BIG WHITE UTILITIES
GAS DISTRIBUTION STUDY
NETWORK EXPANSION
(Design Basis)

PROJECT NO : CEG-21-0615P
REPORT NO : CEG-210615-004

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DESIGN BASIS MEMORANDUM

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DESIGN BASIS MEMORANDUM
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1 Introduction

Big White Utilities currently operates a propane gas distribution system serving Big White Ski Resort. The resort is undergoing expansion with new residential and commercial development and requires planning and design of an expanded future gas distribution system. As such, a new model of the existing gas distribution network that can be used for the preparation of a plan of the expanded system has been developed and verified. This document presents the Design Basis for planning and design of the expanded future gas distribution network of gas mains.

2 Scope

The scope of the Design Basis is limited to the piping that comprises the gas distribution network. Please note that propane storage and vaporization system, gas services and meter sets are considered in establishing the Design Basis for the gas distribution network, but these facilities are not within the scope of the gas distribution network design.

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3 Definitions

Design Criteria Design Criteria are established, but generally non-quantifiable, inputs that must be applied in the design process to adhere to the philosophy.

Design Parameters Design Parameters are quantifiable inputs that must be used in completing a design.

Gas Distribution Main A gas distribution facility consisting of pipe and fittings, normally installed below ground, to transport gas at pressure below 100 psig within a community, commercial or industrial area.

Gas Distribution Network Interconnected gas distribution mains that extend from a source to a gas consumer service line. The distribution network is an integral part of a gas distribution system.

Gas Distribution System A network consisting of distribution mains and gas services that distributes propane from the gas supply system gas to the gas utilization systems.

Gas Service A gas distribution facility consisting of pipe and other components. A service may be comprised of either steel and/or PE materials. It transports propane between a pipeline or main and a customer meter installation. Gas services will consist of both below and above ground components.

Gas Supply System Any system that provides the supply of gas to the gas distribution system. (for natural gas systems this may be a high pressure pipeline and pressure regulating equipment but for propane or LPG system, this may be gas storage and vaporization equipment).

Gas Supply Area For the purposes of operational responsibility, the gas supply area is the geographic area supplied with gas by a gas distribution system.

Bed Unit As defined within the All-Seasons Resort Guidelines A bed unit is defined as the accommodation required for one person to stay overnight. Bed units can be publicly available on a night-by-night basis and/or privately available on a permanent basis for second home, resort residential and employee use.[1]

[1] https://www.for.gov.bc.ca/ftp/HDI/external/!publish/Web/resort-development/asr/asr_guidelines_mountain_resort_c2.pdf

Premise A physical location where a commercial or residential customer may utilize gas. A premise may contain one or more bed units.

Delivery Pressure The pressure at which propane is to be delivered to a customer at the inlet to the utilization piping.

Degree Day A “degree-day” (DD) is essentially a unit of measurement which identifies the difference in degrees Celsius (°C) between a selected base temperature of 18°C and the actual mean daily air temperature in a 24 hour cycle.

Total Connected Load Sum of the installed gas appliance input rated capacity, typically expressed in an hourly rate.

Diversified Load Where a premise has multiple appliances installed it can be assumed that not all appliances will be operated coincidentally at the full input ratings. The diversified load is thus typically some fraction of the total connected load.

Gas Quality The chemical composition of the gas supplied to the gas distribution system.

Supplier Any entity, agency or authority that supplies gas via a gas supply system.

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4 Design Principles

The key design principles that shall be adhered to are:

- In all matters, the overriding goal is safety
- Adoption of the best practices utilizing appropriate modern technology.

In addition, the design principles shall include:

- Protection of customers, public, property and environment from injury, damage or harm.
- Assurance of a safe, reliable, effective, efficient and secure supply of propane to consumers.
- Achievement of a financially viable investment.

These principles shall be achieved by:

- Making provisions to reasonably mitigate the risk and consequences of system failure, naturally occurring hazards or third-party interference.
- Optimizing the use of the entire propane system during its operating life cycle.
- Ensuring that any design is appropriate to serve current demands yet is flexible enough to serve markets which are identified as being available during the design period.
- Ensuring that the scope of impact of the failure of one or more components on the gas supply to consumers can be controlled and localized.
- Minimizing the complexity of the system from both the construction and operational standpoints.

