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Northland Power Thorold Cogen GP Inc. / Thorold Cogen L.P.

EMISSION SUMMARY AND DISPERSION MODELLING REPORT

Thorold Generating Station

October 2023

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Thorold Generating Station

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Northland Power Thorold Cogen GP Inc., as general partner for and on behalf of Thorold Cogen L.P. (TCLP) holds the ECA for the Facility, which is managed and operated by Northland Power Inc. (Northland). As described in the ECA, the Facility consists of one (1) natural gas-fired gas turbine generator (GTG), nominally rated at 160 MW, one (1) heat recovery steam generator (HRSG) with duct firing capability (up to 100 MMBTU/hr), one (1) steam turbine generator (STG), two (2) natural gas-fired auxiliary boilers, each with nominal rating of 337.4 MMBTU/hr, one (1) integrated natural gas-fired boiler and superheater nominally rated at 22.03 MMBTU/hr and 2.11 MMBTU/hr respectively, and one (1) emergency standby diesel generator with nominal power rating of 1500 kW. The emergency standby diesel generator meets the requirements for exemption under O.Reg.524/98. Emissions from natural gas-fired comfort heating equipment are considered negligible in accordance with s.8 of O.Reg. 419/05.

TCLP is proposing to make changes to the GTG, in response to a request from the provincial electricity grid operator, the Independent Electricity System Operator (IESO). On a daily basis, TCLP responds to dispatch instructions it receives from the IESO, operating when directed to do so and selling its energy into the provincial electricity grid. The IESO is looking to address forecast electricity supply shortages and TCLP is able to assist and reduce the shortages, as follows:

• TCLP utilizes a General Electric (GE) gas turbine as its main combustion unit, and GE offers an upgrade package which allows the GTG to run more efficiently and increases its energy output. The gas turbine upgrade package involves exchanging many components (rotating vanes, burners and control software) within the engine package itself, but no other construction work is required at the site and no outdoor work is needed. The GE upgrade package has been implemented elsewhere for several years, including another similar plant Northland operates in Saskatchewan. There are no planned changes for any of the other Facility combustion units.

The original Certificate of Authorization (CofA) provided for the combustion of landfill gas in one of the existing auxiliary boilers, with a matching reduction in the use of natural gas. The landfill gas was supplied by a third-party, and this fuel is not available to the Facility any longer and has been removed from the ESDM evaluation.

As well, the Facility originally operated as a cogeneration plant, exporting steam to an adjacent paper mill. The paper mill is no longer in operation and the two auxiliary boilers that had provided back-up steam to the mill currently operate intermittently and only at very low load. It is anticipated that these will be shutdown and laid-up when the permanent shutdown of the mill is confirmed in the steam sales agreement. Despite these units being largely idle, they have been modelled in this ESDM evaluation until they are permanently shutdown and mothballed.

The Facility is subject to s.20 of O.Reg.419/05. Therefore, the modelled impact of contaminant emissions has been assessed using the U.S. EPA AERMOD model as ½-hour, 1-hour and 24-hour maximum point of impingement (POI) concentrations and compared with the applicable limits listed in the Ministry document titled “Air Contaminants Benchmark (ACB) List: Standards, guidelines and screening levels for assessing point of impingement concentrations or air contaminants “, dated April 2018 (ACB List).

The Facility is expected to emit products of combustion “including nitrogen oxides (NO_x), sulphur dioxide (SO_2) carbon monoxide (CO) and suspended particulate matter (SPM).

The maximum POI concentrations were estimated based on the operating conditions where all significant sources are operating simultaneously at their individual maximum rates of production. The maximum emission rates for each significant source were calculated in accordance with s. 11 of O. Reg. 419/05 and the data quality assessed following the process outlined in the requirements of the ESDM Procedure Document.

A POI concentration for each significant contaminant emitted from the Facility was estimated for each operating scenario based on the calculated emission rates and the output from the approved dispersion model. The results are presented in the Emission Summary Table, **Table ES.1**, in accordance with s.26 of O. Reg.419/05.

The POI concentrations for all contaminants listed in the Emission Summary Table were compared against the criteria listed in the MECP’s Air Contaminants Benchmark (ACB) List. Of the four (4) contaminants listed in the Emission Summary Table that have a limit in the ACB List, the predicted POI concentrations are below the corresponding benchmark limits. The highest POI concentration predicted for the Facility is 39.3 µg/m^3 of NO_x, which is 10% of the 1-hour standard of 400 µg/m^3, and 13.8 µg/m^3 which is 7% of the 24-hour standard of 200 µg/m^3.

This ESDM Report demonstrates that the Facility can operate in compliance with O. Reg. 419/05.

Emission Summary Table
Thorold Cogen L.P. (TCLP)

Contaminant Name	Contaminant CAS #	Scenario	Total Facility Emission Rate (g/s)	Air Dispersion Model Used	Averaging Period (hours)	Maximum POI Concentration (1) (ug/m3)	ACB Benchmark Limit (ug/m3)	Limiting Effect	Source & Category(2)	Percentage of ACB Benchmark (%)
Nitrogen Oxides (NOx)	10102-44-0	Start-up - Max 1-hr	25.7	AERMOD 22112	1	39.3	400	Health	Standard B1	10%
		Max 24-hr	28.4		24	13.8	200	Health		7%
Sulphur Dioxide (SO_2)	7446-09-5	Max 24-hr	0.5	AERMOD 22112	1	0.42	100	Health & Veg	Standard B1	0.4%
					24	0.19	275	Health & Veg		0.1%
					Annual	1.4E-02	10	Health & Veg	Standard B2	0.1%
Carbon Monoxide (CO)	630-08-0	Start-up - Max 1-hr	27.0	AERMOD 22112	1/2	48.1	6,000	Health	Standard B1	0.8%
Suspended Particulate Matter (SPM)	-	Max 24-hr	2.6	AERMOD 22112	24	1.1	120	Visibility	Standard B1	0.9%
Emergency Scenario (3)										
Nitrogen Oxides (NOx)	10102-44-0		3.8	AERMOD 22112	0.5	789	1880	-	EDG Checklist	42%

Notes:

(1) Maximum POI Concentrations after the elimination of meteorological anomalies.

(2) B1 - Benchmark 1 values (standards and guidelines) - 'Benchmarks as identified in the document "Air Contaminants Benchmarks List: standards, guidelines and screening levels for assessing point of impingement concentrations of air contaminants 2.0, dated April, 2018".

Notes on Emergency Scenario:

(3) Maximum half hour NOx concentration for the generator based on the maximum modelled 1-hr value multiplied by a factor of 1.2 as per guidance in the ADMGO.

1.0 INTRODUCTION AND FACILITY DESCRIPTION

Arcadis Canada Inc. (Arcadis) was retained by Northland Power Thorold Cogen GP Inc. / Thorold Cogen L.P. (TCLP) to prepare an Emission Summary and Dispersion Modelling (ESDM) Report, in support of an application for amendment to Environmental Compliance Approval (ECA) No. 3700-BNFNU in accordance with Ontario Regulation (O.Reg.) 419/05, for its electricity generating station located at 90Allanburg Rd, Thorold, Ontario (Facility).

This ESDM Report was prepared in accordance with s.26 of O. Reg. 419/05. In addition, guidance in the Ministry publication “Procedure for Preparing an Emission Summary and Dispersion Modelling Report” dated March 2018 (ESDM Procedure Document) PIBS 3614e04.1 was followed as appropriate.

For ease of review and to promote clarity, this ESDM Report is structured to correspond to each of the items listed in the Ministry publication “2017 Emission Summary and Dispersion Modelling Report Check-list” PIBS 5357e.

This section provides a description of the Facility as required by subparagraph 1 of s. 26(1) of O.Reg. 419/05.

1.1 Purpose and Scope

This ESDM Report was prepared to support an application for amendment to Environmental Compliance Approval (ECA) No. 3700-BNFNU for all the identified emission sources at the Facility. The ESDM Report was prepared in accordance with s.26 of O. Reg. 419/05 in support of the ECA application for amendment.

TCLP is proposing to increase the output of its GE 7FA gas turbine (GTG), by implementing an upgrade package offered by GE which allows the GTG to run more efficiently and increases its electrical output. The gas turbine upgrade package involves exchanging many components (rotating vanes, burners and control software) within the engine package itself, but no other construction work is required at the site and no outdoor work is needed. There are no proposed changes to the other approved Facility equipment as listed in the current ECA No. 3700-BNFNU. The Facility is owned by a single purpose company, TCLP and is operated and managed by Northland Power. The Facility is located in a general industrial zone with urban residences located immediately southof the site.

The original Certificate of Authorization (CofA) provided for the combustion of landfill gas in one of the existing auxiliary boilers, with a matching reduction in the use of natural gas. The landfill gas was supplied by a third-party, and this fuel isnot available to the Facility any longer and has been removed from the ESDM evaluation.

As well, the Facility originally operated as a cogeneration plant, exporting steam to an adjacent paper mill. The paper mill is no longer in operation and the two auxiliary boilers that had provided back-up steam to the mill currently operate intermittently and only at very low load. It is anticipated that these will be shut down and laid-up when the permanent shutdown of the mill is confirmed in the steam sales agreement. Despite these units being largely idle, they have been modelled in the ESDM evaluation until they are permanently shut down and mothballed.

The location of the Facility is presented in **Figure 1** – Site Location Plan and the land use designation of the site and surrounding area is presented in **Figure 2** – Land Use Zoning Plan. The location of the discharges from each source is presented in **Figures 3a and 3b** – Dispersion Modelling Plan; the location of each of the sources is specified with the source reference number.

1.2 Facility Description

1.2.1 Process Description and NAICS Code

Northland Power, together with participation from Resolute Forest Products Inc. (RFP) (formerly Abitibi-Consolidated Company of Canada), developed the Thorold Generating Station, originally a combined heat and power (cogeneration) facility located at the RFP's Thorold paper mill site (Thorold Mill) in Thorold, Ontario. As originally configured, the Facility sold process steam and small amounts of electricity to the RFP Thorold Mill, with the main electricity supply sold to the provincial grid. Due to economic reasons, RFP has ceased operation of their Thorold Mill and is no longer receiving process steam and electricity for paper making The Facility now works as an intermediate electricity supply plant (operating for longerdurations than a peaking plant) and, depending on the province's electricity demand, may have daily start-ups.

The existing Facility configuration consists of a gas turbine based combined-cycle, plant comprised of the following:

- One (1) General Electric 7FA PG7241 DLN-2.6 gas turbine generator (GTG), nominally rated at 160 MW, using Dry Low NO_x combustors;
- One (1) heat recovery steam generator (HRSG) to feed a steam turbine generator with duct firing capability (up to 100 MMBTU/hr), triple-pressure with reheat exhausting to the atmosphere through the GTG-HRSG stack having a diameter of 5.8 m and extending 60.9 m above grade;
- One (1) reheat/extraction/condensing steam turbine generator (STG), nominally rated at 95 MW;
- Two (2) 337.4 MMBTU/hr Auxiliary Boilers, with Low NO_x burners (both boilers operate on natural gas (NG) exhausting to the atmosphere through each auxiliary boiler stack (AUXB-1 and AUXB-2) each having a diameter of 1.8 m and extending 60.9 m above grade);
- One (1) 1500 kW standby emergency diesel generator set (the unit is located at the site to provide power in case of an emergency and is tested weekly for ½ hour);
- One (1) Saturated steam Boiler nominally rated at 22.03 MMBTU/hr; and one (1) Superheater with a capacity of 2.11 MMBTU/hr, with both units exhausting through the same stack (B3).
- One (1) diesel storage tank, having a storage capacity of 11,360 L; and,
- Natural gas fired comfort heating equipment, having a maximum heat input capacity of about 7 GJ/hr.

As a consequence of the Thorold Mill closing, the existing Auxiliary Boilers are over-sized forthe Facility's own utility steam needs and TCLP received approval to install a smaller boiler/superheated steam system (emission point B3) to better match the current needs. The smaller boiler/superheater system has not been installed at this time but has been proactively included in this ESDM evaluation. The Boiler and Superheater (B3) operate together to produce superheated steam for the Facility's use during periods of low electricity demand.

With the proposed Gas Turbine Upgrade Project, the GTG designation becomes a GE 7FA AGP DLN2.6+ with Peak Firing Capability (AGP standing for advance gas path – the main internal engine upgrade).

The North American Industry Classification System (NAICS) code that applies to this Facility is "*221112 – Fossil-Fuel Electric Power Generation.*"

1.2.2 Description of Products and Raw Materials

Natural gas is combusted in the gas turbine (using low NOx combustors) which drives the 160 MW (If approved increasing by approximately 23 MW as part of the GTG Upgrade Project) nominal generator to produce electricity. The hot combustion exhaust gases from the gas turbine are used by a Heat Recovery Steam Generator (HRSG) to produce steam. The HRSG also has the capability of firing up to 100 MMBtu/hr of natural gas (NG) in its duct burners for supplemental steam production. The high-pressure steam from the HRSG is used in the 95 MW nominal STG to generate electricity.

As originally configured, the HRSG and the STG can supply intermediate pressure steam to the RFP Thorold Mill. If the HRSG and STG are not producing sufficient intermediate pressure steam for RFP's needs, the Auxiliary Boilers, with low NOx combustors, can produce up to 100% steam production using NG (approx. 337 MMBTU/hr). In addition, one of the Auxiliary Boilers (either AUXB-1 or AUXB-2) can burn up to 150 MMBTU/hr of Landfill Gas (LFG) instead of natural gas, however the LFG is no longer available.

With the ceased operation of RFP Thorold Mill, an integrated boiler/superheater (B3) system will be natural gas-fired and will provide smaller flows of intermediate steam which the Facility needs (such as sealing steam for the steam turbine and pulling vacuum in the condenser etc. for combined cycle start- up) for its own use and which cannot be economically supplied by the over-sized Auxiliary Boilers. Once the combined cycle is up and running, the auxiliary boiler is shutdown, as the combined cycle mode of operation is self-sufficient to provide the required steam from the HRSG circuit.

Heat being rejected from the steam turbine is cooled using once-through cooling water from the Welland Canal.

Raw materials and associated information are provided in greater detail in **Appendix A** – Supporting Calculations. Refer to **Table 1** – Sources and Contaminants Identification Table, which tabulates the individual sources of emissions at the Facility.

1.2.3 Operating Modes

The Facility is able to operate in, and can transition between, basic modes:

1. **Combined Cycle with Aux Boiler Mode**: The GTG, HRSG, STG are operational. The new Boiler/Superheater (B3) system is not operational. Although unlikely to operate in this manner, this mode includes the operation of the auxiliary boilers. At this time the requirement to supply steam could be restored if the Thorold Mill were repurposed. The Independent Electricity System Operator (IESO) dictates how much electricity is to be produced and delivered to the provincial grid. Pending the approval of the Gas Turbine Upgrade Project, the IESO will be able to request an additional 23 MW of electrical output.

2. **Backup Mode:** The GTG, HRSG, STG are *NOT* operational. Process steam requirements are provided by the existing Auxiliary Boilers. The new Boiler/Superheater (B3) is not operational. This mode is highly unlikely but will be evaluated as long as the Aux Boilers may be called to operate.

3. **Combined Cycle – Start-up Mode**: The Facility will operate the GTG, HRSG and STG, if the provincial grid requires the Facility's electricity and dispatches the Facility to start-up. The Boiler/Superheater (B3) will operate at this time to provide utility steam (such as sealing steam, pulling vacuum in the condenser etc. for combined cycle start-up only) to the Facility, until the combined cycle operation starts to produce its own steam through the HRSG. For the ESDM evaluation, the Source B3 is included and the GTG emissions are estimated to at 50% load and a duration of ½ hour.

With the ceased operation of Thorold Mill, the Facility currently generates electricity in Combined Cycle mode. The IESO may dispatch the Facility multiple times a week, as such the Boiler/Superheater (B3) may operate to provide the necessary heat to keep the steam systems warm for a faster start-up once a dispatch order is received from the IESO. For design purposes, the GTG, HRSG and STG are capable of starting up and shutting down two to three times daily.

1.3 Process Flow Diagram

Refer to **Figure 4** – Process Flow Diagram for a simplified graphical representation of the process at the Facility.

1.4 Operating Schedule

The Facility operates seven (7) days per week, twenty-four (24) hours a day, fifty-two (52) week per year.

2.0 INITIAL IDENTIFICATION OF SOURCES AND CONTAMINANTS

The following section provides an initial identification of all the sources and contaminants emitted at the Facility, as required by subparagraphs 2 to 4 of s.26(1) of O.Reg. 419/05.

There may be general ventilation from the Facility that only discharges uncontaminated air from the workspaces or air from the workspace that may include contaminants that come from commercial office supplies, building maintenance products or supplies and activities; these types of ventilation sources are considered to be negligible and were not identified as sources at the Facility.

