# APPROVAL SHEET

**TITLE**: Prime Focus Image Spectrograph (PFIS) ICD of the Southern African Large Telescope (SALT)

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**SYNOPSIS**: This document describes the Interface between PFIS and various subsystems of the Southern African Large Telescope (SALT).

**KEYWORDS**: ICD, PFIS

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**DATE**: May 2003

This issue is only valid when the above signatures are present.
# ACRONYMS AND ABBREVIATIONS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>µm</td>
<td>Micron</td>
</tr>
<tr>
<td>arcsec</td>
<td>Seconds of arc</td>
</tr>
<tr>
<td>VI</td>
<td>Virtual Instrument</td>
</tr>
<tr>
<td>CCD</td>
<td>Charge-coupled Device (Camera)</td>
</tr>
<tr>
<td>Deg</td>
<td>Degrees</td>
</tr>
<tr>
<td>PM</td>
<td>Primary Mirror</td>
</tr>
<tr>
<td>MMI</td>
<td>Man-Machine Interface</td>
</tr>
<tr>
<td>SDSU</td>
<td>San Diego State University</td>
</tr>
<tr>
<td>PFIS</td>
<td>Prime Focus Imaging Spectrograph</td>
</tr>
<tr>
<td>RA, DEC</td>
<td>Right Ascension and Declination</td>
</tr>
<tr>
<td>SALT</td>
<td>Southern African Large Telescope</td>
</tr>
<tr>
<td>TBC</td>
<td>To Be Confirmed</td>
</tr>
<tr>
<td>TBD</td>
<td>To Be Determined</td>
</tr>
<tr>
<td>TCS</td>
<td>Telescope Control System</td>
</tr>
</tbody>
</table>
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1. **Scope**

1.1 **Identification**

This document describes the interface between PFIS and the various subsystems of SALT. The subsystems are:

a) Tracker rotation stage  
b) Guidance Probes  
c) SALTICAM (slit image)  
d) Igloos behind Primary Mirror  
e) Cooler Boxes on TOP HEX  
f) Cooler boxes for electronics on PFIS  
g) Computer Room  
h) Control Room  
i) Glycol and air Supply  
j) Electrical Power
2. **Interfaces**

2.1 PFIS

The PFIS can be divided into the following major components that will have interfaces with the Payload Structure and or other parts of SALT:

- Cooler Boxes on PFIS, enclosing all PFIS electronics
- Structure (Which will mount onto Tracker Rotation Stage)
- Cryocooler (mounted in a cooler box behind the Primary Mirror-called the Igloo)
- PFIS computer (Located in control Room)
- PFIS Man Machine Interface (MMI) display and controls, called from any computer on the network

Note: A cryocooler will also be required for the commissioning instrument. If possible both the PFIS and Commissioning instrument can use the same one.

The following schematic diagram shows the location of the various PFIS subsystems and interfaces. Interfaces are numbered and will be discussed subsequently (i indicates internal and e external interfaces).

![Figure 1](image-url)
The subsequent sections will describe the various external interfaces of PFIS.

### 2.1.1 PFIS Detector Computer <-> TCS Server (1e)
#### 2.1.1.1 ELECTRICAL

- a) Network connection
  1) Connectors
  2) Electrical wiring details
  3) Distance
- b) Precise Time Signal (TBC)
  1) Connectors
  2) Electrical wiring details
  3) Distance

#### 2.1.1.2 DATA

- a) Health status information (TBD)
- b) Commands for slit alignment (TBD)
- c) RA and DEC (TBC)

### 2.1.2 PFIS <-> Electrical Power (2e)

- a) Power Supply

![Diagram of electrical power distribution](Figure 2)
NOTE: SALT to Supply Power up to Isolator Switches, from there it is the responsibility of PFIS

See Tracker Payload Electrical interface diagram in Appendix A

b) Cable Routes to TOP HEX and Igloo behind Primary Mirror

![Diagram of cable routes and marker distances]

