Monitoring Plan
Continuous Monitoring System
Using Dry Sorbent Injection

L'Anse Warden Electric Company

Project No. 191493
October 29, 2020

fishbeck
Engineers | Architects | Scientists | Constructors

fishbeck
Engineers | Architects | Scientists | Constructors

39500 MacKenzie Drive, Suite 100
Novi, Michigan 48377

248.324.2090 | fishbeck.com

Monitoring Plan
Continuous Monitoring System
Using Dry Sorbent Injection

Required by PTI 128-18

Prepared For:
L'Anse Warden Electric Company
L'Anse, Michigan

October 13, 2020
Revised October 29, 2020
Project No. 191493

fishbeck
Engineers | Architects | Scientists | Constructors

List of Figures

List of Tables

List of Appendices

List of Abbreviations/Acronyms

Btu	British thermal unit(s)
CEMS	continuous emission monitoring system
CO_2	carbon dioxide
CO	carbon monoxide
COMS	continuous opacity monitoring system
CMS	continuous monitoring system
°F	degrees Fahrenheit
dp	mean diameter
DSI	dry sorbent injection
EGLE	Michigan Department of Environment, Great Lakes, and Energy
ESP	electrostatic precipitator
HAP	hazardous air pollutant
HCl	hydrogen chloride
LWEC	L'Anse Warden Electric Company
MAP	Malfunction Abatement Plan
MW	megawatts
MMBtu/hr	million Btus per hour
NO_X	oxides of nitrogen
O&M	operations and maintenance
O_2	oxygen
lb/hr	pound(s) per hour
PM	preventive maintenance
ppm	parts per million
PTI	permit to install
RATA	Relative Accuracy Test Audit
ROP	Title V Renewable Operating Permit
$NaHCO_3$	sodium bicarbonate
NaCl	sodium chloride
NaF	sodium fluoride
Na_2CO_3	sodium carbonate
Na_2SO_4	sodium sulfate
SO_2	sulfur dioxide
TDF	tire-derived fuel
tph	ton(s) per hour
tpy	ton(s) per year
H_2O	water

1.0 Introduction

L'Anse Warden Electric Company (LWEC) operates a power plant in L'Anse, Michigan, consisting of a cogenerating steam boiler, with a nominal heat input rate of 324 MMBtu/hr and steam electrical generator, with a nameplate capacity of 22 MW. PTI 128-18 was issued allowing the facility to burn engineered fuel pellets (pellets), provided that DSI is in use while burning the pellets. The purpose of this Plan is to document operation of the monitoring equipment and explain procedures that are in place to ensure compliance with the facility's HCl emission limits. It should be noted that LWEC has demonstrated compliance with HCl emission limits without use of the DSI system when burning its traditional fuel mix (creosote-treated railroad ties, wood chips, fines, bark, and TDF) and can return to its traditional fuel mix if the DSI or monitoring system malfunctions.

2.0 Permit Requirements

LWEC has accepted an HCl limit to ensure its status as an area source of HAP emissions. To avoid classification as a major source of HAPs, LWEC must accept emission limits to ensure HAP emissions remain below 10 tpy of an individual HAP and 25 tpy of a combination of HAPs. Because chlorine is present in some fuels, LWEC monitors the chlorine content, as well as other fuel characteristics, as described in the Fuel Procurement and Management Plan and as required by the permit.

2.1 Monitoring System Requirements

The PTI requires LWEC to *…install, calibrate, maintain and operate a continuous monitoring system (CMS).* In Section EUBOILER#1, Section VI – Monitoring/Record keeping, Condition 2, requirements for the CMS are described and are summarized below:

- Provisions for alternative monitoring if the DSI injection monitoring system is not operational or is out of control
- Description of process monitors, including stack test data demonstrating a correlation between HCl emissions and information provided by the CMS
- Monitor maintenance activities, as well as ongoing calibration activities
- Include emission information demonstrating the relationship between pellet usage and the reagent injection rate necessary to maintain compliance with emission limits

An important element of the air construction and operating permit are the compliance monitoring requirements. After establishing an emission limit and averaging time, a method of demonstrating compliance must be established for each limit, taking into account its' respective averaging time. Compliance monitoring refers to those *activities sources undertake, on a regular basis, to ensure that their operations are meeting all emission limitations and standards, including work practice standards*. It can include actual measurements of emissions (either continuous or periodic) or what is known as parametric monitoring, where the *company keeps track of an indicator of process or control device performance*, for example the reagent injection rate of a DSI.

3.0 Control System Description

LWEC operates an existing power plant in L'Anse, Michigan, consisting of a cogenerating steam boiler, with a nominal heat input rate of 324 MMBtu/hr and steam electrical generator, with a nameplate capacity of 22 MW. Steam extracted from the turbine reduces the net available electric output of the turbine generator to approximately 17.7 MW under normal operating conditions. The fuels currently permitted are natural gas, TDF, chipped railroad ties, pellets, and non-chemically-treated biomass, which includes wood and fines/bark. A complete list of allowed fuels is presented in the facility's Fuel Management and Procurement Plan. LWEC has a Power Purchase Agreement to provide renewable power and renewable energy credits under Michigan's Clean and Renewable Energy and Energy Waste Reduction Act (Public Act 342) which amends Michigan's 2008 Energy Law (Public Act 295).

3.1 Emission Control Methodology

The boiler add on emission control technology includes a multi cyclone, followed by a three section ESP and a DSI system. DSI is a technology to control HCl and other acid gases while burning pellets. The chemistry associated with DSI technology is relatively straightforward and well understood. LWEC currently purchases SOLVAir® S200 Trona[1] based sorbent (not milled, dp < 30 µm) and will continue to use Trona or an equivalent sorbent. Trona is injected into the gas stream; upon heating, it thermally decomposes to a more porous sodium carbonate particle, which then reacts with the acid gases present in the flue gas stream. Additional information on Trona is provided in Appendix 1.

The basic Trona reaction for sulfur capture is:

$$2(Na_2CO_3\ NaHCO_3{\cdot}2H_2O) \rightarrow 3Na_2CO_3 + CO_2 + 5H_2O$$

$$Na_2CO_3 + 0.5O_2 + SO_2 \rightarrow Na_2SO_4 + CO_2$$

Following the Trona decomposition step to Na_2CO_3, the global hydrogen chloride capture mechanism for Trona are as follows, respectively:

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$$

Wood ash is alkaline and reacts with acid gas emissions to form salts which remain in the fly ash and bottom ash. All fuel blends at LWEC contain a considerable amount of wood, which makes performing a mass balance on chlorine from fuels at LWEC problematic. However, LWEC has an aggressive and comprehensive pellet testing program to maintain chlorine levels in the pellets; this program is detailed in its *Fuel Procurement and Monitoring Plan*. A summary of data collected since the beginning of 2018 is provided in Table 1. LWEC has developed specific requirements for the materials that can be used in the pellets the facility burns, which includes a maximum target concentration of chlorine of 1,200 ppm (as received). That being said, LWEC has developed *worst-case* emissions from burning pellets and used that information in the application for PTI 128-18, as well as in the design of the DSI System. Other testing conducted over the years suggests that, while burning wood (including wood chips and/or cross-tie derived fuel), the wood ash *scrubs* the boiler exhaust,[2] reducing acid gas emissions to a significant degree. Sulfur content of the wood is relatively consistent and any SO_2 produced by the boiler is also scrubbed by the wood ash and reduced by the Trona.

