



**LBT PROJECT
2x8,4m TELESCOPE**

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**LBT PROJECT
2 X 8,4m OPTICAL TELESCOPE**

LBT Adaptive Optics System Acceptance Test

Unit #2 Software test plan

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Released	Douglas Miller	13 May 2011

1. Revision History

Issue	Date	Changes	Responsible
a	12-May-11	Initial Issue	Douglas Miller
b	13-May-11	Few additional AI and corrections	Douglas Miller
c			
d			
e			
f			
g			
h			
i			
j			

2. Tables

2.1. Table Of Contents

1.	Revision History	2
2.	Tables	3
2.1.	Table Of Contents	3
2.2.	Table of Arcetri Action Items	5
2.3.	Table of LBTO Action Items	7
2.4.	Table of Abbreviations	7
3.	About this document	8
3.1.	Purpose	8
3.2.	Scope	8
3.3.	Reference Documents	8
4.	High Level Software Functionality	9
4.1.	AO System Startup and Shutdown	9
4.1.1.	Startup	9
4.1.2.	Shutdown	12
4.2.	Test of Individual AO Commands	13
4.2.1.	PresetFlatAO	13
4.2.2.	SetReference	15
4.2.3.	PresetAO	16
4.2.4.	AcquireRefAO	17
4.2.5.	CheckRefAO	19
4.2.6.	StartAO	21
4.2.7.	StopAO	22
4.2.8.	PauseAO	23
4.2.9.	ResumeAO	24
4.2.10.	OffsetXYAO	25
4.2.11.	OffsetZAO	26
4.2.12.	RefineAO	27
4.2.13.	CorrectModesAO	28
4.2.14.	ModifyAO	29
4.3.	PresetTelescope: Test The AO Sequence	30
4.4.	Telemetry	32
4.4.1.	AOS Connection, Communication and Disconnect	32
4.4.2.	AOS Data Integrity	33
4.4.3.	AOS Loss of Connection	33
5.	Error handling	34
5.1.	Operator error	34
5.2.	Parameter checking	35
5.3.	Network failure recovery	35
5.4.	Process failure	38
5.5.	Maximum force exceeded	39
5.6.	Lost guide star	40

- 6. GUI's..... 41
 - 6.1. GUI inspection 41
 - 6.1.1. AOS GUI 41
 - 6.1.2. AdSec Arbitrator GUI..... 41
 - 6.1.3. WFS Arbitrator GUI 42
 - 6.2. Event and Error display to operator 42
- 7. Configuration 43
 - 7.1. Computer inventory 43
 - 7.2. Version check..... 43
 - 7.3. Network configuration 44
 - 7.4. IP configuration 44
 - 7.5. Configuration control 1 44
 - 7.6. Configuration control 2..... 45
- 8. Additional Action Items..... 45

2.2. Table of Arcetri Action Items

AI 1: Display Lab Mode on AOS GUI	10
AI 2: Display power on progress of AdSec on AOS GUI	10
AI 3: Timeout for StartAdSec on AOS GUI is too short.....	10
AI 4: Display progress of setting of AdSec on AOS GUI	10
AI 5: Automatic selection of flat for the current Authorized Instrument	11
AI 6: Automatic selection of slope null for the current Authorize Instrument.....	11
AI 7: Display when TSS is "Activated" on AOS GUI.....	11
AI 8: Display progress of power on of wfsc on AOS GUI.....	11
AI 9: Confirmation message box for On/Off of AdSec and W unit on AOS GUI.....	11
AI 10: Implement automatic "Recover Fail" for all failures	11
AI 11: WFS Arbitrator died for unknown reason	11
AI 12: Allow setting of AdSec with M2 swing arm retracted	11
AI 13: Change swing arm status from binary value to string label	11
AI 14: Determination of Safe Operation of TSS	11
AI 15: Change to w_start and w_check routines	12
AI 16: Set timeout or max retries for moving the camera lens.....	12
AI 17: Increase timeout in AOS for acquireRefAO request.....	12
AI 18: Display Adsec and WFS are in "Lab Mode" on the AOS GUI.....	12
AI 19: Display progress of AdSec "Rest" on AOS GUI	13
AI 20: Display power off progress of AdSec on AOS GUI	13
AI 21: Adsec Arbitrator should check the flat filename path	14
AI 22: Flat s Shape not displayed on AOS GUI	14
AI 23: Adsec Arbitrator should check the flat filename suffix.....	14
AI 24: Set Mode label on AOS GUI should be set to "Fix_AO" after AdSec "Set"	14
AI 25: Error message on AOS GUI when flat file is not found.....	14
AI 26: adsc, w_stop should also kill WFS and AdSec engineering GUI's.....	14
AI 27: Document How to Change Default Flat	15
AI 28: Return and error if measured brightness is 2 mags larger than expected	17
AI 29: Fix problem adjusting CCD39 bias levels.....	17
AI 30: Received "CCD39 not Ready" error	17
AI 31: AO status on AOS GUI after failed acquireRefAO is incorrect.....	19
AI 32: AcquireRefAO continued even after Secondary Ripped.....	19
AI 33: "Set" button available on AOS GUI while "Recover Fail" in progress	19
AI 34: Clear PresetFlat failure label on AOS Command GUI.....	19
AI 35: Send more informative "Shell Ripped" error message to TCS log.....	19
AI 36: AOS GUI should reject rather than queue button clicks	19
AI 37: Improve intensity cut on Field Viewer on AOS GUI.....	19
AI 38: Add a date and time to the AOSGUI Messages	19
AI 39: Add a scroll bar (up/down, left/right) to AOS GUI message display.....	19
AI 40: Test acquireRefAO with repoint flag on sky	19
AI 41: Put moved values in the WFS log rather than measured.....	21
AI 42: Add more information in .events file for maximum skipframe exceeded.....	21

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 6
--	--	---	--------

AI 43:	Autoscale Count –vs- time graph in up direction only on AOS GUI.....	22
AI 44:	Set original scale of Count –vs- time graph on AOS GUI	22
AI 45:	Fix Current/Acquisition button on AOS GUI.....	22
AI 46:	Offload T/T/F values on AOS GUI not updating	22
AI 47:	Improve error message for failed resumeAO request.....	24
AI 48:	Increase AOS timeout for offsetXYAO	26
AI 49:	Apply curved focal plane stage Z-shift for W-unit.....	27
AI 50:	Implement RefineAO Command.....	28
AI 51:	Implement CorrectModesAO in WFS arbitrator	29
AI 52:	Increase timeout in AOS for CorrectModesAO	29
AI 53:	Fix the AOS GUI display of ModifyAO parameters.....	30
AI 54:	Fix conflict of auto-drift routine and ModifyAO request.....	30
AI 55:	Change AO Command Document.....	30
AI 56:	Error not return to AOS when presetAO failed.....	32
AI 57:	Send better error message when acquireRefAO fails	32
AI 58:	Determine cause of Mode=1.0E10 error	32
AI 59:	Parallelize the acquisition of darks on CCD39 and CCD47	32
AI 60:	Add parameter checking to AOS Command GUI	35
AI 61:	AO Arbitrator did not re-sync after network loss test	37
AI 62:	Shell Ripped on network loss test, should have remained Flat	37
AI 63:	NAN slopes sent from WFS after reconnect to Slope BCU.....	37
AI 64:	Low Level AO System Errors in TCS Event Log.....	39
AI 65:	Error homing WFS XYZ stages	39
AI 66:	Display SkipFrame Percentage on AOS GUI and “Warning”	39
AI 67:	AOS GUI does not display WFS “On” after WFS Arbitrator restart	41
AI 68:	Incorrect AO Status on AOS GUI after loop opened for skipframe max.....	41
AI 69:	AdSec Ripped for lost star in bin=4 mode	41
AI 70:	Determine performance parameter in Graph on AOS GUI.....	42
AI 71:	AOS GUI Graph Vectors into Telemetry	43
AI 72:	Return information to IIF about what system timeout was from	45
AI 73:	Make timeout in AOS for presetAO longer.....	45
AI 74:	Disconnect of fiber from WFS Slope BCU to the AdSec now detected	45
AI 75:	Convert offsetXYAO arguments from arcsec to mm.....	46
AI 76:	Status of Adaptive Secondary Mirror Telemetry, A. Riccardi, Document	46

2.3. Table of LBTO Action Items

AI LBTO 1: Add "Quick Start" list to "FLAO System Operator Manual".....	12
AI LBTO 2: PresetFlatAO command rejected.....	14
AI LBTO 3: Removed: Change to Arcetri AI 75	26
AI LBTO 4: Check expected argument units for offsetZAO	27
AI LBTO 5: Check AO values in Telemetry at the LBT.....	33
AI LBTO 6: Check IRC parameter check works with current IRC version.....	35
AI LBTO 7: Doug determine algorithm to set Compass on AOS GUI.....	45
AI LBTO 8: Make a list of data the AOS should send to Telemetry.....	46
AI LBTO 9: Doug check with Norm the status of mountain sx computers	46
AI LBTO 10: Will there be a spare AO switch with fiber inputs for Clean Room	46
AI LBTO 11: Check the status of the Cisco switch for AdSec SX	46

2.4. Table of Abbreviations

AOS	Adaptive Optics Subsystem of the TCS
AOS GUI	Adaptive Optics Subsystem Graphical Interface
DX	Right Side of the Large Binocular Telescope
IIF	Instrument InterFace Subsystem of the TCS
IRC	InfraRed Client
MCS	Mount Control Subsystem of the TCS
OSS	Optical Structure Subsystem of the TCS
RIP	Rest In Peace: Adaptive Secondary coils are disabled and the shell is pulled against the reference body
PCS	Point Control Subsystem of the TCS
PSF	Point Spread Function of the TCS
SX	Left Side of the Large Binocular Telescope
TCS	Telescope Control System
TSS	Thin Shell Suction (Safety System)
TV	Technical Viewer (CCD47)
WFS Image	Pyramid Wave Front Sensor Image (CCD39)

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 8
--	--	---	--------

3. About this document

3.1. Purpose

This document is a test plan for acceptance testing of the AO software package for AO Unit #2 required for operation of the LBT adaptive optics system. This acceptance testing will take place at OAA in Florence after system integration and testing. Based on the test results, LBTO will make an executive decision regarding system readiness for shipping to the telescope.

