Quantification Protocol for Engine Fuel Management and Vent Gas Capture

Alberta Offset System Protocol Review

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Presentation Outline

- Process Overview
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Process Overview

Initiating Entities: EnCana, REM Technology

Seed Documents:

- CAPP Fuel Gas Best Management Practices
- PTAC 'Emissions and Efficiency Enhancement with REMVue® Air Fuel Ratio Systems'

Technical Review:

- Limited technical review conducted during draft preparation
- Technical Stakeholder Review Session held October 8th, 2008

j1 add CCAR

jamie, 08/12/2008

Definitions

Engine Management System

- The process control system used to control the air flow and fuel flow into an engine to manage the power demands on the engine

Air / Fuel Ratio

- The ratio of air to fuel fed into the combustion chamber of an engine.
  - Stoichiometric ratio = perfect combustion
  - Excess air = lean burn (i.e. better fuel economy)
  - Excess fuel = rich burn (i.e. better power)

Definitions

Vent Gas

- Gases containing methane that are designed to be vented to atmosphere to allow for safe operation of equipment.
  - Instrument gas, compressor rod packing gas etc.

Brake Specific Fuel Consumption (BSFC)

- The ratio between the rate fuel energy is supplied to an engine divided by the mechanical power available for the engine load.
  - Units of BTU/BHp-hr or kJ/bKW-hr
  - Engine performance can be expressed independent of engine type and size

Applicability Criteria

The protocol applies to two activities:

1. The implementation of engine management systems that control the air-fuel ratio to improve fuel use efficiency; and / or

2. The implementation of vent gas capture systems that prevent the venting of greenhouse gases to the atmosphere.

   – Protocol applicable to natural gas combustion engines.
   – Process changes may be designed for retrofits or for new installations.

The protocol **does not** apply to:

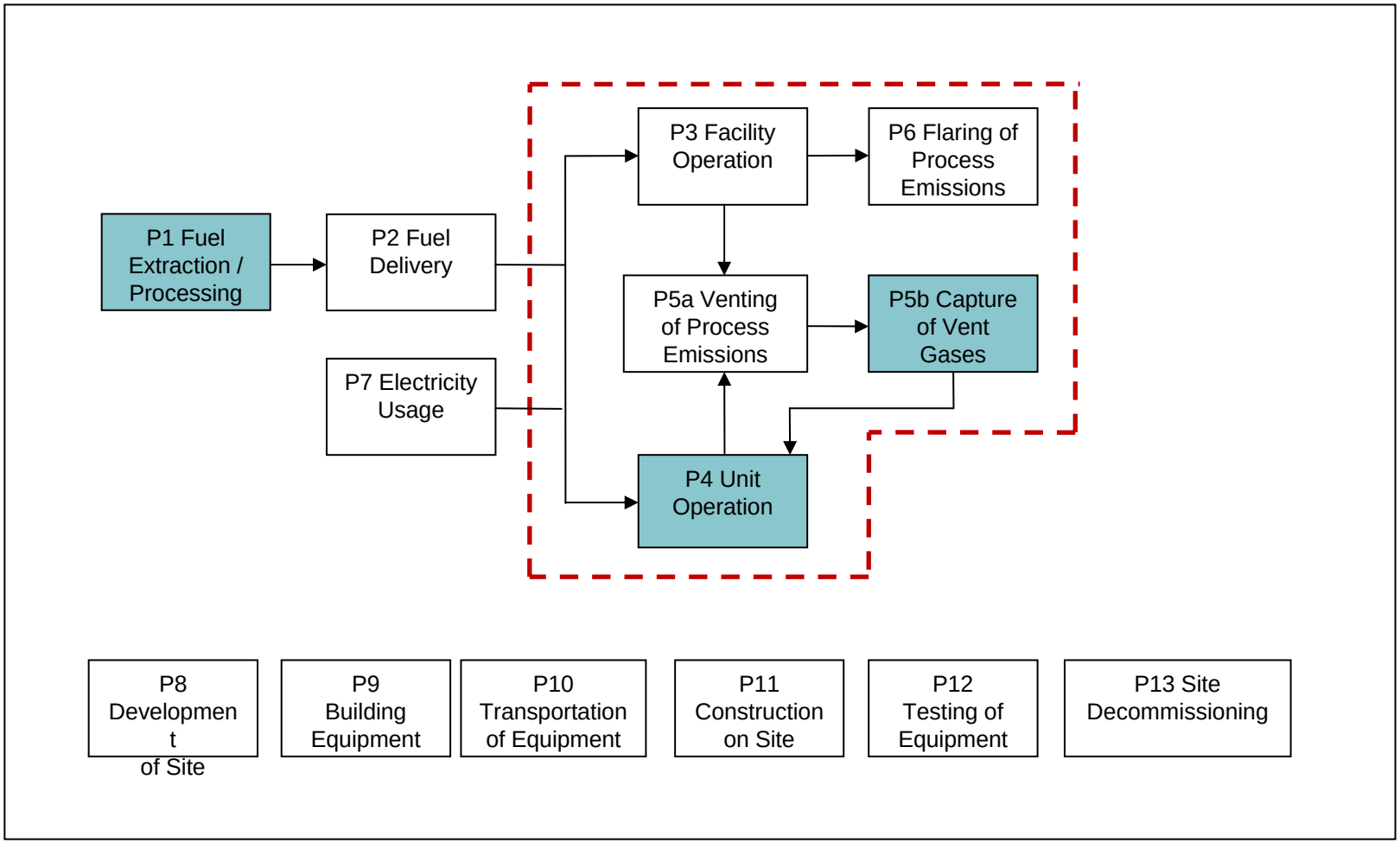
- Facilities regulated under Alberta's SGER
- Activities required by ERCB Directive 060

