WWSIS III: Western Frequency Response and Transient Stability Study

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TRC Task 1 Discussion and Review
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imagination at work

Study Overview (from Kick-off)

- Illustrate the frequency response and transient stability of the US WECC to large disturbances, including generation outages and critical tie-line disturbances, under a variety of system conditions.
- Explore the potential impact of substantially increased levels of wind and solar generation on frequency response and transient stability
- Test various operational and control options to improve system frequency response and transient stability
- Examine and test metrics of system conditions intended to provide operational assistance in positioning the system for adequate frequency and transient stability performance.
    - Consider how possible additional dynamic constraints on system performance might be included in economic simulations

Task 1 - Study Databases & Establish Initial Conditions (from Kick-off)

- Model:
  - WWSIS II Baseline and High Mix Scenarios for Renewable Penetration
  - (that work based on) Full c. 2018 WECC loadflow and stability
- Initial Conditions:
  - High stress, e.g. time of high EOR or COI flow or times of low load and (potentially) high variable generation
  - 2 or 3 conditions to be evaluated in detail
  - Calculate key (initial) metrics
- Siting:
  - By BA, based on WWSIS scenario
  - Local/intra-BA changes minimal (we are focused on bulk WECC system issues, not local constraints)
- Incremental Commitment and Dispatch (for added wind & solar)
  - Critical to credible and comparable cases
- Incremental (but minimal) transmission reinforcements

Today's Call: Task 1 – Establish Study Databases

Key Considerations:

- Credibility: Stakeholders must have confidence that the starting point for investigation is credible and meaningful
  - Does the load flow include changes (especially transmission additions, generation additions and retirements) for which there is broad consensus? Realistic, not overly optimistic? (good)
  - Does the load flow include changes for which there is NOT broad consensus (pet projects, pipedreams,…) (bad)?
  - Is the matching dynamic dataset "clean", up-to-date?
- Stress: The baseline should be for a condition(s) that are challenging from a transient stability and frequency response perspective
  - Heavy interface loadings desirable (for transient stability)
  - Lighter load desirable (for frequency response)

A perfect base case isn't likely or necessary, but credibility is critical

Today's Call: Task 1 –Study Databases

Options:

- WECC issued multiple approved cases in '12:
  a. 2013 LW
  b. 2013 HW
  c. 2013 HS
  d. 2018 HS
  e. 2022 LS
  f. 2016 LS
  g. 2023 HS
  h. 2013 HS
  i. 2013 LS
- Sandia is mostly working with 2015 HS case.
  - Seems to have been well exercised for stability work; good confidence at WECC, elsewhere (???)
- Longer horizon, e.g. 2022 cases
  - Seems to have less "exposure", and have not been used much for stability work
- Light load condition would be better for this study
  - 2016 LS seems a good candidate, especially if well scrubbed dynamics and transmission Δs from 2015 HS apply

IS 2016 LS acceptable to TRC? Suggestions?

Today's Call: Task 1 – Establish Events

Outages/Events:

- What events are know to be of particular interest for light-load transient stability and/or frequency response
- For Transient Stability
  - Avoid events with heavy RAS dependence
  - Difficult N-1 events best
  - Possibilities:
    - Fault & Trip Palo Verde – Devers
    - 1 Pole PDCI
    - Fault & Trip a COI Line
    - Fault & Trip a Bridger or Colstrip Line
    - Others
  - Performance: Are there indicators of stability (beyond standard measures) unique to any of these cases?
- For Frequency response
  - Trip 2 Palo Verde units
  - An event that will stress the most heavily loaded interface (?)

Task 1 - Siting

Method for Wind & Solar siting:

- Reference WWSIS II High Mix Scenarios for Renewable Penetration
- Add wind and solar, starting with “known” projects
  - Sandia has good data on where/amount of wind is on radar
  - Additional info in longer-term WECC/TEPPC data sets
  - Other sources, as available
- Further add resources, to reach High Mix, using
  - WWSIS II build-out
- Physical location of new plants at or with pigtails to major transmission nodes/lines…. Avoid local transmission/planning issues (not focus of this work) .

Task 1 - Establish Initial Conditions

Method for Incremental Commitment and Dispatch (for added wind & solar):

- Use WWSIS II Plexos Results
- Mine for Hours with similar characteristics to study initial conditions (load level, season, approx. time).
- Determine/extract incremental W/S generation by BA; set initial loading (instantaneous CF) accordingly
- Modify commitment/dispatch by BA, using trends established by comparison of baseline vs. high mix hourly solutions from PLEXOS cases.
    - Initial screening of WWSIS II Δs underway now
- Recommit and dispatch cases/conditions with wind & solar added.

Task 1 – Transmission and Model Changes

Method for Incremental Transmission:

Following recommitment and redispatch of all study cases, test for static violations (thermal and voltage).

- Compare transmission (path) upgrades used for WWSIS II Plexos with capability of base case loadflow (thermal and voltage only). Note paths with substantive differences.
- Use convolution of difference *and* violations to select (gross) transmission reinforcements. Trim voltages and modify dispatch/commitment to establish reasonable initial conditions.
- Process heuristic; deliberately skewed towards *under* building new transmission

Updates of selected WECC Database

- Use new composite load model
- Selectively disable RAS and other protections that may make comparison of results difficult or confusing

Closure

Project : (at conclusion of this call)

- Base case selected
- Outages/events identified
- Comments on methods lodged
- Other actions items

We are ready to start the heavy lifting