

Construction Plan Report

Woolwich Bio-en

Elmira Anaerobic Digestion Facility

Elmira, Ontario

Prepared For:

Woolwich Bio-en Inc.

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1.0 Introduction

Frey Building Contractors (FBC) has prepared this Construction Plan (CP) report, on behalf of Woolwich Bio-en Inc. (Bio-en) in support of an application for Renewable Energy Approval (REA), for its proposed Anaerobic Digestion (AD) facility to be located at 40 Martin's Lane in Elmira, Ontario (Proposed Facility). This CP report was prepared in accordance with Ontario Regulation (O.Reg.) 359/09. The Proposed Facility is an AD operation that will receive and process organics to produce biogas, liquid soil amendment, and solid soil amendment.

The biogas will be used for combustion in a co-generation system (CHP) to generate 2,852 kilowatts (kW_{el}) of electricity and 3,020 kW_{therm} of heat. The electricity will be sold to the Ontario Power Authority (OPA) under the OPA's Feed-in-Tariff (FiT) Program. The thermal energy produced may be sold to neighbouring industrial users and used in the AD process. The digestate will be temporarily stored at the Proposed Facility before it is transported by one or more contracted third-party haulers, to be applied to agriculture fields as a soil amendment or to be used as a fertilizer in the agriculture industry.

The Proposed Facility will receive and process organic materials, manage the resulting digestate, emissions, and manage the environmental impacts of processing operations.

1.1 Purpose of this Construction Plan Report

This CP report has been prepared in support of an application for REA as required by O. Reg. 359/09.

The purpose of the CP report is to describe in sufficient detail all project construction activities to identify all potential negative environmental effects that may result from these activities. The report will also describe the mitigation measures that will be undertaken to minimize the potential negative environmental effects from construction or installation activities.

The CP report should contribute to and be consistent with information presented in other reports submitted as part of a REA application. For instance, the construction plans will attempt to describe the installation of all project components detailed in the Design and Operations (D&O) report. In addition, the CP report also provides details regarding the potential negative environmental effects identified in the Project Description Report.

The CP report provides an overview of the construction of a 2.85-megawatt (MW) biogas co-generation plant to be located at 40 Martin's Lane in Elmira, Ontario. The Proposed Facility will

convert an annual maximum of 70,000 tonnes of organic waste into biogas through an AD process. The biogas will be combusted in two (2) reciprocating engines, which run two (2) 1.426 MW electrical generators. Appendix A provides engine specifications for the reciprocating engines to be used at the Proposed Facility.

The Proposed Facility will be constructed on an approximately 1.55 hectares of land located at 40 Martin's Lane in Elmira, Ontario. The basic components to be constructed and operated at the proposed 2.85MW AD facility include, but are not limited to, the following:

Anaerobic Digestion Tanks and Processing Building Area

This area, located at the centre of the site, contains the following major elements:

- Three (3) – poured reinforced concrete pre-treatment(PT) tanks 9m in diameter, 8m in height (refer to Section 4.5 of D & O Report)
- Two (2) – poured reinforced concrete main digester tanks 24m in diameter, 8m in height (refer to Section 4.5 of D & O Report)
- One (1) – poured reinforced concrete secondary digestion and repository tank 28m in diameter, 8m in height (refer to Section 4.5 of D & O Report)
- One (1) – poured reinforced concrete water tank 6.5m in diameter, 6.3m in height (refer to Section 5.1.4 of the D & O report)
- One (1) – Digestate Loading Station
- One (1) – Weigh Scale to weigh trucks containing incoming organic material or digestate
- Three (3) – Tecon Gas Buffer Domes, one to cover each of the Main Digester Tanks and one (1) to cover the secondary digestion and repository tank (refer to Section 4.5 of the D & O report)

Four (4) Liquid Organic receiving tanks 4.04m in diameter and 14.17 m in height (refer to Section 4.1 of the D & O report).

- One (1) Glycerine receiving tank 1.70m in diameter and 9.0 m in height
- One process building with an area of 855.7 m² (refer to Section 5.1.3 of the D&O report) containing:

- Mechanical Equipment including: pumps, agitators, organic mixing equipment, pipes, pipe augers, and heating ducting required to process organics prior to and during the AD process (refer to Section 4.4 of the D&O report)
- Electrical wiring and equipment to be installed per building code requirements
- Controls & Communication equipment required for operations and monitoring
- Air collection system vented through a biofilter as described in Sections 8.1.2 and 3.1.1 of the D&O report. The specifications for the biofilter are provided in Appendix B
- Stainless steel above ground and HDPE below ground gas lines and
- Gas analysis and safety equipment

Biogas Utilization, Electrical Generation, and Distribution Area

This area, located at the Northeast corner of the site consists of:

- One (1) 318.0 m² Operations Building containing:
 - Electrical generation room
 - Electrical control room
 - Office and operations
 - Lunch room
 - Washroom/ change room
 - All mechanical/ plumbing to code
 - All gas lines and gas line to code
 - All electrical to code
 - All electrical generation equipment (refer to Appendix C for description)

- Reinforced poured concrete electrical transformer barrier

A biogas flare with an input capacity of 1,500 m³/h will be located outside of the building to the South.

Upon completion of construction and installation, the Proposed Facility will feature: a fire reservoir, chain-link security fence, a gate, hard surfaces, landscaping, and storm water management features. A figure illustrating the Site Plan is provided as Figure 1.

The design, construction, and operation of the Proposed Facility will meet or exceed the requirements of the following:

- Ontario Regulations 359/09 Renewable Energy Approval
- Ontario Building Code (OBC)
- Fire Code – Req. 213/07
- Digester gas Code/ CGA – B105 M93
- Fertilizer Regulations (CRC.C.666)
- Occupational Health and Safety Act (OHSA)
- Electrical Codes
- Workplace Safety and Insurance Board (WSIB)
- Ontario regulation 213/9L- Construction Projects and Occupational Health and Safety Act
- Township of Woolwich Bylaw to Control Noise

2.1 Description of Construction and Installation Activities

General Requirements

The Proposed Facility will be designed, constructed, and commissioned in accordance with all applicable codes, and safety requirements. The AD facility will be designed by Agrinz Engineering, a leading Austrian design firm.

To the greatest extent possible, outdoor construction activities will be carried out during the normal working hours of 7:00 a.m. to 7:00 p.m., six (6) days per week. Indoor construction activities may be performed up to twenty-four (24) hours per day, seven (7) days per week if required by time restraints or construction schedules.

Every effort will be made to mitigate local impact during hours outside of normal working hours (i.e. outside of the hours from 7:00am to 7:00pm) some examples of the measures to be implemented to mitigate local impact include: minimization of the delivery of materials or equipment before 7am and after 7pm, reduction of outdoor activity outside of these hours.

2.1.1 Site Work

In order to facilitate the design of site features and structures, a soil test must be undertaken. The soil test and the report summarizing the findings will be prepared by a licensed soil testing technician. The report will be available to the site design engineer, structural design engineer, and building or project constructor, site work contractor, the Ontario Ministry of Environment (MOE), and Bio-en . The site work will be done in accordance to the Site Plan prepared by the Walter Fedy Partnership as submitted to the Township of Woolwich.

Before site earthwork begins, a siltation fence will be installed along the perimeter of the construction site. An estimated 670m of siltation fence will be installed to meet OBC# 9.12.3.1. requirements.

The entire site will initially be stripped of topsoil using a bulldozer. The topsoil will be piled and stored until it can be used for final grading, landscaping, and berm building. It is estimated that 1750m³ excess topsoil will be relocated on-site using dump trucks (approximately 140 loads).

A storm water management pond will be installed in accordance with OBC, Grand River Conservation Authority (GRCA) and the Township of Woolwich requirements. This pond will be dug out with an excavator. An estimated 5400m³(approximately 440 loads) of soil will be removed for the construction of the storm water management pond and loaded on dump trucks to be relocated on the site.

After the top soil is removed, and the storm water management pond is constructed, the rough cut will be performed to bring the site to rough grade levels according to the Site Plan provided as Figure 1. This work will be carried out using a bulldozer and excavator. Some of the soil will be loaded on to dump trucks to be removed from the site and some of the soil will be stored on site for later use. An estimated 14,600 m³ of excess soil will be relocated on-site using dump trucks (approximately 1185 loads).

It is estimated that 3800m³ of granular B gravel will be transported on to the site to build the roadway and the parking base. Approximately 300 truckloads of gravel will be hauled on site using dump trucks, levelled by a bulldozer and compacted to 98 proctors.

The footings will be excavated for the tanks and building foundations, an estimated 10,630m³ of soil will be excavated and relocated on-site using dump trucks (approximately 860 loads).

After the concrete for the tanks is poured and before the back filling is complete, approximately 460 m of 100 mm diameter drainage pipe will be installed. The drainage pipe will be 100 mm Big "O" drainage tile with filter sock and 12-inch stone bed. The pipe will be installed around all proposed tanks. This drainage pipe is to connect to a 75cm diameter sump.

The tanks and building foundations will be backfilled with soil originally from the site and compacted to 98 proctors.

Approximately 6,000 m² of sod will be installed on the embankment and storm water management pond area, per the Site Plan provided as Figure 1. Approximately 5 loads of sod will be brought on site in trucks and hand installed.

Approximately 560 m of 1.8 m high chain link fence will be installed per the Site Plan.

Rough grading will be completed throughout site by placing granular B gravel to establish proper grades and site drainage. The approximately 100 loads of granular B gravel will be moved with a bulldozer and compacted to 98 proctors.

As the construction project nears completion and after all sub-grade work is completed, final grading of all sub-ground work, roadway and parking will be done by installing an estimated 1300m³ of granular A gravel that will be brought on site using dump trucks levelled with a bulldozer and compacted to an estimated 98 proctor (approximately 120 loads).

After the final grading, the roadways and parking area of the site will be asphalted. This will require approximately 390m³ of HL4 asphalt and 260m³ of HL3 asphalt. The asphalt will be spread, levelled, and compacted. The asphalt will be brought on site using trucks (approximately 55 loads). Landscaping and final site touch up will be done after the asphaltting has been completed.

It is estimated that approximately 32,380m³ (2,625 truckloads) of excess soil will be relocated on-site during site construction.

It is estimated that approximately 7,000m³ (580 truckloads) of fill material will be brought to the site during site construction.

Equipment

The following table presents the equipment that will be used on site for site construction activities.

	<i>Approximate Width (m)</i>	<i>Approximate Length (m)</i>	<i>Approximate Height (m)</i>	<i>Approximate Weight (tonne)</i>
Dump Truck	2.56	9.50	3.50	13.6
Excavator	3.20	9.50	2.40	22.68
Bull Dozer	3.05	7.00	3.125	13.6
Asphalt Paver	3.00	6.00	3.00	15.00
Asphalt Roller	1.50	3.46	2.73	6.60

Fluids and Fuels

The following fluids and fuels will be used during site construction:

- Engine Oil 15W40
- Hydraulic Oil #32
- Transmission Fluid Dexron #2
- Diesel Fuel Dyed
- Antifreeze Heavy Duty

The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

2.1.2 Concrete Work

All concrete will be brought to the site using ready-mix concrete trucks. Most of the concrete will be poured into forms using a concrete pump. Most of the concrete footings and concrete slabs on grade will be poured directly from the ready mix trucks, as is a common construction practice.

Poured Concrete Tanks

The tanks will be formed using white PVC Octa Form System forming that includes an engineered bracing system. Horizontal reinforcing bars (rebar) will be installed as the forming system is placed. Vertical rebar will be installed after the forming system is in place and before the concrete is poured.

Most of the tank openings will be formed into the Octa Form System forming system, some of the smaller pipe openings will be core drilled after the concrete has been placed and cured. It is anticipated that the Concrete tanks will require:

Approx. 1,400m ³	Ready Mix Concrete	Approx. (120 trucks)
Approx. 5,400m ²	Octa Form Systems	Approx. (3 trucks)
Approx. 100	Tonnes Re Bar	Approx. (3 trucks)
	Stainless steel frame openings	Approx. (2 trucks)

Equipment

The following table presents the equipment that will be used on site for the pouring of concrete tanks.

	<i>Approximate Width (m)</i>	<i>Approximate Length (m)</i>	<i>Approximate Height (m)</i>	<i>Approximate Weight (Tonne)</i>
6+ Man lifts	1.50	6.00	8.00	5.89
1 Zoom Boom	2.00	6.00	2.75	15.89
Crane	2.60	11.45	4.00	31.75
Concrete Pump	2.60	13.10	4.00	31.75

Fluids and Fuels

The following fluids and fuels may be used in the equipment that will be used for the concrete work.

Engine Oil	15W40
Hydraulic Oil	#32
Transmission Fluid	Dexron #2

Diesel Fuel Dyed
 Propane Gas
 Antifreeze Heavy Duty

The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

Building Footings Foundations and Floors

The building foundation footings will be poured using Symons forming system or the equivalent, reinforcement steel will be installed as forms are erected and before concrete is poured. It is anticipated that the building foundations will require:

Approx. 750m³ Ready Mix Concrete Approx. (75 trucks)
 Approx. 1,250m² Symons Forming System Approx. (1 truck)
 Approx. 50 tonne re-bar Approx. (2 trucks)
 Misc. opening frames

The following equipment will be used to pour building foundations and slabs.

	<i>Approximate Width (m)</i>	<i>Approximate Length (m)</i>	<i>Approximate Height (m)</i>	<i>Approximate Weight (Tonne)</i>
1+ Man lifts	1.50	6.00	8.00	5.89
1 Zoom Boom	2.00	6.00	2.75	15.89
Crane	2.60	11.45	4.00	31.75
Concrete Pump	2.60	13.10	4.00	31.75

Fluids and Fuels

The following fuels and fluids may be used during the construction of the building foundations and footings:

Engine Oil 15W40
 Hydraulic Oil #32

Transmission Fluid	Dexron #2
Diesel Fuel	Dyed
Propane	Gas
Antifreeze	Heavy Duty
Form Oil	Release Agent

The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

Fire Reservoir

The base of the fire reservoir will be poured immediately after excavation.

The walls will be poured using Symons forming system or equivalent using same protocol as building foundations.

The top will be formed using a PERI deck forming system or equivalent. It is anticipated that the fire reservoir will require.

Approx. 90m ³	Ready Mix Concrete	Approx. (10 Trucks)
Approx. 290m ²	Symons Forming System	Approx. (2 trucks)
Approx. 5 Tonne	Re-Bar	Approx. (1 truck)
Approx. 15m ²	PERI deck forming System or equivalent	Approx. (2 trucks)

Equipment

The following table presents the equipment that will be used on site for the construction of the fire reservoir.

	<i>Approximate Width (m)</i>	<i>Approximate Length (m)</i>	<i>Approximate Height (m)</i>	<i>Approximate Weight (Tonne)</i>
2 or more man lifts	1.50	6.00	8.00	5.89
1 zoom boom	2.00	6.00	2.75	15.89
Concrete Pump	2.60	13.10	4.00	31.75

Fluids and Fuels

The following fuels and fluids may be used during the construction of the building foundations and footings:

Engine Oil	15W40
Hydraulic Oil	#32
Transmission Fluid	Dexron #2
Diesel Fuel	Dyed
Propane	Gas
Antifreeze	Heavy Duty
Form Oil	Release Agent

The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

2.1.3 Structural Steel

The final design for the building foot prints and heights have not been determined as of the writing of this report. It is estimated that there will be approximately 27.50 tonnes of structural steel delivered to the site using approximately fifteen (15) trucks.

It is estimated that 1300m² light gauge metal roof deck will be delivered to site using one (1) truck. The Proposed Facility will require a variety of miscellaneous materials including stairs, catwalks, safety railings, and pollards. The quantity of these items has not been determined, however, it is anticipated that they will be delivered using approximately fifteen (15) trucks.

Equipment

The following table presents the equipment that will be used on site to erect or install the steel components of the Proposed Facility.

	<i>Approximate Width (m)</i>	<i>Approximate Length (m)</i>	<i>Approximate Height (m)</i>	<i>Approximate Weight (Tonne)</i>
1 Man lift	1.50	6.00	8.00	5.89
1 zoom boom	2.00	6.00	2.75	15.89
Crane	2.60	11.45	4.00	3.:75

Fluids and Fuels

The following fuels and fluids may be used during the erection or installation of structural steel components:

Engine Oil	15W40
Hydraulic Oil	#32
Transmission Fluid	Dexron #2
Diesel Fuel	Dyed
Propane	Gas
Antifreeze	Heavy Duty

The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

It is anticipated that approximately sixteen (16) trucks will import structural steel – roof deck and miscellaneous metals to site during structural steel construction.

2.1.4 Thermal Moisture

The exterior of the poured concrete tanks will be a white PVC Octa Form System or the equivalent. It is estimated that approximately 2000m² of cladding will be required. The walls of Process and Operations buildings will be clad with 3” King Span 26 GA pre-painted building panel or the equivalent. This cladding will include fasteners, trims, and caulking as required. The materials required for the metal cladding will be transported on site using approximately three (3) trucks.

Equipment

The following table presents the equipment that will be used on site to install the metal cladding on the tanks and buildings.

	<i>Approximate Width (m)</i>	<i>Approximate Length (m)</i>	<i>Approximate Height (m)</i>	<i>Approximate Weight (Tonne)</i>
3 Man lifts	1.50	6.00	8.00	5.89
1 zoom boom	2.00	6.00	2.75	15.89

Fluids and Fuels

The following fuels and fluids may be used during installation of the cladding on the tanks and buildings:

Engine Oil	15W40
Hydraulic Oil	#32
Transmission Fluid	Dexron #2
Diesel Fuel	Dyed
Propane	Gas
Antifreeze	Heavy Duty

The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

The roofs of Process and Operations buildings, as well as the three (3) PT tanks will be covered with conventional build up asphalt bituminous roofing. It is anticipated that approximately 1,500 m² will be required. The roofing will be transported to the site using approximately five (5) trucks.

2.1.5 Doors and Windows

It is estimated that the following doors and windows will be required in the Process and Operations buildings:

Approx. 10 - 3' x 7' Hollow Metal Doors and Frames including hardware

Approx. 1 - 8' x 8' Hollow Metal Doors and Frames including hardware

Approx. 2 - 16' x 14' overhead door including power operators

Approx. 1 - 20' x 14' Overhead door including power operators

Approx. 1 - 22' x 15' overhead door including power operators

Approx. 2 - 4' x 3' Windows in site office

The doors listed above will be delivered to the site using approximately four (4) trucks.

Equipment

The following table presents the equipment that will be used on site to install doors at the Proposed Facility.

	<i>Approximate Width (m)</i>	<i>Approximate Length (m)</i>	<i>Approximate Height (m)</i>	<i>Approximate Weight (Tonne)</i>
1 Man lift	1.50	6.00	8.00	5.89
1 Material Lift	2.00	6.00	2.75	15.89

Fluids and Fuels

The following fuels and fluids may be used during installation of the doors at the Proposed Facility:

Engine Oil 15W40
Hydraulic Oil #32
Transmission Fluid Dexron #2
Antifreeze Heavy Duty
Propane Gas

The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be

handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

2.1.6 Weigh Scale Bridge

The weigh scale bridge will require minimal excavation and backfilling activity. An estimated 35m³ of concrete will be used for construction of the piers and footings. The weight of the bridge and deck is not currently available.

Equipment

The following table presents the equipment that will be used on site to construct the weigh scale at the Proposed Facility.

	<i>Approximate Width (m)</i>	<i>Approximate Length (m)</i>	<i>Approximate Height (m)</i>	<i>Approximate Weight (Tonne)</i>
1 Excavator	1.50	6.00	8.00	5.89
Compaction Equipment	2.00	6.00	2.75	15.89
Crane	2.60	11.45	4.00	31.75

Fluids and Fuels

The following fuels and fluids may be used during the construction of the weighbridge:

- Engine Oil 15W40
- Hydraulic Oil #32
- Transmission Fluid Dexron #2
- Diesel Fuel Dyed
- Antifreeze Heavy Duty

The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

2.1.7 Bio Filter and Ducting

The Biofilter and ducting will be installed at the Proposed Facility per the manufacturer specifications as provided in Appendix B.

Equipment

The following table presents the equipment that will be used on site to install the biofilter and ducting.

	<i>Approximate Width (m)</i>	<i>Approximate Length (m)</i>	<i>Approximate Height (m)</i>	<i>Approximate Weight (Tonne)</i>
1 Crane	2.60	11.45	4.00	31.45
1 Excavator	1.50	6.00	8.00	5.89
1 Zoom Boom	2.00	6.00	2.75	15.89
1 Man lift	1.50	6.00	8.00	5.89

Fluids and Fuels

Engine Oil	15W40
Hydraulic Oil	#32
Transmission Fluid	Dexron #2
Diesel Fuel	Dyed
Propane	Gas
Antifreeze	Heavy Duty

The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

2.1.8 Organics Processing and Solid Digestate Handling Equipment

The Proposed Facility will include a solid organic pre-processing unit, a liquid organic pre-processing and mixing unit and equipment for solid digestate removal.

Equipment

The following table presents the equipment that will be used for the installation of the organics pre-processing and the solid digestate handling equipment.

