

Generating Resources Advisory Committee Meeting

February 27, 2014

- Meeting Time:** 9:00 A.M. to 12:25 P.M.
- Meeting Location:** Northwest Power and Conservation Council
851 SW 6th Ave.
11th Floor
Portland, OR 97204
- Facilitators:** Gillian Charles and Steven Simmons, Northwest Power and Conservation Council
- Note Taker:** Kyle Gustafson
- Attendees:** *On-Site*
Nate Sandvig, MWH Global
Greg Mendonca, PNGC Power
Rick Sterling, Idaho PUC
James Gall, Avista
Eddie Abadi, Bonneville Power Administration
Fred Heutte, NW Energy Coalition
Sarang Amirtabar, Seattle City Light
Robert Brown, Portland General Electric
David Nightingale, WA Utilities and Transportation Commission
Jimmy Lindsay, Renewable Northwest
Tom Haymaker, Clark PUD
John Robbins, Wärtsilä North America
Gillian Charles, Northwest Power and Conservation Council
Steven Simmons, Northwest Power and Conservation Council
Charlie Black, Northwest Power and Conservation Council
Jeff King, J.C. King and Associates
- Attendees:** *Via GoToMeeting*
Brian Dekiep, Northwest Power and Conservation Council
Dave LeVee, Pwrcast
Elizabeth Osborne, Northwest Power and Conservation Council
Joel Klein, California Energy Commission
Richard Jensen, California Energy Commission
Keith Knitter, Grant County PUD
Erin Erben, Eugene Water and Electric
Rob Petty, Bonneville Power Administration
Russ Schneider, Flathead Electric Coop
Leann Bleakney, Northwest Power and Conservation Council
Mike Murray, Benton PUD
Tom Kaiserski, Montana Department of Commerce
Zac Yanez, Snohomish PUD
George Brown, Bonneville Power Administration
Greg Nothstein, Washington Department of Commerce
Peter Williams, Bonneville Power Administration

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David Vidaver, California Energy Commission
Bryan Neff, California Energy Commission
Rick Rozanski, McMinnville Power and Light
Bob Essex, Cowlitz PUD
Chris Johnson, Benton PUD
Jeff Kugel, PNGC Power
Cathy Carruthers, Tacoma Power
Phil Obenchain, PacifiCorp
Bo Downen, PPC
Lynn Marshall, California Energy Commission

Welcome and Introductions

Presenters: Steven Simmons and Gillian Charles, Northwest Power and Conservation Council

Steven Simmons with the Northwest Power and Conservation Council opened the Generating Resources Advisory Committee (GRAC) meeting at 9:00 A.M. He introduced some of the attendees of the GRAC meeting and reviewed the meeting's agenda.

The meeting attendees introduced themselves.

Simmons reviewed the role of the GRAC, as outlined in the third slide, reminding members that they are serving in an advisory capacity to the Council.

Charter—Update

Gillian Charles with the Northwest Power and Conservation Council reviewed the fourth slide regarding the charter update. She stated that the Council is scheduled to vote to adopt new two-year advisory committee charters in March 2014, noting that GRAC membership follows the charter. Charles said that she'd email a list of the GRAC members to the meeting attendees for review after the meeting.

[Update: The Council approved the new two-year charter for the GRAC at its meeting on March 12.]

Council Symposium

Charlie Black with the Northwest Power and Conservation Council discussed the Council's past symposiums. He stated that the Council plans to host more symposiums in 2014 about topics related to the next Power Plan, such as productivity, the evolution of utility business models and trends related to energy efficiency. Black stated that the main theme would be about "power as it contributes to broader overall productivity of the economy and society." Currently, there is no date scheduled for the next symposium. Black invited the meeting participants to share any ideas or thoughts regarding the next symposium.

David Nightingale with the Washington Utilities and Transportation Commission stated that his agency has been discussing productivity as it relates to energy efficiency.

Gas-Fired Power Plant Characteristics, 6th Power Plan

Simmons briefly reviewed the fifth slide about gas-fired power plant characteristics from the Sixth Power Plan. He pointed out the differences between the technologies and their strengths and “compromises.”

