DX-LGSW acceptance test report

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Name Date

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Change Record

Issue	Date	Section/ Paragraph Affected	Reasons / Remarks	Name
0.1	14.01.2014	all	created	Busoni
0.2	15.01.2014	Compliance matrix		LB, SE
0.3	15.01.2014	Compliance matrix	typos	LB, SE
1.0	20.01.2014	Top-Level Req. / all		LB
	29.01.2014	Executive Summary, Operation with Engineering SW, Action Items added		JB, DS, GR
2.0	07.02.2014	All	Revision	LB
2.1	17.02.2014		CAN numbered, minor	JB

1 Scope

This technical note reports about DX-LGSW acceptance test. It presents the tests demonstrating that the DX-LGSW unit fulfills the top-level requirements and a number of additional tests demostrating that operability and reliability of the system.

2 Applicable documents

No.	Title	Number & Issue
AD 1	ARGOS_FDR_003 “Top Level Requirements”	1.0 - 09/02/2010
AD 2	TechNote 120 “DX-LGSW integration report”	2.0 - 30/01/2014
AD 3	ARGOS_PDR_005 “System Design”	1.0 29/05/2009
AD 4	ARGOS_FDR_015b “Wavefront sensor design”	3.0

3 Executive summary

On January 28-30 of 2014 the ARGOS DX LGS wavefront sensor was examined for readiness for shipment to the LBT Observatory. The testing was done in Arcetri as a joint effort between the ARGOS team and the LBTO. The test followed the standard procedure for LBT Lab Acceptance Testing (LAT). Performance was verified by the ARGOS team in advance of the test, see results in [AD2] and re-verified during the LAT, see sections 6-9 of this document. Interfaces were verified, and results are presented in section 5. Software functionality and operability is discussed in section 11, and the compliance matrix is presented in section 15.

It shall be noted that this test is for the DX WFS only, and that the SX WFS will be tested separately at a later point in time. In addition, the Tip-Tilt sensor system, while nominally part of the WFS and required for ARGOS closed loop operation, was not yet available and that subsystem was de-scoped from this test. It will be further developed and should be treated as a separate subsystem.

In general, the DX WFS unit and control electronics was found to be complete, well integrated, and its performance was found to be excellent. While most interfaces are internal to ARGOS, no significant interfacing problems were noted.

On the software side, Engineering interfaces were made available for the test and used for operation of the WFS during the test and performance measurements. The next levels of software (AARB and AOS) are not yet available and were not considered to be within the scope of this test. Some parts of the WFS software is not yet available (see detailed discussion in section 11).

In summary, the formal outcome of the review is that the DX WFS opto-mechanics and electronics is Passed With Action Items, see section 14.
On the software side, while well advanced, and with the provided Engineering GUI's providing an excellent user interface, some parts are still in development and the conclusion is that the WFS software status shall be re-assessed within the context of the SX WFS.

4 Top-Level requirements verification

verify the performances and characteristic of the DX-LGSW against top-level requirements specified in AD1.

ID	Description	Requirement	Value	Remark	C/NC
TLR-6	Operation Zenith distance	0-60°			C
TLR-7	Mainteinance allowable Zenith distance	0-90°			C
TLR-8	Operation temperature range	-15 to 25 °C	See AD2 – Sect 24		C
TLR-21	Operation current	120V 60Hz			C
TLR-23	System cooling water temp.	6± 2°C		And regulated water	C
TLR-25	System surface temperatures above/below ambient	<1°C	See Sect 5.6		C
TLR-31	DM	LBT ASM			
TLR-32	Number of corrected modes	150		15x15 subaps	C
TLR-33	AO update rate	1000 Hz	1kHz		C
TLR-35	LGS photons/msec/subap	>300			C
TLR-42	Constellation radius	2 arcmin			C
TLR-45	Gated Laser beacon height	12± 1 km			C
TLR-46	Laser wavelenght	532nm	532nm	Coating optimized	C
TLR-80	Number of simultaneous detected LGS's	3	3		C
TLR-81	Spatial resolution projected on primary	0.56 m	0.56		C
TLR-82	Temporal resolution	1 ms		1kHz	C
TLR-83	Measurement accuracy	50 nm	43nm		C
TLR-84	Accepted LGS spot FWHM	0.5-2.5"			C
TLR-85	WFS system transmission at 532nm	>75%			
TLR-86	Optical shutter frequency	10kHz	10kHz		C
TLR-87	Optical shutter rise/fall time	10 ns			C
TLR-88	Optical shutter open tim	1-2 us	0.1-2.5 us		C
TLR-89	Optical shutter trigger jitter	9ns			C
TLR-96	Patrol Cameras	Provide patrol cameras for the LGS on sky position outside the WFS field			C

