Appendix 5.15 Thermal Energy Plan Development Study (Stantec 2016)

2016-007 – Thermal Energy Plant Development Study – Rev. 1

Conceptual planning and design for a 5 MWe, 10 MWe, and 20 MWe LNG and diesel thermal station in the Whitehorse area



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V:\133547248_8_8 Revision 1

November 21, 2016

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INTRODUCTION November 21, 2016

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by Yukon Energy Corporation (YEC) to conduct a desktop conceptual planning and design exercise to support their resource planning activities relative to thermal generation. The objective of this study is to determine a potential site within the Whitehorse and surrounding area for the new facility, and to complete conceptual designs for a power generation plant in size increments of 5 MW_e, 10 MW_e, and 20 MW_e output. In all cases, the plant is to use LNG or diesel as its primary fuel.

The study was conducted in a series of finite tasks, building methodically toward the solutions outlined herein. Siting was conducted in two phases. The first phase identified attributes and characteristics desired for the potential site, with the second phase applying the criteria to the candidate sites, leading to selection of a recommended site. Results for this aspect of the study are outlined in Chapter 2 – Plant Siting.

In parallel to the siting exercise, conceptual designs for the three plant capacities using LNG and diesel fuel were developed. This design process included securing budgetary quotations from major equipment vendors for reciprocating engines and fuel handling equipment. Preliminary site layouts were generated for each option, along with AACE Class 5 opinions of probable capital cost, in order to support YEC planning activities. The engineering effort also included a preliminary implementation schedule, as expected performance of the plant, and commentary on other plant attributes. Results for this effort are covered in Chapter 3 – Conceptual Design.



2.0 PLANT SITING

The plant siting selection was executed as a mainly desktop study. Stantec carried out site visits for some of the sites and had preliminary conversations with City of Whitehorse and Yukon Government officials concerning planning and zoning regulations as well as land tenure and disposition. Mandatory criteria and desired criteria were confirmed with YEC prior to the selection of sites (Appendix A). These criteria were assembled to create a 'level of importance matrix' for site criteria, which is presented in Table 1.

Table 1 Selected Criteria and Level of Importance

	Low	Medium	High
Greenfield –undisturbed land	Х		
Brownfield – previously developed land			Х
Proximity to existing YEC generating facilities in Whitehorse		Х	
Connected to city services (water and sewer)		х	
Inside city limits	х		
Ease of constructability (laydown area, security, heavy equipment access)		х	
Proximity to residential areas (noise, smell, spill containment)			Х
Proximity to YEC transmission/substation			Х
Proximity to AEY distribution/substation			Х
Opportunity to connect to District Energy System	Х		
Accessible directly off Alaska Hwy/Klondike Hwy			Х
Commissioner's Land		Х	

OCP and Zoning Review City of Whitehorse

The City of Whitehorse has advised that any thermal generation plant must be located on land designated 'Public Utilities' in the Official Community Plan (OCP). It must also be within a PU (Public Utilities) zone in the Zoning Bylaw. Because all existing PU land use and zoning designations are on lands that have existing utility uses, the City has advised that both an OCP and zoning amendment will be required to permit the use of a thermal generation plant on a new site. This is not unexpected as new uses require public input and consideration. The City of Whitehorse is carrying out an OCP review in 2017 and it is our recommendation that YEC engage with the City early to identify and plan for future needs.



Whitehorse Periphery Area Development Regulations

The Yukon Government administers the zoning of lands in the Whitehorse periphery. Similar to Whitehorse's planning and zoning regulations there are no large sites that are currently identified for thermal energy generation. Public Utilities are a permitted use in most zones and are defined as 'the use of land for a sewerage, water, telecommunications, electricity or transportation systems'.

2.1 SITE SELECTION

Stantec applied the siting criteria and level importance as determined by YEC and identified four (4) sites for consideration: two (2) within the City of Whitehorse, and two (2) just north of the City of Whitehorse boundaries. A site selection memo was prepared to support YEC's decision on a site for the study. See Appendix B for these documents. Following review of the site selection memo, YEC indicated they would like to further investigate two sites, Site 1 – Whitehorse Landfill and Site 3 – Mayo Road Substation (Takhini S164).

2.1.1 Site 1: City of Whitehorse Landfill

This is a land parcel that is owned by the City of Whitehorse and is located within the area of their existing landfill. The land is appropriately zoned and would not require a public planning process. Information on the potential site is outlined below, with the selection criteria in Table 2, and site photos in Figures 1 and 2.

Owner: City of Whitehorse

Size: A 4 hectare parcel would need to be surveyed out of the larger City of Whitehorse War Eagle Landfill

Tenure opportunity: Long term lease from the City of Whitehorse

OCP Designation: Public Utilities

Zoning: PU - Public Utilities

Table 2 Selection Criteria - Landfill	Table 2	Selection	Criteria	- Landfill
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Criteria	Yes	No
Greenfield – undisturbed land		\checkmark
Brownfield – previously developed land	\checkmark	
Proximity to existing YEC generating facility on Robert Service Way, Whitehorse		0 m
Connected to city services (water and sewer)	345 m	\checkmark



Criteria	Yes	No	
nside city limits			
Ease of constructability (laydown area, security, heavy equipment access)			
Proximity to residential areas (noise, smell, spill containment)		1400 m	
Proximity to YEC transmission/substation		2500 m	
Proximity to AEY distribution/substation		0 m	
Opportunity to connect to a DES		910 m	
Accessible directly off Alaska Hwy		500 m	
Commissioner's Land		\checkmark	



Figure 1 Conceptual Map of Potential Site Location (Landfill)



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Figure 2 Photo of Potential Plant Location at Landfill

2.1.2 Site 3: Mayo Road Substation - Lot Enlargement

This is a parcel of Vacant Commissioner's land adjacent to the existing Yukon Energy Corporation substation on the Mayo Road, and is within the Mayo Road Area Development Regulations. Information on the potential site is outlined below, with the selection criteria in Table 3, and site photos in Figures 3 and 4.

Owner: Commissioner of Yukon

Size: The existing substation property is not large enough to accommodate the thermal energy plant. However, carving a 4.0 hectare parcel from the Commissioner's land to add to the existing parcel seems to be a reasonable expectation. This additional land is required to maintain a buffer to separate the Agriculture zoned parcel to the north and First Nation Land Use (TKC C-36B) zoned parcel to the south.

Tenure opportunity: Purchase and consolidate with existing parcel

Local Area Planning Zoning Designation: H - Hinterland (Uses include public utilities)



Table 3 Selection Criteria – Takhini Substation

Criteria - Level of Importance in Site Selection	Yes	No
Greenfield – undisturbed land	\checkmark	
Brownfield – previously developed land		✓
Proximity to existing YEC generating facility on Robert Service Way, Whitehorse	21,	660 m
Connected to city services (water and sewer)		\checkmark
Inside city limits		\checkmark
Ease of constructability (laydown area, security, heavy equipment access)	\checkmark	
Proximity to residential areas (noise, smell, spill containment)		50 m
Proximity to YEC transmission/substation		10 m
Proximity to AEY distribution/substation		0 m
Opportunity to connect to a DES		\checkmark
Accessible directly off Alaska Hwy/Klondike Hwy	\checkmark	200 m
Commissioner's Land	\checkmark	





Figure 3 Conceptual Map of Potential Site Location (Takhini)

Figure 4 Photo of Potential Plant Location at Takhini



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3.0 CONCEPTUAL DESIGN

Using the two selected sites, Stantec was tasked with the development of conceptual designs for the multiple options desired by YEC. The following sub-sections cover each topic of interest to YEC, and present the results.

3.1 BASIS OF DESIGN

In order to drive the conceptual design and document the assumptions made, a Basis of Design (BOD) document was generated. The BOD considers both sites, both technologies, and three (3) unit capacities, resulting in the twelve (12) options. The BOD is a standalone document containing the site layout drawings and opinions of probable capital costs. Please refer to Appendix D for the full BOD document and supplemental information.

3.2 PRIME MOVERS

A budgetary request for quotation was issued to several prominent engine suppliers in order to validate performance and establish lead times and costing for the units required for the YEC plant configurations. Packages were received, but due to the quick turnaround required, they were not complete and did not address all unit sizes requested. Because of the budgetary nature of the request, detailed price break-outs for specific equipment options of interest were not available. For example, half of the units quoted were supplied with enclosures for outdoor installation. Vendor responses have been provided for YEC to future reference.

Similar to the scope of supply, the unit pricing also varied significantly depending on options included and on the extent of construction and commissioning support embedded in the quotation. Therefore, Stantec relied on in-house data and professional judgement as well as the budgetary quotations to arrive at an appropriate Class 5 opinion of probable cost (OPC). Using the following scope of supply, engine equipment costs utilized are presented in Table 4.

Table 4 Summary of Opinion of Probable Capital Cost

Scope of Supply:	Unit / Fuel Type	Unit Cost (CAD)
Prime Mover	$2.5~MW_{ m e}$ / NG	\$2.0 M
Generator and Auxiliaries	$5.0~\text{MW}_{ m e}$ / NG	\$4.0 M
Mechanical Auxiliaries (circulating pumps / radiator)	$2.5\ \text{MW}_{\rm e}$ / Diesel	\$1.5 M
Electrical Control Equipment	5.0 MWe / Diesel	\$3.5 M
Heat Recovery / Rejection		
Engineering / Project Management / Drawings		
Sound Attenuation		



3.3 CONCEPTUAL SITE LAYOUTS

Building on the design characteristics outlined in the BOD in Appendix C, site layout drawings were prepared for each option. To appreciate land requirements, a tentative layout of the generating halls and switchyards, as well as fuel storage requirements have been provided. The site layout drawing is embedded within the BOD document in Appendix D and are presented in two forms for each option. The site layout (or general arrangement) is presented on its own to facilitate review and an understanding of the site itself (see sample in Figure 5) as well as on a second sheet with a satellite image in the background to appreciate its impact to the selected site (see Figure 6). Both drawings we used during the course of the study to finalize design considerations in the BOD as well as complete each options' OPC.



Figure 5 Site Layout Sample for Landfill, 20 MW, LNG (Plant)



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CONCEPTUAL DESIGN November 21, 2016



Figure 6 Site Layout Sample for Landfill, 20 MW, LNG (Satellite)

3.4 ENGINE WASTE HEAT RECOVERY, HEAT RATE AND LOAD PICK-UP CAPABILITY

3.4.1 Engine Waste Heat Recovery

A typical reciprocating engine, whether diesel or natural gas, will have a fuel-to-power conversion efficiency based on fuel lower heating value (LHV) and ISO conditions of between 41-48%. The remainder of the fuel energy is rejected as heat in the engine cooling system and the engine exhaust. Most of this 'waste heat' can be recovered and may be sold to heat buildings or provide industrial process heat. Therefore, waste heat recovery should be considered if any significant commercial/industrial heating load is expected near the plant.



Based on the potential site locations selected for the study, there are no existing potential heat customers nearby. Recovered heat can also be transported for use at more distant locations, including for winter site fire water heating. However, this 'district heating' piping is not inexpensive, and an evaluation of district heating network economics is not part of the study.

3.4.2 Heat Rate

Fuel purchases are based on Higher Heating Values (HHV). The difference between the two values is the heat of vaporization of the exhausted water vapor (which is formed during combustion). The ratio of LHV to HHV for natural gas is typically 0.90; and for light or distillate oils is typically 0.93.

Representative heat rates for both diesel and NG reciprocating engines (as provided by Wartsila) are based on Lower Heating Values (LHV) of the fuels. So, suggested heat rates for YEC's financial model are as follows:

For Natural Gas:	7634 Btu/kWh (LHV)/0.90	=	8842 Btu/Kwh (HHV)
For Diesel:	7876 Btu/kWh (LHV)/0.93	=	8469 Btu/kWh (HHV)

3.4.3 Load Pick-Up Capability

The thermal energy plant would be required to back up existing generation, so would be required to operate continuously in the event of low water (drought) conditions, or intermittently in the event of an outage of a critical unit (n-1), and during a post outage restoration.

As discussed with YEC, diesel and natural gas generators accommodate load fluctuations differently. In general, diesel engines respond better to load changes and are better able to respond to quick electrical load addition.

The performance variation can be depicted in a load application graph as shown in Figure 7 for a sample 'dual-fuel' reciprocating engine. A dual-fuel generator's performance was used to clearly illustrate load step performance based solely on the fuel used, performance will vary by model. The diesel's maximum tolerable instant load step increase is equal or better than the gas engine up to 90% of rated generator load.

Furthermore, considering time step, during operation, the ramp rate on gas would be greater than 50% per minute, but on liquid fuel the operational ramp rate could exceed 100% per minute.



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3.5 OPINION OF PROBABLE COST

The opinions of probable capital costs (OPC) for the multiple options are outlined in Appendix C as part of the Basis of Design document. A summary of the results of the study are presented in Table 5 for easy reference.



Option #	Fuel Type Natural Gas or	Site Landfill or	Plant Capacities 5 MW _e , 10 MW _e , 20 MW _e	Opinion of Probable Capital
	Diesel	Takhini		Cost (OPC)
NG-LF-05	Natural Gas	Landfill	5 MWe (2x 2.5 MWe)	\$48.6 M
NG-LF-10	Natural Gas	Landfill	10 MWe (4x 2.5 MWe)	\$66.9 M
NG-LF-20	Natural Gas	Landfill	20 MW _e (4x 2.5 MW _e , 2x 5 MW _e)	\$100.1 M
NG-TK-05	Natural Gas	Takhini	$5~\text{MW}_{ ext{e}}$ (2x 2.5 MW _e)	\$48.5 M
NG-TK-10	Natural Gas	Takhini	10 MW $_{ m e}$ (4x 2.5 MW $_{ m e}$)	\$66.8 M
NG-TK-20	Natural Gas	Takhini	20 MW _e (4x 2.5 MW _e , 2x 5 MW _e)	\$100.0 M
DL-LF-05	Diesel	Landfill	5 MW_{e} (2x 2.5 MW _e)	\$32.0 M
DL-LF-10	Diesel	Landfill	10 MWe (4x 2.5 MWe)	\$42.2 M
DL-LF-20	Diesel	Landfill	20 MW _e (4x 2.5 MW _e , 2x 5 MW _e)	\$62.5 M
DL-TK-05	Diesel	Takhini	5 MWe (2x 2.5 MWe)	\$31.7 M
DL-TK-10	Diesel	Takhini	10 MWe (4x 2.5 MWe)	\$41.9 M
DL-TK-20	Diesel	Takhini	20 MWe (4x 2.5 MWe, 2x 5 MWe)	\$62.2 M

Table 5 Summary of Opinion of Probable Capital Cost

Note that the 10 MW_e Natural Gas options presented result in an OPC of \$66.8M - \$66.9M (\$6.7/MW_e), which compares with a YEC recent LNG plant installed in Whitehorse which was roughly \$42M, for 8.8 MW_e (\$4.8M/MW_e) using two engines. The existing installation was less costly because existing utilities infrastructure was available at the site and because the generators were installed in weatherproof enclosures instead of in a building.

In detailed design of an LNG plant, attention should be paid to the requirement for a flare stack for commissioning, boil-off gas management and emergencies. There may also be additional O & M costs related to instrumentation, tank and process equipment maintenance.

3.6 OPINION OF PROBABLE O&M COST

Plant operating costs are addressed in discreet categories described below:

Labor - The labor component, excluding fuel cost, is typically the largest cost in an O&M budget. It consists of the salaries and benefits for the plant manager; licensed operators; maintenance staff (mechanical; electrical; and instrumentation techs); plant engineering; and administration staff including safety; purchasing; accounting; etc. The size of the staff can vary significantly depending on the size and complexity of the plant.



For this reciprocating engine plant because of its proximity to other YEC operations in Whitehorse, staff will not be dedicated solely to this plant. Labor costs are therefore expected to be approximately ½ of what they might otherwise be for a standalone plant.

Maintenance and Materials - The cost for maintenance and materials reflects normal daily, weekly, monthly costs for regular plant maintenance.

Environmental Testing - Most environmental operating permits require annual testing for any air, water or waste water discharges from a plant to verify compliance with the permit conditions.

Consumables, Chemicals, & Misc. - The cost of lubricants, oils, chemicals and miscellaneous consumables used during normal plant operation is included in this line item. It also covers the general administrative cost of running the power plant: phones, office supplies, computers, etc.

Major Equipment Repair Reserve Fund - The major equipment in a reciprocating engine plant needs to be overhauled and repaired on a regular basis in accordance with the vendor's recommended procedures. An engine typically has a service life of 100,000 or more operating hours. Wear components such as valves, piston rings and bearings are normally replaced about every three (3) years and a more thorough engine overhaul is carried out two (2) or three (3) times during the life of the engine. During these, the pistons, cylinder heads, piston liners, connecting rods and turbocharger rotors are replaced or overhauled. This reserve fund is primarily associated with the reciprocating engines but could also include other major pieces of equipment. A reserve fund is established so that money is available to cover the significant costs of the equipment overhaul several years in the future.

In lieu of planning and reserving for major equipment overhauls and inspections, owners sometime establish a Long-Term Service Agreement (LTSA) with the reciprocating engine vendor. The LTSA provides annual performance guarantees from the generator supplier as well as responsibility for all reciprocating engine repairs and overhauls. The term of the LTSA can vary from 10 to 20 years (or can be based on operating hours). Note this approach was not taken for this O&M estimate – cost of the packages depend on option/coverage selected and vary significantly by vendor and offering.

The following Table 6 is a summary of estimated O&M costs for an Owner operated reciprocating engine power plant:



Description	5 MWe	10 MW _e	20 MW _e
Labor	\$300,000	\$400,000	\$500,000
Maintenance & Materials	\$80,000	\$100,000	\$125,000
Major Equipment Repair Fund	\$200,000	\$300,000	\$400,000
Environmental Testing	\$40,000	\$70,000	\$90,000
Consumables, Chemicals, Misc.	\$55,000	\$65,000	\$75,000
Total O&M Estimated Cost*	\$675,000	\$935,000	\$1,190,000

Table 6 Opinion of Probable Reciprocating Engine O&M Costs (Excluding Fuel)

*The estimated cost for O&M reflects the estimated average annual cost. It does not include cost normally incurred by the owner. These costs include insurance; property taxes or asset management fees. It also does not include fees if the O&M is subcontracted out.

3.7 IMPLEMENTATION SCHEDULE

Development of either option on a greenfield site depending on several factors outside YEC's control. Initial planning activities and preliminary engineering need to be further developed to finalize site selection (see implementation schedule in Table 7). With a short-list of sites selected, land negotiations, as well as commencement of the YESAA process will drive the project timeline. Permitting for diesel fuel is expected to be less involved than a new LNG facility, but with the recent LNG installation at the Whitehorse Generating Station, precedence exists for LNG storage and permitting in the Territory. Detailed engineering will need to commence following approval of preliminary engineering activities and YEC go-decision for the project. Engineer will support YESAA activities as well as prepare technical drawings and specifications to support project tendering and/procurement of major equipment. Reciprocating engine lead times require approximately 8 -12 months from receipt of order to delivery to site. Construction and commissioning activities will vary slightly depending on the size of the plant and site accessibility.

Task Description	YR1	YR2	YR3	YR4
Planning and Preliminary Engineering				
Environmental Permitting (YESAA) and Site Selection				
Detailed Engineering and Procurement				
Construction				
Start-up & Commissioning				

Table 7 Implementation Schedule



3.8 YEC PERFORMANCE ATTRIBUTES

A summary table of the performance attributes of the options is presented in Table 8 below. Data provided indicates the high availability and generation capabilities of the technology. YEC is to reconcile final plant capacities to the expected load forecast, in order to determine a true capacity factor for the plant and expected annual energy generation.

The Levelized Cost of Capital (LCOC) for each option has been shown. Financial analysis sheets for each option are included in Appendix C.

Table 8 Performance Attributes by Option

Option #	Installed Capacity [MW _e]	Availability Factor [%]	Maximum Annual Energy [GWh]	Project Life [years]	Opinion of Probable Capital Cost (OPC)	Levelized Cost of Capital (LCOC)
NG-LF-05	5	>95	41.6	20 yr / 60,000 hrs	\$48.6 M	\$679/kW
NG-LF-10	10	>95	83.2	20 yr / 60,000 hrs	\$66.9 M	\$467/kW
NG-LF-20	20	>95	166.4	20 yr / 60,000 hrs	\$100.1 M	\$350/kW
NG-TK-05	5	>95	41.6	20 yr / 60,000 hrs	\$48.5 M	\$678/kW
NG-TK-10	10	>95	83.2	20 yr / 60,000 hrs	\$66.8 M	\$466/kW
NG-TK-20	20	>95	166.4	20 yr / 60,000 hrs	\$100.0 M	\$349/kW
DL-LF-05	5	>95	41,6	20 yr / 60,000 hrs	\$32.0 M	\$447/kW
DL-LF-10	10	>95	83.2	20 yr / 60,000 hrs	\$42.2 M	\$295/kW
DL-LF-20	20	>95	166.4	20 yr / 60,000 hrs	\$62.5 M	\$218/kW
DL-TK-05	5	>95	41,6	20 yr / 60,000 hrs	\$31.7 M	\$443/kW
DL-TK-10	10	>95	83.2	20 yr / 60,000 hrs	\$41.9 M	\$293/kW
DL-TK-20	20	>95	166.4	20 yr / 60,000 hrs	\$62.2 M	\$217/kW



4.0 **RISK IDENTIFICATION**

As this study was only a desktop effort resulting in a concept design, a series of project risks exist that must be mitigated should any option for a thermal generating station be considered in the future. These initial risks are presented in Table 9 for YEC's consideration.

Table 9 Project Development Risks

Site 1: City of Whitehorse Landfill

No.	Risk Description	Potential Impact
1	Land Tenure	Yukon Energy Corporation currently has no tenure. YEC will need to enter into a long term lease with the City of Whitehorse (City). The City's land disposition process is public and invites comments. Public processes that solicit input always have some risk of local opposition to the project.
2	Access	Yukon Government Highways and Public Works will need to approve access off Alaska Highway. Entrance to the landfill is a fairly steep incline but should not pose a significant issue. The City identified a site behind the landfill as an alternative to the one used in the study for the plant. Increase in truck traffic can be mitigated by securing the site closer to the highway and the existing transmission line.
3	Mineral Claims	There are quartz mining claims on both sites. The subsurface rights are encumbered but should not affect the ability to develop on the surface. Engagement with the claim holder is recommended.

Site 3: Mayo Road Substation - Lot Enlargement

No.	Risk Description	Potential Impact
	The site is vacant Commissioners Land. Yukon	
		Energy Corporation currently has no tenure. YEC
4 Land Tenure	will need to enter into a long term lease or	
	purchase with Yukon Government. The Yukon	
	Government's land disposition process will trigger	
		a YESAB application which is public and invites



		comments. Public processes that solicit input
5 Adjacent Land Uses		This parcel of land would be situated between a Ta'an Kwäch'än Council (TKC) owned vacant parcel and privately owned agricultural piece of
		land. TKC future development plans may not be compatible with a thermal generating facility.
6	Land Use and Zoning Designation	The parcel is designated in the Mayo Road Development Area Regulations as Hinterland (H) which allows public utility uses. The existing substation is designated Public Use and Institutional (PI). An argument may be made that a zoning amendment is required. Interpretation of the regulation is a risk.

Fuel Storage and Usage

No.	Risk Description	Potential Impact
7	Diesel fuel option	YEC will need to consider approach to diesel storage, number of tanks, containment, and volume. Study assumed double walled tanks to reduce containment requirements and real estate.
8	LNG fuel option	YEC has recent firsthand experience with the design and permitting constraints associated with LNG. As the site is a greenfield, YEC will have the ability to better arrange tankage to avoid the need for expensive vapour barriers and restriction on road layouts. This should reduce costs and operational issues experienced with the existing plant but will need to be kept at the forefront of design to minimize these impacts while meeting code requirements.
9	Dual fuel	Dual fuel units were not used in the study but provide YEC with an avenue to avoid the issues associated with NG engines poorer load pick-up performance. Fuel blending is also an option. Although operations flexibility would be gained, YEC would have to review fuel storage requirements to have both fuels on site while maintaining code separation requirements.



		While outside the scope of this study, fuel pricing
		and security, price hedging, and supply contracts
10 Fuel Procurement	will all impact the project business case and	
		require YEC due diligence. Fuel delivery issues due
		to weather are also a factor.

Prime Movers

No.	Risk Description	Potential Impact
11	Technology	Reciprocating engines running on either NG or diesel are a mature technology used throughout the continent. Technology risk is minimal. Similarly, auxiliary equipment and infrastructure to support the engines also carry minimal technology risk (transformer, switchgear, controls).
12	Procurement	Procurement processes, cost and schedule control, and ensuring options selected meet the project requirements are main risks with the prime movers. These risks are mitigated with proper planning and engineering to ensure the units selected are fit for purpose and represent the best value for YEC. The project delivery method needs to be determined. Responsibility for project implementation risk can be more easily assigned to 3 rd parties under some delivery methods. Whether YEC intends to procure the engine and free-issue to a contractor, or equipment procurement and installation are in a common tender (DB/EPC), remains to be decided, each with their own pros/cons.
13	Enclosures	The study assumes that any option would be executed with a new generating hall to house the units. Alternatively, the project can use stand- alone engine enclosures similar to the existing LNG plant. Future study is needed to properly compare the two options, with input from YEC operations.

General Site



No.	Risk Description	Potential Impact
		Fire protection, fuel system alarms and
		procedures, site fencing and access, telecom
14 Safety and Security	Safaty and Sacurity	and security, etc. are all critical areas require
	salety and security	future study and refinement. Risk in these areas is
		mitigated with proper planning, assessment, and
		engineering.



Appendices November 21, 2016

5.0 **APPENDICES**

- Appendix A Siting Criteria Memo
- Appendix B Site Identification and Evaluation Memo
- Appendix C Financial Analysis
- Appendix D Basis of Design



November 21, 2016







To:	Marc-Andre Lavigne	From:	Lesley Cabott RPP	
	Yukon Energy Corporation		Stantec	
File:	Thermal Energy Plant Development Study: 133547248_21_8	Date:	April 21, 2016	

Reference: Thermal Generation Siting Criteria

This memo has been prepared to support the site selection of Yukon Energy Corporation's (YEC) resource planning study of a future thermal generation plant in and/or around Whitehorse. There are some criteria that are mandatory and other criteria that will be preferred by YEC. This memo identifies those items that are mandatory as well as the criteria that YEC may wish to consider. It is the intent of this memo to confirm mandatory criteria and receive direction as to the importance of the other criteria. The feedback we receive will inform the site selection for conceptual design purposes.

OCP AND ZONING REVIEW CITY OF WHITEHORSE

The City of Whitehorse has advised that a thermal generation plant will need to be located on land designated Public Utilities (PU) in the Official Community Plan (OCP) and within a PU zone in the Zoning Bylaw. The existing PU land use and zoning designations are on lands that have existing utility infrastructure – no undeveloped PU land existing today. The City has advised that both an OCP and zoning amendment will be required to permit the use of a thermal generation plant. This is not unexpected as new uses require public input and consideration. The City is carrying out an OCP review in 2017 and it is our recommendation YEC engage with the City early to identify and plan for future needs if a decision is made to pursue a new thermal plant.

WHITEHORSE PERIPHERY AREA DEVELOPMENT REGULATIONS

The Yukon Government administers the zoning of lands in the Whitehorse periphery. Similar to the City planning and zoning regulations, there are no large sites that are currently identified for a thermal generation plant. A rezoning process would also need to be undertaken in the periphery.

SITE CRITERIA THAT WILL BE CONSISTENT FOR ALL SITES (MANDATORY):

As discussed and excluded from our scope of work, any environmental (heritage, archaeology, biophysical, wildlife, water sources/quality, etc.) and socio-economic impact are not included. Our assessment will touch on topics of noise, air quality, and wildlife protected areas as they relate to engine performance and are publically available data but an in-depth site assessment is not included.

DESIRED CRITERIA

In addition to mandatory criteria, several site selection preferences (design criteria) may exist at YEC based on past/recent generation development experience, operational requirements, and current utility needs. Please review the mandatory criteria and confirm and advise as to the importance associated with the desired criteria.



April 21, 2016 Marc-Andre Lavigne Page 2 of 2 **Reference: Thermal Generation Siting Criteria**

Criteria - level of importance in site selection	Low	Medium	High
Greenfield -undisturbed land			
Brownfield – previously developed land			
Proximity to existing YEC generating facilities in Whitehorse			
Connected to city services (water and sewer)			
Inside City limits			
Ease of constructability (laydown area, security, heavy equipment access, rail siding)			
Proximity to residential areas (noise, smell, spill containment)			
Proximity to YEC transmission/substation			
Proximity to AEY distribution/substation			
Opportunity to connect to a DES			
Accessible directly off Alaska Hwy/Klondike Hwy			
Commissioner's Land			

We are available to discuss and look forward to receiving your direction as soon as possible.

Best regards

STANTEC CONSULTING LTD.

Lesley Cabott Senior Planner Phone: (709) 576-1458 Fax: (709) 576-2126 Lesley.Cabott@stantec.com

c. Lee Fleming, Chris van Driel

November 21, 2016







To:	Marc-Andre Lavigne	From:	Lesley Cabott, RPP
	Yukon Energy Corporation		Stantec
File:	Thermal Energy Plant Development Study: 13354728	Date:	May 4, 2016

Reference: Thermal Generation – Site Identification and Evaluation

This memo has been prepared to support the site selection of a future thermal generation plant in and/or around Whitehorse for Yukon Energy Corporation's (YEC) resource planning study, and builds upon the background work and siting criteria outline in Stantec's memo of April 21, 2016. Stantec has reviewed the City of Whitehorse Planning and Zoning bylaws and have met with the Managers of Planning and Engineering to discuss potential sites within the City. We have also reviewed the Whitehorse Periphery Planning and Zoning Regulations including: Mayo Road, Ibex, Hotsprings Road, Golden Horn and Mount Lorne. We met with a representative of the Lands Department at Yukon Government and carried out site visits to sites 1, 3, and 4.

The four sites are discussed below. The feedback we receive from YEC will help us identify the "preferred site" that will be used for conceptual design purposes.

The criteria and their associated level of importance were determined as follows in consultation with YEC:

Criteria – level of importance in site selection	Low	Medium	High
Greenfield -undisturbed land	Х		
Brownfield – previously developed land			Х
Proximity to existing YEC generating facilities in Whitehorse		х	
Connected to city services (water and sewer)		х	
Inside City limits		Х	
Ease of constructability (laydown area, security, heavy equipment access)		х	
Proximity to residential areas (noise, smell, spill containment)			Х
Proximity to YEC transmission/substation			Х
Proximity to AEY distribution/substation			Х
Opportunity to connect to District Energy System	Х		
Accessible directly off Alaska Hwy/Klondike Hwy			Х
Commissioner's Land		Х	



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Reference: Thermal Generation – Site Identification and Evaluation

SITE 1: CITY OF WHITEHORSE LANDFILL

The City of Whitehorse identified the opportunity to lease a portion of land that is within the area of their existing landfill. The land is appropriately zoned and would not require a public planning process.

Owner: City of Whitehorse

Size: A 4 hectare parcel would need to be surveyed out of the larger City of Whitehorse War Eagle Landfill

Tenure opportunity: Long term lease from the City of Whitehorse

OCP Designation: Public Utilities

Zoning: PU - Public Utilities

Criteria	Yes	No
Greenfield – undisturbed land		\checkmark
Brownfield – previously developed land	\checkmark	
Proximity to existing YEC generating facility on Robert Service Way, Whitehorse	8500 m	
Connected to city services (water and sewer)	345 m	\checkmark
Inside City limits	\checkmark	
Ease of constructability (laydown area, security, heavy equipment access, rail siding)	\checkmark	
Proximity to residential areas (noise, smell, spill containment)	1400 m	
Proximity to YEC transmission/substation	7300 m	
Proximity to AEY distribution/substation	1890 m	
Opportunity to connect to a DES	910 m	
Accessible directly off Alaska Hwy/Klondike Hwy	\checkmark	2200 m (Alaska Hwy)
Commissioner's Land		\checkmark

This site offers opportunities for synergies with waste to energy with waste from Whitehorse landfill.



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Reference: Thermal Generation - Site Identification and Evaluation



Figure 1: Landfill Potential Site



Figure 2: Landfill Access Road



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Reference: Thermal Generation – Site Identification and Evaluation

SITE 2: CITY OF WHITEHORSE LIVINGSTONE TRAIL LAGOONS

The City of Whitehorse identified the opportunity to lease a portion of land that is within the area of the Livingstone Trail Environmental Control Facility (sewage lagoon). The land is appropriately zoned and would not require a public planning process.

Owner: City of Whitehorse

Size: A 4 hectare parcel would need to be surveyed out of the lagoon lands

Tenure opportunity: Long term lease from the City of Whitehorse

OCP Designation: Public Utilities

Zoning: PU - Public Utilities

Criteria – level of importance in site selection	Yes	No
Greenfield – undisturbed land	\checkmark	
Brownfield – previously developed land		\checkmark
Proximity to existing YEC generating facility on Robert Service Way, Whitehorse	7,660 m	
Connected to city services (water and sewer)		\checkmark
Inside City limits	\checkmark	
Ease of constructability (laydown area, security, heavy equipment access, rail siding)	\checkmark	
Proximity to residential areas (noise, smell, spill containment)	1,630 m	
Proximity to YEC transmission/substation	1,120 m	
Proximity to AEY distribution/substation	3,800 m	
Opportunity to connect to a DES	12,250 m	
Accessible directly off Alaska Hwy/Klondike Hwy		\checkmark
Commissioner's Land		\checkmark

This site currently has challenges with access. The City is currently doing a planning study that is looking at the timing of development on the east side of the Yukon River and construction of a second crossing. Currently access to the site would be along the Long Lake Road and the Livingstone Trail Road.



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Reference: Thermal Generation - Site Identification and Evaluation

SITE 3: MAYO ROAD SUBSTATION - LOT ENLARGEMENT

This is a parcel of Vacant Commissioner's land adjacent to the existing Yukon Energy Corporation substation on the Mayo Road within the Mayo Road Area Development Regulations.

Owner: Commissioner of Yukon

Size: There is sufficient area to survey a 4.0 hectare parcel of land from the Commissioner's land to add to the existing parcel and to maintain a buffer to separate the Agriculture zoned parcel to the north and First Nation Land Use (KDFN C- 135B) zoned parcel to the south.

Tenure opportunity: Purchase and consolidate with existing parcel

Local Area Planning Zoning Designation: H – Hinterland (Uses include public utilities)

Criteria – level of importance in site selection	Yes	No
Greenfield – undisturbed land	\checkmark	
Brownfield – previously developed land		\checkmark
Proximity to existing YEC generating facility on Robert Service Way, Whitehorse	21,660 m	
Connected to city services (water and sewer)		\checkmark
Inside City limits		\checkmark
Ease of constructability (laydown area, security, heavy equipment access)	\checkmark	
Proximity to residential areas (noise, smell, spill containment)	260 m	
Proximity to YEC transmission/substation	110 m	
Proximity to AEY distribution/substation	15,090 m	
Opportunity to connect to a DES	N/A	
Accessible directly off Alaska Hwy/Klondike Hwy	\checkmark	200 m off
Commissioner's Land	\checkmark	

The Yukon Government Land application process is a public process and includes First Nation and public consultation which can take up to six months. Spot land applications are not accepted for this area; however this can be considered a lot enlargement. This land will not require rezoning. Definition from Area Development Regulations: 'public utility' means the use of land for sewerage, water, telecommunications, electricity, or transportation systems.



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Reference: Thermal Generation - Site Identification and Evaluation



Figure 3: Takhini Substation Potential Site



Figure 4: Takhini Substation Access Road


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Reference: Thermal Generation – Site Identification and Evaluation

SITE 4: COPPER MINE SITE – CITY OF WHITEHORSE

This is a parcel of Commissioner's land currently within the City of Whitehorse, between the Mt. Sima Road and the Copper Haul Road.

Owner: Commissioner of Yukon

Size: There is sufficient area to survey a 4.0 hectare parcel of land from the Commissioner's land

Tenure opportunity: Purchase/lease

OCP Designation: IH – Industrial Heavy

Zoning: FP – Future Planning

Criteria – level of importance in site selection	Yes	No	
Greenfield – undisturbed land	\checkmark		
Brownfield – previously developed land		\checkmark	
Proximity to existing YEC generating facility on Robert Service Way, Whitehorse	6,400 m		
Connected to city services (water and sewer)		\checkmark	
Inside City limits		\checkmark	
Ease of constructability (laydown area, security, heavy equipment access)	\checkmark		
Proximity to residential areas (noise, smell, spill containment)	1,640 m		
Proximity to YEC transmission/substation	6,400 m		
Proximity to AEY distribution/substation	2,790 m		
Opportunity to connect to a DES	N/A		
Accessible directly off Alaska Hwy/Klondike Hwy	\checkmark	2,720 m (Alaska Hwy)	
Commissioner's Land	\checkmark		

There are quartz mining claims on the parcel which is consistent with many areas of Whitehorse. The Yukon Government Lands Department advised the subsurface claims should not affect the development of the generating facility; some consultation with claim holders may be required. The Manager of Planning with the City has indicated that an OCP amendment to PU may not be required.



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Reference: Thermal Generation – Site Identification and Evaluation



Figure 5: Whitehorse Copper Potential Site 1



Figure 6: Whitehorse Copper Potential Site 2



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Reference: Thermal Generation – Site Identification and Evaluation



Figure 7: Whitehorse Copper Access Road (off Mt. Sima Road)



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Reference: Thermal Generation – Site Identification and Evaluation

SUMMARY OF RESULTS

The results from the preliminary site assessments are summarized in the table below:

Criteria	Priority	Site 1: Landfill	Site 2: Lagoon	Site 3: Takhini Substation	Site 4: Whitehorse Copper
Greenfield	L	No	No	Yes	Yes
Brownfield	н	Yes	Yes	No	No
Proximity to YEC Generation Plant	М	8.5 km	7.7 km	> 2 km	6.4 km
Serviced by City	М	No	No	No	No
Inside City limits	М	Yes	Yes	No	Yes
Constructability (laydown area, security, access)	М	Excellent	Good	Good	Excellent
Proximity to residence	Н	None	> 1.5 km	~ 300 m	> 1.5 km
Proximity to YEC transmission line	Н	7.3 km	1.1 km	110 m	6.4 km
Proximity to AEY distribution line	Н	1.9 km	3.8 km	15 km	2.8 km
Opportunities for DES	L	1 km	None	None	None
Access to Alaska/Klondike Hwy	Н	Good	Poor	Excellent	Excellent
Commissioner's Land	М	No	No	Yes	Yes
Mining Claims	L	Yes	No	No	Yes
Correct Zoning	М	Yes	Yes	Yes	No

Please review the potential sites and let us know YEC's preferred option. We are available to discuss and look forward to receiving your direction.

STANTEC CONSULTING LTD.

