DRAFT MINUTES, FOR REVIEW

RENEW Interconnection Workshop Summary and Next Steps

Introduction

On May 14, 2012 Renewable Energy New England (RENEW) organized a one-day workshop in which the people listed in the attached attendee list brainstormed what can be done to improve the ISO New England interconnection process for wind projects . This workshop is part of an ongoing effort that ISO-NE and RENEW are engaged in to improve the processing of wind energy interconnection requests.

A summary of the discussions is provided below, broken down by the topics listed in the table of contents. At the end of each topic section is a list of suggested next steps.

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Performance of the Interconnection Study

- ISO-NE is responsible for interconnection studies associated with Schedules 22 and 23 of its tariff.
- ISO-NE may select the transmission owner to do the interconnection study but National Grid is the only one who typically does them internally.
- Otherwise ISO contracts out to vendors such as Siemens, TRC, or RLC to do the studies.
- ISO-NE must contract for the study. The customer may not contract directly with a consultant to perform the studies.
- Developers can request access to stability and steady state base cases, posted on the ISO website, to perform preliminary study work on their own including contingency analysis.

- ISO is now mostly caught up on the queue backlog, so when an IR is submitted, the developer should be ready for their study to be started very soon.

  ISO just updated the metrics they'll submit to FERC. They will be reporting a 300 day reduction in the average IR processing time.

- **Next steps**: Continue discussion of how stakeholders can advocate for additional staffing to enable more study work to be done internally by ISO or TO staff to reduce costs and timelines.

Separate Feasibility Study (FS) vs combined FS and System Impact Study

- Many customers are electing to bypass the separate FS and proceed directly into an SIS.
- A project electing to bypass the separate FS should have a (nearly) finalized project design, whereas the discrete and separate FS allows a stopping point to re-evaluate plant design before proceeding with more significant analysis.
- If a developer skips the FS, and after the six month period provided for under Appendix 7 of the LGIP makes design or control changes for reasons other than meeting the Interconnection Standards, those changes will be subject to a material modification determination and may result in additional study work or the need for the project to go to the bottom of the Queue. The extra time for a FS plus SIS is the check-in time between the two studies and the establishment of an additional study agreement. The New England and pro-forma interconnection procedures are designed with the expectation that all the project modifications should be identified and provided during that check-in time.

Next Steps:

- RENEW will include this in communications with developers.
- When a developer does not yet have a near-finalized collector system design at the beginning of the Feasibility Study, ISO-NE should consider whether a reduced-scope FS would be appropriate. Leaving detailed voltage studies until the System Impact Study, when the project design has been refined, may be a better use of time and resources. This is further discussed in the equivalent vs detailed models section below.

Modifications to Attachment A – System Impact Study Data

- ISO has found they need more information about the turbine controls than what is requested in Attachment A. Specifically, they need a description of how to model the VAR support including response speed of reactive output changes of individual turbines and the plant controller as well as fixed power factor or adjustable power factor with park controller. ISO also needs park voltage limits.

- Changing Attachment A to specify which version of the model is being used would be helpful so it's clear what was submitted when.
- Attachment A revisions would have to go through the stakeholder committee process and the PTO AC for approval and be filed with FERC. ISO-NE would be willing to work with RENEW on this.

Next steps: Draft a separate version of Attachments A and B designed specifically for wind projects so that it covers all of the information ISO needs to do a wind study and omits the sections that are not relevant for wind projects. ISO should prepare first draft, review with RENEW and/or wind stakeholder group.

Generic vs Vendor Specific Models

- If customers use a generic wind turbine stability model and identifies upgrade requirements, then the customer wants to try using the proprietary model to see if it eliminates the upgrades, that's a problem for ISO due to the amount of extra work and project delays that are created.
- The generic models will always lag a little behind the industry.
- The most accurate and best model for a particular turbine is the vendor-specific model.
- PTI is now working on the 2nd generation of generic models that will include park control and frequency control. PTI wants to develop a new type of model that is vendor-specific but non-proprietary.
- ISO's main concern is that whatever model is provided it needs to run without problems. When they receive prototype models that do not run, it wastes a lot of time and customer money.
- ISO doesn't have any protected models now and can't accept any additional PSSE or PSLF models that have confidentiality provisions associated with them. This is now hard-wired in the tariff. If a vendor-specific model is used, ISO cannot provide any confidentiality protection.
- PSCAD models can have confidentiality agreements associated with them.

