MONTSERRAT VOLCANO OBSERVATORY

GOVERNMENT OF MONTSERRAT

Moving the seismic monitoring from Mongo Hill to Flemings

Glenn Thompson

MVO Open File Report 03/02

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Table of Contents

EXECUTIVE SUMMARY

The Montserrat Volcano Observatory now has a superb new location above Flemings with great views of the volcano. This is in sharp contrast to the previous site at Mongo Hill which was possibly the worst location on the island in terms of viewing the volcano – a 15 minute drive was required to reach a vantage point from where the volcano could be seen.

The move occurred at a time of great concern. In October 2002 the exclusion zone was extended due to hazards posed by the accumulation of dome material above the Belham Valley. Over the next few months, numerous pyroclastic flows were observed in Tyers Ghaut, which feeds into the Belham Valley. This was a time of greater concern than any since 1997. It was imperative under these conditions to make a seamless transition of the seismic monitoring from Mongo Hill to Flemings without losing any data.

This was ultimately successful, even though due to lack of meetings an integrated plan was not in place before the move. Particular credit should go to the Electronics Team. The move was completed on 19th January 2003 with no loss of data.

1 INTRODUCTION

The move to the observatory in Flemings finally became a reality in January 2003 following discussions going back to 1997 at least, and numerous delays. For the first time since the observatory moved from Old Towne in 1997, staff in the Operations Room could actually see the volcano themselves, and therefore provide better backup to field parties and information to the authorities and the public. This report combines some of the documents that were written during the planning stages of moving the seismic networks, as well as some of the images from the new observatory.

2 PLANNING

2.1 Issues

The goal of this exercise is to prevent data loss, as round-the-clock seismic monitoring must be sustained, particularly with the large size of the dome and ongoing threat to the Belham Valley.

This is logistically complicated, as it is not simply a matter of putting the computers in a vehicle, driving them over to the Flemings, and plugging them in. We have two seismic networks with a complex telemetry topology, which needs to be optimised for Flemings. Cables and receivers need to be set up at Flemings. The new Operations Room needs to be electrically designed to handle the large power requirement of all the computers and other equipment. The layout of the new Operations Room needs to be optimised to faciliate its work. Additional equipment must be purchased or hired months in advance in order to arrive in Montserrat in time and be cleared through customs. There needs to be a strategy for doing these in a sequence such that monitoring is not compromised, subject to the constraint that MVO is not running up bills simultaneously at Mongo Hill and Flemings for any longer than is necessary.

2.2 Strategy

The general strategy will be as follows:

1. Decide on the layout of the Operations Room at Flemings, and the necessary power requirements.
2. Outfit the new observatory with the necessary receiving equipment, cables, and a replica data acquisition and analyis system.

3. Establish a computer network between both observatories, so that data from each can be merged in real-time. This is a crucial step in minimising data loss while reconfiguring telemetry.
4. Borrow/purchase enough spare telemetry equipment so that redirecting a signal from one observatory to another is a simple as turning an antenna.
5. First move the digital seismic network, while continuing to monitor from Mongo Hill using the analog seismic network. If (3) goes to plan, it should also be possible to continue monitoring using the digital seismic network, even if those signals are being transmitted to Flemings.
6. Once monitoring with the digital seismic network is operational at Flemings, move the short-period seismic network.

2.3 Reconfiguration of the seismic networks/telemetry

January 2001:

- All present broadband stations to be retained, with the exception of Mongo Hill, which will be moved to Harris.
- MLYT and MJHT to be retained. Decision on other 4 short-period stations can be made at the time.
- Eastern stations (MBSS, MBRY, MBLG, MBHA and MJHT) will be telemetred to Silver Hills and put on a phone line from there.
- Western stations will be telemetred direct (MBWH, MBGB, MBGH, MLYT) or via Garibaldi Hill (MBBY).
- Nevis will continue to be acquired directly.

May 2001:

The fact that MVO has two seismic networks is a distinct bonus when it comes to the meeting this challenge. It means it is possible to move one network to the new observatory, while continuing to monitor with the other network at Mongo Hill. Once the capability exists to monitor with one network from Flemings, the other network can be switched. For example:

- Move the Earth Data network to Flemings, while keeping the short-period network going at Mongo Hill.
- Move the short-period system over.

A significant complication is the uncertain status of the seismic network upgrade. In many ways it would help if the new Reftek network can be installed before

Flemings is available, as this would make a seemless transition easier, and be less work. The strategy would be:

- Install the Reftek network at Flemings, while keeping the short-period and Earth Data networks going at Mongo Hill.
- Move the short-period network to Flemings.
- Dismantle the Earth Data network.

June 2002:

Senior Electronics Technician, Dave Williams was asked to draw up a proposal indicating how the move of the broadband seismic network would take place. Dave communicated this proposal in an email to Director Peter Dunkley on 14-06-2002:

Mr Dunkley,

To get the broad band seismic station into the new MVO building would be done in three phase.

1. Prep the building to receive MBGB, MBGH & MBWH before the move. (area shown on map in Green)

2. Prep repeater sit at MBGB to receive MBSS,MBRY & MBLG from Silver Hills and transmit to the new mvo. (area shown on map in Blue)

3. Move equipment for MBBY for centre hills and install them at MBGBRS and New mvo. (area shown on map in Orange)

The above can be done two may,

1. Take the equipment down from MVO and move them to the new sits in the above order as job is done.

2. Get 9 receivers and 3 transmitters to do this by only turning the antennas.

This is an skeleton outline for you please let me know.

Dave Williams

A graphic was attached to this email and is shown in figure 1.

