DESIGN BASIS MEMORANDUM

FARREL CREEK GAS PLANT

c-93-H / 94-B-1

Excelsior Project Number: 1757

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DESIGN BASIS MEMORANDUM

1.0 INTRODUCTION

The following design basis memorandum (DBM) is provided for use by the owner, engineer, and subcontractors in understanding the design philosophy and expectations for the project described herein. The DBM should not be taken as the final basis on all aspects of design, but is meant to be used as a reference and guideline that establishes a common approach to the successful execution of the project.

2.0 DESIGN SCOPE

2.1 Project Scope and Justification

Canadian Spirit Resources Inc. (CSRI) proposes to install a "grass roots" Pilot Project Gas Processing Plant in the Farrell Creek Area of North East British Columbia at c-93-H/94-B-1 (c-93-H), as well as expand their natural gas gathering system. The pilot plant will be installed to process Coal Bed Methane (CBM) sweet natural gas and other associated water saturated gases with approximately 10 mol% CO_2 and C_3+ rich hydro carbon component. The gas will be processed and transported to a Spectra Energy sales line (Spectra) at sales gas pipeline specifications.

The proposed project involves the engineering, procurement, and construction management of a Gas Processing Pilot Plant and pipeline infrastructure. The site is located approximately 30km northwest of Hudson's Hope, British Columbia and 120km south-west of Fort St. John, British Columbia.

The pilot plant will be designed for a processing capacity of 33.8 e^3m^3/d (1.2 MMscfd) raw gas with an inlet pressure of 35 kPag (5 psig), and a sales gas pressure of 5,516 kPag (850 psig), and a maximum CO_2 concentration of 2 mol%.

Inlet field production is directed through separation prior to compression. The raw gas will then be compressed through a screw booster compressor to a pressure of approximately 758 kPag (110 psig) with a gas temperature of 140 - 150°F before being processed through the Pressure Swing Adsorption Unit (PSA). The PSA unit will ensure the gas meets Spectra pipeline specifications by removing excessive CO_2 H_2O an C3+ concentrations. After the PSA unit, the processed gas is further compressed in a three stage compressor before being directed to a Spectra designed meter station and pipelined to a 24" Spectra pipeline located approximately 2 km northwest at d-7-I/94-B-1 (TBC).

The initial plant lease is 200 meters by 200 meters in area with provision for future expansion.

The inlet/sales risers and pipelines are included within the scope of this DBM. The Spectra sales metering facilities required are also included within the scope of this DBM. Spectra has retained Starco Engineering for the initial design of the meter station

The major equipment includes the following:

- One (1) 30" OD x 10' S/S Vertical Low Pressure Inlet Separator /w Senior Meter Run (TBC)
- One (1) Screw Booster Gas Compressor Driven by a 220 BHP Natural Gas Driven 3306 ATAAC Caterpillar Engine c/w coalescing and carbon filtering
- One (1) Three Tower PSA Gas Treating Package with Liquid Ring Compressor and Buffer Tank Skid
- One (1) 3-Stage Gemini H302 Reciprocating Sales Gas Compressor Driven by a 200 BHP Natural Gas Driven Caterpillar 3306 TAW Engine, c/w senior meter run for sales gas and one fuel gas meter for plant fuel gas requirements.
- One (1) 100 BBL Double Wall Cradled Fibreglass Flare Knock Out Drum c/w truck pump out
- One (1) 4" x 40' High Pressure Emergency Flare Stack
- One (1) 7.5 HP Instrument Air Compressor Skid Package c/w 100% Standby
- One (1) 12' W x 28' L MCC/Office/Control Building (TBC)
- One (1) 150 kW Continuous Duty Generator c/w enclosure and heater

- 200 m Gathering Pipeline, 88.9 mm x 5.23 mm WT SDR 17 HDPE 3608, 690 kPa MOP
- 1,650m Gathering Pipeline, 114.3 mm x 6.72 mm WT SDR 17 HDPE 3608, 690 kPa MOP
- 1,000 m Gathering Pipeline, 168.3 mm x 9.9 mm WT SDR 17 HDPE 3608, 690 kPa MOP
- 2,450 m Sales Pipeline, 168.3mm x 3.2mm WT, CSA Z245.1, Gr. 359, Cat II, YJ1 External Coating, 6,450 kPa MOP

2.2 Electrical Infrastructure Requirements

Electrical power will be required on site to service items such as motors, heat tracing, building heaters, lighting, and plant control. A 150kW continuous duty generator will provide this power requirement. The power generated will be 480 V, 3 phase power. The following is a list of the major motors and the associated loads requiring 3 phase electrical power. Lighting power to be supplied from 120/208V, three phase lighting panels. Estimated loads area per below.