3.2. Scope

Test cases for testing of AO SW are contained in this document. Note that system performance verification and hardware testing are described in other documents.

3.3. Reference Documents

- [RD1] 640s009 LBT AOS GUI requirements, D Miller
- [RD2] nnnfnnn Adaptive Secondary Mirror Telemetry, A. Riccardi
- [RD3] 481s009 LBT Control GUI Specification, M. De La Pena
- [RD4] 481s010 LBT TCS GUI Guidelines, M. De La Pena
- [RD5] 481f301 AOS – The complete guide
- [RD6] 486f009 AO Supervisor – Functional description

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 9
--	--	---	--------

4. High Level Software Functionality

Comment about logs:

Currently each AO Supervisor process has its own log file. They all have the same format and can be merged via a graphical log viewer. Plan is to remain with multiple files for convenience of copying. Doug requested that a “high level” log file is available with important info for non-expert AO user. This could be the message daemon log.

In the following section, the initial and final state of the AO Systems in described. The possible states are:

- “SeeingLmtd”
- “ReadyToAcquire”
- “RefAcquired”
- “LoopClosed”
- “LoopSuspended”

4.1. AO System Startup and Shutdown

Test case: Go through full startup and shutdown of the AO system.

4.1.1. Startup

This test will start with the AO System hardware fully powered off. AO computers and network hardware will be powered and ready for use.

1. The AOS GUI should display that the AO System is not ready for operation.
2. The startup should be semi-automatic such that:
 - a. Only one Graphical User Interface is needed to startup the AO System.
 - b. After startup is complete, the AO System should be in a “SeeingLmtd” state.
 - c. No more than six (6) mouse-clicks are needed to startup.
 - d. No manual setting of parameters needed for startup.
3. After startup is complete, the AOS GUI should display that the AO is ready for operation and in a “SeeingLmtd” state.
4. Information about the startup (systems started, configuration files used, errors, etc) should be written in an AO log and the TCS event log.
5. Measure the time required for startup sequence to be completed.
6. Observe any irregularities.

Results/Comments:

1. “No Connection” to msgdmn. “No Arbitrator” if AO Arbitrator is not running.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 10
--	--	---	---------

- a. Ping ts839sx (Ethernet to serial converters in WFS unit) from wfssx computer
 - b. Ping adamsx (Adsec power unit) from adsecsx computer
2. New Adam has been ordered. Test with Magellian unit. Upgrade Unit #1 soon.
3. Separated the Hexapod hardware. Need to discuss Software separation
4. Start adsec
 - a. adsc_check (not running)
 - b. adsc_start (starting process...)
 - c. AOS GUI display (Operating)
 - d. Adsc_start says msgdm already running
 - e. Must start single processes from "System Process" GUI
 - f. If process is off, red bar for Adsec. Under "OFF"
 - g. If AO Arbitrator stops, then displayed on AOS GUI
5. AOS GUI display "Ready for SL" is green
6. Times
 - a. Adsc_start: 10 seconds
 - b. Adsec power on: ~2.5 minutes
 - c. Set: ~2.0 minutes
7. Wfc_startup
 - a. W_check (not running)
 - b. W_start (starting process...) 10 seconds
 - c. AOSGUI "On" button ~4 minutes. Need progress update (AI).
 - d. Green bar
 - e. "Ready for AO" is green
 - f. WFS "FLAOWFS" label
8. AOSGUI displays Field Viewer up to 1Hz. When ccd47 is in bin=1 mode, then display 1 ever 4 seconds. Acquisition image not available till first presetTelescope.

AI 1: Display Lab Mode on AOS GUI

When AdSec is in lab mode update the variable on Adsec Arbitrator so "Lab Mode" is displayed on the AOS GUI.

AI 2: Display power on progress of AdSec on AOS GUI

List power on information for AdSec in the AOS GUI message window so the user has feedback that power on is proceeding. Do not need to display all steps but maybe just "BCU powered on", "Code loading", "Code loading complete", etc

AI 3: Timeout for StartAdSec on AOS GUI is too short

AI 4: Display progress of setting of AdSec on AOS GUI

List setting information for AdSec in the AOS GUI message window so the user has feedback that flattening is proceeding. Do not need to display all steps but maybe just "Enabling Coils", "Moving Shell", etc

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 11
--	--	---	---------

AI 5: Automatic selection of flat for the current Authorized Instrument

Have automatic selection of flat for different Authorized Instrument. Will need configuration parameters in AOS config file.

AI 6: Automatic selection of slope null for the current Authorize Instrument

Have automatic selection of slope null for different Authorized Instrument. Will need configuration parameters in AOS config file.

AI 7: Display when TSS is "Activated" on AOS GUI

Display if TSS is "Activated" on Adsec and AOS GUI. Currently only Enabled and Disabled. Activation is in Hardware, but can do some logic to display the Activated/Enabled state. (Marco)

AI 8: Display progress of power on of wfsc on AOS GUI

List power on information for WFS in the AOS GUI message window so the user has feedback that power on is proceeding. Do not need to display steps but maybe just "CCD39 power on", "Filter wheel 1 homed", etc

AI 9: Confirmation message box for On/Off of AdSec and W unit on AOS GUI

AI 10: Implement automatic "Recover Fail" for all failures

Implement automatic "Recover Fail" for all failures. Currently only auto R.F. when in closed loop

AI 11: WFS Arbitrator died for unknown reason

WFS Arbitrator died trying to server a ccd47 image to the AOSGUI while we were at lunch.

AI 12: Allow setting of AdSec with M2 swing arm retracted

Change AdSec software to allow setting of shell in either deployed or retracted, but not in unknown (moving) state. If state changes to unknown, the shell should be Ripped. This AI should only be implemented after a release from the deployed only flattening requirement from ADS. Armando will contact ADS. The original reason for this requirement was that the clocking error between the reference body and the cold plate could allow banging of the magnets for a slightly rotated flattening position (M2 swing arm retracted). This clocking has been fixed.

AI 13: Change swing arm status from binary value to string label

Change the AdSec Control Gui to show "Deployed", "Retracted" or "Unknown", not 0 or 1

AI 14: Determination of Safe Operation of TSS

Install automatic procedure to determine if it is safe to use TSS (eg no dust in gap: boulder test). This procedure will be run every time the shell is pulled against the

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 12
--	--	---	---------

reference body and a status variable will be set in the DD by the AOS. The AOS will also add a Large Clear Red Warning label on its GUI saying there is a possible gap contamination and Arcetri and/or IQ Group staff notified immediately.

AI 15: Change to w_start and w_check routines

W_start should also star the pupilcheck39 routine so that a w_check show all processes as “running”. The w_check procedure should not check pupilcheckt1 and pupilcheckt2 so a w_check will have all processes as “running”

AI 16: Set timeout or max retries for moving the camera lens

Set a timeout, or maximum number of retries, for moving the lens. Make sure the AOS timeout is long enough that the lens moving routine will return an error to the AOS and will be passed up to the IIF/IRC.

AI 17: Increase timeout in AOS for acquireRefAO request.

AI 18: Display Adsec and WFS are in “Lab Mode” on the AOS GUI.

Display that the Adsec (and WFS) is/are in “Lab Mode” on the AOS GUI. This is needed to users know that they should not do anything with the AO system, move the telescope or open the chamber.

AI LBTO 1: Add “Quick Start” list to “FLAO System Operator Manual”.

Guido and Doug write a “Quick Start” list for starting up the AO System. This will be inserted into the “FLAO System Operator Manual”.

4.1.2. Shutdown

This test will start with the AO System in a “SeeingLmtd” state. The shutdown will leave all AO System hardware fully powered off. AO Computers and network hardware will remain powered on and ready for use.

1. The AOS GUI should display that the AO System is ready for operation and in a “SeeingLmtd” state.
2. The shutdown should be semi-automatic such that:
 - a. Only one Graphical User Interface is needed to shutdown the AO System.
 - b. No more than six (6) mouse-clicks are needed to shutdown.
3. After shutdown is complete, the AO System hardware should be powered off. AO Computers and network hardware will remain powered on and ready for use.
4. Information about the shutdown (systems stopped, errors, etc) should be written in an AO log and the TCS event log.
5. Measure the time required for shutdown sequence to be completed.
6. Observe any irregularities.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 13
--	--	---	---------

Results/Comments:

1. "Rest" ~ 5 seconds
2. "Off" Adsec ~ 5 seconds
3. "Off" WFS ~20 seconds (had flowerpot power off timeout error. Alfio will increase timeout from 2 to 4 seconds)

AI 19: Display progress of AdSec "Rest" on AOS GUI

List setting information for AdSec in the AOS GUI message window so the user has feedback that flattening is proceeding. Do not need to display all steps but maybe just "Enabling Coils", "Moving Shell", etc

AI 20: Display power off progress of AdSec on AOS GUI

List power off information for AdSec in the AOS GUI message window so the user has feedback that power on is proceeding.

4.2. Test of Individual AO Commands

The tests in these sections will be performed with both a successful and an unsuccessful completion. We may have to manufacture an unsuccessful request by manually setting a parameter or system setup such that each request fails.

All the following commands will be sent to the AO System via irc request to the IIF and passed through the AOS.

