Southern Africa Large Telescope

Prime Focus Imaging Spectrograph

SAAO Detector Subsystem

SALT-3190AS0002: SAAO Interface Control Document

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Issue History

Number And File Name	Person	Issue	Date	Change History
saao.icd.doc	WPK	1.8	26 Sep 2001	PFIS PDR issue
SALT-3190AS0002 SAAO ICD Issue 1.9.doc	DOD	1.9	4 Nov 2002	First pre-PFIS CDR update
SALT-3190AS0002 SAAO ICD Issue 1.10.doc		1.10	6 Nov 2002	Major pre-PFIS CDR update
SALT-3190AS0002 SAAO ICD Issue 1.11.doc		1.11	18 Feb 2003	Resolution of TBDs.
SALT-3190AS0002 SAAO ICD Issue 1.12.doc		1.12	23 Feb 2003	Update with inclusion of cooler box I/F
SALT-3190AS0002 SAAO ICD Issue 1.13.doc		1.13	03 Mar 2003	Final PFIS CDR update with inclusion of cryostat info

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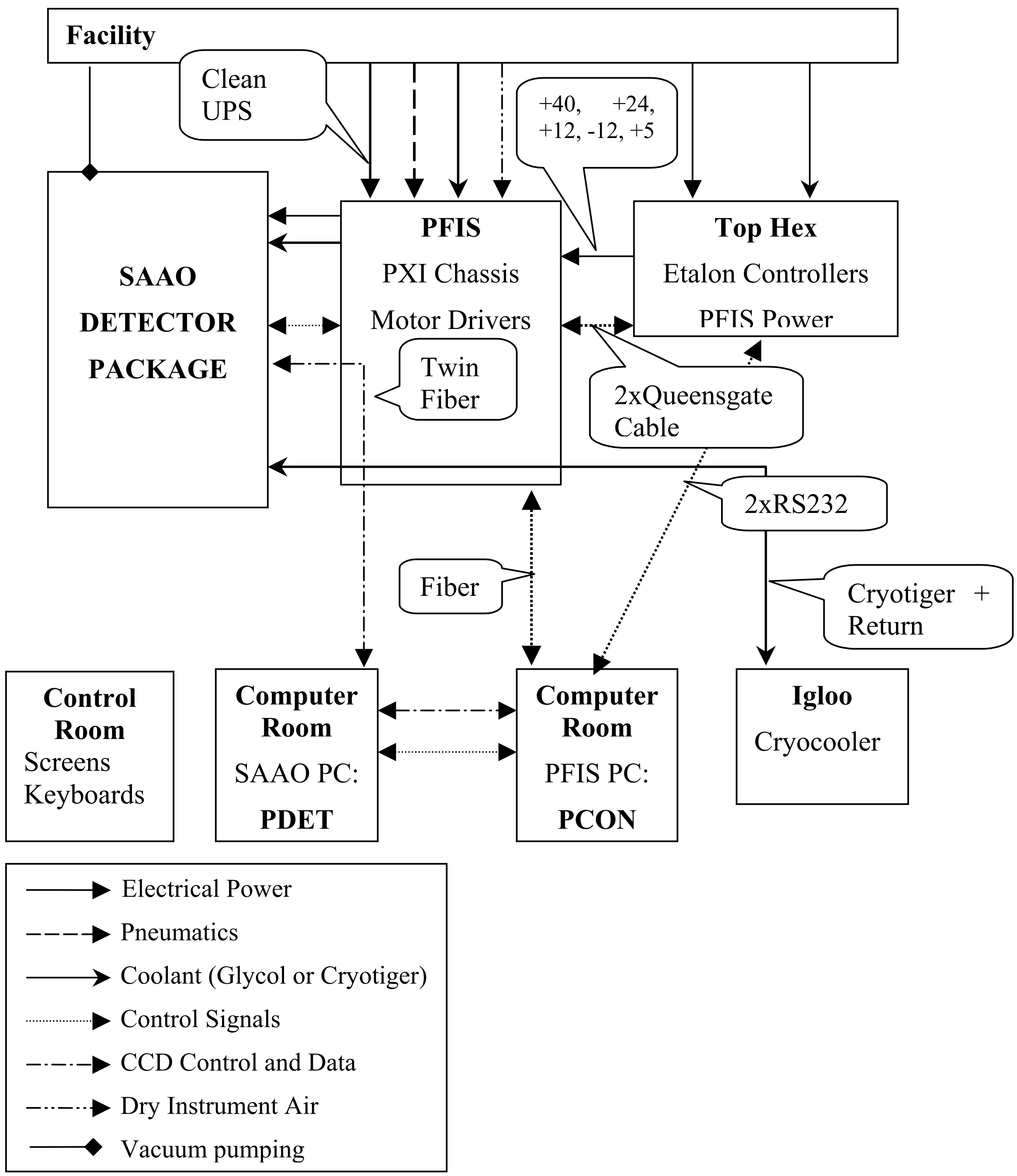


Figure 1 shows the PFIS/SALT block diagram.

