DANSKAMMER ENERGY CENTER

Case No. 18-F-0325

1001.9 Exhibit 9

Alternatives

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Exhibit 9: Alternatives

9(a) Reasonable and Available Alternative Location Sites

Pursuant to the Siting Board regulations at 16 NYCRR § 1001.9 (a), a private facility applicant may limit its identification and description of alternative location sites to those owned by, or under option to, the applicant or its affiliates. A private facility applicant, in turn, is defined under Section 1000.2(ae) of the Siting Board regulations as one that "does not have the power of eminent domain, either directly or indirectly."

Danskammer is a private facility applicant because it does not have eminent domain authority nor does it intend to acquire it from an entity that may have such authority by statute (such as an industrial development agency). Accordingly, its analysis of available alternative location sites in this Exhibit 9 is limited to those sites owned, or under option, to Danskammer or its affiliates.

Danskammer owns approximately 180 acres in the Town of Newburgh (the "Danskammer Property"). The proposed Project Site (or Site) comprises approximately 100 acres within the Danskammer Property (see Figure 4-4). The Project Site is transected in a northwest/southeast orientation by a narrow parcel of land owned by the CSX Transportation, on which a rail line is located.

Danskammer does not own, or have under option, any other property in New York. Danskammer is wholly-owned by Danskammer Holdings LLC, which in turn, is indirectly owned by upstream investment funds that have equity ownership in other portfolio companies, one of which is a company that owns or has control over another site in New York. However, Danskammer is not under common voting or management control with such portfolio company, and thus, Danskammer does not have control over such other site located in New York. Furthermore, such other site is currently being developed for other projects and is not available or suitable for the proposed Project. As stated in Exhibit 1, the ownership interests in Danskammer were acquired from Mercuria Energy in December 2017. Those ownership interests were acquired specifically for the purpose of repowering the existing Danskammer Generating Station on the existing Danskammer-owned property in Newburgh, New York.

9(b) Site Selection Process and Relevant Project Details

(1) Overview

In siting the proposed Project on the Danskammer Property, Danskammer adhered to a set of design goals including: minimizing disturbance of any streams and wetlands to the greatest extent practicable, minimizing clearing of wooded and natural areas, efficiently using existing disturbed land, avoiding any disturbance to the landfill located on Danskammer Property, and maintaining existing electric generation capacity levels at the Site until the existing units at the Danskammer Generating Station cease operation and are replaced by the new unit at the proposed Danskammer Energy Center. The determination to situate the Project immediately adjacent to the existing Danskammer Generating Station promotes these design goals by taking advantage of existing infrastructure (i.e., natural gas and electrical interconnections, access roads, security infrastructure) and minimizing construction-related environmental impacts. The repowered Project will interconnect with Central Hudson's 115-kilovolt (kV) transmission system through the existing substation on the Project Site. As such, no additional off-site electrical transmission system right-of-way will be required for the interconnection to Central Hudson's transmission system. The repowered Project will also use the existing natural gas transmission system and metering station for the delivery of natural gas. The preferred location for the Project does not require new off-site infrastructure to be constructed because the existing Site has this infrastructure available to support future operations.

(2) Project Details Relevant to Site Selection Process

Initial repowering evaluations by Danskammer resulted in several repowering scenarios that included various configurations of new unit(s) and potential design layouts on the Danskammer Property. As discussed more fully in Section 9(c) "Description and Evaluation of Reasonable Alternatives at the Primary Proposed Location, Project details relevant to the Project Site selection included performance, size, emissions, costs, and configurations utilizing equipment platforms from two combustion turbine manufacturers. Danskammer also evaluated the use of alternative energy sources (e.g., wind and solar power), but found that these options would not generate sufficient electric generating capacity to be reasonable and feasible alternatives, given the size constraints of the Danskammer Property and the capacity factors of such alternative energy sources. (Additional evaluation of alternative energy sources is provided in Section 9(g) of this Exhibit 9). Based on these initial evaluations, it was determined that the combustion turbine design review should include designs with a proven track record, be of a size that will meet Danskammer's goals and objectives and fit within the environmental and topographical constraints of the Project Site.

Also pertinent to the location of the Project, Danskammer obtained turbine performance and emissions data and information related to air pollution-control technology, different turbine options (with and without duct firing), operation and maintenance costs, and balance of plant options. Air pollution-control technology is determined by the United States Environmental Protection Agency (EPA) and New York State Department of Environmental Conservation (NYSDEC) air quality regulations. Specifically, and as it relates to the use of aqueous ammonia (or any proposed alternative) in the selective catalytic reduction system, Danskammer chose the use of aqueous ammonia because it is industry proven technology.

Danskammer also evaluated various physical layouts to determine how a unit or units could be located on the Danskammer Property along with the environmental and operational benefits and challenges presented by each. As outlined in more detail in Exhibit 31(e) of this Application, a substantial portion of the Danskammer Property is not buildable due to steep slopes, which constrains the available area for the Project. Of the remaining land, there are a number of areas subject to utility easements that would not be available for the Project. Danskammer also chose not to build on top of or too close to the existing NYSDEC-regulated coal ash landfill and associated coal ash leachate facility, as well as to avoid other solid waste management areas on the Danskammer Property that may fall under the jurisdiction of the U.S. Environmental Protection Agency and NYSDEC, as described more fully in Exhibits 15 and 21. Further, Danskammer also avoided siting the Project under existing transmission lines.

