RPG Meeting
April 22, 2014

Agenda

- Antitrust Admonition
- Miscellaneous Updates
- Panhandle Generation Interconnection Update
- DATC Phoenix Project
- Oncor West Texas Update
- Katy Area Project – ERCOT Independent Review
- 2014 RTP Update
- 2014 LTSA Update

Miscellaneous Updates

- The public version of the PREZ report only differs from the confidential version in that it does not contain the contingencies that cause stability issues.
- ERCOT is not participating in MISO study of an HVDC connection at the moment.
- PLWG requests more participation from resource owners experiencing constrained generation issues. Thus far the conversation has been TSP-heavy. PLWG would like to look at specific changes to the planning guide and protocols that may be necessary to resolve constrained generation issues.
- Prabhu requests information from TSPs in regards to PRC-023-2 analysis and reminds them to respond to his email.

Panhandle Generation Interconnection Update

- 5600 MW of wind with IA in panhandle. 3250 MW of that has financial commitment. 1800 MW of those with IA are concentrated at Windmill-Ogallala.
- Q&A: Does financial commitment mean that all planning guide requirements have been met? Does it include notice to proceed with construction? Fred will check.
- Q&A: Are we past the first trigger point?
    - Yes. There continues to be discussion on what the upgrades will look like. ERCOT will continue to monitor the loop from Windmill – Ogallala over the next month. There may only be a need for synchronous condensers for the current level of interconnection requests, but one more project may lead to the full upgrade being required.
    - Sharyland expects to submit a full RPG proposal for first-level upgrades. Sharyland will give a full presentation on options and studies at the May RPG meeting.
- Q&A: Do the specifics need further study? Yes. Sharyland has studies on the specific locations for synchronous condensers underway.

- The locations of interconnection requests affect specific needs and locations of synchronous condensers.
- Jeff referred to PUC comments on PREZ study / issue at last PUC open meeting.
- Q&A: Chairwoman Nelson opened a project number on the PREZ issue. Are we going to delay until we see where they go with it? Will ERCOT check with the PUC before moving forward? ERCOT will move forward until specific direction is received from the PUC. A CCN is not required for the first upgrade.
- Q&A: Is ERCOT hoping to get feedback from commission on phase 2? ERCOT isn't necessarily seeking feedback, but may get it. There is a ways to go before the second trigger is hit. The project at the commission may give direction on this.
- Q&A: Is it possible to determine if projects are meeting the milestones laid out in the IA? Can we know the timing of projects coming online versus upgrade projects needed to ensure stability?
    - Further Q&A: We would like to know whether or not projects are meeting milestones laid out in the IAs. Can we assume all projects are meeting milestones unless an amendment is filed? ERCOT tracks if there is an IA and FC, but not sub-milestones within those. ERCOT could potentially poll the TSPs.
- Phase 1 upgrades are not likely to be finished this year, but the TSPs understand the urgency.

DATC Phoenix Project

- Plan to repurpose units from the Duke fleet and use them as synchronous condensers for phase 1 upgrades.
- Project focus is on a synchronous condenser at Windmill (200 Mvar proposed). DATC realizes that this is only part of the phase 1 upgrades and is willing to meet with TSPs involved.
- Phase 2 calls for a 400 Mvar synchronous condenser and a shunt reactor at Windmill. DATC proposal may meet most of the phase 2 requirements at Windmill for the cost of the phase 1 upgrades.
- The synchronous condenser proposed by DATC can handle much of the congestion expected between phase 1 and phase 2.
- Repowering of Duke generators would involve in-depth engineering study by equipment manufacturers, extraction of rotor and exciter, and relocation to the new site. Ancillary equipment and stator would be replaced with new equipment.
- DATC intends to submit a CCN application for the synchronous condenser.
- Q&A: What would the CCN be for? To own and operate a transmission asset you need a CCN. There is a clear legal and regulatory path for DATC.
- Q&A: Has DATC looked at studies where this equipment is modeled dynamically? Does it resolve the need? Yes. They solve the issue and provide other benefits. ERCOT identified the need for synchronous condensers. DATC is providing repurposed equipment that they believe is as effective as new equipment.
- ERCOT plans to do an independent review of any proposed synchronous condenser that is proposed and ensure that it meets the identified needs.

