Offset Project Plan Form:
Chevron Canada Pneumatic Device Project

Project Developer:
Chevron Canada Ltd.

Prepared by:
GreenPath Energy Ltd.

Date:
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1.0 Contact Information

Table 1-1: Project Contact Information

Project Developer Contact Information	Additional Contact Information
Chevron Canada Limited	*GreenPath Energy Limited*
Paul Dziuba	*Michael D'Antoni*
500 - 5th Avenue S.W.	*148-555 Strathcona Blvd SW PO Box 74102*
Calgary, AB T2P 0L7	Calgary AB T3H 3B6
403.234.5049	*250.886.1751*
https://canada.chevron.com/	www.greenpathenergy.com
PDziuba@chevron.com	*mdantoni@greenpathenergy.com*

2.0 Project Scope and Site Description

Table 2-1: Project Information

Project title	Chevron Canada Pneumatic Device Project
Project purpose and objectives	The purpose of this project is to quantify greenhouse gas (GHG) emission reductions resulting from the conversion of gas driven pneumatic devices to electric (solar & grid) powered devices, conversion of high bleed pneumatic controllers to low bleed devices and installation of new solar electric pumps. Chevron Canada Pneumatic Device Project has two components: 1) Pneumatic Pump Electrification – Includes the installation of solar and grid-tied electric pumps and conversion of gas driven pneumatic chemical injection pumps to solar and grid-tied electric pumps at greenfield/brownfield facilities. 2) Pneumatic Level Controller High to Low Conversions – Involves the conversion of high bleed pneumatic controllers (including level controllers) at brownfield facilities to low bleed devices. Each subproject will reduce or avoid the release of greenhouse gas emissions throughout the Proponent's asset portfolio. They eliminate or reduce methane and carbon dioxide which would have been vented from pneumatically driven devices had the project not occurred. Field data will be aggregated for all project components and reported in one annual assertion. Carbon offset credits are generated in accordance with the *Quantification Protocol for Greenhouse Gas Emission Reductions from Pneumatic Devices* (V 2.0 January 2017).

Activity start date	Different sub-projects have different activity start dates. All the relevant information is submitted to the registry via the aggregated planning and reporting sheets.
Offset crediting period	The expected offset crediting period is from the day the project documents are submitted to the registry (July 3, 2019) till the end of Dec 31, 2022.
Estimated emission reductions/ sequestration	The project involves installing/conversion of electric chemical injection pumps as well as high to low bleed conversion of level controllers. It is expected during the project crediting period, 60 electric chemical injection pumps will be installed at both greenfield and brownfield facilities. On average each pump will be reducing vented fuel gas by 100 tonnes of CO2e per year. Also, it is assumed that 13 of the high bleed rate level controllers (Fisher L2 Model) in the Project Proponent's assets, will be converted to low bleed devices (Fisher L2-LG). On average, each level controller conversion will be reducing vented fuel gas by 83 tonnes of CO2e per year. The estimated total greenhouse gas emission reductions from the Project are as follows:

July 3, 2019 – December 31, 2019	2,042 tonnes of CO_{2e}
December 31, 2019 – December 31, 2020	4,084 tonnes of CO_{2e}
December 31, 2020– December 31, 2021	5,584 tonnes of CO_{2e}
December 31, 2021 – December 31, 2022	7,084 tonnes of CO_{2e}

Unique site identifier	Different sub-projects have different locations. All the relevant information is submitted to the registry via the aggregated planning and reporting sheets.
Is the project located in Alberta?	YES
Project boundary	1) Pneumatic Pump Electrification This sub project includes the installation of electric powered chemical injection pumps at greenfield and brownfield facilities instead of gas driven pneumatic pumps. The source of electricity is solar the for the eligible project sites. Chevron has several sites with other sources (TEG, Self-Generation, Grid) of electricity these sites are not eligible to generate offsets from electric pumps, while a few sites get the power from grid electricity. The pumps are owned and operated by the Project Proponent. Currently all the pumps are located at greenfield facilities, but the Project Proponent may have retrofits of gas driven chemical injection pumps to electric pumps at brownfield facilities during the project crediting period. All of the electric pumps are installed at the production facilities where they are needed. Depending on the processes, these pumps inject methanol or other chemicals such as corrosion inhibitor.

	The Project encompasses the Proponent's oil and gas facilities operating in Alberta. The Aggregated Project Planning Sheet contains geological locations of sub-projects included in the Project. The electric pumps in this project are operating year-round and emission reductions are calculated based on the pumps stroke counts on an annual basis. 2) Pneumatic Level Controller High to Low Conversions This sub-project includes the conversion of higher vent rate Fisher L2 level controllers to lower bleed Fisher L2-LG controllers by changing the level controller relay. Fisher L2-LG Relay is purpose built for a Liquid-Gas Interface in a separator which eliminates transient emissions. The level controllers may be located on a single wellsite, battery, satellite etc. The legal land location of each device is tracked within the Project inventory and the Aggregated Project Planning Sheet.
Ownership	Chevron Canada Limited owns and operates the facilities at which the Project is implemented and asserts that it has ownership of the emissions reductions. Furthermore, no emission reductions associated with the Project have been registered under any other emissions trading scheme.

2.1 Project Description

Project Component #1 – Pneumatic Pump Electrification

Chemical injection pumps are used in production facilities to help prevent adverse conditions in the production network such as freezing and corrosion, through injecting different chemicals getting pumped into the production stream. Typically, these pumps use pneumatic pressure supplied by a fuel gas or instrument gas line to actuate the pump, then the natural gas is vented to the atmosphere. This fuel gas, which is the actuator of the pneumatic pressure for pumps, is primary composed of methane which is a potent GHG with a GWP of 25 times that of carbon dioxide. Efforts to decrease this venting have produced a zero-venting solution by using electric energy to actuate the same fluid that was actuated by fuel gas in the traditional pneumatic system. This reduces the amount of natural gas vented to the atmosphere by the process to zero.

Baseline and project conditions at the sites can be easily compared as only the drive source has been converted, while pump operations have remained the same.

Baseline condition for all subprojects is defined as the state of facility operations prior to the installation (conversion[1]), where fuel gas would have been used to drive pneumatic chemical injection pumps, similar to other sites at the Project Proponent facilities. The pneumatic

[1] Until the start date of crediting period, all the subprojects have been new install in greenfield facilities. However, depending on the future development plans of the Project Proponent, conversion (retrofits) may happen at brownfield facilities in future, during the crediting period. Conversions at brownfield facilities are allowed to generate offset credits as stated and allowed by the Protocol.

powered chemical injection pumps were then converted to electric driven chemical injection pumps, and no fuel gas was further required to operate the pumps. The most common fuel gas driven pump in the baseline condition are BRUIN (BR5000) with a plunger size of 1 ¼″ with a full stroke length[2].

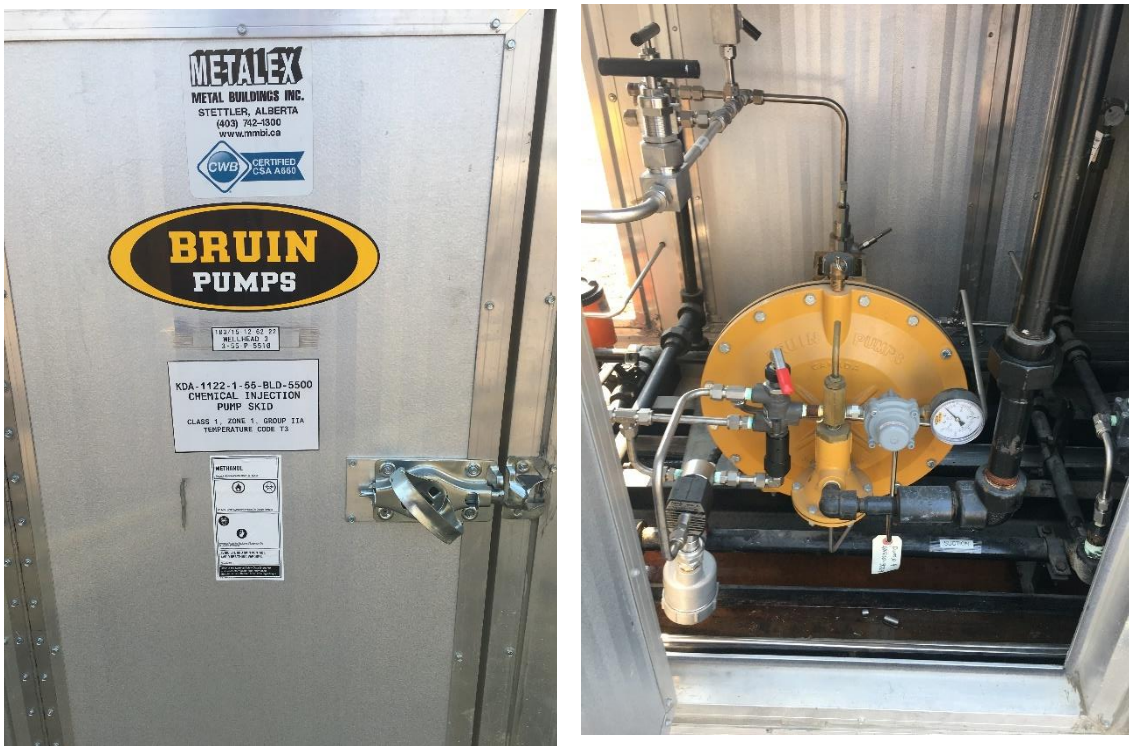


Figure 2-1 Baseline Pumps (Pneumatic pumps)

Project condition for those subprojects is defined as pneumatic pumps that use solar powered electricity as their actuating source which results in no-venting and therefore no emissions are associated in this aspect of the project. For grid tied electric pumps, there are no venting emissions in the project condition. However, there are emissions associated with electricity usage which are captured using the suggested approach in the protocol.

[2] This configuration was chosen for the baseline as it has been the most common pneumatic pump in the Project Proponent facilities.

Figure 2-2 Project pumps (solar pumps)

As mentioned in the protocol, gas-driven chemical injection pumps vent on a per stroke basis and this is the metric for establishing functional equivalence. Electric pumps in the Project Proponent's sites have a stroke counter installed on them. The stroke counts do not change in the baseline versus project condition. The emission reductions resulting from the installations of electric pumps is calculated based on the stroke count in the project condition.