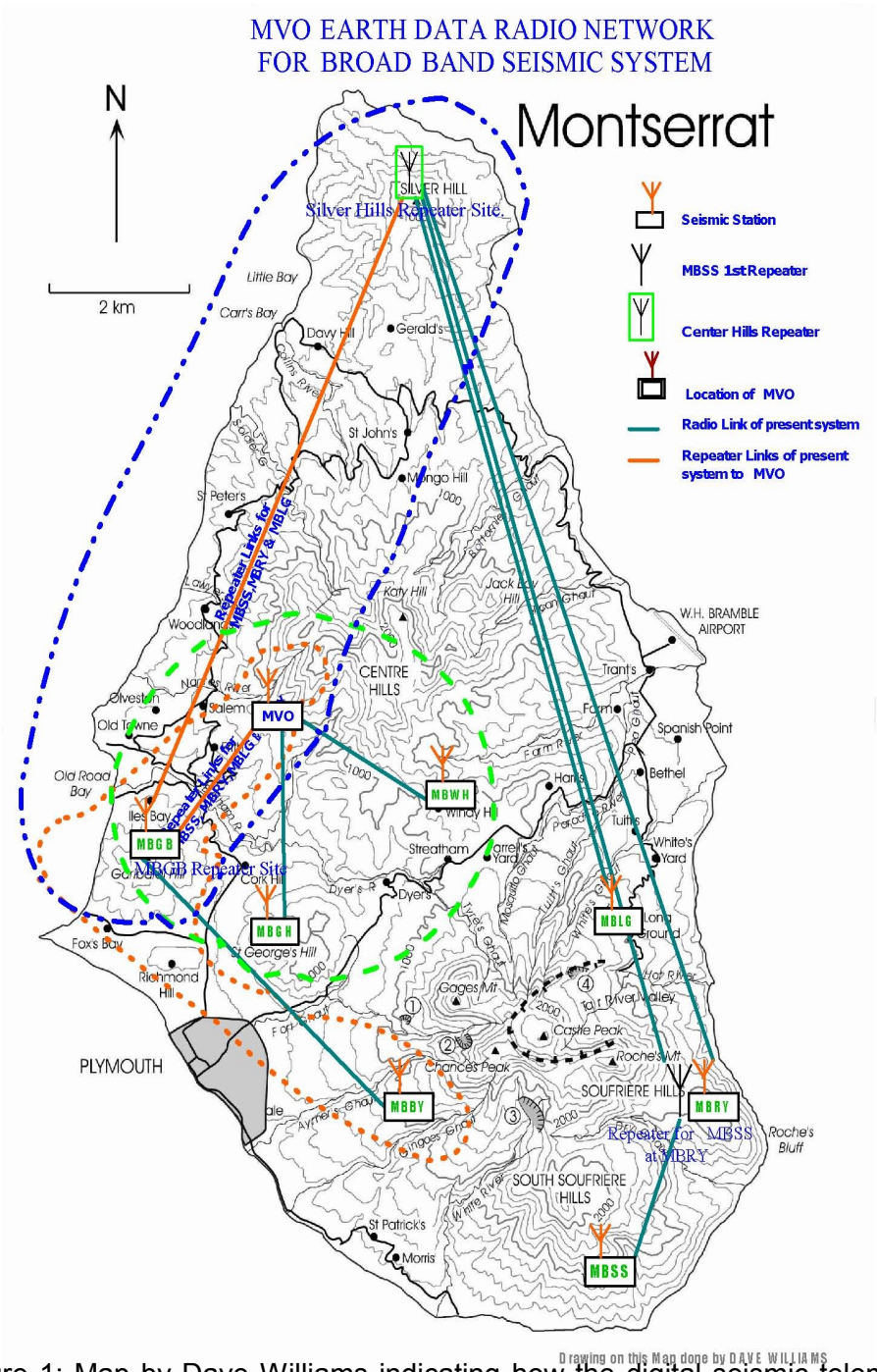

Figure 1: Map by Dave Williams indicating how the digital seismic telemetry would be realigned for transmitting data to MVO Flemings.

It was a start, and crucially gave an assessment on the number of extra Earth Data receivers and transmitters we needed. Preparing the tower and cabling the new observatory building at Flemings was crucially important, as was preparing the repeater sites in Olveston (not Garibaldi Hill anymore because it was in the exclusion zone) and Silver Hills. Further details were needed on how the move would be accomplished, and what other additional equipment would be required, and these had to be thought out well in advance given the long lead time.

July 2002:

On 03-07-2002, there was a rare MVO meeting, on the occasion of a rare visit by Project Manager, Bill McCourt. I introduced a more detailed, draft proposal as follows, and stressed the advantages of making preparations in the field that would then simplify and reduce the workload, rather than only begin when the move hit :

Its crucial to reconstruct reorientate the telemetry so that data is transmitted to Flemings in the most efficient and maintainable manner. For example, we suffer presently from having repeaters in places that are difficult to access without a helicopter (Centre Hills), which makes our network vulnerable. We also want a design that has as few links as necessary so there are fewer points of potential failure.

Figure 2 shows the digital seismic network as it is now, and the proposed new network after the move to Flemings. Figure 3 shows the same for the analog seismic network. Obviously the move to Flemings is going to be an extremely busy time and the objective is to minimize downtime, and so detailed plans are required. The following is a first draft, and needs to be further discussed and revised through consultation with the Electronics Team and Director. Weekly meetings at a set time could be useful to keep focused and monitor progress. Here is the strategy I propose:

Before the move:

- *Repeat MLGT at Silver Hills (that is move it from MJHT).*
- *Repeat MJHT at Silver Hills.*
- *Repeat MBBY at Garibaldi Hill.*
- *Install a new station at Silver Hills (MBSH).*
- *Prepare the digital repeater site at Garibaldi Hill to receive MBSS, MBRY and MBLG from Silver Hills and transmit to MVO Flemings.*
- *Prepare the analog repeater site at Garibaldi Hill to receive MJHT, MRYT and MLGT from Silver Hills and transmit to MVO Flemings.*
- *Prepare MVO Flemings to receive MBGB, MBGH and MBWH, including receiving antennae and cables into Ops Room.*
- *Prepare MVO Flemings to receive MLYT, MGHZ and MWHZ, including receiving antennae and cables into Ops Room.*

- *Meetings to be held weekly, to update progress, discuss issues, and assign priorities.*

During the move:

- *Turn antenna for MBWH, MBGH and MBGB (MBBY should already be repeated at MBGB) from Centre Hills to MVO Flemings.*
- *Turn antenna at Silver Hills digital repeater site from MVO Mongo Hill to Garibaldi Hill.*
- *Complete the migration of the digital seismic network.*
- *Turn antenna at MWHZ, MGHZ and MLYT from Centre Hills to MVO Flemings.*
- *Move demod rack, RSAM, QNX, helicorders and communications radio.*
- *Turn antenna at Silver Hills analog repeater site from MVO Mongo Hill to Garibaldi Hill.*

After the move:

- *Dismantle MBMH.*
- *Dismantle Centre Hills repeater sites.*

This same proposal also outlined the work that would be necessary within the Operations Room too, but that is discussed in another section below.