- Q&A: Have the dynamic models specific to these units been implemented in the ERCOT cases? Yes. DATC has committed to providing the information needed to conduct the independent review.
- Q&A: Has ERCOT looked at the modularity of the synchronous condensers identified as needed? For example, has the use of a 150 Mvar and a 50 Mvar synchronous condenser instead of a single 200 Mvar synchronous condenser been considered? DATC's proposal does not limit this approach. The units can be combined in a way that ERCOT chooses.
- Q&A: Is it safe to assume that these would only be compensated as transmission assets and would not compete in any future SIR market? That is a safe assumption. It is illegal for TSPs to compete in markets.
- Q&A: Are you proposing installing 600 Mvar initially? DATC is committed to providing whatever combination of units that the stakeholders request.
- There is little difference in cost between proposals A and B. The difference is due to the different size of step up transformer needed.
- There is an estimated a 20-30% savings over new synchronous condenser installation.
- The equipment is immediately available.
- Q&A: The benefit is that these units are off the books? Yes. They are being sold at their salvage equivalent, because their book value is zero.
- Q&A: Synchronous condensers have been presented as essentially maintenance-free. Would that be the same for repurposed equipment? Rewound prime movers would be similar. The ancillary equipment will be replaced.
- Q&A: What is the actual age of the units? They are 1960s vintage, but were rewound and placed back into service five years ago.
- Q&A: Are there fuel / water requirements? No fuel is required. Hydrogen cooling is an option. Any coolant, including water, would be trucked in.
- Q&A: Are you proposing to put an operating center in Texas to operate these synchronous condensers? Maintenance will be in Texas. Control Centers are in Wisconsin. Operational control will be turned over to ERCOT.
- Q&A: Would ERCOT have to contact someone in Wisconsin with SCADA to change voltage set points? Yes.
- Q&A: Do synchronous condensers require cooling water? Some cooling water would be required to cool the hydrogen cooling units.
- Q&A: Would the facility be unmanned? Yes.
- Q&A: How long has the oldest synchronous condenser converted been operated? 7 years.
- Q&A: Do we need to look at field reversals to realize entire operating range? Or is that not required? When the SC makes the transition from full var export to full var import, only the level of excitation in the rotor is changed. The field current remains positive, but changes its value.
- Q&A: Can it be totally unmanned with lube oil and rotating parts? There will be service intervals. There will be staff in Texas for this purpose. There is no expectation to have anyone out at the station 24/7.
- Q&A: Will GE warranty the entire installation? Rewound units have some warranty associated with them. Test and inspection allow some warranty to be put into place for other components.

- Q&A: Do you see any possibility of sub-synchronous resonance issues? Torsional resonances seem to be above 100 Hz. We would not expect SSR issues to be a problem.
- Q&A: When can the full dynamic models be expected to be provided to ERCOT? Soon.
- Q&A: We're usually vendor-neutral. Are DATC / GE willing to put out a RFP for equipment? It would be a competitive bid situation.