Project Condition

Project Condition:

- Fuel consumption of the engine following installation of the new engine management system and/or vent gas capture
- Project monitoring/measurement consists of:
  - Direct measurement of fuel gas flow rate continuously
  - Average monthly engine load and engine speed (RPM)
  - Direct measurement of the quantity, composition and heating value of vent gases captured and combusted

Process Flow Diagram for the Project Condition



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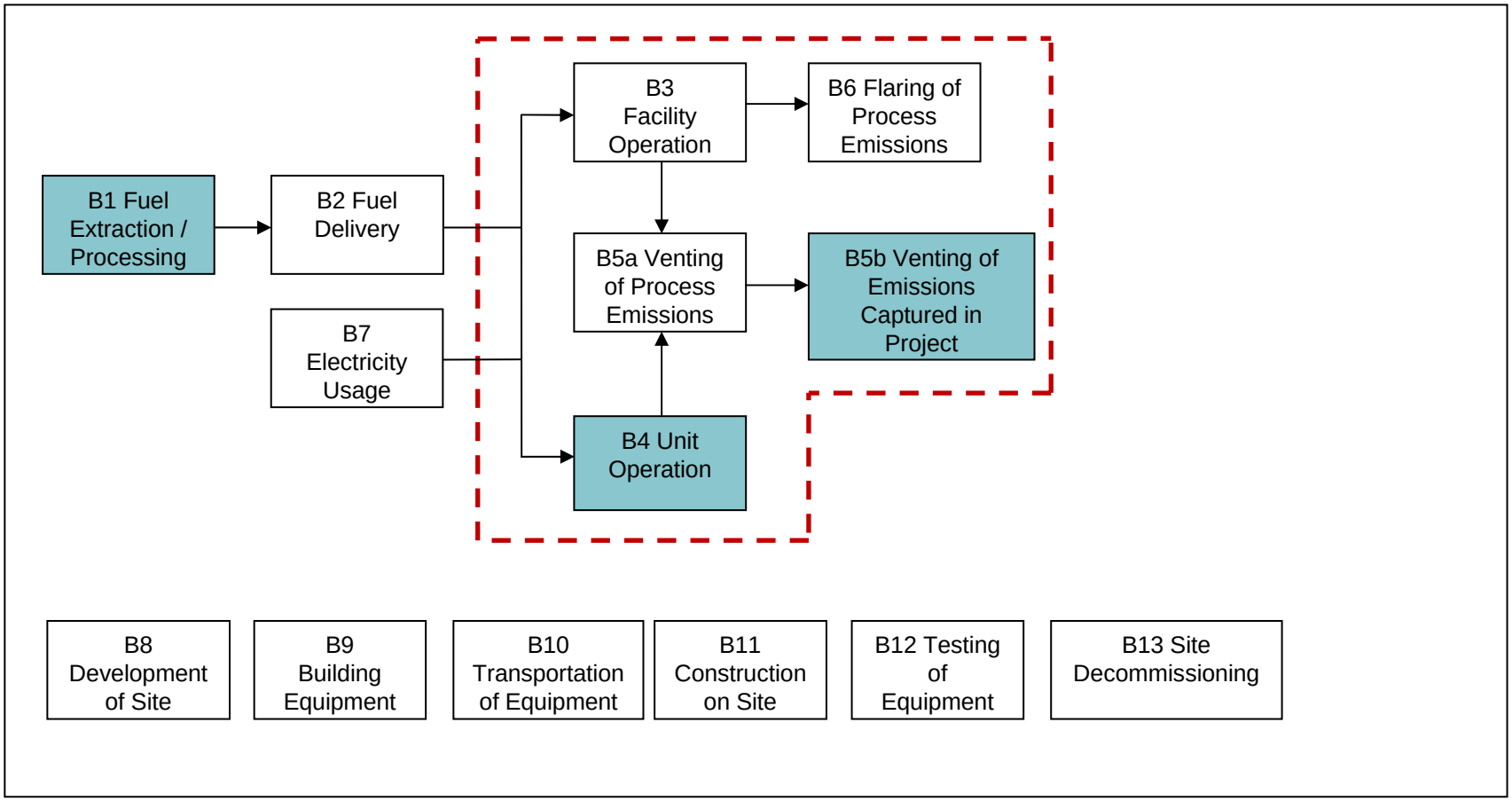
Baseline Condition