	<i>Approximate Width (m)</i>	<i>Approximate Length (m)</i>	<i>Approximate Height (m)</i>	<i>Approximate Weight (Tonne)</i>
1 Crane	2.60	11.45	4.00	31.95
1 Zoom Boom	2.00	6.00	2.75	15.89
1 Man lift	1.50	6.00	8.00	5.89

Fluids and Fuels

The following fuels and fluids may be used during the installation of the processing and solid digestate removal equipment:

Engine Oil	15W40
Hydraulic Oil	#32
Transmission Fluid	Dexron #2
Diesel Fuel	Dyed
Propane	Gas
Antifreeze	Heavy Duty

The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

2.1.9 Digester Covers

Each of the digester tanks will be covered with a gas buffer membrane (by Tecon). A gas cover membrane will be installed on each of the two (2) main digester tanks (24m diameter) and the one (1) secondary digestion and repository tank (28m in diameter).

Equipment

The following table presents the equipment that will be used on site to install the digestion tank covers.

	<i>Approximate Width (m)</i>	<i>Approximate Length (m)</i>	<i>Approximate Height (m)</i>	<i>Approximate Weight (Tonne)</i>
6 Man lifts	1.50	6.00	8.00	5.89
1 Crane	2.00	6.00	2.75	15.89

Fluids and Fuels

The following fuels and fluids may be used during the installation of the digestion tank covers:

Engine Oil	15W40
Hydraulic Oil	#32
Transmission Fluid	Dexron #2
Diesel Fuel	Dyed
Propane	Gas
Antifreeze	Heavy Duty

The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

2.1.10 Agitation Equipment

The PT and digester tanks will have approximately twenty-one (21) agitators, which can be installed no earlier than twenty-eight (28) days after the concrete is poured. The agitators will be obtained from Europe and will be shipped in approximately ten (10) containers that will be transported on approximately ten (10) trucks.

Equipment

The following table presents the equipment that will be used on site to install the agitation equipment.

	<i>Approximate Width (m)</i>	<i>Approximate Length (m)</i>	<i>Approximate Height (m)</i>	<i>Approximate Weight (Tonne)</i>
1 Zoom Boom	1.50	6.00	8.00	5.89
1 Crane	2.00	6.00	2.75	15.89
2 Man lifts	1.50	6.00	8.00	5.89

Fluids and Fuels

The following fuels and fluids may be used during the installation of the digestion tank covers:

Engine Oil	15W40
Hydraulic Oil	#32
Transmission Fluid	Dexron #2
Diesel Fuel	Dyed
Propane	Gas
Antifreeze	Heavy Duty

The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

2.1.11 Electrical

The electrical work associated with the Proposed Facility includes:

- Wiring of PT and digester agitation equipment, pumps, power valves, controls and gas sensors
- Wiring of solid and liquid organic pre-processing equipment
- Wiring of BIOREM Biofilter
- Wiring of solids separator
- Lighting and outlets throughout Process and Operations buildings
- Wiring of CHP for electrical generation

- Wiring of motor control centre
- Installation of one (1) – 1200 Amp 600/ 347 Volt Service
- Installation of one(1) 1 – 1200 Amp 600/ 347 Volt Breaker Panel
- Installation of 1 – Metering Compartment
- Performing of ESA inspection
- ESA Planning Department Approval

The following outlines the electrical work that will be required for the generation of power from biogas produced and associated infrastructure required to export the power to the grid.

Power will be generated by using biogas to run a reciprocating engine whose output shaft is connected to an electrical generator. The generator will be connected to an indoor electrical substation next to the room where the generators are located. The normal power distribution is supplied from Waterloo North Hydro, via overhead 27.6KV feeder and will be connected to the substation. The overhead feeder is extended from the street and brought into the Proposed Facility ending at a dip pole close to the substation and connected to the transformer through fusible disconnect. A complete description of the ancillary electrical equipment is provided in Appendix C.

The transformer for the Proposed Facility has not been specified at this time; however, an example of a typical transformer that would be used for this type of installation Bio-en will operate the transformer in accordance with the manufacturer’s recommended procedures. An instruction manual for a typical transformer is provided in Appendix C.

Equipment

The following table presents the equipment that will be used on site to install the agitation equipment.

	<i>Approximate Width (m)</i>	<i>Approximate Length (m)</i>	<i>Approximate Height (m)</i>	<i>Approximate Weight (Tonne)</i>
1 Zoom Boom	1.50	6.00	8.00	5.89
1 Crane	2.00	6.00	2.75	15.89
2 Man lifts	1.50	6.00	8.00	5.89

Fluids and Fuels

The following fuels and fluids may be used during the installation of the digestion tank covers:

Engine Oil	15W40
Hydraulic Oil	#32
Transmission Fluid	Dexron #2
Diesel Fuel	Dyed
Propane	Gas
Antifreeze	Heavy Duty

The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

2.1.12 Process Mechanical and Gas and Heat Piping

- It has been estimated that the piping equipment required will include, but is not limited to the following:
 - Approximately 220m of 355cm HDPE Gas Piping (underground)
 - Approximately 40m of 300cm steel gas piping
 - Approximately 30m of 150cm steel gas piping
 - Approximately 800m of 150cm steel heating piping
 - Approximately 300m of 205cm steel process piping
 - Approximately 400m of 300cm steel process piping
 - One (1) – Heating manifold
 - Two (2) – Process manifolds
 - Approximately twelve (12) – Circulation pumps
 - Approximately four (4) – Ball valves

- Approximately forty-two (42) – Hand slide valves
- Approximately thirty (30) – Pneumatic slide valves
- Approximately four (4) – Magnetic valves
- Approximately eight (8) – HOV hand valves
- Approximately seven (7) – Control valves
- Approximately twenty-eight (28) – Throttle valves

A variety of miscellaneous elbows, tees, flanges, and fittings will be required. The piping components listed above will be transported to the site using approximately twenty (20) trucks. At the site, the piping will be assembled and installed by cutting, fitting and welding.

Equipment

The following table presents the equipment that will be used on site for the assembly and installation of the piping at the Proposed Facility:

	<i>Approximate Width (m)</i>	<i>Approximate Length (m)</i>	<i>Approximate Height (m)</i>	<i>Approximate Weight (Tonne)</i>
Man lifts	1.50	6.00	8.00	5.89
Zoom Boom	2.00	6.00	2.75	15.89
Cut Off Saw	0.20	0.40	0.40	0.23
Hand Grinder	0.05	0.20	0.05	0.09
Arc Welder	0.40	0.80	0.40	0.90

Fluids and Fuels

The following fuels and fluids may be used during the assembly and installation of the mechanical, process, and heating piping:

Engine Oil	15W40
Hydraulic Oil	#32
Transmission Fluid	Dexron #2
Diesel Fuel	Dyed

Propane

Gas

Antifreeze

Heavy Duty

The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

2.2 Schedule of Construction Activities

<i>Week #</i>	<i>Type</i>	<i>Description</i>
Week #1	Operation approval Design	REA Approval Site plan approval Process Design Structural Design
Week #2	Permits	Building Permit Mobilization
Week #3	Site Work	Install siltation fence Strip top soil
Week #4	Site Work	Cut site Excavate SWM pond
Week #5	Site Work	Cut site Construct SWM pond
Week #6	Site Work Site Work	Cut site Excavate fire reservoir slab
Week #7	Site Work Concrete Work	Cut site Install site services Pour fire reservoir slab
Week #8	Site Work Concrete Work	Install site roadway Install site services Final grading embankment Form and pour fire reservoir tank walls
Week #9	Site Work Concrete Work	Install granular B on parking area Install sod on embankments and SWM pond Form fire reservoir tank top
Week #10	Site Work Concrete Work	Excavate for tank footings Install chain link fence Pour fire reservoir tank top

Week #	Type	Description
Week #11	Site Work Concrete Work	Excavate for tank footings Install chain link fence Pour tank slabs
Week #12	Site Work Concrete Work	Excavate for tank footings Pour tank slabs Octa Form System forming for PT tank #1
Week #13	Concrete Work	Pour PT #1 tank walls Octa Form System forming for PT tank #2
Week #14	Concrete Work	Pour PT #2 tank walls Octa Form System forming for PT tank #3
Week #15	Site Work Concrete Work	Excavate process building footings Pour PT #3 tank walls Octa Form System forming for main digester #1
Week #16	Concrete Work	Pour Digester #1 tank walls Pour footings for process building Octa Form System forming for main digester #2
Week #17	Concrete Work	Octa Form System forming for main digester #2 Form and pour process building foundation
Week #18	Concrete Work Mechanical Work	Pour main digester #2 walls Octa Form system forming for repository Form and pour process building foundations Install mechanical in ground
Week #19	Site Work Concrete Work Mechanical Work	Excavate control building footings Octa Form System forming for repository Form and pour process building foundations Install mechanical in ground
Week #20	Concrete Work Mechanical Work Gas Work Electrical Work	Pour repository tank walls Form and pour process building foundations Form PT #1 roof Install mechanical in ground Install gas in ground Install electrical in ground
Week #21	Site Work Concrete Work Mechanical Work Gas Work	Back fill tanks Pour PT #1 roof Form and pour control building foundation Install mechanical in ground Install gas in ground

Week #	Type	Description
	Electrical Work	Install electrical in ground
Week #22	Site Work Concrete work Structural Work Gas domes Mechanical Gas Electrical	Back fill foundations Form PT #2 Roof Form and pour concrete building foundation Erect structural for process building Install gas domes on main digester #1 and #2 Install mechanical in ground Install gas in ground Install electrical in ground
Week #23	Site Work Concrete Work Structural Work Gas dome Mechanical Gas Electrical Work	Back fill foundations Pour PT #2 roof Erect structural for project building Install gas dome on repository Install mechanical in ground Install gas in ground Install electrical in ground Install electrical distribution
Week #24	Structural work Tank liner Mechanical work Electrical work	Form PT #3 roof Erect structural for process building Install interior tanks linear main digester #1 Mechanical in ground Electrical in ground
Week #25	Concrete Work Structural Work Structural Work Thermal-Moisture Tank liner Mechanical Gas Electrical	Pour PT 3 roof Pour process building floor slab Install roof decking process building Erect structural for control building Install metal building panels on process building Install interior tank liner main digester #2 Mechanical in plant Gas in plant Electrical distribution
Week #26	Concrete Work Structural Work Thermal-Moisture Tank liner	Pour process building floor slab Install roof decking controls building Install building panels on process building Install tank and gravel roof on process building Install interior tank liner repository

Week #	Type	Description
	Agitation Mechanical Gas Bio Filter Electrical	Install agitators main digester #1 Mechanical in plant Gas in plant Install bio filter Electrical in plant Electrical distribution
Week #27	Concrete Work Structural Work Thermo Moisture Tank Liner Agitation Mechanical Gas Bio filter Electrical Work Electrical Work	Pour process building floor slab Install controls building roof deck Install building panels on process building Install tar and gravel roof on control building Install interior tank liner P. #1 Install agitators main digester #2 Mechanical in plant Gas in plant Install bio filter Electrical in plant Electrical distribution
Week #28	Concrete work Thermal moisture Tank liner Agitation Mechanical Gas Bio filter Electrical	Pour controls building floor slab Install building panels on controls building Install tar and gravel roof on PT tanks Install interior tank liner PT #2 Install agitation repository Mechanical in plant Gas in plant Install bio filter Install duct work Electrical in plant Electrical distribution Electrical generation
Week #29	Thermal moisture Tank liner Agitation Mechanical Gas Bio filter Electrical	Install building panels on control building Install interior tank liner PT #3 Install agitation repository Mechanical in plant Gas in plant Install duct work Electrical in plant

Week #	Type	Description
		Generation
Week #30	Site Misc. Metals Agitation Mechanical Gas Bio Filter Flare Electrical	Final grading Misc. metals in plant Install agitation PT #1 Mechanical in plant Gas in plant Install duct work Install gas flare Electrical in plant Electrical generation
Week #31	Site work Misc. metals Doors – Windows Agitation Mechanical Gas Bio Filter Flare Electrical	Final grading Misc. metals in plant Install doors in process building Install agitation PT #2 and PT #3 Mechanical in plant Gas in plant Install duct work Install flare Electrical in plant Electrical generation
Week #32	Site Work Misc. Metals Doors windows Mechanical Gas Bio filter Electrical	Final grading Paving Misc. metals in plant Install door in controls building Mechanical in plant Gas in plant Install duct work Electrical in plant Electrical generation
Week #33	Site work Misc. metals Painting Mechanical Gas Electrical	Paving Misc. metals in plant Painting and finished Mechanical in plant Gas in plant Electrical in plant Communications and controls Generation
Week #34	Painting	Painting and finishes

Week #	Type	Description
	Mechanical Gas Electrical	Mechanical in plant Gas in plant Electrical in plant Communications and controls Electrical generation
Week #35	Site work Painting Electrical Work	Final landscaping etc. Painting and finished Electrical in plant Communications and controls Electrical generation
Week #36	Buffer Week	Final cleaning
Week #37	Buffer Week	Final cleaning Commission and testing
Week #38		Commission and testing
Week #39	Occupancy	Final commission and testing Turn project over to occupant

2.3 Description of Negative Environmental Impacts

Storm water Runoff Impacts

As construction will consist of site grading and the addition of hard surfaces, there is a potential for storm water runoff and the erosion of soil. Siltation fencing will be used during construction to mitigate erosion. A storm water management pond is included in the Proposed Facility design and will manage the storm water during and after construction.

Dust and Noise Emissions

The use of heavy equipment and the lack of vegetative cover increase the likelihood that dust will be generated during site construction. The site may be sprayed with water when dust generation is excessive. Noise from the use of heavy equipment will be limited to comply with local noise bylaws.

Destruction of Vegetation and Habitat

The site is currently a crop field and the development of this site is not anticipated to have any negative impact on any sensitive vegetation or wildlife habitats. A natural heritage assessment has been conducted and approved by the Ministry of Natural Resources (MNR).

Impacts on Water Bodies

The Canagagigue Creek is the only major water tributary in the general area of the site and is outside of the 300-meter radius perimeter of the construction site. Thus, there will be no adverse environmental impacts because of construction. Protection of water tables from spills is addressed in section entitled “Construction Equipment Used”

Impacts Related to Water Takings

There are no wells or rivers on the site from which water can be taken. All water will be provided via a municipal connection or tanker truck until municipal connection is completed.

Fuel and Hazardous Spills

See section entitled “Construction Equipment Used”

Insulation Overspray

There is the potential for overspray from the spray of urethane on the tanks. This impact will be mitigated using isolation tents or spraying in low wind conditions as per standard construction procedure.

Impacts on Archaeological and Heritage Resources

The Proposed Facility is not expected to result in any impacts on archaeological or heritage resources. Archaeological and heritage assessment reports were prepared in support of the Proposed Facility’s Application for Renewable Energy Approval (REA) and were approved by the Ministry of Culture.

Construction and Installation Residual Waste

Residual waste materials will be generated during construction and installation activities. The site will be cleaned up daily, removing any residual waste materials from the working areas. Waste materials will be sorted to salvage any wastes that have the potential to be recycled or that have salvage value. The balance of the waste will be placed into appropriate roll off bins to be removed from the site and taken to landfills for disposal or to be recycled by a licensed hauler.

During the construction period, waste bins containing residual waste will be removed from the site on a bi-weekly basis to minimize the quantity of waste stored on the site at a given time. The quantity of residual waste and the number of bins that will be hauled from the site cannot be determined at this time.

2.4 Mitigation Measures

Storm water Runoff Impacts

The Proposed Facility will have a storm water management plan in place during construction activities, this plan will be implemented to treat run off and siltation resulting from storm water during the construction period. The Siltation fencing will be used during construction to mitigate erosion.

A storm water management pond is included in the Proposed Facility design and will manage the storm water runoff generated during construction activities and after construction activities are completed. The storm water management pond will be installed as early in construction period as possible. A visual inspection will be performed on a bi-weekly basis for sediment and chemical contaminants. If sediment is present at a depth of more than 0.3 m, the sediment will be removed, dried, and stored on site in a landscape barrier/berm. Chemical contamination will be addressed with the MOE and other agencies according to standard construction procedure.

The construction process may encounter groundwater. It has been estimated that the amount of groundwater that may need to be redirected will be less than 50,000 L/day.

Access Roads

Access to the site will be via Martin's Lane leading east from Arthur Street North. Incoming traffic will travel east along this road to the Proposed Facility and enter via the access gates located on the southwest side of the site. Outbound traffic will exit via the same entrance and travel west along Martin's Lane from the Proposed Facility. It is likely that there will be some residual siltation on Martin's Lane because of construction truck and vehicle traffic. Martin's Lane will be inspected daily and cleaned of residual siltation as required. It is noted that this road provides access to the Proposed Facility and does not receive general traffic flow.

Dust

The use of heavy equipment and the lack of vegetative cover increase the likelihood that dust will be present during construction. The site can be sprayed down with water to mitigate dust.

The water will be hauled from an off-site location by NOHA's Squirting Services or an equivalent service provider. The quantity of water to be utilized will be determined by the site conditions and the time of year, e.g. dust control would not be an issue in fall, winter, or spring.

Destruction of Vegetation and Habitat

The site is currently a crop field and is void of any native vegetation or habitat, therefore, there is not expected to be an impact.

Embankment Erosion

As early as feasible in the construction period (or as early as the plant growing season permits) embankments created on the north/west and the east sides of site will be final graded and sodded with grass to reduce storm water runoff and prevent the erosion of embankments.

Impacts on Water Bodies

The Canagagigue Creek is a local water tributary and falls outside the 300-meter radius perimeter of the construction site. Cox Creek is approximately 240m northeast of the site. There is a ridge of high ground between Cox Creek and site ridge (elevation 365.27). The site will be cut at an elevation of approximately 362.25. Thus, there will be no adverse environmental impacts into the Cox Creek basin because of construction.

Impacts Related to Water Takings

There are no wells or rivers on the site from which water can be taken. All water will be provided via a municipal connection or tanker until municipal connection is completed. The construction process may encounter groundwater. It has been estimated that the amount of groundwater that may need to be redirected will be less than 50,000 L/day, and no permit to take water will be required.

Noise Emissions

Noise from the use of heavy equipment will be limited by local noise bylaws. To mitigate noise, heavy construction activities will be restricted to the normal working hours of 7:00 a.m. through 7:00 p.m., six (6) days per week.

Fuel and Hazardous Spills

During construction, fuel will not be stored on site in any significant quantity. Spills of fuel or any liquid wastes inadvertently brought to the site are to be contained as quickly as possible by

the construction of temporary berms and/or the application of absorbent materials. Every reasonable effort will be made to minimize the area affected by the spill. The affected area will be marked off to prevent access. The spill will be reported immediately to the MOE District Office or the Spills Action Centre (800-268-6060). Documentation of the spill, the remediation, and the impact to the environment will be maintained with the records for the construction period. Refer to the Ontario Regulation 675/98 Classification and exemption of spills and reporting of discharges in regards to fuel spills on site. The contractor will follow the spill reporting guidelines as required by the MOE. In addition, the contractor will have a spill kit onsite in order to contain any spills promptly. The material will be handled in accordance with Regulation 347 and will be transported by a licensed hauler and disposed of at a licensed waste disposal site (if applicable).

Emergency Contacts

The following emergency contact numbers will be posted on the main entrance gate:

- Constructor's Emergency contact number
- Emergency services (i.e., fire, police, ambulance, etc.)
- Site security service contacts

Fire

In the event that a fire is identified on the site, firefighting assistance will be requested from the Woolwich Fire Department. The Proposed Facility will have water on-site in a fire fighting water reservoir available for fighting fires per the Fire Code. The site supervisor or designated representative will then be made available to assist the fire department as requested by the fire department officials.

The Woolwich Fire Department either will respond through a site monitoring system, or will be called by the construction lead by dialling 911.

The Woolwich Fire Department will be provided with a copy of the Proposed Facility layout and will be advised on the facility and emergency protocols.

Accidents

First aid kits will be maintained, regularly inspected and re-supplied as required and will be located in the Construction Site Office.

The following emergency numbers will be provided to all crew members working on site.

Ambulance: 911
Fire Department: 911
Police: 911

Refer to Construction Safety Association of Ontario or Frey Building Contractors Health and Safety Policy Manual (Excerpts provided in Appendix D) for details regarding accidents.

Insulation Overspray

There is the potential for overspray from the spray urethane. This impact will be mitigated using isolation tents or spraying in low wind conditions as per standard construction procedure.

Construction Truck and Vehicle Traffic (approximately 898 vehicles)

During the construction period of approximately thirty-nine (39) weeks (nine (9) months) there will be considerable truck and vehicle traffic. The following traffic volumes resulting from construction have been estimated:

Transportation of granular fills	520	Truck Loads approximately
Transportation of asphalts	55	Truck Loads approximately
Transportation of concrete	209	Truck Loads approximately
Transportation of structural steel	15	Truck Loads approximately
Transportation of construction materials	44	Truck Loads approximately
Transportation of Equipment	30	Truck Loads approximately
Transportation of Dust Control	5	Truck Loads approximately
Site Containment Services	20	Truck Loads approximately

50% of this traffic is expected to travel in the first three months of construction (during site cut and roadwork). This may result in an average vehicle flow of five (5) to ten (10) vehicles per day.

The above volumes take into account material delivered to the site or removed from the site. It does not include onsite truck movements.

It is not likely that this will have a negative environmental impact within a 300 m radius of the site.

To mitigate noise and aggravation to the community it is intended to actively engage in construction activities, or receive shipments between 7:00 a.m. to 7:00 p.m., six (6) days per week.

