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2.0 PROJECT DESCRIPTION

2.1 Introduction

Imperial Oil Resources Limited (Imperial) is applying to the Alberta Energy Regulator (AER) to continue phased development of its in situ Cold Lake Operations (CLO). The proposed Cold Lake Expansion Project (the project), will have a bitumen production capacity of up to 8,740 m³/cd (55,000 bbl/cd) from the Grand Rapids Formation.

The project is located on Crown land approximately 23 km northwest of the City of Cold Lake, Alberta in the municipal district of Bonnyville No. 87. The project area covers parts of Townships 65 and 66 in Ranges 2, 3 and 4, West of the Fourth Meridian.

Existing CLO facilities support cyclic steam stimulation crude bitumen extraction from the Clearwater Formation and share common infrastructure including water supply, water disposal, power supply, diluent supply and shipping pipelines. Water is managed at a district level and coordinated between facilities.

The project is an expansion of existing operations that will target bitumen resources in the Grand Rapids Formation using a solvent-assisted steam-assisted gravity drainage (SA-SAGD) recovery process. The project will interconnect with existing CLO plants and infrastructure. New development associated with the project includes a central processing facility (CPF), well pads and associated field facilities and infrastructure.

2.2 Bitumen Recovery Process

The project will use a SA-SAGD thermal recovery process to produce bitumen resources in the Grand Rapids Formation. Although there is some spatial overlap between the project and existing operations, high-pressure cyclic steam stimulation and SA-SAGD recovery will not simultaneously occur in overlapping areas.

The SA-SAGD process uses horizontal wellpairs spaced 100 m apart laterally and about 5 m apart vertically. Steam mixed with solvent will be sent into an upper injection well to heat bitumen and allow it to flow by gravity into a lower production well located near the reservoir base.

Imperial plans to develop 52 pads in the project area to recover approximately 87.5 million m³ (550 million bbl) of bitumen from the Grand Rapids Formation. Over the 30-year life of the project, continued delineation and improvements in recovery efficiency are expected to increase the potential recoverable resource. Up to 37 potential well pads could further extend the life of the project and have been included in the project footprint for the environmental assessment.

The resource associated with potential well pads is excluded from the current resource estimate as development would be subject to further delineation, reservoir performance and future economic conditions.

Similar to SAGD recovery operations, SA-SAGD involves four stages of operation:

- ▶ startup;
- ▶ ramp-up;
- ▶ steady-state; and
- ▶ wind-down.

2.3 Project Schedule

The project schedule depends on regulatory approvals, internal funding decisions, and market conditions. Construction is expected to last up to three years followed by an operational life of 30 years.

Table 2.3-1 shows the earliest proposed project schedule.

Table 2.3-1: Proposed Project Schedule

Activity	Timing
Aboriginal and public engagement	Ongoing
Regulatory application submission	2016
Anticipated regulatory approval	2018
Start site clearing for construction	2019
Commissioning and startup (first steam)	2022
Progressive reclamation (start)	2032
CPF decommissioning (start)	2057
Reclamation complete	2067

It is expected that construction workers will be lodged in camps near the project and will be transported by bus to and from the site. The project plans to use existing camps and is also assessing a new camp located on the CPF worksite to improve construction efficiency.

2.4 Geology and Resource Base

The project is situated in the Cold Lake oil sands area and is targeting bitumen deposits trapped in Cretaceous sandstones of the Lower Grand Rapids Formation, except for an area under a portion of Marie Lake that is exempt from development.

The primary caprock for the project is the Colorado-Lea Park sequence, a succession of regionally continuous shales at least 100 m thick that have a low natural fracture frequency. A fracture study indicates that caprock in the project area has not experienced major deformation, and no interconnected fractures were observed that would compromise caprock integrity.

The proposed maximum operating pressure for the project is 5,000 kPag, which is less than 80% of the measured fracture closure pressure at the base of the caprock in the project area, and is also less than 80% of the estimated vertical stress at the base of the caprock.