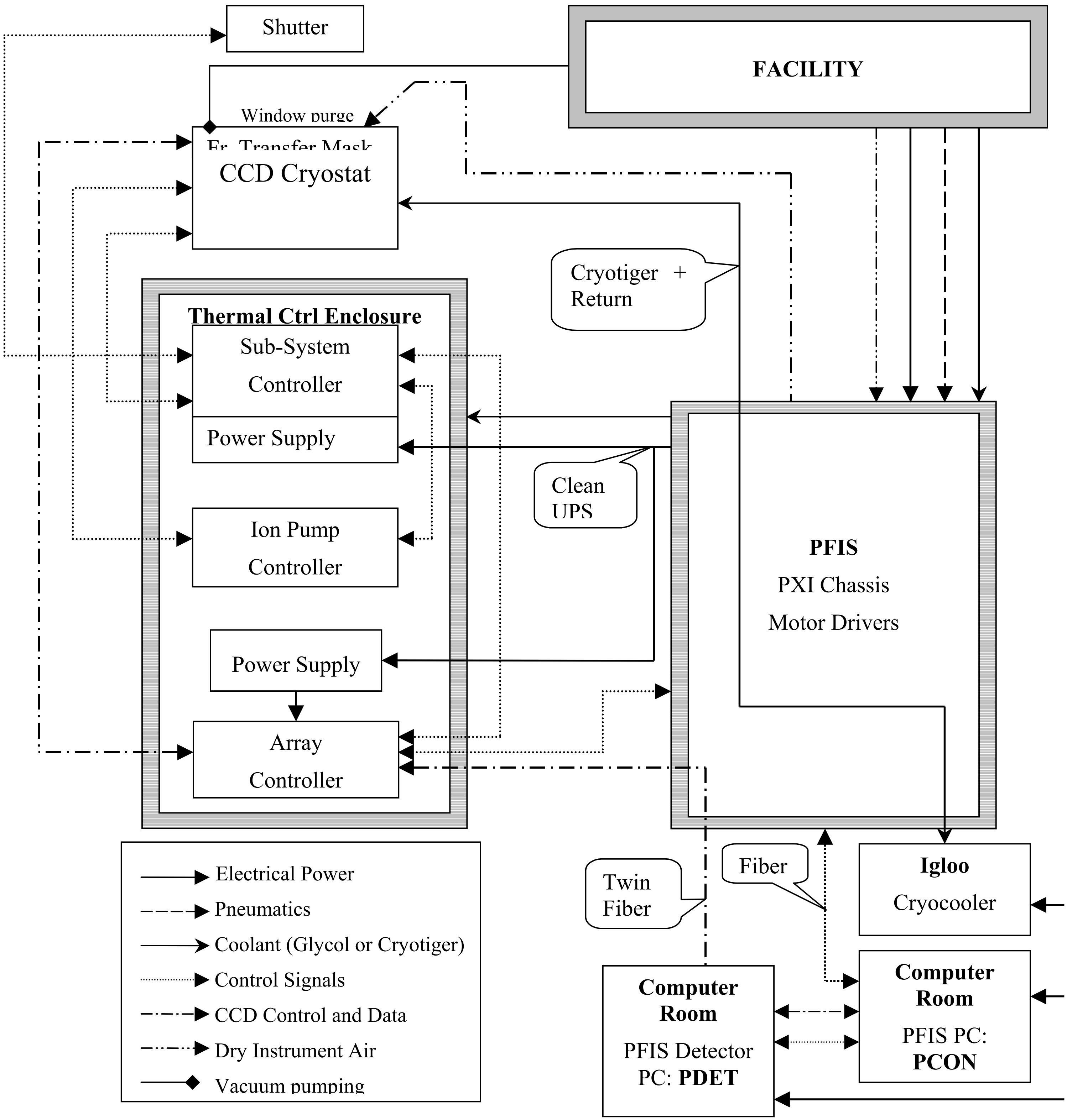


Figure 2 shows the SAAO part of Figure 1 in more detail.

1 Scope

This document specifies the interfaces between the UW-Madison part of the Prime Focus Imaging Spectrograph (PFIS) and the SAAO-supplied Detector subsystem. The interfaces are optical, mechanical, electrical, cryogenic, software, and communications. There are no pneumatic interfaces between the Detector subsystem and PFIS. Figure 1 shows a block diagram with Figure 2 showing more detail in the SAAO detector subsystem.

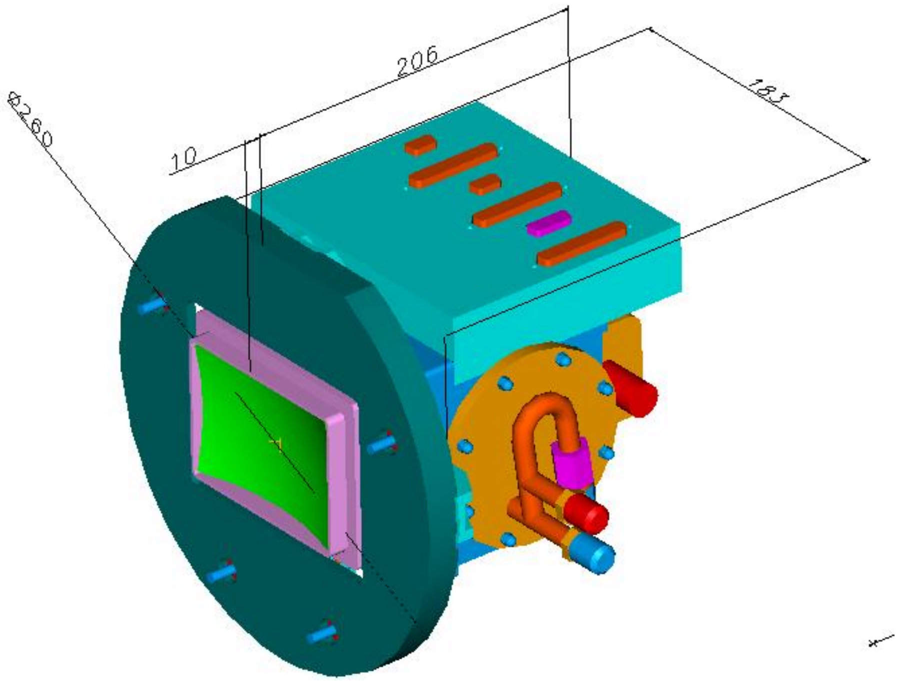
Note that PFIS presents a single interface to the facility. Resources required by the PFIS subsystems (detector assembly and the etalons) are routed from the PFIS interface within the instrument. This is required for designing the PFIS wire harness.

2 Optical

The optical interface between PFIS and the Detector subsystem is defined to be the cryostat window. During assembly and thereafter, this will be the field lens, the final optical element, of the PFIS camera. However, for testing of the cryostat, the field lens will not be available in South Africa. In any case current test plans involve mounting the cryostat on the SAAO 1-m telescope. Thus, a separate, optically flat, cryostat window will be needed and has been procured from Mount Stromlo and Siding Spring Observatories.

