Sienel, Beth

From: Teras, Markus
Sent: Monday, August 25, 2003 4:44 PM
To: Sienel, Beth
Cc: Leach, Don; Bronson, Kevin; Wamser, Chris; Wanczyk, Robert; Boivin, Joe; Dreyfuss, John; Amidon, Doug; Pelton, David
Subject: NRC Request - Aug 14 Grid Disturbance

Beth,

Attached are VY answers (and graphs) to the NRC Information Request on the Grid Disturbance on 8/14/03. If you have any further questions please contact me or Doug Amidon (X3018).

Thanks,

Markus Teras


NRC Question Response.doc (42 ...


TREND_1.pdf (49 KB)


TREND_2.pdf (43 KB)


TREND_3.pdf (37 KB)


TREND_4.pdf (38 KB)

A-186

Information Request to Support the Working Group on Nuclear Generator Issues. (Entergy Vermont Yankee Station)

A.1 Describe any observed offsite power supply abnormalities on the afternoon of August 14, 2003.

At approximately 4:11 p.m. significant voltage and power swings occurred for a number of seconds at the VY Switchyard. It is believed that these swings coincided with the tripping of the New York to New England Tie Lines. This conclusion is based on the observed power swings, combined with fairly wide fluctuations in system frequency following the transient. Initially, system frequency increased from 60Hz to 60.37Hz over a 30 second period. Frequency then slowly decreased to a low of 59.6Hz over the next six minutes and recovered to 60Hz over the following seven minute period as ISO-NE worked to more closely match New England generation with area loads following the event. A Reactor Protection System (RPS) trip would occur at 56.5 Hz. From this point forward, system frequency was maintained at 59.9 – 60.2 Hz. [Note: System frequency was calculated using Turbine-Generator Speed PTID T005.]

Generator output voltage dipped from 21.5 kV to 17.8 kV at the onset of the event, but immediately recovered to steady state conditions. Field voltage was appropriately boosted during the transient, indicating proper auto voltage regulator response.

Generator Reactive Power increased from 130 MVARs to a peak of 351 MVARS and then returned to the normal range over a five second period. This was in response to the initial grid under voltage condition. Although the peak MVAR level was at the edge of the generator capability curve, there are no equipment damage concerns since the limit is associated with sustained field overheating (vs. a transient response to a momentary overload or fault.)

Switchyard voltages declined considerably. The 115 KV low recorded voltage was approximately 79kV and 345 KV low recorded voltage was approximately 238kV (as recorded on the Oscillograph / DFR). This is an indication that actual bus voltages decreased to a point that the subsequent 345 and 115 KV under voltage alarms were valid and functioned correctly. This was corroborated by the concurrent alarming of multiple independent alarms. No relays tripped. This was verified immediately following the event.

All alarms noted on the annunciator panels and DFR were expected and can be justified. No abnormal indication or actuations were noted. Evaluation to date indicates that all protective equipment responded according to correct parameters and settings.

B.1 Describe any load adjustments experienced.

All plant process parameters (e.g., recirculation flow, steam flow, vessel level, feed flow, Rx pressure, APRM power level, etc.) responded appropriately during the event.

The Recirculation MG set drive motors are sourced from 4kv Bus 1 and Bus 2. As bus voltage and frequency fluctuated, so followed the Recirculation MG set Drive motors. The Recirculation MG set generator output followed, driving recirculation pump speed, which drove recirculation flow. The change in recirculation flow caused the appropriate change in reactor power.

The increase in reactor power was less than 1% and peaked about 1 minute after the event start. Reactor power returned below 100% in 4 minutes after event start. Within 15 minutes of event start all process parameters returned essentially to their pre-event values, with no anomalies noted. Very minor fluctuations continued for some time as the grid itself continued to demonstrate some instabilities.

B.2. What was the setpoint for the runback?

Vermont Yankee did not experience a generator runback. Vermont Yankee does not have a runback circuit.

B.3 Did any electrical under voltage relays actuate? &
B.4 Were there any voltage swings experienced and, if so, what was the magnitude from 4:00 to 5:00 pm on August 14, 2003?