Jeff King with J.C. King and Associates stated that he thinks the slide needs a fifth column with the “shape of the heat rate curve.”

James Gall with Avista stated that graph should also have a column for the capacity curve, “with temperature.”

Preliminary Assumptions for Natural Gas Peaking Technologies

Presenter: Gillian Charles, Northwest Power and Conservation Council

Charles reviewed the outline for her presentation, referring to the first slide. She set the context for the presentation by explaining that this was the first discussion with GRAC on natural gas peaking units. The intention is to propose preliminary information and get feedback and comments from the GRAC, and then return with more finalized assumptions at a future GRAC meeting. She noted that while she will touch on all peaking technologies at this meeting, the focus would be on aeroderivative gas turbine technologies.

Peaking Power Plant Characteristics, 6th Power Plan (\$2006)

Charles reviewed the respective slide – the same slide Simmons had shown earlier but with modifications - and noted that she had replaced information on combined-cycle combustion turbine technology (CCCT) with information for intercooled aeroderivative hybrid technology so that the chart now showed only gas peaking technologies.

Historical Peaking Plant Additions in the Region (MW)

Charles stated that the third slide showed the new installation of peaking units in the Pacific Northwest by year, and pointed out the diversity among the different technologies in the past 10 years. She also noted that there are currently no intercooled/aeroderivative hybrid units installed in the region.

Utility IRPs—Peaking Plants Analyzed

Charles reviewed the respective slide, which depicted what model types utilities had used as reference plants in their integrated resource plans (IRPs) for each peaking technology. She noted that the reference plants for frame and intercooled/aero hybrid technologies seemed consistent amongst utilities; however, there was variation among aeroderivative and reciprocating technologies.

Proposed Configuration for Reference Peaking Plants

Charles stated that the figures for the proposed configurations for peaking unit reference plants are “very preliminary” as she reviewed the information in the fifth slide.

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Greg Mendonca with PNGC Power asked Charles why she used Port Westward II as the “capacity target” because historically there haven’t been too many 200+ MW installed in the region.

Charles explained that she used Port Westward II because it is a current plant that’s “going in as a peaker to deal with the flexibility of variable energy resources.” She also noted that plants that were installed in the past may have been serving different purposes.

Gall asked if the Council would include information about the cost changes, like an economy of scale, if they choose to use a capacity that differs from 200 megawatts.

Nightingale suggested adding levelized costs in the charts.

Simmons stated that the finalized data would include levelized costs.

Fred Heutte with the Northwest Energy Coalition commented that there is another “use case” in regards to peaking and plant flexibility. The exact same plant configuration may be used in two different cases for entirely different purposes and therefore have different operating and cost characteristics.

Black agreed with Fred about the use of peaking plants now versus traditional use in the past and stated that the Council is considering including a supplemental reference plant with a “load following” or “system following” purpose. Nightingale proposed using a wind-following peaking plant associated with average wind plants.

Black responded that when the Council does its system analysis, he doubts that it will target specific CT projects to specific wind farms because it will look at it “as a more system basis.”

King stated that Heutte’s comment about the application of units is important and that it was becoming apparent to staff as the Council put together its last plan (Sixth Power Plan). The traditional application of the units in the Northwest has evolved. They initially dealt with low hydro-year situations – the units are turned on for a month or so until the reservoirs have recovered and then are shut off again. The frame units (with low capital cost, but higher operating cost) were the optimal choice for this type of use. King noted that we are now seeing a different type of application emerging in addition to the traditional use. King said that he wondered if the Council is capturing the full range of generation technologies in the traditional reference plants of frame, aero, intercooled, and recip for the use of rapid response at a relatively high efficiency. King noted that another plant to consider is a flexible combined cycle, which Simmons presented on later in the meeting. In addition, other technologies on the load side like storage could be used for this purpose.

Huette added that the market has changed and become a lot more competitive in response to the new applications of units. It raises some interesting challenges for analytics – “how many bins do you put these things in?”

Charles said that the Council would conduct some more research and include an additional reference plant.

