Next Generation Adaptive Optics System

Environmental Control and Monitoring

(Draft)

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VersionV1.0

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REVISION HISTORY

Revision	Date	Author (s)	Reason for revision / remarks
1.0	April 10, 2009	JC	Initial release

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INTRODUCTION

As part of the Next Generation Adaptive Optics (NGAO) System, non-real time control (RTC) electronics will be needed to support the operation of the Adaptive Optics System and the Laser System. A significant portion of the non-RTC electronics focuses on motion control devices. These devices include motors, shutters, filter wheels, and other robotic or remotely operable control stages and devices. This document covers a class of non-real time devices that provide support for the AO and Laser System environments. These functions include environmental control, environmental monitoring, and power control, and power monitoring. For simplicity, this class of devices will come under Environmental Control and Monitoring (ECM).

2 REFERENCES

2.1 Referenced Documents

Documents referenced are listed in Table 1. Copies of these documents may be obtained from the source listed in the table.

Ref. #	Document #	Revision or Effective Date	Source	Title
1	Work Scope Planning Sheet	1.1	WMKO	Non-Real-Time Control Electronics 3.2.4.2
2	KAON 511	2.1	WMKO	NGAO System Design Manual
3	KAON 569	2.2	WMKO	Non-Real-Time Controls System Design Report

Table 1: Reference Document.

2.2 Acronyms and Abbreviations

Table 2 defines the acronyms and abbreviations used in this document.

Acronym/Abbreviation	Definition
AO	Adaptive Optics
CCR	Closed Cycle Refrigeration
ECM	Environmental Control and Monitoring
EPICS	Experimental Physics Industrial Control System
GPIB	General Purpose Interface Bus
HTML	Hyper-text Mark-up Language
KAON	Keck Adaptive Optics Note
LSE	Laser Service Enclosure
NGAO	Next Generation Adaptive Optics System
PC	Personal Computer
RTC	Real Time Control
TBD	To Be Determined
TBR	To Be Reviewed
WMKO	W.M.K. Observatory

Table 2: Acronyms and Abbreviations.

3 ENVIRONMENTAL CONTROL AND MONITORING

3.1 AO Control

The AO Environmental Control and Monitoring (ECM) is part of the overall AO Control System shown in the in Figure 1. The ECM provides the functions of control and monitoring of the environment and power of which the AO system resides. Although the ECM is under the AO Sequencer, it is unlikely a sequencer will be necessary to operate the ECM itself. AO Sequencers will be control and monitor devices attached to the ECM. The ECM is expected to be slaved to processes requiring information or processes requesting to cycle power in the AO system.

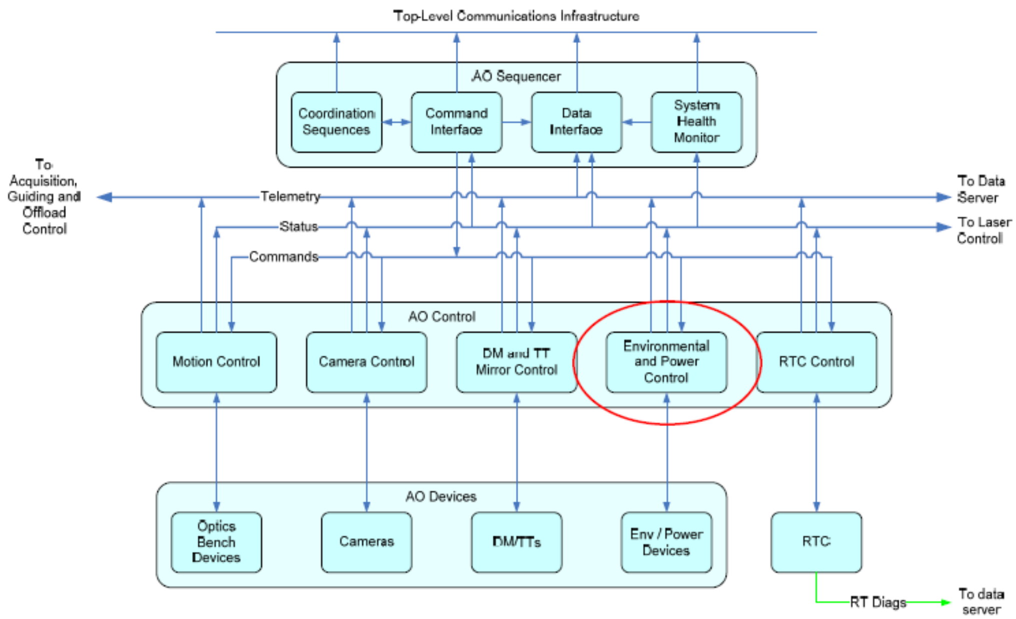

Figure 1: AO Environmental Control and Monitoring

3.2 Laser System Control

Similar to the AO ECM, the laser system control (Figure 2) has a subsystem providing similar if not the identical functions. The laser ECM will operate in the Laser Facility which includes the Laser Service Enclosure, the Beam Transport System, and equipment in the secondary socket of the telescope.