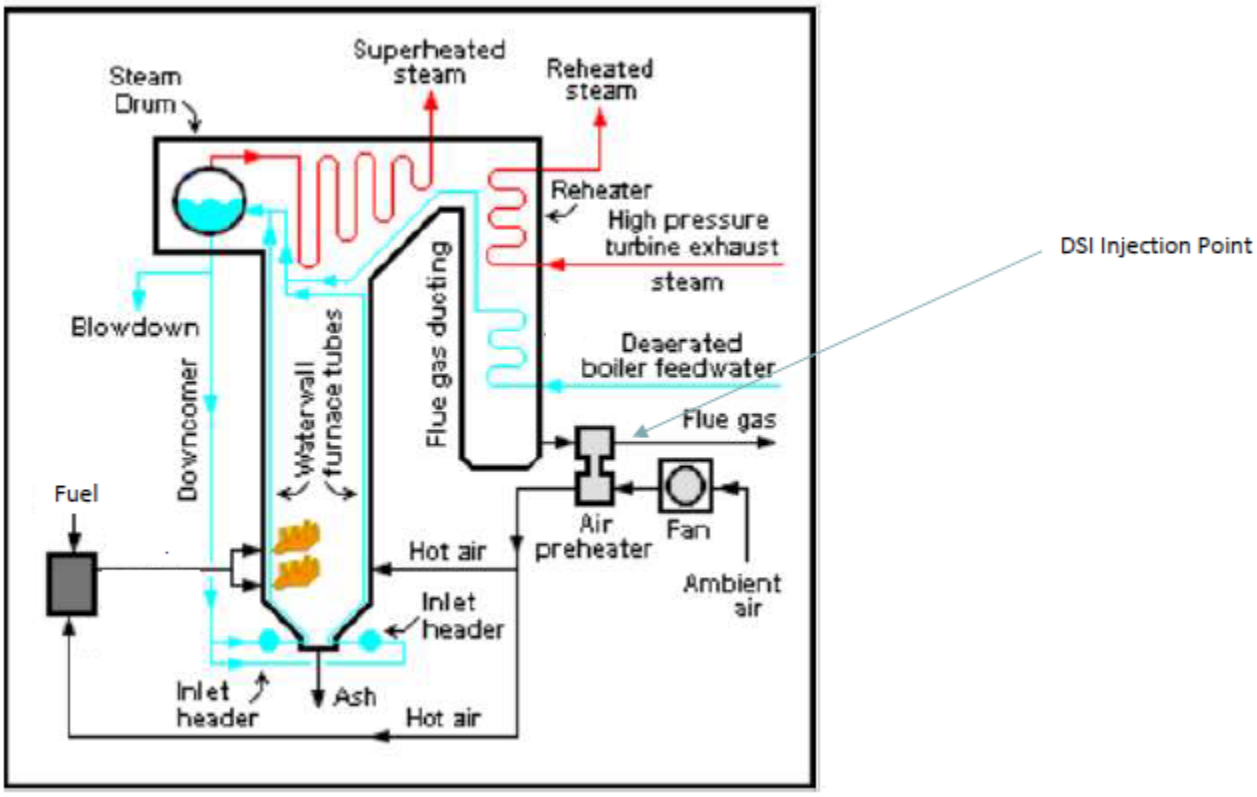
Nol-Tec designed and installed the DSI injection system at LWEC. Utility boilers, like the one at LWEC, are designed to recover heat from the combustion of fuel which is then used to generate steam for electricity. As the boiler diagram demonstrates (Graphic 1 on the following page), there are boiler tubes within the furnace which absorb heat and generate steam. The air heater affords another opportunity to recover heat from the boiler, as it allows combustion air to be preheated by the exhaust that is headed to the exhaust stack. It should be noted that the LWEC system actually has two air heaters. This heat recovery enables the boiler to generate steam to produce electricity and the more heat that is recovered, the more efficiently the boiler operates.

When designing the DSI system, Nol-Tec came onsite, collected information, and conducted testing to determine the best point in the ductwork at which to inject the sorbent for maximum overall performance. Nol-Tec placed the DSI system after the second air heater where the temperature is approximately 500°F. The boiler diagram indicates that the injection point is far downstream of the furnace, at which point heat has been removed from the exhaust stream at several locations. The boiler would not function if steam was not being generated from boiler heat and used to generate electricity. In addition, the exhaust temperature at LWEC (designated as *flue gas* on the diagram) is always above 285°F. Recently, the stack temperature was measured between 400° and 455°F.

---

[1] Trona – sodium sesquicarbonate

[2] Wood ash is alkaline and reacts with acid gas to form salts which are collected in the ESP.

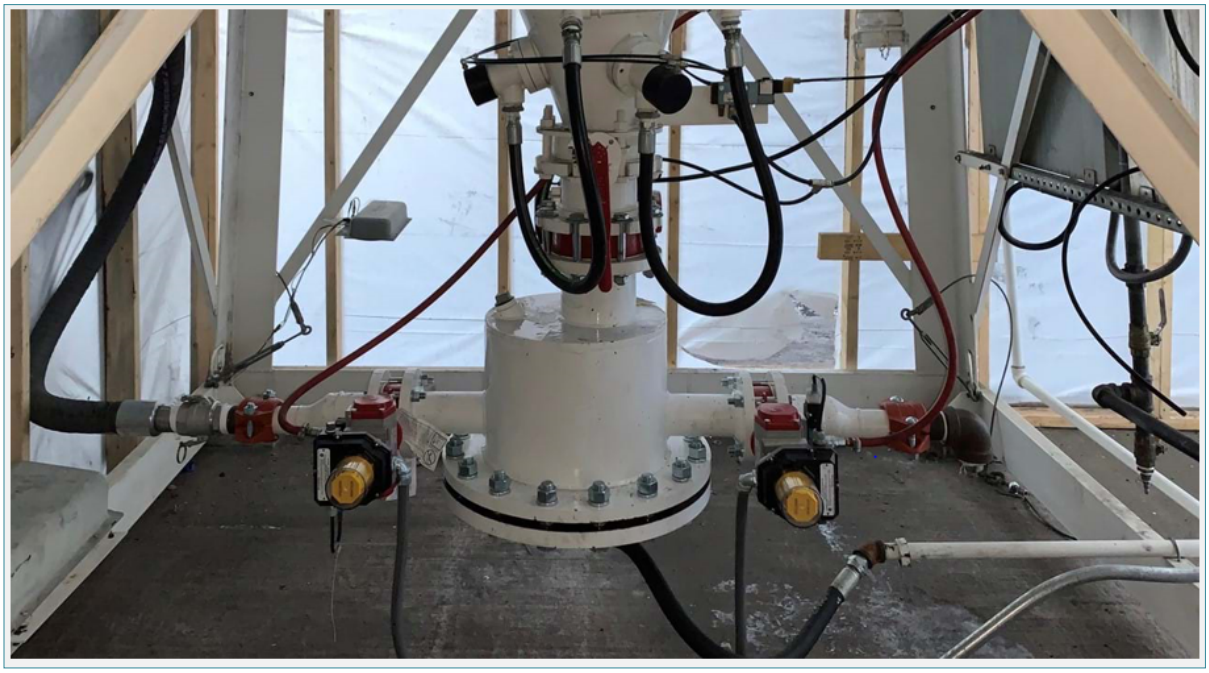


Graphic 1 – Boiler Diagram

Combustion controls include an oxygen trim system (though it does not operate as conventional oxygen trim due to the nature of the fuels). The ESP is also monitored to ensure it operates properly. The boiler has a CO CEMS and opacity COMS and monitors these parameters continuously. The sodium-based sorbents used in the DSI improve flyash resistivity and ESP performance. Under PTI 128-18, LWEC must monitor emissions or operation of the DSI system when burning pellets to ensure compliance with HCl emission limits. This Monitoring Plan includes information regarding the LWEC HCl DSI reagent monitoring system which can be used to demonstrate compliance with emission limits and proper operation of the DSI system. LWEC has also pledged that, in the event of emissions or operating parameter monitoring system issues, the facility will return to its traditional fuel blend for which it has verified compliance with HCl emission limits on a number of occasions. The testing that forms the basis for the DSI reagent injection system is included in Table 3 with additional information included in Tables 4 and 5. These tables include emissions information, DSI Injection rates during testing and the types and amounts of each fuel burned. This forms the basis of the Plan. This Monitoring Plan will reference parameters that are monitored as well as acceptable ranges for those parameters.

3.2 Reagent System Description

As described in Section 2.1, a DSI system has been added as emission control technology when combusting pellets to further reduce SO_2 and HCl emissions. The DSI system that has been installed at LWEC consists of the *live bottom system*, which allows the direct injection of Trona from super sacks into the flue gas before the ESP. The system was designed specifically for LWEC by Nol-Tec Systems (Nol-Tec) and a fair amount of testing and boiler modeling was performed to ensure that the injection system could be designed and operated properly.



Graphic 2 – DSI Reagent Injection System Piping

Trona is delivered to the live bottom system when the super sack is placed over the receiver with the discharge spout holed to the delivery system. Trona is emptied from the super sack by vibrating the gyrator over the bin which includes screw feeders. The speed of the screw feeders determines the delivery rate. Use of the live bottom allows material to be fed across the entire inlet area.