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Attachment: Conceptual Options Map

Design with community in mind

 $cl \clubel{limit} cl \clubel$



YEC THERMAL SITING STUDY CONCEPTUAL LOCATIONS



November 21, 2016





Option # NG-LF-05

			MW	Winter MW	
Capital (\$000)	2016	\$48,600	5.	0 5.0	
Capital (\$000)	2020	\$52,606			
Energy		41.6	GWh/yr		
Capacity Factor		(95%CF)		Load Growth	
Fuel	2016			0.0%	
O&M (Fixed)	2016	675.0	\$000/yr	41.6 GW.	h
O&M (Variable)	2016	0.0	\$/MWh		
Life		20	vears		
Salvage cost		0%	•		

Year-End Balance Depr \$000 Return \$000 O&M Total \$000 cents/ kW.h 20 49,976 2,630 2,795 731 6,156 15 21 47,346 2,630 2,795 731 6,156 15 22 44,715 2,630 2,509 760 5,899 14 23 42,085 2,630 2,222 791 5,643 14 24 39,455 2,630 2,222 791 5,643 14 25 36,824 2,630 1,935 823 5,388 13 27 31,564 2,630 1,792 839 5,261 13 28 28,933 2,630 1,262 891 4,883 12 30 23,673 2,630 1,218 908 4,757 11 31 21,042 2,630 1,023 4,012 10 33 15,782 2,630 502 1,003 4,135		Option # NG-LF-05					
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21 47,346 2,630 2,652 745 6,028 14 22 44,715 2,630 2,509 760 5,899 14 23 42,085 2,630 2,365 775 5,771 14 24 39,455 2,630 2,222 791 5,643 14 25 36,824 2,630 1,935 823 5,388 13 27 31,564 2,630 1,792 839 5,261 13 28 28,933 2,630 1,505 873 5,009 12 30 23,673 2,630 1,218 908 4,757 11 32 18,412 2,630 1,075 927 4,632 11 33 15,782 2,630 932 945 4,507 11 34 13,152 2,630 768 964 4,383 11 35 10,521 2,630 358 1,023 4,012 10 38 2,630 2,103 3,766 9 9	2020	49,976	2,630	2,795	731	6,156	15
22 44,715 2,630 2,509 760 5,899 14 23 42,085 2,630 2,365 775 5,771 14 24 39,455 2,630 2,222 791 5,643 14 25 36,824 2,630 1,935 823 5,388 13 26 34,194 2,630 1,935 823 5,388 13 27 31,564 2,630 1,792 839 5,261 13 28 28,933 2,630 1,505 873 5,009 12 20 23,673 2,630 1,218 908 4,757 11 31 21,042 2,630 932 945 4,507 11 33 15,782 2,630 788 964 4,383 11 35 10,521 2,630 358 1,023 4,012 10 36 7,891 2,630 21 1,044 3,889 9 9 40 <td< td=""><td>2021</td><td>47,346</td><td>2,630</td><td>2,652</td><td>745</td><td>6,028</td><td>14</td></td<>	2021	47,346	2,630	2,652	745	6,028	14
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25 36,824 2,630 2,079 807 5,516 13 26 34,194 2,630 1,935 823 5,388 13 27 31,564 2,630 1,792 839 5,261 13 28 28,933 2,630 1,505 873 5,009 12 30 23,673 2,630 1,362 891 4,883 12 31 21,042 2,630 1,218 908 4,757 11 32 18,412 2,630 932 945 4,507 11 33 15,782 2,630 932 945 4,507 11 34 13,152 2,630 655 983 4,259 10 36 7,891 2,630 358 1,023 4,012 10 37 5,261 2,630 358 1,023 4,012 10 38 2,630 2,630 72 1,064 3,766	2024	39,455	2,630	2,222	791	5,643	14
26 34,194 2,630 1,935 823 5,388 13 27 31,564 2,630 1,792 839 5,261 13 28 28,933 2,630 1,649 856 5,135 12 29 26,303 2,630 1,505 873 5,009 12 30 23,673 2,630 1,218 908 4,757 11 31 21,042 2,630 1,075 927 4,632 11 31 21,042 2,630 788 964 4,383 11 33 15,782 2,630 788 964 4,383 11 35 10,521 2,630 645 983 4,259 10 36 7,891 2,630 502 1,003 4,135 10 37 5,261 2,630 72 1,064 3,889 9 39 0 2,630 72 1,064 3,766 9 44 10 10 <t< td=""><td>2025</td><td>36,824</td><td>2,630</td><td>2,079</td><td>807</td><td>5,516</td><td>13</td></t<>	2025	36,824	2,630	2,079	807	5,516	13
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30 23,673 2,630 1,362 891 4,883 12 31 21,042 2,630 1,218 908 4,757 11 32 18,412 2,630 932 945 4,507 11 33 15,782 2,630 788 964 4,383 11 34 13,152 2,630 645 983 4,259 10 36 7,891 2,630 502 1,003 4,135 10 37 5,261 2,630 358 1,023 4,012 10 38 2,630 2,630 72 1,064 3,766 9 40 44 41 44 42 44 43 55 56 56	2029	26,303	2,630	1,505	873	5,009	12
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33 $15,782$ $2,630$ 932 945 $4,507$ 11 34 $13,152$ $2,630$ 788 964 $4,383$ 11 35 $10,521$ $2,630$ 645 983 $4,259$ 10 36 $7,891$ $2,630$ 502 $1,003$ $4,135$ 10 37 $5,261$ $2,630$ 215 $1,044$ $3,889$ 99 39 0 $2,630$ 72 $1,064$ $3,766$ 9 40 41 43 44	2032	18,412	2,630	1,075	927	4,632	11
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36 7,891 2,630 502 1,003 4,135 10 37 5,261 2,630 358 1,023 4,012 10 38 2,630 2,630 215 1,044 3,889 9 39 0 2,630 72 1,064 3,766 9 40 41 42 43 44	2035	10,521	2,630	645	983	4,259	10
37 5,261 2,630 358 1,023 4,012 10 38 2,630 2,630 215 1,044 3,889 9 39 0 2,630 72 1,064 3,766 9 40	2036	7,891	2,630	502	1,003	4,135	10
38 2,630 2,630 215 1,044 3,889 9 39 0 2,630 72 1,064 3,766 9 40 41 41 41	2037	5,261	2,630	358	1,023	4,012	10
39 0 2,630 72 1,064 3,766 9 40 41 42 43 44 44 44 44 44 45 46 47 48 50 51 55 56 <	2038	2,630	2,630	215	1,044	3,889	9
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PV 33,284 21,282 10,851 65,417 15PV 30,750 19,661 10,024 60,435	.064						
15PV 30,750 19,661 10,024 60,435	PV		33,284	21,282	10,851	65,417	
	015PV		30,750	19,661	10,024	60,435	

Weighted Average Cost of Capital	5.45%
Inflation Rate	2%
Real Weighted Average Cost of Capital	3.38%

LCOE and LCOC with 5.45% WACC, Option # NG-LF-05

Life Cycle Cost (2016\$000's)	60,435
Depreciation & Return Cost (2016\$000's)	50,411

Project LCOE (\$/kWh)	\$0.098
Project LCOC (\$/MW)	\$678,898
Project LCOC (\$/kW)	\$678.90

Year from In- service	Annual Energy GW.h, Option # NG-LF-05	Annual Winter Capacity MW, Option # NG- LF-05
1	41.61	5.00
2	41.61	5.00
3	41.61	5.00
4	41.61	5.00
5	41.61	5.00
6	41.61	5.00
7	41.61	5.00
8	41.61	5.00
9	41.61	5.00
10	41.61	5.00
11	41.61	5.00
12	41.61	5.00
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ı otal energy	832	
ıg Annual energy	42	

Option # NG-LF-10

			MW	Winter MW
Capital (\$000)	2016	\$66,900	10.0	10.0
Capital (\$000)	2020	\$72,415		
Energy		83.2	GWh/yr	
Capacity Factor		(95%CF)		Load Growth
Fuel	2016			0.0%
O&M (Fixed)	2016	935.0	\$000/yr	83.2 GW.h
O&M (Variable)	2016	0.0	\$/MWh	
Life		20	years	
Salvage cost		0%		

	Option # NG-LF-10					
Year	Year-End Balance	Depr	Return	0&M	Total	cents/
	\$000	\$000	\$000	\$000	\$000	kW.h
2020	68,794	3,621	3,848	1,012	8,481	10
2021	65,173	3,621	3,651	1,032	8,304	10
2022	61,553	3,621	3,453	1,053	8,127	10
2023	57,932	3,621	3,256	1,074	7,951	10
2024	54,311	3,621	3,059	1,096	7,775	9
2025	50,690	3,621	2,861	1,117	7,599	9
2026	47,070	3,621	2,664	1,140	7,424	9
2027	43,449	3,621	2,467	1,163	7,250	9
2028	39,828	3,621	2,269	1,186	7,076	9
029	36,207	3,621	2,072	1,210	6,902	8
2030	32,587	3,621	1,875	1,234	6,729	8
2031	28,966	3,621	1,677	1,258	6,556	8
2032	25,345	3,621	1,480	1,284	6,384	8
2033	21,724	3,621	1,283	1,309	6,213	7
2034	18,104	3,621	1,085	1,335	6,041	7
2035	14,483	3,621	888	1,362	5,871	7
2036	10,862	3,621	691	1,389	5,701	7
.037	7,241	3,621	493	1,417	5,531	7
038	3,621	3,621	296	1,445	5,362	6
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P۷		45,817	29,296	15,030	90,143	
)15PV		42,328	27,065	13,885	83,278	
					136,471	

Weighted Average Cost of Capital	5.45%
Inflation Rate	2%
Real Weighted Average Cost of Capital	3.38%

LCOE and LCOC with 5.45% WACC, Option # NG-LF-10

Life Cycle Cost (2016\$000's)	83,278
Depreciation & Return Cost (2016\$000's)	69,393

Project LCOE (\$/kWh)	\$0.067
Project LCOC (\$/MW)	\$467,266
Project LCOC (\$/kW)	\$467.27

Year from In- service	Annual Energy GW.h, Option # NG-LF-10	Annual Winter Capacity MW, Option # NG- LF-10
1	83.22	10.00
2	83.22	10.00
3	83.22	10.00
4	83.22	10.00
5	83.22	10.00
6	83.22	10.00
7	83.22	10.00
8	83.22	10.00
9	83.22	10.00
10	83.22	10.00
11	83.22	10.00
12	83.22	10.00
13	83.22	10.00
14	83.22	10.00
15	83.22	10.00
16	83.22	10.00
17	83.22	10.00
18	83.22	10.00
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let Present Value	1,053	
Total energy	1,664	
vg Annual energy	83	

Option # NG-LF-20

			MW	Winter MW
Capital (\$000)	2016	\$100,100	20.0	20.0
Capital (\$000)	2020	\$108,351		
Energy		166.4	GWh/yr	
Capacity Factor		(95%CF)		Load Growth
Fuel	2016			0.0%
O&M (Fixed)	2016	1190.0	\$000/yr	166.4 GW.h
O&M (Variable)	2016	0.0	\$/MWh	
Life		20	years	
Salvage cost		0%		

	Option # NG-LF-20					
Year	Year-End Balance	Depr	Return	0&M	Total	cents/
	\$000	\$000	\$000	\$000	\$000	kW.h
2020	102,934	5,418	5,758	1,288	12,463	7
2021	97,516	5,418	5,462	1,314	12,194	7
2022	92,099	5,418	5,167	1,340	11,925	7
2023	86,681	5,418	4,872	1,367	11,656	7
2024	81,264	5,418	4,576	1,394	11,388	7
2025	75,846	5,418	4,281	1,422	11,121	7
2026	70,428	5,418	3,986	1,451	10,854	7
2027	65,011	5,418	3,691	1,480	10,588	6
2028	59,593	5,418	3,395	1,509	10,322	6
2029	54,176	5,418	3,100	1,539	10,057	6
2030	48,758	5,418	2,805	1,570	9,793	6
2031	43,341	5,418	2,510	1,602	9,529	6
2032	37,923	5,418	2,214	1,634	9,266	6
2033	32,505	5,418	1,919	1,666	9,003	5
2034	27,088	5,418	1,624	1,700	8,741	5
2035	21,670	5,418	1,329	1,734	8,480	5
2036	16,253	5,418	1,033	1,768	8,219	5
:037	10,835	5,418	738	1,804	7,959	5
038	5,418	5,418	443	1,840	7,700	5
039	0	5,418	148	1,877	7,442	4
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PV		00,000	45,654	19,129	131,318	
015PV		63,334	40,496	17,672	121,502	
					198,700	

Weighted Average Cost of Capital	5.45%	
Inflation Rate	2%	
Real Weighted Average Cost of Capital	3.38%	

LCOE and LCOC with 5.45% WACC, Option # NG-LF-20

Life Cycle Cost (2016\$000's)	121,502
Depreciation & Return Cost (2016\$000's)	103,830

Project LCOE (\$/kWh)	\$0.049
Project LCOC (\$/MW)	\$349,577
Project LCOC (\$/kW)	\$349.58

Year from In- service	Annual Energy GW.h, Option # NG-LF-20	Annual Winter Capacity MW, Option # NG- LF-20
1	166.44	20.00
2	166.44	20.00
3	166.44	20.00
4	166.44	20.00
5	166.44	20.00
6	166.44	20.00
7	166.44	20.00
8	166.44	20.00
9	166.44	20.00
10	166.44	20.00
11	166.44	20.00
12	166.44	20.00
13	166.44	20.00
14	166.44	20.00
15	166.44	20.00
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let Present Value	2,106	
Total energy	3,329	
vg Annual energy	166	

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Option # NG-TK-05

		N	ΛW	Winter MW	
Capital (\$000)	2016	\$48,500	5.0	5.0	
Capital (\$000)	2020	\$52,498			
Energy		41.6 G	6Wh/yr		
Capacity Factor		(95%CF)		Load Growth	
Fuel	2016			0.0%	
O&M (Fixed)	2016	675.0 \$	000/yr	41.6 GW.h	1
O&M (Variable)	2016	0.0 \$	5/MWh		
Life		20 y	ears		
Salvage cost		0%			

	Option # NG-TK-05					
Year	Year-End Balance	Depr	Return	O&M	Total	cents/
	\$000	\$000	\$000	\$000	\$000	kW.h
2020	49,873	2,625	2,790	731	6,145	15
2021	47,248	2,625	2,647	745	6,017	14
2022	44,623	2,625	2,503	760	5,889	14
2023	41,998	2,625	2,360	775	5,761	14
2024	39,373	2,625	2,217	791	5,633	14
2025	36,749	2,625	2,074	807	5,506	13
2026	34,124	2,625	1,931	823	5,379	13
2027	31,499	2,625	1,788	839	5,252	13
2028	28,874	2,625	1,645	856	5,126	12
2029	26,249	2,625	1,502	873	5,000	12
2030	23,624	2,625	1,359	891	4,875	12
2031	20,999	2,625	1,216	908	4,749	11
2032	18,374	2,625	1,073	927	4,624	11
2033	15,749	2,625	930	945	4,500	11
2034	13,124	2,625	787	964	4,376	11
2035	10,500	2,625	644	983	4,252	10
2036	7,875	2,625	501	1,003	4,129	10
2037	5,250	2,625	358	1,023	4,006	10
2038	2,625	2,625	215	1,044	3,883	ç
2039	0	2,625	72	1,064	3,761	ç
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PV		33,216	21,238	10.851	65.305	
		33,210	=1,200	10,001	55,505	

Weighted Average Cost of Capital	5.45%
Inflation Rate	2%
Real Weighted Average Cost of Capital	3.38%

LCOE and LCOC with 5.45% WACC, Option # NG-TK-05

Life Cycle Cost (2016\$000's)	60,331
Depreciation & Return Cost (2016\$000's)	50,307

Project LCOE (\$/kWh)	\$0.098
Project LCOC (\$/MW)	\$677,501
Project LCOC (\$/kW)	\$677.50

Year from In- service	Annual Energy GW.h, Option # NG-TK-05	Annual Winter Capacity MW, Option # NG- TK-05
1	41.61	5.00
2	41.61	5.00
3	41.61	5.00
4	41.61	5.00
5	41.61	5.00
6	41.61	5.00
7	41.61	5.00
8	41.61	5.00
9	41.61	5.00
10	41.61	5.00
11	41.61	5.00
12	41.61	5.00
13	41.61	5.00
14	41.61	5.00
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let Present Value	527	
Total anarr	000	
i otai energy	832	
vg Annual energy	42	

Option # NG-TK-10

			MW	Winter MW
Capital (\$000)	2016	\$66,800	10.0	10.0
Capital (\$000)	2020	\$72,306		
Energy		83.2	GWh/yr	
Capacity Factor		(95%CF)		Load Growth
Fuel	2016			0.0%
O&M (Fixed)	2016	935.0	\$000/yr	83.2 GW.h
O&M (Variable)	2016	0.0	\$/MWh	
Life		20	years	
Salvage cost		0%	-	

	Option # NG-TK-10					
Year	Year-End Balance	Depr	Return	O&M	Total	cents/
	\$000	\$000	\$000	\$000	\$000	kW.h
2020	68,691	3,615	3,842	1,012	8,470	10
2021	65,076	3,615	3,645	1,032	8,293	10
2022	61,460	3,615	3,448	1,053	8,116	10
2023	57,845	3,615	3,251	1,074	7,940	10
2024	54,230	3,615	3,054	1,096	7,765	ç
2025	50,615	3,615	2,857	1,117	7,590	ç
2026	46,999	3,615	2,660	1,140	7,415	ç
2027	43,384	3,615	2,463	1,163	7,241	9
2028	39,769	3,615	2,266	1,186	7,067	8
2029	36,153	3,615	2,069	1,210	6,894	8
2030	32,538	3,615	1,872	1,234	6,721	8
2031	28,923	3,615	1,675	1,258	6,549	8
2032	25,307	3,615	1,478	1,284	6,377	8
2033	21,692	3,615	1,281	1,309	6,205	7
2034	18,077	3,615	1,084	1,335	6,034	7
2035	14,461	3,615	887	1,362	5,864	7
2036	10,846	3,615	690	1,389	5,694	7
2037	7,231	3,615	493	1,417	5,525	7
2038	3,615	3,615	296	1,445	5,356	6
2039	0	3,615	99	1,474	5,188	6
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P۷		45,749	29,252	15,030	90,031	
2064 PV \$2015PV		45,749 42,265	29,252 27,024	15,030 13,885	90,031 83,174 136,304	

Weighted Average Cost of Capital	5.45%
Inflation Rate	2%
Real Weighted Average Cost of Capital	3.38%

LCOE and LCOC with 5.45% WACC, Option # NG-TK-10

Life Cycle Cost (2016\$000's)	83,174
Depreciation & Return Cost (2016\$000's)	69,289

Project LCOE (\$/kWh)	\$0.067
Project LCOC (\$/MW)	\$466,568
Project LCOC (\$/kW)	\$466.57

Year from In- service	Annual Energy GW.h, Option # NG-TK-10	Annual Winter Capacity MW, Option # NG- TK-10
1	83.22	10.00
2	83.22	10.00
3	83.22	10.00
4	83.22	10.00
5	83.22	10.00
6	83.22	10.00
7	83.22	10.00
8	83.22	10.00
9	83.22	10.00
10	83.22	10.00
11	83.22	10.00
12	83.22	10.00
13	83.22	10.00
14	83.22	10.00
15	83.22	10.00
16	83.22	10.00
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Net Present Value	1,053	
Total energy	1 664	
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vy Annuui energy	83	

Option # NG-TK-20

			MW	Winter MW
Capital (\$000)	2016	\$100,000	20.0	20.0
Capital (\$000)	2020	\$108,243		
Energy		166.4	GWh/yr	
Capacity Factor		(95%CF)		Load Growth
Fuel	2016			0.0%
O&M (Fixed)	2016	1190.0	\$000/yr	166.4 GW.h
O&M (Variable)	2016	0.0	\$/MWh	
Life		20	years	
Salvage cost		0%		

Year-End Balance Depr \$000 Return \$000 O&M Total \$000 cents/ kW.h 20 102,831 5,412 5,752 1,288 12,452 7 21 97,419 5,412 5,152 1,340 11,914 7 22 92,007 5,412 4,857 1,340 11,914 7 23 86,595 5,412 4,867 1,367 11,646 7 24 81,182 5,412 4,277 1,422 11,111 7 25 75,770 5,412 3,982 1,451 10,845 7 25 95,534 5,412 3,992 1,539 10,049 € 28 59,534 5,412 2,802 1,570 9,784 € 31 43,297 5,412 2,212 1,634 9,258 € 33 32,473 5,412 1,327 1,734 8,473 5 34 27,061 5,412 1,032 <t< th=""><th></th><th></th><th colspan="6">Option # NG-TK-20</th></t<>			Option # NG-TK-20					
\$000 \$000 <th< th=""><th>Year</th><th>Year-End Balance</th><th>Depr</th><th>Return</th><th>O&M</th><th>Total</th><th>cents/</th></th<>	Year	Year-End Balance	Depr	Return	O&M	Total	cents/	
20 102,831 5,412 5,752 1,288 12,452 7 21 97,419 5,412 5,457 1,314 12,183 7 22 92,007 5,412 4,867 1,367 11,646 7 24 81,182 5,412 4,572 1,394 11,378 7 25 75,770 5,412 4,277 1,422 11,111 7 26 70,358 5,412 3,687 1,480 10,579 6 28 59,534 5,412 3,697 1,539 10,049 6 30 48,709 5,412 2,802 1,570 9,784 6 31 43,297 5,412 2,507 1,662 9,521 6 33 32,473 5,412 1,917 1,664 8,966 5 34 27,061 5,412 1,927 1,734 8,473 5 35 21,649 5,412 1,327 1,734 8,473 5 36 16,236 5,412 1,327 1,734		\$000	\$000	\$000	\$000	\$000	kW.h	
21 97,419 5,412 5,457 1,314 12,183 7 22 92,007 5,412 5,162 1,340 11,914 7 23 86,595 5,412 4,867 1,367 11,646 7 24 81,182 5,412 4,572 1,394 11,378 7 25 75,770 5,412 4,277 1,422 11,111 7 26 70,358 5,412 3,982 1,451 10,845 7 27 64,946 5,412 3,687 1,480 10,579 6 28 59,534 5,412 2,607 1,539 10,049 6 30 48,709 5,412 2,802 1,570 9,784 6 31 43,297 5,412 2,212 1,634 9,258 6 33 32,473 5,412 1,917 1,666 8,996 5 34 27,061 5,412 1,032 1,768 8,213 5 35 21,649 5,412 1,373 1,804	2020	102,831	5,412	5,752	1,288	12,452	7	
22 92,007 5,412 5,162 1,340 11,914 7 23 86,595 5,412 4,867 1,367 11,646 7 24 81,182 5,412 4,572 1,394 11,378 7 25 75,770 5,412 3,982 1,451 10,845 7 26 70,358 5,412 3,982 1,451 10,845 7 26 70,358 5,412 3,097 1,539 10,049 6 30 48,709 5,412 2,802 1,570 9,784 6 31 43,297 5,412 2,212 1,633 9,258 6 33 32,473 5,412 1,917 1,666 8,996 5 34 27,061 5,412 1,327 1,734 8,473 5 35 21,649 5,412 1,327 1,804 7,953 5 37 10,824 5,412 1,437 7,436	2021	97,419	5,412	5,457	1,314	12,183	7	
23 86,595 5,412 4,867 1,367 11,646 7 24 81,182 5,412 4,277 1,422 11,111 7 25 75,770 5,412 3,982 1,451 10,845 7 26 70,358 5,412 3,982 1,451 10,845 7 27 64,946 5,412 3,097 1,539 10,049 6 30 48,709 5,412 2,802 1,570 9,784 6 31 43,297 5,412 2,507 1,602 9,521 6 33 32,473 5,412 1,917 1,666 8,996 5 34 27,061 5,412 1,927 1,734 8,473 5 35 21,649 5,412 1,032 1,768 8,213 5 37 10,824 5,412 1,327 1,734 8,473 5 36 16,236 5,412 1,327 1,804 7,694 5 38 5,412 5,412 1,461 1,624 <td>2022</td> <td>92,007</td> <td>5,412</td> <td>5,162</td> <td>1,340</td> <td>11,914</td> <td>7</td>	2022	92,007	5,412	5,162	1,340	11,914	7	
24 81,182 5,412 4,572 1,394 11,378 7 25 75,770 5,412 4,277 1,422 11,111 7 26 70,358 5,412 3,982 1,451 10,845 7 27 64,946 5,412 3,992 1,509 10,313 6 28 59,534 5,412 3,097 1,539 10,049 6 30 48,709 5,412 2,802 1,570 9,784 6 31 43,297 5,412 2,907 1,603 9,521 6 32 37,885 5,412 2,212 1,634 9,258 6 33 32,473 5,412 1,327 1,700 8,733 5 35 21,649 5,412 1,327 1,784 8,473 5 36 16,236 5,412 1,327 1,804 7,694 5 38 5,412 1,471 1,877 7,436	2023	86,595	5,412	4,867	1,367	11,646	7	
25 $75,770$ $5,412$ $4,277$ $1,422$ $11,111$ 77 26 $70,388$ $5,412$ $3,982$ $1,451$ $10,645$ 77 27 $64,946$ $5,412$ $3,982$ $1,451$ $10,645$ 77 28 $59,534$ $5,412$ $3,997$ $1,539$ $10,049$ 66 29 $54,122$ $5,412$ $2,507$ $1,602$ $9,521$ 66 31 $43,297$ $5,412$ $2,507$ $1,602$ $9,528$ 66 32 $37,885$ $5,412$ $1,917$ $1,666$ $8,996$ 57 33 $32,473$ $5,412$ $1,327$ $1,734$ $8,473$ 57 35 $21,649$ $5,412$ $1,327$ $1,734$ $8,273$ 57 36 $16,236$ $5,412$ 737 $1,804$ $7,953$ 57 37 $10,824$ $5,412$ $13,777$ $7,436$ 44 40 440 440	2024	81,182	5,412	4,572	1,394	11,378	7	
26 70,358 5,412 3,982 1,451 10,845 7 27 64,946 5,412 3,687 1,480 10,579 6 28 59,534 5,412 3,097 1,539 10,049 6 30 48,709 5,412 2,802 1,570 9,784 6 31 43,297 5,412 2,507 1,602 9,521 6 32 37,885 5,412 1,917 1,666 8,996 5 34 27,061 5,412 1,622 1,700 8,734 5 34 27,061 5,412 1,327 1,734 8,473 5 35 21,649 5,412 1,327 1,768 8,213 5 37 10,824 5,412 1,377 7,436 4 40 40 44 4	2025	75,770	5,412	4,277	1,422	11,111	7	
27 $64,946$ $5,412$ $3,687$ $1,480$ $10,579$ 6 28 $59,534$ $5,412$ $3,392$ $1,509$ $10,313$ 6 29 $54,122$ $5,412$ $2,802$ $1,570$ $9,784$ 6 30 $48,709$ $5,412$ $2,507$ $1,602$ $9,521$ 6 31 $43,297$ $5,412$ $2,212$ $1,634$ $9,258$ 6 33 $32,473$ $5,412$ $1,917$ $1,666$ $8,996$ 5 34 $27,061$ $5,412$ $1,327$ $1,734$ $8,473$ 5 36 $16,236$ $5,412$ $1,327$ $1,768$ $8,213$ 5 37 $10,824$ $5,412$ $1,327$ $1,768$ $8,213$ 5 38 $5,412$ $1,427$ $1,804$ $7,953$ 5 39 0 $5,412$ $1,477$ $1,877$ $7,436$ 44 42 -444 -444 -444	2026	70,358	5,412	3,982	1,451	10,845	7	
28 $59,534$ $5,412$ $3,392$ $1,509$ $10,313$ 6 29 $54,122$ $5,412$ $3,097$ $1,539$ $10,049$ 6 30 $48,709$ $5,412$ $2,802$ $1,570$ $9,784$ 6 31 $43,297$ $5,412$ $2,507$ $1,602$ $9,521$ 6 32 $37,885$ $5,412$ $2,212$ $1,634$ $9,258$ 6 33 $32,473$ $5,412$ $1,917$ $1,666$ $8,996$ 5 34 $27,061$ $5,412$ $1,327$ $1,734$ $8,473$ 5 35 $21,649$ $5,412$ $1,327$ $1,768$ $8,213$ 5 36 $16,236$ $5,412$ $1,427$ $1,804$ $7,953$ 5 37 $10,824$ $5,412$ 147 $1,877$ $7,436$ 4 40 64 64 64 64 64 64 64 66 64 64 66	2027	64,946	5,412	3,687	1,480	10,579	6	
29 $54,122$ $5,412$ $3,097$ $1,539$ $10,049$ 6 30 $48,709$ $5,412$ $2,802$ $1,570$ $9,784$ 6 31 $43,297$ $5,412$ $2,507$ $1,602$ $9,521$ 6 32 $37,885$ $5,412$ $2,212$ $1,634$ $9,258$ 6 33 $32,473$ $5,412$ $1,917$ $1,666$ $8,996$ 5 34 $27,061$ $5,412$ $1,327$ $1,734$ $8,473$ 5 36 $16,236$ $5,412$ $1,327$ $1,734$ $8,213$ 5 37 $10,824$ $5,412$ 1327 $1,788$ $8,213$ 5 38 $5,412$ $5,412$ 147 $1,877$ $7,436$ 44 40 444 41 444 42 <t< td=""><td>2028</td><td>59,534</td><td>5,412</td><td>3,392</td><td>1,509</td><td>10,313</td><td>6</td></t<>	2028	59,534	5,412	3,392	1,509	10,313	6	
30 $48,709$ $5,412$ $2,802$ $1,570$ $9,784$ 6 31 $43,297$ $5,412$ $2,507$ $1,602$ $9,521$ 6 32 $37,885$ $5,412$ $2,212$ $1,634$ $9,258$ 6 33 $32,473$ $5,412$ $1,917$ $1,666$ $8,996$ 5 34 $27,061$ $5,412$ $1,327$ $1,734$ $8,473$ 5 35 $21,649$ $5,412$ $1,327$ $1,768$ $8,213$ 5 36 $16,236$ $5,412$ 1032 $1,768$ $8,213$ 5 37 $10,824$ $5,412$ 142 $1,840$ $7,694$ 5 39 0 $5,412$ 1447 $1,877$ $7,436$ 44 40 $$	2029	54,122	5,412	3,097	1,539	10,049	6	
31 $43,297$ $5,412$ $2,507$ $1,602$ $9,521$ 6 32 $37,885$ $5,412$ $2,212$ $1,634$ $9,258$ 6 33 $32,473$ $5,412$ $1,917$ $1,666$ $8,996$ 5 34 $27,061$ $5,412$ $1,622$ $1,700$ $8,734$ 5 35 $21,649$ $5,412$ $1,327$ $1,744$ $8,473$ 5 36 $16,236$ $5,412$ $1,032$ $1,768$ $8,213$ 5 37 $10,824$ $5,412$ 1477 $1,804$ $7,694$ 5 39 0 $5,412$ 147 $1,877$ $7,436$ 4 40 440 444 444 444 444 444 444 444 446 446 446 <	2030	48,709	5,412	2,802	1,570	9,784	6	
32 $37,885$ $5,412$ $2,212$ $1,634$ $9,258$ 6 33 $32,473$ $5,412$ $1,917$ $1,666$ $8,996$ 5 34 $27,061$ $5,412$ $1,622$ $1,700$ $8,734$ 5 35 $21,649$ $5,412$ $1,327$ $1,734$ $8,473$ 5 36 $16,236$ $5,412$ $1,032$ $1,768$ $8,213$ 5 37 $10,824$ $5,412$ 737 $1,804$ $7,953$ 5 38 $5,412$ $5,412$ 1477 $1,877$ $7,436$ 4 40 4 41 4 <td>2031</td> <td>43,297</td> <td>5,412</td> <td>2,507</td> <td>1,602</td> <td>9,521</td> <td>6</td>	2031	43,297	5,412	2,507	1,602	9,521	6	
33 $32,473$ $5,412$ $1,917$ $1,666$ $8,996$ 5 34 $27,061$ $5,412$ $1,622$ $1,700$ $8,734$ 5 35 $21,649$ $5,412$ $1,327$ $1,734$ $8,473$ 5 36 $16,236$ $5,412$ $1,032$ $1,768$ $8,213$ 5 37 $10,824$ $5,412$ 737 $1,804$ $7,694$ 5 38 $5,412$ $5,412$ 147 $1,877$ $7,436$ 4 40 44 44 44 44 44 44 44 44 44 44 46 47 56 57 57 55 57	2032	37,885	5,412	2,212	1,634	9,258	6	
34 27,061 5,412 1,622 1,700 8,734 5 35 21,649 5,412 1,327 1,734 8,473 5 36 16,236 5,412 1,032 1,768 8,213 5 37 10,824 5,412 737 1,804 7,953 5 38 5,412 5,412 442 1,840 7,694 5 39 0 5,412 147 1,877 7,436 4 40 4 41 42 <	2033	32,473	5,412	1,917	1,666	8,996	5	
35 21,649 5,412 1,327 1,734 8,473 5 36 16,236 5,412 1,032 1,768 8,213 5 37 10,824 5,412 737 1,804 7,953 5 38 5,412 5,412 442 1,840 7,694 5 39 0 5,412 147 1,877 7,436 4 40 4 41 4 42 4 43 4	2034	27,061	5,412	1,622	1,700	8,734	5	
36 16,236 5,412 1,032 1,768 8,213 5 37 10,824 5,412 737 1,804 7,953 5 38 5,412 5,412 442 1,840 7,694 5 39 0 5,412 147 1,877 7,436 4 40 4 41 4 42 4 44 4	2035	21,649	5,412	1,327	1,734	8,473	5	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	2036	16,236	5,412	1,032	1,768	8,213	5	
38 5,412 5,412 442 1,840 7,694 5 39 0 5,412 147 1,877 7,436 4 40	2037	10,824	5,412	737	1,804	7,953	5	
39 0 5,412 147 1,877 7,436 4 40	2038	5,412	5,412	442	1,840	7,694	5	
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41	.040							
42	.041							
43	2042							
44	2043							
45 - - - - 46 - - - - 47 - - - - 48 - - - - 49 - - - - 50 - - - - 51 - - - - 52 - - - - 53 - - - - 54 - - - - 55 - - - - 56 - - - - 57 - - - - 58 - - - - 60 - - - - 61 - - - - 62 - - - - 63 - - - - 64 - - - - 15PV 63,271 40,455 17,672 121,398	2044							
40 - - - - 47 - - - - 48 - - - - 49 - - - - 50 - - - - 51 - - - - 52 - - - - 53 - - - - 54 - - - - 55 - - - - 56 - - - - 57 - - - - 58 - - - - 60 - - - - 61 - - - - 62 - - - - 63 - - - - 64 - - - - 15PV 63,271 40,455 17,672 121,398	2045							
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Ho Image: Constraint of the second	2047							
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PV 68,486 43,790 19,129 131,405 15PV 63,271 40,455 17,672 121,398	064							
15PV 63,271 40,455 17,672 121,398	PV		68.486	43.790	19.129	131.405		
101 V 00,271 40,405 17,072 121,070	2015PV		63 271	40.455	17 672	121 302		
400 E33	OTOL A		03,271	+0,455	17,072	100 500		

Weighted Average Cost of Capital 5.45% Inflation Rate 2% Real Weighted Average Cost of Capital 3.38%

LCOE and LCOC with 5.45% WACC, Option # NG-TK-20

Life Cycle Cost (2016\$000's)	121,398
Depreciation & Return Cost (2016\$000's)	103,726

Project LCOE (\$/kWh)	\$0.049
Project LCOC (\$/MW)	\$349,227
Project LCOC (\$/kW)	\$349.23

Year from In- service	Annual Energy GW.h, Option # NG-TK-20	Annual Winter Capacity MW, Option # NG- TK-20
1	166.44	20.00
2	166.44	20.00
3	166.44	20.00
4	166.44	20.00
5	166.44	20.00
6	166.44	20.00
7	166.44	20.00
8	166.44	20.00
9	166.44	20.00
10	166.44	20.00
11	166.44	20.00
12	166.44	20.00
13	166.44	20.00
14	166.44	20.00
15	166.44	20.00
16	166.44	20.00
17	166.44	20.00
18	166.44	20.00
19	166.44	20.00
20	166.44	20.00
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let Present Value	2,106	
Total eneray	3,329	
g Annual energy	166	

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Option # DL-LF-05

			MW	Winter MW
Capital (\$000)	2016	\$32,000	5	.0 5.0
Capital (\$000)	2020	\$34,638		
Energy		41.6	GWh/yr	
Capacity Factor		(95%CF)		Load Growth
Fuel	2016			0.0%
O&M (Fixed)	2016	675.0	\$000/yr	41.6 GW.h
O&M (Variable)	2016	0.0	\$/MWh	
Life		20	years	
Salvage cost		0%	-	

	Option # DL-LF-05						
Year	Year-End Balance	Depr	Return	0&M	Total	cents/	Year se
	\$000	\$000	\$000	\$000	\$000	kW.h	
2020	32,906	1,732	1,841	731	4,303	10	
2021	31,174	1,732	1,746	745	4,223	10	
2022	29,442	1,732	1,652	760	4,144	10	
2023	27,710	1,732	1,557	775	4,065	10	
2024	25,978	1,732	1,463	791	3,986	10	
2025	24,246	1,732	1,369	807	3,907	9	
2026	22,515	1,732	1,274	823	3,829	9	
2027	20,783	1,732	1,180	839	3,751	9	
2028	19,051	1,732	1,085	856	3,673	9	
2029	17,319	1,732	991	873	3,596	9	
2030	15,587	1,732	897	891	3,519	8	
2031	13,855	1,732	802	908	3,443	8	
2032	12,123	1,732	708	927	3,366	8	
2033	10,391	1,732	614	945	3,291	8	
2034	8,659	1,732	519	964	3,215	8	
2035	6,928	1,732	425	983	3,140	8	
2036	5,196	1,732	330	1,003	3,065	7	
2037	3,464	1,732	236	1,023	2,991	/	
2038	1,732	1,732	142	1,044	2,917	/	
2039	0	1,732	47	1,064	2,843	/	
2040							
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2004		21.010	14.012	10.054	10 770		Not Door
PV		21,916	14,013	10,851	46,779		Net Pres
\$2015PV		20,247	12,946	10,024	43,217		Tot
					71,268		Avg Annu

Weighted Average Cost of Capital	5.45%
Inflation Rate	2%
Real Weighted Average Cost of Capital	3.38%

LCOE and LCOC with 5.45% WACC, Option # DL-LF-05

Life Cycle Cost (2016\$000's)	43,217
Depreciation & Return Cost (2016\$000's)	33,192

Project LCOE (\$/kWh)	\$0.070
Project LCOC (\$/MW)	\$447,011
Project LCOC (\$/kW)	\$447.01

Year from In- service	Annual Energy GW.h, Option # DL-LF-05	Annual Winter Capacity MW, Option # DL-LF- 05
1	41.61	5.00
2	41.61	5.00
3	41.61	5.00
4	41.61	5.00
5	41.61	5.00
6	41.61	5.00
7	41.61	5.00
8	41.61	5.00
9	41.61	5.00
10	41.61	5.00
11	41.61	5.00
12	41.61	5.00
13	41.61	5.00
14	41.61	5.00
15	41.61	5.00
16	41.61	5.00
17	41.61	5.00
18	41.61	5.00
19	41.61	5.00
20	41.61	5.00
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let Present Value	527	
Total energy	832	
vg Annual energy	42	

Option # DL-LF-10

			MW	Winter MW
Capital (\$000)	2016	\$42,200	10.0	10.0
Capital (\$000)	2020	\$45,679		
Energy		83.2	GWh/yr	
Capacity Factor		(95%CF)		Load Growth
Fuel	2016			0.0%
O&M (Fixed)	2016	935.0	\$000/yr	83.2 GW.h
O&M (Variable)	2016	0.0	\$/MWh	
Life		20	years	
Salvage cost		0%		

	Option # DL-LF-10					
Year	Year-End Balance	Depr	Return	O&M	Total	cents/
	\$000	\$000	\$000	\$000	\$000	kW.h
2020	43,395	2,284	2,427	1,012	5,723	7
2021	41,111	2,284	2,303	1,032	5,619	7
2022	38,827	2,284	2,178	1,053	5,515	7
2023	36,543	2,284	2,054	1,074	5,412	7
2024	34,259	2,284	1,929	1,096	5,309	6
2025	31,975	2,284	1,805	1,117	5,206	6
2026	29,691	2,284	1,680	1,140	5,104	6
2027	27,407	2,284	1,556	1,163	5,002	6
2028	25,123	2,284	1,431	1,186	4,901	6
2029	22,839	2,284	1,307	1,210	4,800	6
2030	20,555	2,284	1,183	1,234	4,700	6
2031	18,271	2,284	1,058	1,258	4,600	6
2032	15,988	2,284	934	1,284	4,501	5
2033	13,704	2,284	809	1,309	4,402	5
2034	11,420	2,284	685	1,335	4,304	5
2035	9,136	2,284	560	1,362	4,206	5
2036	6,852	2,284	436	1,389	4,109	5
2037	4,568	2,284	311	1,417	4,012	5
2038	2,284	2,284	187	1,445	, 3,916	5
2039	0	2,284	62	1,474	3,821	5
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PV		28,901	18,479	15,030	62,411	
\$2015PV		26.700	17.072	13.885	57.658	
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Weighted Average Cost of Capital	5.45%
Inflation Rate	2%
Real Weighted Average Cost of Capital	3.38%

LCOE and LCOC with 5.45% WACC, Option # DL-LF-10

Life Cycle Cost (2016\$000's)	57,658
Depreciation & Return Cost (2016\$000's)	43,772

Project LCOE (\$/kWh)	\$0.047
Project LCOC (\$/MW)	\$294,748
Project LCOC (\$/kW)	\$294.75

Year from In- service	Annual Energy GW.h, Option # DL-LF-10	Annual Winter Capacity MW, Option # DL-LF- 10
1	83.22	10.00
2	83.22	10.00
3	83.22	10.00
4	83.22	10.00
5	83.22	10.00
6	83.22	10.00
7	83.22	10.00
8	83.22	10.00
9	83.22	10.00
10	83.22	10.00
11	83.22	10.00
12	83.22	10.00
13	83.22	10.00
14	83.22	10.00
15	83.22	10.00
16	83.22	10.00
17	83.22	10.00
18	83.22	10.00
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20	83.22	10.00
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let Present Value	1 052	
Total	1,033	
i otal energy	1,664	
vg Annual energy	83	

Option # DL-LF-20

			MW	Winter MW
Capital (\$000)	2016	\$62,500	20.0	20.0
Capital (\$000)	2020	\$67,652		
Energy		166.4	GWh/yr	
Capacity Factor		(95%CF)		Load Growth
Fuel	2016			0.0%
O&M (Fixed)	2016	1190.0	\$000/yr	166.4 GW.h
O&M (Variable)	2016	0.0	\$/MWh	
Life		20	years	
Salvage cost		0%	-	

Year Year-End Balance Depr \$000 Return \$000 O&M Total \$000 cents/ kW.h 2020 64,269 3,383 3,595 1,288 8,266 9 2021 60,887 3,383 3,411 1,314 8,107 9 2022 57,504 3,383 3,426 1,340 7,949 9 2023 54,122 3,383 3,042 1,367 7,791 9 2024 50,739 3,383 2,673 1,422 7,478 4 2025 47,356 3,383 2,120 1,509 7,012 4 2027 40,591 3,383 1,936 1,557 6,764 4 2030 30,443 3,383 1,557 1,670 6,704 4 2031 27,061 3,383 1,353 6,858 4 4 2033 20,296 3,383 1,934 1,666 6,474 3 2034 16,913 3,383				Option #	DL-LF-20		
S000 S000 S000 S000 S000 Kw.h 2020 64,269 3,383 3,595 1,288 8,266 9 2021 60,887 3,383 3,411 1,314 8,107 9 2022 57,504 3,383 3,226 1,340 7,949 9 2023 54,122 3,383 2,857 1,422 7,478 4 2026 47,356 3,383 2,673 1,422 7,478 4 2027 40,591 3,383 2,304 1,450 7,162 4 2028 37,209 3,383 1,356 1,602 6,551 4 2030 30,433 3,383 1,567 1,602 6,551 4 2031 27,061 3,383 1,383 1,634 6,399 4 2033 20,296 3,383 1,198 1,666 6,427 4 2034 16,913 3,383 1,134 5,499 <	Year	Year-End Balance	Depr	Return	0&M	Total	cents/
2020 64,269 3,383 3,595 1,288 8,266 9 2021 60,887 3,383 3,411 1,314 8,107 9 2022 57,504 3,383 3,226 1,340 7,949 9 2023 54,122 3,383 3,042 1,367 7,791 9 2024 50,739 3,383 2,857 1,394 7,634 9 2025 47,356 3,383 2,364 1,451 7,322 4 2026 43,974 3,383 2,304 1,450 7,167 4 2028 37,209 3,383 1,396 1,539 6,858 4 2030 30,433 3,383 1,557 1,602 6,551 4 2031 27,061 3,383 1,934 1,666 6,247 4 2033 20,296 3,383 1,014 1,700 6,096 4 2034 16,913 3,383 1,754		\$000	\$000	\$000	\$000	\$000	kW.h
2021 60,887 3,383 3,411 1,314 8,107 5 2022 57,504 3,383 3,226 1,340 7,949 5 2023 54,122 3,383 3,042 1,367 7,791 5 2024 50,739 3,383 2,857 1,342 7,478 4 2025 47,356 3,383 2,673 1,422 7,478 4 2026 43,974 3,383 2,304 1,480 7,167 4 2027 40,591 3,383 1,936 1,539 6,858 4 2029 33,826 3,383 1,936 1,539 6,858 4 2030 30,443 3,383 1,557 1,602 6,551 4 2031 27,061 3,383 1,198 1,666 6,247 4 2034 16,913 3,383 1,014 1,704 5,667 3 2037 6,765 3,383 461 1,804 5,647 3 2038 3,383 3,383 2,77	2020	64,269	3,383	3,595	1,288	8,266	5
2022 57,504 3,383 3,226 1,340 7,949 5 2023 54,122 3,383 3,042 1,367 7,791 5 2024 50,739 3,383 2,857 1,394 7,634 5 2025 47,356 3,383 2,673 1,422 7,478 44 2026 43,974 3,383 2,489 1,451 7,322 44 2027 40,591 3,383 2,304 1,480 7,167 44 2028 37,209 3,383 1,519 6,858 44 2030 30,443 3,383 1,571 1,570 6,704 44 2031 27,061 3,383 1,567 1,602 6,551 44 2033 20,296 3,383 1,014 1,700 6,096 44 2034 16,913 3,383 1,014 1,700 6,047 5 2035 13,530 3,383 3,277 1,840 5,447 5 2038 3,383 3,283 277 1,84	2021	60,887	3,383	3,411	1,314	8,107	5
2023 54,122 3,383 3,042 1,367 7,791 5 2024 50,739 3,383 2,857 1,394 7,634 5 2025 47,356 3,383 2,673 1,422 7,478 4 2026 43,974 3,383 2,489 1,451 7,322 4 2027 40,591 3,383 2,304 1,480 7,167 4 2028 37,209 3,383 1,509 7,012 4 2030 30,443 3,383 1,557 1,509 7,04 4 2031 27,061 3,383 1,567 1,602 6,551 4 2033 20,296 3,383 1,198 1,666 6,247 4 2034 16,913 3,383 1,014 1,700 6,096 4 2034 10,148 3,383 461 1,804 5,647 5 2037 6,755 3,383 461 1,804 5,499 5 2038 3,383 3,383 2,77 1,840	2022	57.504	3.383	3.226	1.340	7.949	5
2024 50,739 3,383 2,857 1,394 7,634 5 2025 47,356 3,383 2,673 1,422 7,478 4 2026 43,974 3,383 2,489 1,451 7,322 4 2027 40,591 3,383 2,304 1,480 7,167 4 2028 37,209 3,383 2,120 1,509 7,012 4 2029 33,826 3,383 1,936 1,539 6,704 4 2030 30,443 3,383 1,575 1,602 6,551 4 2031 27,061 3,383 1,198 1,666 6,247 4 2034 16,913 3,383 1,198 1,666 6,247 4 2036 10,148 3,383 645 1,768 5,796 5 2037 6,765 3,383 277 1,840 5,647 5 2039 0 3,383 277 1,840 </td <td>2023</td> <td>54,122</td> <td>3,383</td> <td>3,042</td> <td>1,367</td> <td>7,791</td> <td>5</td>	2023	54,122	3,383	3,042	1,367	7,791	5
2025 47,356 3,383 2,673 1,422 7,478 4 2026 43,974 3,383 2,489 1,451 7,322 4 2027 40,591 3,383 2,149 1,450 7,167 4 2028 37,209 3,383 1,120 1,509 7,012 4 2029 33,826 3,383 1,936 1,539 6,858 4 2031 27,061 3,383 1,567 1,602 6,551 4 2032 23,678 3,383 1,567 1,602 6,551 4 2033 20,296 3,383 1,198 1,666 6,247 4 2034 16,913 3,383 645 1,768 5,796 5 2035 13,530 3,383 645 1,768 5,796 5 2037 6,765 3,383 92 1,877 5,351 5 2039 0 3,383 92 1,877 5,351 5 2040 <td>2024</td> <td>50,739</td> <td>3,383</td> <td>2,857</td> <td>1,394</td> <td>7,634</td> <td>5</td>	2024	50,739	3,383	2,857	1,394	7,634	5
2026 43,974 3,383 2,489 1,451 7,322 4 2027 40,591 3,383 2,304 1,480 7,167 4 2028 37,209 3,383 2,120 1,509 7,012 4 2029 33,826 3,383 1,751 1,570 6,704 4 2030 30,443 3,383 1,751 1,570 6,704 4 2031 27,061 3,383 1,634 6,399 4 2032 23,678 3,383 1,181 1,666 6,247 4 2034 16,913 3,383 1,014 1,700 6,096 4 2035 13,530 3,383 830 1,734 5,946 4 2037 6,765 3,383 92 1,877 5,5351 5 2038 3,383 3,383 277 1,840 5,499 5 2040 2041 2041 2041 2041 2041 2041 2041 2041 20	2025	47,356	3,383	2,673	1,422	7,478	4
2027 40,591 3,383 2,304 1,480 7,167 4 2028 37,209 3,383 2,120 1,539 6,858 4 2030 33,826 3,383 1,936 1,539 6,858 4 2031 27,061 3,383 1,751 1,570 6,704 4 2031 27,061 3,383 1,567 1,602 6,551 4 2033 20,296 3,383 1,198 1,666 6,247 4 2034 16,913 3,383 1,014 1,700 6,096 4 2035 13,530 3,383 1,014 1,700 6,096 4 2035 13,530 3,383 461 1,840 5,647 3 2036 10,148 3,383 2077 1,840 5,499 3 3 2039 0 3,383 3,383 2077 1,840 5,499 3 2041 3 2044	2026	43,974	3,383	2,489	1,451	7,322	4
2028 37,209 3,383 2,120 1,509 7,012 4 2029 33,826 3,383 1,936 1,539 6,658 4 2030 30,443 3,383 1,751 1,570 6,704 4 2031 27,061 3,383 1,567 1,602 6,551 4 2032 23,678 3,383 1,183 1,634 6,399 4 2034 16,913 3,383 1,014 1,700 6,096 4 2035 13,530 3,383 830 1,734 5,946 4 2036 10,148 3,383 645 1,768 5,796 3 2037 6,765 3,383 92 1,877 5,351 3 3 2040 2 2041 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	2027	40,591	3,383	2,304	1,480	7,167	4
2029 33,826 3,383 1,936 1,539 6,858 4 2030 30,443 3,383 1,751 1,570 6,704 4 2031 27,061 3,383 1,383 1,602 6,551 4 2032 23,678 3,383 1,383 1,666 6,247 4 2033 20,296 3,383 1,198 1,666 6,247 4 2034 16,913 3,383 1,014 1,700 6,096 4 2035 13,530 3,383 830 1,734 5,946 4 2036 10,148 3,383 645 1,768 5,796 3 2037 6,765 3,383 2077 1,840 5,647 3 2038 3,383 3,383 277 1,840 5,499 3 2040 2041 2042 2041 2042 2042 2047	2028	37,209	3,383	2,120	1,509	7,012	4
2030 30,443 3,383 1,751 1,570 6,704 4 2031 27,061 3,383 1,567 1,602 6,551 4 2032 23,678 3,383 1,183 1,634 6,399 4 2033 20,296 3,383 1,198 1,666 6,247 4 2034 16,913 3,383 1,014 1,700 6,096 4 2035 13,530 3,383 830 1,734 5,946 4 2036 10,148 3,383 2077 1,804 5,647 5 2037 6,765 3,383 461 1,804 5,647 5 2038 3,383 3,383 277 1,840 5,499 5 5 2040 5	2029	33,826	3,383	1,936	1,539	6,858	4
2031 27,061 3,383 1,567 1,602 6,551 4 2032 23,678 3,383 1,383 1,634 6,399 4 2033 20,296 3,383 1,198 1,666 6,247 4 2034 16,913 3,383 1,014 1,700 6,096 4 2035 13,530 3,383 830 1,734 5,946 4 2036 10,148 3,383 645 1,768 5,796 5 2037 6,765 3,383 461 1,804 5,647 5 2038 3,383 3,383 92 1,877 5,351 5 2040 2041 <td< td=""><td>2030</td><td>30,443</td><td>3,383</td><td>1,751</td><td>1,570</td><td>6,704</td><td>4</td></td<>	2030	30,443	3,383	1,751	1,570	6,704	4
2032 23,678 3,383 1,383 1,634 6,399 4 2033 20,296 3,383 1,198 1,666 6,247 4 2034 16,913 3,383 1,014 1,700 6,096 4 2035 13,530 3,383 830 1,734 5,946 4 2036 10,148 3,383 645 1,768 5,796 3 2037 6,765 3,383 461 1,840 5,647 3 2038 3,383 3,383 277 1,840 5,499 3 2040 4 2041 5,351 3 2041 </td <td>2031</td> <td>27,061</td> <td>3,383</td> <td>1,567</td> <td>1,602</td> <td>6,551</td> <td>4</td>	2031	27,061	3,383	1,567	1,602	6,551	4
2033 20,296 3,383 1,198 1,666 6,247 4 2034 16,913 3,383 1,014 1,700 6,096 4 2035 13,530 3,383 830 1,734 5,946 4 2036 10,148 3,383 645 1,768 5,796 5 2037 6,765 3,383 461 1,804 5,647 5 2038 3,383 3,383 277 1,840 5,499 5 2039 0 3,383 92 1,877 5,351 5 2040 2041	2032	23,678	3,383	1,383	1,634	6,399	4
2034 16,913 3,383 1,014 1,700 6,096 4 2035 13,530 3,383 830 1,734 5,946 4 2036 10,148 3,383 645 1,768 5,796 3 2037 6,765 3,383 461 1,804 5,647 3 2038 3,383 3,383 277 1,840 5,499 3 2039 0 3,383 92 1,877 5,351 3 2040 2041	2033	20,296	3,383	1,198	1,666	6,247	4
2035 13,530 3,383 830 1,734 5,946 4 2036 10,148 3,383 645 1,768 5,796 3 2037 6,765 3,383 461 1,804 5,647 3 2038 3,383 3,383 277 1,840 5,499 3 2039 0 3,383 92 1,877 5,351 3 2040 2041 2041	2034	16,913	3,383	1,014	1,700	6,096	4
2036 10,148 3,383 645 1,768 5,796 3 2037 6,765 3,383 461 1,804 5,647 3 2038 3,383 3,383 277 1,840 5,499 3 2039 0 3,383 92 1,877 5,351 3 2040 2041 2041	2035	13,530	3,383	830	1,734	5,946	4
2037 6,765 3,383 461 1,804 5,647 3 2038 3,383 3,383 277 1,840 5,499 3 2039 0 3,383 92 1,877 5,351 3 2040 2041	2036	10,148	3,383	645	1,768	5,796	3
2038 3,383 3,383 277 1,840 5,499 3 2039 0 3,383 92 1,877 5,351 3 2040	2037	6,765	3,383	461	1,804	5,647	3
2039 0 3,383 92 1,877 5,351 3 2040	2038	3,383	3,383	277	1,840	5,499	3
2040	2039	0	3,383	92	1,877	5,351	3
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2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 PV 42,804 27,369 19,129 89,302 135,820	2050						
2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2064 PV 42,804 27,369 19,129 89,302 39,544 25,285 17,672 82,501 135 820	2052						
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2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 PV 42,804 27,369 19,129 89,302 30,544 25,285 17,672 82,501 135,820	2054						
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2064 42,804 27,369 19,129 89,302 S2015PV 39,544 25,285 17,672 82,501 135,820 135,820	2063						
PV 42,804 27,369 19,129 89,302 \$2015PV 39,544 25,285 17,672 82,501 135,820 135,820	2064						
2015PV 39,544 25,285 17,672 82,501 135,820	PV		42,804	27,369	19,129	89,302	
135 820	\$2015PV	I	39,544	25,285	17,672	82,501	
			•			135.820	