Existing Aeroderivative Gas Plants in the Region

Charles presented a sampling of aeroderivative plants existing in the region and noted that the majority of the plants use Pratt & Whitney models. The Council has selected the GE LM6000 as the aero reference plant, which has only been used in the region at the Highwood Generating Station. She stated that the configuration of many of the existing plants in the region is between two and three units, however Dave Gates Generating Station has three units but has an option for a fourth unit that is already sited.

Recent Aero Gas Plants in WECC

Charles said that the Council looks at different plants across the Western Electricity Coordinating Council (WECC) for its AURORA resource database, referring to the eighth slide. The sampling on the slide represents the trend in WECC towards the installation of GE LM6000s.

Simmons noted the economy of scale in the graph—the Orange Grove project is the smallest in regards to capacity, but is also the most expensive.

Proposed Aeroderivative Reference Plant

Charles reviewed Slide 9 and explained the reasoning behind the Council proposing to use a GE LM6000 PF SPRINT as its aeroderivative reference plant. As it has been a popular choice among new installs in the WECC region, there is more information available on cost and performance. Charles also noted that the Council's Sixth Power Plan used the GE LM6000 PD, the same generation as the PF but with reduced NOx emissions technology (an improvement in the PF model). She stated that the LM6000 PF gas turbines were first commercially available in 2007. She said that a third generation model is commercially available, but there doesn't seem to be any installations yet.

Nightingale asked a question about the difference in performance between the second and third generation gas turbines. King stated that the third generation model is "PG and PH." PG is the base version and the PH is the low-NOx burning version. King said that he thinks that the primary change is in increased capacity, as GE modified the staging on the power turbine and updated the compressor, so the capacity and efficiencies of a single unit increased. However, it is not a dramatic difference from the second generation.

Charles continued describing the specifications of the proposed reference plant, including output and ramp rate. She noted that while the region has installed more Pratt & Whitney turbines, the Council is choosing the GE LM6000 as its reference plant. She asked the committee for feedback on this and everyone was comfortable with this choice.

King stated that there is more published cost information about the second generation GE LM6000 gas turbine, which is a compelling reason to use it. He explained that a Pratt & Whitney twin-pac has two gas turbines that are clutched and driving a single generator, which levels the heat rate curve more than a single gas turbine. There might be a slight advantage to using this technology in smaller balancing areas.

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Russ Schneider with Flathead Electric Coop asked if it is important for the reference plant to be in the Northwest.

Charles replied that the Council would choose a reference plant that is in the Pacific Northwest, which will cause some elevation de-rates. She added that the Council chooses locations for all 16 load resource areas in AURORA.

Charles reviewed Slide 10 and delved deeper into the configuration and specifications of the GE LM6000 PF SPRINT reference plant.

Other Assumption Parameters

Charles reviewed Slide 11. She stated that the Council uses the assumption parameters in AURORA and the Regional Portfolio model. Charles noted that the parameters apply to generic aeroderivative plants, not necessarily GE or Pratt & Whitney plants. She stated that the parameters shown are from the Sixth Power Plan and asked for feedback from the committee if some assumptions should be highlighted for further research and possible updating.

Gall suggested checking the figure for the “minimum load” as new technologies may have lowered this.

Nightingale asked if the 25 percent assumption applies to each unit, noting that the reference plant configuration is for four units.

King stated that the 25 percent assumption comes from the Sixth Plan. The Sixth Plan aeroderivative reference plant used a two-unit configuration, giving each a 50 percent efficiency “per machine minimum load” – which is probably too high.

Charles continued to review assumption parameters on Slides 12 and 13.

Heutte asked if fixed and variable operating and maintenance (O&M) costs change when new generations of units come on the market.

King replied that O&M costs are “difficult to get a handle on” because there is very little published information on which to base them. He said that the current O&M costs were revised for the Sixth Power Plan and were greatly influenced by the 2007 California Energy Commission’s report on generation technologies. King discussed other factors that affect O&M costs, such as the number of starts and operating hours, cycling up and down, cost of water, etc. Huette agreed that the O&M data is hard to get and to “keep that in the back of our minds.”

Nightingale stated that he’s only seen one set of values related to decommission costs, and it wasn’t “zero compared to salvage.” However, he said that he thinks that the decommissioning cost in the slide is “comfortable.”