4.2.1. PresetFlatAO

- **Initial State of AO System:** "SeeingLmtd"
 - **Test case:** Request PresetFlatAO using the IRC interface tool.
 - **Input Parameters:** "Flat_Filename", "left"
 - **Expected Result:** The AO System is in a "SeeingLmtd" state with the requested "Flat" applied to the Adaptive Secondary
1. Check that for a successful PresetFlatAO request:
 - a. The AO System is left in a "SeeingLmtd" state.
 - b. The appropriate "Default" is applied for the current authorized instrument and focal station.
 - c. The resulting state is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. The applied flat name is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - e. A success flag is returned to the IIF and is noted in the TCS event log.
 - f. A success flag is returned to the IRC interface tool.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 14
--	--	---	---------

2. Check that for an unsuccessful PresetFlatAO request:
 - a. The AO System is left in a “known” state.
 - b. The resulting state information is displayed on the AOS GUI.
 - c. The reason the PresetFlatAO request failed is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A fail flag is returned to the IIF and is noted in the TCS event log.
 - e. The reason the PresetFlatAO request failed is returned to the IIF and is written in the TCS event log.
 - f. A fail flag is returned to the IRC interface tool along with the reason the PresetFlatAO request failed.
3. Measure the time for information about either a successful or unsuccessful PresetFlatAO request to be returned to the IRC interface tool.

Results/Comments:

1. Time is ~5 seconds for seconds, <1 sec for failure

AI 21: **Adsec Arbitrator should check the flat filename path**

Adsec Arbitrator should check the flat filename (absolute path –vs- just a filename) sent with IRC command (Confirm that Alfio made a fix)

AI 22: **Flat s Shape not displayed on AOS GUI**

Flat shape not displayed on AOSGUI. Had used presetFlatAO default.sav left. Code had been commented out that did the display because variable has full path but want only name

AI 23: **Adsec Arbitrator should check the flat filename suffix**

presetFlatAO default left and failed because expected default.sav. Should automatically add .sav, if not present.

AI 24: **Set Mode label on AOS GUI should be set to “Fix_AO” after AdSec “Set”**

Set Mode label on AOS GUI should be set to “Fix_AO” after AdSec “Set”, not empty. When presetFlatAO is sent, it changed to “FIX_AO” even though the AdSec was already ready for seeing limited operation.

AI 25: **Error message on AOS GUI when flat file is not found**

Currently error returns IDL File Error. Change this to “Flat file not found, file = default.sav”.

AI LBTO 2: **PresetFlatAO command rejected**

Sent presetFlatAO default.sav right and received back “Requested side for this instrument focal station combination not allowed”. Had set to IRTC @ RFBG

AI 26: **adsc, w_stop should also kill WFS and AdSec engineering GUI’s.**

Now some close, some stay open. Continuing work.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 15
--	--	---	---------

AI 27: **Document How to Change Default Flat**

Document the name and location of the default flat for each instrument, and how to change these. This will be in AOS GUI config file. Luca is working on it.

4.2.2. SetReference

This command must be executed, with an appropriate file with the reference star coordinates, before a PresetAO. The reference star coordinates sent to the IIF are passed to the AOS when a PresetAO request is made.

- **Initial State of AO System:**
 - “SeeingLmtd” state
 - All TCS subsystems and simulators needed are running
 - TCS “servers” are running
 - IIF, MCS, PCS subsystems are running
 - mcsSimulator is running in the appropriate setup (set az, el and rot to holding at the mcsDisplay GUI)
 - Simulated “telescope” is tracking at an appropriate target star. This is achieved via the pcsclient routine, selection 1.
 - **Test case:** Request SetReference using the IRC interface tool.
 - **Input Parameters:** None (a default file is used) or “filename.dat”
 - **Expected Result:**
 - The AO System is in a “SeeingLmtd” state
 - The AO System ready to accept a PresetAO request.
 - The IIF contains in memory the reference star coordinates. **Note**, it may not be possible to determine it this is the case until these coordinates are passed to the AOS.
1. Check that for a successful SetReference request:
 - a. The AO System is left in a “SeeingLmtd” state.
 - b. The AO System is ready to accept a PresetAO request.
 - c. A success flag is returned to the IIF and is noted in the TCS event log.
 - d. A success flag is returned to the IRC interface tool.
 2. Check that for an unsuccessful SetReference request:
 - a. The AO System is left in a “SeeingLmtd” state.
 - b. A fail flag is returned to the IIF and is noted in the TCS event log.
 - c. A fail flag is returned to the IRC interface tool along with the reason the SetReference request failed.
 3. Measure the time for information about either a successful or unsuccessful SetReference request to be returned to the IRC interface tool.

Results/Comments:

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 16
--	--	---	---------

1. Used pcsclient to set Ra/Dec to 00:00:00, 00:00:00, etc
2. Irc_sendreference with 00:00:00 00:00:00, 8.5, etc
3. Time: almost no time

Note: This command does not exercise any AO software, only IIF.

4.2.3. PresetAO

- **Initial State of AO System:**
 - “SeeingLmtd” state
 - All TCS subsystems and simulators needed are running
 - TCS “servers” are running
 - IIF, MCS, PCS subsystems are running
 - mcsSimulator is running in the appropriate setup (set az, el and rot to holding at the mcsDisplay GUI)
 - Simulated “telescope” is tracking at an appropriate target star. This is achieved via the pcsclient routine, selection 1.
 - Coordinates for an appropriate reference star have been passed to the AOS with the IRC SetReference command.
 - **Test case:** Request PresetAO using the IRC interface tool.
 - **Input Parameters:** “left”
 - **Expected Result:**
 - The AO System is in a “ReadyToAcquire” state
 - The AO System ready to accept a CheckRefAO or AcquireRefAO request.
 - The WFSC stages are positioned at the correct x,y position by comparing:
 - AO Engineering GUIs
 - PCS logging of x,y values sent to AOS in /var/log/messages
 - Request guide star x,y position using the pcsclient routine, selection 14.
1. Check that for a successful PresetAO request:
 - a. The AO System is left in a “ReadyToAcquire” state.
 - b. The WFSC stages are in the correct position (see above).
 - c. The AO System is ready to accept a CheckRefAO or AcquireRefAO request.
 - d. The resulting state is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - e. A success flag is returned to the IIF and is noted in the TCS event log.
 - f. A success flag is returned to the IRC interface tool.
 2. Check that for an unsuccessful PresetAO request:
 - a. The AO System is left in a “SeeingLmtd” state.
 - b. The resulting state information is displayed on the AOS GUI.
 - c. The reason the PresetAO request failed is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A fail flag is returned to the IIF and is noted in the TCS event log.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 17
--	--	---	---------

- e. The reason the PresetAO request failed is returned to the IIF and is written in the TCS event log.
 - f. A fail flag is returned to the IRC interface tool along with the reason the PresetAO request failed.
3. Measure the time for information about either a successful or unsuccessful PresetAO request to be returned to the IRC interface tool.

Results/Comments:

1. Sent reference.dat to IIF
2. Sent presetAO, /ACE, retval
 - a. Now values of X and Y in focal plane are near 0.0 (.44, .42)
 - b. Setting up ccd's, filter wheels, etc
 - c. Failed with WFS arbitrator timeout (AI)
3. AOSGUI now has Status: AOPrepared and Status: "ReadyToAcquire"
4. Time: 41 seconds
5. Sent a presetAO in TTM mode and communication was successful. However, the lamp was too bright and the 0 T/T shape of the mirror was strange.

AI 28: Return and error if measured brightness is 2 mags larger than expected

If the observer sends the wrong magnitude, or the wrong star is found and the CCD39 is saturated, then the converged shape of the AdSec may be bad. An error should be returned in this case so observer can fix the problem.

AI 29: Fix problem adjusting CCD39 bias levels

WFS Arbitrator timed out after 10 seconds while ccd39 was adjusting the bias levels. Should only take 1 second. Tried a second and failed. Alfio tried with his routines and success. We are sending the same irc request. Not clear what is different. I sent from IDL and received "failed - Reading shared buffer masterdiagnostic...."

AI 30: Received "CCD39 not Ready" error

Sent a new presetAO and received a "Ccd39 not ready". Alfio said he and Enrico had fixed it yesterday.

4.2.4. AcquireRefAO

- **Initial State of AO System:**
 - "ReadyToAcquire" state
 - PresetAO has already been successfully executed
- **Test case:** Request AcquireRefAO using the IRC interface tool.
- **Input Parameters:** "left"
- **Expected Result:**
 - The AO System is in a "RefAcquired" state

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 18
--	--	---	---------

- The AO System ready to accept a StartAO request.
 - The WFSC stages are positioned so the reference star is placed on the peak of the Pyramid WFSC, or at least with its capture range.
1. Check that for a successful AcquireRefAO request:
 - a. The AO System is left in a “RefAcquired” state.
 - b. The WFSC stages are positioned so the reference star is placed on the peak of the Pyramid WFSC, or at least with its capture range by checking:
 - i. The reference star is on, or very near, the “Hotspot” of the Technical Viewer camera.
 - ii. The Pyramid WFSC is reporting Tip and Tilt values that are within its capture range.
 - c. The AO System is ready to accept a StartAO request.
 - d. The resulting state is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - e. A success flag is returned to the IIF and is noted in the TCS event log.
 - f. A success flag is returned to the IRC interface tool.
 2. Check that for an unsuccessful AcquireRefAO request:
 - a. The AO System is left in a “ReadyToAcquire” state.
 - b. The resulting state information is displayed on the AOS GUI.
 - c. The reason the AcquireRefAO request failed is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A fail flag is returned to the IIF and is noted in the TCS event log.
 - e. The reason the AcquireRefAO request failed is returned to the IIF and is written in the TCS event log.
 - f. A fail flag is returned to the IRC interface tool along with the reason the AcquireRefAO request failed.
 3. Measure the time for information about either a successful or unsuccessful AcquireRefAO request to be returned to the IRC interface tool.