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5 Design Criteria

- The upstream gas supply shall be considered to be suitable, constant and adequate to supply the peak demand as stipulated in the gas purchase contract.
- Where possible, designs should allow for routine operation and maintenance without interruption of supply to consumers.
- Provision shall be made to incorporate means of control of propane flow within the distribution system including isolation of damaged facilities or components.
- The gas supply source pressure considered in design shall be determined based on the propane supply contract and upstream design conditions.
- The distribution network shall be designed without compression equipment.
- The distribution network shall be adequate for the design load at each stage of its development.
- Distribution network shall be designed to supply a forecast hourly peak demand.
- The peak demand or peak network load that should be applied during design shall be the sum of individual customer diversified loads with consideration for the possibility that all customers will not consume gas at their full diversified load coincidentally.
- Designs should minimize the types and size range of materials and use only material items for which approved materials exist (e.g., mains will be designed using pipe sizes already in use in the network).
- All materials should be suitable for local climatic conditions.
- The design shall allow construction to be undertaken using existing and/or reasonably available methods, tools and equipment. Where appropriate industry best practices shall be utilized.
- The design shall be prepared considering the location of other utilities plant or obstructions, where known.
- The design shall include provision for Gas Services to be installed to every plot and/or building.

- The pipeline shall be buried with a minimum cover of 24”
- Pipe material shall be polyethylene (PE) to CSA 137.4 Standards SDR-11
- Within a contiguous network, one MOP pressure shall be utilized.

6 Design Standards

All designs must comply with Canadian laws and regulations as listed below.

Per BC Gas Safety Regulations : [2]

Canadian gas standards adopted as B.C. Natural Gas and Propane Code 30

(1) In this section, ”national code” means the following codes or standards:

(a) CSA-B149.1-15 Natural gas and propane installation code;

(b) CSA-B149.2-15 Propane storage and handling code;

(c) CSA-B149.3-15 Code for the field approval of fuel-related components on appliances and equipment;

(d) CSA-B149.5-15 Installation code for propane fuel systems and containers on motor vehicles;

(e) Repealed. [B.C. Reg. 208/2019, s. 12 (a).]

(f) CSA-Z662-15 Oil and gas pipeline systems;

(g) ANSI/CSA-B149.6-15 Code for digester gas, landfill gas, and biogas generation and utilization;

(h)-(i) Repealed. [B.C. Reg. 208/2019, s. 12 (a).]

(j) CSA B108-18 Natural gas refuelling stations installation code;

(k) CSA B109-17 Natural gas for vehicles installation code.

(2) The national code is adopted by reference, with the changes set out in the Schedule, as the B.C. Natural Gas and Propane Code.

[en. B.C. Reg. 50/2007, Sch. 1; am. B.C. Regs. 150/2011, s. 5; 209/2016, App. 1, s. 4 and App. 2; 208/2019, s. 12.]

Per Gas Distribution Systems Safety and Loss Management System Guidelines:

https://www.technicalsafetybc.ca/sites/default/files/2018-07/gas_distribution_systems_safety_and_loss_management_system_guidelines_man405700.pdf

Gas installations owned or operated by a gas utility, must be designed, installed, operated and maintained in accordance with CSA Z662-15 Oil and Gas Pipeline Systems adopted in Section 30 of the Gas Safety Regulation.

Where deviations from the above standards are proposed detailed risk assessments are required and shall be evaluated and approved by Big White Utility.

[2] (https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/15_103_2004)

7 Design Parameters

The following design parameters have been adopted for Big White to the nature of the specific local environment in which the propane distribution systems must be constructed.

7.1 Typical Gas Supply Quality

Superior Propane: Propane GHS SDS 2018-8-8. Table 1 shows gas specifications from Superior Propane.

Superior Propane

SAFETY DATA SHEET

Propane

Date of Preparation: August 8, 2018

Section 3: COMPOSITION / INFORMATION ON INGREDIENTS

Hazardous Ingredient(s)	Common name /	CAS No.	% vol./vol.
Propane	Not available.	74-98-6	90 - 99
Ethane	Not available.	74-84-0	0 - 5
1-Propene	Propylene	115-07-1	0 - 5
Butane	Not available.	106-97-8	0 - 2.5

Table 1: Superior Propane Gas Specification

7.2 Network Pressure

The gas distribution was originally designed and tested for a maximum allowable operating pressure (MAOP) of 20.3 psig (140 KPa). However, since the gas distribution system was constructed and service commencement in 1997 an operating pressure (MOP) of 14 psig has been used. Notably the operating practice has been that the gas supply pressure is:

- Summer 13.5 psig (without vaporizers being operated)
- Winter 14 psig (with vaporizers being operated)

Minimum design operating pressures for mains within the gas distribution network of mains is selected based on the allowance for pressure drop in service lines and meter sets to still provide the required delivery pressure to customers. Considering that :

- the maximum delivery pressure to any customer is 5 psig and

- allowance of pressure drop in the service line and meter set of 25% of the service line inlet pressure establishes the minimum design pressure to be 6.67 psig.