Joel Klein with the California Energy Commission said that the Commission has a 49.9-megawatt and 100-megawatt unit in its model, and that it puts all of its operating and maintenance costs into “fixed O&M.” He agreed that it is difficult to get a handle on the costs, and it is just as hard (if not harder) to

break it up between fixed and variable. Klein said that for the 49.9-megawatt unit, in 2011 dollars, the Commission has \$26.85 per kilowatt year fixed O&M costs. For the 100-megawatt unit, it has \$25.95 per kilowatt year fixed O&M costs.

Black suggested having separate columns for each type of service (for example, pure peaking, hydro firming, system balancing) for the different types of plants.

Preliminary Cost Estimates

Charles reviewed Slides 14 and 15.

Regarding sources used to create the preliminary cost estimates, Klein noted that the latest California Energy Commission “Cost of Generation” report should be released within the next month. Huette added that WECC is in the process of adopting new capital costs based on surveys and literature searches.

Charles described the points on the preliminary overnight capital cost estimates chart. She noted that the Sixth Power Plan had forecast a downward trend from 2008 to 2009, but instead we seem to be seeing a consensus on more of a continuation from that 2008 point. We seem to be converging around \$1,200/kw (in 2012 dollars). She emphasized that this is preliminary and that more studies and analysis will be added to the chart to show at the next GRAC meeting.

Eddie Abadi with the Bonneville Power Administration suggested separating the as-built costs in the 15th slide by greenfield and brownfield to see if it affects capital costs. For example, Almond may have been a repowered plant.

Jimmy Lindsay with Renewable Northwest asked what the Energy and Environmental Economics, Inc. (E3) ratio of equipment costs were and how the costs influence gas turbine projections. Charles stated that Gas Turbine World has high and low costs for equipment. The low cost in the graph on Slide 15 assumes that the equipment makes up 63 percent of the total overnight plant cost. She said that the Council makes adjustments to add in the remaining 37 percent. Charles explained that the high case assumes that the equipment makes up 50 percent of the total cost. She said that the E3 report has a breakdown of labor, materials and equipment. Using the Gas Turbine World information, Charles applied the E3 breakdown (E3 chose 35 percent for their equipment costs) so the remaining 65 percent is for the rest of the plant.

Next Steps

Charles reviewed Slides 16 and 17. Preliminary assumptions for all peaking units will be refined and reference plants will be defined.

Wärtsilä, Flexible Power Generation

Presenter: John Robbins, Wärtsilä North America

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Simmons introduced John Robbins from Wärtsilä for a presentation on flexible power generation. Robbins said that in his role at Wärtsilä he is responsible for business development on the west coast and he operates out of an office in Portland. In light of the previous conversations on the difficulty of procuring costs, he encouraged staff and GRAC members to reach out to him and noted he would help provide information as he could. He reviewed what he planned to discuss during his presentation – background on the company, technology capabilities, capital and levelized cost of energy (LCOE) costs, and reference plants.

He reviewed Slides 2 to 16, which covered information about Wärtsilä, international operations and its engines and their specifications.

In Slide 6, “Wärtsilä Gas Engines,” Robbins explained the notation for the configuration of gas engines. For example, with a 20V34SG engine: “20” represents the number of cylinders, “V” represents the formation of the cylinders, “34” is the cylinder’s diameter in centimeters and “SG” stands for spark-ignited gas.

After discussing the minimum loading/unloading times and spinning reserves operating at 30% load to meet emissions requirements, Robbins noted that cycling and ramping up/down the machines does not have any impact on maintenance schedules. This is a difference from traditional gas turbines, which suffer penalties from these actions in regards to their maintenance schedules.

In response to Simmons’ question about Slide 15, “Combustion Engines, Multiple Unit Efficiency,” Robbins stated that the dips in the graph’s orange line represent another unit coming online.

Nightingale asked if the orange line in the graph on Slide 15 represented a specific plant.

Robbins replied that he thinks the orange line represents a five-engine plant.

Emissions and Technology

Robbins reviewed Slide 17 and stated that the data represents Wärtsilä’s “standard emission levels.” Some of the units, however, are able to produce lower emission levels on a project-by-project basis.

Simmons asked if Wärtsilä has stated CO₂ emissions.