Results/Comments:

1. Acquirerefao, retval (had to remove the check=True/False flag)
2. Failed: No stars found on TV (filter was rolled in so laser too dim)
3. Loop not close because re-rotator position was incorrect (should have lab mode for wfsc). Secondary stopped, rip'd and the recover fail, as it should
4. acquireRefAO with repoint flag TRUE. Can not repoint telescope
5. In log, AOS requested an offset x=0.28 -> 0.28, y=0.34 -> 0.34 (same numbers), however, on wfsc control GUI it says that error is x=-0.27, y = 0.032. The offset request values should have been the sum of these values. **Alfio and Luca corrected this. Tested and now the requested x and y are in absolute position (difference of original and delta x,y).
6. Time: 1'47”

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 19
--	--	---	---------

AI 31: AO status on AOS GUI after failed acquireRefAO is incorrect

After acquireRefAO failure and set of Adsec, AOSGUI still shows RefAcquired. It should be ReadyToAcquire. "AOSet" state of WFSC should be put back to "Operational" if AcquireRef command fails.

AI 32: AcquireRefAO continued even after Secondary Ripped

Forced an error (wrong rotator value so closed loop failed). The Adsec ripped, then did a "Recover Fail". AcquireRefAO continued even after Secondary ripped. Should send the AcquireRefAO thread a stop.

AI 33: "Set" button available on AOS GUI while "Recover Fail" in progress

AOS GUI showed Adsec in Safe mode and "Recover Fail" was in operation, but "Set" button was still available.

AI 34: Clear PresetFlat failure label on AOS Command GUI

On Command GUI of AOS the previous PresetFlat command failure or success labels should be cleared. All other failures and successes for other commands are already cleared.

AI 35: Send more informative "Shell Ripped" error message to TCS log

When AdSec ripped and recovered, only a "coil status = 0" was sent to the TCS log. Should send Shell Ref'ed and reason, Recover Fail in progress, then Recover Fail complete.

AI 36: AOS GUI should reject rather than queue button clicks

"Set" button press should be rejected if Adsec is busy (say with Recover Fail) and a message saying that Recover Fail in progress. Currently (maybe) the Set button presses are queued.

AI 37: Improve intensity cut on Field Viewer on AOS GUI

Can not see dim stars on Field Viewer on AOSGUI. Need better range cuts, log scale, etc. Use "Amplification" slider, same as CCD47 and 39 GUI, on AOSGUI

AI 38: Add a date and time to the AOSGUI Messages

AI 39: Add a scroll bar (up/down, left/right) to AOS GUI message display

AI 40: Test acquireRefAO with repoint flag on sky

4.2.5. CheckRefAO

- **Initial State of AO System:**
 - "ReadyToAcquire" state
 - PresetAO has already been successfully executed

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 20
--	--	---	---------

- **Test case:** Request CheckRefAO using the IRC interface tool.
 - **Input Parameters:** “left”
 - **Expected Result:**
 - The AO System is in a “ReadyToAcquire” state.
 - The AO System ready to accept a AcquireRefAO request.
 - The telescope is re-pointed so the reference star is placed on the peak of the Pyramid WFSC, or at least with its capture range.
1. Check that for a successful CheckRefAO request:
 - a. The AO System is left in a “ReadyToAcquire” state.
 - b. The telescope has been re-pointed, if needed, via a request to the PCS to changing the guide star origin. This is checked by comparing:
 - i. The size of the guide star origin change request sent by AOS to the PCS, written in the AO log and the TCS event log.
 - ii. The size of the actual guide star origin change applied by the PCS, written in the TCS event log.
 - c. The re-pointing of the telescope successfully places the reference star on the peak of the Pyramid WFSC, or at least with its capture range by checking:
 - i. The reference star is on, or very near, the “Hotspot” of the Technical Viewer camera.
 - ii. The Pyramid WFSC is reporting Tip and Tilt values that are within its capture range.
 - d. The AO System is ready to accept an AcquireRefAO request.
 - e. The resulting state is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - f. A success flag is returned to the IIF and is noted in the TCS event log.
 - g. A success flag is returned to the IRC interface tool.
 2. Check that for an unsuccessful CheckRefAO request:
 - a. The AO System is left in a “ReadyToAcquire” state.
 - b. The resulting state information is displayed on the AOS GUI.
 - c. The reason the CheckRefAO request failed is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A fail flag is returned to the IIF and is noted in the TCS event log.
 - e. The reason the CheckRefAO request failed is returned to the IIF and is written in the TCS event log.
 - f. A fail flag is returned to the IRC interface tool along with the reason the CheckRefAO request failed.
 3. Measure the time for information about either a successful or unsuccessful CheckRefAO request to be returned to the IRC interface tool.

Results/Comments:

1. Can not do a checkrefao after an acquirerefao. The acquirerefao has set the optical setup to the send all light to the pyramid.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 21
--	--	---	---------

AI 41: Put moved values in the WFS log rather than measured

The values in AOSGUI Command display are moved values, but values in the wfsc log are measured. Why is the movement not equal to first measurement, +/- 0.1 (allowed error)?

4.2.6. StartAO

- **Initial State of AO System:**
 - “RefAcquired” state
 - PresetAO and AcquireRefAO have already been successfully executed
 - **Test case:** Request StartAO using the IRC interface tool.
 - **Input Parameters:** “left”
 - **Expected Result:**
 - The AO System is in “LoopClosed” state.
1. Check that for a successful StartAO request:
 - a. The AO System is left in “LoopClosed” state.
 - b. The resulting state is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - c. A success flag is returned to the IIF and is noted in the TCS event log.
 - d. A success flag is returned to the IRC interface tool.
 2. Check that for an unsuccessful StartAO request:
 - a. The AO System is left in a “RefAcquired” state.
 - b. The resulting state information is displayed on the AOS GUI.
 - c. The reason the StartAO request failed is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A fail flag is returned to the IIF and is noted in the TCS event log.
 - e. The reason the StartAO request failed is returned to the IIF and is written in the TCS event log.
 - f. A fail flag is returned to the IRC interface tool along with the reason the StartAO request failed.
 3. Measure the time for information about either a successful or unsuccessful StartAO request to be returned to the IRC interface tool.

Results/Comments:

1. Success:
2. Time: < 1second

AI 42: Add more information in .events file for maximum skipframe exceeded

Turned off lamp, frames were skipped for 1 second (100% loss), then loop was opened. In AOSGUI message box, “Maximum skip reached” (should change to red, now green and add comment “Loop Opened”). In .events log, only says

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 22
--	--	---	---------

LOOPON:0. Caused a loop by Marco turning off coils. Again, only LOOPON: 0 in log. Javier added a “Recovering AdSec Failure...”. No “Recover Finished”.

AI 43: Autoscale Count –vs- time graph in up direction only on AOS GUI

The graph will use the initial value of Counts to set the scale of the graph. As the closed loop continues and the Counts change, the graph is allowed to autoscale in only one direction (eg of the Counts become smaller, the low limit of the graph is decrease so the original level of Counts is all ways on the graph). This is the same behavior as the Performance Metric –vs- Time. This graph should be cleared and recreated for a new preset.

AI 44: Set original scale of Count –vs- time graph on AOS GUI

Set original scale of Count –vs- time graph according to first value, or to equation from Alfio

AI 45: Fix Current/Acquisition button on AOS GUI

Current button is switch rather than clicking current or acquisition button.

AI 46: Offload T/T/F values on AOS GUI not updating

Should have two decimal places displayed.

4.2.7. StopAO

- **Initial State of AO System:**
 - The AO system is in “LoopClosed” state.
 - **Test case:** Request StopAO using the IRC interface tool.
 - **Input Parameters:** “left”
 - **Expected Result:**
 - The AO System is in a “SeeingLmtd” state.
1. Check that for a successful StopAO request:
 - a. The AO System is left in a “SeeingLmtd” state.
 - b. The resulting state is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - c. A success flag is returned to the IIF and is noted in the TCS event log.
 - d. A success flag is returned to the IRC interface tool.
 2. Check that for an unsuccessful StopAO request:
 - a. The AO System is left in a known state. This could be either a “SeeingLmtd” state or remain in “LoopClosed” state, depending on the reason for the failure.
 - b. The resulting state information is displayed on the AOS GUI.
 - c. The reason the StopAO request failed is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A fail flag is returned to the IIF and is noted in the TCS event log.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 23
--	--	---	---------

- e. The reason the StopAO request failed is returned to the IIF and is written in the TCS event log.
 - f. A fail flag is returned to the IRC interface tool along with the reason the StopAO request failed.
3. Measure the time for information about either a successful or unsuccessful StopAO request to be returned to the IRC interface tool.