The initial evaluations considered simple cycle and combined cycle (1-on-1 and 2-on-1) configurations. The simple cycle configuration was not considered in great detail given the lower efficiency. Initial design considerations included options on land immediately adjacent to existing Units 3 and 4 stack and Units 3 and 4 precipitator building (on the east side of the CSX railroad tracks, land on the west side of the CSX railroad tracks (former coal storage area), and land adjacent to the existing landfill. It was determined that each of these locations presented concerns both internally as well as in discussions with various stakeholders. Based upon these concerns, Danskammer determined that the preferred location within the Danskammer Property for the combined-cycle unit's main footprint is on the east side of the CSX railroad tracks, immediately adjacent to existing Units 3 and 4 stack and Units 3 and 4 precipitator building.

However, different orientations of the combined-cycle gas turbine power block in that general location were evaluated. Each orientation resulted in a different lay-out of the heat recovery steam generator (HRSG), steam turbine, air-cooled condenser, and exhaust stack in that general location to the east of the CSX rail road. Some orientations/configurations would have likely resulted in operational inefficiencies and constructability issues.

9(c) Description and Evaluation of Reasonable Alternatives at the Primary Proposed Location

The following information provides a description and evaluation of reasonable alternatives to the Project at the preferred Project location.

(1) Alternative General Arrangement and Design

Potential design configurations and layouts were considered for both combined-cycle and simple-cycle options. The main factor that was considered for the sizing component of the Project was the optimal number of megawatt hours of electricity that could be injected into the electric grid using the existing infrastructure for both gas and electric, specifically considering any transmission system limitations. The two combined-cycle configurations that were evaluated consisted of (a) one gas turbine and one steam turbine power block (1-on-1) and (b) a two-gas turbine and one-steam turbine power block (2-on-1).

(2) Alternative Technology

The design configuration selection for the proposed Project also included evaluation of both simple-cycle and combined-cycle operational modes and alternative turbine and cooling technologies. These analyses are set forth below.

(i) Combined-Cycle and Simple-Cycle Combustion Turbines

Combined-cycle and simple-cycle operational modes were evaluated by Danskammer as part of the Project design selection. In selecting a combined-cycle operational mode as its preferred alternative, Danskammer considered the several key advantages that a combined cycle facility has over a simple-cycle facility:

- By using the waste heat from a combustion turbine to produce steam that in turn generates additional electricity, a combined-cycle facility operates with a higher thermal efficiency than other types of electric generating facilities.

- Combined-cycle technology has an overall efficiency as high as 64 percent (MHPS n.d.). Simple-cycle technology has an overall efficiency of approximately 34 percent. (Wikipedia, 2019).
- Because a combined-cycle plant uses less fuel than either a steam turbine or a gas turbine to generate a kilowatt-hour of electricity, the savings in fuel is significant and results in lower operating costs that ultimately benefit the consumer. As a combined-cycle facility, the Project would likely be dispatched more continuously, enabling it to displace older, less efficient electric generating facilities, resulting in a net environmental benefit for the State of New York.

As a result of the matrix analysis conducted by Danskammer and set forth in Section 9(c)(2)(iii) below, Danskammer has specifically selected the Mitsubishi M501JAC combined-cycle technology as its preferred technology for numerous reasons, including that it is designed for faster start-ups and turn downs to respond to rapidly changing system demands. The flexibility allows for turning down or off in periods of low system demand and provides the New York Independent System Operator (NYISO) greater flexibility in its selection of generation resources (both fossil and renewables) from within its generation portfolio.

(ii) Alternative Combustion Turbines and Providers

The increased efficiency and associated reduction in operating costs and environmental benefits resulted in Danskammer’s selection of combined-cycle technology for the Project. Consideration was given to various frame (F-, G-, H-, and J-class) turbine technologies and configurations that would have resulted in a project of a larger or smaller generating capacity. These different frame turbine technologies, while similar, result in different turbine performance and potential environmental impacts. Two turbine vendors/providers (GE and MHPS) were contacted to obtain turbine performance specifications. Danskammer evaluated the Project’s potential life-cycle costs, preliminary engineering design, vendor emissions data, costs, operations and maintenance programs, and warranties.

In reviewing the vendor specifications, Danskammer also considered the proposed Project Site location and recognized that the Project would be affected by the following:

- The Project Site is located in an Ozone Transport Region;
- The Project would result in an emissions increase of greater than 40 tons of nitrogen oxides (NO_x) and volatile organic compounds (VOCs) per year and would be subject to ozone non-attainment requirements;
- The Project would need to comply with Lowest Achievable Emission Rate provisions;
- Emission Reduction Credits for NOx and VOCs would need to be acquired; and
- The proposed Project would be a major modification to an existing major source and require Best Available Control Technology for pollutants that trigger a major modification but that are not subject to non-attainment New Source Review requirements.

Based on these considerations, Danskammer determined that the alternative frame F- and H-class turbine technologies previously mentioned would result in similar, but not identical, turbine performance and potential environmental impacts. After consideration of the above, Danskammer determined the selection of the Mitsubishi 501JAC combustion turbine generator was the preferred alternative.

(iii) Alternative Sizes and Power Block Arrangements

Danskammer considered several different sizes/power block arrangements within the alternative frame F- and H-class turbine technologies (both simple- and combined-cycle) during its technology evaluation. To compare the various sizes and power block arrangements, Danskammer scored them on several criteria, using a scale of 1 to 5, with 5 being the highest score. The following twelve criteria promote the design goals of the Project (see Section 9(b)(1) of this Exhibit 9, above), many of which are environmentally based:

- Power density capability similar to the existing facility;
- Use existing gas and electric interconnections;
- Eliminate use of cooling water;
- Fit within existing Project Site footprint;
- Lowest heat rate;
- Lowest emissions;
- Dispatchable output;
- Rapid start and ramping;
- High turndown;
- Advanced fuels capabilities;

- Improved emergency operations; and,
- Proven latest design.