The initial volume of bitumen in-place is 753 million m³ (4,736 million bbl) and the initial volume of developable bitumen in-place is 499 million m³ (3,139 million bbl). Future reservoir delineation wells and geologic modelling will refine these volumes.

2.5 Wells and Field Facilities

Field facilities for the project include SA-SAGD well pads, observation well pads, access roads, laydown areas, pipelines, and utility corridors.

2.5.1 SA-SAGD Well Pads and Wellpairs

The SA-SAGD process requires steam injection and production wellpairs. Multiple wells will be drilled from common production well pads. The size of the well pad will depend on the number of wellpairs needed for resource recovery and will include up to 11 wellpairs. Steam injection wells will produce condensed water and some bitumen during the steam circulation startup. Although the production wells will be primarily used to produce bitumen, they will also be used for steam circulation to initiate bitumen production.

2.5.2 Field Development Approach

The initial development plan includes 11 SA-SAGD well pads. As these well pads approach the end of their productive life, 41 productivity maintenance pads will be developed over the remaining life of the project. Depending on future resource delineation and reservoir performance, up to 37 additional potential pads may be developed.

The project plans to use existing CLO infrastructure and access where practical. The SA-SAGD well pad locations and well trajectories will be designed to reduce potential environmental effects and to maximize resource recovery based on current geologic data. Consistent with previous CLO standard pad design, project pads will be designed to minimize surface disturbance.

The access roads, pipelines and power lines required for each SA-SAGD well pad will be constructed in a common corridor concurrently with the well pads.

2.5.3 SA-SAGD Well Drilling

SA-SAGD wells will be directionally drilled starting with a vertical hole. Wellbore design will depend on the pad and reservoir geometry and will typically include:

- ▶ build rates of 8 to 10⁰ per 30 m;
- ▶ true vertical depths of horizontal section between 370 and 410 m;
- ▶ average horizontal length of 1,000 m (700 to 1,100 m range); and
- ▶ total measured depth between 1,100 and 2,200 m.

2.5.4 Wellhead Design

The production and injection wellheads will be rated for steam thermal service. Production wells will have downhole monitoring.

2.5.5 SA-SAGD Well Design

Provision will be made for maintaining produced gas in the annulus to provide a gas blanket to manage heat loss.

Steam circulation will be used to reduce bitumen viscosity and to help unload wellbore fluids during initial startup. Artificial lift may be required during the startup phase. Sand production is expected to be minimal during normal operation. However, initial production might contain small amounts of produced fines until the wells build adequate sand bridges against the liners.

For steady-state operations in the producing well, the toe tubing string will be retrieved. An appropriately sized rod pump will be run inside the heel tubing. Other forms of artificial lift may be considered as technology evolves, and electric submersible pumps may be considered for higher rate wells. Produced gas that bypasses the rod pump will flow up the casing annulus and will be captured by gas collection equipment at surface.

2.5.6 SA-SAGD Well Instrumentation

All production and select injection wells will be instrumented to gather downhole temperature and pressure data. A thermocouple or fibre optic string for temperature monitoring and a bubble tube for pressure monitoring will be run inside a coil tubing string or banded to the tubing for the production well.

A thermocouple or fibre optic string for temperature monitoring will be run inside a coil tubing string or banded to the tubing for the injection well.

2.5.7 Observation Wells

Vertical or deviated wells will be used for observation wells. Surface casing will be set into the first competent shale found below the Quaternary. Thermal cement will be used for all cementing operations for observation wells to provide zonal isolation. Typically, two to five observation wells will be drilled for each SA-SAGD well pad.

Observation wells will monitor pressure and temperature. Ongoing pressure monitoring will demonstrate that injection rates and pressures stay within the limits stated in this application.

2.5.8 Wellbore Integrity Monitoring

Casing integrity management will be used to reduce:

- ▶ loss of production capability or steam; and
- ▶ migration of produced fluids to uphole formations or to the surface.

Imperial is committed to safe and efficient operations and will leverage Imperial's experience at CLO, where appropriate, for a SA-SAGD operation.