Oncor West Texas Update

- Finished projects associated with moving Sharyland load into ERCOT.
- Started reconductoring work on Odessa-Odessa North. Got some improvement in rating with the new conductor. There are still some terminal equipment issues. Those will be resolved this year.
- Congestion in West Texas is going down. TSPs are starting to get ahead of the load growth before it creates challenges on the transmission system.
- A number of capacitors are being installed. There are issues getting construction clearances during off-peak due to voltage issues. Capacitors are not only supporting summer peak, but also supporting voltage for construction clearances.
- Shunt reactors are being installed to control high voltage situations.
- Q&A: Are you completing previously planned projects? There has been some delay, but they are being completed.
- The detailed design on Ackerly Vealmoor Indicated the need for a new station (Buzzard Draw).
- The Dermott – Ennis Creek 138-kV line is proposed due to A-1 N-1 issues. A 69-kV line will be converted to 138 kV. Load in the area will be surrounded by either generation or 345/138-kV autotransformers.
- Oncor is focusing on converting 69-kV lines to 138 kV.
- Q&A: Have you looked at outages for all of this? We are still in the scheduling phase.
- Q&A: Are you using a standard conductor for the 69-to-138-kV conversions so that they can be modeled? A number of conductors can be used in the upgrades.
- Q&A: Are the dates end of month or first of the month? Sometime in the month. This far out, we're happy that engineering construction can even give us a month. TPIT asks for a month and year, but the spreadsheet puts a day in there. The TSP is typically not adding the day.
- Because lots of this is rebuild and not new build, there are uncertainties with obtaining outages.
- Q&A: Do any of these projects require CCN? No. We're working on a path that doesn't require a CCN for some things. 69-to-138-kV conversion doesn't typically require a CCN if certain requirements can be met. Conversion to 345 kV requires a CCN if the line was not previously certified for 345 kV.
- New activity in Culberson – Mason area is leading to the possibility of an entire rebuild of the line from Culberson - Mason prior to installing the new Permian Basin – Mason line.
- Some customer-owned stations in the Garden City area have expressed no desire to convert voltage from 69 kV to 138 kV.
- New customer interconnection requests and post-contingency low voltage situations are leading to the proposal of the Texaco Mabee – Paul Davis 138-kV line.

- The West Texas Dynamic Assessment looks at modeling complex load due to the large quantity of motor load. Preliminary results indicate that WTS projects improve stability. An additional 345-kV line from Odessa EHV through Moss to Permian Basin will provide voltage stability improvements if Permian Basin generation is not running.
- Oncor is currently discussing / verifying motor load modeling assumptions with the oil and gas industry. The goal is to have the final study complete by June.

Katy Area Project – ERCOT Independent Review

- After the review, ERCOT will make a recommendation for the tier 2 project. It will not go to TAC.
- Centerpoint has projected significant load growth in the Katy area.
- Final 2018 case from 2013 RTP used as base case. The Katy area upgrade project was already included in that case and had to be removed to confirm the need for the EIR.
- Need found under N-1 analysis. G-1 N-1 and X-1 N-1 analysis were also performed.
- Three project options were studied. The installation of a second 800 MVA normal rated / 1000 MVA emergency rated 345/138-kV autotransformer at Zenith Station was common to all options.
- Option B is Centerpoint's preferred option.
- Future upgrade costs added to costs of option C.
- Total costs are close for all three options.
- Option B provides more loss savings.
- Option B is ERCOT's preferred option based on resolving reliability issues and serving future load.

2014 RTP Update

- The generation included in the cases is based on planning guide rules regarding wind assumptions, solar assumptions, and interconnection agreements / financial commitment.
- A reserve margin has been left in the cases to represent the size of the largest unit (STP).
- Q&A: A task force to look at RTP assumptions was promised at the board meeting. Is that still the plan? ERCOT will bring discussion to the May PLWG meeting. We are not sure if ERCOT staff can create a task force and may need to ask ROS to do so.
- Stakeholder comment on RTP load: The 2017 CDR Load is approximately 15,000 MW lower than the 2017 RTP load. There is concern about overbuilding the system.
    - ERCOT response – It is not valid to compare CDR load values to RTP load values for the following reasons:
        - The CDR uses ERCOT's 50th percentile coincident peak load forecast, whereas the RTP uses the higher of either a) the SSWG load forecast or b) the ERCOT 90th percentile load on a per-weather-zone basis.
        - The load values used in the RTP are non-coincident peaks, whereas those used in the CDR are system-wide coincident peaks.
        - The CDR load values do not include self-serve load, whereas the RTP load values do include self-serve load.