2.1 Sources and Contaminants Identification Table

Table 1 – Sources and Contaminants Identification Table tabulates all of the emission sources and contaminants expected from the Facility. This table provides the information required by subparagraphs 2 to 4 of s. 26(1) of O. Reg. 419/05.

The expected contaminants emitted from each source are also identified in **Table 1**; for example, the expected contaminants emitted from the gas turbine generator stack are nitrogen oxides (NO_x), sulphur dioxide (SO_2) carbon monoxide (CO) and suspended particulate matter (SPM). Each of the identified sources has been assigned a source reference ID, for example the gas turbine generator (with associated HRSG including duct burners) stack has been designated GTG-HRSG.

The location of the discharges from each of the sources is presented in **Figure 3b** – Dispersion Modelling Plan; the location of each source is specified with the source reference ID.

3.0 ASSESSMENT OF THE SIGNIFICANCE OF CONTAMINANTS AND SOURCES

This section provides an explanation for each source and contaminant identified as negligible in **Table 1** – Sources and Contaminants Identification Table, as required by subparagraph 5 of s.26(1) of O. Reg. 419/05.

In accordance with s.8 of O. Reg. 419/05 emission rate calculations and dispersion modelling do not have to be performed for emissions from negligible sources or for the emission of negligible contaminants from significant sources.

3.1 Identification of Negligible Sources and Contaminants

Of the seven (7) sources listed in Table 1 – Sources and Contaminants Identification Table, four (4) sources have been identified as negligible. Each negligible source is identified in the table, for example the diesel storage tank (TNK) has been labelled as negligible.

The remaining three (3) sources are considered significant. For example, the gas turbine generator (with associated HRSG including duct burners) (GTG-HRSG) is considered a significant source. These three (3) significant sources were included in the dispersion modelling for the site.

3.2 Rationale for Assessment

For each source in **Table 1** that has been identified as being negligible there is an accompanying rationale, for example the rationale for the conclusion that the source TNK is negligible is listed as Table B-3B, Low temperature handling of compounds with a vapour pressure less than 1 kiloPascal. The technical information required to substantiate this is presented in **Appendix B** – Supporting Information for Assessment of Negligibility.

4.0 OPERATING CONDITIONS, EMISSION RATE ESTIMATION AND DATA QUALITY

This section provides a description of the operating conditions used in the calculation of the emission estimates and an assessment of the data quality of the emission estimates for each significant contaminant from the Facility as required by subparagraphs 6 and 7 of s. 26(1) of O. Reg. 419/05. In accordance with s. 8 of O. Reg. 419/05, emission rate calculations and dispersion modelling do not have to be performed for emissions from negligible sources or for the emission of negligible contaminants from significant sources.

4.1 Description of Operating Conditions

As noted in Section 1.2, the NAICS code that applies to this Facility is 221112 – Fossil-Fuel Fired Electric Power Generation and is listed in Schedule 4 of O. Reg. 419/05. Therefore, the Facility is subject to s.20 of O.Reg. 419/05 and the modelled impact of contaminant emissions has been assessed using the U.S. EPA AERMOD model as 1-hour and 24-hour maximum POI concentrations and compared to the benchmarks published within the ACB List.

Section 10 of O. Reg. 419/05 states that an acceptable operating condition is a scenario that assumes operating conditions for the Facility that would result, for the relevant contaminant, in the highest concentration of the contaminant at POI that the Facility is capable of emitting. The operating condition described in this ESDM Report meets this requirement.

For contaminants emitted from the Facility, the ACB limits are ½-hour, 1-hour and 24-hour. The operating condition used for this Facility that results in the maximum concentration at the POI is the scenario where all significant sources are operating simultaneously at their individual maximum rates of production. The individual maximum rates of production for each significant source of emissions correspond to the maximum emission rate during any ½-hour, 1-hour and 24-hour period (depending on contaminant).

As discussed above, the Facility can operate under different operational modes. Based on the emissions estimates for the sources, the Cogeneration Operating Mode is considered the worst-case operating scenario. This is considered because the emissions from the boiler and superheater (B3) are considered insignificant compared to the Auxiliary boilers (AUXB-1 and AUXB-2). The nitrogen oxides emission rates associated with the start-up of the GTG differ significantly from those associated with GTG operating at 100% load. Therefore, two separate worst-case emission scenarios were developed and modelled for nitrogen oxides, one for estimating the maximum 1-hour POI concentrations and one for estimating maximum 24-hour POI concentrations. The individual maximum rates of production for each significant source of emissions are explicitly described in **Appendix A** – Supporting Calculations.

4.2 Explanation of the Methods Used to Calculate Emission Rates

The maximum ½-hour, 1-hour and 24-hour emission rates for each significant contaminant emitted from the significant sources were calculated in accordance with requirements of the ESDM Procedure Document.

The emission rate for each significant contaminant emitted from a significant source was estimated and the methodology for the calculation is documented in **Table 2** – Source Summary Table. For example, the emission of NO_x from the gas turbine generator (with associated HRSG including duct burners) (GTG-HRSG) was calculated using an emission factor (EF) technique.

4.3 Sample Calculations

The technical rationale, including sample calculations, required to substantiate emission rates presented in **Table 2** – Source Summary Table is documented in **Appendix A** – Supporting Calculations.

4.4 Assessment of Data Quality

This section provides a description of the assessment of the data quality of the emission estimates for each significant contaminant from the facility, as required by subparagraph 7iii of s.26(1) of O. Reg. 419/05.

The assessment of the data quality of the emission rate estimates for each significant contaminant emitted from the significant sources was performed in accordance with the requirements of subparagraph 7iii of s.26(1) of O. Reg. 419/05. The emissions listed in **Table 2** – Source Summary Table are documented as having the highest available data quality and correspond to the operating scenario where all sources are operating simultaneously at their individual maximum rates of production.

For example, the emissions of NO_x from the gas turbine generator (with associated HRSG including duct burners) (GTG-HRSG) was estimated using manufacturer supplied emission factors and were applied to the maximum rate of operation for each generator. Therefore, the emission rate estimate is not likely to be an underestimate of the actual emissions rates and use of these emission rates will result in a calculated concentration at POI greater the actual concentrations. These sources were documented as having Data Quality of “Average,” which is generally acceptable according to requirements of the ESDM Procedure Document.

For each contaminant, the emission rate was estimated and the data quality for the estimate was documented in **Table 2** – Source Summary Table. The assessment of data quality for each source listed in **Table 2** is documented in **Appendix A** – Supporting Calculations.

4.5 Comparison to Boiler and Heater Emission Limits

The MECP “Guideline A-9: NO_x Emission from Boilers and Heaters” (Guideline A-9) (MECP, 2017) dictates the emission limits of NO_x from large fossil fuel fired boilers and heaters. The guideline applies to any new or newly modified boiler or heater which burns either oil or gas with a heat input of greater than 10.5 gigajoules/hour (GJ/hr). For boilers and heaters burning gaseous fuel with a capacity between 10.5 to 105

GJ/hr, the NO_x emission limit is 26 g/GJ. For boilers greater than 105 GJ/hr, the NO_x emission limit is 40 g/GJ.

The Facility auxiliary boilers (AUXB-1 and AUXB-2) have been certified when operating on NG to comply with the MECP Guideline A-9 maximum allowable limit for boilers. The manufacturer certifications for each boiler are presented in **Appendix E** - Manufacturer Specifications.

5.0 SOURCE SUMMARY AND SITE PLAN

This section provides the table required by subparagraph 8 and the site plan required by subparagraph 9 of s. 26(1) of O. Reg. 419/05.

5.1 Source Summary Table

The emission rate estimates for each source of a significant contaminant are documented in **Table 2** – Source Summary Table in accordance with the requirements of subparagraph 8 of s.26(1) of O. Reg. 419/05.

5.2 Site Plan

The locations of the emission sources listed in **Table 2** – Source Summary Table are presented in **Figure 3b** – Dispersion Modelling Plan; the location of each of the sources is specified with the source reference ID. The location of the property line is indicated on **Figure 3a**, with the end points of each section of the property-line clearly referenced to the UTM coordinate system (NAD 83, Zone 17). The location of each source is referenced to this UTM coordinate system under a column in **Table 2** – Source Summary Table.

The heights of the structures that are part of the Facility are labelled as “Tier Heights” in **Figure 3a** – Dispersion Modelling Plan.

6.0 AIR DISPERSION MODELLING

This section provides a description of how the dispersion modelling was completed for the Facility to predict the maximum POI concentrations, as required by subparagraphs 10 to 13 of s. 26(1) of O. Reg. 419/05.

The Facility is subject to s.20 of O.Reg.419/05, therefore, the modelled impact of contaminant emissions has been assessed using the U.S. EPA AERMOD model as 1-hour and 24-hour maximum POI concentrations and compared to the benchmarks published within the ACB List.

Dispersion modelling was completed in accordance with the MECP's "Air Dispersion Modelling Guideline for Ontario, Version 3.0" dated February 2017 (ADMGO). A general description of the input data used in the dispersion model is provided below and summarized in **Table 3**.

The AERMOD modelling system has been identified by the MECP as one of the approved dispersion models under O. Reg. 419/05, and currently includes the Plume Rise Model Enhancements (PRIME) algorithms for assessing the effects of buildings on air dispersion. The use of a more refined model, such as AERMOD, is necessary when assessing air quality criteria listed in the ACB List. It is also applicable to rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including point, area, and volume sources).

The AERMOD modelling system is made up of the AERMOD dispersion model, the AERMET meteorological pre-processor and the AERMAP terrain pre-processor. The following approved dispersion model and pre-processors were used in the assessment:

- AERMOD dispersion model (v.22112);
- AERMAP surface pre-processor; and,
- BPIP building downwash pre-processor.

AERMET was not used in this assessment as a pre-processed Ministry meteorological dataset was used.

6.1 Dispersion Modeling Input Summary Table

A description of the way in which the approved dispersion model was used is provided in **Table 3** – Dispersion Modelling Input Summary Table. This table meets both the requirements of s.26(1)11 and sections 8-17 of O. Reg. 419/05 and follows the format provided in the ESDM Procedure Document.

As per Section 4.5 of the ADMGO, the significant sources at the Facility were classified as point sources. The source data required for each source was determined according to the procedures provided in the ADMGO. The locations of all sources are shown on **Figure 3b** – Dispersion Modelling Plan. The locationof the property line in relation to the dispersion modelling sources is also presented in **Figure 3a.**

6.2 Coordinate System

The UTM coordinate system, as per Section 5.2.2 of the ADMGO, was used to specify model object sources, buildings and receptors. All coordinates were defined in the North American Datum of 1983 (NAD83).

6.3 Meteorology and Land Use Data

In this assessment, the AERMOD model was run using a MECP pre-processed 5-year dispersion meteorological dataset (i.e., surface and profile files), last updated in November 2019, using AERMET version . As the Facility is located in the geographical coverage of the MECP Niagara District Office, the m eteorological dataset for the West Central Region was used. This data set is based on surface data fromLondon and upper air data from the White Lake station for the period 1996-2000.

The land use surrounding the Facility includes industrial, residential and rural, as a result, the MECP's "Crops" meteorological dataset was used.

need to add the 22112 version number and perhaps the "m" can be attached to "eteorological"

6.4 Terrain

Terrain data used in this assessment was obtained from the MECP (7.5-minute format). DEM files used in this assessment include:

- 0787_4.DEM
- 0787_3.DEM
- 0786_4.DEM
- 0786_3.DEM
- 0785_4.DEM
- 0785_3.DEM

6.5 Receptors

Receptors were chosen based on recommendations provided in Section 7.1 of the ADMGO, which is in accordance with s.14 of O. Reg. 419/05. Specifically, a nested receptor grid, centered on the emissions sources, were placed as follows:

a) 20 m spacing, within an area of 200 m by 200 m;
b) 50 m spacing, within an area surrounding the area described in (a) with a boundary at 300 m by 300 m outside the boundary of the area described in (a);
c) 100 m spacing, within an area surrounding the area described in (b) with a boundary at 800 m by 800 m outside the boundary of the area described in (a);
d) 200 m spacing, within an area surrounding the area described in (c) with a boundary at 1,800 m by 1,800 m outside the boundary of the area described in (a); and,
e) 500 m spacing, within an area surrounding the area described in (d) with a boundary at 4,800 m by 4,800 m outside the boundary of the area described in (a).

In addition to using the nested receptor grid, receptors were also placed every 10 metres along the property line.

There is no childcare facility, health care facility, senior's residence, long-term care facility or an educational facility located at the Facility. Furthermore, the nearest POI is located greater than 5 metres from the building on which the point of emissions are located. As such, same structure contamination was not considered.

6.6 Building Downwash

Building wake effects were considered in this assessment using the U.S. EPA's Building Profile Input Program (BPIP-PRIME), another pre-processor to AERMOD. The inputs into this pre-processor include the coordinates and heights of the buildings and stacks. The output data from BPIP is used in the AERMOD building wake effect calculations.

The PRIME plume rises algorithms include vertical wind shear calculations (important for buoyant releases from short stacks [i.e., stacks at release heights within the recirculation zones of buildings]). The PRIME algorithm also allows for the wind speed deficit induced by the building to change with respect to the distance from the building. These factors improve the accuracy of predicted concentrations within building wake zones that form in the lee of buildings.

6.7 Averaging Times

The shortest time scale that AERMOD predicts is a 1-hour average value. Schedule 3 standards of O. Reg. 419/05 apply to this Facility; many of these standards are based on 1-hour and 24-hour averaging times, which are averaging times that are easily provided by AERMOD. In cases where a standard has an averaging period less than 1-hour (e.g., ½-hour), a conversion to the appropriate averaging period was completed using the Ministry recommended conversion factors, as documented in the ADMGO.

6.8 Dispersion Modelling Options

The options used in the AERMOD dispersion model are summarized in the table below.

Modelling Parameter	Description	Used in this Assessment
DFAULT	Specifies that regulatory default options will be used	Yes
CONC	Specifies that concentration values will be calculated	Yes
DDPLETE	Specifies that dry deposition will be calculated	No
WDPLETE	Specifies that wet deposition will be calculated	No
FLAT	Specifies that the non-default option of assuming flat terrain will be used	No
NOSTD	Specifies that the non-default option of no stacktip downwash will be used	No
AVERTIME	Time averaging periods calculated	1-hr and 24-hr

Modelling Parameter	Description	Used in this Assessment
URBANOPT	Allows the model to incorporate the effects of increased surface heating from an urban area on pollutant dispersion under stable atmospheric conditions	No
URBANROUGHNESS	Specifies the urban roughness length (m)	No
FLAGPOLE	Specifies that receptor heights above local ground level are allowed on the receptors	No

6.9 Dispersion Modelling Input and Output Files

The dispersion model input data are summarized in the Dispersion Modelling Input Summary Table (**Table 3**).

Electronic copies of the input files for the AERMOD model have been submitted with this report in **Appendix C**.

7.0 EMISSION SUMMARY TABLE AND CONCLUSIONS

This section provides the table required by subparagraph 14 of s.26(1) of O. Reg. 419/05 and provides an interpretation of the results as required by the ESDM Procedure Document.

7.1 Emission Summary Table

A POI concentration for each significant contaminant emitted from the Facility was calculated for each operating scenario based on the calculated emission rates listed in **Table 2** – Source Summary Table and the output from the approved dispersion model presented in **Appendix C**. The results are presented in **Table 4** – Emission Summary Table. This table follows the format provided in the ESDM Procedure Document.

The POI concentrations listed in **Table 4** were compared against the s.20 benchmarks in the ACB List dated April 2018.

Meteorological anomalies (as described in the ADMGO) were eliminated from the assessment.

All of the predicted POI concentrations are below the corresponding benchmarks for each contaminant. The highest POI concentration predicted for the Facility is 39.3 µg/m^3 for NO_x, which is 10% of the 1-hour standard of 400 µg/m^3 and 13.8 µg/m^3, which is 8% of the 24-hour standard of 200 µg/m^3.

7.2 Assessment of Contaminants with No POI Limits

Subparagraph 14 subsection viii of s.26(1) O. Reg. 419/05 requires an indication of the likelihood, nature and location of any adverse effect if the contaminant is not listed in the ACB List. All contaminants listed in the Emission Summary Table (**Table 4**) have corresponding benchmarks in the ACB List.

7.3 Conclusions

The ESDM Report was prepared in accordance with s.26 of O. Reg. 419/05. In addition, guidance in the ESDM Procedure Document was followed as appropriate.

The Facility is subject to s.20 of O.Reg.419/05, therefore, the modelled impact of contaminant emissions has been assessed using the U.S. EPA AERMOD model as 1-hour and 24-hour maximum point of POI concentrations and compared to the s.20 benchmarks in the ACB List. The results are presented in **Table 4** – Emission Summary Table.