Casing integrity practices will comply with AER Directive 051: *Injection and Disposal Wells – Well Classifications, Completions, Logging, and Testing Requirements*. Suspended wells will be managed to meet AER Directive 013: *Suspension Requirements for Wells*.

2.5.9 Existing Wellbore Integrity for SA-SAGD Operations

Imperial has completed an integrity assessment on wellbores (41 open hole and 13 cased) near the initial SA-SAGD well pads, and work is ongoing to assess wellbores in proximity to future productivity maintenance and potential well pads.

For the initial SA-SAGD well pad area, eight cased wells were found to be not thermally compatible. These are active or suspended Grand Rapids gas wells that appear to need additional cement plugs inside the casing or alternate mitigation. All of these wells are operated by others. Imperial will work with the operators of these wells to ensure that they will be thermally compatible prior to commencing steaming operations for the project. Similarly, should any of the wells near the future pads be found not thermally compatible, Imperial will work with the operator to ensure thermal compatibility.

There are some wells in the area that have been abandoned with non-thermal cement. Imperial's experience at CLO has demonstrated that non-thermal cement plugs, when placed correctly in abandoned wells, have sufficient integrity for thermal operations. Imperial does not recommend re-abandoning these historical wells.

2.5.10 SA-SAGD Well Pads

Four to 11 wellpairs will be drilled from a single well pad location. Initially, 106 wellpairs will be drilled from 11 SA-SAGD well pads.

The steam header will direct steam to the injection wells through SA-SAGD well pad flow lines. Steam valves will control the steam injection rate to each injector. Production from the producing wells will be collected and routed to the production header on the SA-SAGD well pad, and then sent through the production gathering system to the CPF.

2.5.11 SA-SAGD Well Flow Measurement

A test separator will separate and meter the produced fluids for one well at a time at the well pads. This production will then be recombined with the production from other wells on the well pad and piped to the CPF. Imperial will consider eliminating the test separator and replacing it with multiphase or inline flow meters during the next stage of engineering.

The SA-SAGD well pads will be configured using switching valves or rotary valves so that one production well can be tested while the production from the remaining wells on the pad is co-mingled and piped to the CPF. The steam and solvent injection flow rate will be continuously measured on each injection well.

2.6 Central Processing Facility

The CPF will separate produced water and gas from bitumen and solvent liquids. The CPF will also distribute steam and solvent to the field for subsequent injection into the reservoir. Produced gas will be cooled to recover the produced solvent. The remaining produced gas will be used to supplement purchased natural gas as fuel in the steam generators. Recovered solvent will be reused to reduce the amount of makeup solvent. Produced water will be deoiled, combined with makeup water, treated to remove impurities, and used to generate high-pressure, high-quality steam. Bitumen will be dewatered, blended with diluent, and pumped to market as dilbit.

A steam separator will be used to provide 100% quality steam for distribution to the field.

Onsite tankage will be provided at the CPF for dilbit and diluent storage, and other process requirements.

The CPF will be sized to support a bitumen production capacity of 8,740 m³/cd (55,000 bbl/cd) and will include:

- ▶ emulsion separation for dewatering and degassing the bitumen;
- ▶ produced water deoiling;
- ▶ produced water and makeup water treatment;
- ▶ produced gas treatment with solvent recovery;
- ▶ steam generation;
- ▶ steam generator blowdown handling equipment;
- ▶ storage tanks;
- ▶ flare system; and
- ▶ utilities, such as instrument air, glycol, domestic and utility water.

2.6.1 Central Processing Facility Processes

The CPF will:

- ▶ separate water, solvent, and gas from the produced bitumen;
- ▶ recover solvent from the produced gas prior to the produced gas being used as fuel;
- ▶ send solvent to the field facilities to enhance the bitumen recovery performance of the SA-SAGD process;
- ▶ use diluent to aid in bitumen processing and to meet export pipeline specifications;
- ▶ deoil produced water;
- ▶ treat produced water, blowdown water, regeneration wastewater and makeup water from CLO for steam generation;

- ▶ transfer surplus water to CLO for recycle or disposal; and
- ▶ generate steam for injection into the reservoir.

