PM$_{2.5}$ SIP Evaluation Report: Proctor and Gamble Paper Products Company

UTAH PM$_{2.5}$ SIP SERIOUS SIP

Wasatch Front Nonattainment Area

Utah Division of Air Quality

Major New Source Review Section

July 1, 2018

$PM_{2.5}$ SIP EVALUATION REPORT
PROCTOR AND GAMBLE PAPER PRODUCTION COMPANY

1.0 Introduction

The following is an updated version of the original RACT evaluation that was completed on May 1, 2017 as a part of the Technical Support Documentation for Section IX, Parts H.11, 12 and 13 of the Utah SIP; to address the Salt Lake City $PM_{2.5}$ and Provo, Utah $PM_{2.5}$ Nonattainment Areas.

1.1 Facility Identification

Name: Proctor and Gamble Paper Production Company
Address: 5000 North Iowa String Road, Bear River City, Utah 84301
Owner/Operator: Proctor and Gamble Paper Products Company (P&G)
UTM coordinates: 4,463,300 m Northing, 437,400 m Easting, Zone 12

1.2 Facility Process Summary

P&G owns and operates a paper and soap manufacturing facility located in Bear River City, Utah. The plant consists of two separate product lines; a paper process line and a soap manufacturing process line.

The paper process line consists of the following equipment and operations; paper machine, converting room, boilers and support equipment.

A paper machine is comprised of the following equipment: a drying section with a natural gas fired duct burner system with a combined heat input of 150 MMBTU/hr, two cyclonic separators and a venturi scrubber to assist in the removal of the particulates. The paper machine has up to five individual permitted process exhaust stacks, as well as additional room exhaust vents.

The converting room houses equipment used to convert the paper roll stock obtained from the paper machine into individual paper products for distribution. The converting operation contains three converting lines. Fugitive emissions within this operation are routed to three dust control systems. The dust control system consists of one drum filter vented to a separate stack.

Steam is essential for the paper making line which requires two boilers to supply steam for the paper making machine. Each boiler is rated at 60.24 MMBTU/hr and is operated on natural gas as primary fuel and propane as secondary fuel (used only during natural gas curtailment). Emissions from each boiler are vented through its own single stack.

All space heaters are operated on natural gas. The paper machine room has up to 3 direct fired heaters with a total heat input of approximately 40.3 MMBTU/hr. The converting room has two direct fired heaters with a total heat input capacity of approximately 2.2 MMBTU/hr and the distribution warehouse has several space heaters with a combined heat input rating of approximately 25 MMBTU/hr.

In order to support cooling needs for the paper making line, there are three (3) existing cooling towers. The existing cooling towers are equipped with drift eliminators to minimize particulate emissions.

The soap manufacturing process lines consist of the following equipment/operations; soap manufacturing process line, consumer article cleaning products manufacturing, assembled paper product line, chemical surfactant products line, and bottle blowing process.

The soap manufacturing process line includes three soap products. The first of these three soap product lines is referred to as Soap A. The Soap A manufacturing process involves a mixing and blending operation with a few chemical transformations. Raw materials will be unloaded into the building for placement into the mixing system. Raw materials are pumped from the totes or from on-site storage tanks for blending. As the blending occurs in a closed system, on a batch basis, there are no process vents, which results in minimal VOCs emitted from the Soap A manufacturing process. The resultant mixture represents the final product. Variations of the mixture are dependent upon the soap product to be manufactured. The soap from Soap A, once made, is piped into a bottle filling line. After filling the containers, the product will proceed to packaging for off-site transport. Alternatively, the soap product may be loaded into truck via a pipeline for packaging at an external facility.

The emission sources for the Soap A manufacturing process include: storing raw materials (in tanks, totes, or drums), bottle filling and truck loading. The materials used in the soap making process have low volatility. Ethanol's vapor pressure is used in PTE emissions calculations as a conservative estimate of VOC emissions

The second and third soap product lines are herein referred to as Soap B and C. The Soap B and C manufacturing processes involve storage, mixing, and packaging operations that are anticipated to result in VOC and PM emissions. These soap lines involve mixing multiple raw ingredients in line or in tanks to make the desired product. Once mixed, the material is transported to a converting process for placing the soaps into containers. The converting process involves filling and capping multiple types of consumer product packaging. The sources of emissions include the following equipment; raw material storage tanks, mixing tanks, converting, tanker truck loading and finished product packaging.

The primary raw materials include fragrances and surfactant pastes. The emission estimates are based on the raw materials with the highest vapor pressure to account for the worst case VOCs emissions and to represent the multiple formulations in the soap manufacturing process. Ethanol is used in the manufacturing of Soap B, and is controlled with an ethanol scrubber.

The consumer article cleaning products manufacturing consist of a substrate that is unrolled (or manipulated) and scented raw materials and cleaners are added to the substrate for use as the final product. The process includes delivery of raw materials and transfer of material to holding and mixing tanks. The raw materials and cleaning mixtures are then applied onto a substrate to produce the cleaning article. Once the cleaning articles are complete, they are sent to be packaged and then onto a warehouse for distribution.

The sources of emissions from consumer article cleaning products manufacturing for each process line include the following equipment; raw material storage tanks, material handling equipment, and converting and finished product packaging.

Particulate matter is produced from receiving, sizing, and handling during the substrate converting process. Controls used for particulate emissions include a baghouse.

The assembled paper product line functions to assemble various raw materials into the finished product. Emissions from an Assembled Paper Product line are Particulate Matter ($PM/PM_{10}/PM_{2.5}$) and VOCs. Several raw materials are unwound at points along the assembly process. Some raw materials are de-bulked in an offline process and delivered via air to the lines. Various raw and scented materials are also used in the assembly and packaging of Assembled Paper Products. Particulate is captured during the de-bulking of raw materials, the delivery of raw materials, and from the cutting operations on the line. VOCs occur as a result of raw and scented material application as well as from finished product packaging. Emission points for the assembled paper products include: converting line, CVC baghouse, drum filters and drum filter baghouses.

The chemical surfactant products line manufacture surfactants at the Box Elder facility. The purpose of the surfactants is primarily to use the products in downstream soap manufacturing. The primary product manufactured is a surfactant paste. Secondary products include amine oxide, sulfuric acid and a byproduct precipitated acid mix (PAM) paste. The amine oxide process produces variable intermediates which are either used in the surfactant paste manufacturing process, or provided to soap manufacturing directly depending on its end use. A number of variations to the surfactant paste product are intended, based on the end use. These variations are achieved through the use of different raw materials in different quantities in the surfactant manufacturing process.

The surfactant process requires P&G to preheat a sulfur converter which is accomplished with the use of a natural gas preheater. This is only intended to occur approximately four (4) times per year. A by-product that results during the changeover period is sulfuric acid (H_2SO_4). As the preheater brings the sulfur converter to the desired temperature, combustion gases and the H_2SO_4 are vented through sulfur dioxide (SO_2) packed bed scrubber.

The proposed surfactant making processes are anticipated to emit the following criteria pollutants; SO_2, VOCs, PM_{10} and $PM_{2.5}$.

Small amounts of NO_X, CO, and SO_2 are emitted through the preheating of the sulfur reactor using a natural gas preheater and/or the oxidation of sulfur involved in making the surfactant paste. All potential emissions during normal operations and startup and shutdown of the sulfate reactor are vented through an SO_2 packed bed scrubber. The VOC emissions are emitted from raw material and product storage tanks, inline mixing tanks, and truck loading. As a result of the variations of products to be produced, the raw materials with the highest volatility were used to estimate product storage and truck loading emissions.

The emission sources in the surfactant processes include the following: raw material (intermediate and product tanks), natural gas preheater, in-line mixing, mixing tanks and product truck loading.

The surfactant process will be controlled with a packed bed scrubber to control SO_2 and PM emissions. The surfactant process has fugitive VOC emissions.

The bottle blowing process; the bottles and containers needed for site-wide packaging purposes are molded. The process begins with plastic beads that are delivered to a silo and then conveyed to the appropriate equipment on-site. These plastic pieces are fed into an extruder where the final container shape is formed. This container then receives a label and is delivered for use within the other business units on-site. Any scrap plastic that is created is recycled back to the bottle and container making processes through regrinding. The sources of emissions include the following equipment or processes: raw material storage silos, recycled material grinding, conveying converting finished product packaging and two (2) cooling towers.

In order to support the Soap Manufacture lines, heating, cooling, ventilation, and steam needs the following equipment is needed: two (2) 50 MMBtu/hr steam boilers, and seven (7) cooling towers. The boilers will be fueled by natural gas and equipped with low NO_X burners with propane available as a secondary fuel for emergencies or curtailment. The cooling towers are for cooling manufacturing equipment associated with the surfactant, soap making processes and assembled paper products. The cooling towers will be designed with drift eliminators to minimize particulate emissions. For power outages on the Soap Manufacturing lines, the following equipment is installed: one (1) 350 KW emergency generator, and one (1) 30 KW emergency generator. The emergency generators will be fueled by diesel and meet U.S. EPA’s Tier 3 specifications. One 1,955 gallon diesel storage tank to act as a diesel fuel refueling station.

1.3 Facility 2014 Baseline Emissions

Plant-wide 2014 Actual Emissions (tons/yr)

$PM_{2.5}$	SO_2	NO_X	VOC
38.13	0.30	27.23	18.58

1.4 Facility Criteria Air Pollutant Emissions Sources

Emission Unit	Potential to Emit				
	$PM_{2.5}$	NO_x	SO_2	VOC	NH_3
Paper Machine	102.11	79.91	0.48	90.93	<0.01
Boilers	15.02	38.71	0.58	4.87	<0.01
Solid Material Handling	12.01	0.00	0.00	11.37	0.00
Cooling Towers	1.50	0.00	0.00	0.00	0.00
Chemical Make Process-Scrubber	6.01	1.25	0.38	4.87	0.00
Storage Tanks	0.00	0.00	0.00	14.61	0.00
Fugitive VOC	0.00	0.00	0.00	6.49	0.00
Truck Loading	0.00	0.00	0.00	<1.62	0.00
Emergency Generators	0.00	2.50	0.00	0.00	0.00
Warehouse Space Heaters	0.00	2.50	0.01	0.00	0.00

2.0 BACT Selection Methodology

The general procedure for identifying and selecting BACT is through use of a process commonly referred to as the "top-down" BACT analysis. The top-down process consists of five steps which consecutively identify control measures, and gradually eliminate less effective or infeasible options until only the best option remains. This process is performed for each emission unit and each pollutant of concern. The five steps are as follows:

1. Identify All Existing and Potential Emission Control Technologies: UDAQ evaluated various resources to identify the various controls and emission rates. These include, but are not limited to: federal regulations, Utah regulations, regulations of other states, the RBLC, recently issued permits, and emission unit vendors.

2. Eliminate Technically Infeasible Options: Any control options determined to be technically infeasible are eliminated in this step. This includes eliminating those options with physical or technological problems that cannot be overcome, as well as eliminating those options that cannot be installed in the projected attainment timeframe.

3. Evaluate Control Effectiveness of Remaining Control Technologies: The remaining control options are ranked in the third step of the BACT analysis. Combinations of various controls are also included.

4. Evaluate Most Effective Controls and Document Results: The fourth step of the BACT analysis evaluates the economic feasibility of the highest ranked options. This evaluation includes energy, environmental, and economic impacts of the control option.

5. Selection of BACT: The fifth step in the BACT analysis selects the "best" option. This step also includes the necessary justification to support the UDAQ's decision.

Should a particular step reduce the available options to zero (0), no additional analysis is required. Similarly, if the most effective control option is already installed, no further analysis is needed.

2.1 Emission Unit (EU) and Existing Controls

2.1.1 Paper Machine

Description:

The paper machine produces both paper towel and tissue paper products. Pulp, manufactured at separate facilities, is mixed with water and additives as raw material. The raw materials that form into a web are dried with hot air from a combination of process heaters and steam dryers.