- Stakeholder comment: When you are reducing load in other regions, a shift factor study is needed to only reduce loads in areas that don't have an impact on the line. Perhaps this can be discussed at the new task force.
- JT Deely retiring in 2018 affects generation in the 2019 and 2020 cases.
- There is uncertainty as to how much of Antelope's output is available to serve ERCOT load. It is not included in the cases yet.
- TSPs are encouraged to provide feedback on generation not added to the cases.
- The study regions were chosen based on large load pockets.
- Stakeholder comment: Study regions make sense for studying projects totally within a study region. However, projects across study areas can be affected by scaling. It may be appropriate to discuss this at the new task force.
    - ERCOT response: During the 2013 RTP, projects for issues across study regions were confirmed using historical data. Similarly, interface-related projects will be considered for sensitivity study in the 2014 RTP.
- Wind gen outside the study region was scaled to 25th percentile output to help deal with the generation-load imbalance. Also, mothball generation outside the study region has been turned on.
- Load was scaled following generation changes.
- Q&A: How much was wind increased outside of study region? It is our opinion that wind in West should be turned off.
    - ERCOT response: We will run a sensitivity with western wind off.
- Load will be scaled down from "higher-of" levels, not SSWG forecasts. All outside load will be scaled by the same percentage.
- Historical analysis was used to pick the representative weather year for wind and hydro dispatch. Twelve sample forecasts for 2017 with the only variable being weather (2002-2013) were used for the analysis.
- Q&A: Would it be better to look at the forecasts on a monthly level? ERCOT will look into that.
- Q&A: How were the twelve forecasts obtained? The same economic assumptions were used for all twelve, but the weather shapes from historical years were applied to get the different forecasts.
- Q&A: How many temperature points were used? Is the forecast on a weather zone basis? For each weather zone there are a few weather stations used to determine the forecast.
- An annual comparison of the forecasts was performed on both a yearly energy and annual peak basis. 2012 and 2006 are the best matches based on these comparisons. We don't have 2012 wind profiles, so 2006 was chosen as the representative weather year.
- Wind and hydro profiles will be from 2006 weather year.
- Q&A: Was 2006 an el niño watch year? Was any monthly analysis done? Monthly analysis did not indicate a good correlation for a particular year, so an annual comparison was done. 2006 seems like a good generic year.
- Stakeholder comment: You should use a few years to represent variation.
    - ERCOT response: Brattle has recommended not just using a representative year. That is a conversation that needs to be had moving forward. We need to figure out how to take

this into account properly. This won't happen in time for this RTP. We have always had to pick a weather year for wind profiles, but instead of using a normal load pattern, we've correlated the wind and the load together.

- Q&A: I thought AWS was using typical profiles. Did they go back and use actual data? Profiles use actual wind from a given year to predict the output of plants if that wind pattern should occur again. AWS profiles include existing and future sites.
- Stakeholder comment: It would be nice to see charts comparing wind in the way that load was compared.
    - ERCOT response: Even though the official load forecast is based on an average over 12 years, wind cannot be looked at in the same way or the volatility will be lost.
- Q&A: Didn't we have several 100 degree days in April 2006? There were rolling blackouts on April 17, 2006. Won't this skew results? ERCOT will go back and look at that.
- Historical dispatch from 2006 will be used for hydro dispatch.
- Stakeholder comment: There has been a drought since then. I don' think this is fair.
    - ERCOT response: We can compare 2006 dispatch to more recent years to check on this concern.
- Q&A: Are LCRA's hydro plants used in synchronous condenser mode to deal with voltage issues? The hydro dispatch is for economic analysis, not reliability analysis. We are trying to represent an average condition. We have seen hydro output on the grid even in drought years.
- Q&A: How are you dealing with offer prices for hydro? The assumption is similar to that for wind. They are given a dispatch and have no fuel cost, so only variable costs are considered.
- Q&A: Wind has a negative tax. Can that be included? ERCOT will look into that.
- Solar dispatch was changed from 50% to 70% based on a similar analysis as that done for wind.
- The Horse Hollow plant will be left connected to Kendall until notified otherwise by the plant operator.
- X-1 N-1 nomenclature is now being used in lieu of A-1 N-1.
- Q&A: Will the scaling you showed be included in the posted cases? Were the percentages based on a peak hour or an average of ten hours? The scaling is in the cases. The scaling percentages were not based on historical analysis. They merely reflect how much scaling was needed to balance generation with load and losses.

