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Outline of Methodology: Target 4 – Review Dual Fuel Capability

This Memorandum outlines for stakeholders the methodology to be utilized to perform the dual fuel analysis set forth as Target 4 in Section 8 of the of the EIPC Statement of Work ("SOW") for the Gas-Electric System Interface Study. Specifically, the approach is designed to:

- Utilize the identification of pipeline constraints set forth in Target 2[1] as the starting point for identifying areas for further analysis in Target 4 through the examination of mitigation options, including the availability of dual fuel capability at specific-identified pipeline constrained locations;
- Develop a PPA specific gas sector database and associated tools that can be utilized by the PPAs and stakeholders within the individual PPA planning activities;
- Provide additional gas sector information to the PPAs and their stakeholders as they consider issues associated with the future portfolio mix of generation; and
- Meet the needs of the PPAs and stakeholders, to address fuel-related infrastructure issues associated within those geographic areas where natural gas deliverability to generation capacity is or is projected to be constrained over the 5- and 10-year study horizon.

Specifics of Target 4 - Task 5 Analysis (SOW Section 8.3)

The Target 4 - Task 5 analysis focuses on identifying pipeline expansion costs versus the costs associated with installation of dual fuel capability on a unit/location specific basis to achieve a near 100% fuel availability situation for those units, thereby making additional generating resources available for dispatch by the System Operator. It is important to note that this is a forward-looking analysis to inform the locational requirements for future gas-fired generation, rather than a detailed unit-specific analysis of existing gas-fired generation units[2].

The Target 4 analysis builds on the pipeline and local distribution company ("LDC") constraints identified within Target 2. The Target 2 analysis for identifying location-specific, gas sector constrained areas, lays the foundation for the analysis of mitigation options through Target 4. These could include:

- Expansion of pipeline capacity to provide for the procurement of firm transportation on interstate[3] natural gas pipelines and/or LDCs to ensure "firm" fuel availability/fuel assurance for gas-fired generation units - which directly bolsters electric system reliability;
- Given the potential high cost of new pipeline build-out on a heavily-constrained pipeline segment or LDC system, another solution is the installation of dual fuel capability with corresponding non-firm transportation on the pipeline delivery system;

[1] Target 2 – Evaluate the Capability of the Natural Gas Systems to Satisfy the Needs of the Electric System.
[2] Individual PPA's may designate certain existing unit locations for analysis as appropriate.
[3] All references to interstate natural gas pipeline also include, if applicable, intrastate as well as both interprovincial and intraprovincial pipelines.

- Some combination of firm transport at the pipeline level in addition to some level of dual fuel capability, to primarily address potential LDC delivery constraints ; or
- Construction of a lateral to directly connect to the interstate pipeline system to mitigate existing or future LDC delivery constraints.

Although the goal of this portion of the project is to identify the potential solutions for gas-fired generators to improve their availability by "firming-up" their fuel supply, it must be noted that the decision surrounding fuel procurement (and related business strategies) is ultimately up to the owner of those assets. Therefore, this portion of the study is designed to provide information to the PPAs as to the array of viable infrastructure alternatives and their associated costs that may be available within a gas-constrained area, should those PPAs ultimately decide to require some form of a "firm-fuel" component for generating resources.[4]

The Target 4 analysis, as well as the EIPC study as a whole, is rooted strictly in a reliability analysis. Specific market rule changes to address any of these options are indeed relevant but are best addressed through individual ISO/RTO processes. As such, the analysis to be performed in Target 4 provides important information regarding the gas infrastructure requirements and alternative mitigation measures during peak periods for consideration by the PPAs, stakeholders and policymakers within each individual ISO/RTO processes, but does not attempt to answer the question of what solution or market reform, if any, should be considered by a particular PPA. This distinction is important given the diversity of each of the PPA regions as well as their market rules, governance and form of regulatory oversight.

With regard to the reference to "cost-benefit" analysis within Target 4 of the SOW, the "benefit" is the increased availability of fuel to the gas-fired generator (and power system) and the "cost" is the estimated cost of infrastructure to ensure such fuel availability, whether it is in the form of dual fuel or firm gas transportation.

