Title: Graphical User Interface (GUI) Design Requirements for the WIYN 3.5 Meter Telescope

Document number: WODC 01-22-1

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1. General 1
1.1 Description 1
1.2 Scope 1
1.3 Operational Model 1
1.4 Design 1
1.5 Document Organization 2
2. System Start-up 2
2.1 Cold Start 2
2.2 Warm Start 2
3. Operator Controls 2
3.1 Remote EDS Client Enable 2
3.2 Remote CLI Client Enable 3
3.3 Select Video Display 3
3.4 CLI Window 3
4. Mount Main Drive Control 3
4.1 Drive Enable 3
4.2 Rates 3
4.3 Track 3
4.4 Initialize Encoders 3
4.5 Park 4
5. Mount Pointing Control 4
5.1 Coordinate System Selection 4
5.2 Equinox 4
5.3 Object Name 4
5.4 Next Object 4
5.5 Previous Object 4
5.6 Pre-defined Positions 4
5.7 Enter Offsets 5
5.8 Set Encoders 5
5.9 Move 5
5.10 Search 5
5.10.1 Search Parameters 5
5.10.2 Start/Stop Search 5
5.11 Cancel 5
6. Object Caches 6
6.1 Cache format 6
6.2 Select Cache 6
6.3 Select Object 6
6.4 Add Cache 6
6.5 Delete Cache 6
6.6 Search Criteria 6
6.7 Write Cache 6
6.8 Save Current Object 6
6.9 Delete Object 6
6.10 Save Current Position 7
7. OSS Functions 7
7.1 Mirror Covers 7
7.2 Flat Field Lamps 7
7.2.1 Intensity 7
7.2.2 Selection 7
8. Primary Mirror 7
8.1 Temperature Control 7
8.2 Mirror Temperature Setpoint 7
8.3 Programmed Temperature Control 7
8.4 Active Support Enable 8
8.5 Download Active Forces 8
9. Secondary Mirror 8
9.1 Vacuum Support Enable 8
9.2 Enter Focus Position 8
9.3 Enter Focus Offset 8
9.4 Focus 8
9.5 Enable Autofocus/Collimation 8
10. Tertiary Mirror 8
10.1 Pressure Support Enable 8

10.2 Select Rotator Position..... 9
10.3 Insert Tertiary Mirror..... 9
11. Nasmyth Instrument Rotators..... 9
11.1 Initialize Encoders..... 9
11.2 Select rotator coordinate system..... 9
11.3 Enter Rotator Angle..... 9
11.4 Enter rotator Offset..... 9
11.5 Move rotator..... 9
11.6 Stow..... 10
11.7 Cancel..... 10
11.8 Set Software Limits..... 10
11.9 Drive Enable..... 10
11.10 Track Rotator..... 10
12. Dome..... 10
12.1 Drive Enable..... 10
12.2 Track Enable..... 10
12.3 Stow..... 11
12.4 Enter Dome Position..... 11
12.5 Rotate to Position..... 11
12.6 Track Mode..... 11
12.7 Stop..... 11
12.8 Park..... 11
13. Hand controller..... 11
13.1 Manual Controller Enable..... 11
13.2 Rates..... 11
14. Image Processor..... 12
14.1 Select Guide Camera..... 12
14.2 Camera Set-up..... 12
14.2.1 Orientation..... 12
14.2.2 Scale..... 12
14.2.3 Focus Sensor..... 12
14.2.4 Save settings..... 12
14.3 Enter Leak Time..... 12
14.4 Video Output Control..... 12
14.5 Integrate..... 12
14.6 Overlay..... 13
14.6.1 Grid..... 13
14.6.2 Cursor..... 13
14.6.3 Select Cursor..... 13
14.6.4 Delete Cursor..... 13
14.6.5 Center Cursor..... 13
14.6.6 Send Cursor..... 13
14.7 Autoguide..... 13
14.7.1 Enter Rate..... 13
14.7.2 Enter Threshold Intensity..... 13
14.7.3 Enter Maximum Correction..... 14
14.7.4 Display..... 14
14.7.5 Enable/disable..... 14
14.8 Closed Loop Autofocus..... 14
14.8.1 Enter Rate..... 14
14.8.2 Enable/disable autofocus..... 14
15. Acquisition & Wavefront CCD..... 14
15.1 Integration Time..... 14
15.2 Save File..... 14
15.3 Display Control..... 14
15.4 Acquire frame..... 14
15.5 WCS Sequence..... 15
16. Instrument Adapter..... 15
16.1 Initialize..... 15
16.2 Reset..... 15
16.3 Dark Cover..... 15
16.4 Atmospheric Dispersion Compensator..... 15
16.4.1 Insert/Remove..... 15
16.4.2 Initialize encoders..... 15
16.4.3 Set to Neutral..... 15