NOTE: Only a single customer is currently provided 5 psig so this higher design pressure can be used only for that unique customer location or in the future on a special request basis as available in other locations. More commonly delivery pressures are 0.3937 psig and 2 psig so the minimum design pressure for those locations may be 2.67 psig.

7.3 Gas Velocity

The maximum gas flow velocity for underground gas distribution piping used for this design shall be 20 m/s

7.4 Gas Flowing Temperature

Key considerations will include:

- Ground temperature
- Gas supply system send out temperature
- Vapor pressure of gas supply varies with temperature (see figure 1)
- Design temperature used in modeling studies: $-20°C$. (see Appendix B)

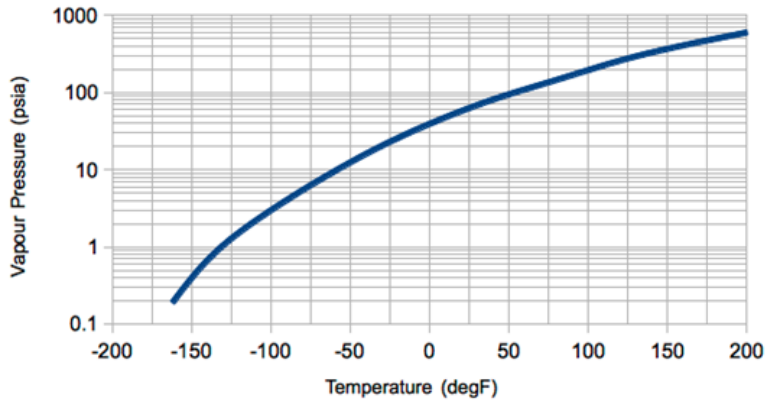

Figure 1: Vapour pressure vs Temperature: Engineering Toolbox

7.5 Elevation

Being a mountain ski resort the elevation in the Big White Community varies significantly. As such elevations will be considered in the gas distribution system modeling and planning.

8 Gas Load

Known information about the existing gas distribution network:

- the location of the current propane storage and vaporization station
- the geographic area that comprises the existing Gas Supply Area
- the current number of premises served and the type of customers at each served premise
- the existing bed units in the service area and bed units at each premise
- the existing gas load,
- the existing ratios of:
  - gas load per bed unit
  - gas load per premise

Regarding the future gas distribution network Big White has provided:

- the location of the new propane storage and vaporization station
- the geographic area that will comprise the future Gas Supply Area
- the projected number of bed units in the future Gas Supply Area

To complete the planning and design of the future gas network the following must be determined:

- the number of bed units that will be located and result in infill in the existing Gas Supply Area.
- the number of bed units that will be in the expansion areas of the future Gas Supply Area.
- the number of premises that the bed units represent.

- load per premise.
- the percentage of premises that will be served by the gas distribution network.
- the load and load location.

9 Original Design

The original design of the pipe network was carried out by ITEC in 2007 and is summarized in Appendix A

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A Original Big White Gas Distribution Design Notes

The Big White gas distribution system was designed based on the system having a capacity equal to the total connected load of all of the appliances at all the premises identified. There is no apparent allowance for a Diversity Factor at each premise nor for a Coincidence Factor in the system. Notably after 20 years the peak day volume is only about 25% of the peak hour that the system was designed for.

