Imperial

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Innovative Energy Technologies Program
Research and Technology Branch
9th Floor, Petroleum Plaza North
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Attention: Christopher Holly
Branch Head
Research and Technology

Dear Mr. Holly:

Re: Imperial Oil CSP IETP Annual Project Technical Report

Attached is Imperial Oil's 2013 Annual Project Report for the CSP pilot as required under IETP Approval 06-094.

Please contact Jianlin Wang at (403) 284-7402 or at jianlin.wang@exxonmobil.com with any questions or concerns.

Yours truly,

[Original Signed]

J.F. (John) Elliott, P.Eng.
Manager, Oil Sands Recovery Research

Attachment
cc: Michelle Sieben, IOR
cc: Martin Mader, ADOE

IETP Application No. 06-094

Imperial Oil Resources – Cyclic Solvent Process Pilot

2013 Annual Project Technical Report

Confidential under IETP Agreement

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1 Abstract

Imperial Oil Resources (Imperial) is conducting a Cyclic Solvent Process (CSP) experimental pilot scheme at Cold Lake in the Clearwater formation to be operated under Energy Resources Conservation Board (ERCB) Approval 11604, dated May 5, 2011.

CSP is a non-thermal, in-situ bitumen recovery process that utilizes injected solvent to reduce the viscosity of the bitumen, enabling its production from wells drilled for that purpose. The liquid-phase solvent is injected into a horizontal well cyclically and, because of the large mobility contrast between the solvent and the bitumen, it fingers into the bitumen. Following injection, the solvent-bitumen blend is produced from the same well. Cyclic injection and production operations continue for multiple cycles over several years until the bitumen produced no longer justifies the cost of the solvent or until the bitumen production rate is no longer economic. The cyclic operation is followed by a final blow-down period, when additional solvent is recovered by vaporization at low abandonment pressure.

Since CSP is a non-thermal process, the two key challenges facing traditional thermal processes (e.g. Cyclic Steam Stimulation and Steam Assisted Gravity Drainage) are avoided: (1) production of GHGs arising from burning natural gas to produce steam and (2) thermal inefficiencies which limit applicability to thinner and/or lower bitumen saturation reservoirs.

The pilot is located at K50 pad in Imperial's Cold Lake development and is being conducted in the Clearwater formation. Three horizontal wells will be operated using CSP as a recovery process. The project has achieved mechanical completion and is currently in commissioning phase with no operations and little surveillance completed to date.

This report summarizes progress that was made through year-end 2013.

2 Summary Project Status Report

2.1 Members of the project team

The following were key members of the CSP project team to the end of 2013, with changes from 2012 noted:

J.F. (John) Elliott, P.Eng.	Oil Sands Recovery Research Manager
T.J. (Tom) Boone, PhD, P.Eng.	ExxonMobil Senior Technical Professional
J. (Jianlin) Wang, PhD	CSP Team Lead *Replaced Dave Courtnage on July 1, 2013*
L. (Lu) Dong, PhD, P.Eng.	CSP Reservoir Engineer *Added to the team in September 2013, replacing Xiaomeng Yang*
N. (Nafiseh) Dadgostar, PhD	CSP Reservoir Engineer *Added to the team on June 1, 2013*
A.J. (Andrew) Hodgetts, P.Eng.	Projects Manager Brownfield/Research
M. (Mike) Sheptycki, P.Eng.	CSP Project Manager *Replaced Vera Ivosevic on February 12, 2013*

2.2 Key activities

Key activities during the reporting period are described below:

- Horizontal well completions, discussed in Section 4.2
- Completion of surface facilities construction, discussed in Section 5.2

2.3 Production, material and energy balance flow sheets

As of year-end 2013, operation of the pilot had not started, and there were thus no injected or produced volumes to be reported. Operation of the pilot is expected to begin in the second quarter of 2014. In the future, injection volumes will be shown in Table 1. Production volumes will be shown in Table 2. Other energy balance data will be shown in Table 3.

2.4 Reserves

Based on the new Petrel-based geologic model (Section 3.2), the estimate of bitumen-in-place in the pilot area is 879 km3. The current reservoir simulation estimate of recovery is 17 km3 after the planned five cycles of the pilot with 42 km3 solvent injection. The ratio of these values is not indicative of the recovery factor of the process – the wells have been spaced farther apart than would be anticipated during a commercial project, and the process may not run to an economic limit. Recovery factor and reserves will be determined by history-matched reservoir simulation model at the completion of the pilot.

3 Well Layout and Geology

3.1 Well and pad layout

The pilot consists of six observation (OB) wells and three horizontal wells:

IMP 08 OV COLD LK 14-18-65-4 – UWI 1AA/14-18-065-04W4/00
IMP 10 CSP OB-1 LEMING 14-18-65-4 – UWI 105/14-18-065-04W4/00
IMP 10 CSP OB-2 LEMING 14-18-65-4 – UWI 100/14-18-065-04W4/00
IMP 10 CSP OB-3 LEMING 14-18-65-4 – UWI 102/14-18-065-04W4/00
IMP 10 CSP OB-4 LEMING 14-18-65-4 – UWI 103/14-18-065-04W4/00
IMP 10 CSP OB-5 LEMING 14-18-65-4 – UWI 104/14-18-065-04W4/00

IMP 11 CSP H-01 LEMING 3-19-65-4 – UWI 100/03-19-065-04W4/00
IMP 11 CSP H-02 LEMING 14-18-65-4 – UWI 110/04-18-065-04W4/00
IMP 11 CSP H-03 LEMING 14-18-65-4 – UWI 111/04-18-065-04W4/00

The layout of the wells is shown in Figure 1. The six OB wells are drilled from three pads and the three horizontal wells are drilled from a fourth pad. Surface facility and pad locations are shown in Figure 2.

Well 14-18 was drilled in 2009; the remaining five OB wells were drilled in 2011. The horizontal wells were drilled in March 2012. All wells were completed from late 2012 to early 2013, which are discussed in Section 4.1 below.

3.2 Geology

The pilot is being conducted in the Clearwater formation. A cross-section of the reservoir, through the observation wells, is shown in Figure 3. The reservoir consists of two sequences: the lower sequence, between the lower sequence boundary (bright green line in three wells in Figure 3) and the upper sequence boundary (purple line in Figure 3); and, the upper sequence between the upper sequence boundary and the top of the Clearwater formation (red line in Figure 3). The primary target is the lower sequence, with an average thickness of 21 m. The depth of the horizontal wells is shown approximately by the dashed dark green line in Figure 3.

The sands are generally clean, although one noticeable feature on the logs is the calcite cemented zones (colored blue in Figure 3). From core, we believe these features to be limited in areal extent. Observation of similar features elsewhere in the development would suggest their impact on conformance should be limited. Should the calcite zones be more extensive and have zero permeability, they may change the conformance of the solvent-invaded zone, but should not impact our ability to interpret the pilot results. Heterogeneity is higher in OB1 through OB5 than in the first well 14-18, upon which the site was picked. Again, this increase in heterogeneity is not expected to adversely impact the pilot results.

Also noticeable from Figure 3 is that three of the OB wells were drilled shallower than the other three. This was to avoid a higher water saturation zone below the Clearwater formation. Although the wells are cemented, it was decided not to penetrate that sand in the last three wells.

4 Well Information

4.1 Drilling, completion, and work-over operations

The 2012 annual report provided a detailed summary of the drilling activities and a brief description of the OB well completions. Figure 4 shows the OB wells surface and bottom-hole locations relative to the horizontal wells (HW1-3) and provides an overview of the OB wells instrumentation for surveillance. Specifications of the OB Well Completions are summarized in Table 4.

Below is a summary of the horizontal well Completions design, shown in Figure 5:

- 7″ casing string landed with a packer and expansion piece ~10 m above the top of the Clearwater formation. Casing string is necessary to complete annular isolation tests as part of the regulatory requirement for hydrocarbon injection-class wellbores.
- ~125 m long, 5″ OD horizontal wellbore liner at bottom of well. Liner has 5 inflow control devices in place.
- Downhole heater: provides heat to the well liner region if necessary to reduce viscosity and improve flow capabilities.
- 12-Thermocouple bundle: takes temperature reading at specific points. Set points are primarily at or midpoint between wellbore liner inflow control devices. Thermocouples are set as close as possible to target based on tubing tag and trip precision.
- ERD (electronic resonating diaphragm) dual sensor, connected into tubing mandrel. Precision pressure and temperature monitoring at single set point 5 m above the top of the horizontal wellbore liner.
- Two Bubble Tubes. Bubble tube #1 landed near toe of horizontal liner; Bubble tube #2 at rod insert pump seating depth. Pressure monitoring system tied into nitrogen skid at surface.
- ~120 clamps of 14 separate designs used to secure and protect all lines across the length of the wellbore tubing string

The first phase of Horizontal Well completions work occurred during September 2012-March 2013 (Figure 6 shows some well site pictures during the Completions work). The design scope for the CSP Horizontal wells involved setting a packer string for annular pressure monitoring, and deploying a tubing string with multiple instrumentation cables clamped to its exterior.

Installing the annular packers proved challenging as the initial packer installation procedure did not fully achieve a pressure seal. Modifications were made to the packer unit and procedures to capture and apply additional setting force. This primary packer model was subsequently successfully installed in Horizontal Wells #1 and #2. Difficulties remained in setting the primary packer model in the final horizontal well. A different packer system was sourced and fully installed in two stages; the packer element in February 2013, and a seal and expansion joint stinger in July 2013. All three annular packer systems have now been installed.

Installation of the tubing string with attached thermocouples, heater, ERD sensor, and bubble tubes began in January 2013. The installation was completed successfully with full function tests on Horizontal Well #1. At Horizontal Well #2 all tubing and equipment was placed at the final setting position; at this point the final heater function test was not successful and the equipment was retrieved to surface. The primary finding was that one of the electrical connections necessary to splice the downhole heater unit to the well power cable suffered some water seepage, which was sufficient to foul the heater. As Completions ran out its allocated time in

2013, installation of instrumented tubing strings in wells HW2 and HW3 was rescheduled to Q1 2014. The status of the HW completions is summarized in Table 5.

There were no workovers attempted in the reporting period.

4.2 Wellbore schematics

A general schematic of the three horizontal wells, to be completed similarly, is shown in Figure 5. Schematics of the six observation wells were provided in the 2012 annual report.

4.3 Spacing and pattern

The horizontal wells are spaced approximately 200 m apart, with approximately 100 m of drainage length per well, as shown in Figures 1-3. Adding 50 m to the potential drainage area on each end of each HW, the pilot encompasses 120,000 m^2 (600 m x 200 m), which is roughly 32.5 acres per well.

4.4 Well operation

None of the wells was in operation during the reporting period.

5 Surface Facilities

5.1 Detailed Design

Engineering design of surface facilities had been completed by August 2012. The process flow diagrams (PFDs) in Appendix A provide a high-level overview of the surface facilities.

5.2 Progress

One of the key milestones achieved in the current reporting report is completion of the Surface Facilities constructions. The major completed tasks include:

- Fabrication of skids completed and received on site: injection, separator and MCC building
- Construction and installation of equipment, piping, instrumentation and electrical

Pad equipment skids fabrication started in August 2012, following the completion of detailed design for all mechanical & piping system on the main injection/production pad as well as for the production pipeline back to the Mahihkan P4 plant site. The key task of skid fabrication was construction of the solvent injection building, multiphase pump building, and propane transfer skid and associated piping, including

- Construction and erection of skid frames, walkways, piping and equipment supports
- Construction and installation of piping and valves
- Installation / mounting of packaged equipment on skids
- Surface preparation, painting and insulation of structural steel and piping

All skids were completed and received on site in the spring of 2013. Major pad facility construction started in February 2013, including the following activities:

- Construction and installation of lease piping and supports
- Pad pipeline construction to bring the pipeline onto the lease and pipeline installation
- Installation of shop fabricated skids on pile foundations
- Installation of equipment and buildings on pile foundations
- Installation of valves
- Pressure testing, inspection and non-destructive examination, draining and flushing of piping

Surface facilities construction was complete by year end of 2013, with only some minor activities such as cleanup, insulation, and hydro-testing to be completed in 1Q 2014. Figure 7 includes a couple of site views after completion of facilities construction. Figure 8-16 include a set of pictures that provide some good views of the major surface facilities completed, including

- Injection, production and separator buildings (Figure 8, 9)
- MCC building (Figure 8, 10)
- Solvent storage facilities: propane bullets and diluent tanks (Figure 11)
- Propane transfer skid and vent stack (Figure 11)
- Nitrogen skid and storage (Figure 12)
- Recycle cooler (Figure 8)
- Piping and pipe rack (Figure 8)
- Solvent heaters (Figure 13)
- Liquid separator, multi-phase pump (MPP), makeup water tank, etc. (Figure 14)
- Diluent transfer pump, pulsation dampener, lube oil tank, etc. (Figure 15)
- Underground pipeline (Figure 16)

It can be seen from these pictures that all the injection, production, and control facilities are in place. The construction has been complete with the commissioning to follow.

