STARTUP, SHUTDOWN AND MALFUNCTION PLAN
MALFUNCTION ABATEMENT PLAN

Indeck Niles Energy Center

For Two (2) Natural Gas-Fired Combustion Turbines

2200 Progressive Drive
Niles, Michigan

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NTH Consultants, Ltd.
3300 Eagle Run Dr NE, Suite 202
Grand Rapids, MI 49525

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1.0 INTRODUCTION

Indeck Niles, LLC (Indeck) operates a natural gas-fired combined-cycle (NGCC) power plant at the Indeck Niles Energy Center located at 2200 Progressive Drive in Niles, Cass County, Michigan. The NGCC plant consists of two (2) combustion turbine generators (CTGs) equipped with heat recovery steam generators (HRSGs) for generation of electricity and various ancillary equipment including an auxiliary boiler, fuel dew-point heaters, and an emergency diesel-fired generator.

The CTG/HRSG trains, each rated at 3,651 Million British thermal units per hour (MMBtu/hr), are equipped with dry low NO_x burners (DLNB), selective catalytic reduction (SCR), and oxidation catalysts for emissions control. Aqueous ammonia is used in the SCR system to reduce nitrogen oxides (NO_x) in the combustion CTG/HRSG exhaust.

Indeck is required to implement and maintain a Malfunction Abatement Plan (MAP) and Startup, Shutdown, and Malfunction (SSM) Plan for the CTG/HRSG trains that describes the practices and procedures pertaining to the operation and maintenance of the CTG/HRSG and combustion controls, corrective procedures during a malfunction, operating variables, and how emissions will be minimized during startups and shutdowns in accordance with R 336.1911 and 336.1912 of the Michigan Air Pollution Control Rules.

This document and its referenced manuals constitute Indeck's SSM Plan (Section 2.0) and MAP (Section 3.0) for the CTG/HRSG trains. The referenced manuals are maintained on-site and electronically at the Indeck Niles Energy Center.

2.0 STARTUP, SHUTDOWN AND MALFUNCTION PLAN

Indeck is required to prepare a SSM plan for the CTG/HRSG trains pursuant to the air permit and Michigan Air Pollution Control Rule R 336.1912. The SSM Plan details procedures for operating and maintaining the CTG/HRSG trains during periods of startup and shutdown in a manner consistent with good air pollution control practices. Malfunction requirements for the CTG/HRSG trains and control equipment are addressed in Section 3.0 of this plan.

Indeck will operate and maintain the CTG/HRSG trains, DLNB, SCR system, and oxidation catalysts in a manner consistent with safety and good air pollution control practices during startups and shutdowns. Indeck is prepared to correct abnormal conditions during startups and shutdowns as soon as it is safe and practicable to do so, in order to minimize excess emissions. This SSM Plan will be followed to minimize emissions during these events. In accordance with the air permit, the total hours for startup and shutdown for each CTG/HRSG train will not exceed 500 hours per 12-month rolling time period as determined at the end of each calendar month.

Suggested startup and shutdown procedures are included in the *2020 – NEC – GE – 88.15.02.002-RE-0012-001 Plant Startup and Operating Philosophy (T210)* and *GEK121243_E Unit Operation HA Gas Turbine* manuals. These manuals are included as Attachments A and B of this plan, respectively. The latest versions of documents referenced in this plan will be maintained electronically at Indeck Niles Energy Center.

2.1 Startup Procedures

The CTG/HRSG operator will minimize the time spent at idle during startup of the CTG/HRSG trains while maintaining appropriate and safe loading of the CTG/HRSG trains. The CTG/HRSG trains will be operated in a manner consistent with good air pollution control practices.

According to the air permit:

> *Startup is defined as the period of time from initiation of the combustion process (flame-on) from shutdown status and continues until steady state operation (loads greater than a demonstrated percent of design capacity) is achieved.*

Pursuant to FGCTGHRSG Special Condition III.2, the demonstrated "percent of design capacity or demonstrated steady state level" specified in the startup definition above is required to be described in the SSM Plan as the end of the startup period. The demonstrated percent of design capacity or demonstrated steady state level is achieved at Minimum Emission Compliance Load (MECL). MECL is met when CTG/HRSG trains exceed 140 MW and NO_x

concentration is less than 4 ppm (as measured by CEMS to serve as an indicator of SCR operation).

