

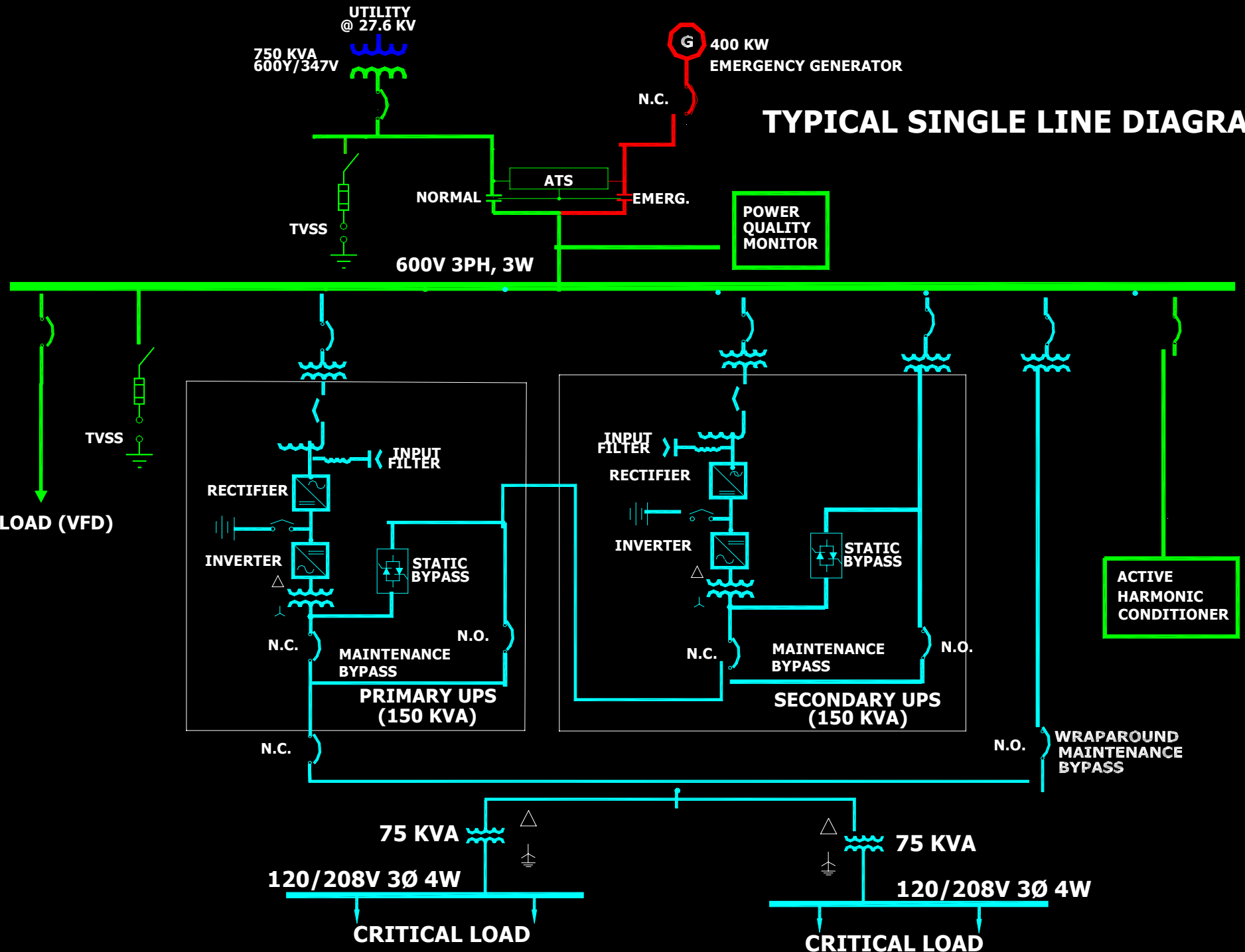
What Can We Learn About AC Systems From Monitoring Batteries ?

Robert Hanna, Ph. D., P. Eng.