The DSI system is *a pneumatic conveying system which transports material from the discharge of the loss-in-weigh feeders to the duct*. The DSI Reagent Injection System includes the following components:

- Bulk Bag Unloader System. The bulk bag unloader system is designed to unload sorbent bags and dispense sorbent into the feeder. The bag is agitated to allow material to flow smoothly. The Unloader has systems to ensure that when a bag is emptied, another bag is placed in service. This includes the use of two hoppers to fill the system which are directly below the super sack, as well as alarms described in Section 4.
- Feed System. Bulk bags are emptied into the Feed System below it from one discharge point. The feeder feeds material through the air lock at a controlled rate into the conveyor line . The system includes a scale programmed to drop material onto the conveyor at the required rate and a feeder that controls the conveyor speed to ensure the proper sorbent feed rate into the system. This system generally adjusts the sorbent feed based on pellet feed rate; however, its mode of operation can be changed to allow a volumetric feed rate (a specific volume instead of weight of feed or simply operated in a manual mode at a fixed speed.
- Sorbent Conveying System. This system is comprised of blowers which convey sorbent from the feeder to the duct injection location. Injection blowers use compressed air as the motive force to deliver sorbent from the bulk bag unloader. The injection temperature and pressure are monitored (as described in Section 4.3) to ensure proper operation.

4.0 Monitoring Control System Performance

The performance of this system depends on:

- Flue gas characteristics, such as composition, temperature, and humidity.
- Reagent used as sorbent.
- Dispersion of the sorbent through the flue gas and location of the injection.

The facility's current ROP requires a Fuel Procurement and Management Plan and includes detailed information regarding fuel sampling and analysis. Fuel specifications are also clearly outlined in the Plan and are designed to ensure compliance with HCl and other emission limits. Use of the traditional fuels originally permitted at LWEC does not require use of the DSI system to meet HCl emission limits; should issues arise with the DSI system, LWEC could return to its original fuel mix to maintain compliance with its emission limits. Conformance with the sulfur and chlorine ranges identified as normal for the fuel will ensure proper operation of the DSI system.

The Trona S200 product, an unmilled Trona with a dp< 35 μm, is a lower grade Trona product and was used in all the testing conducted at LWEC. It has an established track record for reducing acid gas emissions and has proven effective in reducing acid gas emissions in several tests at LWEC. As long as a Trona product is in use, the system should operate as designed. LWEC has a long-term contract with Solvay to provide Trona. A Safety Data Sheet for Trona is provided in Appendix 1.

Some difficulties were identified with the temporary system during the testing performed in December 2017. These issues, mostly associated with shielding the system from changes in the weather, have been addressed with the new permanent system, which is largely enclosed.

Trona reacts readily above 285°F and must be injected at a point in the duct work where the temperature is always above 285°F while the boiler is burning fuel. In addition, if the temperature is above 1500°F, the Trona will sinter and will not react with acid gases. Nol-tec designed the system and selected an injection point at which the temperature is approximately 500°F.

4.1 DSI Injection Rate Development

LWEC utilized a consultant/equipment supplier, Nol-Tec, and worked with the Trona manufacturer/ supplier, Solvay, to design both the DSI System and the Test Burn Program. The Test Burn Program, which was permitted by EGLE under PTIs 53-17 and 53-17A, produced the emission data summarized in Table 2. Emission factors for HCl were developed in Table 3. Information collected during the Test Burn Program was then used to develop PTI 128-18. LWEC performed extensive pre-permit work, including input and discussions with EGLE, to calculate the HCl emissions from the pre-control fuel mix at different levels of pellet use (from 0 tph up to 6 tph) and corresponding DSI injection rates. Table 2 provides HCl and SO_2 emissions from the traditional fuel mix without use of the DSI reagent, as well as stack testing while burning pellets. Emissions during testing were reduced by an average of 67% of SO_2 and 86% of HCl as demonstrated in Table 4. Higher levels of wood or cross-tie derived fuel in the mix provide more scrubbing to the boiler exhaust and the higher acid gas removal that will occur.

The CMS monitors operating parameters as described in Section 4 (i.e., factors affecting the air pollution control device performance) which affect operation of the control system and can provide feedback regarding emissions compliance. LWEC monitors reagent injection rate coupled with the pellet feed rate to ensure compliance with its HCl emission limit. Stack test data has been used to develop an injection curve correlating HCl emissions to reagent injection rate (pounds of sorbent reagent injection per hour) at a particular pellet usage (feed rate in tons per hour); Figure 1 graphically presents an established reagent injection curve and indicates the relationship between the quantity of pellets burned in the boiler and the amount of reagent needed to adequately control acid gas emissions. If necessary, this curve will be updated based on additional stack testing information collected during the normal periodic stack testing required under the permit. Table 2 includes stack test data used to develop the curve. Alternatively, the boiler could be programmed for a default reagent injection rate, in instances

where information from the CMS is unavailable, that default rate could be used to ensure that emissions are adequately controlled. Figure 1 demonstrates that a default reagent injection rate of 250 lb/hr can be used for pellet maximum usage rate of 6.0 tph.

4.2 DSI System Operation

An injection rate curve has been established, based on stack testing, which can be used to estimate emissions as well as to demonstrate compliance. Figure 1 provides the DSI injection curve developed through stack testing. The curve indicates that, as pellet use increases from 0 tph to 6 tph (the permit limit), Trona use must increase from 0 to 256 lb/hr as indicated on Figure 1. The curve is designed to ensure that emissions are at or below 1.7 lb/hr HCL for each hour in which the reagent injection rate meets or exceeds the required reagent injection rate on Figure 1, which corresponds to the pellet burn rate. The target 1.7 lb/hr HCl was set to provide a satisfactory margin below the average annual emission rate of 2.17 lb/hr and to keep HCl emissions under the 9.5 tpy limit specified in the permit at the maximum usage rates. A stack testing summary is included in Table 2 and demonstrates compliance with the emission limit at all expected monitoring conditions.

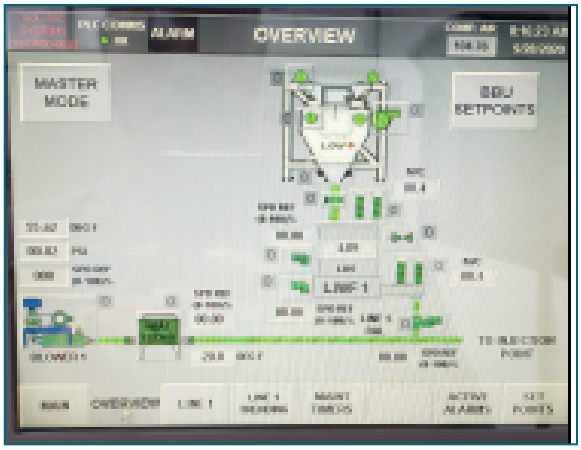
These tables demonstrate that emissions will be comfortably low enough that continued operation at that rate will ensure continued compliance with the 9.5 tpy HCl limit when reagent is injected at the recommended rates as illustrated on Figure 1. Deviation from the required daily injection rate requires corrective action. Any deviation from the required daily injection rate will result in an excursion that must be reported under the Compliance Assurance Monitoring Plan. The DSI system is programmed to keep DSI injection rates at levels which comply with these emissions. Alarms will be activated when parameters are outside of applicable ranges discussed in this Plan, which will trigger the following corrective actions:

1. Changing the fuel mix to reduce HCl content (reducing pellets)
2. Increasing the injection rate to reduce HCl
3. Removing pellets from the blend and returning to the TDF/wood/railroad ties fuel blend

Table 5 includes a summary of the primary operating parameters that are monitored by the DSI system.

4.3 Monitoring System Operation

The relationship between pellet burn rate and reagent injection rate depicted on Figure 1 has been introduced into the DSI monitoring system logic. Information used in developing Figure 1 is summarized in Table 5.It has been programmed to inject the required reagent as a function of pellet burn rate. It will alarm if the target injection rate cannot be met. .A default reagent injection rate can be selected and, in instances where information from the CMS is unavailable, that default rate could be used to ensure that emissions are adequately controlled. Currently, a default reagent injection rate of 250 lb/hr will allow compliance at pellet usage up to 6 tph.