Weighted Average Cost of Capital	5.45%
Inflation Rate	2%
Real Weighted Average Cost of Capital	3.38%

LCOE and LCOC with 5.45% WACC, Option # DL-LF-20

Life Cycle Cost (2016\$000's)	82,501
Depreciation & Return Cost (2016\$000's)	64,829

Project LCOE (\$/kWh)	\$0.033
Project LCOC (\$/MW)	\$218,267
Project LCOC (\$/kW)	\$218.27

Year from In- service	Annual Energy GW.h, Option # DL-LF-20	Annual Winter Capacity MW, Option # DL-LF- 20		
1	166.44	20.00		
2	166.44	20.00		
3	166.44	20.00		
4	166.44	20.00		
5	166.44	20.00		
6	166.44	20.00		
7	166.44	20.00		
8	166.44	20.00		
9	166.44	20.00		
10	166.44	20.00		
11	166.44	20.00		
12	166.44	20.00		
13	166.44	20.00		
14	166.44	20.00		
15	166.44	20.00		
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18	166.44	20.00		
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	2,106			
Total energy	gy 3,329			
vg Annual energy	166			

Option # DL-TK-05

			MW	Winter MW
Capital (\$000)	2016	\$31,700	5.0	5.0
Capital (\$000)	2020	\$34,313		
Energy		41.6	GWh/yr	
Capacity Factor		(95%CF)		Load Growth
Fuel	2016			0.0%
O&M (Fixed)	2016	675.0	\$000/yr	41.6 GW.h
O&M (Variable)	2016	0.0	\$/MWh	
Life		20	years	
Salvage cost		0%		

Year	Year-End Balance	Depr	Return	O&M	Total	cents/	Year 1 se
	\$000	\$000	\$000	\$000	\$000	kW.h	
2020	32,597	1,716	1,823	731	4,270	10	
2021	30,882	1,716	1,730	745	4,191	10	
2022	29,166	1,716	1,636	760	4,112	10	
2023	27,450	1,716	1,543	775	4,034	10	
2024	25,735	1,716	1,449	791	3,956	10	
2025	24,019	1,716	1,356	807	3,878	9	
2026	22,304	1,716	1,262	823	3,801	9	
2027	20,588	1,716	1,169	839	3,724	9	
2028	18,872	1,716	1,075	856	3,647	9	
2029	17,157	1,716	982	873	3,571	9	
2030	15,441	1,716	888	891	3,495	8	
2031	13,725	1,716	795	908	3,419	8	
2032	12,010	1,716	701	927	3,344	8	
2033	10,294	1,716	608	945	3,269	8	
2034	8,578	1,716	514	964	3,194	8	
2035	6,863	1,716	421	983	3,120	7	
2036	5,147	1,716	327	1,003	3,046	7	
2037	3,431	1,716	234	1,023	2,972	7	
2038	1,716	1,716	140	1,044	2,899	/	
2039	0	1,/16	47	1,064	2,827	/	
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PV		21,710	13,881	10,851	46,442		Net Prese
\$2015PV		20,057	12,824	10,024	42,905		Tota
					70,766		Avg Annua

Weighted Average Cost of Capital	5.45%
Inflation Rate	2%
Real Weighted Average Cost of Capital	3.38%

LCOE and LCOC with 5.45% WACC, Option # DL-TK-05

Life Cycle Cost (2016\$000's)	42,905
Depreciation & Return Cost (2016\$000's)	32,881

Project LCOE (\$/kWh)	\$0.069
Project LCOC (\$/MW)	\$442,820
Project LCOC (\$/kW)	\$442.82

Year from In- service	Annual Energy GW.h, Option # DL-TK-05	Annual Winter Capacity MW, Option # DL- TK-05
1	41.61	5.00
2	41.61	5.00
3	41.61	5.00
4	41.61	5.00
5	41.61	5.00
6	41.61	5.00
7	41.61	5.00
8	41.61	5.00
9	41.61	5.00
10	41.61	5.00
11	41.61	5.00
12	41.61	5.00
13	41.61	5.00
14	41.61	5.00
15	41.61	5.00
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iet Present Value	527	
Total energy	832	
vg Annual energy	42	

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Option # DL-TK-10

			MW	Winter MW
Capital (\$000)	2016	\$41,900	10.0	10.0
Capital (\$000)	2020	\$45,354		
Energy		83.2	GWh/yr	
Capacity Factor		(95%CF)		Load Growth
Fuel	2016			0.0%
O&M (Fixed)	2016	935.0	\$000/yr	83.2 GW.h
O&M (Variable)	2016	0.0	\$/MWh	
Life		20	years	
Salvage cost		0%		

Year Year-End Balance Depr \$000 Return O&M Total cents/ 2020 43,086 2,268 2,410 1,012 5,690 7 2021 40,819 2,268 2,286 1,032 5,586 7 2022 38,551 2,268 2,286 1,032 5,586 7 2023 36,283 2,268 1,014 5,381 6 2024 34,015 2,268 1,916 1,096 5,279 6 2024 34,015 2,268 1,792 1,117 5,177 6 2025 31,748 2,268 1,421 1,186 4,875 6 2026 29,480 2,268 1,421 1,186 4,875 6 2029 22,677 2,268 1,174 1,234 4,676 6 2030 20,409 2,268 1,051 1,258 4,577 5 2032 15,874 2,268 680 1,	
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Weighted Average Cost of Capital	5.45%
Inflation Rate	2%
Real Weighted Average Cost of Capital	3.38%

LCOE and LCOC with 5.45% WACC, Option # DL-TK-10

Life Cycle Cost (2016\$000's)	57,347
Depreciation & Return Cost (2016\$000's)	43,461

Project LCOE (\$/kWh)	\$0.046
Project LCOC (\$/MW)	\$292,653
Project LCOC (\$/kW)	\$292.65

Year from In- service	Annual Energy GW.h, Option # DL-TK-10	Annual Winter Capacity MW, Option # DL- TK-10
1	83.22	10.00
2	83.22	10.00
3	83.22	10.00
4	83.22	10.00
5	83.22	10.00
6	83.22	10.00
7	83.22	10.00
8	83.22	10.00
9	83.22	10.00
10	83.22	10.00
11	83.22	10.00
12	83.22	10.00
13	83.22	10.00
14	83.22	10.00
15	83.22	10.00
16	83.22	10.00
17	83.22	10.00
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	1,053	
Total energy	1,664	
vg Annual energy	83	

Option # DL-TK-20

			MW	Winter MW
Capital (\$000)	2016	\$62,200	20.0	20.0
Capital (\$000)	2020	\$67,327		
Energy		166.4	GWh/yr	
Capacity Factor		(95%CF)		Load Growth
Fuel	2016			0.0%
O&M (Fixed)	2016	1190.0	\$000/yr	166.4 GW.h
O&M (Variable)	2016	0.0	\$/MWh	
Life		20	years	
Salvage cost		0%		

			Option # I	DL-TK-20		
Year	Year-End Balance	Depr	Return	O&M	Total	cents/
	\$000	\$000	\$000	\$000	\$000	kW.h
2020	63,961	3,366	3,578	1,288	8,232	5
2021	60,595	3,366	3,394	1,314	8,074	5
2022	57.228	3.366	3.211	1.340	7.917	5
2023	53,862	3,366	3,027	1,367	7,761	5
2024	50,495	3,366	2,844	1,394	7,604	5
2025	47,129	3,366	2,660	1,422	7,449	4
2026	43,763	3,366	2,477	1,451	7,294	4
2027	40,396	3,366	2,293	1,480	7,139	4
2028	37,030	3,366	2,110	1,509	6,985	4
2029	33,664	3,366	1,926	1,539	6,832	4
2030	30,297	3,366	1,743	1,570	6,679	4
2031	26,931	3,366	1,559	1,602	6,527	4
2032	23,565	3,366	1,376	1,634	6,376	4
2033	20,198	3,366	1,193	1,666	6,225	4
2034	16,832	3,366	1,009	1,700	6,075	4
2035	13,465	3,366	826	1,734	5,926	4
2036	10,099	3,366	642	1,768	5,777	3
2037	6,733	3,366	459	1,804	5,629	3
2038	3,366	3,366	275	1,840	5,481	3
2039	0	3,366	92	1,877	5,335	3
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					135,318	

Weighted Average Cost of Capital	5.45%
Inflation Rate	2%
Real Weighted Average Cost of Capital	3.38%

LCOE and LCOC with 5.45% WACC, Option # DL-TK-20

Life Cycle Cost (2016\$000's)	82,190
Depreciation & Return Cost (2016\$000's)	64,517
	ćo 022

Project LCOE (\$/kWh)	\$0.033
Project LCOC (\$/MW)	\$217,219
Project LCOC (\$/kW)	\$217.22

Year from In- service	Annual Energy GW.h, Option # DL-TK-20	Annual Winter Capacity MW, Option # DL- TK-20
1	166.44	20.00
2	166.44	20.00
3	166.44	20.00
4	166.44	20.00
5	166.44	20.00
6	166.44	20.00
7	166.44	20.00
8	166.44	20.00
9	166.44	20.00
10	166.44	20.00
11	166.44	20.00
12	166.44	20.00
13	166.44	20.00
14	166.44	20.00
15	166.44	20.00
16	166.44	20.00
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	2,106	
rotal energy	3,329	
vg Annual energy	166	

November 21, 2016





Basis of Design (BOD) Thermal Energy Plant Study



Prepared for: Yukon Energy Corporation Whitehorse, Yukon

Prepared by: Stantec Consulting Ltd. 845 Prospect Street Fredericton, NB E3B 2T7

Project File: 133547248_6_2

August 5, 2016



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1.0 Introduction

Design scope for this study effort was broken down by major discipline to support design decisions and discussions to-date. The following document is considered the Basis of Design (BOD) for the study and provides the overall conceptual considerations given to the multiple options and sites.

In general, the plant was to be a stand-alone, greenfield installation adjacent to brownfield sites, but not to be supported by any current YEC infrastructure (i.e., near existing Whitehorse Generating Station). It was desired to site the plant within the Whitehorse area or within a 25 km boundary outside city limits, as well as near suitable infrastructure for interconnection (i.e., existing substations/T&D lines).

The study considered plant options and sites as outlined in Table 1.0 to provide YEC with multiple scenarios for consideration during its resource planning exercise. This resulted in twelve (12) independent options for consideration and AACE Class 5 opinions of probable capital costs.

Table 1.0 – Summary Options and Sites

Fuel Type	Site		Plant Capacities	
Natural Gas or	Whitehorse	5 MWe	10 MW _e	20 MW _e
Diesel	Landfill or Takhini	(2x 2.5 MW _e)	(4x 2.5 MW _e)	(4x 2.5 MW _e ,
	Substation (\$164)			2x 5 MWe)



2.0 Detailed Project Scope Definition

2.1 CIVIL / STRUCTURAL

The civil/structural scope includes:

- Greenfield site (YEC April 12, 2016 (Kick-off)):
 - Plant will be new, not located near to the existing Whitehorse plant (brownfield sites adjacent to assumed plant locations).
 - Concept layouts completed to allow for up to 20 MW_e plant, allowing for smaller plants to be easily incorporated.
 - Concept design assumed reciprocating engines will be installed inside a generating hall (YEC April 20, 2016). It is recognized that containerized/enclosures are a possibility to be evaluated in future engineering design efforts (similar to existing YEC LNG plant).
- Site Work including:
 - Clearing and grubbing overall site.
 - Site grading including road and parking preparation.
 - Site drainage and culverts.
 - Base, sub-base, and asphalt for site roads and parking areas, including improvements to access roads from main highway (i.e., upgrading Takhini gated entrance and new road to plant, widening and strengthening landfill access road/hill).
 - Foundation excavation and preparation for structures and slabs.
 - New septic system for plant washrooms and facilities.
 - Site fencing and security motorized vehicle gates (two gates), separate substation fenced area. Fencing assumes YEC standard 8 ft. chain linked fence with angular barb wire. As per plant layouts, fencing extends beyond assumed vapour dispersion area of the LNG plant to avoid use of vapour fencing. Future study is required to confirm extent of vapour cloud. The current 60 m allowance around impoundment areas is based on a worst case scenario from existing LNG plant modeling. Fencing for diesel options provides at least a 15 m buffer from plant equipment.
- Concrete Work:
 - LNG fuel storage area to meet CSA Z276-15:
 - LNG tank, process area, and truck unloading containment pads.
 - Open trenching to impoundment area.
 - Impoundment sized in excess of 110% of largest tank + 10% (or 50 cm) for snow/rain collection.
 - LNG tankage located outside 15 kW/m² assumed heat flux zone. Radii used for heat flux zones based on worse case scenarios from existing LNG plant modelling. New plant will vary based on site specific characteristics.



- Thickened slabs for generator foundations.
- Equipment foundations for: stack and silencers, radiators, transformers, breaker, and steel structures.
- LNG cases include aboveground pipe bridge from LNG process area to generating station. Diesel options use underground double walled pipes connecting the tank farm pump house to the generating station.
- Pre-engineered building unit costs are based on previous work in Whitehorse area and territory. Unit price includes: Building steel, insulated walls, insulated roof, doors, slab and concrete footings. Equipment within the building or building services are not included in the unit cost.
- Allowance for building Internals including Interior rooms & sanitary (washroom).
- Fire protection loop is based on using water storage for site wide protection. Options exist for wells instead of storage, and for a potential hybrid system, which can be investigated in future studies. Current water storage for fire protection system incorporates:
 - Fire water heated storage (2x 30ft dia x 30ft tanks, insulated, 250,000 gal).
 - Fire water pump house (electric and diesel driven fire pumps, building).
 - Fire Loop (allowance) & Recirculation Pumps.
 - Fire Hydrants.

Civil/structural assessment will be based on: area/unit factors, recent Whitehorse projects, and parametric techniques.

2.2 MECHANICAL / MAJOR EQUIPMENT

The mechanical/process as well as major equipment scope includes:

• The generating stations are designed for the dedicated use of one fuel supply. Plants were either LNG/NG or diesel. Blending or dual fuel units were not to be considered, though some vendor's engines are dual fuel capable.

Desired plant capacities:

- 5 MW_e nominal:
 - 2 small engines (~2.5 MWe).
- 10 MW_e nominal:
 - 4 small engines (~2.5 MW_e).
- 20 MW_e nominal:

•

- 4 small engines (~2.5 MW $_{
 m e}$).
- 2 larger engines (~5 MW_e).
- Standard vendor submissions included the following as a minimum. Most submissions received did not provide sufficient breakdown in cost, and typically included enclosures, stack heat recovery, site services, testing, and commissioning:
 - Prime Mover.
 - Generator and Auxiliaries.
 - Mechanical Auxiliaries (circulating pumps / radiator).
 - Electrical and Control Equipment.
 - Heat Recovery / Rejection.



- Engineering / Project Management / Drawings.
- Sound Attenuation.
- Fuel Delivery and Storage:
 - YEC requested Stantec to allow for 7-days of fuel storage on-site using horizontal tanks.
 - For LNG cases, the following equipment was scaled from YEC's previous LNG project since LNG vendors did not respond to RFQs:
 - LNG storage tanks: 1x 150 m³ (usable) vacuum jacketed, horizontal storage tank (number of tanks depending on plant capacity).
 - Vaporizers.
 - LNG storage infrastructure, truck unloading station, piping, and infrastructure.
 - Transportation.
 - For diesel cases, pricing for common tank sizes were used and incorporates double wall containment to mitigate the need for dykes or berms. Future study into the desired approach for a diesel tank farm should consider custom sized double wall tanks, single wall tanks with secondary containment, larger single tank instead of horizontal tankage. OPC includes:
 - Diesel storage tanks: Double Walled (100% secondary containment, standard 75,000 L design).
 - Diesel truck unloading and pump house, underground containment tank, sump and lines.
 - Transportation.
- General mechanical and process equipment were based on fuel type and plant capacity (number of units). Allowances were made for larger system to support the overall pricing. Internal fire protection would tie into new fire water loop and include building sprinklers and local protection equipment. Mechanical scope of work includes:
 - Fuel System Piping (from fuel storage, building internal).
 - Glycol Heating System (including unit heaters, electric & diesel boiler).
 - Generating Station HVAC (electric unit heaters, building and combustion ventilation).
 - Allowance for Building Services / Plumbing.
 - Allowance for Lube / Waste Oil System.
 - Continuous Emissions Monitoring System.
 - Instrument and Plant Compressed Air Systems.
 - Generating Station Sprinkler System, extinguisher, fire protection equipment.

Mechanical/process assessment will be based on: area/unit factors, recent Whitehorse projects, and parametric techniques.



2.3 ELECTRICAL

The EI&C scope of work includes:

- Pole line brought to the local substation or nearest distribution line at 34.5 kV (Site 1 S170 McIntyre, Site 3 S164 Takhini) (YEC May 16, 2016). Two circuits 10 MW_e circuits assumed for each 20 MW_e site at 10 MW_e each, otherwise one circuit assumed.
 Major equipment:
- Major equipment:
 - New engines to generate at 4,160V (YEC April 21, 16).
 - Generator Step up Transformer 34.5 kV high side, generator bus voltage on low side, +/- 5% off load taps.
 - 34.5 kV incoming breaker.
 - 34.5 kV vertical break, vertical mounted disconnect switch.
 - Medium voltage cable between generator step up transformer and generator switchgear.
 - Bus work / Dead end structure at substation at thermal plant.
 - VTs/surge arrestor and station service transformers.
- Generator Substation:
 - Ground Grid.
 - Substation Fence.
 - Cable and conduit.
 - Cable trench.
- Inside Generator Building Electrical Room:
 - Transformer protection and control panel.
 - 34.5 kV line protection panel.
 - Metering panel.
 - 125 VDC Station service battery.
- The plant control system will be a distributed control system (DCS), with local PLC control for various systems as appropriate.
- Allowance for station service transformer and associated equipment (MCC, etc.).
- Allowance for site wide grounding grid.
- Allowances for plant communication and security, including:
 - Roadway / Site Lighting.
 - CCTV Security and Integration to System Control Centre.
 - Fire and Gas Alarm Systems.
 - Communications (fibre, CAT5, telephone).
- Allowance for Uninterruptible Power Supply (UPS) system and black start genset.
- 34.5 kV Interconnection poles, conductor, hardware, deadends.
- Allowances will be made for building services, lighting, fire alarms, receptacles, etc.

EI&C assessment will be based on: area/unit factors, recent Whitehorse projects, and parametric techniques.



2.4 MISCELLANEOUS CONSTRUCTION DIRECTS

Most construction directs will be accounted for in a blended labor rate. This would include small tools and consumables. Allowances for required equipment rentals used as part of a normal installation are included in the blended labor rate. Supervision, crew trailer, meals & accommodations for out of territory staff, and personal PPE are also included.

Freight is included in the material and equipment pricing, unless otherwise noted.



3.0 Detailed Basis of Estimate

The following sub-sections outline assumptions related to direct and indirect costs for the project as it is understood today. These will be carried forward into the Opinion of Capital Cost (OPC) and presented in the draft study report.

3.1 ENGINEERING

A preliminary engineering allowance of \$400,000 was carried which would include generating a feasibility study design and Class 3 OPC for project appropriations (option to conduct study in two phases also exists, with pre-feasibility study for a Class 4 OPC). A detailed engineering allowance is 8% of capital will be included to cover detailed engineering, schedule and cost control.

3.2 PROCUREMENT

Major equipment is assumed to be purchased by YEC and supplied to the installation contractor on site. In this particular study, that would include the reciprocating engines, auxiliaries, switchgear, the step-up transformer, transfer switches, and other vendor supplied equipment. This approach is advantageous in that:

- It ensures adherence to the utility standards for equipment where many options and additions are commonly available.
- It does not delegate away the responsibility of expediting these items to site. By maintaining responsibility, the Owner can exercise greater control of delivery on these critical items.
- It avoids the standard contractor markup of 10-15% (or more) being added to large value line items.

All other items, including piping, cable, cable tray, and all other commodity items required for the installation shall be supplied by the contractor(s) as part of their lump sum installation pricing. This eliminates the need for utility engineers, managers, or consultants to be responsible or concerned with inventory levels of items that are extremely hard to track on a busy construction site.

3.3 PRODUCTIVITY FACTORS

Labour factor adjustments were be applied to the OPC based on the following:

- Work in Whitehorse as it applies to accessing supplies and skilled labour.
- Estimated inventory levels at local supply houses.
- Working outdoors or in non-serviced building in Whitehorse, Yukon weather.



• Productivity was applied as a factor to labour or embedded in allowance made depending on the line item.

3.4 CONSTRUCTION

This OPC is based on the following sources of data for labor and materials:

- In-house databases built from historical or manufacturer's listed prices.
- Direct contact with vendors for indicative pricing of reciprocating engine and auxiliaries (including fuel tankage).
- NECA (National Electrical Contractors Association) Manual of Labor Units for specific items covered by that publication.
- Historical labor costs for other items not specifically listed or requiring special consideration.

3.5 INDIRECT CONSTRUCTION COSTS

At this stage of study and classification of the OPC, indirect costs are assigned as a percentage of expected direct costs based on previous experience, industry norms, and Stantec professional judgement.

3.5.1 Construction Staff & Consultants

An allowance of 2.5% of capital will be carried for an on-site construction manager. An allowance of 1% of capital will be carried for site engineering services to support construction.

3.5.2 Commissioning Costs

Commissioning costs will be carried as 1.5% of capital. This includes allowances to bring vendor representatives to site.

3.5.3 Escalation Costs

An escalation allowance of 3.5% will be allowed based on lead time required before construction begins.

3.5.4 Capital Spares

A capital spares allowance of 2% of the major equipment cost will be included.

3.5.5 Indirects Specifically Not Included

The indirect costs associated with the following are typically not considered and are assumed to be supplied by Owner. At YEC's request, an 18% factor of direct costs will be assigned to these services based on recent utility experience:

• Security.



- Lock-out tag-out (LOTO) coordination.
- Waste removal.
- Snow removal.
- Warehousing and utilities including temporary power supply.
- Temporary construction lighting.
- Taxes.
- Interest charges during construction.
- Land acquisition and zoning.
- Environmental studies, YESAB assessment and all permitting.
- Owner's administration costs, including:
 - Legal fees.
 - Insurance.
 - Salaries & expenses of Owner's project staff.
 - Allowance for operators hours & fuel costs during training, commissioning, and start up.
 - Special costs to dispose from site construction waste.



4.0 Opinion of Probable Capital Cost

The Opinion of Probable Capital Cost (OPC) for the study is in line with an AACE Class 5 estimate, following a level of engineering project definition of 0 – 2%. From AACE, "Class 5 estimates are prepared for any number of strategic business planning purposes...typical accuracy ranges for Class 5 estimates are - 20% to -50% on the low side, and +30% to +100% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination". Given the expected level of effort for this study, an order of magnitude estimate of +50%/-30% is expected. Full line item OPCs are attached in Appendix A.

	Fuel Type	Site	Plant Capacities	Opinion of
Option #	Natural Gas or	Landfill or	5 MWe, 10 MWe, 20 MWe	Probable Capital
	Diesel	Takhini		Cost (OPC)
NG-LF-05	Natural Gas	Landfill	5 MWe (2x 2.5 MWe)	\$48.6 M
NG-LF-10	Natural Gas	Landfill	10 MW _e (4x 2.5 MW _e)	\$66.9 M
	Natural Cas		20 MW _e	¢100.1 M
NG-LF-20	Natural Gas	Lanatili	(4x 2.5 MWe, 2x 5 MWe)	\$100.1 IVI
NG-TK-05	Natural Gas	Takhini	5 MWe (2x 2.5 MWe)	\$48.5 M
NG-TK-10	Natural Gas	Takhini	10 MWe (4x 2.5 MWe)	\$66.8 M
		Tokhini	20 MWe	¢100.0 M
NG-IK-20	Natural Gas	Taknini	(4x 2.5 MWe, 2x 5 MWe)	\$ 100.0 IVI
DL-LF-05	Diesel	Landfill	5 MWe (2x 2.5 MWe)	\$32.0 M
DL-LF-10	Diesel	Landfill	10 MWe (4x 2.5 MWe)	\$42.2 M
	Discol	Londfill	20 MWe	
DL-LF-20	Diesei	Landilli	(4x 2.5 MW $_{ m e}$, 2x 5 MW $_{ m e}$)	\$02.5 IVI
DL-TK-05	Diesel	Takhini	5 MWe (2x 2.5 MWe)	\$31.7 M
DL-TK-10	Diesel	Takhini	10 MW _e (4x 2.5 MW _e)	\$41.9 M
	Discol	Takkini	20 MWe	¢())
DL-IK-20	Diesei	Taknini	(4x 2.5 MWe, 2x 5 MWe)	\$02.2 IVI

Table 2.0 – Summary of Opinion of Probable Capital Cost

4.1 CAPITAL COST RISK ANALYSIS

No detailed risk analysis (Monte Carlo) is planned for the OPC. A contingency of 20% will be allocated.



5.0 Appendices

Appendix A Opinions of Probable Capital Cost

Appendix B Concept Layouts



APPENDIX A

Opinions of Probable Capital Cost

Client: Yukon Energy Corporation Project: Thermal Energy Plant Study Project No: 133547248 Currency: CAD



STANTEC CONSULTING Opinion of Probable Construction Cost Summary NG-LF-05: LNG - Landfill - 5 MWe

Area	Line	Rev.	Description	Labour Hours	Labour Cost	Mat'l/Commodity Cost	Equipment Cost	Sub-Contractor Cost	Total Cost
-	0	-	PROJECT TOTAL, BASE SCOPE	15,628 hrs	\$1,868,080	\$7,374,763	\$17,061,163	\$4,400,750	\$48,592,020
-	1	-	Major Equipment	6,448 hrs	\$709,280	\$673,000	\$13,460,000	\$150,000	\$14,992,280
-	2	-	General Civil	00 hrs	\$0	\$3,370,450	\$807,500	\$0	\$4,177,950
-	3	-	Buildings and Structures	00 hrs	\$0	\$1,478,913	\$0	\$4,200,000	\$5,678,913
-	4	-	Mechanical and Process	4,143 hrs	\$455,693	\$112,500	\$1,413,750	\$0	\$1,981,943
-	5	-	Electrical, Instrumentation & Controls	5,037 hrs	\$604,089	\$1,739,900	\$1,110,713	\$0	\$3,454,702
-	6	-	Sub Total Directs	15,628 hrs	\$1,769,063	\$7,374,763	\$16,791,963	\$4,350,000	\$30,285,788
-	7	-	Preliminary Engineering for Budget Approval (Class 3)	-	-	-	-	-	\$400,000
-	8	-	Detail Engineering @ 8% Direct Construction Cost	-	-	-	-	-	\$2,422,863
-	9	-	Construction Staff & Consultants and Construction Management Fee @3.5%	-	-	-	-	-	\$1,060,003
-	10	-	Commissioning Costs - Excluding Owner's Staff @ 1.5% of Directs	-	-	-	-	-	\$454,287
-	11	-	Escalation Allowance @ 3.5% Labour, 3.5% Construction Staff & Mgmt Fee, & 3.5% of 1/3 Sub-Contractor Cost	-	\$99,017	-	-	\$50,750	\$149,767
-	12	-	Capital Spares - 2% Major Equipment	-	-	-	\$269,200	-	\$269,200
-	13	-	Indirect Construction Costs and Owner's Costs (See Line Item List, 18% of Directs)	-	-	-	-	-	\$5,451,442
-	14	-	Sub Total In-Directs	00 hrs	\$99,017	\$0	\$269,200	\$50,750	\$10,207,562
-	15	-	Contingency of 20% - AACE Class 5 Opinion of Probable Cost						\$8,098,670

Prepared by: **Team** Date: **16-May-16** Revision No.: **A**

Issue Date: 1-Jun-16

Checked: CGV

Client: Yukon Energy Corporation Project: Thermal Energy Plant Study Project No: 133547248 Currency: CAD



STANTEC CONSULTING Opinion of Probable Construction Cost Major Equipment NG-LF-05: LNG - Landfill - 5 MWe

							Labour					Mat'l/Commodity		Equipment		Sub-Contractor		Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					6,448		709,280		673,000		13,460,000		150,000	14,992,280
	1			Generating Station					0		0		0		0		0	0
	2			NG fired Reciprocating Engine - 2.5 MWe capacity, 4,160V	2	unit	1,280	1.30	3,328	110.00	366,080	100,000	200,000	2,000,000	4,000,000		0	4,566,080
	3			Transportation	2	ea			0		0		0		0	75,000	150,000	150,000
	4			Includes:					0		0		0		0		0	0
	5			Prime Mover					0		0		0		0		0	0
	6			Generator and Auxiliaries					0		0		0		0		0	0
	7			Mechanical Auxiliaries (circulating pumps / radiator)					0		0		0		0		0	0
	8			Electrical Control Equipment					0		0		0		0		0	0
	9			Heat Recovery / Rejection					0		0		0		0		0	0
	10			Engineering / Project Management / Drawings					0		0		0		0		0	0
	11			Sound Attenuation					0		0		0		0		0	0
	12			LNG Tank Farm					0		0		0		0		0	0
	13			LNG storage tanks: 1x 150 m3 (usable) vacuum jacketed, horizontal storage tank	2	ea	240	1.30	624	110.00	68,640	37,500	75,000	750,000	1,500,000		0	1,643,640
	13			Storage Infrastructure	1	ea	480	1.30	624	110.00	68,640	43,250	43,250	865,000	865,000		0	976,890
	14			Vaporizers	2	ea	480	1.30	1,248	110.00	137,280	95,750	191,500	1,915,000	3,830,000		0	4,158,780
	15			LNG truck unloading station, piping, and infrastructure	1	ea	480	1.30	624	110.00	68,640	163,250	163,250	3,265,000	3,265,000		0	3,496,890
	16			Transportation	6	ea			0		0		0		0	75,000	450,000	450,000

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: HC

Client: Yukon Energy Corporation Project: Thermal Energy Plant Study Project No: 133547248 Currency: CAD



STANTEC CONSULTING Opinion of Probable Construction Cost Civil NG-LF-05: LNG - Landfill - 5 MWe

							Labour					Mat'l/Commodity		Equipment		Sub-Contractor		Tabal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			GENERAL CIVIL TOTAL					0		0		3,370,450		807,500		0	4,177,950
	1			Clearing & Grubbing	6.5	ha			0		0	\$30,000	195,000		0		0	195,000
	2			Excavation & Backfill for Structures & Slab (Allowance)	1	ea.			0		0	\$225,000	225,000		0		0	225,000
	3			Site Drainage and Culverts (Allowance)	1	ea.			0		0	\$125,000	125,000		0		0	125,000
	4			Site Grading - Incl. Roads and Parking Lot Preparation	6,500	m ³			0		0	\$15	97,500		0		0	97,500
	5			General Landscaping	1	ea.			0		0	\$60,000	60,000		0		0	60,000
	6			Water and Sewer Piping	80	m			0		0	\$250	20,000		0		0	20,000
	7			Granular Base - 150mm	4,950	tonne			0		0	\$35	173,250		0		0	173,250
	8			Granular Sub-Base - 300mm	9,900	tonne			0		0	\$18	178,200		0		0	178,200
	9			Asphalt - (Base and Seal)	3,150	tonne			0		0	\$150	472,500		0		0	472,500
	10			Fencing (8ft, angular razor wire)	1,100	m			0		0	\$300	330,000		0		0	330,000
	11			Automatic Slide Gate (10m)	2	ea.			0		0	\$6,000	12,000		0		0	12,000
	12			Slide Gate (10m)	1	ea.			0		0	\$2,000	2,000		0		0	2,000
	13			Potable Water Well, pump, line, and HW tank.	1	ea.			0		0	\$80,000	80,000		0		0	80,000
	14			Septic System	1	ea.			0		0	\$50,000	50,000		0		0	50,000
	15			FIRE WATER					0		0		1,350,000		807,500		0	2,157,500
	16			Fire water heated storage (2x 30ft dia x 30ft tanks, insulated, 250,000 gal)	2	ea			0		0		0	300,000	600,000		0	600,000
	17			Fire water pump house (electric and diesel driven fire pumps, building)	1	lot			0		0	900,000	900,000		0		0	900,000
	18			Fire Loop (allowance) & Recirc Pumps	1,500	m			0		0	\$300	450,000		50,000		0	500,000
	19			Fire Hydrants	15	ea.			0		0		0	10,500	157,500		0	157,500

Prepared by: AW / RM Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: AF


STANTEC CONSULTING Opinion of Probable Construction Cost Buildings and Structures NG-LF-05: LNG - Landfill - 5 MWe

									Labou	ur		Mat'l/Cor	nmodity	Equip	oment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0		0		1,478,913		0		4,200,000	5,678,913
	1			FUEL STORAGE					0		0		759,600		0		0	759,600
	2			Truck Unloading Pad					0		C		0		0		0	C
	3			Concrete Pad 8 m x 10 m x 0.3 m	24	m ³			0		C	1,500	36,000		0		0	36,000
	4			Containment Sump					0		C		0		0		0	C
	5			Base 10 m x 20 m x 0.3 m	60	m ³			0		C	1,500	90,000		0		0	90,000
	6			Walls 60 m x 2 m x 0.3 m	36	m ³			0		C	1,500	54,000		0		0	54,000
	7			LNG Control Module					0		C		0		0		0	C
	8			Base 6 m x 22 m x 0.3 m	40	m ³			0		C	1,500	59,400		0		0	59,400
	9			Tank Containment					0		C		0		0		0	(
	10			Concrete pad 25 m x 40 m x 0.3 m	300	m ³			0		C	1,500	450,000		0		0	450,000
	11			Containment Curb 130 m x 0.3 m x 0.2 m	8	m ³			0		C	1,500	11,700		0		0	11,700
	12			Concrete Trenching					0		C		0		0		0	C
	13			Base 60 m x 0.5 m x 0.3 m	9	m ³			0		C	1,500	13,500		0		0	13,500
	14			Walls 120 m x 1 m x 0.25 m	30	m ³			0		C	1,500	45,000		0		0	45,000
	15			GENERATOR HALL					0		0		114,225		0		4,200,000	4,314,225
	16			Pre-engineered Building					0		C		0		0		0	C
	17			Building Size 25 m x 70 m	1,750	m ²			0		C		0		0	2,400	4,200,000	4,200,000
	18			Generator Foundation					0		C		0		0		0	C
	19			Thickened Slab 4 m x 10 m x 0.5 m / each quantity 2	40	m ³			0		C	1,500	60,000		0		0	60,000
	20			Generator Stack Foundation					0		C		0		0		0	C
	21			Concrete Pad 2.5 m x 2.5 m x 0.3 m / each quantity 2	4	m ³			0		C	1,500	5,625		0		0	5,625
	22			Diesel Storage Tank					0		C		0		0		0	C
	23			Base 5 m x 12 m x 0.3 m	18	m ³			0		C	1,500	27,000		0		0	27,000
	24			Radiator Foundation					0		C		0		0		0	C
	25			Concrete Pad 4 m x 6 m x 0.3 m / each quantity 2	14	m ³			0		C	1,500	21,600		0		0	21,600
	26			SUBSTATION					0		0		369,000		0		0	369,000
	27			Transformer					0		C		0		0		0	C
	28			Base 12 m x 18 m x 0.5 m	108	m ³			0		C	1,500	162,000		0		0	162,000
	29			Containment Walls 60 m x 1.2 m x 0.25 m	18	m ³			0		C	1,500	27,000		0		0	27,000
	30			Pier 11 m x 7.4 m x 1.2 m	98	m ³			0		C	1,500	146,520		0		0	146,520
	31			Steel Grating 1.5 m x 48.8 m	73	m²			0		C	150	10,980		0		0	10,980
	32			Breaker					0		C		0		0		0	C
	33			Concrete Pad 5 m x 10 m x 0.3 m	15	m ³			0		C	1,500	22,500		0		0	22,500
	34			OTHER					0		0		236,088		0		0	236,088
	35			Pipe Bridge 115 m Long					0		C		0		0		0	0
	36			Weight of Steel per Meter 72 kg	8,280	kg			0		C	15	124,200		0		0	124,200
	37			Pipe Bridge Foundation (14 total)					0		C		0		0		0	C
	38			Footing 4 m x 3 m x 0.3 m @ 14 locations	50	m ³			0		C	1,500	75,600		0		0	75,600
	39			Pier 0.6 m x 0.6 m x 2.4 m @ 28 locations	24	m ³			0		C	1,500	36,288		0		0	36,288

Prepared by: JS Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Mechanical & Process NG-LF-05: LNG - Landfill - 5 MWe

									Labou	Jr		Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Tatal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					4,143		455,693		112,500		1,413,750		0	1,981,943
	1			Prime Movers and Fuel Storage (See Major Equipment)					0		0		0		0		0	0
	2			Fuel System Piping (from fuel storage, building internal)	2	lot	107	1.30	277	110.00	30,507	5,000	10,000	75,000	150,000		0	190,507
	3			Glycol Heating System (incl LNG vaporizers, unit heaters, electric & diesel/NG boiler)	2	lot	107	1.30	277	110.00	30,507	7,500	15,000	150,000	300,000		0	345,507
	4			Generating Station HVAC (electric unit heaters, building and combustion ventilation)	1	lot	1,280	1.30	1,664	110.00	183,040	40,000	40,000	400,000	400,000		0	623,040
	5			Allowance for Building Services / Plumbing	1	lot	480	1.30	624	110.00	68,640	15,000	15,000	110,000	110,000		0	193,640
	6			Allowance for Lube / Waste Oil System	1	lot	320	1.30	416	110.00	45,760	10,000	10,000	80,000	80,000		0	135,760
	7			Continuous Emissions Monitoring System	1	lot	360	1.30	468	110.00	51,480	15,000	15,000	175,000	175,000		0	241,480
	8			Instrument and Plant Compressed Air Systems	1	lot	320	1.30	416	110.00	45,760	5,000	7,500	50,000	50,000		0	103,260
	9			Generating Station Sprinkler System, extinguisher, fire protection equipment	1,750	m ²			0		0		0	85	148,750		0	148,750

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16

Checked: LF



STANTEC CONSULTING Opinion of Probable Construction Cost Electrical, I&C NG-LF-05: LNG - Landfill - 5 MWe