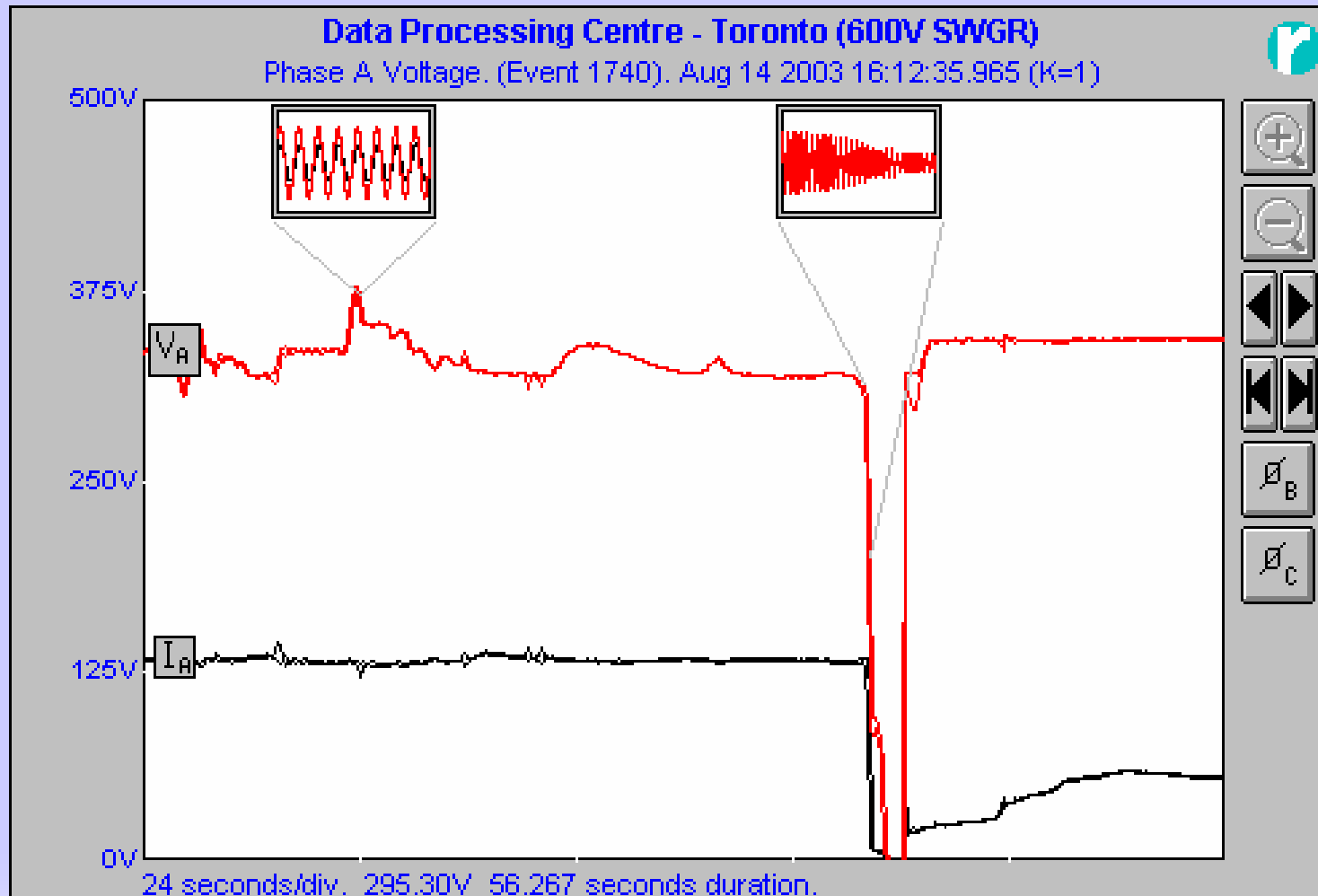
September 19, 2003

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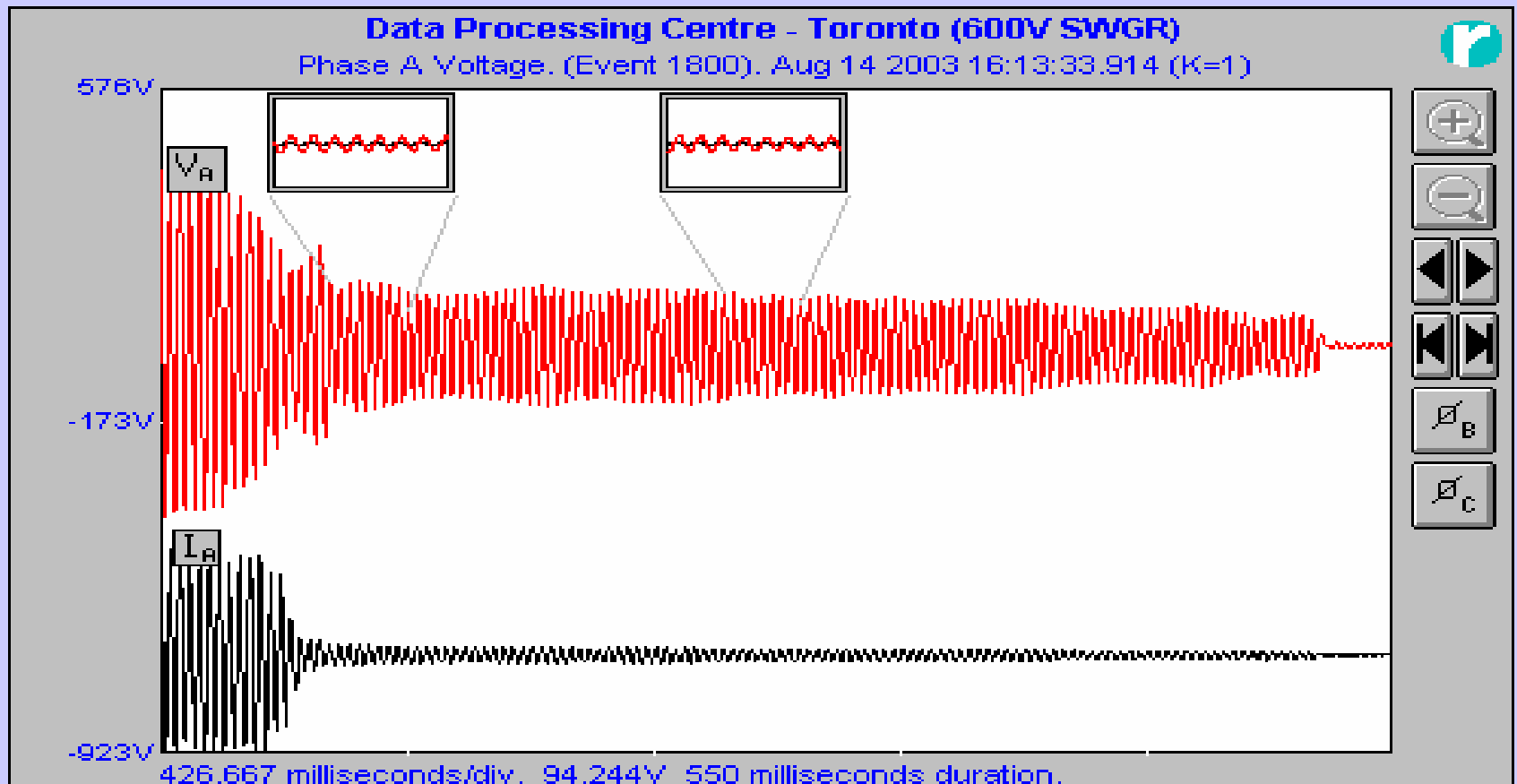
TYPICAL SINGLE LINE DIAGRAM