Robbins replied that he thinks the CO₂ emissions are 960 pounds per megawatt hour, which is slightly better than gas turbines.

Robbins reviewed Slides 18 to 24, discussing noise levels, water use, low pressure natural gas use, modularity of units for easy capacity additions, power density and size of units (area) versus output, availability and reliability, and aesthetics.

Referring to Slide 25, Robbins reviewed the maintenance procedures. He stated that the company takes “each individual unit offline in series.” Robbins explained that Wärtsilä doesn’t shut down the whole plant to perform maintenance, so more firm capacity is available all the time compared to a combined-cycle gas turbine plant.

Levelized Cost of Energy (LCOE)

After showing Slide 25, Robbins stated that Wärtsilä hired KEMA and Energy Exemplar to do a study of the California system. The study replaced the “base case” in the state’s Long-Term Procurement Plan (LTPP)—which called for adding 5.5 gigawatts of combined cycles to meet future needs—with a Wärtsilä Smart Power Generation, or flexible generation, system to determine the system cost savings. Robbins reported that KEMA found a 7 percent system-wide cost savings from replacing the combined cycle system with the flexible generation system. Energy Exemplar found a similar cost savings, as well as a reduction in CO₂ because of the higher efficiencies found in the flexible generation technology and the reduced need for capacity.

Robbins reviewed Slides 26 to 31, comparing a Wärtsilä single cycle with various industrial gas turbines.

Robbins showed pictures of plants that use Wärtsilä technology in Slides 32 to 39. He concluded with Slides 40 and 41.

King commented about the shorter lifespan of recip plants and asked about the longevity and maintenance of Wärtsilä plants.

Robbins answered that the units have an overhaul cycle at 1,800 operating hours. At 1,800 hours, Wärtsilä replaces the heads and cylinder liners, so the engines are “like new” or like a “zero-hour engine.” He explained that there is a half-percent loss in efficiency between overhauls, but there are no capacity losses. Robbins stated that the Wärtsilä equipment could last indefinitely as long as it receives routine maintenance.

King commented that the units in the slides look standardized in regards to the engines, enclosures and mechanical arrangements. He asked how Wärtsilä comes up with the arrangements.

Robbins replied that Wärtsilä works with a vendor in Europe that provides the emission-control technology, which it offers with its engine and ancillary equipment as a complete package.

King asked about the time period between “the equipment ordered to the commissioned plant.”

Robbins answered that delivery-to-site takes eight to ten months. Construction takes four to six months to complete. So, “notice to proceed” to commissioning takes 14 to 16 months.

King asked if Wärtsilä plants have experienced any problems or perceived problems.

Robbins stated that a plant in San Diego, California experienced permitting problems because of the site’s proximity to a park.

Nightingale asked what type of technology produces the 960 pounds per megawatt hour of CO₂ emissions.

Robbins replied that the simple-cycle standard units produce this level of emissions. He added that the emission levels with combined-cycle units are about 10 percent lower.

In response to Simmons' question, Robbins stated that most of the plants in the U.S. are gas-fired only; about 10 to 20 percent of them are dual-fuel.

Heutte asked Robbins to give some more information about the delays caused in Port Westward when an engine accidentally tipped onto a train.

Robbins answered that he doesn't know about the incident's start-date impact, but thinks that the delay could be a few weeks. The replacement engine was factory-tested and is en-route to Port Westward on a ship from Italy. He explained that the engine in the accident arrived on a barge that stopped in the Columbia River, next to the Port Westward plant. The vehicle transporting the engine, the "crawler," lost its balance and tipped.

Black asked if Wärtsilä products are well suited to distributed generation applications.

Robbins replied that the company works well in combined heat and power applications and has a few references in the U.S., as well as projects in development. Wärtsilä is better with combined heat and power applications that use hot water instead of steam, but it can make steam that isn't super-heated or high-pressure.

Combined-Cycle Combustion Turbines

Presenter: Steven Simmons, Northwest Power and Conservation Council

Simmons reminded the committee that this is follow-up from the last GRAC meeting on combined cycle combustion technologies. Simmons showed a map that highlights the pipelines in the region, some gas hubs and combined-cycle projects in operation.