The paper process begins with the wet end starting with stock preparation, which consists of mixing pulp, additives, and water. This slurry is then fed to the forming system where the sheet screening, formation of paper, and draining occur. The wet paper undergoes drying where the wet paper web is passed through drying zones. Air and heat distribution are required to uniformly dry the paper sheet. Hot air is transferred across the wet paper web, passing directly through the product in the forming system and dry end. The air is heated by two duct burners referred to as Burner #1 and Burner #2.

Burner #1 is a 100 million British thermal units per hour (MMBtu/hr) natural gas fired dryer with a low NOx burner. Burner #2 is rated at 50 MMBtu/hr and uses preheated air from the paper process, which was initially heated by Burner #1. Burner #2 duct burner is equipped with the same style of low NOx burner. Burner #1 heats ambient air for the use in drying the wet paper web. This hot air travels through the paper machine and into the duct heated by Burner #2.

Make-up air is delivered into the paper machine room by make-up air units used for room balance and temperature control. The make-up air units provide additional flow, but only heat the air during times of colder ambient temperatures.

The paper towel or tissue paper finishes in the paper machine as a large roll for further processing. The dry-end of the process is controlled by a Venturi scrubber. The wet end of the process and under dryer are controlled by cyclonic separators that function as mist eliminators and remove particulate.

Depending on the product being created, heat intensity and steam demand are varying process parameters required to adapt to new product specifications in a short period of time to eliminate wasting product. The paper machine emission points, are as follows:

Paper Machine Process Stack
Wet End Cyclonic Separator
Under Dryer Cyclonic Separator
Dry End Venturi Scrubber

Four (4) Paper Machine Room Exhaust Fans

The emissions from process stack include natural gas combustion emissions from Burner #1 and Burner #2 as well as particulate matter and VOC emissions from the drying of the wet paper web. The cyclonic separator and venturi scrubber collect cellulose that becomes entrained during the process in the paper machine as particulate matter. The primary function of the cyclonic separator is to act as a mist eliminator, but the cyclonic separator removes particulate matter. The under dryer stack particulate matter is controlled by a cyclonic separator. The make-up air units exhaust and blow air directly into the paper machine room. The emissions associated with the natural gas combustion during the cooler months from the make-up air units are exhausted through the paper machine room exhaust fans.

The make-up air units are equipped with low NOx burners, each burner has the capacity of 15.75 MMBtu/hr. The make-up air units only run half the year, providing a reduction in annual emissions. The make-up air units exhaust to a large room, making any sort of add-on control technologies impractical. The make-up air units are also specifically designed for the space and are not standard packaged units, pricing without purchasing a new unit is not feasible. The emissions associated with the make-up air units make up less than 10% of the paper machines total NOx emissions not being cost effective to replace or add on controls.

Emissions Summary:
The paper machine has the following stacks that will be addressed; wet exhaust stack, process stack, under dryer stack, dry end stack and the roof exhaust. The following are the actual emissions associated with each point in tpy.

Paper Machine	**$PM_{2.5}$**	**NO_X**	**SO_2**	**VOC**
Wet Exhaust Stack	9.38	0.00	0.00	0.00
Process Stack	56.67	67.76	0.48	71.72
Under Dryer Stack	10.23	0.00	0.00	0.00
Dry End Stack	10.66	0.00	0.00	0.00
Roof Exhaust	15.17	12.15	0.00	19.21

[Pollutant - $PM_{2.5}$]
Raw materials including pulp, additives, and water, are used in the paper machine. The beginning of the process is wet, and the pulp dries and becomes a paper web as it moves through the machine. The wet end is where the raw material is introduced to the paper machine and the dry-end is where the product is formed. The particulate matter emitted from the paper machine is generally larger in size. $PM_{2.5}$ is emitted as a by-product of incomplete combustion of the natural gas from Burner #1, Burner #2, and make up air units. The dry-end of the process is controlled by a Venturi scrubber, the wet end of the process and under dryer stack is controlled by a cyclonic separator. Both Venturi scrubber and cyclonic separator installed and are control technologies designed to remove larger particulate. P&G has conducted studies on ways to minimize particulate matter emissions during the paper making process. P&G have taken the results of the studies and

incorporating appropriate techniques into the operation of the paper machine (Mcintyre 2009).

Available Control Technology

The control technologies for $PM_{2.5}$ emissions for the paper machine include:

- Fabric Filters (baghouse),
- Wet Scrubbers,
- Dry Electrostatic precipitators (ESP), and
- Cyclone Separator

Technological Feasibility:

Baghouse/Fabric Filter

There is no proven fabric filter technology that will control condensable $PM_{2.5}$. On the wet end and process stack, a fabric filter would bind up. The high moisture content of the gas stream would clog/plug the fabric filter. On the dry end, the fabric collection of combustible fibers as filterable $PM_{2.5}$ presents a safety hazard for potential fire. Fires in the baghouse are a potential, because of the heat of the gas stream and the presents of cellulose fibers (US-EPA 2002a; US-EPA 2002b).

Wet Scrubbers

A wet gas scrubber is an air pollution control device that removes $PM_{2.5}$ from stationary point sources waste streams. $PM_{2.5}$ is primarily removed through the impaction, diffusion, interception, and/or absorption of the pollutant onto droplets of liquid. This control technology has been operated successfully on the dry-end portions of paper machines at other P&G plants. P&G currently has installed and operates a wet scrubber at the Box Elder paper machine on the dry end with an estimated 95% control efficiency of $PM_{2.5}$.

Wet gas scrubbing is not effective for the process stack because of the high flow rate (250,000 acfm) and low concentration of emissions (US-EPA 2002c). Current wet scrubber designs can accommodate 100,000 acfm. Adding a wet scrubber to the process stack would create backpressure in the operating room. This would require a complete redesign of the heat distribution through the paper machine as well as industrial hygiene concerns to employees. The redesign would take into consideration new infrastructure, building, and paper machine to meet the design requirements, and huge amounts of power to accommodate the large fans required due to back pressure. A wet scrubber is technically infeasible for the wet and process stacks.

Dry ESPs

A dry ESPs is a particle control device that uses electrical forces to move the particles out of the gas stream onto collector plates. This process is accomplished by the charging of particles in the gas stream using positively or negatively charged electrodes. The particles are then collected as they are attracted to oppositely opposed electrodes. Once the particles are collected on the plates, they are removed by knocking them loose from the plates, allowing the collected layer of particles to fall into a hopper. Dry ESPs are used to capture coarse particles at high concentrations. Small particles at low concentrations are not effectively collected by an ESP (US-EPA 2002d).

The low concentration, high moisture content and high flowrate of the process stack makes this control device technically infeasible. This technology is technically infeasible for the dry end, like the baghouse, in that fire hazard is present with accumulation of combustible material and the possibility of arcing with the collector plates (US-EPA 2002d). Changing between paper towel product and tissue paper is expected to cause upsets to this control technology making this control device technically infeasible.

Cyclone Separator
A cyclone separator (cyclone) operates on the principle of centrifugal separation. Exhaust enters the inlet and spirals around towards the outlet. As the particles proceed through the cyclone, the heavier material hits the outside wall and drops out. The cleaned gas escapes through an inner tube. Cyclones function to reduce dust loading and collect large particles.

P&G is currently operating this technology on the wet end of the paper machine process and the under dryer stack with an estimated 85% control efficiency. The Venturi scrubber has higher control efficiency than the cyclonic separator and can handle high moisture streams. The primary purpose of the cyclonic separator on the wet end is to capture the excess moisture contained in the exhaust stream. The Venturi scrubber could be used as an add-on control technology to the end of the cyclonic separator, but the exhaust stream of the cyclonic separator has particulate concentrations lower than a wet scrubber can practically control.

The wet end and under dryer stack are currently being controlled by cyclonic separators. The wet scrubber controls has the highest control efficiency controls the dry end stack. The wet scrubber technology will be further evaluated for economic feasibility.

Economic Feasibility:
Baghouse and electrostatic precipitator technology have been eliminated as technically infeasible options for all stacks on the Paper Machine. A wet scrubber is currently operating to control filterable particulate on the dry end of the paper machine.

Combining a wet scrubber to the existing cyclonic separator on the wet end stack would reduce the $PM_{2.5}$ emissions to 0.48 tpy. The cost per ton of $PM_{2.5}$ removed calculated for a wet scrubber is $165,250.

BACT Selection:
The wet end and under dryer stack are currently being controlled by cyclonic separators. The dry end stack is controlled by a Venturi Scrubber. The process stack is uncontrolled because of the high flow rate and low concentration of emissions. All existing controls are considered BACT.

Implementation Schedule:
All selected BACT control technologies for the paper machine have been installed and operating. No implementation date is needed.

[Pollutant NO_X]

NOx is emitted from Burner #1, Burner #2, and the make-up air units. Burner #1 and Burner #2 exhaust primarily through the process stack. NOx is formed during combustion by two major mechanisms: thermal NOx and fuel NOx. Since natural gas is relatively free of fuel-bound nitrogen, the contribution of this second mechanism to the formation of NOx emissions in natural gas-fired equipment is minimal and thermal NOx is the chief source of NOx emissions. Thermal NOx formation is a function of residence time, oxygen level, and flame temperature, and can be minimized by controlling these elements in the design of the combustion equipment.

Available Control Technology

The control technologies for NO_X emissions for the paper machine include:

- Low NOX Burners
- Ultra-Low NOX Burners
- Flue Gas Recirculation
- Selective Catalytic Reduction
- Selective Non-Catalytic Reduction
- Good Combustion Practices

Technological Feasibility:

Low NO_X Burners (LNB)

LNB technology uses advanced burner design to reduce NOx formation through the restriction of oxygen, flame temperature, and/or residence time. There are two general types of LNBs: staged fuel and staged air burners. In a stage fuel LNB, the combustion zone is separated into two regions. The first region is a lean combustion region where a fraction of the fuel is supplied with the total quantity of combustion air. Combustion in this zone takes place at substantially lower temperatures than a standard burner. In the second combustion region, the remaining fuel is injected and combusted with left over oxygen from the first region. This technique reduces the formation of thermal NOx.

LNB technology is specific to the combustion unit itself and is therefore evaluated for Burner #1, Burner #2, and make-up air units. The burner installed on Burner #1 and Burner #2 was designed specifically for in-line duct firing. The low NOx emissions are achieved through a patented simulated pre-mix technology that enables the fuel to be fired in a very lean mixture while ensuring optimum flame stability. Low NOx and carbon monoxide (CO) emissions are achieved across a wide firing rate turn down without the need for fuel-to-air ratio combustion controls. Low NOx Burner technology is technically feasible and is currently utilized on the Paper Machine.

Ultra-Low NO_X Burners (ULNB)

ULNB technology uses internal flue gas recirculation, which involves recirculating the hot oxygen depleted flue gas from the heater into the combustion zone using burner design features and fuel staging to reduce NOx. Research conducted on other paper machines (Mcintyre 2009) determined that the only available technology would involve a complete re-design of the hot air system that would allow using a single register style round low NOx burner. The redesign of the paper machine technology would greatly reduce heat efficiency maintained within the machine. The ULNB is considered technically infeasible due to the redesign and reduced heat efficiency.

Flue Gas Recirculation (FGR)

FGR combined with LNB as a method of ULNB technology is another combustion control used to reduce NOx. FGR involves the recycling of flue gas into the air-fuel mixture at the burner to help cool the burner flame. External FGR, usually used with LNB, requires the use of hot-side fans and ductwork to route a portion of the flue gas in the stack back to the burner windbox.

The burners installed on the existing paper machine simulate pre-mix technology that enables the fuel to be fired in a lean mixture while ensuring optimum flame stability. Induced FGR for Burner #1 is impractical as it is firing directly into process air and the significant amount of cellulose would greatly reduce the reliability of the burner. Burner #2 uses process air heated by Burner #1 for efficiency and is used as combustion air. As thermal efficiencies have already been engineered throughout the second generation paper machine, the use of heated air is already implemented and the use of process air would damage the burner; therefore, FGR is considered technically infeasible.

