

Wind and Transmission Working Group Summary Notes – September 22nd, 2016

Overview & Update on Montana Wind – Montana DEQ

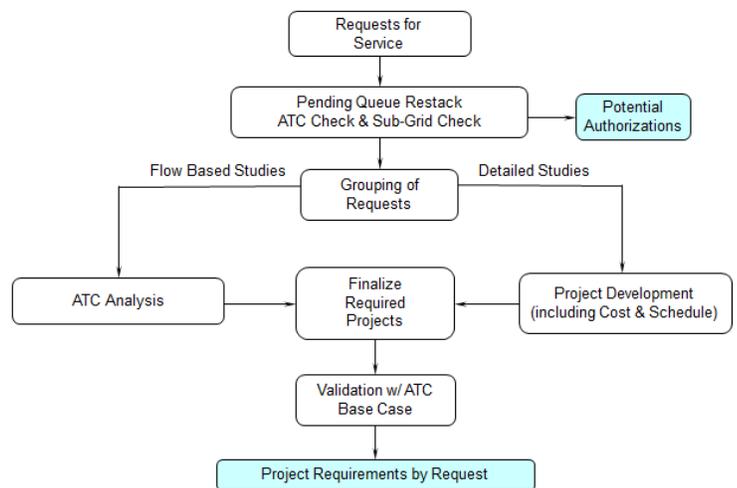
- Garrett Martin – Montana DEQ Senior Energy Analyst
- Montana wind development from 2005 to present
 - In 2005 wind energy kicked off with the development of Judith Gap
 - In 2006 another development outside of Great Falls, Horseshoe Bend
 - In 2007 there was no development, possibly a consequence of the wind production tax credit being re-upped and no development was due to projects starting back up
 - In 2008, 2 developments, Diamond Willow and Glacier I
 - In 2009, Glacier II developed
 - In 2010, Diamond Willow II developed
 - No development in 2011
 - 2012 saw the biggest year of development in Montana so far with Gordon Butte, Musselshell, Rim Rock, Spion Kop
 - No development in 2013
 - In 2014, Fairfield and Two Dot
 - No development in 2015
 - 2016 – Wrapping up completion of Greenfield which in many ways is phase II of Fairfield project being only a few miles East
 - Moving future there are a number of projects on the table including Greycliff, Mud Springs, Colstrip/Orion
 - Massive amounts of wind energy potential in Montana especially in the East. Biggest challenge is transmission and grid constraints. Eastern Montana is very far from load centers. Seam of western interconnect and eastern interconnect is an increasingly discussed issue on the federal level and regionally.

Montana Transmission Service Requests & Study and Expansion Project - Bonneville Power Administration (BPA)

- Brian Altman – Transmission Account Executive
 - Montana to Washington Project (M2W) was a requested project under the old Network Open Season (NOS) system. BPA did a lot of work on the technical and environmental side and ultimately the requestor backed out and Bonneville lost 2.5 million dollars.
 - BPA needed to develop a new system in order to take some risk out of project requests.
- Abbey Nulph – Long Term TX planning
 - With the old NOS system there were precedent agreements signed by requestors to give BPA some assurance that when the studies were completed there would be a buyer on the other end. In 2010-2013 BPA found that a lot of requestors wanted out of the agreements.

- The new project request process is called Transmission Service and Expansion Project (TSEP). Given a new name so requestors could recognize it as an entirely new process.
 - No precedent agreements at the beginning and Bonneville does not fund, but requestors fund the next phases if they would like to move forward. There are exit points at the end of each phase.
 - TSEP will be an ongoing annual process and projects will happen in parallel.
- Patrick Rochelle – Network Planning
 - Montana Requests
 - Leftover NOS:
 - 2010, 1 TSR for 41 MW
 - 2013, 3 TSRs for 164 MW
 - Current
 - 2016, 13 TSRs for 1,100 MW
 - Why does BPA perform a cluster study?
 - Previous process was difficult to move forward financially so BPA had to develop a way to move forward with requests where the financial commitment necessary for proceeding could be shared.
 - What goes into cluster study?
 - Determine what requests could be met from existing systems and which require system reinforcement
 - Identify study areas for requests requiring system reinforcement
 - Attribute requests with project or group of projects that would accommodate the requested service
 - Model all requests, along with existing commitments in an out-year ATC base case in order to demonstrate that the interconnected transmission system, together with the required reinforcements, would be able to provide the requested service.