		stop			
TLR-97	Patrol Camera FoV	1 arcmin			
TLR-98	Jitter compensation	Provide a fast LGS jitter compensation			C
TLR-99	WFS total mass (2 units)	<1000 kg	480kg		C
TLR-101	WFS electronic racks total mass	<500 kg	500kg	By design	C
TLR-149	The operational states can be changed remotely		Ok		C
TLR-150	Timescale OFF-STANDBY	<1h	30min		C
TLR-151	Timescale STANDBY-ONLINE	<10min	<3min		C
TLR-152	Timescale SHUTDOWN	<30min			C

5 Interfaces verification

5.1 Envelope and mechanical interfaces

5.2 WFS unit

The envelope of the unit has been verified on 18/01/2014.
The mechanical parts differs from the CAD drawings by <1mm. The test is more interesting if we consider the volume occupied by cabling and pipes that have not been completely modeled in the CAD model.
Figure 1 show the area occupied by cables. It exceeds the table's profile (that corresponds to the allocated volume) by 20mm behind the WFS camera.

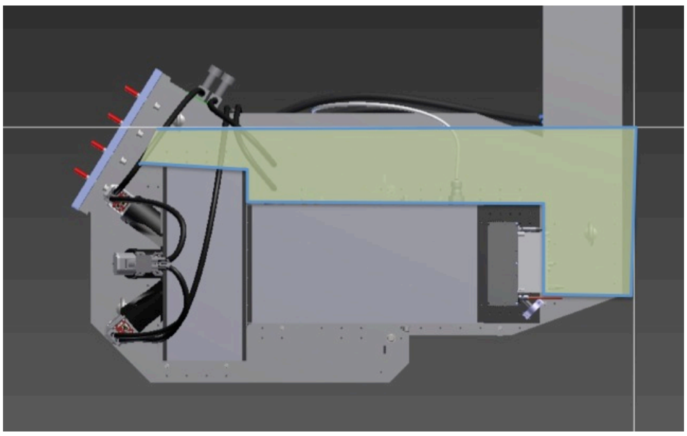

Figure 1 Area occupied by cabling and pipes. It exceeds the table profile by 20mm

Remarks:
AIs: *add if required*

5.3 Weight

The DX-LGSW unit mass is 95kg.
The DX WFS table mass is 125kg
Cables and cooling circuit (estimated) <20 kg.
The DX-Rack mass is 250kg (from model).

Remarks: *None*
AIs: *Provide measured weight for the as-built units.*

5.4 Cooling

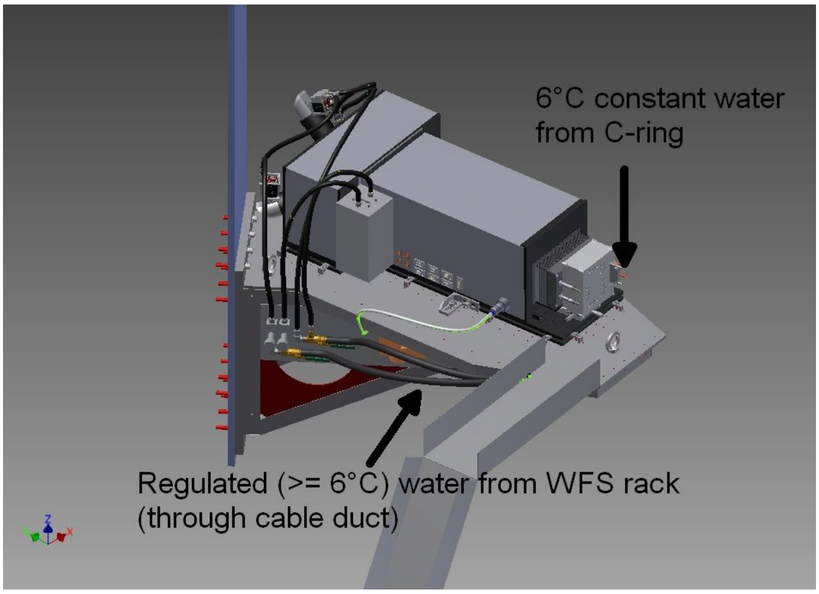

Figure 2 Scheme of cooling lines

A manifold that distributes the coolant to Pockels Cells Driver and Patrol Cameras is installed on the WFS bench. The interface is internal to ARGOS, as it derives the coolant from the Laser Supply Rack.
The WFS camera has an independent line already installed on the C-RING extension.

