Australian Synchrotron
Turning bright ideas into brilliant outcomes

UPS Improvements to Beam Availability at the Australian Synchrotron Light Source

Don McGilvery

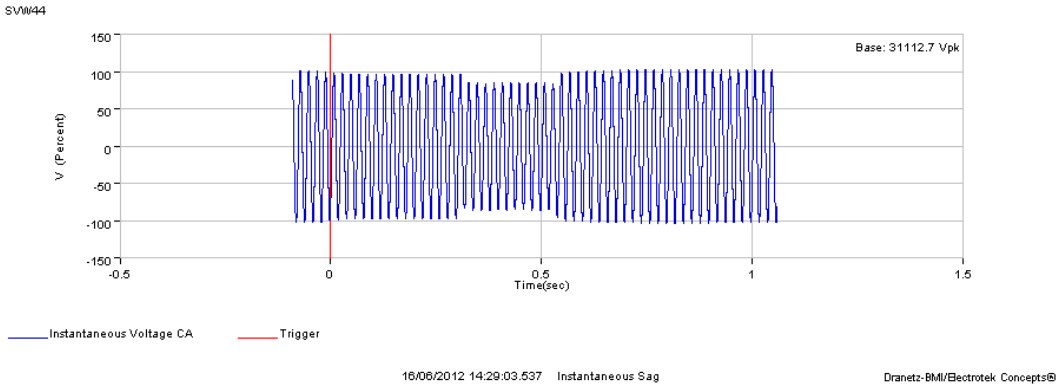
Supported by
Australian Government
State Government Victoria

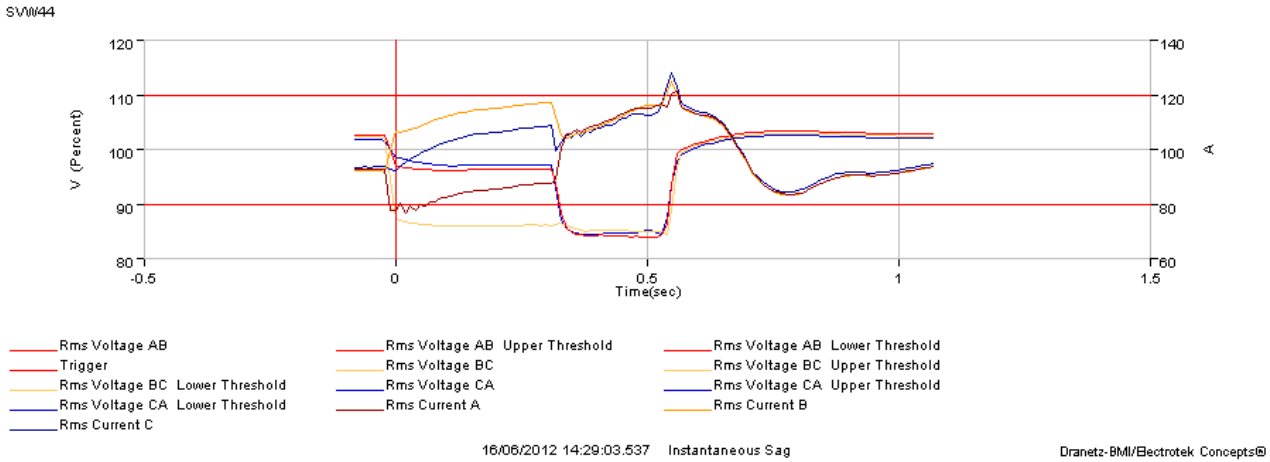
The Australian Synchrotron Light Source

- 3rd Generation Synchrotron Light Source with a full energy injection system.
- Have good beam availability – Why do more?
- Biggest cause of downtime – interruptions to incoming power feed.

