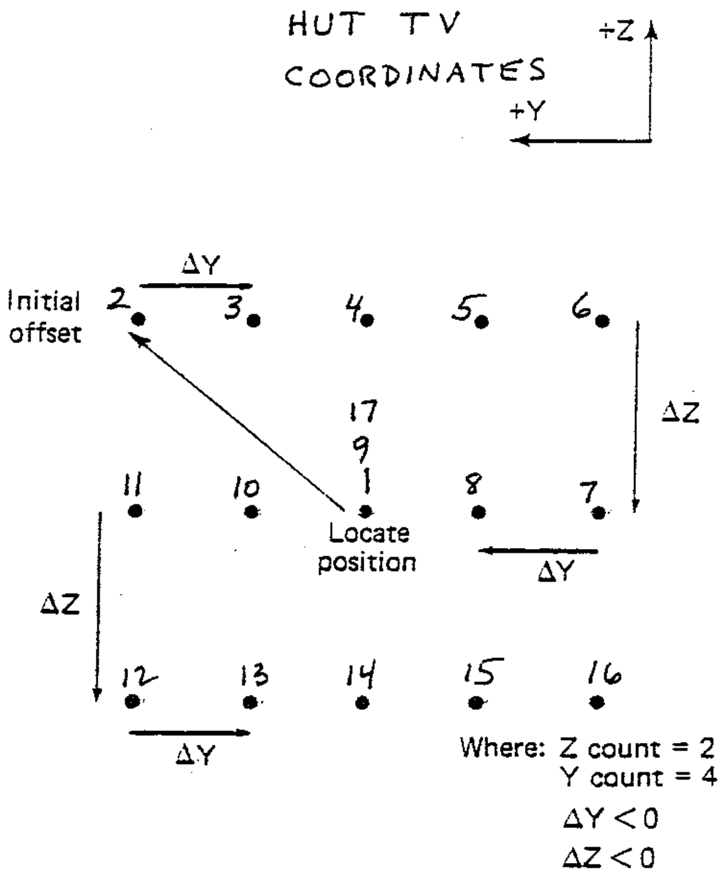
To perform a raster pattern, one specifies a number of parameters in a sequence load as follows:

Zcount = # of rows in pattern – 1
Ycount = # of points in each row – 1
dZ = step size in Z direction, in arcsec
dY = step size in Y direction, in arcsec
Interval = nominal time spent at each dwell point, in seconds

The time to perform a raster can then be estimated as

$$T_{req} = \text{Zcount } (50 + \text{Interval} + 3.0\,|dZ|)$$
$$+ \text{ Ycount (Zcount+1) } (50 + \text{Interval} + 3.4\,|dY|)$$
$$+ \ 2\ (50 + \text{Interval} + 1.7 \text{ Ycount } |dY|).$$

An example raster pattern is shown in Figure A1.



Mirror raster pattern.

Figure A1: An example HUT Raster of Mirror motions. The sense of the raster image shown is for $dZ<0$ and $dY<0$. The mirror will point at the positions in the numerical order shown. Thus, in going from position 1 to position 2, for example, the star field in the camera will move **down** and **to the right**. (Note: Original Figure is from HUT SRD, Rev. D., pg. 322.)

