LG&E KU
PPL companies

New Generation Options Feasibility Study

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Table of Contents

APPENDICES

COMBINED CYCLE FEASIBILITY STUDY

1.0 EXECUTIVE SUMMARY

LG&E and KU Services Company (LG&E|KU) is conducting an evaluation of advanced class Natural Gas Combined Cycle (NGCC) generation options to be applied to serve as an intermediate to base load dispatched plant. The evaluation considers siting 1x1 combined cycle unit(s) at the existing Mill Creek and E.W. Brown generating stations. This feasibility study includes potential development of up to two 1x1 power blocks across the LG&E|KU system located at one or more of the two existing generation sites. The power block ratings considered are nominally aligned with existing coal-fired generation unit(s) with upcoming service retirements and consist of 620 mega-watt (MW) class units. The study also considers two unit F/G class simple cycle gas turbine (SCGT) installations for peaking service.

The evaluated configuration/technology and arrangement considered for implementation include:

620 MW Combined Cycle Power Block

- 1x1 General Electric (GE) 7HA.03
- 1x1 Mitsubishi Power America (MPA) 501JAC
- 1x1 Siemens 9000HL

500 MW Simple Cycle Power Block

- 2x0 GE 7FA.05
- 2x0 MPA 501GAC
- 2x0 Siemens 5000F

Site Configurations Evaluated

- Mill Creek Generating Station: Single Unit NGCC, Two Unit NGCC and Two Unit SCGT
- E.W. Brown Generating Station: Single Unit NGCC, Two Unit NGCC and Two Unit SCGT (the E.W. Brown base case considered is located on the Unit 1-2 footprint with an alternate E.W. Brown Webb Farm site)

1.1 COMBINED CYCLE CONFIGUARTIONS

The combined cycle plant design includes duct firing to the level necessary to maintain the annual average net plant output capacity on a summer day to that of the average day design condition. Each combustion turbine technology produces a specific output; therefore, a uniform specific net plant output MW capacity is not provided.

An intermediate operational dispatch schedule of 6000 to 8000 annual hours with shoulder season cycling, has been assumed for all the options considered. The plant will be configured to support cycling operation. The dispatch model for the emission and economic analysis is based on up to 5 cold, 45 warm and 100 hot starts annually.

All NGCC options include design features to support ramp rates equal to or in excess of 85 MW/minute. Rapid ramp rates are necessary to support the integration of intermittent generation sources onto the LGE|KU electric transmission system.

This feasibility study describes the intended plant configuration, integration, power block arrangement, and design criteria proposed for the NGCC facility proposed to be located at one or more of the existing Mill Creek and E.W. Brown Generating Stations. The study is based on a single defined common set of ambient conditions and site elevation representative of either of the two project sites which results in common performance used for all sites.

The current North American advanced class combined cycle market has included a number of single shaft configurations installed. The single-shaft design is employed to minimize the footprint of the power block(s) to more efficiently use the land available, while also reducing the amount of major equipment purchases (two generator step-up transformers (GSUs) for two single-shaft 1x1 plants as opposed to four). The single-shaft arrangements are particularly advantageous for operational flexibility in comparison to an equivalent 2x1 or 3x1 multi-shaft configuration with simplified starting and steam bypass systems associated with multiple heat recovery steam generators and a single steam turbine. Due to space constraints associated with each of the brownfield sites under consideration (Mill Creek and E.W. Brown) as well as operational and construction advantages of a unitized plant configuration the power blocks evaluated for this generation addition are single-shaft designs. Each of the three major Original Equipment Manufacturers (OEMs) has the ability to offer single-shaft configurations.

Site specific capital costs are provided for the Mill Creek and E.W. Brown sites to differentiate site variations and assist in future siting evaluations. The Mill Creek site selected is within the existing coal pile area and is available to support construction beginning in 2024 supporting the 2027 Commercial Operation Date (COD). The E. W. Brown site is located adjacent to the Unit 1-2 footprint and is planned to be available for construction to commence in 2025 resulting in a 2028 COD. The E. W. Brown Unit 1-2 site construction start includes the additional timeline required to complete the decommissioning/demolition of the Unit 1 and Unit 2 facilities in advance of NGCC construction. The E. W. Brown assessment includes identification of an optional site (Webb Farm) located north of the existing combustion turbine area for further consideration to mitigate unit retirement schedule coordination. The alternate E. W. Brown site has been evaluated and determined to result in minimal differential cost associated with adjustments in site civil and land purchase. The E. W. Brown Webb Farm site is considered to be available to support a 2024 construction start with 2027 COD pending successful land acquisition.

Also, project schedule, plant performance, operational impacts, lifecycle economics, air emissions, and water consumption estimates have been provided for comparison between NGCC arrangements and serve a foundation for future project development efforts.

The existing station electrical transmission system will be extended to serve the additional generation with the following points of interconnection:

- Mill Creek: 345 kV at existing Mill Creek Substation
- E. W. Brown (Webb Farm Site): 345 kV at existing Brown North Substation
- E. W. Brown (Unit 1-2 Site): 138 kV at existing Brown North Substation

The site development for each existing station includes relocation of existing overhead lines as required to facilitate construction.

Raw water for each facility will be provided from the adjacent surface water resource utilizing existing plant facilities to the extent available to support long term operation of the NGCC unit(s). The Mill Creek site NGCC unit addition(s) will be served from the existing Mill Creek service water system. The retirement of Mill Creek Unit 1 and Unit 2 will result in freed capacity to serve the NGCC units via the existing Ohio River intake system, and the planned longer term operation of Mill Creek Unit 3 and Unit 4 will ensure the current system utilization will align with site needs for a lengthy timeframe.

The E. W. Brown site will utilize the Unit 1 Herrington Lake intake structure retrofitted with replacement traveling screens. The proposed modifications to the intake structure will meet the requirements set forth by Phase II of Section 316(b) for existing facilities and also Phase I requirements for new facilities.

The NGCC facility’s project schedule from full notice to proceed (FNTP) to commercial operation date has been estimated to be 37 months for a single 1x1 unit and 41 months for the two 1x1 unit configurations with a four-month staggered unit COD. The expected construction durations have been extended to account for current market conditions.

Natural gas will be supplied to the NGCC facility via extension and/or upgrade of the interstate pipeline system available near each site. The Owners cost includes budget to install the off-site gas pipeline facilities to meet the gas demand associated with the proposed facility. The feasibility study is based on natural gas pipeline minimum delivery pressure at the site boundary to be nominally 500 psig. The planned gas pressure is not adequate to meet the combustion turbine OEM requirements and on-site gas compression is included in the conceptual design. The gas compression system design is based on furnishing one compressor provided for each installed advanced class unit. The E. W. Brown site designs also include an additional gas compressor to serve the existing two Alstom GT-24 combustion turbines which require 525 psig gas pressure. The additional gas compressor is sized to provide a 3 x 50% configuration for reliability.

Figure 1.1-1 provides a graphical summary of expected “new and clean” 1x1 unit net output for the advanced class NGCC technologies across all ambient conditions.

Figure 1.1-1. 1x1 NGCC Unit Net Output Across Ambient Design Conditions (New and Clean)

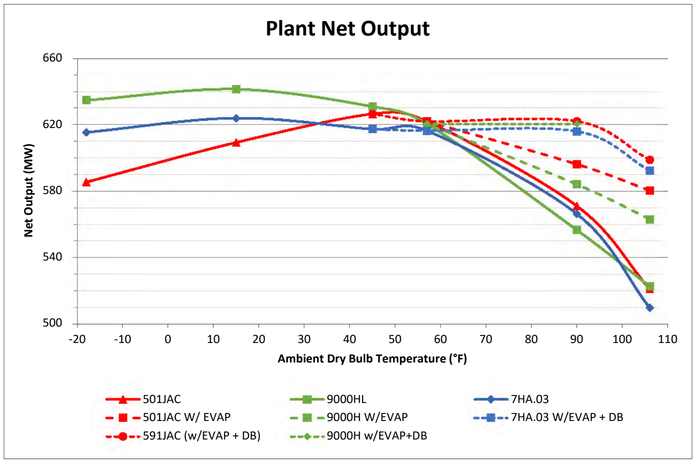
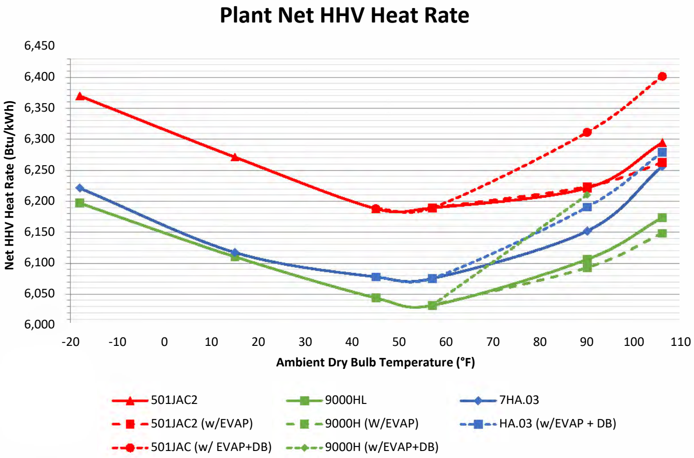


Figure 1.1-2 provides a graphical summary of expected "new and clean" 1x1 unit heat rate for the advanced class NGCC technologies across all ambient conditions.

Figure 1.1-2. 1x1 NGCC Unit Net Heat Rate Across Ambient Design Conditions (New and Clean)



A summary of the estimated plant Engineering, Procurement, and Construction (EPC) costs and Owner's costs are provided in Table 1.1-3 and Table 1.1-4 for each NGCC arrangement considered.

Table 1.1-3. Total Single Unit NGCC Project Cost

LG&E|KU 2027 NGCC
NGCC Single Unit Cost Summary

		Mill Creek	EW Brown Webb Farm Site	EW Brown Unit 1-2 Site	EW Brown Webb Farm Site [1]
Commercial Operation Date		1-Apr-27	1-Apr-27	1-Apr-28	1-Apr-28
GE 7HA.03	Net Capacity (MW)	616.3	616.3	616.3	616.3
	EPC Cost ($)	$531,767,853	$552,166,560	$577,871,646	$569,462,999
	EPC Cost ($/kw)	$863	$896	$938	$924
	Total Cost ($)	$654,984,633	$671,912,100	$693,053,982	$692,874,050
	Total Cost ($/kW)	$1,063	$1,090	$1,124	$1,124
Siemens 9000HL	Net Capacity (MW)	620.5	620.5	620.5	620.5
	EPC Cost ($)	$536,032,138	$556,588,365	$582,424,765	$574,016,119
	EPC Cost ($/kw)	$864	$897	$939	$925
	Total Cost ($)	$662,425,346	$679,526,086	$700,812,414	$700,714,981
	Total Cost ($/kW)	$1,068	$1,095	$1,129	$1,129
Mitsubishi 501JAC	Net Capacity (MW)	622.0	622.0	622.0	622.0
	EPC Cost ($)	$548,780,843	$571,575,647	$597,918,123	$589,509,476
	EPC Cost ($/kw)	$882	$919	$961	$948
	Total Cost ($)	$673,973,922	$693,537,096	$715,380,107	$715,208,425
	Total Cost ($/kW)	$1,084	$1,115	$1,150	$1,150

Notes: 1. E.W. Brown Webb Farm cost provided at Unit 1-2 COD for site selection comparison purposes only.

Table 1.1-4. Total Two Unit NGCC Project Cost

LG&E|KU 2027 NGCC
NGCC Two Unit Cost Summary

		Mill Creek	EW Brown Webb Farm Site	EW Brown Unit 1-2 Site	EW Brown Webb Farm Site [1]
Commercial Operation Date		1-Apr-27	1-Apr-27	1-Apr-28	1-Apr-28
GE 7HA.03	Net Capacity (MW)	1232.6	1232.6	1232.6	1232.6
	EPC Cost ($)	$981,767,248	$1,015,282,891	$1,043,597,671	$1,047,137,916
	EPC Cost ($/kw)	$797	$824	$847	$850
	Total Cost ($)	$1,165,281,242	$1,256,805,580	$1,282,960,713	$1,296,045,939
	Total Cost ($/kW)	$945	$1,020	$1,041	$1,051
Siemens 9000HL	Net Capacity (MW)	1241.0	1241.0	1241.0	1241.0
	EPC Cost ($)	$990,602,760	$1,024,435,691	$1,052,741,815	$1,056,561,652
	EPC Cost ($/kw)	$798	$825	$848	$851
	Total Cost ($)	$1,180,500,306	$1,272,318,659	$1,298,464,271	$1,312,020,398
	Total Cost ($/kW)	$951	$1,025	$1,046	$1,057
Mitsubishi 501JAC	Net Capacity (MW)	1244.0	1244.0	1244.0	1244.0
	EPC Cost ($)	$1,025,136,085	$1,054,607,525	$1,083,986,462	$1,087,754,609
	EPC Cost ($/kw)	$824	$848	$871	$874
	Total Cost ($)	$1,213,536,963	$1,300,117,677	$1,327,443,383	$1,340,780,951
	Total Cost ($/kW)	$976	$1,045	$1,067	$1,078

Notes: 1. E.W. Brown Webb Farm cost provided at Unit 1-2 COD for site selection comparison purposes only.

Incorporating the capital, operating and maintenance costs, the total cost of generation values for each NGCC option have been presented in Table 1.1-5. Costs are presented on both a first year basis and a levelized basis for an intermediate dispatch plant operating 8,000 hours annually.

Table 1.1-5. Electrical Cost of Generation Summary – 1x1 NGCC Power Block

NGCC Power Block	First Year Cost of Generation [1]						Levelized COG
	Capital Recovery ($/MWH)	Fixed O&M ($/MWH)	Variable O&M ($/MWH)	Consumables ($/MWH)	Fuel Costs ($/MWH)	Total COG ($/MWH)	Total Levelized COG ($/MWh)
Mill Creek Generating Station							
1x1 GE 7HA.03	$9.42	$1.06	$1.13	$0.12	$20.52	$32.25	$39.22
1x1 MPSA 501JAC	$9.60	$0.74	$1.03	$0.13	$20.90	$32.39	$39.55
1x1 SIEMENS 9000HL	$9.46	$0.72	$0.94	$0.12	$20.37	$31.61	$38.57
EW Brown Generating Station Unit 1-2 Site							
1x1 GE 7HA.03	$9.95	$1.17	$1.16	$0.12	$21.02	$33.41	$40.45
1x1 MPSA 501JAC	$10.17	$0.84	$1.05	$0.13	$21.41	$33.60	$40.82
1x1 SIEMENS 9000HL	$9.99	$0.82	$0.96	$0.12	$20.87	$32.76	$39.78
EW Brown Generating Station Webb Farm Site							
1x1 GE 7HA.03	$9.65	$1.13	1,13	$0.12	$20.52	$32.56	$39.56
1x1 MPSA 501JAC	$9.87	$0.81	$1.03	$0.12	$20.90	$32.74	$39.92
1x1 SIEMENS 9000HL	$9.70	$0.80	$0.94	$0.12	$20.37	$31.93	$38.91

Notes: 1. First Year Cost of Generation based on April 2027 COD for Mill Creek and E.W. Brown Webb Farm Site and April 2028 COD for E.W. Brown Unit 1-2 Site

As shown in the tables above, the production cost is comparable for each option evaluated with the two 1x1 unit power block developments resulting in the lowest cost of generation. The Siemens 9000HL plant configurations provide the lowest cost of generation for each site alternatives considered. The differential cost between OEM technology and sites is not significant from a cost of generation perspective and equipment/site optimization could likely be driven by other factors.

1.2 SIMPLE CYCLE GAS TURBINE CONFIGUARTIONS

The simple cycle gas turbine (SCGT) plant design consists of two F/G-class combustion turbines provided with dry low NOx combustors and does not include hot SCR emission control devices. Each combustion turbine technology produces a specific output; therefore, a uniform specific net plant output MW capacity is not provided.

A peaking operational dispatch schedule of 1,000 annual hours has been assumed for all the options considered. The plant will be configured to support cycling operation. The dispatch model for the emission and economic analysis is based on up to 125 starts annually.

This feasibility study describes the intended plant configuration, integration, power block arrangement, and design criteria proposed for the SCGT facility proposed to be located at one or more of the existing Mill Creek and E. W. Brown Generating Stations. The study is based on a single defined common set of ambient conditions and site elevation representative of either of the two project sites which results in common performance used for all sites.

Site specific capital costs are provided for the Mill Creek and E. W. Brown sites to differentiate site variations and assist in future siting evaluations. The Mill Creek site selected is within the existing coal pile area and is available to support construction beginning in 2024 supporting the 2026 COD. The E. W. Brown site is located adjacent to the Unit 1-2 footprint and is planned to be available for construction to commence in 2025 resulting in a 2027 COD. The E. W. Brown Unit 1-2 site construction start includes the additional timeline required to complete the decommissioning/demolition of the Unit 1 and Unit 2 facilities in advance of SCGT construction. The E. W. Brown assessment includes identification of an optional site (Webb Farm) located north of the existing combustion turbine area for further consideration to mitigate unit retirement schedule coordination. The alternate E. W. Brown site has been evaluated and determined to result in minimal differential cost associated with adjustments in site civil and land purchase. The E. W. Brown Webb Farm site is considered to be available to support a 2024 construction start with 2026 COD pending successful land acquisition.

Also, project schedule, plant performance, operational impacts, lifecycle economics, and air emissions have been provided for comparison between SCGT arrangements and serve a foundation for future project development efforts.

The existing station electrical transmission system will be extended to serve the additional generation with the following points of interconnection:

- Mill Creek: 345 kV at existing Mill Creek Substation
- E. W. Brown (Webb Farm Site): 345 kV at existing Brown North Substation
- E. W. Brown (Unit 1-2 Site): 138 kV at existing Brown North Substation

The SCGT electrical interconnection will be implemented through a power plant located collector bus (138 kV or 345 kV) which will consolidate the output into a single circuit routed to the point of interconnection (POI).

The site development for each existing station includes relocation of existing overhead lines as required to facilitate construction.

The SCGT facility's project schedule from FNTP to commercial operation date has been estimated to be 24 months.

Natural gas will be supplied to the SCGT facility via extension and/or upgrade of the interstate pipeline system available near each site. The Owners cost includes budget to install the off-site gas pipeline facilities to meet the gas demand associated with the proposed facility. The feasibility study is based on natural gas pipeline minimum delivery pressure at the site boundary to be nominally 500 psig. The planned gas pressure is not adequate to meet the combustion turbine OEM requirements and on-site gas compression is included in the conceptual design. The gas compression system design is based on furnishing one compressor provided for each Installed power block (two simple cycle F/G class units). The E. W. Brown site designs also include an additional gas compressor to serve the existing two Alstom GT-24 combustion turbines which require 525 psig gas pressure. The additional gas compressor is sized to provide a 3 x 50% configuration for reliability.

Figure 1.2-1 provides a graphical summary of expected "new and clean" 2x0 unit net output for the SCGT technologies across all ambient conditions.

Figure 1.2-1. 2x0 SCGT Net Output Across Ambient Design Conditions (New and Clean)

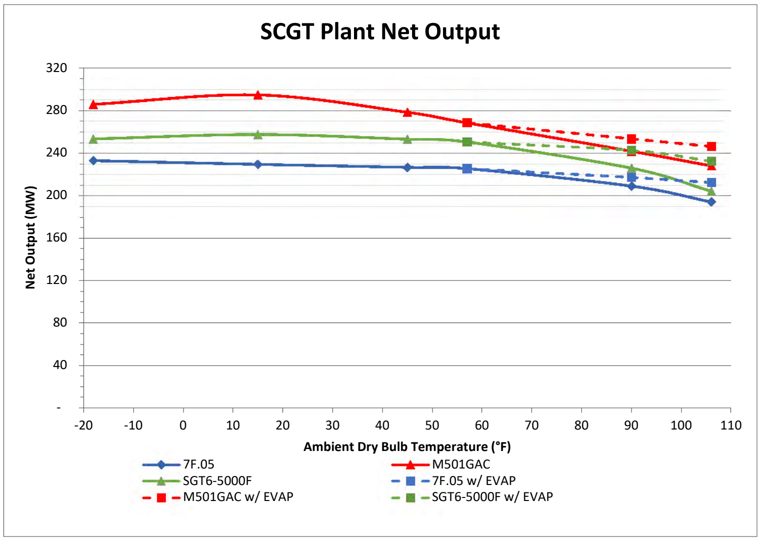
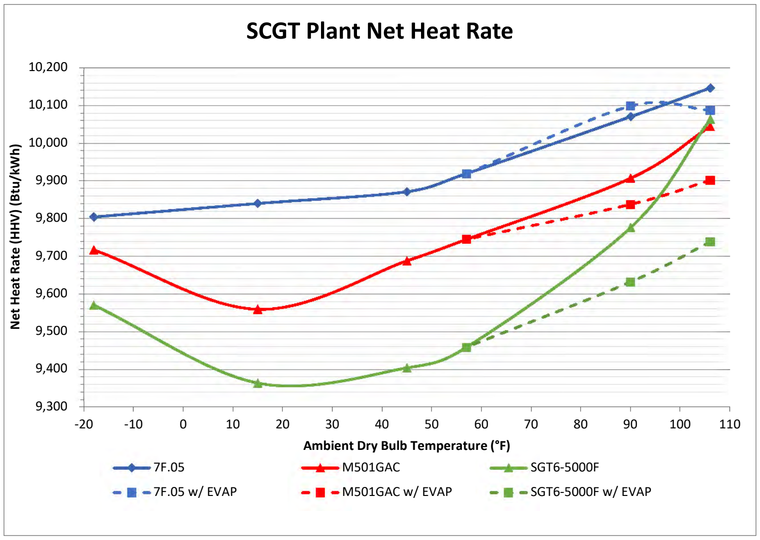


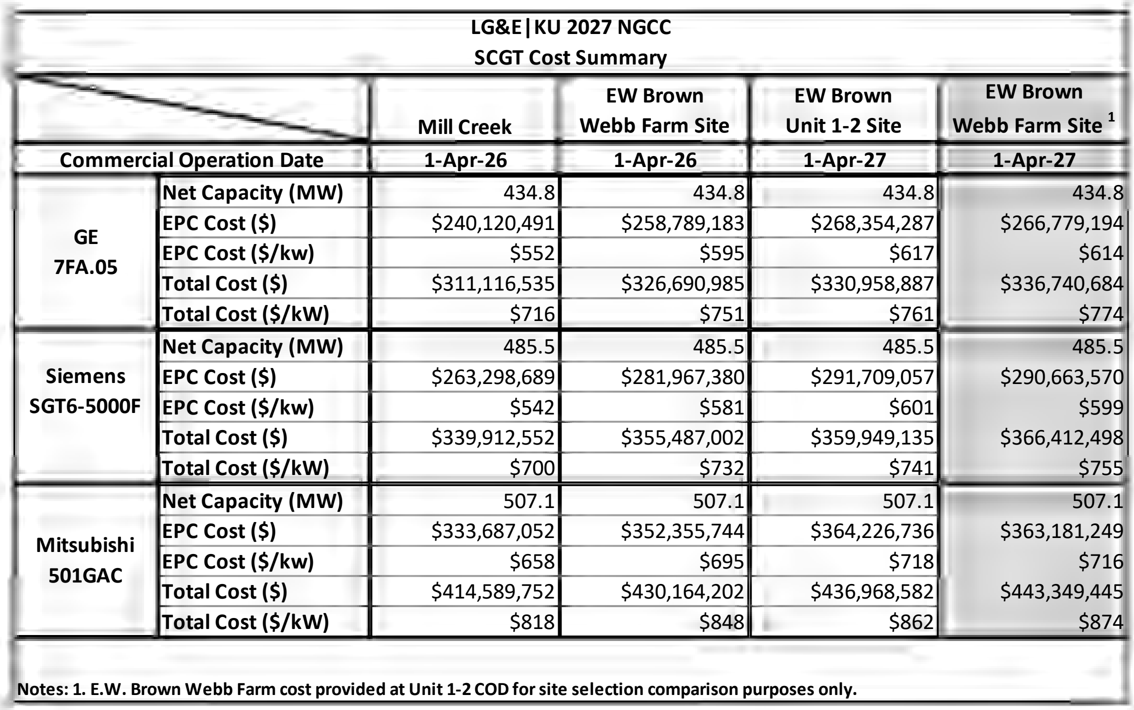
Figure 1.2-2 provides a graphical summary of expected "new and clean" 2x0 unit heat rate for the SCGT technologies across all ambient conditions.

Figure 1.1-2. 2x0 SCGT Net Heat Rate Across Ambient Design Conditions (New and Clean)



A summary of the estimated plant EPC costs and Owner's costs are provided in Table 1.2-3 for each SCGT arrangement considered.

Table 1.2-3. Total SCGT Project Cost



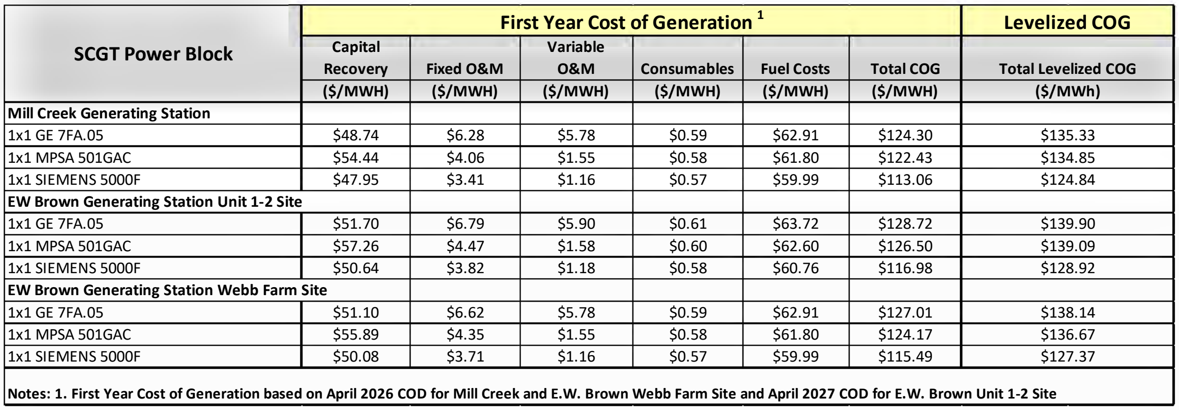
LG&E|KU 2027 NGCC
SCGT Cost Summary

		Mill Creek	EW Brown Webb Farm Site	EW Brown Unit 1-2 Site	EW Brown Webb Farm Site[1]
Commercial Operation Date		1-Apr-26	1-Apr-26	1-Apr-27	1-Apr-27
GE 7FA.05	Net Capacity (MW)	434.8	434.8	434.8	434.8
	EPC Cost ($)	$240,120,491	$258,789,183	$268,354,287	$266,779,194
	EPC Cost ($/kw)	$552	$595	$617	$614
	Total Cost ($)	$311,116,535	$326,690,985	$330,958,887	$336,740,684
	Total Cost ($/kW)	$716	$751	$761	$774
Siemens SGT6-5000F	Net Capacity (MW)	485.5	485.5	485.5	485.5
	EPC Cost ($)	$263,298,689	$281,967,380	$291,709,057	$290,663,570
	EPC Cost ($/kw)	$542	$581	$601	$599
	Total Cost ($)	$339,912,552	$355,487,002	$359,949,135	$366,412,498
	Total Cost ($/kW)	$700	$732	$741	$755
Mitsubishi 501GAC	Net Capacity (MW)	507.1	507.1	507.1	507.1
	EPC Cost ($)	$333,687,052	$352,355,744	$364,226,736	$363,181,249
	EPC Cost ($/kw)	$658	$695	$718	$716
	Total Cost ($)	$414,589,752	$430,164,202	$436,968,582	$443,349,445
	Total Cost ($/kW)	$818	$848	$862	$874

Notes: 1. E.W. Brown Webb Farm cost provided at Unit 1-2 COD for site selection comparison purposes only.

Incorporating the capital, operating and maintenance costs, the total cost of generation values for each SCGT option have been presented in Table 1.2-4. Costs are presented on both a first year basis and a levelized basis for a peaking dispatch plant operating 1000 hours annually.

Table 1.2-4. Electrical Cost of Generation Summary – 2x0 SCGT Power Block



SCGT Power Block	First Year Cost of Generation[1]						Levelized COG
	Capital Recovery ($/MWH)	Fixed O&M ($/MWH)	Variable O&M ($/MWH)	Consumables ($/MWH)	Fuel Costs ($/MWH)	Total COG ($/MWH)	Total Levelized COG ($/MWh)
Mill Creek Generating Station							
1x1 GE 7FA.05	$48.74	$6.28	$5.78	$0.59	$62.91	$124.30	$135.33
1x1 MPSA 501GAC	$54.44	$4.06	$1.55	$0.58	$61.80	$122.43	$134.85
1x1 SIEMENS 5000F	$47.95	$3.41	$1.16	$0.57	$59.99	$113.06	$124.84
EW Brown Generating Station Unit 1-2 Site							
1x1 GE 7FA.05	$51.70	$6.79	$5.90	$0.61	$63.72	$128.72	$139.90
1x1 MPSA 501GAC	$57.26	$4.47	$1.58	$0.60	$62.60	$126.50	$139.09
1x1 SIEMENS 5000F	$50.64	$3.82	$1.18	$0.58	$60.76	$116.98	$128.92
EW Brown Generating Station Webb Farm Site							
1x1 GE 7FA.05	$51.10	$6.62	$5.78	$0.59	$62.91	$127.01	$138.14
1x1 MPSA 501GAC	$55.89	$4.35	$1.55	$0.58	$61.80	$124.17	$136.67
1x1 SIEMENS 5000F	$50.08	$3.71	$1.16	$0.57	$59.99	$115.49	$127.37

Notes: 1. First Year Cost of Generation based on April 2026 COD for Mill Creek and E.W. Brown Webb Farm Site and April 2027 COD for E.W. Brown Unit 1-2 Site

As shown in the tables above, the Siemens SGT6-5000F configurations provide the lowest cost of generation for each site alternative considered. The differential cost between OEM technology and sites is not significant from a cost of generation perspective and equipment/site optimization could likely be driven by other factors.