2.6.2 Auxiliary Systems and Buildings

2.6.2.1 Vapour Recovery Systems

Vapour recovery systems will consist of compressors and discharge scrubbers to recover vapours from storage tanks and process vessels. Recovered vapours will be combined with produced gas from the inlet production streams and directed to the hydrogen sulphide removal system (if required) prior to being used as fuel in the steam generators.

2.6.2.2 Glycol Cooling and Heating System

An ethylene glycol and water solution will be used as a heat transfer medium for the cooling and heating loads at the CPF. The glycol system will be used to:

- ▶ cool hot production fluids to meet process temperature requirements; and
- ▶ provide hot glycol for heating and heat recovery purposes, including winterization.

2.6.2.3 Fuel Gas

The main CPF fuel source will be purchased natural gas supplied by pipeline from CLO. The gas entering the CPF will be used to supply the:

- ▶ fuel gas mix drum and subsequently the steam generators;
- ▶ glycol heaters;
- ▶ CPF natural gas compression system to boost the pressure for uses at the SA-SAGD well pads);
- ▶ medium pressure blanket gas to various process vessels, including the inlet degasser, free-water knock out drum, treaters, and the produced gas slug catcher;
- ▶ lower pressure gas for the tank blanket gas and vapour recovery unit system makeup gas; and
- ▶ utility gas for the office and other staff buildings.

2.6.2.4 Flare System

The facility will not continuously flare gas. However, a flare system is provided to allow for the safe handling and combustion of flammable gases during upset, emergency or planned maintenance activities.

The flare system will have a continuous fuel gas purge and fluidic (velocity) seal to prevent air ingress. The seal will reduce the required purge gas quantity. The flare will also have a continuous pilot and electronic ignition.

2.6.2.5 Central Processing Facility Production Measurement

The CPF will have meters and sampling devices for operation and control purposes and volumes will be measured in accordance with AER Directive 017: *Measurement Requirements for Oil and Gas Operations*.

2.6.2.6 Air and Nitrogen Systems

An air compression system with air dryers will be used for utility and instrument air. Nitrogen to support operations and maintenance activities will be provided via a third party system.

2.6.2.7 Buildings

Buildings will shelter some of the equipment and will include:

- ▶ oil treating building;
- ▶ deoiling building;
- ▶ water treatment building;
- ▶ steam generation building;
- ▶ utilities buildings, including motor control centres; and
- ▶ control room and office building.

2.7 Infrastructure

The project will leverage the current infrastructure in place for Imperial's CLO.

Infrastructure that already exists in the project area includes:

- ▶ diluent, dilbit, water and natural gas pipelines;
- ▶ third party diluent supply and dilbit export pipeline systems;
- ▶ natural gas metering station;
- ▶ substations connected to the Alberta electrical power grid;
- ▶ fibre optic communications; and
- ▶ access roads.

New infrastructure will be extensions of the current system. Pipelines, roads and power lines will be primarily located in shared corridors, making use of existing disturbance areas, where practical. This approach will result in fewer infrastructure corridors and will reduce the amount of new disturbance and the number of watercourse crossings required.

New project infrastructure will include:

- ▶ access roads and corridors;
- ▶ pipelines from existing infrastructure to CPF;

- ▶ transmission and electrical distribution system;
- ▶ operations support buildings;
- ▶ borrow sites; and
- ▶ temporary facilities.

2.7.1 Access Roads and Corridors

Access to the CPF will be from an existing road (Imperial LOC 100083) that connects Imperial's Nabiye and Maskwa plants. A new approach off this road (plant access road) will be the main access to the site. A system of access roads will connect the CPF to SA-SAGD well pads.

2.7.2 Pipelines

Buried pipelines that will connect the project with existing CLO infrastructure include:

- ▶ natural gas supply pipeline;
- ▶ diluent supply pipeline;
- ▶ dilbit shipping pipeline;
- ▶ saline makeup water supply pipeline;
- ▶ surplus saline water export pipeline; and
- ▶ non-saline water supply pipeline.