Graphic 3 - DSI Overview Screen

There are also other safeguards in place to ensure that the required sorbent injection rate can be maintained. To ensure proper operation of the DSI System, the following parameters are monitored:

- Blower speed – displays blower speed in % form (0-100% - depends on required feed rate)
- Blower temperature – displays the blower temperature (above 25°F)
- Blower pressure – displays the pressure of the blower from the line (if the pressure is too high there, it could indicate the line is clogged) (below 10 psi)

- Conveyor line temperature – displays temperature of the conveyor line and is used to prevent product from going down a cold condensed line (above 25°F)
- Dust filter differential pressure – displays the pressure of dust filters in inches water column and may indicate whether the Bulk Bag Unloader or scales have built up pressure (automatically runs a cleaning cycle if the pressure is too high and cleaning cycle is indicated on the screen)
- Bulk bag unloader low level – display tells us that the bulk bag unloader is low or sorbent is not draining into the hopper (displays a red "low" sign if low)

Should problems occur with the system, an alarm will be triggered. These alarms are leading indicators that, if system performance is not improved, the DSI injection rate will likely fall below the required rate referenced on Figure 1. It should be noted that most of these secondary alarms simply provide information. For example, LWEC uses one or two Trona Super Sacks per day. Before a bag is changed, an alarm will be received indicating one of the hoppers is low; that alarm will automatically clear when a new bag is placed in service. When the system is changing between bags, it may use the *volumetric mode*, in which Trona is fed to the system based on a volume of material instead of weight. This is temporary, though the system may register alarms until it returns to normal operation. During system maintenance, the feeder system can be operated in manual mode by the operator and several alarms may register until the system returns to normal operations; this is simply to remind the operator that the system is in *manual operation mode*. None of these should be considered permit deviations as they do not interfere with the system's ability to feed the required reagent to the system.

5.0 Monitoring System Inspection, Maintenance, and Corrective Actions

LWEC has a comprehensive maintenance program, including equipment inspections and scheduled maintenance. Additional information is included in its approved *Preventive Maintenance/Malfunction Abatement Plan* (PM/MAP). Work required as part of the PM/MAP is based on a system of inspections and corrective actions. Work described in the PM/MAP is performed primarily by LWEC plant personnel; however, outside contractors may also be utilized onsite as deemed necessary. In addition to monitoring pellet burn rate and reagent injection rate, secondary operating parameters – which are leading indicators of system performance – are also monitored by the operators. Because the system is relatively new, changes to the secondary alarm systems may be needed once the system has been operational for a while.

5.1 Daily Monitoring

Information regarding the current pellet feed rate (in tons per hour) and reagent injection rate (in pounds per hour) will be electronically available to operators. The system is designed to meet the reagent injection rate corresponding to the current level of pellets burned in the boiler which is summarized on Figure 1

An alarm will occur when the actual DSI injection rate drops below the reagent injection rate setpoint. The DSI injection rate setpoint is determined from the pellet feed rate to required DSI injection rate as shown on the curve on Figure 1. Reagent injection rate is continuously monitored for recording once per hour to determine a daily average lb/hr. Operators will also conduct a physical inspection of the pellet feed system, hoppers, and DSI injection system at least once per day. *Exception only* reporting will be used. Deviations will be noted in a log book as well as corrective actions needed. While operators record information on log sheets every hour as they perform their daily rounds, LWEC will only rely on these written records in the unlikely event that the computer system associated with the monitoring system fails. Operators also monitor secondary operating parameters and respond to alarms associated with these parameters as discussed in Section 4.0.

5.2 Annual Maintenance

Outages of the boiler take place at least annually. During that time, preventive maintenance is performed on the boiler as well as on all the auxiliary systems. LWEC already operates material handling equipment associated with FG FUEL; similar maintenance activities will be performed on the DSI system. Additional detail is included in the PM/MAP as well as in the Advanced Maintenance Management System (AMMS), the LWEC electronic maintenance database.

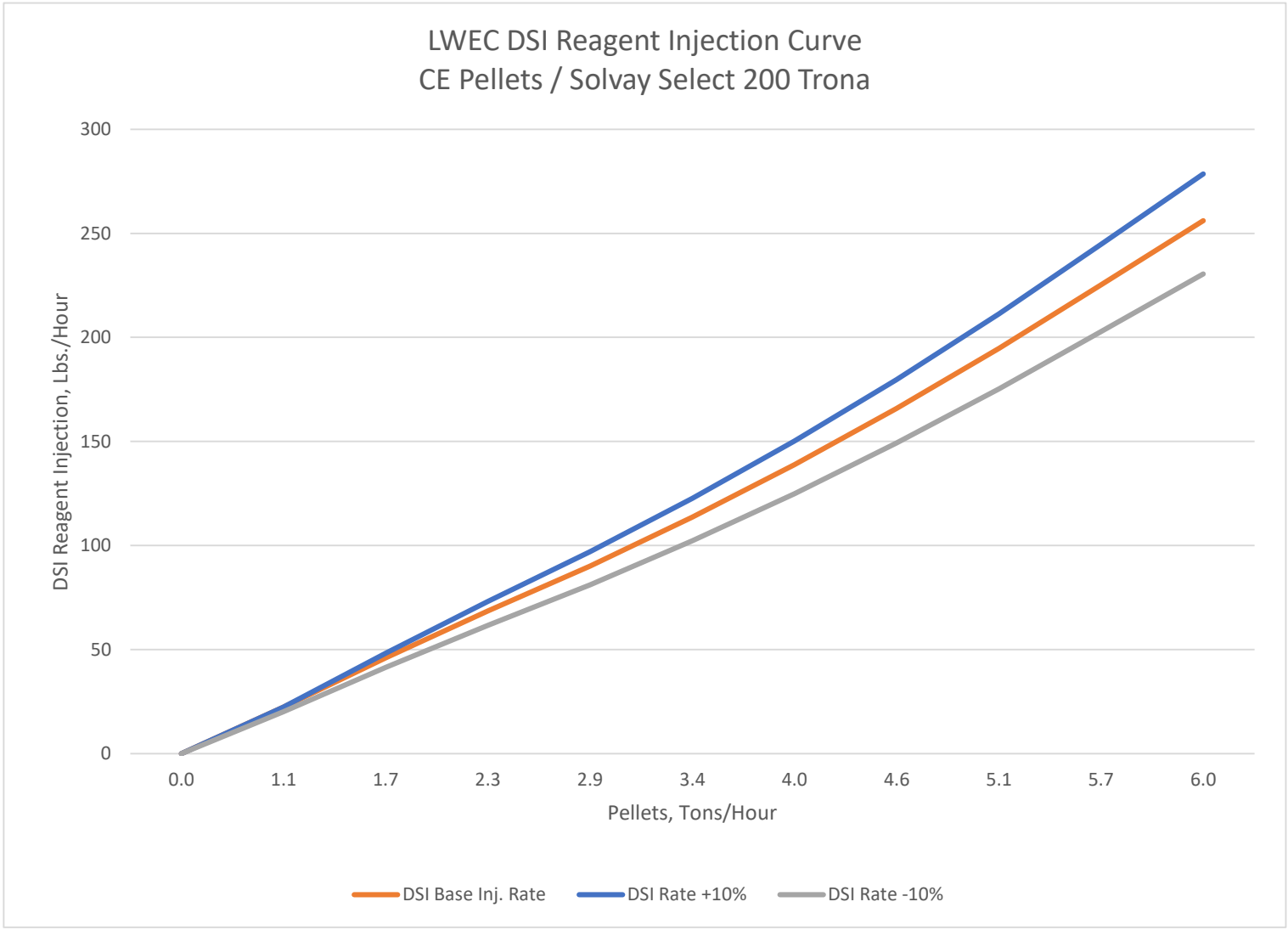
5.3 Corrective Actions

LWEC operators will monitor reagent injection rate as well as pellet consumption in the boiler. Issues identified by the monitoring system must be addressed to ensure HCl emissions are below permit levels. A summary of the most important potential alarms and the expected response is included in Table 7.