5.3 Surface equipment

Table 6 provides a list of major equipment and their design basis. Below is a description of the major equipment and how they are used in the injection and production system. Please refer to the Process Flow Diagrams (PFDs) in Attachment A.

Solvent Preparation & Blending (Injection)

Propane supplied via truck will be stored in two storage vessels, V-0061/62. Propane transfer pumps, P-0061/62, will supply liquid propane to the primary injection pumps P-0051/52. Diluent will also be supplied via truck and will be stored in two atmospheric storage tanks, T-0071/72. Diluent transfer pumps, P-0071/72 will boost the pressure for blending with the propane upstream of the static mixer, filters and primary injection pumps. The basket strainer, FIL-0071 is installed on the filling line of diluent tanks will remove debris suspended in the diluent supply. The tanks will be blanketed by low pressure nitrogen supplied by a LP nitrogen skid.

The blended injection fluid is mixed in an in-line static mixer and then filtered via fine mesh filters (FIL-0051/52) to remove basic sediment. Filtered solvent is routed to the primary injection pumps, P-0051/52 and electric solvent heaters, H-0051/52 before injecting into the wells.

Production System

After each injection cycle has been completed, the injected well then starts producing. Production flows through ROV-401 where it is directed either to the electric production fluid heater (H-0054) and subsequently the group production line or to the electric test fluid heater (H-0053) and subsequently the test separator (V-0011).

Any gas which may pressure up the casing is vented to multiphase pumps which compresses the vent gas and sends the compressed gas into the group header. The system uses common vent piping at the wellhead manifolds to gather the vent gas from individual flow lines. A dedicated multiphase pump (MPP) suction header then conveys the fluid from the manifolds to the MPPs (P-0030/40). In order to achieve sealing requirements, water will be used as seal liquid stored in on-site tankage (T-0023) and supplied by a small pump (P-0023). The recycled water is cooled by means of an aerial cooler (E-0005) and utilized to minimize make up water requirements. The cooled recycled liquid is mixed into the vent gas stream. The mixed stream enters the multi-phase pump (MPP), and is compressed. The discharge from the MPP flows into the liquid separator, V-0003. The liquid in the pump discharge stream is separated in this vessel, which is recycled to the aerial cooler while maintaining a minimum liquid inventory in the vessel. Excess water from the liquid separator is purged to the group header. In case of accumulation of any propane in the liquid separator, the excess propane will be purged to the group header by the purge liquid pump, P-0024.

For methanol injection into production fluids at the inlet of the pipeline to avoid hydrate, a chemical methanol injection system is provided. Chemical Methanol injection consists of a metering methanol pump (P-0022) and a chemical methanol tank (T-0022).
With the exception of the propane storage and transfer pump area, all site PSVs will discharge to an atmospherically vented pop tank (T-0001).PSV releases from the propane vessels, V-0061/62, and the propane transfer pumps will be discharged to atmosphere through a vent stack located at southwest corner of K-50 pad.

5.4 *Capacity limitation, operational issues, and equipment integrity*

No capacity limitations, operational issues or equipment integrity issues have been identified to date.

6 Production Performance

6.1 Injection and production history

There has been no injection or production to date. The pilot is expected to begin operating in the 2Q of 2014.

6.2 Composition of injected and produced fluids

There has been no injection or production to date.

6.3 Predicted vs. actual comparisons

There has been no injection or production to date. Predictions are still being finalized.

6.4 Pressures

There has been no injection or production to date. All wells are assumed to be at original reservoir pressure.

7 Pilot Data

7.1 Additional data

Due to the early stage of the project, little surveillance data has been collected to date. All wells were logged after drilling and an initial 3D seismic survey was shot over the area in 2010. During 2012, the initial shoot of the cross-well borehole tomography was completed, which was discussed in the 2012 annual report.

7.2 Interpretation of pilot data

Initial pilot surveillance plans included shooting cross-well borehole tomography between the wells in an effort to better identify and quantify the conformance of the solvent injection. The base survey was completed in April 2012, with processing and interpretation taking place over the rest of the year.

In 2013, we evaluated methods of improving process of the cross-well seismic data. After revisit of the data, it was determined that the value of repeat cross-well surveys will be very limited and thus will be dropped from the surveillance program. Repeat 3D seismic surveys and passive seismic monitoring (in three of six the observation wells) remain in the surveillance plans.

There have been no other surveillance data collected to date.

8 Pilot Economics

8.1 Sales volumes of natural gas and by-products

There has been no solution gas produced to date.
There has been no recovered propane produced to date.
There has been no recovered diluent produced to date.

8.2 Revenue

As the CSP pilot is part of Imperial Oil's Cold Lake Production Project, injection and production volumes are blended with Mahihkan plant volumes, and thus revenue is not calculated separately. This section provides the methodology of the estimated revenue calculation.

Revenue is derived from four sources: sale of produced bitumen, the theoretical sale of produced solution gas (offsets natural gas purchases elsewhere in the operation), the theoretical sale of recovered propane (offsets natural gas purchases elsewhere in the operation), and the theoretical sale of recovered diluent (offsets diluent purchases for shipping the bitumen).

There has been no production, and therefore no revenue to date.

8.3 Drilling, completions, and facilities costs

Table 7 summarizes drilling, completions, facilities, and related costs by category, incurred in 2013. Often these costs are referred to as capital costs, but because of the uniqueness and short life of the facilities and the research nature of the pilot, they have not been capitalized. Total drilling, completions, and facilities costs in 2013 were 22,776 k$.

8.4 Direct and indirect operating costs

Table 8 summarizes direct and indirect operating costs by category, incurred in 2013. There have been no operating costs incurred to date.

8.5 Injectant costs

Table 9 summarizes injectant costs by category, including trucking costs associated with transporting these volumes to site, incurred in 2013. There have been no injectant costs incurred to date.

8.6 Crown royalties

This pilot is part of Imperial Oil's Cold Lake Production Project, with revenue and costs impacting the total Cold Lake payable royalty. An estimation of the impact on royalty payable is shown in Table 10.

8.7 Cash flow

As revenue is only estimated for the pilot, cash flow can only be estimated. Using the data from Tables 7 through 10, it is estimated as follows:

Revenue	= Bitumen + Solution Gas + Recovered Propane + Recovered Diluent
	= 0 + 0 + 0 + 0
	= 0 k$
Costs	= Drilling & Facilities Costs + Operating Costs + Injectant Costs – CCEMC Credit
	= 22,776 + 0 + 0 – 2,480
	= 20,296 k$
Royalties	= - 7,185 k$
Cash Flow	= Revenue – Costs – Royalties
	= 0 – 20,296 + 7,185
	= - 13,111 k$

This estimation of cash flow does not include taxes.

8.8 Cumulative project costs and net revenue

Cumulative project costs to date are shown in Table 11. Cumulative project revenue is shown in Table 12.

8.9 Deviations from budgeted costs

Changes to individual cost components are expected. To date, there is no change to the total cost of the pilot.

9 Environmental/Regulatory/Compliance

A copy of any approvals mentioned in the following sections, as well as amendments made, can be supplied upon request.

9.1 Regulatory Compliance

The project is operating under ERCB scheme approval 11604. To date, the pilot has been in full compliance, and no regulatory issues have arisen.

9.2 Environmental Considerations

The CSP pilot (construction, operation and reclamation) has been planned to align with the environmental objectives as outlined in the Cold Lake Expansion Project (CLEP) Environmental Impact Assessment (EIA) (Imperial Oil Resources, 1997) as well as with the requirements outlined in operating approval No. 73534-01-00 (as amended) issued by Alberta Environment and Sustainable Resources Development (ESRD) under the Alberta Environmental Protection and Enhancement Act (AEPEA). Numerous other directives and codes of practice have also been reviewed during the planning phase to ensure full compliance. Imperial has an internal database system populated with commitments, requirements and responsibilities as outlined in applicable regulations.

9.3 Air Quality

The CSP pilot has not resulted in any change to air emissions as considered in the EIA discussed previously. Imperial presently conducts air quality monitoring in the Cold Lake Operations (CLO) area outside of regulatory mandates and as a measure of due diligence, Imperial actively monitors the air quality of the CLO area air shed through placement of eleven passive air quality monitoring stations targeting H_2S and SO_2 gas emissions associated with operating CLO facilities.

9.4 Aquatic Resources

Imperial regularly conducts monitoring programs involving aquatic resources located within the CLO area including surface water, wetlands and groundwater. These programs are regularly expanded and modified as a consequence of field expansion. Imperial presently reports its water diversion volumes in response to corresponding regulations and is in full compliance with water diversion reporting requirements. The addition of the CSP pilot did not generate an increase in water demand.

A Wetland Monitoring Program (Imperial Oil Resources 2005) was implemented in 2006 in which wetland vegetation, water quality and flow dynamics are evaluated on a regular basis. Groundwater monitoring instrumentation is utilized proximal to wetland areas to monitor water flow and drainage performance as well as to monitor water quality/chemistry. Setback requirements associated with environmentally sensitive areas have been maintained in proposed pad and facilities designs.

9.5 Wildlife

Imperial develops its project schedules in a manner consistent with applicable regulations. Environmental aspects are considered and evaluated during the pre-construction planning phase of all Cold Lake projects with special attention paid to wildlife habitat and movement issues. The

CSP development was conducted with the objective of minimizing disturbance to wildlife habitat and movement.

During production, Imperial personnel adhere to the Wildlife Mitigation and Monitoring Plan which outlines specific actions and responsibilities designed to reduce operations-related risks to wildlife and wildlife habitat in the CLO area.

Reclamation plans are developed and implemented with particular attention paid to returning the land to an equivalent land capability. Wildlife use of reclaimed sites is a key aspect of reclamation success and will be monitored through the Cold Lake Reclamation Monitoring Program.

9.6 Noise

Through direct consultation with regulators and other stakeholders, Imperial has developed a noise prediction model to meet the requirements of ERCB Directive 038 (ERCB 2007). The entire Cold Lake Expansion Project has shown to be significantly below the allowable p sound level (PSL).

9.7 Reclamation

The CSP pilot decommissioning and reclamation activities will be addressed in accordance with EPEA Approval 73534-0-00, as amended.

10 Future Operating Plan

10.1 Project schedule

Availability and competition for some project resources and the problems with the well completions discussed in Section 4.1 have impacted the original construction schedule. With the mechanical completion achieved by end of 2013, here is a list of completion dates for key activities:

Well completions	February 2014
Pre-commissioning	April 2014
Commissioning	May 2014
Start Up	May 2014

10.2 Changes in pilot operation

Currently, no changes have been implemented to the pilot operation.

10.3 Optimization strategies

Currently, no optimization strategies have been implemented.

10.4 Salvage update

Currently, no plans to salvage any of the equipment on site have been developed.

11 Interpretations and Conclusions

With pilot operation not yet commenced, no performance assessment of the recovery process has been made.