Aboveground pipelines will include:

- ▶ steam, solvent and natural gas from CPF to the SA-SAGD well pads; and
- ▶ multiphase well production and potentially a separate casing gas pipeline from the SA-SAGD well pads to the CPF.

2.7.2.1 Electrical Power Lines

A new overhead 144 kV transmission line will be constructed by Imperial to supply power to the project CPF. The new transmission line will connect to an existing substation within Imperial's industrial system designation.

Power lines for the well pads will be located in a common corridor along with pipelines and roads. An aboveground fibre optic line for communication between the pads and the CPF will also be routed in this corridor.

2.7.2.2 Operations Support Buildings

Operations support buildings will include a control room, warehouses and office buildings. These buildings will be located adjacent to the CPF process area.

2.7.2.3 Borrow Sources

Imperial has conducted a preliminary inventory and has identified 58 potential borrow sources in the project area. Imperial expects that about 10 borrow sources will be used for project startup (initial SA-SAGD well pads, CPF and supporting infrastructure), and an additional 10 sources will be required for construction of future productivity maintenance SA-SAGD well pads.

2.7.2.4 Temporary Infrastructure

Temporary infrastructure will include modular-type trailer complexes and free-standing single trailers. Soft-walled structures will be used for construction warehousing. In addition, Imperial is considering an onsite camp to support construction activities to improve overall productivity and to manage costs as part of project planning. No decisions have been made, and assessments are ongoing regarding potential onsite camp facilities, leveraging existing offsite camps, and using local accommodations.

2.8 Aboriginal and Public Engagement

Imperial recognizes the importance of Aboriginal and public engagement in the regulatory approval process and is committed to open, meaningful and transparent communication and consultation with Aboriginal communities, stakeholders and interested parties. Imperial's stakeholder interactions are guided by five principles: inclusion, respect, timeliness, responsiveness, and accountability.

Imperial has developed plans for public and Aboriginal engagement that will guide engagement throughout the project. In addition to Imperial's internal engagement plans, the project prepared a First Nations consultation plan that was submitted to, and approved by, the Aboriginal Consultation Office.

The project seeks to understand Aboriginal perspectives on issues of mutual interest and constructively address differing views. Meaningful engagement and consultation will ensure that the project understands the interests and concerns of the First Nations and will allow Imperial to address those issues and concerns over the life of the project.

2.9 Water Management

2.9.1 Project Water Needs

The project's primary water needs include:

- ▶ saline water for steam generation;
- ▶ non-saline water for:
 - domestic use;
 - utility purposes such as wash water and fire water; and
 - construction and drilling operations.

2.9.2 Project Water Sources

The project will interconnect with the existing CLO and will have access to the same water sources as CLO, as well as produced water from the project. As with the interconnection between the existing CLO plants, this integration will aid in minimizing surface water and groundwater withdrawals.

Non-saline water will not be required for steam generation. Saline water for steam generation will be sourced from:

- ▶ recycled produced water from the project;
- ▶ transfer of surplus produced water from the existing CLO; and
- ▶ saline groundwater from the existing CLO brackish water system, if required.

Non-saline water will be sourced from:

- ▶ existing licenced sources for utility, domestic, drilling, and construction operations;
- ▶ other water licences, to be acquired as necessary;
- ▶ temporary diversion licence for portions of the drilling and construction operations (e.g., from borrow sites and existing lease areas); and
- ▶ *Water Act* diversion licences to manage plant runoff water.

2.9.3 Project Non-Saline Water Use Details

2.9.3.1 Construction Water

During construction, water will be used for:

- ▶ domestic use;
- ▶ construction operations, including:
 - road construction and other civil construction activities, including winter access road construction and dust control on roadways during dry periods; and
 - hydrotesting piping systems and tanks.

Water used during construction will be drawn from the existing CLO non-saline water system or from sources under a temporary diversion licence. Bottled water will be used for potable water needs.