Causes of Brownouts

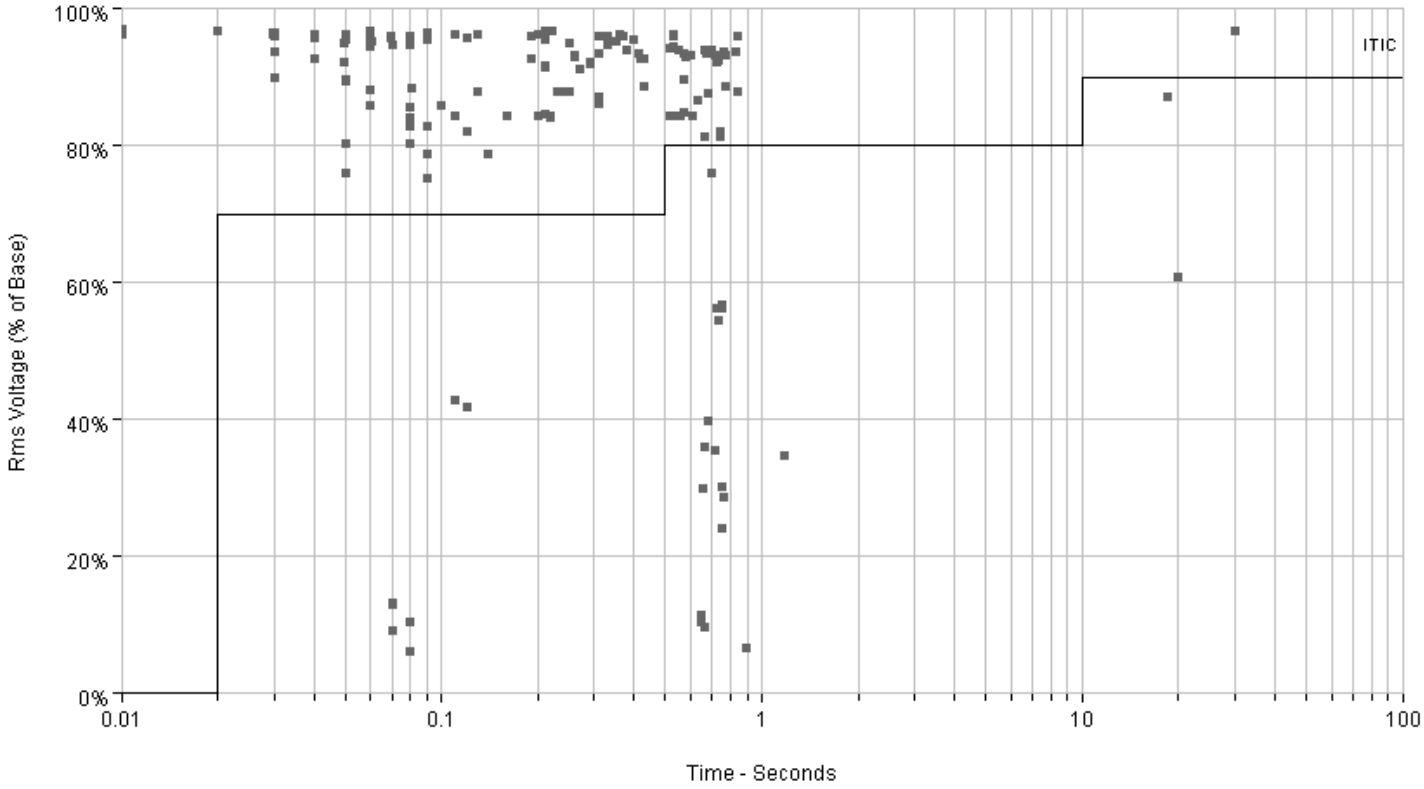
- We have redundant high quality underground feeds from 2 local substations on the national grid.
- Most interruptions are from distant, not local causes.
- Electrical Storms
- High winds
- Electrical distribution Network maintenance
- Vehicles and poles
- Furry creatures
- Bushfires (floods?)
- Earthquake(?)


SVW44
Base: 31112.7 Vpk
V (Percent)
Time(sec)
Instantaneous Voltage CA
Trigger
16/06/2012 14:29:03.537 Instantaneous Sag
Dranetz-BMI/Electrotek Concepts®


SVW44
V (Percent)
A
Time(sec)
Rms Voltage AB
Trigger
Rms Voltage BC Lower Threshold
Rms Voltage CA Lower Threshold
Rms Current C
Rms Voltage AB Upper Threshold
Rms Voltage BC
Rms Voltage CA
Rms Current A
Rms Voltage AB Lower Threshold
Rms Voltage BC Upper Threshold
Rms Voltage CA Upper Threshold
Rms Current B
16/06/2012 14:29:03.537 Instantaneous Sag
Dranetz-BMI/Electrotek Concepts®