- Load fully applied
- Formula - IGT Flow vs Panhandle A
- Friction Factor
- Flowing Temperature

System Data

- Distribution Main Pressure - 140 kPag at Tank Discharge
- Total Projected Load - 2220 cu.m/hr
- System Vertical Lift - 275m

General Notes:

- Future Service Connections to the individual site are not shown
- Service size to individual lots is 30mm unless noted otherwise (Typical for both existing and future services)
- Pipe material shall be polyethylene (PE) to CSA 137.4 Standards SDR-11
- Distribution and service piping shall be installed with a 24” cover
- System operating pressure is 20 psig (140kPag) max. at Tank Farm and 10 psig (70 kPag) min at the end of the distribution system
- Propane Properties: Min Heating Value = 2488 Btu/cu ft (87862 BTU/cu.m)
  Specific Gravity = 1.5 Vapour (Approx)

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B Gas Temperatures

The assumed Heating Degree Days below 18^oC for Big White are 4000 based on BC Building Code data and comparison with Revelstoke 4000 and Whistler 4180[3]. At Big White gas mains are shallowly buried with a cover of 24". Converting to degree days Fahrenheit by applying a ratio of 9/5 Big White climate results in 7200 Heating Degree Days and using the chart below the ground temperature is determined to be as low as -22^oC:

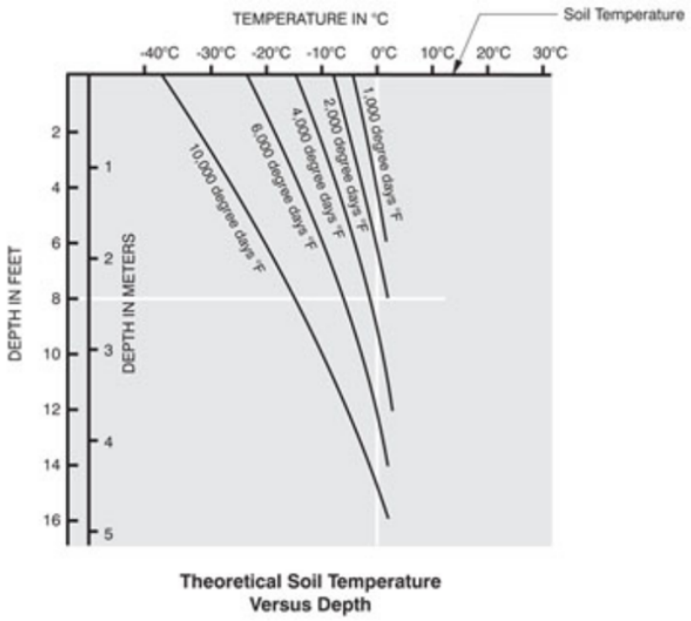

Figure 2: Theoretical soil temperatures vs depth of cover

Big White has a high snowpack which provides some insulating effect to the ground effecting ground temperature. While for short distances mains may be subjected to areas where minimal snowpack exists the flowing temperature is expected to be moderated and tend towards the ground temperature in areas of high snowpack. Other considerations however are:

- design allowance for no snowpack conditions and peak cold temperature of soil throughout the system

[3]Climatic and Seismic Information for Building Design in Canada Division B – Appendix C

- typical gas distribution practice of steady state modelling of peak hour flow that does not consider heat transfer to soil
- minimal to no flow overnight due to high proportion of load being for secondary heat and cooking (i.e., gas fireplaces and restaurants) potentially resulting in stagnation of flow and heat transfer to soil

As such the flowing gas design temperature is assumed to be -20 Celsius for steady state simulation purposes

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C Pipe Dimensions

PE-2406 PIPE AND TUBING DIMENSION

Nominal Diameter	Nominal Outside Diameter.		M.O.P.	Minimum Wall Thickness		Pipe Weight	
Inches	*Inches*	*mm*	*psi*	*Inches*	*mm*	*lbs/ft*	*lbs/m*
*SDR 11							
3/4"	1.050	26.7	100	0.095	2.42	0.122	0.40
1"	1.315	33.4	100	0.119	3.04	0.193	0.63
1 1/4"	1.660	42.2	100	0.151	3.82	0.305	1.01
1 1/4"(SDR 10)	1.660	42.2	110	0.166	4.22	0.334	1.10
1 1/2"	1.900	48.3	100	0.173	4.38	0.41	1.32
2"	2.375	60.3	100	0.216	5.48	0.628	2.06
2 1/2"	2.875	73.0	100	0.261	6.62	0.917	3.02
3"	3.500	88.9	100	0.318	8.08	1.363	4.48
4"	4.500	114.3	100	0.409	10.32	2.253	7.41
6"	6.625	168.3	100	0.602	15.28	4.883	16.05
8"	8.625	219.1	100	0.832	19.94	8.777	27.25

Figure 3: Pipe and Tube Dimensions

NB: The terms “standard dimension ratio” (SDR) and “dimension ratio” (DR) refer to the same ratio—i.e., the ratio of a pipe’s average outside diameter to its minimum wall thickness.