Currently there are 15 solar powered electric chemical injection pumps included in the project. To estimate the emissions during the offset crediting period, the following parameters are taken into account:

- Pump make and model
- Pump plunger size
- Pump stroke length
- Injection pressure
- Pump stroke count or volume of chemical injected
- Methane and carbon dioxide composition in fuel gas

Projects utilize the following technology for the solar electric chemical injection pumps:

- Battery packs that store and supply power to the system
- Photo electric panels that converted solar energy into electric current that are active during the day light hours charging the batteries for night time and cloudy day operation
- High efficiency motor, gearbox, a pump mounting system to facilitate the activation of the conventional pumping systems used in pneumatic systems. The pump systems deliver the amount of liquid per stroke independent of the actuator, pneumatic or electric.
- Pump controller which provides just enough alternating current for the motor to maintain the desired speed. This system is very efficient and allow for automation of the system. The controller also accurately measures the volume of chemical that gets injected regardless of speed variations or back pressure.

The expected lifetime of the electric pumps in this project is expected to be 10 years according to the Eco-Efficiency Handbook [Reference 1].

Project Component #2 – Pneumatic Level Controller High to Low Conversions

Producing wells are typically connected to separators used for separating the various gaseous and liquid components of well fluids. Operators use pneumatic devices/controllers connected to separators in oil and gas facilities to measure process variables such as pressure and temperature and transmit signals to the final control elements. Pneumatic controllers in this project include level controllers. Level controllers use sensors to detect liquid levels or the interface of liquid/liquid or liquid/gas, and then use relays to provide control and action.

Similar to pumps, baseline and project conditions at the sites can be easily compared as only the relay has been converted, while all other controller operations have remained the same. Improved relay will result in lower or no venting from the level controllers. It is expected that all the conversions will occur after the project registration.

Figure 2-3 Baseline level controller

Fisher L2-LG Relay is purpose built for a Liquid-Gas Interface in a separator which eliminates transient emissions. For this controller, the gain has been customized to appropriately widen the span of the vessel to save gas by reducing the frequency of the dump cycles for a given rate of liquid production. It is important to note that the crisp performance of the original relay has been preserved as well as the expected ruggedness and reliability.

The Project Proponent's fisher L2 that are planned to be converted, emit on average 0.88 m^3/hr and when retrofitted to an L2-LL and L2-LG relay, the emission factor is reduced to 0.1 m^3/hr.

The baseline level controllers make and model is typically Fisher L2 at the Project Proponent facilities and the project level controllers are expected to be Fisher L2-LG.

To estimate the offsets generated during the crediting period, the following parameters are taken to account:

- Controller Make (baseline and project)
- Controller Model (baseline and project)
- Supply pressure
- Operation hours of the facility/controller
- Vent rate samples

The expected lifetime of the Fisher L2 liquid level-controllers is in line with typical level controllers depending on process fluid and operating conditions, according to the Eco-Efficiency Handbook [Reference 1].

2.2 Protocol

The *Quantification Protocol for Greenhouse Gas Emission Reductions from Pneumatic Devices* (V 2.0 January 2017) Section 1.2 lists both components of the project as acceptable project types for the generation of emission reductions offset:

Project Component #1 – Pneumatic Pump Electrification

The installation of electric driven chemical injection pumps with alternative electricity[3] sources in greenfield facilities and conversion of pneumatic pumps to grid tied electric pumps in brownfield facilities are considered acceptable project types for the generation of emission reductions offsets under The *Quantification Protocol for Greenhouse Gas Emission Reductions from Pneumatic Devices* (V 2.0 January 2017). This is for those electric devices in the project condition that perform the same effective process control or operational function as in the baseline condition.

Project Component #2 – Pneumatic Level Controller High to Low Conversions

Conversion of pneumatic level controllers from high-bleed to low-bleed models is considered an acceptable project type under The *Quantification Protocol for Greenhouse Gas Emission Reductions from Pneumatic Devices* (V 2.0 January 2017). Converted low-bleed controllers are effective replacements for previously installed high-bleed devices since they offer the same effective process control as the baseline devices while reducing emissions by utilizing improved relays.

In the absence of the two components of the project, higher amounts of methane and carbon dioxide, both greenhouse gases, would have been vented to the atmosphere. The GHG reductions associated with the project are additional since the activities performed under the project are not required by regulation or law. Further, the project involves activities beyond business-as-usual, as pneumatic device electrification and level controller conversion project have both financial and technical barriers.

Table 2-2 below shows how the project will meet the quantification protocol requirements:

Table 2-2 – Protocol Criteria and Project Eligibility

Protocol Criteria	Project Eligibility
1. Pneumatic or electric devices in the project condition perform the same effective process control or operational function as in the baseline condition. This requirement considers changing throughput or production declines. This means the specific frequency of control interventions, volume of methanol injected, or other activity, may change in time, but safe and reliable operation is maintained.	Project Component #1 – Pneumatic Pump Electrification Baseline pneumatic supply pressure becomes functionally equivalent to electric supply amperes after the conversion has taken place. The pump is performing the same function without any pneumatic supply pressure in the Project case. The operational performance unit used to demonstrate functional

[3] Alternative electricity includes solar, wind, biomass, microturbine, waste pressure, waste heat, solid oxide fuel cell and Stirling engine power sources.

	equivalency is the or the pump stroke count and injection pressures. <u>Project Component #2 – Pneumatic Level Controller High to Low Conversions</u> The low-bleed pneumatic controllers that replace the previously installed high-bleed controllers, provide functions and reliability in Project conditions similar to the baseline conditions. The level controllers operate throughout the time that that the well is flowing into the separators and the time of operation remains the same in the project and baseline condition.
2. The protocol is applicable to methane vent reduction projects. Reduction of propane venting and/or conversion from propane to methane is not contemplated in this protocol.	The first component of the project eliminates the methane vent emissions from pneumatic chemical injection pumps. The second component of the project reduces the methane vent emissions from level controllers significantly by utilizing improved relays for the controllers (up to 74% emissions reduction per controller [Reference 2]
3. For the purposes of this protocol, "conversions" are considered to occur at brownfield sites with existing equipment being replaced and "installs" are considered to occur at greenfield sites where no equipment existed prior to the implementation of the project. This must be demonstrated by process flow diagrams and/or accounting records, work orders, invoices or other vendor/third party documentation/evidence.	This first component of the project includes electrification of pneumatic devices in accordance with Table 1 in section "1.2 Protocol Applicability" of the protocol. All the electric pumps installed in greenfield facilities are solar pumps. Additionally, the project may include conversion of existing pneumatic chemical injection pumps to solar and grid-tied electric pumps in brownfield facilities. The second component of the project includes the conversion of high-bleed pneumatic level controllers to low-bleed pneumatic level controller with the same functionality in brownfield facilities in accordance with Table 1 in section "1.2 Protocol Applicability" of the protocol.
4. The Project Proponent must inspect and maintain pneumatic devices as part of regular operations for high to low, compressed air and vent gas capture projects. This must be performed annually by performing operator site visits to ensure that pneumatic devices	Not applicable to the first component of this project as it is categorized as Pneumatic Device Electrification. For the second component of this project, the Project Proponent plans to either perform an annual inspection procedure

do not excessively vent. Operators must keep records demonstrating the maintenance and inspection activities of facilities. If pneumatic device inspection is not performed according to suggested monitoring frequencies, volumes must be reduced using a Discount Factor. This factor is developed in detail in Appendix A. If pneumatic device inspection becomes required by regulation the offset project must inspect and maintain pneumatic devices as per the requirements of the relevant regulation.	for low-bleed level controllers to ensure there is no excessive vent from these devices or use discount factors provided in Appendix A of the Protocol to account for the years during the reporting period that inspections have not been completed.
5.To facilitate verification and allow for changes, the proponent will develop an inventory of devices. Any changes to the inventory (i.e., devices removed) will impact net offsets claimed as illustrated in Appendix B.	The inventory will be maintained annually and adjusted if project conditions change over time. Aggregated project planning sheets also, help maintain the inventory of current and future sub-projects which is submitted to the registry.

The Project Proponent will make use of Protocol Flexibility Mechanism #1:

Mechanism #1: Project Proponents can quantify and aggregate multiple conversions or installs under one project plan. The entire quantification method should apply to each conversion to ensure accuracy.

The Project Proponent is using this flexibility mechanism to aggregate the installation of solar pumps, and conversion of pneumatic level controllers for the crediting period from July 3, 2019 until December 31, 2022. The Project Proponent has the current inventory of all devices that are eligible for offset generation. Any future new installs of electric pumps or any conversion including the replacement of pneumatic driven pumps with electric pumps as well as conversion including high to low-bleed pneumatic level controllers will be submitted to the registry within the acceptable timeframe. The Project Proponent will ensure the emission reductions quantification will be in line with protocol requirements.

The Proponent may or may not make use of Protocol Flexibility Mechanism #3 and Mechanism #4:

Mechanism #3: Site-specific and make and model-specific emission factors may be substituted for the generic emission factors indicated in this protocol document. The methodology for generation of these emission factors must be sufficiently robust to ensure accuracy. See Appendix C of the Protocol.

Mechanism #4: Options are presented in Section 2.0 and in Section 4.1 for proponents to determine emissions related to baseline and project activity for certain project types. Preferential order of methods is presented in Section 2.0 for proponents who have the ability to quantify emissions with more accuracy.

Project Component #1 – Pneumatic Pump Electrification

The Project Proponent's use of Flexibility Mechanism #4 will result in more accurate emission reduction assertions because device specific venting rates, from manufacturer specifications are used. These specific vent rates are reported for different injection pressures and are reported per volume of chemical injected. As stated in the Protocol's appendix C:

> *The pump emission factor is referenced from manufacturer specifications. At a given supply pressure and injection pressure, a pump will consume and vent a known volume of gas for each stroke or volume of chemical injected. In the absence of a known stroke count, Project Proponents can use the volume of chemical injected to determine the volume of gas vented in the baseline, as per Flexibility Mechanism 4.*

The Project Proponent is using *Projection Based Baseline Type* which are claimed to be the most accurate because they measure pump activity and project this to the baseline (as per protocol). The Protocol says that reliable projections can be made on the volume of natural gas that would have been released in the absence of the project based on the pump stroke count (or volume of injected chemicals) in the project condition.