Table 1 – Material Balance Data – Production

Produced Volumes (m^3)	Bitumen	Water	Sol'n Gas	Propane	Diluent
January	0	0	0	0	0
February	0	0	0	0	0
March	0	0	0	0	0
April	0	0	0	0	0
May	0	0	0	0	0
June	0	0	0	0	0
July	0	0	0	0	0
August	0	0	0	0	0
September	0	0	0	0	0
October	0	0	0	0	0
November	0	0	0	0	0
December	0	0	0	0	0
Total 2013	**0**	**0**	**0**	**0**	**0**

Table 2 – Material Balance Data – Injection

Injected Volumes (m^3)	**Propane**	**Diluent**
January	0	0
February	0	0
March	0	0
April	0	0
May	0	0
June	0	0
July	0	0
August	0	0
September	0	0
October	0	0
November	0	0
December	0	0
Total 2013	**0**	**0**

Table 3 – Energy Balance Data

	Electricity (kWhr)	Steam (m^3)	Air (m^3)	Water (m^3)
January	0	0	0	0
February	0	0	0	0
March	0	0	0	0
April	0	0	0	0
May	0	0	0	0
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	0	0	0	0
December	0	0	0	0
Total 2013	**0**	**0**	**0**	**0**

Table 4: Observation Well Completions

	OB1	OB2	OB3	OB4	OB5	14-18
Tubing OD (mm); Grade	73, J-55	73, J-55	73, J-55	73, J-55	73, J-55	60.3, L-80
Casing OD (mm); Grade	177.8, L-80	177.8, L-80	177.8, L-80	177.8, L-80	177.8, L-80	139.7, J-55
Well PBTD Deepened	N	N	N	N	Y	Y
Wellbore Fluids Upon Completion	Annular Cemented	Annular Cemented	Water Filled	Water Filled	Annular Cemented	Water Filled
Fiber Optics Depth (mKB)	459.9	475.2	462.0	483.0	464.2	484.4
Installation Hardware:	Geophones	Geophones	Heater	Heater	Geophones	Heater
Bottom Geophone or Heater Set Depth (mKB)	459.4	474.4	463.0	484.0	459.2	484.1
Well Perforated	Y	N	Y	N	Y	N
Packer Set Downhole (Y/N)	N	N	Y	N	N	N

Table 5: Horizontal Well Completions◊

Well	Liner	Dual Casing	Instrumentation	Pump
CSP HW-01	Installed	Installed	Installed	Installed
CSP HW-02	Installed	Installed	Installed*	Installed
CSP HW-03	Installed	Installed	Installed	Installed

◊ Completions status as of February 2014
* HW-02 well downhole heater not functioning

Table 6: Major Equipment and Design Basis

	Tag number	Equipment Description	Quantity	Size
1	V-0061/62	Propane vessel	2	4420 mm ID X 24282 mm S/S (working capacity 250 m^3 each)
2	T-0071/72	Diluent tank	2	4648 mm OD X 7315 mm H (750 BBL)
3	P-0071/72	Diluent transfer pumps	2 (2 x 100%)	67 m^3/day each
4	P-0061/62	Propane transfer pumps	2 (2x100%)	175 m^3/day each
5	P-0051/52	Injection pumps	2 (2x100%)	7.5 m^3/hr
6	H-0051/52	Electric solvent heater	2 (2x50%)	200 KW each
7	FIL-0071	Diluent filter	1	100 Microns
8	FIL-0051/52	Solvent filter	2	5 Microns
9	P-0030/40	Multiphase vent gas pumps	2 (2x100%)	153 m^3/h
10	V-0003	Liquid separator	1	736 mm ID X 2550 mm S/S
11	E-0005	Recycle liquid cooler	1	203 KW
12	P-0023	Make up water pumps	1 (1x100%)	100 LPH per pump
13	T-0023	Make up water tank	1	1830 mm OD X 3518 mm H (capacity 8 m^3)
14	H-0053	Electric test fluid heater	1	13 KW
15	H-0054	Electric production heater	1	40 KW
16	V-0011	Test separator	1	1219 mm ID X 3600 mm S /S, Boot 508 mm ID X 1200 mm L
17	P-0024	Purge Liquid Pump	1 (1X100%)	0-1000 LPH
18	PK-001	Instrument air package	1	110 sm^3/hr
19	T-0022	Methanol tank	1	2413 mm ID X 3048 mm H (90 BBL)
20	P-0022	Methanol injection pump	1 (1X100%)	1000 LPD
21	P-0073	Utility diluent pump	1 (1X100%)	8000 LPD
22	T-0001	Pop tank	1	2896 mm ID X 3658 mm High (150 BBL)
23	T-0002/0003	Closed Drain Tank	2	1256 mm OD X 3517 mm OAL
24	K50-1/ K50-2/ K50-3	Pump Jack	3	22.2 KW

Table 7: Drilling and Facilities Costs

Drilling and Facilities Costs (k$)	**2013**
Preliminary Engineering	0
Surface Facilities	20,985
OB Well Drilling	-1
HW Drilling	-707
Completions	2,638
Geo Surveillance	-139
Total Drilling and Facilities Costs	**22,776**

Table 8: Operating Costs

Direct and Indirect Operating Costs (k$)	**2013**
Operating Costs	0
TOTAL	0

Table 9: Injectant Costs

Injectant Costs (k$)	**2013**
Propane	0
Diluent	0
TOTAL	0

Table 10: Estimated Crown Royalty Calculation

Crown Royalties (k$)	2009	2010	2011	2012	2013	Total
Pilot Revenue[1]	0	0	0	0	0	0
Pilot Costs[2]	563	1,631	8,991	33,257	22,776	67,217
CCEMC Credit[3]				2,400	2,480	4,880
Pilot Cash Flow	-563	-1,631	-8,991	-30,857	-20,296	-62,337
Cold Lake Royalty Rate[4]	27.8%	30.9%	33.8%	34.2%	35.4%	-
Cold Lake Royalty Impact	-156	-504	-3,039	-10,553	-7,185	-21,437
Total Cold Lake Royalties[4]	438,162	628,311	934,732	680,330	599,433	-

[1] Estimated, see Section 8.2 for assumptions

[2] Based on IETP claim form submissions, see Sections 8.3, 8.4 and 8.5

[3] Grant received from Climate Change and Emissions Management (CCEMC) Corporation offsetting pilot costs. Credit is shown in year earned, independent of when it was received.

[4] Total Cold Lake rate and royalties paid, which include CSP Pilot costs and revenue. Values may change from previous submissions due to revisions.

Table 11: Cumulative Project Costs

Cumulative Costs (k$)	2009	2010	2011	2012	2013	Total
Drilling & Facilities Costs	563	1,631	8,991	33,257	22,776	67,217
Operating Costs	0	0	0	0	0	0
Injectant Costs	0	0	0	0	0	0
Total Costs	**1,375**	**829**	**8,980**	**33,257**	**22,776**	**67,217**

Table 12: Cumulative Project Revenue

Cumulative Revenue (k$)	2009	2010	2011	2012	2013	Total
Bitumen	0	0	0	0	0	0
Solution Gas	0	0	0	0	0	0
Recovered Propane	0	0	0	0	0	0
Recovered Diluent	0	0	0	0	0	0
Total Revenue	**0**	**0**	**0**	**0**	**0**	**0**