Selective Catalytic Reduction (SCR)

SCR can be applied as a stand-alone NOx control or with other technologies such as combustion controls. The reagent reacts selectively with the flue gas NOx within a specific temperature range and in the presence of the catalyst and oxygen to reduce the NOx into molecular nitrogen and water vapor. The optimum operating temperature is dependent on the type of catalyst and the flue gas composition ranging from 480°F to 800°F (US-EPA 2002e).

The hot exhaust gases from the paper machine combustion unit come into direct contact with process material through-air drying process prior to release to the atmosphere. The combustion exhaust cannot be influenced by a reagent prior to contact with the product at the risk of compromising operations and product specifications. If the SCR captures exhaust emissions after the through-air drying process, there is possibility of residue from the PM emissions from the paper machine process coating the surface of the SCR catalyst, reducing effectiveness and increasing maintenance. The paper machine has a process exhaust temperature of 200°F or less. The exhaust stream does not meet the temperature requirements for the SCR (minimum of 480°F) for proper operations leading to optimal efficiency (US-EPA 2002e).

Due to the physical configuration, risk of compromising product, risk of compromising SCR effectiveness through fouling of the catalyst, SCR is considered technically infeasible.

Selective Non-Catalytic Reduction (SNCR)

SNCR can be applied as a stand-alone NOx control or with other technologies such as combustion controls. SNCR can achieve NOx reduction efficiencies of up to 75% in short-term demonstrations. Field applications have provided NOx reductions efficiencies of 30% to 50%. Reductions of up to 65% have been reported for some field applications of SNCR in tandem with combustion control equipment such as LNB.

SNCR is based on the chemical reduction of the NOx molecule into molecular nitrogen and water vapor. A nitrogen based reducing agent, such as ammonia or urea, is injected into the post combustion flue gas. The reagent can react with a number of flue gas components. However, the NOx reduction reaction is favored over other chemical reaction processes for a specific temperature range and in the presence of oxygen, therefore, it is considered a selective chemical process.

Practical application of SNCR is limited by the system design and operating conditions. SNCR becomes difficult at temperatures outside its required temperature range of 1,600°F to 2,100°F (US-EPA 2002f). The paper machine has a process exhaust temperature of 200°F or less. The exhaust stream does not meet the temperature requirements for the SNCR (minimum of 1,600°F) for proper operations leading to optimal efficiency.

Due to the design limitation, exhaust stream temperature differences SNCR is considered technically infeasible.

Good Combustion Practices
The use of good combustion practices include the following components: (1) proper fuel mixing in the combustion zone; (2) high temperatures and low oxygen levels in primary zone; (3) Overall excess oxygen levels high enough to complete combustion while maximizing boiler efficiency, and (4) sufficient residence time to complete combustion. Good combustion practices are accomplished through the in-line duct burners currently used for the paper machine design application as it relates to time, temperature, turbulence, and burner operation. All components of good combustion practices are technically feasible and have been implemented on the paper machine.

Economic Feasibility:
ULNB, FGR, SCR and SNCR technology have been eliminated as technically infeasible options for all stacks on the Paper Machine. LNB and good combustion practices are technically feasible and currently operating to control NOx on the burners on the paper machine.

BACT Selection:
The paper machine burners are currently being controlled by LNB and good combustion practices. No add-on control technologies are considered technically feasible on the stack of the paper machine due to the exhaust steam characteristic. The paper machine uses LNB technology and good combustion practices to control NOx emissions. All existing controls are considered BACT.

Implementation Schedule:
All selected BACT control technologies for the paper machine have been installed and operating.

[Pollutant SO_2]

SO_2 emissions from the Paper Machine result from oxidation of fuel sulfur in Burner #1, Burner #2, and make-up air units. Burner #1 and Burner #2 exhaust primarily through the process stack. The process stack has 0.48 tons per year of SO_2 from the paper machine.

Available Control Technology

There are two primary mechanisms to reduce SO_2 emissions from combustion sources which are: (1) reduce the amount of sulfur in the fuel, and (2) remove the sulfur from the exhaust gases with a post-combustion control device such as flue gas desulfurization utilizing wet scrubbers or dry scrubbers.

The Box Elder Plant will be using pipeline-quality natural gas as the primary fuel which has a low sulfur content. The use of a fuel containing low sulfur content is considered a control technology.

Two main types of SO_2 post-combustion control technologies, wet and dry scrubbing, were identified to reduce SO_2 in the exhaust gas.

Technological Feasibility:

The requirement for low-sulfur natural gas is a control technique that has been achieved in practice and is technically feasible. Post-combustion devices such as wet or dry scrubbers are installed on coal-fired plants that burn fuels with much higher sulfur content. Scrubber control technologies require much higher sulfur concentrations in the exhaust gases to be feasible as a control technology. The SO_2 concentrations in the natural gas combustion exhaust gases from the paper machine are too low for scrubbing technologies to work effectively or to be technically feasible. Since these controls are not technically feasible, they have been eliminated from further consideration for the process stack or wet end stack. A wet scrubber has been installed on the dry end stack; however, its primary purpose is for particulate removal. Therefore, it has been eliminated for further consideration as an SO_2 control device.

Economic Feasibility:

The use of low sulfur fuel (natural gas) is economically feasible and implemented on the paper machine.

BACT Selection:

The use of low sulfur fuel (natural gas) is considered BACT on the paper machine to control SO_2 emissions.

Implementation Schedule:

The paper machine has been designed to operate on natural gas which is a low sulfur fuel. This control technology is currently installed and no implementation date is needed.

[Pollutant VOC]

Raw material for the paper machine include pulp, water, and additives. The additives and pulp for the paper make up approximately 80% of the VOC emissions. The emissions from the additives and pulp are characterized as VOC fugitive emissions. Fugitive emissions are difficult to capture for control thru the use of add-on control technologies. Add-on control techniques for paper machine vents are considered impractical because of the high moisture content, high volume of air, and low VOC concentrations. The remaining 20% of the VOC emissions are generated from combustion of natural gas in Burner #1, Burner #2, and make-up air units.

Available Control Technology

The control technologies for VOC emissions for the paper machine include:

- Regenerative Thermal Oxidizer
- Simple Thermal Oxidizer
- Condenser
- Biofilter
- Low VOC Additives and Good Operating Practices
- Good Combustion Practices and Use of Clean Fuel

Technological Feasibility:

Regenerative Thermal Oxidizer (RTO)

A RTO is equipped with ceramic heat recovery media (stoneware) that has large surface area for heat transfer and can be stable to 2,300°F. Operating temperatures of the RTO system range from 1,500°F to 1,800°F with a retention time of approximately one second to achieve maximum efficiency (US-EPA 2002g). The combustion chamber of the RTO is surrounded by multiple integral heat recovery chambers, each of which sequentially switches back and forth from being a predryer to a heat recovery chamber. Energy is absorbed from the gas exhausted and stored in the heat exchange media to preheat the next cycle of incoming gas.

The process stack exhaust stream from the paper machine is well below 1,500°F. The process stack exhaust stream has high moisture content, high volume of air, and low VOC concentrations making the RTO technically infeasible. Fugitive VOC emission collection from the room would require large volumes of air with low concentrations to be routed to the RTO which makes this technology technically infeasible.

Simple Thermal Oxidizer (TO)

In a simple TO or afterburner, the flue gas is reheated in the presence of sufficient oxygen to oxidize the CO present in the flue gas. A typical TO is a flare and is not equipped with any heat recovery device.

The process stack exhaust stream from the paper machine has high moisture content, high volume of air, and low emission concentrations. Operating the TO on the process stack with the exhaust stream with these characteristics is technically infeasible (US-EPA 2002h). Operating the TO to control the fugitive VOC emission would require large volumes of air with low concentrations to be routed to the TO which makes this technology technically infeasible.

Condenser

A condenser is used to cool an emission stream with organic vapors to change the vapors to a liquid. This liquid is recovered, refined, and reused to prevent release to the atmosphere. This technology is most typically used within the oil and gas industry to recover saleable product and/or dry cleaning. The condenser provides the most effective control for process streams having high emission concentrations and low flow rate. The condenser is less effective in controlling on process streams having low emission concentrations and high flow rates (US-EPA 1995).

The process stack exhaust stream has VOC emissions resulting from the combustion of natural gas. The process stack has low VOC emission concentrations and high flow rates making a condenser technically infeasible. Collecting fugitive VOC emissions would require large volumes of air with low concentration to be routed to the condenser by design this technology is considered technically infeasible.

Biofilter

Biofilters use microbes to consume pollutants from a contaminated stream. Microbes require specific pollutant concentrations, temperatures, humidity, and pH to work properly. The bio reactor system requires steady state temperatures between 60°F and 105°F, with humidity between 40% and 60% and a neutral pH (7) (US-EPA 2003).

The process stack exhaust characteristics do not fit the bio reactor system requirements making the bio reactor technically infeasible. Collecting fugitive VOC emissions would require large volumes of air with low concentration and low humidity to be routed to the bio reactor by design this technology is considered technically infeasible.

Low VOC Additives and Good Operating Practices

P&G is proposing to utilize low-end VOC formulations. P&G has conducted studies for substitute additives to lower VOC emission and maintain product quality (Mcintyre 2009). Studies indicate that the VOC content associated with the proposed additive(s) cannot be lowered any further without compromising product quality. Low VOC additives has not been developed that will effect product quality so low VOC additives are not technically feasible. P&G is conducting research to develop low VOC additives and continually changing operating practices to lower VOC emissions in the paper making operations.

Good Combustion Practices and Use of Clean Fuel

Good combustion practices for VOC emissions combustion byproduct include adequate fuel residence times, proper fuel-air mixing, and temperature control. P&G implement good combustion practices to the operation of the paper machine to lower VOC emissions. Good combustion practices are technically feasible. The use of clean fuel (natural gas) is economically feasible and implemented on the paper machine.

Economic Feasibility:
RTO, TO, condenser, biofilter and low VOC additives control technologies have been eliminated due to the fugitive nature of a majority of VOC emissions and the exhaust stack characteristics of the process stack.

BACT Selection:
Good combustion practices and use of clean burning fuels is the available control technology for combustion VOC emissions. Low VOC additives and good operating practices are the available control technologies for the fugitive VOC emissions.

Implementation Schedule:
The paper machine has been designed to operate on natural gas which is a clean burning fuel to control the combustion VOC emissions. Low VOC additives will be continually researched to determine possible alternatives without impacting quality.

2.1.2 Boilers

Description:
The Box Elder Plant currently has two Paper Machine Boilers which are fire tube boilers. The Paper Making Boilers have a heat input of 60.243 MMBtu/hr (each). Both Paper Machine Boilers are equipped with low NOx burners and flue gas recirculation. The purpose of the Paper Making boilers is to control steam in the Paper Machine. Different paper products require a large difference in steam input, which equates to operating the boilers at a high steam load for one product type and a low steam load for another. A boiler's range in load operability is described by the turn down parameter. The required turn down affects the emissions and exhaust stream and has been considered in this analysis. Additionally, the rate of adjusting the boiler's steam load is significant for product changeover to minimize waste. Adjusting the steam load affects the boiler's exhaust parameters.

The Box Elder Plant currently has two boilers utility boilers to supply steam for Project Maple. The two utility boilers have a heat input of 50 MMBtu/hr (each), and are equipped with ultra-low NOx burners.

Emissions Summary:
The boilers are broken down into two categories; paper making boilers and utility boilers for the Maple Project. The following are the actual emissions associated with paper making boilers and the potential emissions for the utility boilers, in tpy.

Boilers	**$PM_{2.5}$**	**NO_X**	**SO_2**	**VOC**
Paper Making Boilers (combined)	11.80	22.98	0.33	2.54
Utility Boilers (combined)	3.22	15.37	0.25	2.33

[Pollutant $PM_{2.5}$]

Natural gas is a gaseous fuel, by definition, gaseous fuel have low filterable PM emissions. Particulate matter from natural gas combustion has been estimated to be less than one micrometer in size and has filterable and condensable fractions. Particulate matters in natural gas combustion are larger molecular weight hydrocarbons that are not fully combusted. Increased particulate matter emissions can result from poor air/fuel mixing or maintenance problems. P&G is evaluating filterable $PM_{2.5}$ only. The condensable fraction is represented with the other precursors (NO_X, SO_2, and VOCs). The Paper Machine Boilers are permitted for an emission rate of 0.9 lbs/hr of $PM_{2.5}$, each. The Utility Boilers are permitted for an emission rate of 0.74 lb/hr of $PM_{2.5}$, each.