3 Mechanical

Figure 3 shows various views of the mechanical design of the PFIS cryostat. The Cryostat Document (SALT-3197AE0001 Cryostat Issue 2.5.doc) specifies many aspects of the mechanical interface between the PFIS and the Detector subsystem more fully.



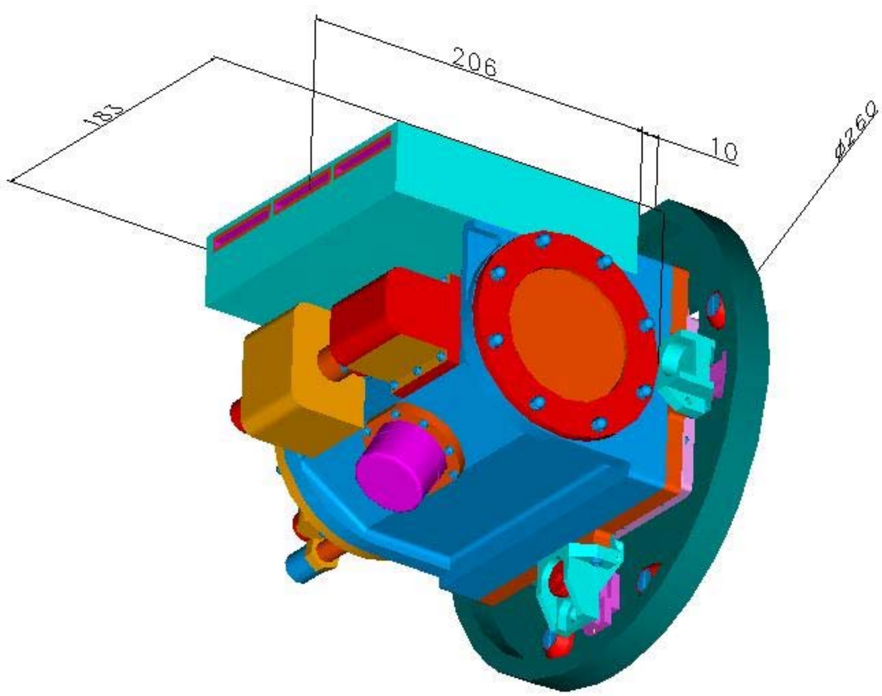


Figure 3 showing general views of the cryostat

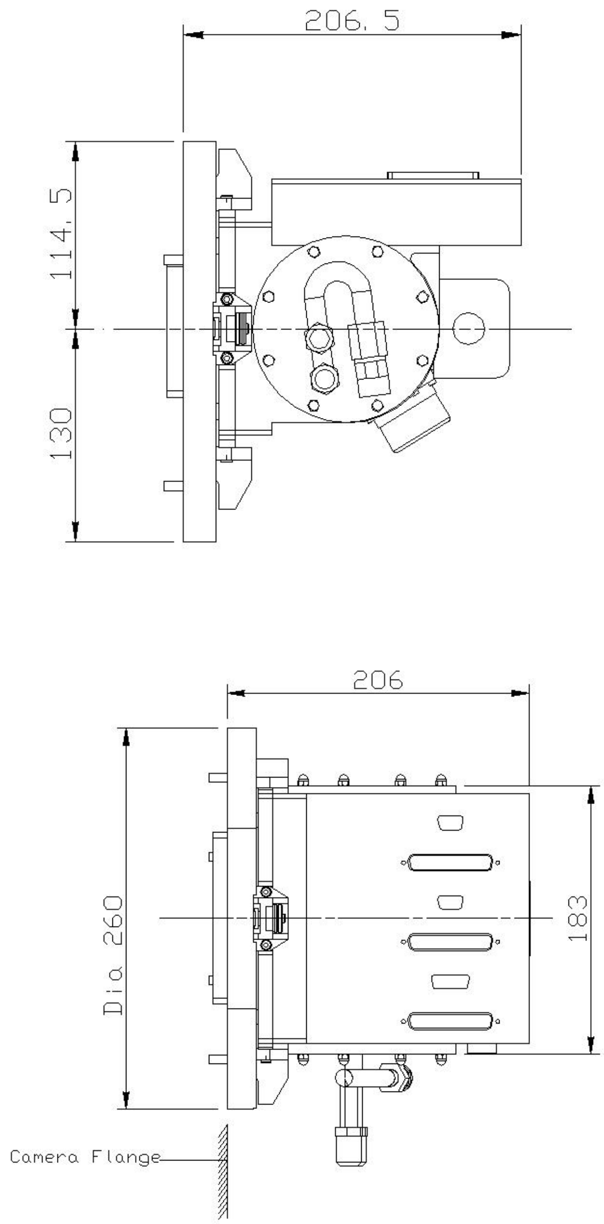


Figure 3 (cont.) showing section views of the cryostat

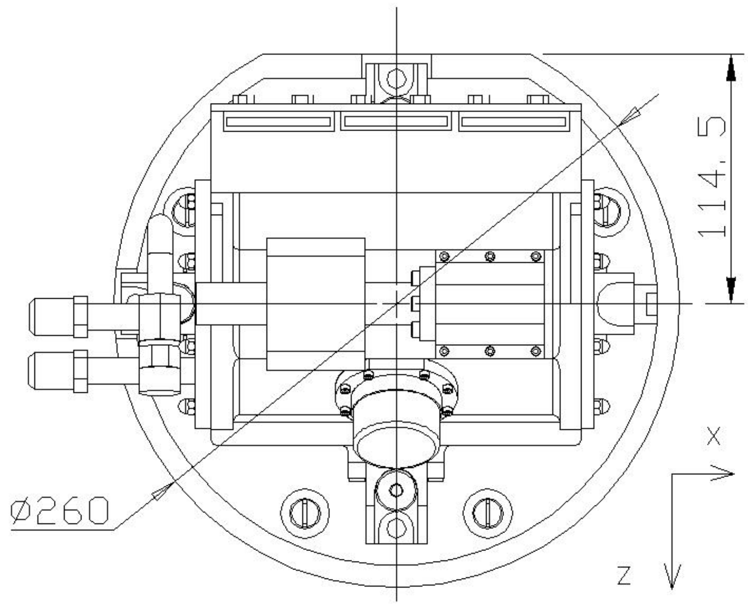


Figure 3 (cont.) showing section views of the cryostat

3.1 Weight Budget

The array controller and power supply are available in two versions – standard and large. Data for both is presented; one or the other option will be used. **TBD2**