The laser itself is expected to provide internal environmental control and monitoring through the laser control interface and not the laser ECM.

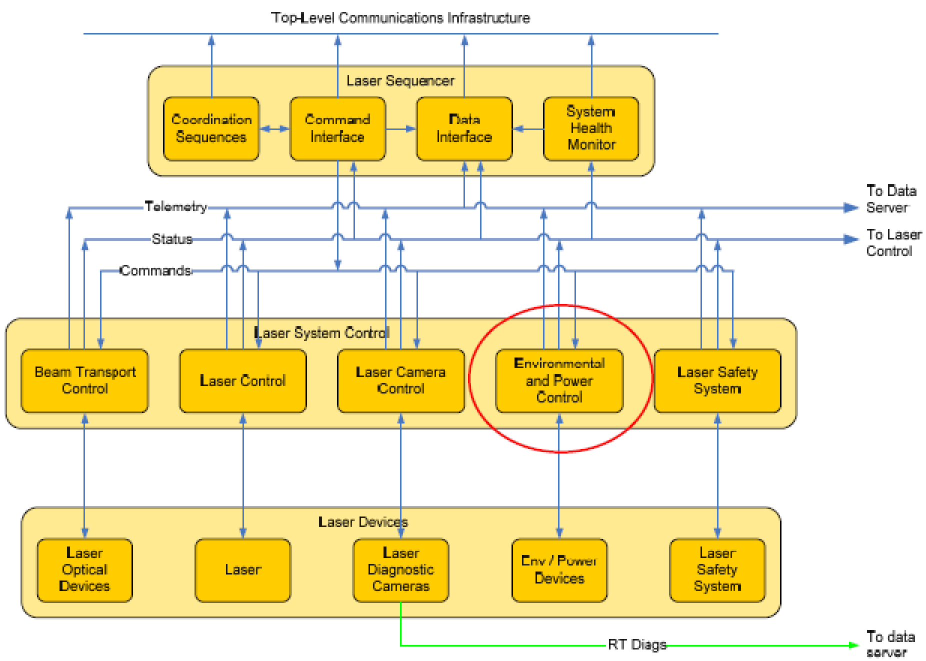

Figure 2: Laser Environmental Control and Monitoring

3.3 Combined AO and Laser ECM

Considering the similarity in functions of the ECM for the AO system and laser system, it may be advantageous and economical to provide a single system that serves both systems. The system will be able to communicate via a common interface such as the Ethernet. The system itself may have a combination of nodes at throughout the observatory.

3.4 ECM versus the Safety System

The ECM is not intended to be a replacement of the safety system. Environmental impact that can affect safety of personnel and equipment shall be part of the safety system. It is possible the ECM may support the safety system by either providing inputs or controlling output (power down). These should be considered carefully as to the criticalness of the sensor and controlling devices related to safety.

4 Devices

4.1 Device Locations

The ECM is expected to communicate with devices in the locations shown in Figure 3. Most of the expected devices will be near the AO Bench/Room, AO Electronics Room, LSE, telescope, and the f/15 secondary. The instrument location is shown as possible area with sensors as well if these sensors are not inherent to the instrument subsystem. Possible sensors and controls may include the instrument Closed Cycle Refrigeration (CCR) system.

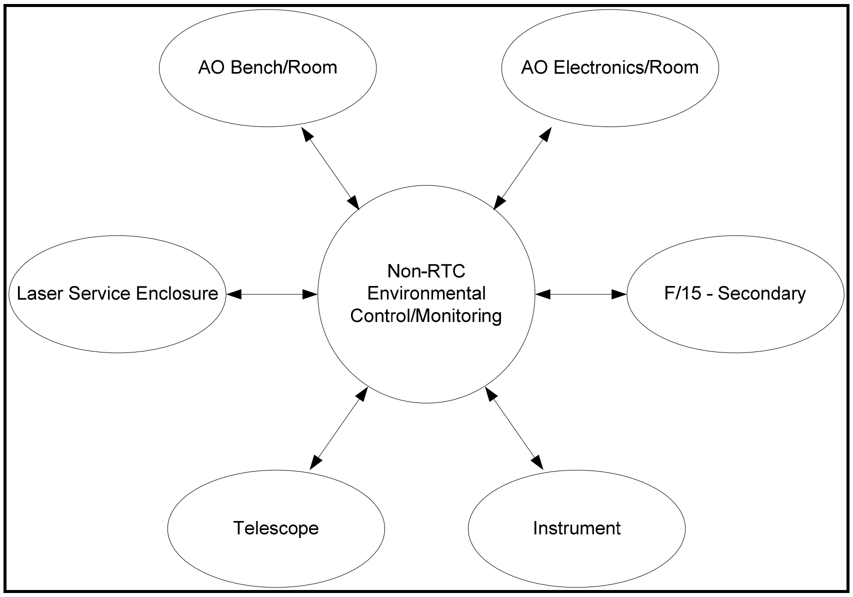

Figure 3: Device Locations

4.2 Device Types

The following types of devices are expected to be controlled or monitor in the ECM. The devices in the ECM are expected to be permanently installed. Intermittent devices such as test equipment are not covered by the ECM.