Results/Comments:

1. Success!
2. Time: ~ 10 seconds

4.2.8. PauseAO

- **Initial State of AO System:**
 - The AO system is in “LoopClosed” state.
 - **Test case:** Request PauseAO using the IRC interface tool.
 - **Input Parameters:** “left”
 - **Expected Result:**
 - The AO System is in a “LoopSuspended” state.
 - The AO Loop can be Closed by a ResumeAO request.
1. Check that for a successful PauseAO request:
 - a. The AO System is left in a “LoopSuspended” state.
 - b. The AO System Closed AO Loop can be resumed by a ResumeAO request.
 - c. The resulting state is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A success flag is returned to the IIF and is noted in the TCS event log.
 - e. A success flag is returned to the IRC interface tool.
 2. Check that for an unsuccessful PauseAO request:
 - a. The AO System is left in a “known” state. This could be either a “LoopSuspended” state or remain in “LoopClosed” state, depending on the reason for the failure.
 - b. The resulting state information is displayed on the AOS GUI.
 - c. The reason the PauseAO request failed is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A fail flag is returned to the IIF and is noted in the TCS event log.
 - e. The reason the PauseAO request failed is returned to the IIF and is written in the TCS event log.
 - f. A fail flag is returned to the IRC interface tool along with the reason the PauseAO request failed.
 3. Measure the time for information about either a successful or unsuccessful PauseAO request to be returned to the IRC interface tool.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 24
--	--	---	---------

Results/Comments:

1. Success: Pause displayed on WFS, AdSec and AO labels. Only allow resumeao or stopao. If star is lost, then resume fails, but can try resumeao again.
2. Time: < 1 sec

4.2.9. ResumeAO

- **Initial State of AO System:**
 - “LoopSuspended” state
 - The AO system was in Closed AO Loop and then a PauseAO request was successfully executed
 - **Test case:** Request ResumeAO using the IRC interface tool.
 - **Input Parameters:** “left”
 - **Expected Result:**
 - The AO System is in “LoopClosed” state.
1. Check that for a successful ResumeAO request:
 - a. The AO System is left in “LoopClosed” state.
 - b. The resulting state is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - c. A success flag is returned to the IIF and is noted in the TCS event log.
 - d. A success flag is returned to the IRC interface tool.
 2. Check that for an unsuccessful ResumeAO request:
 - a. The AO System is left in a “LoopSuspended” state.
 - b. The resulting state information is displayed on the AOS GUI.
 - c. The reason the ResumeAO request failed is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A fail flag is returned to the IIF and is noted in the TCS event log.
 - e. The reason the ResumeAO request failed is returned to the IIF and is written in the TCS event log.
 - f. A fail flag is returned to the IRC interface tool along with the reason the ResumeAO request failed.
 3. Measure the time for information about either a successful or unsuccessful ResumeAO request to be returned to the IRC interface tool.

Results/Comments:

1. Success:
2. Time: milliseconds

AI 47: Improve error message for failed resumeAO request

If star is lost during a pause, then return “Star not found, loop still paused” to IIF/IRC. Alfio Fixed

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 25
--	--	---	---------

4.2.10. OffsetXYAO

- **Initial State of AO System:**
 - “LoopSuspended” state
 - The AO system was in Closed AO Loop and then a PauseAO request was successfully executed
 - **Test case:** Request OffsetXYAO using the IRC interface tool.
 - **Input Parameters:** delta_x (mm), delta_y (mm), “left”
 - **Expected Result:**
 - The AO System is in a “LoopSuspended” state.
 - The Pyramid WFSC stages have been moved by the requested delta x and y distances from their previous positions.
 - The AO Loop can be Closed by a ResumeAO request.
1. Check that for a successful OffsetXYAO request:
 - a. The AO System is left in a “LoopSuspended” state.
 - b. The Pyramid WFSC stages have been moved by the requested delta x and y distances from their previous positions by:
 - i. Note the positions of the stages prior to the OffsetXYAO request:
 1. On the appropriate AO System Engineering GUI
 2. In an AO log
 3. In the TCS event log
 - ii. Note the new positions of the stages after the OffsetXYAO request (find this information in the same location as above in i).
 - c. The resulting state is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A success flag is returned to the IIF and is noted in the TCS event log.
 - e. A success flag is returned to the IRC interface tool.
 2. Check that for an unsuccessful OffsetXYAO request:
 - a. The AO System is left in a “LoopSuspended” state.
 - b. The resulting state information is displayed on the AOS GUI.
 - c. The reason the OffsetXYAO request failed is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A fail flag is returned to the IIF and is noted in the TCS event log.
 - e. The reason the OffsetXYAO request failed is returned to the IIF and is written in the TCS event log.
 - f. A fail flag is returned to the IRC interface tool along with the reason the OffsetXYAO request failed.
 3. Measure the time for information about either a successful or unsuccessful OffsetXYAO request to be returned to the IRC interface tool.

Results/Comments:

1. Success for small offsets <0.5”

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 26
--	--	---	---------

2. If loop is closed, an offsetxyao will move the stage in 0.3” steps, offload T/T to hexapod and step again.
3. If loop is paused then the entire offset is done all at once. This is offset currently available through the IIF.
4. Time: > 1 minute for 9” offset in closed loop. ~10 seconds for 9” offset in paused loop.

AI 48: Increase AOS timeout for offsetXYAO

AOS Timeout too short for both closed loop and paused loop offsets

AI LBTO 3: Removed: Change to Arcetri AI 75

4.2.11. OffsetZAO

- **Initial State of AO System:**
 - “LoopSuspended” state
 - The AO system was in Closed AO Loop and then a PauseAO request was successfully executed
 - **Test case:** Request OffsetZAO using the IRC interface tool.
 - **Input Parameters:** delta_z (mm), “left”
 - **Expected Result:**
 - The AO System is in a “LoopSuspended” state.
 - The Pyramid WFSC focus stage has been moved by the requested delta z distance from its previous position.
 - The AO Loop can be Closed by a ResumeAO request.
1. Check that for a successful OffsetZAO request:
 - a. The AO System is left in a “LoopSuspended” state.
 - b. The Pyramid WFSC focus stage has been moved by the requested delta z distance from its previous position by:
 - i. Noting the position of the focus stage prior to the OffsetZAO request:
 1. On the appropriate AO System Engineering GUI
 2. In an AO log
 3. In the TCS event log
 - ii. Note the new position of the focus stage after the OffsetZAO request (find this information in the same location as above in i).
 - c. The resulting state is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A success flag is returned to the IIF and is noted in the TCS event log.
 - e. A success flag is returned to the IRC interface tool.
 2. Check that for an unsuccessful OffsetZAO request:
 - a. The AO System is left in a “LoopSuspended” state.
 - b. The resulting state information is displayed on the AOS GUI.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 27
--	--	---	---------

- c. The reason the OffsetZAO request failed is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A fail flag is returned to the IIF and is noted in the TCS event log.
 - e. The reason the OffsetZAO request failed is returned to the IIF and is written in the TCS event log.
 - f. A fail flag is returned to the IRC interface tool along with the reason the OffsetZAO request failed.
3. Measure the time for information about either a successful or unsuccessful OffsetZAO request to be returned to the IRC interface tool.

Results/Comments:

1. Can offset in closed and paused loop state

AI LBTO 4: **Check expected argument units for offsetZAO**

AOS expect offset in mm from IIF. What are the units expected by IRC/IIF?

AI 49: **Apply curved focal plane stage Z-shift for W-unit**

Apply curved focal plane stage Z-shift for W-unit (like guider). Andrew has equation of delta Z as a function of R from on-axis.

4.2.12. RefineAO

- **Initial State of AO System:**
 - “SeeingLmtd” state
 - PresetAO and AcquireRefAO have already been successfully executed
 - **Test case:** Request RefineAO using the IRC interface tool.
 - **Input Parameters:** “left”
 - **Expected Result:**
 - The AO System is in a “SeeingLmtd” state.
 - The AO Closed Loop parameters should be optimized.
1. Check that for a successful RefineAO request:
 - a. The AO System is in a “SeeingLmtd” state.
 - b. The AO Closed Loop parameters should be optimized. This will be checked by noting that the loop parameters change from the default values.
 - c. The resulting state is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A success flag is returned to the IIF and is noted in the TCS event log.
 - e. A success flag is returned to the IRC interface tool.
 2. Check that for an unsuccessful RefineAO request:
 - a. The AO System is left in a “SeeingLmtd” state.
 - b. The resulting state information is displayed on the AOS GUI.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 28
--	--	---	---------

- c. The reason the RefineAO request failed is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A fail flag is returned to the IIF and is noted in the TCS event log.
 - e. The reason the RefineAO request failed is returned to the IIF and is written in the TCS event log.
 - f. A fail flag is returned to the IRC interface tool along with the reason the RefineAO request failed.
3. Measure the time for information about either a successful or unsuccessful RefineAO request to be returned to the IRC interface tool.

Results/Comments:

AI 50: **Implement RefineAO Command**

No plans to implement any time soon.

4.2.13. **CorrectModesAO**

- **Initial State of AO System:**
 - The AO system is in Closed AO Loop.
 - **Test case:** Request CorrectModesAO using the IRC interface tool.
 - **Input Parameters:** One Zernike mode amplitude (nm), “left”
 - **Expected Result:**
 - The AO System is in Closed AO Loop.
 - The requested static modes are applied to the Adaptive Secondary.
1. Check that for a successful PauseAO request:
 - a. The AO System is in Closed AO Loop.
 - b. The requested static modes are applied to the Adaptive Secondary. Check this by viewing the position graph on the Adaptive Secondary Engineering GUI to confirm that this mode, with the correct amplitude, has been statically applied to the shape of the secondary shell.
 - c. The resulting state is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A success flag is returned to the IIF and is noted in the TCS event log.
 - e. A success flag is returned to the IRC interface tool.
 2. Check that for an unsuccessful CorrectModesAO request:
 - a. The AO System is left in Closed AO Loop.
 - b. The resulting state information is displayed on the AOS GUI.
 - c. The reason the CorrectModesAO request failed is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A fail flag is returned to the IIF and is noted in the TCS event log.
 - e. The reason the CorrectModesAO request failed is returned to the IIF and is written in the TCS event log.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 29
--	--	---	---------

- f. A fail flag is returned to the IRC interface tool along with the reason the CorrectModesAO request failed.
3. Measure the time for information about either a successful or unsuccessful CorrectModesAO request to be returned to the IRC interface tool.