Cluster Study Process



- Questions
 - Jeff Fox – Why has the 2010 NOS request for 41 MW not been awarded service?
 - On path 8, west of Garrison, BPA has reached sales limit for long term firm.

- Jeff Fox – The “to be determined” costs during P3 and P4 of TSEP creates problems for developers, at what point will people see preliminary numbers for costs? When will the developers get clarification on projects?
 - With the way TSEP has been designed, the cost for the next phase is unknown until it is determined which developers are in. The cost is spread across the board.
 - Developer won't know if they will get service until they are holding a transmission agreement, and that will not happen until late in the process. At each phase of the process things are getting firmer and firmer and there is a pretty probably chance of getting service once the ROD is signed which is at the end of phase 4.
- Jeff Fox - If the ROD is signed, is the project yours?
 - Yes, as long as the developer continues with the process.
- Chelsea Loomis – Have you experienced any pushback from developers based on the changing estimates that comes with others dropping out of projects?
 - There is a lot of fear. This is the first TSEP, so uncertain about how the process will go.
- Chelsea Loomis – In 2016 you have 1,000 MW coming from Montana and nobody has actually applied for that in Montana, so what type of communication has there been with those particular customers to say there is another leg to accounted for here?
 - As far as the individual making transmission service requests there has not been direct correspondence. It is evident, to get from your resource to the Bonneville system there is another leg of transmission you need to acquire. This is a good time to remind folks that there has to be something else to get to that interface.
- Cameron Yourkowski – On the TSEP process, are there future redesigns moving forward?
 - We don't have a lot of control of how deals come together. As we proceed through this process we are hoping to learn how financial analyses are performed and whether or not we are willing to take the rate pressure risk. It could be informed by anchor tenants agreeing to longer power purchase deals with developers.
- Cameron Yourkowski – On the M2W project, was there also a remedial action scheme that's been identified that would provide some capacity over that path?
 - Yes. With the M2W project here was a remedial action scheme (RAS) required as part of the plan of service.
- Cameron Yourkowski – Could the RAS itself create some extra transmission?
 - If we find our requestors can participate in RAS, there is additional capacity there, but they have to meet that part of the plan of service.
- Ray Brush – What assumptions are you making to how power is getting to the Bonneville System?
 - In the 2010 NOS, we had a big block of requests, about 1,000 MW, and at that point it was a big question whether or not that would

- come in at Garrison 500 or Garrison 230. We assumed radially it would come in at Garrison 500. We showed to ourselves that regardless of where it came in at, there was going to be no adverse impact to existing users.
- Garrett Martin – The Midwest has a lot of wind potential, is BPA entertaining using DC lines? How would a merchant HVDC line, coming from Montana, interact with the BPA system?
 - We have looked into DCs, but it will take a lot more than 1,000 MW of wind power to make a DC line pencil out. There is some lower voltage DC line technology becoming available and we have been looking at those, but they are not that close on our horizon. Cost is an issue and there are a lot of operation concerns on how it impacts the system.
 - Coming to part 2 about a merchant transmission line, we would welcome transmission coming in, assuming it was coming in radially, and look at impacts on that part of the system. If it is a networked merchant line, we would have to look at any additional complications.
 - Brian Dekiep – Can you discuss the change in the offer for conditional firm? It looks like the TSEP is changing the way you would offer conditional firm. You have customers looking at transmission service requests on your system, NorthWestern has none, but it appears there are interconnection requests on the Northwester system. Please talk about that and discuss the difference.
 - There are no conditional firm offers as part of the TSEP process.
 - Of the two identified conditional firm products we offer, the bridge service is likely to shift. Initially once a build was identified we would offer conditional firm just until the energization date. But with some builds not having a certain future, we are discussing if we can identify a bridge to nowhere.
 - Jeff Fox – Can you speak to what necessitates an environmental impact statement (EIS)? Is there any hope of avoiding an environmental impact statement under the new process? What are you studying in the environmental impact statement?
 - What drove the need for an EIS originally with M2W was just the sheer number of entities involved. Is there hope of avoiding an EIS this time? Not sure.
 - Stacey Gasvoda – Has any progress been made between BPA and NorthWestern on the intertie issue?
 - We are working together. There is no final resolution, but we are working together to address the issue.