Site Security and Litter Control

It is the intention of the constructor of this project to erect and employ the 1.8m high chain link fence as early as is feasible (approximately by week 12 of the construction schedule). A secure site reduces the likelihood of trespassing by unauthorized persons. Appropriate signs will be posted at the construction site per the Construction Safety Act #44, 184(2), and 187(2). Although the chain link fence will not be the primary control of litter, it will help contain migration of litter within the site.

On Site Construction Records

On-site construction records will contain the quantity of material received, stored, installed, or transferred on a daily basis. The following parameters will be recorded in a daily log:

- Date, quantity, source, and type of material received on site
- Date, quantity, source, and type of material leaving the site
- Date of construction activity
- Weather observations
- Inspection reports

All records related to construction will be retained at the site and made available to the MOE upon request.

Complaint Response

The construction activities and operating procedures have been developed with the intention of minimizing negative environmental impacts to the surrounding community. However, in the event that negative environmental complaints regarding the construction of the site are received, the constructors will handle the complaints as follows.

- Establish a complaint log which includes information such as the following:
 - Weather conditions (wind strength, wind direction, temperature, precipitation).
 - Contact information of the complaint.

- Location, time, and date where the problem occurred and any other person to witness or be involved with the event.
- Time, date, and name of constructor/Bio-En/Township/Regional employee who received complaint.
- Coordinate complaint response with MOE staff where MOE legislation limits are exceeded or condition of the REA
- Cooperate with the MOE on voluntary or mandatory compliance instruments and record actions taken in this regard

Construction Activities Environmental Effects Monitoring Plan

<i>Potential Negative Effect</i>	<i>Performance Objective</i>	<i>Mitigation Strategy</i>	<i>Monitoring Plan and Contingency Measures</i>
Emissions of containments in to the air from Construction Equipment or activity	Emissions of all containments below MOE criteria	<ul style="list-style-type: none"> ● Record and maintain records of all materials as per WHMIS. ● Keep equipment well-maintained 	<ul style="list-style-type: none"> ● Maintenance logs
Noise from the construction activity may impact a nearby receptor	Noise impact from facility below local noise by-law criteria at all nearby receptors	<ul style="list-style-type: none"> ● Outdoor construction activities will be done between 7:00am to 7:00pm 6 days per week 	<ul style="list-style-type: none"> ● Follow up monitoring in response to public complaints. ● Implementation of additional noise controls if not compliant
Storm water runoff from site	No significant change in storm water quality leaving the site as a result of project activities	<ul style="list-style-type: none"> ● All surfaces from the site will be directed to the SWM pond for storage and final discharge into the ditch located north of the future Martin’s Lane. ● See Storm Water Management Report 	<ul style="list-style-type: none"> ● Storm water management pond will be inspected to assess the accumulation of sediment in the bottom of the pond. ● All sediment will be removed from the pond when the depth of sediment exceeds 0.3m.
Impact of spills	Prevent	<ul style="list-style-type: none"> ● Spills clean up 	<ul style="list-style-type: none"> ● Clean up any spills as soon

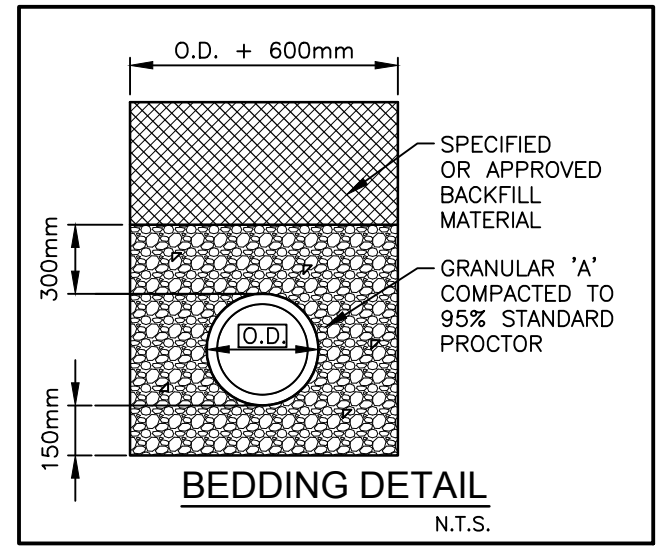
Potential Negative Effect	Performance Objective	Mitigation Strategy	Monitoring Plan and Contingency Measures
to ground water and soil	contamination of the ground water and soil as a result of activities	procedures	as possible <ul style="list-style-type: none"> • Spill kit on site • Perform routine inspection and maintenance of the site
Siltation and Erosion During Construction	Minimize siltation and erosion impacts off-Site during construction	<ul style="list-style-type: none"> • Installation of siltation fencing around the construction site. • Sod embankments and SWM pond area as early in construction activity as possible • Place granular B gravel in proposed roadway and parking areas. 	<ul style="list-style-type: none"> • Inspection of fencing to ensure it is in good condition • Repair of fencing if required • Inspect and maintenance sodded areas
Litter	Minimize litter on-Site and litter impact off site	<ul style="list-style-type: none"> • Site will be cleaned of litter daily. • Litter will be placed in appropriate covered bins • 1.8m high chain link fence to be installed as early during construction activity as possible to provide 2nd line of defense of litter control 	<ul style="list-style-type: none"> • Inspection of site containers and fence daily

LEGEND

- PROPERTY LINE
- OLS EXISTING LIGHT STANDARD
- OP EXISTING UTILITY POLE
- EXISTING GUYWIRE
- EX. SIG. EXISTING SIGN
- EX. SIB EXISTING STANDARD IRON BAR
- EX. GV EXISTING GAS VALVE
- BELL EXISTING BELL BOX
- CAT TV EXISTING CABLE BOX
- EX. TR EXISTING TRANSFORMER
- EX. CB EXISTING CATCHBASIN
- EX. DCB EXISTING DOUBLE CATCHBASIN
- EX. MH EXISTING STORM SEWER MANHOLE
- EX. CBMH EXISTING STORM SEWER CATCHBASIN MANHOLE
- EX. DCBWH EXISTING DOUBLE CATCHBASIN MANHOLE
- EX. DI EXISTING DITCH INLET
- EX. SAN MH EXISTING SANITARY SEWER MANHOLE
- EX. HYD EXISTING FIRE HYDRANT
- EX. CS EXISTING CURB STOP
- EX. CS EXISTING CURB STOP
- EX. CS EXISTING BOREHOLE LOCATION
- EX. CS EXISTING HYDRO POLE
- EX. CS EXISTING EMBANKMENT
- EX. CS EXISTING DITCH
- EX. CS EXISTING WATERMAIN
- EX. CS EXISTING BELL SERVICE
- EX. CS EXISTING CABLE AND BELL SERVICE
- EX. CS EXISTING GASMAIN
- EX. CS EXISTING SANITARY SEWER
- EX. CS EXISTING STORM SEWER
- EX. CS EXISTING OVERHEAD HYDRO SERVICE
- EX. CS EXISTING UNDERGROUND HYDRO SERVICE
- PROPOSED SANITARY SEWER
- PROPOSED WATERMAIN
- PROPOSED STEAM LINE
- PROPOSED SANITARY SEWER MANHOLE
- PROPOSED FIRE HYDRANT
- PROPOSED WATER VALVE
- PROPOSED CURB STOP
- PROPOSED CURB
- PROPOSED ASPHALT
- PROPOSED RIP-RAP
- PROPOSED CONCRETE
- PROPOSED DOOR LOCATIONS
- PROPOSED CHAIN LINK FENCE
- PROPOSED EMBANKMENT (3:1 MAX. UNLESS OTHERWISE NOTED)

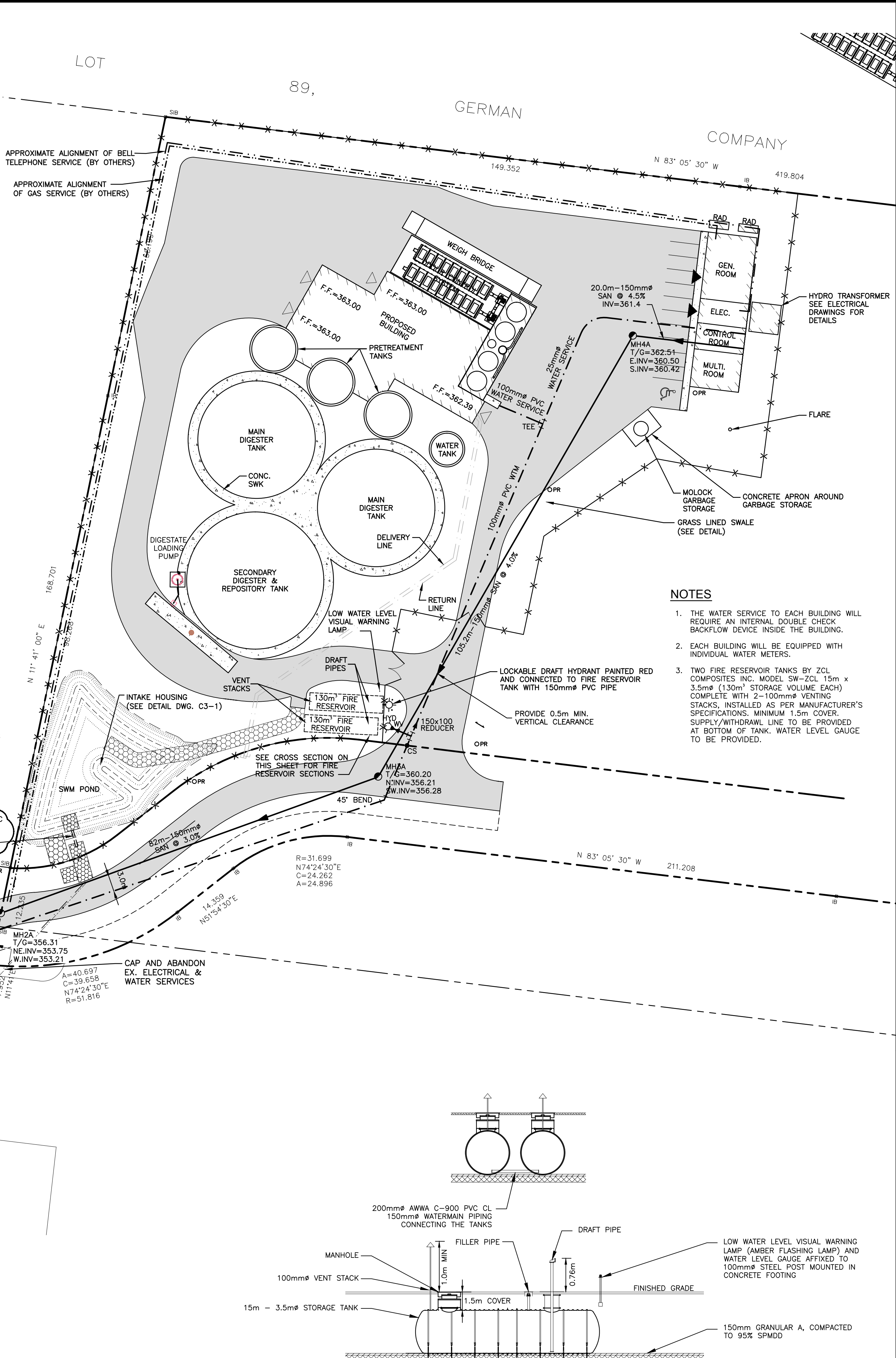
GENERAL NOTES

- EXISTING TOPOGRAPHICAL INFORMATION OBTAINED FROM SURVEY BY WAYNE D. TURPEL SURVEYING LIMITED, DRAWING No. 06-3765 DATED JANUARY 11, 2008.
- ANY AREA DISTURBED DURING CONSTRUCTION SHALL BE RESTORED TO ITS EXISTING CONDITION OR BETTER TO THE SATISFACTION OF THE ENGINEER OR THE MUNICIPALITY. THIS INCLUDES ASPHALT, GRANULAR, PAVING STONE, TOPSOIL, SOD, ETC. THE CONTRACTOR IS RESPONSIBLE FOR RESTORING ALL DAMAGED AND/OR DISTURBED PROPERTY WITHIN THE MUNICIPAL RIGHT-OF-WAY TO MUNICIPAL STANDARDS.
- LOCATIONS OF ALL UNDERGROUND SERVICES SHOWN ARE APPROXIMATE ONLY. CONTRACTOR RESPONSIBLE FOR VERIFYING LOCATION OF SERVICES PRIOR TO CONSTRUCTION AND WILL BE HELD RESPONSIBLE FOR DAMAGE TO ANY SERVICES NOT LOCATED PRIOR TO CONSTRUCTION.
- MATCH EXISTING GRADES AT ALL PROPERTY LINES UNLESS WHERE PROPOSED GRADES ARE NOTED.
- ON ALL ASPHALT RECONSTRUCTION AREAS, EXISTING ASPHALT SHALL BE SAW CUT BEFORE NEW ASPHALT IS PLACED.
- ALL LIGHTING IS TO BE DIRECTED DOWNWARD OR SHIELDED SO AS NOT TO PROJECT BEYOND THE OWNER'S LAND, NOR TO CAUSE A GLARE THAT WOULD IMPACT ADJACENT PROPERTIES OR PASSING TRAFFIC.
- IF THE GARBAGE FACILITY IS LOCATED OUTDOORS, IT SHALL BE INSTALLED IN ACCORDANCE WITH THE SITE PLAN, AND IF NOT SHOWN ON THE PLAN, IT WILL REQUIRE AN ADDENDUM TO PLAN PRIOR TO CONSTRUCTION. ANY GARBAGE FACILITY SHALL BE IN ACCORDANCE WITH THE FOLLOWING:
 - PLACED ON A CONCRETE PAD, ENCLOSED ON ALL SIDES, INCLUDING A GATE, WITH A SOLID WOOD MAINTENANCE FREE FENCE, AT A HEIGHT, WHICH IS GREATER THAN THE GARBAGE BIN AND IN THE LOCATION SHOWN ON THE SITE PLAN, OR
 - DECORATIVE MOLOK(S) CONSTRUCTED IN THE LOCATION SHOWN ON THE SITE PLAN FOR THE GARBAGE BIN, WHICH IS GREATER THAN THE GARBAGE BIN AND INTERFERE WITH A REQUIRED PARKING OR LOADING SPACE, AND TO MAINTAIN THE FACILITY IN AN ACCEPTABLE STATE FOR THE LIFE OF THE DEVELOPMENT.
- THE PROPERTY OWNER OF 30 MARTIN LANE IS TO BE NOTIFIED BY THE DEVELOPER AND THEIR CONTRACTOR PRIOR TO WORK BEING PERFORMED WITHIN THE ROAD ALLOWANCE OR IN FRONT OF THE ENTRANCES TO 30 MARTIN LANE.
- PRIOR TO START OF CONSTRUCTION, THE CONTRACTOR IS REQUIRED TO PROVIDE A WATER COMMISSIONING PLAN TO THE TOWNSHIP A MINIMUM OF FIVE (5) BUSINESS DAYS BEFORE CONSTRUCTION APPROVAL. THE INSTALLATION AND TESTING OF THE WATER SERVICE IS TO BE IN ACCORDANCE WITH THE DGSMS STANDARDS.
- ALL MECHANICAL FITTINGS AND BENDS SHALL HAVE MECHANICAL RESTRAINTS OF AT LEAST TWO PIPE JOINTS OR 10 METRES ON EITHER SIDE OF THE FITTING (WHICHEVER IS GREATER).
- THE WATER SERVICE SHALL HAVE ANODES AND TRACE WIRE ALONG ITS ENTIRE LENGTH AS PER DGSMS STANDARDS.
- WATERMANS AND METERS SHALL BE INSTALLED IN EACH BUILDING FOR EACH SERVICE. THE BACKFLOW DEVICE IS TO BE IN ACCORDANCE WITH CSA B64.10-07/B64.10.1-07.