16.4.4 Track ADC 15
16.5 Slide mirror 15
16.6 Calibration Lamps 16
16.6.1 Select Color Filter 16
16.6.2 Select Neutral Density 16
16.6.3 Lamp Control 16
16.7 Acquisition/WCS Camera Stage 16
16.7.1 Initialize Position 16
16.7.2 Enter Position 16
16.7.3 Enter Offset Position 16
16.7.4 Move 16
16.7.5 Select Filter 16
16.7.6 Focus 16
16.8 Guide/Focus Cameras 17
16.8.1 Select Coordinate System 17
16.8.2 Initialize 17
16.8.3 Enter Position 17
16.8.4 Enter Offset 17
16.8.5 Enter Focus 17
16.8.6 Focus 17
16.8.7 Select Color Filter 17
16.8.8 Select Neutral Density 17
17. Instrument Configuration Control 18
17.1 Initial Setup 18
17.2 Retrieve Standard Configuration Information 18
18. Oracle 18
18.1 Select Object 18
18.2 Display Airmass vs. Time 18
18.3 display altitude vs. Time 18
18.4 Display Remaining Times to Critical Events 18
19. Start-up Checklist 18
19.1 Instrument Checklists 18
19.1.1 Select Instrument 18
19.1.2 Display Checklist 18
19.1.3 Print Checklist 19
19.2 Telescope Checklists 19
19.2.1 Display Checklist 19
19.2.2 Print Checklist 19
20. Pointing Maps 19
20.1 Select Method 19
20.2 Select Grid 19
20.3 Results File 19
20.4 Acquire 19
20.5 Reduce 19
20.6 Apply 19
21. Acronyms & abbreviations 20

1. GENERAL

1.1 DESCRIPTION

This document contains the specifications for a Graphical User Interface (GUI) for the WIYN 3.5 M Telescope.

1.2 SCOPE

The software covered by this specification includes the high-level user interface to the telescope and dome controls including the primary mirror subsystem supplied by NOAO. Also included are the (a) Image Processor and video distribution system and (b) WIYN Instrument Adapter. Auxiliary software required for the routine operation of the telescope is also covered. In this category is (a) object caches, (b) pointing map management, and (c) wavefront sensing and active optic control.

The interface required for remote observing except for those functions required by the on-site operator for managing remote access to the system is not included.

A display tool for Engineering Data System and engineering displays for the primary mirror system are described separately. Science Instrument interfaces and science data reduction software are also outside the scope of this document.

1.3 OPERATIONAL MODEL

In the operational model that is the basis for this document, the Operator controls the telescope functions from a workstation located in the observing room. The functions specified in the body of this document are implemented in a windows running on the Operator's console (OCC).

The scientist/observer, if on-site, will have a separate workstation for controlling the instrument and data reduction. The Observer will have access to the object cache and will be able to send objects over the network to the operator's console. The operator will have sole control over telescope/dome functions. Subject to the review by the observatory, exceptions will be made (a) to facilitate day time instrument calibrations (flat fields) by the observer, (b) to allow instrument control over telescope functions such as guiding, and (c) for remote observing. The GUI design will permit this more distributed control.