Remarks: *During the test, the unit was supplied constant temperature coolant 14.8C in / 15.6C out with an ambient temperature of 20C. This is not representative of the telescope environment where the coolant temperature will track ambient temperature. No hot spots were identified on exterrnal surfaces.*
AIs: *None*

5.5 Cooling system leak check / pressure test

10 bar test is on-going.

Remarks: *add if required*
AIs: *Complete presuure test at 10 bars.*

5.6 Surface temperatures

See DX-LGSW integration report (AD2 - Appendix B) for a complete description. Some tests have been repeated in the context of the acceptance test.

Remarks: *All external surfaces are well within +/-1 degree from ambient.*
AIs: *None*

5.7 Electrical power supply

The electronic rack is powered at 110VAC/60Hz line by the laser suply rack. The interface is internal to ARGOS.
Power consumption is 1000W (by-design).

The only difference with the telescope final configuration is the use in OAA of an external ethernet switch in place of the ARGOS's one that is already installed in the Laser cabinet at LBT. The ethernet switch is powered by the 220V line.

Remarks: *Power supply from the ARGOS central rack.*
AIs: *None*

5.8 Cabling

5.8.1 Laser – LGSW Rack Duct

Cable duct between LGSW rack and Laser Supply rack contains:

- 13 ethernet cables,
- 110V power coord
- FastLink fibers
- Optical fibers from TipTilt unit

AIs: *Provide 3D-model of cable duct to LBTO for review.*

5.8.2 Labeling

All cables are labeled according to ARGOS convention. To avoid mixing-up, connectors are color coded. To improve robustness and to help the arrangement, thinner cables are grouped together and protected in PVC conduits, also labeled.

Remarks: *Some cables/connectors in the WFS rack need to be labeled*
AIs: *Add missing labels to cables/connectors.*

5.9 Dry air line

The dry air line supplied by the telescope through a pressure regulator on the C-Ring. A small needle valve reduces the air flow to a very low level.

Remarks: *None*
AIs: *None*

5.10 Network

The LGSW ethernet devices will be connected to the switch already present in the laser supply platform. The dx-lgsw workstation and all the ethernet devices are configured (IP addresses and network routing) for the use at the telescope.

Remarks: *Network connectivity os provided from the ARGOS main switch in the laser rack.*
AIs: *None*

5.11 General inspection of the LGSW unit

The system was inspected for completeness and workmanship.

Remarks:
AIs: *Vibrations from the electronics rack should be mitigated. The Thor unit should be covered by an enclosure for thermal sheilding, LED lights, and mechanical protection. A model of the cable duct between rack and WFS unit shall be provided to LBTO for review.*

Note 02 Feb (LB): *The THOR unit doesn't need to sits on the WFS table. It will be relocated inside the electronic rack. New sensors cables (6m-long) have been ordered. Thanks to LBTO reviewers to spot this out.*

6 Cold test

See Appendix B of DX-LGSW integration report [AD2] for details.

Remarks: *add if required*
AIs: *add if required*

7 Gravity test

See Appendix A of DX-LGSW integration report [AD2] for details.
The stability of the pupil position and pointing for a full 0-90° rotation is <0.2 subap and <0.25" that are acceptable and can be fully compensated by the internal loops dedicated to that purpose (pupil-stabilization and jitter-compensation).

Remarks: *None.*
AIs: *None.*

8 Functionality

All the devices of the LGSW are fully functional and meet their specification. See the DX-LGSW integration report for a detailed description of all the devices.

8.1 WFSCamera

The following functionality of the WFSCamera is tested:

- cool down the CCD to the working temperature (-20°C) and warm up
- power on and off the CCD
- start and stop the read-out
- send pixels to the analog input of the BCU in the proper format.