Available Control Technology
The control technologies for $PM_{2.5}$ emissions for the paper making boilers and utility boilers include:

- Fabric Filters
- Wet Scrubber
- Dry Electrostatic Precipitator
- Cyclone Separator
- Good Combustion Practices and Use of Clean Burning Fuels

Technological Feasibility:

Fabric Filters (Baghouses)
A fabric filter unit (or baghouse) consists of one or more compartments containing rows of fabric bags. Particle laden gases pass along the surface of the bags then through the fabric. Particles are retained on the upstream face of the bags and the cleaned gas stream is vented to the atmosphere. Fabric filters collect particles with sizes ranging from submicron to several hundred microns in diameter. Fabric filters are used for medium and low gas flow streams with high particulate concentrations. As the boilers combust of natural gas, concentration of $PM_{2.5}$ is low and small in size. As such, a fabric filter is considered technically infeasible for a boiler firing natural gas (US-EPA 2002a; US-EPA 2002b).

Wet Scrubber
A wet gas scrubber is an air pollution control device that removes PM and acid gases from waste streams from stationary point sources. PM and acid gases are primarily removed through the impaction, diffusion, interception and/or absorption of the pollutant onto droplets of liquid. Wet scrubbers are not effective in controlling PM2.5 due to the particulate size in lower concentration. The four boiler stacks have low concentration of PM2.5 and the small size of particulate where a wet scrubber is considered technically infeasible for a boiler firing natural gas (US-EPA 2002c).

Dry Electrostatic Precipitator (ESP)
An ESP is a particle control device that uses electrical forces to move the particles out of the gas stream onto collector plates. This process is accomplished by the charging of particles in the gas stream using positively or negatively charged electrodes. The particles are then collected as they are attracted to oppositely opposed electrodes. Once the

particles are collected on the plates, they are removed by knocking them loose from the plates, allowing the collected layer of particles to fall down into a hopper. ESPs are used to capture coarse particles at high concentrations. Small particles at low concentrations are not effectively collected by an ESP (US-EPA 2002d). As this analysis is for the control technology of $PM_{2.5}$ from the combustion of natural gas, the concentration of $PM_{2.5}$ is low and small in size. ESP is considered technically infeasible for a boiler firing natural gas.

Cyclone Separator (cyclone)
A cyclone operates on the principle of centrifugal separation. Exhaust enters the inlet and spirals around towards the outlet. As the particles proceed through the cyclone, the heavier material hits the outside wall and drops out. The cleaned gas escapes through an inner tube. Cyclones function to reduce dust loading and collect large particles. Small particles at low concentrations are not effectively collected by a cyclone(US-EPA 2002i). As this analysis is for the control technology of $PM_{2.5}$ from the combustion of natural gas, the concentration of $PM_{2.5}$ is low and small in size. A cyclone is considered technically infeasible for a boiler firing natural gas.

Good Combustion Practices and Use of Clean Burning Fuels
The use of good combustion practices include the following components: (1) proper fuel mixing in the combustion zone; (2) high temperatures and low oxygen levels in primary zone; (3) Overall excess oxygen levels high enough to complete combustion while maximizing boiler efficiency, and (4) sufficient residence time to complete combustion. Good combustion practices are accomplished through boiler design as it relates to time, temperature, and turbulence, and boiler operation (which control excess oxygen levels) (BetterBricks 2015). Good combustion practices are technically feasible. The use of clean fuel (natural gas) is technically feasible on the boilers.

Economic Feasibility:
Good combustion practices and use of clean burning fuels are economically feasible.

BACT Selection:
Good combustion practices and use of clean burning fuels is the best available control technology for combustion $PM_{2.5}$ emissions.

Implementation Schedule:
The boilers have been designed to operate on natural gas which is a clean burning fuel to control the $PM_{2.5}$ emissions. This control technology is currently installed and no implementation date is needed.

[Pollutant NO_x]
The NOx that will be formed during combustion in the boilers is from two major mechanisms: thermal NOx and fuel NOx. Since natural gas is relatively free of fuel-bound nitrogen, the contribution of this second mechanism to the formation of NOx emissions in natural gas-fired equipment is minimal, leaving thermal NOx as the main

source of NOx emissions. Thermal NOx formation is a function of residence time, oxygen level, and flame temperature, and can be minimized by controlling these elements in the design of the combustion equipment.

The Paper Machine Boilers are permitted for an emission rate of 45 parts per million (ppm) NOx at 3% Oz and 3.3 lbs/hr of NOx, each. The Utility Boilers are permitted for an emission rate of 10 ppm NOx at 3% O2 and 1.80 lb/hr of NOx, each.

Available Control Technology
The control technologies for NO_X emissions for the paper making boilers and utility boilers include:

- Low NO_X Burners
- Ultra-Low NO_X Burners
- Flue Gas Recirculation
- Selective Catalytic Reduction
- Selective Non-Catalytic Reduction
- Good Combustion Practices

Technological Feasibility:
Low NO_X Burners (LNB)
LNB technology uses advanced burner design to reduce NOx formation through the restriction of oxygen, flame temperature, and/or residence time. There are two general types of LNBs: staged fuel and staged air burners. In a stage fuel LNB, the combustion zone is separated into two regions. The first region is a lean combustion region where a fraction of the fuel is supplied with the total quantity of combustion air. Combustion in this zone takes place at substantially lower temperatures than a standard burner. In the second combustion region, the remaining fuel is injected and combusted with left over oxygen from the first region. This technique reduces the formation of thermal NOx (BetterBricks 2015).

LNB technology is specific to the combustion unit itself and is therefore evaluated for the paper machine boilers and utility boilers. Low NOx Burner technology is technically feasible and is currently utilized on the paper machine boilers and utility boilers.

Ultra-Low NOX Burners (ULNB)
ULNB technology uses internal FGR which involves recirculating the hot O_2 depleted flue gas from the heater into the combustion zone using burner design features and fuel staging to reduce NOx. An ULNB uses an internal induced draft to reach the desired emission limitations. Due to this induced draft, an ULNB cannot handle a quick change in load to achieve the desired operational flexibility necessary for the varied products and change overs in the paper making operation. This technology is technically feasible control technology. Currently, the Utility Boilers are proposing to use this technology to control NOx. An ULNB can achieve an emission rate of approximately 9 ppm or 0.011 lb/MMBtu when used in conjunction with FGR. P&G reviewed potential replacement burner options with an emission rate of 9 ppm NOx or less that would also meet the same process demands as the current Paper Machine Boilers. Due to the different types of

products from the paper machines, the Paper Machine Boilers must have ample turndown capabilities to adjust the amount of steam. ULNB is not technically feasible due to the changing steam load needed for the paper making operation.

Flue Gas Recirculation (FGR)
FGR uses both LNB and ULNB burners. FGR involves the recycling of post-combustion air into the air-fuel mixture to reduce the available oxygen and help cool the burner flame. External FGR requires the use of ductwork to route a portion of the flue gas in the stack back to the burner windbox. FGR can be either forced draft (where hot side fans are used) or induced draft. This technology is technically feasible for the paper machine boilers. The paper machine boilers use this technology in conjunction with LNBs. The utility boilers have ULNB and FGR installed on them.

Selective Catalytic Reduction (SCR)
SCR can be applied as a stand-alone NOx control or with other technologies such as combustion controls. The reagent reacts selectively with the flue gas NOx within a specific temperature range and in the presence of the catalyst and oxygen to reduce the NOx into molecular nitrogen and water vapor. The optimum operating temperature is dependent on the type of catalyst and the flue gas composition ranging from 480°F to 800°F (US-EPA 2002e).

The following are specific technical considerations for the application of a SCR technology on the paper making boilers and utility boilers. The need for turndown or modulation of the paper machine boilers load produces inconsistent exhaust stream in turn producing erratic removal efficiencies. SCR systems require the use of ammonia which will result in ammonia emissions from the ammonia slip associated with the catalyst. The exhaust stream will require additional heating to meet the SCR operating temperature requirements (minimum of 480°F). This increase in exhaust temperature would require an additional combustion device, also increasing NOx, SO_2, and $PM_{2.5}$ emissions. Even with the increase in ammonia, $PM_{2.5}$, and SO_2 emissions, P&G has considered this technology to be technically feasible for the utility boilers and further evaluated the economic feasibility of this technology. Due to the necessary turndown requirements of the paper machine boilers, an SCR is considered technically infeasible for these units.

Selective Non-Catalytic Reduction (SNCR)
SNCR can be applied as a stand-alone NOx control or with other technologies such as combustion controls. SNCR can achieve NOx reduction efficiencies of up to 75% in short-term demonstrations. Field applications have provided NOx reductions efficiencies of 30% to 50%. Reductions of up to 65% have been reported for some field applications of SNCR in tandem with combustion control equipment such as LNB.

SNCR is based on the chemical reduction of the NOx molecule into molecular nitrogen and water vapor. A nitrogen based reducing agent, such as ammonia or urea, is injected into the post combustion flue gas. The reagent can react with a number of flue gas components. However, the NOx reduction reaction is favored over other chemical reaction processes for a specific temperature range and in the presence of oxygen, therefore, it is considered a selective chemical process.

Practical application of SNCR is limited by the system design and operating conditions. SNCR becomes difficult at temperatures outside its required temperature range of 1,600°F to 2,100°F (US-EPA 2002f). The paper machine and utility boilers have an exhaust temperature less than the 1,600°F. The exhaust stream does not meet the temperature requirements for the SNCR (minimum of 1,600°F) for proper operations leading to optimal efficiency.

Due to the design limitation, exhaust stream temperature differences SNCR is considered technically infeasible for all the boilers.

Good Combustion Practices

The use of good combustion practices include the following components: (1) proper fuel mixing in the combustion zone; (2) high temperatures and low oxygen levels in primary zone; (3) Overall excess oxygen levels high enough to complete combustion while maximizing boiler efficiency, and (4) sufficient residence time to complete combustion. Good combustion practices are accomplished through boiler design as it relates to time, temperature, and turbulence, and boiler operation (which control excess oxygen levels) (BetterBricks 2015). Good combustion practices are technically feasible.

Economic Feasibility:

The paper machine boilers have ruled out ULNB, SCR and SNCR as being technically infeasible. The paper machine boilers currently has LNB and FGR technology installed on the units and currently operate them using good combustion practices.

The utility boilers have ruled out NSCR as being technically infeasible. The utility boilers are being constructed with ULNB, FGR and operated using good combustion practices. The cost to add SCR to the utility boilers (which have ULNB and FGR) would be $165,250 per ton of NOx removed. The cost to install SCR on the utility boilers is economically infeasible (US-EPA 2002m).

BACT Selection:

The paper making boilers have been constructed with LNB and FGR technologies. The irregular load demand on the paper making boilers restrict the use of post controls. LNB, FGR and good combustion practices is BACT for the paper making boilers.

The utility boilers are being constructed with ULNB and FGR technologies. The cost of SCR is economically infeasible. NSCR is technically infeasible due to exhaust stack temperature requirements. ULBN, FGR and good combustion practices is BACT for the utility boilers.

Implementation Schedule:

All selected BACT control technologies for the paper making boilers have been installed and operating. All selected BACT control technologies for the utility boilers will be installed when being constructed.

[Pollutant SO_2]

SO_2 emissions associated with the boilers are due to natural gas combustion. Emissions associated with all boilers are less than 1 tpy SO_2.

Available Control Technology

The control technologies for SO_2 emissions for the paper making boilers and utility boilers include:

- Low Sulfur Fuel
- Post-Combustion Control
- Good Combustion Practices

Technological Feasibility:

Low Sulfur Fuel

Low-sulfur natural gas is a control technique that has been achieved in practice and is technically feasible and will be further considered for BACT.