5.4 Emissions Monitoring

Emissions will be calculated on a monthly basis to develop 12-month rolling totals using data available from the CMS. Using the reagent injection system, HCl emissions of 0.006 lb/MMBtu will be recorded for each hour the system demonstrates conformance with the average daily lb/hr injection rate on Figure 1. Data from the DSI System will be maintained at the site. Data demonstrating a correlation between the reagent injection rate and HCl emissions is presented on Figure 1. Data used to develop this curve is provided in Table 3. Monthly emissions are calculated by multiplying monthly heat input by the 00.6 lb/MMBtu emission factor. Monthly and 12-month rolling total HCl emissions will be calculated.

Figures


LWEC DSI Reagent Injection Curve
CE Pellets / Solvay Select 200 Trona
DSI Reagent Injection, Lbs./Hour
300
250
200
150
100
50
0
0.0
1.1
1.7
2.3
2.9
3.4
4.0
4.6
5.1
5.7
6.0
Pellets, Tons/Hour
DSI Base Inj. Rate
DSI Rate +10%
DSI Rate -10%

Tables

Table 1 - Summary of Pollutant Concentrations in Fuel (as Received)
CMS Plan Support
L'Anse Warden Electric Company, L'Anse, Michigan

Sample Month	Cross-tie Derived Fuel (CDF)						Woodchips						Fuel Pellets							Tire-derived Fuel (TDF)				
	Chlorine		Moisture	Ash	Sulfur	Calorific Value	Chlorine		Moisture	Ash	Sulfur	Calorific Value	Fluorine	Chlorine	Moisture	Ash	Sulfur	Calorific Value	lorine (rec'd)		Moisture	Ash	Sulfur	Calorific Value
	%	mg/kg	%	%	%	Btu/lb	%	mg/kg	%	%	%	Btu/lb	mg/kg	mg/kg	%	%	%	Btu/lb	%	mg/kg	%	%	%	Btu/lb
January-18	0.006%	62	19.98%	14.90%	0.27%	6733	0.006%	63	40.95%	14.90%	0.22%	6733		963	2.89%	5.77%	0.002%	11,780	0.001	950	0.01	7.34%	1.49%	15,802
February-18	0.013%	130	16.90%	1.06%	0.20%	7445	0.003%	29	32.09%	1.06%	0.17%	7445	5	433	2.62%	5.93%	0.177%	11,764	0.000	453	0.01	4.51%	1.78%	16,190
March-18	0.007%	73	29.42%	1.43%	0.07%	6250	0.003%	32	49.28%	1.43%	0.05%	6250		1285	2.30%	6.47%	0.284%	12,078	0.001	884	0.04	5.29%	1.54%	16,307
April-18	0.007%	74	15.61%	0.68%	0.13%	7709	0.002%	24	35.36%	0.68%	0.11%	7709		1282	2.82%	5.98%	0.220%	11,427	0.001	574	0.01	4.98%	1.90%	16,259
May-18	0.012%	122	27.06%	2.63%	0.24%	6730	0.002%	20	50.37%	2.63%	0.18%	6730	51	1355	2.86%	6.75%	0.164%	10,927	0.001	601	0.01	5.23%	1.79%	16,060
June-18	0.012%	119	33.70%	5.30%	0.31%	5868	0.002%	21	42.40%	5.30%	0.21%	5868		771	3.49%	6.00%	0.262%	11,269	0.000	497	0.02	7.40%	1.54%	15,402
July-18	0.010%	102	26.41%	8.42%	0.22%	6431	0.002%	23	41.57%	8.42%	0.16%	6431		1712	4.00%	6.13%	0.193%	10,595	0.000	441	0.02	7.00%	1.88%	15,653
August-18	0.006%	56	16.10%	3.28%	0.13%	7602	0.002%	22	49.41%	3.28%	0.11%	7602	5	740	3.56%	7.01%	0.162%	11,424	0.001	551	0.03	6.70%	1.32%	15,477
September-18	0.004%	40	25.17%	9.29%	0.23%	6683	0.002%	22	43.84%	9.29%	0.17%	6683		864	3.70%	7.72%	0.188%	10,775	0.001	504	0.02	6.38%	1.48%	15,737
October-18	0.004%	44	26.34%	3.73%	0.14%	6646	0.003%	27	41.94%	3.73%	0.10%	6646		1518	3.92%	6.88%	0.275%	10,915	0.000	430	0.03	6.67%	1.70%	15,486
November-18	0.019%	188	25.24%	4.61%	0.15%	6847	0.002%	23	40.31%	4.61%	0.11%	6847	5	1265	3.42%	6.73%	0.078%	10,880	0.001	709	0.01	5.96%	1.63%	16,074
December-18	0.004%	40	22.87%	3.66%	0.26%	7435	0.003%	27	38.67%	3.66%	0.20%	7435		1284	2.94%	6.45%	0.067%	11,083	0.000	448	0.06	5.66%	1.67%	15,332
January-19	0.005%	51	31.00%	4.42%	0.17%	5942	0.002%	20	43.97%	4.42%	0.12%	5942		715	3.28%	6.08%	0.135%	10,994	0.000	464	0.06	6.70%	1.84%	14,908
February-19	0.010%	98	27.66%	6.72%	0.18%	6746	0.002%	23	42.17%	6.72%	0.13%	6746	5	917	3.10%	8.61%	0.244%	10,052	0.001	501	0.02	5.77%	1.65%	15,842
March-19	0.004%	38	22.15%	3.51%	0.16%	6871	0.003%	33	30.76%	3.51%	0.12%	6871		809	3.37%	6.70%	0.79%	10,916	0.000	463	0.01	6.79%	1.46%	15,909
April-19	0.009%	95	18.89%	9.73%	0.15%	6943	0.002%	25	46.39%	9.73%	0.12%	6943		794	3.52%	6.50%	0.17%	10,447	0.000	434	0.01	5.77%	1.87%	16,326
May-19	0.007%	67	32.13%	9.85%	0.13%	5173	0.002%	23	46.82%	9.85%	0.09%	5173	5	586	3.41%	6.75%	0.26%	10,801	0.000	388	0.00	5.70%	2.42%	16,035
June-19	0.013%	134	20.81%	3.91%	0.13%	7076	0.003%	27	28.25%	3.91%	0.10%	7076		911	3.39%	7.36%	0.20%	11,107	0.000	491	0.01	6.24%	1.68%	16,240
July-19	0.004%	37	33.04%	4.35%	0.24%	6014	0.003%	32	29.14%	4.35%	0.16%	6014		908	4.06%	7.09%	0.26%	11,140	0.000	452	0.02	7.58%	1.42%	15,726
Average	0.008%	83	24.76%	5.34%	0.18%	6692	0.003%	27	40.72%	5.34%	0.14%	6692	13	1006	3.30%	6.68%	0.22%	11,072	0.001	539	0.02	6.19%	1.69%	15,830
90th Percentile	0.013%	130	0.32	9.76%	0.26%	7476	0.003%	32	49.31%	9.76%	0.20%	7476	28	1388	3.94%	7.43%	0.28%	11,767	0.074%	744	4.14%	7.35%	1.89%	16,269
Maximum	0.019%	188	0.34	14.90%	0.31%	7709	0.006%	63	50.37%	14.90%	0.22%	7709	51	1712	4.06%	8.61%	0.79%	12,078	0.095%	950	6.34%	7.58%	2.42%	16,326
Minimum	0.004%	37	0.16	0.68%	0.07%	5173	0.002%	20	28.25%	0.68%	0.05%	5173	5	433	2.30%	5.77%	0.00%	10,052	0.039%	388	0.31%	4.51%	1.32%	14,908

Table 2 Summary of Stack Test Data (2009-2018)
CMS Plan Support
L'Anse Warden Electric Company, L'Anse, Michigan