Next Steps: RENEW will include this in communications with developers and manufacturers.

When ISO uses an equivalent model vs. a detailed model

- Developer may provide preliminary electrical data representing the wind plant as a single equivalent generator with the Interconnection Request, but then must provide a detailed electrical design, including collector system layout data, within 6 months of submitting the IR (pursuant to Appendix 7 of LGIP).
    - ISO expects the design of the collector system to be known from the beginning, but this is not typically finalized until much later in the process.

    - Developer should provide the best available information about the collector system at each phase of the interconnection study.
- Stability testing is typically done with an aggregated model using equivalent collector system impedance.
    - When collector string impedances vary greatly, ISO uses multiple equivalent models to represent the strings separately.
- Equivalent model is sufficient for thermal portion of load flow study.
    - Thermal portion could be done without a collector layout, but it wouldn't be worth doing a voltage study without the collector layout.
    - When ISO looks at the system side of the study in steady state, ISO is ok with the equivalent model. It's when ISO needs to look inside the plant that they need to use the detailed model to see if the plant can actually provide the reactive support it claims without violating the voltage limits on the collector system or the wind turbine terminals.
- Detailed representation of the wind farm and its collector system needed for voltage component of load flow study.
    - The voltage study is typically done as part of the Feasibility Study.
    - If the detailed plant representation is not available for the feasibility study, this can be deferred to the SIS.
    - Every turbine is expected to stay connected for all normal contingencies, which is why ISO feels they must do a voltage study using the detailed plant model, to verify that turbine terminal voltages all remain within operating limits.
    - A turbine manufacturer looked at load flow and stability for equivalent models vs detailed models for some large wind plants with ~500 turbines. For load flow, measurement at the Point Of Interconnection, the equivalent model was found to be very close to the accuracy of the detailed model and is typically sufficient.
        - An equivalent model might not show a single turbine at the end of the line that would trip.
        - From the power system's point of view, a single turbine trip shouldn't be a problem because current would be slightly reduced and it would help stabilize the system.
        - From ISO's perspective, this violates the normal operating criteria of a generator in New England so ISO cannot rely on the equivalent model.
        - The OEMs pointed out that a trip on a single turbine is not the same as a trip on a conventional plant. Turbines are often only off for a matter of seconds or minutes. There is no lengthy procedure to bring the turbine back online. ISO might consider

whether its standard of not allowing a single turbine to trip is necessary.

- Rick said that beyond meeting the no-tripping standard, they need to know how many turbines will be online and able to provide the VARs the system needs, so they need to know what each turbine is doing.
- If a project provided no-wind VARS, maybe ISO wouldn't need to do a detailed study because the VAR support would be independent of the turbine state?
- Type IV turbines don't perform as well as synchronous generators at nominal voltage, but at 85-95% of voltage they typically perform better. It's important for ISO to correctly understand the turbine performance at non-nominal voltages.
- Bob said turbines won't trip if the voltage goes above 110%, there are other things that happen. If ISO is using the detailed model to determine what happens to each turbine during voltage excursions, ISO needs to know what the turbine characteristics are if the terminal voltage exceeds 110% (or whatever the turbine voltage limits are).

Next Steps:

- RENEW to work with manufacturers and ISO-NE to understand what turbine behavior is outside of nominal voltage (e.g., what triggers units to trip, what is required for units to come back online after trip, what reactive support capability is including during trip for units with no-wind VAR support). RENEW to prepare summary paper for ISO.
- RENEW and ISO to discuss whether operating criteria of zero turbine trips after normal contingencies could or should be relaxed.
- RENEW to discuss with developers why ISO is doing detailed voltage studies within the park and suggest that they could have their owner's engineers perform this work prior to the interconnection study to smooth the interconnection study process.

Wind Turbine Trips

- ISO is very concerned about conventional units tripping offline because of the damage that can cause at the plant. With wind turbines, what happens?
    - OEMs
        - Siemens had one park with huge transient spikes on the transmission system causing much of the park to trip offline regularly. That went on for a few months. There was no accelerated life loss on the turbines for those overvoltage trips.

        - GE said that wind turbines are far more robust than synchronous machines with ride-through. They're able to do what they need to in order to not have damage.
    - Plant operator
        - Frank said that with high voltage trips there's typically a surge that causes some sort of problems like a circuit board getting damaged.
        - The grounding design needs to be done well. Grounding standards have improved over the past 5 years.
        - The interconnection studies don't touch this at all, it is something the developer needs to do on their own to be sure their equipment is protected.
        - Some other regions are starting to do overvoltage studies.
- ISO is concerned about cascading effects from multiple plants having a few turbines trip.