APPENDIX B

HUT Sequence Database File Template and Explanatory Comments

Parameter	Example Entry	Description
NAME	HZ43.052	ENTERED AUTOMATICALLY FROM SCIPLAN
Target_name	HZ43	ENTERED AUTOMATICALLY FROM SCIPLAN
Other_names	_	ENTERED AUTOMATICALLY FROM SCIPLAN
People_responsible	jwk	ENTERED AUTOMATICALLY WHEN DETERMINED
SCI_ID#	0001-10	ENTERED AUTOMATICALLY FROM SCIPLAN
JOTF_#	0001-10	WILL BE ENTERED AUTOMATICALLY FROM JOTF FILE
GI_or_PI_target	P	G, P, or C (cal); ENTERED AUTOMATICALLY FROM SCIPLAN
Sci_prog_ID	H01	ENTERED AUTOMATICALLY FROM SCIPLAN
HUT_ID		OPTIONAL; IF YOU WANT IND. TEAM SCI. PROG. FROM PTL, FEEL FREE TO ADD IT
WUPPE_ID		OPTIONAL; IF YOU WANT IND. TEAM SCI. PROG. FROM PTL, FEEL FREE TO ADD IT
UIT_ID		OPTIONAL; IF YOU WANT IND. TEAM SCI. PROG. FROM PTL, FEEL FREE TO ADD IT
Owning_instrument	H	ENTERED AUTOMATICALLY FROM SCIPLAN
HUT_Sequence_Number	52	ENTERED AUTOMATICALLY, CREATED FROM SCIPLAN TIMELINE
Class	0	ENTERED AUTOMATICALLY FROM SCIPLAN
Subclass	0	ENTERED AUTOMATICALLY FROM SCIPLAN
RA	13 14 00.602	ENTERED AUTOMATICALLY FROM SCIPLAN These coordinates are supposed to be equinox 1950, with proper motion included to epoch 1995, if appropriate.
DEC	+29 21 48.20	ENTERED AUTOMATICALLY FROM SCIPLAN These coordinates are supposed to be equinox 1950, with proper motion included to epoch 1995, if appropriate.
Source_of_coords	4	ENTERED AUTOMATICALLY FROM SCIPLAN This is a code number entry. The code numbers are defined in a controlled file by the FLM. See Bill Blair if you need to track one down. (He has hard copy.)
Accuracy_of_Coords	0.80	ALREADY THERE FROM SCIPLAN; UNITS ARCSEC
Target_RA,GS_Program	13 14 00.642	WILL BE PUT IN BY GUIDE STAR PROGRAM These coordinates will be the target coordinates used when determining the relative position of guide stars. You should flag discrepancies between this and SCIPLAN RA.
Target_Dec,GS_Program	+29 21 48.21	WILL BE PUT IN BY GUIDE STAR PROGRAM

```
                                         These coordinates will be the target coordinates
                                         used when determining the relative position of guide stars.
                                         You should flag discrepancies between this and SCIPLAN Dec.

Coords_Warning!                        WILL BE PUT IN BY GUIDE STAR PROGRAM
                                         If the coordinates in the file from the SCIPLAN disagree with the
                                         coordinates in the guide star database file by more than three
                                         arcseconds, a warning will be put here.

Proper_motion_RA                       (HISTORICALLY) ENTERED FROM PM.DAT; UNITS ARCSEC/YR, NOT SEC/YR
                                         This is basically here for historical reasons.  If a target has a large PM,
                                         you can record it here for future reference, but the coordinates listed above
                                         should be explicitly corrected for PM.  This is a change from Astro-1.

Proper_motion_DEC                      (HISTORICALLY) ENTERED FROM PM.DAT; UNITS ARCSEC/YR
                                         This is basically here for historical reasons.  If a target has a large PM,
                                         you can record it here for future reference, but the coordinates listed above
                                         should be explicitly corrected for PM.  This is a change from Astro-1.

HUT_roll_angle          -99.99           ENTERED AUTOMATICALLY FROM SCIPLAN
                                           Astronomical position angle (degrees East from North) of long axis
                                           of HUT slit.  -99.99 is default entry when there is no requirement.
                                           This is the "requested" roll angle, if there is one.

PI_roll_angle           345.0            WILL BE PUT IN FROM roll.obj.rfmt (essentially the IPOL) FILE
                                           This is the final PI roll angle with no +- 180 ambiguity.  This angle
                                           is used for locating the guide stars in the sequence loads.

Roll_flag               0                ENTERED AUTOMATICALLY FROM SCIPLAN
                                           0 : No requirement
                                           1 : Has roll requirement; exact angle specified is required
                                           2 : Has roll requirement; specified angle +-180 degrees OK
                                           3 : Has roll requirement; specified angle modulo 90 OK

Offset_flag             0                ENTERED AUTOMATICALLY FROM SCIPLAN
                                           0 : Coordinates are final
                                           1 : Coordinates are generic (e.g. center of galaxy).  Final coords
                                                 may differ.  Should not be 1's at this stage.

Ephemeris_object        0                ENTERED AUTOMATICALLY FROM SCIPLAN
                                           0 : Not an ephemeris object
                                           1 : Yes it is an ephemeris object

Solar_system_flag       0                ENTERED AUTOMATICALLY FROM SCIPLAN
                                           0 : Not a solar system object
                                           1 : Yes it is a solar system object

D_or_N                  4                ENTERED AUTOMATICALLY FROM SCIPLAN
                                           0 : No constraint
                                           1 : All night (interpreted strictly for only a few targets)
                                           2 : All day
                                           3 : >1% SAA during the observation is OK
                                           4 : Day into night observation
                                           5 : Night into day observation

Priority                1                ENTERED AUTOMATICALLY FROM SCIPLAN

Requested_Exposure      1000             ENTERED AUTOMATICALLY FROM SCIPLAN; DECIMAL SECONDS
```

```
Scheduled_Exposure        1646        ENTERED AUTOMATICALLY FROM SCIPLAN; DECIMAL SECONDS

MET_start                 28.9335     ENTERED AUTOMATICALLY FROM SCIPLAN; DECIMAL HOURS

MET_end                   29.3907     ENTERED AUTOMATICALLY FROM SCIPLAN; DECIMAL HOURS

Target_V_Mag              12.99      TARGET V MAGNITUDE, IF APPROPRIATE.
                                        Put reference for the entered value in Magnitude_reference below.

Target_V,GS_Program      12.7         WILL BE PUT IN BY GUIDE STAR PROGRAM

Target_B-V               -0.10       *PUT IN IF YOU CAN FIND IT, FLOAT FORMAT
                                        Used for color correction for acquisition camera.
                                        Only important if you are using source or manual locate.

E(B-V)                   0.0         DESIRABLE IF YOU CAN FIND IT; FLOAT FORMAT

Extended_mag,band                    OPTIONAL, GIVES YOU A PLACE FOR EXTENDED TARGET MAGS NOT APPROPRIATE FOR TV

Magnitude_Warning!                   PUT IN BY GUIDE STAR PROGRAM
                                        This appears if target magnitude in database and in guide star files
                                        disagree by more than 0.5 mag.

Magnitude_reference    Holberg et al. 1986,ApJ, 306, 629      OPTIONAL, ASCII STRING, NOT A CODED REFERENCE LIST

Redshift                             DESIRABLE IF YOU CAN FIND IT; FLOAT FORMAT
                                     (Ignore for galactic or low-Z objects.)

Spectral_Class           DA1         DESIRABLE IF YOU CAN FIND IT; ASCII STRING

Reference_wavelength     1350       *YOU MUST PUT IN THIS AND FLUX OR AN ESTIMATED COUNT RATE IN SEQUENCE LOAD