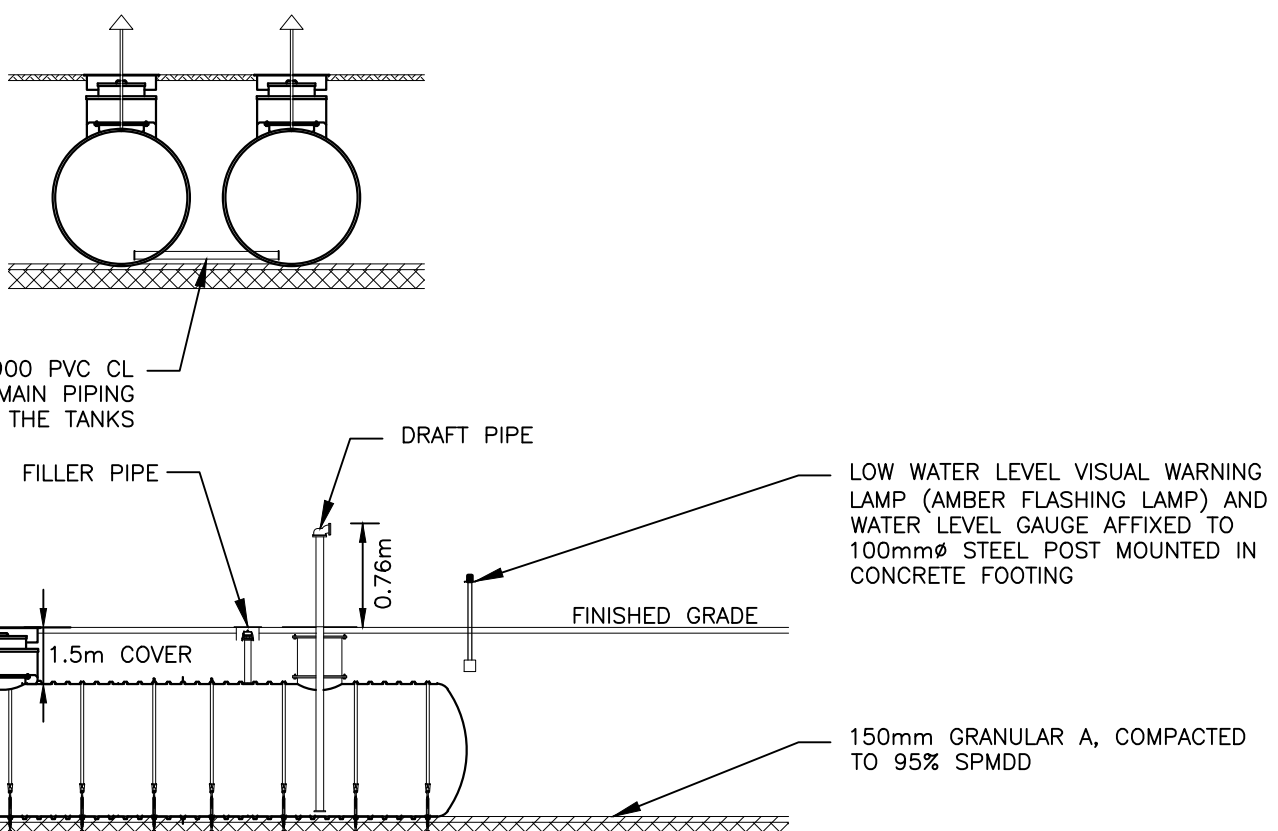
CONSTRUCTION NOTES

- THIS PLAN NOT FOR CONSTRUCTION UNTIL STAMPED BY DESIGN ENGINEER AND APPROVED BY THE LOCAL MUNICIPALITY.
- THIS PLAN IS TO BE USED FOR SERVICING ONLY: ANY OTHER INFORMATION SHOWN IS FOR ILLUSTRATION PURPOSES ONLY.
- NO CHANGES ARE TO BE MADE WITHOUT THE APPROVAL OF THE DESIGN ENGINEER.
- THIS PLAN NOT TO BE REPRODUCED IN WHOLE OR IN PART WITHOUT THE PERMISSION OF THE WALTER FEDY PARTNERSHIP.
- PRIOR TO CONSTRUCTION, THE CONTRACTOR MUST:
 - CHECK AND VERIFY ALL DIMENSIONS AND EXISTING ELEVATIONS WHICH INCLUDES, BUT IS NOT LIMITED TO, THE BENCHMARK ELEVATIONS, EXISTING SERVICE CONNECTIONS AND EXISTING INVERTS.
 - OBTAIN ALL UTILITY LOCATES AND REQUIRED PERMITS AND LICENSES.
- THE CONTRACTOR SHALL ASSUME ALL LIABILITY FOR DAMAGE TO EXISTING WORKS.
- ALL UNDERGROUND SERVICES ARE TO BE CONSTRUCTED IN FULL COMPLIANCE WITH LOCAL AND PROVINCIAL APPLICABLE CODES AND REGULATIONS; WHICH CODES AND REGULATIONS SHALL SUPERCEDE ALL OTHERS.
- ALL PIPE BEDDING TO BE CLASS "B" AS PER OPSD 802.010, 802.030, 802.031, 802.032; TRENCH BACKFILL TO BE NATIVE MATERIAL PLACED IN MAXIMUM 300mm LIFTS AND COMPACTED TO 95% STANDARD PROCTOR DENSITY.
- SANITARY SEWERS 150mm AND SMALLER SHALL BE POLYVINYL CHLORIDE (PVC) PIPE DR28 TO CSA 182.1 & 182.2 WITH INTEGRAL BELL AND SPIGOT UTILIZING FLEXIBLE ELASTOMERIC SEALS. CONNECT TO MANHOLES WITH "KOR-N-SEAL" ADAPTERS OR APPROVED EQUIV.
- STORM SEWERS 200mm TO 375mm SHALL BE POLYVINYL CHLORIDE (PVC) PIPE DR35 WITH CSA STANDARD 182.1 & 182.2 OR RIBBED PVC SEWER PIPE AND FITTINGS TO CSA B182.4 WITH INTEGRAL BELL AND SPIGOT UTILIZING FLEXIBLE ELASTOMERIC SEALS. CONNECT TO MANHOLE WITH APPROVED MANHOLE ADAPTERS.
- FACTORY FABRICATED TEES SHALL BE USED FOR ALL SERVICE CONNECTIONS.
- SANITARY MANHOLES TO BE 1200mm DIAMETER PRECAST AS PER OPSD 1001.01 WITH ALUMINUM SAFETY RUNGS AT 300mm CENTRES. RUNGS AS PER OPSS 1851 & OPSD 405.01.
- MANHOLE FRAMES AND COVERS SHALL CONFORM TO OPSS 1851 AND SHALL BE AS PER OPSD 401.01 TYPE "A".
- PRECAST MANHOLE & CATCHBASIN ADAPTER UNITS SHALL CONFORM TO ASTM C478 AND MANUFACTURED BY HANSON PIPE & PRODUCTS INC. OR APPROVED EQUIV.
- WATERMANS AND FITTINGS 100mm AND LARGER SHALL BE PVC C900 CLASS 150 DR-18 INSTALLED AT A DEPTH OF 2.0m OF COVER.
- WATERMAIN FITTINGS WHICH CHANGE DIRECTIONS VERTICALLY OR HORIZONTALLY TO BE SUPPORTED WITH THRUST BLOCKS AS PER OPSD 1103.01 AND 1103.02.
- WATERMAIN VALVES 100mm AND LARGER SHALL BE CANADA VALVE #55 OR EQUAL (OPEN LEFT) INCLUDING VALVE BOX AND 2.3kg ANODE.
- HYDRANTS SHALL BE CANADA "CENTURY" OR EQUAL WITH TWO (2) 64mm HOSE CONNECTIONS INCLUDING 5.5kg ANODE.
- WATER SERVICE CONNECTIONS 50mm AND SMALLER SHALL BE TYPE "K" SOFT COPPER TUBES WITH SERVICE SADDLES AND 5.5kg ANODE WHERE REQUIRED.
- MAIN STOPS, CURB STOPS, COUPLINGS AND TEES SHALL BE NAWMA C-900 COPPER TO COPPER FLANGED OR COMPRESSION CONNECTION BY EMCO OR EQUAL.
- THE PROPOSED WATERMAIN AND SEWERS ARE TO BE INSTALLED IN ACCORDANCE WITH DGSMS WHICH INCLUDES THE WATER TESTING PROCEDURES.
- SERVICE BOXES TO BE FERGUSON ECLIPSE TYPE FIGURE 222 SIZE NO.9 OR EQUAL COMPLETE WITH ROD AND PLUG.
- STORM AND SANITARY SEWERS TO HAVE MINIMUM 1.2m COVER. ALL WATER SERVICES TO HAVE MINIMUM 2.0m COVER. WHERE COVER OVER SERVICES IS DEFICIENT, THE CONTRACTOR SHALL LONGITUDINALLY CENTRE OVER THE PIPE. STYROFOAM S.M. INSULATION BY DOW CHEMICAL, WITH OVERLAPPING JOINTS. INSULATION TO BE 1800mm WIDE AND 50mm THICK.
- ALL WEeping TILE DRAINAGE TO BE PUMPED TO GRADE.

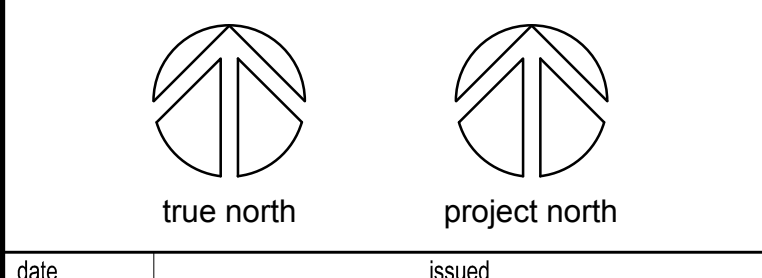
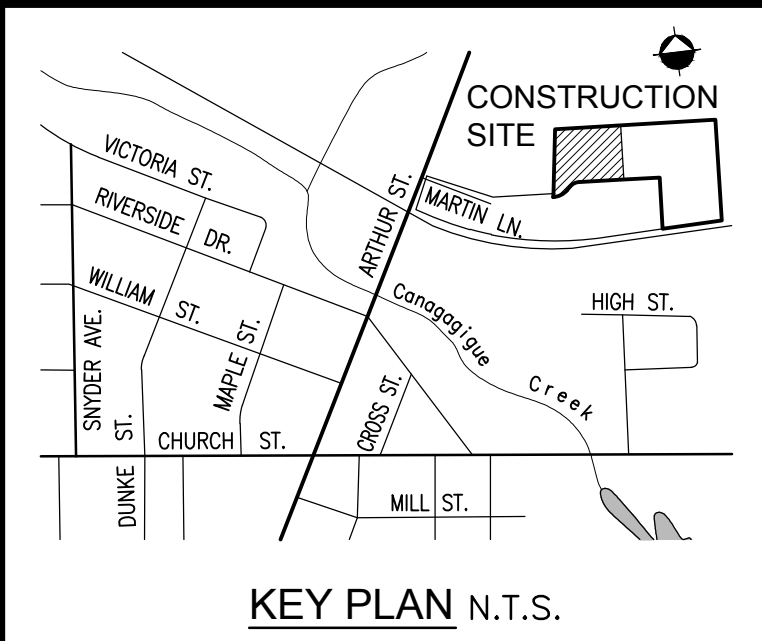


NOTES

- THE WATER SERVICE TO EACH BUILDING WILL REQUIRE AN INTERNAL DOUBLE CHECK BACKFLOW DEVICE INSIDE THE BUILDING.
- EACH BUILDING WILL BE EQUIPPED WITH INDIVIDUAL WATER METERS.
- TWO FIRE RESERVOIR TANKS BY ZCL COMPOSITES INC. MODEL SW-ZCL 15m x 3.5m (130m³ STORAGE VOLUME EACH) COMPLETE WITH 2-100mm VENTING STACKS, INSTALLED AS PER MANUFACTURER'S SPECIFICATIONS. MINIMUM 1.5m COVER. SUPPLY/WITHDRAWAL LINE TO BE PROVIDED AT BOTTOM OF TANK. WATER LEVEL GAUGE TO BE PROVIDED.



BENCHMARK ELEV. = 352.80m
 Geodetic elevation - GRCA monument #007
 Monument located in the southeast corner of concrete bridge on Arthur Street over the Canagagigue Creek.



date	revision	issued
DEC. 8/11	REVISED ODOUR CONTROL SYSTEM LAYOUT	8
NOV. 15/11	REVISED PER MOC COMMENTS (11/10/11)	7
OCT. 19/11	REVISED PER MOC COMMENTS (10/19/11)	6
FEB. 02/11	REVISED PER TOWNSHIP COMMENTS (1/6/11)	5
DEC. 13/10	REVISED PER TOWNSHIP COMMENTS (11/15/10)	4
OCT. 28/10	REVISED PER TOWNSHIP COMMENTS (10/5/10)	3
AUG. 06/10	REVISED PER TOWNSHIP COMMENTS (8/3/10)	2
date	revision	no.

customer
Woolwich Bio-en Inc.

project
Woolwich Bio-en Inc.
 Elmira, Ontario
 title
SITE SERVICING PLAN

WALTER FEDY
 675 Queen Street South, Suite 111
 Kitchener, Ontario, Canada N2M 1M1
 T 519.576.2150 F 519.576.5499
 walterfedy.com



The Walter Fedy Partnership, Architects and Engineers
 The contractor shall check and verify all dimensions and report any errors or omissions to the consultant before commencing or proceeding with any work. Do not scale this drawing.
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 scale: 1:500
 date: OCT. 17, 2011
 job no.: 2007-0359-10
 CAD file: 2007-0359-10
 drawn by: IAC
 checked by:

C3-1

Appendix A

Electrical Generating Equipment



Technical Description
Cogeneration Unit-Container
JMS 420 GS-B.L

Bio-En Elmira Pet Products

Electrical output	1426 kW el.
Thermal output	1510 kW

Emission values
NOx < 500 mg/Nm³ (5% O₂)



0.01 Technical Data (module)

Data at:			Full	Part Load	
			load		
Fuel gas LHV		kWh/Nm ³	6.5		
			100%	75%	50%
Energy input		kW	[2] 3,538	2,743	1,948
Gas volume		Nm ³ /h	*) 544	422	300
Mechanical output		kW	[1] 1,466	1,100	733
Electrical output		kW el.	[4] 1,426	1,068	706
Recoverable thermal output					
~ Intercooler 1st stage		kW	208	40	3
~ Lube oil		kW	165	152	114
~ Jacket water		kW	400	387	296
~ Exhaust gas cooled to 180 °C		kW	737	616	471
Total recoverable thermal output		kW	[5] 1,510	1,195	884
Total output generated		kW total	2,936	2,263	1,590
Heat to be dissipated					
~ Intercooler 2nd stage		kW	78	67	38
~ Surface heat	ca.	kW	[7] 111	106	108
~ Balance heat		kW	35	27	19
Spec. fuel consumption of engine		kWh/kWh	[2] 2.41	2.49	2.66
Lube oil consumption	ca.	kg/h	[3] 0.44	~	~
Electrical efficiency		%	40.3%	38.9%	36.2%
Thermal efficiency		%	42.6%	43.5%	45.3%
Total efficiency		%	[6] 82.9%	82.4%	81.5%
Hot water circuit:					
Forward temperature		°C	90.0	85.8	81.7
Return temperature		°C	70.0	70.0	70.0
Hot water flow rate		m ³ /h	64.9	64.9	64.9

*) approximate value for pipework dimensioning
 [] Explanations: see 0.10 - Technical parameters

All heat data is based on standard conditions according to attachment 0.10. Deviations from the standard conditions can result in a change of values within the heat balance, and must be taken into consideration in the layout of the cooling circuit/equipment (intercooler; emergency cooling; ...). In the specifications in addition to the general tolerance of +/- 8% on the thermal output a further reserve of 10% is recommended for the dimensioning of the cooling requirements.



Main dimensions and weights (container)

Length	mm	~ 12,200
Width	mm	~ 3,000
Height	mm	~ 2,600
Weight empty	kg	~ 35,600
Weight filled	kg	~ 37,500

Connections

Jacket water inlet and outlet	DN/PN	100/10
Exhaust gas outlet	DN/PN	300/10
Fuel gas connection (container)	mm	150/16
Fresh oil connection	G	28x2"
Waste oil connection	G	28x2"
Cable outlet	mm	800x400
Condensate drain	mm	18

Output / fuel consumption

ISO standard fuel stop power ICFN	kW	1,466
Mean effe. press. at stand. power and nom. speed	bar	16.00
Fuel gas type		Biogas
Based on methane number	MZ d)	100
Compression ratio	Epsilon	12.50
Min./Max. fuel gas pressure at inlet to gas train	mbar	120 - 200 c)
Allowed Fluctuation of fuel gas pressure	%	± 10
Max. rate of gas pressure fluctuation	mbar/sec	10
Maximum Intercooler 2nd stage inlet water temperature	°C	55
Spec. fuel consumption of engine	kWh/kWh	2.41
Specific lube oil consumption	g/kWh	0.30
Max. Oil temperature	°C	85
Jacket-water temperature max.	°C	90
Filling capacity lube oil (refill)	lit	~ 437

c) Lower gas pressures upon inquiry

d) based on methane number calculation software AVL 3.1



0.02 Technical data of engine

Manufacturer		GE Jenbacher
Engine type		J 420 GS-A81
Working principle		4-Stroke
Configuration		V 70°
No. of cylinders		20
Bore	mm	145
Stroke	mm	185
Piston displacement	lit	61.10
Nominal speed	rpm	1,800
Mean piston speed	m/s	11.10
Length	mm	3,750
Width	mm	1,580
Height	mm	2,033
Weight dry	kg	6,600
Weight filled	kg	7,300
Moment of inertia	kgm ²	11.64
Direction of rotation (from flywheel view)		left
Flywheel connection		SAE 18"
Radio interference level to VDE 0875		N
Starter motor output	kW	9
Starter motor voltage	V	24

Thermal energy balance

Energy input	kW	3,538
Intercooler	kW	286
Lube oil	kW	165
Jacket water	kW	400
Exhaust gas total	kW	1,110
Exhaust gas cooled to 180 °C	kW	737
Exhaust gas cooled to 100 °C	kW	931
Surface heat	kW	71
Balance heat	kW	35

Exhaust gas data

Exhaust gas temperature at full load	°C [8]	470
Exhaust gas mass flow rate, wet	kg/h	8,098
Exhaust gas mass flow rate, dry	kg/h	7,526
Exhaust gas volume, wet	Nm ³ /h	6,295
Exhaust gas volume, dry	Nm ³ /h	5,609
Max. admissible exhaust back pressure after engine	mbar	60

Combustion air data

Combustion air mass flow rate	kg/h	7,466
Combustion air volume	Nm ³ /h	5,775
Max. admissible pressure drop in front of intake-air filter	mbar	10

basis for exhaust gas data: natural gas: 100% CH₄; biogas 65% CH₄, 35% CO₂



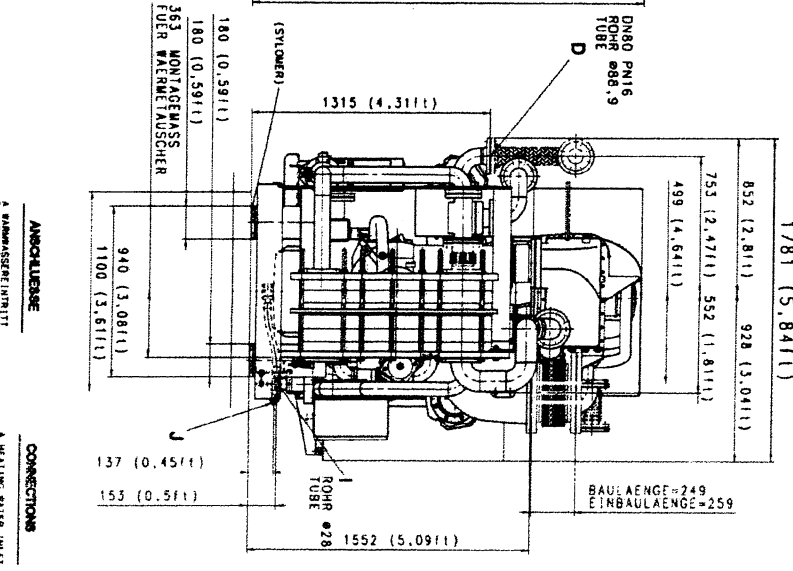
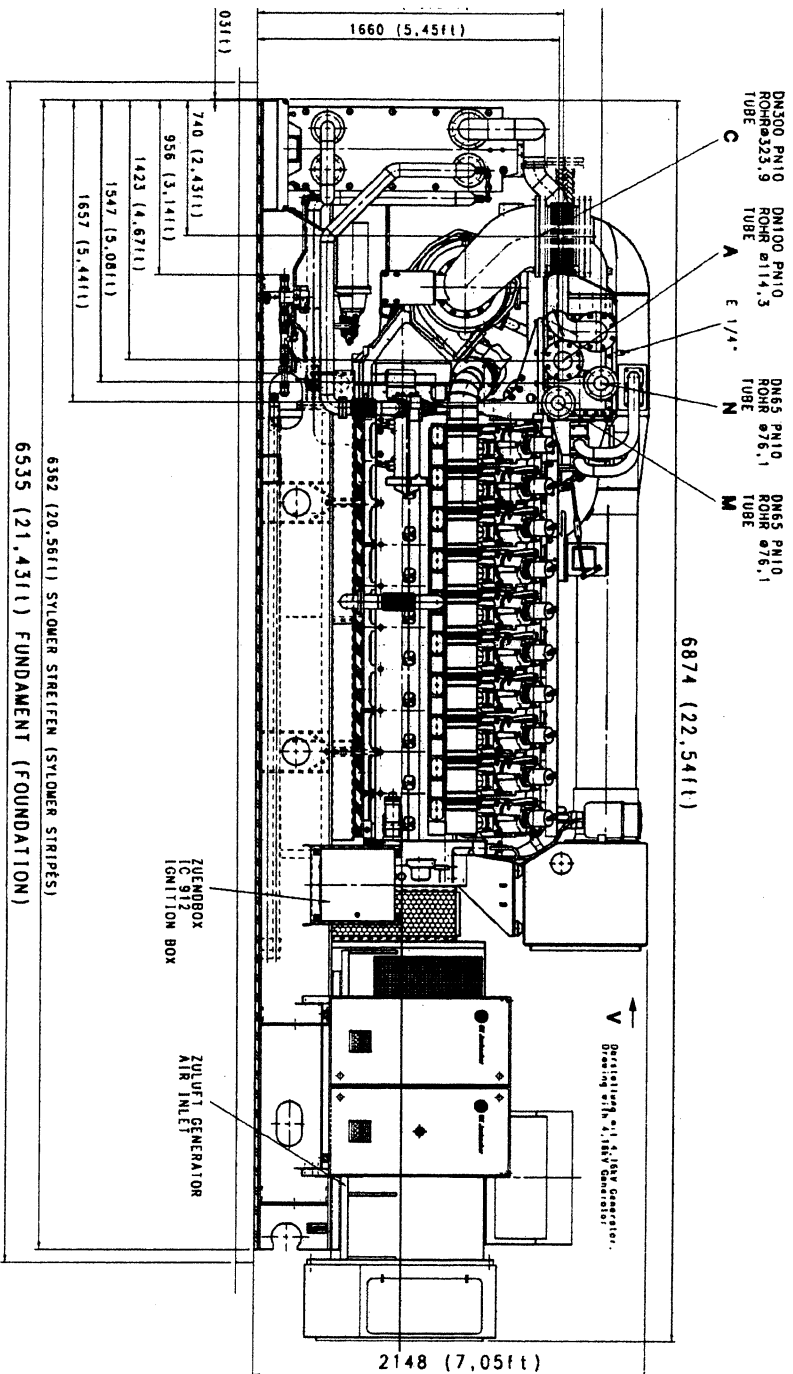
Sound pressure level

Aggregate b)		dB(A) re 20 μ Pa	97
31,5	Hz	dB	79
63	Hz	dB	87
125	Hz	dB	98
250	Hz	dB	95
500	Hz	dB	91
1000	Hz	dB	86
2000	Hz	dB	88
4000	Hz	dB	92
8000	Hz	dB	89
Exhaust gas a)		dB(A) re 20 μ Pa	115
31,5	Hz	dB	95
63	Hz	dB	117
125	Hz	dB	115
250	Hz	dB	113
500	Hz	dB	108
1000	Hz	dB	105
2000	Hz	dB	108
4000	Hz	dB	109
8000	Hz	dB	107

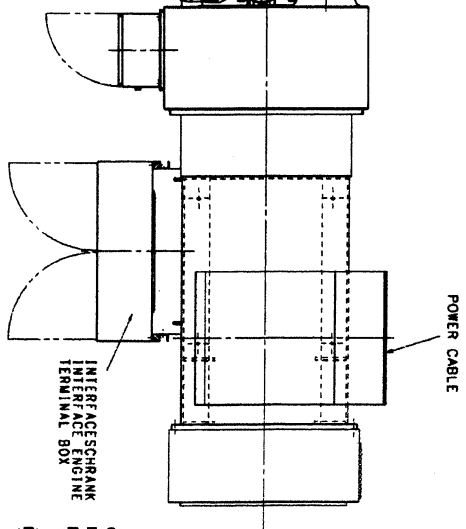
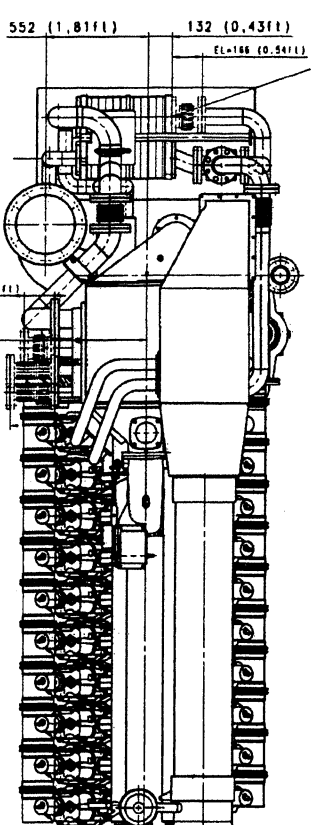
Sound power level

Aggregate	dB(A) re 1pW	117
Measurement surface	m ²	107
Exhaust gas	dB(A) re 1pW	123
Measurement surface	m ²	6.28

a) average sound pressure level on measurement surface in a distance of 1m according to DIN 45635, precision class 2.
 b) average sound pressure level on measurement surface in a distance of 1m (converted to free field) according to DIN 45635, precision class 3.
 Operation with 1200 rpm see upper values, operation with 1800 rpm add 3 dB to upper values.
 Engine tolerance \pm 3 dB



RÜCKLAUF $\leq 74^{\circ}\text{C}$
 RETURN TEMP. $\leq 74^{\circ}\text{C}$



POWER CABLE

LEGENDE SIEHE E 12344 XX
 LEGEND SEE

- ANSCHLÜSSE**
- A RAUWASSER-EINLEITUNG
 - B RAUWASSER-AUSLEITUNG
 - C RAUWASSER-EINLEITUNG
 - D RAUWASSER-AUSLEITUNG
 - E ENTLÜFTUNG
 - F STÖCHRE LEITUNG
 - G SICHERHEITSSIGNAL
 - H SCHWELERBEWÄCHTERLEITUNG
 - I FÜHRUNGSKABEL
 - J FÜHRUNGSKABEL
 - K VERBODENDE MITTELSCHLEIMLEITUNG
 - L VERBODENDE MITTELSCHLEIMLEITUNG
 - M VERBODENDE MITTELSCHLEIMLEITUNG
 - N VERBODENDE MITTELSCHLEIMLEITUNG
- ANSCHLÜSSE**
- A HEATING WATER INLET
 - B HEATING WATER OUTLET
 - C HEATING WATER INLET
 - D HEATING WATER OUTLET
 - E SAFETY VALVE FOR INLET
 - F SAFETY VALVE FOR OUTLET
 - G SAFETY VALVE FOR INLET
 - H SAFETY VALVE FOR OUTLET
 - I LEAD LINE CONNECTION FOR CONTROL WATER INLET
 - J LEAD LINE CONNECTION FOR CONTROL WATER INLET
 - K LEAD LINE CONNECTION FOR CONTROL WATER INLET
 - L LEAD LINE CONNECTION FOR CONTROL WATER INLET
 - M LEAD LINE CONNECTION FOR CONTROL WATER INLET
 - N LEAD LINE CONNECTION FOR CONTROL WATER INLET

ZUR INFORMATION
 FOR INFORMATION

LEGENDE/MASSE

Material	13500	kg
Material	19200	kg

LACKEN- UND ANSTRICH-VERFAHREN

Material	RAL 6018
Material	RAL 6018
Material	RAL 6018

STANDARTEMPL. 80Hz
 DESIGN TEMPERATURE 74°C
 JMS 420 GS-A-420001-C

ÄNDERUNGEN VORBEHALTEN
 TECHNISCHE DATEN SIEHE TECHN. SCHEMATA
 DESIGN SUBJECT TO CHANGE
 FOR TECHNICAL DATA SEE TECHN. DRAWINGS

DE 422001

Material	422001
Material	422001
Material	422001

Appendix B

Biofilter Manufacturer Specifications



BIOREM

BIO-EN Proposal – Two Modular Units

1.0 Product Description

The BASYS[®] modular system extracts foul air for subsequent preconditioning in the humidification stage and oxidation through the BIOSORBENS[®] media bed prior to atmospheric discharge.