The extension of this model to incorporate remote observing is not covered in this document.

1.4 DESIGN

GUI processes communicate using machine-independent network protocols and execute on any compatible system on the network. GUI processes shall allow multiple instances of the same process to run simultaneously on the same or different systems.

Controls that indicate the status of the underlying hardware or display state information must accurately reflect the true state of the system regardless, for example, of changes that may result from external inputs to the base control system or uncertain initialization conditions. The GUI will obtain

its state information from messages in the Engineering Data System message stream. The GUI will receive acknowledgment for commands sent to the low-level system from the Engineering Data System.

GUI processes can exit and restart without changing the low-level systems and without requiring the low-level systems to restart or reinitialize.

The organization of functions into windows and the look-&-feel within windows will be consistent with the Graphical User Interfaces in use at the KPNO Telescopes allowing for the difference capabilities of the WIYN telescope and additional functionality required by WIYN. The interface will use the KPNO object cache format modified as necessary to include WIYN required items such as rotator position angle.

Disabled functions shall present the Operator with a diagnostic message when the associated control is selected indicating the disabling condition. For example, if a function is blocked by an interlock condition in the low level system a message will be displayed indicating which interlock(s) is activated.

The GUI will be implemented using the TCL commands provided by the base control system. Connection to the low level system will be via the message passing protocol provided with the base system.

1.5 DOCUMENT ORGANIZATION

The remainder of this document specifies the functionality of the WIYN GUI. The organization of functions in windows and the assignment of functions to controls is not constrained to follow the document outline.

2. SYSTEM START-UP

2.1 COLD START

Start up the system in its default state. Connect to the TCS and start TCS processes. Start up the GUI windows with controls in their default state.

2.2 WARM START

Start the GUI windows and connect to the TCS processes. Initialize the GUI controls from EDS data. Do not cause changes in the low-level systems.

3. OPERATOR CONTROLS

3.1 REMOTE EDS CLIENT ENABLE

Enable/disable a remote client to connect to the Engineering Data System. Provide a visual indication of enabled clients.

Choices: List of trusted clients.

Default state: All local clients enabled, all remote clients disabled.

3.2 REMOTE CLI CLIENT ENABLE

Enable/disable a remote client to connect to the Command Line Interpreter. Provide a visual indication of enabled clients.

Choices: List of trusted clients.

Default: none enabled.

3.3 SELECT VIDEO DISPLAY

Select one of 10 camera/video sources for each of the two system status display channels. Provide a visual indication of the selections.

Default: Channel 1 TBD, Channel 2 TBD.

3.4 CLI WINDOW

Provide a window running the Command Line Interpreter.

4. MOUNT MAIN DRIVE CONTROL

4.1 DRIVE ENABLE

Generate the sequence of commands that power up the azimuth and altitude drive servos and release the axis clamps. Bring each axis on-line in a stopped condition with tracking disabled. Provide visual feedback to indicate drives enabled.

Fault: Clamps don't release after TBD seconds.

Default: disabled.

4.2 RATES

Input RA and DEC track rates.

Format: arc seconds per second.

Default: Sidereal rates.

4.3 TRACK

Enable/disable open loop tracking in azimuth and elevation. Provide visual feedback of tracking enabled.

Default: disabled.

4.4 INITIALIZE ENCODERS

Command a main axis encoder initialization sequence. Disable tracking at the end of initialization. Provide visual feedback that the command has been successfully completed.

Options: Initialize azimuth, initialize elevation, initialize both.

4.5 PARK

Generate the sequence of commands to bring the mount and instrument rotators to a stop, set the clamps and turn off the drive servos and tracking. Provide visual feedback that the action was completed and that the drives and tracking are disabled.

5. MOUNT POINTING CONTROL

5.1 COORDINATE SYSTEM SELECTION

Select the coordinate system for coordinate input. Provide a visual indication of the currently selected coordinate system.

