BiSON Birmingham Solar-Oscillations Network

TECHNICAL REPORT NO. 276

The Grand Opening of the Sutherland Zoo

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2006 October 16

This technical report series is published by:

THE UNIVERSITY OF BIRMINGHAM

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Abstract

The zoo software is installed in Sutherland on a new computer.

1 Introduction

Ian Barnes and Brek Miller visited Sutherland for two weeks from 2006 June 25 to July 11 in order to replace the computer and install the zoo software. Sutherland was the last of the BiSON stations that was still running with a DOS computer. Steven Hale described [1] the condition of the station prior to our visit.

The complete list of tasks that were due to be undertaken was as follows:

- Remove 2-D Spectrometer.
  - Re-balance the mount.
  - Pack the 2-D spectrometer into its shipping crate and return it to Birmingham.
- Install new Linux computer.
  - Install and configure the Sutherland Zoo.
  - Upgrade network to 100Mbps via a new media converter unit.
- Build a new timber electronics rack.
- Install Temperature Monitor System.
- Install network camera.
- Install GPS unit.

- Install IBPCD.
- Look at resolving the steps in the data.
- Tank temperature control modifications.
  - Remove Richard Bryan's tank controller hardware.
  - Remove Piet Fourie's Cal based tank controller hardware.
  - Replace the two tank temperature probes.
  - Install solid-state relays so that the computer can control the water tank temperature.
- Look at modifying the temperature controllers to provide more power to the interference-filter heater.
- Replace the LDR that is being used as a cloud detector.
- Replace damaged cables to the sensors on the weather arm.
- Replace dome rollers.

2 Software

The installation of the zoo software went smoothly. Like Carnarvon, Narrabri, Mount Wilson, and Las Campanas, the new data-acquisition system is based on a PCI-1753 96-channel digital I/O card [2]. In Las Campanas, we tried [3] connecting the electronics to the PCI-1753 using a new DIO splitter board [4] and three pre-made 37-pin D-connector cables. It worked very well; so we decided to use it on this zoo as well.

Like all other zoo opening, things started with a grand reorganization in the dome. First, we removed the 2-D device from the mount and removed all of the 2-D electronics from the dome. Then, just like in all of our other zoos, we built a timber rack and moved the remaining electronics to it. In this case, our chosen location for the timber rack — the only reasonable place it could go — was occupied by part of a large L-shaped table. We couldn't just move the table out of the way; it was too big to move around in the dome. It had clearly been assembled in place; so we had to take it apart. The workbench also had to be moved and we removed the 2-D 19-inch rack from the dome entirely. This zoo opening involved more furniture moving than any other.

Other than the delays associated with the reorganization, the rest of the zoo installation went reasonably well. Several cables were too short; we remade one of them and built extensions for the others. Some resistors needed to be changed on Interface Module 3 and the Autoguider Module. These changes were known about in advance and are described elsewhere [4].

3 Temperature Monitor Installation

We installed the Sutherland Temperature Monitor [5, 6] on this trip. These monitors have been installed at other BiSON stations and can be used to monitor a wide range of temperatures and other parameters. The temperature monitor can monitor up to sixteen separate channels. The channels on the Sutherland temperature monitor have been allocated as shown in Table 1. The lizard writes one set of temperature readings to the temperature file (*/home/zoo/Results/st*yymmdd*.dat*) every thirty seconds. The component corresponding to each column in this file are also shown in Table 1.

Table 1: Temperature Channels

Channel	*Temperature File Column*	*Description*
0	1	Water Tank Temperature — Top
1	2	Water Tank Temperature — Bottom
2	3	Spectrometer Base Plate Temperature
3	4	Interference Filter Temperature
4	5	Oven Temperature
5		—
6	6	Port Detector Temperature
7	7	Starboard Detector Temperature
8		—
9	8	Dome Ambient Temperature
10	9	Room Ambient Temperature
11		External Ambient Temperature
12	10	Cloud Detector Voltage
13		—
14		—
15		—

Figure 1 shows the entire temperature-monitor system as installed in Sutherland. For more detailed information on the Sutherland Temperature Monitor, consult BTR-277.

4 Temperature Control System Modifications

On this visit, we made several changes to the temperature-control system. Before we describe those, let us first describe how things were setup when we arrived.