The types, sizes (note that MW listed below are gross and not net), numbers, and power block arrangements considered (and the total score), included the following:

- Two GE 7FA.05 combustion turbines in simple-cycle mode, with an output of approximately 486 MW (gross): Total Score = 54;
- Five GE LMS 100 combustion turbines in simple-cycle mode, with an output of approximately 585 MW (gross): Total Score = 52;
- Six GE 7EA combustion turbines in simple-cycle mode, with an output of approximately 585 MW (gross): Total Score = 50;
- Two MHPS 501 GAC combustion turbines in simple-cycle mode, with an output of approximately 566 MW (gross): Total Score = 54;
- Two GE 7HA.02 combustion turbines in simple-cycle mode, with an output of approximately 768 MW (gross): Total Score = 53;
- Two MHPS 501JAC combustion turbines in simple-cycle mode, with an output of approximately 850 MW (gross): Total Score = 53;
- One GE 7HA.02 combustion turbine in simple-cycle mode, with an output of approximately 384 MW (gross): Total Score = 56;
- One MHPS 501JAC combustion turbine in simple-cycle mode, with an output of approximately 425 MW (gross): Total Score = 56;
- Two GE 7FA.05 combustion turbines in combined-cycle mode (2-on-1 configuration), with an output of approximately 756 MW (gross): Total Score = 51;
- One MHPS GAC combustion turbine in combined-cycle mode (1-on-1 configuration), with an output of approximately 427 MW (gross): Total Score = 56;
- One GE 7HA.02 combustion turbine in combined-cycle model (1-on-1 configuration), with an output of approximately 573 MW (gross): Total Score = 57; and,
- One MHPS 501JAC combustion turbine in combined-cycle mode (1-on-1 configuration), with an output of approximately 614 MW (gross): Total Score = 60.

Table 9-1 below presents a summary of the alternatives scoring matrix that evaluates the 12 criteria identified above against each of the alternatives considered.

Table 9-1. Project Alternatives Matrix

	Power Density Capability Similar to Existing Facility	Use Existing Gas and Electric Interconnections	Eliminate Use of Cooling Water	Fit Within Existing Footprint	Lowest Heat Rate	Lowest Emissions	Dispatchable Output	Rapid Start and Ramping	High Turndown	Advanced Fuels Capabilities	Improved Emergency Operations	Proven Latest Design	Total
Two GE 7FA.05 combustion turbine in simple-cycle mode (486 MW gross)	4	5	5	4	4	4	5	5	5	3	5	5	54
Five GE LMS 100 combustion turbines in simple-cycle mode (585 MW gross)	5	5	5	2	4	4	5	5	5	3	5	4	52
Six GE 7EA combustion turbines in simple-cycle mode (585 MW gross)	5	5	5	2	3	3	5	5	5	3	5	4	50
Two MHPS 501 GAC combustion turbines in simple-cycle mode (566 MW gross)	4	4	5	4	4	4	5	5	5	4	5	5	54
Two GE 7HA.02 combustion turbines in simple-cycle mode (768 MW gross)	3	3	5	4	4	4	5	5	5	5	5	5	53

Table 9-1. Project Alternatives Matrix

	Power Density Capability Similar to Existing Facility	Use Existing Gas and Electric Interconnections	Eliminate Use of Cooling Water	Fit Within Existing Footprint	Lowest Heat Rate	Lowest Emissions	Dispatchable Output	Rapid Start and Ramping	High Turndown	Advanced Fuels Capabilities	Improved Emergency Operations	Proven Latest Design	Total
Two MHPS 501JAC combustion turbines in simple-cycle mode (850 MW gross)	3	3	5	4	4	4	5	5	5	5	5	5	53
One GE 7HA.02 combustion turbine in simple-cycle mode (384 MW gross)	3	5	5	5	4	4	5	5	5	5	5	5	56
One MHPS 501JAC combustion turbine in simple-cycle mode (425 MW gross)	3	5	5	5	4	4	5	5	5	5	5	5	56
Two GE 7FA.05 combustion turbines in combined-cycle mode (2-on-1) (756 MW gross)	4	4	5	2	4	5	5	5	4	3	5	5	51
One MHPS GAC combustion turbine in combined-cycle mode (1-on-1) (427 MW gross)	4	4	5	5	5	5	5	5	4	4	5	5	56

Table 9-1. Project Alternatives Matrix

	Power Density Capability Similar to Existing Facility	Use Existing Gas and Electric Interconnections	Eliminate Use of Cooling Water	Fit Within Existing Footprint	Lowest Heat Rate	Lowest Emissions	Dispatchable Output	Rapid Start and Ramping	High Turndown	Advanced Fuels Capabilities	Improved Emergency Operations	Proven Latest Design	Total
One GE 7HA.02 combustion turbine in combined-cycle mode (1-on-1) (573 MW gross)	5	4	5	5	5	5	5	5	4	4	5	5	57
One MHPS 501JAC combustion turbine in combined-cycle mode (1-on-1) (614 MW gross)	5	5	5	5	5	5	5	5	5	5	5	5	60

Note: The scoring is unique to the specifics of the Danskammer site and business views, including: topography, existing facility interconnections, market expectations, views of the evolving market in the Northeast, and selected other confidential screens related to fuels and dispatch management.

After careful consideration of the above (with the highest score determined to be 60), Danskammer determined the selection of the Mitsubishi 501JAC combustion turbine generator (in combined-cycle mode and in a 1-on-1 configuration) was the preferred alternative and the best fit for the proposed Project.