Pollutant	Units	Effective Emission Limit Limit	April, 2009	July 2016	December 2016	March 2017	June 2017	October 2017	December 2017		June 2018	June 2018	
Arsenic				$\leq 1.36 \times 10^{-4}$					2.40×10^{-4}	2.32×10^{-4}		$\leq 1.49 \times 10^{-4}$	$\leq 1.23 \times 10^{-4}$
Chlorine (Cl_2)	lb/hr			<0.26					NA	NA			
Cresol Isomers	lb/hr	0.34 lb/hr		$< 8.12 \times 10^{-4}$									
Hydrogen Chloride (HCl)	lb/hr	2.17 lb/hr		1.75	1.5	1.67	1.73	1.16	1.07	1.33	1.65	1.29	1.35
Lead	lb/hr	0.02 lb/hr		1.10×10^{-3}					1.36×10^{-3}	1.11×10^{-3}		1.84×10^{-3}	1.02×10^{-3}
Manganese	lb/hr			2.42×10^{-3}					9.44×10^{-3}	4.43×10^{-3}		8.50×10^{-3}	2.80×10^{-3}
Nickel	lb/hr			7.60×10^{-4}					1.63×10^{-4}	2.24×10^{-4}		5.27×10^{-4}	5.66×10^{-4}
Nitrogen Oxides (NOx)	lb/hr	145 lb/hr	53						70.5	71.7		66.2	64.7
Opacity	%	20% (6 minute average)		0	1.4	2.74	2.67	1.29	0.93	1.03	0.98	1.65	1.41
Particulate Matter (PM)	lb/hr	19.2 lb/hr	9.8	1.3					1.38	2.78		1.59	0.78
Particulate Matter (PM)	lb/mmbtu	0.06 lb/mmbtu		0.004					0.005	0.01		0.006	0.003
Particulate Matter < 10 mm (PM_{10})	lb/hr	15.4 lb/hr	3.6	7.2					4.51	4.13		3.11	2.88
Particulate Matter < 10 mm (PM_{10})	lb/mmbtu	NA		0.026					0.017	0.014		0.011	0.010
Particulate Matter < 2.5 mm ($PM_{2.5}$)	lb/hr	NA		6.3									
Particulate Matter < 2.5 mm ($PM_{2.5}$)	lb/mmbtu	NA		0.023									
Sulfur Dioxide (SO_2)	lb/hr	290 lb/hr	87.2						6.3	10		7.6	7.1
2,3,7,8 - TCDD Toxic Equivalent	mg/dscm @ 7% O_2			6.59×10^{-6}									
2,3,7,8 - TCDD Toxic Equivalent	lb/hr			1.75×10^{-9}									
Volatile Organic Compounds (VOC)	ppm @ 7% O_2 (as methane)	50 ppm @ 7% O_2	6.3	< 0.12									
Volatile Organic Compounds (VOC)	lb/hr (as methane)	9.1 lb/hr	1.01	< 0.02									
Carbon Monoxide	lb/hr	97.2 lb/hr											
Carbon Monoxide	lb/MMBtu	0.3 lb/mmbtu		0.119	0.108	0.117	0.088	0.119	0.134	0.076	0.174	0.055	0.064
Bark	tph												
Engineered Fuel Pellets	tph								2.2	2.9		6	5.1
Railroad ties (RR ties)	tph	20.1		15.3	13	14.6	12.7	11.9	7.4	6.7	8.2	5.6	6.3
Tire-derived Fuel (TDF)	tph	4.0		0.9	1.5	1.5	1.52	1.5			0.9		
Wood chips	tph			8.5	9	8.9	6.4	8.6	14.5	13.4	13.7	7.2	8
Comments			Wood Chips	USEPA Section 114 Request	TDF, RR ties and Wood chips	TDF, RR ties and Wood chips	TDF, RR ties and Wood chips	TDF, RR ties and Wood chips	Pellets (9.1%), Wood chips and RR ties	Pellets (12.4%), Wood chips and RR ties	TDF, RR ties and Wood Chips	Pellets (31.9%), RR ties, and Wood chips	Pellets (26.4%), RR ties, and Wood chips

"Effective Emission Limit" indicates that the averaging time or format of the limit listed in the permit is different and a calculation to determine hourly emissions was completed.
- indicates that the emissions information was removed
* At this time, mill sludge was permitted and this test included 5.95 tph mill sludge. Mill sludge is no longer part of the fuel mix at LWEC.
CO and opacity data is available from continuous monitoring data at the facility - though this information was not always included in the report.

Table 3 - Development of the HCl Emission Factor

CMS Plan Support

L'Anse Warden Electric Company, L'Anse, Michigan

Test Date	Fuel information	% O_2	HCl Emissions				F Factor
			ppm	lb/dscf	lb/hr	lb/MMBtu	
19-Jun-18	No pellets	8.5	4.27	0.000000404	1.65	0.006	9561
20-Jun-18	6 tpy	6.5	3.64	0.000000345	1.29	0.005	9561
21-Jun-18	5.1	6.6	3.71	0.000000351	1.35	0.005	9561
18-Dec-17	2.2	7.1	2.67	0.000000253	1.07	0.004	9561
19-Dec-17	2.85	7.4	3.36	0.000000318	1.33	0.005	9561

Using Method 19 to calculate HCl (lb/mmbtu)

E (lb/mmbtu) = Cd (ppm) x 9.43 x 10-8 x 9561 (F factor) x ((20.9/20.9-O_2))

Table 4 - Calculation of DSI Rate using the Normalized Stoichiometric Ratio (6 tph Pellets)
CMS Plan Support
L'Anse Warden Electric Company, L'Anse, Michigan

Acid Gas	Pollutant Concentrations	Units	Fuel Rate (tph)	Uncontrolled Emission Rate (lb/hr)	Uncontrolled Emissions After Wood Ash (lb/hr)	Emissions to be Controlled (lb/hr)	Select 200 Trona Required (lb/lb pollutant)	Normalized Stoichiometric Ratio	Trona Required (lb/hr)
Wood Chips (7.2 tph)									
Sulfur Dioxide (SO_2)	0.14%	%	7.2	39.81	15.92	23.89	2.41	1	57.57
Hydrochloric Acid (HCl)	37	ppm	7.2	0.548	0.16	0.38	2.11	1	0.81
									58.38
Cross-tie Derived Fuel (5.6 tph)									
Sulfur Dioxide (SO_2)	0.18%	%	5.6	41.38	16.55	24.83	2.41	1	59.84
Hydrochloric Acid (HCl)	143	ppm	5.6	1.651	0.50	1.16	2.11	1	2.44
									62.28
Fuel Pellets (6 tph)									
Sulfur Dioxide (SO_2)	0.22%	%	6	52.03	20.81	31.22	2.41	1	75.23
Hydrochloric Acid (HCl)	806	ppm	6	9.952	2.99	6.97	2.11	1	14.70
									89.93

SO_2 (lb/hr) - uncontrolled	133.22	SO_2 (lb/hr) - controlled	7.6	**Total % Control**	**94% SO_2**
HCl (lb/hr) - uncontrolled	12.15	HCl (lb/hr) - controlled	1.29		**89% HCl**
% control from the alkalinity of the wood ash:		40% SO_2		Target (lb/hr)	1.8
% control from the alkalinity of the wood ash:		30% HCl			
				Trona required:	210.6 lb/hr
				Chart recommends:	256 lb/hr

* No information on S was collected during the fuel analysis - average data was used.
Figure 1 shows that 6 tph pellets should result in 256 lb/hr reagent injection rate.
Emissions (lb/hr) = (Concentration %) x fuel usage rate (tons/hr) x conversion rate (64/32 for SO_2) x 2000 lb/ton

Table 5 Monitoring System Summary
CMS Plan Support
L'Anse Warden Electric Company, L'Anse, Michigan

	Reagent Injection Rate	Reagent Injection Rate	Pellets Burned
	Variable	Default	
Operating Parameter	Displays lb/hr reagent	Displays lb/hr reagent	Displays pellets burned (tph)
Relationship to Emissions	Testing indicates that maintaining an injection rate matching the injection rate on Figure 1 at any particular pellet combustion rate will ensure compliance. A curve has been established demonstrating injection rates for different pellet rates.	If pellets are burned, reagent injection rate must be more than 250 lb/hr if monitoring problems are encountered. This can be tracked manually.	No pellets can be burned if no reagent is being injected.

