BiSON Birmingham Solar-Oscillations Network

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Blind and mount controller repairs in Las Campanas in 2014 June

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2014 July 15

(minor editorial revisions 2015 November)

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Abstract

The blind open/close limit-switch, and the shutter-down limit-switch were both replaced. The mount controller motor current-limits were increased. The water-cooling pump and motor were restored.

1 Introduction

Steven Hale visited Las Campanas from 2014 June 13 to June 25. The primary purpose of the trip was to fix the electrical problem that was blowing the main fuse in the relay box, and to look at the mount controller that would occasionally stop driving the motors.

2 Blind Fault

The visit began with the dome completely offline. The main fuse in the relay box kept blowing, and so there was no power at all to the dome motors. The dome was not operational.

The fault occurred on May 25. Local staff looked at the site for us, and identified the problem as the blind limit switch. The switch is a Namco EA700-15100 available from Radwell International (plccenter.co.uk) at a cost of £224.88. Since we had a matching spare in the Birmingham dome this was taken out by Steven Hale and a new one ordered for Birmingham. The replacement switch was installed, but it did not help. The fuse still blew as soon as power was applied to the relay box.

After further investigation, it was determined there was an additional fault on the shutter down-limit switch that provides power to the blind only when the shutter is fully down. It was quite damp and dirty inside. Even though the switch has a gasket to make the cover waterproof, the rubber cable gland had never been installed, and so water could get in via the cable entry. The switch is an Omron WLCA12G available from Farnell for £42.82.

Rather than attempting to order one whilst at LCO, we again sent out the switch from the Birmingham dome. The Birmingham switch is an Omron D4B-1116 which is now obsolete, however it is mechanically and electrically compatible. A new switch was ordered for Birmingham.

The switch arrived in just a few days, and once installed the dome was again fully operational. The blind and shutter were exercised to their limits and everything worked correctly. On the afternoon of June 15, Las Campanas collected its first hour of data in almost a month.

3 Mount Controller

The new digital autoguider was installed by Brek Miller in 2011 March [1]. Steven Hale visited in 2012 March [2] to investigate some problems with the guiding stability.

The problem was considered to be the old, thick, sticky grease on the worm and worm-wheel increasing the load on the motors. All the old grease was cleaned off and replaced with fresh "moly" grease designed for sliding joints. This helped for a little while, but eventually the mount started getting stuck again.

On this visit it was noticed that the current-limiting "chopper" could be heard operating even when the motors were powered on 5 V. The PWM frequency from the chopper can be heard through the coils in the motors. When running on 5 V the motors do not require the current to be limited. This must mean that the current limit is set too low.

Each motor has four coils. They can be connected up as two pairs in either series or parallel. The series configuration requires less power, while the parallel configuration produces more torque. The current limit for the coils is 0.7 A. The current limit on the mount controller was set to 0.7 A. But since we use the parallel coil configuration, that means the current gets split between the two pairs equally (Kirchhoff's first law) and so our current limit is actually 1.4 A. The motors were running at only half their rated current.

The current limit was increased to 1.0 A. This is the current limit set at other sites. It still has a safety margin below the maximum rated current, and it seems to work ok. Here, the motors could still be heard "chirping" occasionally as the chopper cut in and out, and they still stuttered a little. The limit was increased again to 1.2 A and the motors began running cleanly.

After leaving the system run for a day or so, it was noticed the in certain spots the motors were still having a little trouble. They were not getting completely stuck any more, but they still stuttered a little. Like the previous trip, all the old grease was removed and it was ensured that both the worm and worm-wheel were clean. The brass came up nice and shiny. A light coat of thinner "LM grease" was applied and now everything seems to be running well through the entire range of motion of the mount. There have been no further problems with the mount controller.

4 Water-cooling Pump

The pump failed in early 2013, and when it seized it took out the motor as well. Steven Hale ordered a new pump and motor in 2013 May from Grainger in the USA and had it sent directly to LCO. On this visit, the new pump and motor were found to have been partially installed. The motor was in place with the pump attached, and all the hoses were connected, but the motor was not plugged into the mains supply. This was expected, since the system temperature logs had been indicating that the spectrometer was not being sufficiently cooled.

When powered, the motor would run for a few seconds and then cut out. After turning it off, it would reset with a "click" after about 15 seconds, and then it would run again. This usually indicates that the motor is overloaded and is tripping on a thermal cut-out. The pump was removed and turned freely by hand, indicating a low load. The motor still showed the same fault.

The short version of this problem is that the motor was configured for use on 120V circuits, and not the 240V system in our dome. It is good that when run on the wrong voltage it simply cuts out rather than being permanently damaged. The motor was disconnected and reconfigured for use on 240V circuits, following the instructions on the printed label. Upon re-installation it sounded better, ran smoothly, and didn't cut out.

