HTS 2001 Peer Review Workshop: Analysis and Concepts to Address Electric Infrastructure Needs

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Observations on the U.S. transmission system

- Utilization of the present grid is growing rapidly
  - Almost no new transmission construction due to
    - aesthetic concerns, which are increasing
    - uncertainty about grid ownership
    - low return on transmission relative to generation assets
  - Data:
    - T. Seppa showed that average "trade area" of U.S. generator has fallen 70% during 1984-1998.
    - E. Hirst showed that transmission capacity (MW-miles/MW peak demand) fell 17% during 1989-1998 and will fall 12.4% further during 1998-2008 using NERC projections

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Restructuring has impact on transmission system use

- Increased power marketing, independent generation, create unexpected, increased flows on power lines
  - Grid originally planned for radial power flows
  - Unexpected flows can result in dispatch of generation that is different than anticipated by planners
- Transmission bottlenecks are resulting in off-economic dispatch of generation
  - Transmission loading relief (TLR) measures increasingly common
  - Regional studies have shown economic benefit to easing transmission bottlenecks, such as New York-New England

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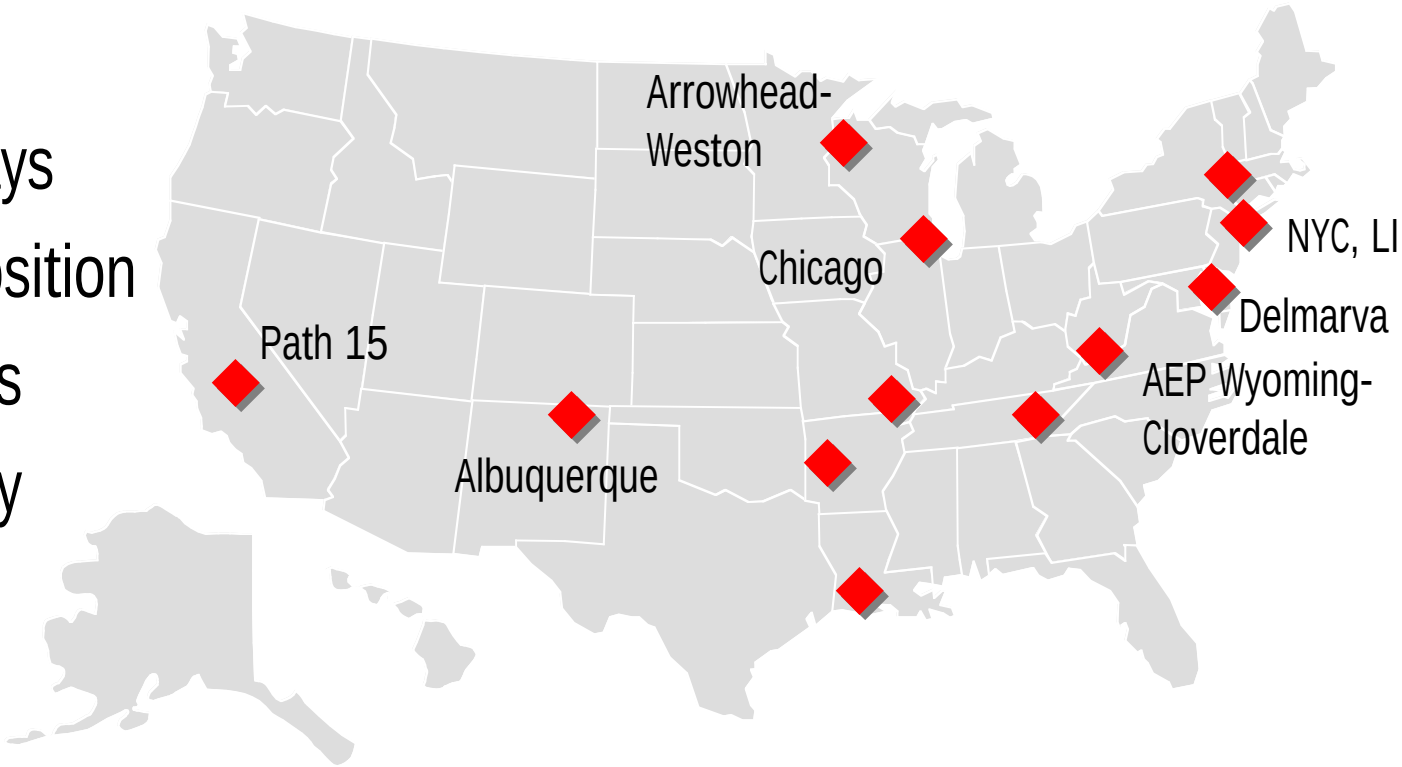
Major transmission bottlenecks are not being addressed today

- Problems:
  - siting delays
  - local opposition
  - low returns
  - uncertainty

Major regional transmission bottlenecks:



Major transmission bottlenecks as identified in NERC reports, TLR log files, POST studies, press accounts, and national energy reports

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Where can HTS help?