Next Steps: See previous section.

Material Modifications

- The interconnection study process is one of many the developer is going through to determine project viability and design. Though it would certainly be easier if all design were finalized prior to submitting an interconnection request, that is not realistic. We should work together to try to minimize the re-work and delays required when changes are made, recognizing that some changes are inevitable.
- Material modification review looks at whether significant restudy would be needed for that project or whether it would impact the cost or timing of later queued projects.
- Kevin M. has only seen one wind project change come out as a material modification over the past 4 years.
- Some of the changes requiring MM review:
    - Project schedule,
        - Delays that are beyond the developer's control are allowed.
        - Failure to get financing is not an allowable reason for delay.
    - Collector system design,
    - Transformer tap settings,
    - Transformer impedances,
    - Wind turbine manufacturer or model
    - Generator controls.

- When the manufacturers update models, ISO often has no idea what has changed and the only way to find out is to run lots of simulations to try to detect a difference.
    - Submitting a verbal description of exactly what has changed would be helpful.
- Should changes be made near the end of the SIS or after the SIS is complete?
    - While the SIS is ongoing, it isn't a huge amount of effort to re-run the cases with a new model. Depending on the results there may be additional analysis and interpretation required. Introducing something new could result in an unsolved contingency, in which case you have to go back by hand to look at it which can take quite a bit of time.
    - For stability cases, getting the model set up takes more time than running the contingency simulations.
    - If an SIS is complete there is a good benchmark to judge future changes by. After the SIS is complete, an updated model needs to perform as well as the SIS benchmark. New "improved" features may not be desirable at this point because they are being compared to the SIS benchmark and are not fully studied from scratch.
    - Once the SIS is completed the study team is dissolved, so it takes time for ISO to assemble technical staff to do a material modification review at this later stage.
- 180 days before initial synchronization, developer needs to supply 'as purchased' data to ISO for review. Prior to initial synch, developer needs to provide 'as built' data to ISO for review.
    - This is a time when stability model updates can be reviewed for materiality. There is always a risk that the change will be material.
    - If there are concerns with the 'as purchased' or 'as built' data because it acts differently from what was studied, it could delay the project's in-service date until the changes are approved.
    - If the 'as purchased' or 'as built' data will differ from what was studied, the earlier the data can be given to ISO the easier it is for everyone and the less likely there will be delays to the in-service date.
- When ISO is trying to design the project's reactive compensation upgrades to the bare minimum, it doesn't give much leeway for the project to make modifications later on that affect reactive behavior.
    - ISO requested that projects provide dynamic voltage support in the initial project design. That would ease the study process.
    - Right now ISO studies a project without dynamic support if the developer doesn't include it at the start. If it is determined to be needed, then ISO has to iterate the voltage support to determine the

minimum that is needed. This is time consuming and doesn't provide a safety margin.

- Customers need to ask OEM about changes to the model at each point in the process.
    - OEMs suggested that developers get concerned that changes will constitute a Material Modification so they don't want to update the models sometimes.
    - ISO could consider changing the Material Modification determination process to incentivize developers to keep the model current.
    - One suggestion was for the turbine manufacturers to notify ISO whenever models are updated.
        - This will not trigger ISO to use the new model, because ISO will always use the model that the customer indicates.
        - If the model is posted on the PTI website, the customer can point to this and ISO can download it, but ISO won't assume which model is the one to use.
        - ISO won't automatically switch to an updated model for all projects, because there is a risk that a project wouldn't be using the controls package associated with the newer model.
- There is a point in the SIS when ISO gets started on the next projects in the queue even before the SIS is completed. After ISO starts on the next project, it gets harder to make a change. Should ISO check in with the project before it starts the next study to confirm there are no changes needed?
- RENEW's developers would still appreciate ISO releasing a Material Modification manual discussing the ways ISO would study the MM and what a sensitivity analysis would consist of.
    - Steve Rourke said that he knows they are giving some thought about how to document that. It's not a one-size fits all process. Kevin M said it's really case-specific.
    - ISO expects any model or data issues to be resolved in an expeditious manner to limit impacts to later queued projects.
    - Steve said they do have a draft of an internal document that they are still reviewing.