As detailed in Section 3.4 of the 2020 – NEC – GE – 88.15.02.002-RE-0012-001 Plant Startup and Operating Philosophy (T210), included as Attachment A, upon startup, unless a different load is requested, the unit will load to the Spinning Reserve load point. The Spinning Reserve load point is slightly greater than no load, approximately 25 megawatts (MW). An exhaust gas temperature of 1,050°F, minimum pressure of 15 psig, and minimum fuel gas temperature of 120°F are required in order to ramp the CTGs to their MECL at 8.33% per minute. Normal startup and loading operations are further described in Section 3.3 of this plan.

Indeck will follow the suggested startup procedures and instructions described in *2020 – NEC – GE – 88.15.02.002-RE-0012-001 Plant Startup* and *Operating Philosophy (T210)* included as Attachment A and *GEK121243_E Unit Operation HA Gas Turbine* manuals included as Attachment B. Indeck will verify that the DLNB, SCR, oxidation catalyst and the associated aqueous ammonia system are operating within acceptable ranges and the CTG/HRSG trains are achieving the MECL, as specified. Suggested startup procedures for the SCR system are included in the *SCR Control Philosophy* manual (pages 11 – 13) of Attachment C. The oxidation catalyst for CO and VOC reduction is passive and requires no control function during startup.

2.2 Shutdown Procedures

According to the air permit:

> *Shutdown is defined as that period of time from the lowering of the turbine output below the demonstrated steady state level, with the intent to shut down until the point at which the fuel flow to the combustor is terminated.*

As described in Section I of the *GEK121243_E Unit Operation HA Gas Turbine* manual (Attachment B), shutdown is initiated by selecting STOP on the Human Machine Interface (HMI) Main Startup Display. The HMI is a personal computer that directly interfaces to the turbine control panel. The control system will follow automatically through generator unloading, generator breaker opening, turbine speed reduction, fuel shutoff at part speed, and

initiation of the cool down sequence. Further, Section 5.0 of *2020 – NEC – GE – 88.15.02.002-RE-0012-001 Plant Startup* and *Operating Philosophy (T210)* (Attachment A) includes the suggested steps and parameters for shutdown of the CTG/HRSG. Typically, the objectives of a normal shutdown procedure are to maintain the steam turbine temperature and HRSG pressure as high as practical to facilitate a subsequent startup while minimizing HRSG and steam turbine stress. For a typical shutdown, the gas turbines are unloaded at designated shutdown rate (8.33%/min) towards MECL before steam turbine shutdown is initiated.

Upon normal shutdown order, the gas turbine load is reduced further until a reverse power situation is detected at which time the gas turbine generator breaker opens. When the generator breaker opening is detected, the gas turbine fuel flow is reduced to a minimum value enough to maintain flame, but not turbine speed. The gas turbine then decelerates. When the gas turbine transitions through approximately 25% speed, the fuel is completely shut off. The purpose of this "fired shutdown" operation is to reduce the thermal fatigue duty imposed on the hot gas path parts. After fuel shutoff, the gas turbine continues to coast down to turning gear speed where turning gear is engaged.

Indeck will follow the suggested shutdown procedures and instructions described in the *2020 – NEC – GE – 88.15.02.002-RE-0012-001 Plant Startup and Operating Philosophy (T210)* manual and *GEK121243_E Unit Operation HA Gas Turbine* manual, included as Attachments A and B, respectively. Suggested shutdown procedures for the SCR are described in the *SCR Control Philosophy* manual included as Attachment C.

3.0 MALFUNCTION ABATEMENT PLAN

Indeck is required to prepare a MAP for the CTG/HRSG trains pursuant to the air permit and Michigan Air Pollution Control Rule R 336.1911. The MAP details procedures for operating and maintaining the CTG/HRSG trains and control equipment (e.g., the DLNB, SCR system, oxidation catalyst), and is comprised of information regarding prevention, detection, and correction of malfunctions that may occur at the CTG/HRSG trains. The MAP describes implementation of preventative maintenance, and, should a malfunction occur, the MAP references procedures for correcting these incidents.

The MAP serves to provide the following information as required by Rule 911(2):

a) A complete preventative maintenance program, including identification of supervisory personnel responsible for overseeing the inspection maintenance and repair of air-cleaning devices, a description of the items or conditions that shall be inspected, the frequency of the inspections or repairs and identification of the major replacement parts that shall be maintained in inventory for quick replacement.
b) An identification of the source and air-cleaning device operating variables that shall be monitored to detect a malfunction or failure, the normal operating range of these variables, and a description of the method of monitoring or surveillance procedures.
c) A description of the corrective procedures or operational changes that shall be taken in the event of a malfunction or failure to achieve compliance with the applicable emission limits.
d) Identification of the source, and operating variables and ranges for varying load, shall be monitored and recorded. The normal operating range of these variables and a description of the method of monitoring shall be maintained.
e) The procedure that will be followed to address a test result that is higher than the emission factor listed in SC V.2 of the air permit.