Transmission Overview - NorthWestern Energy

- Casey Johnston – Director of Grid Operations
 - Have facilities in Montana, South Dakota, and Nebraska
 - Covers almost all of Montana – 97,540+ square miles of service territory
 - Electric - 354,000 customers

- Natural Gas – 189,000 customers
 - Operate in two reliability councils
 - Western Electricity Coordinating Council (WECC)
 - Midwest Reliability Organization (MRO)
 - Operate in an integrated market (South Dakota) and unbundled changing markets (Montana)
 - Montana balancing authority area serves more than 3,600 MW of generation – NorthWestern Energy is a net exporter of power
- Chelsea Loomis – Manager, Regional Electric Transmission Planning
 - One of the unique aspects of the Montana transmission system is the Colstrip 500-kV system itself
 - From a modeling prospective the 500-kV line is a long and spindly line so it can cause some issues if left untreated
 - Developed the acceleration trend relay which triggers an immediate shutdown of the Colstrip units for 500-kV outages which prevents cascading outages throughout the rest of the western interconnection
 - Achieves full path rating on path 8
 - Connected down to Idaho through the AMPS line
 - Retail choice and non-NorthWestern Energy generation on the system
 - Large volume of transmission service requests - 1,500 to 2,000 per week
 - Short term, non-firm requests
 - Montana has four external paths
 - Path 83 to the North
 - Path 80 to the Southeast
 - Path 18 to the Southwest
 - Path 8 to the West
 - Generation Requests
 - In the last year and a half there has been a large influx of solar requests interconnecting to Montana
 - Wind has been very active with 15-18 MW of wind and quite a few wind proposals
 - Interconnection process
 - Application received along with deposit – establishes queue position
 - Scoping meeting held with all major departments and customer
 - Up to three studies
 - Feasibility – may be bypassed
 - System impact
 - Facilities - hone in on estimates
 - Generator Interconnection Agreement
 - Interconnection Timeline (Estimate only – can vary based on project)

Day	0	30	35	65	110	120	123	153	243	253	256	286	376	386	406	421	451	466
		Within 30 Calendar days	Within 5 Business days	Within 30 Calendar days	Within 45 Calendar days	Within 10 Business Days	Within 3 Business Days	Within 30 Calendar days	Within 90 Calendar days	Within 10 Business days	Within 3 Business days	Within 30 Calendar days	Within 90 Calendar days	Within 10 Business days	Within 30 Calendar days of Draft Report	Within 15 Business days	Within 30 Calendar days	Within 15 Business days
Application submitted		Scoping Meeting (has to be scheduled within 10 days)	NWE tenders FEAS study agreement	Customer returns FEAS study agreement along with deposit	Customer receives complete d study report	Results meeting on FEAS results	SIS study agreement sent to Customer	SIS study agreement returned along with deposit	Customer receives completed study report	Results meeting on SIS results	FAC study agreement sent to Customer	FAC agreement returned along with deposit	Customer receives completed Draft report, estimates accurate within 20%	Results meeting on FAC held	Customer responds with written comments to FAC report	Customer receives Final FAC report	Customer receives LGIA draft	Customer receives Final LGIA