The grid instability caused a transient on all 4KV (4160 VAC) and connected lower voltage busses. Bus 1, 2, 3, and 4 (4160 VAC) voltage dipped to below 3700 VAC, and immediately rose to 4400 VAC, before returning to 4160 VAC. Degraded Grid relay targets dropped on Bus 3 & 4 (as expected) by the transient. The under-voltage condition did not last long enough to actuate the Degraded Grid Under voltage Annunciator due to the 10 second time delay on relay outputs. The Emergency Diesel Generators did not start since the under voltage condition was not of sufficient magnitude and duration to generate an LNP signal.

Associated 480 VAC Busses are fed from 4KV Bus 3 and 4 through Transformers. The 480 VAC bus 8 and Bus 9 voltage followed the 4KV Bus voltage transient. Minimum 480 VAC voltage observed was approximately 387 VAC. The Maximum voltage was approximately 512 VAC. MCC-89A and MCC-89B (480 VAC) are normally powered from 480 VAC Bus 8 and 9 through Rotating Uninterruptible Power Supplies (RUPS). The RUPS have batteries as a backup power supply. During the transient, there was evidence the RUPS Units were running powered by their respective batteries due to the reduction of 480 VAC Bus voltage.

The 120 VAC Vital Bus MG Set is normally powered from 480 VAC Bus 8, with a backup 125 VDC supply from Bus DC-3. During the transient, the Vital MG Set

transferred from the AC supply to the DC supply for a few minutes. This automatic transfer occurs when AC input frequency exceeds 60.5 Hz or drops below 59.7Hz. Based on review of ERFIS PTIDs T005 (Turbine Speed) and E009 (DC-2 Voltage), the Vital AC Swap occurred as system frequency decreased below 59.7 Hz (Turbine Speed = 1791 RPM) to a low of 59.6 Hz (Turbine Speed = 1788 RPM). Therefore, the Vital AC MG Set appropriately transferred due to low bus frequency. [Note: Since the turbine-generator is a 4-pole synchronous machine, turbine speed directly corresponds to a system frequency.]

B.5 Should the plant have tripped?

The Main Generator and Station Electrical Systems functioned as expected during the transient. No faults or deficient conditions were noted. The maximum and minimum system fluctuations were not of sufficient voltage, frequency or duration to cause damage to, or tripping of, in-service plant equipment. Additionally, no RPS Half-Scrams or PCIS Half-Isolations were received.

B.6 Record of power station generator MW/MVA from 4:00 to 5:00 pm on August 14, 2003 and any other period of significant grid instability that day.

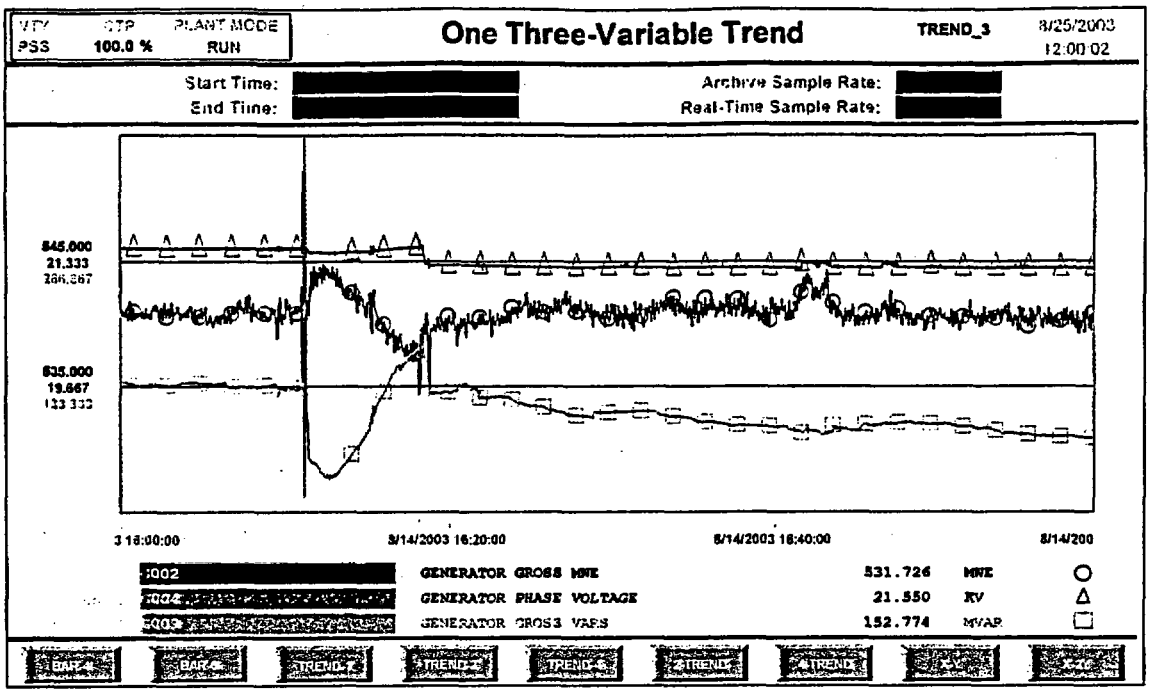
See attached ERFIS Computer trend data.

