LESSONS LEARNED FROM THE 1977 BLACKOUT

CASE STUDY 1

SEQUENCE OF EVENTS
Prior to 20:37

System Load 5868MW, imports 2860MW, operating reserve 1998MW, synchronized reserve 1208MW.

20:37

Lightning strike causes W97 and W98 to flash over B phase to ground. Circuit breaker configuration causes Indian Point 3 to trip. Feeder Y88 opens automatically at Ladentown S/S. W97 reclosed successfully at Millwood.

Feeders W8 1 and A2253 flows greater than normal, less than LTE.

LESSONS LEARNED

* Verify and correct tower grounding
* Test to extent possible complete relay system
* Lockout Relay philosophy

20:45

Fast load pickup alarm is initiated to the generating stations. Astoria GT site is ordered via telephone to but jet engine units in service.

LESSONS LEARNED

* Prepare procedures for operator response to overloads and drill
* Gas turbines should always be available or available via remote start control
* Install alarms at all GT sites
* Periodically test generating units’ emergency response

20:55

Lighting strike causes feeders W93 and W99 to flash over C phase to ground. W99 successfully reclosed. W93 reclosed at Sprain Brook only. Angle too great at Buchanan. W81 trips due to faulty relay. Feeder 80 > LTE, A2253 > normal. East River No. 5 generation being reduced and forced out of service.

LESSONS LEARNED

* Every Megawatt counts
* Syncheck relays vs. blackout potential
* Prepare and drill on procedures for major emergencies
* Prepare and continuously drill on procedures for rapid restoration
* Provide information to operators in clear, concise manner
* Prepare procedures for NYPP/member company interface
* Prepare procedures for proper relay handling
* Have an organization properly staffed to handle all emergencies
21:14

System wide 5% voltage reduction initiated.

**LESSONS LEARNED**

* Master push buttons for quick response

21:18

System wide 8% voltage reduction initiated.

**LESSONS LEARNED**

* Procedure to initiate 8% first

21:19

Feeder 92 (feeder SO) faults opening the last 345kV tie to the north. Sl transformer trips on overload.

**LESSONS LEARNED**

* Review tree trimming schedules

21:22

LILCO tie feeder 901 is opened by LILCO because it exceeded its emergency rating. Feeder A2253 above its STE rating by 150%.

21:24

4kV manual load shedding initiated.

**LESSONS LEARNED**

* Operating procedures needed for all equipment
* Master pushbuttons required for fast response
* Expand procedures to give operators authority to shed load prior to last element failure

21:29:41

A2253 opens automatically due to failure of the phase angle regulator. Two 138kV feeders 11 and 16 open due to power surge. System islands.
Ravenswood No. 3 trips.

**LESSONS LEARNED**

* Review system voltage response  
* Prepare Islanded System Criteria

System shutdown due to mismatch between generation and load.

**LESSONS LEARNED**

* Avoid islanding

Attempt rapid reenergization without sectionalizing the system.

**LESSONS LEARNED**

* Prepare procedures for the rapid restoration of the system  
* Keep the system restoration plan up to date

Six part restoration plan implemented. Problems encountered that hindered the process of restoration included: high system voltage, loss of oil pressure on the pipetype cables, equipment damage during the shutdown and restoration and the unavailability of certain generation.

**LESSONS LEARNED**

* Add or modify system voltage control facilities  
* Install diesel-generators in substations for L&P  
* Modify GT’s for black start operation to supply their own auxiliary load  
* Modify GT’s voltage controls to supply cable charging  
* Investigate isolation of generation to own auxiliaries prior to shutdown  
* Provide backup supply for communications equipment
Additional problems were encountered and significant delays resulted due to the amount of communications required to energize each network.

**LESSONS LEARNED**

* Provide controls to permit restoration of networks remotely from the ECC
* Prepare restoration plan so that load can be energized as the transmission feeders are energized