All of the contaminants listed in the Emission Summary Table are below the corresponding benchmark limits. This ESDM Report demonstrates that the Facility can operate in compliance with O. Reg. 419/05.

TABLES

Table 1
Sources and Contaminants Identification Table
Thorold Cogen L.P. (TCLP)

Source Information Source ID	Source Description/Title	General Location	Expected Contaminants	Significant? (Yes/No)	Rationale
GTG-HRSG	Gas Turbine Generator (GTG), including the Upgrade Project nominally increase of 23 MW and heat recovery steam generator (HRSG) with duct firingcapabilities (up to 100 MMBtu/hr)	West Side of Cogeneration Facility Building	NOx, SO2, PM and CO	Yes	
AUXB-1	337.4 MMBTU/hr Natural Gas Fired Auxiliary Boiler	West Side of Cogeneration Facility Building	NOx, SO2, PM and CO	Yes	
AUXB-2	337.4 MMBTU/hr Natural Gas Fired Auxiliary Boiler	West Side of Cogeneration Facility Building	NOx, SO2, PM and CO	Yes	
EG	Diesel Fired Reciprocating Engine Generator Set (1500 kW)	East Side of Cogeneration Facility Building	NOx	No	Emergency generator meets exemption requirements under O.Reg. 524/98
TNK	Diesel Storage Tank	East Side of Cogeneration Facility Building	Diesel Fumes	No	Listed in Table B-3B of the ESDM Procedure Document - Low Temperature handling of compounds with a Vapour Pressure less than 1 kPa
HEAT	Natural Gas Fired Comfort Heating Equipment (less than 20 million kJ/hr input)	Throughout Facility Building	NOx	No	Listed in Table B-3B of the ESDM Procedure Document - Natural Gas Equipment less than 20 million kJ/hr
B3	Boiler and Superheater	Centre of Cogeneration Facility Building	NOx, SO2, PM and CO	No	Only operates during Combined Cycle Mode which is not considered to be the worst-case operating scenario for the Facility.

Table 2
Sources Summary Table
Thorold Cogen L.P. (TCLP)

Contaminant	CAS	Source Data								Emissions Data						
		Source Identifier	Description	Stack Volumetric Flow Rate (m^3/s)	Stack Temperature (°C)	Stack Inner Diameter (m)	Stack Height Above Grade (m)	Stack Height Above Roof (m)	Source Coordinates (x,y)	Gas Turbine Maximum Emission Rate (g/s)	Duct Burner Maximum Emission Rate (g/s)	Gas turbine and Duct Burner Emission Rate Combined (g/s)	Averaging Period	Estimated Emissions Technique	Emission Data Quality	Percentage of Overall Emission
NOx	10102-44-0	Auxiliary Boiler capable of operating on natural gas (NG)	NG Turbine & Duct Burner (max 24-hr)[1]	632.0	110	5.5	61.0	25.4	(646601, 4774290)	17.01	2.10	19.12	24-hr	EF	Average	67%
NOx	10102-44-0	AUXB-1	Auxiliary Boiler #1 (NG Only)	45.8	149 °C	1.8	61.0	42.7	(646609, 4774313)	4.65	0.00	4.65	24-hr	EF	Average	16%
NOx	10102-44-0	AUXB-2	Auxiliary Boiler #2 (NG)	45.8	149 °C	1.8	61.0	42.7	(646612, 4774329)	4.65	0.00	4.65	24-hr	EF	Average	16%
NOx	10102-44-0	GTG-HRSG*	NG Turbine & Duct Burner (start-up - max 1-hr)[1]	225	107 °C	5.5	61.0	25.4	(646527, 4774230)	14.34	2.10	16.44	1-hr	EF	Average	64%
NOx	10102-44-0	AUXB-1	Auxiliary Boiler #1 (NG Only)	45.8	149 °C	1.8	61.0	42.7	(646609, 4774313)	4.65	0.00	4.65	1-hr	EF	Average	18%
NOx	10102-44-0	AUXB-2	Auxiliary Boiler #2 (NG)	45.8	149 °C	1.8	61.0	42.7	(646612, 4774329)	4.65	0.00	4.65	1-hr	EF	Average	18%
SO_2	7446-09-5	GTG-HRSG*	NG Turbine & Duct Burner (max 24-hr) [1]	632.0	110	5.5	61.0	25.4	(646601, 4774290)	0.35	0.08	0.43	1-hr & 24-hr	EF	Above-Average	90%
SO_2	7446-09-5	GTG-HRSG*	NG Turbine & Duct Burner (100% Load, worst case) [2]	225.0	107 °C	5.5	61.0	25.4	(646601, 4774290)	0.78	0.08	0.86	1-hr & 24-hr	EF	Above-Average	94%
SO_2	7446-09-5	AUXB-1	Auxiliary Boiler #1 (NG Only)	45.8	149 °C	1.8	61.0	42.7	(646609, 4774313)	0.03	0.00	0.03	1-hr & 24-hr	EF	Above-Average	3%
SO_2	7446-09-5	AUXB-2	Auxiliary Boiler #2 (NG)	45.8	149 °C	1.8	61.0	42.7	(646612, 4774329)	0.03	0.00	0.03	1-hr & 24-hr	EF & EC	Average	3%
CO	630-08-0	GTG-HRSG*	NG Turbine & Duct Burner (max 24-hr) [2]	632.0	110	5.5	61.0	25.4	(646601, 4774290)	3.83	0.30	4.13	1/2-hr	EF	Average	53%
CO	630-08-0	GTG-HRSG*	NG Turbine & Duct Burner (Start-up, worst case) [1]	225.0	107 °C	5.5	61.0	25.4	(646601, 4774290)	23.01	0.30	23.31	1/2-hr	EF	Average	86%
CO	630-08-0	AUXB-1	Auxiliary Boiler #1 (NG Only)	45.8	149 °C	1.8	61.0	42.7	(646609, 4774313)	1.85	0.00	1.85	1/2-hr	EF	Average	7%
CO	630-08-0	AUXB-2	Auxiliary Boiler #2 (NG)	45.8	149 °C	1.8	61.0	42.7	(646612, 4774329)	1.85	0.00	1.85	1/2-hr	EF	Average	5%
SPM	-	GTG-HRSG*	NG Turbine & Duct Burner (max 24-hr) [1]	632.0	110	5.5	61.0	25.4	(646601, 4774290)	1.03	0.96	1.99	24-hr	EF	Average	76%
SPM	-	GTG-HRSG*	NG Turbine & Duct Burner (Start-Up & 100% Load) [2]	225.0	107 °C	5.5	61.0	25.4	(646601, 4774290)	1.23	0.96	2.19	24-hr	EF	Average	78%
SPM	-	AUXB-1	Auxiliary Boiler #1 (NG Only)	45.8	149 °C	1.8	61.0	42.7	(646609, 4774313)	0.32	0.00	0.32	24-hr	EF	Marginal	11%
SPM	-	AUXB-2	Auxiliary Boiler #2 (NG)	45.8	149 °C	1.8	61.0	42.7	(646612, 4774329)	0.32	0.00	0.32	24-hr	EF	Marginal	11%
NOx	10102-44-0	EG	Emergency Generator (Diesel)	6.73	438 °C	0.51	9.0	-	(646602, 4774247)	3.83E+00	0.00E+00	3.83E+00	1/2-hr	EF	Average	-

EC: Engineering Calculation
EF: Emission Factor
GTG-HRSG*: Total NOx, CO, SO_2 and SPM Emission Rates for GTG-HRSG source, were calculated as the sum of emissions from the natural gas-fired Turbine and Heat Recovery and from the Duct Burner.

1. These scenarios were modelled and the results were reported.
2. These sceanrios were not modelled.

EF: Emission Factor

Table 3
Dispersion Modelling Input Summary Table
Thorold Cogen L.P. (TCLP)

Relevant Section of the Regulation	Section Title	Description of How the Approved Dispersion Model was Used
Section 8	Negligible Sources	Sources and contaminants that were considered negligible were explicitly identified, and therefore were not modelled, in accordance with s.8 of O. Reg. 419/05. See Table 1 – Sources and Contaminants Identification Table, Section 3.0, and Appendix B of the ESDM Report for more information.
Section 9	Same Structure Contamination	Not applicable as Thorold Cogen L.P. is the only tenant occupying the site, and there is no childcare facility, health care facility, senior's residence, long-term care facility or an educational facility located at the Facility.
Section 10	Operating Conditions	All equipment was assumed to be operating at the maximum production rates simultaneously for the worst-case 1/2-hour, 1-hour and 24-hour period. See Section 4.1 and Appendix A of the ESDM Report.
Section 11	Source of Contaminant Emission Rates	The emission rate for each significant contaminant emitted from each significant source was estimated, the methodology for the calculation is documented in Table 2 – Source Summary Table. See Section 4.2 and Appendix A of the ESDM Report for more information.
Section 12	Combined Effect of Assumptions for Operating Conditions and Emission Rates	The Operating Conditions were estimated in accordance with s.10(1)1 and s.11(1)1 of O. Reg. 419/05 and are therefore considered to result in the highest concentration at a POI that the Facility is capable of for the contaminants emitted. See section 4.4
Section 13	Meteorological Conditions	Meteorology used described in Section 6.3 of the ESDM Report.
Section 14	Area of Modelling Coverage	Modelling domain and modelling grid described in Section 6.5 of the ESDM Report.
Section 15	Stack Height for Certain New Sources of Contaminant	Good Engineering Practice (GEP) stack height requirements of s.15 are applicable.
Section 16	Terrain Data	Section 6.4 of the ESDM Report.
Section 17	Averaging Periods	1 hour and 24-hour averages were modelled as per ACB standards. MECP approved conversion units were used for 1/2-hr averaging periods.

Table 4
Emission Summary Table
Thorold Cogen L.P. (TCLP)

Contaminant Name	Contaminant CAS #	Scenario	Total Facility Emission Rate (g/s)	Air Dispersion Model Used	Averaging Period (hours)	Maximum POI Concentration [1] (ug/m3)	ACB Benchmark Limit (ug/m3)	Limiting Effect	Source & Category[2]	Percentage of ACB Benchmark (%)
Nitrogen Oxides (NOx)	10102-44-0	Start-up - Max 1-hr	25.7	AERMOD 22112	1	39.3	400	Health	Standard B1	10%
		Max 24-hr	28.4		24	13.8	200	Health		7%
Sulphur Dioxide (SO_2)	7446-09-5	Max 24-hr	0.5	AERMOD 22112	1	0.42	100	Health & Veg	Standard B1	0.4%
					24	0.19	275	Health & Veg		0.1%
					Annual	1.4E-02	10	Health & Veg	Standard B2	0.1%
Carbon Monoxide (CO)	630-08-0	Start-up - Max 1-hr	27.0	AERMOD 22112	1/2	48.1	6,000	Health	Standard B1	0.8%
Suspended Particulate Matter (SPM)	-	Max 24-hr	2.6	AERMOD 22112	24	1.1	120	Visibility	Standard B1	0.9%
Emergency Scenario [3]										
Nitrogen Oxides (NOx)	10102-44-0		3.8	AERMOD 22112	0.5	789	1880	-	EDG Checklist	42%

Notes:

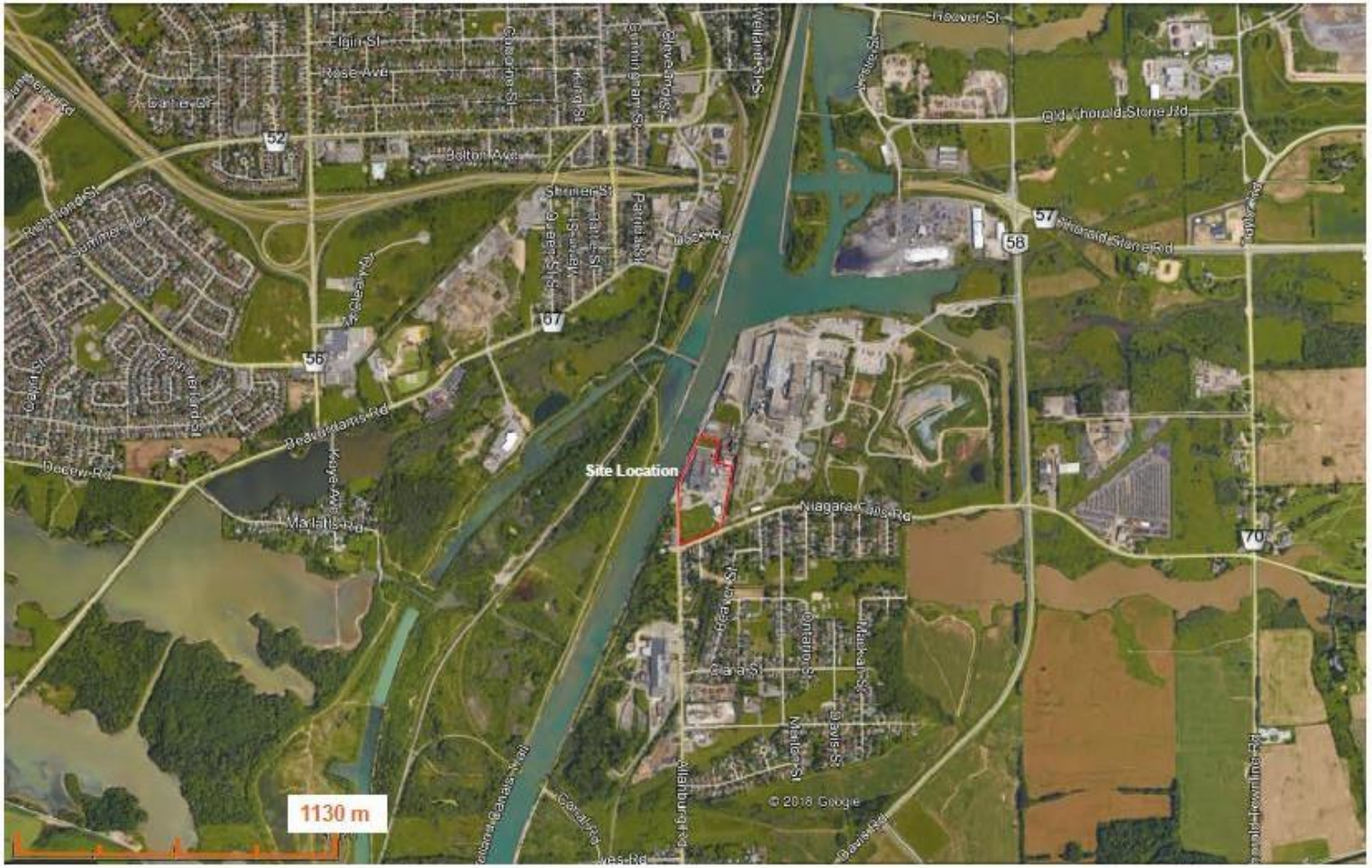
(1) Maximum POI Concentrations after the elimination of meteorological anomalies.

(2) B1 - Benchmark 1 values (standards and guidelines) - 'Benchmarks as identified in the document "Air Contaminants Benchmarks List: standards, guidelines and screening levels for assessing point of impingement concentrations of air contaminants 2.0, dated April, 2018".

Notes on Emergency Scenario:

(3) Maximum half hour NOx concentration for the generator based on the maximum modelled 1-hr value multiplied by a factor of 1.2 as per guidance in the ADMGO.