Project Component #2 – Pneumatic Level Controller High to Low Conversions

The Project Proponent may use site-specific emission factors instead of the generic emission factors indicated in this protocol document. The Project Proponent will make sure that these site-specific emission factors are generated according to the Protocol requirements.

The Project Proponent will be using either the *Historic Benchmark* or *Performance Standard Baseline Type* for level controllers baseline emissions estimates depending on the availability of vent measurements prior to conversion.

2.3 Risks

Table 2-3 below shows all the risks associated with this emission offset project:

Table 2-3 Risk Matrix

Risk Identification	Level of Risk	Mitigation/Management Strategy
Technical Risks		
Lack of maintenance	Low	Performance and upkeep of the electrical motor and solar array have been added to the overall maintenance of the facility. Field personnel are trained to assess and maintain the efficiency of the motor and solar panels.

Lack of uninterrupted electrical energy source	Low	Planning for the solar array accounts for the electrical demand of the pneumatic conversion/installations. Solar panel maintenance has also been added to the facility maintenance procedure to ensure that they are operating at optimal efficiency. When the solar array is not operating (i.e. night) the solar powered devices will run on battery power. The solar array will be used to charge the battery backup during the day; producing more energy than is consumed by the pneumatic conversions/installations.
Failure to store enough energy in the battery backup for use during times of low or no solar power generation	Low	The amount of battery backup has been designed to provide the pneumatic conversions/installations with enough electricity to operate without recharging for several days should the solar array experience suboptimal charging conditions. In addition, improvements to automation by the technology provider will warn the proponent if the battery backup is low at a particular site, allowing them sufficient time to troubleshoot the issue. If the electrical power fails, the pump stops and the current volume of injected chemicals (and therefore the stroke count) is retained in the controller memory. Once power is restored the pump restarts measuring the volume of chemicals from the volume at the time the pump was stopped.
Decommissioning of conversion equipment which could affect the amount of emissions reduction the project can potentially generate	Low	The decommissioning of the conversion/installation equipment is not expected as all equipment has been operating for less than a year and maintains a usable life span far beyond the crediting period defined herein.
Data collection risk	Low	The project relies heavily on automated data and therefore has low risk for degradation or loss. Data management is done through several redundant systems that have local storage both on and offsite providing for robust data as processes and personnel change through time.
Devices existing in the Proponent's project are taken offline	Moderate	If a well is shut in and no longer producing, the pump will also be shut-off and the volume of injected volume and pump stroke counter will remain at zero for the project year.
Equipment failure	Low	An equipment failure could cause excessive vents and downtime. This risk is mitigated by selecting proven technology and robust controller devices from reliable equipment manufacturers.

Political Risk		
Alberta Government requires that pneumatic devices be upgraded to solar electric	Low	There is currently no regulation or draft regulation requiring the conversion of pneumatic to zero emissions (such as solar) and it is not expected to be a requirement under future regulations within the timeframe of carbon offsets eligibility.

3.0 Project Quantification

3.1 Inventory or Sources and Sinks

All the sources and/or sinks for project types that are eligible project activities under the protocol are identified in table 3 and table 4 of the Protocol. For completeness, all those sink and sources are considered and are include in table 3-1 below. This table provides all source and sinks under project and baseline conditions. Also, any inclusion or exclusion of these sources and sink are explained and justified.

Table 3-1 Inventory or Sources and Sinks

1. Identified SS	2. Baseline	3. Project	4. Include or Exclude	5. Justification for Exclusion
Upstream Sources and Sinks				
P1 Raw Gas Production B1 Raw Gas Production	N/A Related	Related N/A	Exclude Exclude	**As per protocol:** Excluded as the production of raw gas is not impacted by the implementation of the project and as such the baseline and the project conditions will be functionally equivalent.
P2 Raw Gas Transportation B2 Raw Gas Transportation	N/A Related	Related N/A	Exclude Exclude	**As per protocol:** Excluded as the transportation of raw gas is not impacted by the implementation of the project and as such the baseline and the project conditions will be functionally equivalent.
P3 Raw Gas Processing B3 Raw Gas Processing	N/A Related	Related N/A	Exclude Exclude	**As per protocol:** Excluded as the processing of raw gas is not impacted by the implementation of the project and as such the baseline and the project conditions will be functionally equivalent.
P5 Fuel Gas for Processing B5 Fuel Gas for Processing	N/A Related	Related N/A	Exclude Exclude	**As per protocol:** Excluded as the fuel gas for facility is not impacted by the implementation of the project and as such the baseline and the project conditions will be functionally equivalent.

P6 Air Compression	N/A	Controlled	Not Relevant	The Project is replacing the pneumatic gas with electric energy not pneumatic air.
P8 Process Control Electricity	N/A	Related	**Included**	The Project is powered by electric energy coming from renewable source (solar) and grid. Those pumps that are grid tied, have additional electricity emission compared to the baseline condition and are captured using suggested approach in the Protocol.
B9 Electricity Usage	Controlled	N/A	Exclude	**As per protocol:** Existing air compression systems that are expanded to include pneumatic devices may have electricity emissions to account for in the baseline. The project air compressor and air management system will require electricity that is incremental to baseline electricity consumption but these emissions are conservatively accounted in all project scenarios under this protocol and this source is therefore redundant and excluded.
P9 Fuel Extraction/ Processing	N/A	Related	**Included**	The electric conversion uses all renewable energy and grid electricity and thus does not have any fuel related emissions. There is no additional fuel use as a result of level controller conversion either.
B10 Fuel Extraction/ Processing	Related	N/A	Exclude	**As per protocol:** Fuel extraction and processing emissions may vary depending on the stage of processing or transportation of the gas. Emissions from fuel extraction and processing may not be relevant to the baseline condition. It is conservative to exclude baseline emissions
P10 Fuel Delivery	N/A	Related	Exclude	**As per protocol:** Excluded as the fuel delivery is not impacted by the implementation of the project and as such the baseline and the project conditions will be functionally equivalent.
B11 Fuel Delivery	Related	N/A	Exclude	
Onsite Sources and Sinks				
P7 Project Vented Gas	N/A	Controlled	**Included**	The first component of this Project includes replacing the pneumatic

				gas with electric energy resulting in no venting emissions. The second component of the project includes converting high to low-bleed level controllers. There is vented gas in Project emissions for new low-bleed level controllers.
B7 Baseline Vented Gas	Controlled	N/A	**Included**	Included as baseline includes pneumatic pumps and controllers which vent natural gas into atmosphere.
B8 Uncaptured Fuel Gas	Controlled	N/A	Not Relevant	Not relevant as these activities apply to emissions reductions from installing or upgrading a vent gas capture and destruction system. This project converts pneumatic devices with electric energy devices resulting in no venting emissions.
P17 Vent Gas Capture	N/A	Controlled	Not Relevant	
Downstream Sources and Sinks				
P4 Processed Gas Distribution and Sale	N/A	Related	Exclude	**As per protocol:** Excluded as the emissions from the distribution and sale of avoided vented gas is the sole responsibility of the end user. It is assumed the final use of this gas will be controlled combustion to produce carbon dioxide. Accountability of this gas is in the hands of end users.
B4 Processed Gas Distribution and Sale	Related	N/A	Exclude	
Other Sources and Sinks				
P11 Construction on Site	N/A	Related	Exclude	**As per protocol:** Emissions from construction on site are not material for the baseline or project condition given the minimal construction on site typically required.
B12 Construction on Site	Related	N/A	Exclude	
P12 Development of Site	N/A	Related	Exclude	**As per protocol:** Emissions from development of site are not material for the baseline condition given the minimal development of site typically required.
B13 Development of Site	Related	N/A	Exclude	**As per protocol:** Emissions from building of equipment are not material given the long project life and the minimal building equipment typically required.
P13 Building of Equipment	N/A	Related	Exclude	**As per protocol:** Emissions from building of equipment are not material given the long project life

				and the minimal building equipment typically required.
B14 Building of Equipment	Related	N/A	Exclude	**As per protocol:** Emissions from building of equipment are not material for the baseline given the minimal building equipment typically required.
P14 Testing of Equipment	N/A	Related	Exclude	**As per protocol:** Emissions from testing of equipment are not material given the long project life and the minimal testing of equipment typically required.
P15 Transportation of Equipment	N/A	Related	Exclude	**As per protocol:** Emissions from transportation of equipment are not material given the long project life and the minimal transportation of equipment typically required.
B15 Transportation of Equipment	Related	N/A	Exclude	
P16 Site Decommissioning	N/A	Related	Exclude	**As per protocol:** Emissions from decommissioning of site are not material given the long project life and the minimal decommissioning typically required.
B6 Site Decommissioning	Related	N/A	Exclude	

The following equations were selected and apply to this GHG emissions offset Project based on the Quantification Protocol for Greenhouse Gas Emission Reductions from Pneumatic Devices (V 2.0 January 2017):

$$Net\ Emission\ Reductions = Emissions_{Baseline} - Emissions_{Project}$$

Where baseline GHG emissions are calculated according to the following:

$$Emissions_{Baseline} = Emissions\ from\ B7\ Baseline\ Vented\ Gas$$

Emissions from B7 Baseline Vented Gas:

The GHG emissions that would have resulted from the vented gas in the baseline condition were calculated.

<u>Project Component #1 – Pneumatic Pump Electrification</u>

The volume of natural gas is calculated based on the pump specifications and manufacturer vent rates. Emission Factors of the pumps are reported in scf NG/Gallon of expected chemical injected based on manufacturer specifications and depend on the pump's injection pressure, plunger size, and stroke length. Pump plunger size and stroke length are used to calculate the volume of injected chemical per pump stroke, then the pump emissions factor is converted from scf NG/Gallon to scf NG/pump stroke using this calculated value. In the absence of stroke counts, the Project Proponent will use the volume of injected chemicals to calculate the vented gas.

Project Component #2 – Pneumatic Level Controller High to Low Conversions

To quantify this source of emission, direct measurements of high vent level controllers are used. These vent rates are then multiplied by the operating hours of the level controllers to estimate the vented gas in the baseline scenario.