Tag Number	Description	HP	kW
K-700A	Instrument Air	7.5	5.59
K-700B	Instrument Air	7.5	5.59
P-214	First Stage Booster Compressor Suction Scrubber Pump	2	1.49
P-101	Low Pressure Inlet Separator Pump	3	2.24
N/A	Heat Trace		5.00
V-130	**Liquid Ring Vacuum Compressor**	**75**	55.93
V-130	Liquid Ring Vacuum Compressor Cooler	5	3.73
	Misc. loads		15.00
	TOTAL		**94.57**

Digital cellular is available in the area. Spectra plans to have a path study for the transmission of data to their system. Excelsior will coordinate with Spectra for confirmation of cellular service for call-outs, communications, and alarming.

2.3 Pipeline Infrastructure Requirements

Production from the well sites at the following locations will be gathered into the proposed gas plant.

- b-91-H/94-B-1
- b-92-H/94-B-1
- b-2-I/94-B-1
- d-93-H/94-B-1
- b-3-I/94-B-1

All well sites will have existing well site separators as well as on site produced water storage capabilities. The scope of this project includes the pipeline portion and riser up to the first flange on all well sites and does not include the supply and installation of well site separators and water tanks.

Please refer to the attached Schematic Metering Diagram for an accurate depiction of the proposed gathering system.

3.0 DESIGN STANDARDS

The **latest editions** of the following codes shall be used in the design of this project:

- ASME/ANSI Sec VIII Div 1 Pressure vessels / Plant Piping: B31.3
- CSA Structural Steel and Electrical
  Pipeline: CAN/CSA Z662
- National Building Code of Canada
- British Columbia Occupational Health & Safety Standards
- NACE MR0175 Edition (As Required)
- British Columbia Safety Authority (BCSA – Pressure Vessels and ASME Piping Systems)
- CEC Canadian Electrical Code

Excelsior General Specifications will be followed. Where deviations are deemed necessary, appropriate approval will be acquired.

4.0 REGULATORY APPROVALS AND PERMITTING

4.1 Overview

Excelsior Engineering Ltd. will co-ordinate the preparation of all regulatory submissions required for the Sweet Gas Processing Plant as defined by the British Columbia Oil and Gas Commission (OGC) and the British Columbia Ministry of Environment. The majority of these will be made to the OGC. Other regulatory bodies such as BC Environment, BC Hydro and BC Transportation may also require submissions.
The minimum regulatory submissions are:

- OGC Gas Processing Plant Facility Application
- OGC BC-20/21 Applications
- OGC Notices for Construction, Pressure Testing, Leave to Open, As-Builts,

- Required Construction Permits
- BC Ministry of Environment

Excelsior can also assist with the preparation of other submissions such as Spectra Energy Application, if required.

BCSA and OGC permit(s) will be filed by Excelsior on behalf of CSRI. The Equipment packagers will insure the registered equipment and components meet BCSA registration requirements and will be confirmed by Excelsior.

Excelsior will utilize all means to ensure CSRI's commitment to noise abatement and all measures to exceed OGC requirements will be incorporated. An independent noise assessment will be conducted by an accredited acoustical engineering firm to determine the predicted noise levels anticipated at the nearest residence(s) or at an OGC specified distance to ensure better than compliance to OGC regulations, as applicable.

All electrical inspection and certification is to be as per BC permit requirements

4.2 Surface Land

Land acquisition will be done by CSRI's designated land agent and is done in conjunction with the OGC Facility application. This will include submissions for Forestry, Archaeology, Public Engagement and First Nations Consultation.

The land at the proposed pilot plant site is located in a pasture land. The proposed plant site is to be on lease with an all weather access road from the north. All land acquisition and road use agreements will be by CSRI.

Please refer to the attached Plot Plan for an accurate depiction of the proposed plant site. (TBA)

4.3 Environmental

Environmental concerns such as caribou habitat, historical native sites, etc. are currently being reviewed, but are not anticipated to provide any delays or set-backs.

Surface runoff from the lease site will be captured to an industrial runoff pond and tested prior to release to the environment, as required by the B.C. Ministry of Environment under the Oil and Gas Waste Regulation.

4.4 Minimum Consultation and Notification Requirements

The following is an excerpt from the OGC Public Engagement and Appropriate Dispute Resolution Guide, applicable for this facility:

Application	Consultation	Notification
Sweet Facility	• Landowner • Occupants • All residents living within 1.0 kilometer • Other tenure holders	• Local government authorities and Indian Reserves whose boundaries are within 1.5 kilometers of the project • Other tenure holders

5.0 DESIGN CONDITIONS

5.1 General Description

The Farrell Creek Pilot Plant will process water saturated rich C_3+ HC, CO_2 (10 mol%) CBM natural gas in the CSRI development area.