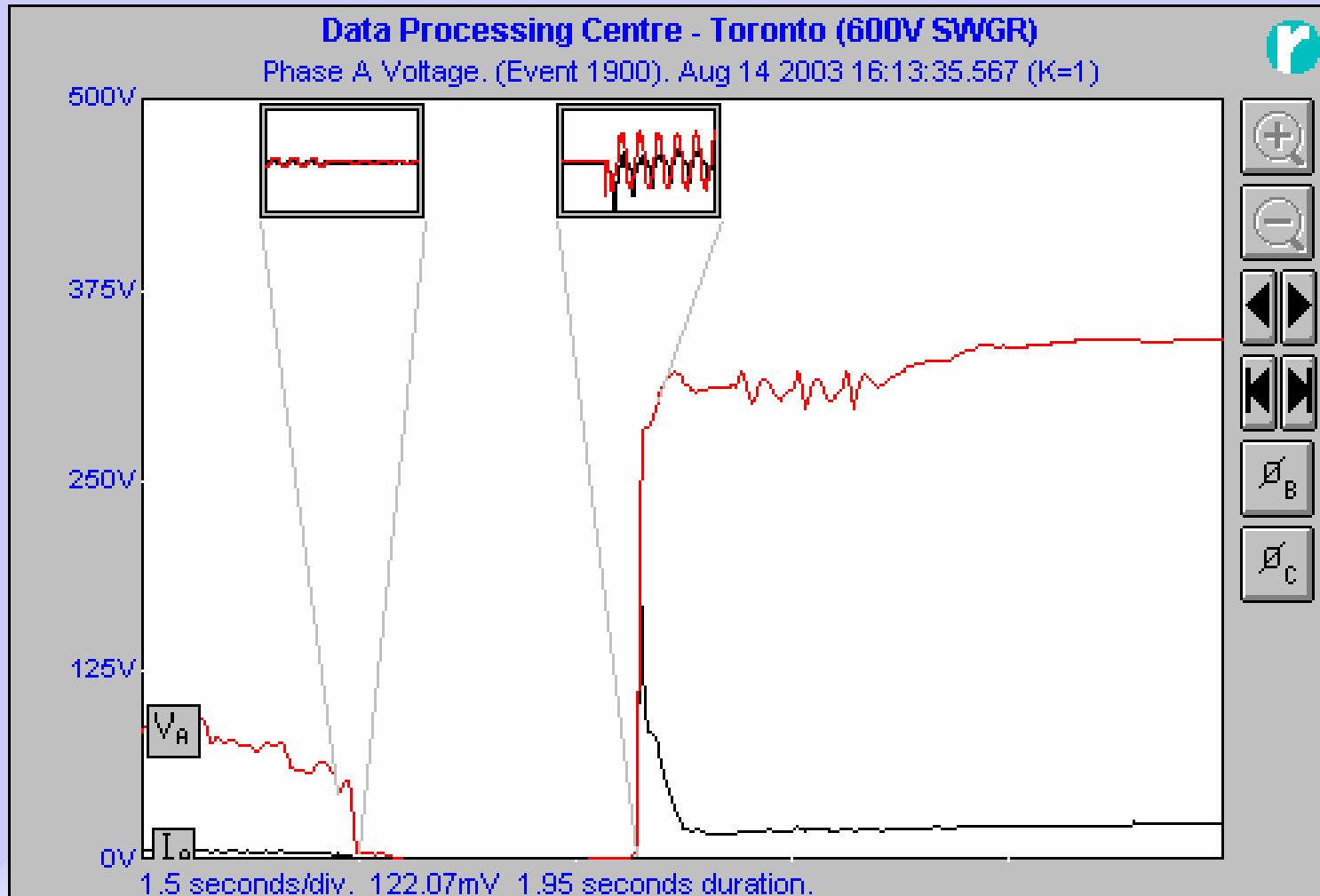
Voltage Summary Profile Covering August 14 Blackout