Project emission sources include the following:

$$Emissions_{Project} = Sum\ of\ \ emissions\ under\ the\ Project\ condition$$

$$= Emissions\ from\ P7\ Project\ Vented\ Gas + P9\ Fuel\ Extraction/\ Processing$$
$$+ P8\ Process\ Control\ Electricity$$

Emissions from P7 Project Vented Gas:

Project Component #1 – Pneumatic Pump Electrification

For the solar and grid-tied pumps, in the project condition, all the energy required to actuate the pump is generated from electric energy and thus the venting emissions for operating the process controller is zero.

Project Component #2 – Pneumatic Level Controller High to Low Conversions

In the Project condition, 13 low-bleed Fisher L2-LG level controllers are used at the Proponent's facilities which lead to vented gas emissions at the Project condition. To quantify this source of emission, direct measurements of high vent level controllers are used. These vent rates are then multiplied by the operating hours of the level controllers to estimate the vented gas in the baseline scenario.

Emissions from P9 Project Fuel Extraction/Processing:

Project Component #1 – Pneumatic Pump Electrification

This is zero as the project does not involve any fuel use.

Project Component #2 – Pneumatic Level Controller High to Low Conversions

This is zero as there is no additional fuel used as a result of level controller conversion.

Emissions from P8 Project Process Control Electricity:

Project Component #1 – Pneumatic Pump Electrification

For solar pumps, this value is zero as there are no emissions associate with electric power supply to the project. For grid tied pumps, the kWh of electric usage of pumps are estimated based on equipment specifications as allowed by the Protocol.

Project Component #2 – Pneumatic Level Controller High to Low Conversions

This is zero as there is no electricity consumption by the level controllers in the project condition.

3.1.1 Data Collection and Monitoring

As further defined in Section 3.5, there are multiple data points required for this Project and each has its own data collection process. Several data points are collected once at the beginning of the Project (e.g.: stroke length, piston diameter, power rate of grid tied pumps), while the ongoing and variable data points (e.g.: stroke counts and injection pressure) will be captured and tracked quarterly to ensure consistent oversight of the data is occurring. The data tracking will be accumulated and reviewed under the Quality Assurance/Quality Control measures defined in Section 3.5.2.

The following figures demonstrate the data collection templates to be used by the Project Proponent to collect project data: **Chevron Canada Pneumatic Device Project**

Data Collection			
Calendar Year: 2019			
Meter Read Date		Read By:	

Project Component #1 – Pneumatic Pump Electrification

Location (LSD)	Pump Serial Number	Solar or Grid tied	Stroke Counts		Injection Pressure (PSI)	Comment
			Cumulative	Incremental		

Location (LSD)	Pump Serial Number	Solar or Grid tied	Volume of Chemical injected (Litre)		Injection Pressure (PSI)	Comment
			Cumulative	Incremental		

Project Component #2 – Pneumatic Level Controller High to Low Conversions

Location (LSD)	Level Controller Serial Number	Operation hours (hr/month)	Comment

Injection pressures and operating hours will be collected regularly through the automated SCADA. However, the stroke counts and/or volume of chemical injected are expected to be collected through the SCADA, upon availability. If SCADA system is not available to capture these two data points, then a third party (GPE) will be sent to pump sites to capture data on a reasonable timeframe. All data will be summarized in an annual summary sheet and reviewed under the QA/QC procedures. The annual summary sheet will be password protected and only known to those individuals responsible for the data collection. If applicable, hard copies of any data collected and input into these sheets will be kept in Chevron's field offices.

3.2 Baseline and Project Condition

Project Component #1 – Pneumatic Pump Electrification

The baseline condition for pneumatic pump electrification is defined as the release of natural gas from pneumatic chemical injection pumps at the Proponent's oil and gas sites through gas pneumatic device activity. As outlined in the Table 2 Description of Baseline Types in the Protocol, for pneumatic pump conversion:

> *Projection based baselines for the electrification are the most accurate because they measure the pump activity and project this to the baseline. Reliable projections can be made on the volume of natural gas that would have been released in the absence of the project based on the pump stroke count in the project conditio*n.

In accordance with the protocol, GHG emissions from chemical injection pumps that would occur from B7 Baseline Vented Gas, if the project was not carried out, is estimated to be 15,000 tonnes of CO_2e over the crediting period.

Based on the Proponent's development plan, 60 pumps will be installed from 2019 until 2022. To estimate the emissions during the offset crediting period, the following parameters are taken into account:

- Pump make and model (Bruin pneumatic pumps, BR 5000)
- Pump plunger size (Pumps are assumed to have a plunger size of 1 ¼")
- Pump stroke length (Pumps are assumed to have a short stroke length)
- Injection pressure (the pressure which the liquid is pumped in the process)
- Stroke counts (if not available volume of chemical injected)
- Methane and carbon dioxide composition in fuel gas

In the project condition, electric driven chemical injection pumps replace the pneumatically driven pumps. The actual pump mechanism is not changed to ensure functional equivalency. Maintaining functional equivalence while improving monitoring capabilities allow for the baseline condition to be accurately calculated regardless of changes to operating practices.

For the solar pumps, in the project condition, all the energy required to actuate the pump is generated from renewable solar energy and thus the emissions for operating the process controller is zero.

For the grid tied pumps, in the project condition, pumps are connected to grid electricity to get the power needed to actuate and thus the emissions for operating the process controller is not zero and the Project Proponent quantified the emissions using the protocol's suggested approach. There are currently zero grid tied pumps that are conversions in brownfield facilities.

In accordance with the protocol, GHG emissions from chemical injection pumps that would occur from P7 Baseline Vented Gas, if the project was not carried out, is estimated to be zero tonnes of CO_2e over the crediting period.

<u>Project Component #2 – Pneumatic Level Controller High to Low Conversions</u>

The baseline condition for converting high- to low-bleed level controllers is defined as the continued use of high-bleed devices, Fisher L2 level controllers, with compressed natural gas that results in venting methane and carbon dioxide emissions into the atmosphere. Vented gas emissions at baseline conditions are quantified according to B7 emission source using either site-specific emission factors (if available) or vent rates provided in GPE PTAC level controller report [Reference 2]. This study has generated emission factors for Fisher L2 level controllers that are beyond the requirements of the Alberta Pneumatic Offset Protocol.

In accordance with the Protocol, GHG emissions from high-bleed level controllers that would occur from B7 Baseline Vented Gas, if the project was not carried out, is estimated to be 4,281 tonnes of CO_2e over the crediting period.

Based on the Proponent's development plan, it is expected that 13 level controllers will be converted from 2019 until 2022. In the Project condition, 13 low-bleed Fisher L2-LG level controllers are used at the Proponent's facilities which lead to vented gas emissions at the Project condition. Similar to Baseline calculations, vent rates provided in GPE PTAC level controller report [Reference 2] are used to estimate Project emissions.

In accordance with the Protocol, GHG emissions from low-bleed level controllers at Project conditions from P7 Project Vented Gas is estimated to be 487 tonnes of CO_2e over the crediting period.

3.3 Quantification Plan

The quantification of reductions of relevant sources of greenhouse gases has been completed according to the methods outlined in Section 3.1 of the Quantification Protocol for Greenhouse Gas Emission Reductions from Pneumatic Devices" Version 2.0 (January 2017). As outlined previously, certain sources and sinks have been excluded where not applicable, and the remaining are presented in the Table 3-1 below:

Table 3-2 – Quantified Sources and Sinks

SS	Related project/baseline activities
On Site SS	
B7 Vented Fuel Gas	The quantity of gas vented to the atmosphere after it has been used by pneumatic control instruments.
P7 Project Vented Gas	For the first component of the project, this value is "zero" as it is replacing the pneumatic gas with electric energy resulting in no venting emissions. For the second component of the project, low bleed level controllers in the project condition have venting emissions which are calculated according to the Protocol's requirements.
Upstream Sources and Sinks	
P8 Process Control Electricity	For solar pumps in the project conduction, the value is "zero" as the pumps are powered by solar energy and do not have additional electricity emission compared to the baseline condition. For grid tied pumps, sources are calculated based on the Protocol requirements.
P9 Fuel Extraction/ Processing	The value is "zero" as there are no fuel combustion in the project condition and thus there are no fuel related emissions.

For each relevant SS above, quantification methods to be used to calculate the GHG emissions for the project and baseline are detailed. The methods are based on those provided in the protocol.

$Emissions_{Reductions} = Emissions_{Baseline} - Emissions_{Project}$

3.3.1 CALCULATION OF BASELINE EMISSIONS

Project Component #1 – Pneumatic Pump Electrification

$Emissions_{Baseline} = [Emissions_{Baseline\ Vented\ Gas\ (SS\ B7)}]$

$Emissions_{Baseline} = Emissions_{Baseline\ Vented\ Gas} = \Sigma_j\ (Vented_{Gas\ Baseline,\ j} * \%CH_4 * \rho\ CH_4 / 1000) * GWP_{CH4} + \Sigma_j\ (Vented\ Gas_{Baseline,\ j} * \%CO_2 * \rho\ CO_2/1000)$

Where

$Vented\ Gas_{Baseline} = Strokes_j * EF_{Pump\ Type\ j}$ (for converting pumps to non-venting equivalents)

$\%CH_4$ – is the methane composition of the fuel gas [%]

ρCH_4 – is the density of methane [kg/m3]

$\%CO_2$ – is the carbon dioxide composition of the fuel gas [%]

$\rho\ CO_2$ – is the density of carbon dioxide [kg/m3]

GWP_{CH4} – Global Warming Potential of methane (stated in the Carbon Offset Emission Factors Handbook)

Manufacturer specifications include Emission Factors of the pumps that are reported in scf NG/Gallon of expected chemical injected and depend on the following:

- Pump injection pressure[4] (Measured)
- Pump plunger size (Measured)
- Pump stroke length (Measured)

Pump plunger size and stroke length are used to calculate/estimate the volume of injected chemical per pump stroke, then the pump emissions factor is converted from scf NG/Gallon to scf NG/pump stroke using this calculated value.

In the absence of stroke counts, as allowed by the Protocol, the Project Proponent will use the volume of injected chemicals to calculate the vented gas.

Project Component #2 – Pneumatic Level Controller High to Low Conversions

$Emissions_{Baseline} = [Emissions_{Baseline\ Vented\ Gas\ (SS\ B7)}]$

[4] The Protocol suggests using actual injection pressures to find relevant emission factors. The Project Proponent, however, rounds down the pressures to 100 PSI intervals. The result is immaterial.