The camera cooling down takes about 30 minutes.

Remarks: *Described functionality checked.*
AIs: *None.*

8.2 BCU

The following functionalities of the BCU are tested:

- frame grabbing
- slope computation
- telemetry
- real-time fastlink communication

8.2.1 Frame grabbing

The BCU can acquire and process frames received from the WFSCamera. Dark frame correction and common mode correction can be configured and the frame is processed accordingly to the configuration. See AD2 – Sect 10 for details.

8.2.2 Slope computation

The BCU computes the slopes accordingly to the requirements. See AD2 – Sect 6.7 for details.

8.2.3 Loop telemetry

The BCU transmits a stream of telemetry data about the AO loop to the LGSW workstation. See AD2 – Sect 20 for details.

8.2.4 Real-time communication

The BCU real-time communication is not working at the moment of the review. See AD2 – Sect 8 for details.

Remarks:
Available functionality (frame grabbing, slope computation and loop telemetry) demonstrated.
Real-time fastlink communication problem has been fixed by Microgate. This needs to be implemented in the ARGOS BCUs.
BCU failed to initialize after a full power-off. Rebooting required. This is a known "feature" of the BCUs.

AIs: *Implement fix to real-time fastlink communication.*

8.3 Pockels cells

The following functionality of the Pockels cells is tested:

- modify the open shutter time (corresponds to adjusting the gating range)
- modify the delay (corresponds to adjusting the gating height)

Remarks:
Not tested. Refer to AD2 (section 7 – "Gating Units").
The Delay Generator has been used only in Master Mode in the lab. It should be tested in Slave Mode (i.e. with an external trigger).
AIs: *Test functionality of external trigger for Delay Generator.*

8.4 Piezo mirrors

Remarks: *Tested as part of jitter stabilization loop demonstration, but without external perturbances. Refer to AD2 (section 13 – "Jitter Stabilization").*
AIs: *None.*

8.5 Pupil recentering units

The following functionality of the pupil motors is tested:

- home the motor
- move to a given position
- the software positive limit (+1500 steps, from configuration file) is verified.
- optical repeatability is 0.02 subapertures.

See AD2 – Sect 12 for details about the pupil stabilization loop.

Remarks: *Functionality demonstrated by moving a pupil away from its nominal position, then closing the pupil stabilization loop and verifying that the system moves the pupil back to its nominal position. Verified positive limit and optical repeatibility.*
AIs: *None.*

8.6 Dark wheel

The following functionality of the dark wheel is tested:

- home the device
- move to "close" position

- move to “open” position

Remarks: *Described functionality checked.*
AIs: *None.*

8.7 Patrol cameras

The following functionality of the Patrol Cameras (a.k.a. acquisition cameras) is tested:

- acquire a frame
- modify the chip binning
- modify the integration time

See AD2 – Sect 16 for details about the acquistion cameras

Remarks:
Frame Acquisition, Chip Binning and Integration Time verified. Checked pixel scale and field of view.
AIs: *None.*

8.8 Temperature and humidity monitors

Both external and interal THORs properly read temperature and humidity (when available) from the probes at a <10s repetion rate.

Remarks: *Described functionality checked.*
AIs: *None.*

8.9 Diode-source

See AD2 – Sect 18 for a description of the internal source.
The following functionality of the diode source is tested:

- Switch a channel on/off
- Set the current

The flux for each channel is measured. Note that it depends also on the reflectivity

	Switch On/Off	Set Current (A)	Result (flux ADU)
Channel 1	OK	0.2	7100
Channel 2	OK	0.2	6100
Channel 3	OK	0.1	6800

The diodesource delivers a sufficient flux to operate the internal calibration unit.

Remarks: *Described functionality checked.*
AIs: *None.*

8.10 Slope Offset

The LGSW is able to apply an offset to the slope vector . See AD2 – Sect 11 for details.

Remarks: *Tested OK.*
AIs: *None.*

8.11 LGS spot size algorithm

The LGSW must provide an indicator of the average spot size of the LGS beams
At the moment, the algorithm has not been implemented yet. The needed inputs (pnCCD frames, subapertures definition) are available to the SW module that will implement the algorithm.