Odourous compounds in the air entering the biofilter are solubilized into the moisture layer surrounding the individual media particles or are adsorbed directly to their surface. Bacteria present within this moisture film utilize the compounds as substrate. The compounds are biologically oxidized to CO₂, H₂O and inorganic salts and clean air is discharged to atmosphere. It is critical that the filter creates an optimal environment to enhance microbial development. Maintaining proper air temperature, pH, moisture and nutrient levels are essential for favorable biofilter performance and removal efficiency.

2.0 Project Details

The biofilter system shall be designed to remove odourous constituents from a process air stream under the following operating conditions:

<u>Process Parameter</u>	<u>Value</u>
Flow Rate	20,000 m ³ /hr
Inlet Air Temperature:	18 C – 40 C
Average Inlet RH:	Min 30 %
Average Inlet Particulate Conc.:	Clean Air
Type of Contaminant:	Average / Peak Concentration Levels
H ₂ S (ppm)	<10 <15
NH ₃ (ppm)	< 5 < 15
Organic Sulfides	< 2
Odour (Odour Units)	< 10,000

The biofilter system will conform to the following specified parameters:

<u>Design Parameter</u>	<u>Value</u>
Model of Modular Biofilter:	BASYS [®] 50X
Material of Construction:	FRP
Media Depth:	1.83 m
Media Volume:	94 m ³
Internal Biofilter Dimensions (L:W:H):	15.2 m : 3.4 m : 2.4 m
Footprint Dimensions (L:W):	16.7 m : 3.7 m
Water Consumption (Humidification):	3.34 m ³ /day
Water Consumption (Irrigation):	2.3 m ³ /day
Electrical (V):	575V, 120V
Empty Weight Biofilter Unit (kg):	10120 kg
Full Weight Biofilter Unit (kg):	153,735 kg



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BIO-EN Proposal – Two Modular Units

3.0 System Performance

- A. When loaded under average and peak conditions the biofilter system shall provide at least 99 percent removal of H₂S when operated at a maximum, equal to the design air flow rate.
- B. Odour Removal Requirements: The biofilter system shall provide 85% removal for average inlet concentration levels of less than 10,000 and greater than or equal to 5000 OU. For inlet concentration levels less than 5000 OU, the outlet concentration levels shall be less than 500 D/T. (Odor D/T concentrations to be determined using ASTM-E679 with a 20 liter/minute odor panel presentation rate).
- C. The system shall be operated under positive pressure.

4.0 Warranties

- A. The Manufacturer warrants that the biofilter media will not compact, degrade or decompose for a period of 10 years from the date of Substantial Completion, provided that the system is operated in accordance with the Manufacturer's printed Operation and Maintenance Manuals.
- B. All mechanical components shall be warranted free of manufacturing defects for a period of 12 months from substantial completion.

5.0 Scope of Supply

- A. The following components are provided with each BASYS 50X unit:
 - 1. Modular biofilter tank with integral humidification and removable covers. Material of Construction to be UV and H₂S resistant FRP.
 - 2. 94 m³ of BIOSORBENS[®] biofilter media provided in bulk.
 - 3. Media surface irrigation systems. Composed of 25 mm, schedule 80 PVC pipe, with unions, tees and spray nozzles for full surface coverage of the Biofilter media bed.
 - 4. Humidification system, integral to the biofilter vessel. Complete with humidification packing and spraying system
 - 5. 25 HP Centrifugal FRP exhaust fan, TEFC, Class 1, Division 2 motor.
 - 6. Level 1 Instrumentation and controls.
 - i. NEMA 12 steel control panel (Compact Logix AB PLC with HMI) , complete with fused disconnect. Includes all system controls, pilot and alarm lights, motor starters, and (2) dry contacts for transmitting signals



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BIO-EN Proposal – Two Modular Units

- to remote location [To be mounted inside – 1 Control Panel for Two Biofilter Units].
- ii. 25 HP VFD with dial speed control.
 - iii. Timer and normally closed solenoid valve for irrigation control
 - iv. Flow indicating totalizer to record irrigation system water usage.
 - v. Flow indicator/switch, to display humidification water flow rate and signal alarm in case of reduced water flow.
 - vi. Local pressure gauge on humidification line.
 - vii. Media temperature gauge.
 - viii. Static pressure gauges before and after system fan.
 - ix. Static pressure gauge to measure pressure drop across media bed.
 - x. 3 HP Recirculation Pump
7. Winterization system: consisting of a 95.3 KW immersion heater with integral thermostat for temperature control.
 8. 5 Submittal packages
 9. Operation and Maintenance Manuals – CD form.
 10. A 1-year BIOSERVE service support package. Includes site visit and system inspection within the first 6 months of system commissioning, media sampling and analysis, system spot performance testing.
 11. Commissions will consist of 1 trip and a maximum of 3 days for system commissioning & operator training.
- B. The following items listed are to be supplied by the Contractor and are not in the Manufacturer's Scope of Supply.
1. All equipment offloading, temporary storage and placement.
 2. Installation and assembly of all equipment and instrumentation components required for a complete system including labor, equipment and materials. Equipment installation to include biofilter vessel, fan, control panel and all associated instrumentation and components, where applicable.
 3. Installation site including site preparation and clearing of materials.
 4. Design and provide an appropriately sized reinforced concrete slab to handle full load of the biofilter vessel and fan.
 5. Supply and install all required protective coatings.



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BIO-EN Proposal – Two Modular Units

6. Supply and install all external water piping and drain piping to and from the biofilter vessel and humidification equipment including heat tracing, insulation, piping supports, drainage traps where necessary and / or UV protective paint.
7. Supply and install air ductwork to and from the biofilter system including exhaust stack, interconnecting ducting, manual or actuated dampers, filters, insulation and piping supports.
8. Supply and install all hardware, supports, guide wires, duct gaskets, expansion joints and connectors needed for a complete and operational system.
9. Media onsite storage and installation. The OTHER party shall be required to remove biofilter cover, install and distribute media evenly across the biofilter, assemble media irrigation system and reinstall cover. Media to be shipped in bulk (end dump truck), unless otherwise requested in writing.
10. Utility requirements including main electrical service and system field wiring outside the main biofilter control panel, water supply at minimum pressure of 40psi. All electrical requirements for heat tracing and equipment not specifically provide by BIOREM[®] to be provided by others.
11. Duct balancing, and system functional, hydrostatic, vibration and performance testing to be conducted by OTHERS as specified.



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BIO-EN Proposal – Two Modular Units



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BIO-EN Proposal – Two Modular Units

6.0 Quotation

November 28, 2008

ITEM #	QUOTATION #: 08 – 5070 – Option 1	Price(CDN\$)
1	Two (2) * BASYS [®] 50X Modular Biofilter (Please refer to Section 5.0 for Scope of Supply)	\$820,000
2	ADD for Redundant Spare Parts (One Extra Fan, One Extra Pump and Critical PLC Components)	\$35,000
3	Commissioning and Training.	INCLUDED
4	BIOSERVE [®]	INCLUDED
NOTES: 1. All components are EXWORKS Factory. Estimated Freight Costs to Elmira - \$40,000 2. Payment Terms: 30% with order, 60% upon equipment delivery, 10% upon system commissioning. 3. Applicable taxes are extra. 4. Prices are guaranteed for 90 days, from date of quotation. 5. Submittals will be provided in 4-6 weeks after receipt of order. Shipment is 12-14 weeks after approved submittals.		



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BIO-EN Proposal – Two Modular Units

TERMS & CONDITIONS

PRICING

Unless otherwise specified in writing by BIOREM Technologies Inc, (BIOREM[®]) price does not include any transportation, crating or packaging charges, or any taxes, excises, duties, tariffs or other governmental charges which BIOREM[®] may be required to pay or collect under existing or future law with respect to the sale, transportation, delivery, storage, installation or use of any of the equipment sold by BIOREM[®].

CANCELLATION

Unless otherwise agreed in writing by the parties, the Buyer may not cancel the Order, except upon written notice and payment to Seller of an amount covering all costs incurred under the Order, all costs which arose out of the cancellation, and a cancellation fee of 50% of the Order Price. Materials received and Goods manufactured in part or whole under the Order prior to the time of cancellation shall be retained by and shall be property of the seller. When calculating the cancellation related costs, payments made by buyer to seller prior to cancellation shall be taken into account.

LIMITATION OF LIABILITY –SELLER'S LIABILITY TO THE PRICE ALLOCABLE TO THE GOODS DETERMINED DEFECTIVE, AND IN NO EVENT WILL SELLER'S CUMULATIVE LIABILITY BE IN EXCESS OF THE TOTAL SALES ORDER PRICE, WHETHER ARISING UNDER WARRANTY, CONTRACT, NEGLIGENCE, STRICT LIABILITY, INDEMNIFICATION, OR ANY OTHER CAUSE OR COMBINATION OF CAUSES WHATSOEVER. SELLER WILL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR INDEMNIFICATION, OR ANY OTHER CAUSE OR COMBINATION OF CAUSES WHATSOEVER. THIS LIMITATION SHALL APPLY NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY. BUYER'S REMEDIES ARE SPECIFICALLY LIMITED TO THE REPAIR OR REPLACEMENT OF THE GOODS AND IS EXCLUSIVE OF ALL OTHER REMEDIES. SHOULD THESE REMEDIES BE FOUND INADEQUATE OR TO HAVE FAILED THEIR ESSENTIAL PURPOSE FOR ANY REASON WHATSOEVER, BUYER AGREES THAT RETURN OF THE FULL SALES ORDER PRICE TO IT BY SELLER SHALL PREVENT REMEDIES FROM FAILING THEIR ESSENTIAL PURPOSE AND SHALL BE CONSIDERED BY BUYER AS A FAIR AND ADEQUATE REMEDY.

Appendix C

Generation and Transmission to Electrical Grid

Generation & Transmission to Electrical Grid

27.6 kV Connection to Existing Feeder

Power will be generated by using biogas to run a reciprocating engine whose output shaft is connected to an electrical generator. The generator will be connected to an indoor electrical substation next to the room where the generators are located. The normal power distribution is supplied from Waterloo North Hydro, via overhead 27.6KV feeder and will be connected to the substation. The overhead feeder is extended from the street and brought into the facility ending at a dip pole close to the substation and connected to the transformer through fusible disconnect.

Switchgear

The digester plant facility and CHP system power distribution will be connected via dedicated switchgear located inside the CHP building. The switchgear lineup will accommodate individual breakers for each CHP package generator, a Main 52M breaker and individual feeder breaker for the following:

- Feeder breakers for MCC's located inside the CHP packages

In addition to the switchgear lineup, the electrical substation will accommodate an auxiliary service transformer and panelboard to feed all electrical auxiliary loads within the enclosure, space heaters, receptacles, lighting.

A Utility Interface Protection panel, dedicated for protection and Remote Trip operations will also be installed inside the electrical enclosure, and in addition, a Balance Of Plant PLC based control panel will be installed and wired to different equipment for monitoring and control purposes.

Cogeneration Plant Electrical Output System

The 1425KW nominally rated cogeneration modules will be generating at 600V and connected to the 27.6KV system via a dedicated Interface Transformer properly sized for the rated capacity of the generator set. The 3500KVA(ONAN)/4600KVA (ONAF), 600V:27600V step-up transformer would be connected to the existing 27.6 kV distribution at the end pole, via a dedicated gang-operated fusible disconnect switch nominally rated at 600 A. (Fuse size will be determined during detailed design and coordination study) The overhead 27.6KV extension will be extended via few poles ending at the interface transformer, and then subsequently connected via underground 27.6 kV cables installed in PVC ducts.

600V Supply to Power Modules and BOP

The power module is equipped from the factory with an MCC that feeds all auxiliary loads within the package, located inside the engine compartment. This MCC will provide power to all genset mounted electrical motors, pumps, block heaters, prelube lubrication systems, Jacket Water system pump, internal ventilation system VFD's, lighting systems, electrical room space heater, louver systems. In addition, this MCC will provide necessary power and controls for the off-module mounted pump, and power for heat tracing certain portions of the coolant distribution piping.

Auxiliary 600Vac power feed to the CHP units will be fed from the electrical room switchgear, from dedicated breakers.

Grounding Systems

For proper grounding, soil measurement analysis and design of power station grounding will be conducted by an independent firm, to ensure grounding will be installed and connected to all new equipment and interconnected to the existing nearest grounding system. All HV and LV grounding will be in accordance to the ESA requirements and as per applicable codes. Bulletin 36-10-12, and Ontario Electrical safety Code, 23rd edition, 2002.

The Scope of Work will consist of:

- a) Perform soil resistivity measurement onsite by implementing Wenner method
 - b) Conduct ground grid study by using software for grounding calculation based on IEEE-80 requirements
 - c) Design ground grid typical drawing

The following information will be used to complete the grounding design.

- a) Ground fault current at the point of installation provided by Waterloo North Hydro
- b) Site plot plan for existing and new equipment
- c) Existing equipment ground grid.

Galvanized ground rods and station Grounding stranded copper conductors will be installed and tap conductors connected to the power module, radiator, chiller package, transformer, posts, gates, switchgear, piping, cable trays and the chain link fence as required.

HIGH VOLTAGE INSTALLATION:

The cogeneration facility's electrical design is on a stand-alone basis with a single point overhead, 27.6 KV tie to HV connection to existing Waterloo North Hydro distribution feeder. The following will be provided as a minimum for the complete installation of the HV systems.

- Provide and install all conduit, wiring, fittings, grounding, bonding and hardware as required for the following installation:
- Supply and install the 27.6KV pole line with all framing, insulators, ACSR wire from pole line to the front of Interface Transformer at a dead end pole.
- Supply and install four 40 foot class poles as required with necessary cross- arm, insulators, guy wires, anchors and rods.
- Supply and install one main gang operated fusible Load Interrupter Switch, Omni-Rupter Switch (S & C or equal) at the point of connection, for PCC connection/isolation and Interface Transformer primary protection.
- Supply spare fuses. (Fuse sizing will be determined from Coordination study).
- Supply Lightning Arresters, Grounding and Grounding Mat.
- Supply and install the termination end pole before the interface transformer, with all necessary hardware, connections, and pole mounted lightning arrestors.
- Supply and install one 3500ONAN/4600 ONAF KVA Interface Transformer on the pre-cast concrete pad at close proximity to the containerized package.
- Supply and install 3 runs of 2/0 28KV full concentric cables, underground from the termination end pole to the transformer primary.
- Supply and install all stress cones and HV terminations, protective conduit and U-guard as required.
- Supply and installation of LV 600V, 4000A rated busduct from transformer secondary to switchgear Main 4000A, 52-M breaker inside electrical room.
- Supply and install all grounding grid and connections to all equipment, container, transformer ...etc.
- Coordinate all work with Electrical Safety Authority and Hydro One/Waterloo North Hydro customer service and line department as required.
- Hi pot testing of cables and ESA plan approval.
- Provide Kirk-key interlocking scheme at HV LBS, generator circuit breaker and metering compartment, for safe operation of the system. (Details to be finalized during the design phase.)

Fault Level Considerations and Coordination study

A 3-phase symmetrical fault level study will be conducted for the equipment based upon the selected generators connected to the existing 27.6 kV substation via the step-up transformer, as described above. Coordination and short circuit study will be performed for the overall system to evaluate the impact of the Cogeneration Modules to the existing electrical distribution system and fault contribution. Electrical coordination study of the generator breaker, generator protection and utility islanding

protection relays will be part of the overall facility coordination study and will be conducted by an independent third party firm.

The testing organization will demonstrate to the relevant authorities, including the local utility, the proper operation of the protective relays and operation of the generator breaker. This organization will provide all necessary hardware, instrumentation and labour to do so. The cogeneration system does not operate in parallel with the utility supply until such work is completed and verified.

Waterloo North Hydro Considerations and Connection Impact Assessment.

Modeling of the Waterloo North Hydro 27.6kV system has been performed by a consultant retained by the LDC using generator data provided and representative feeder loading for Waterloo North Hydro customers. Based on this study it is concluded that the new 2.85 MW generator system could support load on the 27.6kV feeder for an inordinate length of time after a protection trip of the closest Transformer Station supply breaker.

INTERCONNECTION AND SYSTEM PROTECTION

The generation plant will be interfaced through a 3500/4600 KVA Interface Transformer to Waterloo North Hydro distribution system.

The generation will be connected a feeder that is distributed at 27.6KV overhead 3 phase 4 wire, (to be confirmed by Waterloo North Hydro) solidly grounded system.

Power will be generated from two 1425 KW, 600 V Biogas engine driven synchronous generator sets, operating in parallel with the utility in a constant base load mode, at unity Power Factor, exporting the generated power through the Interface Transformer to Feeder. The net exported power output will be the total generated power from the two gensets, less the power consumed by the plant station service.

Protection instrumentation will be provided as necessary at the secondary side of the Interface Transformer, for connection to the Utility Interface Protection Panel (UIP) located inside the electrical room of the Digester plant.

The objective is to specify the minimum requirements that are most important from the points of view of: (a) safety to persons; (b) continuity of service; and (c) protection of property.

Acceptance of Equipment

The equipment in the generation facility will be built to be acceptable to Waterloo North Hydro /Hydro One in regard, but not limited, to the following matters:

- a) Type, rating and interrupting capacity of circuit breakers, fuses and switches
- b) Redundancy and settings of protection systems
- c) Design of transformer winding configuration, core configuration, and neutral grounding
- d) Location of disconnecting means

Disconnecting Means

Disconnecting means will be provided in accordance with section 84-026 of the Ontario Electrical Safety Code to disconnect the generation unit in the facility from the WNH distribution system.

Transformation

Lightning arresters will be provided to protect the high-voltage side of the generation facility's transformer.

The Interface Transformer winding connection selected is LV Delta – HV Wye-grounded. Details and final configuration of Interface transformer will be consulted with Waterloo North Hydro and Hydro One, to select the most appropriate transformer that meets Hydro One's requirements, suitable to the distribution configuration. Presently, we have assumed that the above configuration will be acceptable as per CIA results.

Protection Systems

The generation facility will be equipped with protection systems to automatically disconnect its generation unit from the local distribution system for the following:

- When a fault occurs in a generator circuit.
- When a fault occurs on the distribution system.
- To prevent a generator from supplying other customer loads under islanding conditions.

Internal Fault Protection

To protect against faults occurring in the embedded generation facility, the protection system will comply with section 84 of the Ontario Electrical Safety Code.