2.9.3.2 Drilling Water

During drilling operations, water will be used for:

- ▶ domestic use;

- ▶ drilling, including:
 - generating steam for heating during the winter; and
 - mixing drilling fluids and cement.

Drilling water will be drawn from the existing CLO non-saline water system or from sources under a temporary diversion license. Bottled water will be used for potable water needs.

2.9.3.3 Operations Domestic and Utility Water

During operations, domestic and utility water will be obtained from the existing CLO non-saline water system. Uses for this water during project operations will include:

- ▶ equipment commissioning;
- ▶ domestic uses in the offices and control room;
- ▶ safety showers and eyewash stations in the CPF;
- ▶ utility stations in the CPF (equipment wash water);
- ▶ dust control; and
- ▶ fire water.

Bottled water will be used for potable water needs.

2.9.4 Water Disposal

2.9.4.1 Project Surplus Water

The project will draw surplus saline produced water from the existing CLO for makeup water and will return surplus saline water back to the CLO.

2.9.4.2 Cold Lake Operations Water Disposal

The project surplus saline water system will interconnect with the existing CLO surplus produced water system. If surplus water is not required elsewhere in the CLO, surplus saline water from the project will be routed to disposal. The CLO has a common disposal system for surplus water management and water is injected into the Cambrian sandstone. If required, the disposal system will be expanded to accommodate overall CLO disposal needs.

The disposal of surplus saline water from the project will be made in accordance with the requirements of AER Directive 51. The overall CLO including the project will optimize produced water recycle and wastewater disposal rates to meet AER Directive 081: *Water Disposal Limits and Reporting Requirements for Thermal In Situ Oil Sands Schemes*.

2.9.5 Surface Water, Blowdown Pond and Sewage Pond

2.9.5.1 Surface Water Collection

Surface runoff from the process area of the CPF will be collected in a stormwater pond designed to accommodate the 1:25-year, 24-hour storm event. Water will flow by gravity from the process area to drainage ditches that will collect and direct the water to a stormwater pond. Surface water runoff around soil stockpiles and other non-process areas will drain directly to the surrounding environment.

Stormwater collected in the CPF stormwater pond will be recycled in the CPF or released to the environment if testing confirms that it meets AER Directive 055: *Storage Requirements for the Upstream Petroleum Industry*.

2.9.5.2 Blowdown Pond

A blowdown pond will collect streams associated with the startup, operation and shutdown of the steam generators. The pond will be sized to handle process requirements along with precipitation associated with a 1:25-year, 24-hour rainfall event.

2.9.5.3 Hot Lime Softener Sludge Pond

A HLS sludge pond will collect fluids from startup, shutdown and maintenance events associated with the HLS, as well as occasional upsets to the sludge centrifuge system. The pond will be sized to handle process requirements along with precipitation associated with a 1:25-year, 24-hour rainfall event.

2.9.5.4 Domestic Wastewater Collection and Disposal

Consistent with practices currently used at CLO, a sewage wastewater pond will collect sewage from the project. If domestic wastewater water meets surface discharge criteria, it will be released to the surrounding environment. Solids that accumulate in the storage tanks or sewage pond and any domestic wastewater that cannot be released will be shipped to a licensed waste disposal facility.

2.10 Waste Management

As an extension of existing operations, the project plans to use current CLO waste management practices and facilities as practical. All waste generated by the project will be managed throughout the project's lifecycle, including waste from early works, construction, drilling, completions and operations, in compliance with municipal, provincial and federal regulations.

Imperial's primary objective is to manage the waste generated by the project in a manner that protects the environment and complies with applicable regulatory requirements. Imperial will also:

- ▶ avoid generation of waste, and reduce where practical;
- ▶ focus on the 4 Rs (reduce, reuse, recycle, and recover) of waste management; and
- ▶ dispose of waste if none of the above-mentioned management practices are practical.

