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A Visit to Las Campanas After the Lightning Strike that Destroyed our Step-Down Transformer

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Abstract

A visit was made to Las Campanas in the wake of a major lightning strike. Our step-down transformer was replaced and everything to came back to life. Some problems with the clutch mechanism surfaced, but were dealt with. A new water-cooling system that included a 44-gallon oil drum was installed. And finally, some changes were made to the temperature controllers.

1 Introduction

Las Campanas has at best been on shaky ground since the last visit by Brek Miller [1]. On 1997 August 14, soon after Brek left, the computer started giving problems. At first it looked like it may be a hard-disk failure. However, as time went by, it was apparent that the symptoms were random.

This could be due to a memory problem with the new software. Brek sent the old version of `QSOOSY.EXE` to Las Campanas. Eventually on September 2 Hernan Solis and Patricio Pinto were able to get the computer working again. However, the good times were not to last long. On September 25, disaster struck.

A lightning strike on the main power distribution line wiped out our step-down transformer and a replacement had to be ordered. Our dome was without power until November 11.

2 A Melted Transformer

I arrived November 18 to find site basically working. The new transformer had been fitted ok. The old one was possibly the wrong type, it was a 5 kW step down from 2400 V to 120/240 V. It was possibly wired as 2400 V to 120 V which would give 240 V out from a 4200-V line. The new transformer is 4160 V in for 240 V out and is physically bigger than the old one.

I cannot see much evidence of a direct lightning strike. There is a big hole blasted in the old transformer, but the little metal hut in which it lives is completely undamaged. The same is true for the wires leading into the hut. It looks like a spontaneous failure possibly brought on by a small spike overstressing an already abused transformer. I have photographs.

2400 V multiplied by $\sqrt{3}$ is 4160 V. This may well explain the voltage anomalies in that the old transformer would have been wired from one phase to neutral (2400 V) whereas the new one is hopefully wired between two phases giving 4160 V. However I am assured that the wiring at the other end of the cable is unchanged. There is definitely exactly 240 V in the dome which is what really matters. I have also located a witness to the lightning strike; apparently it struck several hundred yards away towards the Japanese radio telescope which escaped undamaged.

There is a new box in the ground next to the transformer which I presume contains the connection between the spur to our dome and the main 4160-V transmission line to the Japanese telescope. It looks ok to me but they have not finished it yet. Similarly, in the dome, the cover has been off the box by our electricity meter for weeks awaiting the completion of the fibre work.

By the way, an electricity meter has been installed in our dome.

3 Dome Shadowing

The shutter was shadowing Ivan because the dome motor had slipped in the rack. The problem was solved by recalibrating the dome.

4 Clutch Mechanism

There were problems with the dog clutch not fully engaging causing the teeth to wear as happened in Narrabri [2]. This was hopefully solved cutting back the spring bracket allowing teeth to engage properly.

The clutch on the slew motor is starting to give problems. I noticed some of the teeth were worn like narrabri. Further research revealed that a metal bracket had been cut too long so preventing the teeth from fully engaging. I cut back the bracket and the teeth now engage properly but the solenoid is not strong enough to pull the clutch apart cleanly. I am still thinking about this one.

The clutch played up again on November 29, but I think it was my fault for over-lubricating it. Some oil had run down the inside of the solenoid making it difficult for the plunger to be pulled in. It seems to be perfect now. The trouble is that it has to be perfect because the stellar program means there is not enough time to position the mount if the clutch/slew motor do not operate correctly.

5 Water Loop

The oil drum should arrive tomorrow. The spectrometer temperature 10°C to 12°C each day creating mayhem with all the internal temperatures. Not that anyone has complained about the data.

The oil drum arrived November 25. I have installed it in the ante room next to the Neslab water circulator. I spent yesterday afternoon filling it with 30 buckets of cold water. I hope the system does not leak or rust through or the ensuing 44-gallon tidal wave will make Noah look like a weekend wind surfer as it cascades down the mountain washing away all before it. Maybe I could install a diverter valve connected up to the temperature controllers and a sprinkler system so it can do double duty as a automatic fire extinguisher next time we are struck by lightning. Joking apart, it's smart blue-and-white colour scheme does add some much needed colour to a very drab dome. I expect to see the draft of the paper announcing the discovery of the 90-minute fundamental by Christmas.

The water loop was installed and running by November 26. I switched on at 3:30 PM local and waited with baited breath. To set the scene, the spectrometer temperature rise over the last few days has been about 10°C. The residuals have been reasonably flat on Spectrometer H and there has been a footprint on Ivan. On both instruments the temperature rise has been enough to stop the detector servos working correctly. The IF controller also has problems in the case of Ivan.

So, keeping one eye on the real-time, moving-mean readout at the bottom of the screen, I switched on the pump. Over the next twenty minutes the spectrometer temperature dropped from 31.5°C to 24°C. The real-time display never deviated from a straight line.

Waiting to the end of the day I looked at the residuals using ALLFIT. There is a short-lived step of $+3\,\mathrm{m\,s^{-1}}$ when the loop was switched on, with the residuals quickly going back to their previous level. The residuals are as flat as they usually are at Las Campanas both before and after the loop was started. The same is true for Ivan.

Thermally the loop works fine. If my guesstimates and back-of-the-envelope calculations are correct, the diurnal change will be reduced from 10°C to less than 2°C. I have also tightened up the performance on Ivan's servos to the extent that the IF and oven temperature variations are barely visible over the measurement noise. It's almost as good as Sutherland — that well-known stable spectrometer. I am keeping all the daily temperature files for George's deliberation.