2.0 NGCC DESIGN BASIS

LG&E|KU is conducting an evaluation of advanced class Natural Gas Combined Cycle (NGCC) generation options to be applied to serve as an intermediate to base load dispatched plant. The evaluation considers siting 1x1 combined cycle unit(s) at the existing Mill Creek and E. W. Brown generating stations. This feasibility study includes potential development of up to two 1x1 power blocks across the LG&E|KU system located at one or more of the two existing generation sites. The power block ratings considered are nominally aligned with existing coal-fired generation unit(s) with upcoming service retirements and consist of 620 MW class units.

The evaluated configuration/technology and arrangement considered for implementation include:

620 MW Combined Cycle Power Block

- 1x1 GE 7HA.03
- 1x1 MPA 501JAC
- 1x1 Siemens 9000HL

Site Configurations Evaluated

- Mill Creek: Single Unit NGCC and Two Unit NGCC
- E. W. Brown: Single Unit NGCC and Two Unit NGCC (the E. W. Brown base case considered is located on the Unit 1-2 footprint with an alternate Webb Farm site)

The plant design includes duct firing to the level necessary to maintain the annual average net plant output capacity on a summer day to that of the average day design condition. Each combustion turbine technology produces a specific output; therefore, a specific net plant output MW capacity is not provided.

Each combined cycle option was developed based similar cycle design criteria as detailed in this section. Major plant features included in the design are as follows:

- Rapid ramp rate of at least 85 MW/minute and turn-down capability to 40% or less to facilitate integration of intermittent generation resources on the LGE|KU electric transmission system
- Utilization of dry low NOx burners
- Selective catalytic reduction (SCR) for controlling NOx emissions to 2 ppm
- Inclusion of an oxidation catalyst for CO and VOC emissions control. The CO emissions will be controlled to 2 ppm with VOC emissions controlled to 1 ppm for unfired conditions and 2 ppm for duct burner fired operation.
- Evaporative cooling is included for operation at ambient conditions above 60 °F
- Fuel gas performance heating is included
- Deaerating condenser is included
- Full steam bypass of the steam turbine to allow continued generation during a steam turbine outage
- Duct burner firing is incorporated to maintain summer day net plant electrical output similar to that achieved at the unfired, annual average design conditions.
- Mechanical draft, wet cooling heat rejection system with 11 °F cooling tower design approach and 6 °F condenser design approach temperatures.
- Raw water provided from surface water source intake structure located on the site with pre-treatment consisting of clarification if required.

An intermediate operational dispatch schedule of 6,000 to 8,000 annual hours with shoulder season cycling, has been assumed for all of the options considered. The plant will be configured to support cycling operation. The dispatch model for the emission and economic analysis is based on up to 5 cold, 45 warm and 100 hot starts annually. This design requirement should result in a robust plant which will also perform well for cycling or base load service.

Further details regarding combustion turbine (CT) technology, plant performance, emissions, capital costs, and life cycle economic evaluation are presented in the following report sections

The following subsections describe available CT technology, generic plant configuration, site layout, and site specific design criteria proposed for the NGCC facility. Also, plant performance, air emissions, and water consumption estimates have been provided for comparison between the NGCC options.

2.1 AVAILABLE COMBUSTION TURBINE TECHNOLOGY

Dependent upon on the generation capacity LG&E|KU determines to be necessary, there are a number of available advanced class units available. The combined cycle market is nearly exclusively based on H-class- or J-class technology due to higher overall plant efficiency and lower production cost. The application of other combustion turbine technology, including F-class, aeroderivative or other industrial frame units is limited to combined heat and power or station's with capacity less than 300 MW.

Table 2.1-1 depicts the technology proposed by the OEMs as the unit best suited for the LG&E/KU 2027 NGCC project. The table includes the combustion turbine simple cycle net output and heat rate at standard ISO conditions (sea level, 59 °F, 60% relative humidity) for reference.

Table 2.1-1. Available CT Technology

Manufacturer | Model		Gross Simple Cycle ISO Rating	
		Output MW	Heat Rate, LHV/HHV Btu/kWh
GE	7HA.03	430	7,884/8,728
MPA	501JAC	453	7,755/8,595
Siemens	SGT6-9000HL	440	7,899/8,744

Combustion turbine technology continues to evolve at a rapid rate. The Siemens SGT6-9000HL and GE 7HA.03 are currently operating in North America in their offered configuration. The MPA 501JAC unit has achieved commercial operation in June 2022 for its current design, although the MPA machine proposed for this application is a next version update of the current unit which has not yet been placed into service.

Technology risk should be considered in development of the acceptable supplier list and final selection of the combustion turbine with Long Term Service Agreement (LTSA) terms commensurate with the technology risk. Further details on the evolution and technology of each combustion turbine offering are outlined below.

2.1.1 General Electric

GE's latest 60 hertz offering available for purchase, the 7HA series gas turbine (first unit shipped in 2016) expands on the capabilities of the GE fleet, including increased power output and improved or lower heat rate while maintaining a similar emissions profile.

GE introduced the 7HA Series gas turbine in September 2012. In March 2014 GE announced the introduction of the 7HA.02, with a rating of 330 MW in simple cycle. The original HA model was then re-named the 7HA.01 and remains an available turbine model. The first GE 7HA.02 units were installed at Exelon's two Texas projects placed into service in spring/summer of 2017. The GE 7HA fleet includes 69 units in operation and over 1,300,000 operating hours.

The HA.03, an upgraded version of the HA series was announced in October 2019 with a rating of 430 MW at ISO standard conditions. The 7HA.03 has been installed in a 2x1 multi-shaft configuration at Florida Power & Light Company's (FPL) Dania Beach Clean Energy Center near Fort Lauderdale, Florida with commercial operation of June 8, 2022. GE was recently awarded (September 2022) the 7HA.03 based equipment supply contract for the 725 MW Kindle Energy Magnolia Power Project in Louisiana with a planned 2025 COD.

2.1.2 Mitsubishi Power America

Mitsubishi Power America (MPA) has been actively involved in developing a J-class CT, initially a steam cooled unit identified as the 501J for the 60 hertz market. The initial six 501J units sold to Kansai Electric Power Company in Japan achieved commercial operation between 2013 through 2015, with the first unit shipped in March of 2012. Several 501J units have also been placed into service in Asia. The first North American 501J was shipped from the MPA Savannah, Georgia factory in January 2016 for a June 2017 COD. MPA reports over 30 501J units operating worldwide. Because of its elevated 2900 ^{0}F (1600 ^{0}C) firing temperature, the 501J CT was designed to be steam-cooled and is best configured for a base-loaded, combined cycle application.

Similar to the product development applied to the G-class, MPA has undertaken an air-cooled version of the steam cooled 501J known as the 501JAC. The 501JAC employs the same compressor and turbine design with thermal barrier coatings, turbine section aerodynamic modifications and combustor transition design modifications to support the air cooling. The air cooled version has advanced efficiency and heat rate over steam cooled unit and currently offers a 100 MW higher electrical output.

The 501JAC was introduced for sale in 2012, and through Q2 2022 seven units are operating globally with two in North America.

The MPA J class US fleet status is as follows:

- Grand River Dam Authority 495 MW (501J and Steam Turbine) COD May 2017
- Tenaska Westmoreland 940 MW (2x1 501J) COD December 2018
- Dominion Greensville 1500 MW (3x1 501J) COD June 2018
- J-Power Jackson 1200 MW (2-1x1 501JAC + HRSG+ ST Single Shaft) COD May 2022
- Intermountain Power 840 MW (2x1 501JAC + HRSG + ST) Order placed March 2020
- Capital Power (Canada) Genesee (2x2 Repower) 501JAC + HRSG) COD 2023/2024

2.1.3 Siemens

Siemens SGT6-8000H combustion turbine was first announced in 2006. Siemens has acquired significant operation time at numerous United States installations. The H-class CT is an air-cooled design that utilizes dry low NOx combustion technology. It does not require steam or water injection for cooling or emissions control.

The Siemens 8000H US fleet status is as follows:

- FPL Cape Canaveral (3x1 Multi-Shaft) COD 2013
- FPL Riviera Beach (3x1 Multi-Shaft) COD 2014
- FPL Port Everglades (3x1 Multi-Shaft) COD 2016
- Panda Energy Liberty (2x1x1 Single-Shaft) COD 2016
- Ares Capital Oregon Clean Energy Center (2x1 Multi-Shaft) COD 2017
- Clean Energy Future Lordstown (2x1 Multi-Shaft) COD 2018
- Tyr Energy Hickory Run (2x1 Multi-Shaft) COD 2020
- Panda Energy Mattawoman (1x1 Single-Shaft) COD planned 2023

An upgraded H-class machine denoted the SGT6-9000HL was announced in 2017 with a demonstration unit constructed at the Duke Energy Lincoln County site in 2020. The new unit will operate in simple-cycle mode under real-world power plant conditions, allowing Siemens to assess and optimize the performance while gaining valuable commercial operating experience. When testing is completed in 2024, Siemens will turn over the advanced unit to Duke Energy. Siemens was selected to provide SGT6-9000HL technology for the 550 MW Cooperative Energy R.D. Morrow Generating Station Repowering Project in Mississippi which was initially planned to enter commercial operation in 2023.

2.2 PLANT CONFIGURATION

2.2.1 Combined Cycle Plant Configuration / Integration

The NGCC facility will consist of one-on-one single-shaft power blocks with evaporative cooling and fuel gas heating. Each combustion turbine will exhaust to a triple pressure, heat recovery steam generator (HRSG) with a low temperature economizer (LTE) and reheat section. High pressure steam generated by the HRSG will supply high pressure (HP) steam to the steam turbine throttle of a single steam turbine generator (ST) at a maximum pressure of 2400 psia; the pressure will slide downward as steam load to the steam turbine decreases. Steam will exhaust from the HP section of the ST, mix with intermediate pressure (IP) steam within the HRSG, and then will be reheated via the HRSG before entering back into the IP steam turbine section of the ST. Lastly, a low pressure (LP) steam induction on the ST will be supplied by the LP section of the HRSG.

The steam turbine will be of a single reheat, fully condensing design. The heat rejection system will include a deaerating, wet surface condenser with mechanical draft cooling tower.

Air emission control systems for the NGCC facility consist of low NO_x burners for controlling NO_x emissions and a selective catalytic reduction (SCR) system reducing NOx emissions to 2 ppm and an oxidation catalyst to control CO and VOC emissions.

The plant will be designed as a predominantly indoor plant with the single-shaft power train (combustion turbine, steam turbine and generator) installed within a Turbine Building. The boiler feedwater pump(s) and all pump skids will be located indoors. The HRSG will be located outdoors and provided with a full penthouse enclosure by the HRSG manufacturer.

Each single-shaft unit generator will have a main generator step-up transformer with a nominal output voltage corresponding to the site interconnection voltage. In addition, an auxiliary transformer fed from a tap on the isolated phase bus from each power block generator will be provided (single unit installations will include both UAT tapped from the single generator). Each auxiliary transformer will have sufficient capacity to operate the entire NGCC facility.

Natural gas filters, scrubbers and pressure reducing stations will be provided as required to meet the pressure and cleanliness requirements of the combustion turbine manufacturer.

Pressure reduction to meet the natural gas pressure requirements of the HRSG duct burners will be provided with the HRSG(s). Gas compression is included for all options.

For the purpose of this evaluation and developing cost estimates, the following primary external infrastructure systems which will interface with the proposed NGCC facility are assumed:

Natural Gas Transmission – Natural gas will be supplied to the NGCC facility via extension and/or upgrade of the interstate pipeline system available near each site. The feasibility study is based on natural gas pipeline minimum delivery pressure at the site boundary to be nominally 500 psig.

19 Percent Aqueous Ammonia – Aqueous ammonia will be delivered by truck.

Raw Water Supply – Raw water for each facility will be provided from the adjacent surface water resource utilizing existing plant facilities to the extent available to support long term operation of the NGCC unit(s). The Mill Creek site NGCC unit addition(s) will be served from the existing Mill Creek service water system. The retirement of Mill Creek Unit 1 and Unit 2 will result in freed capacity to serve the NGCC units via the existing Ohio River intake system, and the planned longer term operation of Mill Creek Unit 3 and Unit 4 will ensure the current system utilization will align with site needs for a lengthy timeframe.

The E. W. Brown site will utilize the Unit 1 Herrington Lake intake structure retrofitted with replacement traveling screens. The proposed modifications to the intake structure will meet the requirements set forth by Phase II of Section 316(b) for existing facilities and also Phase I requirements for new facilities.

Potable Water Supply – Potable water will be received from a municipal water main.

Wastewater Discharge – Wastewater will be discharged to the raw water source through existing outfalls.

Sanitary Sewer – The Mill Creek site projects will utilize the existing municipal sewer service.

The E. W. Brown site sanitary wastewater will be collected from the various points of origin in the facility and gravity feed (unless deemed impractical) to a relocated E. W. Brown sanitary septic field, or potentially managed through a packaged waste water treatment system and discharged to an existing outfall.

Storm Water – The existing surface drainage system will be expanded and modified as necessary to accommodate the increased storm water runoff of the NGCC facility.

Electrical Transmission – The existing station electrical transmission system will be extended to serve the additional generation with the following points of interconnection:

- Mill Creek: 345 kV at existing Mill Creek Substation
- E. W. Brown (Webb Farm Site): 345 kV at existing Brown North Substation
- E. W. Brown (Unit 1-2 Site): 138 kV at existing Brown North Substation

The site development for each existing station includes relocation of existing overhead lines as required to facilitate construction.

Cycle Make-up Water – The existing Mill Creek demineralized water treatment system will provide the water quality required by the HRSG and steam turbine. The NGCC facility will include forwarding pumps and a demineralized water storage tank. The E. W. Brown site will include a cycle makeup water treatment system.

Fire Protection – The existing Mill Creek fire protection system will be extended to serve the fire protection supply requirements of the NGCC facility. The E. W. Brown site scopes includes dedicated fire water tank capacity and fire pumps sized for the NGCC facility.

2.2.2 Natural Gas Transmission

Natural gas will be supplied to the NGCC facility via extension and/or upgrade of the interstate pipeline system available near each site. The Owners cost includes budget to install the off-site gas pipeline facilities to meet the gas demand associated with the proposed facility. The feasibility study is based on natural gas pipeline minimum delivery pressure at the site boundary to be nominally 500 psig. The planned gas pressure is not adequate to meet the combustion turbine OEM requirements and on-site gas compression is included in the conceptual design with one compressor provided per combustion turbine. A redundant gas compressor is included in a 2x100% configuration for single unit arrangements and 3x50% configuration for two unit builds. . The E. W. Brown site designs also include an additional gas compressor to serve the existing two Alstom GT-24 combustion turbines which require 525 psig gas pressure. The additional gas compressor is sized to match the gas compressors provided for the advanced class units to provide optimized reliability.

2.3 SITE LAYOUT

The site for the NGCC facility has been arranged around some key considerations important to plant operation and maintenance as follows.

- Site arrangement selected based on lowest development costs for property, common facilities interconnection, excavation/fill, and transmission line relocation.
- The cooling tower has been located such that a future drifting plume does not impact the Operations and Maintenance (O&M) function of the existing plant, NGCC facility, or switchyard.
- Provisions for rail delivery and heavy haul access to the construction laydown area have been considered where available for ease of equipment delivery storage.
- Road access to major pieces of equipment and the parking lot has been provided including a main paved drive to the turbine building for trailer access when removing turbine parts.
- Ample parking space for facility staff and visitors.
- Ample space for construction laydown and parking areas.
- Space and equipment arrangement provisions for future expansion of NGCC facility have been considered.

Site arrangements have been included within Appendix A for single unit and two unit NGCC facilities based on a typical (non-OEM specific) advanced class single-shaft unit layout. The E. W. Brown arrangements includes an optional site arrangement located north of the existing combustion turbine area for further consideration to mitigate unit retirement schedule coordination. The alternate E. W. Brown Webb Farm site has been evaluated and determined to result in minimal differential cost associated with adjustments in site civil and land purchase.

2.4 PLANT LAYOUT

Several key factors govern a well arranged power block minimizing building volume while at the same time allowing for equipment access and removal. Key requirements are as follows:

- Each 1x1 power block is to be provided in a single shaft configuration to support optimization of the available plant footprint and associated Kentucky Siting Board criteria.

- Designated space has been reserved (with physical provisions for removal) for condenser tube replacement and condenser water box removal. O&M activities will not be impeded by structural steel, piping, conduit, cable trays, etc.
- The turbine building bridge crane is capable of complying with the power train supplier requirements for maintenance including required hook height and requirements for a main hook for major turbine components and a second light duty crane hook for small components. In general, the turbine room crane will be capable of lifting the combustion turbine rotor. The second hook will be capable of overturning the heaviest shell component. Note the single-shaft generator rotor removal requires jacking and sliding the generator and utilization of mobile equipment.
- The condensate pumps are removable through a hatch in the operating floor with no interfering piping or electrical cable trays.
- Generally, access aisles are 12 feet wide by 14 feet tall with access to all equipment. Likewise, important equipment routing provisions will be made and preserved via box out areas in the plant model to assure that primary equipment has a known and preserved maintenance removal and building egress route to the exterior, either through overhead doors or internal access to the truck load out bay in the turbine room at grade level.
- Maintenance access space will be made available to perform maintenance activities near the physical location of major equipment including condensate pumps, boiler feed pumps, and other major equipment as may be required during equipment laydown reviews.

Power block site arrangements and general arrangements have been included within Appendix A.

2.5 SITE DESIGN CRITERIA

Combined cycle plant efficiencies are a function of the selected combustion turbine efficiency, selected steam conditions, fuel quality, HRSG efficiency, steam turbine efficiency, and achievable steam turbine backpressures based upon ambient conditions, heat rejection system design, and the degree to which the duct burner is utilized. The following discussions identify the key factors which establish the achievable efficiencies for the proposed NGCC facility.

2.5.1 Ambient Data

The evaluation design basis ambient conditions are defined as follows.

<u>Summer Design Day</u>
Dry Bulb: 90 °F
Relative Humidity: 50 percent

<u>Annual Average Design Conditions</u>
Dry Bulb: 57 °F
Relative Humidity: 70 percent

<u>Extreme Hot Design Day</u>
Dry Bulb: 106 °F
Relative Humidity: 40 percent

<u>Minimum Summer Design Day (Electrical Interconnection basis)</u>
Dry Bulb: 45 °F
Relative Humidity: 60 percent

Winter Design Day	
Dry Bulb:	15 °F
Relative Humidity:	55 percent
Extreme Winter Design Day	
Dry Bulb:	-18 °F
Relative Humidity:	50 percent
Site Elevation:	860 ft.

All economic analyses and lifecycle cost analyses were performed using expected plant performance at the annual average design conditions.

2.5.2 Noise Limits

The equipment is designed for a near field noise emitting criterion of 85 dBA maximum at 3 feet from the equipment (in a free field) with exceptions. Where practicable, acoustical insulation and enclosures will be used as required for equipment that would otherwise exceed this criterion. The noise limit will not exceed 85 dBA accumulative for all areas of the site, regardless of individual noise emitted from each piece of equipment. Certain equipment noise may exceed this criterion, even with noise control measures, particularly within enclosures or rooms. In this case, signs indicating that hearing protection is required are included. Locations where noise levels can be expected to exceed limits stated above are the turbine steam chest, the boiler feed pumps, large air compressors, and steam generator safety valves. The HRSG power-actuated pressure relief valves will be equipped with discharge silencers.

The far field noise emissions limit is estimated to be 55 dBA at the property line based on the Kentucky Siting Board 1000 foot setback required.

2.5.3 Basic Structural Design Criteria

The building code to be used for the project is the Kentucky Building Code 2018 (Second Edition) which adopts the International Building Code (IBC) 2015 with defined exceptions.

Snow Loads

Snow design shall be in accordance with IBC 2015, section 1608, utilizing the inputs below:

- Minimum ground snow load = 15 lb/ft2

Wind loads

Wind design shall be in accordance with IBC 2015, section 1609, utilizing the inputs below:

- 3 second gust = 90 miles/hr
- Exposure category = B

Seismic Loads

Seismic design shall be in accordance with IBC 2015, section 1613, utilizing the inputs below:

- Occupancy category = III
- Site (soil) class = D
- Seismic design category = C or D, EPC Contractor to verify exact location and category with building official

Frost Penetration

Underground fire water piping shall have a minimum depth of 30 inches to the top of the pipe. All other underground piping and foundations shall have a minimum depth of 30 inches.

2.5.4 Precipitation

Point precipitation frequency estimates from NOAA Atlas 14 for Louisville, Kentucky:

• Annual average, inches	44.54
• 10 year, 24-hour, inches	6.9
• 25 year, 24-hour, inches	7.86
• 100 year, 24-hour, inches	9.34

2.5.5 Storm Water

Design the storm collection system for a 24 hour, 25 year point precipitation frequency.

2.6 PLANT PERFORMANCE

2.6.1 Thermal Cycle Design

The principal components defined by the cycle design are the HRSG(s), including duct firing requirements, the CT(s), the ST(s), the heat rejection systems and the associated pumps and piping networks.

Each NGCC arrangement has been held to the following general thermal cycle design constraints:

- Natural gas as the primary fuel (higher heating value of 22,029 Btu/lb), with an option for fuel oil as a backup fuel.
- Utilization of low NO_x burners. Selective catalytic reduction (SCR) for controlling NO_x emissions to 2 ppm NOx emissions.
- Inclusion of a CO catalyst for emissions CO and VOC control
- Evaporative cooling is included for operation at ambient conditions above 60 °F
- Fuel gas performance heating is included
- Triple pressure heat recovery steam generator (HRSG) with low temperature economizer (LTE).
- Low temperature economizer (LTE) recirculation to maintain 140°F condensate temperature entering the LTE.
- LTE bypass to avoid condensate steaming within the LTE
- 1112°F/1112°F maximum main steam and reheat steam temperatures
- 2400 psig steam turbine throttle with sliding pressure as steam load decreases
- Deaerating condenser is included
- A minimum stack exit temperature of 175 °F to 180 °F
- Duct burner firing is incorporated to maintain summer day net plant electrical output equal to that achieved at the unfired, annual average design conditions.
- Mechanical draft, wet cooling heat rejection system with 11°F cooling tower design approach and 6°F condenser design approach temperatures.

Additionally, design criteria unique to each combustion turbine option include:

GE 7HA.03

- CT Gas Pressure Requirement: 650 psig at plant boundary

MPA 501JAC

- CT Gas Pressure Requirement: 707 psig at plant boundary

Siemens 9000HL

- CT Gas Pressure Requirement: 650 psig at plant boundary

2.6.2 Key Unit Ratings/Performance

Tables 2.6-1 through 2.6-3 provide a summary of expected "new and clean" plant performance for a variety of NGCC arrangements at 1 percent summer, annual average ambient, and 99 percent winter conditions. Auxiliary loads represent a fully burdened, stand-alone plant, excluding gas compression loads. All heat rates and plant efficiencies are presented on a higher heating value (HHV) basis.

Table 2.6-1. Average Ambient Performance, New and Clean

	Description	Gross Plant Output (MW)	Gross Plant Heat Rate (Btu/kWH - HHV)	Auxiliary Power Percentage (%)	Net Plant Output (MW)	Net Plant Heat Rate (Btu/kWH - HHV)
1	1-1x1 HA.03	632.3	5,922	2.52%	616.3	6,075
2	2-1x1 HA.03	1264.6	5,922	2.52%	1232.7	6,075
4	1-1x1 501JAC	636.7	6,046	2.31%	622.0	6,189
5	2-1x1 501JAC	1273.4	6,046	2.31%	1244.0	6,189
7	1-1x1 9000HL	638.8	5,859	2.86%	620.5	6,032
8	2-1x1 9000HL	1277.6	5,859	2.86%	1241.0	6,032

As can be noted, plant efficiencies for each advanced class combined cycle unit are similar with nominal net plant heat rate ranging from 6032 BTU/KWHr to 6189 BTU/KWHr (HHV). The Siemens 9000HL configuration offers the highest efficiency based on gross unit heat rates and it is noted the auxiliary power utilized for the performance is based on OEM estimates.

To represent how the plant performance will vary with ambient conditions, Tables 2.6-2 and 2.6-3 provide a summary of expected "new and clean" plant performance at 90 ºF / 50 percent relative humidity and 15 ºF / 55 percent relative humidity conditions, respectively.

Table 2.6-2. Summer Ambient Conditions - New and Clean

	Description	Gross Plant Output (MW)	Gross Plant Heat Rate (Btu/kWH - HHV)	Auxiliary Power Percentage (%)	Net Plant Output (MW)	Net Plant Heat Rate (Btu/kWH - HHV)
1	1-1x1 HA.03	632.6	6,028	2.63%	616.0	6,190
2	2-1x1 HA.03	1265.2	6,028	2.63%	1232.0	6,190
4	1-1x1 501JAC	636.7	6,165	2.31%	622.0	6,311
5	2-1x1 501JAC	1273.4	6,165	2.31%	1244.0	6,311
7	1-1x1 9000HL	638.8	6,032	2.86%	620.5	6,210
8	2-1x1 9000HL	1277.6	6,032	2.86%	1241.0	6,210

Table 2.6-3. Winter Ambient Conditions, New and Clean

	Description	Gross Plant Output (MW)	Gross Plant Heat Rate (Btu/kWH - HHV)	Auxiliary Power Percentage (%)	Net Plant Output (MW)	Net Plant Heat Rate (Btu/kWH - HHV)
1	1-1x1 HA.03	639.6	5,968	2.45%	624.0	6,117
2	2-1x1 HA.03	1279.3	5,968	2.45%	1247.9	6,117
4	1-1x1 501JAC	708.1	6,393	2.30%	691.8	6,543
5	2-1x1 501JAC	1416.2	6,393	2.30%	1383.6	6,543
7	1-1x1 9000HL	660.2	5,937	2.85%	641.4	6,111
8	2-1x1 9000HL	1320.4	5,937	2.85%	1282.8	6,111

When comparing Table 2.6-1 with Tables 2.6-2 through 2.6-3, higher ambient temperatures and duct firing reduce combined cycle plant efficiencies. The ambient temperature impact to output and heat rate varies among the OEM technologies. It should be noted that while plant efficiency may improve with less duct firing the incremental generation afforded by duct firing comes at a relatively low capital cost increase.

Colder ambient temperatures result in a lower overall plant efficiency as compared to average day ambient conditions as a result of lower CT exhaust gas temperatures and decreased HRSG steam temperatures.

New and clean Heat Balance diagrams for the cases depicted in Tables 2.6-1 through 2.6-3 are provided in Appendix B.

Degraded plant performance at annual average, summer, and winter design conditions has been depicted for each option in Tables 2.6-5, 2.6-6, and 2.6-7. Degraded plant performance is a function of operating hours and major plant equipment maintenance schedule. The following tables are representative of maximum non-recoverable (average plant life) plant degradation over the 40 year plant design life.

Table 2.6-5. Average Ambient Performance, Non Recoverable Degraded

	Description	Gross Plant Output (MW)	Gross Plant Heat Rate (Btu/kWH - HHV)	Auxiliary Power Percentage (%)	Net Plant Output (MW)	Net Plant Heat Rate (Btu/kWH - HHV)
1	1-1x1 HA.03	619.6	5,981	2.52%	604.0	6,136
2	2-1x1 HA.03	1239.3	5,981	2.52%	1208.0	6,136
4	1-1x1 501JAC	624.0	6,107	2.31%	609.6	6,251
5	2-1x1 501JAC	1247.9	6,107	2.31%	1219.1	6,251
7	1-1x1 9000HL	626.0	5,918	2.86%	608.1	6,092
8	2-1x1 9000HL	1252.0	5,918	2.86%	1216.2	6,092

Table 2.6-6. Summer Ambient Performance - Non Recoverable Degraded

	Description	Gross Plant Output (MW)	Gross Plant Heat Rate (Btu/kWH - HHV)	Auxiliary Power Percentage (%)	Net Plant Output (MW)	Net Plant Heat Rate (Btu/kWH - HHV)
1	1-1x1 HA.03	620.0	6,088	2.63%	603.7	6,252
2	2-1x1 HA.03	1239.9	6,088	2.63%	1207.4	6,252
4	1-1x1 501JAC	624.0	6,227	2.31%	609.6	6,374
5	2-1x1 501JAC	1247.9	6,227	2.31%	1219.1	6,374
7	1-1x1 9000HL	626.0	6,093	2.86%	608.1	6,272
8	2-1x1 9000HL	1252.0	6,093	2.86%	1216.2	6,272

Table 2.6-7. Winter Ambient Performance, Non Recoverable Degraded

	Description	Gross Plant Output (MW)	Gross Plant Heat Rate (Btu/kWH - HHV)	Auxiliary Power Percentage (%)	Net Plant Output (MW)	Net Plant Heat Rate (Btu/kWH - HHV)
1	1-1x1 HA.03	626.8	6,027	2.45%	611.5	6,179
2	2-1x1 HA.03	1253.7	6,027	2.45%	1222.9	6,179
4	1-1x1 501JAC	693.9	6,457	2.30%	678.0	6,609
5	2-1x1 501JAC	1387.9	6,457	2.30%	1355.9	6,609
7	1-1x1 9000HL	647.0	5,996	2.85%	628.6	6,172
8	2-1x1 9000HL	1294.0	5,996	2.85%	1257.1	6,172

Minimum plant load performance data is summarized in Table 2.6-8. Performance is indicated for average day ambient conditions and is representative of new and clean plant conditions.