$Emissions_{Baseline} = Emissions_{Baseline\ Vented\ Gas} = \Sigma_j (Vented\ Gas_{Baseline,\ j} * \%CH_4 * \rho\ CH_4 / 1000) * GWP_{CH4} + \Sigma_j (Vented\ Gas_{Baseline,\ j} * \%CO_2 * \rho\ CO_2/1000)$

Where

$Vented\ Gas_{Baseline} = Op.\ Hrs._j * (Q_{baseline,\ j})$

$Q_{baseline,\ j} = Q_{Direct\ measurements\ j}$

Or

$Q_{baseline,\ j} = Q_{Average\ Controller\ type\ j}$

$\%CH_4$ – is the methane composition of the fuel gas [%]

ρCH_4 – is the density of methane [kg/m3]

$\%CO_2$ – is the carbon dioxide composition of the fuel gas [%]

$\rho\ CO_2$ – is the density of carbon dioxide [kg/m3]

GWP_{CH4} – Global Warming Potential of methane (stated in the Carbon Offset Emission Factors Handbook)

$Op.\ Hrs._j$ – is the operating hours [hrs]

$Q_{Direct\ measurement}$– is the measured vent rate of high vent level controller [m^3/hr]

The Project Proponent is using direct measurements of vent rates from level controllers with high vents prior to the conversions. These values will be used and get multiplied by the operating hours of the level controllers to calculate the vented gas volumes in the baseline condition.

3.3.2 CALCULATION OF PROJECT EMISSIONS

Project Component #1 – Pneumatic Pump Electrification

$Emissions_{Project} = [Emissions_{Project\ Vented\ Gas\ (p7)} + Emissions_{Process\ Control\ Electricity\ (P8)} + Emissions_{Fuel\ Extraction\ /\ Processing\ (P9)}]$

Where

$Emissions_{Project\ Vented\ Gas\ (p7)} = 0$ (for all electric pumps)

$Emissions_{Process\ Control\ Electricity\ (P8)} = Electricity_{Process\ Control} * EF_{Elec\ Supply} / 1000$

Where

$Electricity_{Process\ Control}$ - Total Quantity of Electricity Consumed for Control Functions [kwh]

Where

$EF_{Elec\ Supply}$ - Emission Intensity Factor for Electricity Consumption [Kg CO_2e / kWh]

= EF_{grid} (for projects using grid electricity) – For grid tied electric pumps obtained from the Carbon Offset Emission Factors Handbook

= 0 (for projects using on-site renewable electricity) – For solar electric pumps

$Emissions_{\text{Fuel Extraction / Processing (P9)}}$ = 0 (for all electric pumps as there is no fuel combustion to generate power)

Project Component #2 – Pneumatic Level Controller High to Low Conversions

$Emissions_{\text{Project}} = [\, Emissions_{\text{Project Vented Gas (p7)}} + Emissions_{\text{Process Control Electricity (P8)}} + Emissions_{\text{Fuel Extraction / Processing (P9)}}]$

$Emissions_{\text{Project Vented Gas (p7)}} = \Sigma_j (\text{Vented Gas}_{\text{Project, j}} * \%CH_4 * \rho\, CH_4 / 1000) * GWP_{CH4} + \Sigma_j (\text{Vented Gas}_{\text{Project, j}} * \%CO_2 * \rho\, CO_2/1000)$

Where

$\text{Vented Gas}_{\text{Project}} = \text{Op. Hrs.}_j * (Q_{\text{project, j}})$

$Q_{\text{baseline, j}} = Q_{\text{Average Controller type j}}$

$\%CH_4$ – is the methane composition of the fuel gas [%]

ρCH_4 – is the density of methane [kg/m3]

$\%CO_2$ – is the carbon dioxide composition of the fuel gas [%]

$\rho\, CO_2$ – is the density of carbon dioxide [kg/m3]

GWP_{CH4} – Global Warming Potential of methane (stated in the Carbon Offset Emission Factors Handbook)

Op. Hrs._j – is the operating hours [hrs]

$Q_{\text{Average Controller Type}}$– is the average measurement sample of vent rate of low vent level controller [m^3/hr]

The Project Proponent is using direct measurements of vent rates from level controllers with low vents after to the conversions. These values will be used and get multiplied by the operating hours of the level controllers to calculate the vented gas volumes in the project condition.

$Emissions_{\text{Process Control Electricity (P8)}}$ = 0

The P8 process control electricity is estimated to be zero as there is no electricity consumption by the level controllers in the project condition.

$Emissions_{\text{Fuel Extraction / Processing (P9)}}$ = 0

The P9 fuel extraction/processing is assumed to be zero as there is no additional fuel use as a result of level controller conversion in the project condition.

To summarize the quantification plan, the following table provides a summary of the key data sources used in the calculation of baseline and project emissions for each project component.

Table 3 - Data Sources Used in the Quantification of Baseline and Project Emissions

Parameter	Description	Units	Measured/ Estimated	Source
Project Component #1 – Pneumatic Pump Electrification				
$EF_{Pump\ Type\ j}$	Emission factors of Pumps in the baseline	scf NG/Gallon	Estimated	Pump manufacturer specifications.
Pump stroke counts or Volume of Chemical injected	Number of strokes for each pump which can be calculated based on the volume of chemicals injected as allowed by the Protocol.	Stroke/pump or Gallon chemical Injected/Pump	Measured (if not available, estimated)	If strokes counters are available in the facility, direct measurements of those will be used. If stroke counters are not available, then volume of chemical injected will be used to
%CH4	methane composition of the fuel gas	% volume	Measured	Direct measurement of composition of fuel gas, completed annually by a third-party laboratory.
ρCH4	density of methane	kg/m3	Estimated	0.678 kg/m3 at 15°C and 1 atmosphere[5]. At 15º C and 101.3kPa, the standard reference conditions used by the natural gas industry.
%CO2	carbon dioxide composition of the fuel gas	% volume	Measured	Direct measurement of composition of fuel gas, completed annually by a third-party laboratory.

[5] http://encyclopedia.airliquide.com/Encyclopedia.asp?GasID=41

ρ CO2	density of carbon dioxide	kg/m3	Estimated	1.86 kg/m3 at 15°C and 1 atmosphere. At 15º C and 101.3 kPa, the standard reference conditions used by the natural gas industry[6].
GWPCH4	Global Warming Potential of methane	t CO_2e/ t CH_4	Estimated	Stated in the Carbon Offset Emission Factors Handbook to be 25.
Project Component #2 – Pneumatic Level Controller High to Low Conversions				
$Q_{Direct\ measurement}$	Measured Vent Rate of Control Device	m^3 / hr	Direct measurement	Direct measurement of the high and low vent devices for pre and post conversions, completed by a third-party at the project developer sites as indicated by the Protocol, direct measurement of vent rate provides high confidence
Op. $Hrs._j$	Operating Hours	Hrs	Direct measurement	Continuous operating time measurement is the highest level possible.
%CH4	methane composition of the fuel gas	% volume	Measured	Direct measurement of composition of fuel gas, completed annually by a third-party laboratory.
ρCH4	density of methane	kg/m3	Estimated	0.678 kg/m3 at 15°C and 1 atmosphere[7]. At 15º C and 101.3kPa, the standard reference conditions used by the natural gas industry.
%CO2	carbon dioxide composition of the fuel gas	% volume	Measured	Direct measurement of composition of fuel gas, completed annually by a third-party laboratory.
ρ CO2	density of carbon dioxide	kg/m3	Estimated	1.86 kg/m3 at 15°C and 1 atmosphere.

[6] https://encyclopedia.airliquide.com/carbon-dioxide

[7] http://encyclopedia.airliquide.com/Encyclopedia.asp?GasID=41

				At 15º C and 101.3 kPa, the standard reference conditions used by the natural gas industry8.
GWPCH4	Global Warming Potential of methane	t CO_2e/ t CH_4	Estimated	Stated in the Carbon Offset Emission Factors Handbook to be 25.

The vent rates for the high vent level controllers were measured by a third party at the Project Proponent sites prior the conversion to low vent rate devices that improves the relays. The Project Proponent is using those devices specific vent rates for all the devices to quantify the emission reduction in this offset project.

3.3.3 Sample Calculation

Sample Input Data

$\%CH_4$ = 90%

ρCH_4 = 0.678 [kg/m3]

$\%CO_2$ = 1 %

$\rho\ CO_2$ = 1.86 [kg/m3]

GWP_{CH4} = 25

Pump injection pressure = 500 PSI

Pump plunger size = 11/4" = 1.25 inch

Pump stroke length = Full =1" = 1 inch

Stroke count (provided by the meters on the pump) = 171,073

Manufacturer emission factor @500 PSI & Stroke length of 1” & Plunger size of 1 1/4" = 0.095 Scf NG/stroke

Power of grid tied pumps = 1000 Watt

Operating hours of pumps = 24 hours/d * 30 days/month = 720 hrs/month

$EF_{Elec\ Supply}$ - Emission Intensity Factor for Electricity Consumption = 0.64 t CO2e/MWh = 0.64 Kg CO_2e / kWh

Baseline Calculations

Project Component #1 – Pneumatic Pump Electrification

Emissions $_{Baseline}$ = **Emissions $_{Baseline\ Vented\ Gas\ (SS\ B7)}$**

Vented Gas $_{Baseline}$ = 0.095 scf/stroke * 171,073 stroke/month = 16,304 ft^3 NG/month

[8] https://encyclopedia.airliquide.com/carbon-dioxide

$Emissions_{Baseline} = Emissions_{Baseline\ Vented\ Gas\ (SS\ B7)} = \Sigma_j (Vented_{Gas\ Baseline,\ j} * \%CH4 * \rho\ CH4 / 1000) * GWP_{CH4} + \Sigma_j (Vented\ Gas_{Baseline,\ j} * \%CO2 * \rho\ CO2/1000)$

$Emissions_{Baseline}$ = (16,304 ft^3 NG/month * 0.9 * 0.675 kg/m3 * 0.0283168 m3 / ft^3 * 0.001 Ton/Kg) * 25 + (16,304 ft^3 NG/month * 0.01 * 1.86 kg/m3 * 0.0283168 m3 / ft^3 * 0.001 Ton/Kg) = 7.01 + 0.0086 **= 7.02 T CO2e/month**