(iv) Alternative Stack Heights

Danskammer expended concerted efforts to minimize the visibility of the Project, including changes to the Project profile and size. The Project's HRSG exhaust stack is the most visually prominent feature. A primary means of minimizing stack height is to limit the height of nearby controlling structures that determine the stack height in accordance with Good Engineering Practice (GEP) guidelines. EPA provides specific guidance for determining GEP stack height in the Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations), (EPA, 1985). GEP is defined as "…the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, and wakes that may be created by the source itself, nearby structures, or nearby terrain 'obstacles.'" Using the formula in the GEP guidelines, the GEP stack height was calculated to be 362 feet above grade.

Due to the inherently low emissions resulting from natural gas and ultra-low sulfur diesel (ULSD) for backup fuel usage, air quality standards will be achieved with lower than GEP stack heights. Through optimization, final emission data from the equipment vendor, and modeling analysis, the stack height was reduced to 200 feet. A stack height of 200 feet was determined to be the minimum stack height required to ensure modeled compliance with the ambient air quality standards. This height represents an optimal compromise between minimizing the visual effects and minimizing the air quality impacts. Further, the proposed facility's HRSG exhaust stack will be lower than the existing plant's exhaust stacks (two of the existing plant's exhaust stacks are approximately 220 feet above grade and the other two stacks are approximately 240 feet above grade), resulting in an aesthetic profile when observing from a distance. Exhibit 24 of this Application contains a further discussion of the Project's potential visual impacts.

(v) Use of ULSD as Backup Fuel

Danskammer is proposing to use natural gas as the primary fuel for the combustion turbine. However, natural gas supply can be curtailed during severe cold weather as natural gas supplies are re-routed to support residential, institutional, and commercial heating systems. Using a back-up fuel can relieve the stress on the natural-gas system during such conditions. Back-up fuel use would also ensure that while residences, schools, hospitals, and firm sales customers are given first-order priority for gas supply, the Project's ability to operate and provide power is preserved. For this reason, the use of a back-up fuel is an important reliability issue and Danskammer proposes using ULSD as a back-up fuel.

It is expected that the Project would only operate on ULSD when natural gas is not available or when the price of natural gas is greater than the price of ULSD, and in any event, would not exceed 720 hours per year. The air quality dispersion model addresses the potential air impacts during ULSD-fired operation. The modeling results indicated that the maximum-modeled concentrations from the Project, when added to existing background concentrations, would not result in any National Ambient Air Quality Standards or New York Ambient Air Quality Standards modeled exceedances. Further, Exhibit 37, Back-up Fuel, provides an evaluation of ULSD, including a description of on-site facilities and interconnections required for the transportation, storage, and combustion of ULSD.

(vi) Alternative Cooling Technology

Three cooling technologies are potentially feasible for the Project: wet cooling, hybrid wet/dry cooling, and air cooling. The following sections provide a brief description of the cooling technologies and the reasoning behind selection of an air-cooled condenser for the Project.

(a) Wet Mechanical Draft Cooling Tower System

A wet mechanical draft cooling tower uses evaporative cooling to cool the circulating water. A supply of make-up water (several million gallons per day) is required to account for evaporation losses. In addition to water lost by evaporation, water is also lost due to drift and blowdown. Drift losses result from water being entrained in the exhaust air stream. Drift losses are minimized by proper cooling tower design and maintenance. Blowdown is required of wet towers because evaporation concentrates the impurities in the circulating water. Blowing down the circulating water reduces the impurities.

Danskammer proposes to obtain its water supply from the Town of Newburgh to meet Danskammer Energy Center's water supply requirements. Due to the water demands of the wet cooling tower system, Danskammer determined that it does not represent a technically or environmentally viable option for the Project.

The wet cooling tower system was also determined to be less desirable from an environmental standpoint. An alternative to public water supply is the use of surface water withdrawal from the Hudson River to meet the Project's water supply requirements. However, surface water withdrawal would have a greater potential for adverse environmental impacts (impingement/entrainment of aquatic life).

In addition, water vapor in the saturated air discharged from the cooling tower condenses upon contact with cooler ambient air, creating a plume. The cooling tower plume could have visual impacts and potentially cause fogging and icing conditions. For these reasons, the wet mechanical draft cooling alternative was eliminated from further consideration.

b. Hybrid-Cooling Tower System

A hybrid-cooling system is like a wet-cooling system, except that the cooling tower would include both dry tube heat exchanger sections and wet evaporative cooling sections. A wet/dry cooling tower works in combination to cool the circulating water. The hot water enters the tower and initially goes through the dry section (finned tube coil), and then through the wet (evaporative section). The dry section acts as a reheater, raising the temperature of air discharged from the system. This reduces the relative humidity of the air and partially or completely eliminates the visible water vapor plume. Moisture in the air discharged from the tower may still condense and form ice if it encounters a cold surface during winter operation. Because the hybrid-cooling system incorporates a wet evaporative-cooling section, it requires make-up water and generates blowdown similar to a wet-cooling system. For these reasons, which are like those listed above for the wet mechanical draft cooling tower, a hybrid-cooling tower was ultimately dismissed as a viable alternative for the Project.

c. Air-Cooled Condenser System

An air-cooled condenser relies only on ambient air as a direct heat sink for the steam cycle and, therefore, does not consume water through evaporation or generate a cooling wastewater discharge. Steam from the steam turbine exhaust flows through a main steam duct to the air-cooled condenser. The condenser consists of several modules, each with tube bundles in an A-shape. The steam distribution manifold is located at the top of the A-frame. Steam turbine exhaust passes through these finned tubes while an air stream passes over the outer tube surface. The cooling air flow for each module is provided by a dedicated large-diameter fan. Condensate is collected in the condensate tank, then pumped back to the HRSG feed water system. Because air-cooling systems do not have cooling water demands, they can be located in or near cities and other areas with great demand for electricity irrespective of the availability of large supplies of cooling water. In addition, an air-cooling system does not create a vapor plume. The use of an air cooled system also eliminates the need to discharge heated cooling water, which, as is the case with the existing facility, would necessarily discharge to the Hudson River.