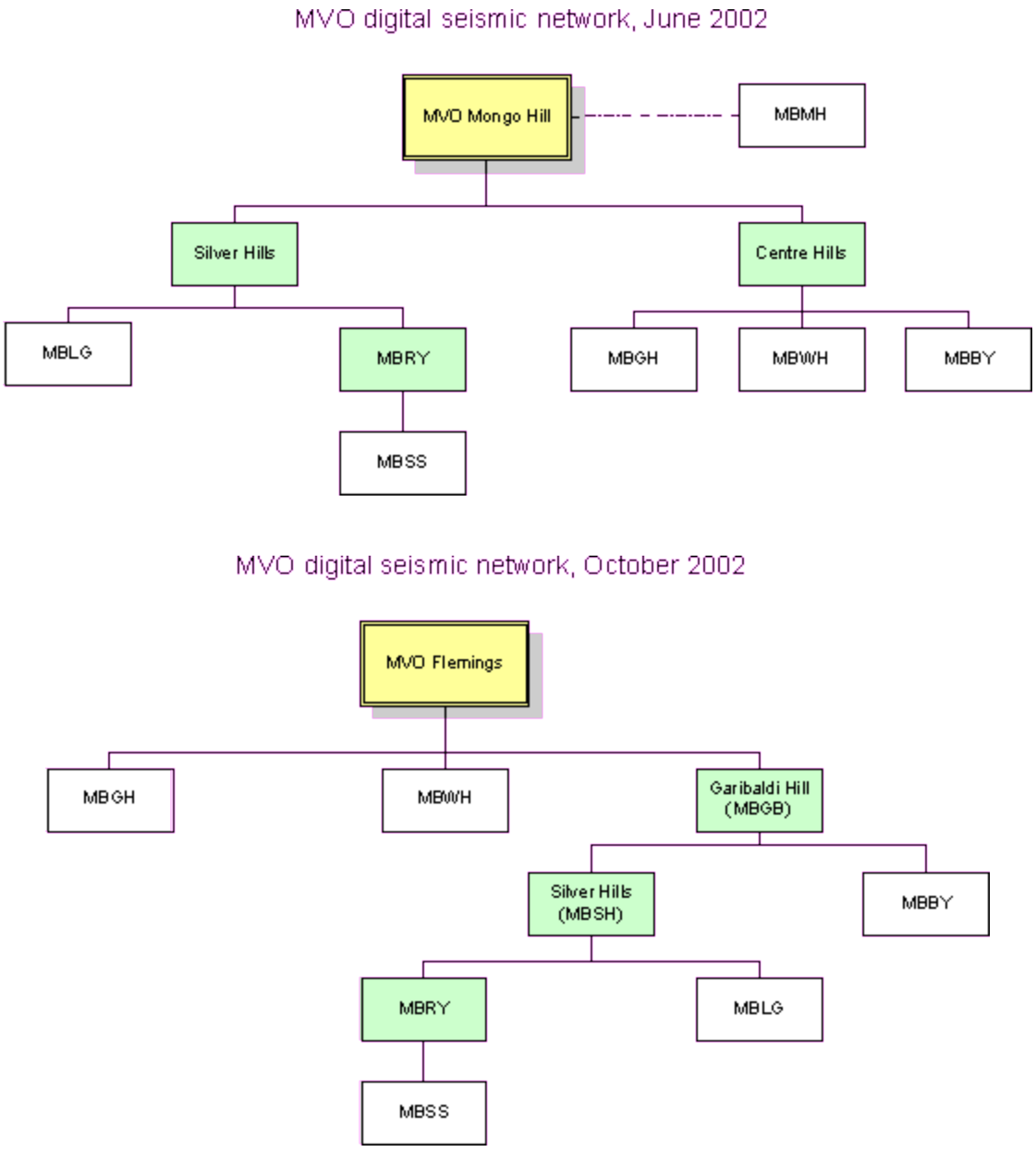

Figure 2: Logical diagram showing how digital seismic telemetry would be optimally realigned to transmit data to MVO Flemings. The repeater at the Centre Hills would be decommissioned. Instead, the western stations would be transmitted directly to MVO (Dave Williams had tested the link between Windy Hill and Flemings). The eastern stations would repeat through Silver Hills (where there is already a repeater) and Garibaldi Hill. The most complicated station would be MBSS (South Soufriere Hills) which would need to be repeated through MBRY (Roche's Yard) also, but this was felt to be more likely than repeating through MBBY which had been dead for 2 years and was difficult to access because of persistent ash.