Options: equatorial, galactic, ALT-AZ.

Default: equatorial.

5.2 EQUINOX

Enter the equinox for input coordinates. Show the current equinox.

Format: 1990.12

Default: TBD.

5.3 OBJECT NAME

Enter the object name.

Format: TBD.

Default: <none>.

5.4 NEXT OBJECT

Enter the next object coordinates in the selected coordinate system and equinox.

Formats: TBD.

Default: <none>.

5.5 PREVIOUS OBJECT

Load previous object coordinates in the next object field. Allow selection from the last 5 objects.

5.6 PRE-DEFINED POSITIONS

Move the mount to pre-defined positions, turn off tracking, disable the servos, and set the clamps. The choice of positions is:

	AZ (°)	EL (°)
a. STOW	180	90
b. WIYN NIR SERVICE	0	90
c. WIYN NIR SERVICE (AZ ONLY)	0	Unchanged
c. MOS NIR SERVICE	180	90
e. MOS NIR SERVICE (AZ ONLY)	180	Unchanged

f. FLAT FIELD † TBD

† Depends on the dome azimuth position. Disable dome motions.

5.7 ENTER OFFSETS

Input telescope pointing offsets in the selected coordinate system and equinox.

5.8 SET ENCODERS

Reset the encoder zero-point so that the position readout is made identical to the requested coordinates.

Options: Set azimuth, set elevation, set both.

5.9 MOVE

Move to the Next Object coordinates and offsets. Clear the Next Object and Offset fields.

5.10 SEARCH

5.10.1 SEARCH PARAMETERS

Set search parameters.

Options: pattern (spiral, raster)

Parameters: number of cycles, field size, scan rate.

5.10.2 START/STOP SEARCH

Start/stop a search.

5.11 CANCEL

Bring the mount to a controlled stop and disable tracking.

6. OBJECT CACHES

6.1 CACHE FORMAT

The object cache information will include at a minimum (a) ID, (b) RA, (c) DEC, (d) equinox, (e) proper motion, and (f) position angle.

6.2 SELECT CACHE

Select an object cache from the Observatory cache library or user supplied cache(s). Highlight the currently selected cache.

Default: TBD.

6.3 SELECT OBJECT

Load the coordinates from the currently selected object cache into the Next Object field.

6.4 ADD CACHE

Add a cache to the cache list. If the named cache doesn't exist, create a new cache. Select the added cache.

6.5 DELETE CACHE

Delete a cache from the cache list.

6.6 SEARCH CRITERIA

Select the criteria for sorting and extracting objects from the currently selected star cache. Show the current search criteria.

Options: Select by RA, by DEC, nearest to Next Object, by object name. Add other options as available from KPNO.

Default: Select by Object name.

6.7 WRITE CACHE

Write the currently selected user cache to a text file.

Option: Mail file to user.

6.8 SAVE CURRENT OBJECT

Save the name and coordinates of the Current Object in the currently selected user cache.

6.9 DELETE OBJECT

Delete an entry from the currently selected user cache.

6.10 SAVE CURRENT POSITION

Write the current telescope position and object name to the currently selected user cache.

7. OSS FUNCTIONS

7.1 MIRROR COVERS

Open/Close the mirror covers. Provide a visual indication of "open", "closed", "moving".

Default: no action.

7.2 FLAT FIELD LAMPS

7.2.1 INTENSITY

Set the intensity for Flat Field lamp banks 1 and 2. Show the current settings.

Range: 0-TBD [TBD units].

Defaults: Bank 1 = TBD, Bank 2 = TBD.

7.2.2 SELECTION

Turn on/off flat field lamps banks 1 and/or 2. Visually indicate bank 1/bank 2 "on".

Default: Both banks off.

Fault: Telescope not pointed at screen.

8. PRIMARY MIRROR

8.1 TEMPERATURE CONTROL

Enable/disable the primary mirror thermal control. Visually indicate if enabled.

Default: Enabled.