External Fault Protection

To protect against faults occurring on the Waterloo North Hydro distribution system, the generation facility will be equipped with a protection system that meets the following criteria:

Ground Faults: Since the high-voltage winding of the selected Interface Transformer (IT) at the generation facility is wye connected with the neutral solidly grounded, a ground overcurrent relay in the neutral circuit will be provided to detect ground faults. Phase Faults: To detect phase faults, at least one of the following protective relays will be installed with acceptable redundancy where required depending on fault values. Distance relay 21, or Phase Directional Overcurrent relay 67

GENERATOR PROTECTION

The generator protection will be accomplished using a multifunction relay and will be programmed for at least the following functions:

- 27/59 – Overvoltage/undervoltage
- 32 – Reverse Power
- 40 – Loss of Excitation
- 46 – Negative Sequence
- 47 – Voltage Phase Reversal
- 51G – Ground Over current
- 50/51 – Phase Over current-Overload/short circuit
- 81O/U – Overfrequency/underfrequency

INTERFACE TRANSFORMER (IT) PROTECTION

The step-up Interface Transformer protections will be accomplished as follows:

Primary Winding Phase Over current protection will be done by the Fusible disconnect switch.
50/51 - Secondary Winding Phase Over current, by 600V Main 4000A circuit breaker.
50/51G-Ground over current to Transformer grounded neutral.

600V PHASE AND GROUND FAULT PROTECTION:

LV Bus faults will be covered by 50/51-51N relays connected to the secondary of the Interface Transformer at the 52-M 600V Bus breaker with LSIG functions. The LSIG Trip unit of the breaker will provide over current protection for the 52M breaker as well as protect the 600V bus and cabling to the generators. This breaker will also serve as breaker failure protection as described below.

Since Transformer LV winding is Delta connected, the plant will be ungrounded system when the generator breakers are not closed. Proper Ground Fault protection will be applied using voltage relay to detect Ground fault on an ungrounded system.

UTILITY INTERFACE PROTECTION (UIP)

A utility interface protection system will consist of the following protection schemes located in the Utility Interface Protection panel and will be utilized to provide:

1. Protection for Line to ground faults on the primary 27.6 kV distribution system
2. Protection for Phase faults on the primary 27.6 kV distribution system
3. Protection for Islanding and Abnormal conditions

4. Breaker failure Protection

The primary ground and phase protection will consist of a single channel transfer trip via wireless Freewave method from Transformer Station and an Embedded Generator End Open (EGEO) logic scheme between the Transformer Station and the Digester Power Plant generator breakers.

The Backup protection will consist of multifunction relays located in the Utility Interface Panel to detect 27.6 kV phase and ground faults or islanding and abnormal conditions.

PRIMARY PROTECTION (Group A)

The Primary Protection System relies upon sending a remote trip signal from the TS to the Biogas power plant if the protection system for the feeder breaker at the TS connected to the power plant operates **or** if the feeder breaker is opened.

The remote trip signal will trip and lockout generator 52-G breakers. Embedded Generation End Open (EGEO) status will be sent back to TS. The feeder breaker connected to the power plant shall be blocked from re-closing until receipt of the EG End Open status. The communication medium between the TS and the power plant will be Wireless transfer trip. SEL relay, will be utilized to transmit and receive transfer trip and EGEO signals. Loss of communication will result in communication failure alarm.

BACKUP PROTECTION (Group B) :

The Backup protection system will consist of multifunction relays to detect 27.6 kV faults or an islanding condition.

Protection for faults on the primary 27.6 kV distribution system:

A Schweitzer SEL 311C multifunction relay (or equal) will be used to detect line to ground and phase faults on the 27.6 kV feeder. The following functions will be programmed:

21 – Line Impedance Protection; or 67 reverse current Protection
51/50 - Time and Instantaneous Overcurrent Protection.

Operation of the relay will trip and lockout the generator breakers 52-G1 and 52-G2.

Protection for islanding and abnormal conditions on the primary 27.6 kV distribution system:

This multifunction relay (SEL, GE or equal) will be used to detect if the plant is operating in an islanded condition. The relay utilizes over/under voltage (27/59), voltage unbalance function (47) and over/under frequency (81O/U) protection settings to detect voltage and frequency deviations when the isolated feeder load is greater than the generation. Operations of this relay will lockout the generator breakers 52-G1 and G2.

Breaker Failure Protection:

Both primary 'A' and Back-up 'B' protection systems will initiate a breaker failure scheme. If any of generator breakers 52-G1 or G2 fails to open within 300 msec, the breaker failure (BF) circuit will trip and lockout the main 4000A secondary breaker 52-M, and other generator breaker.

Coordination with Utility Protection:

To incorporate the connection of embedded generator to the distribution system, the line/feeder, EG facility generation protections including settings and feeder breaker automatic reclosing (if any) circuits will be reviewed and modified as necessary by Hydro One or Waterloo North Hydro authorities to allow for safe operation of the EG.

A short circuit study and a relay coordination study will be undertaken by an independent third party organization, to determine the protective relay settings, in order to coordinate power plant protective relay settings with utility protection relay settings for proper and safe operation of the plant, without impacting the distribution system protective relay sensitivity.

The requirements for Ground Potential Rise (GPR) study will be recommended and conducted as per teleprotection tone equipment requirements if Remote Trip facilities with phone line are implemented. Wireless communication based Remote Tripping will not require a GPR study.

Failure of Utility Interface Protection System:

If any of the UIP protection relays have failed or DC power supply to the relays lost, this will initiate an alarm that will be sent to the master control center.

SYNCHRONIZATION

Synchronization of the generation plant will occur across the generator breakers 52-G1,G2 only. The generation facility will parallel with the LDC using phase and voltage matching synchronizers, without causing a voltage fluctuation at the Point Of Common Coupling greater than +/- 4% of the prevailing voltage level, and will meet the flicker requirements of the Distribution System Code and the recommended levels in IEEE Std. 519-1992.

A synch check relay will be utilized in addition to the synchronizer. Once genset is demanded to start, it will ramp up to normal speed and frequency. The controls will activate the phase matching synchronizer and power factor controller for voltage matching, once in synch with the utility, as compared to generator bus side PT's, the synchronizer will issue a close command. The generator breaker will close as verified by the synch check relay 25, as a backup to the automatic synchronizer.

Once generator breaker is closed, the controls will load the unit smoothly with 3KW increments per seconds (KW ramp is adjustable function within the controls), to the Baseload setpoint level and continue running.

The generation will not actively regulate the voltage at the interconnection point. The Generation will not cause the utility distribution system service voltage at any point on the distribution system from going out of the normal ranges, and will be operating at constant Power Factor control mode close to unity power factor.

The generator will not be allowed to operate in leading power factor, thus avoiding absorbing Vars from the grid. This operation will be detected by the 40Q function (loss of excitation) of the generator protection relay, and will shutdown the generator, indicating a possible problem with the excitation system or voltage regulator/PF controller.

During baseload operation, if either generator protective relays or UIP protection detects a fault or abnormal condition within the utility system, it will trip open generator breaker and safely shutdown the unit.

INTERLOCK SCHEME

The following interlocks will be implemented to ensure that synchronization will never be broken from the utility at any point other than at the generator breakers:

Opening the main transformer switch 89H, when the generator breaker is closed will not be allowed, unless the 52-M breaker is opened first.

Electrical Interlocks will be in place to prevent 52-M from closing, when any of the generator breakers is closed. The Main breaker 52-M will be blocked from closing, unless all generator breakers (52-G1, G2) are open.

The primary disconnect switch (89-H) will be kirk-key interlocked with 52-M main breaker such that it will be closed if 52-M is open and cannot be opened unless the 52-M is open first, in which case generator breakers will be open also.

SUPERVISORY CONTROL

Requirement to install supervisory control unit for the monitoring of the status of the interface points, the status of the generation connection points, the interface protection system alarms and generation system electrical power quantities will be decided and provided by Waterloo North Hydro. This requirement will be decided by Waterloo North Hydro.



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INSTRUCTION MANUAL

N°: G15474

PBW High Voltage Ltd

Substation Transformer, 4000 kVA
27600 Delta - 600Y/347
ONAN/PROV. ONAF, 65°C rise

Serial n° : G15474-1
P.O. : 09-91DC68
Project : Gabae In Waterloo, Ont.



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INSTRUCTION MANUAL

Substation and Padmounted Liquid-Filled Transformers

Revision 04

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1.0 INTRODUCTION

1.1 General

This manual contains information on receiving, handling, installation, operation, and maintenance of liquid-filled transformers. Every transformer will have its own specific and individual combination of accessories. These accessories are detailed in the transformer drawings attached to this manual.

The information, recommendations, descriptions and safety procedures contained herein are based on the company's experience and should not be considered to be all inclusive or covering all contingencies. This manual is not a substitute for adequate training in the safe working procedures of transformers. If further information is desired or required, PIONEER TRANSFORMERS LTD should be consulted.

KEEP THIS INSTRUCTION MANUAL ACCESSIBLE FOR THOSE RESPONSIBLE FOR INSTALLATION, MAINTENANCE, OPERATION, AND SERVICE OF THE TRANSFORMER.

THE TRANSFORMER SHOULD BE OPERATED, SERVICED, AND INSTALLED **ONLY** BY COMPETENT, ADEQUATELY TRAINED ELECTRICAL PERSONNEL.

Additionally, all applicable safety procedures, regional and local safety requirements, and safety guidelines set forth in the Electrical Code must be considered and used by those who operate, service, and install this transformer.

1.2 Sealed tank transformer




Sealed tank transformers have the interior of the transformer sealed from the atmosphere. An air space is left above the oil such that over a specified temperature range the gas pressure will not exceed specified safe values. The oxygen in the air space is absorbed by the oil, but the small quantity involved is of no consequence to the operation or life of the transformer. Once sealed, there is no contact between the oil and the outside atmosphere. Therefore, the oil is not subject to further oxidation during normal service.

1.3 Safety Practices

Electrical equipment can be very dangerous. It is necessary to follow a basic series of precautions prior to working on any equipment. Safety considerations are highlighted in the following manner:

Hazard Statement Definitions

This manual may contain these four types of hazard statements :

-  **DANGER:** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
-  **WARNING:** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
-  **CAUTION:** Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage only.



These warnings are meant to highlight incorrect practices which may be dangerous and which may cause personal injury or damage to the equipment. Any additional safety precautions which may apply as part of the safety program instituted by your company must also of course be followed.

If you are not sure of the correct procedure to follow, refer to this instruction manual and/or contact the person who is trained in the work you are required to perform.

BASIC SAFETY PRECAUTIONS:

- Every employer has a safety program implemented at the location you are working in. Ensure that you know what the program is, including emergency procedures in the event of an accident.
- Make sure safety equipment and tools are always close at hand. Keep fire extinguishers suitable for fires involving electrical equipment near the work location. Make sure it is correctly charged and you know how to use it.
- Always be alert for emergencies. If an accident should occur, quickly utilize the safety equipment and emergency tools at hand. Before you begin any project, make sure that at least two people know first aid procedures (CPR, Cardio-pulmonary resuscitation training, is also recommended) and have the proper first aid kits available.
- Be concerned, not only for your own safety but for the safety of the people around you. Insist that others follow the correct safety rules.
- Make sure that all of the protective equipment required for the job is available for all workers who require it and that it is used correctly. This equipment may include hard-hats, breathing apparatus, eye protection, gloves, foot protection etc.
- Make sure that all electrical circuits have been traced and de-energized. Verify that all safety grounds have been correctly applied to protect personnel against the accidental application of power to these circuits while work is being performed. DO NOT assume that someone else has turned off the power - check for yourself.
- Use padlocking facilities and key interlock systems, where available, to protect yourself and others.
- Do not work under equipment which is raised or blocked. Do not walk under equipment which is suspended from a crane.
- Do not work on or adjust moving equipment. Do not work on or adjust mechanical equipment unless its motive source has been de-activated - Keep your hands away.

1.4 Voltage hazards

The turns ratio between the windings of any transformer make them capable of transforming what are normally considered to be harmless voltages to dangerous and even lethal levels.

Electric welders, continuity checking instruments and insulation testing apparatus are examples of sources of so called harmless voltages. Even if these are direct current (DC) devices, they are capable of producing voltages high enough to be hazardous to human life when their circuits are connected or interrupted.

Other situations which may present hazardous conditions include the high voltages produced by open circuited current transformers which have current flowing in the primary circuit.



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Substation and Padmounted Transformers

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When personnel are working on de-energized transformers, winding terminals should be suitably short circuited and grounded according to correct safety practice to avoid current flowing in CT. Unused current transformers shall always have their secondary windings short circuited with a suitable size of wire to avoid the high open circuit voltages.



2.0 SHIPPING AND RECEIVING

2.1 Shipping

The transformer is normally shipped completely assembled, liquid-filled and sealed for open carrier transport. Shipping clearances determine which accessories must be removed and shipped in separate boxes. Careful inspection of the packing list should be done to check for possible shortages.

2.2 Receiving / Inspection

We have taken normal precautions to prevent damage during shipping. However, even the most elaborate precautions cannot prevent the possibility of a mishap during transit.

Before accepting delivery, it is recommended that the customer examine the shipment before it is off loaded. This inspection should include the following:

- 1 - Ensure that all parts listed on the bill of lading are present.
- 2 - Check the main tank for signs of oil leakage, paint scratches or other indications of damage or mishandling.

If shortages, tampering, damage or any indication of rough handling are noticed, write a brief description on the shipping receipt or the bill of lading. If the transformer was shipped FOB Destination, notify PIONEER immediately.

Transformers are shipped with windings connected according to the customer's instructions, which are shown on the nameplate. It is advisable for the customer to thoroughly check all connections before placing the transformer in operation. Please, contact PIONEER TRANSFORMERS LTD before making any connections not shown on the nameplate.



3.0 HANDLING AND STORAGE

The transformer weight is shown on the transformer nameplate

3.1 Handling

Palletized units may be moved by fork lift trucks of proper capacity, but special care should be taken to not damage the cabinet compartment and cooling radiators. These items can be easily damaged by improper handling.

Lifting hooks are provided on all transformer tanks and heavy parts such as covers, radiators, radiator banks and core and coil assemblies. Approximate total weight is listed on the outline drawing and on the nameplate.

Lifting hooks are designed for vertical strain only and are provided for lifting the complete transformer. When lifting the transformer, use all the hooks and use proper spreaders to obtain a vertical lift in order to prevent horizontal strain on the tank.

Completely assembled transformers can be lifted with chain slings or a lifting beam. Chain slings should be of equal length so that the transformer will be lifted evenly. The cover should always be securely and correctly fastened into place when lifting, to prevent buckling of the tank walls. For safe lifting, we recommend a minimum lifting angle of 60° from horizontal. The working load limit of the chain is then 86.5 % of nominal rating.

Jacking may be accomplished using the jacking pads (if provided) on the transformer. Never attempt to raise the transformer by placing jacks under any other attachments. Transformers may be moved by rollers but care must be taken to distribute the weight uniformly.

3.2 Storage

It is advisable to ship a new transformer directly to its permanent location and to follow the prescribed installation instructions whether or not the transformer is put into immediate service.

If the transformer must be stored, locate it upright preferably in its permanent location on the concrete pad. If a level concrete pad is not available, then a pallet of adequate strength will provide a suitable means of keeping the unit from direct contact with the ground. Adequate ventilation should be maintained under the bottom of the transformer. The transformer should not be stored in the presence of corrosive gases such as chlorine, acid fumes, etc. Periodic inspection should ensure that proper liquid level is maintained at all times.



4.0 INSTALLATION

Installation should comply with the latest edition of the Electrical Code applicable and should be performed only by adequately trained electrical personnel. Transformers are built to operate at altitudes up to 1000 meters at 30°C average in any one day with a temperature never exceeding 40°C and 20°C average in any one year.

4.1 External Inspection

The oil level in the transformer must be at the proper level prior to applying voltage. Oil level can be checked using the liquid level gauge. Any unit that does not contain the proper oil level should be inspected for leaks around the tank.

4.2 Location and Mounting

The Transformer should be mounted on a strong and level foundation of sufficient strength to support the transformer weight. The location should allow for adequate air circulation to avoid overheating and allow sufficient space for future inspection and maintenance of the transformer.

The transformer should be installed level without a tilt in any direction greater than 1½ degrees. This is in order to maintain the proper fluid level for accessories installed at the upper level of the liquid. The transformer cabinet (if any) should be flush against the pad at all points. Any gaps that may exist must be mortar seal in order to maintain the tamper resistant design of a padmount transformer.

When supplied, hold down cleats should be installed to bolt the cabinet securely to the concrete pad.

4.3 Electrical Connections

We suggest the following sequence of connections when installing the transformer:

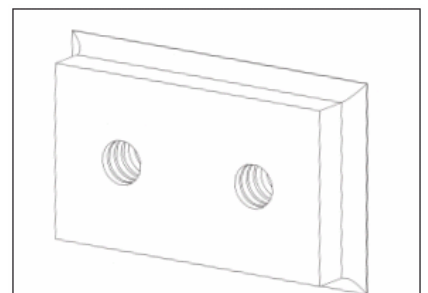
1. all ground connections
2. all low voltage connections
3. all high voltage connections.

When removing the transformer from service the reverse of the above operations is recommended.

4.3.1 Grounding

A permanent and low resistance ground connection must be made for adequate protection from the tank becoming momentarily energized by internal-external faults or lightning surges. Ground the tank permanently by using the ground pads provided near the bottom of the tank.

Transformers designed for use on grounded wye system must have the neutrals solidly grounded to the common neutral of the system prior to applying voltage to the transformer.





4.3.2 Low Voltage Connections

Low voltage bushings through 600 V are supplied with NEMA standard hole spacing and drillings. Lugs (if supplied with the transformer) may be stacked or mounted on either side of the bushing spade. A minimum 2.5 cm (1") air clearance must be maintained between phase-to-phase and phase-to-ground live parts in all applications (30 kV BIL).

4.3.3 High Voltage Connections

High voltage bushing connections are supplied per the transformer specification for each job and can be either live front (porcelain bushings) with exposed eyebolt terminals or spades, or dead front (molded epoxy wells) requiring an insert and elbow connector for each incoming cable.

Connections must be made without placing undue mechanical stress on the bushing terminals. Conductors should be securely fastened in place and supported properly, with allowance for expansion and contraction.



5.0 OPERATION AND MAINTENANCE

5.1 Operation

Transformers are built and tested in accordance with the latest version of the applicable standards and customer's specifications. The transformer is only one piece of equipment in the total electrical distribution system. Therefore, proper consideration must be given to the protection of the transformer from system disturbances, such as: over voltages and over currents. Coordination of the complete distribution system must be achieved for proper operation of the transformer.

5.2 Maintenance



WARNING: Hazardous voltage. Can cause severe injury, or damage to equipment. De-energize transformer from a remote upstream source before opening cabinet and doing cabinet interior inspection or maintenance. Check that all transformer terminals and bushings have zero voltage. Ground transformer following industry accepted safe grounding practices.

Lack of attention to a transformer in service may lead to serious consequences. Careful periodic inspection is essential. The frequency of the inspection is determined by climatic conditions and severity of loading.

Remember that high voltage is present on an energized transformer, and proper safety precautions must be observed when ever you are working on this equipment.

Transformers are very reliable, but if they should fail, they may be out of service for a long time. Proper maintenance of transformers is not difficult, and does not take a great deal of time over the life of the unit, but it can result in significantly lower life cycle costs.

5.2.1 BEFORE ENERGIZATION

After the transformer has been received, prior to the first energization, it is recommended that dissolved gas in oil analysis be performed. This check provides a benchmark for all future gas in oil tests performed throughout the life of the transformer. Dissolved gas in oil tests are probably the most important and powerful method available for protecting against incipient faults - the identification of faults when they are small and have caused little or no permanent damage, before they can grow into major problems.

5.2.2 ROUTINE INSPECTION SCHEDULE

- Radiators should be kept clean and free of obstructions that may interfere with the natural air flow across the cooling surfaces.
- The external ground connection should be checked annually for continuity by measuring the resistance between the tank and ground.
- The liquid level should be checked daily for the first week, than quarterly for the first year, and then on regular scheduled intervals.
- Take periodically an oil sample, to be tested for dielectric strength, water content and power factor.



- Take periodically an oil sample, to be tested for dissolved gas in oil and compare it to the tests performed before energization. It is important to remember that over time even a healthy transformer produces « fault » gases, and it is the trend in gas production that is often more important than the absolute values.

5.3 Insulating fluid

Insulating fluids play a major role in all liquid-filled transformers. They provide good performance and can help maintenance people detect and predict failures. Through the use of proven analytical techniques, a well planned maintenance program can lead to fault detection long before it escalates into a major failure.

Fluid in a transformer acts not only as a coolant but also as insulation. During normal operation, the fluid withstands thermal and electrical stresses. These slowly degrade the fluid, which then loses its insulating property. In extreme cases this can cause transformer failures.

5.3.1 Mineral Oil

An oil-filled transformer offers the best compromise between cost and performance. It has excellent dielectric and cooling properties, but has the inherent weakness of having the lowest flash point. Therefore, is restricted to outdoor installations or installed within a special vault if used indoors.

Naphthenic oils have performed exceedingly well - often for periods in excess of 20 years - in all types of oil-cooled transformers.

They are formulated to resist oxidation and sludge formation in service. All brand insulating oils have negative gassing tendencies which help to prevent the formation of hydrogen gas resulting from electrical breakdowns or discharges in the transformer. This property provides an additional safeguard against explosions or fire resulting from the accumulation of hydrogen gas. These oils have excellent dielectric strength and power factor characteristics.