                                        (FLOAT FORMAT WAVELENGTH, IN ANGSTROMS)

Flux_at_ref_wavelength   3.5e-12    *YOU MUST PUT IN THIS AND FLUX OR AN ESTIMATED COUNT RATE IN SEQUENCE LOAD
                                        (FLOAT FORMAT FLUX, IN ERGS CM-2 S-1 ANGSTROM-1)

Flux_reference      Holberg et al. 1986,ApJ, 306, 629    IF YOU PUT IN FLUX, PUT IN THIS, ASCII STRING

Keywords        hot white dwarf, EUV target     *PUT IN THE TYPE OF TARGET HERE; ASCII STRING

SCI_comments             HUT TV fcs      ENTERED AUTOMATICALLY FROM SCIPLAN

Comment1          Unfiltered, then dither to filtered      OPTIONAL, ASCII STRING INPUT BY "PERSON RESPONSIBLE"

Comment2                             OPTIONAL, ASCII STRING INPUT BY "PERSON RESPONSIBLE"
                             Note: Additional lines (e.g. Comment3, Comment4, etc.) can be added as needed.

Any_guide_stars?         yes            FIELD CREATED AND FILLED IN BY GUIDE STAR PROGRAM
                                     If the Guide star program finds legal "potential" guide stars, it sets
                                     this parameter to "yes" and fills them in below. If, after inspection,
                                     you choose not to use any guide stars, edit this field to be "no".

Guide_star_epoch         1975          FIELD CREATED AND FILLED IN BY GUIDE STAR PROGRAM
                                     The Date entered here will be the date of the HST GS plate from which
                                     the potential guide stars have been selected.  Occasionally two dates
                                     will appear if the target was near the edge of a plate.
```

```
GS_1,deltaRA,DEC,mag,use      78.4  -121.3    12.0  no    *FIELD CREATED AND FILLED IN BY GUIDE STAR PROGRAM
                                                                Flag up to three guide stars you wish to use with "yes"

GS_2,deltaRA,DEC,mag,use      48.4   213.6    11.5  yes   *FIELD CREATED AND FILLED IN BY GUIDE STAR PROGRAM
                                                                Flag up to three guide stars you wish to use with "yes"

GS_3,deltaRA,DEC,mag,use    -153.7    26.1    10.9  yes   *FIELD CREATED AND FILLED IN BY GUIDE STAR PROGRAM
                                                                Flag up to three guide stars you wish to use with "yes"

GS_4,deltaRA,DEC,mag,use     -35.7    89.5    14.1  no    *FIELD CREATED AND FILLED IN BY GUIDE STAR PROGRAM
                                                                Flag up to three guide stars you wish to use with "yes"

(Etc. if more stars...)

TV_filter                                          LEAVE BLANK UNLESS YOU WANT A COLOR FILTER; BUILDSEQ CALCULATES
                                                      0 : ND6                       (DEP uses neutral density magnitude table)
                                                      1 : clear                     (DEP uses neutral density magnitude table)
                                                      2 : ND2                       (DEP uses neutral density magnitude table)
                                                      3 : ND4                       (DEP uses neutral density magnitude table)
                                                      4 : 4845 +- 35 angstrom       (DEP uses color magnitude table)
                                                      5 : 6840 +- 45 angstrom       (DEP uses color magnitude table)
                                                      6 : 5139 +- 45 angstrom       (DEP uses color magnitude table)
                                                      7 : 4500 +- 35 angstrom       (DEP uses color magnitude table)

TV_target_mag                                     *ENTER THIS IF YOU WISH TO FORCE TV MAG TO A VALUE FOR LOCATING
                                                      Used if the setting you want is not derivable from the astronomical
                                                      magnitudes already in the database.

TV_guide_star_mag                                 *ENTER THIS IF YOU WISH TO FORCE TV MAG TO A VALUE FOR GUIDING
                                                      Used if the setting you want is not derivable from the astronomical
                                                      magnitudes already in the database.

Obs_type                       1                  *YOU MUST PUT IN CHOICE, 0-4
                                                      0 : Simple; pointing stays fixed (usual choice)
                                                      1 : Multiple; HUT mirror steps through up to 3 offset positions
                                                      2 : HUT raster
                                                      3 : IPS raster; must be cleared with other teams (UIT esp.)
                                                      4 : SLEW; you will not use this one, already in DEP memory

Door_config_#                  5                  *YOU MUST PUT IN CHOICE, 1-5
                                                      1 : 1 sq. cm.
                                                      2 : 50 sq. cm.  (use also for partial door set-up)
                                                      3 : 2550 sq. cm. (default choice for half aperture obs, not 4)
                                                      4 : 2550 sq. cm.
                                                      5 : 5100 sq. cm. (usual choice)

Partial_door_opening                               LEAVE BLANK UNLESS YOU WANT A PARTIAL DOOR STATE
                                                      If a partial door state is needed, enter the percent of
                                                      full aperture desired, between 2% and 80%.  Be aware,
                                                      however, that implementing partial door states is done through
                                                      target procedures, and does not show up in BUILDSEQ output.
                                                      Note: Door_config_# should be 2.

Locate_mode                    0                  *YOU MUST PUT IN CHOICE, 0-3
                                                      0 : Source; simple target, sufficiently bright
                                                      1 : Manual; bright enough but complex; planet, crowded field
                                                      2 : Guide star; too faint or extended
                                                      3 : None; we don't care, and WUPPE doesn't need us to acquire
```

```
Primary_obs_interval        1000             LEAVE BLANK UNLESS YOU WANT TO DITHER; DECIMAL SECONDS
                                                How long you want to spend in first SP state or slit choice

Primary_SP_mode             1               *YOU MUST PUT IN CHOICE, 1-4
                                                1 : Histogram; default for count rates >500/sec
                                                2 : Single scan; don't use for primary, ok for secondary (diagnostic)
                                                3 : Cumulative unprocessed; you will never specify this
                                                4 : High time resolution; default for count rates <500/sec

Primary_mask                                 LEAVE BLANK UNLESS YOU WANT A MASK OTHER THAN ALL PASS; 1-31
                                                See DEP Requirements Document, Rev. D, p. 142 for other options

Primary_slit                7               *YOU MUST PUT IN CHOICE, 1-3,5-7
                                                1 : 12 arcsec diameter
                                                2 : 32 arcsec
                                                3 : 32 arcsec diameter, aluminum EUV only filter