8.2 MIRROR TEMPERATURE SETPOINT

Enter the mirror setpoint temperature as a constant offset from ambient temperature. Show current air temperature and offset.

8.3 PROGRAMMED TEMPERATURE CONTROL

Future option for more sophisticated control algorithms.

Options: algorithm.

8.4 ACTIVE SUPPORT ENABLE

Enable/disable the active primary mirror supports. Visually indicate control status: "active/off".

Default: enable.

8.5 DOWNLOAD ACTIVE FORCES

Send the most recent correct forces calculated from WCS to the primary mirror system.

9. SECONDARY MIRROR

9.1 VACUUM SUPPORT ENABLE

Turn on/off the vacuum support of the secondary mirror. Visually indicate control status.

Default: on.

9.2 ENTER FOCUS POSITION

Enter a value for the secondary mirror focus position.

Units: millimeters.

9.3 ENTER FOCUS OFFSET

Enter a value for the secondary mirror focus offset.

Units: millimeters.

9.4 FOCUS

Move the secondary to the focus position and offset.

9.5 ENABLE AUTOFOCUS/COLLIMATION

Enable/disable autofocus and autocollimation. Provide a visual indication of the control status.

Default: enable.

10. TERTIARY MIRROR

10.1 PRESSURE SUPPORT ENABLE

Enable/disable the tertiary air bag pressure support. Provide a visual indication of the control status.

Default: enable.

10.2 SELECT ROTATOR POSITION

Move the tertiary mirror rotator to the selected position. Provide a visual indication of the position.

Options: WIYN, MOS, Folded-Cassegrain.

Default: no change to current position.

Interlocks: Mirror cover closed, tertiary mirror folded up.

10.3 INSERT TERTIARY MIRROR

Rotate the tertiary mirror in/out of the beam. Provide a visual indication of the position.

Default: no change to current position.

Interlocks: Primary mirror cover closed, rotator out of position.

11. NASMYTH INSTRUMENT ROTATORS

11.1 INITIALIZE ENCODERS

Start an encoder initialization sequence. Disable rotator tracking, rotate to the index, and set the encoders. Provide a visual indication of "Initialized". Provide separate controls for MOS and WIYN rotators.

11.2 SELECT ROTATOR COORDINATE SYSTEM

Select the current coordinate system for instrument rotator. Provide a visual indication of the selected coordinates. Provide separate controls for MOS and WIYN rotators.

Options: sky coordinates, mount coordinates.

11.3 ENTER ROTATOR ANGLE

Enter an absolute position angle for the instrument rotator in the currently selected coordinate system. Provide separate controls for MOS and WIYN rotators.

11.4 ENTER ROTATOR OFFSET

Enter a position angle offset for the instrument rotator in the currently selected coordinate system. Provide separate controls for MOS and WIYN rotators.

11.5 MOVE ROTATOR

Move the instrument rotator to the position angle and offset in the currently selected coordinate system. Provide separate controls for MOS and WIYN rotators.

11.6 STOW

Turn off rotator tracking, rotate the NIR to the stow position, set the clamp and turn off the servo. Provide separate controls for MOS and WIYN rotators.

11.7 CANCEL

Bring the NIR to a controlled stop but leave the NIR servo enabled. Provide separate controls for MOS and WIYN rotators.

11.8 SET SOFTWARE LIMITS

Input software rotator angle limits. Display current limits. Provide separate controls for MOS and WIYN rotators.

11.9 DRIVE ENABLE

Enable the rotator drive. The power up state is with the servo active, the rotator stopped, tracking disabled and the clamp released. Visually indicate servo status. Provide separate controls for MOS and WIYN rotators.

Default: disable.

Interlock: Stow pin engaged, clamp fails to release.

11.10 TRACK ROTATOR

Enable open loop instrument rotator tracking. Visually indicate control status. Provide separate controls for MOS and WIYN rotators.

Default: disable.