After a few days the water loop from hell (hell's fire extinguisher?) seems less effective than I had hoped. It still cuts the temperature variations in half compared to before, but the variations

are very large compared to my expectations. Last night I added extra insulation to Ivan's lid. The thermal capacity of the water is 900 kJ/°C and the heat input over twelve hours through the front aperture is 250 kJ based on the solar constant. There seems to be a lot of extra heat getting in via convection. The problem may well be that the copper plates do not give sufficient contact area for proper heat exchange between the spectrometer and the water. We had the same problem when the Sutherland system was tried. The Peltiers were in danger of burning out because the heat was not going into the water loop.

I think that in the end there is no substitute for actively expelling heat into the environment rather than just storing it up in swimming pools.

It may be worth pointing out that the water loop is a sealed system. It needs to be this way to work with the Neslab. It also means that rust should be slowed down since air is needed for its formation. There is no antifreeze or algicide in the water.

6 Temperature Controllers

I will do some scans on both instruments. The hot-to-cold ratio on Spectrometer H and Ivan was 20:1 and 14:1 respectively before I cleaned the cells. On removing the cell from Spectrometer H I broke the thermistor. Of course there is no spare on site. There are plenty of the wrong sort. So I spent two days re-engineering the CCS servo for a different thermistor. The moral of the story is: if it works don't fix it. One day I will take my own advice. In the meantime, I was able to remove ten out of thirteen op-amps from the CCS design without affecting performance.

In due course I will recheck the hot-to-cold ratios but will not bother disassembling the spectrometer again unless it is really necessary.

7 Computer

I think we have a real problem with the computer clock. On two occasions it has been out. The first occasion was when I first arrived when the error was exactly 90 minutes. I was not too bothered since the system had not been touched since after the power had gone off. However, this morning I went in to find the clock out by exactly thirty minutes. Inside the PC there is no separate clock battery as usual with other computers; instead there is a module which includes the battery and clock chip. It is a Dallas Semiconductor DS12887, which is replaceable should you happen to have a spare. I will have words with Hernan.

The program was writing to the floppy but there was a fault on the disk and not all the files were showing up in the FAT. Last night it failed completely and the "general disk failure" warning came up. Replacing the disk solved the problem.

There have been no more clock failures on the PC. I unplugged the module and checked the battery volts — all was ok. The PC has been stripped and rebuilt, there is nothing loose and all the edge connectors are pushed fully home. Scandisk and Defrag have been run twice. On neither occasion were any hard-drive problems found. The floppy drive has been cleaned.

8 Relay Box

I have removed the wire link added by Brek Miller [1] in the relay box and replaced the Zener diode. There are another nineteen in the spares box should we run into trouble again. The dome is operating ok.

9 ASP

I have had no joy with the automated stellar photometer (ASP). I can not make out why it does not pick up on the first available star on the list. It just sits there waiting for Altair to rise and does nothing.

The Peltier cooler on the ASP is u/s. There is no spare so I will not be making much more progress on that one.

10 Earthquake

I sat through my first earthquake on Saturday. I was sitting in the top of the dome when the position servos started to chatter. A few seconds later the dome was shaken from side to side and there was an audible rumble lasting maybe fifteen seconds. It was the best part of the trip so far.

The weather is excellent at night for astronomy and I've managed to borrow an astrograph complete with clockwork drive on which to mount my camera. There should be some spectacular photos. I have also found the film I left here by accident on my last trip. Venus is really brilliant — capable of throwing a shadow.

I have had a camera lens stolen from the astrograph building. Apparently the informal redistribution of wealth has become quite common since there have been lots of construction workers on the mountain working on Magellan. Be warned if you come in January.

11 Other

Both spectrometers have been checked for loose bits and pieces. I have glued in a sorbo rubber block between the IFs and the bulkhead to take out any play in the gearboxes they sit on. It does seem to have made some difference to the drifts.

Extra insulation has been fitted to Ivan. The only effect has been to make the lid so heavy that the little rubber clips cannot support the weight. Two self-tapping screws have been added to the lid to make sure it stays on and light tight.

12 Internet Connection

There is a telephone in the dome now (extension 253). It does not work, but Patricio promises me it will next week.

Patricio says the fibre will be installed "soon" to our dome so Brek can think about putting us on the web.

13 Pockels Cell

There is a magnetic Pockels cell in Spectrometer H. I take it the magnetic pockels stays put then? Well, don't say I didn't ask.

14 Canadian Dome

Good news: The Canadian team are packing up and going home. Why is this good news? Because this entails sorting out their dome and putting lots of redundant equipment into a skip. Well versed as I am in the noble art of bin diving, it would be foolish to pass up the opportunity to keep my talents honed to perfection. There is a raid planned for this afternoon.

George Isaak had hoped to acquire the whole dome and building, but the University of Toronto has already agreed to sell it to an Argentinian group.

References

[1] BREK A. MILLER. The trip to Las Campanas during the big snowstorm of 1997 August. *BISON Technical Report Series,* Number 62, High-Resolution Optical-Spectroscopy Group, Birmingham, United Kingdom, November 1997.

[2] BREK MILLER. Installation of new detectors and temperature controllers at Narrabri from 1995 November 21 to December 5. *BISON Technical Report Series,* Number 45, High-Resolution Optical-Spectroscopy Group, Birmingham, United Kingdom, February 1996.