FIGURES



(Thorold, Ontario)

FIGURE 1: SITE LOCATION PLAN

NORTHLAND POWER INC
90 ALLANBURG RD, THOROLD, ON

ARCADIS Design & Consultancy for natural and built assets

FIGURE 1

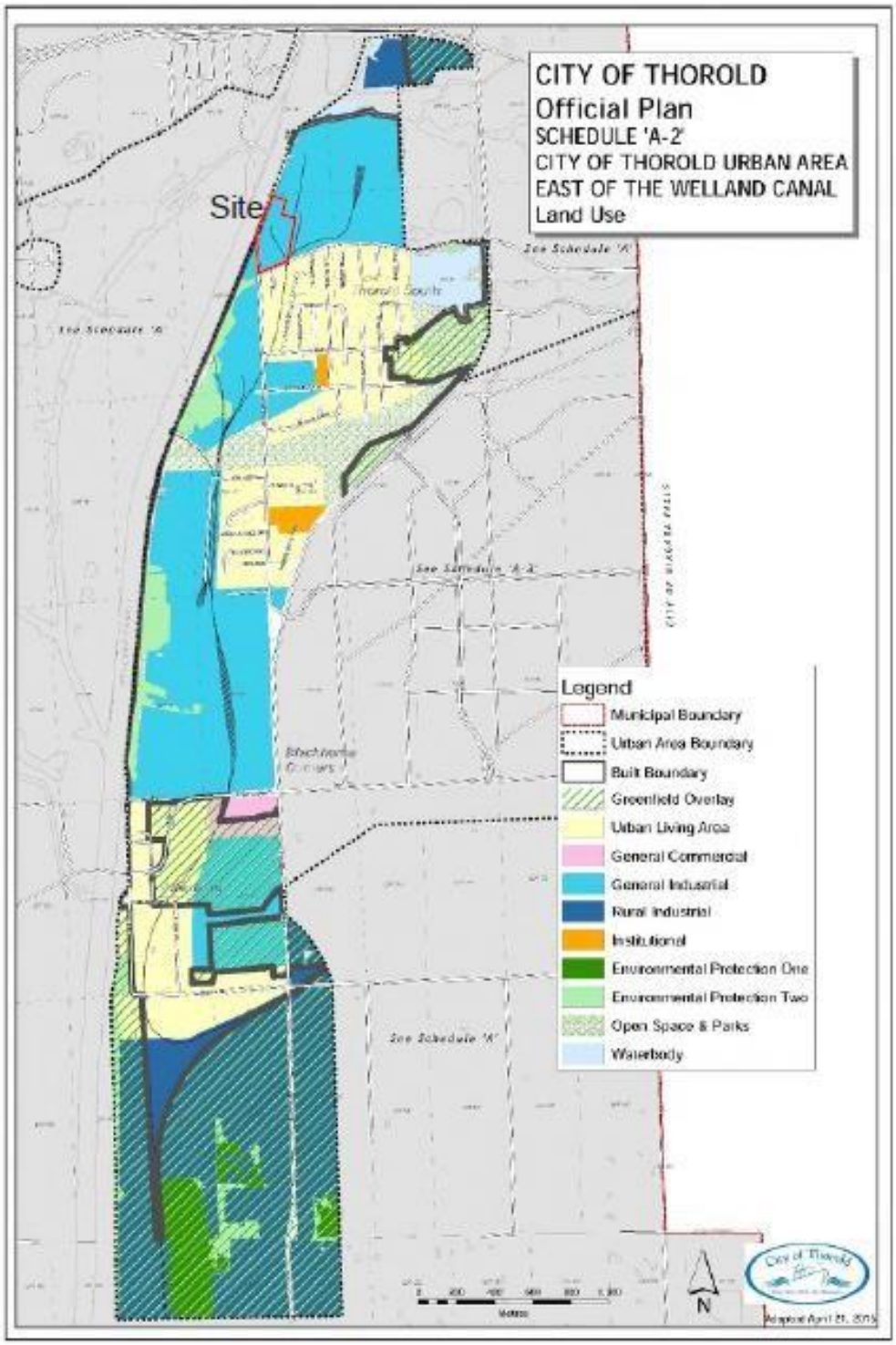


Figure 2 – Land Use Zoning Map

NORTHLAND POWER INC
90 ALLANBURG RD, THOROLD, ON

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2

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LEGEND

- Northland Property
- Buildings
- Point Source

Tier Heights:

- Tier 1: 10.7 m
- Tier 2: 18.3 m
- Tier 3: 35.7 m
- Tier 4: 6.4 m
- Tier 5: 21.9 m
- Tier 6: 10.1 m

DISPERSION MODELLING PLAN

ESDM REPORT – NORTHLAND POWER
90 ALLANBURG ROAD THOROLD, ONTARIO

ARCADIS Designed Delivered Managed formations and built assets

FIGURE 3a

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LEGEND

Buildings

Point Source

List of Point Source

GTG_HRSG

AUXB_1

AUXB_2

B3

EG

DETAILED DISPERSION MODELLING PLAN

ESDM REPORT – NORTHLAND POWER
90 ALLANBURG ROAD THOROLD, ONTARIO

ARCADIS Design & Consultancy for natural and built assets

FIGURE: **3b**

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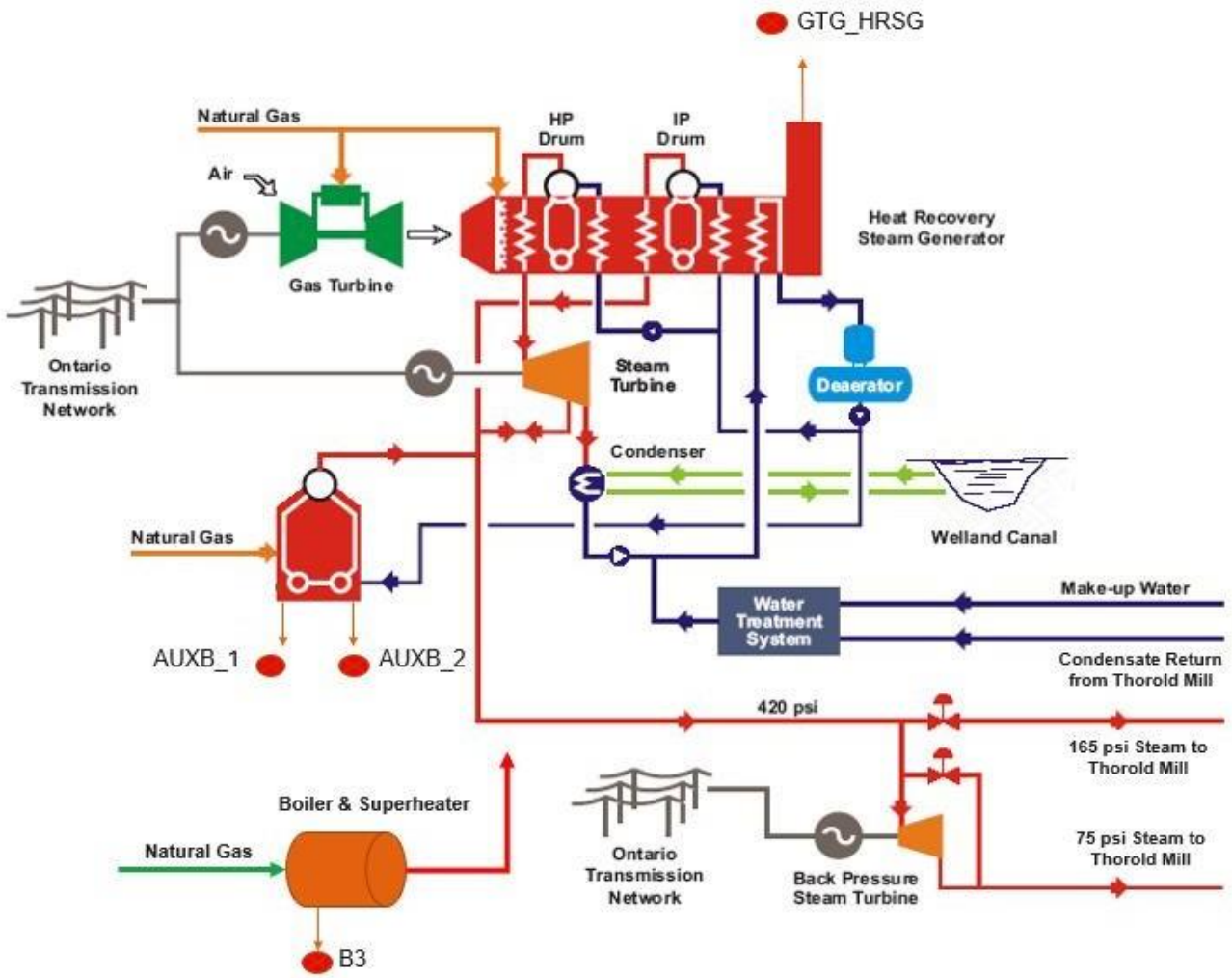

Legend

- Point Sources

FIGURE 4 – PROCESS FLOW DIAGRAM

NORTHLAND POWER INC
90 ALLANBURG RD, THOROLD, ON

ARCADIS

FIGURE 4

APPENDIX A

Supporting Calculations

Source ID: GTG-HRSG Gas Turbine and Heat Recovery Steam Generator Emissions

Emission Calculations for NO_x, CO, SPM and SO_2

Methodology: Emission Factor (EF)

The Facility can operate under three different operational modes:

Operating Modes	
Mode	**Operating Equipment**
Combined Cycle with Aux Boilers Mode	The GTG, HRSG, STG are operational. The new Boiler/Superheater (B3) system is not operational. Although unlikely to operate in this manner, this mode includes the operation of the auxiliary boilers. At this time the requirement to supply steam could be restored if the Thorold Mill were repurposed. The Independent Electricity System Operator (IESO) dictates how much electricity is to be produced and delivered to the provincial grid. Pending the approval of the Gas Turbine Upgrade Project, the IESO will be able to request an additional 23 MW of electrical output.
Backup Mode	The GTG, HRSG, STG are NOT operational. Process steam requirements are provided by the existing Auxiliary Boilers. The new Boiler/Superheater (B3) is not operational. This mode is highly unlikely but will be evaluated as long as the Aux Boilers may be called to operate. will be evaluated as long as the Aux Boilers may be called to operate.
Combined Cycle – Start-up Mode	Start-up Mode: The Facility will operate the GTG, HRSG and STG, if the provincial grid requires the Facility's electricity and dispatches the Facility to start-up. The Boiler/Superheater (B3) will operate at this time to provide utility steam (such as sealing steam, pulling vacuum in the condenser etc. for combined cycle start-up only) to the Facility, until the combined cycle operation starts to produce its own steam through the HRSG. For the ESDM evaluation, the Source B3 is included and the GTG emissions are estimated to at 50% load and a duration of ½ hour

With the ceased operation of Thorold Mill, the Facility currently generates electricity in Combined Cycle mode. The IESO maybe dispatch the Facility multiple times a week, as such the Boiler/Superheater (B3) may operate to provide the necessary heat to keep the steam systems warm for a faster start-up once a dispatch order is received from the IESO. For design purposes, the GTG, HRSG and STG are capable of starting up and shutting down two to three times daily.

NO_x Emissions from TCLP_GE_7FA Upgrade

Emission Factor**:** 135 lb/hr

$$NO_x = \frac{135lbs}{hr} \times \frac{454.3g}{lbs} \times \frac{1hr}{3600s} = \frac{17.04g}{s}$$

NO_x emissions during start-up:

Manufacturer Emission Factor**:** 97 lb/hr

$$NO_x(@\ start-up) = \frac{97lbs}{hr} \times \frac{454.3g}{lbs} \times \frac{1hr}{3600s} = \frac{12.24g}{s}$$

Emission Factor over 24-hour:

$$EF_{NOX}(over\ 24-hour) = \frac{63lbs}{hr} \times \frac{23}{24} + \frac{97lbs}{hr} \times \frac{1}{24} = \frac{64.4lbs}{hr}$$

NO_x emissions during over 24-hour:

$$NO_x(over\ 24-hour) = \frac{64.4lbs}{hr} \times \frac{454.3g}{lbs} \times \frac{1hr}{3600s} = \frac{8.13g}{s}$$

CO Emission from TCLP_GE_7FA Upgrade

Manufacturer Emission Factor**:** 30.4 lb/hr

$$CO = \frac{30.4lb}{hr} \times \frac{454.3g}{lbs} \times \frac{1hr}{3600s} = \frac{3.83\ g}{s}$$

SO2 Emission from TCLP_GE_7FA Upgrade

Manufacturer Emission Factor**:** 2.8 lb/hr

$$SO2 = \frac{2.8lbs}{hr} \times \frac{454.3g}{lbs} \times \frac{1hr}{3600s} = \frac{0.35\ g}{s}$$

SPM Emission from TCLP_GE_7FA Upgrade

Emission Factor**:** 8.2 lb/hr

$$SPM = \frac{8.2lb}{hr} \times \frac{454.3g}{lbs} \times \frac{1hr}{3600s} = \frac{1.03\ g}{s}$$

SO_2 Emissions from GTG-HRSG

AP-42 Section 3.1 Stationary Gas Turbines emission factor was used to estimate SO_2 emission. The AP-42 Table 3.1-2a emission factor is based on the assumption that 100% of the fuel sulphur content is converted to SO_2. Therefore, the SO_2 emission rate is based on the rate of which the fuel is consumed, which is greatest at 100% load. Therefore, worst case SO_2 emissions for the 1-hr and 24-hr time periods are basedon 100% load and not based on start-up conditions.

NG Turbine MMBTU/hr at 100% Load - 1,810 MMBTU/hr

SO_2 Emission Factor: 0.0034 lb/MMBTU

Data Quality: Average & Above-Average

$$SO_2(@\ 100\%load) = \frac{1{,}810MMBTU}{hr} \times \frac{0.0034lbs}{MMBTU} \times \frac{454.3g}{lbs} \times \frac{1hr}{3600s} = \frac{0.78g}{s}$$

SO_2 Emissions: Section 9.2.2 of the ESDM Procedure Document titled “Above-Average Data Quality" Emission Estimating Techniques includes AP-42 emission factor quality rating of 'B'.

NO_x, CO and SPM Emissions: Section 9.2.3 of the ESDM Procedure Document titled “Average Data Quality" Emission Estimating Techniques includes emission factors based on a reasonable number of facilities.

Operating Condition:
The emission rate calculation for this source is based on maximum operations during a start-up period and 100% Load.

NO_x, CO, SPM and SO_2 Emissions from Duct Burner

Methodology: Emission Factor (EF)
AP-42 Section 1.4 Tangential-Fired Boilers emission factors were used to estimate emissions from the 100 MMBTU/hr duct burner that supports the HRSG. **Table A.2** outlines the emission factors and the emission rates for NO_x, CO, SPM and SO_2 from the Duct Burner. A sample calculation for NO_x emission is shown below.

Sample Calculation: NO_x emissions from the duct burner

Duct Burner Maximum Input Rating: 100 MMBTU/hr

NO_x Emission Factor: 170 lb/10^6 ft^3

$$\frac{100{,}000{,}000\,Btu}{hr}\times\frac{1\,ft^3}{1020\,Btu}\times\frac{170\,lb}{10^6\,ft^3}\times\frac{454\,g}{1\,lb}\times\frac{1\,hr}{3{,}600\,s}=\frac{2.1\,g}{s}$$

Data Quality: Marginal to Above-Average
NO_x and SO_2 Emissions: Section 9.2.2 of the ESDM Procedure Document titled “Above-Average Data Quality" Emission Estimating Techniques includes AP-42 emission factor quality rating of 'A' or 'B'.

CO Emissions: Section 9.2.3 of the ESDM Procedure Document titled “Average Data Quality" Emission Estimating Techniques includes AP-42 emission factor quality rating of 'C'.

SPM Emissions: Section 9.2.4 of the ESDM Procedure Document titled “Marginal" Emission Estimating Techniques includes AP-42 emission factor quality rating of 'D'.

Operating Condition:
The emission rate calculation for this source is based on the Duct Burner operating at maximum capacity.

Source ID: AUXB-1 & AUXB-2 Natural Gas Fired Auxiliary Boilers

Methodology: Emission Factor (EF)
Auxiliary Boiler #1 and Auxiliary Boiler #2 operate on NG. To estimate the emissions from these Auxiliary Boilers, the worst-case operation scenario was used to estimate the emissions.

Nitrogen Oxides and Carbon Monoxide
Auxiliary Boiler #1 and Auxiliary Boiler #2 have been certified by the manufacturer to discharge NO_x within the MECP Guideline A-9 maximum allowable limit of 76.3 ppmv NO_x, and CO at a maximum of 50 ppmv. Therefore, it was conservatively assumed NO_x and CO emissions from both boilers are at the maximum certified rates. **Table A.3** outlines the NO_x and CO emission factors and emission rates from the Auxiliary Boilers.

Sample Calculation: NO_x emissions from each of the existing auxiliary boilers (AUXB-1 or AUXB-2)

$$\frac{mg\,NOx}{m^3} = \frac{ppm\,NOx}{22.4 \times \left(\frac{°C + 273}{273}\right)} \times mw = \frac{76.3\,ppm\,NOx}{34.6} \times 46 = \frac{101.4\,mg\,NOx}{m^3}$$

$$\frac{101.4\,mg\,NOx}{m^3} \times \frac{164{,}984\,m^3}{hr} \times \frac{1\,g}{1{,}000\,mg} \times \frac{1\,hr}{3{,}600\,s} = \frac{4.65\,g}{s}$$

Sulphur Dioxide and Suspended Particulate Matter
To estimate the SO_2 and SPM emissions, Auxiliary Boiler #1 and Auxiliary Boiler #2 were based on NG emission factors from AP-42 Table 1.4-2. **Table A.3** outlines the SO_2 and SPM emission factors and emission rates from the Auxiliary Boilers.

Sample Calculation: SPM emissions from each of the existing auxiliary boilers (AUXB-1 or AUXB-2)

$$\frac{337{,}400{,}000\,Btu}{hr} \times \frac{1\,ft^3}{1{,}020\,Btu} \times \frac{7.6\,lb\,SPM}{10\text{^}6\,ft^3} \times \frac{hr}{3600\,s} \times \frac{454g}{lb} = \frac{0.317\,g}{s}$$

Data Quality: Marginal to Above-Average

AUXB-1 NG-fired and AUXB-2 NG-fired SO_2 Emissions: Section 9.2.2 of the ESDM Procedure Document titled "Above-Average Data Quality" Emission Estimating Techniques includes AP-42 emission factor quality rating of 'A or B'.