                                                5:  19 arcsec x 197 arcsec, best diffuse grasp, but lower resolution.
                                                6:  10 arcsec x 56 arcsec, good diffuse grasp, best resolution
                                                7:  20 arcsec diameter; default choice for point sources

Secondary_obs_interval      2000             LEAVE BLANK UNLESS YOU WANT TO DITHER; DECIMAL SECONDS
                                                How long you want to spend in second SP state or slit choice (then cycles to first)

Secondary_SP_mode           4                LEAVE BLANK UNLESS YOU WANT TO DITHER; DECIMAL SECONDS
                                                Same choices as for primary

Secondary_mask              0                LEAVE BLANK UNLESS YOU WANT A SECONDARY MASK OTHER THAN ALL PASS; DECIMAL 1-31
                                                Same choices as for primary

Secondary_slit              3                LEAVE BLANK UNLESS YOU WANT TO DITHER; DECIMAL 1-3,5-7
                                                Same choices as for primary

Initial_position_interval   1000             LEAVE BLANK UNLESS YOU WANT MULTIPLE POINTINGS; DECIMAL SECONDS
                                                How long you want to spend at first HUT mirror position for multiple obs

Initial_expected_rate       2500.           *YOU MUST PUT IN THIS RATE (COUNTS/SEC) OR REFERENCE WAVELENGTH AND FLUX ABOVE
                                                Displayed for payload specialist reference; best if comes from HUTSIM2.
                                                DO NOT INCLUDE AIRGLOW IN COUNT RATE.

Comment_rate           hutsim, no airglow    ENTER COMMENT ABOUT RATE CALCULATION

Offset_1_interval           2000             LEAVE BLANK UNLESS YOU WANT MULTIPLE POINTINGS; DECIMAL SECONDS
                                                How long you want to spend at second HUT mirror position for multiple
                                                observations.  Obs_type must be 1.

Offset_1_dRA,dDEC           -2.5  -3.2       LEAVE BLANK UNLESS YOU WANT MULTIPLE POINTINGS; FLOAT FORMAT ARCSECONDS
                                                Offset coords of SECOND HUT mirror position in dRA and dDEC coordinates,
                                                relative to FIRST for multiple obs.  (Note: use either (dRA,dDEC) or
                                                (dZ,dY) offsets, but not both.)

Offset_1_dZ,dY                               LEAVE BLANK UNLESS YOU WANT MULTIPLE POINTINGS; FLOAT FORMAT ARCSECONDS
                                                Offset coords of SECOND HUT mirror position in TV (Y,Z) camera coordinates,
                                                relative to FIRST for multiple obs.  (Note: use either (dRA,dDEC) or
                                                (dZ,dY) offsets, but not both.)

Offset_1_rate               50.              LEAVE BLANK UNLESS YOU WANT MULTIPLE POINTINGS; FLOAT FORMAT COUNTS/SEC
                                                Displayed for payload specialist reference; best if comes from HUTSIM2.
                                                DO NOT INCLUDE AIRGLOW IN COUNT RATE.
```

```
Offset_2_interval                          LEAVE BLANK UNLESS YOU WANT MULTIPLE POINTINGS; DECIMAL SECONDS
                                              How long you want to spend at third HUT mirror position for multiple
                                              observations.  Obs_type must be 1.

Offset_2_dRA,dDEC                          LEAVE BLANK UNLESS YOU WANT MULTIPLE POINTINGS; FLOAT FORMAT ARCSECONDS
                                              Offset coords of THIRD HUT mirror position in dRA and dDEC coordinates,
                                              relative to SECOND for multiple obs.  (Note: use either (dRA,dDEC) or
                                              (dZ,dY) offsets, but not both.)

Offset_2_dZ,dY                             LEAVE BLANK UNLESS YOU WANT MULTIPLE POINTINGS; FLOAT FORMAT ARCSECONDS
                                              Offset coords of THIRD HUT mirror position in TV (Y,Z) camera coordinates,
                                              relative to SECOND for multiple obs.  (Note: use either (dRA,dDEC) or
                                              (dZ,dY) offsets, but not both.)

Offset_2_rate                              LEAVE BLANK UNLESS YOU WANT MULTIPLE POINTINGS; FLOAT FORMAT COUNTS/SEC
                                              Displayed for payload specialist reference; best if comes from HUTSIM2.
                                              DO NOT INCLUDE AIRGLOW IN COUNT RATE.

Offset_3_interval                          LEAVE BLANK UNLESS YOU WANT MULTIPLE POINTINGS; DECIMAL SECONDS
                                              How long you want to spend at fourth HUT mirror position for multiple
                                              observations.  Obs_type must be 1.

Offset_3_dRA,dDEC                          LEAVE BLANK UNLESS YOU WANT MULTIPLE POINTINGS; FLOAT FORMAT ARCSECONDS
                                              Offset coords of FOURTH HUT mirror position in dRA and dDEC coordinates,
                                              relative to THIRD for multiple obs.  (Note: use either (dRA,dDEC) or
                                              (dZ,dY) offsets, but not both.)

Offset_3_dZ,dY                             LEAVE BLANK UNLESS YOU WANT MULTIPLE POINTINGS; FLOAT FORMAT ARCSECONDS
                                              Offset coords of FOURTH HUT mirror position in TV (Y,Z) camera coordinates,
                                              relative to THIRD for multiple obs.  (Note: use either (dRA,dDEC) or
                                              (dZ,dY) offsets, but not both.)

Offset_3_rate                              LEAVE BLANK UNLESS YOU WANT MULTIPLE POINTINGS; FLOAT FORMAT COUNTS/SEC
                                              Displayed for payload specialist reference; best if comes from HUTSIM2.
                                              DO NOT INCLUDE AIRGLOW IN COUNT RATE.

Mirror_step_interval                       LEAVE BLANK UNLESS YOU WANT HUT RASTER; DECIMAL SECONDS
                                              How long you want to spend at each mirror position in HUT raster mode.
                                              Obs_type must be 2.

Mirror_step_dZ,dY                          LEAVE BLANK UNLESS YOU WANT HUT RASTER; FLOAT FORMAT ARCSECONDS
                                              Spacing between rows in arcsec; spacing between columns in arcsec.

Mirror_step_Z,Y_counts                     LEAVE BLANK UNLESS YOU WANT HUT RASTER; DECIMAL INTEGERS
                                              Number of rows desired minus 1; number of points desired per row minus 1.

Save_rate                                  LEAVE BLANK UNLESS YOU WANT TO SAVE LESS FREQUENTLY THAN EVERY 2 SECONDS;
                                               DECIMAL SECONDS (Used for ground data archiving only.)

Comment_cal        Al_filt_trans           OPTIONAL COMMENT FIELDS SUCH AS THIS CAN BE ADDED AS NEEDED.

Comment_call       TV_distortion_test      OPTIONAL COMMENT FIELDS SUCH AS THIS CAN BE ADDED AS NEEDED.

ALT1                TO_2ND                 LEAVE BLANK UNLESS YOU NEED A PARTICULAR TARGET PROCEDURE; ASCII STRING NAME OF ALT
                                              See Appendix C.  For historical reasons, these are
                                              called ALTs because they were called Alternate Procedures.
                                              If you need a target procedure that does not already exist, see
```