An air-cooled condenser is somewhat larger than a wet or hybrid system. Project structure visibility is somewhat enhanced through the use of air-cooled condenser technology. Nonetheless, Danskammer identified an air-cooling system as the preferred cooling technology. An air-cooled condenser system is technologically compatible with Danskammer's intent to use the Town of Newburgh's public water supply and will minimize environmental impacts associated with water use, withdrawal, and discharge. Air-cooled condensing will be employed to dramatically minimize water usage, reduce water treatment costs, and eliminate cooling tower plume impacts.

(3) Alternative Scale and Magnitude

Please see the above section titled "Alternative Sizes and Power Block Arrangements" that summarizes the different scale, sizes, magnitude, and power block arrangements considered by Danskammer during its evaluation. The scale of the Project is limited to a maximum net generation capacity of 600 MW, due to various factors including the mechanical limitations of the plant equipment, the electrical grid and connection limitations, and auxiliary loads supporting various plant equipment.

(4) Alternative Timing

As it relates to its evaluation of the preferred timing for the Project's proposed commercial operation date (COD), Danskammer considered what was currently occurring in the electricity generation marketplace, as well as future forecasts for the marketplace. The recent electricity generation additions to the New York marketplace (1,100-MW Cricket Valley Energy Center in Dover Plains, New York that is expected to come online in 2020 and the 680-MW Valley Energy Center in Wawayanda, New York that achieved commercial operation in October 2018) were considered, and Danskammer determined that there will still be a need for the proposed Danskammer Energy Center despite these other additions.

These additions will not have an impact on the proposed Project's timing or its proposed in-service date for three main reasons: (a) New York's fleet of power plants has an average age of over 35 years and has heat rates significantly higher than the Project (efficiency/fuel consumption per MWh), (b) the Indian Point Energy Center in Buchanan, New York will be closing, with the shutdown of Unit 2 scheduled for April 30, 2020, and the shutdown of Unit 3 scheduled for April 30, 2021, resulting in the loss of over 2,000 MW in NYISO Zone H, and (c) the recent proposed rulemaking by the NYSDEC entitled "Ozone Season Oxides of Nitrogen (NO_x) Emission Limits for Simple Cycle and Regenerative Combustion Turbines," which if implemented, is expected to lead to the shutdown of New York peaking generating units installed before 1986, which total about 3,400 MW.

While it is not anticipated that the Project can be licensed, constructed, and in-service before Indian Point Units 2 and 3 come offline, Danskammer has focused on achieving a COD as reasonably expeditious as possible. As of the date of the Application, Danskammer anticipates commencing construction of the Project in January 2021, after the necessary construction permits and approvals have been granted. Currently, Danskammer is estimating construction to last between 30 and 33 months, with construction activities expected to end in 4th quarter of 2023, based on mobilization for construction in 1st quarter 2021. It is also expected that a 2- to 3-month outage would be required to transition from operation of the existing Danskammer Generating Station (where operations will cease) to the newly constructed Project. Danskammer wants to ensure that either the existing Danskammer Generating Station or the proposed Project would be in-service and available during the summer of 2023. To this end, Danskammer intends for commercial operation to be achieved in the fourth quarter of 2023, again subject to the timing for the start of construction following the receipt of all approvals and completion of financing.

(5) Alternative Points of Electrical Interconnection and Voltage

While Danskammer did consider interconnecting to the 345-kV transmission system, it ultimately decided not to pursue that connection because it was expected to require new off-site electrical infrastructure, which would result in additional potential environmental impacts, have an unpredictable schedule due to studies, permitting, engineering, and construction of new infrastructure, and higher costs. Rather, Danskammer proposes to interconnect to the Central Hudson 115-kV transmission system through the existing substation on Site where the existing Danskammer Generating Station interconnects. This interconnection does not require new off-site electrical infrastructure. However, as set forth in Exhibit 34 of this Application, further studies are being performed as part of the interconnection process, which could result in other system upgrades. As described in more detail in Exhibit 5 to the Application, Danskammer has submitted and interconnection application with the NYISO, proceeded through the large generator interconnection process, and is currently part of the 2019 Class Year review process for its facilities study.

9(d) Why the Project Location Best Promotes Public Health and Welfare

For the State to meet its ambitious greenhouse gas reduction goals, the State's existing fleet of generators must become more efficient. More efficient facilities create fewer greenhouse gas emissions per megawatt-hour (MW-hr) produced. This Project, in this location, is specifically designed to drive this efficiency. The Project will be one of the most efficient facilities of its kind in the State of New York and will be significantly more efficient than the existing Danskammer Generating Station. The Project's heat rate will be among the lowest for air cooled combined-cycle combustion turbine projects in the United States, which means less fuel is combusted to produce a given amount of electric power output. To further the goal of modernizing the State's energy infrastructure, the more efficient proposed Project will displace higher-emitting and higher-cost generation. As discussed more fully above, the Project will also eliminate the use of a once-through cooling system at the existing Danskammer Generating Station and the associated water withdrawal from the Hudson River, as well as eliminate the discharge of heated water to the Hudson River.

The Project was designed to minimize environmental impacts by co-locating on an existing industrial parcel, already utilized for the proposed use, and by decommissioning the existing Danskammer Generating Station (e.g., retirement of the water intake and decommissioning of the steam boilers) that would reduce overall environmental effects at the Project Site. The Project is proposed to be sited on property that is surrounded by existing industrial uses rather than a greenfield site that may be in close proximity to residential, commercial, or agricultural uses.