B.7 Describe any equipment or performance problems related to grid problems.

A review of Electrical alarms received determined that there were no alarms that could not be explained as a result of the transient. Plant response was determined to be correct for the situation. Equipment transferred as designed, and was restored to the normal configuration when the grid transient had stabilized.

Operations performed several walk downs of Control Room panels and noted one discrepancy; a lower than normal dissolved O2 reading. In response, the Chemistry Technician found that the oxygen injection system was not in service. After checking with Chemistry management, the system was placed back in service. Readings subsequently returned to normal levels. It was not certain if the trip of the injection system was related to the grid event. However, based on review of the chart recorder, it appeared that the loss occurred simultaneous with the initial grid transient.

The Digital Fault Relay CRT was found non-functional on 8/19/03. The CRT was replaced and the DFR was checked for additional fault initiators on 8/14/03 other than the Grid event (with the CRT not operational, faults will not auto-print). No additional faults were indicated. The CRT failure could be attributed to the low voltage conditions that were experienced during the 8/14/03 Grid event.


VFY
PSS
OTP
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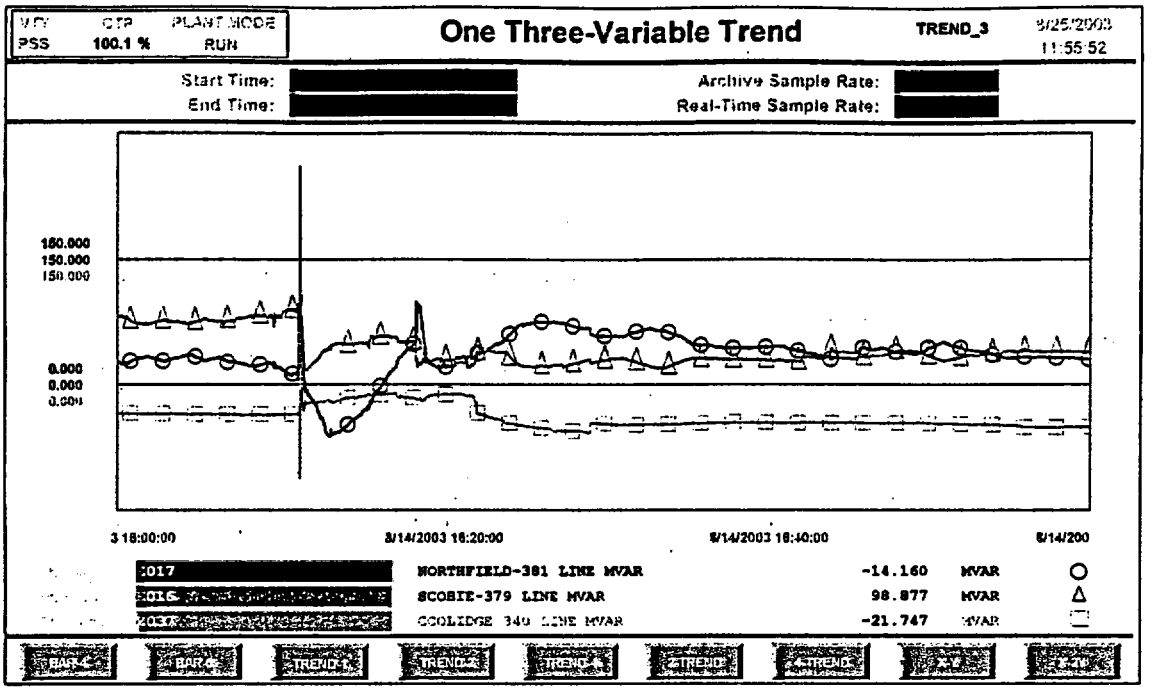
RUN
One Three-Variable Trend
TREND_3
8/25/2003
12:00:02
Start Time:
End Time:
Archive Sample Rate:
Real-Time Sample Rate:
845.000
21.333
635.000
19.667
8/14/2003 16:20:00
8/14/2003 16:40:00
GENERATOR GROSS MWE
531.726
MWE
GENERATOR PHASE VOLTAGE
21.550
KV
GENERATOR GROSS VARS
152.774
MVAR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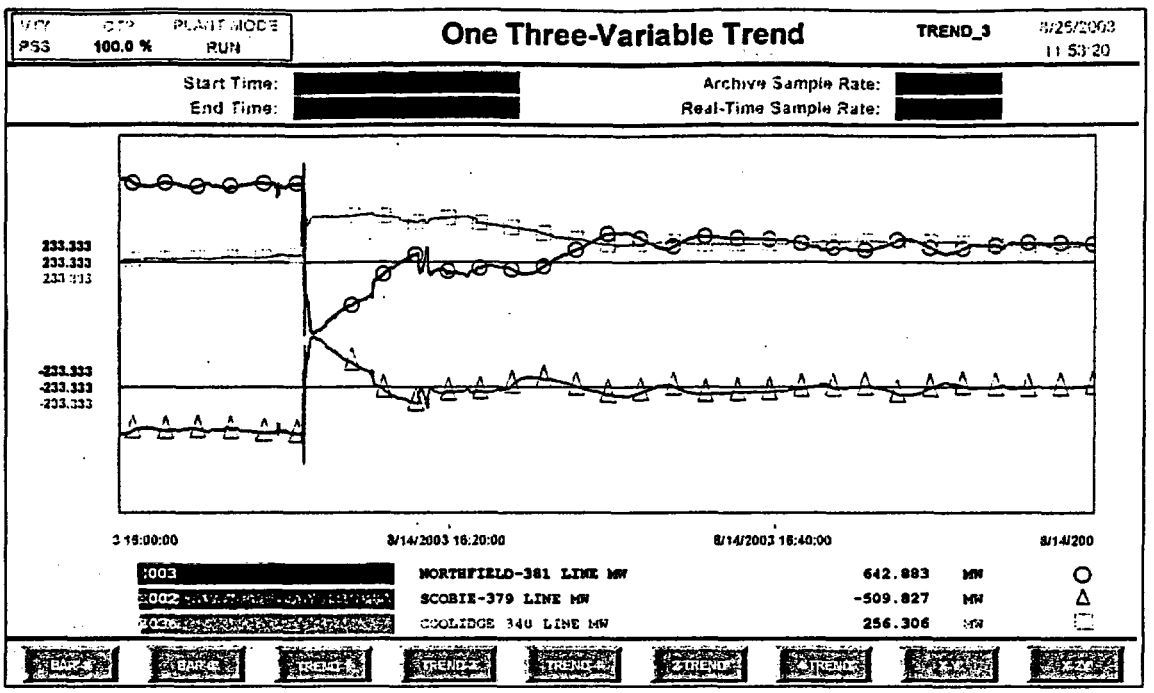
PLANT MODE
RUN
One Three-Variable Trend
TREND_3
9/25/2003
11:55:52
Start Time:
End Time:
Archive Sample Rate:
Real-Time Sample Rate:
180.000
150.000
150.000
0.000
0.000
0.000
3 18:00:00
8/14/2003 18:20:00
8/14/2003 18:40:00
8/14/200
2017
NORTHFIELD-381 LINE MVAR
-14.160
MVAR
2016
SCOBIE-379 LINE MVAR
98.877
MVAR
COOLIDGE 340 LINE MVAR
-21.747
MVAR
BAR 5
BAR 6
TREND 1
TREND 2
TREND 3
TREND 4
TREND 5
TREND 6
TREND 7
TREND 8