[1] Estimated, see section 8.2 for assumptions

Figure 1: Well Layout

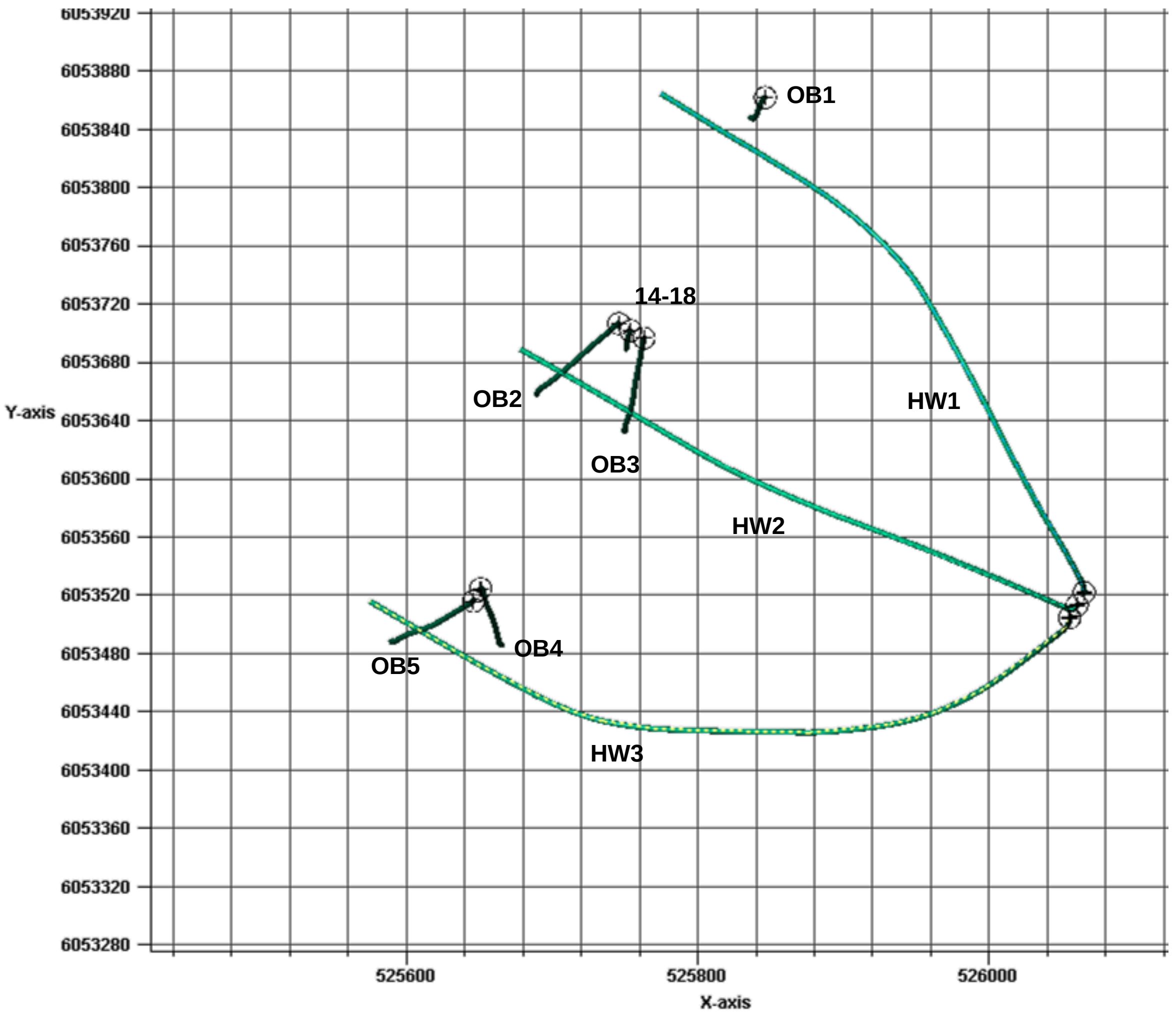

Figure 2: Surface Facility and Pad Locations

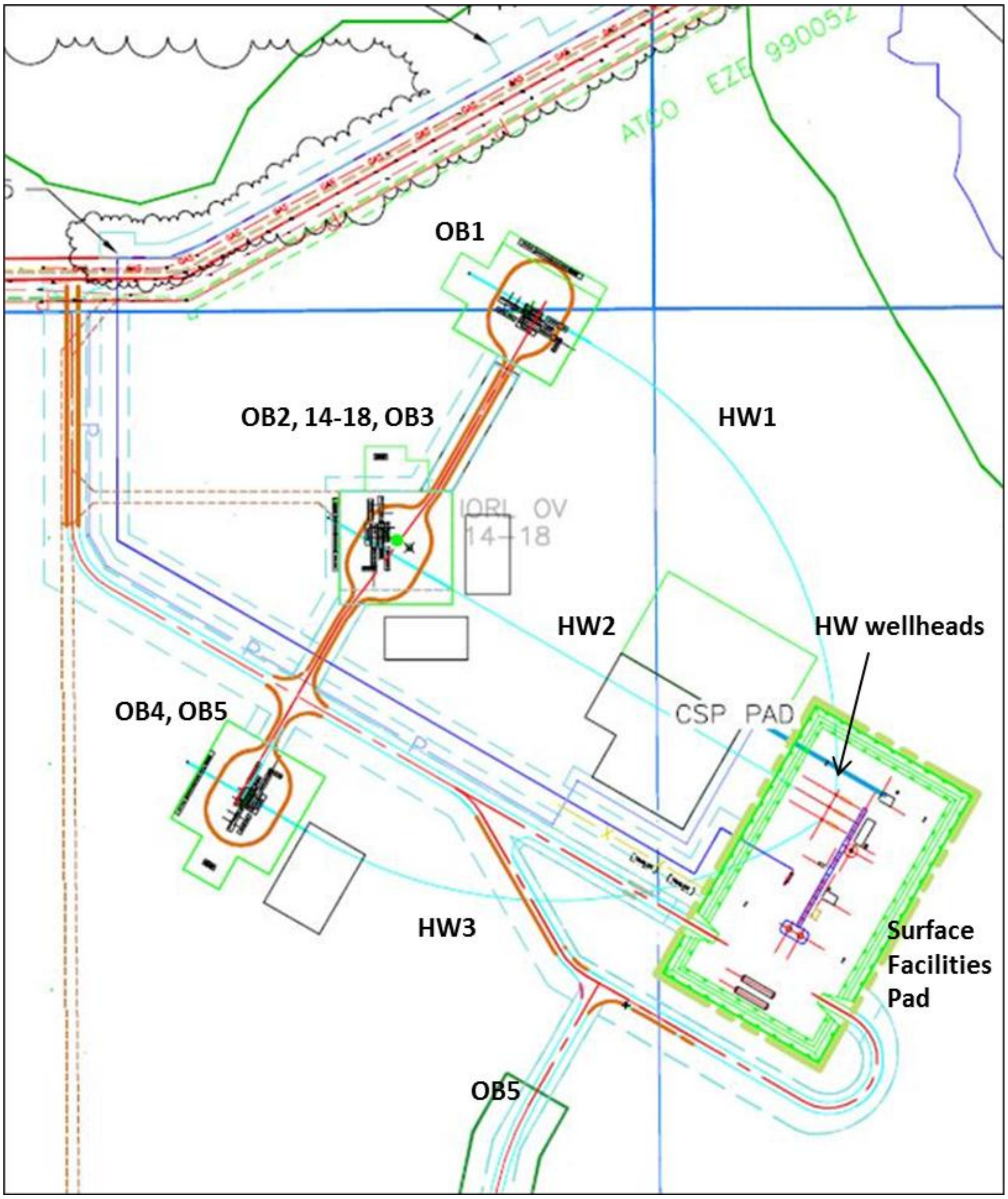

Figure 3: Log Cross Section of Pilot Area through OB Wells

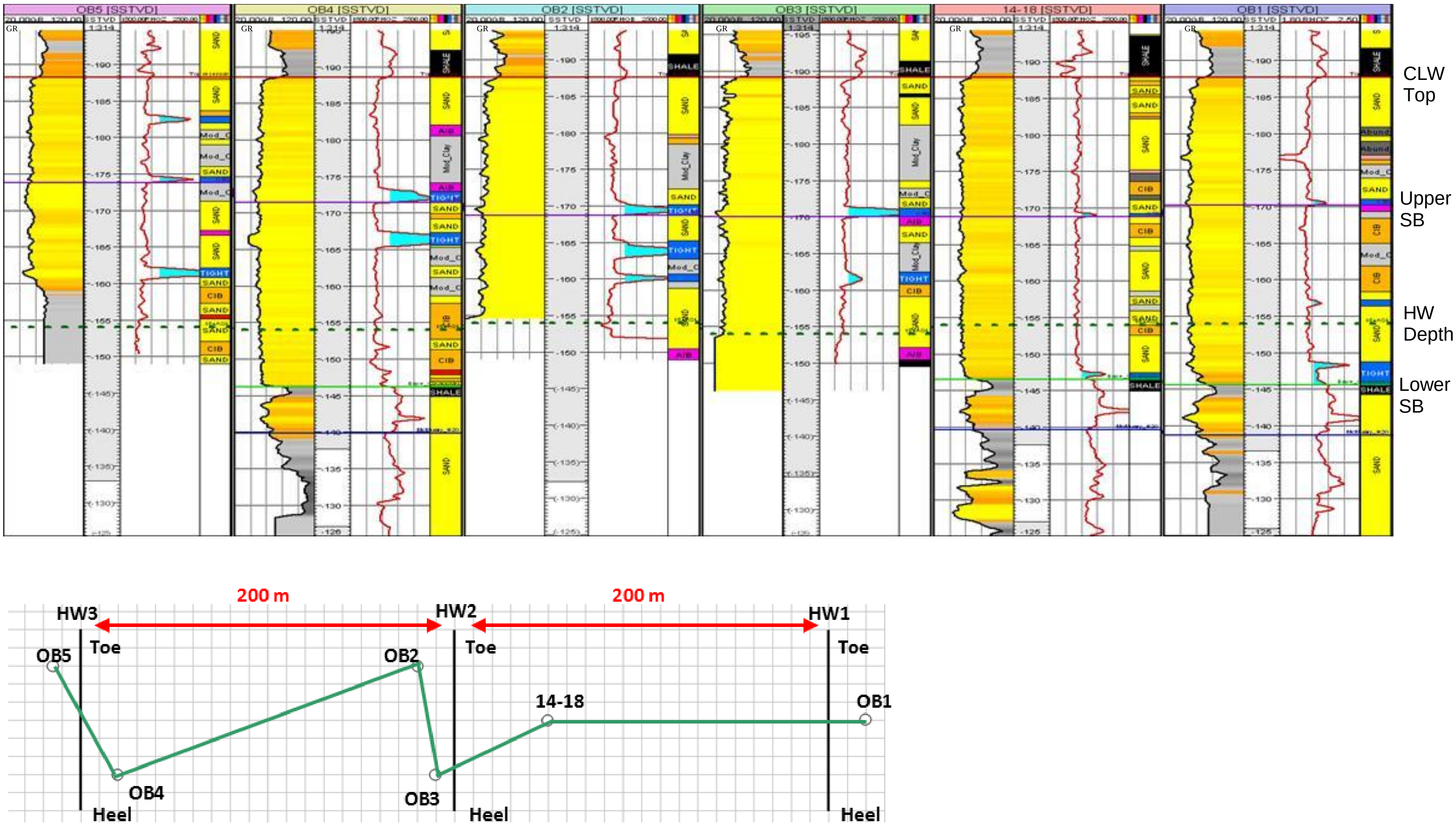

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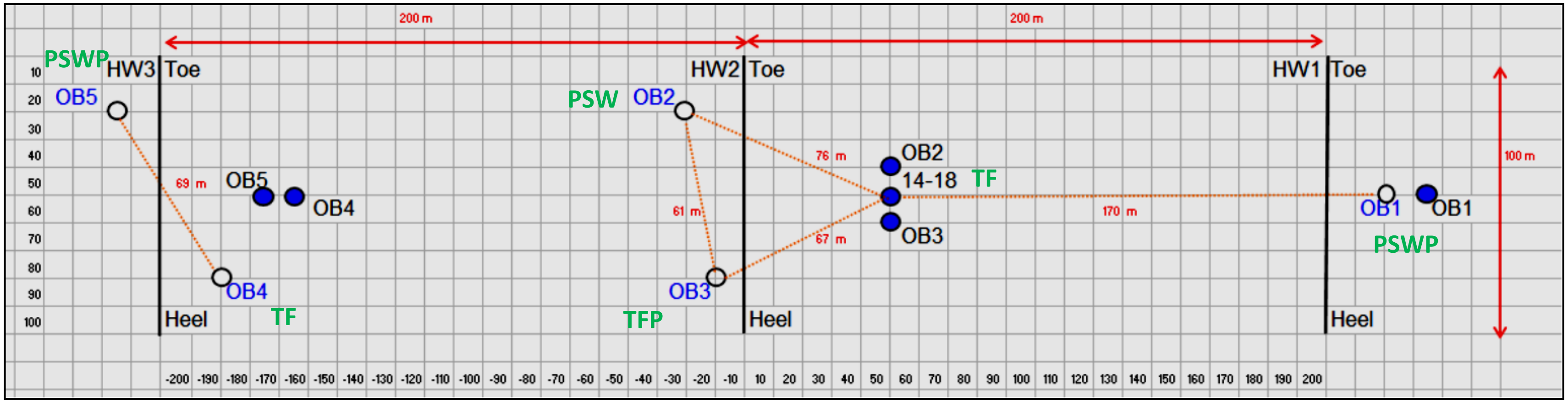
Figure 4: OB Wells Location and Surveillance Instrumentation



● Surface Location ○ Bottom Hole

PSW – Passive Seismic Well (with evacuated tubing)

PSWP – Hybrid PSW (Passive Seismic Well with BHP measurement)

TF – Thermo Fiber Well with Heater

TFP – Thermo Fiber Well with Heater and BHP measurement

Figure 5: CSP Horizontal Well Schematic

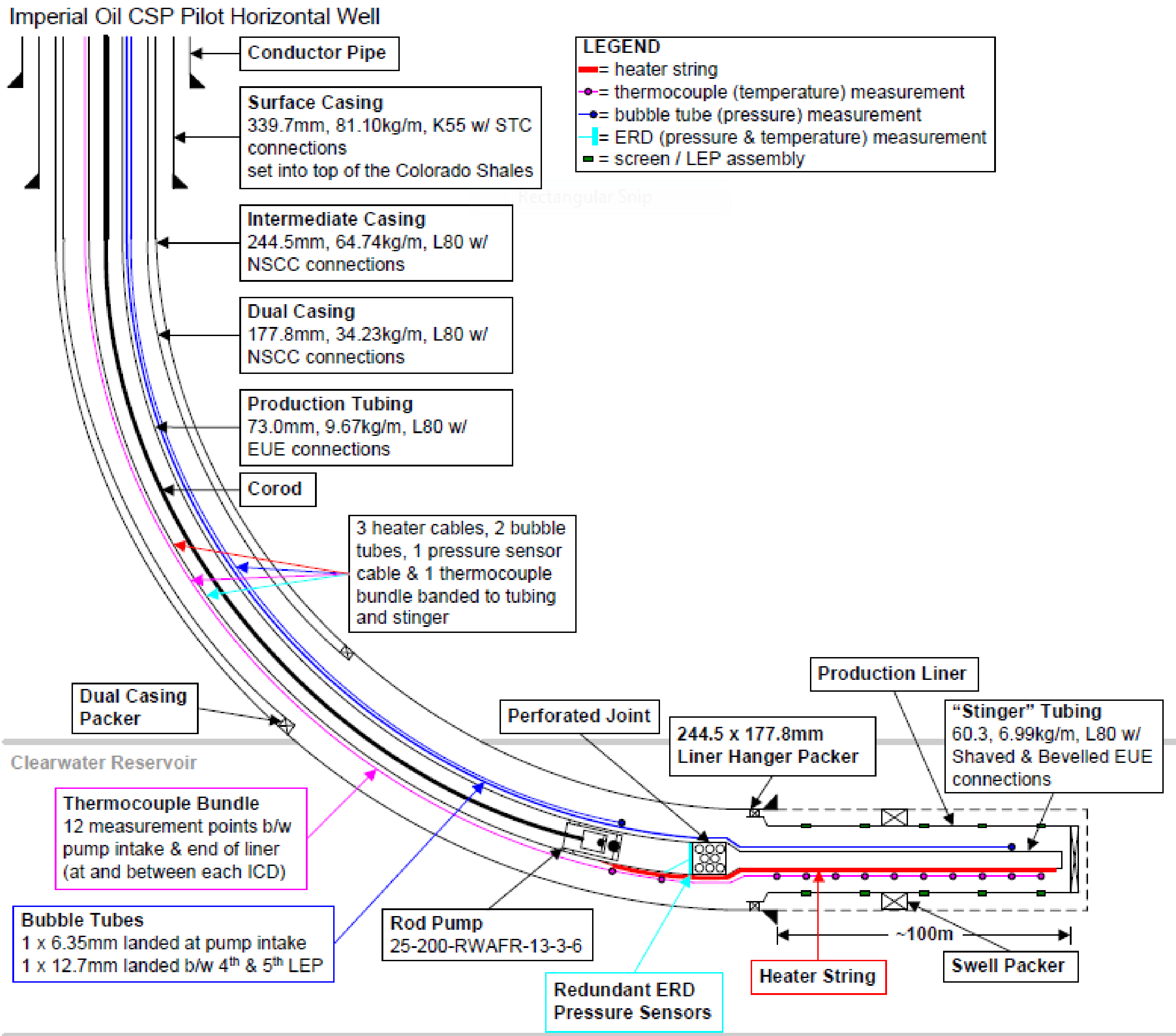
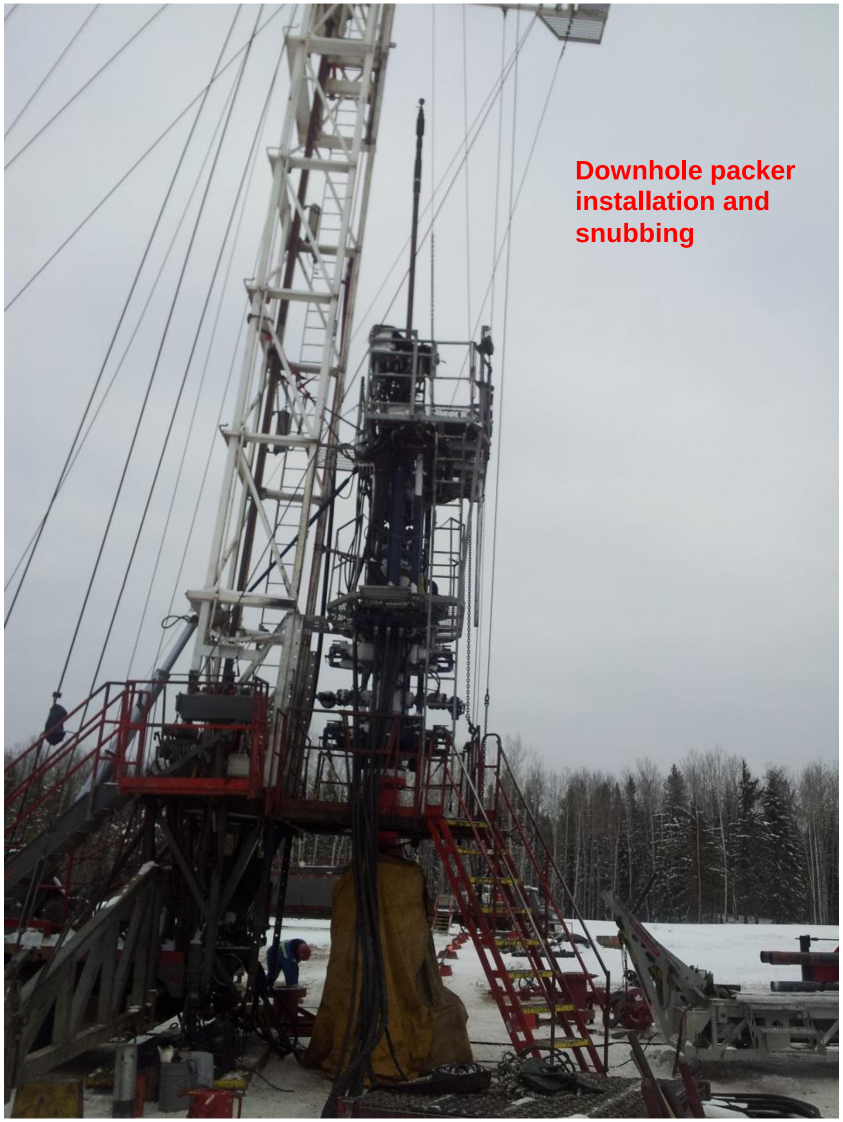