2014 LTSA Update

- Based on input from Brattle, solar costs have been modified and they monotonically decline more slowly and reach a similar cost target in 2029.
- Combined cycle and combustion turbine costs now reflect EIA data.
- The Wood Mackenzie natural gas price forecast was averaged with the EIA natural gas price forecast to obtain an adjusted natural gas price forecast.
- The LNG capacity assumptions will be:
    - 5.8 Bcf/d for the high economic growth scenario
    - 9.8 Bcf/d for the high LNG scenario
    - 1.8 Bcf/d for all other scenarios

- High NG price scenario changed to have LNG exports same as current trends due to an inconsistency in assumptions.
- Stakeholder comment: Natural gas prices can be high in Texas and still allow LNG exports if the world price is higher.
    - ERCOT response: Export capability will drive the differential between the Texas price and the world price. The assumption was changed to match the story given in the scenario description.
- The ERCOT official load forecast already includes oil and gas drilling load. The load forecast will be adjusted in 2 ways for current trends: (a) incremental EE and DR will be considered and (b) LNG load will be added.
- Q&A: Aren't EE and DR considered in the official load forecast? The official forecast reflects current EE and DR, but doesn't reflect technological improvements that many occur in the next 10-15 years.
- Q&A: Some scenarios discussed changes in EE and DR. How will those change based on this adjustment? Calvin has some factors that he can use to model the more aggressive EE and DR scenarios.
- Any further comments should be sent to ERCOT by the end of the week.

Wrap-up

- Q&A: ERCOT's panhandle numbers don't match mine. Can we compare lists? Can ERCOT periodically update the diagram for connections at the various buses in the panhandle? ERCOT would like to stick to the official report. Interconnection requests are a moving target. The most updated list is the April ROS report. Questions on specific projects can be sent to Fred.
- Q&A: Can an interconnection report be added to the ROS report? ERCOT can provide the POI for plants included in the PREZ report.
- Q&A: Sharyland plans to do more studies regarding PREZ. Does ERCOT, as well? Independent reviews will be done for any proposed projects.
- Q&A: Will further work be done based on changes in interconnection requests? ERCOT doesn't anticipate anything being done prior to independent review. Sharyland has a model that they update for new interconnection requests.
- Mike Juricek (Oncor): April ROS report is actually posted on the May calendar page.
- Q&A: DATC has submitted their project for review. Could NRG, for example, direct comments towards that project? The comment period for the DATC project ends on May 5.
- Q&A: Would DATC's project replace the PREZ project if approved? DATC has proposed part of upgrade 1. ERCOT will look at whether or not the complete upgrade 1 is needed and make one recommendation based on the findings.
- Q&A: Would ERCOT look at all of phase 1 or just the synchronous condenser part? ERCOT would look at the whole thing. Any recommendation will look at everything needed.
- Q&A: DATC has already submitted a proposal with a timeline for review. What if circuits aren't proposed for a few months? ERCOT will recommend the circuits if there is a need for them.

- Q&A: If another TO submits a proposal for alternative synchronous condensers during review of the DATC project, how would that affect recommendation for DATC project? ERCOT would look at all of the alternatives, including the consideration of new synchronous condensers.