Post-Combustion Control

Post-combustion devices such as wet or dry scrubbers are installed on sources that burn fuels with much higher sulfur contents. The SO_2 concentrations in the natural gas combustion exhaust gases from the boilers are too low for scrubbing technologies to work effectively or to be technically feasible. Scrubber control technologies require much higher sulfur concentrations in the exhaust gases to be feasible as a control technology. Post-combustion SO_2 control devices (wet and dry scrubbing) have not been achieved in practice on natural gas boilers. The post-combustion controls are not technically feasible.

Good Combustion Practices

The use of good combustion practices include the following components: (1) proper fuel mixing in the combustion zone; (2) high temperatures and low oxygen levels in primary zone; (3) Overall excess oxygen levels high enough to complete combustion while maximizing boiler efficiency, and (4) sufficient residence time to complete combustion. Good combustion practices are accomplished through boiler design as it relates to time, temperature, and turbulence, and boiler operation (which control excess oxygen levels) (BetterBricks 2015). Good combustion practices are technically feasible. The use of clean fuel (natural gas) is technically feasible on the boilers.

Economic Feasibility:

The use of low-sulfur natural gas as a control technique for SO_2 emissions from boilers is cost-effective. The SO_2 concentrations in the natural gas combustion exhaust gases from the boilers are too low for scrubbing technologies to be cost effective.

BACT Selection:

The use of low-sulfur natural gas is BACT for controlling SO_2 emissions for the paper making and utility boilers.

Implementation Schedule:
The paper making boilers are operated on low-sulfur natural gas. The utility boilers will be operated on low-sulfur natural gas once constructed.

[Pollutant VOC]
The VOC emissions associated with the boilers are due to natural gas combustion. Emissions associated with all boilers are 4.85 tpy.

Available Control Technology
The control technologies for VOC emissions for the paper making and utility boilers include:

- Thermal Oxidizer/Afterburner
- Regenerative Thermal Oxidizer
- Catalytic Oxidation
- Good Combustion Practices

Technological Feasibility:

Thermal Oxidizer/Afterburner
In a Thermal Oxidizer (TO) or afterburner, the flue gas exiting the boiler is reheated in the presence of sufficient oxygen to oxidize the VOC present in the flue gas. A TO requires additional fuel to heat the gas stream starting (from 280°F to at least 1,600°F) generating additional emissions (US-EPA 2002h). A TO functions like the combustion chamber of the boiler. Adding a TO in conjunction with a combustion chamber has results in small amounts of reduction in VOC with an increase in other combustion pollutants for the required heating of the exhaust stream. Increasing other combustion pollutants makes the TO technically infeasible.

Regenerative Thermal Oxidizer
A Regenerative Thermal Oxidizer (RTO) is equipped with ceramic heat recovery media (stoneware) that has large surface area for heat transfer and can be stable to 2,300°F. Operating temperatures of the RTO system typically range from 1,500°F to 1,800°F (US-EPA 2002g)with a retention time of approximately one second. The combustion chamber of the RTO is surrounded by multiple integral heat recovery chambers, each of which sequentially switches back and forth from being a preheater to a heat recovery chamber. Energy is absorbed from the gas exhausted from the unit and stored in the heat exchange media to preheat the next cycle of incoming gas. RTO require additional fuel to heat the gas stream from 280°F to at least 1,500°F which will generate additional emissions. Increasing other combustion pollutants makes the RTO technically infeasible.

Catalytic Oxidation
Catalytic oxidation allows complete oxidation to take place at a faster rate and a lower temperature than is possible with thermal oxidation. Oxidation efficiency depends on exhaust flow rate and composition. Residence time required for oxidation to take place at the active sites of the catalyst may not be achieved if exhaust flow rates exceed design

specifications. Sulfur and other compounds may foul the catalyst, leading to decreased efficiency. The gas stream, in a catalytic oxidizer, is passed through a flame area and then through a catalyst bed at a velocity in the range of 10 to 30 feet per second. Catalytic oxidizers operate at a narrow temperature range of approximately 600°F to 1100°F (US-EPA 2002j). Catalytic oxidizer require additional fuel to heat the gas stream from 280°F to at least 600°F and generate additional combustion emissions. Increasing other combustion pollutants makes the catalytic oxidation technically infeasible.

Good Combustion Practices
Good combustion practices for VOCs include adequate fuel residence times, proper fuel-air mixing, and temperature control (BetterBricks 2015). Good combustion practices to control VOC emissions is technically feasible.

Economic Feasibility:
Good combustion practices to control VOC emissions is technically feasible.

BACT Selection:
Good combustion practices are BACT to control VOC emissions.

Implementation Schedule:
The Box Elder Plant operates good combustion practices to maintain combustion optimal to their process. This control technology is currently installed and no implementation date is needed.

2.1.3 Solid Material Handling

<u>Description:</u>
Processes that will generate particulate emissions from solid material handling include Converting Lines, Cleaning Article Manufacturing, and Assembled Paper Product A. Dry materials in each of these processes are involved in unloading, conveying, converting, and/or packaging.

The converting room has paper rolls that are removed from the paper machine are unwound and converted into the final product using one of the three converting lines. The paper is rerolled onto cores, printed, and packaged according to specification. Finished products are sent to the distribution center for storage and/or shipping. Each converting line is equipped with a drum filter. One inlet to the drum filter, stream A, collect material from the floor sweeps/CVC system and the air stream is pretreated with a cyclone unit to dropout large material. The other inlet stream, stream B, collects dust directly from the unit operations. Streams A and B pass through a mesh pre-separator filter to remove large particulate materials prior to passing through the drum filter. The system achieves >99.5% control efficiency of filterable PM10 and does not control condensable particulate.

Two manufacturing lines produce consumer article cleaning products, which were recently permitted in 2016 undergoing a BACT analysis. In this process, substrate is unrolled (or manipulated) and scented raw materials and cleaners are added for use as the final product. Once the cleaning articles are complete, they are sent to be packaged and then onto a warehouse for distribution. Particulate matter is produced from receiving, sizing, and handling during the substrate converting process. This process is currently controlled by a baghouse that controls to 0.01gr/dscf.

Each Assembled Paper Product line functions to assemble various raw materials into the finished product. Several raw materials are unwound at points along the assembly process. Some raw materials are de-bulked in an offline process and delivered via air to the lines. Particulate is captured during the de-bulking of raw materials, the delivery of raw materials, and from the cutting operations on the line. This process is equipped with drum filters and baghouses, which provide control efficiencies of 99%.

Emissions Summary:

Solid Material Handling operations include Converting Room, Cleaning Article Manufacturing, and Assembled Paper Product. The following are the potential emissions for all operations pertaining to the solid material handling, in tpy.

	$PM_{2.5}$	**NO_X**	**SO_2**	**VOC**
Solid Material Handling	25.53	0.00	0.00	35.72

[Pollutant $PM_{2.5}$]

Fugitive particulate matter is emitted during the processing of the paper. This section addresses filterable $PM_{2.5}$ only.

Available Control Technology

The control technologies for $PM_{2.5}$ emissions for the converting lines in the paper making process:

- Fabric Filters,
- Wet Scrubbers,
- Wet Electrostatic precipitators (ESP),
- Cyclone Separator,
- Drum Filter, and
- Water Sprays/Dust Suppression

Technological Feasibility:

Fabric Filters

Fabric Filters (baghouse) remove particulates by collecting particulates on the filter bag as the exhaust stream passes through the baghouse. Baghouses typically cannot withstand high exhaust temperatures (greater than 500 °F). Fabric filer technology is a well-established particulate control technology that has historically been established as BACT. Baghouses have been shown to obtain particulate collection efficiency up to 99.5% for PM_{10}, and up to 99% capture for $PM_{2.5}$. The use of a baghouse is technically feasible.

Wet Scrubbers
Wet gas scrubber (WGS) technology was also evaluated for us as a particulate control technology for the proposed gas stream. A WGS reduces particulate emissions by mixing flue gas with scrubber liquid to remove particulate. The purge stream containing the collected particulate exits the bottom of the WGS to be further treated as wastewater. High efficiency wet scrubbers have been shown to achieve 99% capture for PM_{10}, but only up to 90% capture for $PM_{2.5}$. This type of control technology is technically feasible for use with the proposed gas stream.

Wet Electrostatic precipitators
Wet Electrostatic Precipitator (ESP) technology removes particulates by electrically charging the particles and collecting the charged particles on plates. The collected particulate is washed off the plates and collected in hoppers at the bottom of the ESP. High efficiency ESPs have been shown to achieve control of particulates up to 99.5% for PM_{10}, and up to 95% capture for $PM_{2.5}$. Due to the presence of small consumer fiber filaments when sizing the substrate for the Cleaning Article Manufacturing and absorbency materials for Assembled Paper Product A, this type of control technology is technically infeasible (US-EPA 2002k).

Cyclone Separator
Cyclones use centrifugal force and inertia to remove particles from a gas stream. The inertia of the particles resists the change in direction of the gas and they move outward under the influence of centrifugal force until they strike the walls of the cyclone. At this point, the particles are caught in a thin laminar layer of air next to the cyclone wall and are carried downward by gravity where they are collected in hoppers. Cyclones are capable of removing in excess of 90% of the larger diameter (> 30 pm) PM. However, their efficiency decreases with smaller particles. This technology is feasible for PM but not effective for PM_{10} and $PM_{2.5}$ (US-EPA 2002i).

Drum Filter
Air containing particulate or fibers is drawn into a chamber with a rotating drum wrapped with filter material. The solids are captured on the filter material. As the drum rotates there are vacuum pickup points that remove the solids material captured on the drum. From the pickup points the particulate matter is conveyed to a storage or processing area to be recycled or disposed. Drum filters are typically used in applications based on the type of particulate matter material to be controlled where a baghouse would be infeasible due to plugging (US-EPA 2002l). The drum filters have a 99.5% control efficiency. The drum filter control technology is technically infeasible for the Cleaning Article manufacturing. Drum filter are technically feasible for Converting Line and Assembled Paper Product A.

Water Sprays/Dust Suppression
Considering the processes work with final product and packaging, adding water or chemicals would degrade the integrity of material for use. Water sprays and dust suppression are considered technically infeasible for any of solid material handling

processes.

Economic Feasibility:
Baghouses, WGS, Wet ESP, and Cyclone Separator technologies are all technically feasible and economically feasible. The baghouse technology is currently operating to control $PM_{10}/PM_{2.5}$ missions for the solid material handling process.

BACT Selection:
BACT will be addressed for each induvial process; Converting Room, Cleaning Article Manufacturing, and Assembled Paper Product.

Converting Line
The drum filter system achieves >99.5% control efficiency of filterable PM2.5 and does not control condensable particulate. No add on control technology has better control efficiency. The drum filter system is BACT for the Converting Line.

Cleaning Article Manufacturing
The baghouse achieves 0.01 gr/dscf of filterable PM2.5 and does not control condensable particulate. No add on control technology has better control efficiency. A baghouse is BACT for the Cleaning Article Manufacturing.

Assembled Paper Product A
The drum filter system achieves >99% control efficiency of filterable PM2.S and does not control condensable particulate. No add on control technology yields a better control efficiency. The drum filter system is BACT for the Assembled Paper Product A.

Implementation Schedule:
The solid material handling operations are conducted with the gas stream going through a baghouse and drum filter systems prior to being discharged to the atmosphere. This control technology is currently installed and no implementation date is needed.

[Pollutant VOC]
VOC emissions are emitted during the solid material handling operations at Converting room (Paper Manufacturing Line), Cleaning Article Manufacturing, and Assembled Paper Product (Soap Manufacturing lines). The majority of the 35.72 tons per year of VOC emissions are fugitive emissions. To collect the fugitive VOC emissions requires extensive exhaust collections systems throughout the entire facility (for both manufacturing lines) with large volumes of air with small VOC concentrations.

Converting Room
The converting lines involve preparing the process for shipment including the sealing with adhesives, use additives and/or printing.