August 14, 2003 Blackout



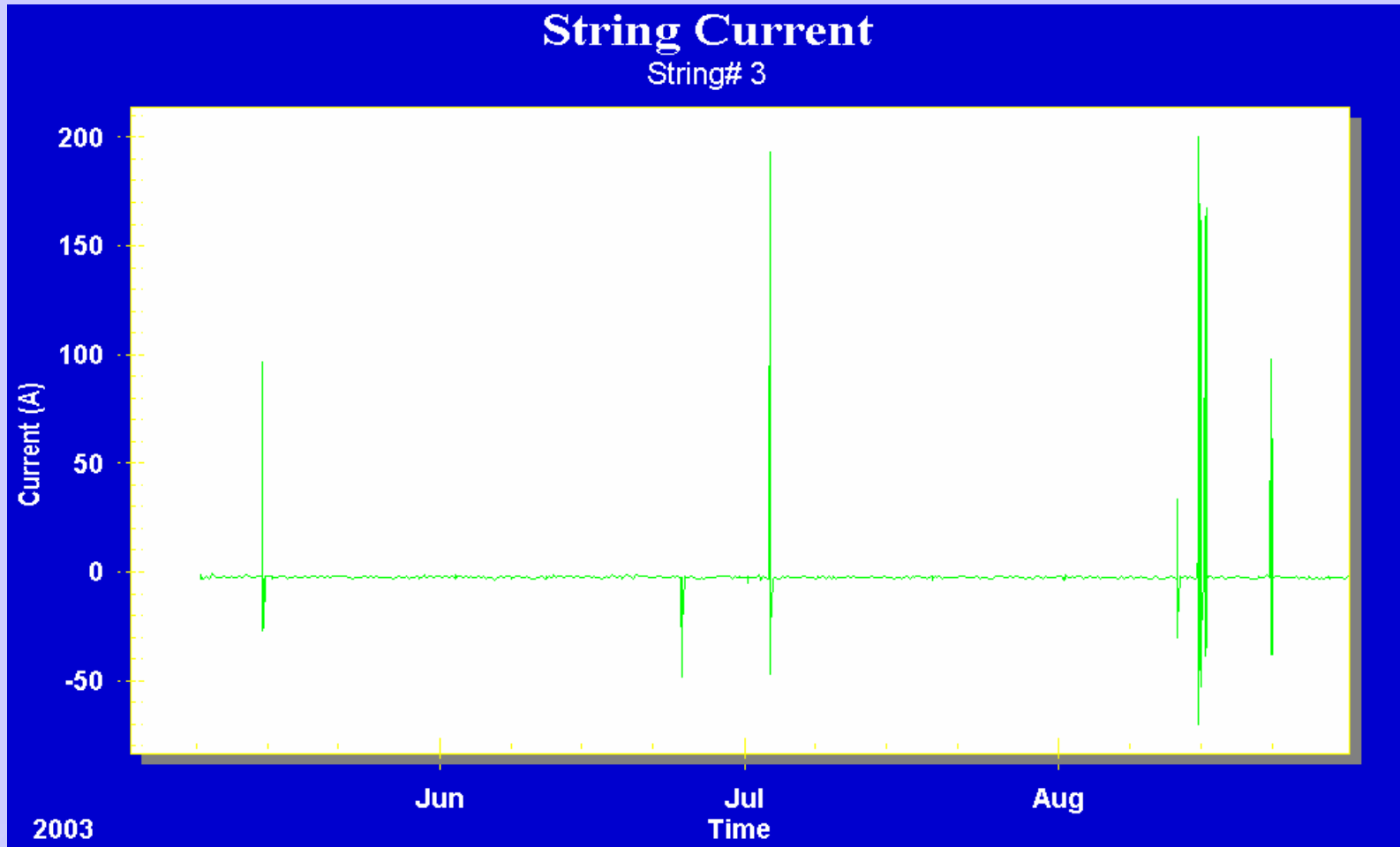
Emergency Generator Starting



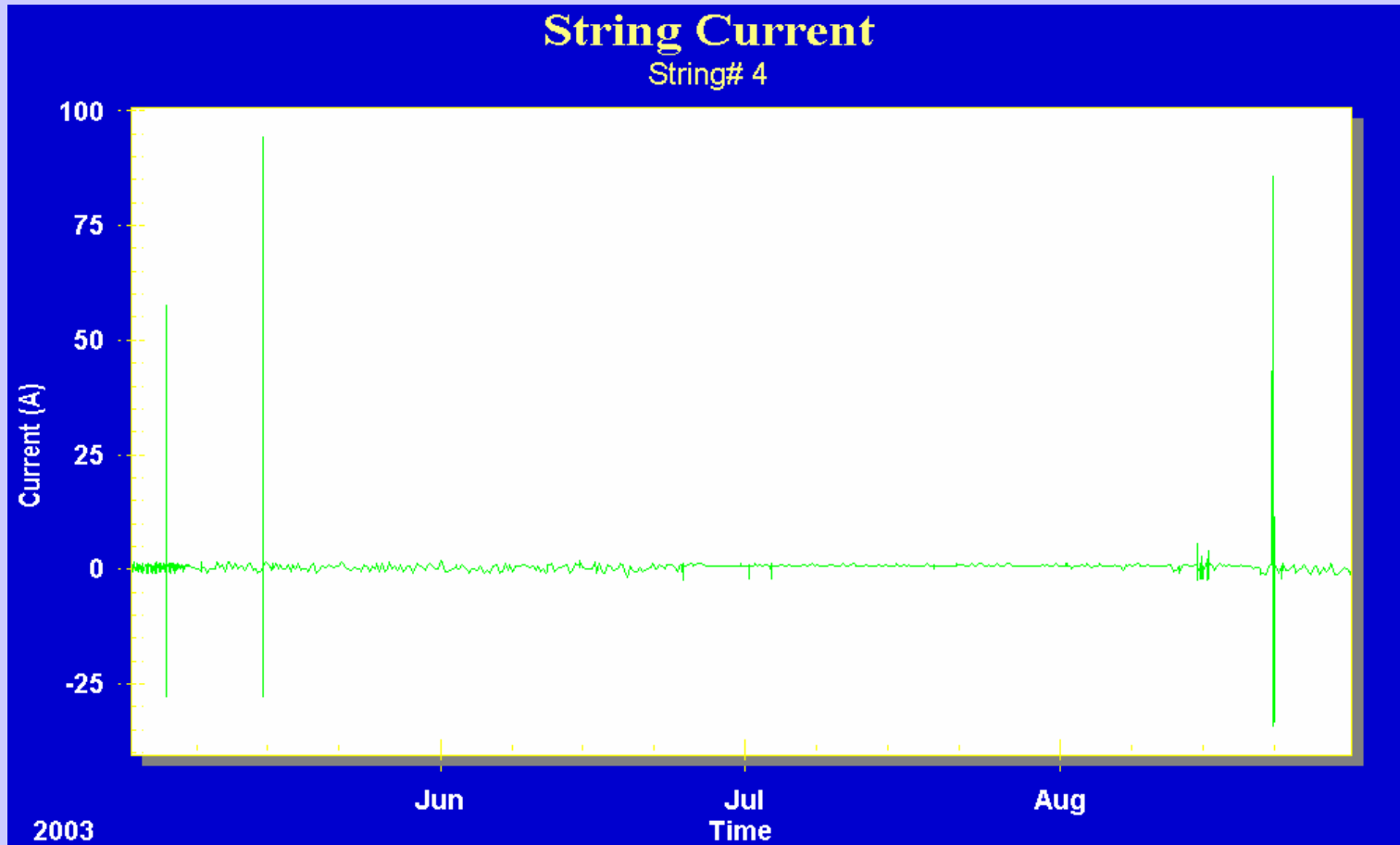
UPS Alarm History on August 14

1357	08/14/03	16:10:54.45.0	rct in recharge
1358	08/14/03	16:10:54.45.0	input voltage normal
1359	08/14/03	16:10:54.44.1	rct phase locked
1360	08/14/03	16:10:54.34.0	input frequency normal
1361	08/14/03	16:10:52.45.1	UPS pwr supply inp normal
1362	08/14/03	16:10:50.47.0	input frequency low
1363	08/14/03	16:10:50.46.1	UPS pwr supply inp failure
1364	08/14/03	16:10:50.44.0	rct not phase locked
1365	08/14/03	16:10:50.44.0	input frequency high
1366	08/14/03	16:10:50.43.0	UPS pwr supply inp normal
1367	08/14/03	16:10:50.42.1	UPS pwr supply inp failure
1368	08/14/03	16:10:50.42.0	UPS pwr supply inp normal
1369	08/14/03	16:10:50.41.0	UPS pwr supply inp failure
1370	08/14/03	16:10:49.04.0	UPS summary alarm
1371	08/14/03	16:10:48.44.1	input voltage low
1372	08/14/03	16:10:10.42.0	UPS Normal