		JWK or GAK about creating a new one and defining a unique name.
ALT2		LEAVE BLANK UNLESS YOU NEED A PARTICULAR TARGET PROCEDURE; ASCII STRING NAME OF ALT
For_xsciplan_instead?	no	USUALLY NO; XSCIPLAN WAS FOR "EXTRA" TARGETS ONE MIGHT WANT TO OBSERVE IN REAL TIME. This entry is for historical purposes; not clear it will even be used on Astro-2.

Appendix C -- Listing of Current Target Procedures
(Version: 6/27/94)

1CMPHD.ALT:
Combines the 1CM_AP alt with the PHDMON alt. Used when there is yet another ALT in force (such as C_LR2), since only two different alts can be specified for any particular pointing.

1CM_AP.ALT:
Must be used whenever an observation is planned for the 1 cm**2 aperture. Pressure will get very high inside the telescope from outgassing if it is sealed except for this small hole. We therefore crack open one of the large doors, so that telescope can outgas but no additional light leaks in. Pressure should be quite comfortable in this case.

The reason we don't crack the door until the acquisition has been made is the following. We want the PS to monitor the brightness of the TV field while the door cracking takes place to confirm that the door does not open too far, leading to dangerous flux on the detector when the observation begins.

Note also that in order to save time at the SETUP command, we open the small aperture door during the slew so that at SETUP, the large doors swing closed and the small door is already in position.

Also moves neutral density filter to ND6 before QUIT command, because setup for SLEW will sometimes open large doors before adjusting TV camera parameters, exposing the camera to a 9 magnitude increase in light.

50CMAP.ALT:
This is not the default 50 cm**2 observing ALT; that is SMALAP.ALT. This alt has been created to be on hand should we unexpectedly discover that the telescope module pressure is unacceptably high (>3 X 10**(-5) torr) with the 50 cm**2 door as well as the 1 cm**2 door.

We would therefore crack open one of the large doors, so that the telescope can outgas but no additional light leaks in. Pressure should be quite comfortable in this case.

The reason we don't crack the door until the acquisition has been made is the following. We want the PS to monitor the brightness of the TV field while the door cracking takes place to confirm that the door does not open too far, leading to dangerous flux on the detector when the observation begins.

Note also that in order to save time at the SETUP command, we open the small aperture door during the slew so that at SETUP, the large doors swing closed and the small door is already in position.

Also moves neutral density filter to ND6 before QUIT command, because setup for SLEW will sometimes open large doors before adjusting TV camera parameters, exposing the camera to a 9 magnitude increase in light.

ACQ1.ALT:
Used for ALF-CENA observations. Descriptive note for PS, telling him which of the closely spaced sources is the desired target.

ACQ2.ALT:
Used for ALF-CENB observations. Descriptive note for PS, telling him which of the closely spaced sources is the desired target.

ACQ4.ALT:
Used for SK69-270. Descriptive note for PS, telling him which of the closely spaced sources is the desired target.

ALFCEN.ALT:
Tells PS to acquire the brighter of the closely spaced sources first and that the DEP will automatically offset to ALF-CENB after 1000 seconds.

ALFILT.ALT:
Used for going from observing with a clear filter and a small aperture to observing with the aluminum filter and the full aperture. Makes sure the camera and detector are safe before opening the large doors.

APCEN.ALT:
The default acquisition slit for Astro-2 will be the observing slit. This ALT is used whenever one wishes to acquire using the blank slit. It changes the default back to the observing slit at the end.

BR_OUT.ALT:
If a very bright source is just outside the field, you may want to set up at a bright TV camera magnitude and bring up the TV magnitude slowly if it appears to be safe. ALT usage went away when we decided that camera safety is not endangered as long as the following condition is met: min(TV mag, 10) - (bright star mag) < 5. If that condition is not met, use this ALT and put a bright TV magnitude in the sequence load for setting up.

COMGAL.ALT:
Used only for COMA-CL observations. Informs PS that guide stars may be fuzzy galaxies; don't be surprised.

CTATST.ALT:
Used for IPS CTA test pointing during Astro-1 activation. Early practice at contingency target acquisition procedure; Ken Nordsieck made up these steps for Astro-1 and arbitrarily assigned the ALT to HUT.

C_HR2.ALT:
Used if setting at door state 3 or 4, and you suspect the count rate may actually be too high for safety.

If the observed count rate is >10000/2sec, tells PS to change to door state 2 (50 cm**2) and do the usual camera-protecting change to the ND6 filter before the QUIT in that case.

The safety count rate may also be redlined during the mission, if we get more bold (or less so).

C_HTIM.ALT:
Used a few times where predicted rate was just above the 500/sec high time limit. If observed rate is <800/2sec, tells PS to change to high time resolution mode.

C_LR2.ALT:
Used when setting up at door state 1 (1 cm**2), but predicted rate is just a bit over 400/sec.

If observed rate is < 800/2sec, can safely open to door state 2 (50 cm**2). However, must first protect the camera from the 3 magnitude brightness change by putting in ND6 filter. Once door is opened, reset the TV mag to the desired guide star mag. This ALT implies that 1CM_AP.ALT was also used, since you are starting at door state 1.

C_LR3.ALT:
Used when setting up at door state 2 (50 cm**2), but predicted rate is just a bit over 100/sec.

If observed rate is < 200/2s, can safely open to door state 3 (2550 cm**2). However, must first protect the camera from the 5 magnitude brightness change by putting in ND6 filter. Once door is opened, reset the TV mag to the desired guide star mag. Implies that some form of the SMALAP.ALT is also in place, since you are starting at door state 2.

C_LR5.ALT:
Used when setting up at door state 3 or 4 (2550 cm**2), but predicted rate is just a bit over 2500/sec.

If observed rate is < 5000/2s, tells PS to open to door state 5 (full aperture). This one magnitude change does not require special camera precautions.

C_NOLC.ALT:
Used when acquisition is expected to be difficult, and we don't care all that much exactly where we are pointing. If can't acquire with HUT, don't let that hold you up from beginning.

DRFLAT.ALT:
Used for a late door state 5 vs. 3 relative flux calibration. Used on a pointing which is also used for flat-fielding by observing at 3 offsets within the 30" slit. When that offsetting activity is complete, then the door cal can be performed. Tells PS to shut one door after TBD seconds for relative door cal (default 1400 seconds).

DR_2-1.ALT:
Used for door state 2 vs. 1 relative flux calibration, in combination with SMALAP.ALT.

Tells PS to change to 1 cm**2 position after 600 or TBD seconds. Because going to door state 1, gets door cracked for safety during 1 cm**2 portion of the observation. Must be used with SMALAP.ALT, which takes care of the telescope pressure and camera safety considerations of 50 cm**2 aperture observations.