Simmons reviewed Slides 2 to 5, focusing on what was discussed at the last meeting and what some of the outstanding issues and questions were.

CCCT Capacity Factors

Simmons reviewed Slides 6 and 7.

Simmons explained that he did a brief study on the capacity factor of combined cycle plants in the Northwest and compared it to some other NERC regions. He concluded that generation from combined cycle projects in the Northwest is lower than other regions, primarily due to strong hydropower contributions. However, he discovered that capacity factors for units in the Northwest are comparable to other regions (except during strong hydro years in the Northwest).

Heutte referred to eGRID data—the national combined Energy Information Administration (EIA) and Environmental Protection Agency (EPA) data set—and stated that he was surprised to see the variation of regional capacity factors listed in 2009. He said that, at around 50 percent, Northwest and New England tend to be higher than other areas of the country, so he thinks there is a different use pattern.

He commented that he is surprised to hear Simmons state that the Northwest's CCCT capacity factors are similar to other regions.

Simmons replied that the "regions" refer to the list of areas in his slides.

After discussing percentages of CCCT net generation in various regions, Slide 8, he pointed out in Slide 9 that the annual capacity factors for CCCT were similar in 2008 to 2010 in all the regions, except for the Midwest Reliability Organization.

In slides 10 and 11, Simmons continued to show the correlation between hydropower capacity factors and CCCT capacity factors, dependent on water year.

CCCT Costing

Simmons went over Slides 12 through 15, describing the cost sources and methodologies he used. New to the analysis at this meeting was a cost analysis of three advanced CCCT units – Mitsubishi, Siemens, and Alstom. Simmons noted that the bigger the unit (Mitsubishi), the lower the heat rate. Conversely, the smaller unit (Alstom) had a higher heat rate. He also noted that the unit size and capital cost are inversely related to the cost/kw.

Heutte noted that the "spread" of heat rates between the technologies isn't very large.

CCCT Water Cooling

Simmons discussed Slides 16 to 18, which touched on the three types of water cooling – once through cooling (OTC), wet cooling (the majority of the plants currently in operation), and dry cooling (which may be a trend going forward). From a CEC report, Simmons described an example of results from a wet and dry cooling unit in the Central Valley. In general, there is a 96% decrease in water usage but 13.5% increase in capital cost when switching from a wet cooling to a dry cooling unit. The heat rate is also increased 1.5%.

Abadi asked if there is any information about CCCT water cooling in the Pacific Northwest, referring to Slide 18. He explained that for plants in California who choose to switch from wet to dry cooling, the 13.5% increase in capital cost up front would be worth it considering the O&M they would potentially save with the dramatic reduction in water usage.

Simmons replied that he doesn't have this information, but it's something that he's interested in learning more about as well, particularly in regards to water usage cost compared to dry cooling. Simmons noted another example of a plant in California that instead of moving to dry cooling, they located the plant next to a wastewater treatment plant.

Nightingale stated that the Power Act calls for water to be a non-energy benefit or cost. He said that he's interested in learning if this issue has been quantified for at least the Washington-region of the Power Act.

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Gall, referring to Slide 14, stated that the decrease in power output during the summer months needs consideration. Regarding dry versus wet cooling, it may not be an issue of cost but of availability - can you even get the water. Another thing Avista is considering is hybrid cooling, where you air-cools in the winter and water-cool in the summer. Avista is exploring the economics of this now.

CCCT Projects

Simmons reviewed a few wet cooling projects on Slide 19.

Heutte commented that the project at Carty will share the reservoir with Threemile Canyon Farms, but he's not sure about the arrangements.

Normalization Adjustments

Simmons then went over Slides 20 through 24. Based on varying sources of information, Simmons described the adjustments he made to normalize configuration, performance, output, and cost. He then presented normalized overnight capital costs for CCCTs using wet cooling (slide 21) and dry cooling (slide 22).

Simmons stated that the plants highlighted in Slide 23 are the two proposed CCCT reference plants, in response to suggestions at the previous GRAC meeting to explore both a wet and a dry cooling plant. The Siemens H-class model is normalized to Boardman's location and elevation and uses wet cooling. The other proposed reference plant is a Mitsubishi J-class using dry cooling. Simmons described the specifications of both reference plants on slide 24.