- Generation Queue – Have both public and private information
 - Public information includes – which projects are active, size of the projects, project number, date request received, approximate location, type (network or energy), in-service date, and scrubbed studies
 - Private information includes – project name and the developer/customer's name and contact information (until signed)
 - Available on [website](#)
 - 40 active projects with 14 being wind and 26 being solar
 - 140 MW of solar and 2116 MW of wind
- Funding of Projects
 - All projects and upgrades funded by customers
 - Customer gets reimbursed for network upgrades over time (for online generation)
- Mike McGowan – Manager, Transmission Services
 - Transmission Service
 - Requestor submits written application on Oasis site and pays deposit
 - Transmission Services reviews application and works with Planning to ascertain if request can be accommodated with the system “as is” or if study is required
 - Transmission Paths
 - Path 8 has capacity available, Path 18 is nearly out of capacity with only 6 MW left, and Path 80 also has capacity available
 - NWE also connects with the Montana Alberta Tie Line (MATL) and has internal paths within the state
 - Transmission Service Queue
 - Very little activity in long term firm transmission service queue
 - Wide open to the northwest currently
 - Queue may include Network (load serving) or Point to Point (wheeling) request
 - Ancillary Service Considerations
 - System balancing and regulation to balance fluctuations in generation
 - Contingency reserves – 3% of generation and 3% of load must be held in reserve
 - Transmission Costs and Consideration
 - Costs – just under 40,000 per MW based on capacity reserved
 - Consider other transmission providers rates and requirements
 - Transmission service study
 - Written application on Oasis and pay deposit
 - No feasibility option, goes directly to a system impact study
 - Transmission services department goes over the request and decides if it can be accepted or a study must be conducted
 - Customer only pays actual study costs
 - If there are no problems, a transmission agreement will be issued
 - If the request requires upgrades to the system, then there is a more detailed facility study that must be done

- Insufficient Transmission Capacity
 - Requires upgrades to the transmission system – can be direct assignment or network upgrades
 - NorthWestern has security requirements for resulting upgrades
- Emmett Riordan – Director of Transmission Engineering, Construction & Planning
 - Past proposed transmission projects
 - Trying to proactively find a better path out of Montana into load areas
- Chelsea Loomis
 - Shutdown of Colstrip units 1 & 2
 - Shutdown will happen by 2021/2022 or sooner
 - 1 & 2 are the smaller of 4 total units
 - Almost directly tied to path 8 and there are concerns about transmission out of path 8 after shutdown - doing studies to look at how the shutdown will affect transmission on path 8
 - Besides some voltage issues, operationally NWE will be okay after shutdown of 1 & 2
 - Coal puts a lot of inertia on the system, but wind does not – there could be some ramifications if there was a 1 for 1 replacement of wind for coal
- Ray Brush – Manager, Regional Transmission Policy
 - What is different today?
 - Shutdown of coal strip – frees up capacity
 - States are realizing they need diversity in their wind fleet
 - NorthWestern will no longer develop projects without contracts for transmission service
- Questions
 - Dave McClain – On the broader system planning, why don't you look at reinforcing the connection between Colstrip and yellowtail? And then improving the connection into PAC?
 - Part of the reason we haven't looked into that tie is because Wyoming is just as rich in wind resources as Montana. Being able to get down to Gateway, you still have to pay for transmission out of Montana which is an extra addition to your product. We focus more on getting to load serving areas. Also, we have not received any request to go into that area.
 - Jeff Fox – When Colstrip shuts down, will the capacity previously owned by NorthWestern Energy and Puget be governed by open access transmission after shut down?
 - The short answer is yes. Transmission services can also be met by OATT.
 - Cameron Yourkowski – Regarding the South Dakota footprint and joining the SPP, what were the drivers to join?
 - Western Area Power Administration announced they were joining SPP, and they provide 90% of our transmission, so wherever they go, we go. It was not a decision on NorthWestern Energy's end.
 - Cameron Yourkowski – Do you have any thoughts on the expanding energy imbalance market?