Depending on the intended application and required service life, insulating oils are available with different low temperature performance characteristics and oxidation inhibitor contents. These products do not contain any polychlorinated biphenyl's (PCB's).

- **CLASS A TYPE 2** is a premium inhibited (0.30% of antioxidant) electrical insulating oil designed to meet the critical operation requirements of most power transformers operating at ambient temperatures below -25°C (-13°F). It meets the CSA C50 and ASTM D3487 specifications for viscosity limit of 2500 cSt max. at -40°C (-40°F).
- **CLASS B TYPE 2** is a fully inhibited (0.30% of antioxidant) electrical oil that has the higher viscosity uninhibited electrical oil which use widely in distribution transformers. It meets the CSA C50 and ASTM D3487 specifications for viscosity limit of 4000 cSt max. at -40°C (-40°F).

5.3.2 Envirotemp® FR3 Fluid

Envirotemp® **FR3™** fluid is a Fire Resistant Natural Ester based dielectric coolant specifically formulated for use in distribution transformers where its unique environmental, fire safety, chemical, and electrical properties are advantageous.

Envirotemp FR3 fluid is formulated from edible seed oils and food grade performance enhancing additives. It does not contain any petroleum, halogens, silicones or any other questionable material. It quickly and thoroughly



biodegrades in both, soil and aquatic environments. The fluid tested not-toxic in aquatic toxicity tests. It is tinted green to reflect its favorable environmental profile.

Envirotemp FR3 fluid has an exceptionally high fire point of 360°C and flash point of 330°C. It has the highest ignition resistance of less-flammable fluids currently available. It is referred to as a High Fire Point or "Less-Flammable" fluid, and is listed as a Less-Flammable Dielectric Liquid by Factory Mutual and Underwriters Laboratories for use in complying with the National Electric Code (NEC®) and insurance requirements.

5.3.3 Silicone Fluid

A wide variety of synthetic polymer chemicals are referred to by the generic term "silicone". Silicone transformer liquids are actually known chemically as Poly Dimethyl Siloxane (PDMS) fluid. It is a water-clear, odorless, chemically stable and non-toxic liquid. Silicone insulating material provides a unique combination of dependable safety features and high-performance characteristics. It makes an excellent replacement for transformer filled with askarel.

Silicone transformer liquid is a heat-stable dielectric coolant featuring much greater fire and oxidation resistance than mineral oils.

5.3.4 Oil sampling procedure

Cautions:

1. Sampling should be performed on a mostly sunny day when the humidity is less than 75%.
2. Have proper equipment: safety glasses, safety hat if required (not metal), long sleeved cotton shirt, cotton pants, and safety shoes. Obey all safety rules.
3. Oil temperature in the transformers should be at least at ambient temperature; oil colder than ambient can cause moisture condensation in the oil samples resulting in a contaminated sample.
4. There must be a bottom valve with sampling apparatus attached for sampling to be conducted safely and with minimal contamination.
5. Always clean the sampling valves prior to sampling to reduce the potential for contamination.
6. Always check pressure gauge to make sure the transformer is under a positive pressure.
7. Always check oil level to make sure there is enough oil to complete sampling.
8. Do not let air get into transformer from sampling activities.
9. Do no sample if electrical storms are nearby or visible.

Sampling Frequency

1. Routine tests are normally done on a regular basis once per year.

For ASTM tests: (Dielectric strength, interfacial tension, acidity, density, colour, water content, power factor, PCB content, furan content and inhibitor content)



Supplies needed:

1. Flushing container at least 5 litres in capacity.
2. Leak-proof plastic box to protect from spills.
3. 650ml sampling jar with label, red arrow indicates fill level.
4. Label for sample.
5. Paper wipes to clean outside of jars and sampling area before and after sampling.

Procedures:

1. Flush valve allowing approximately 1 litre of oil to drain into flushing container.
2. Capture about ¼ jar of oil after initial flushing and gently swirl and dump into flushing container. Do this two or three time to make sure the jar is clean of any contaminants.
3. Fill jar again to about 2cm from top, at the jar shoulder.
4. Visually examine for obvious particles or water. If present, dump sample into flushing container and take another sample, making sure to get a clean sample.
5. Cap jar tightly and place label with date sampled.
6. Clean area with wipes.

For Dissolved Gas Analysis (DGA) :

Supplies needed:

1. Flushing container of at least 5 litres in capacity.
2. Leak-proof plastic box to protect from spills.
3. 30cc syringe with attached stopcock.
4. Label for sample.
5. Paper wipes to clean sampling area before and after sampling.

Procedures:

1. If a sampling valve is not already installed, make sure drain valve is fully closed and remove the end cap carefully. Install cap with sampling valve installed and place the 18" long clear tubing over the barb.
2. Make sure the stopcock is securely attached to the sampling syringe.
3. **NOTE:** The stopcock handle **always** points towards to closed port.
4. Attach the syringe to the tubing being careful not to break the stopcock.
5. Slowly open the transformer stopcock and allow about 500ml to flush the tubing and stopcock, going into the waste container. Do two or three times to get bubbles out of tubing and syringe.
6. Allow the syringe to fill with oil to 30cc. If the syringe sticks, pull it gently to make sure the glasses becomes lubricated. Move the stopcock handle forward to the transformer, parallel to the syringe axis, and eject the oil into the waster container by pressing the syringe handle all the way forward.
7. Move the stopcock handle back down to the waster container and fill the syringe to 30cc, stopping the flow by moving the stopcock handle back to the syringe, parallel to the syringe axis. Make sure there are no bubbles in the oil and then close the transformer valve and remove the syringe and place in the shipping container. Place label on outside of box. When ready for shipping, seal the box with tape.
8. Attach label to the container with date. Clean syringe and sampling area. Empty waste container into proper disposal area.



5.3.5 Oil Analysis

Testing the oil is an inexpensive and reliable way of assessing the operating condition of a transformer.

5.3.5.1. Typical Properties

The American Society for Testing Materials (ASTM) has developed a series of tests to determine oil quality by determining the physical, chemical and electrical properties. The major tests are: dielectric breakdown, neutralization number, interfacial tension (IFT), color, moisture content, specific gravity, sediment, power factor and PCB content.

Some of these tests are very closely related. For example, IFT and neutralization number go hand in hand. IFT determines the probability of sludging occurring in a transformer's insulating system. The neutralization number measures the acidity of the oil, which is caused by oxidation. Low IFT numbers indicate a probability of sludge formation and high acidity indicates oil deterioration and the formation of acidic compounds which, in extreme cases, will also form sludge. Dielectric strength and water content follow the same pattern. To be a good insulator, oil must retain high dielectric strength. Dissolved water can lower the insulating properties of oil, affecting the dielectric strength and increasing the risk of flashover.

5.3.5.2 Gases dissolved in Insulating Fluid

The detection of certain gases generated in a liquid-filled transformer in service is frequently the first available indication of a malfunction that may eventually lead to failure if not corrected. The two principal causes of gas formation within an operating transformer are thermal and electrical disturbances. Arcing, corona discharge, sparking, severe overloading and overheating in the insulation are the causes of gas generation. Normal operation will also result in the formation of some gases. Generated gases can be found dissolved in the insulation fluid. The Dissolved Gas Analysis (DGA) produced from a sample of fluid will give a status of the transformer condition. However, interpretation of their significance is not a science, but an art subject to variability. Their presence and quantity are dependent on variables such as loading conditions, location, temperature of the fault and even the sampling procedure.

The interpretation of Gas Analysis refers to various diagnostic techniques such as Dornenburg ratios, Rogers ratios, Duval and IEC. For more details, please refer to the following guides:

- | | | |
|--------------|---|---------------------|
| IEEE C57.104 | <i>Guide for the Interpretation of Gases Generated in</i> | <i>Oil-Immersed</i> |
| | <i>Transformers.</i> | |
| IEEE C57.106 | <i>Guide for Acceptance and Maintenance of Insulating Oil in Equipment.</i> | |
| IEEE C57.111 | <i>Guide for Acceptance of Silicone Insulating Fluid and Its Maintenance in Transformers.</i> | |



6.0 COMPONENTS AND ACCESSORIES

6.1 Bushings

Transformers are equipped with one or more of four types of bushings:

- Porcelain oil-filled bushing
- Porcelain dry-type bushing
- Molded epoxy type
- Molded Bushing Well (padmounted transformers)

The type and design of the bushing is coordinated with the impulse level of the transformer to form an integrated insulation system. Transformers are shipped with the bushings mounted in place.

6.2 Radiator(s)

Each panel consists of two plates seam welded along the edges and mounted on a header at the top and the bottom with a maximum of 36 panels to form a radiator. Our radiators will withstand full vacuum and are pressure tested at 12 PSI prior to installation.

6.2.1 Installation of removable radiators (if applicable)

Radiators can be installed on site if needed. Carefully check for shipping damage and notify PIONEER Transformers if any.

Remove the transit flanges (cover plate) of the radiators. Lift a radiator from the pallet taking care to protect the panels from possible damage. Use the two lugs at the top for lifting and if necessary the single lug at the bottom to stabilize the radiator (using the two lugs will maintain balance on the radiator). Top and bottom sides are reversible unless otherwise indicated. Purge the inside with dry compressed air to remove any trace of humidity.

Install a pan under the radiator valve. Remove the transit flanges (cover plates) of the radiator valves on the tank wall (top and bottom).

Re-assemble using the gasket shipped with the radiator which is a large O'Ring gasket. Use some petroleum compound to hold in place the gasket in its groove. Tighten down on the flanges. Install the other radiators by the same method. Install support angles and tie bars if supplied.

After installation is completed fill each radiator, one at a time, by slowly opening the radiator valves bottom first. Check for leaks and top off the transformer tank. Then proceed to filling the subsequent radiators the same way. Wait for 4 hours before energizing the unit. Check for any leakage.



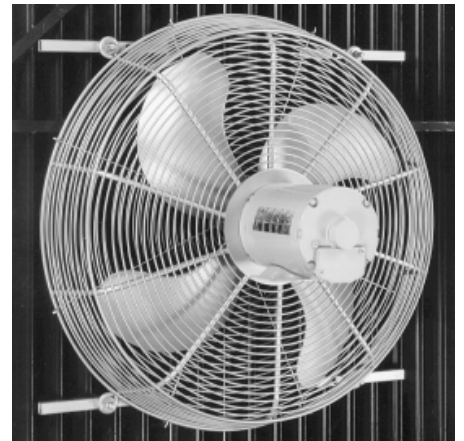
6.3 Fan(s)

Cooling fans are supplied on transformers where additional forced air capacities or upratings have been specified. Operation is automatic and is controlled by temperature sensitive devices: either a top oil temperature gauge or a winding temperature indicator. When the insulating liquid and/or transformer winding reaches the temperature for which the automatic control is set, it then closes the control contacts. The control contacts close the auxiliary circuit which energizes a motor starter solenoid to put the fans in operation. All wiring conduits and control boxes are weather proof.

The fan units are usually attached to the radiators, but may be mounted on brackets affixed to the main tank.

The fans are equipped with the following: guards on the motor and blade sides, auto-reset thermal protection, water slingers and "satmos" treated motors. Transit plugs must be removed from drain holes before being placed into service.

Air movement on the inlet and outlet sides of the fan must not be obstructed since restriction might cause overloading of the fan.



6.4 Gaskets

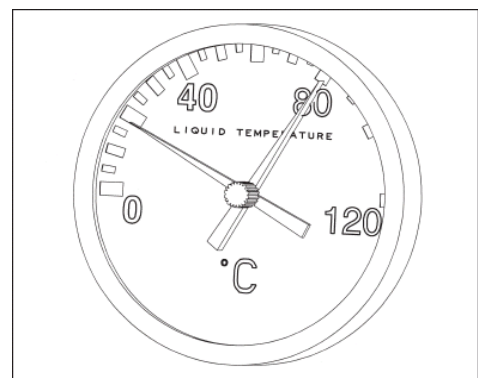
Gaskets which are used on liquid filled transformers are manufactured from a nitrile/cork material, or Buna-N.

On occasion, it may become necessary to replace a gasket in the field or to make up a replacement gasket. Contact PIONEER TRANSFORMERS LTD, in order to ensure, that the replacement gasket material and thickness are the same as the present one.

6.5 Liquid Thermometer

Transformers may be furnished with a temperature gauge as optional equipment to indicate the top liquid temperature in the tank in degrees Centigrade. The temperature-sensitive element is mounted in a leak-proof well, permitting removal of the thermometer without lowering the oil level. The device is furnished with an additional red pointer to show the highest temperature attained since the last reset. To reset the maximum indicator, turn the knob in the center of the dial.

The thermometer may have two SPDT contacts for a high temperature alarm, for energizing a fan circuit or for a low temperature alarm.



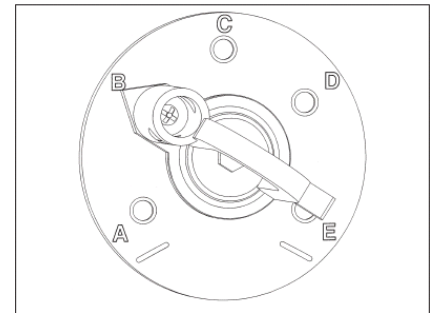


6.6 Off Load Tap Changer

The externally operated tap changer switch is designed for use in transformers filled with oil, FR3 or Silicone fluid. The Tap Changer is usually the only sophisticated mechanical device in an otherwise stationary apparatus. Due to this fact, it is also responsible for the majority of transformer outages and failures. Therefore it is very important to understand its function, application and weak points.

Off load tap changers are located inside the transformer tank and utilize the transformer fluid for dielectric strength. Most specifications ask for plus and minus 2 steps of 2.5 %, so that switch has five positions. To reduce the operating current, the Tap Changer is normally located on the HV side of the transformer. Off load tap changers are normally gang operated by a handle outside the tank. The handle can be padlocked in any position. The indicator plate permits easy identification of the position of the contacts.

The contacts of the switch are slow moving and are only designed to select a position while the transformer is de-energized. No current can be interrupted. After selecting the required tap, the handle should be padlocked in position.



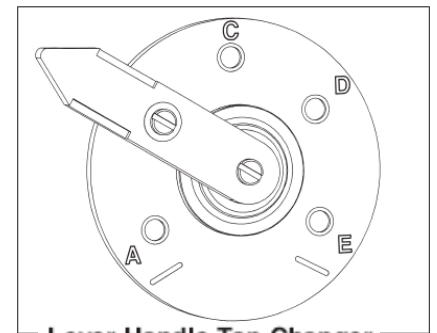
Hotstick-Operable Tap Changer (Style I)



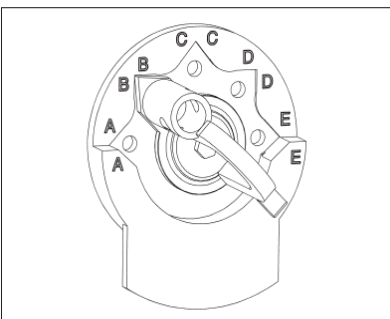
WARNING: Hazardous voltage. Can cause severe injury, death or damage to equipment. De-energize transformer from a remote upstream source before operating non-loadbreak tap changers, dual-voltage switches, or delta-wye switches.

Transformers equipped with a tap changer can be changed from one operating voltage to another. The transformer must be de-energized and grounded before the tap changer is operated. Operating voltages accessible through use of the tap changer are indicated on the transformer nameplate.

On most three-phase padmounted transformers equipped with tap changers, the tap changer operating handle is located on the faceplate in the high-voltage terminal compartment.



Lever Handle Tap Changer

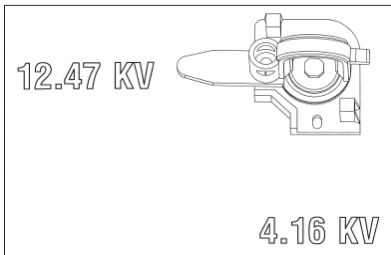


Hot stick-Operable Tap Changer (Style II)

The standard style of tap changer will have a hotstick-operable handle. There are two styles of tap changer with this type of handle, each requiring a slightly different method for changing tap settings.



6.7 Dual Voltage Switch



The externally operated under-oil Dual Voltage switch is used to change the connection of de-energized transformer windings between series and parallel to provide different common transformer voltage ratios. It connects primary windings either in series for a higher winding ratio, or in parallel for a lower winding ratio. Tri-voltage switches are also available.

Dual-Voltage/Delta-Wye Switch (Hotstick-Operable)



WARNING: Hazardous voltage. Can cause severe injury, death or damage to equipment. De-energize transformer from a remote upstream source before operating non-loadbreak tap changers, dual-voltage switches, or delta-wye switches.



CAUTION: Excessive current. Can cause damage to transformer winding. When dual-voltage or delta-wye switches are set to connect transformer windings in parallel, tap changers must be in the position shown on the transformer nameplate.

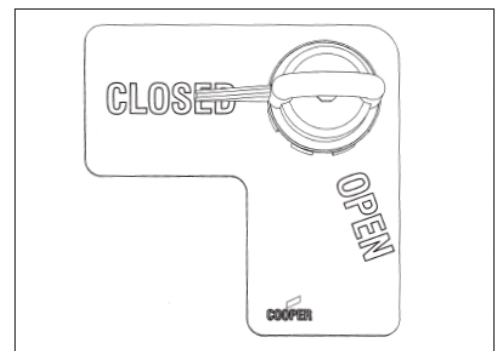
Externally operable switches eliminate many of the hazards associated with manual internal tap changing. The switches are designed for use in distribution transformers filled with mineral oil, FR3 or Silicone fluid. Series multiple switches have a pad-lockable and a hotstick operable handle, which provide greater leverage and positive indication of the switch position.

6.8 Internal Loadbreak Switch

6.8.1 Sectionalizing

Sectionalizing loadbreak switches rotates 360° in either direction for alternate source selection. An externally-installed index plate prevents rotation to positions other than the one desired. The switch cannot be switched more than one position without resetting the index plate.

A spring-loaded activating mechanism ensures quick loadbreak action and positive contact engagement through all positions. Switching can be accomplished in less than one cycle, and should be performed with a hotstick.



Two-Position Loadbreak Switch Handle and Indicator Plate

6.8.2 Load Interrupter Switch

6.8.2.1 Under oil type

The compact two-position loadbreak/loadmake switch is designed for use in oil, FR3 or Silicone fluid. The switch mechanism employs a manually charged over-toggle stored spring assembly, which is independent of operator speed. The spring loaded activating mechanism ensures quick loadbreak and loadmake operation in less than one cycle. Incorporated into the switch mechanism are internal stops that restrict the handle orientation to only two positions : "Open" and "Close". The switch should be hotstick-operated and will require 15ft-lbs. minimum input torque to operate



6.8.2.2 Air Type (NAL)

The NAL Type, 3 pole load interrupter switch is suitable for use as a main or feeder load interrupter switch. The NAL switch is available with, either a quick make, quick break mechanism, or a spring stored-energy mechanism that can be activated by a shunt trip. The latter feature allows the switch to be tripped remotely or used in conjunction with protective relays.

The NAL switch uses the "auto-pneumatic" interruption principle. The switch utilizes a blast of air generated by a piston which is mechanically connected to the operating mechanism. This piston drives a jet of air across the arcing contacts, which are located inside the upper insulator assembly. To further enhance interruption performance the nozzle surrounding the arcing contacts is made of gas evolving material which produces de-ionizing gas to complete the interruption process.



WARNING: Hazardous voltage. Can cause severe injury, death, or damage to equipment.

- Do not operate loadbreak equipment if a fault condition is suspected. Doing so can cause an explosion or fire.
- Use a hotstick to operate transformer loadbreak equipment.
- After operating transformer loadbreak equipment, check that voltages at transformer terminals are the expected values. Checking voltages verifies that loadbreak equipment operated properly and that electrical circuit conditions are as expected.
- Before servicing transformer secondary connected equipment, verify that all transformer secondary terminals have zero voltage and ground the transformer secondary terminals following industry accepted safe grounding practices. Grounding secondary terminals protects against situations such as a standby generator energizing transformer from the secondary circuit.
- Before servicing transformer, ALWAYS DE-ENERGIZE the transformer from a remote upstream source and then proceed to ground all primary and secondary transformer terminals following industry accepted safe grounding practices. Grounding secondary terminals protects against situations such as a standby generator energizing transformer from the secondary circuit.
- Follow industry accepted safety practices. Utilize protective clothing and equipment when working with loadbreak equipment.

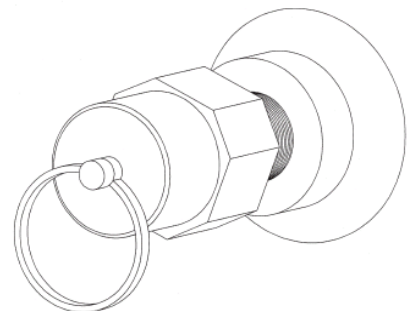
6.9 Pressure Relief Valve

The pressure relief valve features a one-piece brass housing. A stainless steel spring, factory selected to a pre-determined setting, is designed to release pressure build-up within a sealed tank. A Viton O-ring seals the valve and a stainless steel pull ring is attached to the valve shaft to facilitate manual pressure relief operation. These valves are designed to operate under environmental conditions encountered on outdoor applications. The exhaust port is protected by a "bug shield" cover which inhibits foreign matter from entering the valve body.