Next Steps:

- Manufacturers should include (or developers should request and provide to ISO) a verbal description of any changes to a model when a project updates the turbine model for an interconnection study.
- ISO could consider revising or clarifying the material modification review process to incentivize developers to keep models updated.

- RENEW and ISO should continue discussion of a material modification manual and what would be helpful to developers to clear up the process and make things easier on everyone.

Balance of Plant and Transformer Design

- Who is responsible for designing the park versus the interconnection requirements? It seems that ISO-NE is trying to dig into the plant design itself.
- A developer that has the capability in house (like FP&L) to do all the analysis and design up front will do so early on. They might have some kind of standard layout to use so they have a lot ready to use out of the box. A lot of the other developers hire out for that to be done. Some don't do any of this and then ISO finds they run into problems. Because of this history, ISO now looks at the internal plant design.
- The shift is because the developers weren't providing the analysis of the proper operation of the plant. They were assuming that was part of the results of the interconnection study. ISO is realizing that this work was never being done, so they're now incorporating it into the interconnection study process. ISO has recently gotten more involved with discussions with developer's consultants about the plant design.
- Carter said the electrical designer usually circles back to the preliminary design after the SIS is completed to make sure the plant can meet the requirements of the SIS. The SIS provides the needs at the POI and then the developer makes sure they can meet those requirements. ISO-NE is doing this detailed work as part of the SIS instead.
- ISO believes all this detailed design work needs to happen before the PPA is signed.
    - In ISO-NE the Proposed Plan Application says what the project is going to build.
    - Carter said if they got an interconnection study and a PPA, then later realized they needed a cap bank for optimal operations, they would come back to request a PPA change.
    - ISO sees that as a problem for the serial interconnection study process because it changes the assumptions for lower-queued projects being studied.
- If the SIS were more of a system spec based on a range of performance and it were up to the developer to make sure that the wind plant behaved in the same way as the black box, that would be sufficient.
    - The turbine manufacturers would prefer to see crisp requirements they can meet. ISO said that even if they do that, ISO still needs to look at the specifics for the project.
    - ISO believes a design specification at the POI would be very difficult to do. Bob Nelson says that the Canadian provinces are doing this –

certain response rate, power factor range, etc. Bob can provide that for reference.

- The customer typically needs more information than they have to determine a final design, such as the expected voltage range at the POI. If ISO and the TO do not provide this to the customer, how can they expect the customer to be able to finalize their design?
    - In addition to making clear what information the customer needs to provide to ISO through modifying Attachment A, there should be a clear listing of information the ISO and TO should provide to the customer.
- Transformer Tap Settings
    - As of the last 2 years ISO standard practice is to come back to the interconnection customer and recommend what tap setting to use, independent of what the customer initially puts in Attachment A.
    - Sometimes they suggest load tap changers.
    - For comparison, ISO does a tap study as part of the synchronous generator study to determine the transformer tap for optimum voltage performance.
    - ISO and the customer should have a discussion about a tap study and whether the customer would like ISO to include that in the interconnection study or whether they have already done it and want ISO to stick with what is listed in Attachment A.

Next Steps:

- Bob Nelson to provide Canadian design specification at point of interconnection for reference.
- RENEW to work with ISO on a list of information that developers can request from ISO and the TOs to help them better design their plants from the beginning (e.g., transmission maps, substation drawings, NX-9A line ratings documentation, expected operating voltage range at the POI).
- ISO should include discussion of tap study in the scoping meeting agenda and discuss with the customer whether and when that would be performed.

Lessons from ISO Planning and Operational Experience

- Because switched capacitors are static in nature, consideration should be given to installing dynamic reactive support as an alternative.
- Switched capacitors that don't have any automatic controls can't be counted on by the ISO operators because of the inherent time delay in taking manual action to switch them in.