The detectors and the oven in Fred were controlled by Richard Lines temperature controllers [7]. The interference filter (IF) was controlled by a CAL 9900; through a Richard Lines

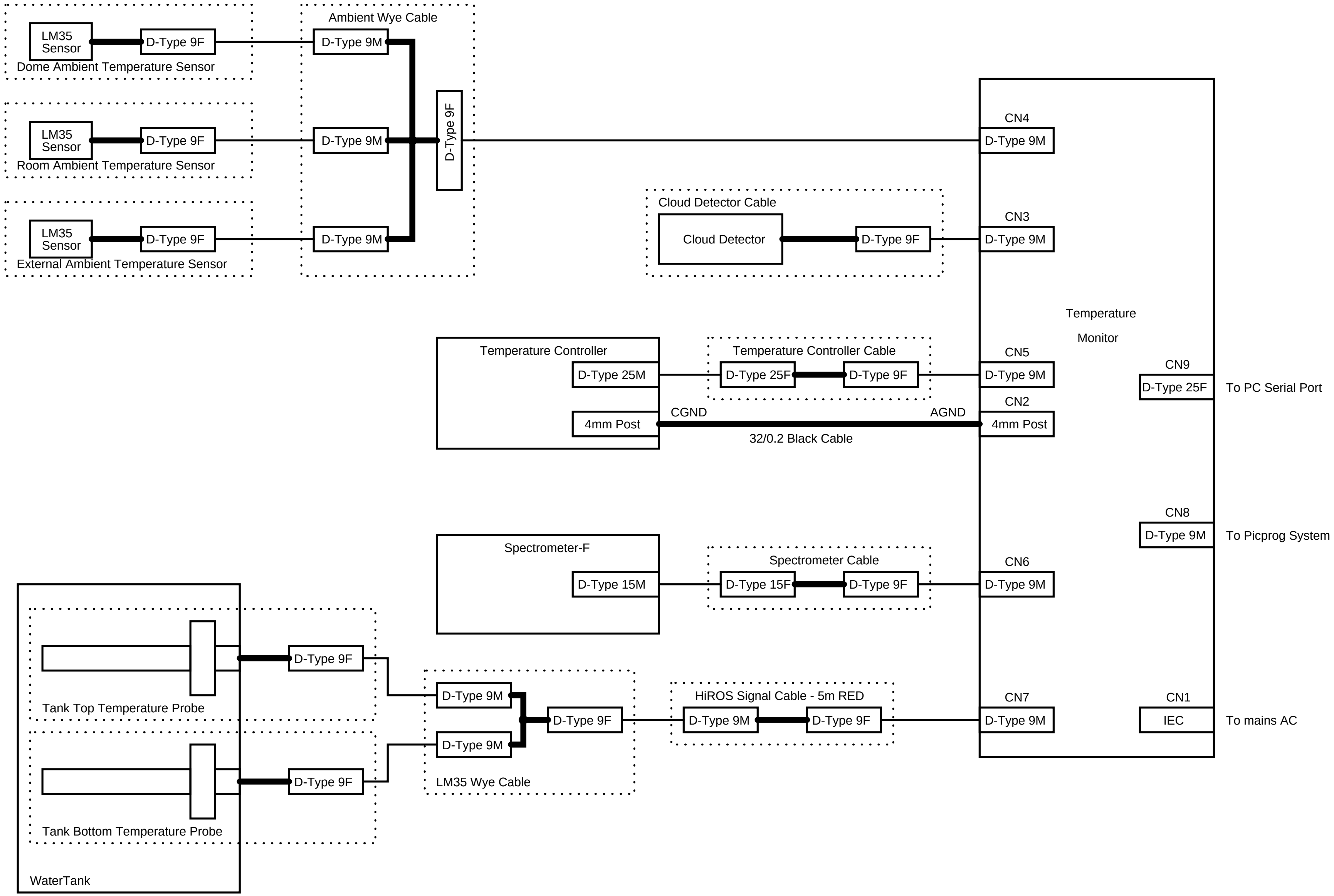

Figure 1: The temperature monitor system diagram.