2.10.1 Waste Management System

To meet regulatory and internal requirements, Imperial will update existing CLO waste management manuals and waste management plans to include the project. These plans will provide guidance on waste management throughout the project's lifecycle and will include information regarding waste:

- ▶ characterization;
- ▶ handling;
- ▶ storage;
- ▶ transportation; and
- ▶ disposal.

Imperial will also use an existing CLO waste verification tool to provide guidance and help identify gaps throughout all aspects of the project's waste management.

2.10.1.1 Storage and Disposal

Project waste storage and disposal facilities that may be used include:

- ▶ dangerous oil field waste (DOW) and non-DOW waste storage areas for temporary waste storage before recycling, treatment or disposal. The DOW storage areas will be fenced and have secondary containment;
- ▶ drilling waste storage areas;
- ▶ cement pits for disposing of drilling cement waste;
- ▶ disposal wells; and
- ▶ animal-proof storage containers, as appropriate.

Imperial is evaluating the benefits of an onsite landfill in conjunction with the location and availability of existing regional and local landfill facilities. Imperial will consult with other local operators and contractors regarding alternative offsite disposal options. If the project were to include an onsite Class II landfill, it would be the subject of a separate application.

2.10.2 Waste Streams

Waste types include solids, liquids and sludge that will be produced during the project's construction, operations, and drilling and completions activities.

Waste will include:

- ▶ substances that are designated by provincial or federal regulations as being hazardous (DOW);
- ▶ substances that are designated by provincial or federal regulations as being non-hazardous (non-DOW); and
- ▶ benign substances that are not designated under regulations.

The amount of construction waste generated at the site will be minimized through the use of offsite module construction. Operations waste will be minimized by reusing and recycling, wherever practical. Waste generated during decommissioning and reclamation of the CPF and other project facilities will be managed in accordance with applicable regulatory requirements.

2.11 Air Emissions Management

The project is located in an airshed that includes existing and planned emission sources. The project's baseline conditions were established using the emissions data from facility operators and previously submitted environmental assessments and *Environmental Protection and Enhancement Act* approvals. This data was used as an input for the air emissions model.

2.11.1 Sources

2.11.1.1 Combustion Emissions

The combustion sources at the CPF that have been modelled based on continuous operations are:

- ▶ two glycol heaters;
- ▶ one flare pilot; and
- ▶ seven once-through steam generators.

The steam generators will be fuelled by mixed fuel gas that will be a combination of produced gas recovered during the production of bitumen and purchased natural gas. Produced gas will supply about 9% of the fuel required for steam generation and the remainder will come from purchased natural gas.

The CPF will have a total of two glycol heaters. The glycol heaters will be fuelled by natural gas and will operate when required to supplement the heat in the hot glycol system. The air emissions model assumed continuous operation of these sources. Consequently, the modelling results are conservative because the glycol heaters will not be continuous emission sources but will operate only infrequently.

The combustion sources at the CPF that have been modelled as intermittent are:

- ▶ two diesel-driven backup electrical power generators;
- ▶ two diesel-driven fire water pumps; and
- ▶ occasional flaring events.

The project will not normally flare gas because produced gas will be recovered from all wells for use as fuel for the steam generators. Also, hydrocarbon tank vapours will be recovered and used as fuel. Therefore, the flare system is in place to handle emergency upset flow conditions and to support planned maintenance activities.

2.11.1.2 Fugitive Emissions

Fugitive emissions are hydrocarbon emissions that might arise from various sources at the CPF or field facilities. Fugitive emissions will be reduced through:

Proactive facility design:

- ▶ connecting the CPF product storage tanks to a vapour recovery unit system; and
- ▶ providing redundancy in the CPF vapour recovery unit system compressors, in case a compressor upset occurs.

Responsible operating:

- ▶ fugitive emissions management leak detection and equipment repair;
- ▶ using gas detection systems in buildings to enable early detection; and
- ▶ purging piping and equipment before completing maintenance.