3.1 Preventative Maintenance Procedures

This section outlines components of Indeck's preventative maintenance program and applicable documents for maintaining the CTG/HRSG trains and associated DLNB, SCR system, and oxidation catalysts.

3.1.1 Supervisory Personnel

Supervisory personnel responsible for preventative maintenance, including inspections, maintenance, and repair of the CTG/HRSG trains include:

Operations & Maintenance (O&M) Manager – Responsible for overseeing CTG/HRSG inspections, maintenance and corrective procedures/repairs.

Compliance Manager – Responsible for compliance demonstrations, reporting abnormal conditions and malfunctions, and recordkeeping.

Other personnel may be tasked with implementing the requirements of this plan, including inspections, routine maintenance, and repair, along with overall operations of the CTG/HRSGs and maintenance of combustion controls.

Suggested preventative maintenance procedures and schedules for the CTG/HRSG trains and associated equipment are included in *G.E. Master Comprehensive Equipment Manual GEK 134793* (this document is maintained electronically / on-site).

Recommended maintenance procedures and schedules for the SCR and oxidation catalyst are identified in the *SCR Control Philosophy* manual included as Attachment C.

3.1.2 Frequency of Repairs and Items to Be Inspected

Equipment repairs will be conducted as necessary, as suggested in *GEK121243_E Unit Operation HA Gas Turbine*. A list of parts to be inspected, descriptions of maintenance tasks, and specific inspection schedules for the CTG/HRSG trains and associated equipment are provided in the *G.E. Master Comprehensive Equipment Manual GEK 134793* (this document is maintained electronically / on-site) and for the SCR and oxidation catalyst in the *SCR Control Philosophy* manual included as Attachment C.

Records of inspections as well as maintenance events, including date and time of repairs will be documented electronically in the work order system (Maximo) and on-site in the eLogger system at Indeck Niles Energy Center.

3.1.3 Replacement Parts

Indeck maintains major replacements parts for the CTG/HRSG and associated equipment at the facility for quick replacement. If a spare part for the system is not available when needed, the CTG/HRSG will be shut down (when deemed necessary to maintain emission compliance) until the part or system can be installed or repaired. CTG/HRSG spare parts inventory tracking will be maintained in Maximo CMMS and physical part inventory will be maintained on site.

3.2 CTG/HRSG Operating Variables

Indeck will operate and maintain the CTG/HRSG, including the DLNB, SCR system, and oxidation catalysts, in a manner consistent with the safety and good air pollution control

practices during malfunctions and abnormal conditions. Indeck will not operate the CTG/HRSG unless the DLNB, SCR system, and oxidation catalysts are installed, maintained, and operated in accordance with this MAP.

Control Room Operators will monitor operation, issue commands, and manage alarms for the CTG/HRSGs using the Human Machine Interface (HMI), a personal computer that directly interfaces to the turbine control panel. Normal operating variables for the CTG/HRSGs and components are included in the *2020 – NEC – GE - 88.15.02.002-RE-0012-001 Plant Startup and Operating Philosophy (T210)* and *GEK121243_E Unit Operation HA Gas Turbine* manuals included as Attachment A and B.

Normal operating variables for the CTG/HRSGs are summarized in Table 3-2. CTG/HRSG operators will monitor the NO_x and CO emissions rate using Continuous Emissions Monitoring System (CEMS) to ensure the CTG/HRSG trains are in compliance with the air permit and as an indicator of proper operation of the CTG/HRSGs and control equipment.

Table 3-2. CTG/HRSG Operating Variables

Monitored Variable	Normal Operating Range
CTG Exhaust Gas Temperature (°F)	1,050 - 1,250 °F
Fuel Gas Temperature (°F)	120 °F
HRSG Pressure (psig)	15 - 30 psig
Maximum Steam Outlet Temperature (°F)	1,085 °F
Maximum Overall Vibration Velocity (in/sec)	1.0 in (2.54 cm)
Maximum Rotor Temperature (°F)	185 °F
Maximum Stator Temperature (°F)	140 °F
HRSG Exhaust Temperature (°F)	65 - 80 °F*
Flame Out Speed (%)	94%

*If, during steady state and loading/unloading operation, there has been an increase in exhaust temperatures above the normal 65°F to 80°F, the thermocouples in the exhaust plenum should be examined. The thermocouples will be inspected for debris and checked that they are radially oriented relative to the turbine.