<table>
<thead>
<tr>
<th>Distance Marker</th>
<th>Distance[m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>6.557</td>
</tr>
<tr>
<td>S2</td>
<td>2.676</td>
</tr>
<tr>
<td>S3</td>
<td>6.557</td>
</tr>
<tr>
<td>S4</td>
<td>4.209</td>
</tr>
<tr>
<td>S5</td>
<td>1.500</td>
</tr>
<tr>
<td>S6</td>
<td>3.300</td>
</tr>
<tr>
<td>S7</td>
<td>12.986</td>
</tr>
</tbody>
</table>

Figure 3

Cable List

See cable list table 2.1.9 (page14)

2.1.3 PFIS <-> Glycol and Air Supply (3e)

a) SALT to supply glycol to cooler boxes and Igloo.
b) Clean air supply: Outlet supplied by SALT on Payload
   1) Flow rate 3l/min
   2) Pressure 6bar (+-1)
c) Normal air supply: Outlet supplied by SALT on Payload
   1) Flow rate 3l/min
2) **Pressure 6bar (+/-1)**

d) Glycol
   Female quick couplings, Parker fluid connectors, 6145 Lewis road, Minneapolis, MN 55427, website
   [www.parker.com/quickcoupling](http://www.parker.com/quickcoupling)
   Part No: BH4-60 (2 off)

   Air
   Female quick couplings, Parker fluid connectors, 6145 Lewis road, Minneapolis, MN 55427, website
   [www.parker.com/quickcoupling](http://www.parker.com/quickcoupling)
   Part No: BH2-60 (1 off)

e) Electrical and Connector
f) Maximum Cooling Capacity Available to PFIS: 1.3Kw
Note:

3) The system specification requires that no subsystem in the optical path should:
   • have a surface temperature of more than 8degC above ambient.
   • have forced-air cooling which is exhausted into ambient
   • dissipate more than 4Watts continuously to ambient, if so the item must be housed within an
     enclosure from which heat will be removed by the Glycol system

4) The system specification requires that no subsystem outside the optical path should:
   • have a surface temperature of more than 8degC above ambient.
   • have forced-air cooling which is exhausted into ambient
   • dissipate more than 6.5Watts continuously to ambient, if so the item must be housed within an
     enclosure from which heat will be removed by the Glycol system

2.1.4 PFIS Structure <-> Tracker Rotation Stage – 4e

2.1.4.1 Physical
a) PFIS – Tracker Rotation Stage interface drawing

See next paragraph for an explanation of the coordinate system.

See Appendix B for complete mechanical Tracker Payload Interface.
b) PFIS – Orientation relative to SALTICAM

The picture below shows the telescope configuration in V I mode. The coordinate system is centred on the PFIS focal plane. The sky is in the negative Z-direction. SALTICAM will be mounted in the YZ plane (below the star tracker head in the figure below), with the PFIS slit coincident with Y. The fixed mounting point of PFIS and the structure carrying SALTICAM will be on X. +Y is at a nominal elevation (relative to local horizon) of 37°.

See PFIS figure 6 shown in ACSI mode – page 11
2.1.4.2 Constraints

a) Mass of PFIS < 525kg (including Infra Red Beam and Star Tracker)

b) Volume above prime focus:
c) Centre of Gravity in a cubic volume of less than 20x20x20cm, centred less than 65cm above the focal plane.

d) Structural stability of mechanical mounting points (under all loading and environmental conditions):
   (i) Stability of mounting points relative to one another, in z-direction, should be less than 10 microns. (peak to valley 20µm)
   (ii) Global tilts relative to optical axis shall be less than 100 arc seconds
   (iii) Movement in focus direction shall be less than 100 microns

e) Accessibility
   (i) Slit mask replacement once a week
   (ii) Filter wheel replacement once a month

f) Adjustability: The PFIS structure shall provide mechanisms to adjust alignment with the focal plane and optical axis. This means 5 degrees of freedom adjustability, x, y, z, tip and tilt. The ranges to provide for is as follows:
   (iii) X, Y >= 3mm
   (iv) Z >= 2mm
   (v) Tip and Tilt < ± 0,05°

2.1.5 PFIS Structure <-> Guidance Probe – 5e

2.1.5.1 Physical

PFIS interface plate.
2.1.6 TOP HEX Cooler Box <-> TOP HEX – 6e

2.1.6.1 Physical

a) Dimensions of packaging space required by PFIS: 480 x 380 x 270mm
b) Cooling Capacity required: TBD
c) Interface between Cooler Box and electronics Frame: TBD
d) The figure below depicts the layout on the top hex.
2.1.7 PFIS Cooler Boxes <-> PFIS Structure – 6e