The long version is much, much, more complicated. Let's start at the beginning. The Observatory is connected to the Chilean national grid. Chile uses 220V@50Hz much like the UK. However unlike the UK, Chile uses a "Type L" three-pin in-line unpolarised connector the same as central Europe. The middle pin is a centre-tap on the output windings, and so the two outer pins are both 110V meaning when you connect across them you get the 220V standard. This is why the connector can be unpolarised and therefore plugged in either way around. In the UK we have a "neutral" and "live" so the sockets have to be polarised to ensure you plug in the correct way around.

The observatory is run by a US institution. They didn't want the Chilean standard, since it would be more convenient if they were able to bring hardware straight from their labs in the US and plug it in without worrying about voltage or polarisation. The observatory takes the feed from the Chilean national grid, and runs it through a motor-generator that outputs 5000V@60Hz for high-voltage distribution around the site. The motor-generator is required to take care of the frequency change. Each building on the site then has its own step-down transformer, taking the 5000V distribution level and providing 120V@60Hz domestic power as used in the US.

When our dome was built, a similar decision was made to make the power UK-like. Our step-down transformer outputs a non-standard 240V@60Hz. Inside the dome, we still have the "Type L" unpolarised Chilean sockets. To make the power UK-like, rather than grounding the centre-tap from the windings one side is grounded. This means you get a "neutral" that is very close to ground and a "live" 240V phase. But remember, they are going into the unpolarised sockets. So you have to make sure you insert the non-polarised plug the right way around. Some of the symmetric sockets have red and white tape stuck on them to indicate which way around it is wired. It would have been better if UK sockets had been used when the dome was commissioned. If you connect one of our UK four-way socket extension leads to a Chilean socket backwards, then you end up with 240V where the "neutral" pin is supposed to be. That is, you get 240V between neutral and earth.

The old, identical, motor was configured exactly the same way for 120V systems. It is not clear how the old motor could possibly have even been working at all. After re-configuring the new motor for high voltage operation there were no further problems.

The water level in the tank was topped up. The level was below the level of the long metal temperature probe, and so previously it was not actually measuring the water temperature. There is a water tap in the dome, but the flow rate is very slow. It took 9 minutes to fill a bucket. The water pump on the other hand is quite fast, it could empty the bucket into the tank in just 1 minute and 45 seconds. It took five buckets to completely fill the tank. It took about an hour and a half including time moving the bucket and switching the hoses around.

On some of the warmer days here, the spectrometer has been getting up to 33C in temperature. In only one hour with the pump running, it reduced the temperature by 10C. Within four hours the temperature was down to 17C, and after running all night was down to almost 16C. Obviously the tank temperature slowly increases as it takes heat away from the spectrometer. The temperature of both the spectrometer and the water have now equalised at around 18C. Hopefully this will improve instrument stability that has been poor over the last twelve months.

There is no float switch in the water tank. The computer has no way to turn off the pump if the water level starts to drop. If there is a leak near the spectrometer, then the pump will happily push 44 gallons of water up into the dome ready for it to rain back down over the electronics and the computer. This should probably be rectified on the next visit.

5 UPS

Like our other sites, Las Campanas uses two UPS devices. One is a "Full Power" branded 1500VA unit supplying the computer, the other is a Belkin of unstated capacity supplying the dome motors.

Both devices were tested. The Belkin is functioning perfectly and successfully closes the dome from fully-open in the event of a power failure.

The "Full Power" unit no longer supplies any back up power when the mains fails. The computer just powers-off instantly as soon as the incoming supply is removed. The batteries have been replaced previously. There is a note on the top of the case giving a warning that loose batteries are inside. Presumably the batteries were replaced with ones of sufficient capacity but not mechanically identical. The batteries will need to be replaced again.

Meanwhile, the computer has been moved over onto the Belkin UPS. It is now supplying emergency power for both the dome and the computer. It appears to be more than capable of handling both loads. The dome was tested to close from fully open whilst ensuring that the computer remained operational. It works fine.

The failed UPS, or at least the batteries, should be replaced at the next opportunity.

References

[1] Brek A. Miller. The installation of a digital autoguider in Las Campanas in 2011 March. *BiSON Technical Report Series,* Number 343, High-Resolution Optical-Spectroscopy Group, University of Birmingham, UK, May 2011.

[2] Steven J. Hale. Autoguider repairs in Las Campanas in 2012 March. *BiSON Technical Report Series,* Number 357, High-Resolution Optical-Spectroscopy Group, University of Birmingham, UK, April 2012.