The pilot plant will be designed to have a maximum gas processing capacity of 33.8 e^3m^3/d (1.2 MMscfd) at an inlet pressure of 35 kPag (5 psig), and a discharge pressure of 5,860 kPag (850 psig), and a maximum inlet CO_2 concentration of 10 – 12 mol% HC rich gas. Main process headers and inlet separation will be designed to 56 e^3m^3/d (2.0 MMscfd).

The inlet gas stream will be routed to a vertical 2-phase, gas separator package for free liquids separation and metering via senior meter run (TBC). Free liquids captured in the separator will pumped to the underground 100 bbl knockout tank. No contingency for slug handling will be considered, but allowance for pigging to the knockout tank will be included.

After separation, the natural gas will flow to a booster screw compressor. The booster natural gas driven compressor will compress the gas from 35 kPag (5 psig) to approximately 758 kPag (110 psig).

The compressed gas will then be directed to a PSA unit, which has three (3) adsorbing towers which cycle as required to ensure the outlet gas meets Spectra specifications. CO_2, water and heavy HC's are adsorbed and released on a regenerative cycle. The process regenerates on pressure / vacuum cycles.

The gas after being processed in the PSA unit is directed to a sales gas 3-stage natural gas driven compressor for delivery at a sales pressure of approximately 5,500 kPag (800 psig).

The sales gas will then be directed to a Spectra designed sales meter package. The metered sales gas will then be sent to sales.

The "off gas" from the PSA unit is removed via a vacuum pump and directed into the vent line and the knockout tank. Water and condensates will be pumped to the 100 bbl underground knockout tank.

All produced liquids will be collected and pumped to the double wall 100 bbl underground knockout tank. Liquids produced at the facility will be trucked out from the site.

5.2 Site Design Parameters

Location:	c-93-H / 94-B-1
Max Wind Velocity:	100 kph
Prevailing Wind Direction:	Southwest
Elevation	730 m (2,395 feet)
Atmospheric Pressure:	97 kPag (14.0 psig)
Ambient Temperature:	Min.: -40 ^oC (-40 ^oF)

	Max.: 35 °C (95 °F)
Site Access:	Via Highway 29
Sales Gas Specification:	< 4 lbs/MMscf of saturated water < 2 mole% CO_2 < -10C HC dew point spec
Sales Gas MOP:	6,454 kPa (936 psi)
Sales Gas Normal Operating Pressure:	4,867 kPa-5,516 kPa (700 psi – 800 psi)
Sales Gas Minimum Operating Pressure:	3,448 kPa (500 psi)
Max. Gas Flow Rate:	33.8 e^3m^3/d (1.2 MMscfd)
Min. Gas Flow Rate:	8.46 e^3m^3/d (300 Mscfd)
Inlet Pressure:	34 kPag (5 psig)
Sales Pressure:	5,515 kPag (800 psig)
Max. Design Pressure	6,895 kPag (1,000 psig)
Plant Temp:	10°C / 50 °F
Gas Temp:	49°C / 120 °F (max)

Guild Associates, Inc., the manufacturer of the PSA package, have confirmed a performance guarantee for their process.

The gas composition, sales gas and tail gas compositions are based on a simulated modeling translating to the following compositions:

	Raw Feed	Sales Product	Tail Gas
Flow, MM SCFD	1.20	0.98	0.22
Pressure, psig	150	140	3
Temperature, F	100	120	150
Composition, Mole %			
C1	83.49	95.76	27.77
N2	-	-	-
CO2	12.00	1.00	61.97
C2	2.75	2.88	2.14
C3	0.64	0.36	1.92
C4	0.22	-	1.22
C5	0.05	-	0.28
C6+	0.34	-	1.88
H2O	0.51	4 #/MM SCF	2.83
HHV, BTU/FT3	933	1027	507

A representative liquids analysis was not provided, but should a representative analysis become available for the anticipated actual production, then the process model is to be updated and equipment sizing confirmed.