Table 2.6-8. Minimum Load at Average Ambient Conditions, New and Clean

	Description	Gross Plant Output (MW)	Gross Plant Heat Rate (Btu/kWH - HHV)	Auxiliary Power Percentage (%)	Net Plant Output (MW)	Net Plant Heat Rate (Btu/kWH - HHV)	MECL Load Turndown (%)
1	1-1x1 HA.03	244.0	6,971	4.63%	232.7	7,310	38%
2	2-1x1 HA.03	488.0	6,971	4.63%	465.4	7,310	38%
4	1-1x1 501JAC	355.0	6,402	4.93%	337.5	6,734	54%
5	2-1x1 501JAC	710.0	6,402	4.93%	675.0	6,734	54%
7	1-1x1 9000HL	265.0	7,038	4.68%	252.6	7,384	41%
8	2-1x1 9000HL	530.0	7,038	4.68%	505.2	7,384	41%

2.6.3 Major Equipment Design Margins

Major equipment design margins are included in Table 2.6-9.

Table 2.6-9 Major Equipment Design Margins

Equipment	Design Margins
Cooling Tower	Circulating Water Range: 20 °F Cooling Tower Approach to Wet-bulb: 11 °F
Condenser	Condenser Terminal Temperature Difference: 6 °F
Condensate Pumps	Flow: 10%, Head: 10%
Feedwater Pumps	Flow: 10%, Head: 10%
Circulating Water Pumps	Flow: 5%, Head: 5%

2.6.4 Major Auxiliary Equipment Redundancy

It is anticipated that the NGCC facility will be operated as a cycling plant at maximum continuous rating. Cyclic operation with overnight or longer shutdown is anticipated.

The design and redundancy of major auxiliary equipment will prevent complete loss of any main equipment item in event of the failure of the auxiliary equipment.

Major auxiliary equipment redundancy for the each 1x1 power block is to be specified as listed below (typical of Cane Run 7 except where noted):

- Condenser – 1 x 100%
- Cooling Tower – 1 x 100% (with one spare cell at summer ambient conditions)
- Condensate Pumps – 2 x 100%
- Boiler Feed Pumps – 2 x 100% per HRSG (CR7 is 1x100% w/warehouse spare)
- Condenser Vacuum Pumps – 2 x 100%
- Circulating Water Pumps – 2 x 60%
- Closed Cooling Water Pumps – 2 x 100%
- Raw Water Supply Pumps – 2 x 100%
- Auxiliary Cooling Water Pump – 1 x 100% (supports plant standby operation only when ST is off-line to supply closed cycle cooling water system)
- Unit Auxiliary Transformers - 2 x 100%
- GSU Transformers – 1 x 100% with one spare unit purchased and stored on site

2.7 AIR EMISSIONS

Air pollutant emission rates should be in accordance with the final approved air permit. U.S. EPA test methods for each pollutant will be utilized in accordance with the permit. For the purposes of this assessment and the economic analysis completed in Section 7.0, the target emission levels utilizing emissions controls for a single 1x1 unit are summarized below in Table 2.7-1. The target emissions are based on providing 2 ppm NOx emissions representative of Best Available Control Technology (BACT) for Prevention of Significant Deterioration (PSD) based permitting. Emissions are summarized for one 1x1 unit on a lb/hr basis.

Table 2.7-1. Unit Stack Emissions – NGCC Power Block Units

Stack Emissions - NGCC Power Block Unit (per CT/HRSG)							
		1x1 7HA.03		1x1 501JAC		1x1 9000HL	
		Summer Fired	Winter Unfired	Summer Fired	Winter Unfired	Summer Fired	Winter Unfired
Temperature		90	15	90	15	90	15
Relative Humidity		50	55	50	55	50	55
CTG Heat Input	mmBtu/h, HHV	4077.8	4203.7	3,806	3,830	3,566	3,928
Duct Burner Heat Input	mmBtu/h, HHV	110.7	0	217	0	296	0
NOx as NO2	ppmvd @ 15% O2	2.00	2.00	2.00	2.00	2.00	2.00
	lb/hr	30.6	30.6	32.00	31.00	29.60	30.10
	lb/mmBtu	0.0073	0.0073	0.0080	0.0081	0.0077	0.0077
CO	ppmvd @ 15% O2	2.00	2.00	2.00	2.00	2.00	2.00
	lb/hr	18.6	18.6	19.00	19.00	18.00	18.30
	lb/mmBtu	0.0044	0.0044	0.0047	0.0050	0.0047	0.0047
VOC	ppmvd @ 15% O2	2.00	1.00	2.00	1.00	2.00	1.00
	lb/hr	10.7	5.3	10.90	5.30	10.30	5.30
	lb/mmBtu	0.0026	0.0013	0.0027	0.0014	0.0027	0.0013
PM Total	lb/hr	19.4	18	23.30	19.90	16.40	14.90
	lb/mmBtu	0.0046	0.0043	0.0058	0.0052	0.0042	0.0038
PM Filterable	lb/hr	19.4	18	23.30	19.90	16.40	14.90
	lb/mmBtu	0.0046	0.0043	0.0058	0.0052	0.0042	0.0038
SO2	lb/hr	7.1	7.1	6.80	6.50	6.56	6.68
	lb/mmBtu	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017
H2SO4	lb/hr	5.1	4.8	4.80	4.60	4.63	4.71
	lb/mmBtu	0.0012	0.0011	0.0012	0.0012	0.0012	0.0012
Formaldehyde	ppbvd @ 15% O2	91	91	91	91	91	91
	lb/hr	0.90	0.90	0.87	0.82	0.84	0.84
	lb/mmBtu	2.15E-04	2.14E-04	2.16E-04	2.14E-04	2.18E-04	2.14E-04
NH3 Slip	ppmvd @ 15% O2	5.00	5.00	5.00	5.00	5.00	5.00
	lb/hr	28.3	28.3	22.00	22.00	27.40	27.90
	lb/mmBtu	0.0068	0.0067	0.0055	0.0057	0.0071	0.0071
CO2	lb/hr	488,589	490,362	469,225	446,711	450,502	458,201
	lb/mmBtu	116.65	116.65	116.65	116.65	116.65	116.65
	lb/MWH gross	772	767	737	699	705	694
	lb/MWH net	793	786	754	733	726	714

The estimated worst case annual emissions for each technology for a single 1x1 unit are summarized in Table 2.7-2 through Table 2.7-4. The annual emissions are calculated on a potential to emit basis with 5 cold starts, 45 warm starts, 100 hot starts, 150 shutdowns and full load operation for all non-startup/shutdown durations (no downtime). Emissions are summarized for one 1x1 unit on an annual ton basis.

Table 2.7-2. GE 7HA.03 Single Unit Annual Emissions

GE 1x1 7HA.03 Combined Cycle					
Maximum Potential to Emit					
	No. of Starts	NOx	CO	VOC	PM10
		lbs	lbs	lbs	lbs
Cold Starts	5	2,100	1,550	500	160
Warm Starts	45	11,700	10,350	3,825	1,215
Hot Starts	100	13,500	20,000	8,000	1,400
Shutdowns	150	6,000	26,250	9,000	750
Steady State	8,629	264,053	160,503	69,033	161,365
TOTAL (TPY)		149	109	45	82

Table 2.7-3. MPA 501JAC Single Unit Annual Emissions

MPA 1x1 501JAC Combined Cycle					
Maximum Potential to Emit					
	No. of Starts	NOx	CO	VOC	PM10
		lbs	lbs	lbs	lbs
Cold Starts	5	360	2,665	675	150
Warm Starts	45	325	2,380	605	125
Hot Starts	100	5,500	30,300	9,100	1,500
Shutdowns	150	7,800	19,500	26,000	500
Steady State	8,626	271,727	163,899	69,873	186,327
TOTAL (TPY)		143	109	53	94

Table 2.7-4. Siemens 9000HL Single Unit Annual Emissions

Siemens 1x1 9000HL Combined Cycle					
Maximum Potential to Emit					
	No. of Starts	NOx	CO	VOC	PM10
		lbs	lbs	lbs	lbs
Cold Starts	5	540	3,790	350	33
Warm Starts	45	2,655	12,825	2,025	216
Hot Starts	100	5,900	28,500	4,500	480
Shutdowns	150	6,900	36,600	7,350	600
Steady State	8,632	257,655	156,665	67,327	135,086
TOTAL (TPY)		137	119	41	68

2.8 WATER

Raw water for each facility will be provided from the adjacent surface water resource utilizing existing plant facilities to the extent available to support long term operation of the NGCC unit(s). The Mill Creek site NGCC unit addition(s) will be served from the existing Mill Creek service water system. The retirement of Mill Creek Unit 1 and Unit 2 will result in freed capacity to serve the NGCC units via the existing Ohio River intake system, and the planned longer term operation of Mill Creek Unit 3 and Unit 4 will ensure the current system utilization will align with site needs for a lengthy timeframe.

The E. W. Brown site will utilize the Unit 1 Herrington Lake intake structure retrofitted with replacement traveling screens. The proposed modifications to the intake structure will meet the requirements set forth by Phase II of Section 316(b) for existing facilities and also Phase I requirements for new facilities.

Plant water streams including the following:

- Raw Water
- Service Water
- Steam Cycle Makeup
- Potable Water

Plant water consumption and wastewater discharge rates have been presented in Section 2.7.4 for each NGCC arrangement operating at annual average design conditions.

2.8.1 Raw Water

The raw water system distributes low-pressure water to the following uses:

- Cooling tower makeup
- Service water

2.8.2 Service Water

The service water system served from the raw water system distributes low-pressure water throughout the power station for the following uses:

- CT evaporative cooling system
- Hose stations for maintenance washdowns
- Cycle make-up water treatment (E. W. Brown sites only)

The service water system consists of a storage tank, pumps, and distribution piping network.

2.8.3 Steam Cycle Makeup Water

For the Mill Creek site, the steam cycle makeup water will be provided by the existing cycle makeup water treatment system for steam/condensate cycle makeup. The E. W. Brown site will require a cycle makeup water treatment system to be provided.

The NGCC facility demineralization system will include a demineralized water storage tank and pumps.

2.8.4 Potable Water

Potable water will be provided by the municipal water main. A single interface point with the water main will be made and routed into the power station site. Backflow preventers and water meters will be provided as required.

2.8.5 Water Consumption and Wastewater Discharge

Plant water consumption and wastewater discharge rates have been presented in Table 2.8-1 for each NGCC arrangement operating at full load during peak and annual average design conditions.

Table 2.8-1. NGCC Facility Water Consumption and Wastewater Discharge Rates (3 Cycles of Concentration Cooling Tower)

Water Consumption and Discharge (3 COC)		1x1 7HA.03	1x1 501JAC	1x1 9000HL	2-1x1 7HA.03	1x1 501JAC	1x1 9000HL
Peak Water Consumption	GPM	4200	4600	4400	8400	9200	8800
Peak Water Discharge	GPM	1400	1533	1467	2800	3067	2933
Average Water Consumption	GPM	3050	3350	3175	6100	6700	6350
Average Water Discharge	GPM	1017	1117	1058	2033	2233	2117

2.9 WASTEWATER

The wastewater collection and transfer system will be provided to collect, monitor, and discharge of the facility wastewater streams including the following.

- Oily Wastewater
- HRSG Blowdown
- Cooling Tower Blowdown
- Gas Turbine Wash Water

All wastewater lift stations will be furnished with sump pumps installed in 100 percent capacity pairs. Sump pumps will be vertical sump pumps with the motor installed above the sump cover.

2.9.1 Sanitary Wastewater

The Mill Creek project site will discharge sanitary wastewater to the local municipal utility system.

The E. W. Brown site sanitary wastewater will be collected from the various points of origin in the facility and gravity feed (unless deemed impractical) to a relocated E. W. Brown sanitary septic field, or potentially managed through a packaged wastewater treatment system and discharged to an existing outfall.

2.9.2 Oily Wastewater

Plant wastewater that has the potential for oil contamination will be collected and routed through an oil water separator.

The separator will be capable of removing entrained oil to a maximum instantaneous concentration of 10 ppm. A level probe with high level switches and leak detection devices will be provided. This system will be designed so that separated oily waste can be removed from the plant via vacuum truck. Separated wastewater will be periodically sampled by means of a grab sample and routed to the plant wastewater collection sump (PWCS).

2.9.3 Plant Wastewater

The effluent limits from the wastewater collection sump are anticipated to be in accordance with EPA Title 40, Chapter 1, Subchapter N, Part 423 - Steam Electric Power Generating Point Source Category based on representative river water data. Therefore, plant wastewater from the PWCS will not require wastewater treatment plant prior to discharge to the outfall. It should be noted that the above conclusions are based on a typical river water analysis.

The plant wastewater discharge will be automatically monitored and measured as required by the plant wastewater permits and all applicable federal, state and local codes. Provisions also will be made to provide grab samples. Sample collections on the water discharge piping to facilitate the collection of grab samples will be provided.

Treated water will be combined with cooling tower blowdown and discharged through the plant wastewater discharge outfall.

2.9.4 Cooling Tower Blowdown

Cooling tower blowdown will be routed directly to the facility's outfall.

Cooling tower blowdown discharge will be monitored and measured as required by the plant wastewater permits and all applicable Federal, State and Local codes. Provisions to provide grab samples also will be made. Sample connections on the waste discharge piping to facilitate the collection of grab samples will be provided.

2.9.5 HRSG Blowdown

HRSG blowdown water will be quenched with service water and sent to the PWCS. Hot drain piping will be designed to accommodate temperatures up to 212 °F.

2.9.6 Combustion Turbine Water Wash

The CT water wash system will be provided with a double wall, fiberglass holding tank or concrete sump sized to contain the wastewater from two complete CT water wash cycles. The tank system will be provided with connections and designed for vacuum truck removal.

2.9.7 Storm Water

Site run-off will be collected and routed to maintain the site storm water drainage system with sentiment or detention ponds provided as required.

Discuss site facilities, offices, warehouses control rooms and differences between the sites

3.0 SCGT DESIGN BASIS

LG&E|KU is conducting an evaluation of F/G class simple cycle gas turbine (SCGT) generation options to be applied to serve as a peaking load dispatched plant. The evaluation considers siting 2x0 simple cycle units at the existing Mill Creek and E. W. Brown generating stations. The power block ratings considered are nominally aligned with existing coal-fired generation unit(s) with upcoming service retirements and consist of two 250 MW class units resulting in an installed nominal capacity of 500 MW.

The evaluated configuration/technology and arrangement considered for implementation include:

500 MW Simple Cycle Power Block

- 2x0 GE 7FA.05
- 2x0 MPA 501GAC
- 2x0 Siemens 5000F

Site Configurations Evaluated

- Mill Creek: Two Unit SCGT
- E. W. Brown: Two Unit SCGT (the E. W. Brown base case considered is located on the Unit 1-2 footprint with an alternate E. W. Brown Webb Farm site)

Each combustion turbine technology produces a specific output; therefore, a specific net plant output MW capacity is not provided.

Each simple cycle option was developed based similar design criteria as detailed in this section. Major plant features included in the design are as follows:

- Utilization of dry low NOx burners

- Evaporative cooling is included for operation at ambient conditions above 60 °F
- No hot side SCR or oxidation catalyst is included

A peaking operational dispatch schedule of 1000 annual hours has been assumed for all the options considered. The plant will be configured for cycling operation and deep turn-down capability, which is necessary to integrate intermittent generation resources into the LGE|KU system. The dispatch model for the emission and economic analysis is based on up to 125 starts annually.

Further details regarding combustion turbine (CT) technology, plant performance, emissions, capital costs, and life cycle economic evaluation are presented in the following report sections

The following subsections describe available CT technology, generic plant configuration, site layout, and site specific design criteria proposed for the NGCC facility. Also, plant performance, air emissions, and water consumption estimates have been provided for comparison between the NGCC options.

3.1 AVAILABLE COMBUSTION TURBINE TECHNOLOGY

Dependent upon on the generation capacity LG&E|KU determines to be necessary, there are several available F/G class units available. Table 3.1-1 depicts the technology proposed by the OEMs as the unit best suited for the LG&E-KU 2027 NGCC project. The table includes the combustion turbine simple cycle net output and heat rate at standard ISO conditions for reference.

Table 3.1-1. Available CT Technology

Manufacturer | Model		Gross Simple Cycle ISO Rating	
		Output MW	Heat Rate, LHV/HHV Btu/kWh
GE	7FA.05	239	8,871/9,820
MPA	501GAC	283	8,531/9,444
Siemens	SGT6-5000F	260	8,530/9,443

The F/G class combustion turbine technology proposed has been operating in North America in their offered configuration for many years and is considered an established, mature product line. The F/G class combustion turbines in simple cycle configuration is the dominant technology applied in the US for peaking service 200 MW and larger. Peaking facilities rated under 200 MW currently favor reciprocating internal combustion engine (RICE) technology over the historically applied aeroderivative combustion turbine technology.

3.2 PLANT CONFIGURATION

3.2.1 Simple Cycle Plant Configuration / Integration

The SCGT facility will consist of two simple cycle combustion turbines with evaporative cooling. Each combustion turbine will exhaust to a simple cycle exhaust stack furnished with horizontal silencers as required to meet the far field noise limits. The design will include layout provisions for future combined cycle conversion.

The plant will be designed as a predominantly outdoor plant with the combustion turbines and auxiliaries furnished with the OEM weather enclosures and applicable cold weather provisions. The boiler feedwater pump(s) and all pump skids will be located indoors.

Each combustion turbine generator will have a main generator step-up transformer with a nominal output voltage corresponding to the site interconnection voltage. In addition, an auxiliary transformer fed from a tap on the isolated phase bus from each generator will be provided. Each auxiliary transformer will have sufficient capacity to operate the entire SCGT facility.

Natural gas filters, scrubbers and pressure reducing stations will be provided as required to meet the pressure and cleanliness requirements of the CT manufacturer.

For the purpose of this evaluation and developing cost estimates, the following primary external infrastructure systems which will interface with the proposed NGCC facility are assumed:

Natural Gas Transmission – Natural gas will be supplied to the NGCC facility via extension and/or upgrade of the interstate pipeline system available near each site. The feasibility study is based on natural gas pipeline minimum delivery pressure at the site boundary to be nominally 500 psig.

Service Water Supply – Service water for each facility will be provided from the existing plant facilities to the extent available to support long term operation of the SCGT units.

Potable Water Supply – Potable water will be received from a municipal water main.

Wastewater Discharge – Wastewater will be discharged to the raw water source through existing outfalls.

Sanitary Sewer – The SCGT installation will not require sanitary sewer.

Storm Water – The existing surface drainage system will be expanded and modified as necessary to accommodate the increased storm water runoff of the NGCC facility.

Electrical Transmission – The existing station electrical transmission system will be extended to serve the additional generation with the following points of interconnection;

- Mill Creek: 345 kV at existing Mill Creek Substation
- E. W. Brown (Webb Farm Site): 345 kV at existing Brown North Substation
- E. W. Brown (Unit 1-2 Site): 138 kV at existing Brown North Substation

The site development for each existing station includes relocation of existing overhead lines as required to facilitate construction.

Cycle Make-up Water – The existing demineralized water treatment system will serve the evaporative coolers (blended with service water) and CT water wash demineralized water requirements.

Fire Protection – The existing fire protection systems will be extended to serve the fire protection supply requirements of the SCGT facility.

3.2.2 Natural Gas Transmission

Natural gas will be supplied to the SCGT facility via extension and/or upgrade of the interstate pipeline system available near each site. The Owners cost includes budget to install the off-site gas pipeline facilities to meet the gas demand associated with the proposed facility. The feasibility study is based on natural gas pipeline minimum delivery pressure at the site boundary to be nominally 500 psig. The planned gas pressure is not adequate to meet the combustion turbine OEM requirements and on-site gas compression is included in the conceptual design. The gas compression system design is based on furnishing one compressor provided for each Installed power block (two simple cycle F/G class units). The E. W. Brown site designs also include an additional gas compressor to serve the existing two Alstom GT-24 combustion turbines which require 525 psig gas pressure. The additional gas compressor is sized to provide a 3 x 50% configuration for reliability.

3.3 SITE LAYOUT

The site for the SCGT facility has been arranged around some key considerations important to plant operation and maintenance as follows.

- Site arrangement selected based on lowest development costs for property, common facilities interconnection, excavation/fill, and transmission line relocation.
- Provisions for rail delivery and heavy haul access to the construction laydown area have been considered where available for ease of equipment delivery storage.
- Road access to major pieces of equipment and the parking lot has been provided including a main paved drive to the combustion turbines for trailer access when removing turbine parts.
- Ample parking space for facility staff and visitors.
- Ample space for construction laydown and parking areas.
- Space and equipment arrangement provisions for future conversion of the SCGT to combined cycle have been considered.

Site arrangements have been included within Appendix A for the 2x0 SCGT facilities based on a typical (non-OEM specific) F/G class outdoor unit layout. The E. W. Brown arrangements includes an optional site arrangement located north of the existing combustion turbine area for further consideration to mitigate unit retirement schedule coordination. The alternate E. W. Brown Webb Farm site has been evaluated and determined to result in minimal differential cost associated with adjustments in site civil and land purchase.

3.4 SITE DESIGN CRITERIA

The following identify the key design criteria for the proposed SCGT facility.

3.4.1 Ambient Data

The evaluation design basis ambient conditions are defined as follows.

Summer Design Day
Dry Bulb: 90 °F
Relative Humidity: 50 percent

Annual Average Design Conditions
Dry Bulb: 57 °F
Relative Humidity: 70 percent

Extreme Hot Design Day
Dry Bulb: 106 °F
Relative Humidity: 40 percent

Minimum Summer Design Day (Electrical Interconnection basis)
Dry Bulb: 45 °F
Relative Humidity: 60 percent

Winter Design Day

Dry Bulb:	15 °F
Relative Humidity:	55 percent

Extreme Winter Design Day

Dry Bulb:	-18 °F
Relative Humidity:	50 percent
Site Elevation:	860 ft.

All economic analyses and lifecycle cost analyses were performed using expected plant performance at the annual average design conditions.

3.4.2 Noise Limits

The equipment is designed for a near field noise emitting criterion of 85 dBA maximum at 3 feet from the equipment (in a free field) with exceptions. Where practicable, acoustical insulation and enclosures will be used as required for equipment that would otherwise exceed this criterion. The noise limit will not exceed 85 dBA accumulative for all areas of the site, regardless of individual noise emitted from each piece of equipment. Certain equipment noise may exceed this criterion, even with noise control measures, particularly within enclosures or rooms. In this case, signs indicating that hearing protection is required are included. Locations where noise levels can be expected to exceed limits stated above are the turbine steam chest, the boiler feed pumps, large air compressors, and steam generator safety valves. The HRSG power-actuated pressure relief valves will be equipped with discharge silencers.

The far field noise emissions limit is estimated to be 55 dBA at the property line based on the Kentucky Siting Board 1000 foot setback required.

3.4.3 Basic Structural Design Criteria

The building code to be used for the project is the Kentucky Building Code 2018 (Second Edition) which adopts the International Building Code (IBC) 2015 with defined exceptions.

Snow Loads

Snow design shall be in accordance with IBC 2015, section 1608, utilizing the inputs below:

- Minimum ground snow load = 15 lb/ft2

Wind loads

Wind design shall be in accordance with IBC 2015, section 1609, utilizing the inputs below:

- 3 second gust = 90 miles/hr
- Exposure category = B

Seismic Loads

Seismic design shall be in accordance with IBC 2015, section 1613, utilizing the inputs below:

- Occupancy category = III
- Site (soil) class = D
- Seismic design category = C or D, EPC Contractor to verify exact location and category with building official

Frost Penetration

Underground fire water piping shall have a minimum depth of 30 inches to the top of the pipe. All other underground piping and foundations shall have a minimum depth of 30 inches.

3.4.4 Precipitation

Point precipitation frequency estimates from NOAA Atlas 14 for Louisville, Kentucky:

Annual average, inches	44.54
10 year, 24-hour, inches	6.9
25 year, 24-hour, inches	7.86
100 year, 24-hour, inches	9.34

3.4.5 Storm Water

Design the storm collection system for a 24 hour, 25 year point precipitation frequency.

3.5 PLANT PERFORMANCE

3.5.1 Thermal Cycle Design

Each SCGT arrangement has been held to the following general thermal cycle design constraints:

- Natural gas as the primary fuel (higher heating value of 22,029 Btu/lb), with an option for fuel oil as a backup fuel.
- Utilization of low NO_x burners.
- Evaporative cooling is included for operation at ambient conditions above 60 °F

Additionally, design criteria unique to each combustion turbine option include:

GE 7FA.05

- CT Gas Pressure Requirement: 550 psig at plant boundary

MPA 501GAC

- CT Gas Pressure Requirement: 665 psig at plant boundary

Siemens 5000F

- CT Gas Pressure Requirement: 535 psig at plant boundary

3.5.2 Key Unit Ratings/Performance

Tables 3.5-1 through 3.5-3 provide a summary of expected "new and clean" plant performance for a variety of SCGT arrangements at 1 percent summer, annual average ambient, and 99 percent winter conditions. Auxiliary loads represent a fully burdened, stand-alone plant, excluding gas compression loads. All heat rates and plant efficiencies are presented on a higher heating value (HHV) basis.

Table 3.5-1. Average Ambient Performance, New and Clean

	Description	Gross Plant Output (MW)	Gross Plant Heat Rate (Btu/kWH - HHV)	Auxiliary Power Percentage (%)	Net Plant Output (MW)	Net Plant Heat Rate (Btu/kWH - HHV)
3	2x0 GE 7FA.05	455.9	9,820	1.00%	451.3	9,919
6	2x0 501GAC	542.6	9,648	1.00%	537.2	9,745
9	2x0 5000F	506.2	9,364	1.00%	501.1	9,459

As can be noted, plant efficiencies for each F/G class simple cycle unit are similar with nominal net plant heat rate ranging from 9459 BTU/KWHr to 9919 BTU/KWHr. The Siemens 5000F configuration offers the highest efficiency based on gross unit heat rates and it is noted the auxiliary power utilized for the performance is based on uniform estimates performed by HDR.

To represent how the plant performance will vary with ambient conditions, Tables 3.5-2 and 3.5-3 provide a summary of expected "new and clean" plant performance at 90 ºF / 50 percent relative humidity and 15 ºF / 55 percent relative humidity conditions, respectively.

Table 3.5-2. Summer Ambient Conditions - New and Clean

	Description	Gross Plant Output (MW)	Gross Plant Heat Rate (Btu/kWH - HHV)	Auxiliary Power Percentage (%)	Net Plant Output (MW)	Net Plant Heat Rate (Btu/kWH - HHV)
3	2x0 GE 7FA.05	439.2	9,997	1.00%	434.8	10,098
6	2x0 501GAC	512.2	9,739	1.00%	507.1	9,838
9	2x0 5000F	490.4	9,536	1.00%	485.5	9,632

Table 3.5-3. Winter Ambient Conditions, New and Clean

	Description	Gross Plant Output (MW)	Gross Plant Heat Rate (Btu/kWH - HHV)	Auxiliary Power Percentage (%)	Net Plant Output (MW)	Net Plant Heat Rate (Btu/kWH - HHV)
3	2x0 GE 7FA.05	464.0	9,742	1.00%	459.3	9,840
6	2x0 501GAC	595.6	9,464	1.00%	589.6	9,559
9	2x0 5000F	520.4	9,270	1.00%	515.2	9,364

When comparing Table 3.5-1 with Tables 3.5-2 through 3.5-3, higher ambient temperatures reduce simple cycle plant efficiencies. The ambient temperature impact to output and heat rate varies among the OEM technologies. The simple cycle performance data is included in Appendix B.

3.6 AIR EMISSIONS

Air pollutant emission rates should be in accordance with the final approved air permit. U.S. EPA test methods for each pollutant will be utilized in accordance with the permit. For the purposes of this assessment and the economic analysis completed in Section 7.0, the target emission levels utilizing emissions controls for a single simple cycle unit are summarized below in Table 3.6-1. The target emissions are based on providing 9 ppm NOx/CO emissions representative of BACT for PSD based permitting with an operating hour limit applied. Emissions are summarized for one simple cycle unit on a lb/hr basis.

Table 3.6-1. Unit Stack Emissions – SCGT Simple Cycle Units

Stack Emissions - Simple Cycle Unit (per CT)								
		7FA.05		501GAC		5000F	
		Summer	Winter	Summer	Winter	Summer	Winter
Temperature		90	15	90	15	90	15
Relative Humidity		50	55	50	55	50	55
CTG Heat Input	mmBtu/h, HHV	2195.4	2260.0	2,500	2,825	2,343	2,417
NOx as NO2	ppmvd @ 15% O2	9.00	9.00	9.00	9.00	9.00	9.00
	lb/hr	71.3	74.1	90.00	101.00	79.10	81.60
	lb/mmBtu	0.0325	0.0328	0.0360	0.0358	0.0338	0.0338
CO	ppmvd @ 15% O2	9.00	9.00	10.00	10.00	4.00	4.00
	lb/hr	32.6	34.4	61.00	69.00	21.40	22.10
	lb/mmBtu	0.0148	0.0152	0.0244	0.0244	0.0091	0.0091
VOC	ppmvd @ 15% O2	1.40	1.40	2.00	2.00	1.00	1.00
	lb/hr	3.2	3.3	7.00	7.90	1.80	3.20
	lb/mmBtu	0.0015	0.0015	0.0028	0.0028	0.0008	0.0013
PM Total	lb/hr	6.8	6.8	5.67	6.36	9.20	9.50
	lb/mmBtu	0.0031	0.0030	0.0023	0.0023	0.0039	0.0039
PM Filterable	lb/hr	6.8	6.8	5.67	6.36	9.20	9.50
	lb/mmBtu	0.0031	0.0030	0.0023	0.0023	0.0039	0.0039
SO2	lb/hr	3.2	3.3	3.50	3.90	3.30	3.30
	lb/mmBtu	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014
H2SO4	lb/hr	0.2	0.3	0.30	0.32	0.20	0.20
	lb/mmBtu	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Formaldehyde	ppbvd @ 15% O2	91	91	45	45	45	45
	lb/hr	0.24	0.24	0.27	0.30	0.25	0.26
	lb/mmBtu	1.07E-04	1.07E-04	1.08E-04	1.06E-04	1.07E-04	1.07E-04
CO2	lb/hr	256,093	263,629	291,625	329,536	273,311	281,943
	lb/mmBtu	116.65	116.65	116.65	116.65	116.65	116.65
	lb/MWH gross	1166	1136	1139	1107	1115	1083
	lb/MWH net	1178	1148	1150	1118	1126	1094

The estimated worst case annual emissions for each technology for a single simple cycle unit are summarized in Table 3.6-2 through Table 3.6-4. The annual emissions are calculated on a potential to emit basis with 150 starts full load operation for 1000 hours of operation. Emissions are summarized for one simple cycle unit on an annual ton basis.