2.11.1.3 Greenhouse Gas Emissions

More than 95% of the estimated project greenhouse gas emissions will be the result of carbon dioxide (CO₂) from combustion. The remaining 5% will be associated with fugitive emissions and construction emissions. At full production, the total project emissions were estimated to be about 3.1 kt CO₂e/cd, which is equivalent to 1,138 kt CO₂e/y.

2.11.1.4 Construction Emissions

Construction emissions at the CPF will arise primarily from fuel combustion in construction equipment, transport vehicles and temporary power generation equipment. The construction emissions will peak during the CPF construction period (i.e., 2019 to 2022). However, construction emissions are expected to be much less than the estimated emissions for operations. For this reason, CPF construction emissions were estimated only and not modelled.

Some well pad and field construction emissions will occur throughout the life of the project and these were included in the emissions modelling as part of the operations emissions. To provide a conservative estimate, peak well pad and field construction emissions were used even though these emissions are unlikely to occur at the same time as the operations emissions.

2.11.2 Emissions Control and Energy Efficiency

In addition to the innovation of applying SA-SAGD as the bitumen recovery process, emissions control measures and energy efficiency measures will be considered during project development. The measures that will be used for the project are ones that have been successfully applied at CLO.

2.12 Environmental Management

2.12.1 Policies and Management Framework

Imperial is committed to conducting business in a manner that is compatible with the environmental and economic needs of the communities in which it operates, and in a manner that protects the safety, security, and health of its employees, those involved with its operations, its customers, and the public. These policies are put into practice through a disciplined management framework called the Operations Integrity Management System (OIMS).

Imperial's OIMS Framework establishes common expectations for addressing risks inherent in its business. OIMS is ISO 14001 certified and this certification is confirmed through periodic assessments. In accordance with OIMS, existing CLO operating and maintenance procedures will be revised to include the project to ensure that operations integrity is maintained.

2.12.2 Emergency Response

An emergency response management system, an OIMS requirement, applies to all Imperial operations. The CLO Emergency Response Plan (ERP) will be updated to include the project.

The ERP includes procedures for public notification, safety and reporting.

Imperial has adopted a tiered response system known as the incident command system. This response structure will be used for interacting with government agencies, the public, contractors and others that would be involved during an incident. The incident command system is a dynamic system that facilitates rapid and orderly movement of resources to address the needs of responding to an incident.

The ERP is reviewed, modified and updated in accordance with regulatory and corporate requirements. Typically, the plan is reviewed annually.

2.12.3 Spill Prevention and Response

Prevention of releases is the ultimate goal of any spill management program. Consequently, Imperial has various corporate spill prevention initiatives in place that will also apply to the project.

A Spill Response Plan is part of the existing CLO ERP and provides information on responding, reporting, containing and cleaning up leaks and spills (e.g., hydrocarbons, diluent, solvent, process-affected water and chemicals) in a manner that reduces hazards and environmental effects.

2.12.4 Wildfires

Wildfire management for CLO and the project will be addressed in the:

- ▶ ERP;
- ▶ Industrial Wildfire Control Plan, which will be developed in accordance with the *Forest Prairie Protection Act*; and

- ▶ FireSmart plans for the project, which will be developed in accordance with Enform's FireSmart Field Guide for Upstream Oil and Gas Industry and the ESRD's FireSmart Guidebook for the Oil and Gas Industry.

To help reduce the threat of wildfires, vegetation will be managed around facilities and infrastructure in accordance with regulatory requirements, such as the fire code and AER directives.

2.12.5 Environmental Monitoring and Reporting

After the project has been approved, Imperial will incorporate the project into existing CLO monitoring programs in accordance with regulatory approval conditions and Imperials internal reporting and performance evaluation requirements.

CLO environmental monitoring programs will be modified as new information and regulatory requirements are received to support continuous improvement through an adaptive management approach.

2.12.6 Regional Initiatives

Imperial actively participates in several organizations, initiatives, alliances and partnerships that were created to:

- ▶ monitor for environmental change;
- ▶ develop environmental management objectives;
- ▶ undertake research on detecting and mitigating environmental effects; and
- ▶ manage existing and emerging socio-economic issues.