Maximum Water Rate:	Negligible Water Rates (Saturated Conditions) Existing separators and tanks are available at the well sites
Line Design Class:	Plant inlet: 150 ANSI Inlet Separator: 150 ANSI Booster Comp Suction: 150 ANSI Booster Comp Discharge: 150 ANSI

PSA System: 150 ANSI
Sales Compressor Suction: 150 ANSI
Sales Compressor Discharge: 600 ANSI
Spectra Meter Package: 600 ANSI
Utilities: 150 ANSI

5.3 Pipeline Design Parameters

Source Location:	b-91-H/94-B-1
Destination Location:	b-2-I/94-B-1
Length:	850 metres
Outside Diameter:	114.3 mm
Wall Thickness:	6.72 mm
Material:	HDPE
Type:	3608
Maximum Operating Pressure:	690 kPa

Source Location:	b-92-H/94-B-1
Destination Location:	b-2-I/94-B-1
Length:	800 metres
Outside Diameter:	114.3 mm
Wall Thickness:	6.72 mm
Material:	HDPE
Type:	3608
Maximum Operating Pressure:	690 kPa

Source Location:	b-2-I/94-B-1
Destination Location:	c-93-H/94-B-1
Length:	1,000 metres
Outside Diameter:	168.3 mm
Wall Thickness:	9.9 mm
Material:	HDPE
Type:	3608
Maximum Operating Pressure:	690 kPa

Source Location:	d-93-H/94-B-1
Destination Location:	d-93-H/94-B-1
Length:	150 metres
Outside Diameter:	88.9 mm
Wall Thickness:	5.23 mm
Material:	HDPE
Type:	3608
Maximum Operating Pressure:	690 kPa

Source Location:	b-3-I/94-B-1
Destination Location:	b-3-I/94-B-1
Length:	50 metres
Outside Diameter:	88.9 mm
Wall Thickness:	5.23 mm
Material:	HDPE
Type:	3608
Maximum Operating Pressure:	690 kPa

Source Location:	c-93-H/94-B-1
Destination Location:	d-7-I/94-B-1
Length:	2,450 metres
Outside Diameter:	168.3 mm
Wall Thickness:	3.2 mm
Material:	Steel
Type:	Grade 359, Cat II
Maximum Operating Pressure:	6,450 kPa

6.0 CIVIL/STRUCTURAL DESIGN

All major equipment to be installed piles or gravel pads and rig matting. Piping will be design to be modular and on racks supported by steel driven piles. The site will be enclosed by a 6' industrial chain link fence with appropriate panic hardware and lockable double-wide entry gate.

Prior to any civil work being completed, a theoretical geotechnical soils analysis will be conducted. Excelsior will coordinate having test holes drilled and analyzed to an appropriate depth for a detailed analysis prior to civil engineering finalization.

All new piping, with the exception of a portion to the Vent Stack and from the vent tank will be above ground and supported on new pipe racks. Piping will be prefabricated and modularized to reduce on-site construction times.

7.0 MAJOR EQUIPMENT

7.1 Main Process Inlet Header

The header into the plant will be 168mm (6") OD SDR 17 HDPE 3608 pipe to accommodate field production. The inlet header will be designed to handle 2 MMscfd at an inlet pressure of 35 kPag (5 psig) at a design pressure of 690 kPag (100 psig). A common header will be designed and the inlet production will be directed to the Inlet Separator building.

7.2 Inlet Separator

The inlet separator will be designed to handle 56.4 e3m3/d (2 MMscfd) gas at 35 kPag (5 psig) working pressure. The 36" x 10' s/s horizontal separator will be packaged and dressed for 2 phase service to accommodate gas and produced water separation and measurement. The vessel will have a MAWP of 1,965 kPag (285 psig) or greater. A produced water transfer pump 4 gpm (moyno) will be utilized for transferring produced fluids to a 100 BBL double walled underground knockout tank. No contingency for slug handling capability has been included.

7.3 Process Compressors

Booster Compressor Design Parameters (TBC)

Driver:	220 HP Caterpillar 3306 ATAAC
Compressor:	Screw
Application:	Natural Gas
Number of Stages:	1
Max. Gas Flow Rate:	33.84 e^3m^3/d (1.2 MMscfd)
Min. Gas Flow Rate:	8.46 e^3m^3/d (300 Mscfd)
Suction Pressure:	35 kPag (5 psig)
Operating Discharge Pressure:	758 kPag (110 psig)
Design Discharge Pressure:	1,965 kPag (285 psig)
Suction Temp:	10°C (50°F)
Discharge Temp:	49°C (120°F)
Gas Composition:	See above gas analysis

Sales Compressor Design Parameters (TBC)

Driver:	200 HP Caterpillar 3306 TAW
Compressor:	Gemini H302
Application:	Natural Gas
Number of Stages:	3
Max. Gas Flow Rate:	33.84 e^3m^3/d (1.0 MMscfd)
Min. Gas Flow Rate:	8.46 e^3m^3/d (300 Mscfd)
Suction Pressure:	620 kPag (90 psig)
Operating Discharge Pressure:	5,516 kPag (800 psig)
Design Discharge Pressure:	6,895 kPag (1,000 psig)
Suction Temp:	65°C (150°F)
Discharge Temp:	49°C (120°F)
Gas Composition:	See above gas analysis

The booster screw compressor package will have a suction pressure of 5 psig (35 kPag) and a discharge pressure of 758 kPag (110 psig) and the sales reciprocating compressor package will have a suction pressure of 620 kPag (90 psig) with a discharge operating pressure of 5,516 kPag (800 psig). Both compressor skids will include scrubbers and an engine driven Air-X cooler forced draft fin tube cooler. The compressor packages will be complete with suction control valve, auto bypasses, auto blowdowns, and auto speed control. A 2.0 HP produced water pump (Grundfos or equivalent) will be utilized for transferring produced fluids from the first stage of the suction scrubber for the booster compressor package.