Remarks: *Not tested*
AIs: *see SW AIs*

8.12 Wavefront Focus algorithm

The LGSW must provide the necessary informations to compute the average wavefront focus term
The slope vector and the slope-offset vector needed to compute the focus-term are available in LGSW Control SW but at the moment are not available to the ARGOS Arbitrator that is responsible for implementing the computation.

Remarks: *Not tested*
AIs: *see SW AIs*

9 Performance (Specs)

The following specification are checked:

9.1 Number of subaperture

The LGSW pupil is sampled with 15 subapertures

9.2 Arrangement of spots grid on CCD

Spots are positioned on the CCD in agreement with the design

9.3 Framerate

WFSCamera can run at 1kHz and BSU can grab frames and produce slopes at 1kHz.

9.4 WFS pixel scale

The pixel scale of the LGSW is 0.56 arcsec/pix.

9.5 WFS Field of view

The field of view of the sensor using piezo mirrors is 4.5 arcsec.

9.6 Camera noise

Camera noise in the current configuration using Microgate ADC is 4e-

9.7 Camera noise spectrum

The camera noise appears to be correlated as it shows residual of common-mode correction. This effect introduces an asymmetry that is visible in the x-slopes noise being bigger than the y-slopes noise. See AD2– Sect 6.5 “Common Mode residual” for details.

9.8 Noise propagation

In the design phase [AD3 Sect 7] the wavefront sensing error was required to be 38nm in case of a nominal flux of 1800 ph./subaps. In the TLR- this error was generalized to 50nm.
The wavefront sensing noise has been measured to be 50nm with 1000ph/subap/frame. See AD2– Sect 25 “WFS measurement noise” for details.

9.9 Pupil stabilization

Pupil stability was measured: 0.02 subaps rms. See AD2 – Sect 12 “Pupil stabilization” for details.

9.10 Jitter compensation

Jitter compensation residual= 5 mas (X), 3 mas (Y), for 6000-7000 ADU flux. See AD2 – Sect 13 "Jitter stabilization" for details.

9.11 Patrol camera field of view

Patrol Cameras FoV is 60x53 arcsec measured using the external source. See AD2 – Sect 16 "Acquistion cameras"

9.12 Pockels cell suppression rate

From AD2 – Sect 7 "Gating units": Pockel cell suppression rate Ton/Toff is about 1000.

9.13 Pockels cell homogeneity

From AD2 – Sect 7 "Gating units": Variation around median value <20%

9.14 Optical Transmission

AIs: *Provide estimate of overall optical transmission of the WFS.*

9.15 WFS static aberration

The slopes offset when using the internal source have a peak-to-valley value of 0.6" on-sky, in good agreement with the simulated value during the design phase (AD4-Fig 8).

10 Safety

Close main cooling line: After one minute the pnCCD subsystem indicated "device error" and the system automatically initiated a shutdown.

Network failures: The main network connection was unplugged. The system quickly flagged "housekeeping error" and attempted an automatic shutdown. This shutdown was of course not succesful since there was no network connection. Upon network re-connection the MOCON and Pulse generator units were no longer operational (althou pingable) and a power cycle was required.

AIs: *Investigate ways to improve MOCON and Pulse generator units tolerance to network loss.*
Note 30 Jan (LB, WG): *The MOCON configuration has been modified to release the TCP connection after 30s. This will solve the re-connection issue. On Jan, 30 we repeated 10 times the network failure test and all the devices were able to reconnect, including the Pulse generator (with a maximum delay of about 30s)*

11 Operation with Engineering SW

11.1 Software Review Comments and Recommendations

The LGSW lab acceptance test does not explicitly include software tests. However, the team was gracious in allowing for discussion of software development status and issues during the review. The LBTO team wishes to recognize and thank the ARGOS team for their support of these software discussions during the review.

The findings on DX-LGSW software are included below. The executive summary is that the software is incomplete and somewhat lagging HW development. As such, the software can not achieve "lab acceptance" in its current form. This will not gate DX-LGSW delivery and continued integration at the telescope, but will require a later review when missing low level software and higher level GUIs are ready.

The DX-LGSW component is currently being exercised with engineereing GUIs. These GUIs are deemed sufficient to conduct the lab acceptance test and integration tests at the telescope. The team easily demonstrated many functions successfully using the GUIs. Some SW functionality has been noted by the ARGOS team in the integration report as incomplete. The missing software appears to correlate well to resource availability and integration test schedule. LBTO generally discourages this approach given precious telescope time. The recommended actions for software follow a theme of encouraging the ARGOS team to stay ahead of the test curve with efficient tests of already developed software before coming to the telescope.

