Overview of Congestion Metrics in the Western Interconnection

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Overview

- Goal of studies: indication of value of expanding transmission system
- Kinds of congestion
- Western rating and scheduling practices
- Historical analysis and metrics
- What the TEPPC studies produce
  - Simulated flows
  - Nodal and Shadow prices
    - Uses and limitations on interpretation in the West

Kinds of Congestion

- Excess:
  - Requests for transmission service
  - Requests to schedule
  - Real time flow
- TEPPC simulation studies show (as congestion) something like a mix of the last two
  - Flow from economic dispatch as constrained by path limits
  - Differential nodal prices and associated non-zero shadow prices on path constraints

Historical Analysis for the West – Rating and Scheduling Practices

- Path ratings in West take account of anticipated parallel flows and system conditions, including potential contingencies
  - Operating Transfer Capability (OTC, ~ System Operating Limit) accounts for seasonal and shorter term conditions
- Western practice limits both schedules and flows to OTC
  - Many Western paths are stability limited
  - Western usage allows nonfirm counter-schedules against firm or nonfirm schedules
- Limited flow does not clearly demonstrate lack of demand
  - High levels without constraint binding can indicate potential congestion

Historical Analysis for the West – Metrics

- Historical flow analysis:
  - Flow vs. OTC vs. schedules
  - ATC and reservation data currently too incomplete to use
- Usage metrics
  - Uxx values – U75, U90, U99
  - Percent of time flow or schedule exceeds xx% of OTC
  - Paths rated to operate reliably at 100% of rating

Nodal and Shadow Prices

- Change in value of total production cost for one unit (MW) change in value of constraint
  - Nodal prices: from change in load or generation level
  - Shadow prices: from change in level of path constraint
- Load nodal prices typically affected by multiple generation changes in constrained system
- Limitations:
  - Cannot extrapolate to large changes in constraint value
  - Cannot assume values of nodal/shadow prices are additive
    - Changing one constraint could change multiple prices

Uses of Nodal and Shadow Prices

- Congestion rent – index based on multiplying path shadow price by total flow or path limit
  - Distinguishes between effect on large and small lines
  - Doesn't answer question (with exception), extrapolates beyond range of shadow price
  - Exception: In organized market framework (CAISO), congestion rent is useful metric
  - Not generally applicable in rest of West
- Uses in TEPPC simulation studies
  - Highlight paths and locations where problem of some magnitude exists
  - Find modeling and data problems