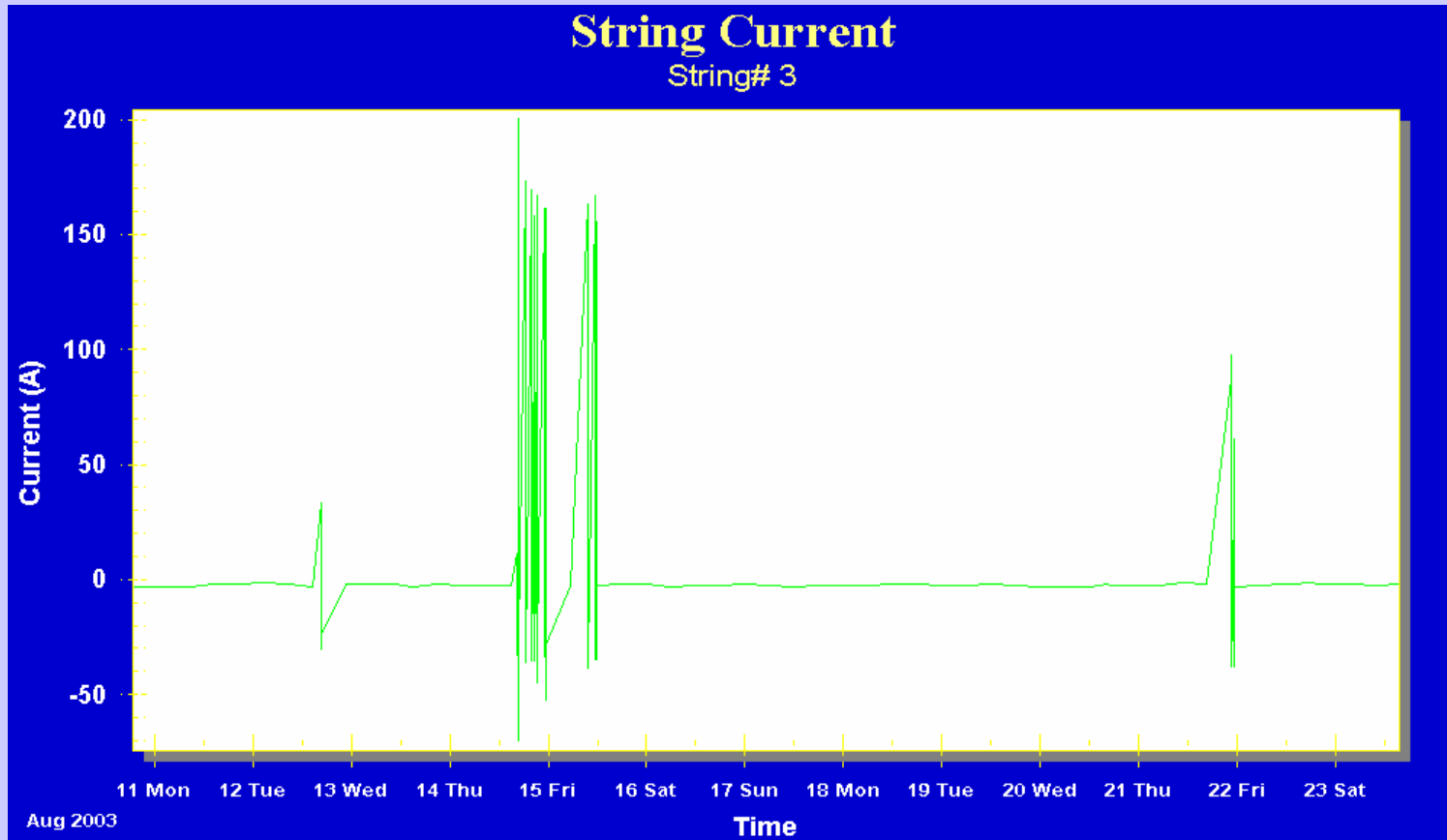
String 3 Current Profile – 3 Months



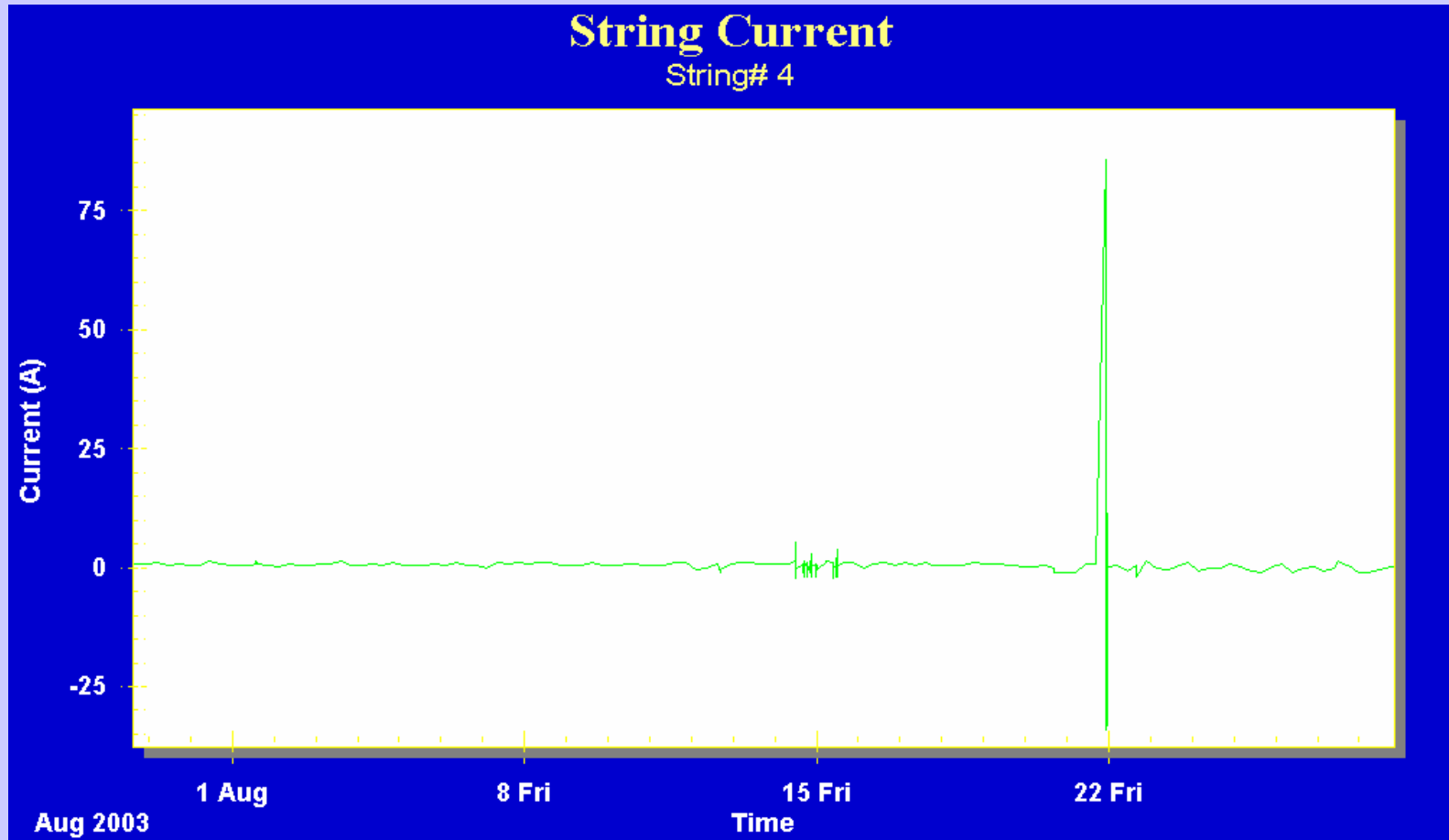