Cleaning Article Manufacturing
The consumer article cleaning products manufacturing consist of a substrate that is unrolled (or manipulated) and scented raw materials and cleaners are added to the

substrate for use as the final product. The process includes delivery of raw materials and transfer of material to holding and mixing tanks. The raw materials and cleaning mixtures are then applied onto a substrate to produce the cleaning article. Once the cleaning articles are complete, they are sent to be packaged and then onto a warehouse for distribution.

Assembled Paper Products
The assembled paper product line functions to assemble various raw materials into the finished product. Several raw materials are unwound at points along the assembly process. In addition, some raw materials are de-bulked in an offline process and delivered via air to the lines. Various raw and scented materials are also used in the assembly and packaging of Assembled Paper Products. VOCs occur as a result of raw and scented material application as well as from finished product packaging.

Available Control Technology
The control technologies for VOC emissions for the solid material handling operations are as follows:

- Wet Scrubber
- Carbon Filtration System
- Simple Thermal Oxidizer
- Low Vapor Recovery Products

Technological Feasibility:
Wet Scrubber
Absorption through a packed-bed tower wet scrubber is used for raw material and/or product recovery technique in separation and purification of gaseous streams containing high concentrations of water soluble VOCs compounds such as methanol, ethanol, isopropanol, butanol, acetone, and formaldehyde. Wet scrubbers are used to control inorganic gases. Removal efficiencies for gas absorbers vary for each pollutant-solvent system with the type of absorber used. The suitability of gas absorption as a pollution control method is generally dependent on the availability of the solvent, required removal efficiency, pollutant concentration inlet vapor, capacity required for handling waste gases and recovery value of the pollutants or the disposal cost of unrecoverable solvent. Air flow rates for packed bed scrubbers are 500 to 75,000 standard cubic feet per minute (scfm) (US-EPA 2002c). Due to the required flow rate needed for the scrubber this technology is technically infeasible.

Carbon Filtration System
Carbon Filtration System (adsorption) may be used on a low or medium concentrated gaseous stream to remove VOCs. During adsorption, a gaseous molecule is attracted to the solid material in the filtration system. Carbon adsorption has a linear control rate with the vapor pressure. The vapor pressures of the material in solid material handling operations are low, making the control rate low (US-EPA 1995). The use of vapor recovery systems would require the gas stream entering the vapor recovery system to be consistent makeup which makes this technology infeasible.

Simple Thermal Oxidizer
In a simple Thermal Oxidizer (TO) or afterburner, the displaced headspace gas is reheated in the presence of sufficient oxygen to oxidize the VOC. A TO is a flare not equipped with any heat recovery device. This technology is implemented with storage tanks large throughputs and several tanks co-located. TO control technology requires a combustion source increasing VOC, NO_X, and $PM_{2.5}$ from the facility (US-EPA 2002h). This technology is technically not feasible for a source with minimal concentrations and volume of air flow.

Low Vapor Pressure Material
Solid material handling operations are low vapor pressure materials and/or mixtures. Materials selected are low VOC containing materials that meet specifications for product requirements (Mcintyre 2009). As low vapor pressure materials are in use by the Box Elder Plant this option is considered technically feasible.

Economic Feasibility:
Low vapor pressure material is technically feasible and economically feasible.

BACT Selection:
BACT to control the VOC emissions from he solid material handling operations is the use of low vapor pressure material.

Implementation Schedule:
The use of low vapor pressure material is already in use so no implementation date is needed.

2.1.4 Cooling Tower

Description:
The cooling tower is a multi-cell, mechanical induced draft cooling tower that will be used to reject heat from cooling water to cool plant water. There are nine cooling towers to support the Box Elder Plant processes.

Particulate matter is emitted from wet cooling towers because the water circulating in the tower contains small amounts of dissolved solids that crystallize and form airborne particles as some of the water (drift) leaves the cooling tower through the induced draft fans and evaporates.

Emissions Summary:
The following are the potential emissions for the cooling towers, in tpy.

	$PM_{2.5}$	NO_X	SO_2	VOC
Cooling Towers	1.50	0.00	0.00	0.00

Available Control Technology
The control technologies for $PM_{2.5}$ emissions for the cooling towers are as follows:

- Drift/Mist Eliminator

Technological Feasibility:
Technically feasible technology includes a drift eliminator on the cooling tower. Based on established control efficiencies for these technologies, the drift eliminator is ranked as the control device providing the highest control efficiency. Additionally, the cooling towers are engineered to minimize water evaporation and cool machines as necessary. The DAQ has determined that for and proper engineering control and design has been selected as BACT for proposed gas stream for the control of $PM_{2.5}$ emissions.

Economic Feasibility:
The installation of drift/mist eliminators on the cooling towers is economically feasible. The DAQ is determined that the conversion from a 0.005% drift eliminators to 0.001% drift eliminators is not economically feasible to additionally control the 1.50 tons per year of $PM_{2.5}$.

BACT Selection:
BACT for $PM_{2.5}$ emissions from the proposed gas stream is use of a drift eliminator. The DAQ has reviewed the cooling towers as a common emitting unit with minor emissions. DAQ determined that new cooling towers shall have drift eliminator installed with a drift of 0.001%. Drift eliminator technology, with a drift of 0.005% is currently installed and operating at the Facility.

Implementation Schedule:
This control technology is currently installed and no implementation date is needed.

2.1.5 Chemical Making Process

<u>Description:</u>
The chemical manufacturing process involves the production of surfactants at the Box Elder facility. Surfactants are made through oxidation of sulfur in a reactor. Emissions associated with the surfactant making process are NO_X, CO, SO_2, H_2SO_4, VOCs, and PM_{10} and $PM_{2.5}$. Exhaust gases containing both combustion and process emissions from the reactor are routed through a duct and controlled by a packed bed scrubber. An ESP which is upstream of the packed bed scrubber is inherent to the process, and also serves to remove particulate matter.

<u>Emissions Summary</u>
The following are the potential emissions for the cooling towers, in tpy.

	$PM_{2.5}$	**NO_X**	**SO_2**	**VOC**
Chemical Making Process	6.01	1.25	0.38	4.87

<u>[Pollutant $PM_{2.5}$]</u>
In the chemical manufacturing/surfactant making process there is only one solid material

generated, which is a precipitated acid mix (PAM) from the dry electrostatic preceptor (dry ESP). The PAM is a product developed for soap manufacturing. Since the dry ESP is inherent to the process and removes the PAM upstream of the wet gas scrubber, the amount of particulate in the gas stream entering the scrubber is negligible.

Available Control Technologies:
The control technologies for $PM_{2.5}$ emissions for the chemical manufacturing/surfactant making process are as follows:

- Wet Gas Scrubbers
- Electrostatic Precipitators

Technological Feasibility:

Wet Gas Scrubbers
Wet Gas Scrubber technology was also evaluated for us as a particulate control technology for the proposed gas stream. A packed bed wet scrubbers reduces particulate emissions by mixing flue gas with scrubber liquid to remove particulate. The purge stream containing the collected particulate exits the bottom of the packed bed wet scrubber to be further treated as wastewater. High efficiency wet scrubbers have been shown to achieve 99% capture for PM_{10}, but only up to 90% capture for $PM_{2.5}$. This type of control technology is technically feasible for use with the proposed gas stream.

Wet Electrostatic Precipitators
Wet Electrostatic Precipitator (ESP) technology removes particulates by electrically charging the particles and collecting the charged particles on plates. The collected particulate is washed off the plates and collected in hoppers at the bottom of the ESP. High efficiency ESPs have been shown to achieve control of particulates up to 99.5% for PM_{10}, and up to 95% capture for $PM_{2.5}$. This type of control technology is technically feasible for this application.

Economic Feasibility:
Both ESP and packed bed wet scrubbers are both technically and economically feasible.

BACT Selection:
BACT to control the $PM_{2.5}$ emissions from the chemical manufacturing/surfactant making process is the use of ESP and a wet gas scrubber.

Implementation Schedule:
The use of an ESP and a wet gas scrubber for the chemical manufacturing/surfactant making process is already in use so no implementation date is needed.

[Pollutant NO_X]
Preheaters are used to heat the oxidation ovens in order to achieve a desired temperature for the oxidation reaction for the surfactant making process. The preheater burners are fired with natural gas. The preheaters are anticipated to operate a total of 12 hours per year. Emissions from natural gas combustion from the preheater are vented through a

packed bed wet scrubber prior to venting into the atmosphere.

Available Control Technologies:
The control technologies for NO_X emissions for the chemical manufacturing process are as follows:

- Natural Gas Combustion
- Low NOX burners
- LoTox

Technological Feasibility:

Natural Gas Combustion
Natural gas is a clean burning fuel that can be produced domestically and is technically feasible.

Low NO_X Burners
A Low NO_X Burners (LNB) provides a stable flame with two zones. There are many variations on the LNB theme of reducing NO_X that can produce more than 80% destruction removal efficiency. As the preheaters are rated less than 5 MMBtu/hr, LNB are not technically feasible (C.B. Oland 2002).

LoTox
LoTox™ technology (oxidation/reduction scrubbing), is a low-temperature oxidation process that employs ozone to oxidize NO_2 to higher oxides of nitrogen such as N_2O_5. NO is also converted to NO_2, which is NO_X. This technology requires to be paired with SCR or SNCR (The Linde Group 2017) for gas streams such as those from the proposed oven, which is expected to emit larger portions of NO than NO_2. The potential to increase total NOx emissions makes this option technically infeasible.

Economic Feasibility:
The only control technology that is technically feasible is the use of natural gas for combustion which is economically feasible.

BACT Selection:
BACT for the preheaters in the chemical making process to control NO_X is the use of natural gas.

Implementation Schedule:
The use of natural gas for the preheaters is already in use so no implementation date is needed.

[Pollutant SO_2]
In the surfactant making process, the primary reaction includes oxidation of sulfur. The resultant emissions from the surfactant making process will be SO_2, H_2SO_4, NO_X, CO, PM_{10}, $PM_{2.5}$ and VOCs. The emissions from the surfactant making process are captured and controlled by a packed bed scrubber.

Available Control Technology
The control technologies for SO_2 emissions for the chemical manufacturing/surfactant making process are as follows:

- Wet Gas Scrubber
- Double Adsorption

Technological Feasibility:

Wet Gas Scrubber
In a wet scrubber, the gaseous SO_2 is absorbed into an aqueous solution in a contacting section that has a large liquid surface for mass transfer. Contacting sections may include sprays, venturis, tray beds, or packed beds. Once the SO_2 is absorbed into the water, it is neutralized by an alkali (either sodium or calcium based). Sodium based scrubbers use either soda ash, sodium bicarbonate, or sodium hydroxide as a neutralizing agent. In a caustic scrubber, the blow-down (which would contain dissolved salts such as sodium sulfate) would have to be disposed of offsite. Caustic scrubbing is technically feasible.

Double Adsorption
Double adsorption is used to make H_2S0_4. The primary purpose of the chemicals process is to make surfactants and not H_2S0_4, it is not applicable to surfactant making process. The chemical manufacturing/surfactant making process is needed to make surfactant by oxidizing sulfur with H_2SO_4 being generated as a byproduct from the sulfur trioxide (SO_3) scrubber in the proposed chemicals process. The gas stream leaving the SO_3 scrubber is routed through the packed bed scrubber. The double adsorption is technology is used to make H2SO4 not control it, making this technology not feasible to control SO_2 emission.

Economic Feasibility:
The wet gas scrubber is the only option that is technically feasible and is economically feasible.

BACT Selection:
BACT to control the SO_2 emissions from the chemical manufacturing/surfactant making process is the use of wet gas scrubber.

Implementation Schedule:
The use of a wet gas scrubber for the chemical manufacturing/surfactant making process is already in use so no implementation date is needed.

<u>**[Pollutant VOC]**</u>
The chemical manufacturing process/surfactant making produces VOC emissions from the mixing and oxidation of material and from the combustion of the preheaters. Exhausts from the surfactant making process will be directly ducted and treated by the SO_2 wet gas scrubber.