Figure 6: Well Site Photo during HW Completions Work



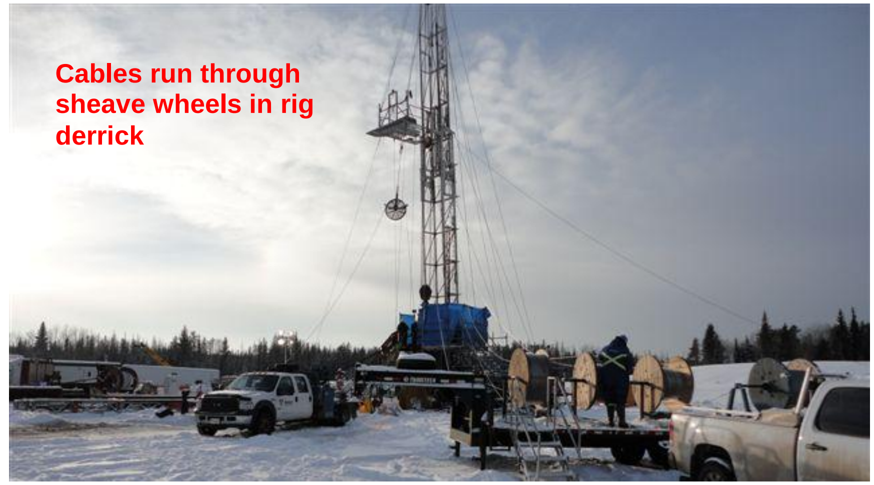
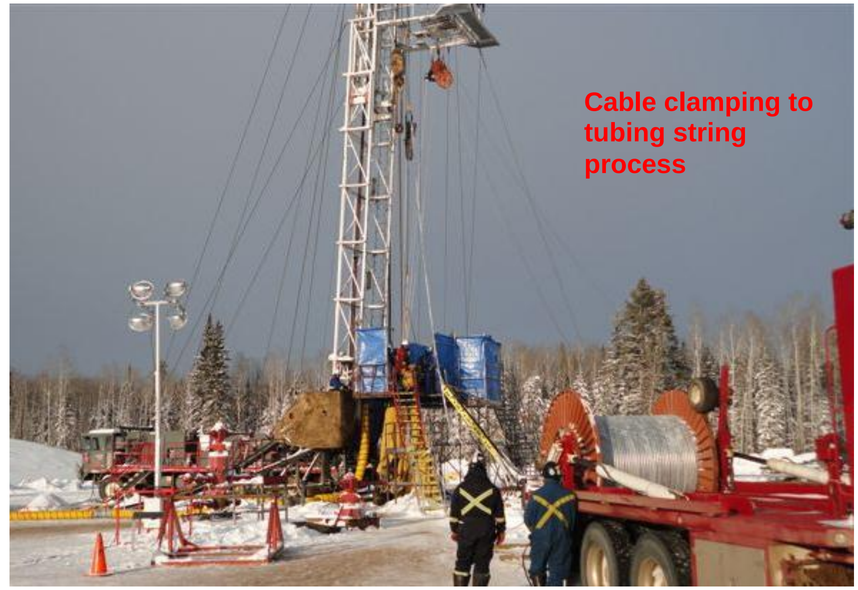


Figure 6: Well Site Photo during HW Completions Work (Cont'd)



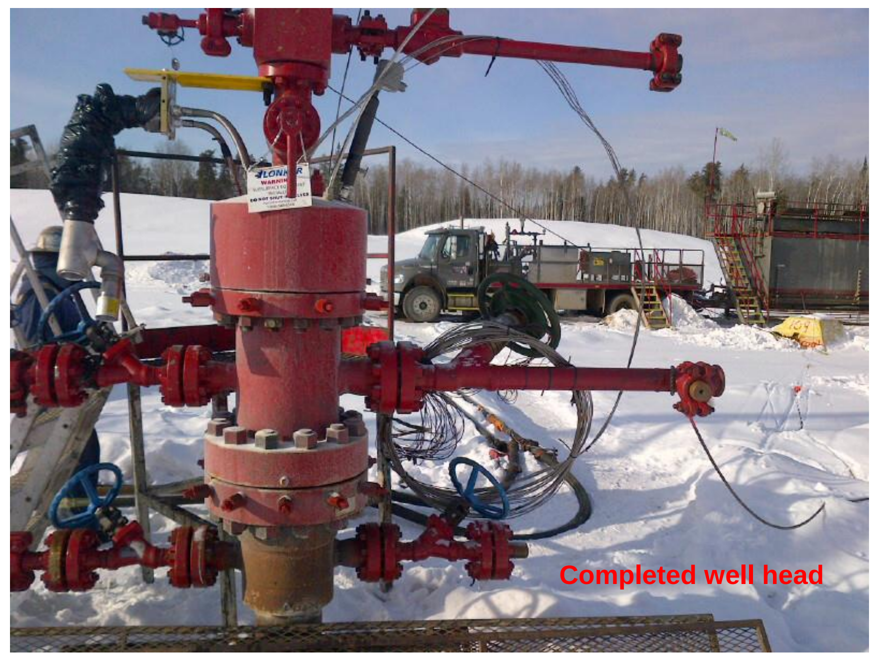


Figure 7: CSP Pilot Site View

Figure 8: CSP Pad Facility in the Pilot Site South Area

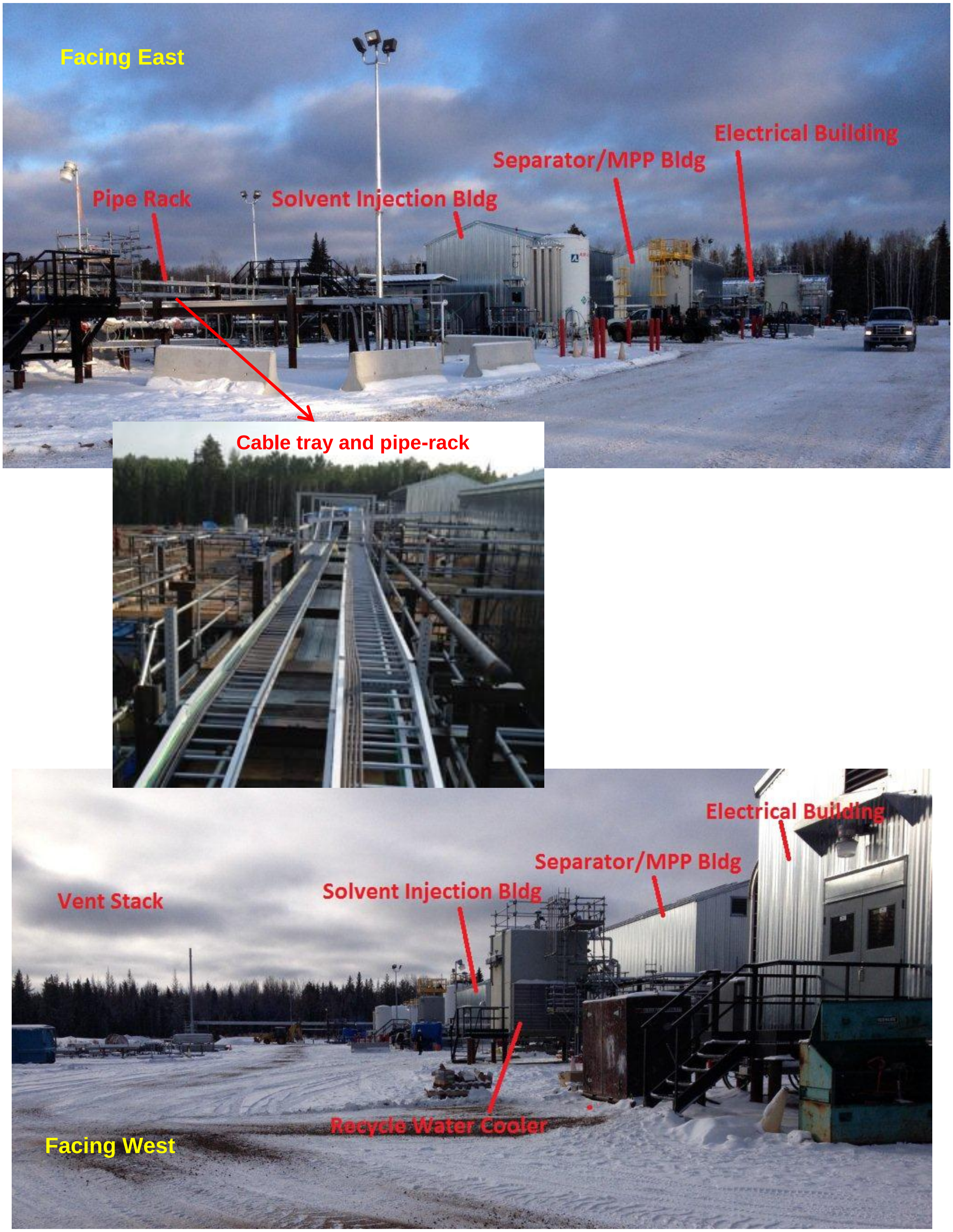
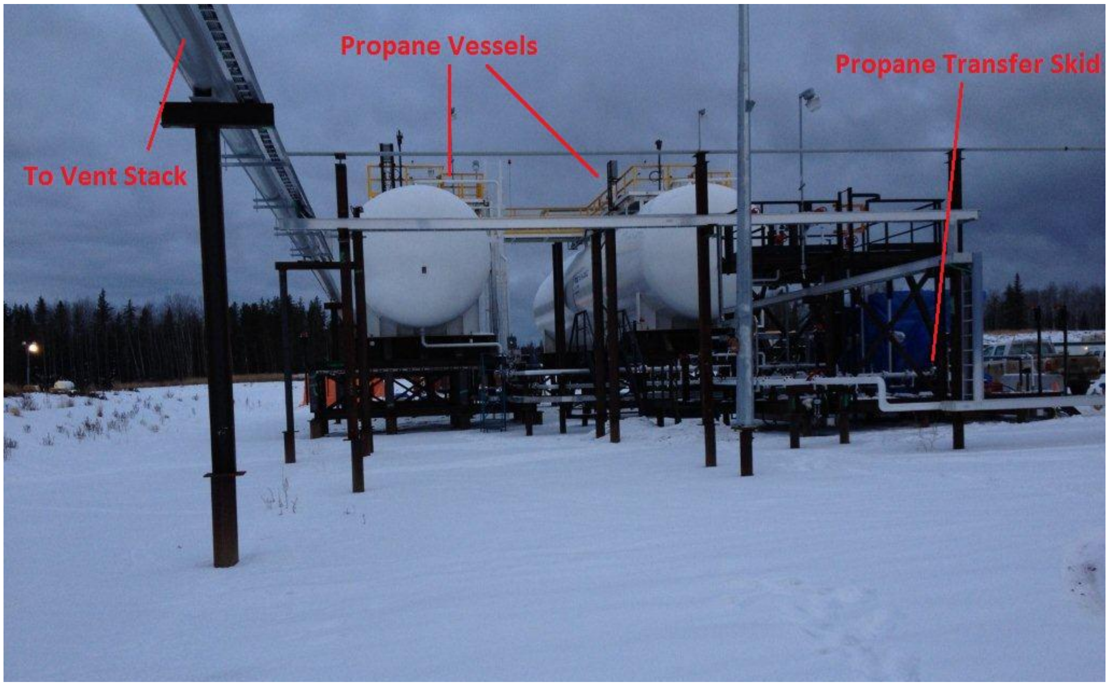