String 4 Current Profile – 3 Months



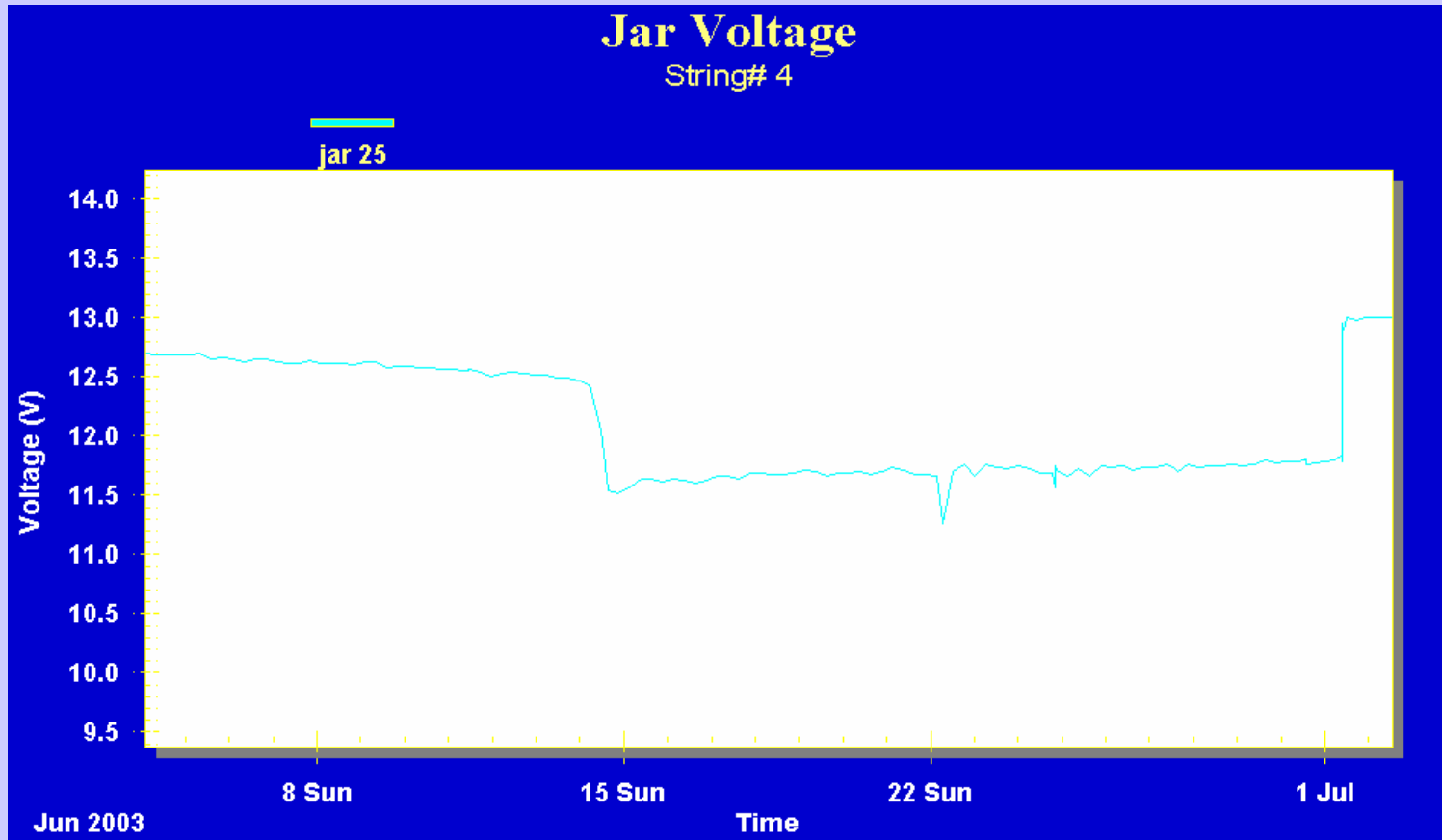
Expanded View of String 3 Current Profile