The Project was also designed to avoid the need for new off-site infrastructure and to use existing infrastructure. The repowered Project facility will interconnect with Central Hudson's 115-kV transmission system through the existing substation on Site. As such, no additional off-site electrical transmission system right-of-way or construction will be required for the interconnection to Central Hudson's transmission system. The Project will also use the existing natural gas transmission system for the delivery of natural gas. Once operational, the proposed Project will help satisfy regional energy needs and will reduce the amount of electricity that New York State imports.

The Project will apply to the Orange County Industrial Development Agency (”OCIDA”) for a Payment in Lieu of Tax agreement (the “PILOT”) in early 2020. If Danskammer successfully negotiates payment structures with, and receives the required approvals from OCIDA to enter into the PILOT, the PILOT will establish a defined set of payments for the property parcels covered under the PILOT. The affected tax jurisdictions include: Orange County, the Town of Newburgh, and the Marlboro Central School District. PILOT terms are commonly 15 years, but can approach 20 years if approved. The affected tax jurisdictions will use the payments from the PILOT in the same fashion as they would use property tax proceeds, including funding for administration, infrastructure, government services, law enforcement and other budgetary funding needs. In addition, Danskammer will continue to pay special district charges for fire and water, whereas each district will use payments received to fund their annual budgetary requirements. At its peak, the construction of the Project will produce approximately 350 to 450 construction jobs for approximately 2 to 3 years. Further, the maintenance of approximately 23 existing, high-skilled permanent jobs will provide a meaningful benefit to local communities. These and other socioeconomic impacts are more fully described in Exhibit 27.

Based on the above, and the additional information on public health and safety (Exhibit 15), air emissions (Exhibit 17), noise (Exhibit 19), and visual resources (Exhibit 24) described elsewhere in the Application, Danskammer determined that the primary proposed Project Site is best suited to promote public health and welfare.

9(e) Why the Project Design, Technology, Scale, and Timing are Best Suited for Public Health and Welfare

The Project was designed to be built on existing industrial parcels and to be co-located with existing industrial infrastructure. To maximize the public benefit of a power generation facility on a compact site, Danskammer selected an efficient, combined-cycle facility that will produce a high level of stable output, providing a baseload to the electric grid and providing consistent, reliable service. The scale of the Project balances electric demand, changes in generation facility infrastructure, and the proximity to existing power lines and other infrastructure to minimize the need for new ancillary structures. While other potential power sources were available, they were either not a power generation source or not appropriate for the

Danskammer Property and, thus, were not considered feasible, considering Danskammer's objectives and capabilities as a private facility applicant.

Renewable energy sources, including wind and solar generation, are intermittent and cannot be dispatched to meet changing system demand. Such projects, while important components of a diverse energy portfolio, are not a feasible alternative to providing reliable base load generation. See Section 9(g) of this Exhibit 9 for a full discussion on wind and solar generation. Further, sufficient infrastructure would not fit on the Project Site in order to make wind or solar development commercially viable as an alternative. It is worth noting that a wind turbine would likely be much taller (more than 200 feet) than the proposed HRSG exhaust stack, which is proposed to be approximately 200 feet above grade, and would have a greater visual impact. Solar development would require land to be cleared for photovoltaic (PV) panels and would generate far less MW-hrs than the proposed Project, providing much less nameplate capacity. Battery storage was also considered, but this would not serve as a power generation source and therefore, did not meet Danskammer's objectives as a private facility applicant.

The proposed scale of the Project is best suited to promote public health and welfare in several ways. The proposed Project will be located entirely within the Danskammer Property. Specifically, this industrially zoned property has hosted the Danskammer Generating Station since the 1950s and the proposed Project will continue the current use of the Site and will use the available existing infrastructure. The anticipated output, in MW, of the proposed Project, under baseload conditions, will be approximately the same as the Capacity Resource Interconnection Service (CRIS) rights of the existing Danskammer Generating Station, and the proposed Project will have the ability, through supplemental firing, to provide additional output to potentially ramp up to meet market demands or support variations in generation from renewable resources. The scale of the Project is limited due to various factors including mechanical limitations of the plant equipment, the electrical grid and connection limitations, and auxiliary loads supporting various plant equipment.

By replacing older, less efficient steam-generating units with modern generating technology, the Project will result in an increase in energy efficient resource deployment. The Project's proposed use of the MHPS 501JAC combined-cycle technology, which is designed for higher ramp rates and faster start-ups compared to the existing Danskammer units, will allow the Project to respond to rapidly increasing system demands. This will give NYISO greater flexibility in its selection of generation resources from within its generation portfolio to meet system demands. The proposed Project was developed in order to provide an option for the market to meet demand that is more preferable than some of the older generating facilities in the State (or outside of the State, with imports), thus reducing the overall use of low efficiency power-generating plants. The Project's combined-cycle facility will contribute to the baseload power plants that provide the backbone for the electric supply system in New York. Regarding timing, the Project will serve as a bridge facility now, assisting the State in its planned transition to a predominantly renewable-based energy economy, and provide reliable baseload generating capacity during that period of time that it takes for renewable and battery energy storage projects to be developed, permitted and constructed, and become more price competitive.

9(f) Description and Evaluation of No Action Alternative

The no action alternative assumes that the proposed Project would not be constructed at the Project Site. The no action alternative does not meet the objective of Danskammer, which is to provide reliable electric generation to the NYISO grid in a more cost efficient and environmentally conscious manner than the existing Danskammer Generating Station.