- Because of minimal voltage support from wind plants, ISO is seeing unacceptable voltage performance both inside and outside the plants that cause reduced operating limits for wind projects.
    - One of the questions a customer needs address early in the interconnection process is whether they want to model voltage support as a fixed quantity all through the study or whether they want ISO during the course of the interconnection study to determine the necessary voltage support to ensure the wind plant can run a higher percentage of the time.
    - If a project comes in with the Cadillac design with ample voltage support capability, the interconnection and operating studies can be done very quickly.
    - If the interconnection study as current performed determines the minimum size dynamic voltage device is 5 MVAr as an example and that's what the customer puts in, then the project in general terms operating right at the limit and may run into operational problems as system condition vary from those used in the interconnection study. The only way currently to determine the optimal amount of voltage support would be through an elective transmission upgrade.
    - During the course of the interconnections study how does the project know if they're on the edge? If you look at power flow plots and/or stability plots there are predicative indicators of relative system strength.
        - The amount of margin should be known by the interconnection study team.
        - There isn't a place to study this directly in the interconnection process.
        - The study team can provide information about their intuition during the results review meetings, but that's it.
    - Are elective transmission upgrades the avenue for developers/owners to learn about whether additional VAR support would allow increased operation?
        - Yes, probably.
    - If all of the wind plants in New England had 0.95 to 0.95 operating range, it would eliminate a high percentage of the problems ISO has seen so far.
    - If FERC Order 661A doesn't change at all, and ISO isn't counting on it changing. ISO Planning will need to do more rigorous studies as part of the interconnection process to reduce the number of operating restrictions on a plants found in the Operational Studies. Interconnection studies will get harder, longer, and more expensive if

we go forward like this. Just about every wind plant has operating challenges for ISO right now.

- ISO Operations prefers the increased flexibility of having full dispatch capability of all generators on the system for capacity issues as well as for voltage support. Restricting the wind generators under certain conditions reduces some of that flexibility.
- Having dynamic reactive capability from a wind plant allows the system operator to know they can rely on the reactive capability all the time.
- Rick said that even if the turbine can offer reactive power, you might not be able to get it out of the plant depending on the collector system design.
- Jason said this starts turning into a markets discussion and what incentive the wind plant owners have to add reactive capability. What types of ancillary service markets can incentivize this capability?
    - NYISO has a reactive reserves market and they pay more for having more reactive capability. New England also has that, but wind plants do not participate in it currently.
    - Worth exploring what can be done so that wind can start participating in VAR market in New England.

- The developers need to keep more of an open mind about elective upgrades. Because of the Minimum Interconnection Standard and Network Capability Interconnection Standard, we're trading off generators for generators.
    - Developers can do a congestion study independently.
    - This is not part of the interconnection study.
- Turbine vs plant control systems
    - John said that when ISO operations finds there are problems with the stability model in the operating study they'll come back to the plant and work with them to resolve the issues.
    - Rick said he thinks a lot of the issues with the park controllers and how to model them have been worked out.

Next Steps: RENEW and ISO could discuss the Schedule 2 Reactive Supply and Voltage Control Service and how wind could participate in this market. If there is an opportunity for wind to participate, a short presentation to the wind stakeholder group could inform the development community of this incentive to provide additional reactive support.

PSLF vs PSSE

- There are New England utilities that use PSLF. Where are the manufacturers with the development of PSLF models?
- PSLF standard library models are not a problem for GE machines.

- There are user-written models for all of the other manufacturer's turbines. Some manufacturers are willing to develop and maintain those models, some aren't.
- Vestas is finishing up a PSLF model for all of their turbines to be available at the beginning of June. That includes the park controller.
- Gamesa has a PSLF model. Alvaro is not sure if it is updated, Alvaro would need to check on that.
- Siemens has a user-defined model for PSLF but they prefer the generic model be used. They think the WECC generic model (standard library model) in PSLF is pretty good.

Next Steps: No action needed.

Operating studies vs Interconnection Planning Studies

- The ISO is not supposed to be operating at an unstudied state at any time hence the more rigorous analysis in the operating studies.
- More generation dispatch sensitivities and plant parameter sensitivities will be done in the operating studies than the planning interconnection studies.
- Operations is now meeting with planning early on to help scope the interconnection studies.
- Projects may have a desired voltage schedule and a range. The operating studies will test projects being at either end of the range instead of the more conservative middle. Same with reactive power output, they'll look at the extremes.
- Operations also models outage conditions and additional restrictions that may be needed.
- The initial operating studies are done before commercial operation using the system impact modeling information and models, but as the system/equipment changes occur during construction, ISO operations will revisit these studies and there may be changing results.
- They always notify a plant owner if the operating study identifies a problem prior to or after COD.
- If all you do is come in under the MIS standard, it's like driving a used car, you don't really know what's going to happen in operations.

Next Steps: No action needed

Transfer Limits

- In Maine it's mostly transient stability and voltage that is limiting transfers. Thermal limits are quite a bit higher.
- OEMs suggested that series compensation may help stability limits. This has been done in Texas.