Results/Comments:

1. IIF and AOS command is available, but has not been implemented in wfs arbitrator. However, we received a command timeout from AOS

AI 51: Implement CorrectModesAO in WFS arbitrator

**This command will remain unavailable because the Telescope policy is that the instrument must correct any internal aberrations with a change in configuration. The observer will not send a slope null vector for any

AI 52: Increase timeout in AOS for CorrectModesAO

4.2.14. ModifyAO

- **Initial State of AO System:**
 - “SeeingLmtd” state
 - PresetAO and AcquireRefAO have already been successfully executed
 - **Test case:** Request RefineAO using the IRC interface tool.
 - **Input Parameters:** “left”
 - **Expected Result:**
 - The AO System is in a “SeeingLmtd” state.
 - The AO Closed Loop parameters should be optimized.
1. Check that for a successful RefineAO request:
 - a. The AO System is in a “SeeingLmtd” state.
 - b. The AO Loop parameters are set to the requested values. This will be checked by looking at the AOS GUI.
 - c. The resulting state is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A success flag is returned to the IIF and is noted in the TCS event log.
 - e. A success flag is returned to the IRC interface tool.
 2. Check that for an unsuccessful ModifyAO request:
 - a. The AO System is left in a “SeeingLmtd” state.
 - b. The resulting state information is displayed on the AOS GUI.
 - c. The reason the ModifyAO request failed is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A fail flag is returned to the IIF and is noted in the TCS event log.
 - e. The reason the ModifyAO request failed is returned to the IIF and is written in the TCS event log.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 30
--	--	---	---------

- f. A fail flag is returned to the IRC interface tool along with the reason the ModifyAO request failed.
3. Measure the time for information about either a successful or unsuccessful ModifyAO request to be returned to the IRC interface tool.

Results/Comments:

1. Wfs arbitrator receives the requested values
2. Tested and works to change
 - a. TT Modulation
 - b. Filter 1
 - c. Filter 2
 - d. Nbins
 - e. Frequency
3. Change nmodes is not allowed
4. This command is only allowed after a presetAO and before an acquireRefAO

AI 53: Fix the AOS GUI display of ModifyAO parameters

AOS GUI puts frequency in TT modulation box and filter 2 value is not displayed

AI 54: Fix conflict of auto-drift routine and ModifyAO request

Changing frame rate failed with “can not change decimation” error. Have to turn off anti-drift routine. Alfio Fixed this and we tested it. Confirm this is true.

AI 55: Change AO Command Document

Change the Argument label for irc ModifyAO from Itime to Freq in document 481f301 and make change request to LBTO to modify the IRC ModifyAO command to mirror this argument name change.

4.3. PresetTelescope: Test The AO Sequence

This test will string together all the AO commands that will be called by the IIF to put the AO System into Closed AO Loop when a PresetTelescope in ACTIVE mode is received. This sequence will be an script (IDL in this case) that will call each of the following AO commands serially:

1. StopAO
 2. PresetAO
 3. AcquireRefAO
 4. StartAO
- **Initial State of AO System:**
 - The AO system is in a “SeeingLmtd” state.
 - **Test case:** Request the “PresetTelescope: AO sequence” commands listed above using the IRC interface tool.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 31
--	--	---	---------

- **Input Parameters:** “left”
 - **Expected Result:**
 - The AO System is in Closed AO Loop.
1. Check that for a successful “PresetTelescope AO sequence” request:
 - a. The AO System is in a “LoopClosed” state.
 - b. The resulting state is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - c. A success flag is returned to the IIF and is noted in the TCS event log.
 - d. A success flag is returned to the IRC interface tool.
 2. Check that for an unsuccessful “PresetTelescope AO sequence” request:
 - a. The AO System is in the final state of the last successful individual AO command.
 - b. The resulting state information is displayed on the AOS GUI.
 - c. The reason that one of the individual “PresetTelescope AO sequence” requests failed is displayed on the AOS GUI and written to an AO log and the TCS event log.
 - d. A fail flag is returned to the IIF and is noted in the TCS event log.
 - e. The reason that one of the individual “PresetTelescope AO sequence” requests failed is returned to the IIF and is written in the TCS event log.
 - f. A fail flag is returned to the IRC interface tool along with the reason that one of the individual “PresetTelescope AO sequence” requests failed.
 3. Measure the time for information about either a successful or unsuccessful “PresetTelescope AO sequence” requests to be returned to the IRC interface tool.

Results/Comments:

Used Doug’s IDL script /home/tscnew/idl/wfsc/irc/irc_list.pro to Open and then Close the loop.

1. StopAO, PresetAO, AcquireRefAO, StartAO
 - a. 3’04” from StopAO to StartAO
 - b. 2’21” from StopAO to StartAO
 - c. 2’24” from StopAO to StartAO
2. Change ref mag to 11.5 to force bin=2 (from bin=1)
 - a. 3’10” from StopAO to StartAO
 - b. 2’37” from StopAO to StartAO
 - c. 2’34” from StopAO to StartAO

Verified that the current command requested from IRC interface is displayed on AOSGUI on Command window. Resulting state is correctly displayed on Main AOSGUI.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 32
--	--	---	---------

AI 56: Error not return to AOS when presetAO failed

A presetao failed with timeout waiting for ccd39, but AOS returned OK for status and returned error message. My IDL routines thought there was no error and continued. Should return Error.

AI 57: Send better error message when acquireRefAO fails

When acquirerefao failed due to failed closed loop with low order correction to determine best parameters the returned error message to the IRC was “Illegal command for state Failure (TTOffload)” The actual error was closing the loop, but the TTOffload did not know the acquirerefao had failed and had sent an offload request. Acquirerefao error should be captured and the proper error message sent to the IRC.

AI 58: Determine cause of Mode=1.0E10 error

Check Adsec Log for Mode=1.0E10 at 10:40 am. This caused an error in a recover fail at 5:00 pm. Seems that this problem is not caused by the mirror, but related to the fast diagnostic.

AI 59: Parallelize the acquisition of darks on CCD39 and CCD47

Parallelize the acquisition of darks on CCD39 and CCD47 to save ~ 30 seconds in presetAO request.

4.4. Telemetry

Verify that AOS is able to write data to Telemetry according to [RD2]. The provided data extraction tool, telexporter, can generate a human-readable file containing all of the data in table format. This data file should be created as part of the test.

4.4.1. AOS Connection, Communication and Disconnect.

- **Initial State of AO System:** AOS is not running
 - **Test case:** Start the AOS to invoke a connection the Telemetry, send data to Telemetry and shutdown the AOS to cause the connection to Telemetry to close.
 - **Input Parameters:** None
 - **Expected Result:**
 - The AOS will properly connect to Telemetry, without errors.
 - AOS data will be sent and accepted by Telemetry without error.
 - AOS will disconnect from Telemetry, without errors, when the AOS is shutdown.
1. Check an appropriate AO log and the TCS event log that the AOS connects to, writes to and disconnects from Telemetry, without errors
 2. On startup, AOS connect to telemetry with no errors. Write to TCS event log

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 33
--	--	---	---------

3. On shutdown, AOS disconnect from telemetry with no errors. Write to TCS event log
4. Do not write event when write to telemetry

Results/Comments:

1. AOS connects and disconnects from Telemetry with no error.
2. A new database block appears
3. Not able to read telemetry at Arcetri, telexporter not functioning

4.4.2. AOS Data Integrity

- **Initial State of AO System:** Test 4.4.1 must have been successful.
 - **Test case:** Use the telexporter tool to check the integrity of the AOS data in the Telemetry database
 - **Input Parameters:** None
 - **Expected Result:** The data written to Telemetry by the AOS will correct and can be extracted with the telexporter tool.
1. Inspect the list of sample streams in telexporter. There should a sample stream resulting from the test. It should identify the telemetry system to be "adsc" and the subsystem to be "sx.
 2. Using telexporter, export the sample stream and inspect the data file.
 - a. There should be one column for each data item described in the specification
 - b. The first column contains the sample times. These times should all be during the time of testing. If the data is collected periodically, the difference between two subsequent times should be approximately the sample period.

Results/Comments:

1. Not able to read telemetry at Arcetri, telexporter not functioning

AI LBTO 5: Check AO values in Telemetry at the LBT

4.4.3. AOS Loss of Connection

- **Initial State of AO System:** AOS is running and connected to Telemetry.
- **Test case:** Stop Telemetry.
- **Input Parameters:** None
- **Expected Result:**

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 34
--	--	---	---------

- The AOS will sense Telemetry has stop and properly close its connections, without errors.
1. Check an appropriate AO log and the TCS event log that the AOS closes the old Telemetry connection, without errors.

Results/Comments:

5. Error handling

5.1. Operator error

- **Test case:** Request an individual AO command via the IRC interface tool when the AO System in not the appropriate state.
 - **AOS GUI Input Parameters:** Those appropriate for the command
 - **Expected Result:** The AO System should return an error with a description of why the request failed (eg command not allowed), plus write this information in the AO log and in the TCS event log.
1. While AO System is in a “SeeingLmtd” state, request:
 - a. CheckRefAO
 - b. AcquireRefAO
 - c. StartAO
 - d. PauseAO
 - e. ResumeAO
 - f. OffsetXYAO
 - g. OffsetZAO
 2. While AO System is in a “ReadyToAcquire” state, request:
 - a. StartAO
 - b. PauseAO
 - c. ResumeAO
 - d. OffsetXYAO
 - e. OffsetZAO
 3. While AO System is in a “RefAcquired” state, request:
 - a. PauseAO
 - b. ResumeAO
 - c. OffsetXYAO
 - d. OffsetZAO
 4. While AO System is in a “LoopClosed” state, request:
 - a. PresetFlatAO
 - b. PresetAO
 - c. CheckRefAO
 - d. AcquireRefAO

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 35
--	--	---	---------

- e. StartAO
- f. ResumeAO
- g. ModifyAO

Result/Comments:

1. Not able to test IRC argument error because running old version at Arcetri.

AI LBTO 6: Check IRC parameter check works with current IRC version

5.2. Parameter checking

AOS GUI Interface and IRC Interface Tool

- **Test case:** Request an individual AO command using the IRC interface tool with parameter errors
 - **Input Parameters:** Those appropriate for the command
 - **Expected Result:** The AO System should return an error with a description of why the request failed (eg parameter error, which parameter and why), plus write this information in the AO log and in the TCS event log.
1. Send several individual AO commands from the IRC Interface Tool with
 - a. Incorrect number of parameters
 - b. Incorrect type of parameter (eg send string in place of an integer)
 - c. Parameter out of range (eg nbins = 10)

Result/Comments:

1. WFS spec “string” is compared to available focal stations. If no match, then return an error.
2. Not able to test IRC argument error because running old version at Arcetri.