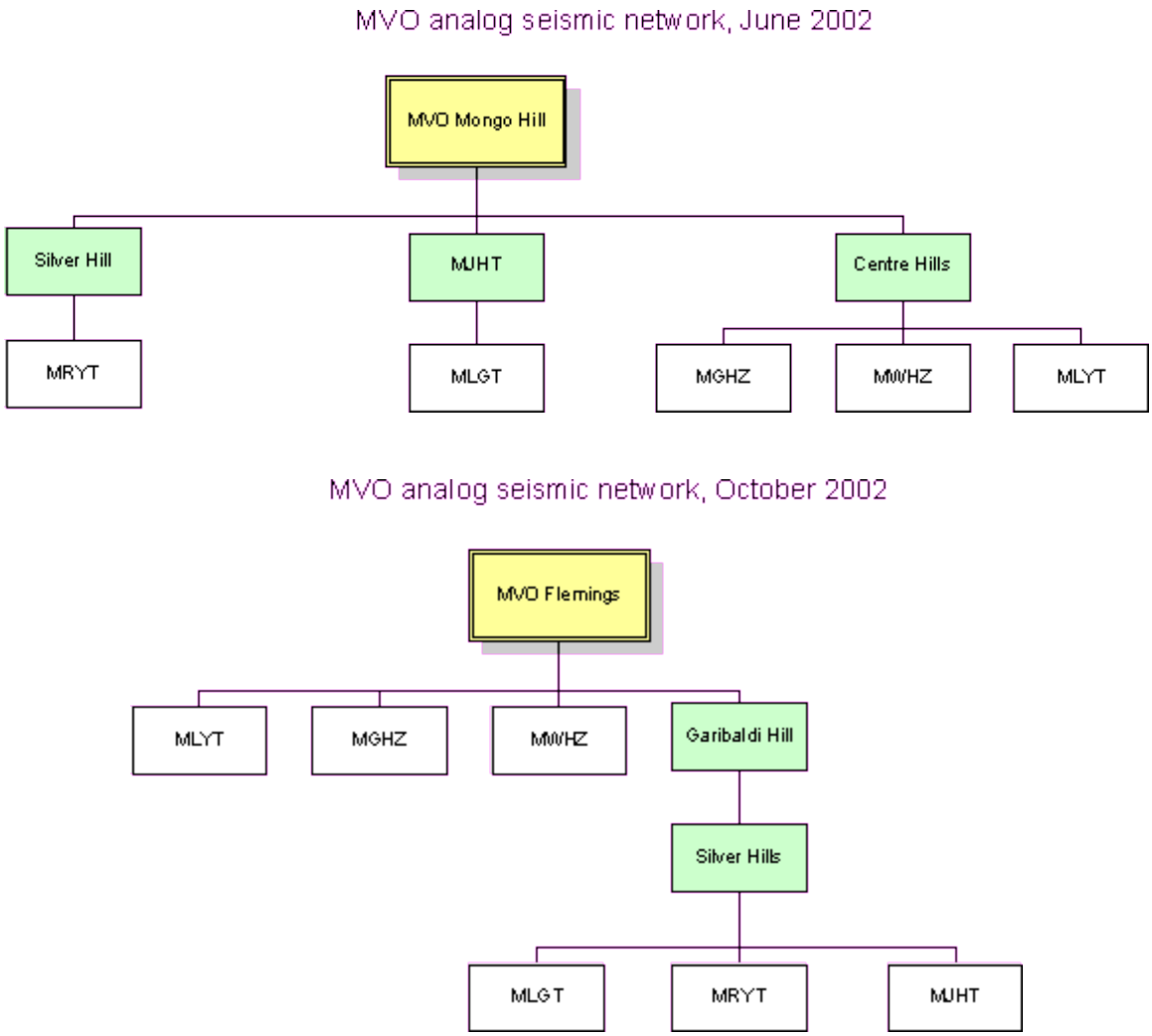

Figure 3: Logical diagram showing how analog seismic telemetry would be optimally realigned to transmit data to MVO Flemings. The repeaters at MJHT (Jack Boy Hill) and the Centre Hills would be decommissioned. Instead, the western stations would be transmitted directly to MVO (Dave Williams had tested the link between Windy Hill and Flemings). The eastern stations would repeat through Silver Hills (where there is already a repeater) and Garibaldi Hill.

October 2002:

By 16-10-2002, no progress had been made regarding the tasks identified as needing to be performed 'before the move' above. There had been no weekly meetings – indeed no meetings at all – and this had hampered coordination. There had been no feedback on my proposal either. An additional problem was that now the most important station, MBWH, was down. The MVO Director, was contemplating calling the move off, particularly given the large dome and threat to the north west.

The timeline was beginning to look tight. The Electronics Team had a contract whereby they worked for other government departments most of the time. Instead, the MVO Director was pushing for hiring Dave Petrie (an experienced Electronics Engineer who had worked with BGS Seismology for many years) as a consultant to assist with the move, although it was anticipated this might cause friction with the Electronics Team.

2.4 Operations Room equipment

The following proposal was written in June 2002.

To ensure effective seismic monitoring at the time of the move to the new MVO, it will be necessary to have data acquisition systems running in parallel at both observatories throughout the transition phase, which is likely to last at least 1 month. This is not a significant departure from normal practice, since for over 1 year now we have had two Earthworm and data analysis PCs running in parallel at MVO, to provide some failover capability. The only difference is that other systems will have to be mirrored.

The extra equipment required depends on whether we are still using the Earth Data digital seismic network at that time, or whether the RefTek upgrade has been made. It seems likely that we will still be using the Earth Data equipment. This would be our worst case scenario in terms of extra equipment required, and the specifications below are based on this scenario:

Operations Room equipment for the digital seismic network:

ITEM	***COST (Sterling)***
1 x 24-bit ILI unit (loan from BGS or Earth Data)	*500 (2 way shipping)*
1 x SA24 data acquisition workstation	*2000*
1 x EarthWorm data acquisition workstation	*2000*
1 x Seisan data analysis workstation	*2000*
1 x UPS (1.5 kW)	*1500*

1 x HP SureStore DDS-3 DAT drive	*700*
*1 x network switch **	*0*
*1 x Radiocode GPS800 clock**	*0*
TOTAL	*10000*

** These items are already on order, since they were previously identified as mission critical spares*

We can borrow an ILI. Earth Data are happy to loan us one for up to 2 months, so long as we pay for shipping. I've also contacted BGS Edinburgh to see if they could loan us one. We already have on order all the ILI cards, SA24 card and the GPS clock we'd need to set up a parallel Earth Data system at the new MVO.

I've based the workstation costs on the following specification, and a quotation from www.dell.com:

1.5 GHz processor, 256 MB RAM, 18 GB SCSI hard drive, 80 GB IDE hard drive, 17" monitor, Ethernet card, CD-RW.

These workstations should be purchased soon, since we currently have no spares for our current SA24, EarthWorm and Seisan workstations, and each is critical.

I've made the assumption that an Ethernet will be available at both MVOs throughout the transition period, and that no additional receivers or cables will be required. Otherwise extra expenditure will be necessary. Dave Williams will be able to advise.