- NorthWestern Energy has been very active in the northwest power pool effort to look at any imbalance market in the northwest. We have continued to stay plugged into that process. From our prospective we are looking at all options and keeping all the doors open.

Columbia Gorge and Montana Wind Study & Report – Northwest Power & Conservation Council

- Ben Kujala – Director of Power Division
 - Judith Gap and Great Falls were the specific areas looked at for this study
 - The way people have studied wind in the past used Expected Load Carrying Capacity (ELCC):
 - Take an existing system simulation with an estimated Loss of Load Probability or other reliability metric
 - Add load to the system which will make the system less reliable
 - Add wind generation until the system is back to the same reliability level
 - This is the way wind studies have been done for a very long time, but Northwest Power & Conservation Council used a different approach because there are problems with ELCC:
 - There are different ways to measure load which create ambiguity
 - Hydro generation may be re-dispatched, integrated with wind, and water conditions change every year.
 - Northwest Power & Conservation Council took a unique Seventh Plan approach by measuring the system capacity contribution of a new resource:
 - Associated System Capacity Contribution (ASCC) is the effective change in the aggregate system capacity when a resource is added to existing power supply
 - The ASCC can be thought of as a resource's nameplate capacity plus any capacity gained by the hydroelectric system.
 - What you really want to measure for every resource is, what the system contribution that it gives to reliability overall as you look at the entire system.
 - Calculating ASCC
 - The main component to look at is the short fall. The council has a set standard loss of load probability (LOLP) of 5%
 - When you add in another resource such as wind, you don't need to come up with the same amount of capacity. It all depends on the shape of the wind resource.
 - Adding wind in Montana produces much more towards system capacity needs than Columbia Gorge Wind.
 - Caveats & Notes
 - There was more information about the wind produced in Columbia Gorge than Montana, so there were some assumptions made and small sample size
 - Conclusion

- In Montana there is a higher annual energy generation, especially in Winter
 - Montana wind correlates much better with the timing of peaking regional load than additional Gorge wind
 - What's next?
 - Update study with additional data and continue to add as available
 - Investigate other potential wind site in Montana
- Questions
 - Kyla Maki – How transferrable is this method of analysis on an individual utility basis? As you get more granular does it become less relevant? Is it more appropriate on a regional level?
 - This sets up a good way of talking about how you would analyze it on an individual utility basis, but the utilities should do the homework for themselves.
 - Jeff Fox – How can federal hydro system and investor utilities share the benefits of renewable diversity?
 - Public power customers would hope the federal system would take advantage of cheap power if it's there to sell more valuable power during peak times. Sharing the benefit is a touchy conversation.
 - Dana Dogterom – How does your mandate effect/correlate to Mid-C pricing?
 - It doesn't really; our mandate is to work regionally to work with a lot of people. Our goal is to work toward best economic result for this region
 - Jim Burress – You glossed over some of the system constraints hydro might have in regards to fish. Can you touch on flow concerns with the hydro system?
 - Low flow conditions make up the majority of the issues. Fish constraints under low flow are what you have to be careful about.
 - Jim Burress – I was thinking more on an hourly basis and how the flows are changing minute to minute and hour to hour. Flows going up and flows going down have definite fishery population impact as well as insect diversity and abundance impacts.
 - We are going through a big effort right now in redeveloping our current models on the hydro system to get a better view of the hourly flow on each project.