Compressor design will include the flexibility to operate as low as 0.300 MMscf at minimum speed and minimum recycle usage.

The compressor will be equipped with a Murphy local panel. Remote shutdown, run status, fire, and gas detection will be installed and routed to the plant PLC/HMI, in addition to ether I/O for remote monitoring as required by CSRI.

7.4 PSA Process Skid

The PSA unit will have three (3) adsorbing towers which cycle on a time interval basis as dictated by continuous monitoring to ensure delivery of Spectra sales specification gas. A building will have to be field erected over the PSA at site.

The system is designed to process 33.8 e3m3/d (1.2 MMscfd) of raw natural gas with a C_3+ composition and CO_2 concentrations of 10-12 mol% and deliver Spectra sales gas of not greater than 2 mol% CO_2 by volume.

The PSA Processing Skid includes the following main systems:

- Inlet Filtration
- Three (3) PSA Vessels with fixed adsorbent beds with numerous butterfly valves and limit switches to allow cycling of gas adsorbing, generation, and venting off gas to the vent stack
- Two (2) buffer tanks
- One (1) Liquid Ring Vacuum Compressor System with a cooler and 5 hp cooler fan

Raw gas passing through the PSA system contacts a fixed bed of adsorbent. The adsorbent is a solid material that will adsorb the CO_2, C_3+ HCs', and H_2O molecules. Methane passes through the bed uninhibited.

When the adsorbing towers reach saturation with HC/CO_2/H_2O the raw gas feed is switched to another vessel. The HC/CO_2/H_2O is removed from the vessels by reduction of the gas pressure to vacuum. When the bed is regenerated the vessel will be re-pressurized as required and switched back to the adsorption cycle (hence the name pressure – swing – adsorption or PSA).

The system will be designed for unattended operation. Normal operation would require a site visit to the unit each day to monitor the operations.

Liquid Ring Vacuum Compressor (TBC)

Driver:	Electric Drive
Compressor:	Liquid Ring
Application:	Pressure Vacuum Cycle
Number of Stages:	1
Max. Gas Flow Rate:	6.2 e^3m^3/d (0.2 MMscfd)
Min. Gas Flow Rate:	220 Mscfd
Suction Pressure:	0 to Vacuum (0 kPag, 0 psig)
Operating Discharge Pressure:	20 kPag (3 psig)
Design Discharge Pressure:	1,827 kPag (265 psig)
Suction Temp:	10°C (50°F)
Discharge Temp:	49°C (120°F) Max at 35°C (95°F) amb

The major components of the Vacuum Compressor System will include a 480V, EMD TEFC, electric drive engine rated for 75 HP driving a Liquid Ring compressor. The package will be capable of compressing 6.2 e3m3/d (.22 MMscfd) at a suction pressure of 0 kPag (0 psig) to approximately 21 kPag (3 psig).

A plant sales and waste gas meter complete with OGC approved RTU's will be included in the PSA Process skid for accounting, monitoring, and trending.

The PSA process has been designed with buffer tanks to dampen the flow fluctuating as the process vessels cycle from adsorption to regeneration

A downstream Spectra SS3000 analyzer for monitoring CO_2/H_2O will sample the outlet gas continuously and will automatically adjust the system cycles respective to changes in the raw gas rates. The analyzer will also ESD the facility on off-spec gas. The SpectraSensors SS3000 is a Dual Channel Gas Analyzer

7.5 Vent System

The vent system consists of a 4" OD x 40' H vent stack. The "off gas" from the discharge of the vacuum compressor on the PSA process skid will be directed to the vent line and knockout tank on a continuous basis. Condensed liquids will be retained in the 100 bbl knockout tank. The "off gas" will then be directed to the vent stack

Normal blow down and emergency gas venting will be routed through a 114 mm (4") OD flare header sized for a maximum emergency relieving capacity of 56.4 e3m3/d (2 MMscfd) at a pressure not greater then 10% of the lowest pressure PSV (normally the plant inlet separator). The high pressure vent gas will be directed to a 100 BBL double wall underground fibreglass tank complete with a tank cradling system used for impact protection, ease of placement and removal.