4.2.1 AC Power Control/Monitoring

These devices are power distribution units which provide AC power to subsystems. Generally, these subsystems require less than 15 amps and can be power cycle without negative impacts. It is sound engineering practice for subsystems to have its own internally controlled reset; however, if one is not available or effective, a hard power cycle may be the only mean for recovery. Examples used at the WMKO are Pulizzi controllers.

4.2.2 DC Power Control/Monitoring

These devices are similar to their AC counterpart except they control DC power. DC powers can range from 5VDC supplies for motor encoders to 600 VDC power supplies to drive piezo-actuators (PZT). PZT devices driven off these power supplies may require additional features such as slew rates and current limiting to prevent damages during power cycles.

4.2.3 Digital Inputs and Outputs

Some devices will be controlled and monitored digitally. Device formats may include TTL or 24VDC. Non standard formats should be optically isolated to prevent grounding issues. Relays to turn on/off calibration lamps are possible candidates for these devices.

4.2.4 Analog Inputs and Outputs

These devices will require analog inputs for controls or provide status via analog outputs. Examples of analog inputs are temperature or flow set points for HVAC and glycol systems, and temperature sensing in the AO Enclosure and LSE. The ECM will also input similar status from the HVAC and glycol systems in the Laser Facility.

4.2.5 Surveillance Cameras

Unlike cameras used for wavefront sensing or guiding, these cameras have lower resolution and sensitivity and are mainly used for monitoring of the environment. Examples of these cameras are those used to monitor the AO enclosure and the LSE. Images from these cameras are not expected to be archived.

4.2.6 Environmental Sensors

Although most of the devices will be covered under the previous section on digital and analog inputs, it is worthwhile to mention other sensors that are part of the environmental suites of sensors. These include humidity, particulates, or other sensors that may impact AO and laser performance.

4.2.7 Test Measurement Devices

These devices include power monitors, and or volt or current meters normally used for diagnostics.

4.3 Device Selection

For device selection, engineers shall consider the type of sensor or controls, the interface, operating frequency, and reliability. The appendix provides a form for device selection. This form is expected to be filled out by the engineering staff selecting the devices.

5 CONTROLLER

The controller should be able to support the type of devices suggested in Section 4. The ECM may be a distributed system with multiple controllers to support devices at different locations. Possible architectures for the controllers include Allen Bradley programmable logic controllers, VME systems, Sun Microsystems, PCs, National Instrument Systems, pr custom designs. These systems allow for a wide selection of hardware for interfacing with devices mentioned in the Section 4. Controller selection should also consider the type of control system used throughout NGAO. Control systems such as EPICS provide significant driver support to minimize software development.

6 RECOMMENDED INTERFACES

To minimize the complexity of the ECM, the following interfaces are recommended for sensing and controlled. All other interfaces shall need approval with the NGAO System Design Team.

6.1 Serial Interface

RS232 serial or RS422 for longer distances are well established communications at WMKO and are used extensively with terminal servers.

6.2 Ethernet Interface

Interfaces via Ethernet using remote procedural calls (RPC) or hardware with built-in HTML servers are also encouraged.

6.3 GPIB Interface

GPIB Interfaces are often used for test and measurement devices such as oscilloscopes, voltage supplies, and voltage meters.

6.4 4-20mA

Analog sensors at long distances should consider digital interfaces if at all possible. If not, 4-20mA format should be considered to improve signal integrity.

6.5 Digital TTL or 24 VDC opto-isolated

TTL format is widely accepted for digital communications. For PLC type inputs and outputs, 24VDC opto-isolated format should be used.

6.6 Analog

Analog voltage formats should only be considered with proper signal conditioning and sufficient signal to noise margin. The use of twisted pair and shielding should also be considered to minimize the noise pickup.

7 APPENDIX

Originator:		Date:	
Subsystem:			
Location:			
Device:	Name:	Location:	Control vs. Sensing:
Manufacturer:		Manufacture Name and version:	
Interface/format:			
Additional Interface Reference Doc:			
Max. Operating Frequency:		Required Operating Frequency:	
Resolution:		Range:	
Scaling:			
Additional Notes or Special Requirements:			

Table 3: Device Type Description