Project Component #2 – Pneumatic Level Controller High to Low Conversions

$Emissions_{Baseline} = Emissions_{Baseline\ Vented\ Gas\ (SS\ B7)}$

$Q_{baseline} = Q_{Direct\ Measurement}$= 31.1 scf/hr

$Vented\ Gas_{Baseline} = Op.\ Hrs. * Q_{baseline}$= 52 hr/month * 31.1 scf/hr = 1,615 scf/month

$Emissions_{Baseline} = Emissions_{Baseline\ Vented\ Gas} = Vented\ Gas_{Baseline} * \%CH_4 * \rho\ CH_4 / 1000) * GWP_{CH4} + Vented\ Gas_{Baseline} * \%CO_2 * \rho\ CO_2/1000)$

$Emissions_{Baseline}$ = (1,615 NG/month * 0.9 * 0.675 kg/m3 * 0.0283168 m3 / ft^3 * 0.001 Ton/Kg) * 25 + (1,615 NG/month * 0.01 * 1.86 kg/m3 * 0.0283168 m3 / ft^3 * 0.001 Ton/Kg) = 0.69 + 0.0008 **= 0.69 T CO2e/month**

Project Calculations

Project Component #1 – Pneumatic Pump Electrification

$Emissions_{Project} = [Emissions_{Project\ Vented\ Gas\ (p7)} + Emissions_{Process\ Control\ Electricity\ (P8)} + Emissions_{Fuel\ Extraction\ /\ Processing\ (P9)}]$

$Emissions_{Project\ Vented\ Gas\ (p7)} = 0$

$Emissions_{Fuel\ Extraction\ /\ Processing\ (P9)} = 0$

$Emissions_{Process\ Control\ Electricity\ (P8)} = 0$ (For solar pumps)

$Emissions_{Process\ Control\ Electricity\ (P8)} = Electricity_{Process\ Control} * EF_{Elec\ Supply} / 1000$ (For grid-tied pumps)[9]

$Electricity_{Process\ Control}$ = 1000 watt * 720 hours/month = 720 KWh/month

$Emissions_{Process\ Control\ Electricity\ (P8)}$ = 720*0.64/1000 = 0.46 T CO2e/month

$Emissions_{Project}$ = 0 + 0.46 + 0 = **0.46 T CO2e/month**

Project Component #2 – Pneumatic Level Controller High to Low Conversions

$Q_{project} = Q_{Average\ Controller}$ type= 3.53 scf/hr

$Vented\ Gas_{Project} = Op.\ Hrs. * Q_{Project}$ = 52 hr/month * 3.53 scf/hr = 183.56 scf/month

[9] Currently there are zero eligible grid tied pumps in the project. This analysis is provided for any potential retrofits in future.

$Emissions_{Project\ Vented\ Gas}$ = Vented $Gas_{Project}$ * %CH_4 *ρ CH_4 / 1000) * GWP_{CH4} + Vented $Gas_{Project}$ * %CO_2 * ρ CO_2/1000)

= (183.56 NG/month * 0.9 * 0.675 kg/m3 * 0.0283168 m3 / ft^3 * 0.001 Ton/Kg) * 25 + (183.56 NG/month * 0.01 * 1.86 kg/m3 * 0.0283168 m3 / ft^3 * 0.001 Ton/Kg) =

0.08 + 0.0001 **= 0.08 T CO2e/month**

$Emissions_{Process\ Control\ Electricity\ (P8)} = 0$

$Emissions_{Fuel\ Extraction\ /\ Processing\ (P9)} = 0$

Emissions $_{\textbf{Project}}$ = 0 + 0.08 + 0 = **0.08 T CO2e/month**

Emission Reduction Calculation

Emissions $_{\textbf{Reductions}}$ **= Emissions** $_{\textbf{Baseline}}$ **- Emissions** $_{\textbf{Project}}$

$Emissions_{Reductions}$ = (**7.02 T CO2e/month + 0.69) – (0.46 T CO2e/month + 0.08) = 7.17 T CO2e/month**

3.4 Monitoring Plan

The primary parameters used to calculate emission offsets from the Project are pump emission rates, the volume of chemical injected (or stroke counts), injection pressures, the high and low bleed controller vent rates, facility operating hours and gas composition analyses. The pump information is gathered at the individual pump level and the emission factors are obtained manually from manufacturer specification. To complete the quantification of emission reductions, the gas injection pressures are also considered.

For level controllers, pre and post conversions vent rates measurement are used to ensure the project specific quantifications are in place. The operating hours of each controller are estimated based on facility production data and runtime hours. Facility production data (e.g. run time of the wells flowing) is tracked electronically on a continuous basis and provides sufficient means to estimate the operating hours of pneumatic controllers at each site. Where applicable, additional data such as downtime events and maintenance records related to specific process units will be retrieved to better estimate operating hours at the controller level.

Gas composition analyses, which is used both for pumps and controllers, are generally collected on an annual basis by a third-party lab for all sales gas and fuel gas streams. Copies of these analyses are provided to the Project Proponent and the lab maintains a database of records.

For the 1st project component, the calculation of baseline emissions under B7 and project emissions under P8 are performed by using the manufacturer vent rates for pumps, the volume of chemical injected or stroke counts, injection pressure and the percent methane and CO_2 in the instrument gas (fuel gas or sales gas) at each facility. The methane and CO_2 % are obtained from annual gas analyses at each site and this data is entered into the calculation spreadsheet annually. Strokes or volume of chemical injected as well as injection pressures are tracked at the pump level. In case of grid-tied pumps in the project conditions, the electricity consumption of pumps is calculated based on the pump specifications and grid electricity emission factors (from the Carbon Offset Emission Factors Handbook) will be used.

For the 2nd project component, the calculation of baseline emissions under B7 and project emissions under P7 are performed by using the direct vent rates for each controller, the operating hours of each facility, and the percent methane and CO_2 in the instrument gas (fuel gas or sales gas) at each facility. Similar to the first component, methane and CO_2 % are obtained from annual gas analyses at each site and this data is entered into the calculation spreadsheet annually. Operating hours are tracked at the facility.

For both of the project components, prior to verification, the direct vent rates, operating hours, and gas composition percentages, manufacturer vent rates, volume of chemicals and injection pressures are manually input into a summary spreadsheet to aggregate emission reductions for each reporting period.

The net GHG emission reductions are then calculated based on the difference between the baseline and project emissions. The tables below demonstrate the primary procedures for data monitoring. Quality control procedures in place at the facility are described in Section 3.5.2.

Project Component #1 – Pneumatic Pump Electrification

Table 3-4 - Monitoring plan and data sources for pump electrification

SS Identifier and Name	Parameter/ Variable	Unit	Measured/ Estimated	Method	Source / Origin	Frequency	Uncertainty	Justify Measurement or Estimation and Frequency
B7 Baseline Vented Gas	$Emissions_{Baseline\ Vented\ Gas} = \Sigma_j (Vented\ Gas_{Baseline,\ j} * \%CH_4 * \rho\ CH_4 / 1000) * GWP_{CH4} + \Sigma_j (Vented\ Gas_{Baseline,\ j} * \%CO_2 * \rho\ CO_2/1000)$ Where Vented Gas =Stroke Count * $EF_{Pump\ Type\ j}$ (for converting pumps to non-venting equivalents) Or =Volume of chemical injected * $EF_{Pump\ Type\ j}$ (for converting pumps to non-venting equivalents)							
	$Emissions_{Baseline\ Vented\ Gas}$	tonnes of, CO_2e	N/A	N/A	N/A	N/A	N/A	As per protocol: Quantity being calculated in aggregate form as fuel use is different for each site.
	Volume of Vented Gas Emitted by Pneumatic Device / $Vented\ Gas_{baseline}$	m^3	Calculated	Method provided in equations above	N/A	Per report	N/A	As per protocol: Intermediary quantity being calculated.
	Pump Strokes / Strokes	-	Measured	Direct measurement	Measured at pump level	Continuous	Low. Direct measurement..	Continuous counting is the highest frequency of monitoring possible.
	Volume of chemical injected	Litre or M3	Measured	Direct measurement	Measured at pump level	Continuous	Low. Direct measurement.	Continuous counting is the highest frequency of monitoring possible.

	Pump Emission Factor / EF Pump Type	SCF of NG/Gallon of Chemical Injected	Estimated	See Appendix C, Manufacturer's vent gas per volume of injected chemicals table	See Appendix C, Manufacturer's vent gas per volume of injected chemicals table	Annual	Low. Based on manufacturer specifications or published emission factors. Use of emission factors from the Protocol or published values from manufacturer specifications results in low uncertainty.	Annual estimates in consideration of changes to injection pressure provide sufficient confidence in emission rates, and manufacturer specifications are conservative estimates. Values were gathered from the Manufacturers specifications and compiled in a table based on pump specifications such as plunger size, stroke length and injection pressure.
	Methane Composition in Vented Gas / % CH_4	%	Measured	Direct measurement from accredited references of industry standards	Direct samples of fuel gas taken annually by third party.	Annual	N/A	Fuel gas composition should remain relatively stable during steady-state operation. Estimating gas composition from accredited references provides a reasonable estimate when the more accurate method cannot be used.
	Carbon Dioxide Composition in Vent Gas / % CO_2	%	Measured	Direct measurement	Direct samples of fuel gas taken annually by third party.	Annual	N/A	Fuel gas composition should remain relatively stable during steady-state operation.
	Density of Methane / ρCH_4	kg/m^3	Estimated	Reference value corresponding	N/A	N/A	N/A	As per protocol: If this value is used all values must be adjusted for

				to conditions at which volumes are reported 0.678 kg/m^3 at STP				standard temperature and pressure (STP).
	Density of Carbon Dioxide / ρCO_2	kg/m^3	Estimated	Reference value corresponding to conditions at which volumes are reported	N/A	N/A	N/A	As per protocol: If this value is used all values must be adjusted for standard temperature and pressure (STP).
	GWP $_{CO2,\ CH4,\ N2O}$ Global Warming Potential	Unitless	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	N/A	N/A	The Project Proponent uses the most current factors published in the Carbon Offset Emission Factors Handbook.
P8 Process control electricity			$Emissions_{Electric\ Process\ Control} = Electricity_{Process\ Control} * EF_{Elec\ Supply} / 1000$					
	Emissions $_{Electric\ Process\ Control}$	tonnes of CO_2e	N/A	N/A	N/A	N/A	N/A	As per protocol: Quantity being calculated in aggregate form as fuel use is different for each site.