As an existing electric-generating facility, the Danskammer Generating Station provides electric power into the NYISO grid. The no action alternative would mean that the Danskammer Generating Station would continue to operate into the future at NYISO's discretion and in accordance with the existing facility's existing environmental permits/approvals. From an environmental perspective, under the no action alternative, if the Danskammer Generating Station was not repowered, the existing conditions of the Project Site and Danskammer Property would remain the same. Further, under the no action alternative, the socioeconomic benefits of the proposed Project during construction and operation would not be realized. The construction phase labor and material supply economic benefits would also not occur. The proposed Project would also not replace the existing facility with a more modern and efficient facility. Without the proposed Project, the existing Danskammer Generating Station would continue to operate, which includes continued withdrawal of water from the Hudson River and the use of the water intake channel. Withdrawal of water through the existing water intake would cease as a result of the proposed Project, reducing potential impacts to aquatic life.

The existing Danskammer Generating Station also has higher emissions on a per MW basis than the proposed Project. The benefits to regional air quality would also be lost under the no action alternative with the continued reliance on older generating facilities that operate with lower generation efficiency and typically greater environmental impacts. While the existing facility currently has a very low capacity factor of less than 5 percent, upon closure of the Indian Point units in 2020 and 2021, Danskammer forecasts that the capacity factor of the existing facility could increase significantly after those units are closed, while almost certainly operating more on oil than it does currently.

The benefits of the proposed Project have been detailed throughout the Application and are many, including but not limited to vastly improved generation efficiency and emission rates per MW-hr, local benefits from hundreds of construction jobs, and the elimination of the once-through cooling water system. In Exhibit 2, Danskammer summarized the relevant and material facts supporting each of the five determinations the Board must make pursuant to PSL Section 168(3) prior to issuance of the Certificate of Environmental Compatibility and Public Need. These include: 1) the Project is a beneficial addition or substitution for the electric generation capacity of New York State, 2) the construction and operation of the Project will serve the public interest, 3) the adverse environmental effects of the construction and operation of the Project will be minimized or avoided to the maximum extent practicable, 4) Danskammer will avoid, offset or minimize the impacts caused by the Project upon the local community, and 5) the Project is designed to operate in compliance with applicable state and local laws and regulations. All of these benefits would not be realized with the no-action alternative.

9(g) Identification and Description of Alternative Energy Supplies

(i) Solar Facilities

Danskammer's objective as a private facility applicant is to develop a combined-cycle gas turbine energy facility in New York State. Given that objective and the capabilities of Danskammer, alternative energy supply sources are not feasible alternatives. Danskammer considered wind and solar energy as alternative energy supply source alternatives, as well as ancillary battery storage facilities. Development of a portion of the existing Site with solar panel arrays is an alternative option, albeit not a viable, reasonable, feasible alternative. Using the assumption of 1 MW of electricity being generated for every 5+ acres of land for solar (NREL 2013), Danskammer would need over 2,700 acres of land to be developed with solar panels to result in 536 MW of electric capacity, the approximate average net capacity of the proposed combined-cycle power facility. The Danskammer Energy Center will be capable of operating at a 96- to 98-percent capacity factor and could produce more than 4.5 million MW-hrs annually as needed, while the same-sized solar plant, even if 2,700 acres were available for such a project, would be expected to produce less than 0.66 million MWhs annually. A solar facility capable of producing the same amount of electric energy (MWhs) each year as the Project would require between 16,000 and 19,000 acres of reasonably flat, cleared land based on the solar insolation values for New York and specific data from New York Stewart International Airport.

Given its constraints, as discussed above in Section 9(g) of this Exhibit 9, less than 10 MW of solar capacity could be constructed on the Danskammer Property, including areas associated with the existing landfill. It is expected that this nameplate 10 MW would produce 0.0105 million MWhs annually. The terrain on the Danskammer Property will have a number of challenges given the elevation changes and the significant slope of the Site to the southwest. This property would also require tree clearing and using the landfill after it is closed (which raises other potential environmental concerns that would need to be addressed). Furthermore, the projected annual capacity factor (annual MW-hr) for solar photovoltaics in this area is approximately 12 percent, although NYISO has used 14 percent in some of its estimates (NYISO, 2019), compared to a 96- to 98-percent capacity factor for a combined-cycle generating facility.

Thus, the limited amount of buildable land available within the Danskammer Property as well as the intermittent nature of a solar facility makes the development and construction of a solar facility not a feasible or reasonable alternative to the Project as a combined-cycle power facility, given Danskammer's objective of providing reliable, baseline capacity of at least 536 MW of electric generation capacity to the NYISO grid.

(ii) Wind Facilities

Similarly, development of a portion of the Danskammer Property with wind power and/or battery storage are also alternative options, but not viable, reasonable, feasible alternatives given Danskammer's objectives and capabilities. Wind farms require large amounts of space between turbines. Some of that space is to minimize turbulence, but some is to follow ridge lines or avoid other obstacles. Much of this area is used for other purposes, such as agricultural farms. National Renewable Energy Laboratory ("NREL") researchers have surveyed the total land use required for 127 large-scale wind power projects (Gaughan, 2019). NREL roughly calculated that one square kilometer (or about 247 acres) would be needed for 4 MW of wind generation. Based on these calculations, a 2-MW wind turbine would require a total area of about half a square kilometer (or about 124 acres). In order to generate the 536 net MW of electric power projected to be produced by the Project, the total land area required for an equivalent wind farm would be over 33,000 acres, or more than 51 square miles. Therefore, the 180 acres of Danskammer Property (much of which is not buildable) is vastly insufficient in size to accommodate a wind power array that could generate an equivalent 536 MW of power (putting aside capacity factor). Considering a wind facility typically has a capacity factor of 25 to 40 percent, an even larger wind farm of approximately 2.5 to 4 times the optimal net capacity of the Project (1,340 to 2,144 MWs), and requiring 83,080 to almost 133,000 acres of land, would be required to be the equivalent to the electric energy of the proposed Project.