Table 2: CAL Settings

Function	*Function Description*	*Old Option*	*New*[†] *Option*	*Option Description*
*	set point	32.0		
2	SP2 adjust	0.5		
3	SP1 lock	0		unlocked
4	SP1 proportional cycle time	8		0.3 s
5	SP1 proportional band	AT 2.0	AT 3.0	% of CR
6	SP1 derivative time	AT 5	AT 4	seconds
7	SP1 approach control	AT 1.0		× prop. band
8	SP1 integral time	AT 1.9	AT 1.5	minutes
9	sensor error correction	-5.8		
10	SP2 proportional cycle time	0		
11	SP2 proportional band	0		
12	loop break alarm	0		out
16	sensor select	9		PT100
17	negative temperature ranging	0		disabled
18	display resolution	1		high res
19	SP2 operating mode	0		out
20	SP1 sensor break	0		upscale
21	SP2 sensor break	0		upscale
22	deg C / deg F	0		deg C
24	configured range (CR)	75		
26	SP1 heat power limit	0		100%
27	SP2 cool limit	0		100%
28	SP1 Output	0		
29	SP1 LED	0		
30	SP2 Output	0		
31	SP2 LED	0		
32	error indicator resolution	0		normal
33	temperature display sensitivity	0		normal
34	derivative polling ratio	0		0.5× derv. time
35	sensor span adjust	0		
36	SP2 latch alarms	0		normal

[†]Not shown if it is the same as the old option.

power stage built on a piece of Veroboard. The spectrometer was cooled by a water loop incorporating a 1500-liter tank outside the dome. There was a heating element inside the tank and a Neslab Flow-Thru cooler inside the dome; both of these were controlled by CAL 9900s. The tank had an insulating jacket on it.

The first problem was that the insulating jacket was too good at keeping the heat in. The tank was loosing heat far too slowly, even in the winter. During the afternoons, the spectrometer temperature was getting too high and the detector temperature controllers were losing control of the detector temperatures.

We removed the insulating jacket on this visit. This allowed the water in the tank to cool. The spectrometer became quite cold and the IF temperature controller was unable to maintain the temperature of the IF. We anticipated this problem — it was the reason the heater and insulation were added to the tank in the first place.

We modified the power circuit on the Veroboard in the IF controller. It used to return the current to ground; we changed it so that it now returns the current to −15 V. Now the controller can put a full 30 V across the IF heating elements instead of just 15 V. The IF controller is now able to maintain the correct IF temperature, even when the spectrometer is very cold.

We also removed the two CAL 9900s that were controlling the heater and cooler. Instead, we connected the heater, cooler, pump, and dome extractor fans to the computer. Each of these can now be turned on and off under software control. However, there wasn't time to write control software. Brek hopes to do that in Birmingham shortly.

We had hoped that these changes would be all that were required. However, on one of the power cycles, the oven temperature controller did not come back to life. We traced the problem to a blown 2.5-V reference. We didn't have an exact replacement. Instead, Ian connected up a TLE2425 2.5-V reference on a piece of Veroboard. It's now hanging off the back of the temperature controller crate. It looks ugly, but it does seem to be working.

Later, after our return to Birmingham, it was discovered that the oven temperature controller has difficulty keeping the oven at the correct temperature when the spectrometer is very cold. Steve Hale wrote a quick cron job to turn the heater on and off. It's working ok for now. A better, more complete control program will be written later.

Also later, after our return to Birmingham, it was discovered that the IF temperature controller was oscillating slightly. Our modification to the power circuit in the IF controller effectively doubled the proportional gain of the device. On September 6, Piet Fourie ran the CAL 9900 through its autotune routine — it selected new parameters. The old and new CAL 9900 settings are shown in Table 2. The IF temperature is no longer oscillating.

5 Pockels-Cell Driver Installation

The Sutherland station has not been visited at all for a number of years and it was still using a very old design of Pockels Cell driver. It was decided that on this trip, the two single units were to be replaced with a new dual unit — the IBPCD.

The IBPCD was tested back in Birmingham and seemed to be pretty reliable although at this stage it is still a prototype design. The decision was therefore taken to install the unit in Sutherland as it was felt that the new IBPCD was superior to the units that were in use at present.

Once all of the wiring between the IBPCD and "Fred" was completed there was a problem. There appeared to be no power to one of the drivers. Further investigation found that there was a damaged pad on the Power board that had to be fixed with some wire.

Once the unit was fixed it was noticed that the output was very unstable indeed and the output was oscillating. Further investigation found no reason for the oscillating output and it was decided that as it was near the end of the trip that the original drivers be installed instead. The IBPCD would be returned back to Birmingham for further investigation.

One possible reason for the oscillation was the power supply that is available in Sutherland. Whilst on site it was found that the voltage over there was pretty low compared to the UK. This would mean that the power supply was supplying a dc voltage to the LM12 op-amp that was right on the minimum supply threshold. However this theory can only be tested back in Birmingham.

When the problem with the IBPCD has been found and rectified, the existing Pockels Cell drivers will be replaced in Sutherland.