- Type 4 turbines are fine with series compensation. Type 3 can be reinforced to deal with it.
- The manufacturers can do studies to determine if there are concerns and how to deal with them.
- They did control interaction studies and PSCAD studies for the series compensation and the wind parks.

Next Steps: No immediate action needed. ISO should consider series compensation as an option in evaluating the ability to increase Maine stability limits.

Other Interconnection Process Improvements

- Rick Conant said he'd like to see the manufacturers have someone assigned to the study team that the ISO's consultants can contact with questions.
  - Bob said that Siemens has relationships with many consulting firms and that is helpful. They would be open to this.
  - Rich said that having multiple parties involved creates difficulties, but ISO understands that having a developer/turbine manufacturer team could be valuable to the process.
- Developers requested an online repository like FCTS for all of the latest documentation and keeping track of version history.
  - Capturing all of the project changes in one place would make it easier to confirm accuracy.
  - Could help with getting files through to ISO. ISO's email firewall is a huge problem now for delivering study data.
  - Kevin M. said that ISO is already working on an electronic data submittal system similar to FCTS. The expected timing was unknown.
- More frequent calls to check in
  - If there's a delay between the scoping meeting and the study process actually beginning, customers would like to have a check-in with ISO before the study actually starts in case any data should be updated.
  - The scoping meeting is so early that it's hard to know the questions to ask. Having another meeting with the customer at 30%, when the study scope goes out to the task forces for review, would make a lot of sense.
  - The next check in could be at the transition from steady state to dynamic studies. That would allow two check points before the study is finalized.
  - Rick thinks these two check-points would have to be a stopping point in the study where the customer could consider the study status and whether any changes need to be made.
    - Cheryl is concerned about this slowing down the study.

- If ISO runs into trouble at any point, it would be good to have a check in call then.
- Prior to ISO starting lower-queued studies that will depend on the current project's design and make it more difficult to make modifications, ISO should check in with the customer.
- Instead of these check-in calls at various points through the study process, a monthly check-in call with the ISO, its consultant, the TO, developer, and the manufacturer could be very helpful at speeding up resolution of concerns. If all 4 parties are on the call, resolution time should be quicker.

- Bob Nelson also asked if the OEMs can see the studies to make sure ISO is modeling the turbines correctly.
  - After the first round of simulations is run, if manufacturers could review plots they might be able to say whether it all looks right or not. They also might be able to suggest settings that could be changed to improve responses.
  - There may be CEII access concerns with sharing study data or reports with turbine manufacturers. The individuals at the turbine manufacturer who want to see the data or report would need to fill out a CEII access request form.
  - ISO agreed that a small amount of data sharing so the manufacturers can do a cursory review to ensure data validation is a reasonable goal. They would not support having the manufacturers review early drafts of the full study.
  - Sometimes there are a couple turbine controls available and it may become obvious that a different option should be used than what was initially selected. ISO's consultants would like to be able to have that dialogue with the manufacturers.
- Short circuit study assumptions
  - If the manufacturers had documentation for how to model the turbines in short circuit studies, that would be really helpful.
  - The short circuit programs don't represent full converter machines well, so it's very difficult to do this well now. That is changing, the programs are developing. Until then, it's a question of giving a best guess for how to characterize the turbines in the software.
  - Would ISO be better suited using PSCAD? No. For type 4 it's very easy to determine the short circuit contribution. The manufacturers need to provide the assumptions that should be used.
- Improve Model Documentation
  - Some interconnection studies have been done assuming voltage control when it wasn't there because of poor documentation.

        - Kevin F. said that the documentation that comes with the models can be really poor and it's often difficult to get documentation updated.
    - RLC and TRC asked if model documentation could provide example responses to show what expected performance should look like. That would help them, because now they don't know how the black box is supposed to react and whether the responses they see are correct.
    - It would also be helpful for ISO to understand what conditions the model can get into because if they don't trigger it during the interconnection study process, the operations group may end up getting surprised.
    - ISO also requested clear documentation of the wind plant's reactive power response rate.
- Standardizing the project data required for the Interconnection Request and Interconnection Agreement.
    - The project data requirements in Appendix C of the Large Generator Interconnection Agreement do not parallel the project data in Appendix A of the Interconnection Request that are used for the interconnection studies. This can create confusion.
    - ISO is working to improve the IA project specification so that there's a standard specification used in both the IR and in the SIS.
- Non-binding Study Process for preliminary project design and evaluation
    - Similar to the Southwest Power Pool's preliminary impact study, it would be useful for developers to have the option to have ISO perform a non-binding preliminary study that would look at more general concerns that could come up with a project and help refine the plant design prior to launching into a binding SIS. Much of the plant design issues that ISO has gotten involved with are independent of other project's studies. There are publicly available cases for the developer to use to perform these types of studies to assist in their project design prior to submitting and IR.
    - The owner's engineer should be able to provide a stand-alone study of the project of what happens within the project when the POI voltage swings around. That can all be done before launching into an SIS. If developers used their owner's engineer to the best of their ability, it might allow the studies to be completed more smoothly without ISO needing to do all this work.