12. DOME

12.1 DRIVE ENABLE

Enable the dome servo control. The power up state is with the servo drives active, rotation stopped, tracking disabled and the clamps released. Provide a visual indicator showing control status.

Fault detection: TBD second timeout error if clamp does not release.

Default: disable.

Interlocks: Clamps fail to release, inverter fault.

12.2 TRACK ENABLE

Enable open loop tracking of the dome to follow the telescope. Provide a visual indicator showing control status.

Default: disable.

Interlocks: Dome clamp engaged.

12.3 STOW

Rotate the dome to the stow position, disable tracking, set the rotation clamp, and disable the servo control.

12.4 ENTER DOME POSITION

Enter a dome azimuth position angle.

12.5 ROTATE TO POSITION

Rotate the dome to the azimuth position and disable tracking.

12.6 TRACK MODE

Set track mode. Provide a visual indicator showing control status.

Options: Fast response/minimum deadband, Slow response.

Default: Slow.

12.7 STOP

Bring the dome to a controlled stop and disable tracking. Change the tracking indicator to reflect the new status.

12.8 PARK

Bring the dome to a controlled stop, disable tracking, set the rotation clamp, and disable servo control. Change the tracking, clamp and drive status indicators to reflect the new status.

13. HAND CONTROLLER

13.1 MANUAL CONTROLLER ENABLE

Enable/disable a manual controller. Provide a visual indication of the selected/enabled controller.

Options: Controller port.

Default: None enabled.

13.2 RATES

Set the high/medium/low motion rates for the manual controller. Display current settings.

Separate control for main axis coordinates (equatorial, galactic, ALT-AZ), WIYN instrument rotators (2), and focus.

14. IMAGE PROCESSOR

14.1 SELECT GUIDE CAMERA

Select the video input for the image processor. Visually indicate the selected input.

14.2 CAMERA SET-UP

Camera set-up menu loaded at start-up from the instrument configuration files.

14.2.1 ORIENTATION

Enter camera field angle and orientation in the rotator coordinate system. Display current values. Provide separate entries for each camera.

Options: Angle and right/left reverse.

14.2.2 SCALE

Enter field scale. Display current values. Provide separate entries for each camera.

Units: TBD.

14.2.3 FOCUS SENSOR

Probe configured as a focus sensor. Show current state. Provide separate entries for each camera.

Options: TRUE/FALSE.

14.2.4 SAVE SETTINGS

Save set-up values in the configuration file.

14.3 ENTER LEAK TIME

Set the integration time of the "leaky" running average. Display current value.

Range: 0 to TBD seconds.

14.4 VIDEO OUTPUT CONTROL

Adjust the video output map table. Display current settings.

Parameters: Floor and gain.

Units: [TBD]

14.5 INTEGRATE

Select video integrator mode. Show current mode.

Choices: Raw, Integrate, Freeze.

14.6 OVERLAY

Display overlay information on the video monitor.

14.6.1 GRID

Display the a coordinate system grid. Label axes with the currently selected guider coordinate system. Intersect the axes at the guide center.

14.6.2 CURSOR

Create a cursor for selecting objects/regions-of-interest from the video display. Provide cursor position read out in the currently selected coordinates. Set cursor position by mouse or by entering coordinates. Leave the old cursor, if any, displayed but inactive. Provide an indicator of the active cursor on the screen.

14.6.3 SELECT CURSOR

Select a cursor and make it active cursor. Deactivate the previous active cursor. Provide an indicator of the active cursor on the screen.

14.6.4 DELETE CURSOR

Delete the selected cursor.

14.6.5 CENTER CURSOR

Set the active cursor position equal to the centroid under the cursor.

14.6.6 SEND CURSOR

Send the active cursor position to Next Object.

14.7 AUTOGUIDE

14.7.1 ENTER RATE

Set autoguide update rate. Display the current rate.

Range: 0.1 to TBD seconds.

Default: TBD.

14.7.2 ENTER THRESHOLD INTENSITY

Enter the threshold intensity below which autoguiding is disabled and a warning message and audible signal are generated.