	Total Quantity of Electricity Consumed for Control Functions / Electricity $_{Process\ Control}$	kWh	Estimated/ Measured	Estimated based on equipment specifications. In the case of renewable electricity generation, the quantity of electricity consumed is not necessary since the emission factor, and emissions will be zero.	Equipment specifications	Per report	N/A	Both methods are standard practice. Estimated parameter is standard practice and a conservative overestimation in absence of equipment measurement. If measurement has no impact on emissions, measurement is not necessary.
	Emission Intensity Factor for Electricity Consumption / EF $_{Elec\ Supply}$	Kg CO_2e / kWh	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	N/A	N/A	The Project Proponent uses the most current factors published in the Carbon Offset Emission Factors Handbook.

Project Component #2 – Pneumatic Level Controller High to Low Conversions

Table 3-5 Monitoring plan and data sources for level controllers high to low conversions

SS Identifier and Name	Parameter/ Variable	Unit	Measured/ Estimated	Method	Source / Origin	Frequency	Uncertainty	Justify Measurement or Estimation and Frequency
B7 Baseline Vented Gas	$Emissions_{Baseline\ Vented\ Gas} = \Sigma_j (Vented\ Gas_{Baseline,\ j} * \%CH_4 * \rho\ CH_4 / 1000) * GWP_{CH4} + \Sigma_j (Vented\ Gas_{Baseline,\ j} * \%CO_2 * \rho\ CO_2/1000)$ Where Vented Gas $= Op.\ Hrs._j * Q_{Baseline\ j}$ (for converting controllers to lower or non-venting controllers) $Q_{Baseline\ j}$ And Q Baseline, j $= Q_{Direct\ Measurement\ j}$ (for controllers with direct measurement samples) $= Q_{Average\ Controller\ Type\ j}$ (for controllers with average measurement samples) $= Q_{Manufacturer\ Specification\ j}$ (for controller with no direct measurement or sample statistics)							
	$Emissions_{Baseline\ Vented\ Gas}$	tonnes of, CO_2e	N/A	N/A	N/A	N/A	N/A	As per protocol: Quantity being calculated.
	Volume of Vented Gas Emitted by Pneumatic Device / $Vented\ Gas_{baseline}$	m^3	Calculated	Method provided in equations above	N/A	Per report	N/A	As per protocol: Intermediary quantity being calculated.
	Methane Composition	%	Measured	Direct measurement	Direct samples of	Annual	N/A	Fuel gas composition should remain relatively stable during

	in Vented Gas / % CH_4			from accredited references of industry standards	fuel gas taken annually by third party.			steady-state operation. Estimating gas composition from accredited references provides a reasonable estimate when the more accurate method cannot be used.
	Carbon Dioxide Composition in Vent Gas / % CO_2	%	Measured	Direct measurement	Direct samples of fuel gas taken annually by third party.	Annual	N/A	Fuel gas composition should remain relatively stable during steady-state operation.
	Density of Methane / ρCH_4	kg/m^3	Estimated	Reference value corresponding to conditions at which volumes are reported 0.678 kg/m^3 at STP	N/A	N/A	N/A	As per protocol: If this value is used all values must be adjusted for standard temperature and pressure (STP).
	Density of Carbon Dioxide / ρCO_2	kg/m^3	Estimated	Reference value corresponding to conditions at which volumes are reported	N/A	N/A	N/A	As per protocol: If this value is used all values must be adjusted for standard temperature and pressure (STP).
	Vent Rate of High Vent Control Device / $Q_{baseline}$	m^3 / hr	Measured or estimated	Direct measurement	N/A	Per report	N/A	As per protocol: Value is an intermediate used for subsequent calculations, based on project type.

	Measured Vent Rate of Control Device / Q Direct Measurement	m^3 / hr	Measured	Direct measurement	Direct measurement at the controller level	Once	Low. Direct measurement.	Direct measurement of vent rate provides high confidence.
	Operating Hours / Op. Hrs. $_j$	hrs	Measured	Direct measurement	Estimated based on facility production data (gas sales or gas production) and other operating records.	Annual	N/A	Continuous operating time measurement is the highest level possible.
	GWP $_{CO2, CH4, N2O}$ Global Warming Potential	Unitless	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	N/A	N/A	The Project Proponent uses the most current factors published in the Carbon Offset Emission Factors Handbook.
P7 Project Vented Gas	$Emissions_{Project\ Vented\ Gas} = \Sigma_j (Vented\ Gas_{Project, j} * \%CH_4 * \rho\ CH_4 / 1000) * GWP_{CH4} + \Sigma_j (Vented\ Gas_{Project, j} * \%CO_2 * \rho\ CO_2/1000)$ Where $Vented\ Gas_{Project}$ $= Op.\ Hrs._j * Q_{Project\ j}$ (for converting controllers to lower or non-venting controllers) $Q_{Project\ j}$ $= Q_{Direct\ Measurement\ j}$ (for controllers with direct measurement samples) $= Q_{Average\ Controller\ Type\ j}$ (for controllers with average measurement samples) $= Q_{Manufacturer\ Specification\ j}$ (for controller with no direct measurement or sample statistics)							
	Emissions Vented Gas for Controlled Instruments	tonnes of, CO_2e	N/A	N/A	N/A	N/A	N/A	As per protocol: Quantity being calculated in aggregate form as fuel use is different for each site.

	Volume of Vented Gas Emitted by Pneumatic Device / Vented Gas$_{Project}$	m^3	Calculated	Method provided in equations above	N/A	Per report	N/A	As per protocol: Intermediary quantity being calculated.
	Methane Composition in Vented Gas / % CH_4	%	Measured	Direct measurement from accredited references of industry standards	Direct samples of fuel gas taken annually by third party.	Annual	N/A	Fuel gas composition should remain relatively stable during steady-state operation. Estimating gas composition from accredited references provides a reasonable estimate when the more accurate method cannot be used.
	Carbon Dioxide Composition in Vent Gas / % CO_2	%	Measured	Direct measurement	Direct samples of fuel gas taken annually by third party.	Annual	N/A	Fuel gas composition should remain relatively stable during steady-state operation.
	Density of Methane / ρCH_4	kg/m^3	Estimated	Reference value corresponding to conditions at which volumes are reported 0.678 kg/m^3 at STP	N/A	N/A	N/A	As per protocol: If this value is used all values must be adjusted for standard temperature and pressure (STP).
	Density of Carbon Dioxide / ρCO_2	kg/m^3	Estimated	Reference value corresponding to conditions at which volumes are reported	N/A	N/A	N/A	As per protocol: If this value is used all values must be adjusted for standard temperature and pressure (STP).

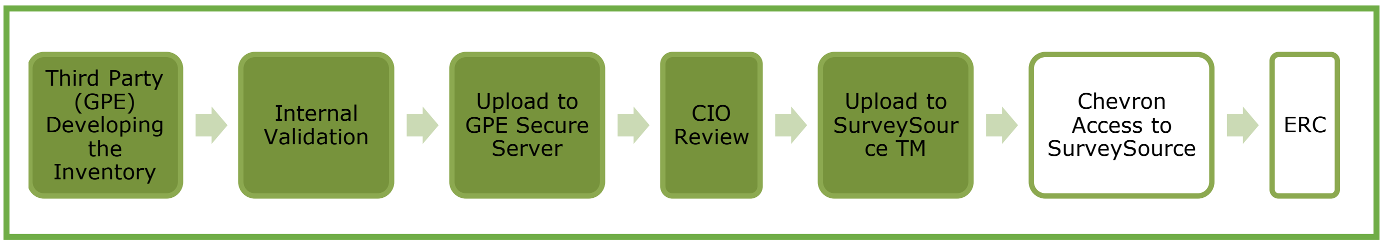
	Vent Rate of Low Vent Control Device / $Q_{project}$	m^3 / hr	Measured or estimated	Direct measurement	N/A	Per report	N/A	As per protocol: Value is an intermediate used for subsequent calculations, based on project type.
	Measured Vent Rate of Control Device / $Q_{Direct\ Measurement}$	m^3 / hr	Measured	Direct measurement	Direct measurement at the controller level	Once	Low. Direct measurement.	Direct measurement of vent rate provides high confidence.
	Operating Hours / Op. $Hrs._j$	hrs	Measured	Direct measurement	Estimated based on facility production data (gas sales or gas production) and other operating records.	Annual	N/A	Continuous operating time measurement is the highest level possible.
	$GWP_{CO2,\ CH4,\ N2O}$ Global Warming Potential	Unitless	Estimated	Provided in Carbon Offset Emission Factors Handbook	N/A	N/A	N/A	The Project Proponent uses the most current factors published in the Carbon Offset Emission Factors Handbook.

3.5 Data Management System

The following describes the data collection systems in place for each data point in the Project. Appropriate data management system controls and quality assurance procedures will also be explained in this section.

For each data point the following flow charts describe the manner with which data is collected and input into the project Emission Reduction Calculator (ERC). In the following flow charts cells that are filled with white color are the Project Proponent's internal resource and those filled with green cells are provided by a third party.

EQUIPMENT INVENTORY



Greenpath Energy (GPE) is the third-party contractor to develop the inventory of relevant offset equipment for this project. Their technical staff collects all relevant equipment inventory data such as pump and controller make, model, plunger size, stroke length, emission rates for controllers, etc. These data points are primary inputs to the Emission Reduction Calculator (ERC).

The process includes validating the list of locations and all relevant pneumatic devices inventory on tablets at the Project Proponent sites. A GPE technician complete the data inputs in their tablets and then uploads the data into Greenpath's secure server. Greenpath CIO reviews the data for internal consistency and then the data gets uploaded to SurveySource™ - Green Path's proprietary database. The Project Proponent is then provided with a link to SurveySource and sent a copy of the data sets. The information collected by third party are then used to populate the ERC. The manual transfer is currently completed by a third-party vendor supporting the Project but will transition to a Proponent employee in the future.