Table 3.6-2. GE FA.05 Single Unit Annual Emissions

GE 7FA.05 Simple Cycle

Peaking Dispatch Annual 1000 Hours

	No. of Starts	NOx	CO	VOC	PM10
		lbs	lbs	lbs	lbs
Starts	150	5,400	57,000	8,100	450
Shutdowns	150	4,500	59,400	12,600	300
Steady State	1,000	72,700	33,500	3,250	6,800
TOTAL (TPY)		41	75	12	4

Table 3.6-3. MPA 501GAC Single Unit Annual Emissions

MPA 501GAC Simple Cycle

Peaking Dispatch Annual 1000 Hours

	No. of Starts	NOx	CO	VOC	PM10
		lbs	lbs	lbs	lbs
Starts	150	1,800	44,325	24,750	750
Shutdowns	150	1,350	45,900	27,000	750
Steady State	1,000	95,500	65,000	7,450	6,015
TOTAL (TPY)		49	78	30	4

Table 3.6-4. Siemens 5000F Single Unit Annual Emissions

3.7 WATER

Raw water for each facility will be provided from the adjacent surface water resource utilizing existing plant facilities to the extent available to support long term operation of the SCGT units. The Mill Creek site NGCC unit additions will be served from the existing Mill Creek service water system. The retirement of Mill Creek Unit 1 and Unit 2 will result in freed capacity to serve the NGCC units via the existing Ohio River intake system, and the planned longer term operation of Mill Creek Unit 3 and Unit 4 will ensure the current system utilization will align with site needs for a lengthy timeframe.

The E. W. Brown site will utilize the Unit 1 Herrington Lake intake structure retrofitted with replacement traveling screens. The proposed modifications to the intake structure will meet the requirements set forth by Phase II of Section 316(b) for existing facilities and also Phase I requirements for new facilities.

Plant water streams including the following:

- Raw Water
- Service Water
- Potable Water

Plant water consumption and wastewater discharge rates have been presented in Section 3.7.4 for each SCGT arrangement operating at annual average design conditions.

3.7.1 Raw Water

The raw water system distributes low-pressure water to the following uses:

- Service water

3.7.2 Service Water

The service water system served from the raw water system distributes low-pressure water throughout the power station for the following uses:

- CT evaporative cooling system
- Hose stations for maintenance washdowns
- Demineralized water treatment (E. W. Brown site only)

The service water system consists of a storage tank, pumps, and distribution piping network.

3.7.3 Demineralized Water

For the Mill Creek site, the demineralized water for CT evaporative cooling and water wash applications will be provided by the existing cycle makeup water treatment system for boiler steam/condensate cycle makeup. The E. W. Brown site will require a demineralized water treatment system to be provided.

The SCGT facility demineralization system will include a demineralized water storage tank and pumps.

3.7.4 Potable Water

Potable water will be provided by the municipal water main. A single interface point with the water main will be made and routed into the power station site. Backflow preventers and water meters will be provided as required.

3.7.5 Water Consumption and Wastewater Discharge

Plant water consumption and wastewater discharge rates are predominantly driven by the evaporative cooler service and will consume 60 to 75 GPM of blended demineralized/service water with a 10 to 15 GPM blowdown. The water consumption and discharge will be minimal for operation at ambient temperatures below 60 °F or other times the evaporative coolers are not in service.

3.8 WASTEWATER

The wastewater collection and transfer system will be provided to collect, monitor, and discharge of the facility wastewater streams including the following.

- Oily Wastewater
- Gas Turbine Wash Water

All wastewater lift stations will be furnished with sump pumps installed in 100 percent capacity pairs. Sump pumps will be vertical sump pumps with the motor installed above the sump cover.

3.8.1 Sanitary Wastewater

The Mill Creek project site will discharge sanitary wastewater to the local municipal utility system.

The E.W. Brown site sanitary wastewater will be collected from the various points of origin in the facility and gravity feed (unless deemed impractical) to a relocated E. W. Brown sanitary septic field, or potentially managed through a packaged wastewater treatment system and discharged to an existing outfall.

3.8.2 Oily Wastewater

Plant wastewater that has the potential for oil contamination will be collected and routed through an oil water separator.

The separator will be capable of removing entrained oil to a maximum instantaneous concentration of 10 ppm. A level probe with high level switches and leak detection devices will be provided. This system will be designed so that separated oily waste can be removed from the plant via vacuum truck. Separated wastewater will be periodically sampled by means of a grab sample and routed to the plant wastewater collection sump (PWCS).

3.8.3 Plant Wastewater

The effluent limits from the wastewater collection sump are anticipated to be in accordance with EPA Title 40, Chapter 1, Subchapter N, Part 423 - Steam Electric Power Generating Point Source Category based on representative river water data. Therefore, plant wastewater from the PWCS will not require wastewater treatment plant prior to discharge to the outfall. It should be noted that the above conclusions are based on a typical river water analysis.

The plant wastewater discharge will be automatically monitored and measured as required by the plant wastewater permits and all applicable federal, state and local codes. Provisions also will be made to provide grab samples. Sample collections on the water discharge piping to facilitate the collection of grab samples will be provided.

Treated water will be combined with cooling tower blowdown and discharged through the plant wastewater discharge outfall.

3.8.4 Combustion Turbine Water Wash

The CT water wash system will be provided with a double wall, fiberglass holding tank or concrete sump sized to contain the wastewater from two complete CT water wash cycles. The tank system will be provided with connections and designed for vacuum truck removal.

3.8.5 Storm Water

Site run-off will be collected and routed to maintain the site storm water drainage system with sentiment or detention ponds provided as required.

4.0 ELECTRICAL INTERCONNECTION

The NGCC Power Block will be interconnected to the LG&E/KU transmission system at the site specific voltages listed below;

- Mill Creek: 345 kV at existing Mill Creek Substation
- E. W. Brown (Webb Farm Site): 345 kV at existing Brown North Substation
- E. W. Brown (Unit 1-2 Site): 138 kV at existing Brown North Substation

The Project estimates include the GSUs and a high-side take-off structure. The direct interconnection cost of the plant will be determined by an Independent Transmission Operator (ITO) study. An allowance for the direct interconnection cost is included in the Owners Indirect cost for each plant configuration.

The SCGT electrical interconnection will be implemented through a power plant located collector bus (138 kV or 345 kV) which will consolidate the output into a single circuit routed to the point of interconnection (POI).

For the specific electric power system configurations refer to the One Line Diagrams located in Appendix C.

5.0 PROJECT SCHEDULE

The NGCC facility’s project schedule from full notice to proceed [FNTP] to commercial operation date (COD) has been estimated to be 37 months for a single unit power block. A two unit project build has been estimated to include 37 months from FNTP to COD for the first unit and an additional 4 months to complete the second unit on site.

The SCGT project schedule from FNTP to commercial operation date (COD) has been estimated to be 24 months.

The NGCC project schedule for each site location considered is essentially the same duration driven by the steam turbine lead time, and similar construction and commissioning activity durations. The FNTP for each option is anticipated to be March 2024 based on the expected regulatory approval timeframe, with the exception of the E. W. Brown base options located on the Unit 1-2 site which will commence in March 2025 to support the decommissioning of the existing retired units.

Appendix D provides the assumed project scope, logic ties and estimated schedule activity durations required to complete the NGCC and SCGT facility.

6.0 PROJECT COST ESTIMATES

The basis for the NGCC and SCGT project cost estimates are defined in the sections below. Complete line item details regarding the scope of costs included in the total project cost estimates are included in Appendix E.

6.1 NGCC PROJECT COST ESTIMATES

Budgetary equipment pricing for certain major mechanical equipment, including the Power Island (ST, HRSG, CT, DCS, CEMS and Bypass Valves), boiler feed pumps, condensate pumps, condenser, and cooling tower, as well as recent equipment estimates from similar projects were utilized in developing the total project cost. The quantity based cost estimate has been calibrated with current advanced class combined cycle project market based development and proposal values. Other assumptions and project scope included in the estimate is summarized as follows:

- Brownfield development with site specific scope items as follows:
  - Mill Creek: The existing Unit 3 and Unit 4 coal-fired generation is currently planned to be in service for an extended period which will support retention of the existing common facility assets to include the administration building, demineralized water and river water intake/discharge systems.
  - E. W. Brown Unit 1-2 Site: The NGCC facilities will be located within the retired Unit 1 and Unit 2 coal-fired footprint after demolition of those facilities by the end of 2024. The 2027 NGCC layout does not require Unit 3 to be retired or demolished but is acknowledged its operational status will impact the Unit 1 and Unit 2 demolition project. The NGCC facility cost estimate is based on providing a replacement 600 gallon per minute (GPM demineralized water treatment system to serve the existing combustion turbines on site.
  - E. W. Brown Webb Farm Site: The NGCC facilities will be located north of the existing combustion turbine area to mitigate unit retirement schedule coordination. The alternate E. W. Brown Webb Farm site has been evaluated and determined to result in minimal differential cost associated with adjustments in site civil and land purchase. The E. W. Brown Webb Farm Site is considered to be available to support a 2024 construction start with 2027 COD pending successful land acquisition. The NGCC scope at each of the three sites includes the following;
- Site specific topography includes rock excavation and imported fill
- No black start generation capacity included
- Condenser with vacuum pumps and mechanical draft cooling tower (no plume abatement)

- SCR and DLN combustors for NOx control
- Oxidation catalyst for CO and VOC control
- Electrical scope includes the GSU transformers and high-side take-off structure
- Natural gas piping starting from site metering station
- Sales tax is included for non-production material
- Construction based on a ten hour per day, five day per week work week

The following Owner’s costs have also been established and are included in the estimate:

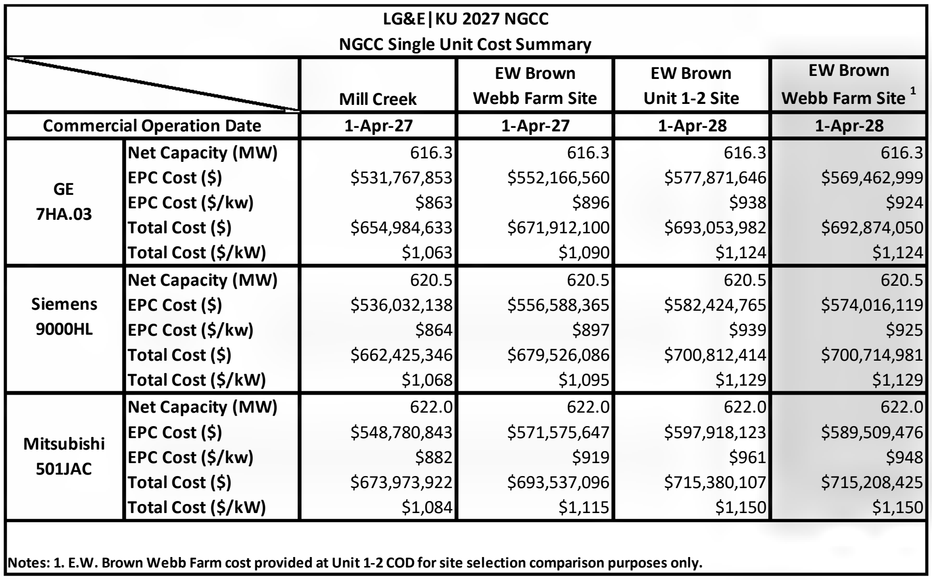
- Project Development
- Transmission Interconnection
- Natural Gas Pipeline Interconnection
- Natural Gas Pipeline Fixed O&M (Startup Period)
- Construction Power (Service Installation and Energy)
- Owner Operations Personnel (Prior to COD)
- Owner’s Project Management
- Owner’s Engineer
- Owner’s Legal Counsel
- Land Cost
- Operator Training
- Startup Testing (Includes Fuel & Power Sales)
- Site Security
- Operating Spare Parts (Excludes CT LTSA Costs)
- Permanent Plant Equipment & Furnishings
- IT and Telecommunication Infrastructure
- Owner costs contingency (10%)

Owner’s contingency of 10 percent of the total EPC project cost has also been included within the project estimate.

The cost estimates are based on the contracting approach utilized for the Cane Run Unit 7 project with LG&E|KU control over the final equipment selection. The current gas-fired combined cycle market conditions support this level of Owner flexibility. An issue that will need to be evaluated in the process is the strong trend toward a power island scope of supply with a single OEM furnishing the CT, HRSG, ST and DCS. The cost premium historically conceived for the full power island scope is not currently present, and the majority of Owners and EPC contractors now prefer this arrangement. The potential air permitting regulatory agency requirement to include equipment selection for the air permit approval process can be supported through an Owner furnished equipment procurement that is ultimately incorporated in the fully wrapped EPC. Under this hybrid Owner furnished equipment approach the major equipment is procured under a Memorandum of Understanding (MOU) in advance of the EPC Contractor selection and subsequently fully assigned to the EPC Contractor. The Major Equipment MOU would include the full technical specifications for the scope of supply, performance/emission guarantees, schedule submittals and delivery dates and commercial terms for transfer to the EPC Contractor. This approach would also include parallel development of the LTSA with the OEM to support the overall equipment selection.

Site specific capital costs are provided for the Mill Creek and E.W. Brown sites to differentiate site variations and assist in future siting evaluations. The E. W. Brown assessment includes identification of an optional site arrangement located north of the existing combustion turbine area for further consideration to mitigate unit retirement schedule coordination. The alternate E. W. Brown Webb Farm Site has been evaluated and determined to result in minimal differential cost associated with adjustments in site civil and land purchase. A summary of the estimated plant EPC costs and Owner's costs for each configuration and site evaluated are depicted in Tale 6.1-1 and Table 6.1-2.

Table 6.1-1. NGCC Single Unit Total Project Cost

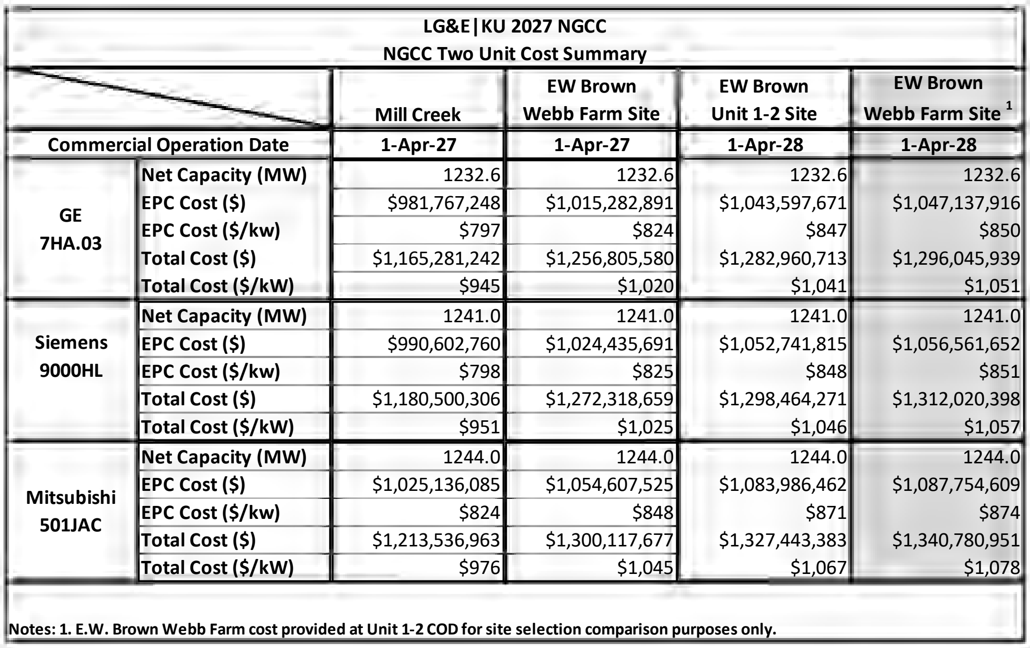


LG&E|KU 2027 NGCC
NGCC Single Unit Cost Summary

		Mill Creek	EW Brown Webb Farm Site	EW Brown Unit 1-2 Site	EW Brown Webb Farm Site ^{1}
Commercial Operation Date		1-Apr-27	1-Apr-27	1-Apr-28	1-Apr-28
GE 7HA.03	Net Capacity (MW)	616.3	616.3	616.3	616.3
	EPC Cost ($)	$531,767,853	$552,166,560	$577,871,646	$569,462,999
	EPC Cost ($/kw)	$863	$896	$938	$924
	Total Cost ($)	$654,984,633	$671,912,100	$693,053,982	$692,874,050
	Total Cost ($/kW)	$1,063	$1,090	$1,124	$1,124
Siemens 9000HL	Net Capacity (MW)	620.5	620.5	620.5	620.5
	EPC Cost ($)	$536,032,138	$556,588,365	$582,424,765	$574,016,119
	EPC Cost ($/kw)	$864	$897	$939	$925
	Total Cost ($)	$662,425,346	$679,526,086	$700,812,414	$700,714,981
	Total Cost ($/kW)	$1,068	$1,095	$1,129	$1,129
Mitsubishi 501JAC	Net Capacity (MW)	622.0	622.0	622.0	622.0
	EPC Cost ($)	$548,780,843	$571,575,647	$597,918,123	$589,509,476
	EPC Cost ($/kw)	$882	$919	$961	$948
	Total Cost ($)	$673,973,922	$693,537,096	$715,380,107	$715,208,425
	Total Cost ($/kW)	$1,084	$1,115	$1,150	$1,150

Notes: 1. E.W. Brown Webb Farm cost provided at Unit 1-2 COD for site selection comparison purposes only.

Table 6.1-2. NGCC Two Unit Total Project Cost



LG&E|KU 2027 NGCC
NGCC Two Unit Cost Summary

		Mill Creek	EW Brown Webb Farm Site	EW Brown Unit 1-2 Site	EW Brown Webb Farm Site ^{1}
Commercial Operation Date		1-Apr-27	1-Apr-27	1-Apr-28	1-Apr-28
GE 7HA.03	Net Capacity (MW)	1232.6	1232.6	1232.6	1232.6
	EPC Cost ($)	$981,767,248	$1,015,282,891	$1,043,597,671	$1,047,137,916
	EPC Cost ($/kw)	$797	$824	$847	$850
	Total Cost ($)	$1,165,281,242	$1,256,805,580	$1,282,960,713	$1,296,045,939
	Total Cost ($/kW)	$945	$1,020	$1,041	$1,051
Siemens 9000HL	Net Capacity (MW)	1241.0	1241.0	1241.0	1241.0
	EPC Cost ($)	$990,602,760	$1,024,435,691	$1,052,741,815	$1,056,561,652
	EPC Cost ($/kw)	$798	$825	$848	$851
	Total Cost ($)	$1,180,500,306	$1,272,318,659	$1,298,464,271	$1,312,020,398
	Total Cost ($/kW)	$951	$1,025	$1,046	$1,057
Mitsubishi 501JAC	Net Capacity (MW)	1244.0	1244.0	1244.0	1244.0
	EPC Cost ($)	$1,025,136,085	$1,054,607,525	$1,083,986,462	$1,087,754,609
	EPC Cost ($/kw)	$824	$848	$871	$874
	Total Cost ($)	$1,213,536,963	$1,300,117,677	$1,327,443,383	$1,340,780,951
	Total Cost ($/kW)	$976	$1,045	$1,067	$1,078

Notes: 1. E.W. Brown Webb Farm cost provided at Unit 1-2 COD for site selection comparison purposes only.

6.2 SGCT PROJECT COST ESTIMATES

Budgetary equipment pricing for combustion turbines, as well as recent equipment estimates from similar projects were utilized in developing the total project cost. The quantity based cost estimate has been calibrated with current F/G class simple cycle project market based development and proposal values. Other assumptions and project scope included in the estimate is summarized as follows:

- Brownfield development with site specific scope items as follows;
    - Mill Creek: The existing Unit 3 and Unit 4 coal-fired generation is currently planned to be in service for an extended period which will support retention of the existing common facility assets to include the administration building, demineralized water and river water intake/discharge systems.
    - E. W. Brown Unit 1-2 Site: The SCCT facilities will be located within the retired Unit 1 and Unit 2 coal-fired footprint after demolition of those units by the end of 2024. The 2027 SCCT layout does not require Unit 3 to be retired or demolished but it is acknowledged its operational status will impact the Unit 1 and Unit 2 demolition project.
    - E. W. Brown Webb Farm Site: The NGCC facilities will be located north of the existing combustion turbine area to mitigate unit retirement schedule coordination. The alternate E. W. Brown site has been evaluated and determined to result in minimal differential cost associated with adjustments in site civil and land purchase. The E. W. Brown Webb Farm site is considered to be available to support a 2024 construction start with 2026 COD pending successful land acquisition.
- Site specific topography includes rock excavation and imported fill
- No black start generation capacity included
- Electrical scope includes the GSU transformers and high-side collector bus switchyard (single breaker/circuit to POI)
- Natural gas piping starting from site metering station
- Sales tax is included for non-production material
- Construction based on a ten hour per day, five day per week work week

The following Owner’s costs have also been established and are included in the estimate:

- Project Development
- Transmission Interconnection
- Natural Gas Pipeline Interconnection
- Natural Gas Pipeline Fixed O&M (Startup Period)
- Construction Power (Service Installation and Energy)
- Owner Operations Personnel (Prior to COD)
- Owner’s Project Management
- Owner’s Engineer
- Owner’s Legal Counsel
- Land Cost
- Operator Training
- Startup Testing (Includes Fuel & Power Sales)
- Site Security
- Operating Spare Parts (Excludes CT LTSA Costs)
- Permanent Plant Equipment & Furnishings

- IT and Telecommunication Infrastructure
- Owner costs contingency (10%)

Owner's contingency of 10 percent of the total EPC project cost has also been included within the project estimate.

The cost estimates are based on the contracting approach utilized for the Cane Run Unit 7 project with LG&E|KU control over the final equipment selection. The current gas-fired combined cycle market conditions support this level of Owner flexibility. The potential air permitting regulatory agency requirement to include equipment selection for the air permit approval process can be supported through an Owner furnished equipment procurement that is ultimately incorporated in the fully wrapped EPC.

Site specific capital costs are provided for the Mill Creek and E.W. Brown sites to differentiate site variations and assist in future siting evaluations. The E. W. Brown assessment includes identification of an optional site arrangement located north of the existing combustion turbine area for further consideration to mitigate unit retirement schedule coordination. The alternate E. W. Brown Webb Farm site has been evaluated and determined to result in minimal differential cost associated with adjustments in site civil and land purchase. A summary of the estimated plant EPC costs and Owner's costs for each configuration and site evaluated are depicted in Tale 6.1-3.

Table 6.1-3 SCGT Total Project Cost

LG&E|KU 2027 NGCC
SCGT Cost Summary

		Mill Creek	EW Brown Webb Farm Site	EW Brown Unit 1-2 Site	EW Brown Webb Farm Site [1]
Commercial Operation Date		1-Apr-26	1-Apr-26	1-Apr-27	1-Apr-27
GE 7FA.05	Net Capacity (MW)	434.8	434.8	434.8	434.8
	EPC Cost ($)	$240,120,491	$258,789,183	$268,354,287	$266,779,194
	EPC Cost ($/kw)	$552	$595	$617	$614
	Total Cost ($)	$311,116,535	$326,690,985	$330,958,887	$336,740,684
	Total Cost ($/kW)	$716	$751	$761	$774
Siemens SGT6-5000F	Net Capacity (MW)	485.5	485.5	485.5	485.5
	EPC Cost ($)	$263,298,689	$281,967,380	$291,709,057	$290,663,570
	EPC Cost ($/kw)	$542	$581	$601	$599
	Total Cost ($)	$339,912,552	$355,487,002	$359,949,135	$366,412,498
	Total Cost ($/kW)	$700	$732	$741	$755
Mitsubishi 501GAC	Net Capacity (MW)	507.1	507.1	507.1	507.1
	EPC Cost ($)	$333,687,052	$352,355,744	$364,226,736	$363,181,249
	EPC Cost ($/kw)	$658	$695	$718	$716
	Total Cost ($)	$414,589,752	$430,164,202	$436,968,582	$443,349,445
	Total Cost ($/kW)	$818	$848	$862	$874

Notes: 1. E.W. Brown Webb Farm cost provided at Unit 1-2 COD for site selection comparison purposes only.

7.0 LIFECYCLE COST ANALYSES

Detailed life cycle analyses have been completed to determine a cost of generation for each of the NGCC and SCGT arrangements under evaluation. For reference, the life cycle analyses have been provided in Appendix F for the NGCC and SCGT options considered herein. The following provides a summary description of each component of the cost of generation of electricity.

7.1 OPERATING AND MAINTENANCE COSTS

Fully burdened plant operations and maintenance staff as well as other fixed costs associated with facility operations such as building and site maintenance, insurances, and property taxes are summarized in Table 7.1-1. Escalation has been applied to these costs at 2.0 percent per year.

Table 7.1-1. Fixed Cost Assumptions

Fixed Cost	First Year Value (2027)
Annual Cost for Salaried Staff – Mill Creek	Not Applicable
Annual Cost for Hourly Staff – Mill Creek	$139,228
Annual Cost for Salaried Staff – Brown	Not Applicable
Annual Cost for Hourly Staff – Brown	$166,298
Insurance	Not Applicable
Property Tax	Not Applicable

The analysis is based on plant staffing levels required to incrementally support the NGCC and SCGT unit(s) in addition to the other assets which will remain in service at the corresponding site. The assets to remain in service include Mill Creek Unit 3 and Unit 4. The E. W. Brown site will retain long term operation of the simple cycle combustion turbines and Unit 3 will continue operation until a retirement date has been established. The following incremental staffing levels are utilized for the analysis for both the Mill Creek and E. W. Brown sites:

- Single Unit NGCC: 12 additional salary staff
- Two Unit NGCC: 17 additional salary staff
- Two Unit SCGT: 4 additional salary staff

(Note staff annual cost varies between sites)

Equipment parts and maintenance costs are included in the analysis as fixed and variable O&M costs and are dependent upon maintenance schedules and hours of operation of the equipment. These costs have included expenses for replacement parts and outsourced labor to perform major maintenance on the combustion turbines, steam turbines, HRSGs, and other major equipment. Escalation has been applied to these costs at 2.0 percent per year.

Consumable costs include costs for material delivery and disposal for all of the materials utilized within the power generation process. These consumable costs include items such as ammonia, water, water treatment chemicals, and spare parts.

The plant will be installed with air quality control equipment intended to comply with emissions limits dictated by federal and state authorities, therefore emissions allowances have not been incorporated into the evaluation.

Unit costs used in the evaluation for the consumables are as defined below in Table 7.1-2.

Table 7.1-2. Consumable Cost Basis

Consumable	First Year Value (2027)
Consumable Escalation Rate	2.0%
Ammonia (as 19% Aqueous)	$202.37 per Ton
Clarified Water - Mill Creek and Brown	$0 per 1000 gallons
Demineralized Water	$5.72 per 1000 gallons
Cycle Chemical Feed	$0.015 per ton steam produced
Annual Site/Building Maintenance Cost	$170,850

7.2 FUEL COSTS

Fuel costs are strictly a function of the cost of fuel as delivered to the facility. These are then converted to a $/MWH basis by utilizing the cycle heat rates. The first year cost of fuel assumed for this evaluation is $2.95/MMBTU with the forecast pricing indicated in Figure 7.2-1. The economic analysis is based on the Mid-Level natural gas forecast.