3.3 Control Equipment Operating Variables

The CTG/HRSG trains are each equipped with DLNB and SCR (for reducing/controlling NO_x emissions) and an oxidation catalyst (for controlling CO and VOC emissions). Indeck will maintain the DLNB, SCR system, and oxidation catalysts in accordance with the *SCR Control Philosophy* manual, included as Attachment C, and *2020 – NEC – CON – PSD Aqueous Ammonia 20026168-MSD-AQA-001.A.IFOR.A.01* manual, included as Attachment D. Indeck will not operate the CTG/HRSG train unless the respective DLNB, SCR, and oxidation catalyst are installed, maintained, and operated in accordance with this MAP.

Indeck will monitor the operating variables of the DLNB, SCR, and oxidation catalysts as described in the *SCR Control Philosophy* manual and as listed in Table 3-4 below. Variables to be monitored according to the SCR Control Philosophy manual include:

- Pressure drop across the catalyst, and
- Flue gas temperatures at the SCR inlet.

Table 3-4. Catalyst Operating Variables

Monitored Variable	Normal Operating Range
NO_x Emission Limit (ppmvd)[1]	< 2 ppmvd at 15% O_2
CO Emission Limit (ppmvd)[1]	< 4 ppmvd at 15% O_2
Flue Gas Temperature, SCR inlet (°F)	665 – 679 °F
dP Across Catalyst (in wc)	2.32 – 2.34 (in wc)
Ammonia Flow Rate (lb/hr)	282 – 845 lb/hr
Ammonia Supply Pressure (psig)	60- 80 psig

[1] 24-hour rolling average as determined each operating hour, except during startup and shutdown.

3.3.1 Response to Malfunction

While operating the CTG/HRSG, if an event happens where obvious damage may occur by continuing to operate, load should be reduced, and the unit taken out of service as soon as practicable. In the event of a malfunction of the CTG/HRSG or control equipment causing an exceedance of an emission limitation, Indeck will document and maintain records of the abnormal conditions. Indeck plant operators will notify the *Compliance Manager* and document the date of the malfunction, the duration of the malfunction, the type of malfunction, and the corrective action(s) taken. If shutdown of the CTG/HRSG is necessary, the CTG/HRSG will be

shut down as described in Section 2.2. If the CTG/HRSG cannot be shut down safely or circumstances prevent the CTG/HRSG from being shut down, Indeck will document the reasons for continuing operation.

Corrective actions will be implemented in the event of a malfunction, in accordance with the *2020 – NEC – GE – 88.15.02.002-RE-0012-001 Plant Startup and Operating Philosophy (T210)* manual included as Attachment A, *GEK121243_E Unit Operation HA Gas Turbine* manual included as Attachment B, or other operational requirements. Records of corrective actions will be documented and maintained electronically in the work order system (Maximo) and on-site in the eLogger system. Corrective actions will be taken to resolve issues as soon as it is safe and practicable to do so.

3.3.2 Fugitive Emissions

A fugitive emissions condition would be considered the release of any air emissions from unintended release points for that emissions unit. In the event of a fugitive emissions condition being discovered, employees will report the area of concern to the Control Room Operator. The Control Room Operator will document the problem. If the condition can be readily corrected (leak stopped), the operator will attempt to do so if it can be done is a safe manner. If the fugitive emissions leak is determined to be a significant safety or environmental hazard, the unit will be shut down as described in Section 2.2.

If the fugitive emissions condition cannot be readily corrected and an immediate shut down of the related unit is not required, Plant Management will be informed of the situation. Plant Management will assess and determine the amount of emissions being released at the fugitive emissions point and will determine what repairs will need to be completed to correct the problem. If it is decided that Michigan EGLE needs to be informed of the situation, an email notification will be sent, including an estimate of the environmental impact of the condition, the proposed plan to repair or correct the condition and any other supporting documentation (i.e., photos, videos, drawings…) deemed relative. The plant will comply with any recommended, immediate, or long-term actions provided by Michigan EGLE, including immediate shut down of the unit and/or providing periodic updates to the Department.

If it is determined the fugitive emissions condition is minimal and the unit will continue with operations, the fugitive emissions condition will be inspected as often as deemed necessary with these results being documented. Once repairs have been completed, continue to monitor the area to ensure the repairs are successful until determined that extra inspections are no longer needed.

3.4 Formaldehyde Emission Factor

In accordance with the air permit, Indeck is required to conduct testing to verify the formaldehyde emission factor for the CTG/HRSG trains at maximum operating conditions. The formaldehyde emission factor and thresholds used to determine emissions testing frequency are listed in Table 3-4.