Available Control Technology
The control technologies for VOC emissions for the chemical manufacturing/surfactant making process are as follows:

- Thermal Oxidation/Afterburner
- Regenerative Thermal Oxidizer
- Recuperative Thermal Oxidizer
- Regenerative Catalytic Oxidation
- Good Combustion Practices

Technological Feasibility:

Thermal Oxidation/Afterburner
In a Thermal Oxidation (TO) or afterburner, the flue gas exiting the scrubber is reheated in the presence of sufficient oxygen to oxidize the CO present in the flue gas. A TO is a flare and is not equipped with any heat recovery device. A TO will require additional fuel to heat the gas stream from 100-150 °F before the scrubber and 80°F after the scrubber to at least 1,600 °F (US-EPA 2002h). This additional fuel will generate additional emissions; therefore, the TO is considered technically infeasible.

Regenerative Thermal Oxidizer
A Regenerative Thermal Oxidizer (RTO) is equipped with ceramic heat recovery media (stoneware) with large surface area for heat transfer and can be stable to 2,300°F. Operating temperatures of the RTO system typically range from 1,500°F to 1,800°F (US-EPA 2002g) with a retention time of approximately one second. The combustion chamber of the RTO is surrounded by multiple integral heat recovery chambers, each of which sequentially switches back and forth from being a preheater to a heat recovery chamber. Energy is absorbed from the gas exhausted from the unit and stored in the heat exchange media to preheat the next cycle of incoming gas. An RTO will require additional fuel to heat the gas stream from 100-150 °F before the scrubber and 80°F after the scrubber to at least 1,500°. This additional fuel will generate additional emissions; therefore, the RTO is considered technically infeasible.

Recuperative Thermal Oxidizer
A Recuperative Thermal Oxidizer (RCTO) is more thermally efficient than simple thermal oxidization but less efficient than an RTO. The thermal efficiency is improved through the use of either a shell-and-tube or a plate-and-frame type heat exchanger in which heat from the treated flue gas is transferred or recirculated to the untreated flue gas. Up to 65 to 70% heat recovery is common. A RCTO is not technically feasible for VOC control for the surfactant process because; the metallic heat exchanger efficiency (65-70 percent) is lower than a RTO system and increasing the need for additional fuel (US-EPA 2002h).

Regenerative Catalytic Oxidation
A regenerative catalytic oxidizer (RCO) employs principles similar to those used in an RTO except that a catalyst is used to enhance the conversion of CO to CO_2 at a lower temperature (600-700°F) than an RTO (US-EPA 2002g). Despite use of a catalyst, it

would be necessary to reheat the post- flue gas to a temperature sufficient to operate the RCO. This reheating would create an increase in NOx relative to the untreated exit gas stream.

The largest potential problem associated with catalytic oxidation involves catalyst fouling and poisoning. Sulfur oxides present in the exit gas stream would poison the catalyst (US-EPA 2002g). Based on the technical difficulties of utilizing the catalyst as well as the fact that catalytic oxidation has not been applied to a surfactant process, catalytic oxidation is considered to be a technically infeasible VOC control option.

Good Combustion Practices
Good combustion practices for VOCs include adequate fuel residence times, proper fuel-air mixing, and temperature control. As it is imperative for process controls, the Box Elder Plant will maintain combustion optimal to their process. This technology is technically feasible.

Economic Feasibility:
A good combustion practice to control the VOCs is the only technically feasible control technology and economically feasible option.

BACT Selection:
BACT to control the VOC emissions from the chemical manufacturing/surfactant making process is the use of good combustion practice.

Implementation Schedule:
The use of good combustion practice for the chemical manufacturing/surfactant making process is already in use so no implementation date is needed.

2.1.6 Storage Tanks

The Box Elder Plant has several storage tanks associated with soap making, cleaning article manufacture, chemical making, gasoline (500 gallons), and a diesel tank (500 gallons). The contents of the tanks range from raw materials, intermediates, final products, and fuel. Storage tanks hold a range of products from organic liquids, ethanol, petroleum products, and mostly inert materials. All chemical tanks are aboveground fixed roof vertical tanks. These tanks are not subject to regulations under NSPS Subpart Kb, Standards of Performance for Volatile Liquid Storage Vessels, since all tanks are either, less than 75 cubic meters, tanks greater than 151 cubic meters storing liquid with a maximum true vapor pressure less than 3.5 kilopascals or tanks greater than 75 to 151 cubic meters storing liquid with a maximum true vapor pressure less than 15.0 kilopascals.

Description:
Emissions from fixed roof storage tanks result from displacement of headspace vapor during filling operations (working losses) and from diurnal temperature and heating

variations (breathing losses). VOC emissions from the storage tanks at the Box Elder Plant are a result from displacement of headspace during filling operations and minimal emissions as a result of temperature variations and solar heating cycles since most of the tanks are indoors.

Emissions:
The following are the potential emissions for the storage tanks , in tpy.

	$PM_{2.5}$	NO_X	SO_2	VOC
Storage Tanks	0.00	0.00	0.00	14.61

Available Control Technology
The control technologies for VOC emissions for the storage tanks are as follows:

- Internal Floating Roof
- Vapor Recovery System
- Wet Scrubber
- Low Vapor Recovery Products
- Carbon Filtration System
- Simple Thermal Oxidizer

Technological Feasibility:

Internal Floating Roof
Internal floating roofs are installed on storage tanks greater than 1,000 barrels (bbls) (42,000 gallons). All storage tanks at the Box Elder Plant are less than 1,000 bbls. Internal floating roofs tanks are considered technically infeasible.

Vapor Recovery System
Vapor recovery through carbon adsorption, vapor balance, or refrigerated condenser provides control of emissions by collecting the vented material for recycle or reuse. Vapor adsorption units are not implemented on facilities with a multiple smaller storage tanks containing different materials with throughputs less than 50,000 barrels. The tanks located onsite are several sets of smaller storage tanks. This option is technically feasible.

Wet Scrubber
Absorption through a packed-bed tower wet scrubber is used for raw material and/or product recovery technique in separation and purification of gaseous streams containing high concentrations of water soluble VOCs compounds such as methanol, ethanol, isopropanol, butanol, acetone, and formaldehyde. Wet scrubbers are used to control inorganic gases. Removal efficiencies for gas absorbers vary for each pollutant-solvent system with the type of absorber used. The suitability of gas absorption as a pollution control method is generally dependent on the availability of the solvent, required removal efficiency, pollutant concentration inlet vapor, capacity required for handling waste gases and recovery value of the pollutants or the disposal cost of unrecoverable solvent. Air flow rates for packed bed scrubbers are 500 to 75,000 standard cubic feet per minute (scfm). An ethanol scrubber is used for the ethanol tanks on a soap making line.

Absorption through a packed-bed tower wet scrubber is not in use for diesel or gasoline storage tanks of similar size and is technically infeasible(US-EPA 2002c).

Low Vapor Recovery Products
Many of the storage tanks store low vapor pressure materials and/or mixtures utilizing fixed roof tanks. For storage tanks containing materials with higher vapor pressure, the storage tanks are sealed and have an inert gas vapor blanket. The source is limited by the material stored in the tanks to maintain product quality. Alternate material is not technically feasible (Mcintyre 2009).

Carbon Filtration System
Carbon Filtration System (adsorption) may be used on a low or medium concentrated gaseous stream to remove VOCs. During adsorption, a gaseous molecule is attracted to the solid material in the filtration system. Carbon adsorption has a linear control rate with the vapor pressure. The vapor pressures of the material in the storage tanks are low, making the control rate low (US-EPA 1995). Adsorption is technically feasible with a low control rate.

Simple Thermal Oxidizer
In a simple Thermal Oxidizer (TO) or afterburner, the displaced headspace gas is reheated in the presence of sufficient oxygen to oxidize the VOC. A TO is a flare not equipped with any heat recovery device. This technology is implemented with storage tanks large throughputs and several tanks co-located. TO control technology requires a combustion source increasing VOC, NO_X, and $PM_{2.5}$ from the facility. This technology is technically not feasible for a source with minimal throughputs (US-EPA 2002h).

Economic Feasibility:
The following technologies are technically feasible, vapor recovery system, wet scrubber to control ethanol, and carbon filtration system. The use of vapor recovery systems would require the source to install on each different material being storage; increase the cost of control, making it economically infeasible. The use of wet scrubber to control ethanol is economically feasible. The use of carbon filiation to control VOC is with low vapor pressure material lower the control efficiency increasing the cost per ton removed (US-EPA 2002m), making carbon filiation economically infeasible.

BACT Selection:
BACT to control the VOC emissions (ethanol) from a soap making line is the use of a wet scrubber. BACT to control the VOC emissions from material with higher vapor pressure is the use of storage tanks are sealed storage tanks and an inert gas vapor blanket. BACT to control the VOC emissions from all other storage tanks is the use of fixed roof tanks.

Implementation Schedule:
The use of fixed roof tanks, wet scrubber for soap making line and sealed storage tanks with vapor blanket for high vapor pressure material is already in use so no implementation date is needed.

2.1.7 Fugitive VOC

The Box Elder Plant uses several additives, inks, and chemicals that contain VOCs and are potentially emitted as fugitives. Fugitive VOC emissions detailed in this section are emitted from the soap making and bottle blowing operations.

<u>Description:</u>

Soap Making

Raw materials to make soaps are pumped for blending. As the blending occurs in a closed system, minimal VOCs are emitted from the soap making operation.

Bottle Blowing Supplier

Within the bottle blowing supplier business unit, the bottles and containers needed for site-wide packaging purposes are molded. The process begins with plastic beads that are delivered to a silo and then conveyed to the appropriate equipment on-site. These plastic pieces are fed into an extruder where the final container shape is formed. This container then receives a label and is delivered for use within the other business units on-site. Any scrap plastic that is created is recycled back to the bottle and container making processes through regrinding.

<u>Emissions:</u>

The following are the potential emissions for the fugitive VOC, in tpy.

	$PM_{2.5}$	NO_X	SO_2	VOC
Fugitive VOC	0.00	0.00	0.00	6.49

Available Control Technology

The control technologies for VOC emissions for the fugitive VOC are as follows:

- Wet Scrubber
- Carbon Filtration System
- Simple Thermal Oxidizer
- Low Vapor Recovery Products

Technological Feasibility:

Wet Scrubber

Absorption through a packed-bed tower wet scrubber is used for raw material and/or product recovery technique in separation and purification of gaseous streams containing high concentrations of water soluble VOCs compounds such as methanol, ethanol, isopropanol, butanol, acetone, and formaldehyde. Wet scrubbers are used to control inorganic gases. Removal efficiencies for gas absorbers vary for each pollutant-solvent system with the type of absorber used. The suitability of gas absorption as a pollution control method is generally dependent on the availability of the solvent, required removal efficiency, pollutant concentration inlet vapor, capacity required for handling waste gases and recovery value of the pollutants or the disposal cost of unrecoverable solvent. Air flow rates for packed bed scrubbers are 500 to 75,000 standard cubic feet per minute (scfm) (US-EPA 2002c). Due to the required flow rate needed for the scrubber this technology is technically infeasible.

Carbon Filtration System
Carbon Filtration System (adsorption) may be used on a low or medium concentrated gaseous stream to remove VOCs. During adsorption, a gaseous molecule is attracted to the solid material in the filtration system. Carbon adsorption has a linear control rate with the vapor pressure. The vapor pressures of the material in the fugitive VOCs are low, making the control rate low (US-EPA 1995). The use of vapor recovery systems would require the gas stream entering the vapor recovery system to be consistent makeup which makes this technology infeasible.

Simple Thermal Oxidizer
In a simple Thermal Oxidizer (TO) or afterburner, the displaced headspace gas is reheated in the presence of sufficient oxygen to oxidize the VOC. A TO is a flare not equipped with any heat recovery device. This technology is implemented with storage tanks large throughputs and several tanks co-located. TO control technology requires a combustion source increasing VOC, NO_X, and $PM_{2.5}$ from the facility (US-EPA 2002h). This technology is technically not feasible for a source with minimal concentrations and volume of air flow.

Low Vapor Pressure Material
Like the storage tanks the perfumes, adhesives, and paper additives are low vapor pressure materials and/or mixtures. Materials selected are low VOC containing materials that meet specifications for product requirements (Mcintyre 2009). As low vapor pressure materials are in use by the Box Elder Plant this option is considered technically feasible.