Item	Standard SDSU (kg)	Large SDSU (kg)
Array controller (populated with pcb's)	6.5	10.5
Array controller power supply (including 3 m cable)	6.0	7.3
Cryostat	8.5	8.5
Ion pump controller	1.8	1.8
Subsystem controller & power supply	4.0	4.0
Cabling	1.0	1.0
TOTAL:	27.8	33.1

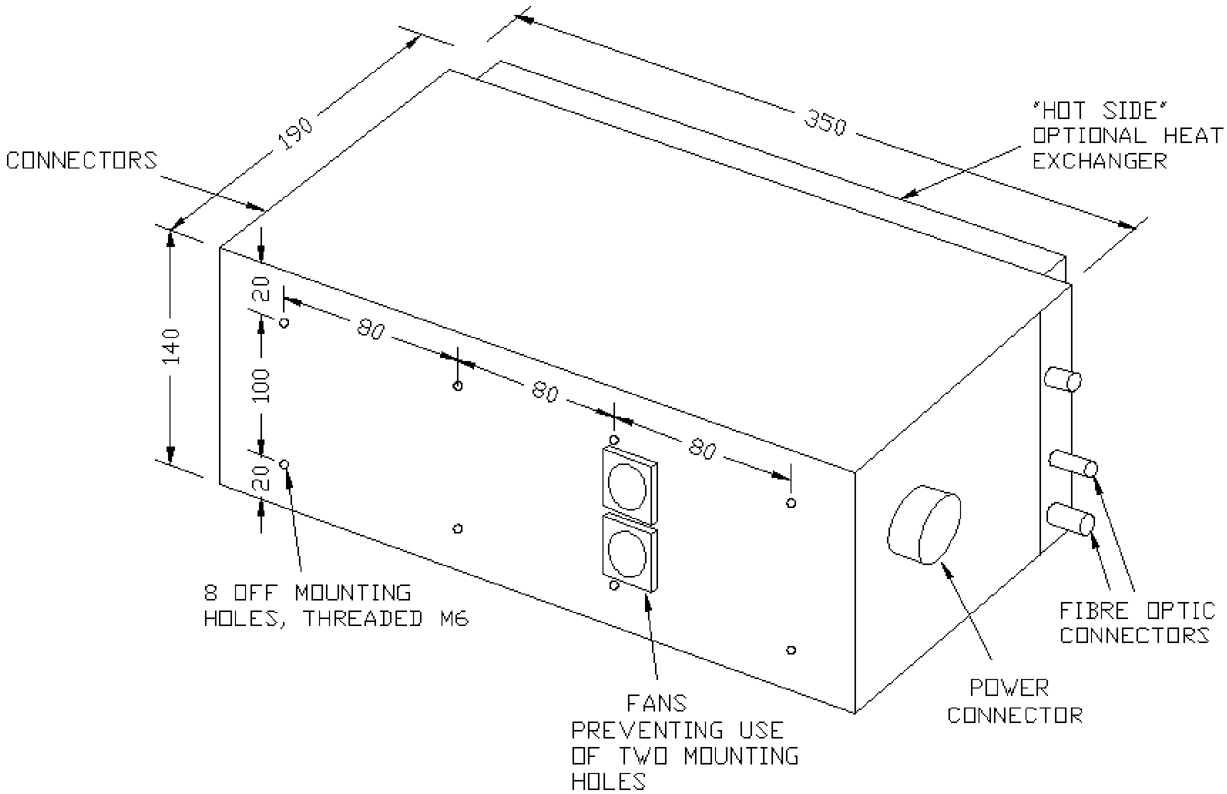


Figure 4 shows the Standard SDSU II array controller envelope and mounting point. Note that the large controller envelope sketch is to follow

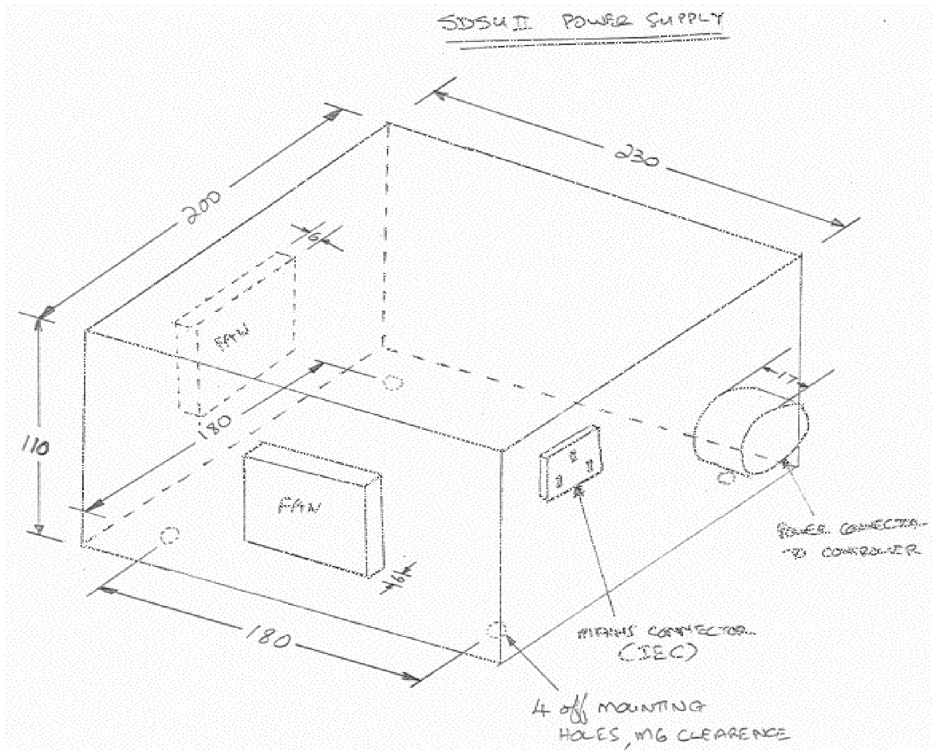


Figure 5 shows the standard SDSU II power supply envelope and mounting point. Note that the large power supply envelope sketch is to follow