It is expected that every six months Greenpath will review any new wellsites and review changes. The data will be integrated into Surveysource as above. It is also expected that the Project Proponent Environmental Specialist will update the project documents every time there are new eligible sites that come online in the future. Project updates are inserted into the ERC by the Project Proponent or by a third-party.

The Project Proponent continues to streamline and improve their data collection practices. In the future, Field Operation staff will work with Environmental Specialists completing various data collection measures for the Proponent to ensure appropriate pump and controller inventory information is collected on the required Project schedule.

INJECTION PRESSURES

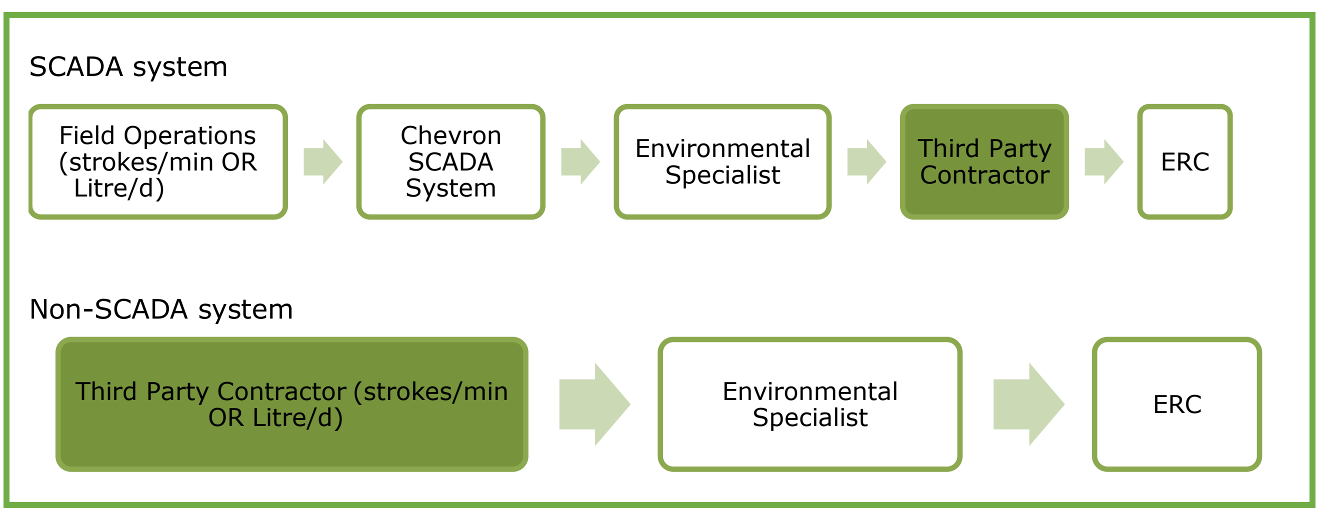
Injection pressures are collected daily in the Proponent's SCADA system. To export injection pressures, Environmental Specialist exports data from SCADA and calculates monthly average pressure for each site. The information is then manually input into Emission Reduction Calculator.

Before project registration and in order to estimate the emission reduction for the Project over its crediting period, injection pressure data was compiled both from SCADA and GreenPath Energy. In the future, if the data is unavailable in the SCADA system, the injection pressure data will be obtained by Greenpath Energy every six months. If none of these are available in the future, injection pressures will be read from the solar pump's manufacturer packages (Sirius Instrumentation and Controls Inc).

OPERATING HOURS

Each well has a meter that tracks the number of hours the well is flowing. This information flows directly into the on-site SCADA system and then gets used to report in Petrinex. To export operating hours, the Environmental Specialist runs a report out of Petrinex. Relevant data is then used by a Project Proponent employee or third-party vendor to update the ERC.

STROKE COUNTER or VOLUME OF CHEMICALS INJECTED



Prior to the registration of the project, the ERC was updated with volume of injected chemicals as collected by Chevron Field Operations. Chevron's Environmental Specialist completes a data integrity review then sends it to a third party contractor to calculate the litre/month by multiplying the measured litre/day by operating hours for the month.

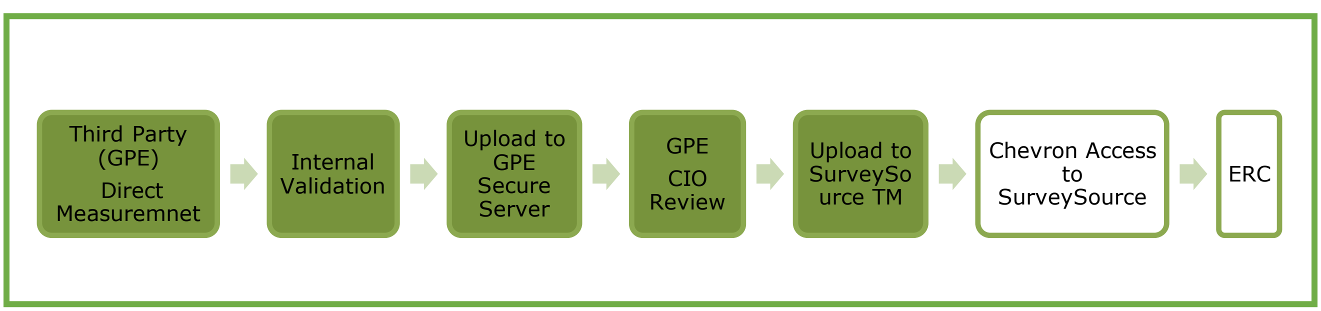
The Project Proponent is planning to have stroke counters on some of the pumps within the project. For the pumps that have stroke counter on them, the measured cumulative number of strokes accumulated over the life of the pump will be used in the ERC. Either stroke counts or the volume of chemicals that are injected will be tracked through the Project Proponent's SCADA automated system, if available. If the SCADA system is not available, then these project data will be gathered through Greenpath Energy filed visits and will be downloaded from the pumps at the sites. This is expected to happen on an annual basis.

The Environmental Specialist will update these stroke counts or volume of chemical injected for both scenarios (with and without stroke counter on pumps) in an internal spreadsheet and save backups. The information is consequently gathered by either corporate staff or a third-party vendor and input into the ERC.

GAS ANALYSIS

Gas analysis will be used to determine the gas composition of the that would have been used to supply fuel gas to the pneumatic pumps and controllers that have been replaced. Fuel gas analysis are collected from Keyera corporation. The information is collected by the Environmental Specialist and then populated in the ERC by either a Proponent staff or a third-party vendor. This information is expected to be collected on an annual basis per site and the most recent gas analysis will be used in the ERC.

LEVEL CONTROLLERS BLEED RATES/EMISSION FACTORS



Greenpath Energy provides the emission factors of the low bleed and high bleed level controllers using the Manual 15 approach and direct metering of high acting level controllers, using Calscan meters. Outputs of Calscan meters is reviewed by Greenpath internally and provided to the Project Proponent's through a link to access the SurveySource. The emission factors are then populated into ERC.

METER CALIBRATION

The meter calibration for the baseline measurements of Fisher L2 controllers is undertaken at the factory and the records retained in Survey Source. Calscan Energy is responsible for completing the calibration and is responsible for the actual calibration logs.

3.5.1 Data Controls

In order to ensure sound data integrity, completeness, accuracy and validity, the following measures are undertaken by the Project Proponent:

- Each data point is associated with a Unique Well Identifier and/or Legal Land Description
- Project education is provided to relevant staff members to ensure data collection is completed in line with the Project requirements
- All data is captured on a daily or monthly or annual basis (depending on the data point) and compiled once annually at the end of the calendar year
- This information is populated into the Quality Assurance/Quality Control document for this Project and scrutinized for anomalies by one Chevron employee (Environmental Specialist) not directly involved in the data collection process
- The QA/QC document is password protected and each tab within the document is password protected as well. These passwords are only known to the Proponent staff members responsible for the data population and the QA/QC procedures
- Data captured on-site by either Proponent employees or third-party vendors are held as hard copies in the Proponent field office following their input into the appropriate data management system
- The copies are retained per the Proponent's corporate data retention policy
- Prior to the completion of the annual Emission Reduction Calculator, data is further scrutinized by a third-party vendor who is not responsible for verification but has distinct knowledge of the project
- The Project Proponent will maintain all the information used in the offset project development for a period of no less than 7 years.

3.5.2 Quality Assurance / Quality Control

- Quality Assurance / Quality Control (QA/QC) procedure is built to provide an annual review of the offset project data collected in a given calendar year.
- There are two designated data reviewers who are Project Proponent employees and who are intimately familiar with the project. The individuals will be appointed at a later date.
- Sufficient training to operators will be provided.
- Manual assessment and checks of reported data is regularly completed by the operators to ensure data integrity.
- This QA/QC review will be completed once a year prior to the serialization of new offsets. The QA/QC documents will be reviewed by a third-party verifier to ensure the appropriate process is followed and to ensure the quality of data meets the verification requirements.

4.0 Project Developer Signature

I am a duly authorized corporate officer of the project developer mentioned above and have personally examined and am familiar with the information submitted in this project plan. Based upon reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, I hereby warrant that the submitted information is true, accurate and complete to the best of my knowledge and belief. I understand that any false statement made in the submitted information may result in de-registration of credits and may be punishable as a criminal offence in accordance with provincial or federal statutes.

The project developer has executed this offset project plan as of the _14__day of June_, 2019_.

Project Title: Chevron Canada Pneumatic Device Project

Signature: ________Paul Dziuba________

Name: Paul Dziuba

Title: Environmental Specialist

5.0 References

Include references. Author, Year, Title.

Reference 1:

Petroleum Technology Alliance Canada, 2017, Upstream Oil & Gas ECO-EFFICIENCY EQUIPMENT AND OPERATIONS HANDBOOK. Available online at https://www.ptac.org/wp-content/uploads/2017/06/Canadian-Upstream-Oil-Gas-Eco-Efficiency-Equipment-and-Operations-Handbook-1.pdf

Reference 2:

GreenPath Energy Ltd., 2018, LEVEL CONTROLLER EMISSION STUDY FISHER L2 AND IMPROVED RELAYS, NORRISEAL 1001A AND EVS. Available online at https://auprf.ptac.org/wp-content/uploads/2018/10/Final-Report-Level-Controller-V8-20181003.pdf