AI 60: Add parameter checking to AOS Command GUI

All strings in number fields in AOS Command GUI are converted to 0 or 0.0. Should return argument error.

5.3. Network failure recovery

- **Test case:** Verify the behavior, detection and recovery of loss of network connection between AO System components by unplugging network cables or fiber optic cables.
- **Expected Result:** The AO System should write error information in the AO log and in the TCS event log with description of the error and displayed on the AOS GUI.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 36
--	--	---	---------

1. Unplug network connections between:
 - a. The AO Supervisor computer and the AOS computer
 - b. The AO Supervisor computer and the W-Unit
 - c. The W-Unit BCU and the WFSC switch BCU, while in closed loop
2. Each test should be performed with the following communication loss times:
 - a. 5 seconds
 - b. 30 seconds
 - c. 5 minutes
3. Note the system's behavior and the procedure needed to re-establish connection after the network communication has resumed.
4. Information about loss of communication should be reported by the AOS Gui and is logged properly.
5. The time required for the AO system to become aware of a loss of communication between components should be noted (ie in almost all cases timeouts for communication should be a few seconds rather than a few minutes).

Result/Comments:

1. At ~9:50 am on Tuesday, May 10, the Arcetri network became very slow. This resulted in not being able to move the camera lens during the acquirerefao procedure. A loop trying to move the lens continued trying for 5+ minutes with no timeout. Then communication to all GUI's and process slowed to almost zero.

“LoopClosed”

2. Killed AOSL
 - a. Loop continue running
 - b. Start AOSL
 - i. Loop still running
 - ii. Offloading resume
3. Unplug adsecsx network cable
 - a. 5 second
 - i. AOS GUI display “No Connection”All GUI's reconnect
 - ii. AOS GUI not resume displaying TV
 - b. 30 seconds
 - i. Same as above
 - ii. All but AOS display of TV resume
4. Unplug wfssx network cable
 - a. 5 seconds
 - i. Loop Continue
 - ii. Resume proper display, Loop Continue
5. Unplug tcstest from network
 - a. 5 seconds
 - i. Loop Continue running
 - ii. AOS GUI show “No Connection”

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 37
--	--	---	---------

- iii. AOS GUI show “Connection” when connection resumed
 - b. 1 minute
 - i. Same as above
- 6. Unplug fast diagnostic Ethernet between adsecsx and wfssx
 - a. 5 seconds
 - i. CCD339 display stop
 - ii. Green “Live” to Red “Not Live”
 - iii. Display resume properly when reconnected
 - b. 30 second
 - i. Same as above, no problems
- 7. Unplug W-Unit network cable
 - a. 5 seconds
 - i. Loop Remain Closed
 - ii. Reconnect cable
 - 1. Filter wheel home
 - 2. Cause bad slope to AdSec
 - 3. Adsec Ripped
 - 4. Slopes continue from W-Unit to Adsec
 - 5. No StopAO was sent to W-Unit when AdSec Ripped because AO Arbitrator did not re-sync on one of the earlier tests
 - b. 5 seconds (a second time)
 - i. Loop Remain Closed
 - ii. Reconnect cable
 - 1. Filter wheel home
 - 2. Connection loss to Slope BCU detected, StopAO sent
 - 3. Loop opened
 - 4. Cable reconnected, and filter re-home.
 - iii. Loop closed again, but slope sent are NAN. See AI below for description.

AI 61: AO Arbitrator did not re-sync after network loss test

In one of the above network unplug tests, the AO Arbitrator did not re-sync. In the unplug W-Unit test, when the filter wheel rehome and bad slopes sent to AdSec and Rip occurred, the AO Arbitrator did not send the StopAO to the WFS (triggered by the AdSec).

AI 62: Shell Ripped on network loss test, should have remained Flat

AdSec should not have Ripped in the W-Unit cable test, but receive a StopAO, and reflattened. Marco check the logs

AI 63: NAN slopes sent from WFS after reconnect to Slope BCU

After 5 second W-Unit network test where the lost connection to the Slope BCU was detected and a StopAO sent, the following Preset, Acquire, Start AO did not work properly. The system said it was in closed loop and slopes were being sent

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 38
--	--	---	---------

from the W-Unit, but the AdSec was not moving (no corrections). Found that the slopes were all NAN. Something did not get reset properly in the slope computer (maybe?). Reset Slope BCU. Now slopes are not NAN. Try closed loop again. OK now. Alfio must look at what happens when reconnection to Slope BCU occurs.

5.4. Process failure

- **Test case:** Verify the behavior, detection of and recovery from the death of an AO process.
 - **Expected Result:** The AO System should write error information in the AO log for the case of AO Supervisor processes. For the death of the AOS, information should be written in the TCS even and the AOS GUI background turn red.
1. Kill an AO process, such as the message daemon, Adsec supervisor, WFSC supervisor, AO Supervisor, etc and check that:
 - d. Information about the lost process is written to the AO log
 - e. The AO Startup GUI displays the death of the process
 - f. Note the procedure and time required to get the AO system operational.
 2. Kill the AOS and check:
 - d. Information about the death of the AO is written in the TCS event log
 - e. The AOS GUI changes its background color to red to indicate the AOS is not running.
 - f. Note the procedure and time required to get the AOS running and the AO System operational.

Result/Comments:

“OpenClosed”

1. Kill filter wheel process
 - a. Green bar turns to Red on AOS GUI
 - b. Send PresetAO
 - i. Received timeout error
 - ii. No information at AOS GUI about what system it was waiting for
2. Turn off baysidex moter
 - a. Error description returned to IRC
3. Turn off Slope Computer control
 - a. Error description returned to IRC
4. Unplug fiber from WFS Slope BCU to thenAdsec
 - a. Disconnect not detected, though test loop had been closed and returned OK to IRC for acquireRefAO

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 39
--	--	---	---------

AI 64: Low Level AO System Errors in TCS Event Log

Make low level errors that arrive to TCS event log and IRC interface are clear what system to check

AI 65: Error homing WFS XYZ stages

Error homing xyz stages when a second “On” command sent to WFS. The stages were already homed and ready for operation even though an error was returned.

“LoopClosed”

1. Netconfig stop AOSL
 - a. Loop continue to run
2. Netconfig Start AOSL
 - a. Loop continue to run
 - b. AOS GUI display correct information

5.5. Maximum force exceeded

- **Test case:** Verify the behavior, detection and recovery when one or more of the Adaptive Secondary actuators exerts more than the maximum allowed force.
- **Expected Results:** The AO loop will open, the Adaptive Secondary shell will be placed in a safe configuration and a quick restart of closed loop operation can be performed easily.
 1. While in a “LoopClosed” state, cause one or more actuator to exhibit higher than the maximum allowed force. (This could possibly be achieved by moving the WFS stage in Z causing a large focus to be bent into the shell)
 2. The AO System should open the loop and leave the shell in a safe position
 3. The AOSGUI should change to show the new state of the AO System (“SeeingLmtd”).
 4. Error information should be displayed on the AOSGUI to inform the user of reason the loop opened
 5. Error information should be written to the AO log and to the TCS event log
 6. Detailed information about which actuators caused the error, what the values of the forces and the full state of the AO system when the high forces occurred so post processing can occur to understand the cause of the error.
 7. Note the procedure to resume AO closed loop and the time required to get the AO loop closed again.

Result/Comments:

AI 66: Display SkipFrame Percentage on AOS GUI and “Warning”

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 40
--	--	---	---------

5.6. Lost guide star

- **Test case:** Verify the behavior, during closed loop, of the loss of reference star (cloud conditions).
- **Expected Result:** The AO system should remain in closed loop but automatically refrain from sending corrections to the Adaptive Secondary.
 1. While the AO System is in a “LoopClosed” state, remove the reference star by gradually lowering its brightness until no light is entering the WFS
 2. Note the behavior (goodness) of the AO correction as the reference star gets dimmer.
 3. For no reference star, the AO system should remain in closed loop but automatically refrain from sending corrections to the Adaptive Secondary when there is no longer enough light on the WFS to determine a valid correction.
 4. The offloading of modes from the Adaptive Secondary shell should automatically stop while no corrections are being sent to the secondary.
 5. If the light level increases to a level to where a valid correction can be determined, these corrections should be sent to the Adaptive secondary.
 6. Display on the AOS GUI when no corrections are being sent to the Adaptive Secondary because of the loss of reference star.
 7. Write a flag at a set interval (1 Hz?) into the AO log and into the TCS event log to indicate that corrections are not being sent to the Adaptive Secondary.