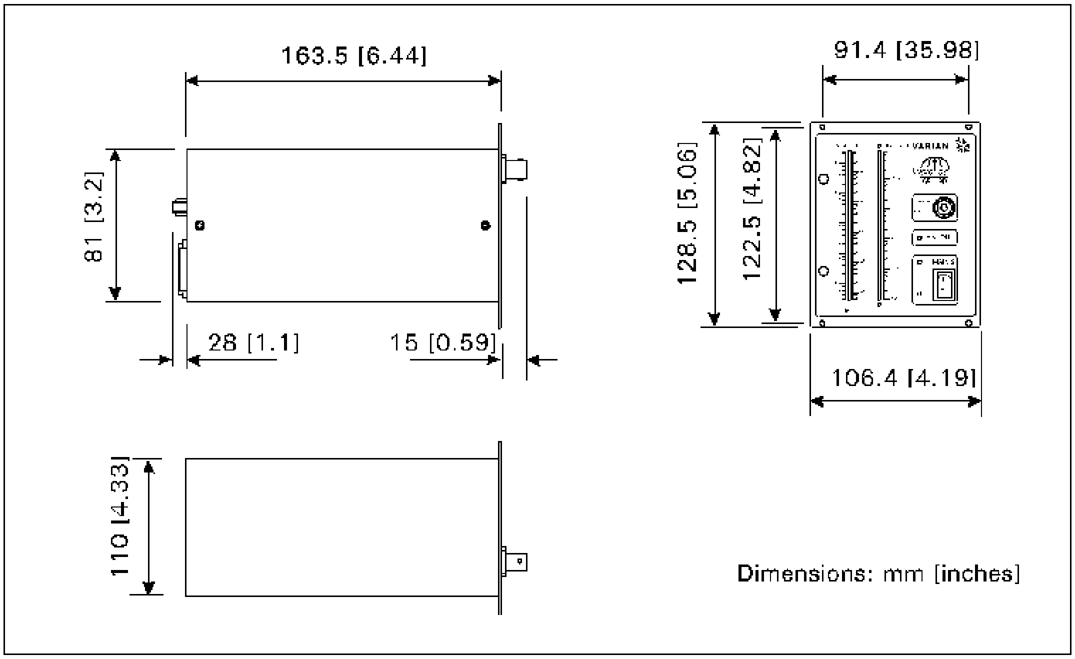


Figure 6 shows the Sub-systems Controller and Power Supply box envelope and mounting point.

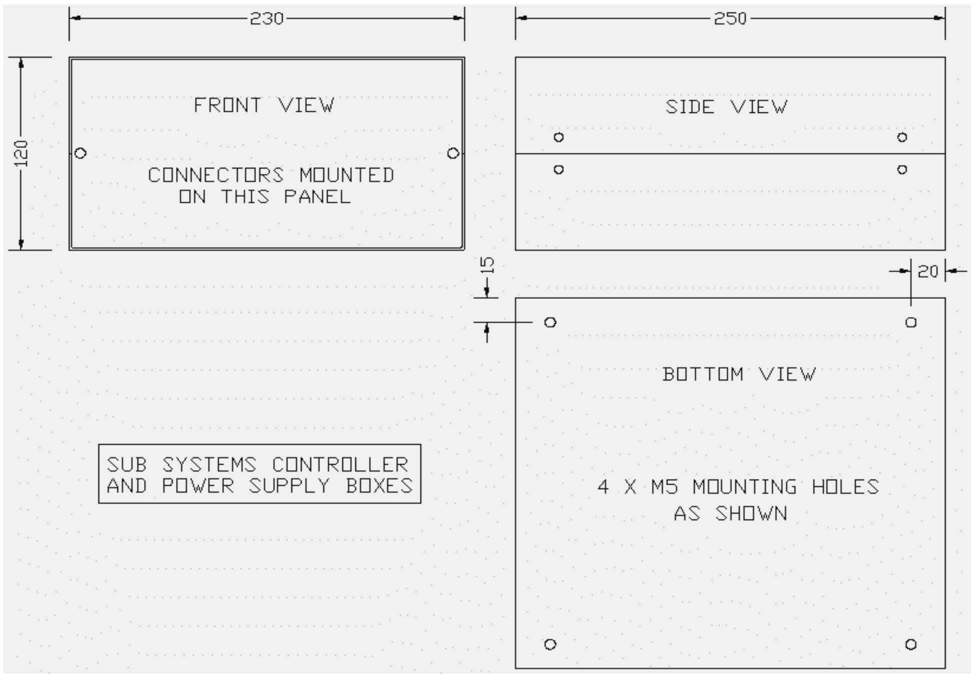


Figure 7 shows the Varian MicroVac Ion Pump Controller envelope and mounting point.

3.2 Envelope

Figure 3 shows the mechanical envelope for the detector housing. Allow an addition ~50 mm at ends carrying plugs.

Figure 4 shows the mechanical envelope for the standard array controller, measuring 360 x 175 x 140 mm. Allow an additional 100mm at each end for cabling – i.e. the 360mm dimension becomes 560mm. If the controller is to be fitted with a heat exchanger and insulated (see section 5), this envelope will have to be increased to 360 x 190 x 140 mm. An additional 20 mm on all three dimensions will be needed for the insulation.

If the larger array controller housing is required, the envelope increases to 360 x 175 x 280 mm with a corresponding increase for heat exchanger. Allow an additional 100mm at each end for cabling – i.e. the 360mm dimension becomes 560mm.