PSS
100.0 %
PLANT MODE
RUN
One Three-Variable Trend
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8/25/2003
11:53:20
Start Time:
End Time:
Archive Sample Rate:
Real-Time Sample Rate:
233.333
233.333
-233.333
-233.333
-233.333
8/14/2003 16:00:00
8/14/2003 16:20:00
8/14/2003 16:40:00
8/14/200
NORTHFIELD-381 LINE MW
642.883
MW
SCOBIE-379 LINE MW
-509.827
MW
COOLIDGE 340 LINE MW
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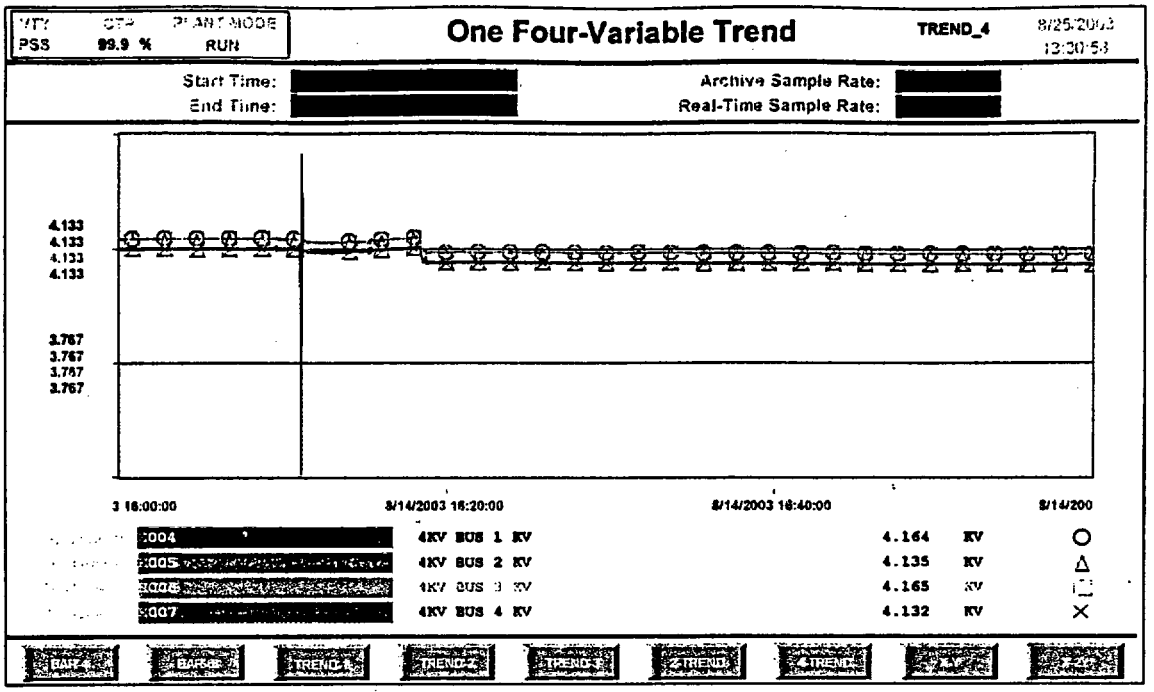
MW
BAR 3
BAR 4
TREND 1
TREND 2
TREND 3
TREND 4
TREND 5


VTY
PSS
CTP
99.9 %
PLANT MODE
RUN
One Four-Variable Trend
TREND_4
8/25/2003
13:30:53
Start Time:
End Time:
Archive Sample Rate:
Real-Time Sample Rate:
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4.133
4.133
4.133
3.767
3.767
3.767
3.767
3 16:00:00
8/14/2003 16:20:00
8/14/2003 16:40:00
8/14/200
4KV BUS 1 KV
4.164 KV
4KV BUS 2 KV
4.135 KV
4KV BUS 3 KV
4.165 KV
4KV BUS 4 KV
4.132 KV