Impacts and Actions Resulting from the August 14, 2003 Blackout

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Summary of August 14 Blackout

● Impacts
  ▪ Over 50 million people
  ▪ 60-65,000 MW
  ▪ 30 hours to restore
  ▪ Manufacturing disrupted
  ▪ 400+ Generators tripped

● Statistics
  ▪ Line trips began at 3:05 PM
  ▪ Cascading began at 4:06 PM
    – Lasted approximately 12 seconds
  ▪ Thousands of discrete events
August 14, 2003
What Happened?

4:10:44 to 4:13:00 p.m.
Every Blackout has Impacts

- **November 9, 1965 – NY Blackout**
  - 30,000,000 people and over 20,000 MW of demand – up to 13 hours

- **July 13, 1977 - New York City**
  - 9,000,000 people and 6,000 MW of demand – up to 26 hours

- **July 2, 1996 - Western US**
  - 2,000,000 customers (10% of the Western Interconnection) and 11,850 MW of demand for up to several hours

- **August 10, 1996 - Western US**
  - 7,500,000 customers; 28,000 MW of demand for up to 9 hours
Recommendations

- The three Ts
  - Tools
  - Trees
  - Training

- Need to implement throughout the industry
Causes of the August 14 Blackout

- Inadequate situational awareness
- Ineffective vegetation management
- Inadequate diagnostic support
- Failure to follow NERC Operating Policies and Planning Standards
Near-Term Actions

- **Voltage and Reactive Management**
  - Ensure sufficient voltage support for reliable operations

- **Reliability Communications**
  - Strengthen and implement communication protocols between Control Area Operators, Reliability Coordinators, and ISOs

- **Failures of System Monitoring and Control Functions**
  - Review, update, and train on plans for loss of monitoring and control systems
Near-Term Actions

● Emergency Action Plans
  ▪ Review, update, and train on emergency plans and actions

● Train for Emergencies
  ▪ Conduct emergency training drills

● Vegetation Management
  ▪ Confirm that ROWs are clear of obstructions
Key Findings

- Inadequate system planning and design studies, operations planning, facilities ratings, and modeling data accuracy
- Operating with insufficient reactive margins
- More effective system protection and controls could slow or minimize spread of cascading outage
Key Findings

- Compliance requires objective measurements and concrete actions to resolve violations
- Problems from prior blackouts were repeated
NERC Blackout Recommendations

- Corrective Actions
- Strategic Initiatives
- Technical Initiatives

Goals:
1. Correct root cause deficiencies
2. Address contributing factors
3. Identify objective and measurable actions
Corrective Actions: FE

- Voltage criteria and reactive resources
- Operational preparedness and action plan
- Emergency response capabilities and preparedness
- Control center and operator training
Corrective Actions: Reliability Coordinators

- **MI SO**
  - Reliability tools
  - Visualization tools
  - Operator training
  - Communications
  - Operating agreements

- **PJ M**
  - Communications protocols and procedures
NERC Strategic Initiatives

- Strengthen compliance
- Readiness audits
- Vegetation-related outage reporting
- Track implementation of recommendations
Performance Reviews

- Strengthen NERC Compliance Enforcement Program
  - Regions to submit results to NERC
  - Provide list of non-compliant entities
- Confidential reports to the NERC Board
  - Specific violations
  - Results of audits
- Release of confirmed violations
  - Identification of violators
Readiness Audits

- Audit control areas and reliability coordinators
- Conduct on a 3-year cycle
- Report to the Board
Readiness Audit Program Status

- On target to audit one-third of control areas and reliability coordinators in 2004
- Audits Completed as of October 14, 2004
  - 57 Control Areas
  - 6 Reliability Coordinators
  - 1 Transmission Operator
Vegetation-Related Outage Reports

- Report tree contacts to the Regions (230+ kV)
- Regions report to NERC
- Regions to conduct and report on annual vegetation management surveys
Recommendations Tracking

- NERC and Regions will track:
  - Implementation of recommendations
  - Compliance audits
  - Readiness audit recommendations
  - Lessons learned from system disturbances
  - Use regional processes as model
Technical Initiatives

- Forward looking to prevent future blackouts
  - New standards, procedures, protocols
  - Existing technologies to be considered
  - New technologies
  - Changes in system planning, design, and assessment
  - Changes to operator training programs
The Gory Details

Really Interesting Plots for Engineers
NY to Ontario 345kV Line Flows at Niagara
Progressively Worsening Stability Conditions

New York to Ontario 345 kV Line Flow at Niagara
(does not include 230 kV line flow)
Detroit Units Slip Poles

Keith-Waterman [J6D] 230 kV - Tie Line

- Detroit Area Generation Puts Out of Synch and Slips 2 Poles as Frequency Increases to ~62 hz
- Significant Generation Loss and/or Transmission Separation in Detroit
- Remaining Detroit Generation Slips 2 Poles as frequency falls at 1.5 hz/sec
- Toledo/Cleveland Island Separates from Detroit
- Severe Voltage Depression in Downtown and Southern Detroit Region

Keith-Waterman Trips at 10:10:43.2

Classical Stability Saddle
Severe Under Frequency Condition

Ontario - Michigan Net Tie Line Flow

Seconds from 15:10:00
View Into Detroit from Lambton

Lambton-St Clair Tie Lines

Keith-Waterman Trips

Location of Distant Asynchronous Island

Hampton-Pontiac Trips

Thetford-Jewell Trips

Toledo/Cleveland Island Separates from Detroit

Detroit Area Generation Trips at 10.5 and 11.3
Frequency in Ontario and New York

Frequency Separation
Interior Ontario and Northern New York

- Northwest Ontario Stays with Manitoba
- Beck Re-Separates from Interior Ontario System
- Beck and St Lawrence Stay Separated from Interior Ontario But Connected to New York State
- Beck Reconnects to Interior Ontario System
- Beck and St Lawrence Separate from Interior Ontario System

Frequency vs. Time (Seconds from 15:10:00)
Next Steps

- Implement strategic initiatives and recommendations
- Readiness audits
- Enact reliability legislation – mandatory standards and compliance enforcement