DR_2-3.ALT:
Used to open to half aperture for nebular observations after an initial pointing at a bright central star requiring a smaller aperture configuration. In this case the nebular emission is also too bright for the full aperture, so the half-open door state 3 is used.

Tells PS to change to half aperture after TBD seconds (after mirror has offset from central star, as defined in sequence load, so that half aperture is now safe).

DR_3-2.ALT:
Used for door state 3 vs. 2 relative flux calibration. Has PS prepare for a shutdown to door state 2 by giving a low level command after the BEGIN to move the small ap to the 50 cm**2 position.

Tells PS to change to 50 cm**2 position after TBD seconds (default 600). Because going to door state 2, includes camera-protecting procedure of putting in ND6 filter before issuing QUIT.

DR_3-5.ALT:
Used to open to full aperture for nebular observations after an initial pointing at a bright central star requiring a smaller aperture

configuration.

Tells PS to change to full aperture after TBD seconds (after mirror has offset from central star, as defined in sequence load, so that full aperture is now safe).

DR_5-3.ALT:
Used for door state 5 vs. 3 relative flux calibration. Tells PS to shut one door after TBD seconds for relative door cal (default 600 seconds).

EARTHA.ALT:
Used for first (aperture center) BR-EARTH observation. At beginning and end of observation, closes doors for moving to or from the ND4 filter, so that you don't pass through the more transparent color filters while looking at bright earth. Also keeps the detector off for this observation (deemed too early to look at bright down-looking airglow through large apertures).

EARTHB.ALT:
Used for second (aperture sizes, line profiles) BR-EARTH observation. Uses same camera-protecting steps as EARTHA, but allows normal pump and detector operations (late in mission, leave detector on for this observation,should be fine).

FNTQSO.ALT:
Used for the faint, high-redshift quasar observations where the target is so faint that the source locate is likely to fail. If it does fail, tells the PS to change to the blank slit and adjust the TV to see as faint as possible, including using software video integration to try to see the quasar. If this succeeds in acquiring the target, switch back to the 20" observing slit.

However, if the QSO is still invisible and source locate fails, tells the PS to switch to the 30" slit and use guide star locate. Changes SP to histogram mode to accommodate the increased airglow of the larger slit.

FTSRC.ALT:
Used for targets where the attempted source locate mode is questionable because the target is faint, and where the guide stars are far enough away that there is concern about the target being in the slit if you switch to guide star locate.

Tells the PS to switch to the 30" slit if source locate fails and he has to switch to guide star locate. Changes SP to histogram mode to accommodate the increased airglow of the larger slit.

Also has him check rate after the BEGIN command--if rate is so low that source does not appear to be in slit even though source locate found something, again switch to 30" slit and histogram mode.

G191B2.ALT:
Warns PS that he can open to full aperture if rate unexpectedly low, and that when slit dithers to aluminum filter, he must open to full aperture.

GD153.ALT:
Because GD153 is too bright to be observed with full aperture and no filter, keeps detector off, pump on, until slit is at aluminum filter position. Protects by getting detector off before slit wheel motions at QUIT command as well.

GLOB.ALT:

Used for observations of globular clusters where we wish to obtain a spectrum of many stars, rather than of a single isolated star. Instructs the PS to center the aperture on the cluster. Acquisition mode in the sequence file should be 3 (none locate).

HER-X1.ALT:
Used with HER-X1 pointings. High time resolution is required. If rate is >500/sec so that counts are being lost, mask Lyman alpha in effort to get full source spectrum in high time mode.

HUTMAN.ALT:
Used for any HUT manual locate. Simply changes expected HUT status at end of acquisition phase--will say overbright CUR for manual locate mode, instead of overbright LOC.

INHSAA.ALT:
Inhibits receipt of SAA message and reenables after observation. Will be used if we decide that grazing crossing of SAA will be safe. Then use this ALT to prevent SP from going into hibernate when ECAS SAA enter message is received. ALT includes reenabling so that next full crossing of SAA is safely handled.

JUPMAN.ALT:
Used for pointings at Jupiter itself (as opposed to Io torus). Manual acquisition; instructs PS to center up on planet. (Sequence then rasters from pole to equator to other pole to equator, etc.) Jupiter is big enough to stick out of the 18" slit, so manual locate with the observing slit in place is appropriate. Acquisition mode in the sequence file should be 3 (no locate).

LCDATA.ALT: (For Historical Purposes only)

$$$$$ DO NOT USE THIS ALT FOR ASTRO-2! $$$$$
We expect to use the observing aperture as the default acquisition aperture for Astro-2, so this ALT is unnecessary. In addition, it would undo our selected default if used.
$$$$$ DO NOT USE THIS ALT FOR ASTRO-2! $$$$$

Used for many diffuse objects on Astro-1. When not using the source for acquisition, might as well get the observing slit in place right at SETUP, instead of at the BEGIN command. This ALT makes the locate slit = observe slit to accomplish that. Resets locate slit = blank slit at the end of the observation.

MANUAL.ALT:
Used when you think HUT source may be visible, and if you think PS can center up on it better than happened automatically with guide stars, he should.

N2264.ALT:
Used for NGC2264. Target star is offset from nominal center of cluster. This star is several magnitudes brighter than the available guide stars, so this ALT instructs the PS to increase the HUT TV camera magnitude accordingly after the mirror offset puts the target star in the slit.

N2782.ALT:
Used before for target N2782. Since acquisition expected to be marginal, offers alternate sequence load using brighter (but more distant) guide stars and guide star locate, should PS give up on seeing target or close in faint guide stars.

NODET.ALT:
No HUT detector operations this pointing. This ALT has been

superceded by the NOOBS.ALT, which keeps the VIP on.

NOLOC.ALT:
Used when there is no hope or no interest in precise HUT acquisition of target. Removes HUT IPS bias step from the nominal procedure.

NOOBS.ALT:
Used when no HUT detector operations are intended on a particular target (presumably because it is just too bright or risky because of sun angle or some such). Keeps VIP ON. Sequence loads for pointings using this ALT should choose slit 0 (blank) to completely rule out danger to the detector.

NR_BRT.ALT:
Different from BR_OUT.ALT. Because the SETUP command is issued at the beginning of the IDOP command, the IPS pointing may be as much as 15 arcminutes off when the TV camera is configured for SETUP. We therefore need to worry about bright stars as far as 22.5 arcminutes from the target. Not a camera safety hazard if the star satisfies:

min(TV mag, 10) - brightstarmag < 5

but if that relation is not satisfied, we want to warn the PS to be on the lookout during the SETUP and be ready to turn the camera down. No bright stars in violation of this constraint were found in the current timeline.