Result/Comments:

LoopClosed, 400 modes, turbulence (0.8” seeing), bin=1, 1kHz

1. 8.5man 250 ph/sub
2. 9.5 88 ph/sub Ok
3. 10.6 30 ph/sub skipframe then system open the loop

LoopClosed, 66 modes, turbulence (0.8” seeing), bin=3, 200 Hz

4. 14.8 mag 32 ph/sub
5. 15.5 18 ph/sub OK
6. 16.1 8 ph/sub skipframe then system open the loop

LoopClosed, 36 modes, turbulence (0.8” seeing), bin=4, 200 Hz

7. 15.6 man 39 ph/sub
8. 16.3 mag 16 ph/sub OK
9. 16.9 mag 9 ph/sub OK
10. 17.0 7 ph/sub RIP

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 41
--	--	---	---------

AI 67: AOS GUI does not display WFS “On” after WFS Arbitrator restart

WFS displayed as off on AOS GUI after Alfio restarted WFS arbitrator. WFS arbitrator is not updating the Power On variable correctly.

AI 68: Incorrect AO Status on AOS GUI after loop opened for skipframe max

When skipframe max was reached and AOSTop sent to WFS and AdSec, the AOS GUI still displayed “Loop Closed”

AI 69: AdSec Ripped for lost star in bin=4 mode

For bin=4, when the lamp was turned down (clouds), the AdSec ripped rather than just catch the skipframes and Stop. Marco will look at logs May 11, 14:40:40

6. GUI's

6.1. GUI inspection

6.1.1. AOS GUI

Test case: Inspect AOS GUI for completeness and logical structure. Verify compliance with [RD1], [RD3] and [RD4].

1. Check information on the display are correct and updated
2. TV realtime and acquisition images update
3. Counts and Quality graphs update
4. Make GUI smaller by removing some empty space and using smaller fonts for some display values
5. Added popup boxes to confirm requested button click for Adsec On/Off/Set/Rest and for WFS On/Off to make sure an accidental button click does on change the current required settings
6. Add scroll bar to “Messages” display box

Result/Comments:

1. Many tests, comments and AI for the AOS GUI listed above while making other tests

6.1.2. AdSec Arbitrator GUI

Test case: Inspect AdSec Arbitrator GUI for completeness and logical structure.

1. Define names and color codes for Mirror Status Display (ie Shell status, TSS status and Adsec power status).

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 42
--	--	---	---------

2. Two up arrows on Arbitrator Log scroll bar
3. Add scroll bar for left/right so can move to see long log entries
4. Is there a display of non-common path aberrations (or at least a file name of the currently applied aberrations for the authorized instrument)
5. Is it possible to add individual aberrations to the closed loop shape of the Adaptive Secondary? This may be needed to determine non-common path aberrations.
6. Make GUI shorter if possible (so it fits on my laptop screen, for remote debugging)

Result/Comments:

6.1.3. WFS Arbitrator GUI

Test case: Inspect WFS Arbitrator GUI for completeness and logical structure.

Result/Comments:

6.2. Event and Error display to operator

- **Test case:** Verify that Events and Exceptions are adequately displayed to operator. Those shall also be sent to TCS event log, syslog (i.e., TCS.log), and other similar logs as appropriate for the software executable.
1. Information messages, warning messages and error messages should be displayed on the AOS GUI with the prescribed LBTO color scheme (green, yellow and red respectively).
 2. Errors/Events recorded in the Event Log should include the telescope side (none, left, right, both), as well as a severity (1-5, where 1 = Failed, 2 = Warning and 5 = OK) code. In this way, the events can be displayed on the AOSGUI (and the LSSGUI which is displaying events from all subsystems) in a manner (i.e., color) which reflects the event severity, and the side needs to be clearly indicated.

Result/Comments:

AI 70: Determine performance parameter in Graph on AOS GUI

Discussion between LBT and Arcetri people it was decided that the RMS residuals measured by the Pyramid will be used as the relative "Performance Metric". The graph will use the initial value of this metric to set the scale of the graph. As the closed loop continues and the metric changes, the graph is allowed to autoscale in only one direction (eg if the metric becomes smaller, the low limit of the graph is decrease so the original level of the metric is all ways on the graph). This is the same behavior as the WFC Counts -vs- Time. This graph should be cleared and recreated for a new preset.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 43
--	--	---	---------

AI 71: **AOS GUI Graph Vectors into Telemetry**

Put Counts/sub –vs- time and Perf. Para –vs- time into telemetry stream

CCD47 and CCD39 are mount on their sides. Thus Engineering Gui CCD47 Move stage +Y then star move up. Move +X then moves right on the display.

Re-Rotator setting is 173.1

CCD37 Move +Y Down and left a bit. +X Right and down a bit. The bit is about 30 degrees.

7. Configuration

7.1. Computer inventory

Test case: Inspect computers used for system operation during acceptance test. Note type and form factor.¹

Result/Comments:

Adsecdx and wfscx machines were purchased by LBTO and currently in Tucson. Sx versions are on order. See LBTO AI in section 8.

1. Spare switch for clean room?
2. 32 bit OS still used. Some conversion to 64 bit tests completed.
3. Where is the Cisco switch for AdSec cabinet? It will be installed in cabinet at Mt Graham

7.2. Version check

Test case: Note version number for all SW modules used during test.

Result/Comments:

TCS version from SVN:

AOSGUI: AOS Version=, AOS GUI Version= (From AOS GUI: Help)

¹ The LBT SW group is buying 4 computers (2 now for AO #1 and 2 later for AO #2). The 2 for a given side will be used for the WFS and Arbitrator, and the other for the AdSec. Thus what will be used in Arcetri for acceptance testing is not these computers therefore things will change once the software is migrated to Tucson. A good test would be to demonstrate the installation and migration of all Arcetri software onto different computers and then to exercise the acceptance test sequence as this will have to be done immediately once everything arrives in Tucson.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 44
--	--	---	---------

Luca will merge new AOS 8.? into TCS truck on 29 May this will be used with BP11 in June.

7.3. Network configuration

Test case: Examine network configuration used during test. Note network equipment and connection types.²

Result/Comments:

Solar Tower Configuration:

LBTO Configuration:

485f004d: LBT AO System Topology currently in CAN

Network layout in Solar tower will be the same at Mt Graham. May have some changes in IP addresses.

7.4. IP configuration

Test case: Examine IP configuration used during test.

Result/Comments:

AO System has been assigned, by LBTO, the IP numbers: 192.168.12.1 through 192.168.15.254. LBTO has reserved use of numbers 1 through 9 for all address.

7.5. Configuration control 1

Test case: Verify that software and firmware is under configuration control for AOS, WFS SW, AdSec, BCU code and WFS low-level SW.

Result/Comments:

Arcetri will continue to use their SVN repository as the master repository and the LBTO SVN repository of AO software will be the slave (ie updated from Arcetri repository as needed).

MicroGate software and firmware will come from MicroGate rather than Arcetri.

² The test assumes the new Cisco switch for AO unit #1 is installed in the AdSec rack. Another switch (the original D-link) is currently being used and is connected to the Cisco for AO unit #1. This D-link switch is functionally acting as the equivalent to the LBTO Cisco 4506. The second switch for unit #2 is in Arcetri but it is not needed for the tests for AO unit #1.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 45
--	--	---	---------

AI New sx machine AO software will be checked out from Arcetri SVN for Unit #2. Once the new machines are fully operational, then a snapshot is moved from Arcetri to Tucson.

Continuing development on the mountain, for some amount of time (through Fall 2011) will be committed to Arcetri SVN repository.

7.6. Configuration control 2

Test case: Verify (by test) the ability to rollback to a prior version of the software. Note required procedures and steps to roll back AOS, WFS, AdSec software. Low level FW is not part of test.

Result/Comments:

Snapshots of Arcetri SVN will be placed in LBTO SVN when major milestones are achieved.

8. Additional Action Items

These action items were added after version (a) of this document was sent out. Thus, to keep the AI numbering the same, these new Action Items are inserted here at the end of the document.

AI LBTO 7: **Doug determine algorithm to set Compass on AOS GUI**

AI 72: **Return information to IIF about what system timeout was from**

Had turn off filter wheel 1 and only received timeout error. Alfio added the motor name to the return string. Tested for fw1

AI 73: **Make timeout in AOS for presetAO longer**

Had turned off BaysideX stage and timeout in AOS was shorter than in WFS Arbitrator so the AOS timed out before the motor timeout. Thus, no information about the real problem was returned to the IIF/IRC.

AI 74: **Disconnect of fiber from WFS Slope BCU to the AdSec now detected**

Disconnect of fiber from WFS Slope BCU to the AdSec now detected (may not be reliable) and error returned to WFS arbitrator, but didn't send stop to the acquireRefAO thread. This thread had an error and this was passed back to the IIF/IRC.

	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 46
--	--	---	---------

AI LBTO 8: Make a list of data the AOS should send to Telemetry

AO Anemometer telemetry stream: four wind values (x, y, z, magnitude) for 1, 10 and 60 second average. The rate will be 1 Hz for all data because the running averages for all the increments will be changing each second.

AI 75: Convert offsetXYAO arguments from arcsec to mm

Units for OffsetXYAO in IRC is arcsec, but AO System expect mm. Currently no conversion to mm is done. The AO System will perform this conversion by calling a PCS routine.

AI 76: Status of Adaptive Secondary Mirror Telemetry, A. Riccardi, Document

In the Reference Document list [RD2] nnnfnnn Adaptive Secondary Mirror Telemetry, A. Riccardi status is unknown. Does this describe data going to AdSec Telemetry, or the the LBT TCS Telemetry subsystem?

AI LBTO 9: Doug check with Norm the status of mountain sx computers

The SX computers can be installed in Control Room even for Clean Room testing. Still using 32 bit OS.

AI LBTO 10: Will there be a spare AO switch with fiber inputs for Clean Room

AI LBTO 11: Check the status of the Cisco switch for AdSec SX

Where is the Cisco switch for AdSec SX cabinet? It will be installed in cabinet at Mt Graham.

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	LBT Adaptive Optics System Acceptance Test Unit #2 Software test plan	Doc.No : 640s013 Issue : b Date : 13-May-2011	Page 47
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Doc_info_start

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