The high pressure relieving gas will be directed from the KO drum to a 4" OD x 40' H vent stack located not less than 25 meters to the nearest piece of process equipment for high pressure plant blow downs. The high pressure system will be designed to blow down the complete plant process piping within a 15 minute timeframe as per recommended API guidelines.

7.6 Knockout Tank

The 100 BBL knockout tank for retention of produced fluid will be complete with a truck pump-out connection. The knockout tank will also be equipped with a level transmitter/switch for remote indication and alarming, pump control, and redundant proximity switches on the local gauge board for emergency shutdowns. The tank will be double walled, with an Envirovault on the "truck out". It will contain a catadyne heater for freeze protection. The tank will have fluid level indication and be monitored remotely within the plant PLC. The tank will be equipped with an emergency high level alarm.

7.7 Field Office / MCC

The Office / MCC / Control Building will be a 12' W x 28' L (TBC) building that will allow space for operations and records area and will be utilized for the motor starters, HMI, PLC, UPS, PC-HW/SW, lighting transformer, panel boards, and other MCC control equipment.

7.8 Instrument Air Skid

The Instrument Air building will housed within a self contained building and will include two (2) 7.5 hp electric air compressors (100% back-up), air receiver, and filters. The instrument air system will be utilized to supply dry instrument air to all required users.

8.0 BUILDINGS

The buildings and skids will be provided by the package suppliers. The buildings shall be self-framing gable type and their design shall conform to the latest edition of the National Building Code of Canada. The process buildings will have a aluminum interior and the building exterior color will be tan with metro-brown trim on pre-colored steel (CSRI to confirm).

All process buildings will be classified as Class I, Zone 1 (or equal) under the Canadian Electrical Code, with the exception of the compressor package and PSA Package, which will be Class I, Zone 2.

All buildings as required without under skid insulation will be skirted and insulated for extreme weather conditions

9.0 ELECTRICAL

9.1 Electrical Service

The electrical service will be provided by a 150 kW gen set package.

9.2 Electrical Distribution System

The electrical power system consists of a new 480VAC 150kVA utility transformer feeding a MCC/Office located in a separate 12' x 28' industrial type building. The MCC will be equipped with main breaker, service metering, and motor starters which will feed all plant loads such as the vacuum compressor, water pumps, unit heaters, and instrument air compressor. Small loads such as lights, heat tracing, fans, Uninterruptible Power Supply (UPS), and main plant PLC/HMI will be fed from a 120V – 208V lighting distribution panel located in the MCC building.

All cables leaving the MCC building will be routed on a cable tray system. TECK cables will be used for feeding the loads and main runs.

All equipment will be specified to meet area classification and installed to meet CEC code.

10.0 CONTROL

The plant will be designed to run on a PLC based system for manned or unmanned operation.

A new Allen-Bradley SLC-505 panel (or equal) will be procured for use as the station's main control system. It will be capable of storing and communicating signals, including shutdown signals, within the station's control devices. Monitoring will include the following: fire, and gas monitoring, compressor/CO_2 operational status, emergency shutdown valve operation and plant suction and recycle control.

A PanelView Plus will be used for plant interface and intervention (HMI - Human Machine Interface). All programming will be completed by Excelsior Engineering with input and direction supplied by CSRI operations and specialist support.

SCADA will be allowed between the pilot plant and a CSRI designated office. All end points, conditions and plant variables programmed for SCADA will be as directed by

CSRI operations and specialist support. Potential remote shutdown and startup by the SCADA will be accessed by remote Ethernet and/or modem access dependent on the existing area infrastructure.

The gas plant will be equipped with one 6" inlet ESDV, one 3" sales ESDV, one 2" fuel gas ESDV, and various failsafe ESDV's for depressurizing individual processing equipment packages. The ESDV's will be utilized in the event of a major upset condition within the plant.

Net Safety Monitoring Inc. fire and gas detection will be utilized within each building as required (or equivalent). An automatic blow-down system will be incorporated to depressurize the plant in the event a fire or high gas detection registering within the Gas Plant.

Normal shutdown event sequencing will be programmed into the PLC as defined by the shutdown key. Excelsior Engineering Ltd. will provide PLC programming and commissioning.

Flow calculations and information forwarding will be done in conjunction with CSRI's designated measurement and SCADA contractor with input by Excelsior as required.

11.0 INSTRUMENTATION

Excelsior Engineering Ltd. will provide instrumentation selection and sizing. Fire and Gas detection sensors as above will be specified by Excelsior Engineering Ltd. Preferred instrument types as expressed by CSRI operations will be implemented where practical.