AUXB-1 and AUXB-2 NO_x and CO Emissions: Section 9.2.3 of the ESDM Procedure Document titled "Average Data Quality" includes emission estimates that are developed from tests on a reasonable number of facilities.

AUXB-1 and AUXB-2 SPM Emissions: Section 9.2.4 of the ESDM Procedure Document titled "Marginal Data Quality" Emission Estimating Techniques includes AP-42 emission factor quality rating of 'D' or 'E'.

Operating Condition:

The emission rate calculation for this source is based on Auxiliary Boiler #1 and #2 operating at maximum capacity.

Source ID: EG Diesel Emergency Generator

Emission Calculations for NO_x Emissions

Methodology: Emission Factor (EF)

The Emergency Diesel Generator manufacturer certifies the engine to meet US EPA Tier 1 Emission Standards for diesel engines: Standards of Performance for Stationary Compression Ignition Internal Combustion Engines. **Table A.4** outlines NO_x emission rates from the Diesel Emergency Generator.

Sample Calculation: NO_x emissions from the diesel emergency generator (EG)

$$NO_x = 1500kW * \frac{9.2g}{kWh} \times \frac{1hr}{3600s} = \frac{3.83g}{s}$$

Data Quality: Average

Section 9.2.3 of the ESDM Procedure Document titled "Average Data Quality" Emission Estimating Techniques includes emission estimates that are developed from tests on a reasonable number of facilities.

Operating Condition:

The emission rate calculation for this source is based on the emergency generator operating at capacity during a half hour.

A-9 Guideline - NO_x Emissions from Boilers and Heaters

The manufacturer has certified that the auxiliary boilers, when operating on NG and LFG or only NG, and the Boiler when operating on NG, will comply with the Ministry of Environment, Conservation and Parks (MECP) maximum allowable limit for boilers, as stated in MECP Guideline A-9. **Table A.5** outlines the MECP NO_x emission limits.

A-5 Guideline - Atmospheric Emissions from Stationary Combustion Turbines

Table A.6 outlines the maximum allowable Atmospheric Emissions from the Combustion Turbine
The calculation of NO_x emission limit (26.2 g/s) is based on the equation provided in Guideline A-5:

(Power output (GJ) x A) + (Heat output (GJ) x B) = grams of NO_2 equiv.

Power and Heat output are on an hourly basis: 3.6 GJ per MW-hour
A = Power output allowance = 140 g/GJ
B = Heat recovery allowance = 40 g/GJ
Gas Turbine Power Output = 160 MW = 576 GJ (on hourly basis)
Steam Turbine Power Output = 95 MW = 342 GJ (on hourly basis)

Hourly Grams of NO_x as NO_2 equiv. = (576 GJ x 140 g/GJ) + (342 GJ x 40 g/GJ) = 94,320 g/hr
NO_x Emission Limit (as NO_2 equiv.) = 26.2 g/s

Thermal efficiency of the cogeneration plant:

- With the duct burner firing – 7,355 BTU/kWh HHV. Net power output = 241.6 MW.
- Without the duct burner firing – 7,258 BTU/kWh HHV. Net power output = 233.6 MW.

Please note that the Facility is equipped with CEM and can provide confirmation of compliance with Guideline A-5 at the request of the MECP.

Please note that for SO_2 the maximum emission rate is at 100% load. The emission rate presented in Table A.1, is based on AP-42 emission factor and Btu rating at maximum load and includes the duct burner.

Source ID: B3 - Natural Gas Fired Boiler and Superheater

The 500 BHP boiler has been certified by the manufacturer to comply with the CCME National Emission Guidelines for Commercial/Industrial Boilers and Heaters guideline A9, thus it was conservatively assumed NO_x emissions from the boiler is at the maximum certified rates (22.039 MMBTU/h).

The Superheater has a maximum capacity of 2.11 MMBTU/h. The emissions were based on its maximum BTU/hr rating and USEPA AP-42 Chapter 1.4 emission factor for NG combustion. **Table A.7** outlines SPM, NO_x, CO, SO_2 emission rates from the Boiler and Superheater.

Methodology: Emission Factor (EF)

Sample Calculation: NO_x emissions from Boiler only (part of source B3):

Stack Exhaust Information	Value	Unit	Reference
Maximum Heat Input	22,039,474	BTU/hr	Boiler Manufacturer Specifications
Stack Flow Rate	4.85	m3/s	Boiler Manufacturer Specifications
Emission Factor NO_x	30	ppmv	Guideline A9
Stack Gas Exit Temperature	293	degrees Celsius	Boiler Manufacturer Specifications

$$Boiler\ NOx\frac{g}{s} = \frac{ppmNOx}{22.4 * \left(\frac{C+273}{273}\right)} * MW = \frac{30\ ppm\ NOx}{44.96} * 46 = \frac{30.69mgNOx}{m^3} * \frac{4.85m^3}{s} * \frac{1g}{1000mg} = 0.\ 144\ g/s$$

Sample Calculation: NO_x emissions from Superheater only (part of source B3):

$$Superheater\ NOx\frac{g}{s} = \frac{2{,}112{,}676BTU}{hr} \times \frac{ft^3}{1020BTU} \times \frac{0.0283m^3}{ft^3} \times \frac{1{,}600kg}{10^6m^3} \times \frac{1000g}{kg} \times \frac{1hr}{3600s} = 0.026\ g/s$$

Sample Calculation: SO_2 emissions from Boiler & Superheater

$$SO_2\ (B3) = \frac{24{,}152{,}150BTU}{hr} \times \frac{ft^3}{1020BTU} \times \frac{0.0283m^3}{ft^3} \times \frac{9.6kg}{10^6m^3} \times \frac{1000g}{kg} \times \frac{1hr}{3600s} = 0.00179\ g/s$$

Data Quality: Marginal to Above-Average

B3 (Superheater) NO_x and B3 (Boiler and Superheater) CO and SPM Emissions: Section 9.2.2 of the ESDM Procedure Document titled “Above-Average Data Quality" Emission Estimating Techniques includes AP-42 emission factor quality rating of 'A or B'.

B3 (Boiler) NO_x Emissions: Section 9.2.3 of the ESDM Procedure Document titled “Average Data Quality" includes emission estimates that are developed from tests on a reasonable number of facilities.

B3 (Boiler and Superheater) SPM Emissions: Section 9.2.4 of the ESDM Procedure Document titled “Marginal Data Quality" Emission Estimating Techniques includes AP-42 emission factor quality rating of 'D' or 'E'.

Operating Condition:
The emission rate calculations for these sources are based on the boiler and superheater operating simultaneously at their maximum capacities.

Table A.1
Natural Gas-Fired Turbine and Heat Recovery Emissions
Thorold Cogen L.P. (TCLP)

Source ID	Contaminant	Emission Factor (lb/hr)[1]	Data Quality	Emission Rate (g/s)
GTG-HRSG	NOx @ 100% Load	63	Average	7.95
GTG-HRSG	NOx @ Start-Up	97	Average	12.24
GTG-HRSG	NOx over 24-hours	64.4	Average	8.13
GTG-HRSG	CO	180	Average	22.72
GTG-HRSG	SPM	9	Average	1.14

Source ID	Contaminant	Emission Factor (lb/MMBtu)[2]	Data Quality	Emission Rate (g/s)
GTG-HRSG	SO2 @ 100% Load	0.0034	Above-Average	0.78

Notes:

(1) Manufacturer supplied emission factors provided in Appendix E were used to estimate emission rates

(2) Emission factor from AP-42 Table 3.2-2a

Emission factor for NOx over 24-hour was estimated as the weighted average of EF for 100% load and EF for start-up.
Emission rate for NOx over 24-hour was used in Table 2.

Table A.2
Duct Burner Emissions
Thorold Cogen L.P. (TCLP)

Source ID	Contaminant	Emission Factor (lb/10^6 ft3)	Data Quality	Emission Rate (g/s)
HRSG-DB	NOx	170	Above-Average	2.10
HRSG-DB	CO	24	Average	0.30
HRSG-DB	SO_2	0.6	Above-Average	0.01
HRSG-DB	SPM	7.6	Marginal	0.09

Notes:

(1) Emission factor from AP-42 Table 1.4-1 Uncontrolled Tangential-Fired Boilers

Table A.3
Auxiliary Boiler Emissions
Thorold Cogen L.P. (TCLP)

Source ID	Contaminant	Emission Factor (ppmv)[1]	Molecular Weight	Data Quality	Emission Rate (g/s)
AUXB-1 & AUXB-2	NOx	76.3	46	Average	4.65
AUXB-1 & AUXB-2	CO	50	28	Average	1.85

Source ID	Contaminant	Emission Factor (lb/10^6 ft³)[2]	Emission Factor	Data Quality	Emission Rate (g/s)
AUXB-1 & AUXB-2	SPM	7.6	AP-42 Table 1.4-2	Marginal	0.317
AUXB-1 & AUXB-2	SO_2	0.6		Above-Average	0.025

Notes:
(1) Manufacturer supplied emission factors provided in Appendix E were used to estimate emission rates.
(2) Emission factor from AP-42 Table 1.4-2

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Table A.4
Emergency Generator Emission
Thorold Cogen L.P. (TCLP)

Source ID	Description	Power Rating (kW)	Contaminant	Emission Factor (g/kWh)[1]	Emission Rate (g/s)
EG	Diesel Generator	1500	NOx	9.2	3.83

Note:
(1) Emission factors from Tier 1 EPA Standards for Diesel Generators

Table A.5
A-9 Guideline – NO_x Emissions from Boilers and Heaters
Thorold Cogen L.P. (TCLP)

Source ID	Source Description	Heat Input Capacity (MMBtu/hr)	Fuel	Ontario MECP NOx Emission Limits (ppmvd @ 3% O_2)	NOx Emission Rates (ppmvd @ 3% O_2)
AUXB-1	Auxiliary NG Boiler	337.4	NG	76.30	76.30
AUXB-2	Auxiliary NG Boiler	337.4	NG	76.30	76.30
B3	Boiler	22.0	NG	49.6 ppm	30 ppm

Note: The manufacturer has certified that the auxiliary boilers will comply with the Ontario Ministry of Environment, Conservation and Parks (MECP) maximum allowable limit for boilers, as stated in MECP Guideline A-9.

Table A.6
A-5 Guideline – Atmospheric Emissions from Stationary Combustion Turbines
Thorold Cogen L.P. (TCLP)

Source ID	Source Description	Operating Load	Ontario MECP Emission Limits			Emission Rates			Compliance with MECP Emission Limits?
			CO (ppmv)	NO_x (g/s)	SO_2 (g/GJ)	CO [(1)] (ppmv)	NO_x (g/s)	SO_2 (g/GJ)	
GTG-HRSG	NG-fired gas turbine with heat-recovery steam generator and supplementary duct burner	100%	60	26.2	800	1.2	10.23	1.5	Yes

(1) Emission rate based on CEM test data.

Table A.7
Boiler and Superheater Emissions
Thorold Cogen L.P. (TCLP)

Stack Exhaust Information	Value	Unit	Reference
Maximum Heat Input	24,152,150	BTU/hr	Boiler Manufacturer Specifications
Stack Flow Rate	4.85	m3/s	Boiler Manufacturer Specifications
Emission Factor NOx	30	ppmv	Guideline A-9
Stack Gas Exit Temperature	293	degrees Celsius	Boiler Manufacturer Specifications

Source ID	Contaminant	Emission Factor (ppmv)	Molecular Weight	Data Quality	Emission Rate (g/s)
Boiler	NOx	30	46	Average	0.144

Source ID	Contaminant	Maximum BTU/hr	Emission Factor ($kg/10^6m^3$)[1]	Data Quality	Emission Rate (g/s)
Superheater	NOx	1,500,000	1600	Above-Average	0.026

Source ID	Compound	Cas No.	USEPA AP-42 EF ($kg/10^6m^3$)[2]	Emission Rate (g/s)	Emission Factor Rating
Boiler & Superheater (B3)	Carbon monoxide	630-08-0	1344	2.50E-01	Above-Average
	Sulphur dioxide	7446-09-05	9.6	1.79E-03	Marginal
	SPM	NA	121.6	2.26E-02	Above-Average

Notes:

(1) Emission factor from AP-42 Table 1.4-2 for Small Uncontrolled Boilers (<100 MMBTU/hr)

(2) Emission factor from AP-42 Table 1.4-2 for Large Uncontrolled Boilers (>100 MMBTU/hr)

APPENDIX B

Supporting Information for Assessment of Negligibility

APPENDIX B: SUPPORTING INFORMATION FOR ASSESSMENT OF NEGLIGIBILITY

Sources and contaminants were screened for negligibility using the following screening protocols listed in the ESDM Procedure Document (Section 7)

- Combustion of natural gas and propane (Section 7.1.1)
- Sources listed on Table B-3A and Table B-3B (Section 7.2.1)

The results of screening are discussed in greater detail in the following text.

Combustion of Natural Gas and Propane (Section 7.1.1):

As per Section 7.1.1 of the ESDM Procedure Document, contaminants other than NO_x are generally considered negligible from combustion equipment firing natural gas or propane.

However, the worst-case scenario assessed herein, includes all contaminants (NO_x, SO_2, CO and SPM) for process equipment and only NO_x has been assessed for the standby emergency diesel generator unit.

Sources Listed on Table B-3A and Table B-3B (Section 7.2.1)

Table B-3B of the ESDM Procedure Document lists sources that can be considered to be insignificant; the following sources at the Facility are listed on Table B-3B:

- Low temperature handling of compounds with a vapour pressure less than 1 kPa (Source: TNK), and
- Natural Gas fired comfort heating equipment rated at less than 20 million kJ/hr (site wide natural gas-fired comfort heaters total approximately 7 million kJ/hr) (Source HEAT).

APPENDIX C

Electronic Copies AERMOD Input and Output Files

APPENDIX C: ELECTRONIC COPIES OF AERMOD INPUT AND OUTPUT FILES

APPENDIX D

ENVIRONMENTAL COMPLIANCE APPROVAL (AIR & NOISE) NO. 3700-BNFNU2

Ontario

Ministry of the Environment, Conservation and Parks
Ministère de l'Environnement, de la Protection de la nature et des Parcs

AMENDED ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER 3700-BNFNU2
Issue Date: May 1, 2020

Northland Power Thorold Cogen GP Inc., as general partner for and on behalf of Thorold Cogen L.P.
30 St. Clair Avenue West, No. 1700
Toronto, Ontario
M4V 3A1

Site Location: 90 Allanburg Road
City of Thorold, Regional Municipality of Niagara

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

One (1) natural gas fired Co-generation Facility, with a nominal output rating of 265 megawatts, producing electricity and steam, consisting of the following equipment and associated accessories:

- one (1) natural gas fired gas turbine (GTG), to generate electricity through its own electrical generator, with a nominal output rating of 160 megawatts with a maximum heat input capacity of 1,899 gigajoules per hour and equipped with dry low-NOx burners, exhausting its hot flue gases to the heat recovery steam generator (HRSG) described below;

- one (1) heat recovery steam generator (HRSG), using the hot flue gases from the above noted gas turbine to generate steam, complete with natural gas fired duct burners having a total maximum heat input of 105.5 gigajoules per hour, exhausting into the atmosphere through a stack, having an exit diameter of 5.8 metres, extending 25.4 metres above the roof and 61.0 metres above grade;

- one (1) reheat/extraction/condensing steam turbine generator (STG), with a nominal rating of 95 megawatts, using the steam generated by the HRSG to generate electricity;

- two (2) natural gas fired auxiliary boilers, designated as AUXB-1 and AUXB-2, used to generate steam, each having a maximum heat input of 356 gigajoules per hour, each exhausting into the atmosphere through an individual stack, having an exit diameter of 1.8 metres, extending 42.7 metres above the roof and 61.0 metres above grade; and

- one (1) natural gas fired boiler, with a maximum heat input of 23.2 million kilojoules per hour and one (1) natural gas fired superheater, with a maximum heat input of 2.23 million kilojoules per hour, operating together to produce superheated process steam, exhausting into the atmosphere through a single stack, having an exit diameter of 0.81 metre, extending 3.18 metres above the roof and 28 metres above grade.

all in accordance with the Environmental Compliance Approval Application submitted by Northland Power Thorold Cogen GP Inc., as general partner for and on behalf of Thorold Cogen L.P., dated October 22, 2019 and signed by Jim Mulvale, Senior Director, Environment and all supporting information associated with the application including the Emission Summary and Dispersion Modelling Report provided by Arcadis Canada Inc., dated October 22, 2019 signed by Tara Bailey, additional information provided by Bob Lo, Arcadis Canada Inc. in emails dated March 27, 2020, April 8, 2020 and April 24, 2020, the Acoustic Assessment Report dated April 24, 2020, and signed by Parnia Lotfi Moghaddam and Adeyinka Afon, Arcadis Canada Inc., and additional information within the letters (e-mails) dated February 26, March 18 and 19, April 7 and 24, 2020 and provided by Adeyinka Afon and Parnia Lotfi Moghaddam, Arcadis Canada Inc.: and the letters (e-mails) dated April 6, 8, and 22, 2020, provided by Jim Mulvale, Senior Director for Environment, for Northland Power Thorold Cogen GP Inc.