Figure 5 shows the mechanical envelope for the standard power supply, measuring 230 x 200 x 110mm. Allow an additional 100mm for cabling – i.e. the 230mm dimension becomes 330mm. If the larger power supply is required, the envelope increases to 312 x 210 x 134 mm.

Figure 6 shows the mechanical envelope of the subsystems controller, measuring 250 x 230 x 120 mm. Allow an additional 100mm for cabling – i.e. the 250mm dimension becomes 350mm.

Figure 7 shows the mechanical envelope of the ion pump controller, measuring 107 x 130 x 164 mm. Allow an additional 130mm for cabling – i.e. the 164mm dimension becomes 294mm.

3.3 Mount Points

Figure 3 shows the detector housing mount plane being co-incidental with the optical focal plane as a 3-point kinematic system (ball-and-groove), centered on the optical axis, 35 mm behind the front surface of the cryostat window.

Figure 4 shows the standard size array controller mount point consisting of eight holes, tapped M6. Two of the holes at the fans are unusable (see Figure 4). Note that the end connecting to the detector housing has a connector length limit of 2000 mm wire length.

Figure 5 shows the standard power supply mount point consisting of 4 x M6 clearance holes.

Figure 6 shows the subsystems controller mount point consisting of 4 x M5 clearance holes.

Figure 7 shows the ion pump controller mount point.

3.4 Centre of Gravity

The CG of the array controller shall lie within a volume of 15 x 15 x 15 mm centred on the locations as depicted in Figure 8. This must be updated if the heat exchanger type of controller is used.

The CG of the power supply shall lie within a volume of 10 x 10 x 10 mm centred on the locations as depicted in Figure 9.

The CG of the detector housing shall lie within a volume of 10 x 10 x 10 mm, measured 50 ± 5 mm with respect to its mount point as depicted in Figure 10.

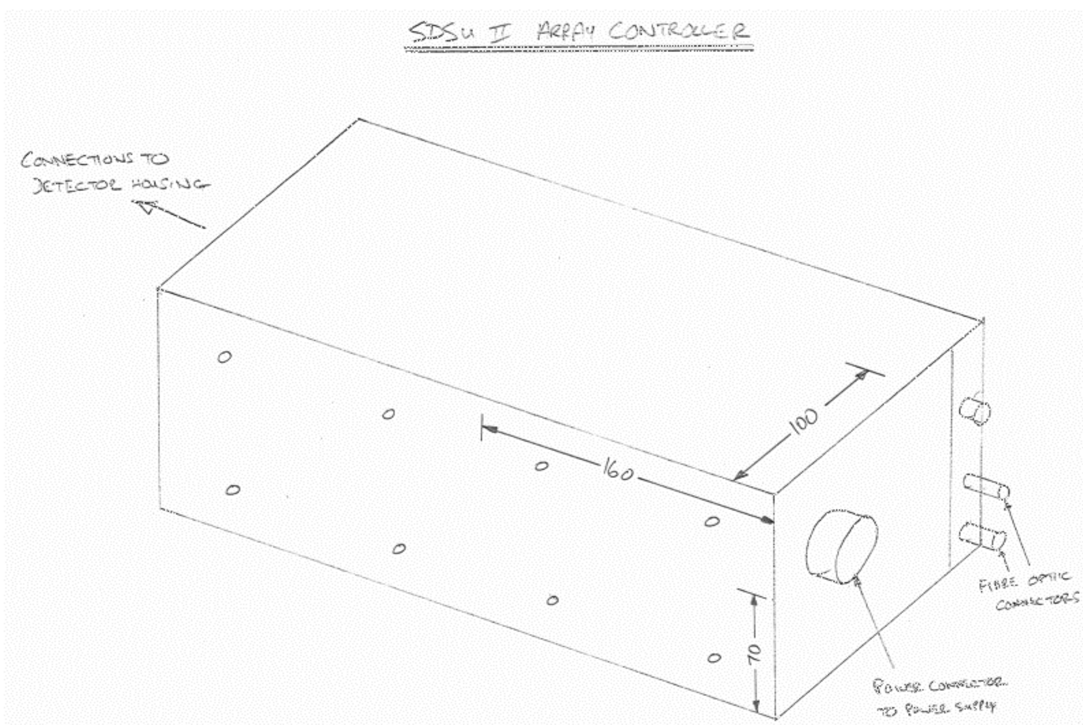


Figure 8 shows the centre of gravity of the standard SDSU II array controller. (Update if the heat exchanger version is to be used).