The SA24 PC and the spare ILI will not be necessary if the Reftek bid is funded and the equipment on island prior to the move. The other equipment is still necessary.

Operations Room equipment for the analog seismic network:

The main problem with moving the short period network is we do not have a spare discriminator rack, and there seems little prospect of getting one (I have checked with USGS and BGS). So the switch of the analog network will have to be made using one discriminator rack, and it will be virtually impossible therefore not to have some hours of downtime.

This said, there is a general need for additional equipment. There exists an ADC card recommended by USGS which would allow data from the analog network to be fed into Earthworm using the adsend module. This would effectively render the QNX obsolete, and provide many of the advantages of the seismic network upgrade, including event detection, classification and hypocentral determination based on all channels simultaneously.

Failing this, we would benefit from a spare QNX PC. We already have a spare data acquisition card for this PC. Thus we can have a QNX PC sitting on the shelf, ready-to-go in case of a failure of the primary. We also have a spare RSAM card.

ITEM	***COST (Sterling)***
1 x Earthworm ADC card, or	*1000*
1 x spare QNX PC	*1000*
TOTAL	*1000*

How do we ensure that there is a computer network?

- *Make sure that the seismic computer network is entirely independent of the servers downstairs (except for internet services). Presently some programs and data are stored on \\dome. These will have to be hosted directly on Seisan.*
- *Ensure we have a spare hub & network cables with connectors. Time will need to be spent making up new cables.*

The proposal of 03-07-2002 fleshed this out further:

Preparatory work:

- *Identify equipment required for the move. Computer hardware arrived in late June. We are still waiting on ILI equipment from Earth Data Ltd. A request has been made to BGS Edinburgh for 9 receivers and 3 transmitters. Dave intends to get quotations for additional hardware/software to split computers from monitors.*
- *Finalise all MVO "Seisan-related" software.*
- *Reserve ip addresses for new seismic computers SA242, Earthworm3 and Seisan4.*
- *Configure Seisan4: (i) install Seisan and MVO software, (ii) install modem, (iii) install DAT drives, (iv) temporarily substitute it for workstation "Seisan" to test it works.*
- *Configure Earthworm3: (i) install Earthworm software, (ii) add SCSI card, (iii) substitute test it.*
- *Configure SA242: (i) install SA24 software, (ii) add SCSI card, (iii) add DMA card, (iv) substitute test it.*
- *Configure spare ILI with new cards from Earth Data.*
- *Substitute test spare ILI and GPS clock.*
- *Put all equipment for move (spare ILI & GPS clock, 3 workstations, 3 UPSs) in boxes and store separately.*

During the move:

- *Setup a computer network including internet for alarms.*
- *Setup ILI and seismic computers (SA242, Earthworm3, Seisan4) and configure alarms.*
- *Complete the migration of the digital seismic network.*
- *Move demod rack, RSAM, QNX, helicorders and communications radio.*
- *Complete the migration of the analog seismic network.*
- *Move any other Ops Room equipment and seismic equipment from Electronics Store (including the safe!).*

After the move:

- *Synchronise seismic databases.*

The following progress was also noted:

- *Seisan has now been setup properly, thanks to successfully inviting Seisan co-author Lars Ottemoeller to visit MVO recently.*
- *Computer hardware ordered and received.*
- *Earth Data finally moving on sending us ILI parts*
- *BGS Edinburgh sending us spare ILI*
- *Dai Stewart has been asked to provide ED receivers/transmitters*
- *Glenn & Dave have discussed plan for new Ops Room*
- *Glenn has now produced first draft of a more in depth plan – need to discuss this, finalise it, set a timetable, and go from there*

By 16-10-2002 the following progress was noted:

- *New computers + monitors + 4 UPS arrived*
- *Seisan4 computer configured with DDS4 drives*
- *Proposal for equipment to multiplex several workstations to one monitor made*
- *Spare ILI arrived on loan from BGS*
- *ILI spares purchased from EDL arrived*

- *1 UPS loaned to Bubble for PhotoPC*
- *Both ILIs sep up identically with 7 channels*
- *Substitute test of ILIs successful*
- *Cleaned data off Seisan2 computer (put onto Seisan)*
- *Seisan2 and SA242 swapped since original SA242 did not have ISA slot. This machine will now be called "Programmer" instead.*
- *EarthWorm3 computer configured and tested*
- *Programmer computer configured and tested*
- *1 monitor loaned to Bubble*
- *1 UPS loaned to Bubble*
- *1 network hub on loan from Ops Room to Bubble replaced*
- *Cable from GPS clock to ILI received from BGS*
- *Cable from ILI to SA24 received from BGS*
- *Final 2 spare UPS forced into service due to UPS problems in Ops Room*
- *EarthWorm3 computer running in parallel with EarthWorm computer as a backup*
- *9 receivers and 3 transmitters arrived on loan from BGS*
- *Installed Windows 98 and Sa24 software on SA242 computer*

But a lot of outstanding work was identified:

SA24:

- *Assign ip address to SA24*
- *Configure SA24 software*
- *Mount data directory on SA24 under EarthWorm and EarthWorm3*
- *Substitute test SA242 for SA24*

ILI:

- *Cannabalise VMEs for DC power supply units*

Seisan4:

- *Assign ip address to Seisan4?*
- *Set up latest software on Seisan4*
- *Add additional network cable around sliding door in Ops Room*
- *Substitute test Seisan4 for Seisan*

EarthWorm3:

- *Configure EarthWorm and EarthWorm3 for MBLY*

Miscellaneous:

- *Ground GPS clock*
- *Order 5 new UPS for Ops Room*
- *Put spare computers in boxes ready for move*
- *Make up 7 cables from receivers to ILI*

General (not time critical):

- *Reinstall Windows2000 on Analyst (eliminate virus)*
- *Reinstall Win98 and SA24 on SA24 computer (eliminate virus)*
- *Repair monitor?*
- *Replace video adapter on Seisan*
- *Install DDS-3 drive on Seisan*
- *Install 100GB ATA drive on Seisan*
- *Troubleshoot floppy, Zip250, CDRW on Analyst*

2.5 Layout of the Operations Room

Driven by the need by architects to plan construction of the new MVO, discussions concerning the layout of the new Operations Room had to begin

much earlier, as outlined in the following email from myself to Dave Williams on 12/09/2000:

Hi Dave,

These on my thoughts on the matter. Welcome your comments:

Power circuits in the Ops Room of new MVO

Based on current usage there should be 40 110V and 20 240V sockets in the Ops Room of the new MVO. To prevent the need for multiple UPS units and extension cables in the Ops Room, which increases the risk of fire, the circuits should be protected by UPS units which isolate the internal MVO power circuits from the national grid.