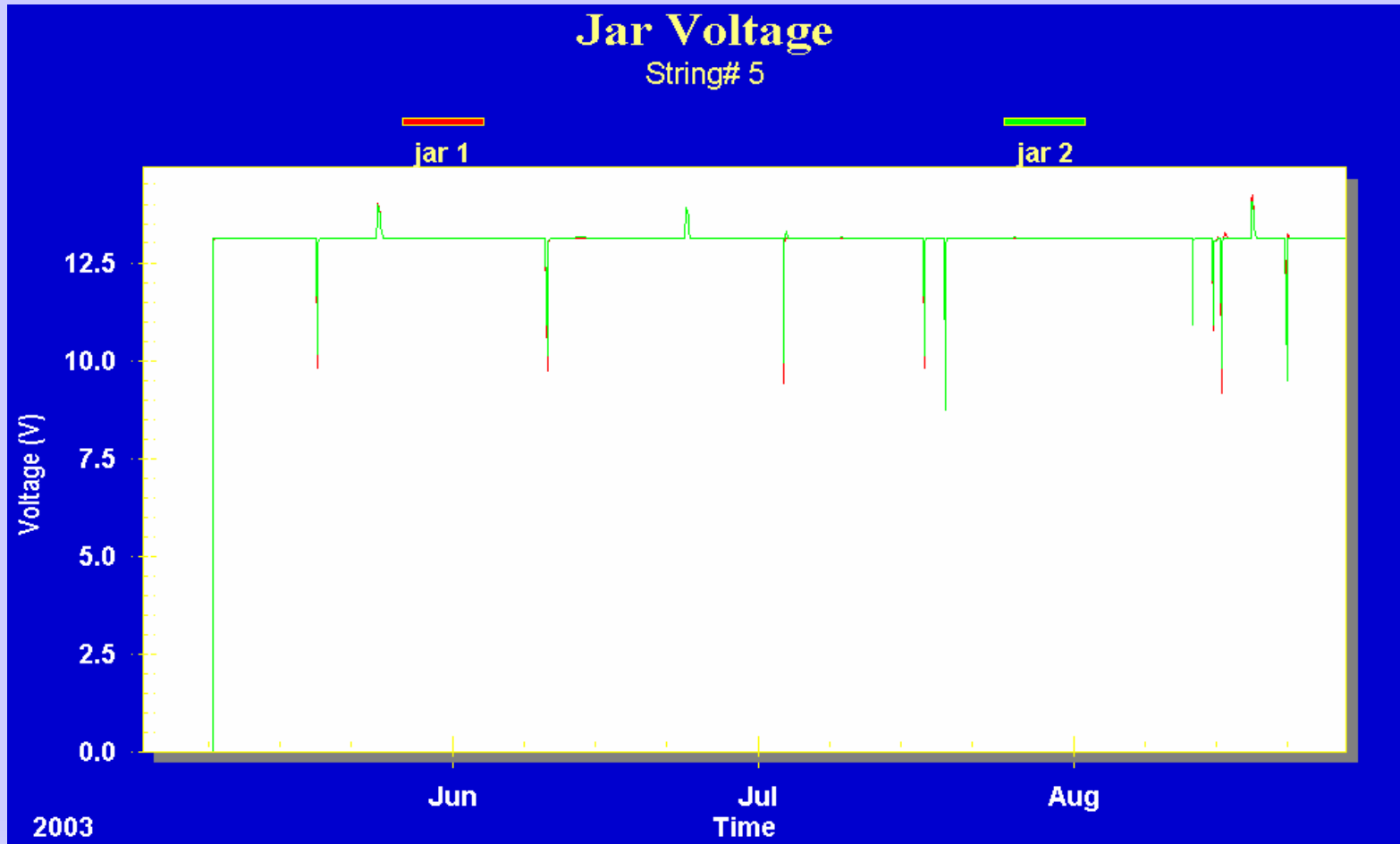
Expanded View of String 3 Current Profile



Deterioration of Cell 25



Emergency Generator Cells profile



Conclusions

- ◆ **On-line Power Quality and Battery Monitoring is extremely important to understand the performance of your system under normal and abnormal conditions**
- ◆ **It is a preventative maintenance tool to replace batteries before is too late**