Target 4 – Task 5 Subtasks and Process Flow

Step 1) Develop a list, by PPA, of the existing and new gas-fired generators that are or projected to be subject to natural gas pipeline or LDC constraints. Identify by pipeline/LDC location and electric transmission system location. This information directly results from the Target 2 GPCM analysis (from the Reference Prime Case), with the gas generation burn profiles calculated from Aurora assuming the "frictionless" price of natural gas. The term "frictionless" in this context reflects use of average monthly delivered prices at key pricing points across the Study Region. It is understood that Aurora will over-estimate the amount of gas consumption because the price of natural gas does not vary with the market, resulting in a potential over-estimation of pipeline constraints. This will produce a "conservative" result which is appropriate for a longer-term planning analysis. Case sensitivity analyses, reflecting the use of market price indices on a peak winter day can be analyzed to lower the frequency and duration of

[4] Although there are potentially a host of electric side mitigation measures ranging from construction of new transmission to procurement of demand response resources, for purposes of this study, the focus is on ensuring ensure fuel availability to generators which are needed to meet the capacity requirements of the PPAs. These other electric sector mitigation measures are outside the scope of this study.

locational constraints across the Study Region at times when the delivered price of natural gas exceeds the corresponding oil price.

Step 2) Map the frequency and duration of these fuel constraints (Step 1 above) from the Target 2 GPCM analysis, by location, to the existing and future gas-fired generators within each PPA. Here, frequency and duration come from the merging of the output of generator gas consumption from Aurora/GPCM for the seasonal peak day, the demand curves created for RCI load, and the certificated capability of the pipelines. Across the Study Region, LAI will run the Aurora model on an hourly basis over three winter months, December, January, and February, to ascertain the total coincidental gas consumption requirements to refine the accuracy of the frequency and duration of any gas system constraints. Each PPA will make a determination as to whether LAI will run the Aurora model during the peak cooling season as well, during the months of June, July and August.

Step 2a) From the pipeline/LDC constraints list from Step 1 and the frequency and duration identification of Step 2, the PPAs will review and then choose the number of locations to be studied for possible mitigation by either installation of dual fuel capability or pipeline expansion. The criteria for this choice will be driven by the magnitude and duration of the pipeline constraints, their geographic diversity related to power system reliability, as well as potential study budget limitations;

Step 3) From the information and results provided by Steps 1, 2 and 2a, determine the costs associated with mitigating the pipeline constraints identified within the Target 2 analysis, so that firm transportation could be procured. This analysis would include either of the following two methods, as appropriate, but would not include a detailed, site-specific engineering design.

Step 3a) Costs obtained from recent pipeline expansion FERC filings that are (geographically and economically) relevant to the mitigation of the constraints based on relevant size or location; or

Step 3b) Point-to-point cost of pipeline expansion based upon engineering judgment and high level estimates of associated cost (e.g. – cost per mile, based on desired capacity, unitized costs of compression, brown-field vs green-field ROW expansion, etc.).

It is recognized as pointed out in comments submitted by Calpine et al, that there are a number of other means to procure firm fuel delivery. However, these alternatives, including the provision of obtaining capacity released into the secondary markets or through asset management agreements, are far more difficult to quantify and certainly cannot be applied universally. As a result, this analysis should be viewed as the "outer-bound" of establishing firm transportation service through construction of additional/incremental pipeline through an anchor shipper. It is not intended to preclude any of the other means available within the markets to procure firm transportation, which may be available on a unit-specific basis, consistent with the requirements of individual-gas pipeline tariffs, ISO/RTO tariffs and/or operational practices.

Step 4) Determine how often is firm transportation needed or how large the back-up fuel storage tanks should be (production MWh) to alleviate the pipeline delivery constraints (frequency & duration) as previously identified (Step 1 and Step 2 above). In order to conduct this analysis, the costs of dual fuel capability needs to be obtained, including logistics of liquid fuel handling and combustions controls, sizing of tanks, liquid fuel replenishment, and sizing of water demineralization systems. This aforementioned information should be an outcome of the Target 4 – Tasks 1 – 4 analyses, as defined in SOW Sections 8.2.1 through 8.2.4. This analysis would not include a detailed, site-specific engineering design, but rather rely on a per-unit type assumptions based upon manufacturer information and typical plant installation costs, adjusted for locational construction materials and regional labor costs by standard indices (e.g. Handy-Whitman).

Step 5) Determine whether firm pipeline transportation or dual fuel capability is more cost effective. Given the assumptions on liquid fuel needs, it can be determined whether firm transportation (thru pipeline addition or expansion) or dual fuel capability is more cost-effective option, while noting that the greater the gas supply interruptions, the more valuable firm transportation becomes, or the fewer the gas supply interruptions, the more cost-effective dual fuel becomes. Here too, the goal is not to define a detailed, site-specific solution for each individual generator, but instead to develop a planning tool that Participating Planning Authorities can use to assess the overall reliability of gas-fired capacity resources under stressed pipeline peak day conditions.