Format: Percent of starting intensity.

14.7.3 ENTER MAXIMUM CORRECTION

Enter the largest permitted correction above which autoguiding is disabled and a warning message and audible signal is generated.

Format: Arcseconds.

14.7.4 DISPLAY

Display guide errors, intensity (arbitrary units) and image size.

14.7.5 ENABLE/DISABLE

Start/stop autoguiding. Provide a visual indicator of the state.

Default: stopped.

14.8 CLOSED LOOP AUTOFOCUS

14.8.1 ENTER RATE

Set autofocus update rate. Display the current rate.

Range: 1 to TBD seconds.

Default: TBD.

14.8.2 ENABLE/DISABLE AUTOFOCUS

Enable/disable autofocus using the focus sensor. Provide a visual indicator of the status.

Default: Disabled.

15. ACQUISITION & WAVEFRONT CCD

15.1 INTEGRATION TIME

Set the CCD integration time.

15.2 SAVE FILE

Specify the file to save CCD frames. If name ends with a "." a sequence number is appended when each file is created. Otherwise new data will overwrite old files with the same name.

15.3 DISPLAY CONTROL

Display a CCD frame in a window on the workstation.

15.4 ACQUIRE FRAME

Acquire a frame and save it to disk.

15.5 WCS SEQUENCE

Perform a wavefront curvature measurement sequence: acquire in- and out-of-focus images and save them to disk.

16. INSTRUMENT ADAPTER

16.1 INITIALIZE

Initialize the Instrument Adapter.

16.2 RESET

Reset the Instrument Adapter motion controller.

16.3 DARK COVER

Open/close the dark cover. Provide an indicator to show the status.

Default: no change from current position.

16.4 ATMOSPHERIC DISPERSION COMPENSATOR

16.4.1 INSERT/REMOVE

Insert/remove the ADC. Provide an indicator to show the status.

Default: no change from current position.

16.4.2 INITIALIZE ENCODERS

Initialize the ADC position angles and Rotate the ADC elements to the neutral/stow position and disable tracking.

16.4.3 SET TO NEUTRAL

Rotate the ADC elements to the neutral/stow position and disable ADC tracking.

16.4.4 TRACK ADC

Enable/disable ADC open loop tracking. Provide an indicator to show the status.

Default: disable.

16.5 SLIDE MIRROR

Insert/remove slide mirror. Provide an indicator to show the status.

Default: no change from current.

16.6 CALIBRATION LAMPS

16.6.1 SELECT COLOR FILTER

Select color correction filter. Display the name of the filter in the beam.

Default: no change from current.

16.6.2 SELECT NEUTRAL DENSITY

Select neutral density filter. Display the name of the filter in the beam.

Default: no change from current.

16.6.3 LAMP CONTROL

Turn on/off lamps. Display lamp status.

Default: lamps off.

16.7 ACQUISITION/WCS CAMERA STAGE

16.7.1 INITIALIZE POSITION

Initialize the acquisition/WCS camera position counter moving the camera to its index position.

16.7.2 ENTER POSITION

Enter the acquisition/WCS camera target position.

Range: -TBD to +TBD relative to the camera centered position.

16.7.3 ENTER OFFSET POSITION

Enter the acquisition/WCS camera target offset position.

16.7.4 MOVE

Move the acquisition/WCS camera to the target position and offset.

16.7.5 SELECT FILTER

Select and insert filter.

16.7.6 FOCUS

Set the acquisition/WCS camera focus.

Default: no change from current.

16.8 GUIDE/FOCUS CAMERAS

16.8.1 SELECT COORDINATE SYSTEM

Select a guider coordinate system. Show the current coordinate system.

Options: Equatorial, ALT-AZ, galactic, rotator (i.e.. "physical").

Default: rotator.

16.8.2 INITIALIZE

Initialize position counter by moving to the index position. Provide separate controls for each probe.