Figure 9: Interior of Production Building

Figure 10: Interior of MCC Building

Figure 11: Propane Bullets, Transfer Station, and Vent Track



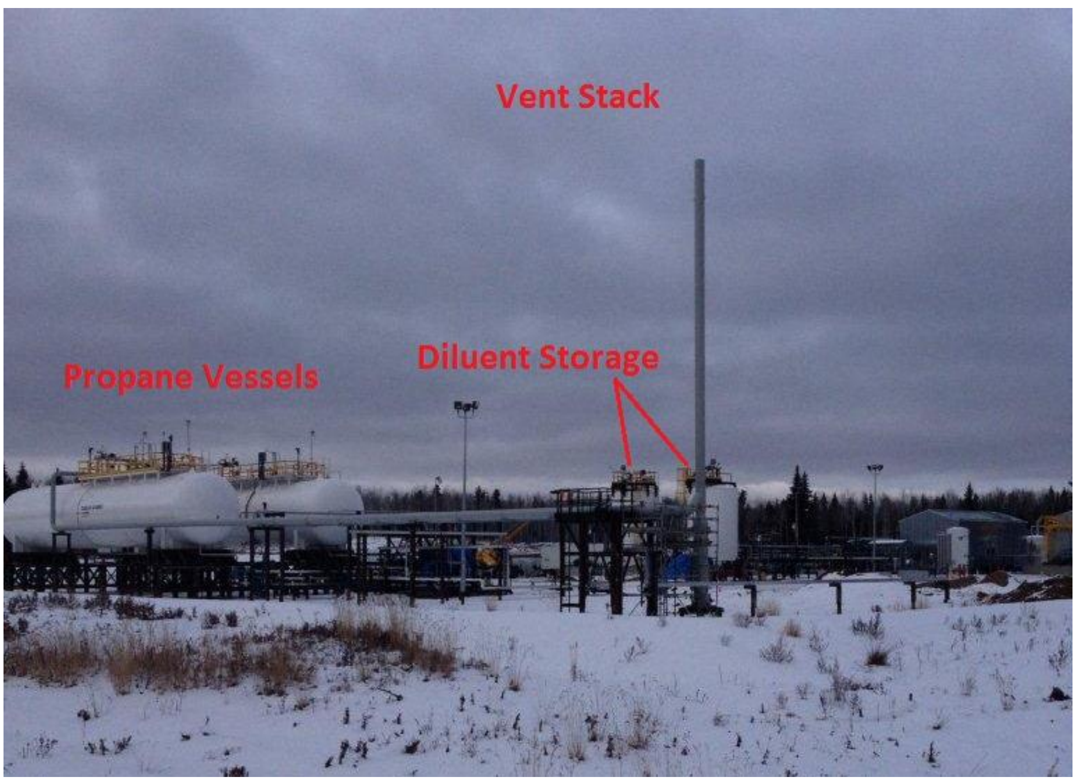


Figure 12: N2 and Diluent Storage

Figure 13: Solvent Heaters

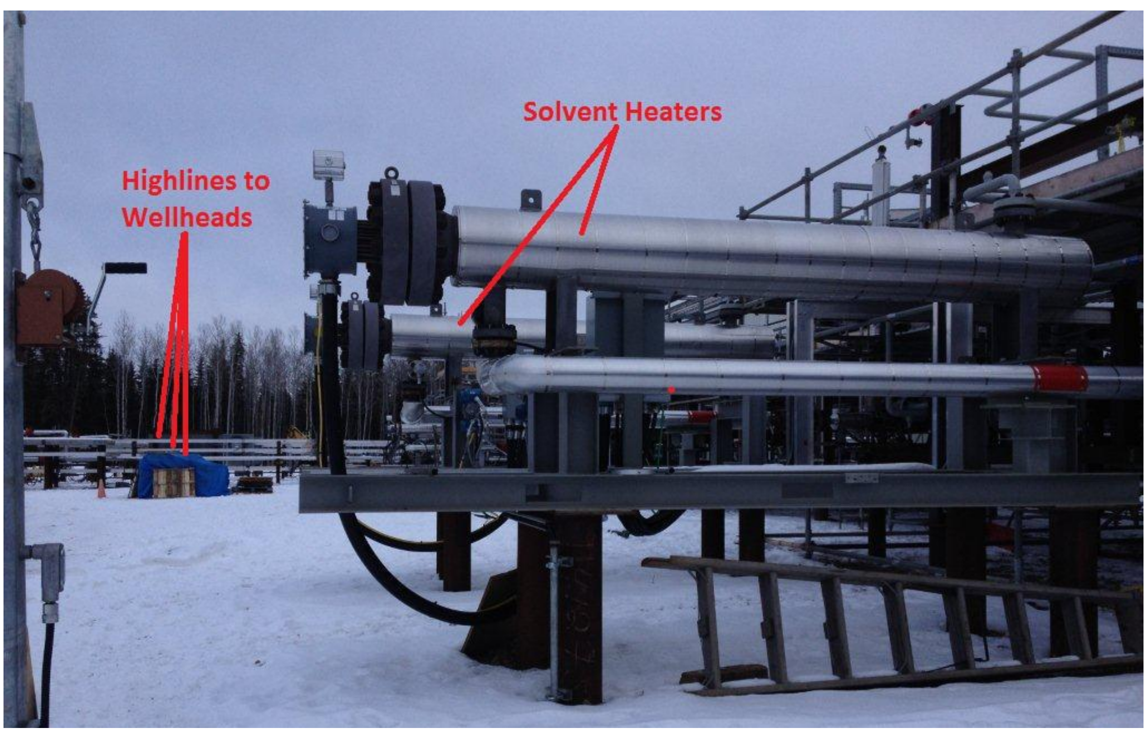


Figure 14: MPP Separator Building

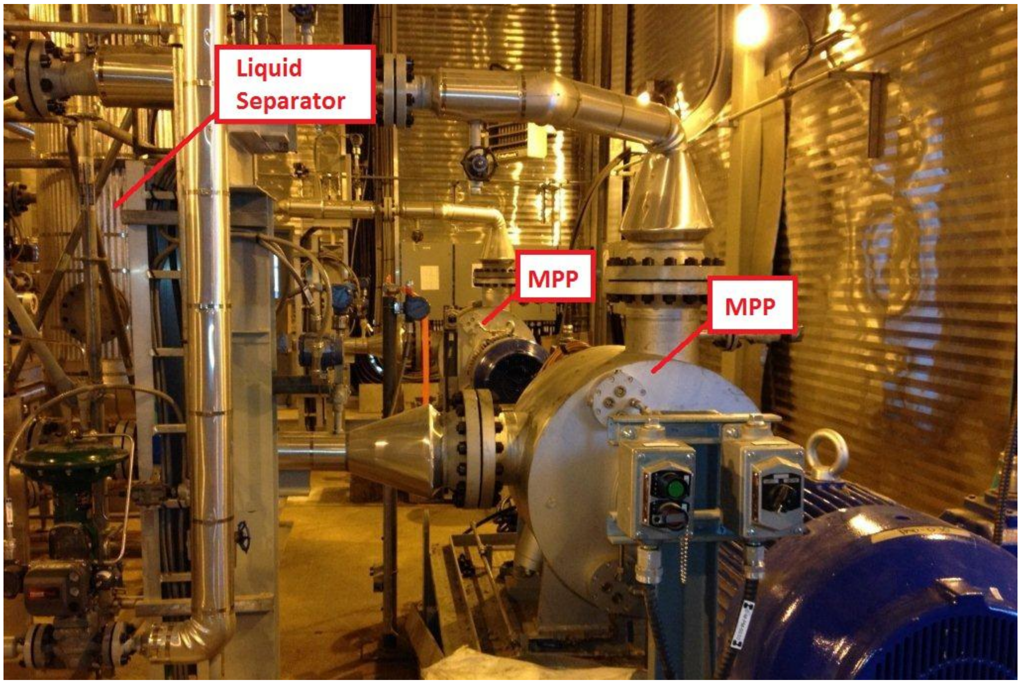


Figure 15: Solvent Injection Building

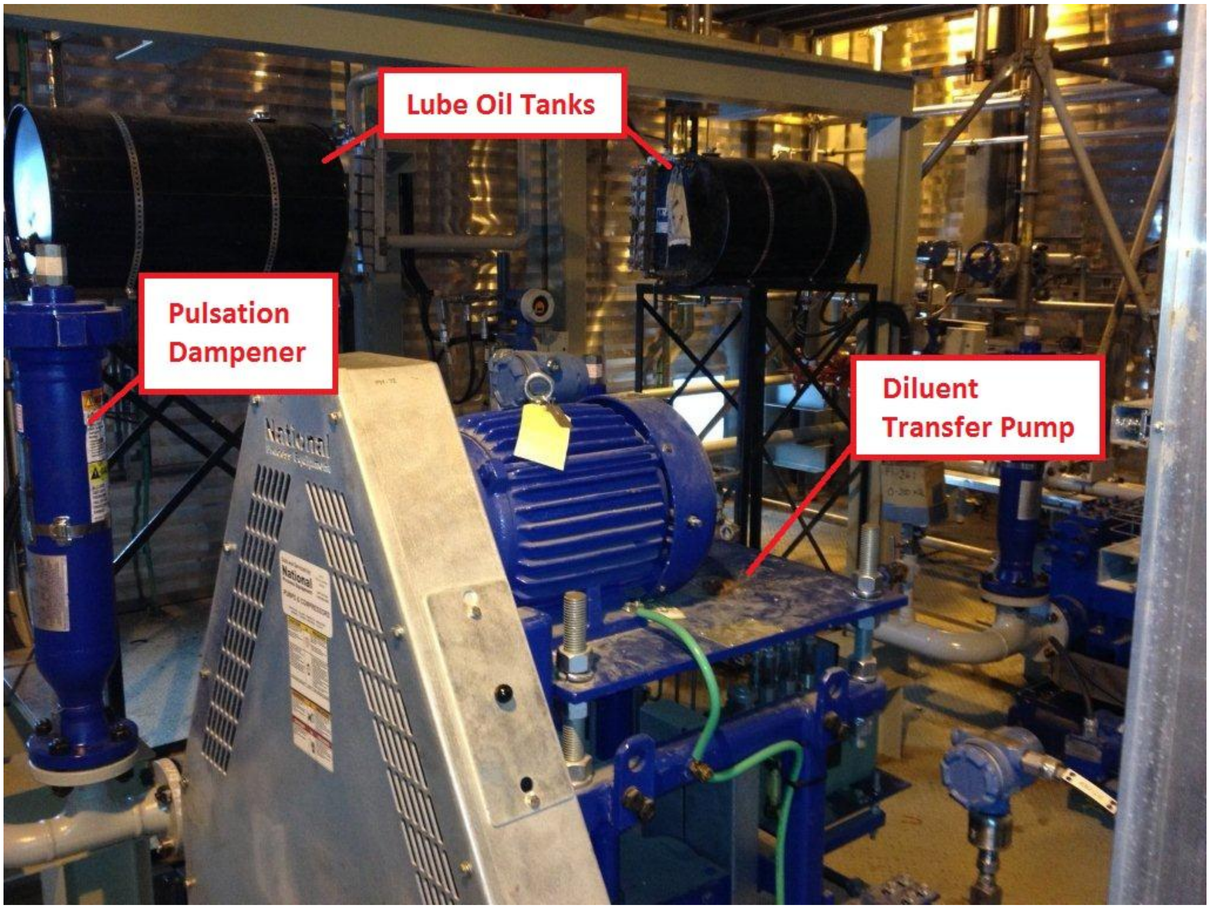
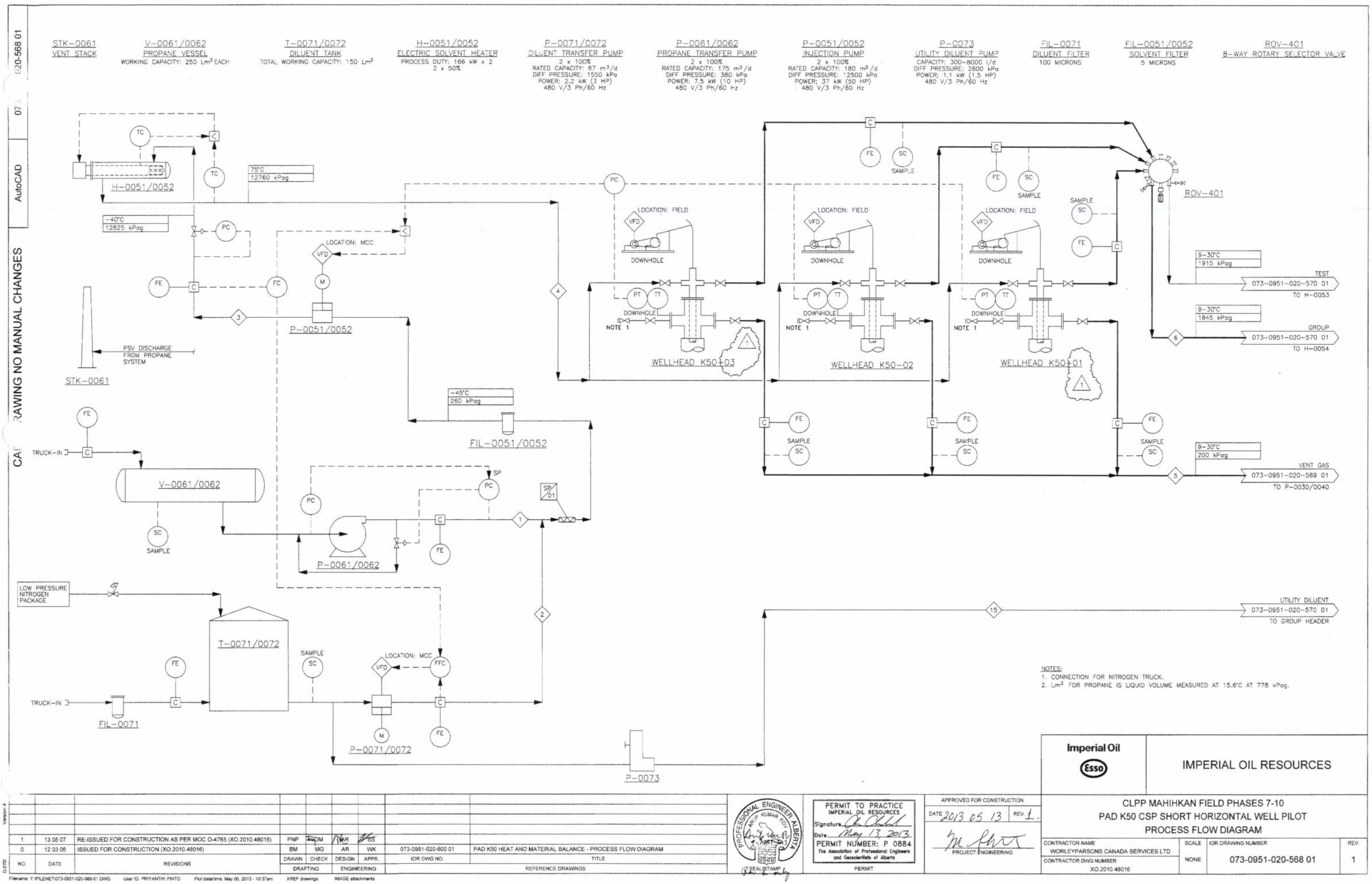
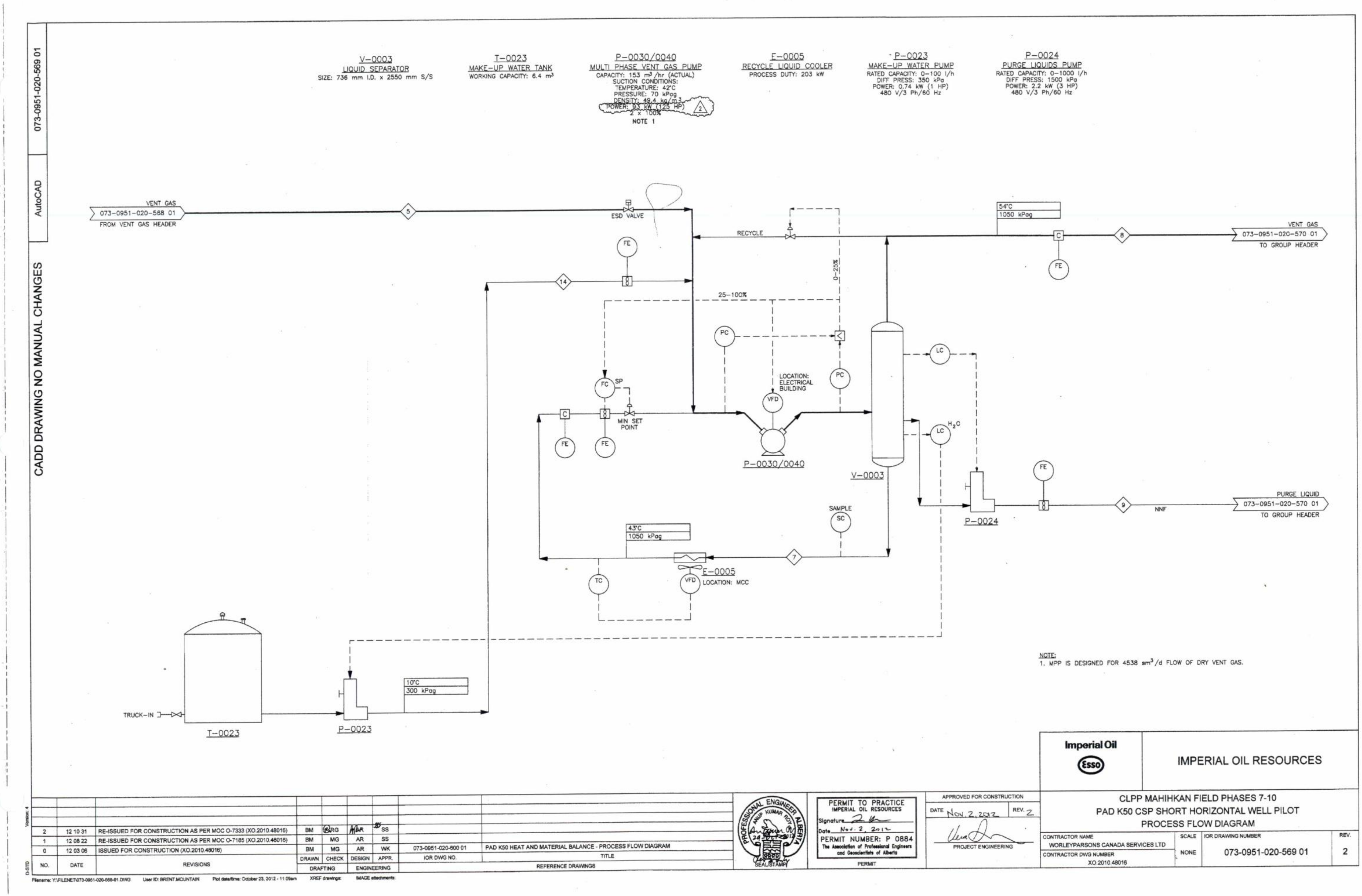


Figure 16: Underground Pipe Installation

Appendix A

Process Flow Diagrams (PFDs)


STK-0061
VENT STACK
V-0061/0062
PROPANE VESSEL
WORKING CAPACITY: 250 Lm³ EACH
T-0071/0072
DILUENT TANK
TOTAL WORKING CAPACITY: 150 Lm³
H-0051/0052
ELECTRIC SOLVENT HEATER
PROCESS DUTY: 166 kW x 2
2 x 50%
P-0071/0072
DILUENT TRANSFER PUMP
2 x 100%
RATED CAPACITY: 67 m³/d
DIFF PRESSURE: 1550 kPa
POWER: 2.2 kW (3 HP)
480 V/3 Ph/60 Hz
P-0061/0062
PROPANE TRANSFER PUMP
2 x 100%
RATED CAPACITY: 175 m³/d
DIFF PRESSURE: 380 kPa
POWER: 7.5 kW (10 HP)
480 V/3 Ph/60 Hz
P-0051/0052
INJECTION PUMP
2 x 100%
RATED CAPACITY: 180 m³/d
DIFF PRESSURE: 12500 kPa
POWER: 37 kW (50 HP)
480 V/3 Ph/60 Hz
P-0073
UTILITY DILUENT PUMP
CAPACITY: 300-8000 l/d
DIFF PRESSURE: 2600 kPa
POWER: 1.1 kW (1.5 HP)
480 V/3 Ph/60 Hz
FIL-0071
DILUENT FILTER
100 MICRONS
FIL-0051/0052
SOLVENT FILTER
5 MICRONS
ROV-401