Next Steps:

- Consider assigning a turbine manufacturer representative to the interconnection study team, inviting them to join the scoping meeting. The manufacturer representative will need CEII clearance and can participate as a representative of the Wind Developer.

- ISO should provide RENEW with an expected timeline for its current efforts to create an online system for submitting and tracking interconnection request data. This is scheduled for 2013 implementation.
- ISO should include additional check-in calls with the customer. Ideally ISO, its consultant, the TO, the developer, and manufacturer should participate. Suggested times for check in:
    - Monthly, or at minimum:
        - Prior to study work beginning if there is a delay of more than a month between the scoping meeting and the study beginning.
        - When the study has progressed to 30% completion, when the study scope goes to the task forces for review.
        - Prior to transition from steady state to dynamic studies.
        - At any time that the study team runs into trouble and input from the customer/manufacturer could be helpful (e.g., clarifying documentation, discussing options for control settings that could be changed to resolve issues)
        - Prior to beginning work on lower-queued projects depends on the current project's design and would make modifications more difficult.
    - ISO is not against having monthly meetings during the study process as long as there is an understanding that additional stopping points cannot be entertained as they could create additional delays to the study processing time. Additional flexibility for projects to make project modifications beyond those permitted under Section 4.4.1 or 4.4.4 would be subject to a material modification determination unless additional flexibility is added into the Tariff, approved by the stakeholder committees and the PTO AC and then filed with FERC.
- Once the first set of simulations are run (and any times ISO's consultant has questions about whether the response seen in the plots is accurate or could be improved by settings changes), ISO should share plots with the customer/manufacturer so that the manufacturer can say whether it looks like it is being modeled correctly and whether any controls setting changes look like they would be helpful.
- Manufacturers should improve model documentation
    - Include verbal description of changes made to updated versions of models.
    - Provide documentation for how turbines should be modeled in a short circuit study.
    - Provide sample model responses to show what expected performance should look like.
    - Provide descriptions of all of the states the model can go into so that if some are not triggered during the interconnection study ISO is not caught off-guard later during operations.
    - Include reactive power response rate.

- ISO should provide RENEW with an expected timeline for its current effort to standardize the project data between the interconnection request and the interconnection agreement. This is expected to be done as part of the Order 764 compliance next year.
- ISO could provide a non-binding feasibility study option to help developers identify major concerns and refine plant design prior to entering a binding process like we have now. SPP does this.
    - Section 4.4.1 of Schedule 22 allows substantial changes to a project (decrease size up to 60 %, modify technical parameters of generator technology or step-up transformer impedance characteristics, and modify interconnection configuration) prior to SIS being executed
    - If a project is not ready to commit to moving forward toward an SIS after receiving the Feasibility Study, it can withdraw and re-apply at a later date. The initial deposit due with the Interconnection Request is applied toward the Feasibility Study costs first, and the deposit due with the Feasibility Study Agreement is applied toward the study costs second, so at the point of withdrawal the excess Feasibility Study deposit is returned. Assuming the Feasibility Study was completed on budget and the total cost of the study exceeded the initial Interconnection Request deposit, the refunded amount would equal the initial Interconnection Request deposit.
    - Together, these allow project sponsors the type of flexibility described above.
- ISO should utilize the wind stakeholder group set up by Bill Henson to share information informally with the wind community, solicit feedback, and discuss upcoming changes. The better informed the wind development/operator community is, the easier it should be for ISO to deal with them.

Overall Next Steps

- Francis said he will put out a draft of today's notes and action items that people can comment on prior to being finalized.
- Cheryl suggested that the interconnecting transmission owners be invited to any subsequent meetings we have.