16.8.3 ENTER POSITION

Enter the absolute position coordinates for the probe. Input coordinates in the current coordinate system. Provide separate controls for each probe.

Default: no change from current.

16.8.4 ENTER OFFSET

Enter the position offset coordinates for the probe. Input coordinates in the current guider coordinate system. Provide separate controls for each probe.

16.8.5 ENTER FOCUS

Enter the camera focus. Provide separate controls for each camera.

Default: no change from current.

16.8.6 FOCUS

Set the camera focus to the entered value. Provide separate controls for each camera.

16.8.7 SELECT COLOR FILTER

Select the guide camera spectral bandpass filter. Show the current filter. Provide separate controls for each camera.

Default: no change from current.

16.8.8 SELECT NEUTRAL DENSITY

Select the camera attenuation filter. Show the current filter. Provide separate controls for each camera.

Default: blank off position.

17. INSTRUMENT CONFIGURATION CONTROL

17.1 INITIAL SETUP

Manually accept the following inputs: instrument id, port where instrument is mounted, initial rotator angle if applicable, bore sight position.

17.2 RETRIEVE STANDARD CONFIGURATION INFORMATION

For input instrument id, retrieve the following information: nominal telescope focus, nominal TV focus/foci, tertiary position, and flexure map.

18. ORACLE

18.1 SELECT OBJECT

Load coordinates manually, from object cache, or from Current Object.

18.2 DISPLAY AIRMASS VS. TIME

For selected object, graphically display airmass vs. time. Indicate time of minimum airmass, time when object reaches 1.5 airmass, and time when object reaches 2.0 airmass. Also indicate times of telescope ALT-AZ violations and zenith blind spot.

18.3 DISPLAY ALTITUDE VS. TIME

For selected object, graphically display altitude vs. time. Indicate times of maximum altitude, altitude limit violation, and zenith blind spot.

18.4 DISPLAY REMAINING TIMES TO CRITICAL EVENTS

For selected object, list remaining time until object reaches: telescope ALT-AZ limits, airmasses of 1.5 and 2.0, zenith blind spot, and NIR limits. In addition, list remaining time until the start of morning astronomical twilight and sunrise.

19. START-UP CHECKLIST

19.1 INSTRUMENT CHECKLISTS

19.1.1 SELECT INSTRUMENT

Select desired instrument.

19.1.2 DISPLAY CHECKLIST

For selected instrument, display start-up and standard configuration checklist.

19.1.3 PRINT CHECKLIST

For selected instrument, print out start-up and standard configuration checklist.

19.2 TELESCOPE CHECKLISTS

19.2.1 DISPLAY CHECKLIST

Display start-up and standard configuration checklist for telescope.

19.2.2 PRINT CHECKLIST

Print out start-up and standard configuration checklist for telescope.

20. POINTING MAPS

20.1 SELECT METHOD

Description: Select the method of taking pointing data.

Options: ALT-AZ scans, Random Grid, Rotator test.

Default: ALT-AZ scans.

20.2 SELECT GRID

Description: Specify number of objects.

Default: TBD.

20.3 RESULTS FILE

Description: Enter the name of the data file.

20.4 ACQUIRE

Description: Take the pointing data.

20.5 REDUCE

Description: Reduce the pointing data. Display the error terms.

20.6 APPLY

Description: Apply the measured pointing corrections to the telescope model.

21. ACRONYMS & ABBREVIATIONS

ADC	Atmospheric Dispersion Compensator
ALT	Altitude
AZ	Azimuth
CCD	Charge Coupled Device
DEC	Declination
GUI	Graphical User Interface
KPNO	Kitt Peak National Observatory
MOS	Multi-Object Spectrograph
NIR	Nasmyth Instrument Rotator
OCC	Operator Control Console
OSS	Optics Support Structure
RA	Right Ascension
TBD	To Be Determined
TCL	Tool Command Language
TCS	Telescope Control System
WCS	Wavefront Curvature Sensor