8-WAY ROTARY SELECTOR VALVE
75°C
12760 kPag
-40°C
12825 kPag
-45°C
260 kPag
LOCATION: MCC
LOCATION: FIELD
DOWNHOLE
NOTE 1
WELLHEAD K50-03
WELLHEAD K50-02
WELLHEAD K50-01
PSV DISCHARGE FROM PROPANE SYSTEM
TRUCK-IN
LOW PRESSURE NITROGEN PACKAGE
SAMPLE
9-30°C
1915 kPag
TEST
073-0951-020-570 01
TO H-0053
9-30°C
1845 kPag
GROUP
073-0951-020-570 01
TO H-0054
9-30°C
200 kPag
VENT GAS
073-0951-020-569 01
TO P-0030/0040
UTILITY DILUENT
073-0951-020-570 01
TO GROUP HEADER
NOTES:
1. CONNECTION FOR NITROGEN TRUCK.
2. Lm³ FOR PROPANE IS LIQUID VOLUME MEASURED AT 15.6°C AT 778 kPag.
CAD DRAWING NO MANUAL CHANGES
AutoCAD
Imperial Oil
Esso
IMPERIAL OIL RESOURCES
CLPP MAHIHKAN FIELD PHASES 7-10
PAD K50 CSP SHORT HORIZONTAL WELL PILOT
PROCESS FLOW DIAGRAM
PERMIT TO PRACTICE
IMPERIAL OIL RESOURCES
PERMIT NUMBER: P 0884
The Association of Professional Engineers and Geoscientists of Alberta
APPROVED FOR CONSTRUCTION
DATE 2013 05 13
REV. 1
PROJECT ENGINEERING
CONTRACTOR NAME
WORLEYPARSONS CANADA SERVICES LTD
CONTRACTOR DWG NUMBER
XO.2010.48016
SCALE
NONE
IOR DRAWING NUMBER
073-0951-020-568 01
REV.
1
1 13 05 07 RE-ISSUED FOR CONSTRUCTION AS PER MOC O-4765 (XO.2010.48016)
0 12 03 06 ISSUED FOR CONSTRUCTION (XO.2010.48016)
NO. DATE REVISIONS
DRAWN CHECK DESIGN APPR.
DRAFTING ENGINEERING
073-0951-020-600 01
PAD K50 HEAT AND MATERIAL BALANCE - PROCESS FLOW DIAGRAM
IOR DWG NO.
TITLE
REFERENCE DRAWINGS
SEAL/STAMP
PERMIT