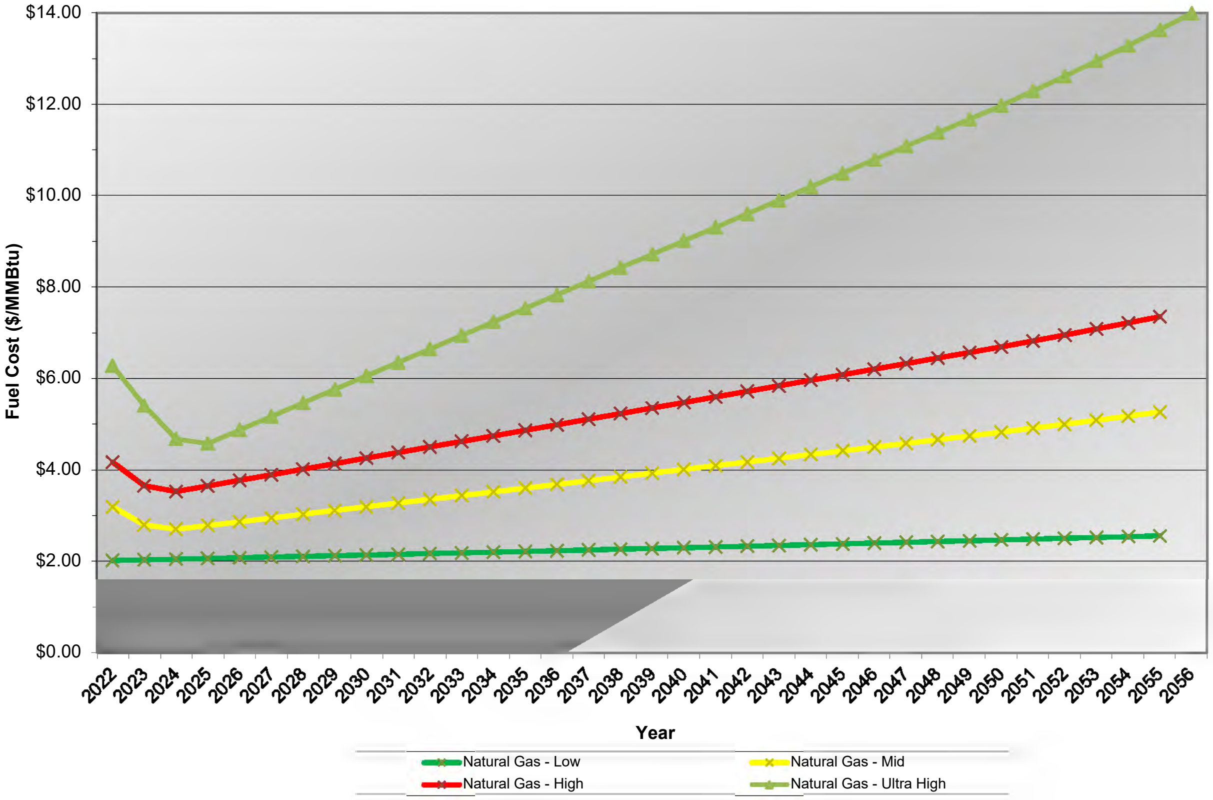


Figure 7.2-1 Fuel Cost Forecast

An annual gas pipeline demand charge for each the proposed NGCC or SCGT facility configuration has been included in the life cycle analysis. The annual demand charge was determined by the maximum natural gas demand required on a heat input per day MMBTU/day) basis, which correlates to the 99 percent winter design condition. A 24 hour operational period was used to determine the demand charge since a demand charge is determined on potential rather than typical or actual use (24 hours potential rather than 16 hours actual or typical). The annual demand charge remains constant for the life of the NGCC or SCGT facility.

7.3 CAPITAL RECOVERY COSTS

Fixed capacity payments, or capital recovery costs have been established for this analysis based upon a 46.8 percent debt / 53.2 percent equity financing approach with a 6.41 percent rate of return. A 40 year debt term has been assumed with an interest rate of 3.96 percent. Capital cost differentials have been utilized as identified in Section 6.0.

Tax depreciation has been assumed based upon a 20 year MACRS schedule with book depreciation assumed as straight line over 40 years. To summarize other factors utilized to determine the fixed capacity payments, Table 7.3-1 is provided.

Table 7.3-1 Economic Assumptions

Common Proforma Parameters	
Discount Rate	6.41%
Depreciation Schedule – Tax	20 Year MACRS
Depreciation Schedule – Book	40 Year SL
Amortization	40 Year
Project Life	40 Year
Capital Escalation	2.00%
Income Tax Rate	24.95%
IRR	6.41%
Debt	46.8%
Interest Rate	3.96%

7.4 SUMMARY OF LIFECYCLE COST ANALYSIS

Incorporating all the above capital cost expectations and operating and maintenance costs, the total cost of generation values for each NGCC and SCGT option and site location have been presented in Tables 7.4-1 through 7.4-6. Costs are presented on both a first year basis and a 40 year levelized basis for applicable peaking or baseload dispatch. Detailed data for the first 40 years of the lifecycle models for these cases are included in Appendix F.

Table 7.4-1. NGCC Electrical Cost of Generation Summary – Mill Creek

Mill Creek Generating Station							
		Option 1	Option 2	Option 4	Option 5	Option 7	Option 8
		1-1x1 HA.03	2-1x1 HA.03	1-1x1 501JAC	2-1x1 501JAC	1-1x1 9000HL	2-1x1 9000HL
Gross Output	(MW)	632.3	1264.6	636.7	1273.4	638.8	1277.6
Auxiliary Power	(MW)	16	32	15	29	18	37
Net Output	(MW)	616.3	1232.7	622.0	1244.0	620.5	1241.0
Net Cycle Heat Rate, HHV	(Btu/kWH)	6,083	6,083	6,197	6,197	6,039	6,039
Net Cycle Efficiency	(% HHV)	56.16%	56.16%	55.12%	55.12%	56.56%	56.56%
Capital Cost	($/kW net)	$1,063	$945	$1,084	$976	$1,068	$951
First Year Cost of Generation							
Capital Recovery	($/MWH)	$9.42	$8.36	$9.60	$8.62	$9.46	$8.41
Fixed O&M	($/MWH)	$1.06	$0.94	$0.74	$0.62	$0.72	$0.60
Variable O&M	($/MWH)	$1.13	$1.13	$1.03	$1.03	$0.94	$0.94
Consumables	($/MWH)	$0.12	$0.12	$0.12	$0.12	$0.12	$0.12
Fuel Costs	($/MWH)	$20.52	$20.52	$20.90	$20.90	$20.37	$20.37
Total COG	($/MWH)	$32.25	$31.07	$32.39	$31.29	$31.61	$30.44
Levelized Cost of Generation							
Capital Recovery	($/MWH)	$9.42	$8.36	$9.60	$8.62	$9.46	$8.41
Fixed O&M	($/MWH)	$1.42	$1.26	$0.99	$0.83	$0.97	$0.81
Variable O&M	($/MWH)	$1.30	$1.30	$1.36	$1.36	$1.24	$1.24
Consumables	($/MWH)	$0.12	$0.12	$0.13	$0.13	$0.12	$0.12
Fuel Costs	($/MWH)	$26.96	$26.96	$27.47	$27.47	$26.77	$26.77
Total Levelized COG	($/MWH)	$39.22	$38.00	$39.55	$38.40	$38.57	$37.35

Table 7.4-2. NGCC Electrical Cost of Generation Summary – E.W. Brown Unit 1-2 Site

E. W. Brown Generating Station Unit 1-2 Site							
		Option 1	**Option 2**	**Option 4**	**Option 5**	**Option 7**	**Option 8**
		1-1x1 HA.03	**2-1x1 HA.03**	**1-1x1 501JAC**	**2-1x1 501JAC**	**1-1x1 9000HL**	**2-1x1 9000HL**
Gross Output	(MW)	632.3	1264.6	636.7	1273.4	638.8	1277.6
Auxiliary Power	(MW)	16	32	15	29	18	37
Net Output	(MW)	616.3	1232.7	622.0	1244.0	620.5	1241.0
Net Cycle Heat Rate, HHV	(Btu/kWH)	6,083	6,083	6,197	6,197	6,039	6,039
Net Cycle Efficiency	(% HHV)	56.16%	56.16%	55.12%	55.12%	56.56%	56.56%
Capital Cost	($/kW net)	$1,124	$1,041	$1,150	$1,067	$1,129	$1,046
First Year Cost of Generation							
Capital Recovery	($/MWH)	$9.95	$9.22	$10.17	$9.45	$9.99	$9.27
Fixed O&M	($/MWH)	$1.17	$1.02	$0.84	$0.69	$0.82	$0.67
Variable O&M	($/MWH)	$1.16	$1.16	$1.05	$1.05	$0.96	$0.96
Consumables	($/MWH)	$0.12	$0.12	$0.13	$0.13	$0.12	$0.12
Fuel Costs	($/MWH)	$21.02	$21.02	$21.41	$21.41	$20.87	$20.87
Total COG	($/MWH)	$33.41	$32.53	$33.60	$32.72	$32.76	$31.89
Levelized Cost of Generation							
Capital Recovery	($/MWH)	$9.95	$9.22	$10.17	$9.45	$9.99	$9.27
Fixed O&M	($/MWH)	$1.57	$1.37	$1.13	$0.93	$1.11	$0.90
Variable O&M	($/MWH)	$1.33	$1.33	$1.39	$1.39	$1.27	$1.27
Consumables	($/MWH)	$0.12	$0.12	$0.13	$0.13	$0.13	$0.13
Fuel Costs	($/MWH)	$27.48	$27.48	$28.00	$28.00	$27.29	$27.29
Total Levelized COG	($/MWH)	$40.45	$39.52	$40.82	$39.89	$39.78	$38.85

Table 7.4-3. NGCC Electrical Cost of Generation Summary – E. W. Brown Webb Farm Site

E. W. Brown Generating Station Webb Farm Site							
		Option 1	**Option 2**	**Option 4**	**Option 5**	**Option 7**	**Option 8**
		1-1x1 HA.03	**2-1x1 HA.03**	**1-1x1 501JAC**	**2-1x1 501JAC**	**1-1x1 9000HL**	**2-1x1 9000HL**
Gross Output	(MW)	632.3	1264.6	636.7	1273.4	638.8	1277.6
Auxiliary Power	(MW)	16	32	15	29	18	37
Net Output	(MW)	616.3	1232.7	622.0	1244.0	620.5	1241.0
Net Cycle Heat Rate, HHV	(Btu/kWH)	6,083	6,083	6,197	6,197	6,039	6,039
Net Cycle Efficiency	(% HHV)	56.16%	56.16%	55.12%	55.12%	56.56%	56.56%
Capital Cost	($/kW net)	$1,090	$1,020	$1,115	$1,045	$1,095	$1,025
First Year Cost of Generation							
Capital Recovery	($/MWH)	$9.65	$9.04	$9.87	$9.26	$9.70	$9.09
Fixed O&M	($/MWH)	$1.13	$0.99	$0.81	$0.67	$0.80	$0.65
Variable O&M	($/MWH)	$1.13	$1.13	$1.03	$1.03	$0.94	$0.94
Consumables	($/MWH)	$0.12	$0.12	$0.12	$0.12	$0.12	$0.12
Fuel Costs	($/MWH)	$20.52	$20.52	$20.90	$20.90	$20.37	$20.37
Total COG	($/MWH)	$32.56	$31.80	$32.74	$31.99	$31.93	$31.17
Levelized Cost of Generation							
Capital Recovery	($/MWH)	$9.65	$9.04	$9.87	$9.26	$9.70	$9.09
Fixed O&M	($/MWH)	$1.52	$1.33	$1.10	$0.90	$1.07	$0.88
Variable O&M	($/MWH)	$1.30	$1.30	$1.36	$1.36	$1.24	$1.24
Consumables	($/MWH)	$0.12	$0.12	$0.13	$0.13	$0.12	$0.12
Fuel Costs	($/MWH)	$26.96	$26.96	$27.47	$27.47	$26.77	$26.77
Total Levelized COG	($/MWH)	$39.56	$38.76	$39.92	$39.12	$38.91	$38.10

Table 7.4-4. SCGT Electrical Cost of Generation Summary – Mill Creek

Mill Creek Generating Station				
		Option 3	Option 6	Option 9
		2-1x0 7FA.05	2-1x0 M501 GAC	2-1x0 SGT6-5000F
Gross Output	(MW)	455.9	542.6	506.2
Auxiliary Power	(MW)	5	5	5
Net Output	(MW)	451.3	537.2	501.1
Net Cycle Heat Rate, HHV	(Btu/kWH)	9,931	9,757	9,470
Net Cycle Efficiency	(% HHV)	34.39%	35.01%	36.07%
Capital Cost	($/kW net)	$689	$772	$678
First Year Cost of Generation				
Capital Recovery	($/MWH)	$48.74	$54.44	$47.95
Fixed O&M	($/MWH)	$6.28	$4.06	$3.41
Variable O&M	($/MWH)	$5.78	$1.55	$1.16
Consumables	($/MWH)	$0.59	$0.58	$0.57
Fuel Costs	($/MWH)	$62.91	$61.80	$59.99
Total COG	($/MWH)	$124.30	$122.43	$113.06
Levelized Cost of Generation				
Capital Recovery	($/MWH)	$48.74	$54.44	$47.95
Fixed O&M	($/MWH)	$8.25	$5.34	$4.47
Variable O&M	($/MWH)	$3.99	$2.03	$1.52
Consumables	($/MWH)	$0.81	$0.79	$0.77
Fuel Costs	($/MWH)	$73.54	$72.25	$70.13
Total Levelized COG	($/MWH)	$135.33	$134.85	$124.84

Table 7.4-5. SCGT Electrical Cost of Generation Summary – E. W. Brown Unit 1-2 Site

E. W. Brown Generating Station Unit 1-2 Site				
		Option 3	Option 6	Option 9
		2-1x0 7FA.05	2-1x0 M501 GAC	2-1x0 SGT6-5000F
Gross Output	(MW)	455.9	542.6	506.2
Auxiliary Power	(MW)	5	5	5
Net Output	(MW)	451.3	537.2	501.1
Net Cycle Heat Rate, HHV	(Btu/kWH)	9,931	9,757	9,470
Net Cycle Efficiency	(% HHV)	34.39%	35.01%	36.07%
Capital Cost	($/kW net)	$733	$813	$718
First Year Cost of Generation				
Capital Recovery	($/MWH)	$51.70	$57.26	$50.64
Fixed O&M	($/MWH)	$6.79	$4.47	$3.82
Variable O&M	($/MWH)	$5.90	$1.58	$1.18
Consumables	($/MWH)	$0.61	$0.60	$0.58
Fuel Costs	($/MWH)	$63.72	$62.60	$60.76
Total COG	($/MWH)	$128.72	$126.50	$116.98
Levelized Cost of Generation				
Capital Recovery	($/MWH)	$51.70	$57.26	$50.64
Fixed O&M	($/MWH)	$8.91	$5.87	$5.01
Variable O&M	($/MWH)	$4.07	$2.07	$1.55
Consumables	($/MWH)	$0.83	$0.81	$0.79
Fuel Costs	($/MWH)	$74.38	$73.08	$70.93
Total Levelized COG	($/MWH)	$139.90	$139.09	$128.92

Table 7.4-6. SCGT Electrical Cost of Generation Summary – E. W. Brown Webb Farm Site

E. W. Brown Generating Station Webb Farm Site				
		Option 3	Option 6	Option 9
		2-1x0 7FA.05	2-1x0 M501 GAC	2-1x0 SGT6-5000F
Gross Output	(MW)	455.9	542.6	506.2
Auxiliary Power	(MW)	5	5	5
Net Output	(MW)	451.3	537.2	501.1
Net Cycle Heat Rate, HHV	(Btu/kWH)	9,931	9,757	9,470
Net Cycle Efficiency	(% HHV)	34.39%	35.01%	36.07%
Capital Cost	($/kW net)	$724	$801	$709
First Year Cost of Generation				
Capital Recovery	($/MWH)	$51.10	$56.43	$50.08
Fixed O&M	($/MWH)	$6.62	$4.35	$3.71
Variable O&M	($/MWH)	$5.78	$1.55	$1.16
Consumables	($/MWH)	$0.59	$0.58	$0.57
Fuel Costs	($/MWH)	$62.91	$61.80	$59.99
Total COG	($/MWH)	$127.01	$124.70	$115.49
Levelized Cost of Generation				
Capital Recovery	($/MWH)	$51.10	$56.43	$50.08
Fixed O&M	($/MWH)	$8.69	$5.71	$4.87
Variable O&M	($/MWH)	$3.99	$2.03	$1.52
Consumables	($/MWH)	$0.81	$0.79	$0.77
Fuel Costs	($/MWH)	$73.54	$72.25	$70.13
Total Levelized COG	($/MWH)	$138.14	$137.21	$127.37

As shown in the tables above, the production cost is comparable for each option evaluated. The Siemens 5000F plant configuration provides the lowest cost of generation for each the site alternatives considered. The differential cost between OEM technology and sites is not significant from a cost of generation perspective and equipment/site optimization could likely be driven by other factors.

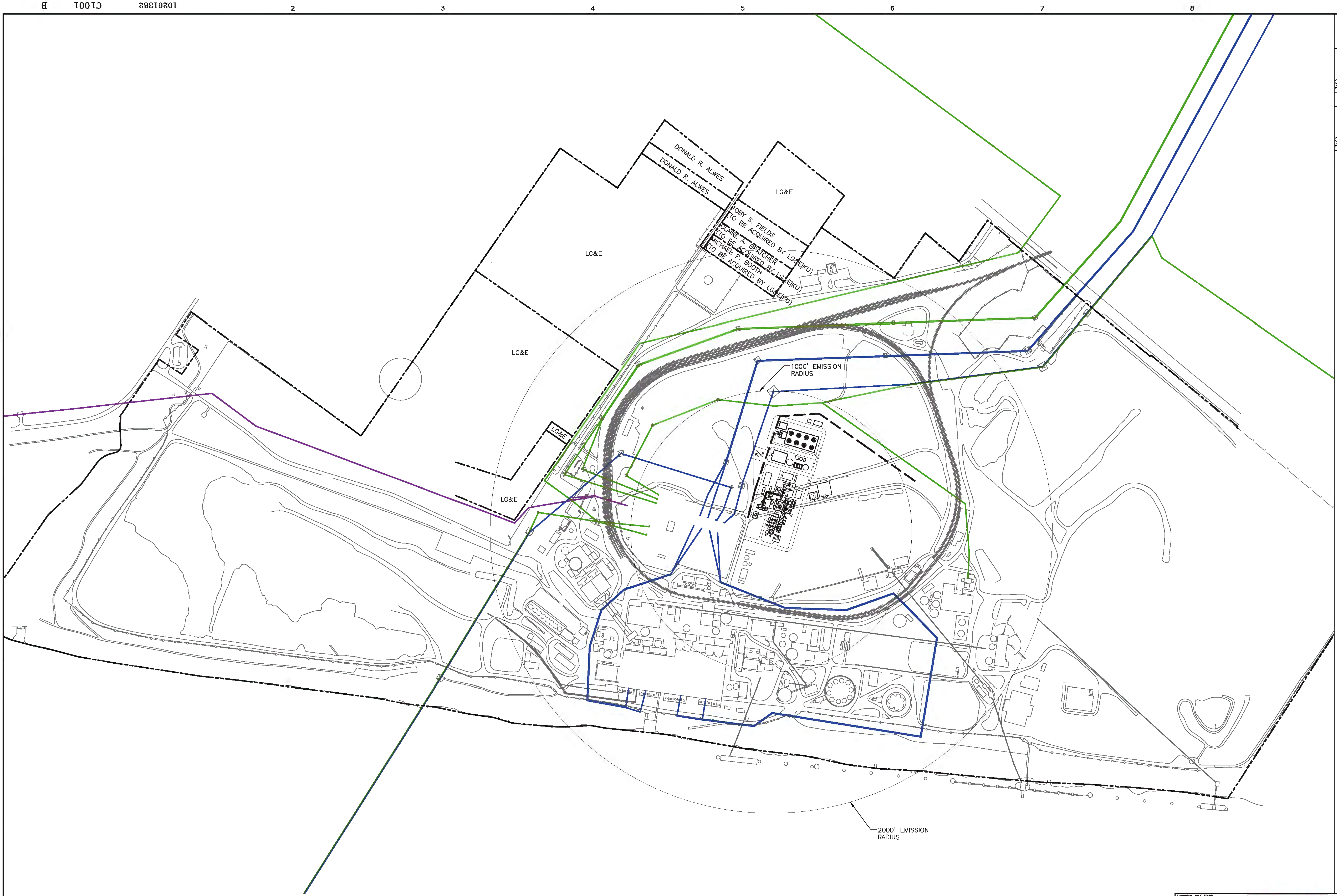
APPENDICES

Appendix A	Site Arrangements
Appendix B	Heat Balance Diagrams
Appendix C	Single Line Diagrams
Appendix D	Project Schedule
Appendix E	Project Cost Estimates
Appendix F	Life Cycle Cost Analysis

APPENDIX A

SITE ARRANGEMENTS

10343340-0GA-C1001	Mill Creek Site Arrangement Single NGCC Unit Build
10343340-0GA-C1001A	Mill Creek Site Aerial Single NGCC Unit Build
10343340-0GA-C1002A	Mill Creek Site Arrangement Two NGCC Unit Build
10343340-0GA-C1001A	Mill Creek Site Aerial Two NGCC Unit Build
10343340-0GA-C2005	E.W. Brown Webb Farm Site Arrangement Single NGCC Unit
10343340-0GA-C2005A	E.W. Brown Webb Farm Site Aerial Single NGCC Unit
10343340-0GA-C2006	E.W. Brown Webb Farm Site Arrangement Two NGCC Unit
10343340-0GA-C2006A	E.W. Brown Webb Farm Site Arrangement Two NGCC Unit
10343340-0GA-C2001	E.W. Brown Unit 1-2 Site Arrangement Single NGCC Unit Build
10343340-0GA-C2001A	E.W. Brown Unit 1-2 Site Aerial Single NGCC Unit Build
10343340-0GA- C2002	E.W. Brown Unit 1-2 Site Arrangement Two NGCC Unit Build
10343340-0GA- C2002A	E.W. Brown Unit 1-2 Site Aerial Two NGCC Unit Build
10343340-0GA-C1003	Mill Creek Site Arrangement Two Unit Simple Cycle
10343340-0GA-C2007	E.W. Brown Webb Farm Site Arrangement Two Unit Simple Cycle
10343340-0GA-C2008	E.W. Brown Unit 1-2 Site Arrangement Two Unit Simple Cycle



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SITE PLAN

SCALE: 1" = 300'-0"

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Revisions

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11 JAN 2021
Dwn: SDK
Chkd:
Appd:

B Project: 10261382
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26 MAR 2021
Dwn: SDK
Chkd:
Appd:

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Contract No. -
Engineering discipline: CIVIL
Drawing type: -
LG&E KU
PPL companies
Generation Services
Drawn: ASK
Checked:
Approved:
Released for: INFORMATION
Alternate Drawing No: –
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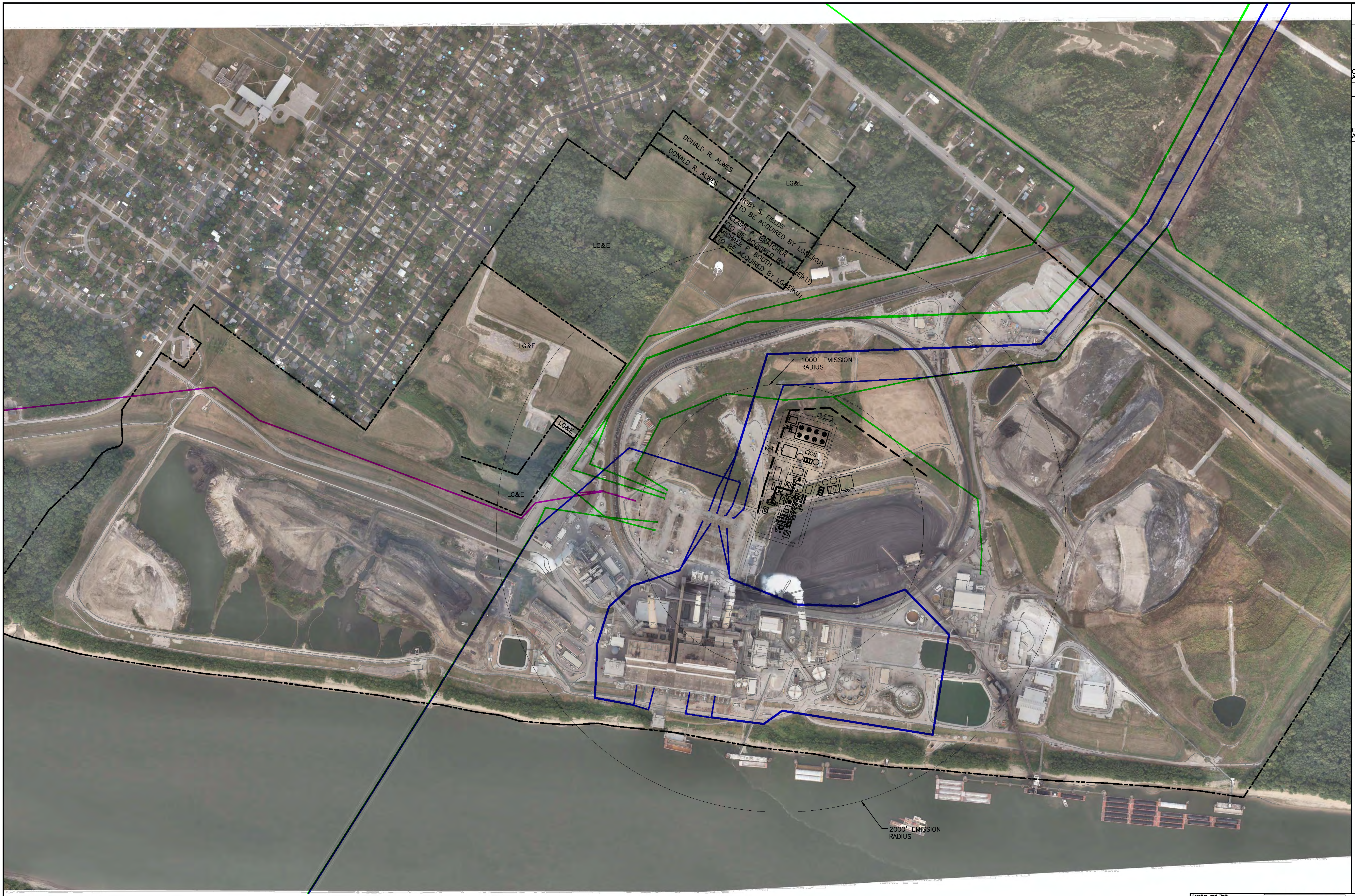
MILL CREEK SITE ARRANGEMENT
SINGLE UNIT BUILD
Originator: HDR, INC.
Job or Project No: 10261382
Drawing No: C1001
Rev. B
DMS Version 2.0

10261382 C1001A B



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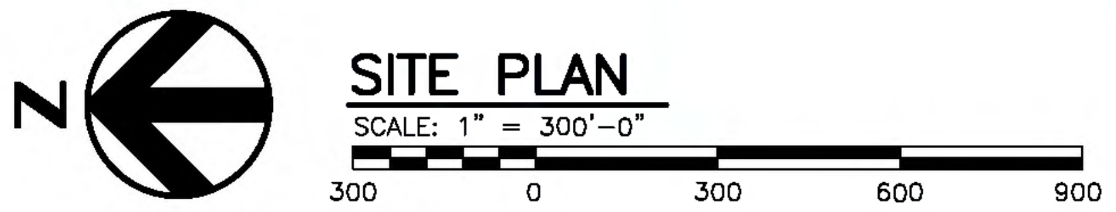

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NOT TO BE USED FOR CONSTRUCTION

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Scale: None
Contract No. -
Engineering discipline: CIVIL
Drawing type: -

LG&E KU
PPL companies
Generation Services

Title
MILL CREEK SITE AERIAL
SINGLE UNIT BUILD

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Approved:
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Originator: HDR, INC.
Job or Project No: 10261382
Drawing No: C1001A
Rev. B

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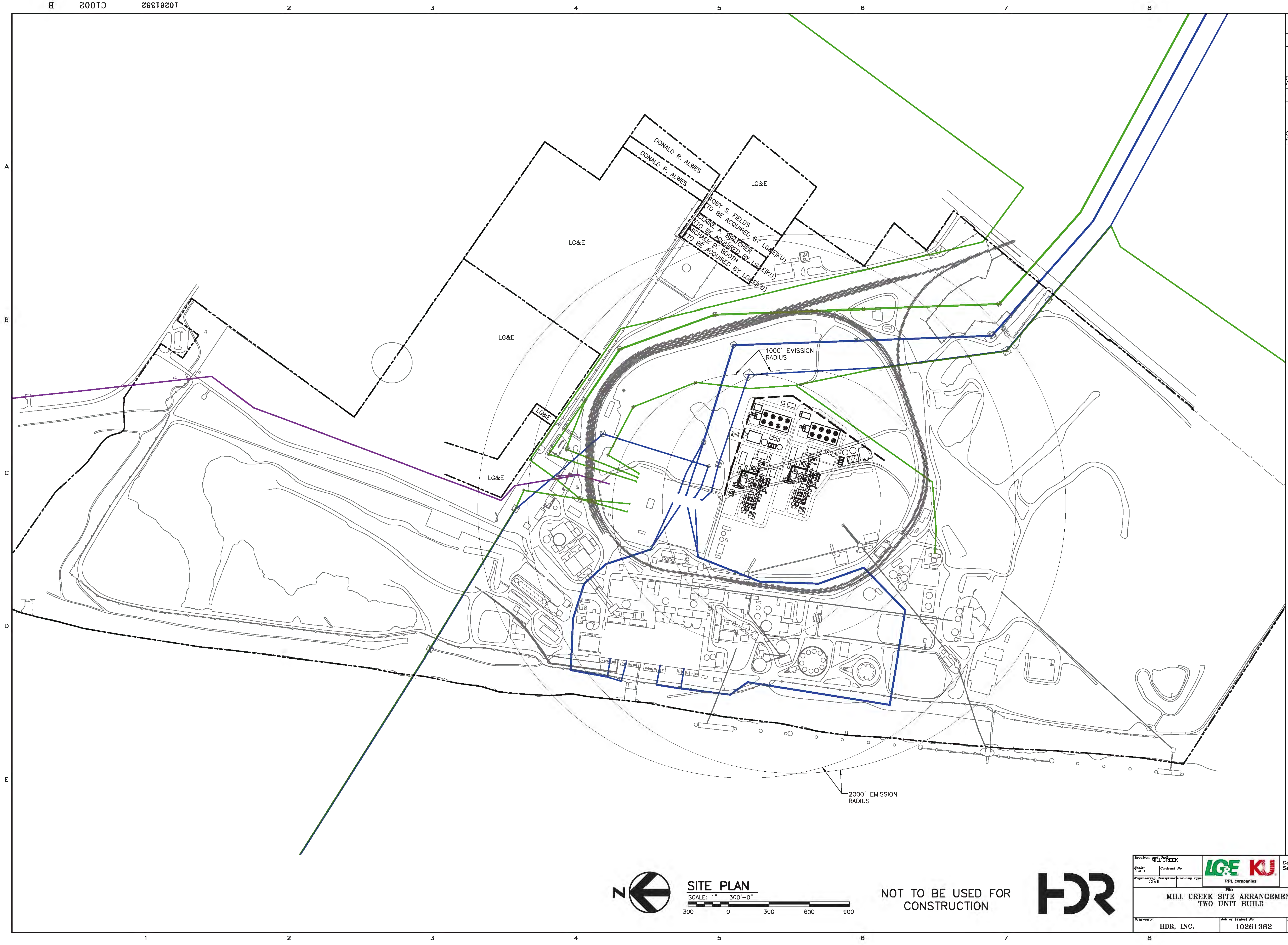