11.1.1 Recommended Actions

The table below provides recommended action items for software:

ID	Description	Due	Resp.	Status
SW-1	Acquisition Cameras (par 16). Implement LUT for flexure based on prior run data.			
SW-2	LGS Spot size estimation (par 14). Perform analysis and preliminary modeling/development of algorithm			
SW-3	Wavefront focus estimation (par 15). Resolve within ARGOS team whether this item is required. If so, perform analysis and preliminary modeling/development of algorithm.			

11.1.2 Items of Note

The following table provides some areas of interest to the LBTO review team. These items are of minor concern and bear monitoring (as noted already within the ARGOS integration report). The ARGOS team is encouraged to continue to closely monitor and resolve these issues as soon as possible.

Item	Functional area	Issue

Centroid algorithm	Slope Computation	Microgate has been asked to implement a firmware update to extend the algorithm for avg subaperture flux (results in better noise propagation). The firmware hasn't been developed yet.
The offset will be modified at about 1Hz from the Truth Sensor loop.	Slope offset	A different (design) approach is needed. It is lacking the capability of being modified at run-time by the Truth Sensor
gain estimation procedure	Dynamical performances	An automatic gain-estimatation procedure will be needed to fine-tune the gain value at the telescope. Dynamical performances are still to be optimized and quantified. SW scripts to optimize performances are still to be developed

11.1.3 Supplemental Comments

A spreadsheet containing more details for items listed in paragraphs 11.1.1 and 11.1.2 above is provided for ARGOS to consider. Most of the items are already described in the integration report provided by the ARGOS team. The ARGOS team is encouraged to continue to monitor SW development and update the LBTO team as progress is made in development and resolution of items.

12 Telemetry

Telemetry and Diagnostic tools are described in AD2 – Sect 20.

13 Installation and handling procedures

AIs: *provide installation and removal procedure for the WFS unit.*

14 Action Items

ID	Description	Due	Resp.	Status
1	Acquisition Cameras (par 16). Implement algorithm to determine LGS position in patrol field.	1 March	ARGOS	Open
2	S-H LGS Spot size estimation (par 14). Perform analysis and preliminary modeling/development of algorithm.	1 March	ARGOS	Open
3	Investigate ways to improve MOCON and Pulse Generator units recovery from network failures.	1 March	ARGOS	Closed (30 Jan LB, WG)
4	Reduce vibrations from rack cooling system.	1 March	ARGOS	Open
5	Add missing cable labels in electronics rack.	10 March	ARGOS	Open
6	Estimate system stability (contiguous and accumulated uptime with/without failures).	1 March	ARGOS	Open
7	Provide enclosure for Thor unit.	1 March	ARGOS	Closed (02 Feb LB)
8	Provide model of cable ducts for LBTO review.	1 Feb	ARGOS	Closed (30 Jan MD)
9	Verify functionality of delay generator in slave mode.	15 Feb	ARGOS	Closed (30 Jan JZ)
10	Verify functionality of BCU real-time communication.	15 Feb	ARGOS	Open (Note 2)
11	Provide estimate of overall as-built optical transmission.	15 Feb	ARGOS	Open
12	Provide installation and removal procedure for WFS unit.	1 March	ARGOS	Open
13	Provide as-built weights for all units including electronics rack.	1 March	ARGOS	Open
14	Complete cooling system pressure test at 10 bars.	15 Feb	ARGOS	Open
15	Resolve issue with Thor unit not working at low temperatures.	15 Feb	ARGOS	Open
16	Add tool-tips to engineering GUI,	1 March	ARGOS	Open
17	Rack I/O GUI change label for second input from "Emergency stop" to "External motor stop".	1 March	ARGOS	Open
18	Investigate excessive stabilization time for humidity sensor in WFS camera.	1 March	ARGOS	Closed (06 Mar LB) See Note 1 below
19	Investigate excessive stabilization time for temperature control in WFS camera.	1 March	ARGOS	Open

Note 1: The humidity sensor reading in the WFSCamera seems to be correlated to the internal pressure. The monitor shows a slow, constant increase of the pressure during the last 6 months after camera #2 was last pumped. At the time of the acceptance test the pressure was about 20mbar and "too-high humidity" warnings were noticed. The week after the test the issue got worse, with a humidity stabilization time of 2h. We repumped the camera to <1mbar and the issue disappeared. The camera needs to be periodically pumped either when pressure >20mbar or when the humidity warning appears. This should happen every about 6months at the telescope.
Comment from LBTO: Please add this requirement to preventive maintenance manual.