11.1 Instrument Standard

Time/cost implications with operations/engineering requests will be clearly communicated prior to implementing required changes. In general the following will be the standards requested for all instrument devices:

Pressure Switches	CCS Dual Snap
Level Transmitter	Radar Type / ISE Magtech / Rosemount 3051
Transmitters	Fisher Rosemount (Smart 3051 Series/3 1 Modbus
Senior Orifice Fittings	Daniel (or equivalent) / V-Cone on Inlet (TBC)
Level Controllers	Fisher 2500-249, 2680 (or equivalent)
Level Switches	SOR 1 ½" NPT
Control Valves	Fisher ("D" or 'E' Body) (or equivalent)
PCs	Fisher 4150 /4195
PSV's	Consolidated, Farris or Crosby
PI's	4" Wika /Bourdon (liquid filled), Dual Scale
TI's	5" Trend / Tel-Tru c/w 316WSST TW, Dual Scale
LG's	Penberthy, Daniel or Jerguson (c/w gauge cocks)
Solenoids	ASCO or Peter Paul
I/P	Fisher Fieldvue (or equivalent)
ESDV	Bettis actuators, Nutron or equivalent DB&B quarter turn ball
Regulators	Regulators Fisher 627 c/w steel body, Fisher 67 CFR (or equivalent)
Instrument Valves	Century
Instrument Manifolds	Swagelok

Liquid meters	Halliburton turbine c/w MCII+/RTU Totalizer (or equivalent)
Fire/ H_2S / Gas Detection	Net Safety
Temperature Controllers	Kimray
Electronic Flow Measurement	Fisher Floboss 103

Instrument tubing will be 3/8 inch (0.049" wall) minimum stainless steel with 316SS Swagelok fittings (no equal). Filter regulators to contain no yellow metal.

11.2 Chemical Injection

The following chemical injection systems will be included within the facility design:

- Inhibited Methanol – Inlet Separator. Inhibited methanol injection will be incorporated with various injection points available throughout the facility for operations use, as required.

Removable corrosion coupons should be installed on all inlet risers to the facility in order to track corrosion rates. No further corrosion tracking/measurement means are proposed within the scope of this design.

12.0 UTILITIES

12.1 Electrical

See Section 9.0

12.2 Heating and Insulating

Process buildings will be heated with electric type oil bath Ruffneck heaters. Pipe freeze protection will be handled with insulation and electrical heat tracing. The MCC / Office building will have an electrical unit heater.

12.3 Instrument Air

An instrument air system for pneumatic instrument air supply and ESD control will be supplied. The package will include a 7.5 Hp electric general purpose rotary screw compressor with 100% backup, a wet air receiver and an integral dryer.

12.4 Water and Sewer

None will be included.

12.5 Drain Systems

All produced water drains will be tied into the 100 BBL knockout tank. The 100 BBL underground storage tank will be used for the retention of produced fluids and trucked out as required

12.6 Telephone

Land line service is not available at site. Cell phone coverage in the area is good with digital service. Radio tower or satellite communication will be considered for data transfer, daily communications and/or call-outs (CSRI to advise).

12.7 Fuel /Start Gas

Fuel gas and start gas will be required for various purposes including engines and heaters etc. Sales gas will be the main source of fuel gas c/w a sales pipeline buyback for emergency startup.

12.8 Lighting

All buildings will have interior and exterior lighting. Yard lighting will be used only where outside building lighting is inadequate.

13.0 PROCUREMENT AND CONSTRUCTION

Excelsior will prepare purchase orders (PO) on behalf of CSRI for all expenses incurred as defined by the DBM and the requirements of CSRI projects personnel for the Farrell Creek project. All PO's will receive the required approvals prior to issuing and Excelsior will keep track of all PO's issued using Excelsior's cost control personnel and purchasing procedures. When required changes at the field level are identified by operations or construction, then a change order will be completed by the site inspector and sent to Excelsior for review and approval. No expenses will be incurred unless the necessary approval and change order has been reviewed and approved by CSRI's personnel.

Excelsior will handle all cost control requirements on behalf of CSRI. Excelsior will utilize existing cost tracking procedures within CSRI purchasing procedures. All costs will be tracked on a daily basis and submitted for review with daily construction updates direct to the appropriate CSRI projects personnel and the Excelsior project engineer. The daily field costs will be added to the cost control summary and will be issued on a weekly basis throughout the construction phase.

Excelsior will arrange for shop inspection for all shop fabrication. Excelsior will propose individual items that require to be purchased through single source or selected vendors depending on specialty or delivery where required to maintain project deadlines or as directed by CSRI.

Miscellaneous pipe, fittings, and small valves will be tendered and purchased as part of the negotiated contract package (time permitting). An additional miscellaneous items required during the project will be captured under a separate PO.

PO's for instrumentation, controls, major electrical equipment and all valves will be prepared and issued to CSRI for approval.