2.1.7.1 Physical

a) Dimensions of packaging space/s required by PFIS: TBD
b) Cooling Capacity required for each: TBD
c) Interface between Cooler Box and electronics Frame: TBD

2.1.8 Layout of igloo behind Primary Mirror – Figure 9
### 2.1.9 Cable List

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Cable Source</th>
<th>Cable Destination</th>
<th>No. cores</th>
<th>Length (m)</th>
<th>Description</th>
<th>Cable OD</th>
<th>Supplier</th>
<th>Cable No</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCON Computer</td>
<td>Electrical Room</td>
<td>Computer Room</td>
<td>3</td>
<td>1</td>
<td>220 V</td>
<td>10</td>
<td>SALT</td>
<td>C138</td>
</tr>
<tr>
<td>PFIS AC</td>
<td>Electrical Room</td>
<td>UPS</td>
<td>3</td>
<td>61.3</td>
<td>220 V</td>
<td>10</td>
<td>SALT</td>
<td>C138</td>
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<tr>
<td>DET Power Leach Control</td>
<td>PFIS Igloo</td>
<td>(Top Hex)</td>
<td>3</td>
<td>46</td>
<td>220 V</td>
<td>10</td>
<td>SALT</td>
<td>C2111</td>
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<tr>
<td>Fiber Optic - Leach</td>
<td>Computer Room</td>
<td>Detector Box</td>
<td>2</td>
<td>110.8</td>
<td>Fiber</td>
<td>5</td>
<td>PFIS/SAAO</td>
<td>C2102</td>
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<tr>
<td>Fiber Optic - PXI Chassis</td>
<td>PCON PC</td>
<td>Computer room</td>
<td>2</td>
<td>110.8</td>
<td>Fiber</td>
<td>5</td>
<td>PFIS</td>
<td>C2103</td>
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<td>RS232 - Etalon</td>
<td>PCI Box</td>
<td>Etalon Controller</td>
<td>2</td>
<td>26</td>
<td>Copper</td>
<td>5</td>
<td>PFIS</td>
<td>???</td>
</tr>
<tr>
<td>Queensgate: xyz + signal</td>
<td>Etalon Controller</td>
<td>(Top Hex)</td>
<td>8</td>
<td>26</td>
<td>Coax</td>
<td>5</td>
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<td>C2123</td>
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<tr>
<td>Queensgate: HV</td>
<td>PFIS (Vis)</td>
<td>(Top Hex)</td>
<td>2</td>
<td>26</td>
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<td>10</td>
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<td>C2136</td>
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<tr>
<td>Queensgate: AC</td>
<td>PFIS Top Hex</td>
<td>(Vis)</td>
<td>3</td>
<td>26</td>
<td>220 V</td>
<td>10</td>
<td>PFIS</td>
<td>C2137</td>
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<tr>
<td>Star Tracker AC</td>
<td>PII Star Tracker</td>
<td>2</td>
<td>5</td>
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<td>10</td>
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<tr>
<td>Star Tracker Video signal</td>
<td>Payload</td>
<td>Computer Room</td>
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<td>C2133</td>
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<td>5</td>
<td>PFIS</td>
<td>C2133</td>
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<td>Cryotiger coolant supply</td>
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<td>PFIS (Vis)</td>
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<td>Braided steel</td>
<td>15</td>
<td>PFIS/SAAO</td>
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<tr>
<td>Cryotiger Coolant return</td>
<td>PFIS Igloo</td>
<td>Igloo - PM</td>
<td>1</td>
<td>46</td>
<td>Braided steel</td>
<td>15</td>
<td>PFIS/SAAO</td>
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<tr>
<td>Compressed dry air - instr</td>
<td>see payload</td>
<td>sheet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycol</td>
<td>see payload</td>
<td>sheet</td>
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<td></td>
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<td>25</td>
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<td></td>
<td></td>
<td>PFIS</td>
<td></td>
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</table>

**Note:** Main Supply power is 220V ac – general mains and UPS.
3. Appendix A

Figure 11
4. Appendix B

Figure 12