Simmons stated that most of the units that he saw have duct firing. Klein added that he has heard that most plants in California are being built with duct firing.

Klein asked if the costs include emission reduction credits in California.

Simmons answered that the costs did not include the credits.

Mendonca asked Simmons to explain the four-year difference in service dates between the two reference plants..

Simmons replied that the Mitsubishi J-Class is more advanced. He said that while the model is available, he hasn't seen applications of it yet. Simmons shared that he thought that the four-year difference was a more realistic modeling detail because it is a more advanced system than the Siemens H-Class. He told the group that he welcomes any opinions about this matter.

King asked Simmons if he's seen evidence regarding the construction of either proposed reference plants.

Simmons replied that he has seen evidence of the H-class in the U.S., but not the J-class. King noted that manufacturers tend to heavily promote their new advanced technologies early, but that it then takes several years before they are put into service. He cited the LMS 100 as an example. Around 2004-2005,

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the “fireworks went up from GE” via advertising and press releases but it wasn’t until 2008-2009 that the first units went into service. “It takes a while from the well-publicized official announcements to the point at which a unit is actually built.”

Simmons noted that advanced plants seem to be trending towards greater flexibility and efficiency.

Referring to Heutte’s question about the names of models using letters (i.e., H-class), King stated that the tradition started with GE. He said the differences originally referred to an increase in the power turbine’s inlet temperature and therefore increased efficiency and power density of the plant. King added that he doesn’t know if this trend applies to the more recent classes or if it is attributed to other innovations and improvements.

Gall commented that GE stated that the third generation of the F-class gas turbine would be more popular across the Western United States compared to the rest of the United States and the world due to smaller unit size and greater flexibility. He said that he thinks that “showing two different turbines from two different time periods” is misleading because a different type of analysis would result in a different conclusion. Gall stated that he also thinks that having an advanced turbine would result in an “efficiency gain or a technology change over time with the same turbine.”

Simmons explained that when he modeled the turbines, he looked at the wet cooling (Siemens H Class) as being more of a current technology and the dry cooling (Mitsubishi J Class) as one that’s an option for the future.

Nightingale stated that since duct firing is rarely used throughout the year, the modeling might be simpler if it didn’t include duct firing. Alternatively, he suggested using one reference plant that includes duct firing and one that does not. King stated that the Council uses the AURORA and Portfolio models. The Portfolio model cannot calculate dispatch stages in duct firing, but the AURORA model can.

Gall suggested that if the Council is contemplating incorporating duct firing or not, it should do an analysis about the cost-effectiveness of duct firing. He supposed that mid-8000 heat rate duct firing unit is pretty cost effective incrementally compared to a peaker, noting that Avista runs theirs “quite often”.

Nightingale said that this type of analysis would be fair as long as the Council incorporated the additional cost penalties on turbines using duct firing and other related costs.

Klein stated that he agrees with staying away from duct firing in regards to modeling.

Gall and Klein discussed duct firing and its modeling at their respective agencies.

Next GRAC Meeting

Presenters: Steven Simmons and Gillian Charles, Northwest Power and Conservation Council

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Simmons stated that at the next GRAC meeting, staff would follow up on single-cycle technologies, reciprocating engines and cost-related information. They will also discuss the preliminary resource evaluation on wind and upcoming resource topics.

Charles reviewed how the committee had categorized and prioritized evaluating resources. She noted that two of the resource topics that had originally been characterized under long term potential have been growing in interest among stakeholders in the region - energy storage and small modular nuclear. Charles said that the Council is thinking of having industry experts present information about each of these topics.

Nightingale suggested looking at offshore wind, which he felt ought to be looked at more closely if we are talking about the next twenty years.

Heutte added that it would be interesting to hear about geothermal technologies and the newer Japanese floating wind platforms.

Charles told the meeting participants that she would be in touch about the date of the next meeting.

Simmons concluded the meeting at 12:25 PM.

These are an accurate and complete summary of the matters discussed and conclusions reached at the Generation Resources Advisory Committee meeting held on 2/27/2014.

Certified by: Steven Simmons /s/, Chairperson.