NUDGIT.ALT:
Used for offset pointings on small planetary nebulae, where a spectrum is obtained centered on the central star, and then the mirror offsets by a small angle to put the star just outside the slit. If the star ends up on the edge of the slit instead of just outside, instructs the PS to use the MPC to nudge it out by a few arcseconds to keep from contaminating the nebular spectrum. This is supposedly possible up to about 5" of motion without screwing up the IMCS correction of UIT and WUPPE pointing.

ORION.ALT:
Target demands the 1 cm**2 aperture; so early in the timeline, do not want to risk this procedure without first trying it out. So, this pointing, no HUT detector ops. Instead, run FO10, which tests the safety of the 1 cm**2 observing alt, 1CM_AP.

PHDMON.ALT:
Used often throughout the timeline, whenever a dither to single scan mode is planned (for calibration purposes). Simply warns the PS that a dither to single scan mode will occur, so he does not become concerned when the spectrum on the TV goes away, and the count rate goes to zero.

PT_D R1.ALT:
To be used for partial door states. Use this procedure to get the smaller of two "calibrated" partial door states. Exact value of the percentage of total aperture is TBD as of June 27, 1994. Contact J. Kruk for more information.

PT_D R2.ALT:
To be used for partial door states. Use this procedure to get the larger of two "calibrated" partial door states. Exact value of the percentage of total aperture is TBD as of June 27, 1994. Contact J. Kruk for more information.

PT_D R3.ALT:
To be used for partial door states. Use this procedure to specify a general partial door state other than one that will be calibrated. Will be used with the SDF parameter "Partial_door_opening" to make

case by case implementation of partial door states. Contact J. Kruk for more information.

PTEST.ALT:
To be used during activation. Checks rate of pressure rise in spectrograph through point source slit 7 with 50 cm**2 aperture in place. Leaves pump off a few minutes and checks turn-on pressure in this configuration.

Indicates no HUT detector ops for this first 50 cm**2 pointing. After target acquisition, sends PS or MS to HUT F09, which directly measures the pressure in the telescope module with the 50 cm**2 aperture in place. Use of this alt assumes that the sequence load has set the observing slit to 4 (the large calibration hole), through which the spectrograph can equilibrate to the outside pressure in the telescope.

PTEST2.ALT:
To be used with second IPS 50 cm**2 observation. If the PTEST alt was not completed in the first pointing, sends the PS back to the to try again with the same sequence number and alt as before.

If they had been successful before, allows PS to continue with normal science observation as sequence numbers and alts indicate on this target book page.

PTEST3.ALT:
If equilibrium pressure within telescope with 50 cm**2 aperture in place has still not been measured (HUT F09), tells PS to do that during slew and idle time before the next target. In nominal Dec. 1 timeline, this activity would barely fit between the end of the second ORION APMAP pointing and the SS-CYG HUT TVSENS pointing.

SATMAN.ALT:
Used for Saturn observations. Instructs PS to center planetary disk in the slit for manual acquisition. With the 11x60" slit the planet should be visible around the aperture edges. Acquisition mode in the sequence file should be 3 (no locate).

SMALAP.ALT:
Used whenever an observation is in door state 2 (50 cm**2). Because of possible pressure buildup in the telescope, leaves VIP on and detector off until the observing slit is in place. (Rotation of slit wheel allows high pressure in telescope to get into spectrograph.) Also protects TV camera at the end of the obsevation by putting the ND6 filter in place before QUIT, so that the doors do not open to the SLEW configuration with the camera set for the small aperture.

Also, to save time at the SETUP, moves the small aperture mechanism to the 50 cm**2 position during preceeding SLEW. Then, when SETUP is commanded, large doors close, and small aperture is already in position for the observation.

SMALR3.ALT:
Used whenever an observation is in door state 2, the predicted rate is only a bit above 100/sec, so you want to use C_LR3.ALT, and you need the second ALT slot for yet something else. Simply combines SMALAP.ALT with C_LR3.ALT.

SMAPHD.ALT:
Combines SMALAP.ALT with PHDMON.ALT, for situations where the second ALT slot is needed for something else.

SPEC1.ALT:
Used for the first spectrograph focus pointing. Before the

observation, move the mirror -150 microns from the best focus position found in the TV camera focus procedure. We hope to get data at 50 microns intervals from -150 to +150 microns in the first pointing. Guides PS to HUT F05B.

SPEC2.ALT:
Used for the second spectrograph focus pointing. Before the observation, moves the mirror to the +150 micron position if no additional data has come from the POCC after their analysis of the first spectrograph focus pointing. More likely, revised values of the starting position will be voiced up. After the observation, sends mirror back to pre-flight focus. Again, values will have to redlined if a different best focus position is found.

SS-CYG.ALT:
Used for observations of SS-CYG (3227). Magnitude of target is quite uncertain (could be outburst). If source is bright, PS will want to preview an alternate sequence which sets up for a lower door state. Because that lower door state is 50 cm**2, first get pump back on, as in normal small aperture observations. Then go to appropriate JOTP and pages that have been prepared for CV contingency observations. Manually edit the sequence number, re-preview and re-setup and go as per the alternate procedure on that page of the JOTP.

SU-UMA.ALT:
Used for observations of sources whose visual brightness is known to vary significantly, but which are not expected to get bright enough to require the use of a different observing sequence depending on what the PS sees. Simply warns the PS not to be surprised if the target is brighter or fainter, since it is quite variable. Does not have him preview a new sequence.

SW-MID.ALT:
Used for SW-MID, which is expected to be hard to acquire. If PS can not see the target or the faint guide stars, offers him a different sequence load using a much brighter (but farther from target) guide star and the 30" diameter aperture.

TO_2ND.ALT:
Used for pointings at EUV sources in which a dither to the aluminum filter is planned. Warns the PS that when the dither occurs, the count rate will drop enormously, to keep him from worrying about the detector.

TVSENS.ALT:
Used for the TV sensitivity pointing at SS-CYG during activation. Simply refers the PS to HUT F05D.