Table 6 - Supporting Data for Figure 1

CMS Plan Support

L'Anse Warden Electric Company, L'Anse, Michigan

Pellet Bin Variable Speed Auger Setting %	Pellets, Tons/Hour	Target DSI Reagent Injection, Lbs./Hour	Lbs Reagent/Ton of Pellets	Curve Factor to account for loss of wood ash	Actual DSI Injection Rate, Lbs./Hr.	To lower injection (target rate = 1.7 lbs/hr HCl	Use this one for Permit Rounded off to 0.9	10%	-10%
0	0.00	0	0	0	0	0	0	0	0
10	1.14	38	21.694	0.65	25	22	22	22	20
15	1.71	57	29.862	0.85	51	45	46	48	41
20	2.28	76	33.375	0.950	76	67	68	73	62
25	2.85	100	35.132	1.000	100	88	90	97	81
30	3.42	126	36.888	1.050	126	111	114	123	102
35	3.99	154	38.645	1.100	154	136	139	150	125
40	4.56	184	40.401	1.150	184	163	166	180	149
45	5.13	216	42.158	1.200	216	191	195	211	175
50	5.70	250	43.914	1.250	250	221	225	245	203
53	6.00	285	47.428	1.350	285	251	256	279	230

		Adj. Stack test data target	Rounded off
Note:	*Added numbers below dial setting 20 and 2.28 tph pellets to complete graph*	0.8824	0.9000

Avg. StackTest Data
1.5 lbs/hr HCl

Target
1.7 lbs/hr. HCl

Table 7 - DSI Troubleshooting

CMS Plan Support - DSI Troubleshooting

L'Anse Warden Electric Company, L'Anse, Michigan

Circumstances	Probable Cause	Corrective Action
Reagent injection rate too low (below set point)	Inadequate reagent injection to exhaust gas stream (verified – not just a computer problem)	Check reagent feed system and weight system to confirm reagent feed rate; reset flow rate if necessary.
		Check reagent injection feed system operation nozzles for blockage and/or corrosion. Clean, replace, or perform maintenance as necessary
Excessive reagent consumption – this will not affect emissions	Malfunctioning reagent feed system	Check reagent feed system and weight system to confirm reagent feed rate; reset feed rate if necessary
	Leak in reagent piping system	Check reagent piping for leakage; repair or replace if necessary
Low reagent consumption (same as #1 above)	Malfunctioning reagent feed pump	Check reagent feed pump and flow meter to confirm flow rate; reset flow rate if necessary
	Blockage in reagent piping system	Check for obstructions in piping; repair or replace if necessary
Monitoring system is not properly recording the injection rate or pellet burn rate	Computer problem	Information is recorded electronically. The system is programmed to maintain the required reagent injection rate. In the event of a recording system failure, the injection rate can be recorded manually.

Appendix

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

- Trade name SOLVAIR® S200 TRONA

1.2 Relevant identified uses of the substance or mixture and uses advised against

Uses of the Substance / Mixture

- Purifying flue gas

1.3 Details of the supplier of the safety data sheet

Company

SOLVAY CHEMICALS, INC.
3737 Buffalo Speedway,
Suite 800,
Houston, TX 77098
USA
Tel: +1-800-7658292; +1-713-5256800
Fax: +1-713-5257804

1.4 Emergency telephone

FOR EMERGENCIES INVOLVING A SPILL, LEAK, FIRE, EXPOSURE OR ACCIDENT, CONTACT CHEMTREC (24-Hour Number): 800-424-9300 within the United States and Canada, or 703-527-3887 for international collect calls.

SECTION 2: Hazards identification

Although WHMIS has not adopted the environmental portion of the GHS regulations, this document may include information on environmental effects

2.1 Classification of the substance or mixture

Hazardous Products Regulations (WHMIS 2015)

Eye irritation, Category 2A H319: Causes serious eye irritation.

2.2 Label elements

Hazardous Products Regulations (WHMIS 2015)

Pictogram

Signal Word

- Warning

Hazard Statements

- H319 Causes serious eye irritation.

Precautionary Statements

Prevention

- P264 Wash skin thoroughly after handling.
- P280 Wear eye protection/ face protection.

Response

- P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- P337 + P313 If eye irritation persists: Get medical advice/ attention.

2.3 Other hazards which do not result in classification

- H402: Harmful to aquatic life.

- Main symptoms
- irritant effects

SECTION 3: Composition/information on ingredients

3.1 Substance

- Not applicable, this product is a mixture.

3.2 Mixture

WHMIS Hazardous Ingredients and Impurities

Chemical name	Identification number CAS-No.	Concentration [% wt/wt or V/V]
Carbonic acid, sodium salt (2:3)	533-96-0	>= 95 - < 99

SECTION 4: First aid measures

4.1 Description of first-aid measures

In case of inhalation

- Move to fresh air.
- If symptoms persist, call a physician.

In case of skin contact

- Wash off with soap and water.
- If symptoms persist, call a physician.
- Remove and wash contaminated clothing before re-use.

In case of eye contact

- If eye irritation persists, consult a specialist.

- In case of eye contact, remove contact lens and rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.

In case of ingestion

- If symptoms persist, call a physician or Poison Control Center immediately.

- If victim is conscious:
- Do NOT induce vomiting.

- If victim is conscious:

- Rinse mouth with water.

- If victim is unconscious:
- Not applicable

4.2 Most important symptoms and effects, both acute and delayed

In case of inhalation

Effects
- May cause nose, throat, and lung irritation.

Repeated or prolonged exposure

- Risk of sore throat, nose bleeds

In case of skin contact

Effects
- Prolonged skin contact may cause skin irritation.

In case of eye contact

Symptoms
- Lachrymation
- Redness

Effects
- Severe eye irritation

In case of ingestion

Effects
- Irritation of the mouth and throat.
- Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.

4.3 Indication of any immediate medical attention and special treatment needed

- no data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

- Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media

- None.

5.2 Special hazards arising from the substance or mixture

Specific hazards during fire fighting

- Not combustible.

Hazardous combustion products:

- none

5.3 Advice for firefighters

Special protective equipment for fire-fighters

- No special precautions required.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Advice for non-emergency personnel

- Avoid dust formation.

Advice for emergency responders

- Sweep up to prevent slipping hazard.

6.2 Environmental precautions

- Prevent any mixture with an acid into the sewer/drain (gas formations).
- Do not flush into surface water or sanitary sewer system.

6.3 Methods and materials for containment and cleaning up

- Sweep up and shovel into suitable containers for disposal.
- Keep in properly labeled containers.
- Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

- no data available

SECTION 7: Handling and storage

7.1 Precautions for safe handling

- Keep away from incompatible products
- Ensure adequate ventilation.

Hygiene measures

- Eye wash bottles or eye wash stations in compliance with applicable standards.
- When using do not eat or drink.
- When using do not smoke.
- Wash hands before breaks and at the end of workday.
- Handle in accordance with good industrial hygiene and safety practice.

7.2 Conditions for safe storage, including any incompatibilities

Technical measures/Storage conditions

- Keep in a dry place.

- Store in original container.
- Keep in properly labeled containers.
- Keep container closed.
- Keep away from incompatible products

Packaging material

Suitable material
- Paper + PE coating.

7.3 Specific end use(s)

- no data available

SECTION 8: Exposure controls/personal protection

Introductory Remarks: These recommendations provide general guidance for handling this product. Because specific work environments and material handling practices vary, safety procedures should be developed for each intended application. Assistance with selection, use and maintenance of worker protection equipment is generally available from equipment manufacturers.

8.1 Control parameters

- Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Control measures

Engineering measures
- Ensure adequate ventilation.
- Provide appropriate exhaust ventilation at machinery.

Individual protection measures

Respiratory protection
- Effective dust mask
- Use only respiratory protection that conforms to international/ national standards.
- Use NIOSH approved respiratory protection.

Hand protection
- Wear suitable gloves.

Eye protection
- Chemical resistant goggles must be worn.

Skin and body protection
- Dust impervious protective suit

Hygiene measures
- Eye wash bottles or eye wash stations in compliance with applicable standards.
- When using do not eat or drink.
- When using do not smoke.
- Wash hands before breaks and at the end of workday.
- Handle in accordance with good industrial hygiene and safety practice.

SECTION 9: Physical and chemical properties

Physical and Chemical properties here represent typical properties of this product. Contact the business area using the Product information phone number in Section 1 for its exact specifications.