For the purpose of this environmental compliance approval, the following definitions apply:

1. *"Acoustic Assessment Report"* means the report, prepared in accordance with *Publication NPC-233* submitted in support of the application, that documents all sources of noise emissions and *Noise Control Measures* present at the *Facility. "Acoustic Assessment Report" also means the Acoustic Assessment Report* dated April 24, 2020, and signed by Adeyinka Afon and Parnia Lotfi Moghaddam, Arcadis Canada Inc.;

2. "*Approval"* means this Environmental Compliance Approval, including the application and supporting documentation listed above;

3. "*Co-generation Unit"* means the co-generation equipment including the natural gas fired gas turbine and the natural gas fired heat recovery steam generator, described in the *Company's* application, this *Approval* and in the supporting documentation referred to herein, to the extent approved by this *Approval;*

4. "*Company"* means Northland Power Thorold Cogen GP Inc., as general partner for and on behalf of Thorold Cogen L.P., that is responsible for the construction or operation of the *Facility* and includes any successors and assigns;

5. "*Continuous Monitoring System"* means the continuous monitoring equipment, data acquisition system and associated operation, maintenance, verification and auditing procedures;

6. "*District Manager"* means the District Manager of the appropriate local district office of the *Ministry,* where the *Facility* is geographically located;

7. "*EPA"* means the Environmental Protection Act, R.S.O. 1990, c.E.19, as amended;

8. "*Equipment"* means the equipment and processes described in the *Company* 's application, this *Approval* and in the supporting documentation submitted with the application, to the extent approved by this *Approval;*

9. "*Facility"* means the entire operation located on the property where the *Equipment* is located;

10. "*Heat Output"* means the total useful heat energy recovered from the combustion turbine as heat, expressed in megawatts;

11. "Interim Sound Level Limit(s)" means a specific sound level limit at a *Point of Reception* in terms of descriptors outlined in *Publication NPC-300,* as applicable, proposed by the *Company* and approved by the *Director* as an Interim Sound Level Limit within the *Memorandum of Understanding,* which was developed to jointly manage and achieve compliance with the sound level limits set in *Ministry Publication NPC-300;*

12. "*Lower Heating Value"* means the energy released during combustion of the fuel, excluding the latent heat content of the water vapour component of the products of combustion, expressed in megajoules per cubic metre at standard temperature and pressure, or megajoules per kilogram;

13. "*Manual"* means a document or a set of documents that provide written instructions to staff of the *Company;*

14. "Memorandum of Understanding" means the “Memorandum of Understanding to Jointly Manage the Site-Wide Noise Assessment and Mitigation, as mandated by the Ontario Ministry of the Environment (MOE), between Abitibi-Consolidated Company of Canada (now Resolute FP Canada Inc.) and Thorold Cogen L.P (now Northland Power Thorold Cogen GP Inc.)” and agreed upon by the *Ministry* in the letter dated April 11, 2007 signed by Vic Schroter, the Ministry Senior Noise Engineer;

15. "*Ministry"* means the ministry of the government of Ontario responsible for the *EPA* and includes all officials, employees or other persons acting on its behalf;

16. "*Noise Control Measures* " means measures to reduce the noise emissions from the *Facility* and/or *Equipment* including, but not limited to, silencers, acoustic louvers, enclosures, absorptive treatment, plenums and barriers, described in the *Company's* application, this *Approval* and in the supporting documentation referred to herein, to the extent approved by this *Approval.* It also means the Noise Control Measures as detailed in the *Acoustic Assessment Report* dated April 24, 2020, and signed by Adeyinka Afon and Parnia Lotfi Moghaddam, Arcadis Canada Inc;

17. "*Power Output"* means the electricity and shaft power production of the combustion turbine, expressed in megawatts;

18. "*Publication NPC-233"* means the *Ministry* Publication NPC-233, "Information to be Submitted for Approval of Stationary Sources of Sound", October, 1995, as amended;

19. *"Publication NPC-300"* means the *Ministry* Publication NPC-300, “Environmental Noise Guideline, Stationary and Transportation Sources – Approval and Planning, Publication NPC-300”, August 2013, as amended;

20. "*Report EPS 1/PG/7* " means the document titled "Protocols and Performance Specifications for Continuous Monitoring of Gaseous Emissions from Thermal Power Generation - Report EPS 1/PG/7" published by Environment Canada in December 2005, as modified; and

21. "*Thermal Efficiency"* means the fraction of the total energy input into the *Co-generation Unit* which is transformed into useful energy output expressed as a percentage on a lower heating value basis.

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. PERFORMANCE LIMITS

1. The *Company* shall ensure that the *Co-generation Unit* is designed and operated to comply, at all times, with the following performance requirements:

    a. the concentrations of nitrogen oxides, carbon monoxide and sulphur dioxide, in the undiluted gas emitted from the *Co-generation Unit* are not greater than the limits specified in Schedule A of this *Approval;* and

    b. the *Thermal Efficiency* of the *Co-generation Unit* is not less than the efficiency specified in Schedule A of this *Approval.*

2. The *Company* shall:

    a. operate the *Equipment/Facility* as outlined in the *Acoustic Assessment Report* dated April 24, 2020, and signed by Adeyinka Afon and Parnia Lotfi Moghaddam, Arcadis Canada Inc.;

    b. ensure at all times that the noise emissions from the *Facility* comply with the *Interim Sound Level Limits* and limits set out in *Ministry Publication NPC-300;* and

    c. ensure that the *Noise Control Measures* are properly maintained and continue to provide the acoustical performance outlined in the *Acoustic Assessment Report.*

2. OPERATION AND MAINTENANCE

1. The *Company* shall ensure that the *Equipment* is properly operated and maintained at all times. The *Company* shall:

   a. prepare,not later than three (3) months after the date of this *Approval,* and update, as necessary, a *Manual* outlining the operating procedures and a maintenance program for the *Equipment,* including:

      i. routine operating and maintenance procedures in accordance with good engineering practices and as recommended by the *Equipment* suppliers;

      ii. emergency procedures;

      iii. procedures for any record keeping activities relating to operation and maintenance of the *Equipment;* and

      iv. all appropriate measures to minimize noise and odorous emissions from all potential sources;

   b. implement the recommendations of the *Manual.*

3. CONTINUOUS MONITORING

1. The *Company* shall install and maintain a *Continuous Monitoring System* not later than three (3) months from the date of this *Approval* to continuously monitor and record the concentrations of nitrogen oxides, carbon monoxide and the oxygen in the undiluted flue gases leaving the *Co-generation Unit.* The *Continuous Monitoring System* shall comply with the requirements outlined in Schedule B.

4. THERMAL EFFICIENCY VERIFICATION

1. The *Company* shall perform a test once, not later than six (6) months from the date of this *Approval,* and once every two (2) calendar years thereafter, to determine the *Thermal Efficiency* of the *Co-generation Unit.* The *Company* shall, as a minimum:

   a. determine the parameters described in Schedule C, during the *Thermal Efficiency* testing for the *Co-generation Unit;*

   b. calculate the *Thermal Efficiency* of the *Co-generation Unit* according to the formula described in Schedule C; and

   c. prepare a summary of the results of the *Thermal Efficiency* testing no later than two (2) months after completing the test. The summary shall indicate the *Thermal Efficiency* of the *Co-generation Unit* and include all parameters described in Schedule C.

2. If the measured *Thermal Efficiency* is less than the anticipated *Thermal Efficiency* specified in Schedule A of this *Approval* (with a tolerance of 0.05 multiplied by the anticipated *Thermal Efficiency),* the *Company* shall notify the *Ministry* so that the emission limits specified in Schedule A of this *Approval* could be revised accordingly.

3. *Thermal Efficiency* testing should be conducted at maximum rating or at the maximum load achievable at the time of testing and shall employ an average time of not less than three hours.

5. RECORD RETENTION

1. The *Company* shall retain, for a minimum of two (2) years from the date of their creation, all records and information related to or resulting from the recording activities required by this *Approval,* and make these records available for review by staff of the *Ministry* upon request. The *Company* shall retain:

    a. all records on the maintenance, repair and inspection of the *Equipment;*

    b. all records produced by the *Continuous Monitoring System;*

    c. all records related to the *Thermal Efficiency* verification required by Condition 4 of this *Approval; and*

    d. all records of notifications required by Condition 7 of this *Approval.*

    e. all records of any environmental complaints, including:

        i. a description, time and date of each incident to which the complaint relates;

        ii. wind direction at the time of the incident to which the complaint relates; and

        iii. a description of the measures taken to address the cause of the incident to which the complaint relates and to prevent a similar occurrence in the future.

6. NOTIFICATION OF COMPLAINTS

1. The *Company* shall notify the *District Manager,* in writing, of each environmental complaint within two (2) business days of the complaint. The notification shall include:

    a. a description of the nature of the complaint; and

    b. the time and date of the incident to which the complaint relates.

7. NOTIFICATION REQUIREMENTS

1. The *Company* shall notify the *District Manager,* in writing either via email or letter, of each exceedance of the nitrogen oxides or carbon monoxide limit specified in Schedule A, within two (2) business days of the exceedance. The notification shall include:

   a. Continuous Monitoring System data for all monitored parameters; and

   b. results of investigation on the cause(s) of the exceedance and remedial action(s) taken if deemed required.

SCHEDULE A

Emission and Thermal Efficiency Limits

Parameter	*Co-generation Unit* Limit
Nitrogen Oxides (1)	36.0 ppmv (2)
Carbon Monoxide	60.0 ppmv
Sulphur Dioxide	173 ppmv
Thermal Efficiency	51.3 percent

(1) "Nitrogen oxides" means oxides of nitrogen, including nitric oxide (NO) and nitrogen dioxide (NO2).

(2) "ppmv" means parts per million by volume on a dry basis normalized to 15 per cent oxygen.

(3) Demonstration of compliance with the limits of nitrogen oxides and carbon monoxide is based on the "arithmetic averaging" of the emissions recorded by the *Continuous Monitoring System* under "normal operation" of the *Co-generation Unit.* "Normal operation" means the full-load operation of the *Co-generation Unit* as defined by the manufacturer. "Arithmetic averaging" means arithmetic averaging of the emissions recorded by the *Continuous Monitoring System* in the entire operation cycle, when the operation cycle lasted for less than 24 hours, or arithmetic averaging of the emissions recorded by the *Continuous Monitoring System* in the operation cycle based on a 24-hour rolling average basis, when the operation cycle lasted more than 24 hours.

SCHEDULE B

Continuous Monitoring System Requirements

PARAMETER: NITROGEN OXIDES

INSTALLATION:

The continuous nitrogen oxides monitor shall be installed at an accessible location where the measurements are representative of the actual concentrations of nitrogen oxides in the undiluted flue gases leaving the *Co-generation Unit* and shall meet the following installation specifications:

	PARAMETERS	**SPECIFICATION**
1	Range (percentage):	0 to 100
2	Calibration Gas Ports:	close to the sample point

PERFORMANCE:

The continuous nitrogen oxides monitor shall meet the following minimum performance specifications for the following parameters:

	PARAMETERS	**SPECIFICATION**
1	Span Value (percentage):	80 to 100 percent of full scale
2	Relative Accuracy:	the greater of ≤ 10 percent of the mean value of the reference method test data or 8 ppm average absolute difference
3	Calibration Drift/Error (24- Hour):	the greater of ≤ 2 percent of full scale or 2.5 ppm absolute difference
4	System Bias:	the greater of ≤ 5 percent of full scale or 5 ppm average absolute difference
5	Procedure for Zero and Span Calibration check:	all system components checked
6	Zero Calibration Drift (24-hour):	the greater of 2 percent of full scale or 2.5 ppm absolute difference
7	Span Calibration Drift (24-hour):	the greater of 2.5 percent of full scale or 2.5 ppm absolute difference
8	Response Time (90 percent response to a step change):	≤ 200 seconds
9	Operational Test Period:	≥ 168 hours without corrective maintenance

CALIBRATION:

Daily calibration drift checks on the monitor shall be performed and recorded in accordance with the requirements of *Report EPS 1/PG/7.*

DATA RECORDER:

The data recorder must be capable of registering continuously the measurement of the monitor with an accuracy of 0.5 percent of a full scale reading or better and with a time resolution of 2 minutes or better.

RELIABILITY:

The monitor shall be operated and maintained so that accurate data is obtained during a minimum of 90 percent of the time for each calendar quarter during the first full year of operation, and 95 percent, thereafter.

PARAMETER: OXYGEN

INSTALLATION:

The continuous oxygen monitor shall be installed at an accessible location where the measurements are representative of the actual concentrations of oxygen in the undiluted flue gases leaving the *Co-generation Unit* and shall meet the following installation specifications:

	PARAMETERS	**SPECIFICATION**
1	Range (percentage):	0 - 20 or 0 - 25
2	Calibration Gas Ports:	close to the sample point

PERFORMANCE:

The continuous oxygen monitor shall meet the following minimum performance specifications for the following parameters:

	PARAMETERS	**SPECIFICATION**
1	Span Value (percentage):	80 to 100 percent of full scale
2	Relative Accuracy:	the greater of ≤ 10 percent of the mean value of the reference method test data or 0.5 percent O2 average absolute difference
3	Calibration Drift/Error (24- Hour):	≤ 0.5 percent O2
4	System Bias:	the greater of ≤ 5 percent of full scale or 0.5 percent O2 average absolute difference
5	Procedure for Zero and Span Calibration check:	all system components checked
6	Zero Calibration Drift (24-hour):	≤ 0.5 percent O2
7	Span Calibration Drift (24-hour):	≤ 0.5 percent O2
8	Response Time (90 percent response to a step change):	≤ 200 seconds
9	Operational Test Period:	≥ 168 hours without corrective maintenance

CALIBRATION:

Daily calibration drift checks on the monitor shall be performed and recorded in accordance with the requirements of *Report EPS 1/PG/7.*

DATA RECORDER:

The data recorder must be capable of registering continuously the measurement of the monitor with an accuracy of 0.5 percent of a full scale reading or better and with a time resolution of 2 minutes or better.

RELIABILITY:

The monitor shall be operated and maintained so that accurate data is obtained during a minimum of 90 percent of the time for each calendar quarter during the first full year of operation, and 95 percent, thereafter.

PARAMETER: CARBON MONOXIDE

INSTALLATION:

The continuous carbon monoxide monitor shall be installed at an accessible location where the measurements are representative of the actual concentrations of carbon monoxide in the undiluted flue gases leaving the *Co-generation Unit* and shall meet the following installation specifications:

	PARAMETERS	**SPECIFICATION**
1	Range (ppmv):	0 to highest concentration anticipated from the source
2	Calibration Gas Ports:	close to the sample extraction point

PERFORMANCE:

The continuous carbon monoxide monitor shall meet the following minimum performance specifications for the following parameters:

	PARAMETERS	**SPECIFICATION**
1	Span Value (nearest ppm equivalent):	80 to 100 percent of full scale
2	Relative Accuracy:	the greater of ≤ 10 percent of the mean value of the reference method test data or 8 ppm average absolute difference
3	Calibration Drift/Error (24- Hour):	≤ 2 percent of the actual concentration or 2.5 ppm average absolute difference
4	System Bias:	the greater of ≤ 5 percent of the mean value of the reference method test data or 5 ppm average absolute difference
5	Procedure for Zero and Span Calibration Check:	all system components checked
6	Zero Calibration Drift (24-hour):	the greater of ≤ 2 percent of full scale value or 2.5 ppm average absolute difference
7	Span Calibration Drift (24-hour):	the greater of ≤ 2.5 percent of full scale value or 2.5 ppm average absolute difference
8	Response Time (90 percent response to a step change):	≤ 200 seconds
9	Operational Test Period:	≥ 168 hours without corrective maintenance

CALIBRATION:

Daily calibration drift checks on the monitor shall be performed and recorded in accordance with the requirements of *Report EPS 1/PG/7* .

DATA RECORDER:

The data recorder must be capable of registering continuously the measurement of the monitor with an accuracy of 0.5 percent of a full scale reading or better and with a time resolution of 2 minutes or better.

RELIABILITY:

The monitor shall be operated and maintained so that accurate data is obtained during a minimum of 90 percent of the time for each calendar quarter during the first full year of operation, and 95 percent, thereafter.