									Labo	ur		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					5,037		604,089		1,739,900		1,110,713		0	3,454,702
	1			STATION ELECTRICAL					2,457		270,270		840,000		345,000		0	1,455,270
	2			Site wide Grounding Grid	1	lot	200	1.30	260	110.00	28,600	50,000	50,000		0		0	78,600
	3			Trench and conduit	1	lot	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	4			Transformer Protection Panel	1	ea	40	1.30	52	110.00	5,720		0	50,000	50,000		0	55,720
	5			Annunciator / Control / Metering Panel	1	ea	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	6			SCADA / Communications	1	lot	60	1.30	78	110.00	8,580		0	50,000	50,000		0	58,580
	7			5kV, 3000A Switchgear	1	lot	40	1.30	52	110.00	5,720	120,000	120,000		0		0	125,720
	8			Station Services MCC (allow 10 Sections)	10	sect	10	1.30	130	110.00	14,300		0	8,500	85,000		0	99,300
	9			BOP PLC and Instrumentation (100 Points, \$1000 per Point)	1	ls			0		0		0	100,000	100,000		0	100,000
	10			Medium/Low Voltage Cable	3,000	ft	0.15	1.30	585	110.00	64,350	30	90,000		0		0	154,350
	11			Cable Tray and Cables from Unit Output to Electrical Room	3,000	ft	0.30	1.30	1,170	110.00	128,700	45	135,000		0		0	263,700
	12			Utility Metering Allowance	1	lot	20	1.30	26	110.00	2,860	20,000	20,000		0		0	22,860
	13			Engine & Auxiliaries Instrumentation	1	lot			0		0	50,000	50,000		0		0	50,000
	14			Black Start Diesel Genset and Auxiliaries	1	lot			0		0	375,000	375,000		0		0	375,000
	15			BUILDING SERVICES					286		31,460		110,000		43,000		0	184,460
	16			Station Service Transformer 300KVA Dry Type Indoor (for Station Services MCC)	1	ea	25	1.30	33	110.00	3,575		0	25,000	25,000		0	28,575
	17			Station Service AC and DC distribution Panels (for transformer and breaker)	2	ea	20	1.30	52	110.00	5,720		0	4,000	8,000		0	13,720
	18			125V DC Station service battery	1	ea	40	1.30	52	110.00	5,720		0	8,000	8,000		0	13,720
	19			125V DC Station service battery charger	1	ea	15	1.30	20	110.00	2,145		0	2,000	2,000		0	4,145
	20			Building Services Allowance	1	lot			0		0	95.000	95.000		0		0	95,000
	21			Miscellaneous (tray, conduit, terminal blocks, etc.)	1	lot	100	1.30	130	110.00	14,300	15,000	15,000		0		0	29,300
	22			SUBSTATION					2,294		252,359		39,900		722,713		0	1,014,972
	23			Transformer - 5MW, 4.16 kV / 34.5 kV, +/- 5% Off Load Tap Changer and multi ratio CTs	1	ea	180	1.30	234	110.00	25,740	12,000	12,000	255,000	255,000		0	292,740
	24			Breaker - 34.5 kV, 650 kV BIL, 600A, 31.5 kA (min) outdoor dead tank c/w multi-ratio CTs	1	ea	135	1.30	176	110.00	19,305	2,250	2,250	166,500	166,500		0	188,055
	25			Disconnect - 34.5 kV, 600A Vertical Break, Group Operated, c/w interlocked ground switch	1	ea	68	1.30	88	110.00	9,653	2,250	2,250	36,000	36,000		0	47,903
	26			Potential Transformer - 34.5 kV, dual winding, outdoor, post type	3	ea	18	1.30	70	110.00	7,722	1,125	3,375	11,250	33,750		0	44,847
	27			Surge Arrestor - 24.4 kV MCOV, outdoor, station class, surge arresters	3	ea	11	1.30	44	110.00	4,826	1,125	3,375	1,238	3,713		0	11,914
	28			Cable - 5 kV, 1/0 AWG, XLPE insulation, aluminum conductor, 100% insulation	240	М	0.5	1.30	140	110.00	15,444	0	0	79	18,900		0	34,344
	29			Conductor - Bare, 336.4 kcmil AAC (Tulip)	60	М	0.7	1.30	53	110.00	5,792	0	0	23	1,350		0	7,142
	30			Cable Terminations	12	ea	7	1.30	105	110.00	11,583	450	5,400	0	0		0	16,983
	31			Misc Hardware and electrical connectors	1	lot	135	1.30	176	110.00	19,305	11,250	11,250	0	0		0	30,555
	32			Line Protection Panel	1	ea	180	1.30	234	110.00	25,740	0	0	112,500	112,500		0	138,240
	33			34.5 kV Interconnection - poles, conductor, hardware, deadends	1	lot	750	1.30	975	110.00	107,250		0	95,000	95,000		0	202,250
	34			SITE SECURITY					0		50,000		375,000		0		0	425,000
	35			Roadway / Site Lighting	1	ls			0		50,000	100,000	100,000		0		0	150,000
	36			CCTV Security and Integration to System Control Centre	1	ls			0		0	75,000	75,000		0		0	75,000
	37			Fire and Gas Alarm Systems	1	ls			0		0	150,000	150,000		0		0	150,000
	38			Communications (fibre, CAT5, telephone)	1	ls			0		0	50,000	50,000		0		0	50,000
	39			EI&C MISCELLANEOUS					0		0		375,000		0		0	375,000
	40			Engine, fuel, and auxiliaries controls installation	300	pt			0		0	750	225,000		0		0	225,000
	41			Miscellaneous BOP Electrical Equipment Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	42			Miscellaneous Engine Electrical Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	43	1		Miscellaneous Electrical Equipment Grounding	1	ls			0		0	50,000	50,000		0		0	50,000

Prepared by: CGV / RF Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: ES



STANTEC CONSULTING Opinion of Probable Construction Cost Indirect and Owner's Costs NG-LF-05: LNG - Landfill - 5 MWe

									Labou	Jr		Mat'l/Co	ommodity	Equip	oment	Sub-Co	ntractor	Tabal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0		0		0)	C		0	5,451,442
	1			Based on recent YEC experience, an 18% factor on direct costs is incorporated to cover:					0		C)	C)	C)	0	5,451,442
	2			Contractor General Conditions					0		C)	C)	C)	0	0
	3			Security					0		C)	C)	C)	0	0
	4			Lock-out tag-out (LOTO) coordination					0		C)	C)	C)	0	0
	5			Waste removal					0		C)	C)	C)	0	0
	6			Snow removal					0		C)	C)	C)	0	0
	7			Warehousing and utilities including temporary power supply					0		C)	C)	C)	0	0
	8			Temporary construction lighting					0		C)	C)	C)	0	0
	9			Taxes					0		C)	C)	C)	0	0
	10			Interest charges during construction.					0		C)	C)	C)	0	0
	11			Land acquisition and zoning					0		C)	C)	C)	0	0
	12			Environmental studies, YESAB assessment and all permitting					0		C)	C)	C)	0	0
	13			Owner's administration costs, including:					0		C)	C)	C)	0	0
	14			Legal fees.					0		C)	C)	C)	0	0
	15			Insurance.					0		C)	C)	C)	0	0
	16			Salaries & expenses of Owner's project staff.					0		C)	C)	C)	0	0
	17			Allowance for operators hours & fuel costs during training, commissioning, and start up.					0		C)	C)	C)	0	0
	18			Special costs to dispose from site construction waste.					0		C)	C)	C)	0	0
	19								0		0)	C)	C)	0	0

Prepared by: **Team**

Date: 16-May-16

Revision No.: A

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Summary NG-LF-10: LNG - Landfill - 10 MWe

Area	Line	Rev.	Description	Labour Hours	Labour Cost	Mat'l/Commodity Cost	Equipment Cost	Sub-Contractor Cost	Total Cost
-	0	-	PROJECT TOTAL, BASE SCOPE	21,030 hrs	\$2,497,220	\$8,336,088	\$25,808,263	\$5,766,500	\$66,911,946
-	1	-	Major Equipment	10,400 hrs	\$1,144,000	\$1,068,500	\$21,370,000	\$300,000	\$23,882,500
-	2	-	General Civil	00 hrs	\$0	\$3,370,450	\$807,500	\$0	\$4,177,950
-	3	-	Buildings and Structures	00 hrs	\$0	\$1,838,838	\$0	\$5,400,000	\$7,238,838
-	4	-	Mechanical and Process	4,697 hrs	\$516,707	\$152,500	\$1,928,750	\$0	\$2,597,957
-	5	-	Electrical, Instrumentation & Controls	5,933 hrs	\$702,616	\$1,905,800	\$1,274,613	\$0	\$3,883,029
-	6	-	Sub Total Directs	21,030 hrs	\$2,363,323	\$8,336,088	\$25,380,863	\$5,700,000	\$41,780,273
-	7	-	Preliminary Engineering for Budget Approval (Class 3)	-	-	-	-	-	\$400,000
-	8	-	Detail Engineering @ 8% Direct Construction Cost	-	-	-	-	-	\$3,342,422
-	9	-	Construction Staff & Consultants and Construction Management Fee @3.5%	-	-	-	-	-	\$1,462,310
-	10	-	Commissioning Costs - Excluding Owner's Staff @ 1.5% of Directs	-	-	-	-	-	\$626,704
-	11	-	Escalation Allowance @ 3.5% Labour, 3.5% Construction Staff & Mgmt Fee, & 3.5% of 1/3 Sub-Contractor Cost	-	\$133,897	-	-	\$66,500	\$200,397
-	12	-	Capital Spares - 2% Major Equipment	-	-	-	\$427,400	-	\$427,400
-	13	-	Indirect Construction Costs and Owner's Costs (See Line Item List, 18% of Directs)	-	-	-	-	-	\$7,520,449
-	14	-	Sub Total In-Directs	00 hrs	\$133,897	\$0	\$427,400	\$66,500	\$13,979,682
-	15	-	Contingency of 20% - AACE Class 5 Opinion of Probable Cost						\$11,151,991

Prepared by: **Team** Date: **16-May-16**

Revision No.: A

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Major Equipment NG-LF-10: LNG - Landfill - 10 MWe

									Labou	Jr		Mat'l/Cor	nmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					10,400		1,144,000		1,068,500		21,370,000		300,000	23,882,500
	1			Generating Station					0		0		0		0		0	0
	2			NG fired Reciprocating Engine - 2.5 MWe capacity, 4,160V	4	unit	1,280	1.30	6,656	110.00	732,160	100,000	400,000	2,000,000	8,000,000		0	9,132,160
	3			Transportation	4	ea			0		0		0		0	75,000	300,000	300,000
	4			Includes:					0		0		0		0		0	0
	5			Prime Mover					0		0		0		0		0	0
	6			Generator and Auxiliaries					0		0		0		0		0	0
	7			Mechanical Auxiliaries (circulating pumps / radiator)					0		0		0		0		0	0
	8			Electrical Control Equipment					0		0		0		0		0	0
	9			Heat Recovery / Rejection					0		0		0		0		0	0
	10			Engineering / Project Management / Drawings					0		0		0		0		0	0
	11			Sound Attenuation					0		0		0		0		0	0
	12			LNG Tank Farm					0		0		0		0		0	0
	13			LNG storage tanks: 1x 150 m3 (usable) vacuum jacketed, horizontal storage tank	4	ea	240	1.30	1,248	110.00	137,280	37,500	150,000	750,000	3,000,000		0	3,287,280
	13			Storage Infrastructure	1	ea	480	1.30	624	110.00	68,640	86,750	86,750	1,735,000	1,735,000		0	1,890,390
	14			Vaporizers	2	ea	480	1.30	1,248	110.00	137,280	134,250	268,500	2,685,000	5,370,000		0	5,775,780
	15			LNG truck unloading station, piping, and infrastructure	1	ea	480	1.30	624	110.00	68,640	163,250	163,250	3,265,000	3,265,000		0	3,496,890
	16			Transportation	6	ea			0		0		0		0	75,000	450,000	450,000

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: HC



STANTEC CONSULTING Opinion of Probable Construction Cost Civil NG-LF-10: LNG - Landfill - 10 MWe

									Labou	r		Mat'l/Con	nmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			GENERAL CIVIL TOTAL					0		0		3,370,450		807,500		0	4,177,950
	1			Clearing & Grubbing	6.5	ha			0		0	\$30,000	195,000		0		0	195,000
	2			Excavation & Backfill for Structures & Slab (Allowance)	1	ea.			0		0	\$225,000	225,000		0		0	225,000
	3			Site Drainage and Culverts (Allowance)	1	ea.			0		0	\$125,000	125,000		0		0	125,000
	4			Site Grading - Incl. Roads and Parking Lot Preparation	6,500	m ³			0		0	\$15	97,500		0		0	97,500
	5			General Landscaping	1	ea.			0		0	\$60,000	60,000		0		0	60,000
	6			Water and Sewer Piping	80	m			0		0	\$250	20,000		0		0	20,000
	7			Granular Base - 150mm	4,950	tonne			0		0	\$35	173,250		0		0	173,250
	8			Granular Sub-Base - 300mm	9,900	tonne			0		0	\$18	178,200		0		0	178,200
	9			Asphalt - (Base and Seal)	3,150	tonne			0		0	\$150	472,500		0		0	472,500
	10			Fencing (8ft, angular razor wire)	1,100	m			0		0	\$300	330,000		0		0	330,000
	11			Automatic Slide Gate (10m)	2	ea.			0		0	\$6,000	12,000		0		0	12,000
	12			Slide Gate (10m)	1	ea.			0		0	\$2,000	2,000		0		0	2,000
	13			Potable Water Well, pump, line, and HW tank.	1	ea.			0		0	\$80,000	80,000		0		0	80,000
	14			Septic System	1	ea.			0		0	\$50,000	50,000		0		0	50,000
	15			FIRE WATER					0		0		1,350,000		807,500		0	2,157,500
	16			Fire water heated storage (2x 30ft dia x 30ft tanks, insulated, 250,000 gal)	2	ea			0		0		0	300,000	600,000		0	600,000
	17			Fire water pump house (electric and diesel driven fire pumps, building)	1	lot			0		0	900,000	900,000		0		0	900,000
	18			Fire Loop (allowance) & Recirc Pumps	1,500	m			0		0	\$300	450,000		50,000		0	500,000
	19			Fire Hydrants	15	ea.			0		0		0	10,500	157,500		0	157,500

Prepared by: AW / RM Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: AF



STANTEC CONSULTING Opinion of Probable Construction Cost Buildings and Structures NG-LF-10: LNG - Landfill - 10 MWe

									Labou	ur		Mat'l/Coi	mmodity	Equip	ment	Sub-Co	ntractor	
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0		0		1,838,838		0)	5,400,000	7,238,838
	1			FUEL STORAGE					0		0		1,032,300		0)	0	1,032,300
	2			Truck Unloading Pad					0		0		0		0)	0	C
	3			Concrete Pad 8 m x 10 m x 0.3 m	24	m ³			0		0	1,500	36,000		0)	0	36,000
	4			Containment Sump					0		0		0		0)	0	C
	5			Base 10 m x 20 m x 0.3 m	60	m ³			0		0	1,500	90,000		0)	0	90,000
	6			Walls 60 m x 2 m x 0.3 m	36	m ³			0		0	1,500	54,000		0)	0	54,000
	7			LNG Control Module					0		0		0		0)	0	C
	8			Base 6 m x 22 m x 0.3 m	40	m ³			0		0	1,500	59,400		0)	0	59,400
	9			Tank Containment					0		0		0		0)	0	C
	10			Concrete pad 40 m x 40 m x 0.3 m	480	m ³			0		0	1,500	720,000		0)	0	720,000
	11			Containment Curb 160 m x 0.3 m x 0.2 m	10	m ³			0		0	1,500	14,400		0)	0	14,400
	12			Concrete Trenching					0		0		0		0)	0	C
	13			Base 60 m x 0.5 m x 0.3 m	9	m ³			0		0	1,500	13,500		0)	0	13,500
	14			Walls 120 m x 1 m x 0.25 m	30	m ³			0		0	1,500	45,000		0)	0	45,000
	15			GENERATOR HALL					0		0		201,450		0)	5,400,000	5,601,450
	16			Pre-engineered Building					0		0		0		0)	0	C
	17			Building Size 25 m x 90 m	2,250	m ²			0		0		0		0	2,400	5,400,000	5,400,000
	18			Generator Foundation					0		0		0		0)	0	C
	19			Thickened Slab 4 m x 10 m x 0.5 m / each quantity 4	80	m ³			0		0	1,500	120,000		0)	0	120,000
	20			Generator Stack Foundation					0		0		0		0)	0	C
	21			Concrete Pad 2.5 m x 2.5 m x 0.3 m / each quantity 4	8	m ³			0		0	1,500	11,250		0)	0	11,250
	22			Diesel Storage Tank					0		0		0		0)	0	C
	23			Base 5 m x 12 m x 0.3 m	18	m ³			0		0	1,500	27,000		0)	0	27,000
	24			Radiator Foundation					0		0		0		0)	0	C
	25			Concrete Pad 4 m x 6 m x 0.3 m / each quantity 4	29	m ³			0		0	1,500	43,200		0)	0	43,200
	26			SUBSTATION					0		0		369,000		0)	0	369,000
	27			Transformer					0		0		0		0)	0	0
	28			Base 12 m x 18 m x 0.5 m	108	m ³			0		0	1,500	162,000		0)	0	162,000
	29			Containment Walls 60 m x 1.2 m x 0.25 m	18	m ³			0		0	1,500	27,000		0)	0	27,000
	30			Pier 11 m x 7.4 m x 1.2 m	98	m ³			0		0	1,500	146,520		0)	0	146,520
	31			Steel Grating 1.5 m x 48.8 m	73	m ²			0		0	150	10,980		0)	0	10,980
	32			Breaker					0		0		0		0)	0	C
	33			Concrete Pad 5 m x 10 m x 0.3 m	15	m ³			0		0	1,500	22,500		0)	0	22,500
	34			OTHER					0		0		236,088		0)	0	236,088
	35			Pipe Bridge 115 m Long					0		0		0		0)	0	C
	36			Weight of Steel per Meter 72 kg	8,280	kg			0		0	15	124,200		0)	0	124,200
	37			Pipe Bridge Foundation (14 total)					0		0		0		0)	0	C
	38			Footing 4 m x 3 m x 0.3 m @ 14 locations	50	m ³			0		0	1,500	75,600		0)	0	75,600
	39			Pier 0.6 m x 0.6 m x 2.4 m @ 28 locations	24	m ³			0		0	1,500	36,288		0)	0	36,288

Prepared by: JS Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Mechanical & Process NG-LF-10: LNG - Landfill - 10 MWe

									Labou	Jr		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					4,697		516,707		152,500		1,928,750		0	2,597,957
	1			Prime Movers and Fuel Storage (See Major Equipment)					0		0		0		0		0	0
	2			Fuel System Piping (from fuel storage, building internal)	4	lot	107	1.30	555	110.00	61,013	5,000	20,000	60,000	240,000		0	321,013
	3			Glycol Heating System (incl LNG vaporizers, unit heaters, electric & diesel/NG boiler)	4	lot	107	1.30	555	110.00	61,013	7,500	30,000	125,000	500,000		0	591,013
	4			Generating Station HVAC (electric unit heaters, building and combustion ventilation)	1	lot	1,280	1.30	1,664	110.00	183,040	50,000	50,000	500,000	500,000		0	733,040
	5			Allowance for Building Services / Plumbing	1	lot	480	1.30	624	110.00	68,640	15,000	15,000	135,000	135,000		0	218,640
	6			Allowance for Lube / Waste Oil System	1	lot	320	1.30	416	110.00	45,760	10,000	10,000	90,000	90,000		0	145,760
	7			Continuous Emissions Monitoring System	1	lot	360	1.30	468	110.00	51,480	20,000	20,000	220,000	220,000		0	291,480
	8			Instrument and Plant Compressed Air Systems	1	lot	320	1.30	416	110.00	45,760	5,000	7,500	75,000	75,000		0	128,260
	9			Generating Station Sprinkler System, extinguisher, fire protection equipment	2,250	m ²			0		0		0	75	168,750		0	168,750

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16

Checked: LF



STANTEC CONSULTING Opinion of Probable Construction Cost Electrical, I&C NG-LF-10: LNG - Landfill - 10 MWe

									Labo	ur		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Tabal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					5,933		702,616		1,905,800		1,274,613		0	3,883,029
	1			STATION ELECTRICAL					3,107		341,770		940,000		412,500		0	1,694,270
	2			Site wide Grounding Grid	1	lot	200	1.30	260	110.00	28,600	60,000	60,000		0		0	88,600
	3			Trench and conduit	1	lot	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	4			Transformer Protection Panel	1	ea	40	1.30	52	110.00	5,720		0	50,000	50,000		0	55,720
	5			Annunciator / Control / Metering Panel	1	ea	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	6			SCADA / Communications	1	lot	60	1.30	78	110.00	8,580		0	50,000	50,000		0	58,580
	7			5kV, 3000A Switchgear	1	lot	40	1.30	52	110.00	5,720	120,000	120,000		0		0	125,720
	8			Station Services MCC (allow 15 Sections)	15	sect	10	1.30	195	110.00	21,450		0	8,500	127,500		0	148,950
	9			BOP PLC and Instrumentation (125 Points, \$1000 per Point)	1	ls			0		0		0	125,000	125,000		0	125,000
	10			Medium/Low Voltage Cable	4,000	ft	0.15	1.30	780	110.00	85,800	30	120,000		0		0	205,800
	11			Cable Tray and Cables from Unit Output to Electrical Room	4,000	ft	0.30	1.30	1,560	110.00	171,600	45	180,000		0		0	351,600
	12			Utility Metering Allowance	1	lot	20	1.30	26	110.00	2,860	20,000	20,000		0		0	22,860
	13			Engine & Auxiliaries Instrumentation	1	lot			0		0	65,000	65,000		0		0	65,000
	14			Black Start Diesel Genset and Auxiliaries	1	lot			0		0	375,000	375,000		0		0	375,000
	15			BUILDING SERVICES					286		31,460		130,000		45,500		0	206,960
	16			Station Service Transformer 400KVA Dry Type Indoor (for Station Services MCC)	1	ea	25	1.30	33	110.00	3,575		0	27,500	27,500		0	31,075
	17			Station Service AC and DC distribution Panels (for transformer and breaker)	2	ea	20	1.30	52	110.00	5,720		0	4,000	8,000		0	13,720
	18			125V DC Station service battery	1	ea	40	1.30	52	110.00	5,720		0	8,000	8,000		0	13,720
	19			125V DC Station service battery charger	1	ea	15	1.30	20	110.00	2,145		0	2,000	2,000		0	4,145
	20			Building Services Allowance	1	lot			0		0	115,000	115,000		0		0	115,000
	21			Miscellaneous (tray, conduit, terminal blocks, etc.)	1	lot	100	1.30	130	110.00	14,300	15,000	15,000		0		0	29,300
	22			SUBSTATION					2,540		279,386		48,300		816,613		0	1,144,299
	23			Transformer - 10 MW, 4.16 kV / 34.5 kV, +/- 5% Off Load Tap Changer and multi ratio CTs	1	ea	180	1.30	234	110.00	25,740	15,000	15,000	330,000	330,000		0	370,740
	24			Breaker - 34.5 kV, 650 kV BIL, 800A (min), 31.5 kA (min) outdoor dead tank	1	ea	135	1.30	176	110.00	19,305	2,250	2,250	166,500	166,500		0	188,055
	25			Disconnect - 34.5 kV, 600A Vertical Break, Group Operated, c/w interlocked ground switch	1	ea	68	1.30	88	110.00	9,653	2,250	2,250	36,000	36,000		0	47,903
	26			Potential Transformer - 34.5 kV, dual winding, outdoor, post type	3	ea	18	1.30	70	110.00	7,722	1,125	3,375	11,250	33,750		0	44,847
	27			Surge Arrestor - 24.4 kV MCOV, outdoor, station class, surge arresters	3	ea	11	1.30	44	110.00	4,826	1,125	3,375	1,238	3,713		0	11,914
	28			Cable - 5 kV, 500MCM, XLPE insulation, aluminum conductor, 100% insulation	480	М	0.5	1.30	281	110.00	30,888	0	0	79	37,800		0	68,688
	29			Conductor - Bare, 2/0 AWG AAC (Aster)	60	М	0.7	1.30	53	110.00	5,792	0	0	23	1,350		0	7,142
	30			Cable Terminations	24	ea	7	1.30	211	110.00	23,166	450	10,800	0	0		0	33,966
	31			Misc Hardware and electrical connectors	1	lot	135	1.30	176	110.00	19,305	11,250	11,250	0	0		0	30,555
	32			Line Protection Panel	1	ea	180	1.30	234	110.00	25,740	0	0	112,500	112,500		0	138,240
	33			34.5 kV Interconnection - poles, conductor, hardware, deadends	1	lot	750	1.30	975	110.00	107,250		0	95,000	95,000		0	202,250
	34			SITE SECURITY					0		50,000		375,000		0		0	425,000
	35			Roadway / Site Lighting	1	ls			0		50,000	100,000	100,000		0		0	150,000
	36			CCTV Security and Integration to System Control Centre	1	ls			0		0	75,000	75,000		0		0	75,000
	37			Fire and Gas Alarm Systems	1	ls			0		0	150,000	150,000		0		0	150,000
	38			Communications (fibre, CAT5, telephone)	1	ls			0		0	50,000	50,000		0		0	50,000
	39			EI&C MISCELLANEOUS					0		0		412,500		0		0	412,500
	40			Engine, fuel, and auxiliaries controls installation	350	pt			0		0	750	262,500		0		0	262,500
	41			Miscellaneous BOP Electrical Equipment Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	42			Miscellaneous Engine Electrical Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	43			Miscellaneous Electrical Equipment Grounding	1	ls			0		0	50,000	50,000		0		0	50,000

Prepared by: CGV / RF Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: ES



STANTEC CONSULTING Opinion of Probable Construction Cost Indirect and Owner's Costs NG-LF-10: LNG - Landfill - 10 MWe

									Labou	Jr		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Tabat
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0		0		0)	C		0	7,520,449
	1			Based on recent YEC experience, an 18% factor on direct costs is incorporated to cover:					0		0		C)	C)	0	7,520,449
	2			Contractor General Conditions					0		0		C)	C)	0	0
	3			Security					0		0		C)	C)	0	0
	4			Lock-out tag-out (LOTO) coordination					0		0		C)	C)	0	0
	5			Waste removal					0		0		C)	C)	0	0
	6			Snow removal					0		0		C)	C)	0	0
	7			Warehousing and utilities including temporary power supply					0		0		C)	C)	0	0
	8			Temporary construction lighting					0		0		C)	C)	0	0
	9			Taxes					0		0		C)	C)	0	0
	10			Interest charges during construction.					0		0		C)	C)	0	0
	11			Land acquisition and zoning					0		0		C)	C)	0	0
	12			Environmental studies, YESAB assessment and all permitting					0		0		C)	C)	0	0
	13			Owner's administration costs, including:					0		0		C)	C)	0	0
	14			Legal fees.					0		0		C)	C)	0	0
	15			Insurance.					0		0		C)	C)	0	0
	16			Salaries & expenses of Owner's project staff.					0		0		C)	C)	0	0
	17			Allowance for operators hours & fuel costs during training, commissioning, and start up.					0		0		C)	C)	0	0
	18			Special costs to dispose from site construction waste.					0		0		C)	C)	0	0
	19								0		0		C)	C)	0	0

Prepared by: Team

Date: 16-May-16 Revision No.: A

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Summary NG-LF-20: LNG - Landfill - 20 MWe

Area	Line	Rev.	Description	Labour Hours	Labour Cost	Mat'l/Commodity Cost	Equipment Cost	Sub-Contractor Cost	Total Cost
-	0	-	PROJECT TOTAL, BASE SCOPE	27,069 hrs	\$3,210,212	\$9,747,413	\$42,201,250	\$8,467,650	\$100,124,167
-	1	-	Major Equipment	14,664 hrs	\$1,613,040	\$1,831,000	\$36,620,000	\$450,000	\$40,514,040
-	2	-	General Civil	00 hrs	\$0	\$3,370,450	\$807,500	\$0	\$4,177,950
-	3	-	Buildings and Structures	00 hrs	\$0	\$2,275,863	\$0	\$7,920,000	\$10,195,863
-	4	-	Mechanical and Process	5,252 hrs	\$577,720	\$187,500	\$2,322,500	\$0	\$3,087,720
-	5	-	Electrical, Instrumentation & Controls	7,153 hrs	\$836,786	\$2,082,600	\$1,718,850	\$0	\$4,638,236
-	6	-	Sub Total Directs	27,069 hrs	\$3,027,546	\$9,747,413	\$41,468,850	\$8,370,000	\$62,613,809
-	7	-	Preliminary Engineering for Budget Approval (Class 3)	-	-	-	-	-	\$400,000
-	8	-	Detail Engineering @ 8% Direct Construction Cost	-	-	-	-	-	\$5,009,105
-	9	-	Construction Staff & Consultants and Construction Management Fee @3.5%	-	-	-	-	-	\$2,191,483
-	10	-	Commissioning Costs - Excluding Owner's Staff @ 1.5% of Directs	-	-	-	-	-	\$939,207
-	11	-	Escalation Allowance @ 3.5% Labour, 3.5% Construction Staff & Mgmt Fee, & 3.5% of 1/3 Sub-Contractor Cost	-	\$182,666	-	-	\$97,650	\$280,316
-	12	-	Capital Spares - 2% Major Equipment	-	-	-	\$732,400	-	\$732,400
-	13	-	Indirect Construction Costs and Owner's Costs (See Line Item List, 18% of Directs)	-	-	-	-	-	\$11,270,486
-	14	-	Sub Total In-Directs	00 hrs	\$182,666	\$0	\$732,400	\$97,650	\$20,822,997
-	15	-	Contingency of 20% - AACE Class 5 Opinion of Probable Cost						\$16,687,361

Prepared by: **Team** Date: **16-May-16** Revision No.: **A**

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Major Equipment NG-LF-20: LNG - Landfill - 20 MWe

									Labo	ur		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					14,664		1,613,040		1,831,000		36,620,000		450,000	40,514,040
	1			Generating Station					0		0		0		0		0	0
	2			NG fired Reciprocating Engine - 2.5 MWe capacity, 4,160V	4	unit	1,280	1.30	6,656	110.00	732,160	100,000	400,000	2,000,000	8,000,000		0	9,132,160
	3			NG fired Reciprocating Engine - 5.0 MWe capacity, 4,160V	2	unit	1,280	1.30	3,328	110.00	366,080	200,000	400,000	4,000,000	8,000,000		0	8,766,080
	3			Transportation	6	ea			0		0		0		0	75,000	450,000	450,000
	4			Includes:					0		0		0		0		0	0
	5			Prime Mover					0		0		0		0		0	0
	6			Generator and Auxiliaries					0		0		0		0		0	0
	7			Mechanical Auxiliaries (circulating pumps / radiator)					0		0		0		0		0	0
	8			Electrical Control Equipment					0		0		0		0		0	0
	9			Heat Recovery / Rejection					0		0		0		0		0	0
	10			Engineering / Project Management / Drawings					0		0		0		0		0	0
	11			Sound Attenuation					0		0		0		0		0	0
	12			LNG Tank Farm					0		0		0		0		0	0
	13			LNG storage tanks: 1x 150 m3 (usable) vacuum jacketed, horizontal storage tank	7	ea	240	1.30	2,184	110.00	240,240	37,500	262,500	750,000	5,250,000		0	5,752,740
	13			Storage Infrastructure	1	ea	480	1.30	624	110.00	68,640	151,750	151,750	3,035,000	3,035,000		0	3,255,390
	14			Vaporizers	2	ea	480	1.30	1,248	110.00	137,280	191,750	383,500	3,835,000	7,670,000		0	8,190,780
	15			LNG truck unloading station, piping, and infrastructure	1	ea	480	1.30	624	110.00	68,640	233,250	233,250	4,665,000	4,665,000		0	4,966,890
	16			Transportation	9	ea			0		0		0		0	75,000	675,000	675,000

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: HC



STANTEC CONSULTING Opinion of Probable Construction Cost Civil NG-LF-20: LNG - Landfill - 20 MWe

									Labou	ur		Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Tabal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			GENERAL CIVIL TOTAL					0		0		3,370,450		807,500		0	4,177,950
	1			Clearing & Grubbing	6.5	ha			0		0	\$30,000	195,000		0		0	195,000
	2			Excavation & Backfill for Structures & Slab (Allowance)	1	ea.			0		0	\$225,000	225,000		0		0	225,000
	3			Site Drainage and Culverts (Allowance)	1	ea.			0		0	\$125,000	125,000		0		0	125,000
	4			Site Grading - Incl. Roads and Parking Lot Preparation	6,500	m ³			0		0	\$15	97,500		0		0	97,500
	5			General Landscaping	1	ea.			0		0	\$60,000	60,000		0		0	60,000
	6			Water and Sewer Piping	80	m			0		0	\$250	20,000		0		0	20,000
	7			Granular Base - 150mm	4,950	tonne			0		0	\$35	173,250		0		0	173,250
	8			Granular Sub-Base - 300mm	9,900	tonne			0		0	\$18	178,200		0		0	178,200
	9			Asphalt - (Base and Seal)	3,150	tonne			0		0	\$150	472,500		0		0	472,500
	10			Fencing (8ft, angular razor wire)	1,100	m			0		0	\$300	330,000		0		0	330,000
	11			Automatic Slide Gate (10m)	2	ea.			0		0	\$6,000	12,000		0		0	12,000
	12			Slide Gate (10m)	1	ea.			0		0	\$2,000	2,000		0		0	2,000
	13			Potable Water Well, pump, line, and HW tank.	1	ea.			0		0	\$80,000	80,000		0		0	80,000
	14			Septic System	1	ea.			0		0	\$50,000	50,000		0		0	50,000
	15			FIRE WATER					0		0		1,350,000		807,500		0	2,157,500
	16			Fire water heated storage (2x 30ft dia x 30ft tanks, insulated, 250,000 gal)	2	ea			0		0		0	300,000	600,000		0	600,000
	17			Fire water pump house (electric and diesel driven fire pumps, building)	1	lot			0		0	900,000	900,000		0		0	900,000
	18			Fire Loop (allowance) & Recirc Pumps	1,500	m			0		0	\$300	450,000		50,000		0	500,000
	19			Fire Hydrants	15	ea.			0		0		0	10,500	157,500		0	157,500

Prepared by: AW / RM Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: AF



STANTEC CONSULTING Opinion of Probable Construction Cost Buildings and Structures NG-LF-20: LNG - Landfill - 20 MWe

									Labou	ur		Mat'l/Con	nmodity	Equip	oment	Sub-Co	ntractor	Tabal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per	Prod.	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
							Unit	Factor	Total Hours	Nate	COST	Unit COst	COst	Unit COst	COSI	UTIIL COSt	COSt	0031
	0			TOTAL					0		0		2,275,863		0		7,920,000	10,195,863
	1			FUEL STORAGE					0		0		1,305,000		0		0	1,305,000
	2			Truck Unloading Pad					0		C)	0		C)	0	C
	3			Concrete Pad 8 m x 10 m x 0.3 m	24	m ³			0		C	1,500	36,000		C)	0	36,000
	4			Containment Sump					0		C)	0		C)	0	C
	5			Base 10 m x 20 m x 0.3 m	60	m³			0	-	C	1,500	90,000		C)	0	90,000
	6			Walls 60 m x 2 m x 0.3 m	36	m³			0	-	C	1,500	54,000		C)	0	54,000
	7			LNG Control Module					0		C)	0		C)	0	C
	8			Base 6 m x 22 m x 0.3 m	40	m³			0		C	1,500	59,400		C)	0	59,400
	9			Tank Containment					0		C)	0		C)	0	C
	10			Concrete pad 55 m x 40 m x 0.3 m	660	m³			0		C	1,500	990,000		C)	0	990,000
	11			Containment Curb 190 m x 0.3 m x 0.2 m	11	m³			0		C	1,500	17,100		C)	0	17,100
	12			Concrete Trenching					0		C)	0		C)	0	C
	13			Base 60 m x 0.5 m x 0.3 m	9	m³			0		C	1,500	13,500		C)	0	13,500
	14			Walls 120 m x 1 m x 0.25 m	30	m³			0		C	1,500	45,000		C)	0	45,000
	15			GENERATOR HALL					0		0		365,775		0		7,920,000	8,285,775
	16			Pre-engineered Building					0	-	C)	0		C)	0	C
	17			Building Size 30 m x 110 m	3,300	m²			0	-	C)	0		C	2,400	7,920,000	7,920,000
	18			Generator Foundation					0	-	C)	0		C)	0	C
	19			Thickened Slab 4 m x 10 m x 0.5 m / each quantity 4	80	m³			0		C	1,500	120,000		C)	0	120,000
	20			Thickened Slab 5.5 m x 14 m x 0.5 m / each quantity 2	77	m³			0	-	C	1,500	115,500		C)	0	115,500
	21			Generator Stack Foundation		2			0		C)	0		C)	0	С
	22			Concrete Pad 2.5 m x 2.5 m x 0.3 m / each quantity 6	11	m³			0		C	1,500	16,875		C)	0	16,875
	23			Diesel Storage Tank		2			0		C)	0		C)	0	С
	24			Base 5 m x 12 m x 0.3 m	18	m³			0		C	1,500	27,000		C)	0	27,000
	25			Radiator Foundation		2			0		C)	0		C)	0	C
	26			Concrete Pad 4 m x 6 m x 0.3 m / each quantity 4	29	m³			0	-	C	1,500	43,200		C)	0	43,200
	27			Concrete Pad 6 m x 8 m x 0.3 m / each quantity 2	29	m³			0		C	1,500	43,200		C)	0	43,200
	28			SUBSTATION					0		0		369,000		0		0	369,000
	29			Transformer		2			0		C)	0		C)	0	C
	30			Base 12 m x 18 m x 0.5 m	108	m°			0		C	1,500	162,000		C)	0	162,000
	31			Containment Walls 60 m x 1.2 m x 0.25 m	18	m°			0		C	1,500	27,000		C)	0	27,000
	32			Pier 11 m x 7.4 m x 1.2 m	98	m°			0		C	1,500	146,520		C)	0	146,520
	33			Steel Grating 1.5 m x 48.8 m	73	m²			0		C	150	10,980		C)	0	10,980
	34			Breaker		2			0		C)	0		C)	0	C
	35			Concrete Pad 5 m x 10 m x 0.3 m	15	m°			0		C	1,500	22,500		C)	0	22,500
	36			OTHER					0		0		236,088		0		0	236,088
	37			Pipe Bridge 115 m Long	0.000				0		0	2	0		C)	0	104.000
	38			Weight of Steel per Meter 72 kg	8,280	кg			0		C	15	124,200		C)	0	124,200
	39			Pipe Bildge Foundation (14 total)	50	3			U		C	1 500	0		0		0	
	40			Piero (m m 0 (m m 0) for a 2) for a strengt	50	m ĭ			U		0	1,500	/5,600		0		0	/5,600
•	41			Pier U.6 m x U.6 m x 2.4 m @ 28 locations	24	m°	•		0	1	0	1,500	36,288		0)	0	36,288

Prepared by: JS Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Mechanical & Process NG-LF-20: LNG - Landfill - 20 MWe

									Labou	ır		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Tatal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					5,252		577,720		187,500		2,322,500		0	3,087,720
	1			Prime Movers and Fuel Storage (See Major Equipment)					0		0		0		0		0	0
	2			Fuel System Piping (from fuel storage, building internal)	6	lot	107	1.30	832	110.00	91,520	5,000	30,000	50,000	300,000		0	421,520
	3			Glycol Heating System (incl LNG vaporizers, unit heaters, electric & diesel/NG boiler)	6	lot	107	1.30	832	110.00	91,520	7,500	45,000	100,000	600,000		0	736,520
	4			Generating Station HVAC (electric unit heaters, building and combustion ventilation)	1	lot	1,280	1.30	1,664	110.00	183,040	60,000	60,000	600,000	600,000		0	843,040
	5			Allowance for Building Services / Plumbing	1	lot	480	1.30	624	110.00	68,640	15,000	15,000	150,000	150,000		0	233,640
	6			Allowance for Lube / Waste Oil System	1	lot	320	1.30	416	110.00	45,760	10,000	10,000	100,000	100,000		0	155,760
	7			Continuous Emissions Monitoring System	1	lot	360	1.30	468	110.00	51,480	20,000	20,000	250,000	250,000		0	321,480
	8			Instrument and Plant Compressed Air Systems	1	lot	320	1.30	416	110.00	45,760	5,000	7,500	75,000	75,000		0	128,260
	9			Generating Station Sprinkler System, extinguisher, fire protection equipment	3,300	m ²			0		0		0	75	247,500		0	247,500

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16

Checked: LF



STANTEC CONSULTING Opinion of Probable Construction Cost Electrical, I&C NG-LF-20: LNG - Landfill - 20 MWe

									Labo	ur		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Tabul
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					7,153		836,786		2,082,600		1,718,850		0	4,638,236
	1			STATION ELECTRICAL					3,757		413,270		1,050,000		480,000		0	1,943,270
	2			Site wide Grounding Grid	1	lot	200	1.30	260	110.00	28,600	70,000	70,000		0		0	98,600
	3			Trench and conduit	1	lot	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	4			Transformer Protection Panel	1	ea	40	1.30	52	110.00	5,720		0	50,000	50,000		0	55,720
	5			Annunciator / Control / Metering Panel	1	ea	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	6			SCADA / Communications	1	lot	60	1.30	78	110.00	8,580		0	50,000	50,000		0	58,580
	7			5kV, 3000A Switchgear	1	lot	40	1.30	52	110.00	5,720	120,000	120,000		0		0	125,720
	8			Station Services MCC (allow 20 Sections)	20	sect	10	1.30	260	110.00	28,600		0	8,500	170,000		0	198,600
	9			BOP PLC and Instrumentation (150 Points, \$1000 per Point)	1	ls			0		0		0	150,000	150,000		0	150,000
	10			Medium/Low Voltage Cable	5,000	ft	0.15	1.30	975	110.00	107,250	30	150,000		0		0	257,250
	11			Cable Tray and Cables from Unit Output to Electrical Room	5,000	ft	0.30	1.30	1,950	110.00	214,500	45	225,000		0		0	439,500
	12			Utility Metering Allowance	1	lot	20	1.30	26	110.00	2,860	20,000	20,000		0		0	22,860
	13			Engine & Auxiliaries Instrumentation	1	lot			0		0	90,000	90,000		0		0	90,000
	14			Black Start Diesel Genset and Auxiliaries	1	lot			0		0	375,000	375,000		0		0	375,000
	15			BUILDING SERVICES					286		31,460		150,000		48,000		0	229,460
	16			Station Service Transformer 500KVA Dry Type Indoor (for Station Services MCC)	1	ea	25	1.30	33	110.00	3,575		0	30,000	30,000		0	33,575
	17			Station Service AC and DC distribution Panels (for transformer and breaker)	2	ea	20	1.30	52	110.00	5,720		0	4,000	8,000		0	13,720
	18			125V DC Station service battery	1	ea	40	1.30	52	110.00	5,720		0	8,000	8,000		0	13,720
	19			125V DC Station service battery charger	1	ea	15	1.30	20	110.00	2,145		0	2,000	2,000		0	4,145
	20			Building Services Allowance	1	lot			0		0	135,000	135,000		0		0	135,000
	21			Miscellaneous (tray, conduit, terminal blocks, etc.)	1	lot	100	1.30	130	110.00	14,300	15,000	15,000		0		0	29,300
	22			SUBSTATION					3,110		342,056		57,600		1,190,850		0	1,590,506
	23			Transformer - 20MW, 4.16 kV / 34.5 kV, +/- 5% Off Load Tap Changer and multi ratio CTs	1	ea	180	1.30	234	110.00	25,740	22,500	22,500	525,000	525,000		0	573,240
	24			Breaker - 34.5 kV, 650 kV BIL, 800A (min), 31.5 kA (min) outdoor dead tank	2	ea	90	1.30	234	110.00	25,740	1,500	3,000	111,000	222,000		0	250,740
	25			Disconnect - 34.5 kV, 600A Vertical Break, Group Operated, c/w interlocked ground switch	2	ea	45	1.30	117	110.00	12,870	1,500	3,000	24,000	48,000		0	63,870
	26			Potential Transformer - 34.5 kV, dual winding, outdoor, post type	6	ea	12	1.30	94	110.00	10,296	750	4,500	7,500	45,000		0	59,796
	27			Surge Arrestor - 24.4 kV MCOV, outdoor, station class, surge arresters	6	ea	8	1.30	59	110.00	6,435	750	4,500	825	4,950		0	15,885
	28			Cable - 5 kV, 500MCM, XLPE insulation, aluminum conductor, 100% insulation	840	М	0.3	1.30	328	110.00	36,036	0	0	53	44,100		0	80,136
	29			Conductor - Bare, 2/0 AWG AAC (Aster)	120	М	0.5	1.30	70	110.00	7,722	0	0	15	1,800		0	9,522
	30			Cable Terminations	42	ea	5	1.30	246	110.00	27,027	300	12,600	0	0		0	39,627
	31			Misc Hardware and electrical connectors	1	lot	90	1.30	117	110.00	12,870	7,500	7,500	0	0		0	20,370
	32			Line Protection Panel	2	ea	120	1.30	312	110.00	34,320	0	0	75,000	150,000		0	184,320
	33			34.5 kV Interconnection - poles, conductor, hardware, deadends	1	lot	1,000	1.30	1,300	110.00	143,000		0	150,000	150,000		0	293,000
	34			SITE SECURITY					0		50,000		375,000		0		0	425,000
	35			Roadway / Site Lighting	1	ls			0		50,000	100,000	100,000		0		0	150,000
	36			CCTV Security and Integration to System Control Centre	1	ls			0		0	75,000	75,000		0		0	75,000
	37			Fire and Gas Alarm Systems	1	ls			0		0	150,000	150,000		0		0	150,000
	38			Communications (fibre, CAT5, telephone)	1	ls	I		0		0	50,000	50,000		0		0	50,000
	39			EI&C MISCELLANEOUS					0		0		450,000		0		0	450,000
	40			Engine, fuel, and auxiliaries controls installation	400	pt			0		0	750	300,000		0		0	300,000
	41			Miscellaneous BOP Electrical Equipment Allowance	1	ls	I		0		0	50,000	50,000		0		0	50,000
	42			Miscellaneous Engine Electrical Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
I	43			Miscellaneous Electrical Equipment Grounding	1	ls			0		0	50,000	50,000		0		0	50,000

Prepared by: CGV / RF Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: ES



STANTEC CONSULTING Opinion of Probable Construction Cost Indirect and Owner's Costs NG-LF-20: LNG - Landfill - 20 MWe