9.1 Information on basic physical and chemical properties

Appearance	Form: fine powder Physical state: solid Color: off-white tan
Odor	odorless musty
Odor Threshold	No data available
pH	9.8 (2 g/l)
Melting point/freezing point	No data available
Initial boiling point and boiling range	No data available
Flash point	Not applicable
Evaporation rate (Butylacetate = 1)	No data available
Flammability (solid, gas)	No data available
Flammability (liquids)	No data available
Flammability / Explosive limit	Lower flammability/explosion limit: Type: Lower explosion limit The product is not flammable. Explosiveness: Not explosive
Autoignition temperature	No data available
Vapor pressure	No data available
Vapor density	No data available
Density	Bulk density: 1,000 kg/m3
Relative density	2.11
Solubility	No data available
Partition coefficient: n-octanol/water	Not applicable
Decomposition temperature	No data available
Viscosity	No data available

Explosive properties	No data available
Oxidizing properties	Not considered as oxidizing.

9.2 Other information

No data available

SECTION 10: Stability and reactivity

10.1 Reactivity

- no data available

10.2 Chemical stability

- Decomposes by reaction with strong acids.
- Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

- no data available

10.4 Conditions to avoid

- none

10.5 Incompatible materials

- Acids
- Finely divided aluminum

10.6 Hazardous decomposition products

- none

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Acute oral toxicity

Carbonic acid sodium salt (1:2)	LD50 : 2,800 mg/kg - Rat , male and female The product has a low acute toxicity Unpublished reports

Acute inhalation toxicity

Carbonic acid sodium salt (1:2)	No data available

Acute dermal toxicity

Carbonic acid sodium salt (1:2)	LD50 : > 2,000 mg/kg - Rabbit Method: according to a standardized method Not classified as hazardous for acute dermal toxicity according to GHS. No mortality observed at this concentration. Unpublished reports
Acute toxicity (other routes of administration)	No data available

Skin corrosion/irritation

Carbonic acid sodium salt (1:2)	Rabbit Not classified as irritating to skin Method: OECD Test Guideline 404 Unpublished reports

Serious eye damage/eye irritation

Carbonic acid sodium salt (1:2)	Rabbit Irritating to eyes. Method: according to a standardized method Unpublished reports

Respiratory or skin sensitization — No data available

Mutagenicity

Genotoxicity in vitro

Carbonic acid sodium salt (1:2)	By analogy Ames test with metabolic activation Product is not considered to be genotoxic Published data Strain: Escherichia coli without metabolic activation negative Product is not considered to be genotoxic Published data

Genotoxicity in vivo — No data available

Carcinogenicity — No data available

This product does not contain any ingredient designated as probable or suspected human carcinogens by:
ACGIH

Toxicity for reproduction and development

Toxicity to reproduction / fertility — No data available

Developmental Toxicity/Teratogenicity

Carbonic acid sodium salt (1:2)	Mouse, female, Oral General Toxicity Maternal NOAEL: >= 580 mg/kg Teratogenicity NOAEL:>= 580mg/kg Method: according to a standardized method no embryotoxic or teratogenic effects have been observed, Unpublished reports

STOT

STOT-single exposure

Carbonic acid sodium salt (1:2) — The substance or mixture is not classified as specific target organ toxicant, single exposure according to GHS criteria.
internal evaluation

STOT-repeated exposure

Carbonic acid sodium salt (1:2) — The substance or mixture is not classified as specific target organ toxicant, repeated exposure according to GHS criteria.
internal evaluation

Experience with human exposure — No data available

Aspiration toxicity — No data available

SECTION 12: Ecological information

12.1 Toxicity

Aquatic Compartment

Acute toxicity to fish

LC50 - 96 h : 30 - 1,200 mg/l - Fishes, various species
Test substance: Sodium carbonate

LC50 - 96 h : 7,550 mg/l - Gambusia affinis (Mosquito fish)
Test substance: Sodium bicarbonate

Acute toxicity to daphnia and other aquatic invertebrates

LC50 - 48 h : 115 - 150 mg/l - Crustaceans, Daphnia sp.
Test substance: Sodium carbonate

LC50 - 48 h : 2,350 mg/l - Daphnia magna (Water flea)
Test substance: Sodium bicarbonate

Toxicity to aquatic plants — No data available

Toxicity to microorganisms — No data available

Chronic toxicity to fish — No data available

Chronic toxicity to daphnia and other aquatic invertebrates — No data available

12.2 Persistence and degradability

Abiotic degradation

Stability in water	Hydrolysis Medium, Water, Degradation products:, carbonic acid/bicarbonate/carbonate, acid/base equilibrium as a function of pH Medium, Soil, Hydrolyzis as a function of pH
Photodegradation	Not applicable Medium Air
Physical- and photo-chemical elimination	No data available

Biodegradation

Biodegradability	aerobic Not applicable anaerobic Not applicable

12.3 Bioaccumulative potential

Partition coefficient: n-octanol/water	No data available
Bioconcentration factor (BCF)	Not applicable

12.4 Mobility in soil

Adsorption potential (Koc)	Water considerable solubility and mobility Soil/sediments non-significant adsorption Air Not applicable
Known distribution to environmental compartments	No data available

12.5 Results of PBT and vPvB assessment	Not applicable
12.6 Other adverse effects	No data available
Remarks	alkaline, Ecological injuries are not known or expected under normal use.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product Disposal

- In accordance with local and national regulations.
- For unused and uncontaminated product, the preferred options include sending to a licensed, permitted: recycler, reclaimer.
- or
- Dissolve in water.
- Neutralize with acid.

Advice on cleaning and disposal of packaging

- To avoid treatments, as far as possible, use dedicated containers.
- Clean container with water.
- Dispose of rinse water in accordance with local and national regulations.
- or
- Must be incinerated in a suitable incineration plant holding a permit delivered by the competent authorities.
- The empty and clean containers are to be reused in conformity with regulations.

SECTION 14: Transport information

TDG
not regulated

DOT
not regulated

NOM
not regulated

IMDG
not regulated

IATA
not regulated

Note: The above regulatory prescriptions are those valid on the date of publication of this sheet. Given the possible evolution of transportation regulations for hazardous materials, it would be advisable to check their validity with your sales office.

SECTION 15: Regulatory information

15.1 Notification status

Inventory Information	Status
United States TSCA Inventory	- Listed on Inventory
New Zealand. Inventory of Chemical Substances	- All components on composite list considered for transfer
Canadian Domestic Substances List (DSL)	- Listed on Inventory
Australia Inventory of Chemical Substances (AICS)	- Listed on Inventory
Japan. CSCL - Inventory of Existing and New Chemical Substances	- One or more components not listed on inventory
Korea. Korean Existing Chemicals Inventory (KECI)	- Listed on Inventory
China. Inventory of Existing Chemical Substances in China (IECSC)	- Listed on Inventory
Philippines Inventory of Chemicals and Chemical Substances (PICCS)	- Listed on Inventory
Taiwan Chemical Substance Inventory (TCSI)	- Listed on Inventory
EU. European Registration, Evaluation, Authorisation and Restriction of Chemical (REACH)	- When purchased from a Solvay legal entity based in the EEA ("European Economic Area"), this product is compliant with the registration provisions of the REACH Regulation (EC) No. 1907/2006 as all its components are either excluded, exempt, and/or registered. When purchased from a legal entity outside of the EEA, please contact your local representative for additional information.

15.2 National Regulations

Canada. CEPA 1999 Significant New Activity (SNAc) List:

- No substances are subject to a Significant New Activity Notification.

SECTION 16: Other information

Revision Date:

05/10/2019

NFPA (National Fire Protection Association) - Classification

Health	1 slight
Flammability	0 minimal
Instability or Reactivity	0 minimal
Special Notices	None

HMIS (Hazardous Materials Identification System (Paint & Coating)) - Classification

Health	1 slight
Flammability	0 minimal
Reactivity	0 minimal
PPE	Determined by User; dependent on local conditions

- ACGIH — American Conference of Governmental Industrial Hygienists
- OSHA — Occupational Safety and Health Administration
- NTP — National Toxicology Program
- IARC — International Agency for Research on Cancer
- NIOSH — National Institute for Occupational Safety and Health

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information, and belief at the date of its publication. Such information is only given as a guidance to help the user handle, use, process, store, transport, dispose, and release the product in satisfactory safety conditions and is not to be considered as a warranty or quality specification. It should be used in conjunction with technical sheets but do not replace them. Thus, the information only relates to the designated specific product and may not be applicable if such product is used in combination with other materials or in any other manufacturing process, unless otherwise specifically indicated. It does not release the user from ensuring he is in conformity with all regulations linked to its activity.