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HDR

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Contract No. -
Engineering discipline: CIVIL
Drawing type: -
LG&E KU PPL companies
Generation Services
Drawn: ASK
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TWO UNIT BUILD
Released for: INFORMATION
Alternate Drawing No: –
Originator: HDR, INC.
Job or Project No: 10261382
Drawing No: C1002
Rev. B
DMS Version 2.0

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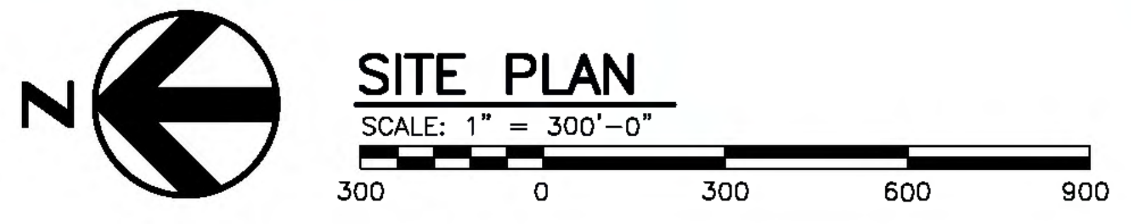

SITE PLAN
SCALE: 1" = 300'-0"

NOT TO BE USED FOR
CONSTRUCTION

HDR

Location and Unit: MILL CREEK
Scale: None
Contract No. -
Engineering discipline: CIVIL
Drawing type: -

LG&E KU
PPL companies
Generation Services

Title
MILL CREEK SITE AERIAL
TWO UNIT BUILD

Drawn: ASK
Checked:
Approved:
Released for: INFORMATION
Alternate Drawing No: –

Originator: HDR, INC.
Job or Project No: 10261382
Drawing No: C1002A
Rev. B

DMS Version 2.0

Revisions

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B	Project: 10343340 ISSUED FOR REVIEW 31 MAY 2022 Dwn: SDK Chkd: Appd:
C	Project: 10343340 ISSUED FOR REVIEW 01 AUG 2022 Dwn: SDK Chkd: Appd:
D	Project: 10343340 ISSUED FOR REVIEW 03 OCT 2022 Dwn: SDK Chkd: Appd:

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SITE PLAN

SCALE: 1" = 250'-0"
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HDR

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Contract No. –
Engineering discipline: CIVIL
Drawing type: -
LG&E KU PPL companies
Generation Services
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Title
EW BROWN WEBB FARM
SITE ARRANGEMENT
SINGLE UNIT NGCC
Originator: HDR, INC.
Job or Project No: 10343340
Drawing No: 0GA-C2005
Rev. D
DMS Version 2.0

10343340 0GA-C2005A D

SITE PLAN

SCALE: 1" = 250'-0"

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D Project: 10343340
ISSUED FOR REVIEW
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Contract No. –
Engineering discipline: CIVIL
Drawing type: -
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Generation Services
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Checked:
Approved:
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EW BROWN
UNIT 1-2 SITE AERIAL SCGT
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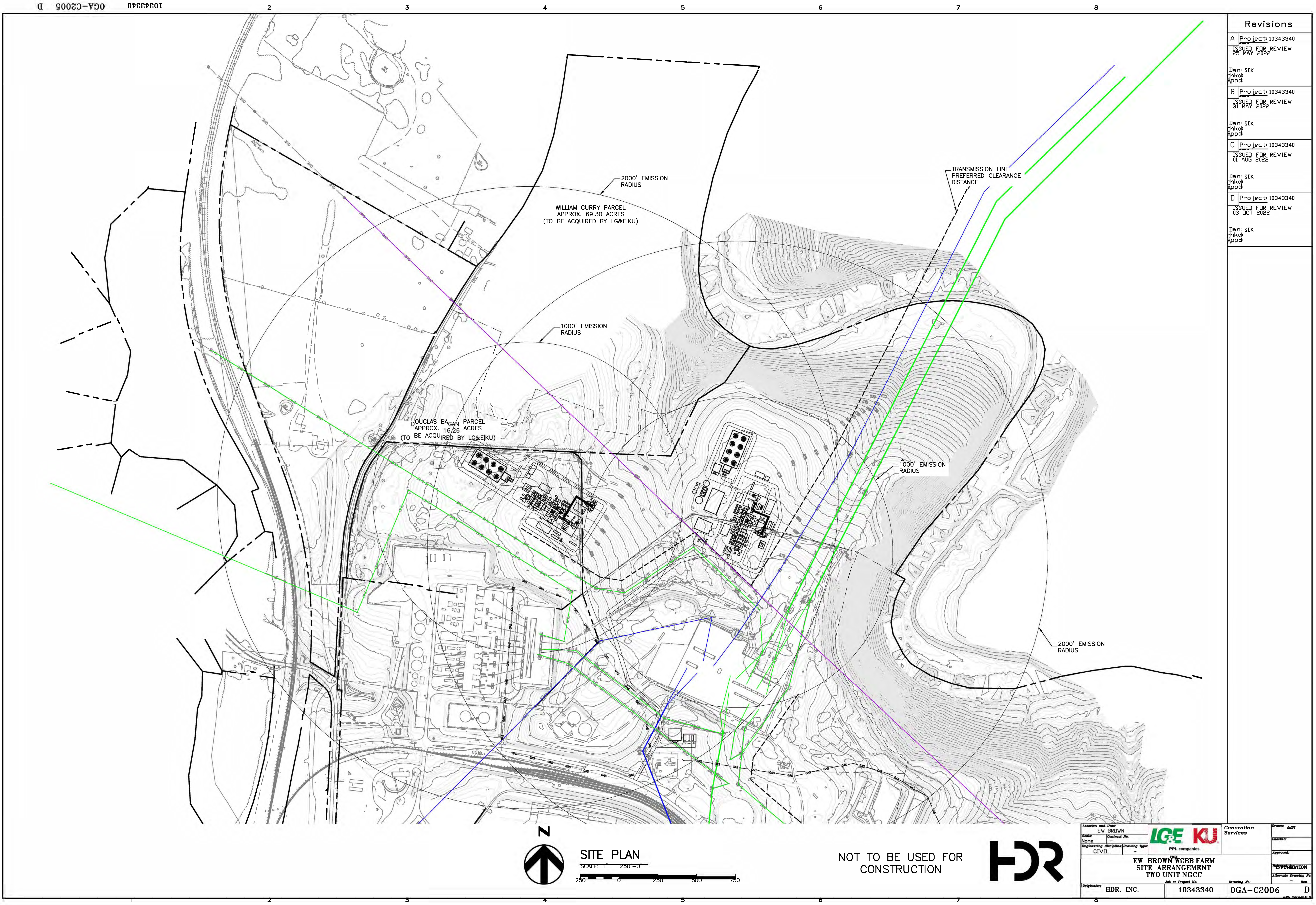
Originator: HDR, INC.
Job or Project No: 10343340
Drawing No: 0GA-C2005A
Rev. D
DMS Version 2.0



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31 MAY 2022
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ISSUED FOR REVIEW
01 AUG 2022
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ISSUED FOR REVIEW
03 OCT 2022
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Location and Unit: EW BROWN
Scale: None
Contract No. –
Engineering discipline: CIVIL
Drawing type: -
PPL companies
Generation Services
Drawn: SDK
Checked:
Approved:
Released for: INFORMATION
Alternate Drawing No: –

Title

EW BROWN WEBB FARM
SITE ARRANGEMENT
TWO UNIT NGCC

Originator: HDR, INC.
Job or Project No: 10343340
Drawing No: 0GA-C2006
Rev. D
DMS Version 2.0

Revisions

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B Project: 10343340
ISSUED FOR REVIEW
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Appd:

C Project: 10343340
ISSUED FOR REVIEW
01 AUG 2022
Dwn: SDK
Chkd:
Appd:

D Project: 10343340
ISSUED FOR REVIEW
03 OCT 2022
Dwn: SDK
Chkd:
Appd:

N

SITE PLAN

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NOT TO BE USED FOR CONSTRUCTION

HDR

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Scale: None	Contract No. –		Checked:
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Title EW BROWN UNIT 1-2 SITE AERIAL SCGT			Released for: INFORMATION Alternate Drawing No: –
Originator: HDR, INC.	Job or Project No: 10343340	Drawing No: 0GA-C2005A	Rev. D

DMS Version 2.0

10343340 0GA-C1003 A

Revisions

N

SITE PLAN

SCALE: 1" = 300'-0"

NOT TO BE USED FOR CONSTRUCTION

HDR

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Contract No. -
Engineering discipline: CIVIL
Drawing type: -
LG&E KU PPL companies
Generation Services
Drawn: ASK
Checked:
Approved:
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MILL CREEK SITE ARRANGEMENT
SCGT
Released for: INFORMATION
Alternate Drawing No: –
Originator: HDR, INC.
Job or Project No: 10343340
Drawing No: 0GA–C1003
Rev. A
DMS Version 2.0

N

SITE PLAN

SCALE: 1" = 250'-0"

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NOT TO BE USED FOR CONSTRUCTION

HDR

Revisions

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25 MAY 2022
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ISSUED FOR REVIEW
31 MAY 2022
Dwn: SDK
Chkd:
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C Project: 10343340
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01 AUG 2022
Dwn: SDK
Chkd:
Appd:

Location and Unit: EW BROWN
Scale: None
Contract No.
Engineering discipline: CIVIL
Drawing type.

LG&E KU PPL companies

Generation Services

Drawn: SDK
Checked:
Approved:
Released for: INFORMATION
Alternate Drawing No: –

Title
EW BROWN WEBB FARM
SITE ARRANGEMENT
TWO UNIT SIMPLE CYCLE

Originator: HDR, INC.
Job or Project No: 10343340
Drawing No: 0GA-C2007
Rev. C

DMS Version 2.0

10343340 0GA-C2008 A

N

SITE PLAN

SCALE: 1" = 250'-0"

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CONSTRUCTION

HDR

Revisions

A Project: 10261382
ISSUED FOR REVIEW
4 JAN 2021

Dwn: SDK
Chkd:
Appd:

Location and Unit: EW BROWN
Scale: None
Contract No.
Engineering discipline: CIVIL
Drawing type:

LG&E KU
PPL companies

Generation
Services

Drawn: SDK
Checked:
Approved:
Released for: INFORMATION
Alternate Drawing No: –

Title
EW BROWN UNIT 1__2
SITE ARRANGEMENT
TWO UNIT SIMPLE CYCLE

Originator: HDR, INC.
Job or Project No: 10343340
Drawing No: 0GA-C2008
Rev. A

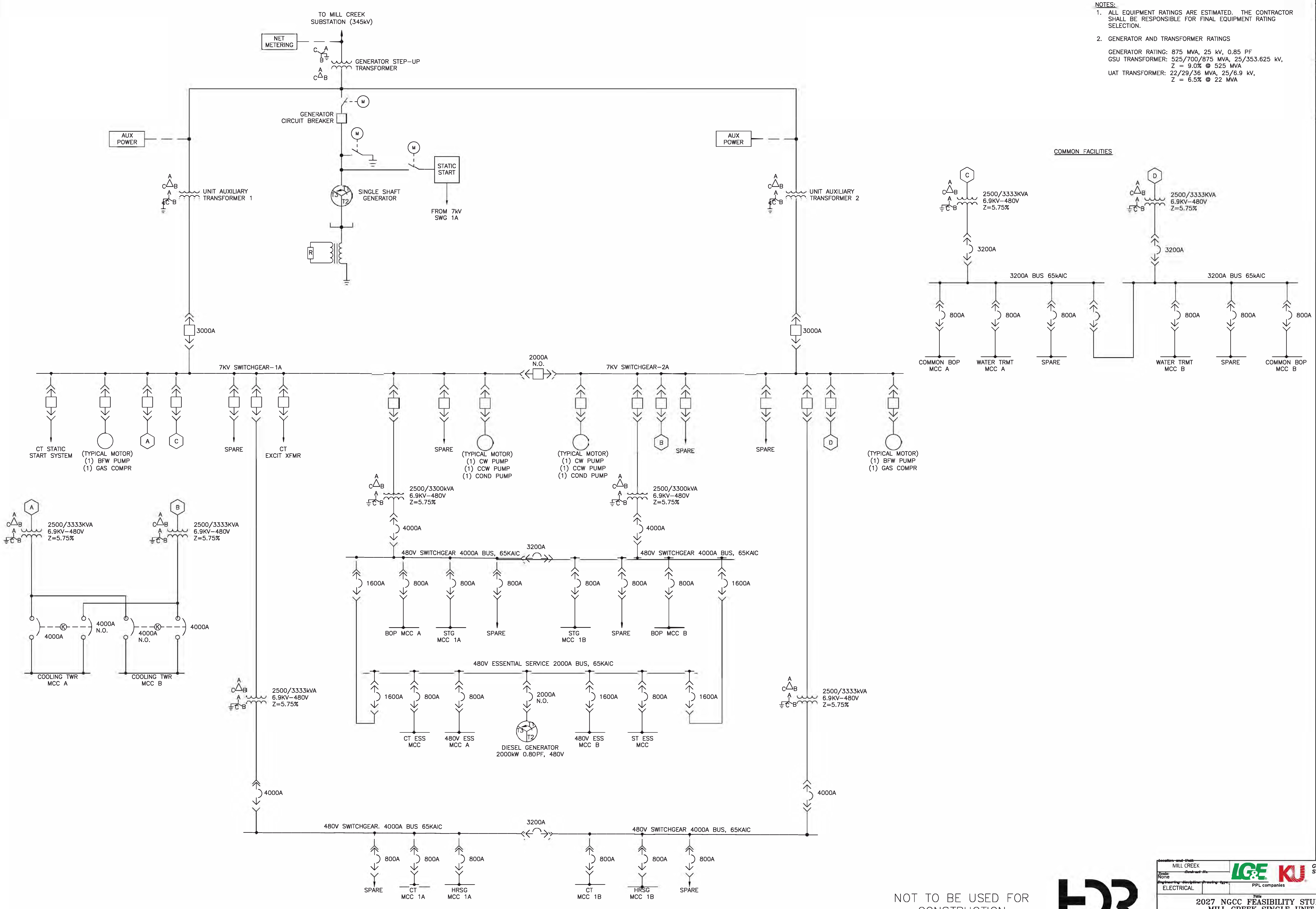
DMS Version 2.0

Appendix B is confidential in its entirety and being provided separately under seal.

APPENDIX C

SINGLE LINE DIAGRAM

10343340-0MP-E1001	2027 NGCC FEASIBILITY STUDY MILL CREEK SINGLE UNIT OVERALL ONE LINE DIAGRAM
10343340-0MP-E1101	2027 NGCC FEASIBILITY STUDY EW BROWN SINGLE UNIT OVERALL ONE LINE DIAGRAM (WEBB FARM SITE 345 kV)
10343340-0MP-E1102	2027 NGCC FEASIBILITY STUDY EW BROWN SINGLE UNIT OVERALL ONE LINE DIAGRAM (UNIT 1-2 SITE 138 kV)



NOTES:

1. ALL EQUIPMENT RATINGS ARE ESTIMATED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FINAL EQUIPMENT RATING SELECTION.

2. GENERATOR AND TRANSFORMER RATINGS

GENERATOR RATING: 875 MVA, 25 kV, 0.85 PF
GSU TRANSFORMER: 525/700/875 MVA, 25/353.625 kV, Z = 9.0% @ 525 MVA
UAT TRANSFORMER: 22/29/36 MVA, 25/6.9 kV, Z = 6.5% @ 22 MVA

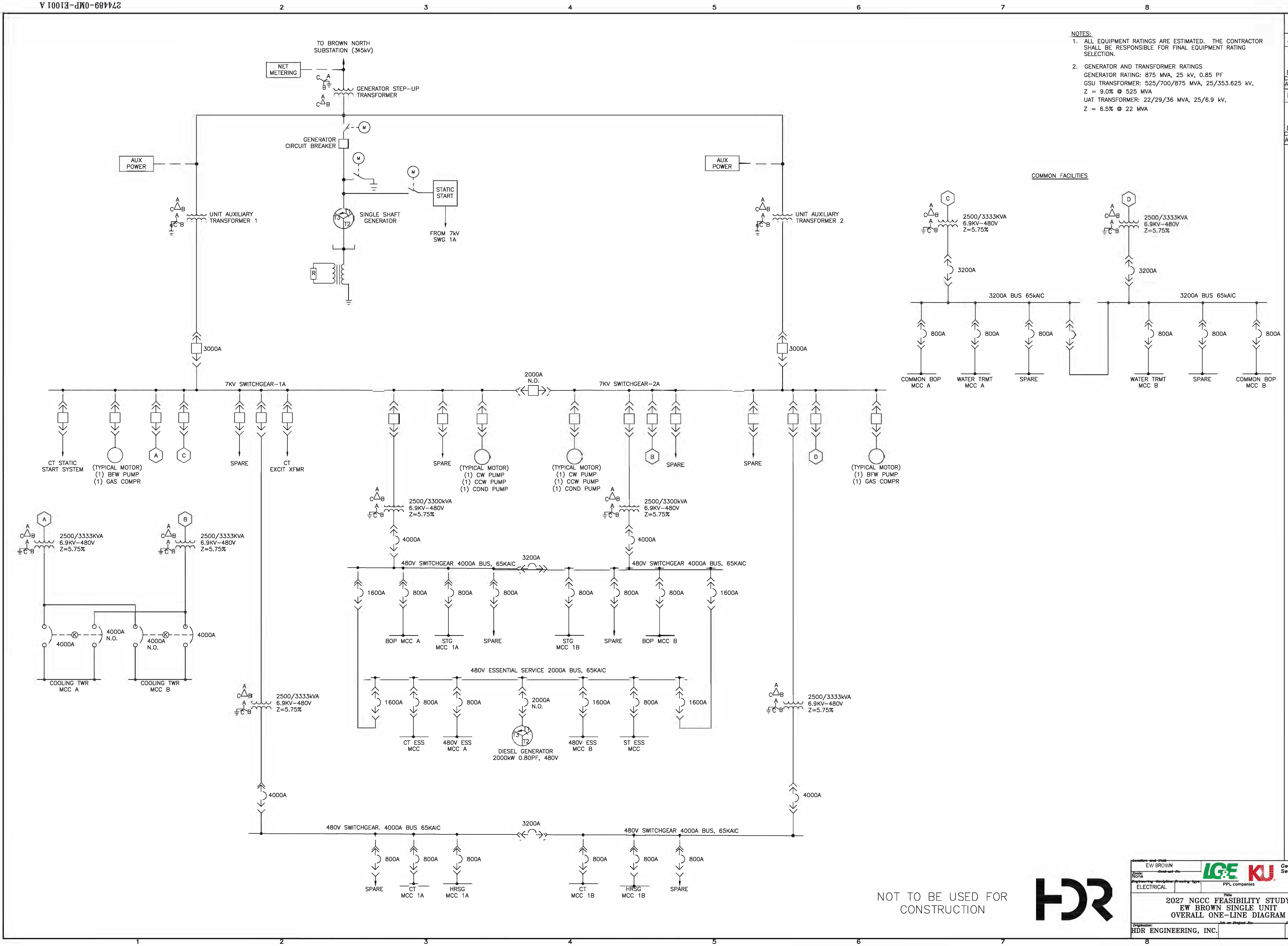
Revisions

A Project:
INITIAL ISSUE
10 JUNE 22
Dwn: ELT
Chkd: MAW
Appd: MAW

B Project:
ISSUED FOR LGIP
15 JUNE 22
Dwn: REB
Chkd: MAW
Appd: MAW

NOT TO BE USED FOR CONSTRUCTION

Location and Unit: MILL CREEK
Contract No.
Scale: None
Engineering discipline: ELECTRICAL
Drawing type:
PPL companies
Generation Services
Drawn: ELT 10 JUNE 22
Checked: MAW
Approved: MAW
Released for: REVIEW
Alternate Drawing No: 0MP-E1001
Title
2027 NGCC FEASIBILITY STUDY
MILL CREEK SINGLE UNIT
OVERALL ONE–LINE DIAGRAM
Originator: HDR ENGINEERING, INC.
Job or Project No:
Drawing No: 10343340-0MP-E1001
Rev. B
DMS Version2.0



NOTES:

1. ALL EQUIPMENT RATINGS ARE ESTIMATED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FINAL EQUIPMENT RATING SELECTION.
2. GENERATOR AND TRANSFORMER RATINGS
   GENERATOR RATING: 875 MVA, 25 kV, 0.85 PF
   GSU TRANSFORMER: 525/700/875 MVA, 25/353.625 kV,
   Z = 9.0% @ 525 MVA
   UAT TRANSFORMER: 22/29/36 MVA, 25/6.9 kV,
   Z = 6.5% @ 22 MVA

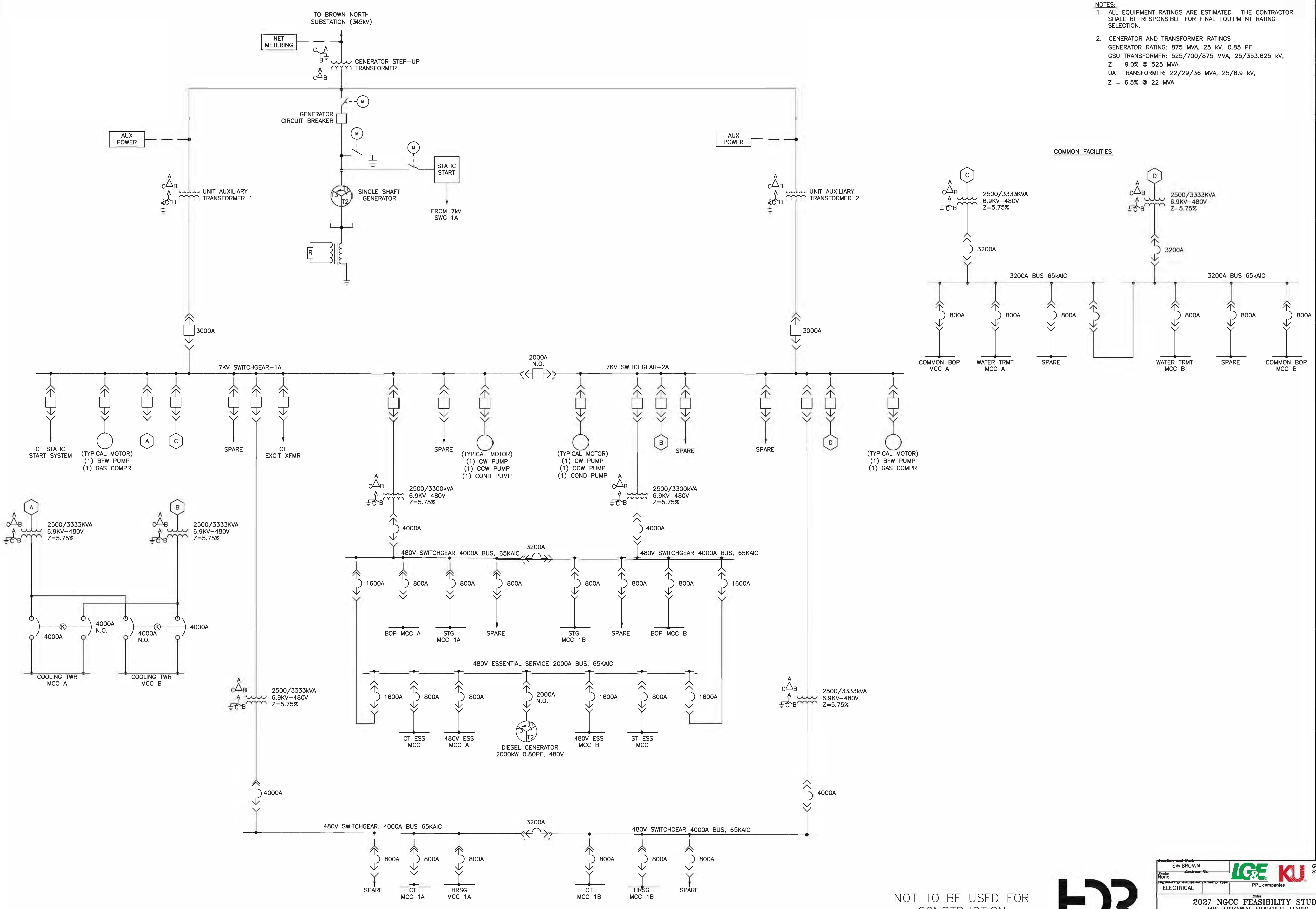
Revisions

A Project:
IINITIAL ISSUE
10 JUNE 22
Dwn: ELT
Chkd: MAW
Appd: MAW

B Project:
ISSUED FOR LGIP
15 JUNE 22
Dwn: REB
Chkd: MAW
Appd: MAW

Location and Unit: EW BROWN
Contract No.
Scale: None
Engineering discipline: ELECTRICAL
Drawing type:
PPL companies
Generation Services
Title
2027 NGCC FEASIBILITY STUDY
EW BROWN SINGLE UNIT
OVERALL ONE-LINE DIAGRAM
Originator: HDR ENGINEERING, INC.
Job or Project No:
Drawing No: 10343340-0MP-E1101
Rev. B
Drawn: ELT 10 JUNE 22
Checked: MAW
Approved: MAW
Released for: REVIEW
Alternate Drawing No: 0MP-E1101
DMS Version2.0

274489-0MP-E1001 A



NOTES:
1. ALL EQUIPMENT RATINGS ARE ESTIMATED. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FINAL EQUIPMENT RATING SELECTION.
2. GENERATOR AND TRANSFORMER RATINGS
GENERATOR RATING: 875 MVA, 25 kV, 0.85 PF
GSU TRANSFORMER: 525/700/875 MVA, 25/353.625 kV,
Z = 9.0% @ 525 MVA
UAT TRANSFORMER: 22/29/36 MVA, 25/6.9 kV,
Z = 6.5% @ 22 MVA

Revisions

A Project:
IINITIAL ISSUE
10 JUNE 22
Dwn: ELT
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Appd: MAW

B Project:
ISSUED FOR LGIP
15 JUNE 22
Dwn: REB
Chkd: MAW
Appd: MAW

NOT TO BE USED FOR
CONSTRUCTION

Location and Unit: EW BROWN
Contract No.
Scale: None
Engineering discipline: ELECTRICAL
Drawing type:
PPL companies
Generation Services
Drawn: ELT 10 JUNE 22
Checked: MAW
Approved: MAW
Released for: REVIEW
Alternate Drawing No: 0MP-E1101
Title
2027 NGCC FEASIBILITY STUDY
EW BROWN SINGLE UNIT
OVERALL ONE-LINE DIAGRAM
Originator: HDR ENGINEERING, INC.
Job or Project No:
Drawing No: 10343340-0MP-E1101
Rev. B
DMS Version2.0

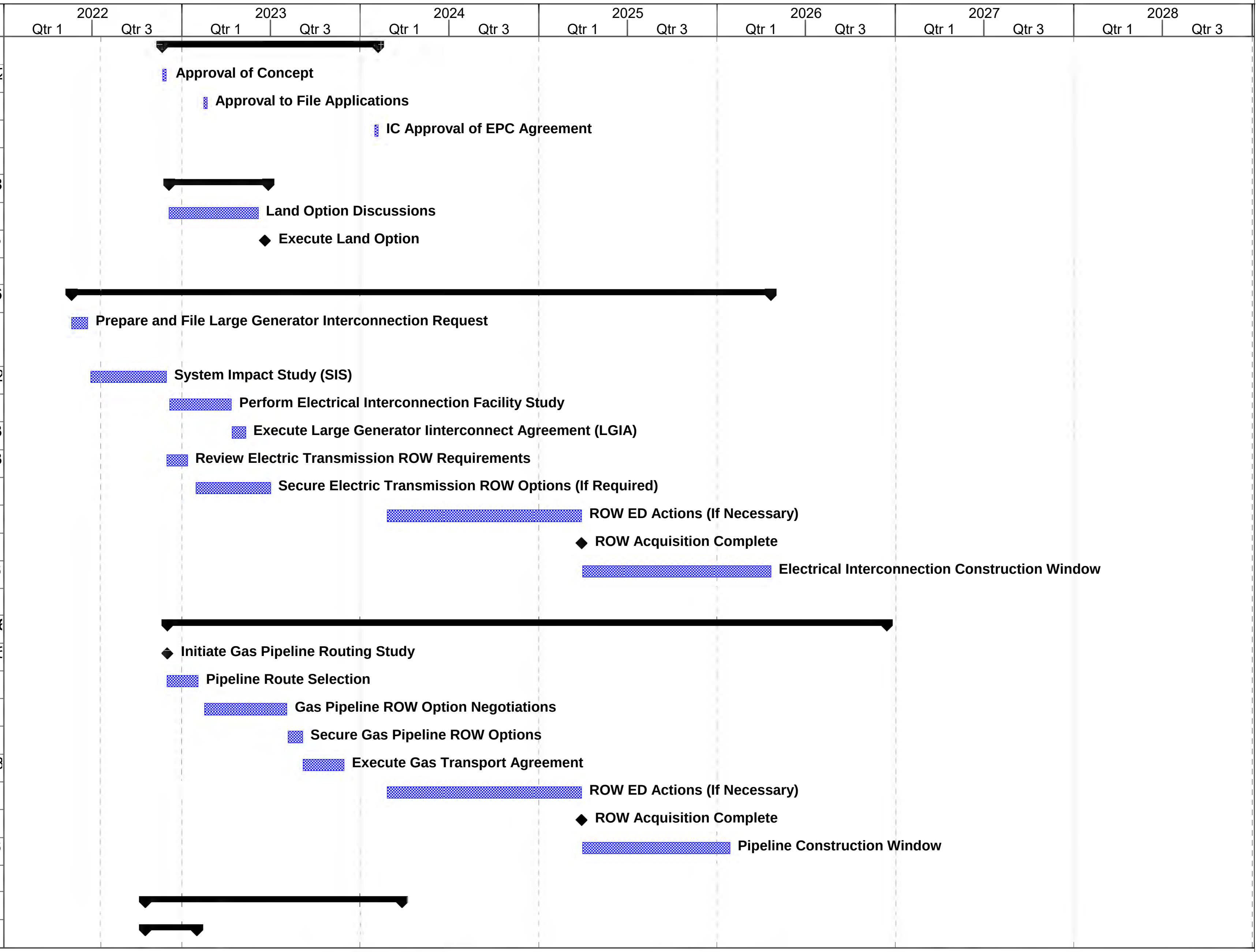
APPENDIX D

PROJECT SCHEDULE

- 2027 NGCC Project Development Schedule – Single Unit NGCC April 2027 COD
- 2027 NGCC Project Development Schedule – Two Unit NGCC April/August 2027 COD
- 2027 NGCC Project Development Schedule – Two Unit Simple Cycle April 2026 COD