Baseline Condition:

- Fuel consumption of engine under its original configuration
- Site specific: Depends on the operating characteristics and performance of the particular unit(s).
  - Mitigate against variations from site to site and engine to engine fuel consumption through a limited set of direct measurements of the original unit
  - Concept of engine ‘Pre-Audits’ and ‘Post-Audits’
- The venting of gases containing methane to the atmosphere.
  - Direct measurement during project

Process Flow Diagram for the Baseline Condition



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Quantification Approach

$$\text{Emission Reduction} = \text{Emissions}_{\text{Baseline}} - \text{Emissions}_{\text{Project}}$$

- **GHG Emissions** $_{\textbf{Baseline}}$ = $\text{Emissions}_{\text{Fuel Extraction / Processing}}$ + $\text{Emissions}_{\text{Unit Operation}}$ + $\text{Emissions}_{\text{Venting of Emissions Captured in Project}}$

- **GHG Emissions** $_{\textbf{Project}}$ = $\text{Emissions}_{\text{Fuel Extraction / Processing}}$ + $\text{Emissions}_{\text{Unit Operation}}$ + $\text{Emissions}_{\text{Capture of Vent Gases}}$

Quantification Approach

Fuel Efficiency Component

- Direct measurement of fuel consumption at various set points (Load and RPM) used to determine the fractional change in fuel consumption before and after installation of the engine fuel management system
  - Advanced approach (development of complete load map)
  - Simple approach (snap-shot of pre-audit conditions)
- Approach designed to be broadly applicable to any natural gas combustion engine regardless of site to site and engine to engine differences.

Quantification Approach

Vent Gas Capture

- Direct metering of quantity of vent gases captured and combusted
  - GHG emissions based on the methane % of the vent gases and carbon content.
- Use of mass and energy balances to quantify fuel gas displaced by the vent gases.
  - supplemental energy from vent gases displaces primary fuel gas
  - Calculated from flow, composition and heating value of vent gas

Flexibility Mechanisms

Primary Flexibility Mechanisms:

- Baseline scenario where waste gas stream is flared and project condition involves re-direction of gas stream for use as supplemental fuel in the engine.
  - Venting of CH_4 not applicable, only fuel saving GHG reductions
- Use of fractional fuel savings data from 5 other engines of the same make and classification when pre and post audits not possible.
  - Requires data from >5 engines of the same make and classification operating with the same type of engine management system.
  - Discount factor based on standard deviation of data set

AB Offset System Eligibility Criteria

Real:

- Project activities result in real GHG emission reductions from a tangible action to decrease fossil fuel consumption and/or to capture vented methane emissions
- Baseline condition established through measurement of fuel consumption under the engines original configuration
  - Ensures that only the incremental benefits of the project activity are credited.

AB Offset System Eligibility Criteria

Quantifiable:

- Quantification based on:
  - Pre and post audit of fractional change in fuel consumption for the specific engine make, model, air/fuel ratio setting and load demands on the unit
  - Direct measurement of quantity of fossil fuels combusted
  - Direct measurement of quantity and heat value of vent gases captured and combusted

Not Required By Law / Counted Once:

- Projects implemented at regulated sites ineligible for offsets
- Gas streams required to be collected, conserved or flared as specified under Directive 060 ineligible

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Sample Calculation

Emission Reduction = Emissions $_{Baseline}$ – Emissions $_{Project}$

	Scenario Data	Emission Reduction
Project and Baseline Condition	6 rich-burn engines equipped with air-fuel ratio (AFR) controllers 2 vent gas capture installations	
Fuel Savings	24.09 MMCF	1,229 tonnes CO_2E
Vent Gas Captured	21.02 MMCF	8,918 tonnes CO_2E
Total Reduction	**45.11 MMCF**	**10,147 tonnes CO_2E**

Questions?

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