SCHEDULE C

Thermal Efficiency **Verification**

The *Company* shall, as a minimum:

1. Determine the following parameters:

   a. *Power Output* (megaWatts)

   b. *Heat Output* (megaWatts)

   c. Fuel Flow Rate (in cubic metres per second at standard temperature and pressure, or kilograms per second)

   d. *Lower Heating Value* of the Fuel (megajoules per cubic metre)

   e. Ambient air temperature (degree of Celsius)

   f. Barometric pressure (kilopascal)

   g. Relative humidity (per cent)

   h. Date, time and duration of test.

2. Calculate the *Thermal Efficiency* of the *Co-generation Unit* according to the following formula:

   - Thermal Efficiency = (Power Output + Heat Output) x 100% / (Fuel Flow Rate x Lower Heating Value).

The reasons for the imposition of these terms and conditions are as follows:

1. Condition No. 1 is included to provide the minimum performance requirement considered necessary to prevent an adverse effect resulting from the operation of the *Facility.*

2. Condition No. 2 is included to emphasize that the *Equipment* must be maintained and operated according to a procedure that will result in compliance with the *EPA,* the Regulations and this *Approval.*

3. Conditions No. 3 and 4 are included to require the *Company* to gather accurate information so that compliance with the *EPA,* the Regulations and this *Approval* can be verified.

4. Condition No. 5 is included to require the *Company* to keep records and to provide information to staff of the *Ministry* so that compliance with the *EPA,* the Regulations and this *Approval* can be verified.

5. Conditions No. 6 and 7 are included to require the *Company* to notify staff of the *Ministry* so as to assist the *Ministry* with the review of the site's compliance.

Upon issuance of the environmental compliance approval, I hereby revoke Approval No(s). 8189-83LPJM issued on November 10, 2010.

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me, the Environmental Review Tribunal and in accordance with Section 47 of the Environmental Bill of Rights, 1993, the Minister of the Environment, Conservation and Parks, within 15 days after receipt of this Notice, require a hearing by the Tribunal. The Minister of the Environment, Conservation and Parks will place notice of your appeal on the Environmental Registry. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

a. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
b. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

Pursuant to subsection 139(3) of the Environmental Protection Act, a hearing may not be required with respect to any terms and conditions in this environmental compliance approval, if the terms and conditions are substantially the same as those contained in an approval that is amended or revoked by this environmental compliance approval.

The Notice should also include:

1. The name of the appellant;
2. The address of the appellant;
3. The environmental compliance approval number;
4. The date of the environmental compliance approval;
5. The name of the Director, and;
6. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary* Environmental Review Tribunal 655 Bay Street, Suite 1500 Toronto, Ontario M5G 1E5	AND	The Minister of the Environment, Conservation and Parks 777 Bay Street, 5th Floor Toronto, Ontario M7A 2J3	AND	The Director appointed for the purposes of Part II.1 of the Environmental Protection Act Ministry of the Environment, Conservation and Parks 135 St. Clair Avenue West, 1st Floor Toronto, Ontario M4V 1P5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca**

This instrument is subject to Section 38 of the Environmental Bill of Rights, 1993, that allows residents of Ontario to seek leave to appeal the decision on this instrument. Residents of Ontario may seek leave to appeal within 15 days from the date this decision is placed on the Environmental Registry. By accessing the Environmental Registry at https://ero.ontario.ca/ , you can determine when the leave to appeal period ends.

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 1st day of May, 2020

Rudy Wa

Rudolf Wan, P.Eng.
Director
appointed for the purposes of Part II.1 of the
Environmental Protection Act

KS/
c: District Manager, MECP Niagara
Bob Lo, Arcadis Canada Inc.

APPENDIX E

MANUFACTURER'S SPECIFICATIONS

Cogeneration and Energy Management Engineering Inc. o/a
CEM Engineering
227 Bunting Road
St. Catharines, Ontario, L2M 3Y2

Tel: 905-935-5815
Fax: 905-935-7878
cemeng.ca

August 12, 2019

Via E-mail: shahid.khan@northlandpower.ca

Northland Power
Thorold Cogeneration Station
90 Allanburg Road
Thorold, Ontario
L2V 0A8

Attention: **Shahid Khan**

Reference: **Environmental Permitting for a 500 BHP Superheated Boiler**
CEM Reference: 3075

This letter is intended to update the information provided in CEM's letter dated June 13, 2019. Please note that the location of the main exhaust stack for the boiler and superheater has been revised per the **attached** Site Plan Drawings. The overall stack height has also been revised.

Drawings 3075-M05-01-01 Revision P2 and 3075-M05-02-01 Revision P2 identify the revised stack location (17'-7" from grid line D and 4'-8" from grid line 8 to stack center). Please note that Drawing 3075-M05-10-01 Revision P1 previously submitted is no longer applicable.

The stack design will change to a fully self-supporting stack from grade located inside the GTG building and will exit the building roof in this revised location at an elevation of 61'-6" above grade. The top of the stack will be at an elevation of 92' above grade which is approximately 10'-5" above the air handling units located on the GTG building roof to the east of the stack.

All other information provided in the June 13, 2019 letter is still applicable.

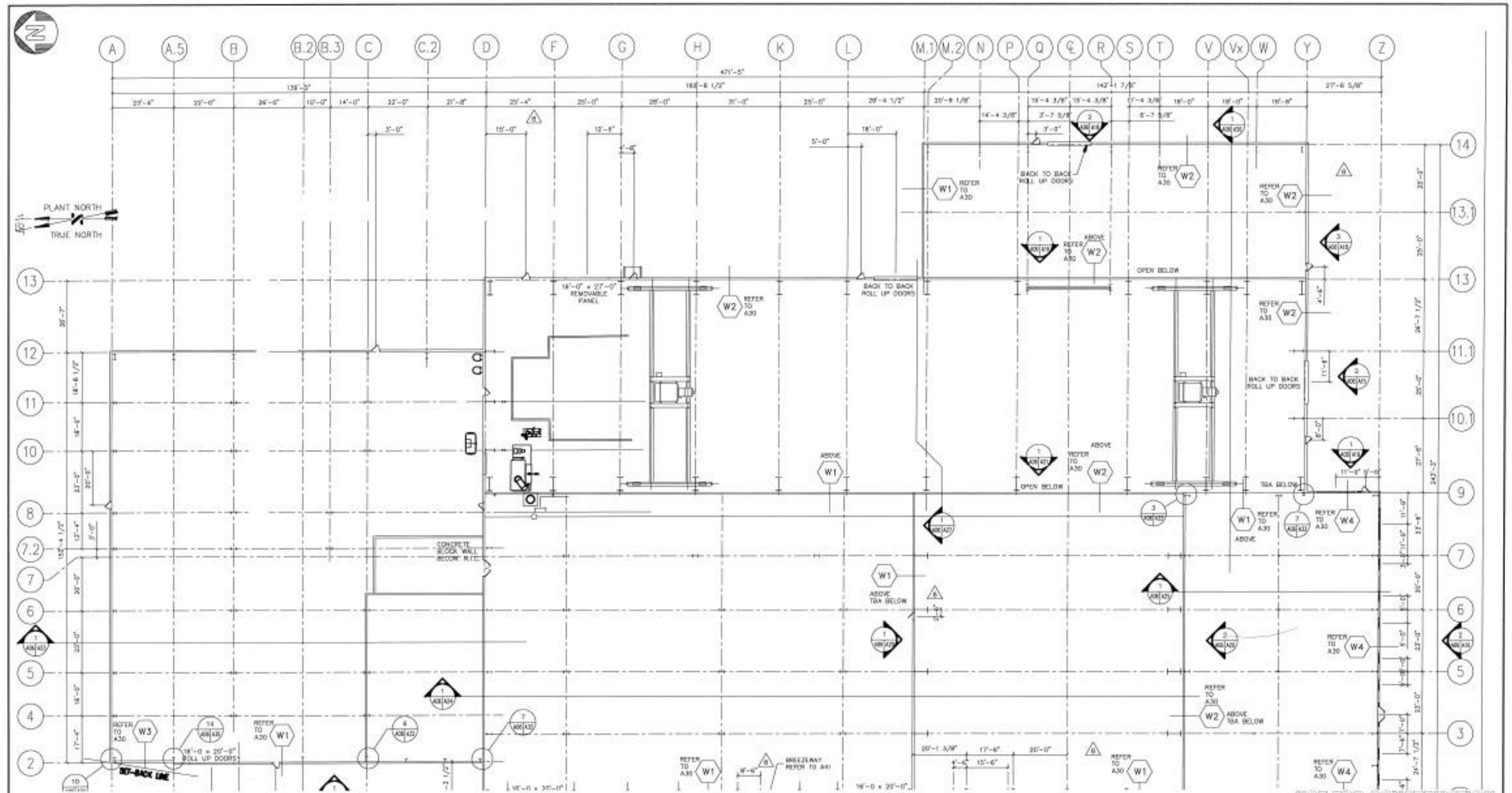
The air and noise model prepared by your consultant will need to be updated based upon the new stack location and height. Please pass this information along to the consultant at your earliest convenience.

If you have any questions, please do not hesitate to contact me to discuss further.

Yours truly,

Lawrence Lighter, P. Eng.
Project Engineer

Attachments: 3075-M05-01-01, Rev. P2 (Site Plan)
3075-M05-02-01, Rev. P2 (Plan



REV.	DATE	DESCRIPTION	DR	CK	APP'D
P2	2019-08-06	REVISED STACK LOCATION, ISSUED FOR REVIEW	JAM	KVB	LL
P1	2019-06-13	ISSUED FOR REVIEW	JAM	KVB	LL

DRAWING REVISIONS

NO.	REF.
NO.	REFERENCE DRAWINGS

PROFESSIONAL STAMP

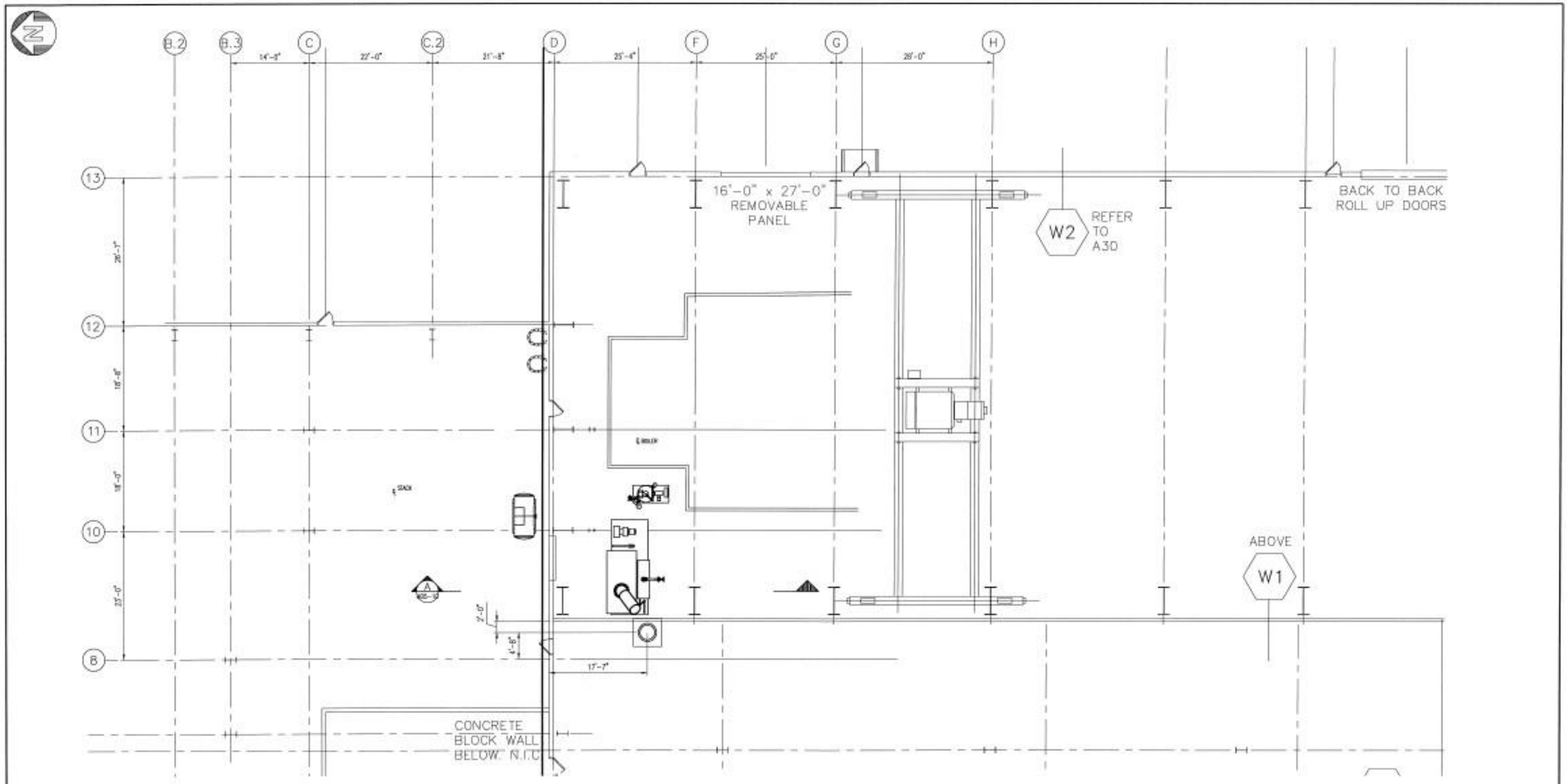
NORTHLAND POWER
THOROLD, ONT

DATE	06-06-19	DRAWN JAM	DIRECTOR
SCALE	1/8"=1'-0"	DESIGN LEAD	PROJECT MANAGER
PROJECT #	3075	ENGINEER	PROJECT ENGINEER

CEM ENGINEERING

NORTHLAND POWER
500BHP @425psig/600°F (SUPERHEATED)
SITE PLAN

SIZE	DWG. No.	SHEET	REV.
D	3075-M05-01-01		P2



NOT FOR CONSTRUCTION

NO.	DATE	DESCRIPTION	DR	CK	APP'R
P2	2019-08-06	REVISED STACK LOCATION, ISSUED FOR REVIEW	JAM	KVB	LL
P1	2019-06-13	ISSUED FOR REVIEW	JAM	KVB	LL

DRAWING REVISIONS

NO. REF.

REFERENCE DRAWINGS

PROFESSIONAL STAMP

NORTHLAND POWER
THOROLD, ONT

DATE	06-06-19	DRAWN	JAM
SCALE	1/8"=1'-0"	DESIGN LEAD	
PROJECT #	3075	ENGINEER	

DIRECTOR
PROJECT MANAGER
PROJECT ENGINEER

CEM ENGINEERING

NORTHLAND POWER

500BHP @425psig/600°F (SUPERHEATED)

PLAN

SIZE	DWG No.	SHEET	REV
D	3075-M05-02-01		P2

Cogeneration and Energy Management Engineering Inc. o/a
CEM Engineering
227 Bunting Road
St. Catharines, Ontario, L2M 3Y2

Tel: 905-935-5815
Fax: 905-935-7878
cemeng.ca

June 13, 2019

Via E-mail: shahid.khan@northlandpower.ca

Northland Power
Thorold Cogeneration Station
90 Allanburg Road
Thorold, Ontario
L2V 0A8

Attention: **Shahid Khan**

Reference: **Environmental Permitting for a 500 BHP Superheated Boiler**
CEM Reference: 3075

Please see the attached documents and drawings which address the details of the proposed 500 BHP boiler. This information is provided to facilitate the environmental permitting process:

1) Site Plan, identifying the location of the new boiler and exhaust stack.
2) Boiler and Superheater Specification, including emission (NO_x) guarantees and maximum BTU input rating.
3) Engineering statement for the compliance of the Boiler to MOECC Guideline A-9 requirements, as well as the Federal requirements for emissions.
4) Exhaust stack parameters, including:
   - Stack height above grade
   - Exit diameter
   - Exhaust temperature
   - Exhaust flow rate
   - Exit velocity
5) Noise specifications from the manufacturer for the boiler and superheater.
6) Noise specifications, with insertion losses for silencers.

If you have any questions, please do not hesitate to contact me to discuss further.

Yours truly,

Lawrence Lighter, P. Eng.
Project Engineer

500 BHP Superheated Boiler Permitting

1) Identification of the location of the new boiler and exhaust stack location on a site plan

Refer to the following drawings (attached):

- 3075-M05-01-01, Rev. P1 (Site Plan)
- 3075-M05-02-01, Rev. P1 (Plan)
- 3075-M05-10-01, Rev. P1 (Section Looking East)

The new boiler and superheater (separate modules) will be located on the main building level to the south of the water treatment room (east of grid line 8 and south of grid line D).

