DHS S&T's Recovery Transformer (RecX)

National Research Council
Workshop on the Resiliency of the Electric Power Delivery System in Response to Terrorism and Natural Disasters
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Homeland Security
Science and Technology

ABB

CenterPoint Energy

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Recovery Transformer – Need

- High priority R&D need (Energy Sector Specific Plan June 2007, 2010)
  - Threat:
    - "The threat is **failure of a high-voltage transformer through a physical or cyber attack**; a new transformer can take 2 to 3 months to install and has a long manufacturing lead time (often more than 18 months), and there is limited/no domestic manufacturing capability."
  - Gap:
    - "There is a need for **a new type of emergency spare** (recovery/mobile) high-voltage transformer that can be **deployed and energized quickly to rapidly recover** from outages caused by natural disasters and deliberate attacks."
  - Desired capability:
    - "The recovery transformer must be able to be **deployed and installed within days** (e.g., 2 days to deliver and 2 days to energize), not months. Size/rating should be adaptable/modular to flexibly accommodate the needs of the utility industry."
- Growing concerns
  - Congressional Report "Physical Vulnerability of Electric Systems to Natural Disasters and Sabotage" (1990)
  - EMP Commission Report to Congress (2008)
  - NERC/DOE HILF Report (2010)
  - NIAC Study on Resiliency of CI

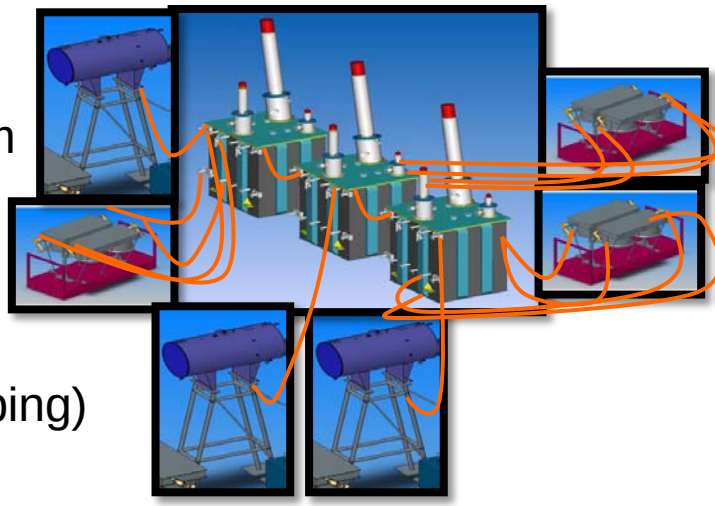
RecX Team

- DHS Science & Technology Directorate (co-sponsor)
- EPRI (co-sponsor)
- ABB
- CenterPoint Energy
- Idaho National Laboratory

Recovery Transformer – Specifications

Single Phase:

- Rated Power 200 / 200 / 30 MVA
- Rated Voltage 352 / 143 / 13.8 kV
- Impedance 14%
- Insulation Hybrid Insulation System
- Efficiency 99.7%
- Operating Temp 120°C
- Dimensions 11’h x 19’l x 9.7’w (shipping)
- Weight 125,300 lbs (shipping)
- Design Life 30 years (warranty)