									Labou	Jr		Mat'l/Co	mmodity	Equip	oment	Sub-Contractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost Cost	Cost
	0			TOTAL					0		0		0		0		0 11,270,486
	1			Based on recent YEC experience, an 18% factor on direct costs is incorporated to cover:					0		0		0)	C)	0 11,270,486
	2			Contractor General Conditions					0		0		0)	C)	0 0
	3			Security					0		0		0)	C)	0 0
	4			Lock-out tag-out (LOTO) coordination					0		0		0)	C)	0 0
	5			Waste removal					0		0		0)	C)	0 0
	6			Snow removal					0		0		0)	C)	0 0
	7			Warehousing and utilities including temporary power supply					0		0		0)	C)	0 0
	8			Temporary construction lighting					0		0		0)	C)	0 0
	9			Taxes					0		0		0)	C)	0 0
	10			Interest charges during construction.					0		0		0)	C)	0 0
	11			Land acquisition and zoning					0		0		0)	C)	0 0
	12			Environmental studies, YESAB assessment and all permitting					0		0		0)	C)	0 0
	13			Owner's administration costs, including:					0		0		0)	C)	0 0
	14			Legal fees.					0		0		0)	C)	0 0
	15			Insurance.					0		0		0)	C)	0 0
	16			Salaries & expenses of Owner's project staff.					0		0		0)	C)	0 0
	17			Allowance for operators hours & fuel costs during training, commissioning, and start up.					0		0		0)	C)	0 0
	18			Special costs to dispose from site construction waste.					0		0		0)	C)	0 0
	19								0		0		0)	C)	0 0

Prepared by: Team

Date: 16-May-16 Revision No.: A

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Summary NG-TK-05: LNG - Takhini - 5 MWe

Area	Line	Rev.	Description	Labour Hours	Labour Cost	Mat'l/Commodity Cost	Equipment Cost	Sub-Contractor Cost	Total Cost
-	0	-	PROJECT TOTAL, BASE SCOPE	15,628 hrs	\$1,867,977	\$7,269,973	\$17,082,163	\$4,400,750	\$48,460,17 9
-	1	-	Major Equipment	6,448 hrs	\$709,280	\$673,000	\$13,460,000	\$150,000	\$14,992,280
-	2	-	General Civil	00 hrs	\$0	\$3,265,660	\$828,500	\$0	\$4,094,160
-	3	-	Buildings and Structures	00 hrs	\$0	\$1,478,913	\$0	\$4,200,000	\$5,678,913
-	4	-	Mechanical and Process	4,143 hrs	\$455,693	\$112,500	\$1,413,750	\$0	\$1,981,943
-	5	-	Electrical, Instrumentation & Controls	5,037 hrs	\$604,089	\$1,739,900	\$1,110,713	\$0	\$3,454,702
-	6	-	Sub Total Directs	15,628 hrs	\$1,769,063	\$7,269,973	\$16,812,963	\$4,350,000	\$30,201,998
-	7	-	Preliminary Engineering for Budget Approval (Class 3)	-	-	-	-	-	\$400,000
-	8	-	Detail Engineering @ 8% Direct Construction Cost	-	-	-	-	-	\$2,416,160
-	9	-	Construction Staff & Consultants and Construction Management Fee @3.5%	-	-	-	-	-	\$1,057,070
-	10	-	Commissioning Costs - Excluding Owner's Staff @ 1.5% of Directs	-	-	-	-	-	\$453,030
-	11	-	Escalation Allowance @ 3.5% Labour, 3.5% Construction Staff & Mgmt Fee, & 3.5% of 1/3 Sub-Contractor Cost	-	\$98,915	-	-	\$50,750	\$149,665
-	12	-	Capital Spares - 2% Major Equipment	-	-	-	\$269,200	-	\$269,200
-	13	-	Indirect Construction Costs and Owner's Costs (See Line Item List, 18% of Directs)	-	-	-	-	-	\$5,436,360
-	14	-	Sub Total In-Directs	00 hrs	\$98,915	\$0	\$269,200	\$50,750	\$10,181,484
_	15	-	Contingency of 20% - AACE Class 5 Opinion of Probable Cost						\$8,076,696

Prepared by: **Team** Date: **16-May-16** Revision No.: **A**

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Major Equipment NG-TK-05: LNG - Takhini - 5 MWe

									Labou	Jr		Mat'l/Cor	nmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					6,448		709,280		673,000		13,460,000		150,000	14,992,280
	1			Generating Station					0		0		0		0		0	0
	2			NG fired Reciprocating Engine - 2.5 MWe capacity, 4,160V	2	unit	1,280	1.30	3,328	110.00	366,080	100,000	200,000	2,000,000	4,000,000		0	4,566,080
	3			Transportation	2	ea			0		0		0		0	75,000	150,000	150,000
	4			Includes:					0		0		0		0		0	0
	5			Prime Mover					0		0		0		0		0	0
	6			Generator and Auxiliaries					0		0		0		0		0	0
	7			Mechanical Auxiliaries (circulating pumps / radiator)					0		0		0		0		0	0
	8			Electrical Control Equipment					0		0		0		0		0	0
	9			Heat Recovery / Rejection					0		0		0		0		0	0
	10			Engineering / Project Management / Drawings					0		0		0		0		0	0
	11			Sound Attenuation					0		0		0		0		0	0
	12			LNG Tank Farm					0		0		0		0		0	0
	13			LNG storage tanks: 1x 150 m3 (usable) vacuum jacketed, horizontal storage tank	2	ea	240	1.30	624	110.00	68,640	37,500	75,000	750,000	1,500,000		0	1,643,640
	13			Storage Infrastructure	1	ea	480	1.30	624	110.00	68,640	43,250	43,250	865,000	865,000		0	976,890
	14			Vaporizers	2	ea	480	1.30	1,248	110.00	137,280	95,750	191,500	1,915,000	3,830,000		0	4,158,780
	15			LNG truck unloading station, piping, and infrastructure	1	ea	480	1.30	624	110.00	68,640	163,250	163,250	3,265,000	3,265,000		0	3,496,890
	16			Transportation	6	ea			0		0		0		0	75,000	450,000	450,000

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: HC



STANTEC CONSULTING Opinion of Probable Construction Cost Civil NG-TK-05: LNG - Takhini - 5 MWe

									Labou	ur		Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Tabal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			GENERAL CIVIL TOTAL					0		0		3,265,660		828,500		0	4,094,160
	1			Clearing & Grubbing	6.5	ha			0		0	\$30,000	195,000		0		0	195,000
	2			Excavation & Backfill for Structures & Slab (Allowance)	1	ea.			0		0	\$225,000	225,000		0		0	225,000
	3			Site Drainage and Culverts (Allowance)	1	ea.			0		0	\$125,000	125,000		0		0	125,000
	4			Site Grading - Incl. Roads and Parking Lot Preparation	6,500	m ³			0		0	\$15	97,500		0		0	97,500
	5			General Landscaping	1	ea.			0		0	\$60,000	60,000		0		0	60,000
	6			Water and Sewer Piping	80	m			0		0	\$250	20,000		0		0	20,000
	7			Granular Base - 150mm	3,960	tonne			0		0	\$35	138,600		0		0	138,600
	8			Granular Sub-Base - 300mm	7,920	tonne			0		0	\$18	142,560		0		0	142,560
	9			Asphalt - (Base and Seal)	2,520	tonne			0		0	\$150	378,000		0		0	378,000
	10			Fencing (8ft, angular razor wire)	1,100	m			0		0	\$300	330,000		0		0	330,000
	11			Automatic Slide Gate (10m)	2	ea.			0		0	\$6,000	12,000		0		0	12,000
	12			Slide Gate (10m)	1	ea.			0		0	\$2,000	2,000		0		0	2,000
	13			Potable Water Well, pump, line, and HW tank.	1	ea.			0		0	\$80,000	80,000		0		0	80,000
	14			Septic System	1	ea.			0		0	\$50,000	50,000		0		0	50,000
	15			FIRE WATER					0		0		1,410,000		828,500		0	2,238,500
	16			Fire water heated storage (2x 30ft dia x 30ft tanks, insulated, 250,000 gal)	2	ea			0		0		0	300,000	600,000		0	600,000
	17			Fire water pump house (electric and diesel driven fire pumps, building)	1	lot			0		0	900,000	900,000		0		0	900,000
	18			Fire Loop (allowance) & Recirc Pumps	1,700	m			0		0	\$300	510,000		50,000		0	560,000
	19			Fire Hydrants	17	ea.			0		0		0	10,500	178,500		0	178,500

Prepared by: AW / RM Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: AF



STANTEC CONSULTING Opinion of Probable Construction Cost Buildings and Structures NG-TK-05: LNG - Takhini - 5 MWe

									Labou	ur		Mat'l/Cor	nmodity	Equip	oment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0		0		1,478,913		0)	4,200,000	5,678,913
	1			FUEL STORAGE					0		0		759,600		0)	0	759,600
	2			Truck Unloading Pad					0		0		0		C)	0	C
	3			Concrete Pad 8 m x 10 m x 0.3 m	24	m ³			0		0	1,500	36,000		C)	0	36,000
	4			Containment Sump					0		0		0		C)	0	C
	5			Base 10 m x 20 m x 0.3 m	60	m ³			0		0	1,500	90,000		C)	0	90,000
	6			Walls 60 m x 2 m x 0.3 m	36	m ³			0		0	1,500	54,000		C)	0	54,000
	7			LNG Control Module					0		0		0		C)	0	C
	8			Base 6 m x 22 m x 0.3 m	40	m ³			0		0	1,500	59,400		C)	0	59,400
	9			Tank Containment					0		0		0		C)	0	C
	10			Concrete pad 25 m x 40 m x 0.3 m	300	m ³			0		0	1,500	450,000		C)	0	450,000
	11			Containment Curb 130 m x 0.3 m x 0.2 m	8	m ³			0		0	1,500	11,700		C)	0	11,700
	12			Concrete Trenching					0		0		0		C)	0	C
	13			Base 60 m x 0.5 m x 0.3 m	9	m ³			0		0	1,500	13,500		C)	0	13,500
	14			Walls 120 m x 1 m x 0.25 m	30	m ³			0		0	1,500	45,000		C)	0	45,000
	15			GENERATOR HALL					0		0		114,225		0)	4,200,000	4,314,225
	16			Pre-engineered Building					0		0		0		C)	0	C
	17			Building Size 25 m x 70 m	1,750	m ²			0		0		0		C	2,400	4,200,000	4,200,000
	18			Generator Foundation					0		0		0		C)	0	C
	19			Thickened Slab 4 m x 10 m x 0.5 m / each quantity 2	40	m ³			0		0	1,500	60,000		C)	0	60,000
	20			Generator Stack Foundation					0		0		0		C)	0	C
	21			Concrete Pad 2.5 m x 2.5 m x 0.3 m / each quantity 2	4	m ³			0		0	1,500	5,625		C)	0	5,625
	22			Diesel Storage Tank					0		0		0		C)	0	C
	23			Base 5 m x 12 m x 0.3 m	18	m ³			0		0	1,500	27,000		C)	0	27,000
	24			Radiator Foundation					0		0		0		C)	0	C
	25			Concrete Pad 4 m x 6 m x 0.3 m / each quantity 2	14	m ³			0		0	1,500	21,600		C)	0	21,600
	26			SUBSTATION					0		0		369,000		0)	0	369,000
	27			Transformer					0		0		0		C)	0	C
	28			Base 12 m x 18 m x 0.5 m	108	m ³			0		0	1,500	162,000		C)	0	162,000
	29			Containment Walls 60 m x 1.2 m x 0.25 m	18	m ³			0		0	1,500	27,000		C)	0	27,000
	30			Pier 11 m x 7.4 m x 1.2 m	98	m ³			0		0	1,500	146,520		C)	0	146,520
	31			Steel Grating 1.5 m x 48.8 m	73	m ²			0		0	150	10,980		C)	0	10,980
	32			Breaker					0		0		0		C)	0	C
	33			Concrete Pad 5 m x 10 m x 0.3 m	15	m ³			0		0	1,500	22,500		C)	0	22,500
	34			OTHER					0		0		236,088		0)	0	236,088
	35			Pipe Bridge 115 m Long					0		0		0		C)	0	C
	36			Weight of Steel per Meter 72 kg	8,280	kg			0		0	15	124,200		C)	0	124,200
	37			Pipe Bridge Foundation (14 total)					0		0		0		C)	0	C
	38			Footing 4 m x 3 m x 0.3 m @ 14 locations	50	m ³			0		0	1,500	75,600		C)	0	75,600
	39			Pier 0.6 m x 0.6 m x 2.4 m @ 28 locations	24	m ³			0		0	1,500	36,288		C)	0	36,288

Prepared by: JS Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Mechanical & Process NG-TK-05: LNG - Takhini - 5 MWe

									Labou	ır		Mat'l/Co	mmodity	Equipr	nent	Sub-Co	ntractor	Tatal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					4,143		455,693		112,500		1,413,750		0	1,981,943
	1			Prime Movers and Fuel Storage (See Major Equipment)					0		0		0		0		0	0
	2			Fuel System Piping (from fuel storage, building internal)	2	lot	107	1.30	277	110.00	30,507	5,000	10,000	75,000	150,000		0	190,507
	3			Glycol Heating System (incl LNG vaporizers, unit heaters, electric & diesel/NG boiler)	2	lot	107	1.30	277	110.00	30,507	7,500	15,000	150,000	300,000		0	345,507
	4			Generating Station HVAC (electric unit heaters, building and combustion ventilation)	1	lot	1,280	1.30	1,664	110.00	183,040	40,000	40,000	400,000	400,000		0	623,040
	5			Allowance for Building Services / Plumbing	1	lot	480	1.30	624	110.00	68,640	15,000	15,000	110,000	110,000		0	193,640
	6			Allowance for Lube / Waste Oil System	1	lot	320	1.30	416	110.00	45,760	10,000	10,000	80,000	80,000		0	135,760
	7			Continuous Emissions Monitoring System	1	lot	360	1.30	468	110.00	51,480	15,000	15,000	175,000	175,000		0	241,480
	8			Instrument and Plant Compressed Air Systems	1	lot	320	1.30	416	110.00	45,760	5,000	7,500	50,000	50,000		0	103,260
	9			Generating Station Sprinkler System, extinguisher, fire protection equipment	1,750	m ²			0		0		0	85	148,750		0	148,750

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16

Checked: LF



STANTEC CONSULTING Opinion of Probable Construction Cost Electrical, I&C NG-TK-05: LNG - Takhini - 5 MWe

									Labo	ur		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					5,037		604,089		1,739,900		1,110,713		0	3,454,702
	1			STATION ELECTRICAL					2,457		270,270		840,000		345,000		0	1,455,270
	2			Site wide Grounding Grid	1	lot	200	1.30	260	110.00	28,600	50,000	50,000		0		0	78,600
	3			Trench and conduit	1	lot	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	4			Transformer Protection Panel	1	ea	40	1.30	52	110.00	5,720		0	50,000	50,000		0	55,720
	5			Annunciator / Control / Metering Panel	1	ea	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	6			SCADA / Communications	1	lot	60	1.30	78	110.00	8,580		0	50,000	50,000		0	58,580
	7			5kV, 3000A Switchgear	1	lot	40	1.30	52	110.00	5,720	120,000	120,000		0		0	125,720
	8			Station Services MCC (allow 10 Sections)	10	sect	10	1.30	130	110.00	14,300		0	8,500	85,000		0	99,300
	9			BOP PLC and Instrumentation (100 Points, \$1000 per Point)	1	ls			0		0		0	100,000	100,000		0	100,000
	10			Medium/Low Voltage Cable	3,000	ft	0.15	1.30	585	110.00	64,350	30	90,000		0		0	154,350
	11			Cable Tray and Cables from Unit Output to Electrical Room	3,000	ft	0.30	1.30	1,170	110.00	128,700	45	135,000		0		0	263,700
	12			Utility Metering Allowance	1	lot	20	1.30	26	110.00	2,860	20,000	20,000		0		0	22,860
	13			Engine & Auxiliaries Instrumentation	1	lot			0		0	50,000	50,000		0		0	50,000
	14			Black Start Diesel Genset and Auxiliaries	1	lot			0		0	375,000	375,000		0		0	375,000
	15			BUILDING SERVICES					286		31,460		110,000		43,000		0	184,460
	16			Station Service Transformer 300KVA Dry Type Indoor (for Station Services MCC)	1	ea	25	1.30	33	110.00	3,575		0	25,000	25,000		0	28,575
	17			Station Service AC and DC distribution Panels (for transformer and breaker)	2	ea	20	1.30	52	110.00	5,720		0	4,000	8,000		0	13,720
	18			125V DC Station service battery	1	ea	40	1.30	52	110.00	5,720		0	8,000	8,000		0	13,720
	19			125V DC Station service battery charger	1	ea	15	1.30	20	110.00	2,145		0	2,000	2,000		0	4,145
	20			Building Services Allowance	1	lot			0		0	95,000	95,000		0		0	95,000
	21			Miscellaneous (tray, conduit, terminal blocks, etc.)	1	lot	100	1.30	130	110.00	14,300	15,000	15,000		0		0	29,300
	22			SUBSTATION					2,294		252,359		39,900		722,713		0	1,014,972
	23			Transformer - 5MW, 4.16 kV / 34.5 kV, +/- 5% Off Load Tap Changer and multi ratio CTs	1	ea	180	1.30	234	110.00	25,740	12,000	12,000	255,000	255,000		0	292,740
	24			Breaker - 34.5 kV, 650 kV BIL, 600A, 31.5 kA (min) outdoor dead tank c/w multi-ratio CTs	1	ea	135	1.30	176	110.00	19,305	2,250	2,250	166,500	166,500		0	188,055
	25			Disconnect - 34.5 kV, 600A Vertical Break, Group Operated, c/w interlocked ground switch	1	ea	68	1.30	88	110.00	9,653	2,250	2,250	36,000	36,000		0	47,903
	26			Potential Transformer - 34.5 kV, dual winding, outdoor, post type	3	ea	18	1.30	70	110.00	7,722	1,125	3,375	11,250	33,750		0	44,847
	27			Surge Arrestor - 24.4 kV MCOV, outdoor, station class, surge arresters	3	ea	11	1.30	44	110.00	4,826	1,125	3,375	1,238	3,713		0	11,914
	28			Cable - 5 kV, 1/0 AWG, XLPE insulation, aluminum conductor, 100% insulation	240	Μ	0.5	1.30	140	110.00	15,444	0	0	79	18,900		0	34,344
	29			Conductor - Bare, 336.4 kcmil AAC (Tulip)	60	Μ	0.7	1.30	53	110.00	5,792	0	0	23	1,350		0	7,142
	30			Cable Terminations	12	ea	7	1.30	105	110.00	11,583	450	5,400	0	0		0	16,983
	31			Misc Hardware and electrical connectors	1	lot	135	1.30	176	110.00	19,305	11,250	11,250	0	0		0	30,555
	32			Line Protection Panel	1	ea	180	1.30	234	110.00	25,740	0	0	112,500	112,500		0	138,240
	33			34.5 kV Interconnection - poles, conductor, hardware, deadends	1	lot	750	1.30	975	110.00	107,250		0	95,000	95,000		0	202,250
	34			SITE SECURITY					0		50,000		375,000		0		0	425,000
	35			Roadway / Site Lighting	1	ls			0		50,000	100,000	100,000		0		0	150,000
	36			CCTV Security and Integration to System Control Centre	1	ls			0		0	75,000	75,000		0		0	75,000
	37			Fire and Gas Alarm Systems	1	ls			0		0	150,000	150,000		0		0	150,000
	38			Communications (fibre, CAT5, telephone)	1	ls			0		0	50,000	50,000		0		0	50,000
	39			EI&C MISCELLANEOUS					0		0		375,000		0		0	375,000
	40			Engine, fuel, and auxiliaries controls installation	300	pt			0		0	750	225,000		0		0	225,000
	41			Miscellaneous BOP Electrical Equipment Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	42			Miscellaneous Engine Electrical Allowance	1	ls			0		0	50,000	50,000		0		0	50,000

Prepared by: CGV / RF Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: ES



STANTEC CONSULTING Opinion of Probable Construction Cost Indirect and Owner's Costs NG-TK-05: LNG - Takhini - 5 MWe

									Labou	ur		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0		0		0		0)	0	5,436,360
	1			Based on recent YEC experience, an 18% factor on direct costs is incorporated to cover:					0		C)	0		C)	0	5,436,360
	2			Contractor General Conditions					0		C)	0		C)	0	0
	3			Security					0		C)	0		C)	0	0
	4			Lock-out tag-out (LOTO) coordination					0		C)	0		C)	0	0
	5			Waste removal					0		C)	0		C)	0	0
	6			Snow removal					0		C)	0		C)	0	0
	7			Warehousing and utilities including temporary power supply					0		C)	0		C)	0	0
	8			Temporary construction lighting					0		C)	0		C)	0	0
	9			Taxes					0		C)	0		C)	0	0
	10			Interest charges during construction.					0		C)	0		C)	0	0
	11			Land acquisition and zoning					0		C)	0		C)	0	0
	12			Environmental studies, YESAB assessment and all permitting					0		C)	0		C)	0	0
	13			Owner's administration costs, including:					0		C)	0		C)	0	0
	14			Legal fees.					0		C)	0		C)	0	0
	15			Insurance.					0		C)	0		C)	0	0
	16			Salaries & expenses of Owner's project staff.					0		C)	0		C)	0	0
	17			Allowance for operators hours & fuel costs during training, commissioning, and start up.					0		C)	0		C)	0	0
	18			Special costs to dispose from site construction waste.					0		C)	0		C)	0	0
	19								0		0)	0		C)	0	0

Prepared by: **Team**

Date: 16-May-16

Revision No.: A

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Summary NG-TK-10: LNG - Takhini - 10 MWe

Area	Line	Rev.	Description	Labour Hours	Labour Cost	Mat'l/Commodity Cost	Equipment Cost	Sub-Contractor Cost	Total Cost
-	0	-	PROJECT TOTAL, BASE SCOPE	21,030 hrs	\$2,497,117	\$8,231,298	\$25,829,263	\$5,766,500	\$66,780,105
-	1	-	Major Equipment	10,400 hrs	\$1,144,000	\$1,068,500	\$21,370,000	\$300,000	\$23,882,500
-	2	-	General Civil	00 hrs	\$0	\$3,265,660	\$828,500	\$0	\$4,094,160
-	3	-	Buildings and Structures	00 hrs	\$0	\$1,838,838	\$0	\$5,400,000	\$7,238,838
-	4	-	Mechanical and Process	4,697 hrs	\$516,707	\$152,500	\$1,928,750	\$0	\$2,597,957
-	5	-	Electrical, Instrumentation & Controls	5,933 hrs	\$702,616	\$1,905,800	\$1,274,613	\$0	\$3,883,029
-	6	-	Sub Total Directs	21,030 hrs	\$2,363,323	\$8,231,298	\$25,401,863	\$5,700,000	\$41,696,483
-	7	-	Preliminary Engineering for Budget Approval (Class 3)	-	-	-	-	-	\$400,000
-	8	-	Detail Engineering @ 8% Direct Construction Cost	-	-	-	-	-	\$3,335,719
-	9	-	Construction Staff & Consultants and Construction Management Fee @3.5%	-	-	-	-	-	\$1,459,377
-	10	-	Commissioning Costs - Excluding Owner's Staff @ 1.5% of Directs	-	-	-	-	-	\$625,447
-	11	-	Escalation Allowance @ 3.5% Labour, 3.5% Construction Staff & Mgmt Fee, & 3.5% of 1/3 Sub-Contractor Cost	-	\$133,794	-	-	\$66,500	\$200,294
-	12	-	Capital Spares - 2% Major Equipment	-	-	-	\$427,400	-	\$427,400
-	13	-	Indirect Construction Costs and Owner's Costs (See Line Item List, 18% of Directs)	-	-	-	-	-	\$7,505,367
-	14	-	Sub Total In-Directs	00 hrs	\$133,794	\$0	\$427,400	\$66,500	\$13,953,604
-	15	-	Contingency of 20% - AACE Class 5 Opinion of Probable Cost						\$11,130,018

Prepared by: **Team** Date: **16-May-16**

Revision No.: A

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Major Equipment NG-TK-10: LNG - Takhini - 10 MWe

									Labou	Jr		Mat'l/Cor	nmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					10,400		1,144,000		1,068,500		21,370,000		300,000	23,882,500
	1			Generating Station					0		0		0		0		0	0
	2			NG fired Reciprocating Engine - 2.5 MWe capacity, 4,160V	4	unit	1,280	1.30	6,656	110.00	732,160	100,000	400,000	2,000,000	8,000,000		0	9,132,160
	3			Transportation	4	ea			0		0		0		0	75,000	300,000	300,000
	4			Includes:					0		0		0		0		0	0
	5			Prime Mover					0		0		0		0		0	0
	6			Generator and Auxiliaries					0		0		0		0		0	0
	7			Mechanical Auxiliaries (circulating pumps / radiator)					0		0		0		0		0	0
	8			Electrical Control Equipment					0		0		0		0		0	0
	9			Heat Recovery / Rejection					0		0		0		0		0	0
	10			Engineering / Project Management / Drawings					0		0		0		0		0	0
	11			Sound Attenuation					0		0		0		0		0	0
	12			LNG Tank Farm					0		0		0		0		0	0
	13			LNG storage tanks: 1x 150 m3 (usable) vacuum jacketed, horizontal storage tank	4	ea	240	1.30	1,248	110.00	137,280	37,500	150,000	750,000	3,000,000		0	3,287,280
	13			Storage Infrastructure	1	ea	480	1.30	624	110.00	68,640	86,750	86,750	1,735,000	1,735,000		0	1,890,390
	14			Vaporizers	2	ea	480	1.30	1,248	110.00	137,280	134,250	268,500	2,685,000	5,370,000		0	5,775,780
	15			LNG truck unloading station, piping, and infrastructure	1	ea	480	1.30	624	110.00	68,640	163,250	163,250	3,265,000	3,265,000		0	3,496,890
	16			Transportation	6	ea			0		0		0		0	75,000	450,000	450,000

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: HC



STANTEC CONSULTING Opinion of Probable Construction Cost Civil NG-TK-10: LNG - Takhini - 10 MWe

									Labou	ur		Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Tabal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			GENERAL CIVIL TOTAL					0		0		3,265,660		828,500		0	4,094,160
	1			Clearing & Grubbing	6.5	ha			0		0	\$30,000	195,000		0		0	195,000
	2			Excavation & Backfill for Structures & Slab (Allowance)	1	ea.			0		0	\$225,000	225,000		0		0	225,000
	3			Site Drainage and Culverts (Allowance)	1	ea.			0		0	\$125,000	125,000		0		0	125,000
	4			Site Grading - Incl. Roads and Parking Lot Preparation	6,500	m ³			0		0	\$15	97,500		0		0	97,500
	5			General Landscaping	1	ea.			0		0	\$60,000	60,000		0		0	60,000
	6			Water and Sewer Piping	80	m			0		0	\$250	20,000		0		0	20,000
	7			Granular Base - 150mm	3,960	tonne			0		0	\$35	138,600		0		0	138,600
	8			Granular Sub-Base - 300mm	7,920	tonne			0		0	\$18	142,560		0		0	142,560
	9			Asphalt - (Base and Seal)	2,520	tonne			0		0	\$150	378,000		0		0	378,000
	10			Fencing (8ft, angular razor wire)	1,100	m			0		0	\$300	330,000		0		0	330,000
	11			Automatic Slide Gate (10m)	2	ea.			0		0	\$6,000	12,000		0		0	12,000
	12			Slide Gate (10m)	1	ea.			0		0	\$2,000	2,000		0		0	2,000
	13			Potable Water Well, pump, line, and HW tank.	1	ea.			0		0	\$80,000	80,000		0		0	80,000
	14			Septic System	1	ea.			0		0	\$50,000	50,000		0		0	50,000
	15			FIRE WATER					0		0		1,410,000		828,500		0	2,238,500
	16			Fire water heated storage (2x 30ft dia x 30ft tanks, insulated, 250,000 gal)	2	ea			0		0		0	300,000	600,000		0	600,000
	17			Fire water pump house (electric and diesel driven fire pumps, building)	1	lot			0		0	900,000	900,000		0		0	900,000
	18			Fire Loop (allowance) & Recirc Pumps	1,700	m			0		0	\$300	510,000		50,000		0	560,000
	19			Fire Hydrants	17	ea.			0		0		0	10,500	178,500		0	178,500

Prepared by: AW / RM Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: AF



STANTEC CONSULTING Opinion of Probable Construction Cost Buildings and Structures NG-TK-10: LNG - Takhini - 10 MWe

									Labou	ur		Mat'l/Cor	nmodity	Equip	oment	Sub-Co	ntractor	
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0		0		1,838,838		0		5,400,000	7,238,838
	1			FUEL STORAGE					0		0		1,032,300		0		0	1,032,300
	2			Truck Unloading Pad					0		0		0		С		0	C
	3			Concrete Pad 8 m x 10 m x 0.3 m	24	m ³			0		0	1,500	36,000		C		0	36,000
	4			Containment Sump					0		0		0		C		0	C
	5			Base 10 m x 20 m x 0.3 m	60	m ³			0		0	1,500	90,000		C		0	90,000
	6			Walls 60 m x 2 m x 0.3 m	36	m ³			0		0	1,500	54,000		C		0	54,000
	7			LNG Control Module					0		0		0		C		0	C
	8			Base 6 m x 22 m x 0.3 m	40	m ³			0		0	1,500	59,400		C		0	59,400
	9			Tank Containment					0		0		0		C		0	C
	10			Concrete pad 40 m x 40 m x 0.3 m	480	m ³			0		0	1,500	720,000		C		0	720,000
	11			Containment Curb 160 m x 0.3 m x 0.2 m	10	m ³			0		0	1,500	14,400		C		0	14,400
	12			Concrete Trenching					0		0		0		C		0	C
	13			Base 60 m x 0.5 m x 0.3 m	9	m ³			0		0	1,500	13,500		С		0	13,500
	14			Walls 120 m x 1 m x 0.25 m	30	m ³			0		0	1,500	45,000		С		0	45,000
	15			GENERATOR HALL					0		0		201,450		0		<mark>5,400,000</mark>	5,601,450
	16			Pre-engineered Building					0		0		0		C		0	C
	17			Building Size 25 m x 90 m	2,250	m ²			0		0		0		C	2,400	5,400,000	5,400,000
	18			Generator Foundation					0		0		0		C		0	C
	19			Thickened Slab 4 m x 10 m x 0.5 m / each quantity 4	80	m ³			0		0	1,500	120,000		C		0	120,000
	20			Generator Stack Foundation					0		0		0		С		0	C
	21			Concrete Pad 2.5 m x 2.5 m x 0.3 m / each quantity 4	8	m ³			0		0	1,500	11,250		С		0	11,250
	22			Diesel Storage Tank					0		0		0		С		0	C
	23			Base 5 m x 12 m x 0.3 m	18	m ³			0		0	1,500	27,000		С		0	27,000
	24			Radiator Foundation					0		0		0		С		0	C
	25			Concrete Pad 4 m x 6 m x 0.3 m / each quantity 4	29	m ³			0		0	1,500	43,200		C		0	43,200
	26			SUBSTATION					0		0		369,000		0		0	369,000
	27			Transformer					0		0		0		C		0	C
	28			Base 12 m x 18 m x 0.5 m	108	m ³			0		0	1,500	162,000		C		0	162,000
	29			Containment Walls 60 m x 1.2 m x 0.25 m	18	m ³			0		0	1,500	27,000		C		0	27,000
	30			Pier 11 m x 7.4 m x 1.2 m	98	m ³			0		0	1,500	146,520		C		0	146,520
	31			Steel Grating 1.5 m x 48.8 m	73	m ²			0		0	150	10,980		C		0	10,980
	32			Breaker					0		0		0		C		0	C
	33			Concrete Pad 5 m x 10 m x 0.3 m	15	m ³			0		0	1,500	22,500		С		0	22,500
	34			OTHER					0		0		236,088		0		0	236,088
	35			Pipe Bridge 115 m Long					0		0		0		C		0	0
	36			Weight of Steel per Meter 72 kg	8,280	kg			0		0	15	124,200		С		0	124,200
	37			Pipe Bridge Foundation (14 total)					0		0)	0		С		0	C
	38			Footing 4 m x 3 m x 0.3 m @ 14 locations	50	m ³			0		0	1,500	75,600		С		0	75,600
	39			Pier 0.6 m x 0.6 m x 2.4 m @ 28 locations	24	m ³			0		0	1,500	36,288		C		0	36,288

Prepared by: JS Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Mechanical & Process NG-TK-10: LNG - Takhini - 10 MWe

									Labou	Jr		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					4,697		516,707		152,500		1,928,750		0	2,597,957
	1			Prime Movers and Fuel Storage (See Major Equipment)					0		0		0		0		0	0
	2			Fuel System Piping (from fuel storage, building internal)	4	lot	107	1.30	555	110.00	61,013	5,000	20,000	60,000	240,000		0	321,013
	3			Glycol Heating System (incl LNG vaporizers, unit heaters, electric & diesel/NG boiler)	4	lot	107	1.30	555	110.00	61,013	7,500	30,000	125,000	500,000		0	591,013
	4			Generating Station HVAC (electric unit heaters, building and combustion ventilation)	1	lot	1,280	1.30	1,664	110.00	183,040	50,000	50,000	500,000	500,000		0	733,040
	5			Allowance for Building Services / Plumbing	1	lot	480	1.30	624	110.00	68,640	15,000	15,000	135,000	135,000		0	218,640
	6			Allowance for Lube / Waste Oil System	1	lot	320	1.30	416	110.00	45,760	10,000	10,000	90,000	90,000		0	145,760
	7			Continuous Emissions Monitoring System	1	lot	360	1.30	468	110.00	51,480	20,000	20,000	220,000	220,000		0	291,480
	8			Instrument and Plant Compressed Air Systems	1	lot	320	1.30	416	110.00	45,760	5,000	7,500	75,000	75,000		0	128,260
	9			Generating Station Sprinkler System, extinguisher, fire protection equipment	2,250	m ²			0		0		0	75	168,750		0	168,750

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16

Checked: LF



STANTEC CONSULTING Opinion of Probable Construction Cost Electrical, I&C NG-TK-10: LNG - Takhini - 10 MWe

									Labo	ur		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL				1000	5,933		702,616		1,905,800		1.274.613		0	3,883,029
	1			STATION ELECTRICAL					3,107		341,770		940,000		412,500		0	1,694,270
	2			Site wide Grounding Grid	1	lot	200	1.30	260	110.00	28,600	60,000	60,000		0		0	88,600
	3			Trench and conduit	1	lot	40	1.30	52	110.00	5,720	,	0	30,000	30,000		0	35,720
	4			Transformer Protection Panel	1	ea	40	1.30	52	110.00	5,720		0	50,000	50,000		0	55,720
	5			Annunciator / Control / Metering Panel	1	ea	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	6			SCADA / Communications	1	lot	60	1.30	78	110.00	8,580		0	50,000	50,000		0	58,580
	7			5kV, 3000A Switchgear	1	lot	40	1.30	52	110.00	5,720	120,000	120,000		0		0	125,720
	8			Station Services MCC (allow 15 Sections)	15	sect	10	1.30	195	110.00	21,450		0	8,500	127,500		0	148,950
	9			BOP PLC and Instrumentation (125 Points, \$1000 per Point)	1	ls			0		0		0	125,000	125,000		0	125,000
	10			Medium/Low Voltage Cable	4,000	ft	0.15	1.30	780	110.00	85,800	30	120,000		0		0	205,800
	11			Cable Tray and Cables from Unit Output to Electrical Room	4,000	ft	0.30	1.30	1,560	110.00	171,600	45	180,000		0		0	351,600
	12			Utility Metering Allowance	1	lot	20	1.30	26	110.00	2,860	20,000	20,000		0		0	22,860
	13			Engine & Auxiliaries Instrumentation	1	lot			0		0	65,000	65,000		0		0	65,000
	14			Black Start Diesel Genset and Auxiliaries	1	lot			0		0	375,000	375,000		0		0	375,000
	15			BUILDING SERVICES					286		31,460		130,000		45,500		0	206,960
	16			Station Service Transformer 400KVA Dry Type Indoor (for Station Services MCC)	1	ea	25	1.30	33	110.00	3,575		0	27,500	27,500		0	31,075
	17			Station Service AC and DC distribution Panels (for transformer and breaker)	2	ea	20	1.30	52	110.00	5,720		0	4,000	8,000		0	13,720
	18			125V DC Station service battery	1	ea	40	1.30	52	110.00	5,720		0	8,000	8,000		0	13,720
	19			125V DC Station service battery charger	1	ea	15	1.30	20	110.00	2,145		0	2,000	2,000		0	4,145
	20			Building Services Allowance	1	lot			0		0	115,000	115,000		0		0	115,000
	21			Miscellaneous (tray, conduit, terminal blocks, etc.)	1	lot	100	1.30	130	110.00	14,300	15,000	15,000		0		0	29,300
	22			SUBSTATION					2,540		279,386		48,300		816,613		0	1,144,299
	23			Transformer - 10 MW, 4.16 kV / 34.5 kV, +/- 5% Off Load Tap Changer and multi ratio CTs	1	ea	180	1.30	234	110.00	25,740	15,000	15,000	330,000	330,000		0	370,740
	24			Breaker - 34.5 kV, 650 kV BIL, 800A (min), 31.5 kA (min) outdoor dead tank	1	ea	135	1.30	176	110.00	19,305	2,250	2,250	166,500	166,500		0	188,055
	25			Disconnect - 34.5 kV, 600A Vertical Break, Group Operated, c/w interlocked ground switch	1	ea	68	1.30	88	110.00	9,653	2,250	2,250	36,000	36,000		0	47,903
	26			Potential Transformer - 34.5 kV, dual winding, outdoor, post type	3	ea	18	1.30	70	110.00	7,722	1,125	3,375	11,250	33,750		0	44,847
	27			Surge Arrestor - 24.4 kV MCOV, outdoor, station class, surge arresters	3	ea	11	1.30	44	110.00	4,826	1,125	3,375	1,238	3,713		0	11,914
	28			Cable - 5 kV, 500MCM, XLPE insulation, aluminum conductor, 100% insulation	480	М	0.5	1.30	281	110.00	30,888	0	0	79	37,800		0	68,688
	29			Conductor - Bare, 2/0 AWG AAC (Aster)	60	М	0.7	1.30	53	110.00	5,792	0	0	23	1,350		0	7,142
	30			Cable Terminations	24	ea	7	1.30	211	110.00	23,166	450	10,800	0	0		0	33,966
	31			Misc Hardware and electrical connectors	1	lot	135	1.30	176	110.00	19,305	11,250	11,250	0	0		0	30,555
	32			Line Protection Panel	1	ea	180	1.30	234	110.00	25,740	0	0	112,500	112,500		0	138,240
	33			34.5 kV Interconnection - poles, conductor, hardware, deadends	1	lot	750	1.30	975	110.00	107,250		0	95,000	95,000		0	202,250
	34			SITE SECURITY					0		50,000		375,000		0		0	425,000
	35			Roadway / Site Lighting	1	ls			0		50,000	100,000	100,000		0		0	150,000
	36			CCTV Security and Integration to System Control Centre	1	ls			0		0	75,000	75,000		0		0	75,000
	37			Fire and Gas Alarm Systems	1	ls			0		0	150,000	150,000		0		0	150,000
	38			Communications (tibre, CAT5, telephone)	1	ls			0		0	50,000	50,000		0		0	50,000
	39			EI&C MISCELLANEOUS	0.5.0				0		0		412,500		0		0	412,500
	40			Engine, ruei, and auxiliaries controls installation	350	pt			0		0	750	262,500		0		0	262,500
	41			INISCEIIaneous BOP Electrical Equipment Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	42			Miscellaneous Engine Electrical Allowance	1	ls			0	1	0	50,000	50,000		0		0	50,000

Prepared by: CGV / RF Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: ES



STANTEC CONSULTING Opinion of Probable Construction Cost Indirect and Owner's Costs NG-TK-10: LNG - Takhini - 10 MWe

									Labou	Jr		Mat'l/Co	ommodity	Equip	oment	Sub-Co	ntractor	Tabul
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0		0		0)	C		0	7,505,367
	1			Based on recent YEC experience, an 18% factor on direct costs is incorporated to cover:					0		0		C)	C)	0	7,505,367
	2			Contractor General Conditions					0		0		C)	C)	0	0
	3			Security					0		0		C)	C)	0	0
	4			Lock-out tag-out (LOTO) coordination					0		0		C)	C)	0	0
	5			Waste removal					0		0		C)	C)	0	0
	6			Snow removal					0		0		C)	C)	0	0
	7			Warehousing and utilities including temporary power supply					0		0		C)	C)	0	0
	8			Temporary construction lighting					0		0		C)	C)	0	0
	9			Taxes					0		0		C)	C)	0	0
	10			Interest charges during construction.					0		0		C)	C)	0	0
	11			Land acquisition and zoning					0		0		C)	C)	0	0
	12			Environmental studies, YESAB assessment and all permitting					0		0		C)	C)	0	0
	13			Owner's administration costs, including:					0		0		C)	C)	0	0
	14			Legal fees.					0		0		C)	C)	0	0
	15			Insurance.					0		0		C)	C)	0	0
	16			Salaries & expenses of Owner's project staff.					0		0		C)	C)	0	0
	17			Allowance for operators hours & fuel costs during training, commissioning, and start up.					0		0		C)	C)	0	0
	18			Special costs to dispose from site construction waste.					0		0		C)	C)	0	0
	19								0		0		C)	C)	0	0

Prepared by: Team

Date: 16-May-16 Revision No.: A

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Summary NG-TK-20: LNG - Takhini - 20 MWe

Area	Line	Rev.	Description	Labour Hours	Labour Cost	Mat'I/Commodity Cost	Equipment Cost	Sub-Contractor Cost	Total Cost
-	0	-	PROJECT TOTAL, BASE SCOPE	27,069 hrs	\$3,210,109	\$9,642,623	\$42,222,250	\$8,467,650	\$99,992,326
-	1	-	Major Equipment	14,664 hrs	\$1,613,040	\$1,831,000	\$36,620,000	\$450,000	\$40,514,040
-	2	-	General Civil	00 hrs	\$0	\$3,265,660	\$828,500	\$0	\$4,094,160
-	3	-	Buildings and Structures	00 hrs	\$0	\$2,275,863	\$0	\$7,920,000	\$10,195,863
-	4	-	Mechanical and Process	5,252 hrs	\$577,720	\$187,500	\$2,322,500	\$0	\$3,087,720
-	5	-	Electrical, Instrumentation & Controls	7,153 hrs	\$836,786	\$2,082,600	\$1,718,850	\$0	\$4,638,236
-	6	-	Sub Total Directs	27,069 hrs	\$3,027,546	\$9,642,623	\$41,489,850	\$8,370,000	\$62,530,019
-	7	-	Preliminary Engineering for Budget Approval (Class 3)	-	-	-	-	-	\$400,000
-	8	-	Detail Engineering @ 8% Direct Construction Cost	-	-	-	-	-	\$5,002,402
-	9	-	Construction Staff & Consultants and Construction Management Fee @3.5%	-	-	-	-	-	\$2,188,551
-	10	-	Commissioning Costs - Excluding Owner's Staff @ 1.5% of Directs	-	-	-	-	-	\$937,950
-	11	-	Escalation Allowance @ 3.5% Labour, 3.5% Construction Staff & Mgmt Fee, & 3.5% of 1/3 Sub-Contractor Cost	-	\$182,563	-	-	\$97,650	\$280,213
-	12	-	Capital Spares - 2% Major Equipment	-	-	-	\$732,400	-	\$732,400
-	13	-	Indirect Construction Costs and Owner's Costs (See Line Item List, 18% of Directs)	-	-	-	-	-	\$11,255,403
-	14	-	Sub Total In-Directs	00 hrs	\$182,563	\$0	\$732,400	\$97,650	\$20,796,919
-	15	-	Contingency of 20% - AACE Class 5 Opinion of Probable Cost						\$16,665,388

Prepared by: **Team** Date: **16-May-16** Revision No.: **A**

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Major Equipment NG-TK-20: LNG - Takhini - 20 MWe

									Labo	ur		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					14,664		1,613,040		1,831,000		36,620,000		450,000	40,514,040
	1			Generating Station					0		0		0		0		0	0
	2			NG fired Reciprocating Engine - 2.5 MWe capacity, 4,160V	4	unit	1,280	1.30	6,656	110.00	732,160	100,000	400,000	2,000,000	8,000,000		0	9,132,160
	3			NG fired Reciprocating Engine - 5.0 MWe capacity, 4,160V	2	unit	1,280	1.30	3,328	110.00	366,080	200,000	400,000	4,000,000	8,000,000		0	8,766,080
	3			Transportation	6	ea			0		0		0		0	75,000	450,000	450,000
	4			Includes:					0		0		0		0		0	0
	5			Prime Mover					0		0		0		0		0	0
	6			Generator and Auxiliaries					0		0		0		0		0	0
	7			Mechanical Auxiliaries (circulating pumps / radiator)					0		0		0		0		0	0
	8			Electrical Control Equipment					0		0		0		0		0	0
	9			Heat Recovery / Rejection					0		0		0		0		0	0
	10			Engineering / Project Management / Drawings					0		0		0		0		0	0
	11			Sound Attenuation					0		0		0		0		0	0
	12			LNG Tank Farm					0		0		0		0		0	0
	13			LNG storage tanks: 1x 150 m3 (usable) vacuum jacketed, horizontal storage tank	7	ea	240	1.30	2,184	110.00	240,240	37,500	262,500	750,000	5,250,000		0	5,752,740
	13			Storage Infrastructure	1	ea	480	1.30	624	110.00	68,640	151,750	151,750	3,035,000	3,035,000		0	3,255,390
	14			Vaporizers	2	ea	480	1.30	1,248	110.00	137,280	191,750	383,500	3,835,000	7,670,000		0	8,190,780
	15			LNG truck unloading station, piping, and infrastructure	1	ea	480	1.30	624	110.00	68,640	233,250	233,250	4,665,000	4,665,000		0	4,966,890
	16			Transportation	9	ea			0		0		0		0	75,000	675,000	675,000