073-0951-020-569 01
AutoCAD
CADD DRAWING NO MANUAL CHANGES
V-0003
LIQUID SEPARATOR
SIZE: 736 mm I.D. x 2550 mm S/S
T-0023
MAKE-UP WATER TANK
WORKING CAPACITY: 6.4 m³
P-0030/0040
MULTI PHASE VENT GAS PUMP
CAPACITY: 153 m³/hr (ACTUAL)
SUCTION CONDITIONS:
TEMPERATURE: 42°C
PRESSURE: 70 kPag
DENSITY: 49.4 kg/m³
POWER: 93 kW (125 HP)
2 x 100%
NOTE 1
E-0005
RECYCLE LIQUID COOLER
PROCESS DUTY: 203 kW
P-0023
MAKE-UP WATER PUMP
RATED CAPACITY: 0-100 l/h
DIFF PRESS: 350 kPa
POWER: 0.74 kW (1 HP)
480 V/3 Ph/60 Hz
P-0024
PURGE LIQUIDS PUMP
RATED CAPACITY: 0-1000 l/h
DIFF PRESS: 1500 kPa
POWER: 2.2 kW (3 HP)
480 V/3 Ph/60 Hz
VENT GAS
073-0951-020-568 01
FROM VENT GAS HEADER
ESD VALVE
RECYCLE
54°C
1050 kPag
VENT GAS
073-0951-020-570 01
TO GROUP HEADER
0-25%
25-100%
LOCATION: ELECTRICAL BUILDING
MIN SET POINT
P-0030/0040
V-0003
SAMPLE
PURGE LIQUID
073-0951-020-570 01
TO GROUP HEADER
NNF
P-0024
43°C
1050 kPag
E-0005
LOCATION: MCC
NOTE:
1. MPP IS DESIGNED FOR 4538 sm³/d FLOW OF DRY VENT GAS.
10°C
300 kPag
TRUCK-IN
T-0023
P-0023
Imperial Oil
Esso
IMPERIAL OIL RESOURCES
CLPP MAHIHKAN FIELD PHASES 7-10
PAD K50 CSP SHORT HORIZONTAL WELL PILOT
PROCESS FLOW DIAGRAM
2 | 12 10 31 | RE-ISSUED FOR CONSTRUCTION AS PER MOC O-7333 (XO.2010.48016) | BM | RG | AR | SS
1 | 12 08 22 | RE-ISSUED FOR CONSTRUCTION AS PER MOC O-7185 (XO.2010.48016) | BM | MG | AR | SS
0 | 12 03 06 | ISSUED FOR CONSTRUCTION (XO.2010.48016) | BM | MG | AR | WK
NO. | DATE | REVISIONS | DRAWN | CHECK | DESIGN | APPR.
DRAFTING | ENGINEERING
073-0951-020-600 01 | PAD K50 HEAT AND MATERIAL BALANCE - PROCESS FLOW DIAGRAM
IOR DWG NO. | TITLE
REFERENCE DRAWINGS
PROFESSIONAL ENGINEER ALBERTA
ANUP KUMAR ROY
SEAL/STAMP
PERMIT TO PRACTICE
IMPERIAL OIL RESOURCES
Date Nov. 2, 2012
PERMIT NUMBER: P 0884
The Association of Professional Engineers and Geoscientists of Alberta
PERMIT
APPROVED FOR CONSTRUCTION
DATE Nov. 2, 2012
REV. 2
PROJECT ENGINEERING
CONTRACTOR NAME
WORLEYPARSONS CANADA SERVICES LTD
CONTRACTOR DWG NUMBER
XO.2010.48016
SCALE
NONE
IOR DRAWING NUMBER
073-0951-020-569 01
REV.
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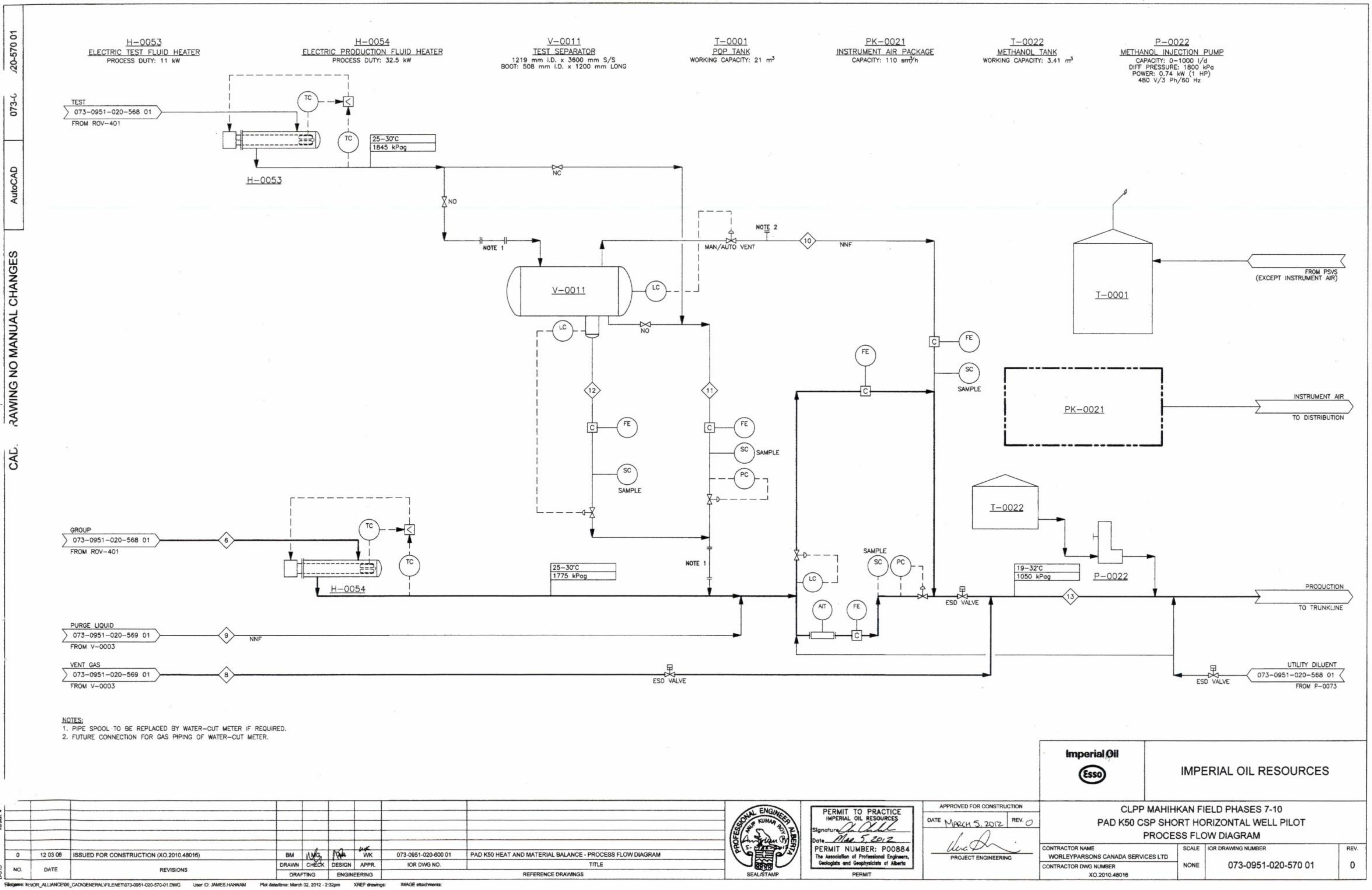

H-0053
ELECTRIC TEST FLUID HEATER
PROCESS DUTY: 11 kW
H-0054
ELECTRIC PRODUCTION FLUID HEATER
PROCESS DUTY: 32.5 kW
V-0011
TEST SEPARATOR
1219 mm I.D. x 3600 mm S/S
BOOT: 508 mm I.D. x 1200 mm LONG
T-0001
POP TANK
WORKING CAPACITY: 21 m³
PK-0021
INSTRUMENT AIR PACKAGE
CAPACITY: 110 sm³/h
T-0022
METHANOL TANK
WORKING CAPACITY: 3.41 m³
P-0022
METHANOL INJECTION PUMP
CAPACITY: 0-1000 l/d
DIFF PRESSURE: 1800 kPa
POWER: 0.74 kW (1 HP)
480 V/3 Ph/60 Hz
TEST
073-0951-020-568 01
FROM ROV-401
25-30°C
1845 kPag
NC
NO
NOTE 1
NOTE 2
MAN/AUTO VENT
NNF
FROM PSVS
(EXCEPT INSTRUMENT AIR)
INSTRUMENT AIR
TO DISTRIBUTION
SAMPLE
GROUP
073-0951-020-568 01
FROM ROV-401
25-30°C
1775 kPag
19-32°C
1050 kPag
ESD VALVE
PRODUCTION
TO TRUNKLINE
PURGE LIQUID
073-0951-020-569 01
FROM V-0003
VENT GAS
073-0951-020-569 01
FROM V-0003
UTILITY DILUENT
073-0951-020-568 01
FROM P-0073
NOTES:
1. PIPE SPOOL TO BE REPLACED BY WATER-CUT METER IF REQUIRED.
2. FUTURE CONNECTION FOR GAS PIPING OF WATER-CUT METER.
CAD DRAWING NO MANUAL CHANGES
AutoCAD
073-0951-020-570 01
Imperial Oil
Esso
IMPERIAL OIL RESOURCES
CLPP MAHIHKAN FIELD PHASES 7-10
PAD K50 CSP SHORT HORIZONTAL WELL PILOT
PROCESS FLOW DIAGRAM
0 | 12 03 06 | ISSUED FOR CONSTRUCTION (XO.2010.48016) | BM | WK
NO. | DATE | REVISIONS | DRAWN | CHECK | DESIGN | APPR.
073-0951-020-600 01 | PAD K50 HEAT AND MATERIAL BALANCE - PROCESS FLOW DIAGRAM
IOR DWG NO. | TITLE
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DRAFTING | ENGINEERING
PERMIT TO PRACTICE
IMPERIAL OIL RESOURCES
PERMIT NUMBER: P00884
The Association of Professional Engineers, Geologists and Geophysicists of Alberta
SEAL/STAMP
PERMIT
APPROVED FOR CONSTRUCTION
DATE March 5, 2012
REV. 0
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CONTRACTOR NAME
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CONTRACTOR DWG NUMBER
XO.2010.48016
SCALE NONE
IOR DRAWING NUMBER
073-0951-020-570 01
REV. 0