Update & Discussion on Northern Tier Transmission Group studies regarding utilizing Colstrip Transmission System for wind energy – Renewable Northwest

- Cameron Yourkowski – Senior Policy Manager
 - Caveats & Disclaimers
 - Advocate for renewables and focus on opportunities getting them to market
 - All information coming from a policy perspective

- Background
 - Colstrip is a long and isolated 500 kV-line
 - Some technical transmission engineering questions are raised
 - Issues
 - Frequency response
 - Transient stability
 - Voltage support
 - Inertia questions
 - Weak grid
- Previous Studies and Conclusions
 - NTTG 2014-15 Public Policy Study
 - Looked at when Colstrip 1 & 2 are retired and replaced with two 305 MW wind plants capable of being tripped individually and connected at Broadview
 - Problem – only looked at steady-state power flow analysis
 - Conclusion – cannot imply or suggest a one-for-one substitution of wind for coal is feasible without more analysis
 - NWE “EPA 111-D Consideration: Retirement of CS units 1 & 2”
 - Looked at when Colstrip 1 & 2 are retired and replaced with all wind, all gas, and a wind and gas combination
 - Conclusions
 - Transmission system responded similarly in all cases to outages and was capable of achieving the current export path rating
 - Path capacity would not change and frequency concerns would lessen
 - Again, the one-for-one substitution of coal is not implied without further study or system upgrades
 - Western Wind and Solar Integration Study Phase 3 (NREL)
 - Looked at both cases with and without one of the Colstrip units running with a high mix of wind and solar around the WECC
 - Conclusion
 - Stability is not degraded in the Hi-Mix case, but does not conclusively show stability will improve
- Current 2016 NTTG Study Request
 - This study has scenarios where Colstrip units 1,2, and 3 are retired
 - Includes dynamic stability analysis and scenarios with all wind replacement, some natural gas, and an addition of a synchronous condenser
 - Results by mid-2017
- Additional Data Points
 - What is the cost of a new remedial action scheme (RAS)?
 - Looking at previous NWE interconnection studies Renewable Northwest estimates 1 to 4 million
 - What is the cost of synchronous condenser?
 - Building a new 200 MVA estimated at 43 million

- Converting a 1257 MW coal plant to 5 condensers estimated at 60 million
 - May want to consider including a “clutch” to provide inertia and voltage to support the grid even when they are not generating
 - Consider the capability of modern wind turbines and improvements
 - They can provide synthetic inertial response and voltage support even when not generating
- Going forward
 - Need to answer all questions as best as possible
 - Need clear and complete studies about challenges and solutions
- How do we get there?
 - Robust NTGG 2016 study report
 - Bonneville Power Association and NorthWestern Energy working together to solve technical questions
 - Leadership from the Wind and Transmission Working Group to drive everyone to work together and solve problems
- Questions
 - Jim Burress – Can you outline more what a coal plant conversion to a synchronous condenser is?
 - The idea is taking the existing generator and disconnecting it from the steam plant side and allowing the spinning mass there to draw electricity off the grid. It is like a flywheel.
 - Jon Fernandez – Instead of just a spinning mass, are the experts involved in these studies looking at other means by which to provide reactive power and other grid balancing services?
 - Any project by a developer of storage has potential to solve all these problems very quickly. The NTGG study does not touch on storage.
 - Anne Hedges – There are layers upon layers on the issue regarding how to move Montana wind to market. When Colstrip goes offline, we want markets to choose our resource. Is there something the state of MT could/should do to engage in the discussion to try to facilitate making all layers come together so that developers will choose Montana?
 - Just getting the transmission providers in the room together to talk through solutions is the first step. Putting money on the table to do more thorough studies will also help answer some questions and move the ball forward. The Governor's plan also identifies an infrastructure authority which would be beneficial in moving some of the transmission projects forward.

Next Steps

- New name for the group:
 - Renewable Energy and Transmission Working Group
 - Transmission Working Group
 - Resource Development and Export Working Group

- Add key players to group:
 - Alberta representatives, WAPA, MDU, Fish Wildlife and Parks (FWP), and Fish Wildlife Service (FWS)
- Future Discussions:
 - New market designs, new market expansions, EIM, PacifiCorp, CAISO, Mountain West Transmission Group – Sage Grouse
- Next Meeting:
 - Possibly 6 months - after legislative session
 - No set date – Look for future survey to set date

Presentations

- For presentations from the Wind and Transmission Working Group meeting please visit: <http://deq.mt.gov/Energy/EnergizeMT/Renewable/Wind>