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: HC



STANTEC CONSULTING Opinion of Probable Construction Cost Civil NG-TK-20: LNG - Takhini - 20 MWe

									Labou	ur		Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Tabal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			GENERAL CIVIL TOTAL					0		0		3,265,660		828,500		0	4,094,160
	1			Clearing & Grubbing	6.5	ha			0		0	\$30,000	195,000		0		0	195,000
	2			Excavation & Backfill for Structures & Slab (Allowance)	1	ea.			0		0	\$225,000	225,000		0		0	225,000
	3			Site Drainage and Culverts (Allowance)	1	ea.			0		0	\$125,000	125,000		0		0	125,000
	4			Site Grading - Incl. Roads and Parking Lot Preparation	6,500	m ³			0		0	\$15	97,500		0		0	97,500
	5			General Landscaping	1	ea.			0		0	\$60,000	60,000		0		0	60,000
	6			Water and Sewer Piping	80	m			0		0	\$250	20,000		0		0	20,000
	7			Granular Base - 150mm	3,960	tonne			0		0	\$35	138,600		0		0	138,600
	8			Granular Sub-Base - 300mm	7,920	tonne			0		0	\$18	142,560		0		0	142,560
	9			Asphalt - (Base and Seal)	2,520	tonne			0		0	\$150	378,000		0		0	378,000
	10			Fencing (8ft, angular razor wire)	1,100	m			0		0	\$300	330,000		0		0	330,000
	11			Automatic Slide Gate (10m)	2	ea.			0		0	\$6,000	12,000		0		0	12,000
	12			Slide Gate (10m)	1	ea.			0		0	\$2,000	2,000		0		0	2,000
	13			Potable Water Well, pump, line, and HW tank.	1	ea.			0		0	\$80,000	80,000		0		0	80,000
	14			Septic System	1	ea.			0		0	\$50,000	50,000		0		0	50,000
	15			FIRE WATER					0		0		1,410,000		828,500		0	2,238,500
	16			Fire water heated storage (2x 30ft dia x 30ft tanks, insulated, 250,000 gal)	2	ea			0		0		0	300,000	600,000		0	600,000
	17			Fire water pump house (electric and diesel driven fire pumps, building)	1	lot			0		0	900,000	900,000		0		0	900,000
	18			Fire Loop (allowance) & Recirc Pumps	1,700	m			0		0	\$300	510,000		50,000		0	560,000
	19			Fire Hydrants	17	ea.			0		0		0	10,500	178,500		0	178,500

Prepared by: AW / RM Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: AF



STANTEC CONSULTING Opinion of Probable Construction Cost Buildings and Structures NG-TK-20: LNG - Takhini - 20 MWe

									Labou	ur		Mat'l/Con	nmodity	Equip	oment	Sub-Co	ntractor	Tabal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per	Prod.	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
							Unit	Factor	Total Hours	Nate	COSt	Unit COst	COst	Unit COst	COSI	UTIIL COSt	COSt	0031
	0			TOTAL					0		0		2,275,863		0		7,920,000	10,195,863
	1			FUEL STORAGE					0		0		1,305,000		0		0	1,305,000
	2			Truck Unloading Pad					0		C)	0		C)	0	C
	3			Concrete Pad 8 m x 10 m x 0.3 m	24	m ³			0		C	1,500	36,000		C)	0	36,000
	4			Containment Sump					0		C)	0		C)	0	C
	5			Base 10 m x 20 m x 0.3 m	60	m³			0	-	C	1,500	90,000		C)	0	90,000
	6			Walls 60 m x 2 m x 0.3 m	36	m³			0	-	C	1,500	54,000		C)	0	54,000
	7			LNG Control Module					0		C)	0		C)	0	C
	8			Base 6 m x 22 m x 0.3 m	40	m³			0		C	1,500	59,400		C)	0	59,400
	9			Tank Containment					0		C)	0		C)	0	C
	10			Concrete pad 55 m x 40 m x 0.3 m	660	m³			0		C	1,500	990,000		C)	0	990,000
	11			Containment Curb 190 m x 0.3 m x 0.2 m	11	m³			0		C	1,500	17,100		C)	0	17,100
	12			Concrete Trenching					0		C)	0		C)	0	C
	13			Base 60 m x 0.5 m x 0.3 m	9	m³			0		C	1,500	13,500		C)	0	13,500
	14			Walls 120 m x 1 m x 0.25 m	30	m³			0		C	1,500	45,000		C)	0	45,000
	15			GENERATOR HALL					0		0		365,775		0		7,920,000	8,285,775
	16			Pre-engineered Building					0	-	C)	0		C)	0	C
	17			Building Size 30 m x 110 m	3,300	m²			0	-	C)	0		C	2,400	7,920,000	7,920,000
	18			Generator Foundation					0	-	C)	0		C)	0	C
	19			Thickened Slab 4 m x 10 m x 0.5 m / each quantity 4	80	m³			0		C	1,500	120,000		C)	0	120,000
	20			Thickened Slab 5.5 m x 14 m x 0.5 m / each quantity 2	77	m³			0	-	C	1,500	115,500		C)	0	115,500
	21			Generator Stack Foundation		2			0		C)	0		C)	0	С
	22			Concrete Pad 2.5 m x 2.5 m x 0.3 m / each quantity 6	11	m³			0		C	1,500	16,875		C)	0	16,875
	23			Diesel Storage Tank		2			0		C)	0		C)	0	С
	24			Base 5 m x 12 m x 0.3 m	18	m³			0		C	1,500	27,000		C)	0	27,000
	25			Radiator Foundation		2			0		C)	0		C)	0	C
	26			Concrete Pad 4 m x 6 m x 0.3 m / each quantity 4	29	m³			0	-	C	1,500	43,200		C)	0	43,200
	27			Concrete Pad 6 m x 8 m x 0.3 m / each quantity 2	29	m³			0		C	1,500	43,200		C)	0	43,200
	28			SUBSTATION					0		0		369,000		0		0	369,000
	29			Transformer		2			0		C)	0		C)	0	C
	30			Base 12 m x 18 m x 0.5 m	108	m°			0		C	1,500	162,000		C)	0	162,000
	31			Containment Walls 60 m x 1.2 m x 0.25 m	18	m°			0		C	1,500	27,000		C)	0	27,000
	32			Pier 11 m x 7.4 m x 1.2 m	98	m°			0		C	1,500	146,520		C)	0	146,520
	33			Steel Grating 1.5 m x 48.8 m	73	m²			0		C	150	10,980		C)	0	10,980
	34			Breaker		2			0		C)	0		C)	0	C
	35			Concrete Pad 5 m x 10 m x 0.3 m	15	m°			0		C	1,500	22,500		C)	0	22,500
	36			OTHER					0		0		236,088		0		0	236,088
	37			Pipe Bridge 115 m Long	0.000				0		0	2	0		C)	0	104.000
	38			Weight of Steel per Meter 72 kg	8,280	кg			0		C	15	124,200		C)	0	124,200
	39			Pipe Bildge Foundation (14 total)	50	3			U		C	1 500	0		0		0	
	40			Piero (m m 0 (m m 0) for a 2) for a strengt	50	m ĭ			U		0	1,500	/5,600		0		0	/5,600
•	41			Pier U.6 m x U.6 m x 2.4 m @ 28 locations	24	m°	•		0	1	0	1,500	36,288		C 0)	0	36,288

Prepared by: JS Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16


STANTEC CONSULTING Opinion of Probable Construction Cost Mechanical & Process NG-TK-20: LNG - Takhini - 20 MWe

									Labou	ır		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Tatal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					5,252		577,720		187,500		2,322,500		0	3,087,720
	1			Prime Movers and Fuel Storage (See Major Equipment)					0		0		0		0		0	0
	2			Fuel System Piping (from fuel storage, building internal)	6	lot	107	1.30	832	110.00	91,520	5,000	30,000	50,000	300,000		0	421,520
	3			Glycol Heating System (incl LNG vaporizers, unit heaters, electric & diesel/NG boiler)	6	lot	107	1.30	832	110.00	91,520	7,500	45,000	100,000	600,000		0	736,520
	4			Generating Station HVAC (electric unit heaters, building and combustion ventilation)	1	lot	1,280	1.30	1,664	110.00	183,040	60,000	60,000	600,000	600,000		0	843,040
	5			Allowance for Building Services / Plumbing	1	lot	480	1.30	624	110.00	68,640	15,000	15,000	150,000	150,000		0	233,640
	6			Allowance for Lube / Waste Oil System	1	lot	320	1.30	416	110.00	45,760	10,000	10,000	100,000	100,000		0	155,760
	7			Continuous Emissions Monitoring System	1	lot	360	1.30	468	110.00	51,480	20,000	20,000	250,000	250,000		0	321,480
	8			Instrument and Plant Compressed Air Systems	1	lot	320	1.30	416	110.00	45,760	5,000	7,500	75,000	75,000		0	128,260
	9			Generating Station Sprinkler System, extinguisher, fire protection equipment	3,300	m ²			0		0		0	75	247,500		0	247,500

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16

Checked: LF



STANTEC CONSULTING Opinion of Probable Construction Cost Electrical, I&C NG-TK-20: LNG - Takhini - 20 MWe

									Labou	ur		Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					7,153		836,786		2,082,600		1,718,850		0	4,638,236
	1			STATION ELECTRICAL					3,757		413,270		1,050,000		480,000		0	1,943,270
	2			Site wide Grounding Grid	1	lot	200	1.30	260	110.00	28,600	70,000	70,000		0		0	98,600
	3			Trench and conduit	1	lot	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	4			Transformer Protection Panel	1	ea	40	1.30	52	110.00	5,720		0	50,000	50,000		0	55,720
	5			Annunciator / Control / Metering Panel	1	ea	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	6			SCADA / Communications	1	lot	60	1.30	78	110.00	8,580		0	50,000	50,000		0	58,580
	7			5kV, 3000A Switchgear	1	lot	40	1.30	52	110.00	5,720	120,000	120,000		0		0	125,720
	8			Station Services MCC (allow 20 Sections)	20	sect	10	1.30	260	110.00	28,600		0	8,500	170,000		0	198,600
	9			BOP PLC and Instrumentation (150 Points, \$1000 per Point)	1	ls			0		0		0	150,000	150,000		0	150,000
	10			Medium/Low Voltage Cable	5,000	ft	0.15	1.30	975	110.00	107,250	30	150,000		0		0	257,250
	11			Cable Tray and Cables from Unit Output to Electrical Room	5,000	ft	0.30	1.30	1,950	110.00	214,500	45	225,000		0		0	439,500
	12			Utility Metering Allowance	1	lot	20	1.30	26	110.00	2,860	20,000	20,000		0		0	22,860
	13			Engine & Auxiliaries Instrumentation	1	lot			0		0	90,000	90,000		0		0	90,000
	14			Black Start Diesel Genset and Auxiliaries	1	lot			0		0	375,000	375,000		0		0	375,000
	15			BUILDING SERVICES					286		31,460		150,000		48,000		0	229,460
	16			Station Service Transformer 500KVA Dry Type Indoor (for Station Services MCC)	1	ea	25	1.30	33	110.00	3,575		0	30,000	30,000		0	33,575
	17			Station Service AC and DC distribution Panels (for transformer and breaker)	2	ea	20	1.30	52	110.00	5,720		0	4,000	8,000		0	13,720
	18			125V DC Station service battery	1	ea	40	1.30	52	110.00	5,720		0	8,000	8,000		0	13,720
	19			125V DC Station service battery charger	1	ea	15	1.30	20	110.00	2,145		0	2,000	2,000		0	4,145
	20			Building Services Allowance	1	lot			0		0	135,000	135,000		0		0	135,000
	21			Miscellaneous (tray, conduit, terminal blocks, etc.)	1	lot	100	1.30	130	110.00	14,300	15,000	15,000		0		0	29,300
	22			SUBSTATION					3,110		342,056		57,600		1,190,850		0	1,590,506
	23			Transformer - 20MW, 4.16 kV / 34.5 kV, +/- 5% Off Load Tap Changer and multi ratio CTs	1	ea	180	1.30	234	110.00	25,740	22,500	22,500	525,000	525,000		0	573,240
	24			Breaker - 34.5 kV, 650 kV BIL, 800A (min), 31.5 kA (min) outdoor dead tank	2	ea	90	1.30	234	110.00	25,740	1,500	3,000	111,000	222,000		0	250,740
	25			Disconnect - 34.5 kV, 600A Vertical Break, Group Operated, c/w interlocked ground switch	2	ea	45	1.30	117	110.00	12,870	1,500	3,000	24,000	48,000		0	63,870
	26			Potential Transformer - 34.5 kV, dual winding, outdoor, post type	6	ea	12	1.30	94	110.00	10,296	750	4,500	7,500	45,000		0	59,796
	27			Surge Arrestor - 24.4 kV MCOV, outdoor, station class, surge arresters	6	ea	8	1.30	59	110.00	6,435	750	4,500	825	4,950		0	15,885
	28			Cable - 5 kV, 500MCM, XLPE insulation, aluminum conductor, 100% insulation	840	Μ	0.3	1.30	328	110.00	36,036	0	0	53	44,100		0	80,136
	29			Conductor - Bare, 2/0 AWG AAC (Aster)	120	Μ	0.5	1.30	70	110.00	7,722	0	0	15	1,800		0	9,522
	30			Cable Terminations	42	ea	5	1.30	246	110.00	27,027	300	12,600	0	0		0	39,627
	31			Misc Hardware and electrical connectors	1	lot	90	1.30	117	110.00	12,870	7,500	7,500	0	0		0	20,370
	32			Line Protection Panel	2	ea	120	1.30	312	110.00	34,320	0	0	75,000	150,000		0	184,320
	33			34.5 kV Interconnection - poles, conductor, hardware, deadends	1	lot	1,000	1.30	1,300	110.00	143,000		0	150,000	150,000		0	293,000
	34			SITE SECURITY					0		50,000		375,000		0		0	425,000
	35			Roadway / Site Lighting	1	ls			0		50,000	100,000	100,000		0		0	150,000
	36			CCTV Security and Integration to System Control Centre	1	ls			0		0	75,000	75,000		0		0	75,000
	37			Fire and Gas Alarm Systems	1	ls			0		0	150,000	150,000		0		0	150,000
	38			Communications (fibre, CAT5, telephone)	1	ls			0		0	50,000	50,000		0		0	50,000
	39			EI&C MISCELLANEOUS					0		0		450,000		0		0	450,000
	40			Engine, fuel, and auxiliaries controls installation	400	pt			0		0	750	300,000		0		0	300,000
	41			Miscellaneous BOP Electrical Equipment Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	42			Miscellaneous Engine Electrical Allowance	1	ls			0		0	50,000	50,000		0		0	50,000

Prepared by: CGV / RF Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: ES



STANTEC CONSULTING Opinion of Probable Construction Cost Indirect and Owner's Costs NG-TK-20: LNG - Takhini - 20 MWe

									Labou	Jr		Mat'l/Co	ommodity	Equip	oment	Sub-Co	ntractor	Tatal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0		0		0		0		0	11,255,403
	1			Based on recent YEC experience, an 18% factor on direct costs is incorporated to cover:					0		0		0		0)	0	11,255,403
	2			Contractor General Conditions					0		0		0		0)	0	0
	3			Security					0		0		0		0)	0	0
	4			Lock-out tag-out (LOTO) coordination					0		0		0		0)	0	0
	5			Waste removal					0		0		0		0)	0	0
	6			Snow removal					0		0		0		0)	0	0
	7			Warehousing and utilities including temporary power supply					0		0		0		0)	0	0
	8			Temporary construction lighting					0		0		0		0)	0	0
	9			Taxes					0		0		0		0)	0	0
	10			Interest charges during construction.					0		0		0		0)	0	0
	11			Land acquisition and zoning					0		0		0		0)	0	0
	12			Environmental studies, YESAB assessment and all permitting					0		0		0		0)	0	0
	13			Owner's administration costs, including:					0		0		0		0)	0	0
	14			Legal fees.					0		0		0		0)	0	0
	15			Insurance.					0		0		0		0)	0	0
	16			Salaries & expenses of Owner's project staff.					0		0		0		0)	0	0
	17			Allowance for operators hours & fuel costs during training, commissioning, and start up.					0		0		0		0)	0	0
	18			Special costs to dispose from site construction waste.					0		0		0		0)	0	0
	19								0		0		0		0)	0	0

Prepared by: Team

Date: 16-May-16 Revision No.: A

REVISION NO.. A

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Summary DL-LF-05: Diesel - Landfill - 5 MWe

Area	Line	Rev.	Description	Labour Hours	Labour Cost	Mat'l/Commodity Cost	Equipment Cost	Sub-Contractor Cost	Total Cost
-	0	-	PROJECT TOTAL, BASE SCOPE	15,420 hrs	\$1,831,477	\$5,771,490	\$7,958,663	\$4,400,750	\$32,007,606
-	1	-	Major Equipment	6,240 hrs	\$686,400	\$223,000	\$4,460,000	\$150,000	\$5,519,400
-	2	-	General Civil	00 hrs	\$0	\$3,048,265	\$755,000	\$0	\$3,803,265
-	3	-	Buildings and Structures	00 hrs	\$0	\$722,825	\$80,000	\$4,200,000	\$5,002,825
-	4	-	Mechanical and Process	4,143 hrs	\$455,693	\$112,500	\$1,463,750	\$0	\$2,031,943
-	5	-	Electrical, Instrumentation & Controls	5,037 hrs	\$604,089	\$1,664,900	\$1,110,713	\$0	\$3,379,702
-	6	-	Sub Total Directs	15,420 hrs	\$1,746,183	\$5,771,490	\$7,869,463	\$4,350,000	\$19,737,135
-	7	-	AFE Engineering @ 3% of Directs	-	-	-	-	-	\$592,114
-	8	-	Detail Engineering @ 8% Direct Construction Cost	-	-	-	-	-	\$1,578,971
-	9	-	Construction Staff & Consultants and Construction Management Fee @3.5%	-	-	-	-	-	\$690,800
-	10	-	Commissioning Costs - Excluding Owner's Staff @ 1.5% of Directs	-	-	-	-	-	\$296,057
-	11	-	Escalation Allowance @ 3.5% Labour, 3.5% Construction Staff & Mgmt Fee, & 3.5% of 1/3 Sub-Contractor Cost	-	\$85,294	-	-	\$50,750	\$136,044
-	12	-	Capital Spares - 2% Major Equipment	-	-	-	\$89,200	-	\$89,200
-	13	-	Indirect Construction Costs and Owner's Costs (See Line Item List, 18% of Directs)	-	-	-	-	-	\$3,552,684
-	14	-	Sub Total In-Directs	00 hrs	\$85,294	\$0	\$89,200	\$50,750	\$6,935,870
-	15	-	Contingency of 20% - AACE Class 5 Opinion of Probable Cost						\$5,334,601

Prepared by: **Team** Date: **16-May-16** Revision No.: **A**

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Major Equipment DL-LF-05: Diesel - Landfill - 5 MWe

									Labo	ur		Mat'l/Cor	nmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					6,240		686,400		223,000		4,460,000		150,000	5,519,400
	1			Generating Station					0		0		0		0		0	0
	2			Diesel fired Reciprocating Engine - 2.5 MWe capacity, 4,160V	2	unit	1,280	1.30	3,328	110.00	366,080	75,000	150,000	1,500,000	3,000,000		0	3,516,080
	3			Transportation	2	ea			0		0		0		0	75,000	150,000	150,000
	4			Includes:					0		0		0		0		0	0
	5			Prime Mover					0		0		0		0		0	0
	6			Generator and Auxiliaries					0		0		0		0		0	0
	7			Mechanical Auxiliaries (circulating pumps / radiator)					0		0		0		0		0	0
	8			Electrical Control Equipment					0		0		0		0		0	0
	9			Heat Recovery / Rejection					0		0		0		0		0	0
	10			Engineering / Project Management / Drawings					0		0		0		0		0	0
	11			Sound Attenuation					0		0		0		0		0	0
	12			Diesel Tank Farm					0		0		0		0		0	0
	13			Diesel storage tanks: Double Walled (100% secondary containment, standard 75,000L design)	4	ea	160	1.30	832	110.00	91,520	3,250	13,000	65,000	260,000		0	364,520
	14			Diesel truck unloading and pump house, undergound containment tank, sump and lines	1	ea	1,600	1.30	2,080	110.00	228,800	60,000	60,000	1,200,000	1,200,000		0	1,488,800
	15			Transportation	5	ea			0		0		0		0	20,000	100,000	100,000

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: HC



STANTEC CONSULTING Opinion of Probable Construction Cost Civil DL-LF-05: Diesel - Landfill - 5 MWe

									Labou	Jr		Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			GENERAL CIVIL TOTAL					0		0		3,048,265		755,000		0	3,803,265
	1			Clearing & Grubbing	5.5	ha			0		0	\$30,000	165,000		0		0	165,000
	2			Excavation & Backfill for Structures & Slab (Allowance)	1	ea.			0		0	\$225,000	225,000		0		0	225,000
	3			Site Drainage and Culverts (Allowance)	1	ea.			0		0	\$125,000	125,000		0		0	125,000
	4			Site Grading - Incl. Roads and Parking Lot Preparation	5,500	m ³			0		0	\$15	82,500		0		0	82,500
	5			General Landscaping	1	ea.			0		0	\$60,000	60,000		0		0	60,000
	6			Water and Sewer Piping	80	m			0		0	\$250	20,000		0		0	20,000
	7			Granular Base - 150mm	3,465	tonne			0		0	\$35	121,275		0		0	121,275
	8			Granular Sub-Base - 300mm	6,930	tonne			0		0	\$18	124,740		0		0	124,740
	9			Asphalt - (Base and Seal)	2,205	tonne			0		0	\$150	330,750		0		0	330,750
	10			Fencing (8ft, angular razor wire)	1,000	m			0		0	\$300	300,000		0		0	300,000
	11			Automatic Slide Gate (10m)	2	ea.			0		0	\$6,000	12,000		0		0	12,000
	12			Slide Gate (10m)	1	ea.			0		0	\$2,000	2,000		0		0	2,000
	13			Potable Water Well, pump, line, and HW tank.	1	ea.			0		0	\$80,000	80,000		0		0	80,000
	14			Septic System	1	ea.			0		0	\$50,000	50,000		0		0	50,000
	15			Double walled U/G diesel line form storage to plant	100	m			0		0	\$1,500	150,000		0		0	150,000
	16			FIRE WATER					0		0		1,200,000		755,000		0	1,955,000
	17			Fire water heated storage (2x 30ft dia x 30ft tanks, insulated, 250,000 gal)	2	ea			0		0		0	300,000	600,000		0	600,000
	18			Fire water pump house (electric and diesel driven fire pumps, building)	1	lot			0		0	900,000	900,000		0		0	900,000
	19			Fire Loop (allowance) & Recirc Pumps	1,000	m			0		0	\$300	300,000		50,000		0	350,000
	20			Fire Hydrants	10	ea.			0		0		0	10,500	105,000		0	105,000

Prepared by: AW / RM Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: AF



STANTEC CONSULTING Opinion of Probable Construction Cost Buildings and Structures DL-LF-05: Diesel - Landfill - 5 MWe

							Labour				Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Tabul
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL				0		(722,825		80,000		4,200,000	5,002,825
	1			FUEL STORAGE				0		(245,000		80,000		0	325,000
	2			Truck Unloading Pad				0		()	0		0		0	C
	3			Concrete Pad 10 m x 35 m x 0.3 m	105	m ³		0		(1,500	157,500		0		0	157,500
	4			Process/Tank Containment				0		()	0		0		0	C
	5			Containment Tank / Piping	1	lot		0		(20,000	20,000	80,000	80,000		0	100,000
	6			Concrete pad 30 m x 5 m x 0.3 m	45	m ³		0		(1,500	67,500		0		0	67,500
	7			GENERATOR HALL				0		(108,825		0		4,200,000	4,308,825
	8			Pre-engineered Building				0		()	0		0		0	C
	9			Building Size 25 m x 70 m	1,750	m ²		0		()	0		0	2,400	4,200,000	4,200,000
	10			Generator Foundation				0		()	0		0		0	0
	11			Thickened Slab 4 m x 10 m x 0.5 m / each quantity 2	40	m ³		0		(1,500	60,000		0		0	60,000
	12			Generator Stack Foundation				0		()	0		0		0	C
	13			Concrete Pad 2.5 m x 2.5 m x 0.3 m / each quantity 2	4	m ³		0		(1,500	5,625		0		0	5,625
	14			Radiator Foundation				0		()	0		0		0	C
	15			Concrete Pad 6 m x 8 m x 0.3 m / each quantity 2	29	m ³		0		(1,500	43,200		0		0	43,200
	16			SUBSTATION				0		(D	369,000		0		0	369,000
	17			Transformer				0		()	0		0		0	C
	18			Base 12 m x 18 m x 0.5 m	108	m ³		0		(1,500	162,000		0		0	162,000
	19			Containment Walls 60 m x 1.2 m x 0.25 m	18	m ³		0		(1,500	27,000		0		0	27,000
	20			Pier 11 m x 7.4 m x 1.2 m	98	m ³		0		(1,500	146,520		0		0	146,520
	21			Steel Grating 1.5 m x 48.8 m	73	m ²		0		(150	10,980		0		0	10,980
	22			Breaker				0		()	0		0		0	0
	23			Concrete Pad 5 m x 10 m x 0.3 m	15	m ³		0		(1,500	22,500		0		0	22,500

Prepared by: JS Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Mechanical & Process DL-LF-05: Diesel - Landfill - 5 MWe

									Labou	ur		Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					4,143		455,693		112,500		1,463,750		0	2,031,943
	1			Prime Movers and Fuel Storage (See Major Equipment)					0		0		0		0		0	0
	2			Fuel System Piping (from fuel storage, building internal)	2	lot	107	1.30	277	110.00	30,507	5,000	10,000	75,000	150,000		0	190,507
	3			Glycol Heating System (incl unit heaters, electric & diesel boiler)	2	lot	107	1.30	277	110.00	30,507	7,500	15,000	150,000	300,000		0	345,507
	4			Generating Station HVAC (electric unit heaters, building and combustion ventilation)	1	lot	1,280	1.30	1,664	110.00	183,040	40,000	40,000	400,000	400,000		0	623,040
	5			Allowance for Building Services / Plumbing	1	lot	480	1.30	624	110.00	68,640	15,000	15,000	110,000	110,000		0	193,640
	6			Allowance for Lube / Waste Oil System	1	lot	320	1.30	416	110.00	45,760	10,000	10,000	80,000	80,000		0	135,760
	7			Continuous Emissions Monitoring System	1	lot	360	1.30	468	110.00	51,480	15,000	15,000	175,000	175,000		0	241,480
	8			Instrument and Plant Compressed Air Systems	1	lot	320	1.30	416	110.00	45,760	10,000	7,500	100,000	100,000		0	153,260
	9			Generating Station Sprinkler System, extinguisher, fire protection equipment	1,750	m ²			0		0		0	85	148,750		0	148,750

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16

Checked: LF



STANTEC CONSULTING Opinion of Probable Construction Cost Electrical, I&C DL-LF-05: Diesel - Landfill - 5 MWe

									Labo	ur		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Tabul
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					5,037		604,089		1,664,900		1,110,713		0	3,379,702
	1			STATION ELECTRICAL					2,457		270,270		840,000		345,000		0	1,455,270
	2			Site wide Grounding Grid	1	lot	200	1.30	260	110.00	28,600	50,000	50,000		0		0	78,600
	3			Trench and conduit	1	lot	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	4			Transformer Protection Panel	1	ea	40	1.30	52	110.00	5,720		0	50,000	50,000		0	55,720
	5			Annunciator / Control / Metering Panel	1	ea	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	6			SCADA / Communications	1	lot	60	1.30	78	110.00	8,580		0	50,000	50,000		0	58,580
	7			5kV, 3000A Switchgear	1	lot	40	1.30	52	110.00	5,720	120,000	120,000		0		0	125,720
	8			Station Services MCC (allow 10 Sections)	10	sect	10	1.30	130	110.00	14,300		0	8,500	85,000		0	99,300
	9			BOP PLC and Instrumentation (100 Points, \$1000 per Point)	1	ls			0		0		0	100,000	100,000		0	100,000
	10			Medium/Low Voltage Cable	3,000	ft	0.15	1.30	585	110.00	64,350	30	90,000		0		0	154,350
	11			Cable Tray and Cables from Unit Output to Electrical Room	3,000	ft	0.30	1.30	1,170	110.00	128,700	45	135,000		0		0	263,700
	12			Utility Metering Allowance	1	lot	20	1.30	26	110.00	2,860	20,000	20,000		0		0	22,860
	13			Engine & Auxiliaries Instrumentation	1	lot			0		0	50,000	50,000		0		0	50,000
	14			Black Start Diesel Genset and Auxiliaries	1	lot			0		0	375,000	375,000		0		0	375,000
	15			BUILDING SERVICES					286		31,460		110,000		43,000		0	184,460
	16			Station Service Transformer 300KVA Dry Type Indoor (for Station Services MCC)	1	ea	25	1.30	33	110.00	3,575		0	25,000	25,000		0	28,575
	17			Station Service AC and DC distribution Panels (for transformer and breaker)	2	ea	20	1.30	52	110.00	5,720		0	4,000	8,000		0	13,720
	18			125V DC Station service battery	1	ea	40	1.30	52	110.00	5,720		0	8,000	8,000		0	13,720
-	19			125V DC Station service battery charger	1	ea	15	1.30	20	110.00	2,145		0	2,000	2,000		0	4,145
	20			Building Services Allowance	1	lot			0		0	95,000	95,000		0		0	95,000
	21			Miscellaneous (tray, conduit, terminal blocks, etc.)	1	lot	100	1.30	130	110.00	14,300	15,000	15,000		0		0	29,300
	22			SUBSTATION					2,294		252,359		39,900		722,713		0	1,014,972
	23			Transformer - 5MW, 4.16 kV / 34.5 kV, +/- 5% Off Load Tap Changer and multi ratio CTs	1	ea	180	1.30	234	110.00	25,740	12,000	12,000	255,000	255,000		0	292,740
	24			Breaker - 34.5 kV, 650 kV BIL, 600A, 31.5 kA (min) outdoor dead tank c/w multi-ratio CTs	1	ea	135	1.30	176	110.00	19,305	2,250	2,250	166,500	166,500		0	188,055
	25			Disconnect - 34.5 kV, 600A Vertical Break, Group Operated, c/w interlocked ground switch	1	ea	68	1.30	88	110.00	9,653	2,250	2,250	36,000	36,000		0	47,903
	26			Potential Transformer - 34.5 kV, dual winding, outdoor, post type	3	ea	18	1.30	70	110.00	7,722	1,125	3,375	11,250	33,750		0	44,847
	27			Surge Arrestor - 24.4 kV MCOV, outdoor, station class, surge arresters	3	ea	11	1.30	44	110.00	4,826	1,125	3,375	1,238	3,713		0	11,914
	28			Cable - 5 kV, 1/0 AWG, XLPE insulation, aluminum conductor, 100% insulation	240	М	0.5	1.30	140	110.00	15,444	0	0	79	18,900		0	34,344
	29			Conductor - Bare, 336.4 kcmil AAC (Tulip)	60	М	0.7	1.30	53	110.00	5,792	0	0	23	1,350		0	7,142
	30			Cable Terminations	12	ea	7	1.30	105	110.00	11,583	450	5,400	0	0		0	16,983
	31			Misc Hardware and electrical connectors	1	lot	135	1.30	176	110.00	19,305	11,250	11,250	0	0		0	30,555
	32			Line Protection Panel	1	ea	180	1.30	234	110.00	25,740	0	0	112,500	112,500		0	138,240
	33			34.5 kV Interconnection - poles, conductor, hardware, deadends	1	lot	750	1.30	975	110.00	107,250		0	95,000	95,000		0	202,250
	34			SITE SECURITY					0		50,000		300,000		0		0	350,000
	35			Roadway / Site Lighting	1	ls			0		50,000	100,000	100,000		0		0	150,000
	36			CCTV Security and Integration to System Control Centre	1	ls			0		0	75,000	75,000		0		0	75,000
	37			Fire Alarm Systems	1	ls			0		0	75,000	75,000		0		0	75,000
	38			Communications (fibre, CAT5, telephone)	1	ls			0		0	50,000	50,000		0		0	50,000
	39			EI&C MISCELLANEOUS					0		0		375,000		0		0	375,000
	40			Engine, fuel, and auxiliaries controls installation	300	pt			0		0	750	225,000		0		0	225,000
	41	1		Miscellaneous BOP Electrical Equipment Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	42			Miscellaneous Engine Electrical Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	43			Miscellaneous Electrical Equipment Grounding	1	ls			0		0	50,000	50,000		0		0	50,000

Prepared by: CGV / RF Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: ES



STANTEC CONSULTING Opinion of Probable Construction Cost Indirect and Owner's Costs DL-LF-05: Diesel - Landfill - 5 MWe

									Labou	ır		Mat'l/Co	ommodity	Equip	oment	Sub-Co	ntractor	Tabul
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0		0		0)	C		0	3,552,684
	1			Based on recent YEC experience, an 18% factor on direct costs is incorporated to cover:					0		0)	C)	C)	0	3,552,684
	2			Contractor General Conditions					0		0)	C)	C)	0	0
	3			Security					0		0)	C)	C)	0	0
	4			Lock-out tag-out (LOTO) coordination					0		0)	C)	C)	0	0
	5			Waste removal					0		0)	C)	C)	0	0
	6			Snow removal					0		0)	C)	C)	0	0
	7			Warehousing and utilities including temporary power supply					0		0)	C)	C)	0	0
	8			Temporary construction lighting					0		0)	C)	C)	0	0
	9			Taxes					0		0)	C)	C)	0	0
	10			Interest charges during construction.					0		0)	C)	C)	0	0
	11			Land acquisition and zoning					0		0)	C)	C)	0	0
	12			Environmental studies, YESAB assessment and all permitting					0		0)	C)	C)	0	0
	13			Owner's administration costs, including:					0		0)	C)	C)	0	0
	14			Legal fees.					0		0)	C)	C)	0	0
	15			Insurance.					0		0)	C)	C)	0	0
	16			Salaries & expenses of Owner's project staff.					0		0)	C)	C)	0	0
	17			Allowance for operators hours & fuel costs during training, commissioning, and start up.					0		0)	C)	C)	0	0
	18			Special costs to dispose from site construction waste.					0		0)	C)	C)	0	0
	19								0		0)	C)	C)	0	0

Prepared by: Team

Date: 16-May-16

Revision No.: A

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Summary DL-LF-10: Diesel - Landfill - 10 MWe

Area	Line	Rev.	Description	Labour Hours	Labour Cost	Mat'I/Commodity Cost	Equipment Cost	Sub-Contractor Cost	Total Cost
-	0	-	PROJECT TOTAL, BASE SCOPE	20,822 hrs	\$2,454,188	\$6,199,300	\$11,896,463	\$5,766,500	\$42,180,847
-	1	-	Major Equipment	10,192 hrs	\$1,121,120	\$382,750	\$7,655,000	\$300,000	\$9,458,870
-	2	-	General Civil	00 hrs	\$0	\$3,044,800	\$755,000	\$0	\$3,799,800
-	3	-	Buildings and Structures	00 hrs	\$0	\$788,450	\$80,000	\$5,400,000	\$6,268,450
-	4	-	Mechanical and Process	4,697 hrs	\$516,707	\$152,500	\$1,978,750	\$0	\$2,647,957
-	5	-	Electrical, Instrumentation & Controls	5,933 hrs	\$702,616	\$1,830,800	\$1,274,613	\$0	\$3,808,029
-	6	-	Sub Total Directs	20,822 hrs	\$2,340,443	\$6,199,300	\$11,743,363	\$5,700,000	\$25,983,105
-	7	-	AFE Engineering @ 3% of Directs	-	-	-	-	-	\$779,493
-	8	-	Detail Engineering @ 8% Direct Construction Cost	-	-	-	-	-	\$2,078,648
-	9	-	Construction Staff & Consultants and Construction Management Fee @3.5%	-	-	-	-	-	\$909,409
-	10	-	Commissioning Costs - Excluding Owner's Staff @ 1.5% of Directs	-	-	-	-	-	\$389,747
-	11	-	Escalation Allowance @ 3.5% Labour, 3.5% Construction Staff & Mgmt Fee, & 3.5% of 1/3 Sub-Contractor Cost	-	\$113,745	-	-	\$66,500	\$180,245
-	12	-	Capital Spares - 2% Major Equipment	-	-	-	\$153,100	-	\$153,100
-	13	-	Indirect Construction Costs and Owner's Costs (See Line Item List, 18% of Directs)	-	-	-	-	-	\$4,676,959
-	14	-	Sub Total In-Directs	00 hrs	\$113, 74 5	\$0	\$153,100	\$66,500	\$9,167,601
-	15	-	Contingency of 20% - AACE Class 5 Opinion of Probable Cost						\$7,030,141

Prepared by: **Team** Date: **16-May-16** Revision No.: **A**

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Major Equipment DL-LF-10: Diesel - Landfill - 10 MWe

									Labo	ur		Mat'l/Co	nmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					10,192		1,121,120		382,750		7,655,000		300,000	9,458,870
	1			Generating Station					0		0		0		0		0	0
	2			Diesel fired Reciprocating Engine - 2.5 MWe capacity, 4,160V	4	unit	1,280	1.30	6,656	110.00	732,160	75,000	300,000	1,500,000	6,000,000		0	7,032,160
	3			Transportation	4	ea			0		0		0		0	75,000	300,000	300,000
	4			Includes:					0		0		0		0		0	0
	5			Prime Mover					0		0		0		0		0	0
	6			Generator and Auxiliaries					0		0		0		0		0	0
	7			Mechanical Auxiliaries (circulating pumps / radiator)					0		0		0		0		0	0
	8			Electrical Control Equipment					0		0		0		0		0	0
	9			Heat Recovery / Rejection					0		0		0		0		0	0
	10			Engineering / Project Management / Drawings					0		0		0		0		0	0
	11			Sound Attenuation					0		0		0		0		0	0
	12			Diesel Tank Farm					0		0		0		0		0	0
	13			Diesel storage tanks: Double Walled (100% secondary containment, standard 75,000L design)	7	ea	160	1.30	1,456	110.00	160,160	3,250	22,750	65,000	455,000		0	637,910
	14			Diesel truck unloading and pump house, undergound containment tank, sump and lines	1	ea	1,600	1.30	2,080	110.00	228,800	60,000	60,000	1,200,000	1,200,000		0	1,488,800
	15			Transportation	8	ea			0		0		0		0	20,000	160,000	160,000

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: HC



STANTEC CONSULTING Opinion of Probable Construction Cost Civil DL-LF-10: Diesel - Landfill - 10 MWe

									Labou	Jr		Mat'l/Coi	nmodity	Equip	oment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			GENERAL CIVIL TOTAL					0		(3,044,800		755,000		0	3,799,800
	1			Clearing & Grubbing	5.5	ha			0		(\$30,000	165,000		0		0	165,000
	2			Excavation & Backfill for Structures & Slab (Allowance)	1	ea.			0		(\$225,000	225,000		0		0	225,000
	3			Site Drainage and Culverts (Allowance)	1	ea.			0		(\$125,000	125,000		0		0	125,000
	4			Site Grading - Incl. Roads and Parking Lot Preparation	5,500	m ³			0		(\$15	82,500		0		0	82,500
	5			General Landscaping	1	ea.			0		(\$60,000	60,000		0		0	60,000
	6			Water and Sewer Piping	80	m			0		(\$250	20,000		0		0	20,000
	7			Granular Base - 150mm	6,930	tonne			0		(\$35	242,550		0		0	242,550
	8			Granular Sub-Base - 300mm	0	tonne			0		(\$18	0		0		0	(
	9			Asphalt - (Base and Seal)	2,205	tonne			0		(\$150	330,750		0		0	330,750
	10			Fencing (8ft, angular razor wire)	1,000	m			0		(\$300	300,000		0		0	300,000
	11			Automatic Slide Gate (10m)	2	ea.			0		(\$6,000	12,000		0		0	12,000
	12			Slide Gate (10m)	1	ea.			0		(\$2,000	2,000		0		0	2,000
	13			Potable Water Well, pump, line, and HW tank.	1	ea.			0		(\$80,000	80,000		0		0	80,000
	14			Septic System	1	ea.			0		(\$50,000	50,000		0		0	50,000
	15			Double walled U/G diesel line form storage to plant	100	m			0		(\$1,500	150,000		0		0	150,000
	16			FIRE WATER					0		(1,200,000		755,000		0	1,955,000
	17			Fire water heated storage (2x 30ft dia x 30ft tanks, insulated, 250,000 gal)	2	ea			0		()	0	300,000	600,000		0	600,000
	18			Fire water pump house (electric and diesel driven fire pumps, building)	1	lot			0		(900,000	900,000		0		0	900,000
	19			Fire Loop (allowance) & Recirc Pumps	1,000	m			0		(\$300	300,000		50,000		0	350,000
	20			Fire Hydrants	10	ea.			0		()	0	10,500	105,000		0	105,000

Prepared by: AW / RM Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: AF



STANTEC CONSULTING Opinion of Probable Construction Cost Buildings and Structures DL-LF-10: Diesel - Landfill - 10 MWe

									Labou	Jr		Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Tabal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0		C		788,450		80,000		5,400,000	6,268,450
	1			FUEL STORAGE					0		C		245,000		80,000		0	325,000
	2			Truck Unloading Pad					0		C)	0		0		0	0
	3			Concrete Pad 10 m x 35 m x 0.3 m	105	m ³			0		C	1,500	157,500		0		0	157,500
	4			Process/Tank Containment					0		C)	0		0		0	0
	5			Containment Tank / Piping	1	lot			0		C	20,000	20,000	80,000	80,000		0	100,000
	6			Concrete pad 30 m x 5 m x 0.3 m	45	m ³			0		C	1,500	67,500		0		0	67,500
	7			GENERATOR HALL					0		C)	174,450		0		5,400,000	5,574,450
	8			Pre-engineered Building					0		C)	0		0		0	0
	9			Building Size 25 m x 90 m	2,250	m ²			0		C)	0		0	2,400	5,400,000	5,400,000
	10			Generator Foundation					0		C)	0		0		0	0
	11			Thickened Slab 4 m x 10 m x 0.5 m / each quantity 4	80	m ³			0		C	1,500	120,000		0		0	120,000
	12			Generator Stack Foundation					0		C)	0		0		0	0
	13			Concrete Pad 2.5 m x 2.5 m x 0.3 m / each quantity 4	8	m ³			0		C	1,500	11,250		0		0	11,250
	14			Radiator Foundation					0		C)	0		0		0	0
	15			Concrete Pad 4 m x 6 m x 0.3 m / each quantity 4	29	m ³			0		C	1,500	43,200		0		0	43,200
	16			SUBSTATION					0		C)	369,000		0		0	369,000
	17			Transformer					0		C)	0		0		0	0
	18			Base 12 m x 18 m x 0.5 m	108	m ³			0		C	1,500	162,000		0		0	162,000
	19			Containment Walls 60 m x 1.2 m x 0.25 m	18	m ³			0		C	1,500	27,000		0		0	27,000
	20			Pier 11 m x 7.4 m x 1.2 m	98	m ³			0		C	1,500	146,520		0		0	146,520
	21			Steel Grating 1.5 m x 48.8 m	73	m ²			0		C	150	10,980		0		0	10,980
	22			Breaker					0		C)	0		0		0	0
	23			Concrete Pad 5 m x 10 m x 0.3 m	15	m ³			0		C	1,500	22,500		0		0	22,500

Prepared by: JS Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Mechanical & Process DL-LF-10: Diesel - Landfill - 10 MWe

									Labou	ur		Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Tatal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					4,697		516,707		152,500		1,978,750		0	2,647,957
	1			Prime Movers and Fuel Storage (See Major Equipment)					0		0		0		0		0	0
	2			Fuel System Piping (from fuel storage, building internal)	4	lot	107	1.30	555	110.00	61,013	5,000	20,000	60,000	240,000		0	321,013
	3			Glycol Heating System (incl unit heaters, electric & diesel boiler)	4	lot	107	1.30	555	110.00	61,013	7,500	30,000	125,000	500,000		0	591,013
	4			Generating Station HVAC (electric unit heaters, building and combustion ventilation)	1	lot	1,280	1.30	1,664	110.00	183,040	50,000	50,000	500,000	500,000		0	733,040
	5			Allowance for Building Services / Plumbing	1	lot	480	1.30	624	110.00	68,640	15,000	15,000	135,000	135,000		0	218,640
	6			Allowance for Lube / Waste Oil System	1	lot	320	1.30	416	110.00	45,760	10,000	10,000	90,000	90,000		0	145,760
	7			Continuous Emissions Monitoring System	1	lot	360	1.30	468	110.00	51,480	20,000	20,000	220,000	220,000		0	291,480
	8			Instrument and Plant Compressed Air Systems	1	lot	320	1.30	416	110.00	45,760	12,500	7,500	125,000	125,000		0	178,260
	9			Generating Station Sprinkler System, extinguisher, fire protection equipment	2,250	m ²			0		0		0	75	168,750		0	168,750