6 Coarse Filter Problems

We discovered the cause of the steps in the data — the coarse-filter retaining ring had come loose and fallen out. We had trouble putting it back in because it was slightly bent and the threads were in bad condition. Although we were able to secure the filter, the front lens assembly is not satisfactory. We will ask Barry Jackson to make a new one.

7 The Removal of the 2-D Device

We removed the 2-D device and rebalanced the mount.

Piet Fourie had located the original 2-D shipping crate and brought it up to the top of the mountain for us. We removed the chassis of the 2-D device from the (very heavy) baseplate. We put the chassis into the crate, but we decided not to keep the baseplate. Because of its weight, it would make shipping the 2-D back to Birmingham more expensive and we believe that if we do use the Spindler and Hoyer-type chassis, we will make new plates for it anyway.

We removed Leysop Pockels Cell L8 from the 2-D device and carried it home separately.

We removed the 2-D and all of its electronics from the dome. We sorted everything out and decided which items were worth returning to Birmingham and which were not. We put the things worth returning into the shipping crate and left the other items in one of Piet's empty offices. Piet said he would dispose of these items later.

We did not have the time nor the materials to properly pack the crate. We left it with Piet. Someday, he may have time to pack the crate. Or perhaps one of us will do it on a future visit to Sutherland. Right now there is no pressing need for the items back in Birmingham.

8 Network Camera

An Axis 205 Network Camera has been installed in the dome. It is attached to the shutter just above the opening. It moves around in azimuth and up and down with the shutter.

The network camera has been assigned its own IP address, which is 10.2.4.3, and is known as *camera.bison.suth*. It can be accessed from anywhere on the SAAO internal network on port 80 (the WWW port) using any web browser. However, there is no access from the outside world to the camera. This is a good thing. We can still access our camera through the dome computer. You can login on the dome computer and get a single image:

```
% ssh sutherland
user@sutherland password: ******
sutherland% cd tmp
sutherland% wget http://camera.bison.suth/jpg/image.jpg
sutherland% exit
% scp sutherland:tmp/image.jpg .
% xv image.jpg
```

Or you can use **ssh** to setup a tunnel through the station computer and then access the network camera using a web browser on *bison*:

```
% ssh -fN -L 2000:camera.bison.suth:80
user@sutherland password: ******
% firefox http://localhost:2000/ &
```

The network camera requires two cable connections: one for the network and one for power. In order to make the installation easier and to reduce the number of cables connecting to the dome, the power for the camera is sent upstairs on one of the unused twisted pairs inside a normal network cable.

9 Dome Rollers

The SAAO staff on-site in Sutherland had been reporting to us that the dome rollers needed replacing. A complete set of new rollers were sent out to Sutherland and it was anticipated that they would be changed during the trip.

However there was insufficient time to replace the dome rollers and so the replacement parts remain on site.

The SAAO staff also mentioned that there was a modification to the APT dome which made the changing of the dome rollers very easy. We had a look at the APT dome but could find no evidence of the cut-out that was mentioned. Maybe it was our dome that was modified. Due to time issues the track on the dome was not checked for any modifications.

10 Further Work

Not all of the jobs that were allocated for the trip were completed. Also during the trip other work was discovered that will require a future visit.

The list of jobs that need doing at Sutherland is as follows:

- Design and build a new temperature monitor system.
  - Design new LM35 board that can eliminate the problems that are known with the current Sutherland Temperature Monitor system [6].
  - Design and build a small PCB that can house the cloud detector interface.
  - Build new Wye cables that do not have the RC filters in them as these will be fitted on the new LM35 PCB.
  - Design and build a new external ambient sensor with mounting bracket, that uses a similar thermocouple pocket like the tank probes.
  - Consider replacing the tank probes with new ones that do not contain a 2-kΩ resistor, which was included in an attempt to prevent the LM35 sensor from oscillating.
- Manufacture replacement red filter mounting pieces for the front of the Fred spectrometer [8].
- Design and build a V-to-F power-supply box using a standard 1U case to replace the bench power supply set-up that is currently in use.
- Install the GPS system.
- Refurbish the weather arm.
  - Replace rain detector cable.

  - Replace wind speed cable.
  - Install GPS antenna.
  - Replace the LDR of the cloud detector.

- Come up with a method to be able to turn the dome light on and off remotely.
- Replace the temperature controllers with a more powerful unit.
- Replace the clutch mechanism on the mount slew motor or install the Mount Controller which makes the clutch redundant.
- Install a working dual Pockels-cell driver.
- Provide a real-time data display for the visitor center.

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