Applicable replacement for over 90% of EHV transformers in 345:138 kV class

Transformer Factory Testing

Testing on Unit 1 at ABB in St. Louis

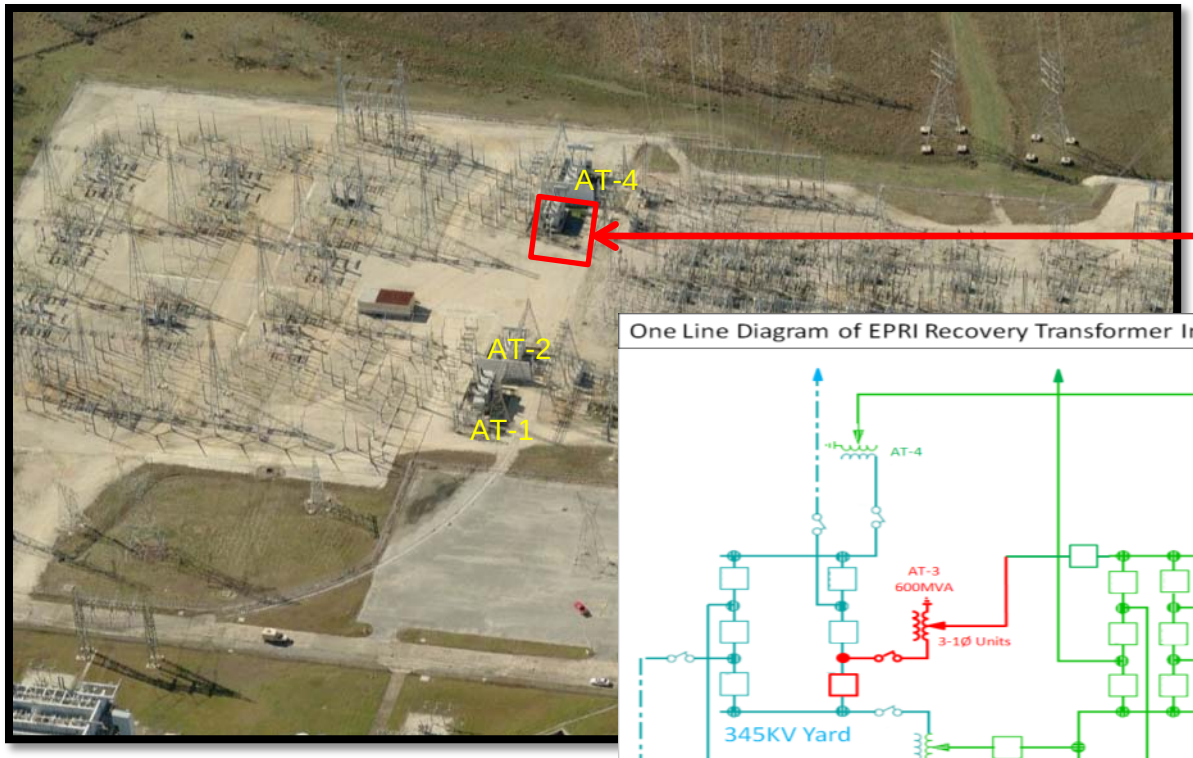
- Three single phase 345kV:138kV / 200 MVA units manufactured at ABB in St. Louis, MO

- All units subjected to and passed industry standard factory acceptance testing

RecX Pilot Demonstration

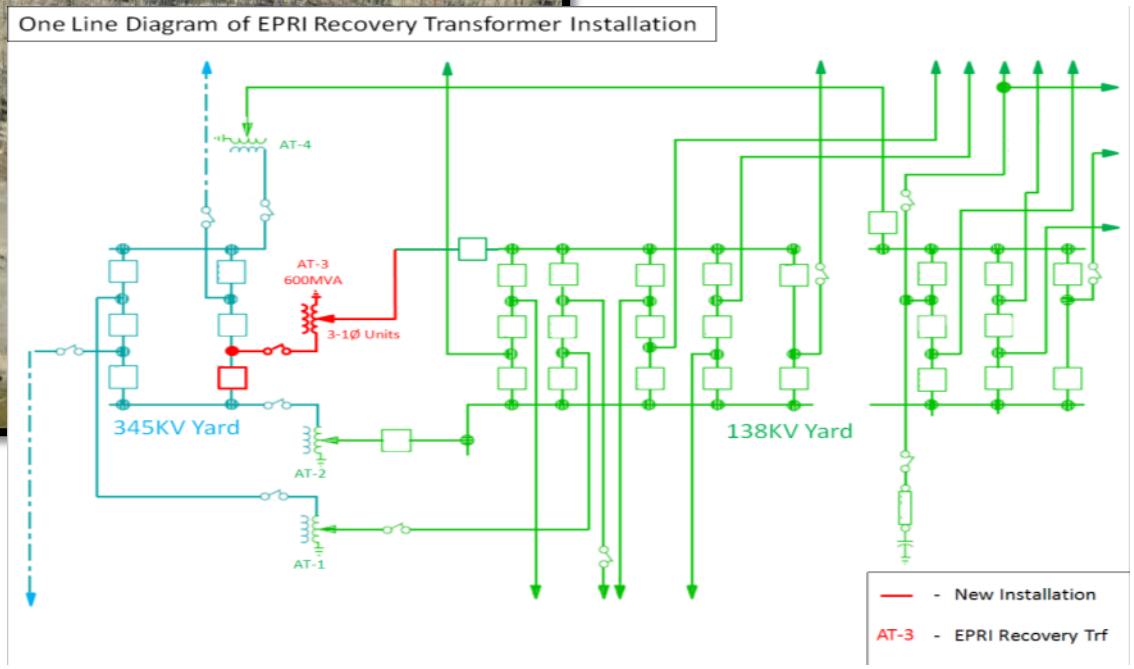
- **Goal: Complete transportation, installation, assembly, commissioning and energization of the RecX in less than 1 week**
  - Pilot demonstration began on Monday, March 12, 2012 at ABB factory in St. Louis, MO
  - By Saturday evening, March 17, 2012 the prototype RecX units were live on the CNP grid