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16

Checked: LF



STANTEC CONSULTING Opinion of Probable Construction Cost Electrical, I&C DL-LF-10: Diesel - Landfill - 10 MWe

									Labo	ur		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Tabul
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					5,933		702,616		1,830,800		1,274,613		0	3,808,029
	1			STATION ELECTRICAL					3,107		341,770		940,000		412,500		0	1,694,270
	2			Site wide Grounding Grid	1	lot	200	1.30	260	110.00	28,600	60,000	60,000		0		0	88,600
	3			Trench and conduit	1	lot	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	4			Transformer Protection Panel	1	ea	40	1.30	52	110.00	5,720		0	50,000	50,000		0	55,720
	5			Annunciator / Control / Metering Panel	1	ea	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	6			SCADA / Communications	1	lot	60	1.30	78	110.00	8,580		0	50,000	50,000		0	58,580
	7			5kV, 3000A Switchgear	1	lot	40	1.30	52	110.00	5,720	120,000	120,000		0		0	125,720
	8			Station Services MCC (allow 15 Sections)	15	sect	10	1.30	195	110.00	21,450		0	8,500	127,500		0	148,950
	9			BOP PLC and Instrumentation (125 Points, \$1000 per Point)	1	ls			0		0		0	125,000	125,000		0	125,000
	10			Medium/Low Voltage Cable	4,000	ft	0.15	1.30	780	110.00	85,800	30	120,000		0		0	205,800
	11			Cable Tray and Cables from Unit Output to Electrical Room	4,000	ft	0.30	1.30	1,560	110.00	171,600	45	180,000		0		0	351,600
	12			Utility Metering Allowance	1	lot	20	1.30	26	110.00	2,860	20,000	20,000		0		0	22,860
	13			Engine & Auxiliaries Instrumentation	1	lot			0		0	65,000	65,000		0		0	65,000
	14			Black Start Diesel Genset and Auxiliaries	1	lot			0		0	375,000	375,000		0		0	375,000
	15			BUILDING SERVICES					286		31,460		130,000		45,500		0	206,960
	16			Station Service Transformer 400KVA Dry Type Indoor (for Station Services MCC)	1	ea	25	1.30	33	110.00	3,575		0	27,500	27,500		0	31,075
	17			Station Service AC and DC distribution Panels (for transformer and breaker)	2	ea	20	1.30	52	110.00	5,720		0	4,000	8,000		0	13,720
	18			125V DC Station service battery	1	ea	40	1.30	52	110.00	5,720		0	8,000	8,000		0	13,720
	19			125V DC Station service battery charger	1	ea	15	1.30	20	110.00	2,145		0	2,000	2,000		0	4,145
	20			Building Services Allowance	1	lot			0		0	115,000	115,000		0		0	115,000
	21			Miscellaneous (tray, conduit, terminal blocks, etc.)	1	lot	100	1.30	130	110.00	14,300	15,000	15,000		0		0	29,300
	22			SUBSTATION					2,540		279,386		48,300		816,613		0	1,144,299
	23			Transformer - 10 MW, 4.16 kV / 34.5 kV, +/- 5% Off Load Tap Changer and multi ratio CTs	1	ea	180	1.30	234	110.00	25,740	15,000	15,000	330,000	330,000		0	370,740
	24			Breaker - 34.5 kV, 650 kV BIL, 800A (min), 31.5 kA (min) outdoor dead tank	1	ea	135	1.30	176	110.00	19,305	2,250	2,250	166,500	166,500		0	188,055
	25			Disconnect - 34.5 kV, 600A Vertical Break, Group Operated, c/w interlocked ground switch	1	ea	68	1.30	88	110.00	9,653	2,250	2,250	36,000	36,000		0	47,903
	26			Potential Transformer - 34.5 kV, dual winding, outdoor, post type	3	ea	18	1.30	70	110.00	7,722	1,125	3,375	11,250	33,750		0	44,847
	27			Surge Arrestor - 24.4 kV MCOV, outdoor, station class, surge arresters	3	ea	11	1.30	44	110.00	4,826	1,125	3,375	1,238	3,713		0	11,914
	28			Cable - 5 kV, 500MCM, XLPE insulation, aluminum conductor, 100% insulation	480	Μ	0.5	1.30	281	110.00	30,888	0	0	79	37,800		0	68,688
	29			Conductor - Bare, 2/0 AWG AAC (Aster)	60	Μ	0.7	1.30	53	110.00	5,792	0	0	23	1,350		0	7,142
	30			Cable Terminations	24	ea	7	1.30	211	110.00	23,166	450	10,800	0	0		0	33,966
	31			Misc Hardware and electrical connectors	1	lot	135	1.30	176	110.00	19,305	11,250	11,250	0	0		0	30,555
	32			Line Protection Panel	1	ea	180	1.30	234	110.00	25,740	0	0	112,500	112,500		0	138,240
	33			34.5 kV Interconnection - poles, conductor, hardware, deadends	1	lot	750	1.30	975	110.00	107,250		0	95,000	95,000		0	202,250
	34			SITE SECURITY					0		50,000		300,000		0		0	350,000
	35			Roadway / Site Lighting	1	ls			0		50,000	100,000	100,000		0		0	150,000
	36			CCTV Security and Integration to System Control Centre	1	ls			0		0	75,000	75,000		0		0	75,000
	37			Fire Alarm Systems	1	ls			0		0	75,000	75,000		0		0	75,000
	38			Communications (fibre, CAT5, telephone)	1	ls			0		0	50,000	50,000		0		0	50,000
	39			EI&C MISCELLANEOUS					0		0		412,500		0		0	412,500
	40			Engine, fuel, and auxiliaries controls installation	350	pt			0		0	750	262,500		0		0	262,500
	41			Miscellaneous BOP Electrical Equipment Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	42			Miscellaneous Engine Electrical Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	43			Miscellaneous Electrical Equipment Grounding	1	ls			0		0	50,000	50,000		0		0	50,000

Prepared by: CGV / RF Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: ES



STANTEC CONSULTING Opinion of Probable Construction Cost Indirect and Owner's Costs DL-LF-10: Diesel - Landfill - 10 MWe

									Labou	Jr		Mat'l/Co	ommodity	Equip	oment	Sub-Co	ntractor	Tabal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0		0		0)	C		0	4,676,959
	1			Based on recent YEC experience, an 18% factor on direct costs is incorporated to cover:					0		0		C)	C)	0	4,676,959
	2			Contractor General Conditions					0		0		C)	C)	0	0
	3			Security					0		0		C)	C)	0	0
	4			Lock-out tag-out (LOTO) coordination					0		0		C)	C)	0	0
	5			Waste removal					0		0		C)	C)	0	0
	6			Snow removal					0		0		C)	C)	0	0
	7			Warehousing and utilities including temporary power supply					0		0		C)	C)	0	0
	8			Temporary construction lighting					0		0		C)	C)	0	0
	9			Taxes					0		0		C)	C)	0	0
	10			Interest charges during construction.					0		0		C)	C)	0	0
	11			Land acquisition and zoning					0		0		C)	C)	0	0
	12			Environmental studies, YESAB assessment and all permitting					0		0		C)	C)	0	0
	13			Owner's administration costs, including:					0		0		C)	C)	0	0
	14			Legal fees.					0		0		C)	C)	0	0
	15			Insurance.					0		0		C)	C)	0	0
	16			Salaries & expenses of Owner's project staff.					0		0		C)	C)	0	0
	17			Allowance for operators hours & fuel costs during training, commissioning, and start up.					0		0		C)	C)	0	0
	18			Special costs to dispose from site construction waste.					0		0		C)	C)	0	0
	19								0		0		C)	C)	0	0

Prepared by: Team

Date: 16-May-16

Revision No.: A

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Summary DL-LF-20: Diesel - Landfill - 20 MWe

Area	Line	Rev.	Description	Labour Hours	Labour Cost	Mat'I/Commodity Cost	Equipment Cost	Sub-Contractor Cost	Total Cost
-	0	-	PROJECT TOTAL, BASE SCOPE	27,381 hrs	\$3,216,122	\$6,948,175	\$20,363,550	\$8,467,650	\$62,478,68 4
-	1	-	Major Equipment	14,976 hrs	\$1,647,360	\$755,500	\$15,110,000	\$450,000	\$17,962,860
-	2	-	General Civil	00 hrs	\$0	\$3,044,800	\$755,000	\$0	\$3,799,800
-	3	-	Buildings and Structures	00 hrs	\$0	\$952,775	\$80,000	\$7,920,000	\$8,952,775
-	4	-	Mechanical and Process	5,252 hrs	\$577,720	\$187,500	\$2,397,500	\$0	\$3,162,720
-	5	-	Electrical, Instrumentation & Controls	7,153 hrs	\$836,786	\$2,007,600	\$1,718,850	\$0	\$4,563,236
-	6	-	Sub Total Directs	27,381 hrs	\$3,061,866	\$6,948,175	\$20,061,350	\$8,370,000	\$38,441,391
-	7	-	AFE Engineering @ 3% of Directs	-	-	-	-	-	\$1,153,242
-	8	-	Detail Engineering @ 8% Direct Construction Cost	-	-	-	-	-	\$3,075,311
-	9	-	Construction Staff & Consultants and Construction Management Fee @3.5%	-	-	-	-	-	\$1,345,449
-	10	-	Commissioning Costs - Excluding Owner's Staff @ 1.5% of Directs	-	-	-	-	-	\$576,621
-	11	-	Escalation Allowance @ 3.5% Labour, 3.5% Construction Staff & Mgmt Fee, & 3.5% of 1/3 Sub-Contractor Cost	-	\$154,256	-	-	\$97,650	\$251,906
-	12	-	Capital Spares - 2% Major Equipment	-	-	-	\$302,200	-	\$302,200
-	13	-	Indirect Construction Costs and Owner's Costs (See Line Item List, 18% of Directs)	-	-	-	-	-	\$6,919,450
-	14	-	Sub Total In-Directs	00 hrs	\$1 <mark>54,256</mark>	\$0	\$302,200	\$ <mark>97,650</mark>	\$13,624,179
-	15	-	Contingency of 20% - AACE Class 5 Opinion of Probable Cost						\$10,413,114

Prepared by: **Team** Date: **16-May-16**

Revision No.: A

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Major Equipment DL-LF-20: Diesel - Landfill - 20 MWe

									Labo	ur		Mat'l/Cor	nmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					14,976		1,647,360		755,500		15,110,000		450,000	17,962,860
	1			Generating Station					0		0		0		0		0	C
	2			Diesel fired Reciprocating Engine - 2.5 MWe capacity, 4,160V	4	unit	1,280	1.30	6,656	110.00	732,160	75,000	300,000	1,500,000	6,000,000		0	7,032,160
	3			Diesel fired Reciprocating Engine - 5.0 MWe capacity, 4,160V	2	unit	1,280	1.30	3,328	110.00	366,080	175,000	350,000	3,500,000	7,000,000		0	7,716,080
	3			Transportation	6	ea			0		0		0		0	75,000	450,000	450,000
	4			Includes:					0		0		0		0		0	C
	5			Prime Mover					0		0		0		0		0	C
	6			Generator and Auxiliaries					0		0		0		0		0	C
	7			Mechanical Auxiliaries (circulating pumps / radiator)					0		0		0		0		0	C
	8			Electrical Control Equipment					0		0		0		0		0	C
	9			Heat Recovery / Rejection					0		0		0		0		0	C
	10			Engineering / Project Management / Drawings					0		0		0		0		0	C
	11			Sound Attenuation					0		0		0		0		0	C
	12			Diesel Tank Farm					0		0		0		0		0	C
	13			Diesel storage tanks: Double Walled (100% secondary containment, standard 75,000L design)	14	ea	160	1.30	2,912	110.00	320,320	3,250	45,500	65,000	910,000		0	1,275,820
	14			Diesel truck unloading and pump house, undergound containment tank, sump and lines	1	ea	1,600	1.30	2,080	110.00	228,800	60,000	60,000	1,200,000	1,200,000		0	1,488,800
	15			Transportation	16	ea			0		0		0		0	20,000	320,000	320,000

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: HC



STANTEC CONSULTING Opinion of Probable Construction Cost Civil DL-LF-20: Diesel - Landfill - 20 MWe

									Labou	ır		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ontractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			GENERAL CIVIL TOTAL					0		0		3,044,800		755,000)	0	3,799,800
	1			Clearing & Grubbing	5.5	ha			0		0	\$30,000	165,000		C)	0	165,000
	2			Excavation & Backfill for Structures & Slab (Allowance)	1	ea.			0		0	\$225,000	225,000		C)	0	225,000
	3			Site Drainage and Culverts (Allowance)	1	ea.			0		0	\$125,000	125,000		C)	0	125,000
	4			Site Grading - Incl. Roads and Parking Lot Preparation	5,500	m ³			0		0	\$15	82,500		C)	0	82,500
	5			General Landscaping	1	ea.			0		0	\$60,000	60,000		C)	0	60,000
	6			Water and Sewer Piping	80	m			0		0	\$250	20,000		C)	0	20,000
	7			Granular Base - 150mm	6,930	tonne			0		0	\$35	242,550		C)	0	242,550
	8			Granular Sub-Base - 300mm	0	tonne			0		0	\$18	0		C)	0	C
	9			Asphalt - (Base and Seal)	2,205	tonne			0		0	\$150	330,750		C)	0	330,750
	10			Fencing (8ft, angular razor wire)	1,000	m			0		0	\$300	300,000		C)	0	300,000
	11			Automatic Slide Gate (10m)	2	ea.			0		0	\$6,000	12,000		C)	0	12,000
	12			Slide Gate (10m)	1	ea.			0		0	\$2,000	2,000		C)	0	2,000
	13			Potable Water Well, pump, line, and HW tank.	1	ea.			0		0	\$80,000	80,000		C)	0	80,000
	14			Septic System	1	ea.			0		0	\$50,000	50,000		C)	0	50,000
	15			Double walled U/G diesel line form storage to plant	100	m			0		0	\$1,500	150,000		C)	0	150,000
	16			FIRE WATER					0		0		1,200,000		755,000		0	1,955,000
	17			Fire water heated storage (2x 30ft dia x 30ft tanks, insulated, 250,000 gal)	2	ea			0		0		0	300,000	600,000)	0	600,000
	18			Fire water pump house (electric and diesel driven fire pumps, building)	1	lot			0		0	900,000	900,000		C)	0	900,000
	19			Fire Loop (allowance) & Recirc Pumps	1,000	m			0		0	\$300	300,000		50,000)	0	350,000
	20			Fire Hydrants	10	ea.			0		0		0	10,500	105,000)	0	105,000

Prepared by: AW / RM Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: AF



STANTEC CONSULTING Opinion of Probable Construction Cost Buildings and Structures DL-LF-20: Diesel - Landfill - 20 MWe

									Labou	ır		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Total Cost
	0			TOTAL					0		C)	952,775		80,000		7,920,000	8,952,775
	1			FUEL STORAGE					0		C)	245,000		80,000		0	325,000
	2			Truck Unloading Pad					0		0)	0		0		0	C
	3			Concrete Pad 10 m x 35 m x 0.3 m	105	m ³			0		C	1,500	157,500		0		0	157,500
	4			Process/Tank Containment					0		C)	0		0		0	C
	5			Containment Tank / Piping	1	lot			0		C	20,000	20,000	80,000	80,000		0	100,000
	6			Concrete pad 30 m x 5 m x 0.3 m	45	m ³			0		C	1,500	67,500		0		0	67,500
	7			GENERATOR HALL					0		C)	338,775		0		7,920,000	8,258,775
	8			Pre-engineered Building					0		C)	0		0		0	C
	9			Building Size 30 m x 110 m	3,300	m ²			0		C)	0		0	2,400	7,920,000	7,920,000
	10			Generator Foundation					0		C)	0		0		0	C
	11			Thickened Slab 4 m x 10 m x 0.5 m / each quantity 4	80	m ³			0		C	1,500	120,000		0		0	120,000
	12			Thickened Slab 5.5 m x 14 m x 0.5 m / each quantity 2	77	m ³			0		C	1,500	115,500		0		0	115,500
	13			Generator Stack Foundation					0		C)	0		0		0	C
	14			Concrete Pad 2.5 m x 2.5 m x 0.3 m / each quantity 6	11	m ³			0		C	1,500	16,875		0		0	16,875
	15			Radiator Foundation					0		C)	0		0		0	C
	16			Concrete Pad 4 m x 6 m x 0.3 m / each quantity 4	29	m ³			0		C	1,500	43,200		0		0	43,200
	17			Concrete Pad 6 m x 8 m x 0.3 m / each quantity 2	29	m ³			0		0	1,500	43,200		0		0	43,200
	18			SUBSTATION					0		C)	369,000		0		0	369,000
	19			Transformer					0		0)	0		0		0	C
	20			Base 12 m x 18 m x 0.5 m	108	m ³			0		C	1,500	162,000		0		0	162,000
	21			Containment Walls 60 m x 1.2 m x 0.25 m	18	m ³			0		C	1,500	27,000		0		0	27,000
	22			Pier 11 m x 7.4 m x 1.2 m	98	m ³			0		C	1,500	146,520		0		0	146,520
	23			Steel Grating 1.5 m x 48.8 m	73	m ²			0		C	150	10,980		0		0	10,980
	24			Breaker					0		C)	0		0		0	C
	25			Concrete Pad 5 m x 10 m x 0.3 m	15	m ³			0		(1,500	22,500		0		0	22,500

Prepared by: JS Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Mechanical & Process DL-LF-20: Diesel - Landfill - 20 MWe

									Labou	Jr		Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					5,252		577,720		187,500		2,397,500		0	3,162,720
	1			Prime Movers and Fuel Storage (See Major Equipment)					0		0		0		0		0	0
	2			Fuel System Piping (from fuel storage, building internal)	6	lot	107	1.30	832	110.00	91,520	5,000	30,000	50,000	300,000		0	421,520
	3			Glycol Heating System (incl unit heaters, electric & diesel boiler)	6	lot	107	1.30	832	110.00	91,520	7,500	45,000	100,000	600,000		0	736,520
	4			Generating Station HVAC (electric unit heaters, building and combustion ventilation)	1	lot	1,280	1.30	1,664	110.00	183,040	60,000	60,000	600,000	600,000		0	843,040
	5			Allowance for Building Services / Plumbing	1	lot	480	1.30	624	110.00	68,640	15,000	15,000	150,000	150,000		0	233,640
	6			Allowance for Lube / Waste Oil System	1	lot	320	1.30	416	110.00	45,760	10,000	10,000	100,000	100,000		0	155,760
	7			Continuous Emissions Monitoring System	1	lot	360	1.30	468	110.00	51,480	20,000	20,000	250,000	250,000		0	321,480
	8			Instrument and Plant Compressed Air Systems	1	lot	320	1.30	416	110.00	45,760	15,000	7,500	150,000	150,000		0	203,260
	9			Generating Station Sprinkler System, extinguisher, fire protection equipment	3,300	m ²			0		0		0	75	247,500		0	247,500

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16

Checked: LF



STANTEC CONSULTING Opinion of Probable Construction Cost Electrical, I&C DL-LF-20: Diesel - Landfill - 20 MWe

									Labou	Jr		Mat'l/Con	nmodity	Equip	oment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL			1		7,153		836,786		2,007,600		1,718,850		0	4,563,236
	1			STATION ELECTRICAL					3,757		413,270		1,050,000		480,000		0	1,943,270
	2			Site wide Grounding Grid	1	lot	200	1.30	260	110.00	28,600	70,000	70,000		0		0	98,600
	3			Trench and conduit	1	lot	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	4			Transformer Protection Panel	1	ea	40	1.30	52	110.00	5,720		0	50,000	50,000		0	55,720
	5			Annunciator / Control / Metering Panel	1	ea	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	6			SCADA / Communications	1	lot	60	1.30	78	110.00	8,580		0	50,000	50,000		0	58,580
	7			5kV, 3000A Switchgear	1	lot	40	1.30	52	110.00	5,720	120,000	120,000		0		0	125,720
	8			Station Services MCC (allow 20 Sections)	20	sect	10	1.30	260	110.00	28,600		0	8,500	170,000		0	198,600
	9			BOP PLC and Instrumentation (150 Points, \$1000 per Point)	1	ls			0		0		0	150,000	150,000		0	150,000
	10			Medium/Low Voltage Cable	5,000	ft	0.15	1.30	975	110.00	107,250	30	150,000		0		0	257,250
	11			Cable Tray and Cables from Unit Output to Electrical Room	5,000	ft	0.30	1.30	1,950	110.00	214,500	45	225,000		0		0	439,500
	12			Utility Metering Allowance	1	lot	20	1.30	26	110.00	2,860	20,000	20,000		0		0	22,860
	13			Engine & Auxiliaries Instrumentation	1	lot			0		0	90,000	90,000		0		0	90,000
	14			Black Start Diesel Genset and Auxiliaries	1	lot			0		0	375,000	375,000		0		0	375,000
	15			BUILDING SERVICES					286		31,460		150,000		48,000		0	229,460
	16			Station Service Transformer 500KVA Dry Type Indoor (for Station Services MCC)	1	ea	25	1.30	33	110.00	3,575		0	30,000	30,000		0	33,575
	17			Station Service AC and DC distribution Panels (for transformer and breaker)	2	ea	20	1.30	52	110.00	5,720		0	4,000	8,000		0	13,720
	18			125V DC Station service battery	1	ea	40	1.30	52	110.00	5,720		0	8,000	8,000		0	13,720
	19			125V DC Station service battery charger	1	ea	15	1.30	20	110.00	2,145		0	2,000	2,000		0	4,145
	20			Building Services Allowance	1	lot			0		0	135,000	135,000		0		0	135,000
	21			Miscellaneous (tray, conduit, terminal blocks, etc.)	1	lot	100	1.30	130	110.00	14,300	15,000	15,000		0		0	29,300
	22			SUBSTATION					3,110		342,056		57,600		1,190,850		0	1,590,506
	23			Transformer - 20MW, 4.16 kV / 34.5 kV, +/- 5% Off Load Tap Changer and multi ratio CTs	1	ea	180	1.30	234	110.00	25,740	22,500	22,500	525,000	525,000		0	573,240
	24			Breaker - 34.5 kV, 650 kV BIL, 800A (min), 31.5 kA (min) outdoor dead tank	2	ea	90	1.30	234	110.00	25,740	1,500	3,000	111,000	222,000		0	250,740
	25			Disconnect - 34.5 kV, 600A Vertical Break, Group Operated, c/w interlocked ground switch	2	ea	45	1.30	117	110.00	12,870	1,500	3,000	24,000	48,000		0	63,870
	26			Potential Transformer - 34.5 kV, dual winding, outdoor, post type	6	ea	12	1.30	94	110.00	10,296	750	4,500	7,500	45,000		0	59,796
	27			Surge Arrestor - 24.4 kV MCOV, outdoor, station class, surge arresters	6	ea	8	1.30	59	110.00	6,435	750	4,500	825	4,950		0	15,885
	28			Cable - 5 kV, 500MCM, XLPE insulation, aluminum conductor, 100% insulation	840	Μ	0.3	1.30	328	110.00	36,036	0	0	53	44,100		0	80,136
	29			Conductor - Bare, 2/0 AWG AAC (Aster)	120	Μ	0.5	1.30	70	110.00	7,722	0	0	15	1,800		0	9,522
	30			Cable Terminations	42	ea	5	1.30	246	110.00	27,027	300	12,600	0	0		0	39,627
	31			Misc Hardware and electrical connectors	1	lot	90	1.30	117	110.00	12,870	7,500	7,500	0	0		0	20,370
	32			Line Protection Panel	2	ea	120	1.30	312	110.00	34,320	0	0	75,000	150,000		0	184,320
	33			34.5 kV Interconnection - poles, conductor, hardware, deadends	1	lot	1,000	1.30	1,300	110.00	143,000		0	150,000	150,000		0	293,000
	34			SITE SECURITY					0		50,000		300,000		0		0	350,000
	35			Roadway / Site Lighting	1	ls			0		50,000	100,000	100,000		0		0	150,000
	36			CCTV Security and Integration to System Control Centre	1	ls			0		0	75,000	75,000		0		0	75,000
	37			Fire Alarm Systems	1	ls			0		0	75,000	75,000		0		0	75,000
	38			Communications (fibre, CAT5, telephone)	1	ls			0		0	50,000	50,000		0		0	50,000
	39			EI&C MISCELLANEOUS					0		0		450,000		0		0	450,000
	40			Engine, fuel, and auxiliaries controls installation	400	pt			0		0	750	300,000		0		0	300,000
	41			Miscellaneous BOP Electrical Equipment Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	42			Miscellaneous Engine Electrical Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	43			Miscellaneous Electrical Equipment Grounding	1	ls			0		0	50,000	50,000		0		0	50,000

Prepared by: CGV / RF Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: ES



STANTEC CONSULTING Opinion of Probable Construction Cost Indirect and Owner's Costs DL-LF-20: Diesel - Landfill - 20 MWe

									Labou	Jr		Mat'l/Co	ommodity	Equip	oment	Sub-Co	ntractor	Tabal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0		0		0)	C		0	6,919,450
	1			Based on recent YEC experience, an 18% factor on direct costs is incorporated to cover:					0		0		C)	C)	0	6,919,450
	2			Contractor General Conditions					0		0		C)	C)	0	0
	3			Security					0		0		C)	C)	0	0
	4			Lock-out tag-out (LOTO) coordination					0		0		C)	C)	0	0
	5			Waste removal					0		0		C)	C)	0	0
	6			Snow removal					0		0		C)	C)	0	0
	7			Warehousing and utilities including temporary power supply					0		0		C)	C)	0	0
	8			Temporary construction lighting					0		0		C)	C)	0	0
	9			Taxes					0		0		C)	C)	0	0
	10			Interest charges during construction.					0		0		C)	C)	0	0
	11			Land acquisition and zoning					0		0		C)	C)	0	0
	12			Environmental studies, YESAB assessment and all permitting					0		0		C)	C)	0	0
	13			Owner's administration costs, including:					0		0		C)	C)	0	0
	14			Legal fees.					0		0		C)	C)	0	0
	15			Insurance.					0		0		C)	C)	0	0
	16			Salaries & expenses of Owner's project staff.					0		0		C)	C)	0	0
	17			Allowance for operators hours & fuel costs during training, commissioning, and start up.					0		0		C)	C)	0	0
	18			Special costs to dispose from site construction waste.					0		0		C)	C)	0	0
	19								0		0		C)	C)	0	0

Prepared by: Team

Date: 16-May-16

Revision No.: A

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Summary DL-TK-05: Diesel - Takhini - 5 MWe

Area	Line	Rev.	Description	Labour Hours	Labour Cost	Mat'I/Commodity Cost	Equipment Cost	Sub-Contractor Cost	Total Cost
-	0	-	PROJECT TOTAL, BASE SCOPE	15,420 hrs	\$1,831,254	\$5,589,165	\$7,958,663	\$4,400,750	\$31,714,160
-	1	-	Major Equipment	6,240 hrs	\$686,400	\$223,000	\$4,460,000	\$150,000	\$5,519,400
-	2	-	General Civil	00 hrs	\$0	\$2,865,940	\$755,000	\$0	\$3,620,940
-	3	-	Buildings and Structures	00 hrs	\$0	\$722,825	\$80,000	\$4,200,000	\$5,002,825
-	4	-	Mechanical and Process	4,143 hrs	\$455,693	\$112,500	\$1,463,750	\$0	\$2,031,943
-	5	-	Electrical, Instrumentation & Controls	5,037 hrs	\$604,089	\$1,664,900	\$1,110,713	\$0	\$3,379,702
-	6	-	Sub Total Directs	15,420 hrs	\$1,746,183	\$5,589,165	\$7,869,463	\$4,350,000	\$19,554,810
-	7	-	AFE Engineering @ 3% of Directs	-	-	-	-	-	\$586,644
-	8	-	Detail Engineering @ 8% Direct Construction Cost	-	-	-	-	-	\$1,564,385
-	9	-	Construction Staff & Consultants and Construction Management Fee @3.5%	-	-	-	-	-	\$684,418
-	10	-	Commissioning Costs - Excluding Owner's Staff @ 1.5% of Directs	-	-	-	-	-	\$293,322
-	11	-	Escalation Allowance @ 3.5% Labour, 3.5% Construction Staff & Mgmt Fee, & 3.5% of 1/3 Sub-Contractor Cost	-	\$85,071	-	-	\$50,750	\$135,821
-	12	-	Capital Spares - 2% Major Equipment	-	-	-	\$89,200	-	\$89,200
-	13	-	Indirect Construction Costs and Owner's Costs (See Line Item List, 18% of Directs)	-	-	-	-	-	\$3,519,866
-	14	-	Sub Total In-Directs	00 hrs	\$ <mark>8</mark> 5,071	\$0	\$ <mark>89,200</mark>	\$50,750	\$6,873,656
-	15	-	Contingency of 20% - AACE Class 5 Opinion of Probable Cost						\$5,285,693

Prepared by: **Team** Date: **16-May-16** Revision No.: **A**

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Major Equipment DL-TK-05: Diesel - Takhini - 5 MWe

									Labo	ur		Mat'l/Cor	nmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					6,240		686,400		223,000		4,460,000		150,000	5,519,400
	1			Generating Station					0		0		0		0		0	0
	2			Diesel fired Reciprocating Engine - 2.5 MWe capacity, 4,160V	2	unit	1,280	1.30	3,328	110.00	366,080	75,000	150,000	1,500,000	3,000,000		0	3,516,080
	3			Transportation	2	ea			0		0		0		0	75,000	150,000	150,000
	4			Includes:					0		0		0		0		0	0
	5			Prime Mover					0		0		0		0		0	0
	6			Generator and Auxiliaries					0		0		0		0		0	0
	7			Mechanical Auxiliaries (circulating pumps / radiator)					0		0		0		0		0	0
	8			Electrical Control Equipment					0		0		0		0		0	0
	9			Heat Recovery / Rejection					0		0		0		0		0	0
	10			Engineering / Project Management / Drawings					0		0		0		0		0	0
	11			Sound Attenuation					0		0		0		0		0	0
	12			Diesel Tank Farm					0		0		0		0		0	0
	13			Diesel storage tanks: Double Walled (100% secondary containment, standard 75,000L design)	4	ea	160	1.30	832	110.00	91,520	3,250	13,000	65,000	260,000		0	364,520
	14			Diesel truck unloading and pump house, underground containment tank, sump and lines	1	ea	1,600	1.30	2,080	110.00	228,800	60,000	60,000	1,200,000	1,200,000		0	1,488,800
	15			Transportation	5	ea			0		0		0		0	20,000	100,000	100,000

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: HC



STANTEC CONSULTING Opinion of Probable Construction Cost Civil DL-TK-05: Diesel - Takhini - 5 MWe

									Labou	ır		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ontractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			GENERAL CIVIL TOTAL					0		0		2,865,940		755,000)	0	3,620,940
	1			Clearing & Grubbing	4.5	ha			0		0	\$30,000	135,000		C)	0	135,000
	2			Excavation & Backfill for Structures & Slab (Allowance)	1	ea.			0		0	\$225,000	225,000		C)	0	225,000
	3			Site Drainage and Culverts (Allowance)	1	ea.			0		0	\$125,000	125,000		C)	0	125,000
	4			Site Grading - Incl. Roads and Parking Lot Preparation	4,500	m ³			0		0	\$15	67,500		C)	0	67,500
	5			General Landscaping	1	ea.			0		0	\$60,000	60,000		C)	0	60,000
	6			Water and Sewer Piping	80	m			0		0	\$250	20,000		C)	0	20,000
	7			Granular Base - 150mm	2,640	tonne			0		0	\$35	92,400		C)	0	92,400
	8			Granular Sub-Base - 300mm	5,280	tonne			0		0	\$18	95,040		C)	0	95,040
	9			Asphalt - (Base and Seal)	1,680	tonne			0		0	\$150	252,000		C)	0	252,000
	10			Fencing (8ft, angular razor wire)	1,000	m			0		0	\$300	300,000		C)	0	300,000
	11			Automatic Slide Gate (10m)	2	ea.			0		0	\$6,000	12,000		C)	0	12,000
	12			Slide Gate (10m)	1	ea.			0		0	\$2,000	2,000		C)	0	2,000
	13			Potable Water Well, pump, line, and HW tank.	1	ea.			0		0	\$80,000	80,000		C)	0	80,000
	14			Septic System	1	ea.			0		0	\$50,000	50,000		C)	0	50,000
	15			Double walled U/G diesel line form storage to plant	100	m			0		0	\$1,500	150,000		C)	0	150,000
	16			FIRE WATER					0		0		1,200,000		755,000		0	1,955,000
	17			Fire water heated storage (2x 30ft dia x 30ft tanks, insulated, 250,000 gal)	2	ea			0		0		0	300,000	600,000)	0	600,000
	18			Fire water pump house (electric and diesel driven fire pumps, building)	1	lot			0		0	900,000	900,000		C)	0	900,000
	19			Fire Loop (allowance) & Recirc Pumps	1,000	m			0		0	\$300	300,000		50,000)	0	350,000
	20			Fire Hydrants	10	ea.			0		0		0	10,500	105,000)	0	105,000

Prepared by: AW / RM Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: AF



STANTEC CONSULTING Opinion of Probable Construction Cost Buildings and Structures DL-TK-05: Diesel - Takhini - 5 MWe

								Labou	Jr		Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Tabul
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL				0		(722,825		80,000		4,200,000	5,002,825
	1			FUEL STORAGE				0		(245,000		80,000		0	325,000
	2			Truck Unloading Pad				0		()	0		0		0	C
	3			Concrete Pad 10 m x 35 m x 0.3 m	105	m ³		0		(1,500	157,500		0		0	157,500
	4			Process/Tank Containment				0		()	0		0		0	C
	5			Containment Tank / Piping	1	lot		0		(20,000	20,000	80,000	80,000		0	100,000
	6			Concrete pad 30 m x 5 m x 0.3 m	45	m ³		0		(1,500	67,500		0		0	67,500
	7			GENERATOR HALL				0		(108,825		0		4,200,000	4,308,825
	8			Pre-engineered Building				0		()	0		0		0	0
	9			Building Size 25 m x 70 m	1,750	m ²		0		()	0		0	2,400	4,200,000	4,200,000
	10			Generator Foundation				0		()	0		0		0	C
	11			Thickened Slab 4 m x 10 m x 0.5 m / each quantity 2	40	m ³		0		(1,500	60,000		0		0	60,000
	12			Generator Stack Foundation				0		()	0		0		0	C
	13			Concrete Pad 2.5 m x 2.5 m x 0.3 m / each quantity 2	4	m ³		0		(1,500	5,625		0		0	5,625
	14			Radiator Foundation				0		()	0		0		0	C
	15			Concrete Pad 6 m x 8 m x 0.3 m / each quantity 2	29	m ³		0		(1,500	43,200		0		0	43,200
	16			SUBSTATION				0		(369,000		0		0	369,000
	17			Transformer				0		()	0		0		0	C
	18			Base 12 m x 18 m x 0.5 m	108	m ³		0		(1,500	162,000		0		0	162,000
	19			Containment Walls 60 m x 1.2 m x 0.25 m	18	m ³		0		(1,500	27,000		0		0	27,000
	20			Pier 11 m x 7.4 m x 1.2 m	98	m ³		0		(1,500	146,520		0		0	146,520
	21			Steel Grating 1.5 m x 48.8 m	73	m ²		0		(150	10,980		0		0	10,980
	22			Breaker				0		()	0		0		0	C
	23			Concrete Pad 5 m x 10 m x 0.3 m	15	m ³		0		(1,500	22,500		0		0	22,500

Prepared by: JS Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Mechanical & Process DL-TK-05: Diesel - Takhini - 5 MWe

									Labou	Jr		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					4,143		455,693		112,500		1,463,750		0	2,031,943
	1			Prime Movers and Fuel Storage (See Major Equipment)					0		0		0		0		0	0
	2			Fuel System Piping (from fuel storage, building internal)	2	lot	107	1.30	277	110.00	30,507	5,000	10,000	75,000	150,000		0	190,507
	3			Glycol Heating System (incl unit heaters, electric & diesel boiler)	2	lot	107	1.30	277	110.00	30,507	7,500	15,000	150,000	300,000		0	345,507
	4			Generating Station HVAC (electric unit heaters, building and combustion ventilation)	1	lot	1,280	1.30	1,664	110.00	183,040	40,000	40,000	400,000	400,000		0	623,040
	5			Allowance for Building Services / Plumbing	1	lot	480	1.30	624	110.00	68,640	15,000	15,000	110,000	110,000		0	193,640
	6			Allowance for Lube / Waste Oil System	1	lot	320	1.30	416	110.00	45,760	10,000	10,000	80,000	80,000		0	135,760
	7			Continuous Emissions Monitoring System	1	lot	360	1.30	468	110.00	51,480	15,000	15,000	175,000	175,000		0	241,480
	8			Instrument and Plant Compressed Air Systems	1	lot	320	1.30	416	110.00	45,760	10,000	7,500	100,000	100,000		0	153,260
	9			Generating Station Sprinkler System, extinguisher, fire protection equipment	1,750	m ²			0		0		0	85	148,750		0	148,750

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16

Checked: LF



STANTEC CONSULTING Opinion of Probable Construction Cost Electrical, I&C DL-TK-05: Diesel - Takhini - 5 MWe

									Labo	ur		Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	s Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					5,037		604,089		1,664,900		1,110,713		0	3,379,702
	1			STATION ELECTRICAL					2,457		270,270		840,000		345,000		0	1,455,270
	2			Site wide Grounding Grid	1	lot	200	1.30	260	110.00	28,600	50,000	50,000		0		0	78,600
	3			Trench and conduit	1	lot	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	4			Transformer Protection Panel	1	ea	40	1.30	52	110.00	5,720		0	50,000	50,000		0	55,720
	5			Annunciator / Control / Metering Panel	1	ea	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	6			SCADA / Communications	1	lot	60	1.30	78	110.00	8,580		0	50,000	50,000		0	58,580
	7			5kV, 3000A Switchgear	1	lot	40	1.30	52	110.00	5,720	120,000	120,000		0		0	125,720
	8			Station Services MCC (allow 10 Sections)	10	sect	10	1.30	130	110.00	14,300		0	8,500	85,000		0	99,300
	9			BOP PLC and Instrumentation (100 Points, \$1000 per Point)	1	ls			0		0		0	100,000	100,000		0	100,000
	10			Medium/Low Voltage Cable	3,000	ft	0.15	1.30	585	110.00	64,350	30	90,000		0		0	154,350
	11			Cable Tray and Cables from Unit Output to Electrical Room	3,000	ft	0.30	1.30	1,170	110.00	128,700	45	135,000		0		0	263,700
	12			Utility Metering Allowance	1	lot	20	1.30	26	110.00	2,860	20,000	20,000		0		0	22,860
	13			Engine & Auxiliaries Instrumentation	1	lot			0		0	50,000	50,000		0		0	50,000
	14			Black Start Diesel Genset and Auxiliaries	1	lot			0		0	375,000	375,000		0		0	375,000
	15			BUILDING SERVICES					286		31,460		110,000		43,000		0	184,460
	16			Station Service Transformer 300KVA Dry Type Indoor (for Station Services MCC)	1	ea	25	1.30	33	110.00	3,575		0	25,000	25,000		0	28,575
	17			Station Service AC and DC distribution Panels (for transformer and breaker)	2	ea	20	1.30	52	110.00	5,720		0	4,000	8,000		0	13,720
	18			125V DC Station service battery	1	ea	40	1.30	52	110.00	5,720		0	8,000	8,000		0	13,720
	19			125V DC Station service battery charger	1	ea	15	1.30	20	110.00	2,145		0	2,000	2,000		0	4,145
	20			Building Services Allowance	1	lot			0		0	95.000	95.000		0		0	95,000
	21			Miscellaneous (tray, conduit, terminal blocks, etc.)	1	lot	100	1.30	130	110.00	14,300	15,000	15,000		0		0	29,300
	22			SUBSTATION					2,294		252,359		39,900		722,713		0	1,014,972
	23			Transformer - 5MW, 4.16 kV / 34.5 kV, +/- 5% Off Load Tap Changer and multi ratio CTs	1	ea	180	1.30	234	110.00	25,740	12,000	12,000	255,000	255,000		0	292,740
	24			Breaker - 34.5 kV, 650 kV BIL, 600A, 31.5 kA (min) outdoor dead tank c/w multi-ratio CTs	1	ea	135	1.30	176	110.00	19,305	2,250	2,250	166,500	166,500		0	188,055
	25			Disconnect - 34.5 kV, 600A Vertical Break, Group Operated, c/w interlocked ground switch	1	ea	68	1.30	88	110.00	9,653	2,250	2,250	36,000	36,000		0	47,903
	26			Potential Transformer - 34.5 kV, dual winding, outdoor, post type	3	ea	18	1.30	70	110.00	7,722	1,125	3,375	11,250	33,750		0	44,847
	27			Surge Arrestor - 24.4 kV MCOV, outdoor, station class, surge arresters	3	ea	11	1.30	44	110.00	4,826	1,125	3,375	1,238	3,713		0	11,914
	28			Cable - 5 kV, 1/0 AWG, XLPE insulation, aluminum conductor, 100% insulation	240	Μ	0.5	1.30	140	110.00	15,444	0	0	79	18,900		0	34,344
	29			Conductor - Bare, 336.4 kcmil AAC (Tulip)	60	М	0.7	1.30	53	110.00	5,792	0	0	23	1,350		0	7,142
	30			Cable Terminations	12	ea	7	1.30	105	110.00	11,583	450	5,400	0	0		0	16,983
	31			Misc Hardware and electrical connectors	1	lot	135	1.30	176	110.00	19,305	11,250	11,250	0	0		0	30,555
	32			Line Protection Panel	1	ea	180	1.30	234	110.00	25,740	0	0	112,500	112,500		0	138,240
	33			34.5 kV Interconnection - poles, conductor, hardware, deadends	1	lot	750	1.30	975	110.00	107,250		0	95,000	95,000		0	202,250
	34			SITE SECURITY					0		50,000		300,000		0		0	350,000
	35			Roadway / Site Lighting	1	ls			0		50,000	100,000	100,000		0		0	150,000
	36			CCTV Security and Integration to System Control Centre	1	ls			0		0	75,000	75,000		0		0	75,000
	37			Fire Alarm Systems	1	ls			0		0	75,000	75,000		0		0	75,000
	38			Communications (fibre, CAT5, telephone)	1	ls			0		0	50,000	50,000		0		0	50,000
	39			EI&C MISCELLANEOUS					0		0		375,000		0		0	375,000
	40			Engine, fuel, and auxiliaries controls installation	300	pt			0		0	750	225,000		0		0	225,000
	41			Miscellaneous BOP Electrical Equipment Allowance	1	Is			0		0	50,000	50,000		0		0	50,000
	42			Miscellaneous Engine Electrical Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	43			Miscellaneous Electrical Equipment Grounding	1	ls			0		0	50,000	50,000		0		0	50,000

Prepared by: CGV / RF Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: ES



STANTEC CONSULTING Opinion of Probable Construction Cost Indirect and Owner's Costs DL-TK-05: Diesel - Takhini - 5 MWe

									Labou	Jr		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Tabal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0		0		0		C		0	3,519,866
	1			Based on recent YEC experience, an 18% factor on direct costs is incorporated to cover:					0		0		C)	()	0	3,519,866
	2			Contractor General Conditions					0		0		C)	()	0	0
	3			Security					0		0		C)	0)	0	0
	4			Lock-out tag-out (LOTO) coordination					0		0		C)	C)	0	0
	5			Waste removal					0		0		C)	C)	0	0
	6			Snow removal					0		0		C)	C)	0	0
	7			Warehousing and utilities including temporary power supply					0		0		C)	0)	0	0
	8			Temporary construction lighting					0		0		C)	0)	0	0
	9			Taxes					0		0		C)	0)	0	0
	10			Interest charges during construction.					0		0		C)	0)	0	0
	11			Land acquisition and zoning					0		0		C)	0)	0	0
	12			Environmental studies, YESAB assessment and all permitting					0		0		C)	()	0	0
	13			Owner's administration costs, including:					0		0		C)	C)	0	0
	14			Legal fees.					0		0		C)	C)	0	0
	15			Insurance.					0		0		C)	C)	0	0
	16			Salaries & expenses of Owner's project staff.					0		0		C)	C)	0	0
	17			Allowance for operators hours & fuel costs during training, commissioning, and start up.					0		0		C)	0)	0	0
	18			Special costs to dispose from site construction waste.					0		0		C)	0)	0	0
	19								0		0		C)	0)	0	0

Prepared by: Team

Date: 16-May-16

Revision No.: A

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Summary DL-TK-10: Diesel - Takhini - 10 MWe