2027 NGCC Project
Development Schedule - Single Unit
April 2027 COD

ID	Task Name	Duration	Start	Finish
1	**Management Approvals**	**316 days**	**Tue 11/22/22**	**Tue 2/6/24**
2	Approval of Concept	5 days	Tue 11/22/22	Mon 11/28/22
3	Approval to File Applications	5 days	Wed 2/15/23	Tue 2/21/23
4	IC Approval of EPC Agreement	5 days	Wed 1/31/24	Tue 2/6/24
5				
6	**Property Acquisition**	**145 days**	**Tue 12/6/22**	**Mon 6/26/23**
7	Land Option Discussions	130 days	Tue 12/6/22	Mon 6/5/23
8	Execute Land Option	5 days	Tue 6/20/23	Mon 6/26/23
9				
10	**Electrical Interconnection**	**1022 days**	**Fri 5/20/22**	**Mon 4/20/26**
11	Prepare and File Large Generator Interconnection Request	23 days	Fri 5/20/22	Tue 6/21/22
12	System Impact Study (SIS)	110 days	Wed 6/29/22	Tue 11/29/22
13	Perform Electrical Interconnection Facility Study	90 days	Wed 12/7/22	Tue 4/11/23
14	Execute Large Generator Iinterconnect Agreement (LGIA	20 days	Thu 4/13/23	Wed 5/10/23
15	Review Electric Transmission ROW Requirements	30 days	Thu 12/1/22	Wed 1/11/23
16	Secure Electric Transmission ROW Options (If Required	110 days	Mon 1/30/23	Fri 6/30/23
17	ROW ED Actions (If Necessary)	285 days	Mon 2/26/24	Fri 3/28/25
18	ROW Acquisition Complete	0 days	Fri 3/28/25	Fri 3/28/25
19	Electrical Interconnection Construction Window	275 days	Tue 4/1/25	Mon 4/20/26
20				
21	**Natural Gas Pipeline**	**1052 days**	**Thu 12/1/22**	**Mon 12/14/26**
22	Initiate Gas Pipeline Routing Study	0 days	Thu 12/1/22	Mon 12/14/26
23	Pipeline Route Selection	45 days	Fri 12/2/22	Thu 2/2/23
24	Gas Pipeline ROW Option Negotiations	120 days	Fri 2/17/23	Thu 8/3/23
25	Secure Gas Pipeline ROW Options	21 days	Mon 8/7/23	Mon 9/4/23
26	Execute Gas Transport Agreement	60 days	Wed 9/6/23	Tue 11/28/23
27	ROW ED Actions (If Necessary)	285 days	Mon 2/26/24	Fri 3/28/25
28	ROW Acquisition Complete	0 days	Fri 3/28/25	Fri 3/28/25
29	Pipeline Construction Window	215 days	Tue 4/1/25	Mon 1/26/26
30				
31	**Environmental**	**376 days**	**Tue 10/18/22**	**Tue 3/26/24**
32	**Site Studies and Permits (Land and Water)**	**76 days**	**Tue 10/18/22**	**Tue 1/31/23**



2027 NGCC Single Unit.mpp
Date: Tue 7/19/22

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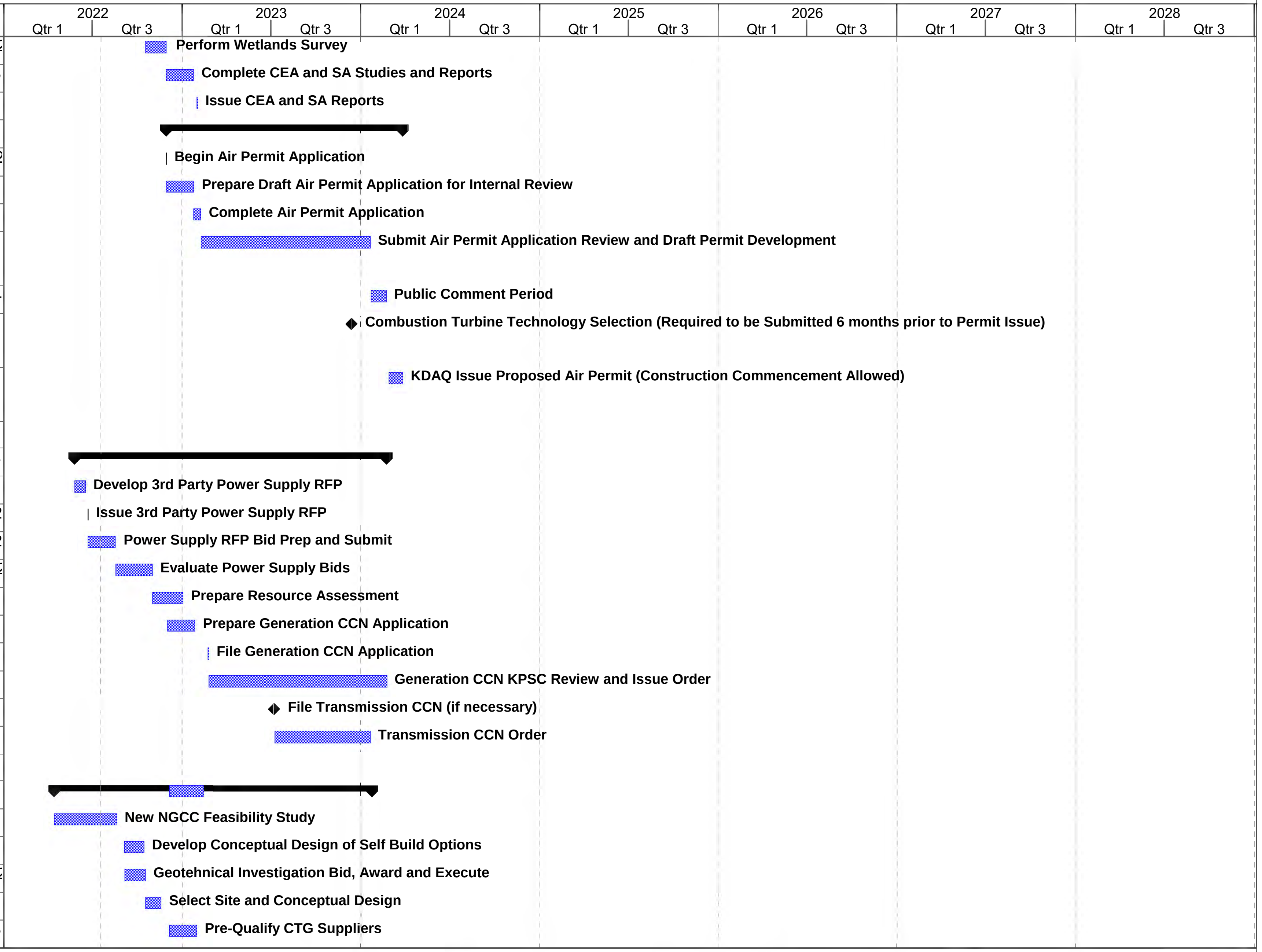
Split	⋯	External Milestone	◆	Manual Task	▬	Finish-only	]
Milestone	◆	Inactive Task		Duration-only	▬	Progress	▬
Summary	▬	Inactive Task		Manual Summary Rollup	▬	Deadline	⇩
Project Summary	▬	Inactive Milestone	◆	Manual Summary	▬		

2027 NGCC Project
Development Schedule - Single Unit
April 2027 COD

ID	Task Name	Duration	Start	Finish
33	Perform Wetlands Survey	30 days	Tue 10/18/22	Mon 11/28/22
34	Complete CEA and SA Studies and Reports	40 days	Tue 11/29/22	Mon 1/23/23
35	Issue CEA and SA Reports	1 day	Tue 1/31/23	Tue 1/31/23
36	**Air Permit**	**346 days**	**Tue 11/29/22**	**Tue 3/26/24**
37	Begin Air Permit Application	1 day	Tue 11/29/22	Tue 11/29/22
38	Prepare Draft Air Permit Application for Internal Revie	40 days	Wed 11/30/22	Tue 1/24/23
39	Complete Air Permit Application	10 days	Wed 1/25/23	Tue 2/7/23
40	Submit Air Permit Application Review and Draft Permit Development	247 days	Thu 2/9/23	Fri 1/19/24
41	Public Comment Period	23 days	Mon 1/22/24	Wed 2/21/24
42	Combustion Turbine Technology Selection (Required to be Submitted 6 months prior to Permit Issue)	0 days	Tue 12/12/23	Tue 12/12/23
43	KDAQ Issue Proposed Air Permit (Construction Commencement Allowed)	20 days	Wed 2/28/24	Tue 3/26/24
44				
45	**Regulatory**	**456 days**	**Thu 5/26/22**	**Thu 2/22/24**
46	Develop 3rd Party Power Supply RFP	16 days	Thu 5/26/22	Thu 6/16/22
47	Issue 3rd Party Power Supply RFP	1 day	Wed 6/22/22	Wed 6/22/22
48	Power Supply RFP Bid Prep and Submit	40 days	Thu 6/23/22	Wed 8/17/22
49	Evaluate Power Supply Bids	52 days	Fri 8/19/22	Mon 10/31/22
50	Prepare Resource Assessment	45 days	Tue 11/1/22	Mon 1/2/23
51	Prepare Generation CCN Application	40 days	Fri 12/2/22	Thu 1/26/23
52	File Generation CCN Application	1 day	Thu 2/23/23	Thu 2/23/23
53	Generation CCN KPSC Review and Issue Order	260 days	Fri 2/24/23	Thu 2/22/24
54	File Transmission CCN (if necessary)	0 days	Fri 7/7/23	Fri 7/7/23
55	Transmission CCN Order	140 days	Mon 7/10/23	Fri 1/19/24
56				
57	**Project Engineering**	**463 days**	**Fri 4/15/22**	**Tue 1/23/24**
58	New NGCC Feasibility Study	91 days	Fri 4/15/22	Fri 8/19/22
59	Develop Conceptual Design of Self Build Options	30 days	Mon 9/5/22	Fri 10/14/22
60	Geotehnical Investigation Bid, Award and Execute	30 days	Tue 9/6/22	Mon 10/17/22
61	Select Site and Conceptual Design	24 days	Tue 10/18/22	Fri 11/18/22
62	Pre-Qualify CTG Suppliers	40 days	Tue 12/6/22	Mon 1/30/23



2027 NGCC Single Unit.mpp
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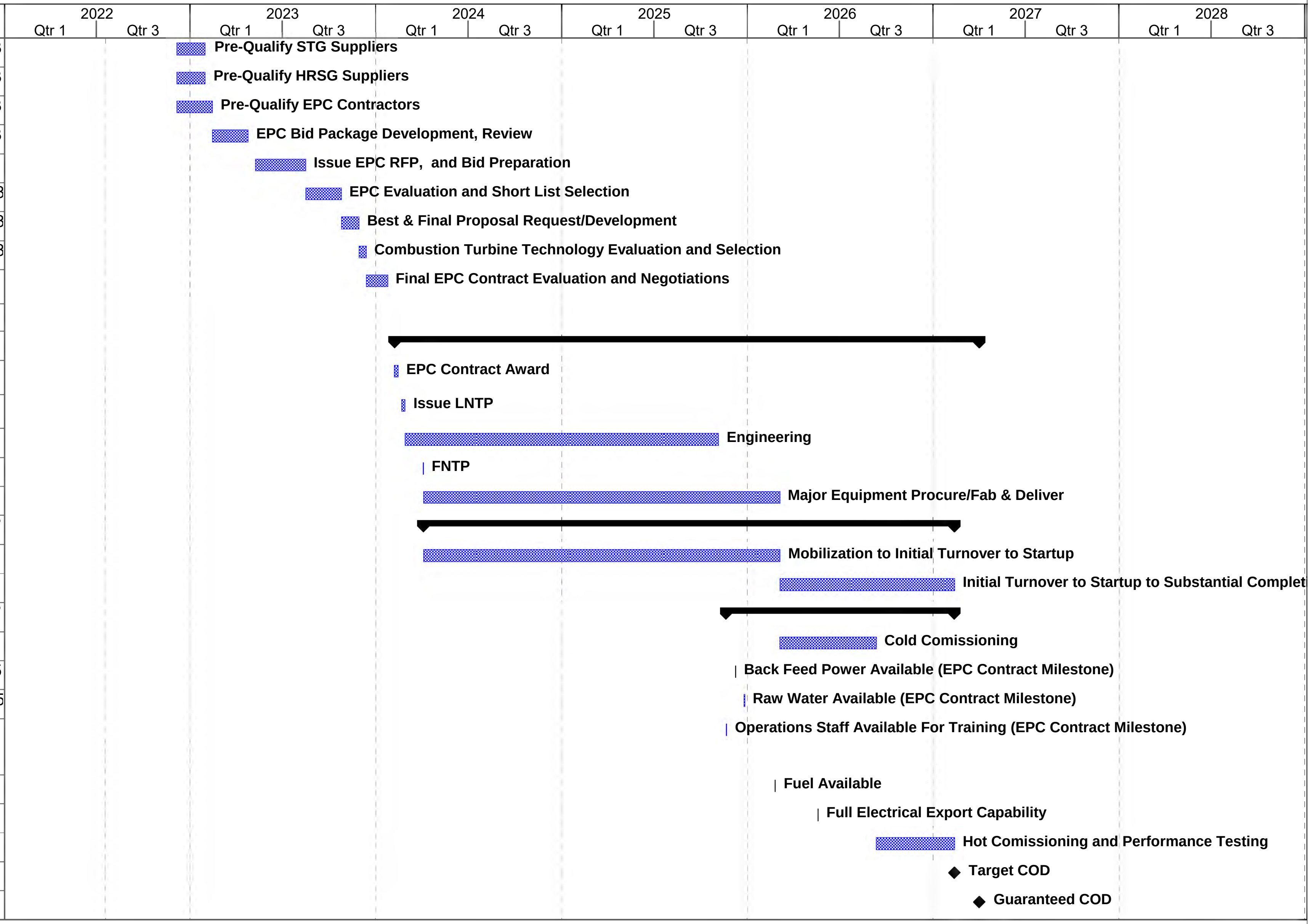
Milestone	◆	Inactive Task	◆	Duration-only	▬	Progress	―
Summary	▬	Inactive Task	▭	Manual Summary Rollup	▬	Deadline	⇩
Project Summary	▬	Inactive Milestone	◆	Manual Summary	▬		

2027 NGCC Project
Development Schedule - Single Unit
April 2027 COD

ID	Task Name	Duration	Start	Finish
63	Pre-Qualify STG Suppliers	40 days	Tue 12/6/22	Mon 1/30/23
64	Pre-Qualify HRSG Suppliers	40 days	Tue 12/6/22	Mon 1/30/23
65	Pre-Qualify EPC Contractors	50 days	Tue 12/6/22	Mon 2/13/23
66	EPC Bid Package Development, Review	50 days	Tue 2/14/23	Mon 4/24/23
67	Issue EPC RFP, and Bid Preparation	71 days	Tue 5/9/23	Tue 8/15/23
68	EPC Evaluation and Short List Selection	50 days	Wed 8/16/23	Tue 10/24/23
69	Best & Final Proposal Request/Development	25 days	Ned 10/25/2	Tue 11/28/23
70	Combustion Turbine Technology Evaluation and Selecti	10 days	Ned 11/29/2	Tue 12/12/23
71	Final EPC Contract Evaluation and Negotiations	30 days	Ned 12/13/2	Tue 1/23/24
72				
73	**EPC Contract Execution**	**822 days**	**Wed 2/7/24**	**Thu 4/1/27**
74	EPC Contract Award	5 days	Wed 2/7/24	Tue 2/13/24
75	Issue LNTP	5 days	Wed 2/21/24	Tue 2/27/24
76	Engineering	440 days	Wed 2/28/24	Tue 11/4/25
77	FNTP	1 day	Wed 4/3/24	Wed 4/3/24
78	Major Equipment Procure/Fab & Deliver	500 days	Thu 4/4/24	Wed 3/4/26
79	**Construction**	**746 days**	**Thu 4/4/24**	**Thu 2/11/27**
80	Mobilization to Initial Turnover to Startup	501 days	Thu 4/4/24	Thu 3/5/26
81	Initial Turnover to Startup to Substantial Completion	245 days	Fri 3/6/26	Thu 2/11/27
82	**Startup and Commisioning**	**321 days**	**hu 11/20/25**	**Thu 2/11/27**
83	Cold Comissioning	135 days	Fri 3/6/26	Thu 9/10/26
84	Back Feed Power Available (EPC Contract Milestone)	1 day	Mon 12/8/25	Mon 12/8/25
85	Raw Water Available (EPC Contract Milestone)	1 day	Thu 12/25/25	Thu 12/25/25
86	Operations Staff Available For Training (EPC Contract Milestone)	1 day	Thu 11/20/25	Thu 11/20/25
87	Fuel Available	1 day	Tue 2/24/26	Tue 2/24/26
88	Full Electrical Export Capability	1 day	Tue 5/19/26	Tue 5/19/26
89	Hot Comissioning and Performance Testing	110 days	Fri 9/11/26	Thu 2/11/27
90	Target COD	0 days	Thu 2/11/27	Thu 2/11/27
91	Guaranteed COD	0 days	Thu 4/1/27	Thu 4/1/27



2027 NGCC Single Unit.mpp
Date: Tue 7/19/22

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Milestone	◆	Inactive Task		Duration-only		Progress	—
Summary		Inactive Task		Manual Summary Rollup		Deadline	⇩
Project Summary		Inactive Milestone	◇	Manual Summary			

2027 NGCC Project
Development Schedule - Two Unit
April 2027 COD

ID	Task Name	Duration	Start	Finish
1	**Management Approvals**	**316 days**	**Tue 11/22/22**	**Tue 2/6/24**
2	Approval of Concept	5 days	Tue 11/22/22	Mon 11/28/22
3	Approval to File Applications	5 days	Wed 2/15/23	Tue 2/21/23
4	IC Approval of EPC Agreement	5 days	Wed 1/31/24	Tue 2/6/24
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13	Perform Electrical Interconnection Facility Study	90 days	Wed 12/7/22	Tue 4/11/23
14	Execute Large Generator Iinterconnect Agreement (LGI	20 days	Thu 4/13/23	Wed 5/10/23
15	Review Electric Transmission ROW Requirements	30 days	Thu 12/1/22	Wed 1/11/23
16	Secure Electric Transmission ROW Options (If Required	110 days	Mon 1/30/23	Fri 6/30/23
17	ROW ED Actions (If Necessary)	285 days	Mon 2/26/24	Fri 3/28/25
18	ROW Acquisition Complete	0 days	Fri 3/28/25	Fri 3/28/25
19	Electrical Interconnection Construction Window	275 days	Tue 4/1/25	Mon 4/20/26
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21	**Natural Gas Pipeline**	**1052 days**	**Thu 12/1/22**	**Mon 12/14/26**
22	Initiate Gas Pipeline Routing Study	0 days	Thu 12/1/22	Mon 12/14/26
23	Pipeline Route Selection	45 days	Fri 12/2/22	Thu 2/2/23
24	Gas Pipeline ROW Option Negotiations	120 days	Fri 2/17/23	Thu 8/3/23
25	Secure Gas Pipeline ROW Options	21 days	Mon 8/7/23	Mon 9/4/23
26	Execute Gas Transport Agreement	60 days	Wed 9/6/23	Tue 11/28/23
27	ROW ED Actions (If Necessary)	285 days	Mon 2/26/24	Fri 3/28/25
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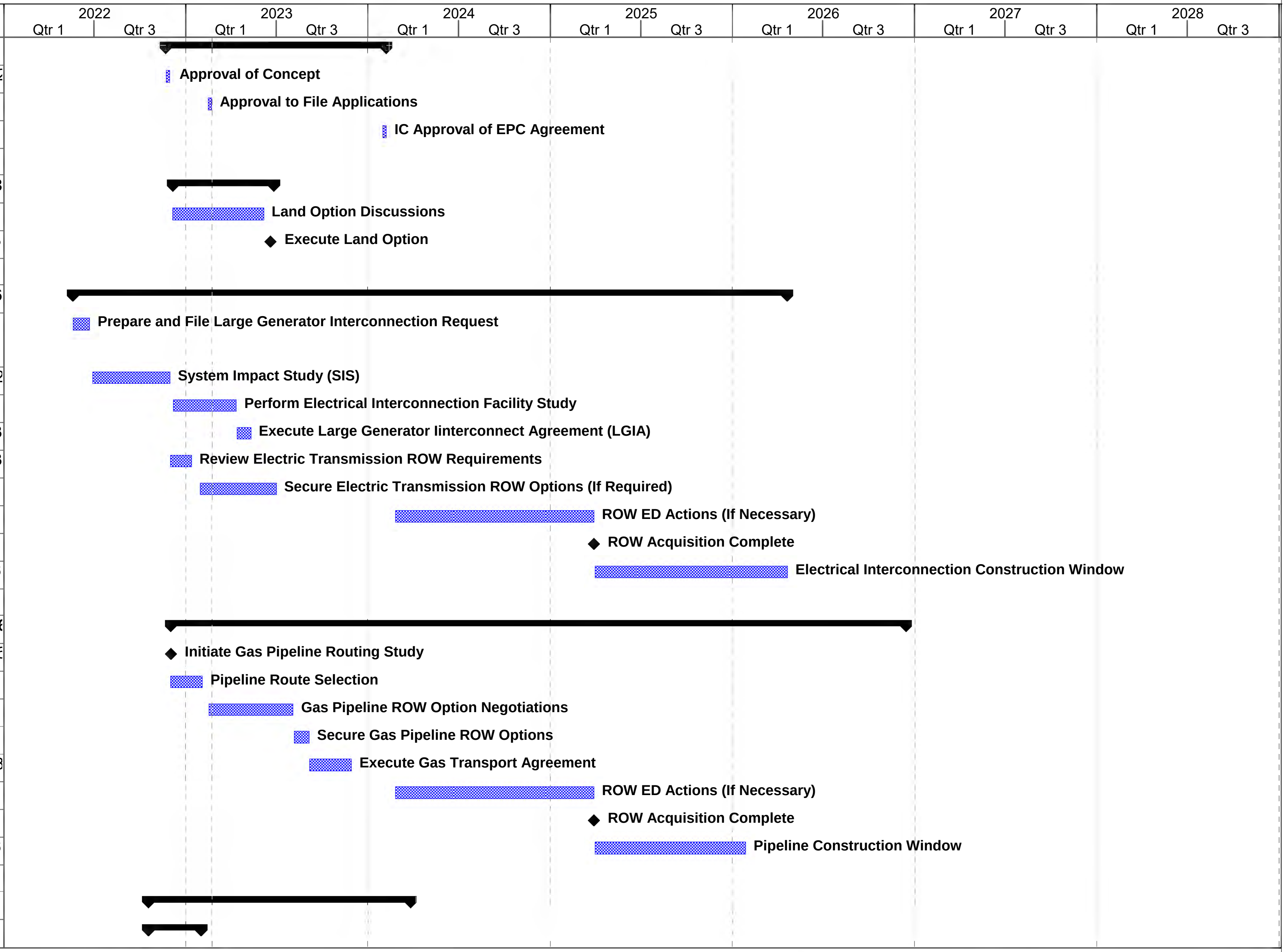

2027 NGCC Two Unit.mpp
Date: Thu 2/23/23

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Milestone	◆	Inactive Task		Duration-only	▬	Progress	▬
Summary	▬	Inactive Task		Manual Summary Rollup	▬	Deadline	⇩
Project Summary	▬	Inactive Milestone	◆	Manual Summary	▬		

2027 NGCC Project
Development Schedule - Two Unit
April 2027 COD

ID	Task Name	Duration	Start	Finish
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35	Issue CEA and SA Reports	1 day	Tue 1/31/23	Tue 1/31/23
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37	Begin Air Permit Application	1 day	Tue 11/29/22	Tue 11/29/22
38	Prepare Draft Air Permit Application for Internal Revie	40 days	Wed 11/30/22	Tue 1/24/23
39	Complete Air Permit Application	10 days	Wed 1/25/23	Tue 2/7/23
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43	KDAQ Issue Proposed Air Permit (Construction Commencement Allowed)	20 days	Wed 2/28/24	Tue 3/26/24
44				
45	**Regulatory**	**456 days**	**Thu 5/26/22**	**Thu 2/22/24**
46	Develop 3rd Party Power Supply RFP	16 days	Thu 5/26/22	Thu 6/16/22
47	Issue 3rd Party Power Supply RFP	1 day	Wed 6/22/22	Wed 6/22/22
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49	Evaluate Power Supply Bids	52 days	Fri 8/19/22	Mon 10/31/22
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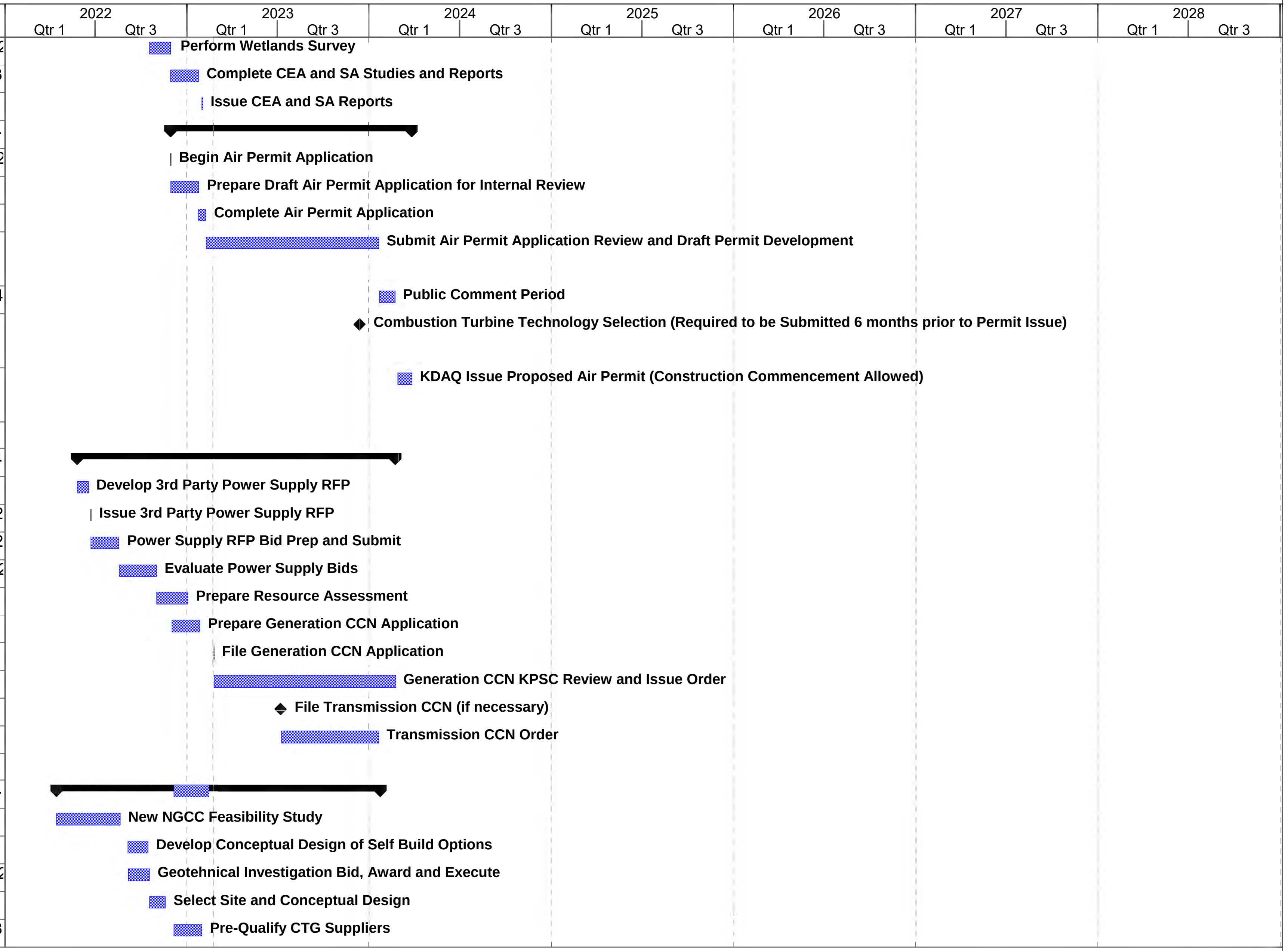
51	Prepare Generation CCN Application	40 days	Fri 12/2/22	Thu 1/26/23
52	File Generation CCN Application	1 day	Thu 2/23/23	Thu 2/23/23
53	Generation CCN KPSC Review and Issue Order	260 days	Fri 2/24/23	Thu 2/22/24
54	File Transmission CCN (if necessary)	0 days	Fri 7/7/23	Fri 7/7/23
55	Transmission CCN Order	140 days	Mon 7/10/23	Fri 1/19/24
56				
57	**Project Engineering**	**463 days**	**Fri 4/15/22**	**Tue 1/23/24**
58	New NGCC Feasibility Study	91 days	Fri 4/15/22	Fri 8/19/22
59	Develop Conceptual Design of Self Build Options	30 days	Mon 9/5/22	Fri 10/14/22
60	Geotehnical Investigation Bid, Award and Execute	30 days	Tue 9/6/22	Mon 10/17/22
61	Select Site and Conceptual Design	24 days	Tue 10/18/22	Fri 11/18/22
62	Pre-Qualify CTG Suppliers	40 days	Tue 12/6/22	Mon 1/30/23