Facility civil/mechanical and electrical/instrumentation construction will be acquired through a tender process with approved CSRI contractors. Should time constraints dictate then force account / single source approval will be obtained on a case by case basis for field installation services.

Contracts where required will be issued by Excelsior Engineering Ltd. for signature and approval by CSRI and the contractor. Purchase orders for the purchases of all other equipment and services will be issued by Excelsior and approved by CSRI.

14.0 FUTURE EXPANSION

The newly acquired Plant site will be 200 m x 200m in area. This lease size will provide for future expansion of up to 30 MMscf/d facility with the addition of amine, refrigeration, compression, and liquid storage tanks. The sales gas line to Spectra will have will have a capacity for ~30 MMcf/d.

15.0 CONSTRUCTION STRATEGY

Recent discussions with major site contractors have indicated that mobilization will likely occur from Fort St. John with an approximate one hour travel time each way.

As an alternative option, accommodations are readily available within the town of Hudson's Hope. The Sportsman's Inn has a total of 95 rooms with a combination of single and double beds. There are no vehicle rentals in Hudson's Hope, with the closest rental location at the Fort St. John airport.

16.0 COST ESTIMATE & SCHEDULE

16.1 Cost Estimate

The cost estimate has been prepared and is submitted to CSRI for review in conjunction with the DBM. The estimate is based on budget pricing obtained from Vendors for the major equipment, and on Excelsior's previous experience with similar projects. Premiums were not allowed for the following:

- Improved Equipment Deliveries
- Overtime/accelerated timelines

Once the final cost estimate has been reviewed and approved it will serve as the form in preparation of cost tracking and the cost control summary. During the project cost will be updated as required and reported back to CSRI projects personnel. As more equipment and materials are purchased the frequency of the cost updates will increase to once per week during the construction phase or as frequent as deemed practical by Excelsior and CSRI.

16.2 Schedule

A Gantt chart summarizing the overall schedule will be completed once the DBM and cost estimate is reviewed. Some key milestones will be:

- Civil Construction Kick-off May 23, 08
- Mechanical Construction Kick-off May 27, 08
- Plant Start-up June 20, 08

17.0 HAZOP / COMMISSIONING

Prior to plant construction / commissioning a complete **Hazard Assessment and Operability (HAZOP)** review will be conducted on the plant with full participation by CSRI operations, CSRI engineering, CSRI start-up personnel, and Excelsior Engineering Ltd. discipline representation (as directed by CSRI). The **HAZOP** will be conducted to ensure a complete and safe operationally functioning gas processing plant. Any hazards identified will be appropriately risked and mitigated and the findings along with the associated recommendations will be reported back through to CSRI management.

A pre-start-up safety review check sheet will be reviewed and completed prior to final start-up of the facilities. **This will require sign-off by CSRI operations, construction management, engineering and inspection.** CSRI operations

personnel will be included for design feedback at all points along the process. CSRI representatives will be included with assistance by construction in purge / final handover of the gas plant facility as well as throughout the entire construction process.

18.0 RISK REGISTRY

The following issues are identified as risks which may potentially delay or impede the proposed construction of the gas plant:

- Design Criteria (scope changes, actual gas and liquids analysis deviations, etc…)
- Minimum capacity limitations – Simultaneous Operations
- Regulatory Issues (OGC or EAO), namely CO_2 / Flare gas issues
- Land status unknown / Aboriginal negotiations
- Weather / Accessibility due to seasonal rainfall

19.0 PROJECT PERSONNEL

Personnel	Name	Phone #
Manager, Projects Canadian Spirit Resources Inc.	Sean Kleiner	403-539-5005
Operations Supervisor Canadian Spirit Resources Inc.	TBA	TBA
Construction Manager Canadian Spirit Resources Inc.	TBA	TBA
Facilities Engineer Excelsior Engineering Ltd.	Glenn Brunner	403-263-6110
Facilities Engineer Excelsior Engineering Ltd.	Andrew Moh	403-263-6110
Electrical / Instrumentation Lead Excelsior Engineering Ltd.	Reg Snowdon	403-680-4215
Electrical Engineer Excelsior Engineering Ltd.	Peter Figura	403-471-9916
Programming / Control Excelsior Engineering Ltd.	Travis May	403-815-7707
Civil Engineer Excelsior Engineering Ltd.	Shane Newman	403-279-6999
Air Quality Excelsior Engineering Ltd.	Ann Jamieson	403-547-7557

20.0 APPENDIX

20.1 Proposed Site Layout

20.2 Schematic Metering Diagram / Process Flow Diagram / Preliminary P&ID's

20.3 Schedule Estimate

20.4 Cost Estimate