Area	Line	Rev.	Description	Labour Hours	Labour Cost	Mat'I/Commodity Cost	Equipment Cost	Sub-Contractor Cost	Total Cost
-	0	-	PROJECT TOTAL, BASE SCOPE	20,822 hrs	\$2,453,969	\$6,020,440	\$11,896,463	\$5,766,500	\$41,892,977
-	1	-	Major Equipment	10,192 hrs	\$1,121,120	\$382,750	\$7,655,000	\$300,000	\$9,458,870
-	2	-	General Civil	00 hrs	\$0	\$2,865,940	\$755,000	\$0	\$3,620,940
-	3	-	Buildings and Structures	00 hrs	\$0	\$788,450	\$80,000	\$5,400,000	\$6,268,450
-	4	-	Mechanical and Process	4,697 hrs	\$516,707	\$152,500	\$1,978,750	\$0	\$2,647,957
-	5	-	Electrical, Instrumentation & Controls	5,933 hrs	\$702,616	\$1,830,800	\$1,274,613	\$0	\$3,808,029
-	6	-	Sub Total Directs	20,822 hrs	\$2,340,443	\$6,020,440	\$11,743,363	\$5,700,000	\$25,804,245
-	7	-	AFE Engineering @ 3% of Directs	-	-	-	-	-	\$774,127
-	8	-	Detail Engineering @ 8% Direct Construction Cost	-	-	-	-	-	\$2,064,340
-	9	-	Construction Staff & Consultants and Construction Management Fee @3.5%	-	-	-	-	-	\$903,149
-	10	-	Commissioning Costs - Excluding Owner's Staff @ 1.5% of Directs	-	-	-	-	-	\$387,064
-	11	-	Escalation Allowance @ 3.5% Labour, 3.5% Construction Staff & Mgmt Fee, & 3.5% of 1/3 Sub-Contractor Cost	-	\$113,526	-	-	\$66,500	\$180,026
-	12	-	Capital Spares - 2% Major Equipment	-	-	-	\$153,100	-	\$153,100
-	13	-	Indirect Construction Costs and Owner's Costs (See Line Item List, 18% of Directs)	-	-	-	-	-	\$4,644,764
-	14	-	Sub Total In-Directs	00 hrs	\$113,526	\$0	\$153,100	\$66,500	\$9,106,569
-	15	-	Contingency of 20% - AACE Class 5 Opinion of Probable Cost						\$6,982,163

Prepared by: **Team** Date: **16-May-16** Revision No.: **A**

Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Major Equipment DL-TK-10: Diesel - Takhini - 10 MWe

									Labo	ur		Mat'l/Co	nmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					10,192		1,121,120		382,750		7,655,000		300,000	9,458,870
	1			Generating Station					0		0		0		0		0	0
	2			Diesel fired Reciprocating Engine - 2.5 MWe capacity, 4,160V	4	unit	1,280	1.30	6,656	110.00	732,160	75,000	300,000	1,500,000	6,000,000		0	7,032,160
	3			Transportation	4	ea			0		0		0		0	75,000	300,000	300,000
	4			Includes:					0		0		0		0		0	0
	5			Prime Mover					0		0		0		0		0	0
	6			Generator and Auxiliaries					0		0		0		0		0	0
	7			Mechanical Auxiliaries (circulating pumps / radiator)					0		0		0		0		0	0
	8			Electrical Control Equipment					0		0		0		0		0	0
	9			Heat Recovery / Rejection					0		0		0		0		0	0
	10			Engineering / Project Management / Drawings					0		0		0		0		0	0
	11			Sound Attenuation					0		0		0		0		0	0
	12			Diesel Tank Farm					0		0		0		0		0	0
	13			Diesel storage tanks: Double Walled (100% secondary containment, standard 75,000L design)	7	ea	160	1.30	1,456	110.00	160,160	3,250	22,750	65,000	455,000		0	637,910
	14			Diesel truck unloading and pump house, undergound containment tank, sump and lines	1	ea	1,600	1.30	2,080	110.00	228,800	60,000	60,000	1,200,000	1,200,000		0	1,488,800
	15			Transportation	8	ea			0		0		0		0	20,000	160,000	160,000

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: HC



STANTEC CONSULTING Opinion of Probable Construction Cost Civil DL-TK-10: Diesel - Takhini - 10 MWe

									Labou	ır		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ontractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			GENERAL CIVIL TOTAL					0		0		2,865,940		755,000		0	3,620,940
	1			Clearing & Grubbing	4.5	ha			0		0	\$30,000	135,000		C)	0	135,000
	2			Excavation & Backfill for Structures & Slab (Allowance)	1	ea.			0		0	\$225,000	225,000		C)	0	225,000
	3			Site Drainage and Culverts (Allowance)	1	ea.			0		0	\$125,000	125,000		C)	0	125,000
	4			Site Grading - Incl. Roads and Parking Lot Preparation	4,500	m ³			0		0	\$15	67,500		C)	0	67,500
	5			General Landscaping	1	ea.			0		0	\$60,000	60,000		C)	0	60,000
	6			Water and Sewer Piping	80	m			0		0	\$250	20,000		C)	0	20,000
	7			Granular Base - 150mm	2,640	tonne			0		0	\$35	92,400		C)	0	92,400
	8			Granular Sub-Base - 300mm	5,280	tonne			0		0	\$18	95,040		C)	0	95,040
	9			Asphalt - (Base and Seal)	1,680	tonne			0		0	\$150	252,000		C)	0	252,000
	10			Fencing (8ft, angular razor wire)	1,000	m			0		0	\$300	300,000		C)	0	300,000
	11			Automatic Slide Gate (10m)	2	ea.			0		0	\$6,000	12,000		C)	0	12,000
	12			Slide Gate (10m)	1	ea.			0		0	\$2,000	2,000		C)	0	2,000
	13			Potable Water Well, pump, line, and HW tank.	1	ea.			0		0	\$80,000	80,000		C)	0	80,000
	14			Septic System	1	ea.			0		0	\$50,000	50,000		C)	0	50,000
	15			Double walled U/G diesel line form storage to plant	100	m			0		0	\$1,500	150,000		C)	0	150,000
	16			FIRE WATER					0		0		1,200,000		755,000		0	1,955,000
	17			Fire water heated storage (2x 30ft dia x 30ft tanks, insulated, 250,000 gal)	2	ea			0		0		0	300,000	600,000)	0	600,000
	18			Fire water pump house (electric and diesel driven fire pumps, building)	1	lot			0		0	900,000	900,000		C)	0	900,000
	19			Fire Loop (allowance) & Recirc Pumps	1,000	m			0		0	\$300	300,000		50,000)	0	350,000
	20			Fire Hydrants	10	ea.			0		0		0	10,500	105,000)	0	105,000

Prepared by: AW / RM Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: AF



STANTEC CONSULTING Opinion of Probable Construction Cost Buildings and Structures DL-TK-10: Diesel - Takhini - 10 MWe

									Labou	r	Mat'l/Co	mmodity	Equipn	nent	Sub-Co	ntractor	Tabul
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0	(D	788,450		80,000		5,400,000	6,268,450
	1			FUEL STORAGE					0	(245,000		80,000		0	325,000
	2			Truck Unloading Pad					0	()	0		0		0	0
	3			Concrete Pad 10 m x 35 m x 0.3 m	105	m ³			0	(1,500	157,500		0		0	157,500
	4			Process/Tank Containment					0	()	0		0		0	0
	5			Containment Tank / Piping	1	lot			0	(20,000	20,000	80,000	80,000		0	100,000
	6			Concrete pad 30 m x 5 m x 0.3 m	45	m ³			0	(1,500	67,500		0		0	67,500
	7			GENERATOR HALL					0	(174,450		0		5,400,000	5,574,450
	8			Pre-engineered Building					0	()	0		0		0	0
	9			Building Size 25 m x 90 m	2,250	m ²			0	()	0		0	2,400	5,400,000	5,400,000
	10			Generator Foundation					0	()	0		0		0	0
	11			Thickened Slab 4 m x 10 m x 0.5 m / each quantity 4	80	m ³			0	(1,500	120,000		0		0	120,000
	12			Generator Stack Foundation					0	()	0		0		0	0
	13			Concrete Pad 2.5 m x 2.5 m x 0.3 m / each quantity 4	8	m ³			0	(1,500	11,250		0		0	11,250
	14			Radiator Foundation					0	()	0		0		0	0
	15			Concrete Pad 4 m x 6 m x 0.3 m / each quantity 4	29	m ³			0	(1,500	43,200		0		0	43,200
	16			SUBSTATION					0	(369,000		0		0	369,000
	17			Transformer					0	()	0		0		0	0
	18			Base 12 m x 18 m x 0.5 m	108	m ³			0	(1,500	162,000		0		0	162,000
	19			Containment Walls 60 m x 1.2 m x 0.25 m	18	m ³			0	(1,500	27,000		0		0	27,000
	20			Pier 11 m x 7.4 m x 1.2 m	98	m ³			0	(1,500	146,520		0		0	146,520
	21			Steel Grating 1.5 m x 48.8 m	73	m ²			0	(150	10,980		0		0	10,980
	22			Breaker					0	()	0		0		0	0
	23			Concrete Pad 5 m x 10 m x 0.3 m	15	m ³			0	(1,500	22,500		0		0	22,500

Prepared by: JS Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16



STANTEC CONSULTING Opinion of Probable Construction Cost Mechanical & Process DL-TK-10: Diesel - Takhini - 10 MWe

									Labou	Jr		Mat'l/Co	mmodity	Equip	ment	Sub-Co	ntractor	Tadal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					4,697		516,707		152,500		1,978,750		0	2,647,957
	1			Prime Movers and Fuel Storage (See Major Equipment)					0		0		0		0		0	0
	2			Fuel System Piping (from fuel storage, building internal)	4	lot	107	1.30	555	110.00	61,013	5,000	20,000	60,000	240,000		0	321,013
	3			Glycol Heating System (incl unit heaters, electric & diesel boiler)	4	lot	107	1.30	555	110.00	61,013	7,500	30,000	125,000	500,000		0	591,013
	4			Generating Station HVAC (electric unit heaters, building and combustion ventilation)	1	lot	1,280	1.30	1,664	110.00	183,040	50,000	50,000	500,000	500,000		0	733,040
	5			Allowance for Building Services / Plumbing	1	lot	480	1.30	624	110.00	68,640	15,000	15,000	135,000	135,000		0	218,640
	6			Allowance for Lube / Waste Oil System	1	lot	320	1.30	416	110.00	45,760	10,000	10,000	90,000	90,000		0	145,760
	7			Continuous Emissions Monitoring System	1	lot	360	1.30	468	110.00	51,480	20,000	20,000	220,000	220,000		0	291,480
	8			Instrument and Plant Compressed Air Systems	1	lot	320	1.30	416	110.00	45,760	12,500	7,500	125,000	125,000		0	178,260
	9			Generating Station Sprinkler System, extinguisher, fire protection equipment	2,250	m ²			0		0		0	75	168,750		0	168,750

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16

Checked: LF


STANTEC CONSULTING Opinion of Probable Construction Cost Electrical, I&C DL-TK-10: Diesel - Takhini - 10 MWe

									Labo	ur		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Tabul
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					5,933		702,616		1,830,800		1,274,613		0	3,808,029
	1			STATION ELECTRICAL					3,107		341,770		940,000		412,500		0	1,694,270
	2			Site wide Grounding Grid	1	lot	200	1.30	260	110.00	28,600	60,000	60,000		0		0	88,600
	3			Trench and conduit	1	lot	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	4			Transformer Protection Panel	1	ea	40	1.30	52	110.00	5,720		0	50,000	50,000		0	55,720
	5			Annunciator / Control / Metering Panel	1	ea	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	6			SCADA / Communications	1	lot	60	1.30	78	110.00	8,580		0	50,000	50,000		0	58,580
	7			5kV, 3000A Switchgear	1	lot	40	1.30	52	110.00	5,720	120,000	120,000		0		0	125,720
	8			Station Services MCC (allow 15 Sections)	15	sect	10	1.30	195	110.00	21,450		0	8,500	127,500		0	148,950
	9			BOP PLC and Instrumentation (125 Points, \$1000 per Point)	1	ls			0		0		0	125,000	125,000		0	125,000
	10			Medium/Low Voltage Cable	4,000	ft	0.15	1.30	780	110.00	85,800	30	120,000		0		0	205,800
	11			Cable Tray and Cables from Unit Output to Electrical Room	4,000	ft	0.30	1.30	1,560	110.00	171,600	45	180,000		0		0	351,600
	12			Utility Metering Allowance	1	lot	20	1.30	26	110.00	2,860	20,000	20,000		0		0	22,860
	13			Engine & Auxiliaries Instrumentation	1	lot			0		0	65,000	65,000		0		0	65,000
	14			Black Start Diesel Genset and Auxiliaries	1	lot			0		0	375,000	375,000		0		0	375,000
	15			BUILDING SERVICES					286		31,460		130,000		45,500		0	206,960
	16			Station Service Transformer 400KVA Dry Type Indoor (for Station Services MCC)	1	ea	25	1.30	33	110.00	3,575		0	27,500	27,500		0	31,075
	17			Station Service AC and DC distribution Panels (for transformer and breaker)	2	ea	20	1.30	52	110.00	5,720		0	4,000	8,000		0	13,720
	18			125V DC Station service battery	1	ea	40	1.30	52	110.00	5,720		0	8,000	8,000		0	13,720
	19			125V DC Station service battery charger	1	ea	15	1.30	20	110.00	2,145		0	2,000	2,000		0	4,145
	20			Building Services Allowance	1	lot			0		0	115,000	115,000		0		0	115,000
	21			Miscellaneous (tray, conduit, terminal blocks, etc.)	1	lot	100	1.30	130	110.00	14,300	15,000	15,000		0		0	29,300
	22			SUBSTATION					2,540		279,386		48,300		816,613		0	1,144,299
	23			Transformer - 10 MW, 4.16 kV / 34.5 kV, +/- 5% Off Load Tap Changer and multi ratio CTs	1	ea	180	1.30	234	110.00	25,740	15,000	15,000	330,000	330,000		0	370,740
	24			Breaker - 34.5 kV, 650 kV BIL, 800A (min), 31.5 kA (min) outdoor dead tank	1	ea	135	1.30	176	110.00	19,305	2,250	2,250	166,500	166,500		0	188,055
	25			Disconnect - 34.5 kV, 600A Vertical Break, Group Operated, c/w interlocked ground switch	1	ea	68	1.30	88	110.00	9,653	2,250	2,250	36,000	36,000		0	47,903
	26			Potential Transformer - 34.5 kV, dual winding, outdoor, post type	3	ea	18	1.30	70	110.00	7,722	1,125	3,375	11,250	33,750		0	44,847
	27			Surge Arrestor - 24.4 kV MCOV, outdoor, station class, surge arresters	3	ea	11	1.30	44	110.00	4,826	1,125	3,375	1,238	3,713		0	11,914
	28			Cable - 5 kV, 500MCM, XLPE insulation, aluminum conductor, 100% insulation	480	Μ	0.5	1.30	281	110.00	30,888	0	0	79	37,800		0	68,688
	29			Conductor - Bare, 2/0 AWG AAC (Aster)	60	Μ	0.7	1.30	53	110.00	5,792	0	0	23	1,350		0	7,142
	30			Cable Terminations	24	ea	7	1.30	211	110.00	23,166	450	10,800	0	0		0	33,966
	31			Misc Hardware and electrical connectors	1	lot	135	1.30	176	110.00	19,305	11,250	11,250	0	0		0	30,555
	32			Line Protection Panel	1	ea	180	1.30	234	110.00	25,740	0	0	112,500	112,500		0	138,240
	33			34.5 kV Interconnection - poles, conductor, hardware, deadends	1	lot	750	1.30	975	110.00	107,250		0	95,000	95,000		0	202,250
	34			SITE SECURITY					0		50,000		300,000		0		0	350,000
	35			Roadway / Site Lighting	1	ls			0		50,000	100,000	100,000		0		0	150,000
	36			CCTV Security and Integration to System Control Centre	1	ls			0		0	75,000	75,000		0		0	75,000
	37			Fire Alarm Systems	1	ls			0		0	75,000	75,000		0		0	75,000
	38			Communications (fibre, CAT5, telephone)	1	ls			0		0	50,000	50,000		0		0	50,000
	39			EI&C MISCELLANEOUS					0		0		412,500		0		0	412,500
	40			Engine, fuel, and auxiliaries controls installation	350	pt			0		0	750	262,500		0		0	262,500
	41			Miscellaneous BOP Electrical Equipment Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	42			Miscellaneous Engine Electrical Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	43			Miscellaneous Electrical Equipment Grounding	1	ls			0		0	50,000	50,000		0		0	50,000

Prepared by: CGV / RF Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: ES



STANTEC CONSULTING Opinion of Probable Construction Cost Indirect and Owner's Costs DL-TK-10: Diesel - Takhini - 10 MWe

									Labou	ır		Mat'l/Co	ommodity	Equip	oment	Sub-Contractor	Total
Area	Line	Rev.	. WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost Cost	Cost
	0			TOTAL					0		0		0		0) ()	4,644,764
	1			Based on recent YEC experience, an 18% factor on direct costs is incorporated to cover:					0		0		C)	C) C	4,644,764
	2			Contractor General Conditions					0		0		C)	C	0	0
	3			Security					0		0		C)	C	0	0
	4			Lock-out tag-out (LOTO) coordination					0		0		C)	C) C	0
	5			Waste removal					0		0		C)	C) C	0
	6			Snow removal					0		0		C)	C) C	0
	7			Warehousing and utilities including temporary power supply					0		0		C)	C) C	0
	8			Temporary construction lighting					0		0		C)	C) C	0
	9			Taxes					0		0		C)	C	0	0
	10			Interest charges during construction.					0		0		C)	C	0	0
	11			Land acquisition and zoning					0		0		C)	C) C	0
	12			Environmental studies, YESAB assessment and all permitting					0		0		C)	C) C	0
	13			Owner's administration costs, including:					0		0		C)	C) C	0
	14			Legal fees.					0		0		C)	C) C	0
	15			Insurance.					0		0		C)	C) C	0
	16			Salaries & expenses of Owner's project staff.					0		0		C)	C) C	0
	17			Allowance for operators hours & fuel costs during training, commissioning, and start up.					0		0		C)	C	0	0
	18			Special costs to dispose from site construction waste.					0		0		C)	C) C	0
	19								0		0		C)	C) C	0 0

Prepared by: **Team**

Date: 16-May-16

Revision No.: A

Issue Date: 1-Jun-16

Checked: CGV



STANTEC CONSULTING Opinion of Probable Construction Cost Summary DL-TK-20: Diesel - Takhini - 20 MWe

Area	Line	Rev.	Description	Labour Hours	Labour Cost	Mat'l/Commodity Cost	Equipment Cost	Sub-Contractor Cost	Total Cost
-	0	-	PROJECT TOTAL, BASE SCOPE	27,381 hrs	\$3,215,903	\$6,769,315	\$20,363,550	\$8,467,650	\$62,190,814
-	1	-	Major Equipment	14,976 hrs	\$1,647,360	\$755,500	\$15,110,000	\$450,000	\$17,962,860
-	2	-	General Civil	00 hrs	\$0	\$2,865,940	\$755,000	\$0	\$3,620,940
-	3	-	Buildings and Structures	00 hrs	\$0	\$952,775	\$80,000	\$7,920,000	\$8,952,775
-	4	-	Mechanical and Process	5,252 hrs	\$577,720	\$187,500	\$2,397,500	\$0	\$3,162,720
-	5	-	Electrical, Instrumentation & Controls	7,153 hrs	\$836,786	\$2,007,600	\$1,718,850	\$0	\$4,563,236
-	6	-	Sub Total Directs	27,381 hrs	\$3,061,866	\$6,769,315	\$20,061,350	\$8,370,000	\$38,262,531
-	7	-	AFE Engineering @ 3% of Directs	-	-	-	-	-	\$1,147,876
-	8	-	Detail Engineering @ 8% Direct Construction Cost	-	-	-	-	-	\$3,061,002
-	9	-	Construction Staff & Consultants and Construction Management Fee @3.5%	-	-	-	-	-	\$1,339,189
-	10	-	Commissioning Costs - Excluding Owner's Staff @ 1.5% of Directs	-	-	-	-	-	\$573,938
-	11	-	Escalation Allowance @ 3.5% Labour, 3.5% Construction Staff & Mgmt Fee, & 3.5% of 1/3 Sub-Contractor Cost	-	\$154,037	-	-	\$97,650	\$251,687
-	12	-	Capital Spares - 2% Major Equipment	-	-	-	\$302,200	-	\$302,200
-	13	-	Indirect Construction Costs and Owner's Costs (See Line Item List, 18% of Directs)	-	-	-	-	-	\$6,887,256
-	14	-	Sub Total In-Directs	00 hrs	\$154,037	\$0	\$302,200	\$97,650	\$13,563,147
-	15	-	Contingency of 20% - AACE Class 5 Opinion of Probable Cost						\$10,365,136

Prepared by: **Team** Date: **16-May-16**

Revision No.: A

Issue Date: 1-Jun-16

Checked: CGV



STANTEC CONSULTING Opinion of Probable Construction Cost Major Equipment DL-TK-20: Diesel - Takhini - 20 MWe

									Labo	ur		Mat'l/Cor	nmodity	Equip	ment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					14,976		1,647,360		755,500		15,110,000		450,000	17,962,860
	1			Generating Station					0		0		0		0		0	0
	2			Diesel fired Reciprocating Engine - 2.5 MWe capacity, 4,160V	4	unit	1,280	1.30	6,656	110.00	732,160	75,000	300,000	1,500,000	6,000,000		0	7,032,160
	3			Diesel fired Reciprocating Engine - 5.0 MWe capacity, 4,160V	2	unit	1,280	1.30	3,328	110.00	366,080	175,000	350,000	3,500,000	7,000,000		0	7,716,080
	3			Transportation	6	ea			0		0		0		0	75,000	450,000	450,000
	4			Includes:					0		0		0		0		0	0
	5			Prime Mover					0		0		0		0		0	0
	6			Generator and Auxiliaries					0		0		0		0		0	0
	7			Mechanical Auxiliaries (circulating pumps / radiator)					0		0		0		0		0	0
	8			Electrical Control Equipment					0		0		0		0		0	0
	9			Heat Recovery / Rejection					0		0		0		0		0	0
	10			Engineering / Project Management / Drawings					0		0		0		0		0	0
	11			Sound Attenuation					0		0		0		0		0	0
	12			Diesel Tank Farm					0		0		0		0		0	0
	13			Diesel storage tanks: Double Walled (100% secondary containment, standard 75,000L design)	14	ea	160	1.30	2,912	110.00	320,320	3,250	45,500	65,000	910,000		0	1,275,820
	14			Diesel truck unloading and pump house, underground containment tank, sump and lines	1	ea	1,600	1.30	2,080	110.00	228,800	60,000	60,000	1,200,000	1,200,000		0	1,488,800
	15			Transportation	16	ea			0		0		0		0	20,000	320,000	320,000

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: HC



STANTEC CONSULTING Opinion of Probable Construction Cost Civil DL-TK-20: Diesel - Takhini - 20 MWe

							Labour			Mat'l/Co	mmodity	Equip	oment	Sub-Co	ontractor	Total		
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			GENERAL CIVIL TOTAL					0		0		2,865,940		755,000)	0	3,620,940
	1			Clearing & Grubbing	4.5	ha			0		0	\$30,000	135,000		0)	0	135,000
	2			Excavation & Backfill for Structures & Slab (Allowance)	1	ea.			0		0	\$225,000	225,000		0)	0	225,000
	3			Site Drainage and Culverts (Allowance)	1	ea.			0		0	\$125,000	125,000		0)	0	125,000
	4			Site Grading - Incl. Roads and Parking Lot Preparation	4,500	m ³			0		0	\$15	67,500		0)	0	67,500
	5			General Landscaping	1	ea.			0		0	\$60,000	60,000		0)	0	60,000
	6			Water and Sewer Piping	80	m			0		0	\$250	20,000		0)	0	20,000
	7			Granular Base - 150mm	2,640	tonne			0		0	\$35	92,400		0)	0	92,400
	8			Granular Sub-Base - 300mm	5,280	tonne			0		0	\$18	95,040		0)	0	95,040
	9			Asphalt - (Base and Seal)	1,680	tonne			0		0	\$150	252,000		0)	0	252,000
	10			Fencing (8ft, angular razor wire)	1,000	m			0		0	\$300	300,000		0)	0	300,000
	11			Automatic Slide Gate (10m)	2	ea.			0		0	\$6,000	12,000		0)	0	12,000
	12			Slide Gate (10m)	1	ea.			0		0	\$2,000	2,000		0)	0	2,000
	13			Potable Water Well, pump, line, and HW tank.	1	ea.			0		0	\$80,000	80,000		0)	0	80,000
	14			Septic System	1	ea.			0		0	\$50,000	50,000		0)	0	50,000
	15			Double walled U/G diesel line form storage to plant	100	m			0		0	\$1,500	150,000		0)	0	150,000
	16			FIRE WATER					0		0		1,200,000		755,000)	0	1,955,000
	17			Fire water heated storage (2x 30ft dia x 30ft tanks, insulated, 250,000 gal)	2	ea			0		0		0	300,000	600,000)	0	600,000
	18			Fire water pump house (electric and diesel driven fire pumps, building)	1	lot			0		0	900,000	900,000		0)	0	900,000
	19			Fire Loop (allowance) & Recirc Pumps	1,000	m			0		0	\$300	300,000		50,000)	0	350,000
	20			Fire Hydrants	10	ea.			0		0		0	10,500	105,000)	0	105,000

Prepared by: AW / RM Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: AF



STANTEC CONSULTING Opinion of Probable Construction Cost Buildings and Structures DL-TK-20: Diesel - Takhini - 20 MWe

							Labour			Mat'l/Co	mmodity	Equipm	ient	Sub-Co	ntractor	Total	
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					0	0)	952,775		80,000		7,920,000	8,952,775
	1			FUEL STORAGE					0	C)	245,000		80,000		0	325,000
	2			Truck Unloading Pad					0	0)	0		0		0	0
	3			Concrete Pad 10 m x 35 m x 0.3 m	105	m ³			0	0	1,500	157,500		0		0	157,500
	4			Process/Tank Containment					0	0)	0		0		0	C
	5			Containment Tank / Piping	1	lot			0	0	20,000	20,000	80,000	80,000		0	100,000
	6			Concrete pad 30 m x 5 m x 0.3 m	45	m ³			0	(1,500	67,500		0		0	67,500
	7			GENERATOR HALL					0	C)	338,775		0		7,920,000	8,258,775
	8			Pre-engineered Building					0	()	0		0		0	0
	9			Building Size 30 m x 110 m	3,300	m ²			0	()	0		0	2,400	7,920,000	7,920,000
	10			Generator Foundation					0	0)	0		0		0	0
	11			Thickened Slab 4 m x 10 m x 0.5 m / each quantity 4	80	m ³			0	0	1,500	120,000		0		0	120,000
	12			Thickened Slab 5.5 m x 14 m x 0.5 m / each quantity 2	77	m ³			0	0	1,500	115,500		0		0	115,500
	13			Generator Stack Foundation					0	0)	0		0		0	0
	14			Concrete Pad 2.5 m x 2.5 m x 0.3 m / each quantity 6	11	m ³			0	0	1,500	16,875		0		0	16,875
	15			Radiator Foundation					0	0)	0		0		0	C
	16			Concrete Pad 4 m x 6 m x 0.3 m / each quantity 4	29	m ³			0	0	1,500	43,200		0		0	43,200
	17			Concrete Pad 6 m x 8 m x 0.3 m / each quantity 2	29	m ³			0	(1,500	43,200		0		0	43,200
	18			SUBSTATION					0	0)	369,000		0		0	369,000
	19			Transformer					0	0)	0		0		0	C
	20			Base 12 m x 18 m x 0.5 m	108	m ³			0	0	1,500	162,000		0		0	162,000
	21			Containment Walls 60 m x 1.2 m x 0.25 m	18	m ³			0		1,500	27,000		0		0	27,000
	22			Pier 11 m x 7.4 m x 1.2 m	98	m ³			0		1,500	146,520		0		0	146,520
	23			Steel Grating 1.5 m x 48.8 m	73	m ²			0	(150	10,980		0		0	10,980
	24			Breaker					0	C)	0		0		0	C

Prepared by: **JS** Date: **16-May-16** Revision No.: **A**

Issue Date: 1-Jun-16

Checked: CGV



STANTEC CONSULTING Opinion of Probable Construction Cost Mechanical & Process DL-TK-20: Diesel - Takhini - 20 MWe

									Labou	ır		Mat'l/Co	mmodity	Equip	oment	Sub-Co	ntractor	Talal
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL					5,252		577,720		187,500		2,397,500		0	3,162,720
	1			Prime Movers and Fuel Storage (See Major Equipment)					0		0		0		0		0	C
	2			Fuel System Piping (from fuel storage, building internal)	6	lot	107	1.30	832	110.00	91,520	5,000	30,000	50,000	300,000		0	421,520
	3			Glycol Heating System (incl unit heaters, electric & diesel boiler)	6	lot	107	1.30	832	110.00	91,520	7,500	45,000	100,000	600,000		0	736,520
	4			Generating Station HVAC (electric unit heaters, building and combustion ventilation)	1	lot	1,280	1.30	1,664	110.00	183,040	60,000	60,000	600,000	600,000		0	843,040
	5			Allowance for Building Services / Plumbing	1	lot	480	1.30	624	110.00	68,640	15,000	15,000	150,000	150,000		0	233,640
	6			Allowance for Lube / Waste Oil System	1	lot	320	1.30	416	110.00	45,760	10,000	10,000	100,000	100,000		0	155,760
	7			Continuous Emissions Monitoring System	1	lot	360	1.30	468	110.00	51,480	20,000	20,000	250,000	250,000		0	321,480
	8			Instrument and Plant Compressed Air Systems	1	lot	320	1.30	416	110.00	45,760	15,000	7,500	150,000	150,000		0	203,260
	9			Generating Station Sprinkler System, extinguisher, fire protection equipment	3,300	m ²			0		0		0	75	247,500		0	247,500

Prepared by: CGV Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16

Checked: LF



STANTEC CONSULTING Opinion of Probable Construction Cost Electrical, I&C DL-TK-20: Diesel - Takhini - 20 MWe

									Labou	Jr		Mat'l/Con	nmodity	Equip	oment	Sub-Co	ntractor	Total
Area	Line	Rev.	WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost	Cost	Cost
	0			TOTAL			1		7,153		836,786		2,007,600		1,718,850		0	4,563,236
	1			STATION ELECTRICAL					3,757		413,270		1,050,000		480,000		0	1,943,270
	2			Site wide Grounding Grid	1	lot	200	1.30	260	110.00	28,600	70,000	70,000		0		0	98,600
	3			Trench and conduit	1	lot	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	4			Transformer Protection Panel	1	ea	40	1.30	52	110.00	5,720		0	50,000	50,000		0	55,720
	5			Annunciator / Control / Metering Panel	1	ea	40	1.30	52	110.00	5,720		0	30,000	30,000		0	35,720
	6			SCADA / Communications	1	lot	60	1.30	78	110.00	8,580		0	50,000	50,000		0	58,580
	7			5kV, 3000A Switchgear	1	lot	40	1.30	52	110.00	5,720	120,000	120,000		0		0	125,720
	8			Station Services MCC (allow 20 Sections)	20	sect	10	1.30	260	110.00	28,600		0	8,500	170,000		0	198,600
	9			BOP PLC and Instrumentation (150 Points, \$1000 per Point)	1	ls			0		0		0	150,000	150,000		0	150,000
	10			Medium/Low Voltage Cable	5,000	ft	0.15	1.30	975	110.00	107,250	30	150,000		0		0	257,250
	11			Cable Tray and Cables from Unit Output to Electrical Room	5,000	ft	0.30	1.30	1,950	110.00	214,500	45	225,000		0		0	439,500
	12			Utility Metering Allowance	1	lot	20	1.30	26	110.00	2,860	20,000	20,000		0		0	22,860
	13			Engine & Auxiliaries Instrumentation	1	lot			0		0	90,000	90,000		0		0	90,000
	14			Black Start Diesel Genset and Auxiliaries	1	lot			0		0	375,000	375,000		0		0	375,000
	15			BUILDING SERVICES					286		31,460		150,000		48,000		0	229,460
	16			Station Service Transformer 500KVA Dry Type Indoor (for Station Services MCC)	1	ea	25	1.30	33	110.00	3,575		0	30,000	30,000		0	33,575
	17			Station Service AC and DC distribution Panels (for transformer and breaker)	2	ea	20	1.30	52	110.00	5,720		0	4,000	8,000		0	13,720
	18			125V DC Station service battery	1	ea	40	1.30	52	110.00	5,720		0	8,000	8,000		0	13,720
	19			125V DC Station service battery charger	1	ea	15	1.30	20	110.00	2,145		0	2,000	2,000		0	4,145
	20			Building Services Allowance	1	lot			0		0	135,000	135,000		0		0	135,000
	21			Miscellaneous (tray, conduit, terminal blocks, etc.)	1	lot	100	1.30	130	110.00	14,300	15,000	15,000		0		0	29,300
	22			SUBSTATION					3,110		342,056		57,600		1,190,850		0	1,590,506
	23			Transformer - 20MW, 4.16 kV / 34.5 kV, +/- 5% Off Load Tap Changer and multi ratio CTs	1	ea	180	1.30	234	110.00	25,740	22,500	22,500	525,000	525,000		0	573,240
	24			Breaker - 34.5 kV, 650 kV BIL, 800A (min), 31.5 kA (min) outdoor dead tank	2	ea	90	1.30	234	110.00	25,740	1,500	3,000	111,000	222,000		0	250,740
	25			Disconnect - 34.5 kV, 600A Vertical Break, Group Operated, c/w interlocked ground switch	2	ea	45	1.30	117	110.00	12,870	1,500	3,000	24,000	48,000		0	63,870
	26			Potential Transformer - 34.5 kV, dual winding, outdoor, post type	6	ea	12	1.30	94	110.00	10,296	750	4,500	7,500	45,000		0	59,796
	27			Surge Arrestor - 24.4 kV MCOV, outdoor, station class, surge arresters	6	ea	8	1.30	59	110.00	6,435	750	4,500	825	4,950		0	15,885
	28			Cable - 5 kV, 500MCM, XLPE insulation, aluminum conductor, 100% insulation	840	Μ	0.3	1.30	328	110.00	36,036	0	0	53	44,100		0	80,136
	29			Conductor - Bare, 2/0 AWG AAC (Aster)	120	Μ	0.5	1.30	70	110.00	7,722	0	0	15	1,800		0	9,522
	30			Cable Terminations	42	ea	5	1.30	246	110.00	27,027	300	12,600	0	0		0	39,627
	31			Misc Hardware and electrical connectors	1	lot	90	1.30	117	110.00	12,870	7,500	7,500	0	0		0	20,370
	32			Line Protection Panel	2	ea	120	1.30	312	110.00	34,320	0	0	75,000	150,000		0	184,320
	33			34.5 kV Interconnection - poles, conductor, hardware, deadends	1	lot	1,000	1.30	1,300	110.00	143,000		0	150,000	150,000		0	293,000
	34			SITE SECURITY					0		50,000		300,000		0		0	350,000
	35			Roadway / Site Lighting	1	ls			0		50,000	100,000	100,000		0		0	150,000
	36			CCTV Security and Integration to System Control Centre	1	ls			0		0	75,000	75,000		0		0	75,000
	37			Fire Alarm Systems	1	ls			0		0	75,000	75,000		0		0	75,000
	38			Communications (fibre, CAT5, telephone)	1	ls			0		0	50,000	50,000		0		0	50,000
	39			EI&C MISCELLANEOUS					0		0		450,000		0		0	450,000
	40			Engine, fuel, and auxiliaries controls installation	400	pt			0		0	750	300,000		0		0	300,000
	41			Miscellaneous BOP Electrical Equipment Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	42			Miscellaneous Engine Electrical Allowance	1	ls			0		0	50,000	50,000		0		0	50,000
	43			Miscellaneous Electrical Equipment Grounding	1	ls			0		0	50,000	50,000		0		0	50,000

Prepared by: CGV / RF Date: 16-May-16 Revision No.: A Issue Date: 1-Jun-16 Checked: ES



STANTEC CONSULTING Opinion of Probable Construction Cost Indirect and Owner's Costs DL-TK-20: Diesel - Takhini - 20 MWe

									Labou	Jr		Mat'l/Co	mmodity	Equip	oment	Sub-Contractor	Tabul
Area	Line	Rev.	. WBS	Description	Qty	Unit	hr per Unit	Prod. Factor	Total Hours	Rate	Cost	Unit Cost	Cost	Unit Cost	Cost	Unit Cost Cost	Cost
	0			TOTAL					0		0		0		0		0 6,887,256
	1			Based on recent YEC experience, an 18% factor on direct costs is incorporated to cover:					0		0		0		0)	0 6,887,256
	2			Contractor General Conditions					0		0		C		0)	0 0
	3			Security					0		0		C		0)	0 0
	4			Lock-out tag-out (LOTO) coordination					0		0		0		0)	0 0
	5			Waste removal					0		0		0		0)	0 0
	6			Snow removal					0		0		0		0)	0 0
	7			Warehousing and utilities including temporary power supply					0		0		0		0)	0 0
	8			Temporary construction lighting					0		0		0)	0)	0 0
	9			Taxes					0		0		0)	0)	0 0
	10			Interest charges during construction.					0		0		0)	0)	0 0
	11			Land acquisition and zoning					0		0		0		0)	0 0
	12			Environmental studies, YESAB assessment and all permitting					0		0		0		0)	0 0
	13			Owner's administration costs, including:					0		0		0		0)	0 0
	14			Legal fees.					0		0		0		0)	0 0
	15			Insurance.					0		0		0		0)	0 0
	16			Salaries & expenses of Owner's project staff.					0		0		0		0)	0 0
	17			Allowance for operators hours & fuel costs during training, commissioning, and start up.					0		0		0		0)	0 0
	18			Special costs to dispose from site construction waste.					0		0		0		0)	0 0
	19								0		0		0		0		0 0

Prepared by: Team

Date: 16-May-16

Revision No.: A

Issue Date: 1-Jun-16

Checked: CGV



APPENDIX B

Concept Layouts



 File No.:
 133547248/6_1_1

 Date:
 August 5, 2016

 Log ID:

Project No. 133547248

Transmittal Drawing List

Drawing No. Sheet No.	Client Drawing No.	Rev. No.	Drawing Title	Drawing By
B-0004		A	SITE LAYOUT - LANDFILL - MAP LNG - 5 MWE (NG-LD-5)	Stantec
1 of 2				
B-0004		А	SITE LAYOUT - LANDFILL - CAD LNG - 5 MWE (NG-LD-5)	Stantec
2 of 2				
B-0005		А	SITE LAYOUT - LANDFILL - MAP LNG - 10 MWE (NG-LD-10)	Stantec
1 of 2				
B-0005		A	SITE LAYOUT - LANDFILL - CAD LNG - 10 MWE (NG-LD-10)	Stantec
2 of 2				
B-0006		A	SITE LAYOUT - LANDFILL - MAP LNG - 20 MWE (NG-LD-20)	Stantec
1 of 2				
B-0006		A	SITE LAYOUT - LANDFILL - CAD LNG - 20 MWE (NG-LD-20)	Stantec
2 of 2				
B-0007		А	SITE LAYOUT - TAKHINI - MAP LNG - 5 MWE (NG-TK-5)	Stantec
1 of 2				
B-0007		А	SITE LAYOUT - TAKHINI - CAD LNG - 5 MWE (NG-TK-5)	Stantec
2 of 2				
B-0008		А	SITE LAYOUT - TAKHINI - MAP LNG - 10 MWE (NG-TK-10)	Stantec
1 of 2				

Drawing No. Sheet No.	Client Drawing No.	Rev. No.	Drawing Title	Drawing By
B-0008		А	SITE LAYOUT - TAKHINI - CAD LNG - 10 MWE (NG-TK-10)	Stantec
2 of 2				
B-0009		А	SITE LAYOUT - TAKHINI - MAP LNG - 20 MWE (NG-TK-20)	Stantec
1 of 2				
B-0009		А	SITE LAYOUT - TAKHINI - CAD LNG - 20 MWE (NG-TK-20)	Stantec
2 of 2				
B-0013		A	SITE LAYOUT - LANDFILL - MAP DIESEL - 5 MWE (DL-LD-5)	Stantec
1 of 2				
B-0013		A	SITE LAYOUT - LANDFILL - CAD DIESEL - 5 MWE (DL-LD-5)	Stantec
2 of 2				
B-0014		А	SITE LAYOUT - LANDFILL - MAP DIESEL - 10 MWE (DL-LD-10)	Stantec
1 of 2				
B-0014		А	SITE LAYOUT - LANDFILL - CAD DIESEL - 10 MWE (DL-LD-10)	Stantec
2 of 2				
B-0015		A	SITE LAYOUT - LANDFILL - MAP DIESEL - 20 MWE (DL-LD-20)	Stantec
1 of 2				
B-0015		А	SITE LAYOUT - LANDFILL - CAD DIESEL - 20 MWE (DL-LD-20)	Stantec
2 of 2				
B-0016		A	SITE LAYOUT - TAKHINI - MAP DIESEL - 5 MWE (DL-TK-5)	Stantec
1 of 2				

Drawing No. Sheet No.	Client Drawing No.	Rev. No.	Drawing Title	Drawing By
B-0016		А	SITE LAYOUT - TAKHINI - CAD DIESEL - 5 MWE (DL-TK-5)	Stantec
2 of 2				
B-0017		А	SITE LAYOUT - TAKHINI - MAP DIESEL - 10 MWE (DL-TK-10)	Stantec
1 of 2				
B-0017		А	SITE LAYOUT - TAKHINI - CAD DIESEL - 10 MWE (DL-TK-10)	Stantec
2 of 2				
B-0018		А	SITE LAYOUT - TAKHINI - MAP DIESEL - 20 MWE (DL-TK-20)	Stantec
1 of 2				
B-0018		А	SITE LAYOUT - TAKHINI - CAD DIESEL - 20 MWE (DL-TK-20)	Stantec
2 of 2				



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133547248	B-0004	of	2	





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										tant	ter
A	JUNE 02, 2016 CLIENT	REVIEW						DESIGN CHK		DES DFTG CGV AAB	SCALE 1:1500
REV.	ISSUED TO	ISSUED FOR	REV.	DATE	BY	REVISIONS	DES		LF		MAY 17, 2016





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A JUNE 02, 2016 REVIEW REVIEW							CONTROL ROOM OFFICE/WASHROOM MAINTENANCE STORAGE		A C C C C C C C C C C C C C C C C C C C	ENERATOR Bomx25m)		CAL ROOM	V SUBST/ (65m×4	\TIO I5m TRA
A JUNE 02, 2016 CLIENT REVIEW REVIEW) S [.]	ta	nt	ec	
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			CONTROL ROC OFFICE/WASHF MAINTENANCE STORAGE	M ROOM GE GE TIC GATE C/W INTER TRY, AND CCTV 10MW OP		GENERATOR S (88mx25m)	TATION
 JUNE 02, 2016 CLIENT	REVIEW			DESIGN	DFTG CHK	DES CGV DFTG AAB	scale 1:1500



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						CENERATOR STATION (110mx30m) CONTROL ROOM OFFICE/WASHROOM MAINTENANCE STORAGE DIESEL STORAGE AUTOMATIC GATE C FOB ENTRY, AND C					ELECTRICAL RO
								S	ta	nt	tec
A REV.	JUNE 02, 2016 CLIENT ISSUED TO	REVIEW ISSUED FOR	REV.	DATE	BY	REVISIONS 2	DESIGN CHK	DFTG CHK P.M. LF	DES CGV P.T.	DFTG AAB	SCALE 1:1500 DATE MAY 17, 2016





n	1										
								/	/ CONTROL R OFFICE/WAS	OOM Shroom	
			GENERA (73mx3	NTOR ST. SOm) —	ATION					CE STORAGE	
-			ELECTR	ICAL RO	ом —						
			TRANSF	ORMER ·							
-			BREAKE	.R ———				**	× × × ×		
-					(57	BSTATION 7mx57m)		AU INT AN	TOMATIC GATE ERCOM, FOB D CCTV ———	C/W ENTRY,	
	T	I		I	I	1	5MV	V OPTIC	N		
									S	tan	tec
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PUMPHOUSE	
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- FIRE WATER STORAGE







0 30m 60m SCALE 1:1500			
YUKON ENERGY			
THERMAL ENERGY PLANT DEVELOPMENT STUDY			
SITE LAYOUT – TAKHINI – CAD DIESEL – 10 MWe (DL–TK–10)			
JOB No. 133547248	DWG. No. B-0017	SHEET 2 of 2	$- \begin{bmatrix} R \\ E \\ V \end{bmatrix} \land A$

FIRE WATER STORAGE

PUMPHOUSE




		30m CALE 1:1500	60m
YUKON ENERGY			
THERMAL ENERGY PLANT DEVELOPMENT STUDY			
SITE LAYOUT – TAKHINI – CAD DIESEL – 20 MWe (DL–TK–20)			
JOB No. 133547248	DWG. No. B-0018	SHEET 2 of 2	$- \begin{bmatrix} R \\ E \\ V \end{bmatrix} \land \land$

- FIRE WATER STORAGE

PUMPHOUSE