Economic Feasibility:
Low vapor pressure material is technically feasible and economically feasible.

BACT Selection:
BACT to control the fugitive VOC emissions is the use of low vapor pressure material.

Implementation Schedule:
The use of low vapor pressure material is already in use so no implementation date is needed.

2.1.8 Truck Loading

Truck loading operations occur at P&G. VOC and HAPs emissions are anticipated to be generated from the loading and unloading of tanker trucks.

Description:
VOC emissions occur when products or intermediates containing organics are loaded or unloaded into tanker trucks. VOC emissions during loading are from vapors evaporated from the new liquid being loaded. Since the Box Elder Plant only loads out products or

intermediates very infrequently, the emissions associated with this operation truck loading is not a significant emissions source. The Box Elder site has evaluated controls for BACT.

<u>Emissions:</u>
The following are the potential emissions for the truck loading (>1% of source wide VOC emission), in tpy.

	$PM_{2.5}$	NO_X	SO_2	VOC
Fugitive VOC	0.00	0.00	0.00	>1.62

Available Control Technology
The control technologies for VOC emissions for the truck loading operations are as follows:

- Vapor Recovery System
- Vapor Balancing
- Submerged Loading

Technological Feasibility:
Vapor Recovery System
Vapor recovery through carbon adsorption, vapor balance, or refrigerated condenser provides control of emissions by collecting the vented material for recycle or reuse. The tanks located onsite are several sets of smaller storage tanks. This control technology requires a large consistent throughput which makes this technically infeasible (US-EPA 1995).

Vapor Balancing
In vapor balancing, hydrocarbon vapors are collected from the compartment where the liquid is being loaded and returned to the tank from which the liquid is being sent. This balancing works since the volume of displaced vapors is almost identical to the volume of liquid removed from the tank. This technique is most effective when loading tank trucks from fixed roof tanks. This technology is technically feasible.

Submerged Loading
The use of submerged loading as a means of control offers the low cost way to control loading emissions. The two types of submerged loading are the submerged fill pipe method and the bottom loading method. In the submerged fill pipe method, the fill pipe extends almost to the bottom of the cargo tank. This technology is technically feasible.

Economic Feasibility:
The following technologies are technically feasible, vapor balancing and submerged loading. The use of vapor balancing would require the source to install additional piping on each storage tanks. The cost to install the piping on the tanks and tankers for the infrequent filling makes this technology economically infeasible. The use of submerged loading to control VOC is economically feasible.

BACT Selection:
BACT to control the truck loading VOC emissions is the use of submerged loading.

Implementation Schedule:
The use of submerged loading is already in use so no implementation date is needed.

2.1.9 Diesel Emergency Generators and Firepumps

P&G has emergency equipment to support operations during power outages or an emergency.

Description:

The P&G has several diesel-fueled non-road engines generators and firepump engines used for emergency purposes. Diesel engines are classified as compression ignition (CI) internal combustion engines (ICE). The primary pollutants in the exhaust gases include NO_X, VOC, SO_2, and $PM_{2.5}$. The engines are for emergency use only (except for readiness testing) and use diesel fuel meeting the requirements of 40 CFR §80.510(b) for nonroad diesel fuel.

Emissions:

The following are the potential emissions for the diesel-fueled non-road engines generators and firepump engines, in tpy.

	$PM_{2.5}$	NO_X	SO_2	VOC
Diesel Non-Road Engines	0.00	2.50	0.00	0.00

Available Control Technology

The control technologies for diesel-fueled non-road engines generators and firepump engines are as follows:

- Limited Hours of Operation
- Good Combustion Practices
- Use of Tier Certified Engine
- Engine Design
- Diesel Particulate Filter
- Ultra-Low Sulfur Fuel
- Oxidation Catalyst
- Selective Catalyst Reduction

Technological Feasibility:

Limited Hours of Operation

One of the apparent opportunities to control the emissions of all pollutants released from the emergency engines powering generators and fire pumps is to limit the hours of operation for the equipment. Due to the designation of this equipment as emergency equipment, only 100 hours of operation for maintenance and testing are permitted per NSPS Subpart IIII. P&G complies with NSPS Subpart IIII requirements and minimizes operation time for emergency generators to maintenance and testing. Limiting hours of operation is technically feasible to control NO_X and $PM_{2.5}$.

Good Combustion Practices

Good combustion practices refer to the operation of engines at high combustion efficiency, which reduces the products of incomplete combustion. The emergency generators are designed to achieve maximum combustion efficiency. The manufacturer has provided operation and maintenance manuals that detail the required methods to achieve the highest levels of combustion efficiency making good combustion practices technically feasible.

Use of a Tier Certified Engines

Today engines are required to meet certain emission limits, or tier ratings, based on the size and model year. Emission standards for engines have progressively gotten more stringent over time and are an indicator of good combustion design. The fire pumps meet the lowest emission rating for their size as identified in 40 CFR 60 Subpart IIII making use of a tier certified engines technically feasible.

Diesel Particulate Filters

This technology is placed in the exhaust pathway to prevent the release of particulate and may be coated with a catalyst to further capture hydrocarbon emissions. The technology is technically feasible.

Ultra Low Sulfur Diesel

Ultra low sulfur diesel (ULSD) contains less than 0.0015 % sulfur by weight. The reduced sulfur content reduces the potential for SO_2 emissions. The low sulfur content results in a lower potential for aggregation of sulfur containing compounds and reduces $PM_{2.5}$ emissions. The use of ULSD is technically feasible.

Diesel Oxidation Catalyst

A diesel oxidation catalyst (DOC) utilizes a catalyst such as platinum or palladium to further oxidize the engine’s exhaust, which includes hydrocarbons (HC), VOC, to carbon dioxide (CO2) and water. Use of a DOC can result in approximately 90 percent reduction in HC/VOC emissions. In addition to controlling HC/VOC a DOC also has the potential to control PM by 30 percent and CO by 50 percent if low sulfur diesel fuel is used.

The use of a DOC reduces the effective power output of RICE and results in a solid waste stream. A DOC is considered technically feasible.

Selective Catalytic Reduction

Selective Catalytic Reduction (SCR) systems introduce a liquid reducing agent such as ammonia or urea into the flue gas stream before a catalyst. The catalyst reduces the temperature needed to initiate the reaction between the reducing agent and NO_X to form nitrogen and water.

For SCR systems to function effectively, exhaust temperatures must be high enough

(200°C to 500°C) to enable catalyst activation (US-EPA 2002e). SCR control efficiencies are relatively low during the first 20 to 30 minutes after engine start up, especially during maintenance and testing. There are also complications controlling the excess ammonia (ammonia slip) from SCR use. SCR is anticipated to have a relatively low combustion efficiency during maintenance and testing, SCR is not considered technically feasible for emergency units.

Economic Feasibility:
The following technologies are technically feasible, limited hours of operation, good combustion practices, use of a Tier Certified engines, diesel particulate filters, ULSD, and DOC. Since the use of the engines is for emergency purposes and operate on a limited time (<100 hrs) for testing and maintenance. The emissions associated with these units are low. The cost to install add-on controls (diesel particulate filters and DOC) to control the low NO_X emitted from the units economically infeasible. The economically feasible control technologies for these units are the limited hours of operation, good combustion practices, use of a Tier Certified engines, and the use of ULSD.

BACT Selection:
BACT to control the diesel-fueled non-road engines generators and firepump engines is limited hours of operation, good combustion practices, use of a Tier Certified engines, and the use of ULSD.

Implementation Schedule:
The source is maintains records of limited hours of operation, and operates the units using good combustion practices, and the engines are Tier Certified engines and the engines operate on ULSD. No implementation date is needed.

3.0 Startup/Shutdown Considerations:

Startup for the Boilers and Paper Machines requires a 30 minute period prior to normal operation for the equipment to reach a steady state operation. Shutdown of the boilers is instantaneous and requires no time period. Shutdown for the paper machines requires a 30 minutes diversion of the hot air to the dryer startup stack.

4.0 Conclusions:

The State of Utah has reviewed P&G operations/equipment and has determined that P&G is meeting RACT. P&G is subject to the following federal requirements; 40 CFR 60 Subpart A- General Provisions, 40 CFR 60 Subpart Dc-Standards of Performance for Small Industrial- Commercial-Institutional Steam Generating Units, 40 CFR 60 Subpart IIII-Standards of Performance for Stationary Compression Ignition Internal Combustion Engines, and 40 CFR 63 Subpart A-General Provisions, and 40 CFR 63 Subpart ZZZZ-NESHAPs for Stationary Reciprocating Internal Combustion Engines.

The following limits shall not be exceeded for P&G operations as per Part H.12.s:
A. 3.3 pounds per hour of NO_X for each Paper Making Boiler.
B. 0.9 pounds per hour of $PM_{2.5}$ filterable and condensable for each Paper Making Boiler.

C. 1.8 pounds per hour of NO_X for each Utility Boiler.
D. 0.74 pounds per hour of $PM_{2.5}$ filterable and condensable for each Utility Boiler.
E. 13.50 pounds per hour of NO_X for each Paper Machine Process Stack.
F. 17.95 pounds per hour of $PM_{2.5}$ filterable and condensable for each Paper Machine Process Stack

Compliance with each limit above emission limits shall be determined by stack test as outlined in Section IX Part H.11.e of the $PM_{2.5}$ SIP. Stack testing is required every three years for NO_X and $PM_{2.5}$ for each boiler and paper machine process stack.

Stationary source emissions monitoring provides data from a regulated stationary source to demonstrate compliance with certain regulatory requirements in Federal or State rules and/or in an operating permit, as well as provides information to the facility operator about the performance of the process and air pollution control device.

An indicator of performance is the parameter measured or observed for demonstrating proper operation of the air pollution control measures and compliance with the applicable emissions limitation or standard. Indicators of performance may include direct emissions measurements, surrogate emissions measurements (including opacity), operational parametric measurements that correspond to process or control device (and capture system) efficiencies or emission rates, and recorded findings of inspections of work practice activities, material tracking, or design characteristics. All of these monitoring techniques can be used to ensure a source is operating within its emission limits.

Stack tests are frequently used in short term sampling programs to determine actual source emissions of criteria pollutants and HAPs. A stack test or a CEMS will verify if a source is operating in compliance with a permitted emission rate or limit. If the source has a production or emission rate that is constant, then a stack test provides sufficient verification of the emissions rate. For example, a natural gas combustion source is constant with little or no variation in the emission rate and performing a stack test once every two to three years provides sufficient information to demonstrate compliance with their permitted emission rate(s). Stack testing more frequently is not cost effective and is over burdensome on a source when it only provides information that is constant. Monitoring using portable monitors, between stack tests, can provide information indicating that the source is complying with their permitted emission rates; however, portable monitors are not always reliable and comparison to the data from stack testing using EPA approved methods is problematic. Although the permit may require stack testing less than annually, DAQ compliance inspectors visit major sources annually and if concerns with stack emissions or source operations are observed, the inspector can recommend and the DAQ Director can require a stack test to be conducted.

A Continuous Emissions Monitor (CEM) costs significantly more and places an undue burden on a source if continuous data collection is not needed to verify process performance or fuel consistency. The cost of the equipment for a CEM is over $25,000, and this does not include the cost of the installation or the operation of a CEM. Operation costs include testing that is performed throughout the year by highly trained personnel.

Skilled workers are needed to properly operate the system on a daily basis. Also, there is no reliable CEM to monitor particulate matter and so stack testing or visibility testing are typically used for particulate monitoring.

The emissions from the P&G boilers and paper machines are a result of the combustion of natural gas and the emissions are steady. Stack tests of these sources have verified that the emissions are consistent and are well below the permit limit. The DAQ has determined that major sources that require stack testing will be tested at a minimum of once every three years, unless more frequent testing is needed due to a variable fuel source or process, or due to a need for more precise data due to the source emissions being near a regulatory threshold. The performance of a stack test costs from $5,000 to $20,000 per testing session and so test frequency should be set at a rate that provides sufficient data to ensure enforceability of the limit.

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