2027 NGCC Two Unit.mpp
Date: Thu 2/23/23

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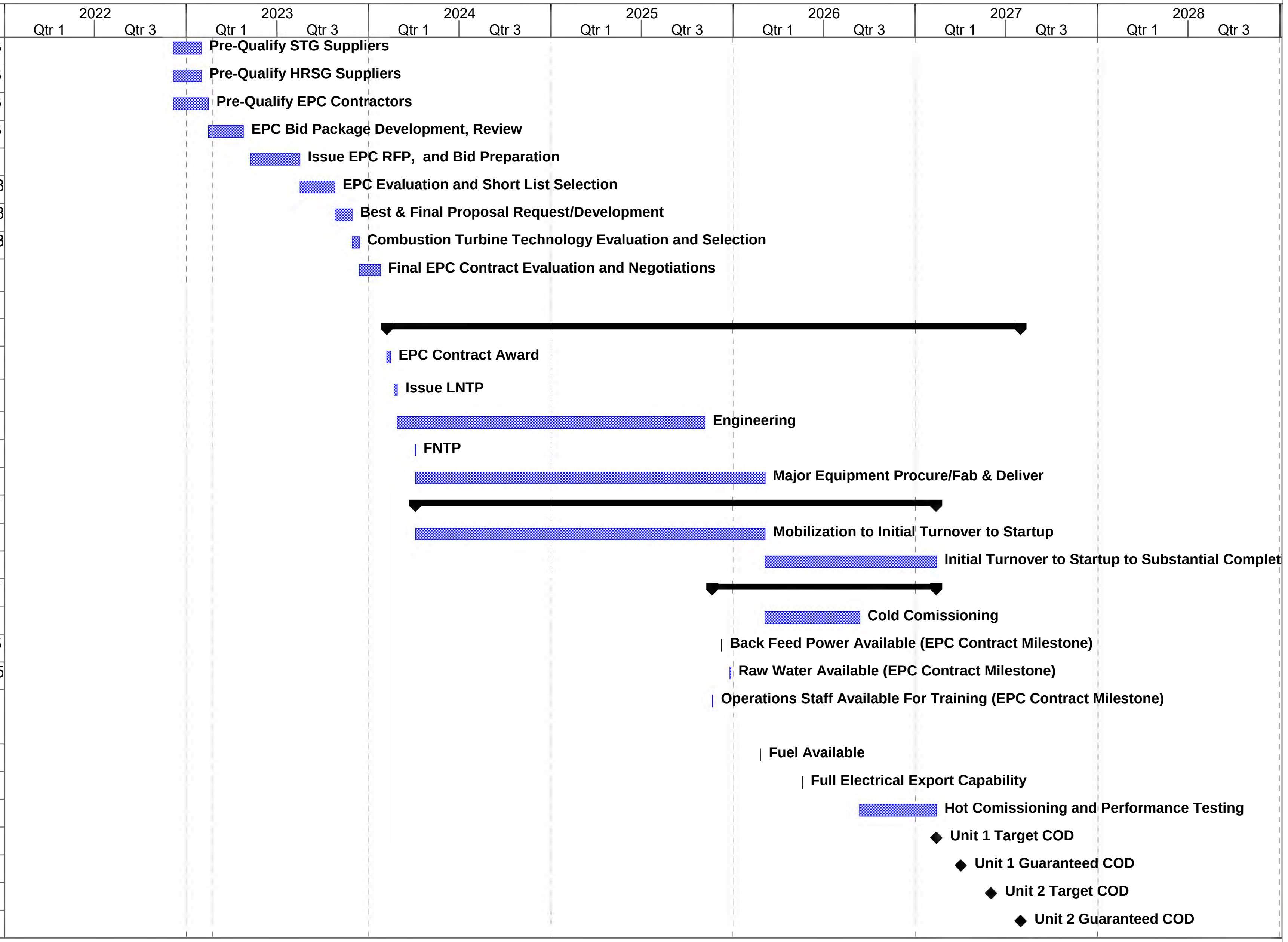
Milestone	◆	Inactive Task	▪	Duration-only	▬	Progress	―
Summary	▬	Inactive Task	▭	Manual Summary Rollup	▬	Deadline	⇩
Project Summary	▬	Inactive Milestone	◇	Manual Summary	▬		

2027 NGCC Project
Development Schedule - Two Unit
April 2027 COD

ID	Task Name	Duration	Start	Finish
63	Pre-Qualify STG Suppliers	40 days	Tue 12/6/22	Mon 1/30/23
64	Pre-Qualify HRSG Suppliers	40 days	Tue 12/6/22	Mon 1/30/23
65	Pre-Qualify EPC Contractors	50 days	Tue 12/6/22	Mon 2/13/23
66	EPC Bid Package Development, Review	50 days	Tue 2/14/23	Mon 4/24/23
67	Issue EPC RFP, and Bid Preparation	71 days	Tue 5/9/23	Tue 8/15/23
68	EPC Evaluation and Short List Selection	50 days	Wed 8/16/23	Tue 10/24/23
69	Best & Final Proposal Request/Development	25 days	Ved 10/25/2	Tue 11/28/23
70	Combustion Turbine Technology Evaluation and Selecti	10 days	Ved 11/29/2	Tue 12/12/23
71	Final EPC Contract Evaluation and Negotiations	30 days	Ved 12/13/2	Tue 1/23/24
72				
73	**EPC Contract Execution**	**908 days**	**Wed 2/7/24**	**Fri 7/30/27**
74	EPC Contract Award	5 days	Wed 2/7/24	Tue 2/13/24
75	Issue LNTP	5 days	Wed 2/21/24	Tue 2/27/24
76	Engineering	440 days	Wed 2/28/24	Tue 11/4/25
77	FNTP	1 day	Wed 4/3/24	Wed 4/3/24
78	Major Equipment Procure/Fab & Deliver	500 days	Thu 4/4/24	Wed 3/4/26
79	**Construction**	**746 days**	**Thu 4/4/24**	**Thu 2/11/27**
80	Mobilization to Initial Turnover to Startup	501 days	Thu 4/4/24	Thu 3/5/26
81	Initial Turnover to Startup to Substantial Completion	245 days	Fri 3/6/26	Thu 2/11/27
82	**Startup and Commisioning**	**321 days**	**Thu 11/20/25**	**Thu 2/11/27**
83	Cold Comissioning	135 days	Fri 3/6/26	Thu 9/10/26
84	Back Feed Power Available (EPC Contract Milestone)	1 day	Mon 12/8/25	Mon 12/8/25
85	Raw Water Available (EPC Contract Milestone)	1 day	Thu 12/25/25	Thu 12/25/25
86	Operations Staff Available For Training (EPC Contract Milestone)	1 day	Thu 11/20/25	Thu 11/20/25
87	Fuel Available	1 day	Tue 2/24/26	Tue 2/24/26
88	Full Electrical Export Capability	1 day	Tue 5/19/26	Tue 5/19/26
89	Hot Comissioning and Performance Testing	110 days	Fri 9/11/26	Thu 2/11/27
90	Unit 1 Target COD	0 days	Thu 2/11/27	Thu 2/11/27
91	Unit 1 Guaranteed COD	0 days	Thu 4/1/27	Thu 4/1/27
92	Unit 2 Target COD	0 days	Tue 6/1/27	Tue 6/1/27
93	Unit 2 Guaranteed COD	0 days	Fri 7/30/27	Fri 7/30/27

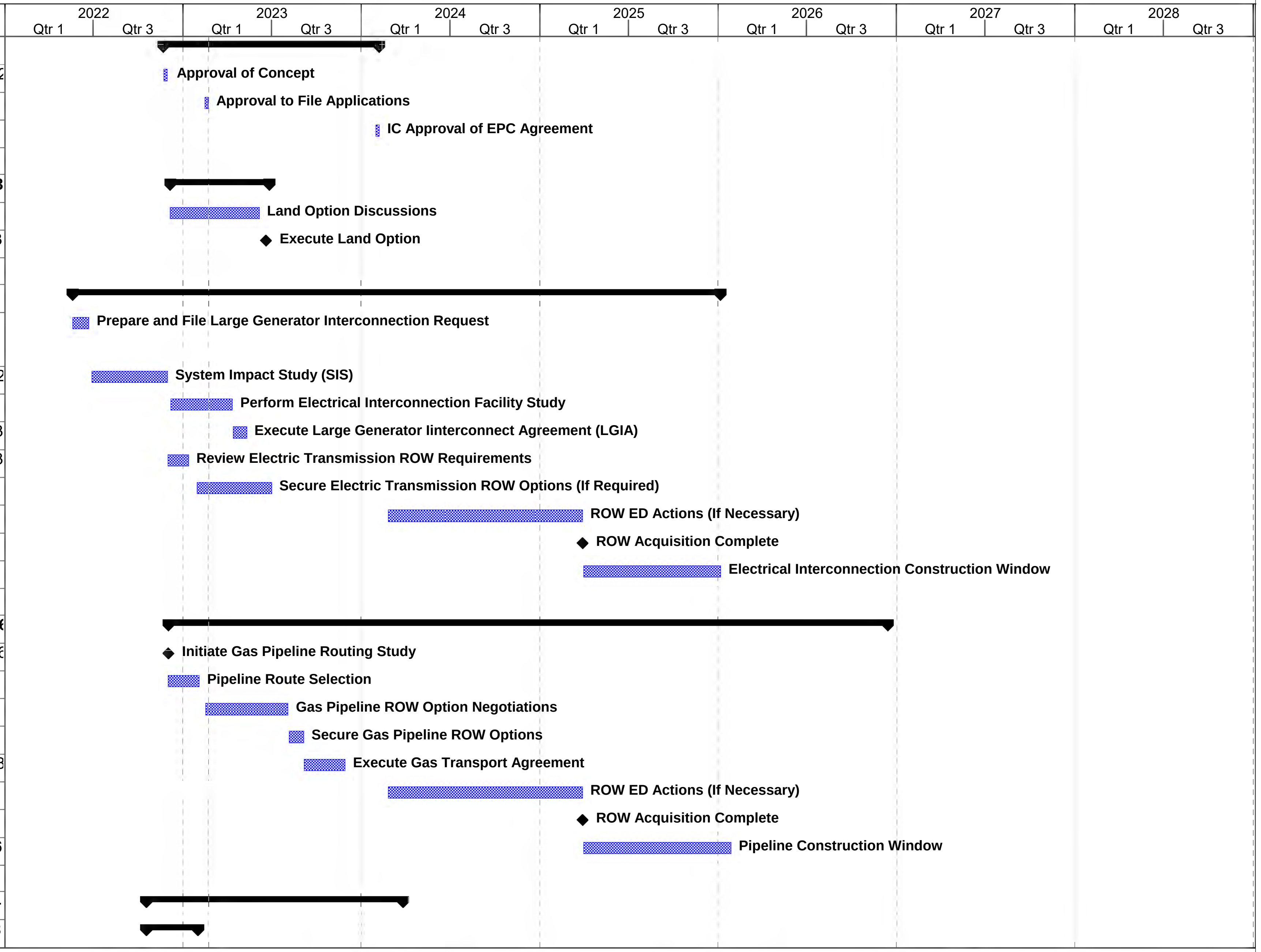


2027 NGCC Two Unit.mpp
Date: Thu 2/23/23

Task	▨	External Tasks	▨	Inactive Summary		Start-only	[
Split	....	External Milestone	◆	Manual Task		Finish-only	]
Milestone	◆	Inactive Task		Duration-only		Progress	—
Summary		Inactive Task		Manual Summary Rollup		Deadline	⇩
Project Summary		Inactive Milestone	◆	Manual Summary			

2027 NGCC Project
Development Schedule - Simple Cycle 2x0
April 2026 COD

ID	Task Name	Duration	Start	Finish
1	**Management Approvals**	**316 days**	**Tue 11/22/22**	**Tue 2/6/24**
2	Approval of Concept	5 days	Tue 11/22/22	Mon 11/28/22
3	Approval to File Applications	5 days	Wed 2/15/23	Tue 2/21/23
4	IC Approval of EPC Agreement	5 days	Wed 1/31/24	Tue 2/6/24
5				
6	**Property Acquisition**	**145 days**	**Tue 12/6/22**	**Mon 6/26/23**
7	Land Option Discussions	130 days	Tue 12/6/22	Mon 6/5/23
8	Execute Land Option	5 days	Tue 6/20/23	Mon 6/26/23
9				
10	**Electrical Interconnection**	**947 days**	**Fri 5/20/22**	**Mon 1/5/26**
11	Prepare and File Large Generator Interconnection Request	23 days	Fri 5/20/22	Tue 6/21/22
12	System Impact Study (SIS)	110 days	Wed 6/29/22	Tue 11/29/22
13	Perform Electrical Interconnection Facility Study	90 days	Wed 12/7/22	Tue 4/11/23
14	Execute Large Generator Iinterconnect Agreement (LGI	20 days	Thu 4/13/23	Wed 5/10/23
15	Review Electric Transmission ROW Requirements	30 days	Thu 12/1/22	Wed 1/11/23
16	Secure Electric Transmission ROW Options (If Required	110 days	Mon 1/30/23	Fri 6/30/23
17	ROW ED Actions (If Necessary)	285 days	Mon 2/26/24	Fri 3/28/25
18	ROW Acquisition Complete	0 days	Fri 3/28/25	Fri 3/28/25
19	Electrical Interconnection Construction Window	200 days	Tue 4/1/25	Mon 1/5/26
20				
21	**Natural Gas Pipeline**	**1052 days**	**Thu 12/1/22**	**Mon 12/14/26**
22	Initiate Gas Pipeline Routing Study	0 days	Thu 12/1/22	Mon 12/14/26
23	Pipeline Route Selection	45 days	Fri 12/2/22	Thu 2/2/23
24	Gas Pipeline ROW Option Negotiations	120 days	Fri 2/17/23	Thu 8/3/23
25	Secure Gas Pipeline ROW Options	21 days	Mon 8/7/23	Mon 9/4/23
26	Execute Gas Transport Agreement	60 days	Wed 9/6/23	Tue 11/28/23
27	ROW ED Actions (If Necessary)	285 days	Mon 2/26/24	Fri 3/28/25
28	ROW Acquisition Complete	0 days	Fri 3/28/25	Fri 3/28/25
29	Pipeline Construction Window	215 days	Tue 4/1/25	Mon 1/26/26
30				
31	**Environmental**	**376 days**	**Tue 10/18/22**	**Tue 3/26/24**
32	**Site Studies and Permits (Land and Water)**	**76 days**	**Tue 10/18/22**	**Tue 1/31/23**

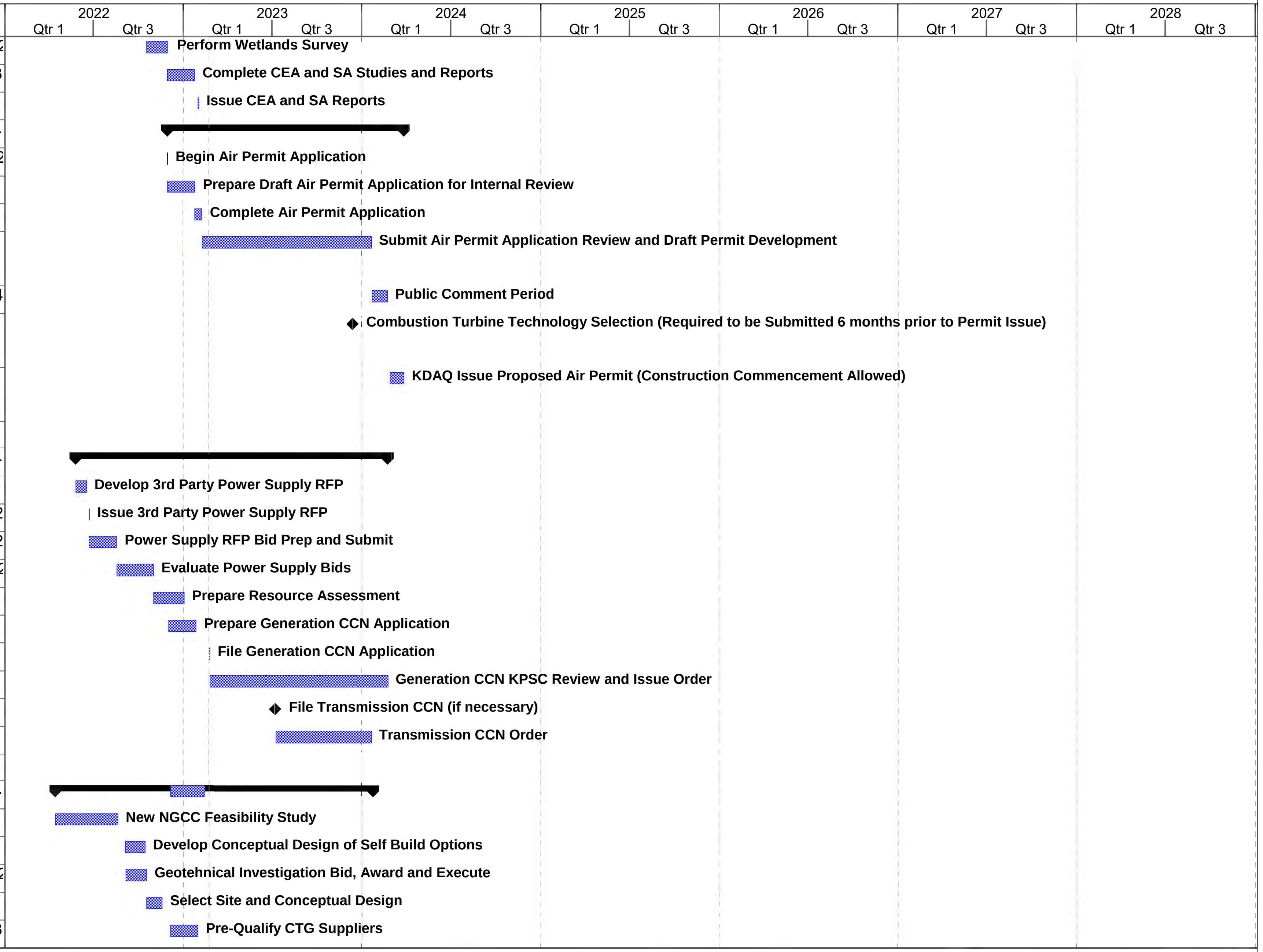


2026 COD Simple Cycle.mpp
Date: Thu 2/23/23

Task	▬	External Tasks	▬	Inactive Summary	▬	Start-only	[
Split	┈	External Milestone	◆	Manual Task	▬	Finish-only	]
Milestone	◆	Inactive Task	◆	Duration-only	▬	Progress	―
Summary	▬	Inactive Task	▭	Manual Summary Rollup	▬	Deadline	⇩
Project Summary	▬	Inactive Milestone	◆	Manual Summary	▬		

2027 NGCC Project
Development Schedule - Simple Cycle 2x0
April 2026 COD

ID	Task Name	Duration	Start	Finish
33	Perform Wetlands Survey	30 days	Tue 10/18/22	Mon 11/28/22
34	Complete CEA and SA Studies and Reports	40 days	Tue 11/29/22	Mon 1/23/23
35	Issue CEA and SA Reports	1 day	Tue 1/31/23	Tue 1/31/23
36	**Air Permit**	**346 days**	**Tue 11/29/22**	**Tue 3/26/24**
37	Begin Air Permit Application	1 day	Tue 11/29/22	Tue 11/29/22
38	Prepare Draft Air Permit Application for Internal Revie	40 days	Wed 11/30/22	Tue 1/24/23
39	Complete Air Permit Application	10 days	Wed 1/25/23	Tue 2/7/23
40	Submit Air Permit Application Review and Draft Permit Development	247 days	Thu 2/9/23	Fri 1/19/24
41	Public Comment Period	23 days	Mon 1/22/24	Wed 2/21/24
42	Combustion Turbine Technology Selection (Required to be Submitted 6 months prior to Permit Issue)	0 days	Tue 12/12/23	Tue 12/12/23
43	KDAQ Issue Proposed Air Permit (Construction Commencement Allowed)	20 days	Wed 2/28/24	Tue 3/26/24
44				
45	**Regulatory**	**456 days**	**Thu 5/26/22**	**Thu 2/22/24**
46	Develop 3rd Party Power Supply RFP	16 days	Thu 5/26/22	Thu 6/16/22
47	Issue 3rd Party Power Supply RFP	1 day	Wed 6/22/22	Wed 6/22/22
48	Power Supply RFP Bid Prep and Submit	40 days	Thu 6/23/22	Wed 8/17/22
49	Evaluate Power Supply Bids	52 days	Fri 8/19/22	Mon 10/31/22
50	Prepare Resource Assessment	45 days	Tue 11/1/22	Mon 1/2/23
51	Prepare Generation CCN Application	40 days	Fri 12/2/22	Thu 1/26/23
52	File Generation CCN Application	1 day	Thu 2/23/23	Thu 2/23/23
53	Generation CCN KPSC Review and Issue Order	260 days	Fri 2/24/23	Thu 2/22/24
54	File Transmission CCN (if necessary)	0 days	Fri 7/7/23	Fri 7/7/23
55	Transmission CCN Order	140 days	Mon 7/10/23	Fri 1/19/24
56				
57	**Project Engineering**	**463 days**	**Fri 4/15/22**	**Tue 1/23/24**
58	New NGCC Feasibility Study	91 days	Fri 4/15/22	Fri 8/19/22
59	Develop Conceptual Design of Self Build Options	30 days	Mon 9/5/22	Fri 10/14/22
60	Geotehnical Investigation Bid, Award and Execute	30 days	Tue 9/6/22	Mon 10/17/22
61	Select Site and Conceptual Design	24 days	Tue 10/18/22	Fri 11/18/22
62	Pre-Qualify CTG Suppliers	40 days	Tue 12/6/22	Mon 1/30/23



2026 COD Simple Cycle.mpp
Date: Thu 2/23/23

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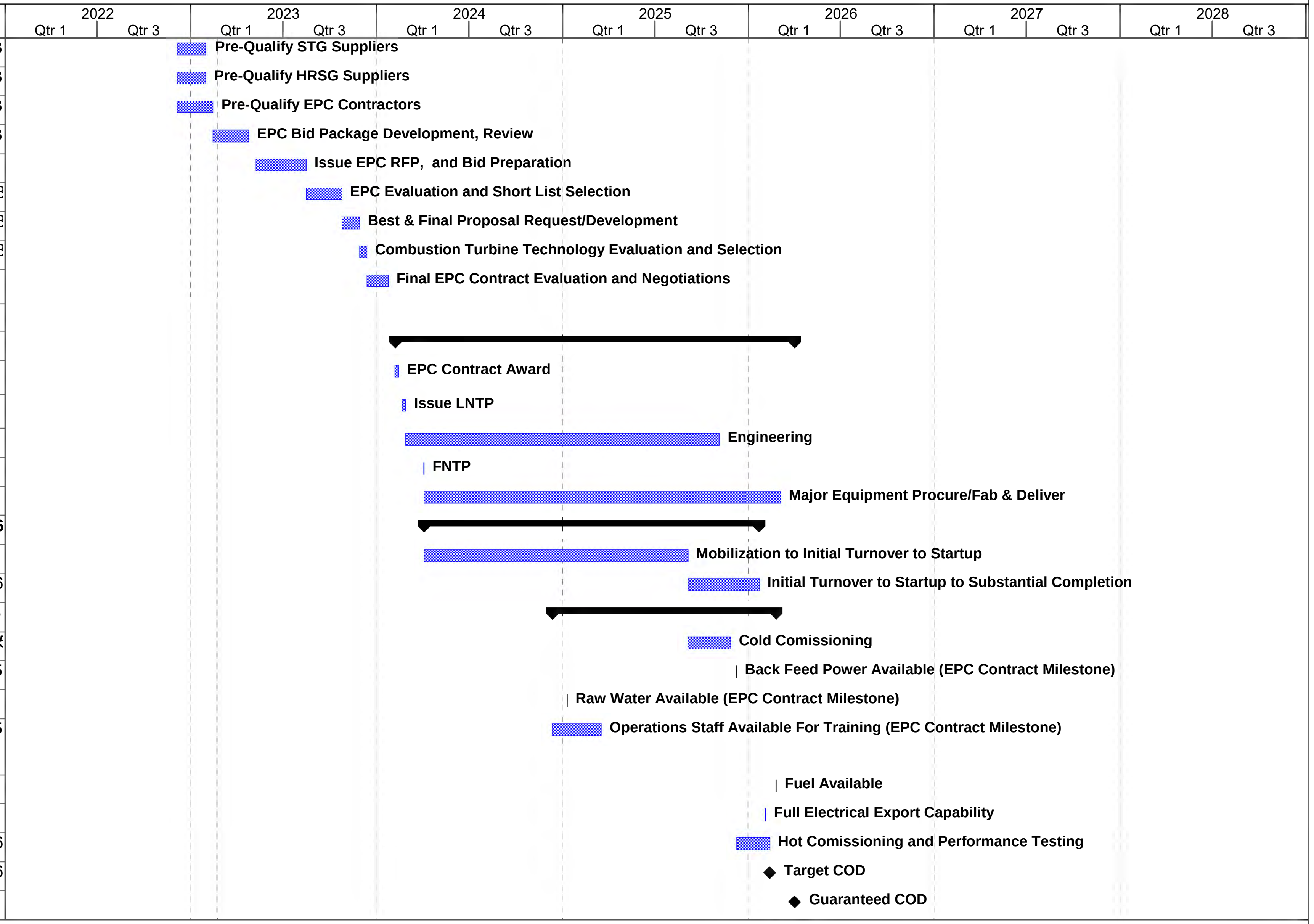
Summary		Inactive Task		Manual Summary Rollup		Deadline	⇩
Project Summary		Inactive Milestone	◇	Manual Summary			

2027 NGCC Project
Development Schedule - Simple Cycle 2x0
April 2026 COD

ID	Task Name	Duration	Start	Finish
63	Pre-Qualify STG Suppliers	40 days	Tue 12/6/22	Mon 1/30/23
64	Pre-Qualify HRSG Suppliers	40 days	Tue 12/6/22	Mon 1/30/23
65	Pre-Qualify EPC Contractors	50 days	Tue 12/6/22	Mon 2/13/23
66	EPC Bid Package Development, Review	50 days	Tue 2/14/23	Mon 4/24/23
67	Issue EPC RFP, and Bid Preparation	71 days	Tue 5/9/23	Tue 8/15/23
68	EPC Evaluation and Short List Selection	50 days	Wed 8/16/23	Tue 10/24/23
69	Best & Final Proposal Request/Development	25 days	Wed 10/25/23	Tue 11/28/23
70	Combustion Turbine Technology Evaluation and Selectio	10 days	Wed 11/29/23	Tue 12/12/23
71	Final EPC Contract Evaluation and Negotiations	30 days	Wed 12/13/23	Tue 1/23/24
72				
73	**EPC Contract Execution**	**561 days**	**Wed 2/7/24**	**Wed 4/1/26**
74	EPC Contract Award	5 days	Wed 2/7/24	Tue 2/13/24
75	Issue LNTP	5 days	Wed 2/21/24	Tue 2/27/24
76	Engineering	440 days	Wed 2/28/24	Tue 11/4/25
77	FNTP	1 day	Wed 4/3/24	Wed 4/3/24
78	Major Equipment Procure/Fab & Deliver	500 days	Thu 4/4/24	Wed 3/4/26
79	**Construction**	**470 days**	**Thu 4/4/24**	**Wed 1/21/26**
80	Mobilization to Initial Turnover to Startup	370 days	Thu 4/4/24	Wed 9/3/25
81	Initial Turnover to Startup to Substantial Completion	100 days	Thu 9/4/25	Wed 1/21/26
82	**Startup and Commisioning**	**314 days**	**Thu 12/12/24**	**Tue 2/24/26**
83	Cold Comissioning	60 days	Thu 9/4/25	Wed 11/26/25
84	Back Feed Power Available (EPC Contract Milestone)	1 day	Mon 12/8/25	Mon 12/8/25
85	Raw Water Available (EPC Contract Milestone)	1 day	Thu 1/9/25	Thu 1/9/25
86	Operations Staff Available For Training (EPC Contract Milestone)	68 days	Thu 12/12/24	Mon 3/17/25
87	Fuel Available	1 day	Tue 2/24/26	Tue 2/24/26
88	Full Electrical Export Capability	1 day	Tue 2/3/26	Tue 2/3/26
89	Hot Comissioning and Performance Testing	47 days	Tue 12/9/25	Wed 2/11/26
90	Target COD	0 days	Wed 2/11/26	Wed 2/11/26
91	Guaranteed COD	0 days	Wed 4/1/26	Wed 4/1/26



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Project Summary		Inactive Milestone	◇	Manual Summary			

Appendix E is confidential in its entirety and being provided separately under seal.

Appendix F is confidential in its entirety and being provided separately under seal.