Table 3-4. CTG/HRSG Formaldehyde Tested Factor

Base Emission Factor Annual Timeframe (ppmvd at 15% O_2 on a dry gas basis)	Emission Factor 75% Threshold 3-Year Timeframe (ppmvd at 15% O_2 on a dry gas basis)	Emission Factor 55% Threshold 5-Year Timeframe (ppmvd at 15% O_2 on a gas basis)
0.160	0.120	0.088

After the baseline data set is developed (i.e., after Indeck conducts formaldehyde emissions testing 180 days after startup and once per year for the following two years – three (3) tests total), the default subsequent testing frequency is annual (once per year).

Following the initial baseline data set testing, if two (2) consecutive emissions test results are below 75 percent of the base emission factor, subsequent emissions testing may be conducted once per three (3) years; if two (2) consecutive emissions test results are below 55 percent of the base emission factor, subsequent emissions testing may be conducted once every five (5) years. If the subsequent emissions test result after a 3-year or 5-year test is at or above 55 percent the subsequent testing shall revert to every three (3) years if below 75 percent (i.e., if the result is between 55 and 75 percent) or once per year if the result is greater than 75 percent of the base emission factor.

If a test results in an emission factor above the listed base emission factor of 0.160 ppmv at 15% O_2, Indeck will implement procedures to address future emissions in accordance with MAP requirements in Section 3.0.

4.0 RECORDKEEPING AND REPORTING REQUIREMENTS

Indeck will maintain this MAP and SSM plan at the Indeck Niles Energy Center. Records associated with the plan will be maintained for a period of at least five (5) years.

Indeck will maintain the following records related to the MAP and SSM plan:

- Records of maintenance events, including the date and time of occurrence;
- Records of actions taken during periods of malfunction to minimize emissions including corrective actions to restore malfunctioning equipment to its normal or usual manner of operation;
- Records of the occurrence and duration of each malfunction or abnormal operating condition of the CTG/HRSG train, DLNB, SCR, and oxidation catalysts; and
- Records explaining the reasoning of continuance of CTG/HRSG train operation if the CTG/HRSG train(s) cannot be shut down safely during a malfunction or abnormal operating condition.

In the event that there is an exceedance of an applicable emission standard in the current permit as a result of a malfunction, abnormal condition, startup or shutdown, the Compliance Manager will provide notice and submit a written report to the AQD District Office, as required by R 336.1912, as described below.

If there is evidence of an air contaminant above a permitted emission limit for more than two (2) consecutive hours, prompt notice and a written report will be provided to the AQD, as follows.

- Prompt notice will be provided to the AQD District Office by reasonable means, such as electronic, by telephone, or oral communication as soon as possible, but not later than two (2) business days after the startup, shutdown, or abnormal condition or malfunction is discovered.

- Indeck will submit a written report within 10 days after a startup or shutdown occurrence, or after correction of the abnormal condition or malfunction, or within 30 days of the abnormal condition or malfunction being discovered.

Written reports will contain the following information:

- Time and date, duration, and probable cause of the abnormal condition, startup, shutdown, or malfunction.
- Identification of the CTG/HRSG equipment or control equipment that experienced the abnormal condition, startup, shutdown, or malfunction, and where it is known or reasonably possible to estimate, the magnitude of emissions in excess of the permitted emission limits.
- Description of measures taken and air pollution control practices followed to minimize emissions.
- Summary of actions taken to correct and prevent the recurrence of the abnormal condition or malfunction and the time taken to correct the malfunction.

5.0 PLAN REVISION HISTORY

The MAP and SSM plan may be revised to address revision requests required by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) or due to the following:

- To incorporate new equipment installed;
- To address a revision request from the AQD District Supervisor;
- To address a malfunction event that occurs and is not addressed or that is inadequately addressed by the plan.

If an event described above occurs that requires Indeck to revise this MAP and SSM plan, Indeck will submit a revised MAP and SSM plan within 45 days of such event. A current copy of the MAP and SSM plan will be maintained electronically and onsite at Indeck Niles Energy Center. Previous versions will be kept on file and available for at least five (5) years from the date of revision. Table 5-1 contains a list of revisions of this document.

Table 5-1. Plan Revision History

Revision No.	Date	Revised By	Comments
Original	June 22, 2022	N/A	Initial Draft
001	November 14, 2022	Thomas Krysiak, Madison Mosher	Addition of Section 3.3.2 Fugitive Emissions