Most of the equipment in the Ops Room needs to be on a high bench (the height of the present workbench is excellent) and wall sockets should therefore be above bench level (a few below would also be helpful).

Other Ops Room requirements

In general there needs to be a lot better utilization of space in the new Ops room. Presently the workspace is cramped and there is limited display area.

- *Shelves should be constructed so that drum recorders, acquisition boxes and peripherals such as DAT drives, printers can be placed above the workbench. Ideally the only things on top of workbenches will be computers that are used on a daily basis, and the radio.*

- *There should be filing space for important documents, so they do not clutter the work benches, and a bookshelf.*

- *There should be large areas in the Ops Room where important procedures, maps and data can be displayed, and whiteboards can be placed.*

Power requirements were first addressed in an email I sent to the MVO Director (Peter Dunkley) on 12-10-2000. This same email included a sketch of how the new operations room should be arranged:

The mission critical devices in the new MVO Ops Room that need UPS protection are likely to be:

DEVICE	*POWER*
1 primary acquisition PC	*900 W*
1 backup acquisition PC	*900 W*

1 routine data analysis PC	*900 W*
1 detailed data analysis PC	*900 W*
2 DAT drives	*1.2 kW*
1 GPS clock	*50 W*
1 discriminator rack	*can run off batteries*
4 drums	*can run off batteries*
1 modem and 1 radio	*very low*

That's a total of 4.85 kW

This should more than suffice for the new Ops Room.

POWER CIRCUITS

Previous recommendation was for 40 110V wall sockets and 20 240V wall sockets, but at this time it was assumed that all sockets would be UPS protected. This now needs some rethought.

All the PCs in the Ops Room currently run off 110V, including the new Linux workstation ordered through BGS. The only mission critical devices in the Ops Room that run off 240V are the Sun, its DAT drives and external drives, the ILI and the VME. It seems likely that none of these systems will be 'mission critical' when we get to the new MVO.

It should be no problem to ensure that all future computer hardware runs off 110V. My conclusion is that UPS protection is not required for the 240V circuit.

Each PC requires 2-6 sockets each. Probably the cheapest way is to have one-UPS protected wall socket and then a multi-socket power strip plugged into it. If so, it would be sufficient to distribute ~ 10 UPS-protected 110V wall-sockets, ~ 10 unprotected 110V wall-sockets and ~ 5 unprotected 240 V wall-sockets throughout the Ops Room, above bench level.

Figure 4 shows the suggested layout of the new Operations Room. The first draft was attached to the above email, but following the installation of Earthworm at MVO in March 2001, this figure was revised as shown here.

The plan was for the computers to be placed along the back wall, with all the monitors placed around the window arc, display critical real-time data and acquisition status. The communications radio and the drums would be placed at the centre of the window, with the best possible view of the volcano.

Spare computers would be stored on the shelves at the back, ready to plug in in the event of failure. Or they would be run in parallel, where failover was possible. Bookshelves would kept clutter off the work surfaces.

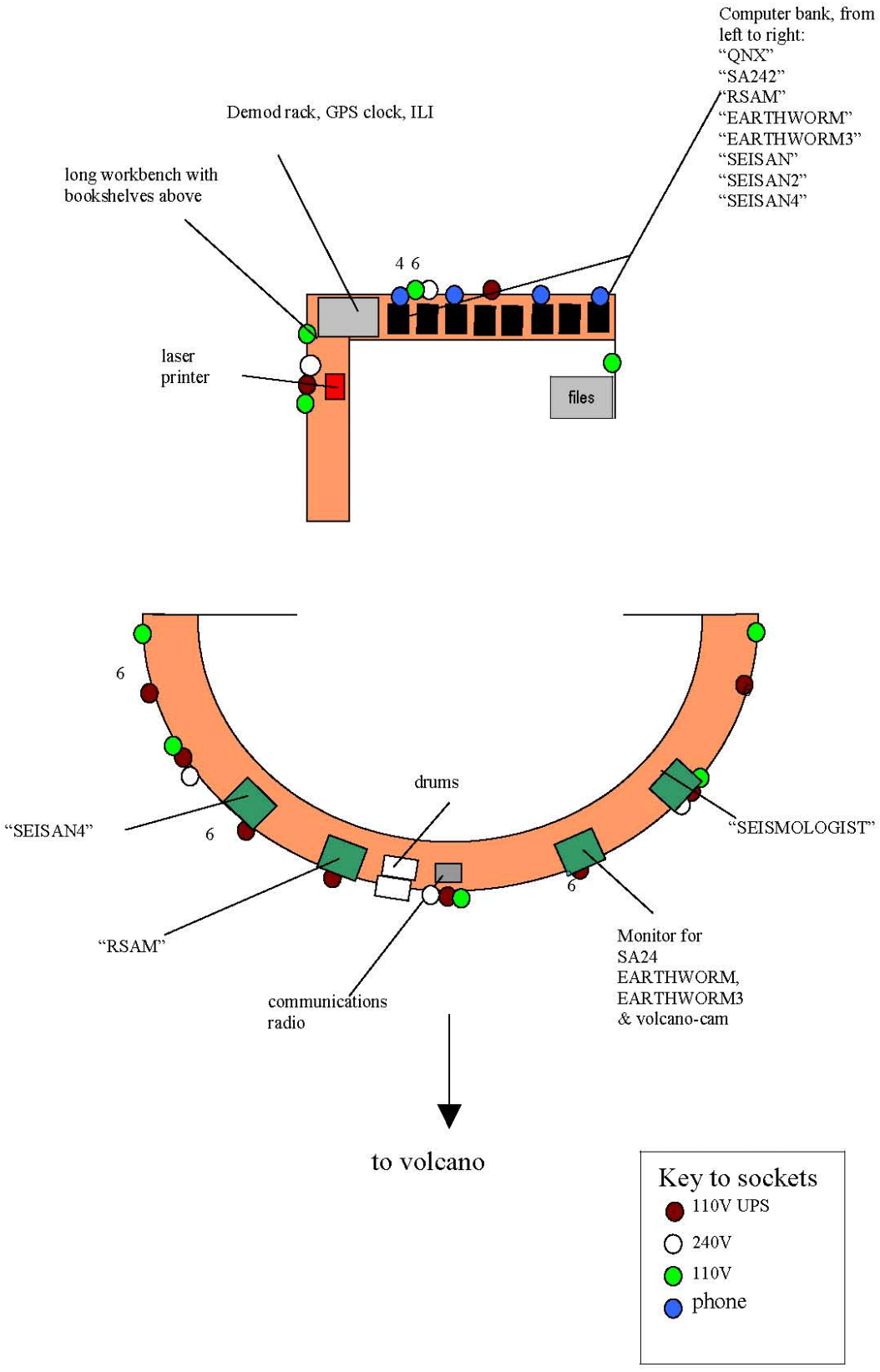
Computer bank, from left to right:
"QNX"
"SA242"
"RSAM"
"EARTHWORM"
"EARTHWORM3"
"SEISAN"
"SEISAN2"
"SEISAN4"
Demod rack, GPS clock, ILI
long workbench with bookshelves above
4 6
laser printer
files
6
drums
"SEISAN4"
6
"SEISMOLOGIST"
6
"RSAM"
Monitor for SA24 EARTHWORM, EARTHWORM3 & volcano-cam
communications radio
to volcano
Key to sockets
110V UPS
240V
110V
phone