SVW44

01/01/2012 01:00:00.000 - 27/07/2012 19:42:21.000



Systems Protected

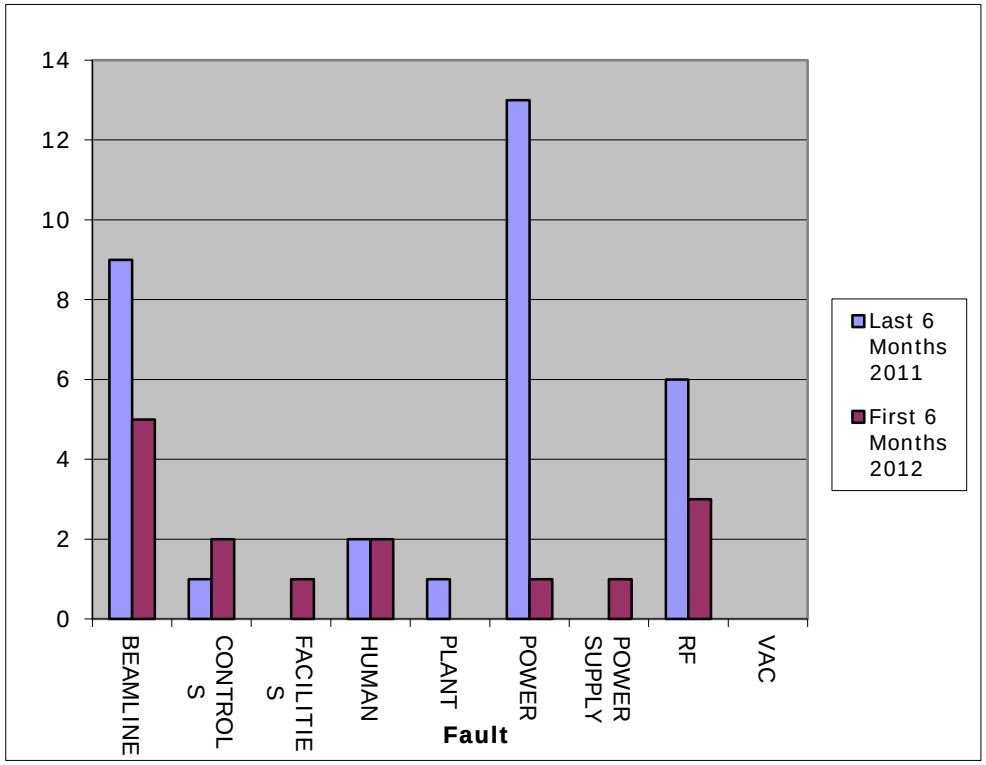
- Three independent flywheel based energy storage
- Storage Ring RF system (1MW UPS)
- Storage Ring magnets/vacuum and control/diagnostic systems (1.2MW)
- Technical Plant, Refrigerated Cooling water systems and compressed air.. (1.8MW) (the largest single unit installed worldwide by the supplier)
- Emergency systems, Beam lines, Control Room and Control systems already protected by battery based UPS systems backed by a 400kW diesel generator.

Systems not Protected

- Injection system - Linac and booster
- Building Hvac, general light and power

Performance

- 50% Reduction in beam loss events
- In the first 6 months no stored beam interruption during 18 brownout events which would have resulted in an estimated 30hrs downtime
- Did not protect against total loss of site power for 2 hrs (short on 22kV feed to another building on site)
- The Switchboard Trip times have been fixed to improve resilience.
- Did not protect against moderate earthquake (measured 5.3 with the epicentre 100kms away) Largest in Victoria for 100 years. No large voltage variation on power grid but large phase shifts inhibited UPS from resynchronising after brownout. A bank data centre had a similar fault.
- Phase synchronisation limits have been relaxed


14
12
10
8
6
4
2
0
BEAMLINE
CONTROLS
FACILITIES
HUMAN
PLANT
POWER
POWER SUPPLY
RF
VAC
Fault
Last 6 Months 2011
First 6 Months 2012

Other Issues

- Cooling issues
- Volume of air and filters
- Ambient temperatures above 35C
- Noise and vibration – no problems so far

Upsides

- Improved outcomes for Users
- Improved machine reliability
- Greater machine stability
- Greater RF stability
- Possible improved power converter reliability
- Reduced Stress in the Control Room