The stack exit will be approximately 5'-2" north of grid line D and 7'-1" east of grid line 10. The stack exit elevation will be 83'-1" above grade or 8' above the building roof line for the new boiler and superheater.

2) Boiler and superheater specification including emission (NO_x) guarantees and maximum BTU input rating

The proposed boiler is a natural gas fired 500 BHP saturated steam boiler with a steam output of 16,550 lb/hr of saturated steam at 425 psig using feedwater at 225°F. There is no other fuel used in the boiler other than natural gas. The boiler is equipped with a natural gas burner and forced draft fan. The BTU input rating for the boiler is 22,039,474 btu/hr.

The saturated steam produced in the boiler is then piped to a separate natural gas fired superheater module complete with natural gas burner and forced draft fan. No other fuel is used in the superheater. The BTU input rating for the superheater is 2,112,676 btu/hr. The superheater model will take saturated steam at 425 psig (454°F) and raise the final steam temperature to 600°F.

The blended NO_x emissions corrected to 3% O_2 (dry) will be 17.5 ppm based on a 9 ppm burner for the boiler plus the emissions from the superheater.

The blended CO emissions corrected to 3% O_2 (dry) will be 100 ppm.

Both the NO_x and CO blended emissions are guaranteed over a 4:1 turndown range.

Both the boiler module and the superheater will share a common stack.

500 BHP Superheated Boiler Permitting

3) Engineering statement for the compliance of the Boiler to MOECC Guideline A-9 requirements as well as the Federal requirements for emissions

The emission guarantees for NO_x will be below 30 ppm at the source which follows the federal requirements versus the Ontario A-9 regulation. Regulation A-9 calls for 49.6 ppm NO_x for a boiler with the heat input as noted above. For this project the federal regulations will govern.

In regards to CO emissions the A-9 regulation is silent on the source emission level and would be dependent on the required CO limits at nearby points of impingement. A dispersion model would ascertain the maximum allowable source emission level. Therefore, the guaranteed CO emission of 100 ppm will need to be verified as being acceptable for this location based on the position and height of the stack exit.

4) Exhaust stack parameters including stack height above grade, exit diameter, exhaust temperature, exhaust flow rate and exit velocity

The stack exit height above grade is 83'-1".

The stack/exit diameter is 32".

The average[1] exhaust temperature in the stack is 560°F.

The combined (boiler and superheater) exhaust flow is 23,030 lb/hr with an exit velocity of 1854 fpm.

[1] Based on a blended inlet temperature of 659°F and accounting for the expected heat loss over the length of the stack

5) Manufacturer noise specifications for the boiler and superheater

The guaranteed noise levels from the forced draft fans for both the boiler and the superheater is 85 dBA at 1 meter from each fan when the fans are equipped with an inlet duct silencer.

6) Noise specifications with insertion losses for silencers

This information is not available.

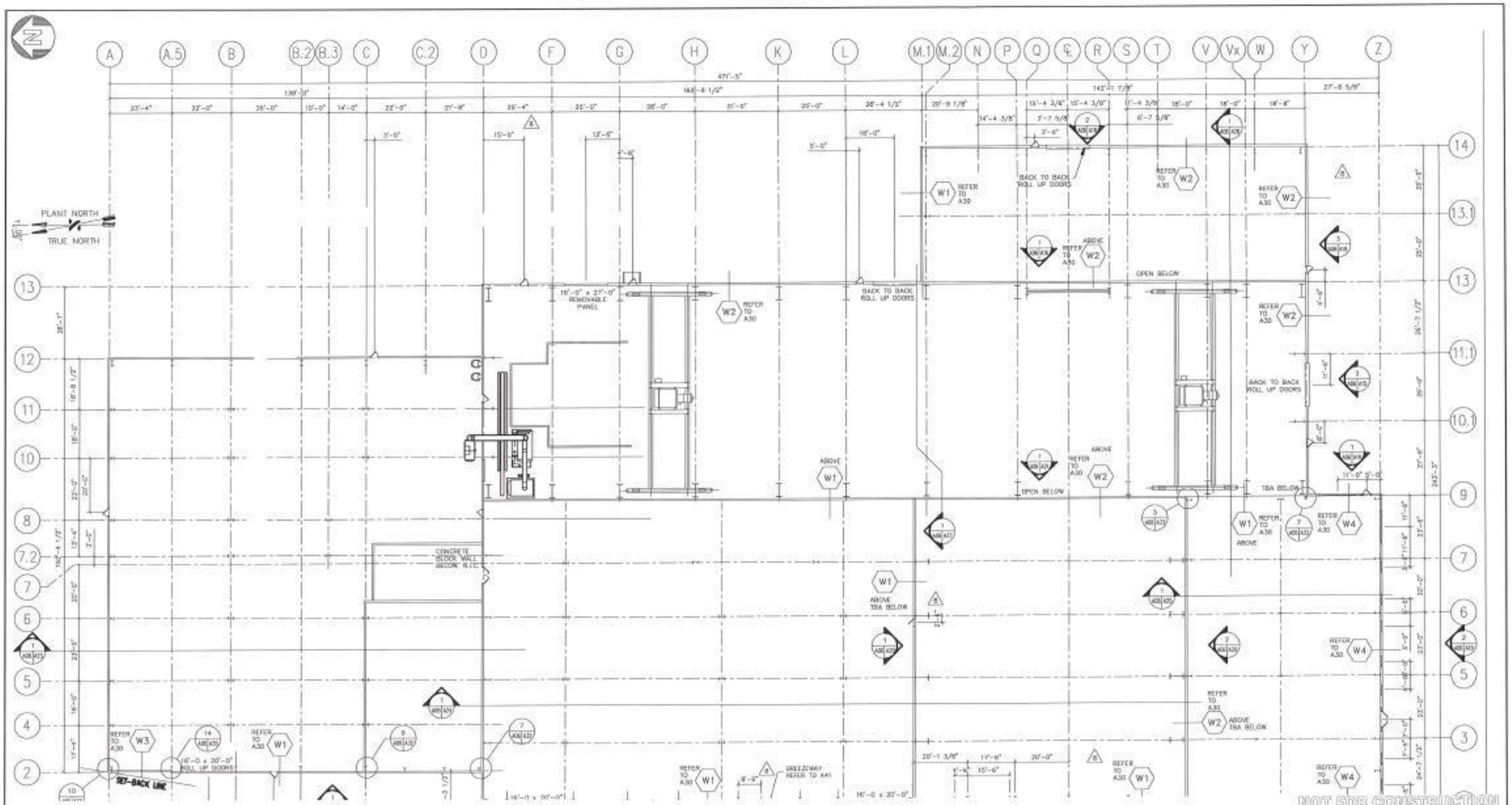
Attachments:

3075-M05-01-01, Rev. P1 (Site Plan)

3075-M05-02-01, Rev. P1 (Plan)

3075-M05-10-01, Rev. P1 (Section Looking East)

Letter from Vapor Power dated May 2, 2019



REV	DATE	DESCRIPTION	BY	CK	APPD
P1	2019-06-13	ISSUED FOR REVIEW	JAM	KVB	LL

DRAWING REVISIONS

NO. REF.

REFERENCE DRAWINGS

PROFESSIONAL STAMP

NORTHLAND POWER
THOROLD, ONT

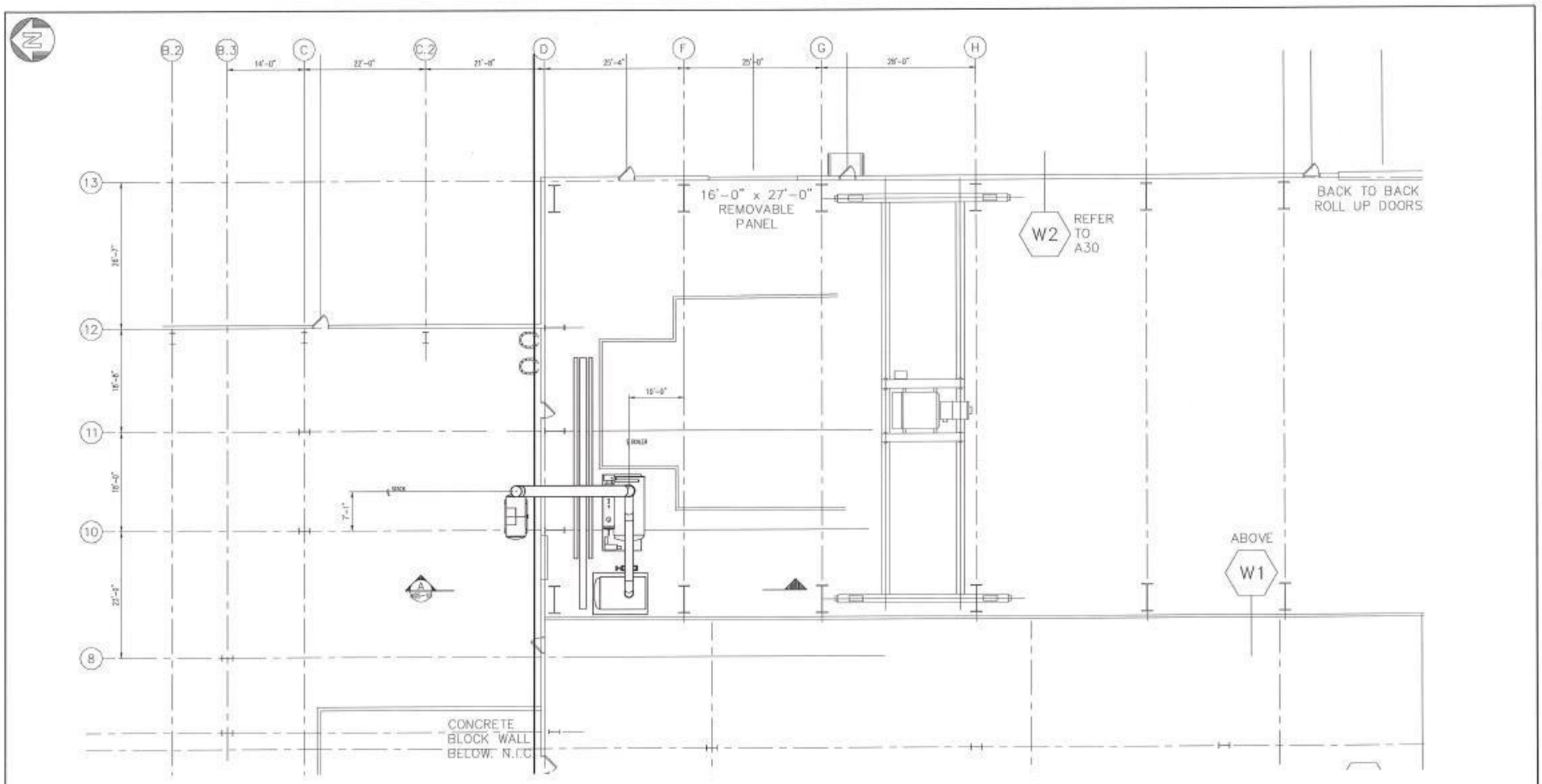
DATE	06-06-19	DRAWN	JAM
SCALE	1/8"=1'-0"	DESIGN LEAD	PROJECT MANAGER
PROJECT #	3075	ENGINEER	PROJECT ENGINEER

CONFIDENCE INFORMATION

CEM ENGINEERING

NORTHLAND POWER
500BHP @425psig/600°F (SUPERHEATED)
SITE PLAN

SIZE	DWG. No.	SHEET	REV.
D	3075-M05-01-01		P1



NOT FOR CONSTRUCTION

REV.	DATE	DESCRIPTION	DR	CK	APPR
P1	2019-06-13	ISSUED FOR REVIEW	JAM	KVB	LL

DRAWING REVISIONS

NO. REF.

REFERENCE DRAWINGS

PROFESSIONAL STAMP

NORTHLAND POWER
THOROLD, ONT

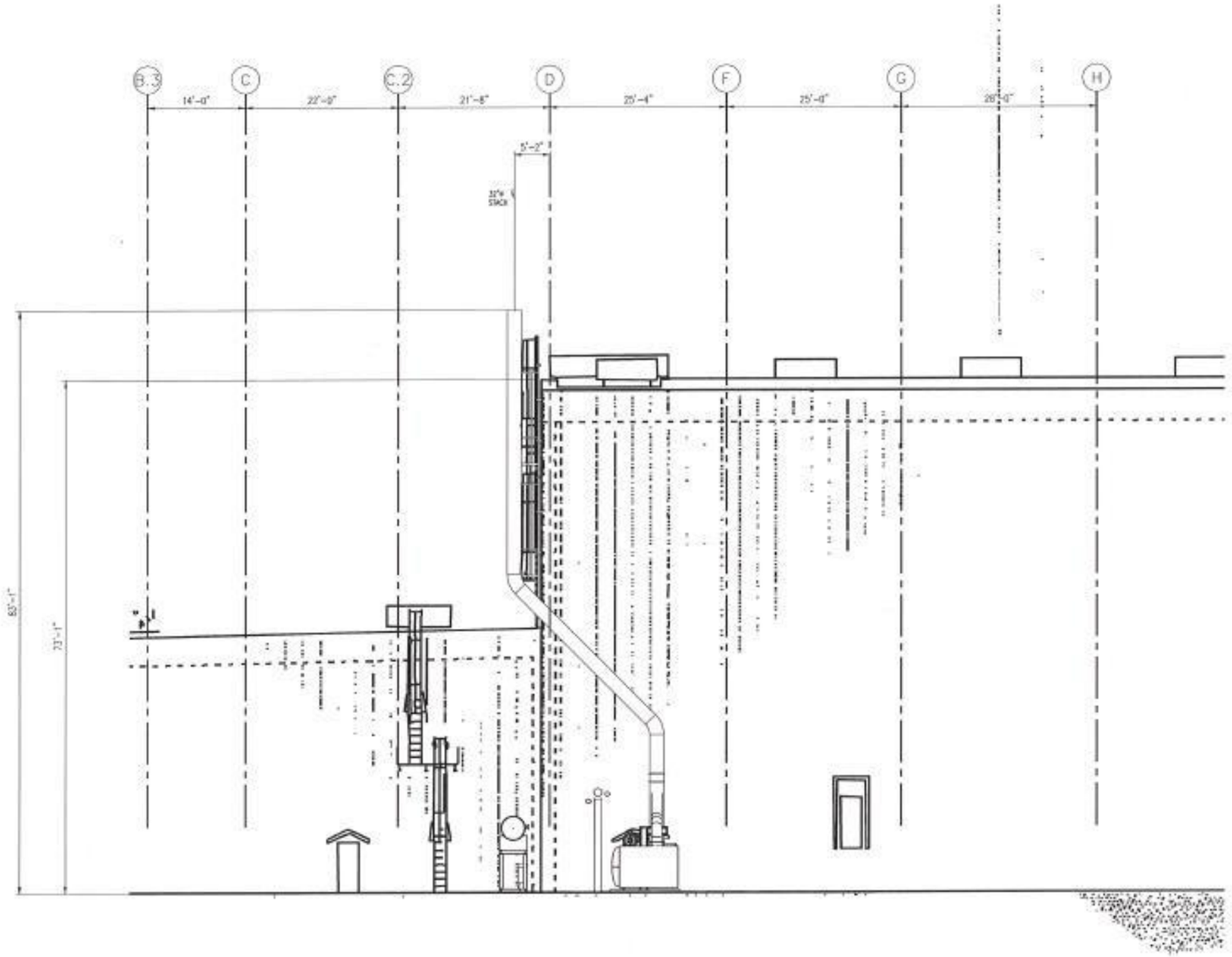
DATE	06-06-19	DRAWN	JAM
SCALE	1/8"=1'-0"	DESIGN LEAD	
PROJECT	3075	ENGINEER	

DIRECTOR
PROJECT MANAGER
PROJECT ENGINEER

CEM ENGINEERING

NORTHLAND POWER
500BHP @425psig/600°F (SUPERHEATED)
PLAN

SIZE	DWG. No.	SHEET	REV.
D	3075-M05-02-01		P1



NOT FOR CONSTRUCTION

REV.	DATE	DESCRIPTION	BY	CK	APPD
P1	2019-06-13	ISSUED FOR REVIEW	JAM	RYE	LL

BRANDING REVISIONS

NO.	REF.
NO.	REFERENCE BRANDING

PROFESSIONAL STAMP

NORTHLAND POWER
THOROLD, ONT

DATE	06-06-19	DRAWN	JAM
SCALE	1/8"=1'-0"	DESIGN LEAD	
PROJECT #	3075	OWNER	
ENGINEERING REVIEWED			

DIRECTOR
PROJECT MANAGER
PROJECT ENGINEER

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CEM ENGINEERING

NORTHLAND POWER
500BHP @425psig/600°F (SUPERHEATED)
SECTION LOOKING EAST

SIZE	DWG No.	SHEET	REV
D	3075-M05-10-01		P1

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