Figure 4: Proposed layout of the Operations Room at Flemings. The idea was to make it as functional as possible. The drums were to be positioned next to the communications radio, at the best position for observating the volcano. The RSAM computer, with its streaming graphical display of seismic amplitude data was to be easily visible. To make it as simple as possible, the data acquisition systems were all connected to a switchable monitor, making it easy to check the status of all systems. At the ends of the arc were the computers to be used by the Seismic Analyst and the Seismologist.

3 THE MOVE

There is no detailed timeline of the move available. But the equipment had all arrived by November 2002 and the move began. It was completed on 19th January 2003.

Dave Petrie came and was asked by Dave Williams to work on configuring the telemetry at the Silver Hills repeater site. We also identified a new seismic site below and the the west of Silver Hill, above Rendezvous Bay, and with pick-axe we chiselled out an excellent hole in some bedrock and installed the new digital seismic network site and called it MBRV (rather than MBSH). Rather than power MBRV with solar panels, a cable was lain from the repeater site to the seismic station several hundred metres in length, and buried.

Meanwhile, Dave Williams and Pyiko had completed other government work and got busy with setting up the repeater in Olveston as an alternative to Garibaldi Hill (which by now was in the exclusion zone), and setting up the antennae, receivers and cables at MVO Flemings. Dave and Pyiko did a superb job on this, and with other key tasks such as networking the two observatories together during the move, an idea Dave deserves full credit for.

Joel and I were busy setting up the new computers in the Operations Room, mirroring the QNX/SA24/Earthworm/Seisan setup at Mongo Hill, and modifying the software to merge the datastreams seamlessly from both sites.

During the move monitoring was complicated by the fact that staff could be anywhere at either site, or between sites, moving equipment, or out in the field reconfiguring telemetry. It was not uncommon for me to be the only person at the observatory for a significant part of the working day, and this became particularly common during the move. On at least two occasions while at Mongo Hill I saw significant pyroclastic flows travelling down Tyers Ghaut on the camera images from Windy Hill, and was unable to raise any staff by radio or cellphone to provide observations, and knowing that members of the public were in the Day Time Entry Zone, I had no choice but to call ZJB and make a live broadcast for people close to the Belham Valley to move to higher ground. This was a persistent problem at Mongo Hill. MVO Flemings provided the Operations Room with a vantage point where staff actually would have a better view of volcanic activity than from just about anywhere else on the island within the designated “Safe Zone”.

4 THE NEW OBSERVATORY

The move of the seismic monitoring was complete by 19th January 2003. Some photos are shown below, to record how things looked at this time:

4.1 Aerial photographs of the observatory

Photo 1: MVO Flemings taken on return from one of the first observation flights from the new observatory.

Photo 2: Another view of MVO Flemings just prior to landing.

4.2 Views from/of the Operations Room

The Operations Room was configured as planned since March 2001, except that the helicorders had to be positioned towards the back of the room, given the length of cabling available.

Photo 3: The view from the Operations Room on 18th March 2003. The helicopter pad and St Georges Hill are directly ahead. Gages Mountain is to the left with the dome behind it. The slope down to Farrels Plain can be clearly seen.

Photo 4: The VDAP rack at the new observatory. The analog network was still vital for real-time seismic monitoring.