As such, a wind generating facility was not considered a reasonable or feasible alternative to the proposed Project, given Danskammer's objective of providing reliable, baseline capacity of at least 536 MW of electric generation capacity to the NYISO grid.

(iii) Battery Storage Facilities

Battery storage, by itself, is not a renewable energy generation source. As the Siting Board itself has recognized:

> Although electrical generation and storage facilities may both be capable of providing capacity, energy and/or ancillary services, the terms "generation" and "storage," as they are commonly used and within the electric power industry are distinct concepts. Generation involves the creation or production of something. Storage involves the deposition or accumulation of an existing product for future use. Moreover, to the extent electrical energy storage involves the reconversion of another form of energy back to electricity, it is still distinguished from electrical generation by the fact that the energy stored was previously electric energy generated elsewhere.[1]

Typically, a battery facility is a means to store energy generated by either renewable energy sources (e.g., typically PV or wind power) or combustion generation facilities during off-peak periods, to be used during times of peak demand. As such, battery storage alone does not replace or offset a generating facility, except in the limited time period, usually 2 to 4 hours, that it sends its energy back to the grid and sets to be charged again from an actual generation source or generation source(s) connected to the grid.

Also, a battery storage system is an electrical storage medium that requires charging prior to discharging, and the lifetime of the battery storage system does not compare to the lifetime of a

[1] Case 13-F-0287, *Petition of AES Energy Storage, LLC*, Declaratory Ruling on Applicability of Article 10 of the PSL to Battery-Based Energy Storage Facilities at 7 (issued and effective Jan. 24, 2014).

combined cycle generating facility. The primary battery storage design will provide output for 4 hours or less before having to be recharged before discharging again. Major battery storage systems have a significant degradation curve, requiring battery replacement or supplementation throughout its lifetime. Most batteries, depending on usage, will need to be replaced within 7 to 10 years. Additionally, the more frequently the battery is charged and discharged, the faster the battery storage system degrades, potentially reducing the already short lifetime of the system.

The only viable option of incorporating a battery storage system and considering it an alternative is to couple the battery storage system with a solar or wind alternative to provide voltage regulation and excess renewable generation storage. Those alternatives have already been identified as infeasible on the Danskammer Property due to space constraints. As such, battery storage, either as a stand-alone facility, or ancillary to electric generating facilities, was not considered a reasonable or feasible alternative to the proposed Project, given Danskammer's objective of providing reliable, baseline capacity of at least 536 MW of electric generation capacity to the NYISO grid. It is also worth noting that the existing facility is not affected by the NYSDEC proposed rulemaking (6 NYCRR Part 227-3 proposed on February 27, 2019) limiting nitrogen oxide emissions from simple cycle and regenerative peaking combustion turbines with a nameplate capacity of 15 MW or greater during the ozone season because the units at the existing Danskammer Generating Station are not simple cycle or regenerative peaking combustion turbines.

9(h) Discussion of Energy Supply Source Alternatives Determined to be Reasonable and Feasible

The energy supply sources alternatives identified and discussed in Section 9(g) (i.e., wind, solar, and battery storage) were determined to be unreasonable and infeasible. Therefore, such alternative energy supply sources were not evaluated further in this Exhibit 9 of the Application.

9(i) Why the Project is Best Suited to Promote Public Health and Welfare

Danskammer's objective in developing the Project is to provide reliable, baseline electric generation capacity of at least 536 MW to the NYISO grid using the existing infrastructure and fuel sources available at the Project Site, which will primarily entail the use of natural gas. Natural gas is the preferred fuel source for the Project because it is the cleanest fossil fuel available today. Non-combustion alternative energy sources are not practical for the Project because of limited land availability and the need to produce large amounts of power that can respond to market conditions on a continuous basis.

Alternative methods of natural gas power generation, other than the proposed combined-cycle generation method, include conventional boilers or simple cycle peaking turbines. Conventional boilers are less efficient and have higher emissions per unit of electric energy produced than turbine-based generation either for baseload or peaking power production. Simple-cycle turbines are not competitive with combined-cycle plants for purposes of baseload or intermediate load generation (which is the anticipated by the Project) but can be part of a competitive portfolio because of their ability to start faster than a combined-cycle project. As discussed more fully in Section (c)(2) of this Exhibit 9, from a feasibility perspective, combined-cycle generation is preferable to simple-cycle generation for reasons of economic competitiveness.

There are various siting constraints on the Danskammer Property that dictated the size and general arrangement of a combined-cycle combustion turbine power generation facility at the Project Site. One of the objectives of Danskammer in developing the Project is to balance the need for additional, reliable baseload electric generation with the need to avoid or minimize impacts to the environment and promote and protect the public health and welfare. As discussed in Section (c) of this Exhibit 9, Danskammer made its best efforts to balance its objectives for the Project with the goals of the State of New York and the local community in determining the preferred alternatives for the Project location, general arrangement, design, technology (types and providers), scale, and magnitude. As set forth in the Application, Danskammer has studied the potential impacts of the proposed Project on the environment (air quality, noise, visual) and public health and safety. Danskammer also spent time working with stakeholders in the local communities to maximize the positive benefits of the Project while minimizing negative impacts.

Section 9(e) discusses how this Project has been designed to support the public health and welfare. Section 9(c)(2) documents the alternative technologies considered, specifically an evaluation of simple-cycle and combined-cycle combustion turbine technology. As discussed in Section 9(g), there are no other alternative energy sources that would, on Danskammer Property, be able to provide a comparable energy output. Solar or wind technology would require a much larger area of buildable property and battery storage, by itself, is not equivalent to power generation. Because it identified no other reasonable and feasible alternatives and the proposed Project has been designed to maximize the public benefits and minimize its impacts, this Project is the best suited to promote public health and welfare, as discussed in Section 9(e).

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