System Hardening

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Agenda

• Background and Sandy Impact
• Storm Hardening Development and Objectives
• Completed Storm Hardening Work
• Summary
Super Storm Sandy Statistics

• Largest Atlantic storm on record spanning 1,000 miles
• Impacted over 8.5 million customers across 21 states
• Sustained winds reached 64 mph at LaGuardia Airport with peak gust of 90 mph on Staten Island
• 14.06 foot storm tide recorded at Battery Park
Sandy Impact on Con Edison

- 1.1 million customer outages
- Lost 4,000 MW of generation
- 60% of 345 kV feeders lost
- 5 transmission substations
- 2 steam stations and 561 steam customers impacted
- 398 gas services interrupted
Damage from Salt Water
Con Edison Response

• Immediate Restoration
  – Get the lights back on!

• System Normalization
  – Repair equipment damage

• Engineering Site Assessments

• Storm Hardening & Resiliency Program
Storm Hardening Objectives

- Mitigate major water entry into stations
- Minimize equipment damage from salt water
- Maintain continuous operation during a coastal storm event
- Allow for rapid recovery
- Employ defense in depth measures
- Allow for future climate change
June 1, 2013
Accomplishments

• Work completed at 9 Substations and 3 Generating Stations
  – 54 new concrete moats (6,100 LF)
  – 210 flood doors and barriers
  – 81 submersible pumps
  – 21 high capacity diesel pumps
  – Approx. 3,000 conduit and trough seals
Storm Hardening (2014 – 2016)

- Higher walls, doors and barriers
- Additional pumps with redundant power supply
- Backup generators
- Raised or relocated critical equipment
- New elevated control room and automation system

Design Standard: FEMA 100 year flood level + 3 feet
Datum Diagram
(Not to Scale)

East 13th St / East River Complex

Battery

New York Harbor

Typical Top of Foundations

Historical (Nov 25, 1950)

Highest Elev of Crit Equip

Lowest Elev of Crit Equip

Mean Lower Low Water Datum

11.2’

10.1’

11.2’

14.06’ @ Battery

19.77’ @ Battery

19.77’

14.06’ Actual

14.06’ Sandy

New Flood Protection Level

MLLW
Substations & Generating Stations

East River Substation

East 14th Street Substation

East River Generating Station

E13th Street Substation
Defense in Depth Explanation

Perimeter Flood Wall

Flood Gate

Critical Equipment

Shrink Wrap

Sump Pump

Internal Moat/Wall

High Capacity Flood Pump

Water Connection w/ Backflow Preventer

Normal Station Electric Supply

Diesel Generator (elevated)

Expansive Foam Seal In Conduit

Electric Supply From Street Network

KEY

First Level of Protection - Most Critical
Second Level of Protection - Critical
Third Level of Protection - Less Critical
Defense in Depth Explanation

**Level 1**
Perimeter Protection

- Reinforced Concrete
- Sheet Pile
- Flood Barriers

**Level 2**
High Capacity Pumps

- Diesel-driven
- Electric

**Level 3**
Interior Protection

- Moats/Compartment
- Elevated Equipment
- Conduit Seals

**Level 4**
Deployable Measures

- HESCO Barriers
- Mobile Diesel Pumps
- Shrink Wrap
Perimeter
Raised Generator
Flood Barriers
Perimeter, Flood Barriers
Concrete Flood Wall
Compartmentalizing Station
Summary

- 16 Substations & 5 Gen Stations & Steam Distribution
- Protection Up to FEMA 100 year flood level + 3’
- Total Storm Hardening measures installed:
  - 11,300 LF of reinforced concrete walls
  - 6,500 LF of sheet pile walls
  - 270 flood barriers
  - 7 new (+ 3 existing) backup generators on elevated platforms
  - 4,000 conduit seals
Questions?