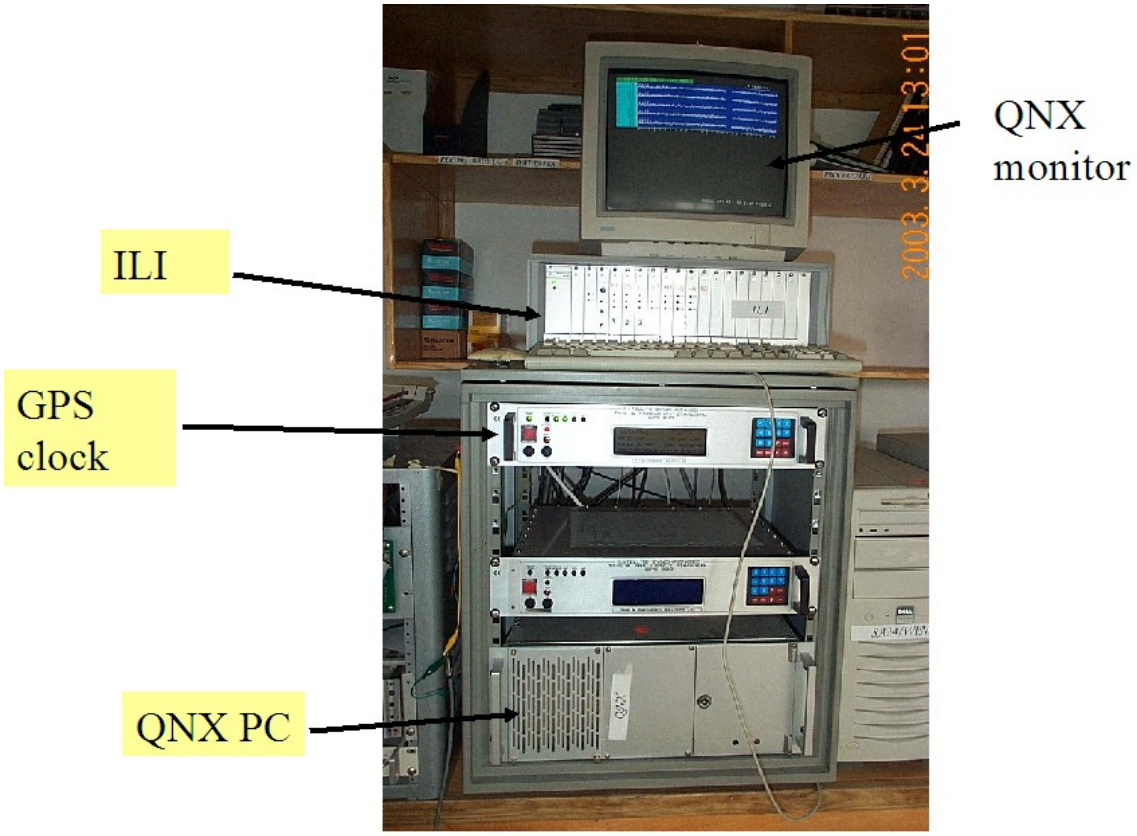

Photo 5: From top to bottom: Seislog running on the QNX monitor, acquiring data from the analog network. The ILI, used for timestamping data received via the Earth Data telemetry system. The primary and backup GPS Radiocode clocks, used for timestamping by the ILI and QNX/Seislog. The QNX PC.

Photo 6: The bank of PCs at the back of the Operations Room as intended, to prevent cluttering up the work bench.

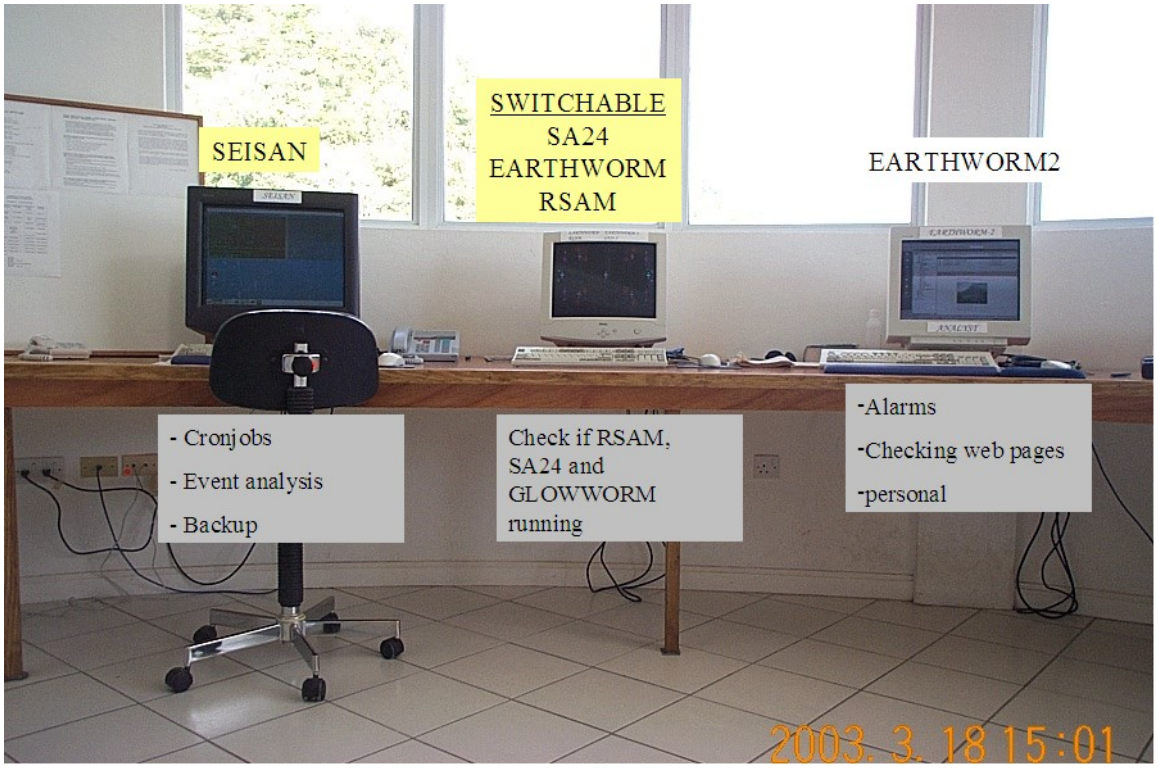

Photo 7: Some of the monitors around the Operations Room. Seisan is used for event classification. The switchable monitor is used for checking the status of SA24, Earthworm and RSAM. The Earthworm2 monitor is used for data analysis and is often used to show the latest images from the photographic network, or for checking the remote monitoring webpage.

Photo 8: The other monitors in the Operations Room: Seisan4, intended as a fully operational backup for Seisan is in fact being used by the Software Engineer (Joel Maranhao, shown here) as his own personal Linux PC (he also has a new dual-boot PC in his office). Earthworm3 runs Earthworm and Glowworm, but with a subset of 'good' stations, as a backup to the primary Earthworm system. It also serves the remote monitoring webpage. The MULTIMO PC is used to run Scream to acquire data from the MULTIMO station at Lees Yard. The MULTIMO Linux server is shown beneath the desk.