Downsides

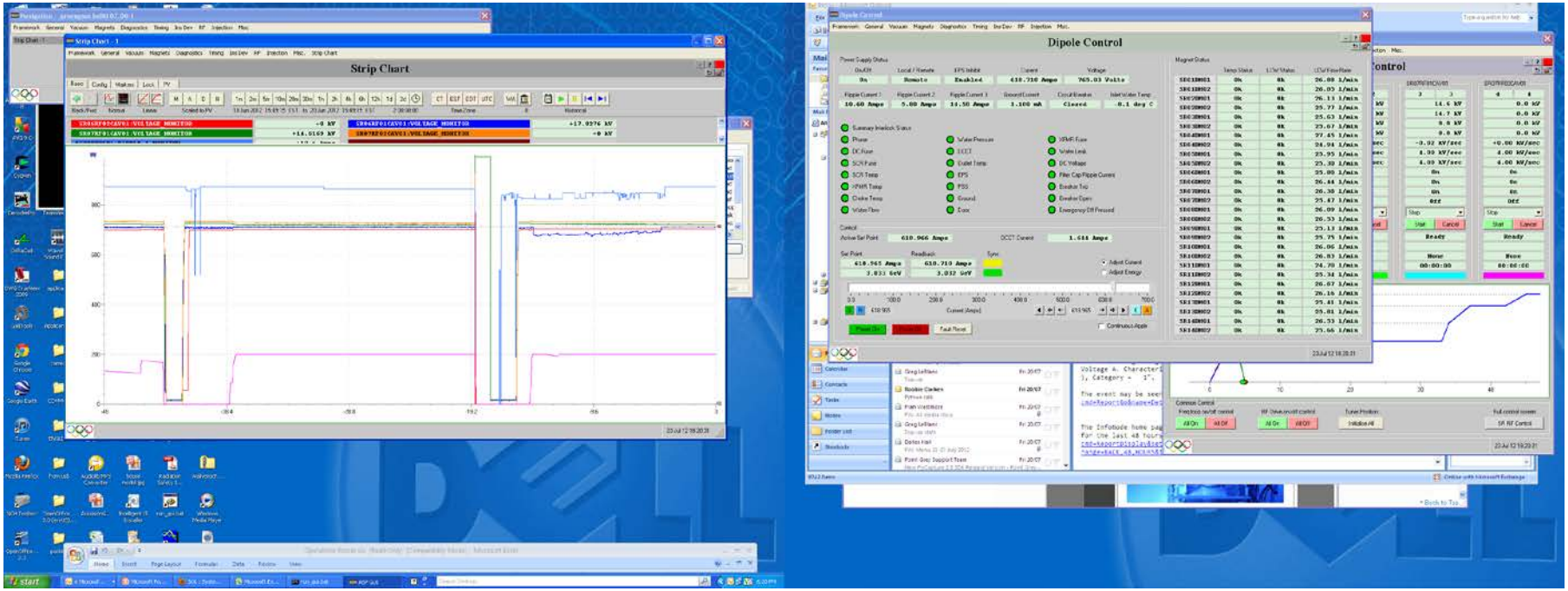
- Cost of System A$4M
- Extra power consumption (possible offset with reduced headroom on RF)
- Lower Stress in the Control Room (reduced vigilance)
- Loss of training opportunities (recovery from big events takes longer)
- Extra point of failure (earthquake shut down UPS system resulting in 4hr downtime rather than 30 minute downtime)
- More difficult to justify further improvements (RF LLE system)
- Possible reduction in urgency from technical support staff if less critical systems fail after event.

Is it worth the cost?

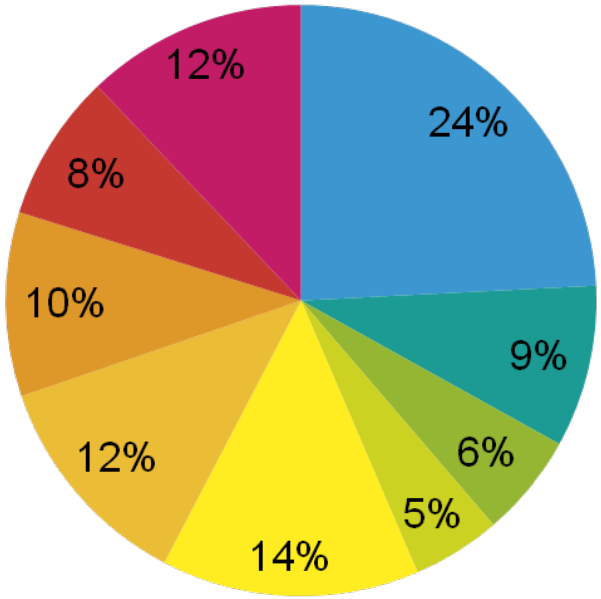
- Light source – yes
- Research Physics facility – probably not
- Can we justify it via cost savings – No!
- Does it improve User Outcomes? – Yes but difficult to quantify
- Does it improve Operator working conditions or health? - Yes

Summary

- After 4 months of operation
- A 50% reduction in downtime
- The longest uninterrupted user run > 500 hrs without an unscheduled beam loss event.
- Operations Manager commented “The best $4M he ever spent”.


Strip Chart
Dipole Control

PIE CHARTS



- 1st Quarter 09
- 2nd Quarter 09
- 3rd Quarter 09
- 4th Quarter 09
- 1st Quarter 10
- 2nd Quarter 10
- 3rd Quarter 10
- 4th Quarter 10
- 1st Quarter 10

COLOUR PALETTE

The Corporate Style Colour Palette consists of the following colours

- The primary colour should always be the Grey
- Other colours should be used sparingly as highlights, feature colours, or in tables and graphs
- In graphs the colours should be used consecutively as they appear below

R 116 B 116 G 118	R 60 B 151 G 209	R 27 B 155 G 148	R 148 B 182 G 51	R 204 B 210 G 33	R 255 B 237 G 33	R 235 B 188 G 53	R 222 B 152 G 41	R 197 B 56 G 48	R 195 B 28 G 103

Australian Synchrotron
Turning bright ideas into brilliant outcomes

Supported by

Australian Government

State Government Victoria

ACKNOWLEDGMENTS