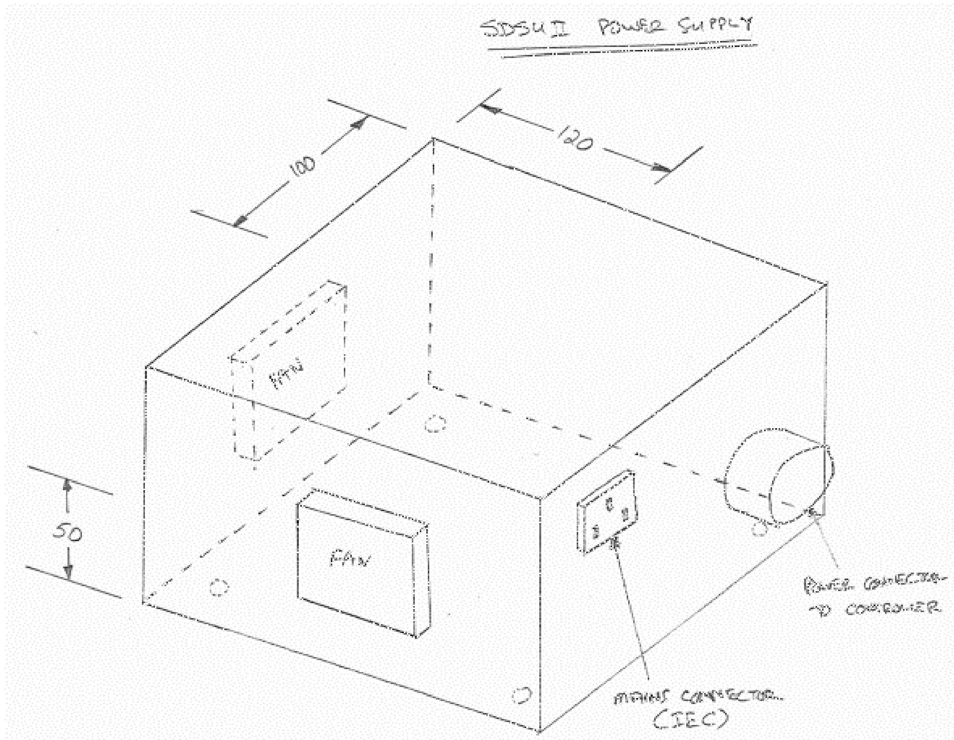


Figure 9 shows the centre of gravity of the standard SDSU II power supply.

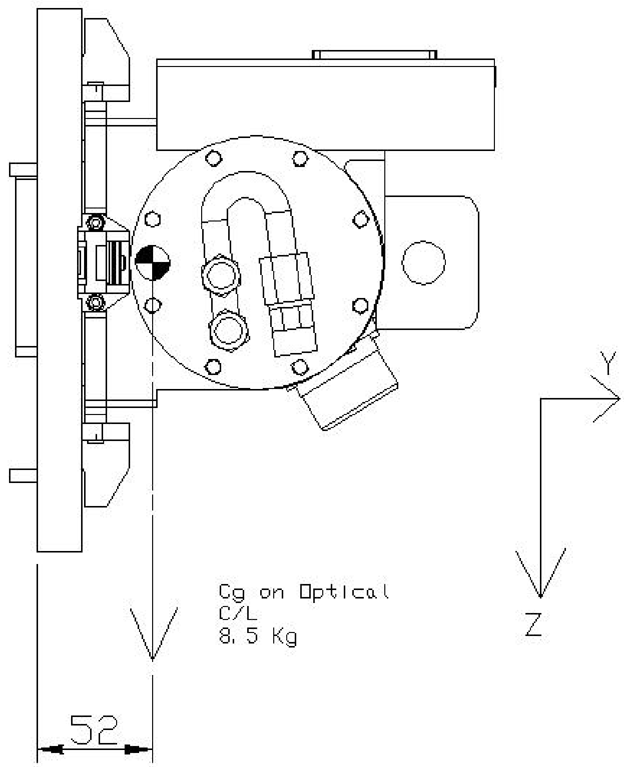


Figure 10 shows the centre of gravity of the detector housing.

Table 1: Systems power requirements for PFIS Detector Package

SYSTEM	LOCATION	VOLTAGE	POWER
Array controller Power Supply	Payload	*UPS 220v	0.15 kW
Ion Pump Controller	Payload	UPS 220v	0.04 kW
Sub-Systems Controller Power Supply	Payload	UPS 220v	0.1 kW **TBC1**

*UPS = "Detector" UPS power.

3.5 Handling Fixtures

The Detector Subsystem components shall accommodate cranes and hoists with suitably placed 1/2-13 threaded holes. Their location will depend on the detailed mechanical design, but should allow the components to be lifted in an attitude suitable for integration with the PFIS structure.

3.6 Shipping Container

The Detector Subsystem components shall be delivered to UW in a container suitable for reuse in shipping the components to South Africa. The shipping container(s) shall provide for the safe transport of the components, and any tools and fixtures required to assemble, install, remove, and disassemble the Detector subsystem; it will be suitable for any combination of road, rail, air, or sea transportation.

4 Electrical

This section specifies the electrical interface between the PFIS and the Detector subsystem.

4.1 Electrical Power

Electrical power is provided by the facility and is described in the PFIS-PFIP ICD. Power requirements are listed in Table 1.

The mains power to the array controller is to be "clean" UPS power while the Cryotiger compressor is to be supplied from "dirty" UPS power. The clean UPS mains power will be fed to the SDSU power supply which will in turn provide power to the array controller and detector. The SDSU/CCD system must NOT be remotely controllable in order to avoid inadvertent switching off. Manual switch on/off only.

4.2 Electrical Connectors

The Detector subsystem shall use the same style electrical connectors as PFIS. The type is IEC type.

4.3 Signal Connectors

The array controller is connected to its host computer via a dual optical fibre bundle (labeled Twin Fibre in Figure 1). This bundle shall be routed through the tracker wrap-up and will pass through the PFIS master interface panel without any interruption, i.e. the fibre optic is a point-to-point connection between the array controller on the one end and the host computer on the other end.

The fiber connector type is as supplied by ARC (Astronomical Research Cameras).

The array controller will also be connected to the detector cryostat by a cable no more than 2000 mm in length.

4.4 Shutter Control

The SDSU array controller uses one control signal for shutter open/close commands. A logic value of 0 will instruct the shutter to open, and a value of 1 to close.

Two TTL level shutter status signals will indicate that the shutter is in its fully open (logic 0) and fully closed position (logic 0).

The PFIS wire harness shall include wires for these signals. All electrical signals between the array controller and PFIS shall be optically isolated. The SDSU controller will have a 9-pin male D-type connector on the connector panel for shutter control. Opto-isolation will be done inside the PFIS PXI control box. Pinout function will be as follows:

Pin 1: Shutter control +V (300 ohms to +5 volts at SDSU end).

Pin 2: Shutter control signal = logical "0" to open shutter (open collector NPN transistor at SDSU end [there is a photodiode between pins 1 and 2 on PFIS end]).

Pin 3: Shutter open = logical "0" (open collector output of an opto-isolator on PFIS; SDSU has a 4.7K pullup to +5 volts).

Pin 4: Shutter closed = logical "0" (open collector output of an opto-isolator on PFIS; SDSU has a 4.7K pullup to +5 volts).

Pin 5: Shutter status signal return (SDSU signal ground; isolated from PFIS system ground).