- Pricey underground options may become attractive due to bottlenecks, obstacles to overhead lines
- Need for higher capacity, especially in existing urban cable corridors, will be initial market for HTS
- Pirelli simulation case studies:
  - Detroit: 1 HTS cable replaces 3 conventional UG cables or 2 120 kV overhead lines
  - Italian grid: 1 HTS cable replaces 4 132 kV overhead circuits

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Simulation of real-world HTS applications

- Rand partnering with PowerWorld to conduct power-flow model analysis of HTS cables used to address specific regional needs
- Will use π-model data provided by Pirelli to simulate HTS cable substitutions, e.g.,
  - *Chicago: urban cable case*
  - Wisconsin: long-distance cable case
  - California Path 15: long-distance cable case

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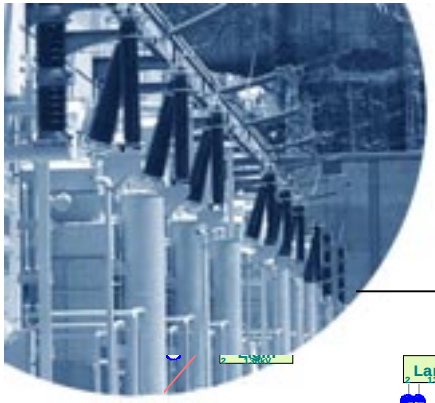
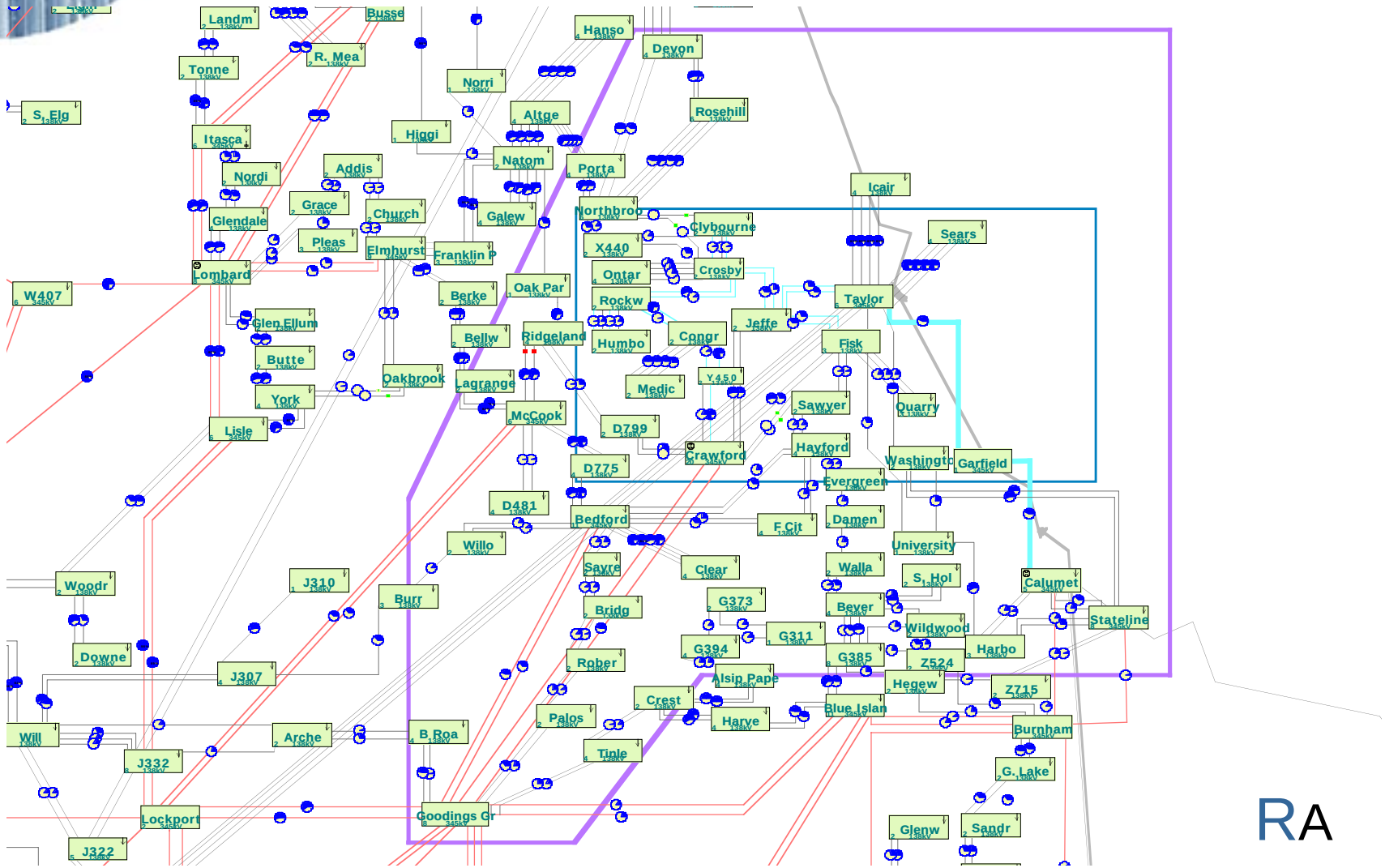


Downtown Chicago's transmission network



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Policies that support HTS adoption to meet national energy needs

- Promotion of new transmission overall
  - increased return on transmission investments
  - resolution of uncertainty about transmission control
  - stronger and larger RTOs to aid in regional planning
  - value increased capacity for impact on reliability, market efficiency
- Promotion of underground transmission
  - whether driven by aesthetic concerns,
  - or by need for less vulnerable transmission system
- Promotion of new technologies
  - support for standards, training, and supporting technologies

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