U-GEM.ALT:
Used for observations of U-GEM (3208). Magnitude of target is quite uncertain (could be outburst). If source is bright, PS will want to preview an alternate sequence which sets up for a different SP mode (histogram instead of high time), door state, and higher expected count rate. Then go to appropriate JOTP and pages that have been prepared for CV contingency observations. Manually edit the sequence number, re-preview and re-setup and go as per the alternate procedure on that page of the JOTP.

Original sequence is set up for faintest magnitude of source, since brightest magnitude would not exceed the camera danger limit anyway, so no TV mag editing required if the source is in the faint state.

VW-HYI.ALT:
Used for observations of VW-HYI (3206). Magnitude of target is quite

uncertain (could be outburst). If source is bright, PS will want to preview an alternate sequence which sets up for a lower door state. Because that lower door state is 50 cm**2, first get pump back on, as in normal small aperture observations. Then go to appropriate JOTP and pages that have been prepared for CV contingency observations. Manually edit the sequence number, re-preview and re-setup and go as per the alternate procedure on that page of the JOTP.
If source is not bright, just adjust TV camera to see faint source and continue with normal sequence.

Appendix D

Annotated Sequence Load File

load01:	130	Sequence number	(4 < n < 512)
load02:	CYGLOOPB	Target name	(up to 20 characters)
load03:	835	Guide star 1 dZ	(tenths of arcsec)
load04:	-156	Guide star 1 dY	(note 1)
load05:	-1665	Guide star 2 dZ	
load06:	969	Guide star 2 dY	
load07:	-780	Guide star 3 dZ	
load08:	-787	Guide star 3 dY	
load09:	0	Observation Type	(note 2)
load10:	5	Door configuration	(note 3)
load11:	2	Locate mode	(note 4)
load12:	1	Filter	(note 5)
load13:	13	Target magnitude	(-6 < m < 21)
load14:	12	Guide star magnitude	(-6 < m < 21)
load15:	7354	Planned time	(between 0 and 32767 sec)
load16:	7354	Primary observation interval	(0 to 32767 sec)
load17:	1	Primary SP mode	(note 6)
load18:	0	Primary SP mask	(note 7)
load19:	2	Primary slit	(note 8)
load20:	0	Secondary observation interval	(0 to 32767 sec)
load21:	1	Secondary SP mode	(note 6)
load22:	0	Secondary SP mask	(note 7)
load23:	2	Secondary slit	(note 8)
load24:	0	Initial position interval	(0 to 32767 sec)
load25:	5250	Initial expected rate	(0 to 32767 cts/2sec)
load26:	0	Offset 1 interval	(0 to 32767 sec)
load27:	0	Offset 1 dZ	(tenths of arcsec)
load28:	0	Offset 1 dY	(tenths of arcsec)
load29:	0	Offset 1 expected rate	(0 to 32767 cts/2sec)
load30:	0	Offset 2 interval	(0 to 32767 sec; 0 quit)
load31:	0	Offset 2 dZ from 1	(tenths of arcsec)
load32:	0	Offset 2 dY from 1	(tenths of arcsec)
load33:	0	Offset 2 expected rate	(0 to 32767 cts/2sec)
load34:	0	Offset 3 interval	(0 to 32767 sec; 0 quit)
load35:	0	Offset 3 dZ from 2	(tenths of arcsec)
load36:	0	Offset 3 dY form 2	(tenths of arcsec)
load37:	0	Offset 3 expected rate	(0 to 32767 cts/2sec)
load38:	0	Mirror step interval	(0 to 32767 sec)
load39:	0	Mirror step dZ	(tenths of arcsec)
load40:	0	Mirror step dY	(tenths of arcsec)
load41:	0	Mirror step Z count	(0 to 32767)
load42:	0	Mirror step Y count	(0 to 32767)

Note 1:
Guide Star Offsets:
These offsets have been converted from those given in the SDF to 0.1" units in HUT TV camera coordinates.

Note 2:
Observation type:

0 : Simple; pointing stays fixed (usual choice)
1 : Multiple; HUT mirror steps through up to 3 offset positions
2 : HUT raster
3 : IPS raster; must be cleared with other teams (UIT esp.)
4 : SLEW; you will not use this one, already in DEP memory

Note 3:
Door configuration:
- 1 : 1 sq. cm.
- 2 : 50 sq. cm. (use also for partial door set-up)
- 3 : 2550 sq. cm. (default choice for half aperture obs, not 4)
- 4 : 2550 sq. cm.
- 5 : 5100 sq. cm. (usual choice)

Note that partial door states are handled on a case by case basis, using Target Procedures and do not show up explicitly in the BUILDSEQ output. Specify Door State 2 by default for these observations.

Note 4:
Locate mode:
- 0 : Source; simple target, sufficiently bright
- 1 : Manual; bright enough but complex; planet, crowded field
- 2 : Guide star; too faint or extended
- 3 : None; we don't care, and WUPPE doesn't need us to acquire

Note 5:
TV filter:

0 : ND6	(DEP uses neutral density magnitude table)
1 : clear	(DEP uses neutral density magnitude table)
2 : ND2	(DEP uses neutral density magnitude table)
3 : ND4	(DEP uses neutral density magnitude table)
4 : 4845 +- 35 angstrom	(DEP uses color magnitude table)
5 : 6840 +- 45 angstrom	(DEP uses color magnitude table)
6 : 5139 +- 45 angstrom	(DEP uses color magnitude table)
7 : 4500 +- 35 angstrom	(DEP uses color magnitude table)

Note 6:
Primary or secondary SP mode:
- 1 : Histogram; default for count rates >500/sec
- 2 : Single scan; don't use for primary, ok for secondary (diagnostic)
- 3 : Cumulative unprocessed; you will never specify this
- 4 : High time resolution; default for count rates <500/sec

Note 7:
Primary or secondary mask:
See DEP S/W Requirements Document, Rev. D, p. 142 for other options

Note 8:
Primary or secondary slit:
- 1 : 12 arcsec diameter
- 2 : 32 arcsec
- 3 : 32 arcsec diameter, aluminum EUV only filter
- 5: 19 arcsec x 197 arcsec, best diffuse grasp, but lower resolution.
- 6: 10 arcsec x 56 arcsec, good diffuse grasp, best resolution
- 7: 20 arcsec diameter; default choice for point sources