Pins 6-8: N/C

Pin 9: PFIS chassis ground (for cable shield; if shield connected on PFIS, open at SDSU end to avoid chassis currents flowing on shield between systems).

5 Dry Air

In order to prevent the detector cryostat window from misting over, a dry air purge is applied. The dry instrument air, as supplied by the facility will be clean enough for this purpose. The optics purge overpressure exit may act as the window dry air purge.

6 Cryogenic and Refrigeration

The Detector subsystem requires both cryogenic cooling for the detector housing, and refrigeration for heat disposal from the SDSU detector array controller and its power supply, the ion pump controller, and the subsystems controller. Thus, the facility shall deliver glycol coolant to the PFIS master interface panel. The connector is specified in the PFIS/SALT ICD. The glycol shall be routed within the PFIS to the locations of the SDSU power supply, the SDSU array controller, the ion pump controller and the subsystems controller. The cooled components shall use the same type of connector. The type of connector is **TBD7**.

The cryocoolant will be routed from the Cryotiger compressor, through the Cryotiger hose to the detector housing. The Cryotiger hose shall be routed from the Igloo, up through the tracker wrap-up, and then to the PFIS master interface panel. Note that although this hose is relatively flexible to bend, it does not allow any movement in twist. This hose shall be a combination of flexible stainless steel hose (as supplied by the cryotiger manufacturer) and solid copper tubing to enable disconnection for maintenance purposes. Flexible hose shall arrive at the PFIS master interface panel. In contrast to earlier versions of this document, there shall be no break in the hose at the master interface panel; instead the hose shall be routed through the panel straight to the detector. The detector housing connector type is **TBD6**.

There are two possibilities of implementing the cooling of power supplies and controller units (**TBD8)** – either using a standard “SALT cooler box” (probably the best option for everything but the array controller. This solution is depicted in Fig. 4) or modify one or more external surface(s) to be a glycol heat exchanger and insulate the complete component (probably the best option for the array controller - most probably the side marked “HOT SIDE” in Figure 4). Although the array controller is shown in Fig. 2 as in the cooler box, if the heat exchanger option is used it will not be in the cooler box.

6.1 Cooler Box

Note that none of the options detailed below have a defined space for the heat exchanger as the heat exchanger details are currently unknown. There is unused volume in all the permutations which *may* be big enough for a heat exchanger.

Space has been allowed space for mounting the units inside the boxes such that air circulation holes/fans are not restricted.

The dimensions are internal requirements - the box wall thickness along with insulation is currently unknown. From conversations with Leon Nel, Payload and Tracker Sub-Project Manager, the payload cooler boxes will likely be 25 mm thick: 15 mm for structural material and 10 mm for insulation. It is therefore suggested that 50 mm is added on to the dimensions given below to assess the volume required.

The PFIS cold box possibilities work out to two options:

6.1.1 Option 1.

Two separate cold boxes, one for the SDSU controller crate, the second for the Sub-systems controller(SSC), Ion Pump controller and SDSU power supply. Dimensions used are assuming the large power and controller crate:

Box 1: SDSU controller

Internal dimensions, L x W x H: 670 x 320 x 240 mm.

Cable access through both end faces - i.e. the 320 x 240 mm faces.

One end face takes all the cabling to the detector cryostat, so must be oriented on the structure such that the resulting cable length to the cryostat is less than two meters.

Box 2: SDSU PSU, Ion Pump, SSC

Internal dimensions, L x W x H: 400 x 400 x 250 mm.

Cable access through side face - i.e. a 400 x 250 mm face. This face

must be removable/opening for installation/removal of the units.

6.1.2 Option 2.

One single cold box that must be within 2m cable length of the cryostat.

Internal dimensions, L x W x H: 670 x 320 x 420 mm.

Cable access through both end faces (the 320 x 420 mm faces) is most convenient, but we can organise things internally to utilize only one face if necessary. One end face must be within 2m cable length of the cryostat. Both end faces should be removable for installation/removal of the units.

7 Computers and Communications

This section specifies the computer and communications interface between the PFIS and the Detector subsystem.

The array controller will be controlled with LabView on a Linux or "Real Time" (RT) Linux PC with a PCI backplane (labelled SAAO PC: **PDET** in Figure 1). The LabView front end will communicate with an RT Linux Module or a normal Linux C application which will control the array controller.

Communications between the PFIS and/or its control PC (**PCON**) and the Detector Subsystem PC **(PDET)** will be on Ethernet, under the control of LabView's network communications protocol.

The Detector Subsystem will provide (via standard LabView protocols) all relevant information about itself. The details are in the Software Document (SALT-3199AS0001 Software Issue 1.1.doc).

8 Software

This interface is specified in the Software Document (SALT-3199AS0001 Software Issue 1.1.doc).

9 Maintenance

The PFIS CCD cryostat will require occasional vacuum pump-downs at a frequency of around 6 months. This will be done with the cryostat in-situ, using a portable vacuum pump, connecting to the cryostat by means of a flexible vacuum hose. The portable vacuum pump will be secured in position as near as possible to the PFIS cryostat for the duration of the pump-down using suitable hooks, clamps, brackets, etc. the type and position(s) of which is to be agreed upon with SALT (**TBD15**). It should be noted that the shorter the vacuum hose between the vacuum pump and the cryostat, the better for achieving a good vacuum in a short time. The connector type will be a standard KF25 flanged vacuum connector.

Regeneration (vacuum baking) of the cryostat getter material will not be required at vacuum pumpdown since activated charcoal is to be used as the getter material. Charcoal outgases its cryopumped gas load when warmed up to room temperature. The cryostat will thus not be required to be opened up for vacuum maintenance.

10 List of TBD And TBCs

TBD1 - Total weight budget for detector subsystem

TBD2 - Standard or Large SDSU controller/power supply

TBD6 - Detector housing connector type

TBD7 - Cooled unit connector type

TBD8 - Alternative cooling schemes for array controller and its power supply

TBD15- Hook and clamps for securing the vacuum pump during vacuum maintenance

TBC1 - Subsystem controller power requirement.