Note 2: On Mon 3 Feb 2014, Mario Andrighettoni from Microgate modified the HW of the 3 ARGOS BCUs to solve the fastlink issue. He did a few hours of low-level communication tests connecting the BCUs with a fiber in the Arcetri lab. The firmware was updated on all the 3 BCUs and the DSP code was modified to fix some bugs encountered during the test. After Mario's visit, Lorenzo debugged the full system to verify that the LGSW Control SW is still able to configure the BCU correctly but he didn't had time to repeat the fiber test. This AI is still formally open until the ARGOS team will repeat the fastlink test using its own software, without using the tools of Microgate.

15 Compliance Matrix

Verified: T=by Test, A= by Analysis, D= by Design
Compliant: C=Compliant, NC= Not Compliant, NYA= Not Yet Assessed

ID	Requirement	Verified	Compliant	Notes
Interface verification				
	Envelope	T	C	
	LGSW unit mass	T	C	
Functionality				
	WFS Camera	T	C	
	Pockel cells	T	C	
	Piezo mirrors	T	C	
	Pupil recentering units	T	C	
	Dark wheel	T	C	
	Patrol cameras	T	C	
	THORs	T	C	
	Diode source	T	C	
	BCU frame grabbing	T	C	
	BCU slope computation	T	C	
	BCU loop telemetry	T	C	
	BCU fastlink communication	T	NC	
	Slope offset	T	C	
	LGS spot size algorithm		NYA	
	WF focus algorithm		NYA	
	Cooling and dry-air		C/NYA	10bar test missing
	Management of calibrations	T	C	
	Diagnostic and Telemetry	T	C	
	Safety	T	C	
Performances				
	Number of subapertures	T	C	
	Arrangement spots on CCD	T	C	
	Framerate	T	C	
	Pixel scale	T	C	To be measured
	WFS field of view	T	C	To be measured
	Camera noise	T	NC	RoC to be issued, non-critical
	Common Mode residual	T		Not specified
	Noise propagation	T	C	
	Pupil stabilization	T	C	
	Jitter compensation	T/A	C/NYA	Residual tilt to be computed
	Patrol camera FoV	T	C	
	Pockel Cells suppression rate	T	C	
	Pockel cells homogeneity	T	C	
	Optical transmission	D	NYA	
	WFS off-axis static aberration	T	C	
	Centroid algorithm	T	C	

	Cold test	T	C	See AD2
	Gravity test	T	C	See AD2

List of acronyms

AGW	Acquisition Guiding and Wavefront sensing
AIP	Astrophysical Institute Potsdam
AOS	Adaptive Optics System
APD	Avalanche Photo Diode
ASM	Adaptive Secondary Mirror
BCU	Basic Computational Unit
DM	Deformable Mirror
DMD	Deformable Mirror Diagnostics
FLAO	First Light Adaptive Optics
FWHM	Full Width Half Maximum
GLAO	Ground Layer Adaptive Optics
IDL	Interactive Data Language
IIF	Instrument InterFace
LBT	Large Binocular Telescope
LBTO	LBT Observatory
LGS	Laser Guide Star
LGSF	LGS Facility
LGSW	LGS Wavefront Sensor
LUCI	LBT Near Infrared Spectroscopic Utility with Camera and Integral Field Unit for Extragalactic Research
NGS	Natural Guide Star
PID	Proportional, Integral and Differential
PSF	Point Spread Function
RLGS	Rayleigh Laser Guide Star
RMS	Root Mean Square
RON	Read Out Noise
RPC	Remote Procedure Call
RTC	Real Time Control
SH	Shack Hartmann
SNR	Signal to Noise Ratio
SR	Strehl Ratio
SVD	Single Value Decomposition
TBC	To Be Confirmed
TBD	To Be Defined
TCS	Telescope Control Software
TT	Tip Tilt
TTW	Tip Tilt Wavefront sensor
WFS	WaveFront Sensor

End of document