RecX In-Grid Demonstration



RecX Location

CenterPoint Energy
345:138kV Substation



Deployment Route

- St. Louis, MO (ABB factory) → CNP Substation ≈ 900 miles
- TX convoy traveled ≈ 45-55 mph; 25 hours
- Equipment convoys traveled ≈ 55-65 mph; 18 hours

RecX Convoy Concept

Equipment Convoys

Ancillary Equipment Convoy

Bushings, control cabinets, etc – preloaded on flat bed trailers, 1 trailer per transformer

Cooling Equipment Convoy

Coolers, hoses, COPS tank – 1 trailer per transformer

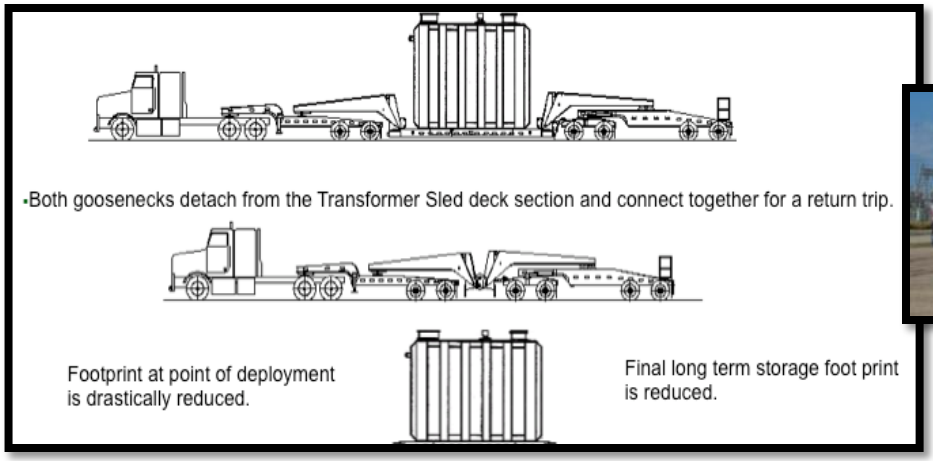
Oil tankers – 1 per transformer

RecX Convoy Concept

Transformer Convoy

- Low-boy trailers
- Requires state permits
- Departs as soon as transformers are secured after draining oil

MA65 Concept



Deployment Activities by Day

DAY 1
- Transformer shipment preparation (drain oil, etc)
- Transportation (aux equipment, cooling equipment, transformers)

DAY 2
- Arrival at substation
- Equipment positioning & citing

DAY 3
- Transformer assembly

DAY 4
- Oil processing
- Controls system set-up

DAY 5
- Final checks
- Commissioning

DAY 6
- Energized!

"A Speed Record on the Power Grid"

New York Times

BEFORE & AFTER

Comparison: Conventional Auto vs. RecX

Activity	Conventional Duration*	RecX Duration*
Acquisition	12-24 months	-
Permitting	Up to 10 weeks	1 week
Transportation	4-8 weeks	1-3 days
Assembly (varies by manufacturer)	2-3 weeks	24 hours
Vacuum	36 hours	8 hours
Oil Fill	24 hours	5 hours
Circulate Oil	48 hours	} 24 hours
Sit Time	48 hours	
Test & Check-out	2-3 days	20 hours
Primary Connections	2 days	4 hours
Transportation →Primary Connections	**7 – 13 weeks**	**4 – 7 days**

* Source: Centerpoint Energy

Next Steps: Monitoring

- One year operational pilot demonstration in CNP's grid
  - First hand utility experience
  - System performance & monitoring
  - Development of training manuals, videos, etc
- Some additional testing

Next Steps: Transition/Outreach

- Technology Transition Agreement (TTA) with DOE and DHS to help introduce successfully developed technology to industry
- Conducting outreach with various stakeholders (industry, regulatory, etc) for feedback & transition options
- Need input from all stakeholders, especially utilities

- Outreach includes:
  - NSS/White House
  - OSTP
  - Dept of Ag RUS program
  - EEI STEP
  - NERC
  - FEMA
  - Utilities
  - EPRI members
  - FERC
  - DOD
  - NARUC
  - NASEO

Contact Information

RecX Deployment Video:
http://www.firstresponder.gov/Pages/FRMediaGalleryDisplay.aspx?eventid=5&gallery=video

Thank you!

Questions?

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