Operation:

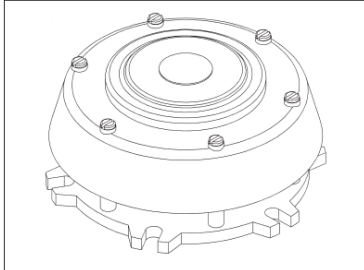
When gas pressure in the transformer tank exceeds a specified limit, the valve automatically compresses the spring which drives the poppet, breaking the seal and venting potentially dangerous gas pressure. With pressure reduced the valve automatically reseals itself to prevent entry of outside air.

Operating pressure tolerance is +/- 2 PSI. The minimum flow rate is 35 scfm @ 15 PSI. Resealing occurs approximately 2 PSI below operating pressure.





6.10 Pressure Relief Device



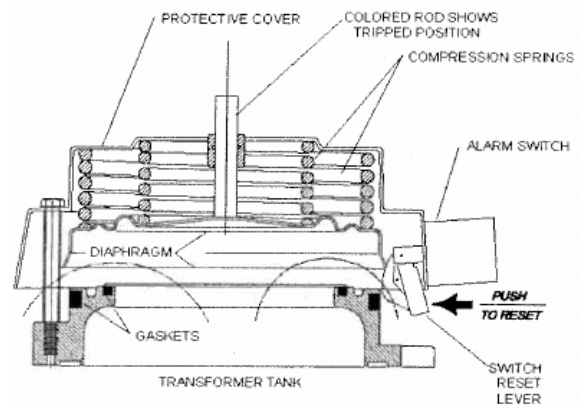
The pressure relief device is essentially a spring-loaded valve having a unique means of providing instantaneous amplification of activation force. The operating disc is spring-loaded and sealed against a Nitrile top gasket and side wiper gasket by springs. The cover provides spring compression and is held in place by six screws. **The cover mounting screws must never be removed without the use of extreme caution.**

Operation is effected when pressure acting against the area defined by the top gasket exceeds the pressure established by the springs. As the operating disc moves slightly upward from the top gasket, the transformer pressure then quickly becomes exposed to the disc area of the Nitrile side gasket, resulting in a greatly increased force and causing extremely rapid opening of the operating disc corresponding to the closed height of the springs. The transformer pressure is rapidly reduced to normal values and springs return the disc to the sealed position.

A brightly colored-coded mechanical indicator pin in the cover although, not fastened to the disc, moves with it during operation and is held in a raised position by the pin bushing guide. This pin is clearly visible from a distance, indicating that the unit has functioned. The pin may be reset manually by pushing it down until it rests on disc. A long-arm semaphore can also be supplied, for visual indication from even greater distances.

This relief device can be provided with a sealed, weather-proof alarm switch assembly mounted on the cover. The switch assembly includes a single-pole, double-throw switch having a 3-conductor cable for connection to a remote alarm or signal. Activated by movement of the disc, the switch is latched and must be manually reset.

A deflection cover is installed over the pressure relief device to prevent splashing. **Do not remove this deflection cover.**



6.11 Pressure-Vacuum Gauge

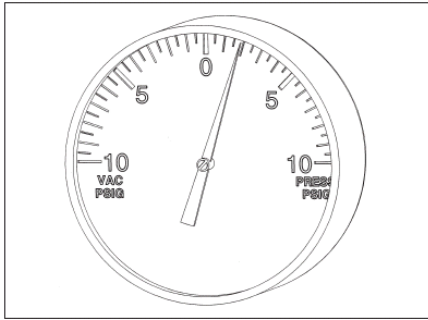


The Pressure-Vacuum Bleeder is a dual function device. It is designed to control both pressure and vacuum conditions in a sealed vessel. When a pressure greater than the setting of the bleeder is developed, it will exhaust gas from the tank. In addition, it will admit air when negative pressure in the tank exceeds the vacuum setting. Standard repeatability is +/- 0.5 PSI from the set-point. The device is ruggedly constructed and coated with ASA # 70 gray epoxy paint suitable for indoor or outdoor applications. The body consists of two end bells and a center section which contains valve ports and interconnecting channels. These valve ports open to provide a passageway between the tank and atmosphere only under excess pressure and vacuum conditions.

The outer chambers are separated from the main body by flexible diaphragms. Each diaphragm is spring loaded to allow the valve seat to lift under a preset pressure or vacuum. Teflon coated valve seats and O-rings are used to provide reliable operation under varied conditions.



This instrument is normally mounted with the diaphragms in the vertical plane and the breather tubes angled downward to avoid the entrance of dust and moisture. This device also includes a sampling valve which allows gas samples to be drawn off for analysis.



The pressure-vacuum gauge is designed to provide long service life under normal conditions. The heavy steel case is coated with ASA # 70 gray epoxy paint. All internal components are made of corrosion resistant materials or plated for protection. A breather hole at the bottom of the case allows the gauge to operate properly through constant exposure to atmospheric pressure. The large 3 1/2" dial has white characters on a black background for easy reading from a distance.

If the gauge remains at zero for a long period of time, this may indicate a possible leak or a defective gauge.

The Pressure-Vacuum gauge utilizes a Bourdon tube element to sense pressure changes. A gear drive movement transfers the tube's deflection to the pointer for indication on the dial.

A removable lens and slotted pointer hub are features provided on this unit. These permit zero adjustment in the field if necessary. The lens material is polycarbonate to provide extra protection against breakage. Accuracy on these gages is +/- 2% in the middle half of the range and +/- 3% over the remaining portion of the scale.

CAUTION: If the indicator reads zero and does not change under any load condition, the transformer should be checked for a possible leak in the seal.

6.12 Rapid Pressure Rise Relay

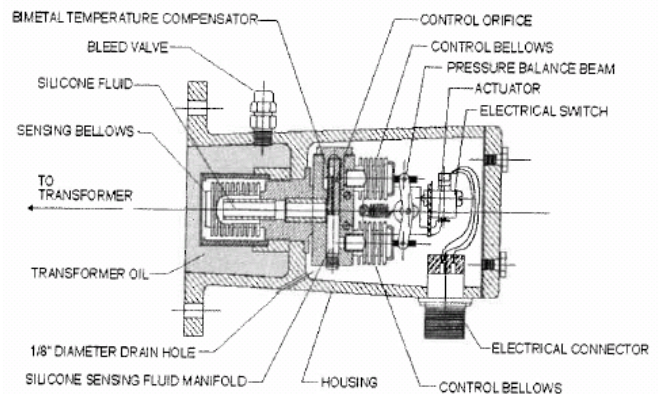


Internal arcing in a liquid-filled transformer tank generates excessive gas pressures that can severely damage equipment and present extreme hazards to operating personnel. The Rapid Pressure Rise Relay, when mounted on the transformer, minimizes the possibility of such occurrences by detecting rates of pressure increase in excess of the safe limits. When such conditions are experienced, it will initiate an electrical signal for an upstream circuit breaker to open de-energizing the transformer and sounding an alarm if desired. The design is such that the relay will not be actuated by normal pressure variations caused by temperature change, vibration, mechanical shock, or pump surges. The relay, mounted on the transformer, can be

subjected to full vacuum or 20 PSI positive pressure without damage.

Operation:

The Rapid Pressure Rise Relay consists of two parts: the sensing bellows and two control bellows which are contained in a sealed system filled with silicon oil. A small orifice in the line of one of the control bellows, whose effective area is varied with temperature by a bimetal strip, causes differential deflection of the two control bellows. The resultant cocking of the actuator linkage trips the electrical switch at unsafe rates of pressure rise. When the two control bellows again reach equilibrium, the electrical switch automatically resets itself.





6.12.1 Seal-In Relay

An optional Seal-In Relay may be used to capture and hold the momentary switch to indicate an SPR trip. It automatically maintains alarm and trip circuits when the momentary contacts of the protective device operate. These signals are held electrically until the reset button is manually depressed. A printed circuit board is used for all internal circuitry. External connections are made on screw-type terminal blocks capable of accepting up to #12 AWG wire. Each Seal-In Relay utilizes components selected to minimize environmental problems and provide long product life.



Operation:

The Seal-In Relay responds to contact actuation by the protective instrument to which it is connected. When this occurs, the Seal-In Relay coil is energized, operating and latching the alarm and trip circuit contacts. These remain latched until the reset switch is manually depressed. A red light emitting diode (LED), turns on when the Seal-In circuit is latched and turns off when the circuit is released, returning all contacts to their normal positions. Application of the Seal-In Relay begins with selection of, AC or DC mode. The jumper plug in the lower left corner of the panel should be inserted in the appropriate position based on the control voltage being applied.

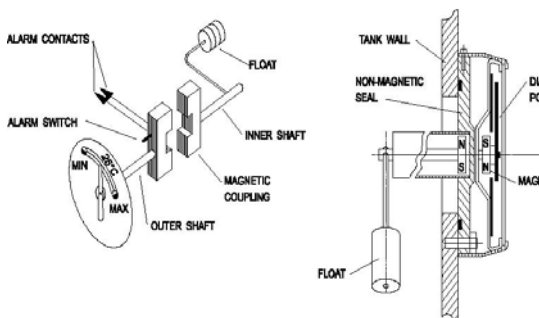
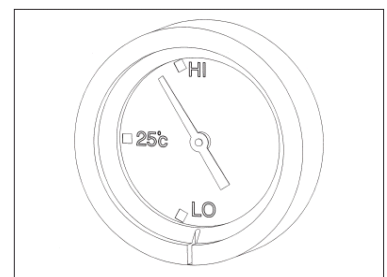
Installation wiring

Terminal Number (s)	Purpose
1	Common
2	Normally Closed Contact
12	Normally Open Contact
6, 7 & 8	Alarm Contacts
9 & 10	Trip Contacts
11 & 12	Supply Power
13	Earth Ground Connector <i>(FOR VAC ONLY)</i> FOR VDC, DO NOT CONNECT TO EARTH GROUND.

6.13 Liquid Level Gauge

Most of our transformers are equipped with a magnetic type liquid level gauge, which provides visible indication of the fluid level inside the transformer.

The gauge is installed at the factory and is ready for operation. However, if a replacement gauge is to be installed, first check the operation of the float by moving it over its entire range.



The movement of the indicating hand on the dial should correspond to the movement of the float. Prior to installation of the gauge, the oil level must be lowered below the mounting flange of the gauge. The gauge should be bolted rigidly to the mounting on the transformer to ensure an oil tight gasket seal. The alarm contacts, when fitted, should be checked for operation at the "Low" level point. Alarm contact leads are connected as shown on the transformer wiring diagram. Generally no maintenance is required for this device. If the gauge does become inoperative the entire gauge should be replaced.



6.14 Winding Temperature Indicator

Direct measurement of transformer winding temperature is not feasible at present. However, there are ways to simulate the temperature of a winding by indirect measurement. The principle of this system uses a dependable remote temperature indicator that has a sensing bulb surrounded by a heater coil in which flows a current proportional to transformer load to indicate hot spot temperature.



Operation:

The variable resistor is connected between the CT and the heater coil. To operate, the heater coil current is adjusted such that the thermometer reading will simulate the hottest spot temperature of the transformer winding at rated output.

The dial thermometer type permits the hottest spot winding temperature to be read directly from the thermometer on the transformer tank. The thermometer bulb is a thermal element mounted in an oil-tight well which also contains the heating coil. The well extends from the flange welded to the tank wall into the top oil of

the transformer. Since this well is oil tight, the thermometer bulb can be inserted or removed without lowering the liquid level of the transformer.

The indicator dial is calibrated in degrees centigrade. The white indicating pointer indicates the equivalent hottest spot temperature of the winding. The maximum temperature attained since the previous resetting of the pointer is indicated by the orange-red maximum pointer. The orange-red maximum pointer is engaged by the white indicating pointer and carried along with it whenever the white pointer exceeds the setting of the orange-red pointer. The maximum indicator is reset on the thermometer by pressing the reset button which extends from the lower side of the indicator housing.

6.15 Current Transformer (CT)

Most of the time, wiring from the current transformer to the control box is assembled at the factory. If connections are to be made in the field, use the following procedure:

- Isolate all leads not in use to prevent them coming in contact with other leads or grounded parts. Ground one side of the CT secondary unless such grounding will interfere with the proper operation of the associated instruments.
- The secondary circuit of the current transformer must not be left open-circuited. It must be closed either through or by a short circuiting link provided. Remove the short circuiting link after the burden has been connected and replace the short circuiting link before disconnecting the burden.
- If the secondary of a current transformer is open when the primary is energized, dangerously high voltages will exist between the secondary terminals. Though the insulation may remain undamaged it will be necessary to demagnetize the CT before normal operation is resumed.

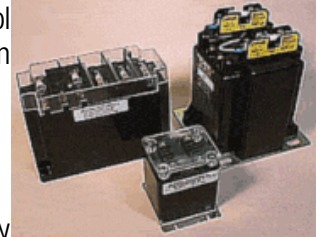


If the secondary of the current transformer has been accidentally opened when line current was flowing in the primary a high peak voltage may have been developed in the secondary, thus causing insulation damage. Ratio tests should be made on the installed CT if symptoms indicate a short circuit condition in the winding.



6.16 Potential Transformer (PT)

Potential transformers are designed for operating meters, instruments, relays and control devices for 60 or 50 Hz circuits up to 5000 V. Units are of molded construction and available in line-to-ground or line-to-line designs, fused or unfused.



6.17 Bay-O-Net Fuse

The Bay-O-Net fuse assemblies are used to protect transformers and distribution systems. They are designed for use in padmounted distribution transformers. The assemblies combine the ease of hotstick operation with the safety of deadfront construction. The optional *Flapper* Bay-O-Net fuse assemblies include a flapper valve inside the housing which closes when the fuse holder is removed. This results in minimal oil spillage from the transformer tank which increase safety to line personnel during fuse change outs.

Removal of the fuse holder from the assembly indicates that the transformer is electrically disconnected. When proper safety practices are followed, the assemblies can be loadbreak-operated for working on the transformer secondary.

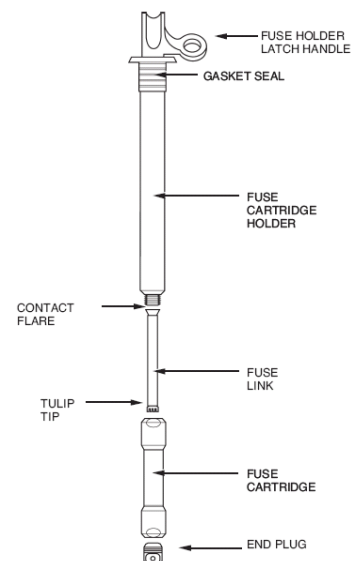
Current sensing, dual sensing, dual element and high ampere overload fuse links can be used in a Bay-O-Net fuse assembly. The assembly must be used in series with an isolation link or current-limiting (CL) fuse to prevent the possibility of a high current fault close-in, even after the fuse link has been replaced. Partial range CL fuses use the low current clearing capabilities of the Bay-O-Net fuse assembly while protecting against high current internal faults that could cause disruptive equipment failure or upstream system damage.



WARNING: Hazardous voltage. Can cause severe injury, death, or damage to equipment. Use a hotstick to service a Bay-O-Net fuse. Do not install a Bay-O-Net fuse to complete an electrical circuit if a fault condition is suspected. DO NOT RE-ENERGIZE suspected failed equipment. After installing Bay-O-Net fuse, energize transformer from a remote upstream source.

Operation:

In a two-fuse protection scheme with a current-limiting backup fuse, the secondary faults and overload currents are cleared by the Bay-O-Net fuse and high level faults are cleared by the CL fuse. The two fuses are connected in series and are coordinated so that the current-limiting fuse operates only upon internal equipment failure. If the Bay-O-Net fuse will not be used in series with a current-limiting fuse, an isolation link is required.



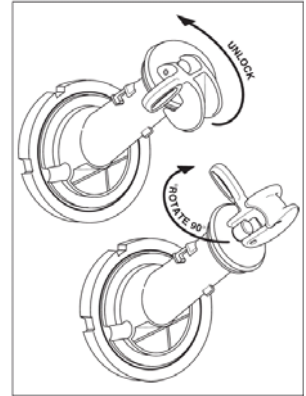


6.17.1 Isolation Link

Isolation links provide extra protection during refusing and switching operations when used in series with a Bay-O-Net fuse. They are not fuses and do not have an interrupting rating. During a transformer failure, the isolation link will melt so that the opened primary circuit of a faulted transformer cannot be re-energized by the line crew.

6.17.2 Current Sensing Fuse Link

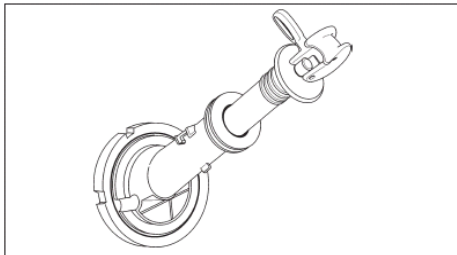
Current Sensing fuse link is used in Bay-O-Net fuse assemblies to protect the transformer from damaging currents and to protect distribution systems from failed apparatus. A Bay-O-Net fuse is ideal for use in a two-fuse protection scheme with a CL backup fuse. The two fuses are connected in series, and are coordinated so that the CL fuse operates only upon internal equipment failure.



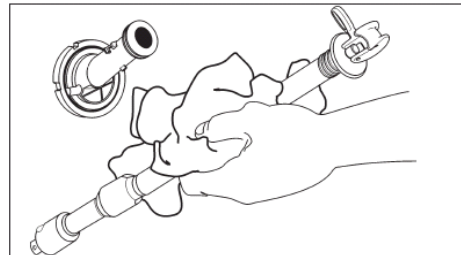
6.17.3 Dual Sensing Fuse Link

Dual Sensing fuse link is used in Bay-O-Net fuse assemblies to protect the transformer from damaging currents and to protect distribution systems from failed apparatus. Dual Sensing links sense not only secondary faults, excessive load currents and transformer faults, but also transformer fluid temperature. They will limit long-term transformer heating caused by overloads and high temperature environments.

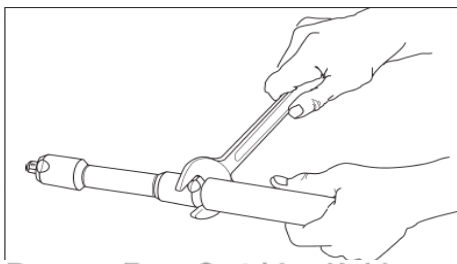
6.17.4 Replace Fuse link



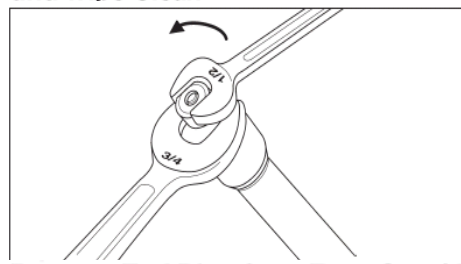
Draw Fuse Holder Out 8 to 10 Inches



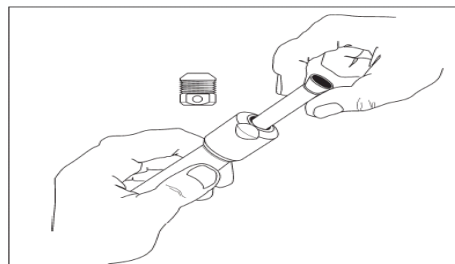
Remove Fuse Holder From Bay-O-Net Housing and Wipe Clean



Remove Fuse Cartridge Holder



Remove End Plug from Fuse Cartridge



Insert Replacement Fuse Link



6.18 Current-Limiting Fuse

The current-limiting (CL) fuses provide both a high interrupting current rating and limit the peak value of current and the amount of energy to within acceptable levels for protection of the transformer. They can be installed under oil or in a dry-well canisters (see below).



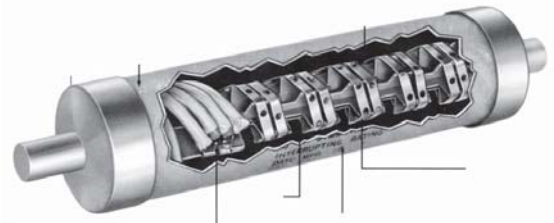
WARNING: Hazardous voltage. Can cause severe injury, death, or damage to equipment. Turn off power to transformer before servicing internal cartridge fuses. Ground transformer following industry accepted safe grounding practices.

Operation:

It consists of one or more silver wires or perforated ribbon elements suspended in an envelope filled with sand. To make the fuse as short as possible, it is normally spiral wound on a high-temperature-resistant, non-tracking form called a spider. The assembly is placed in a tube and filled with high-purity silica sand and sealed at both ends. When operating, the fusible element melts almost instantaneously over its full length. The resulting arc rapidly loses its heat energy to the surrounding sand. This energy melts or fuses the sand surrounding the element into a glass-like tunnel structure called fulgurite.

The rapid loss of heat energy and the confinement of the arc by molten glass fulgurite virtually choke off the current at a relatively small value known as the let-through current. Current interruption takes place in about one quarter cycle.

Due to the fast action of CL fuses at high currents, they should be used in series with Bay-O-Net fuses to provide total transformer protection.



6.18.1 Dry-well Fuseholders for CL Fuses

The dry-well housing consists of filament-wound glass tubing with a resin-rich outer surface. This outer surface serves as the barrier against oil permeating through the tubing wall. In padmounted transformer applications, the dry-well fuseholder is mounted on the transformer front plate, below the oil level. An interlock device can be supplied that prevents opening unless the Loadbreak Switch is in the position OFF.

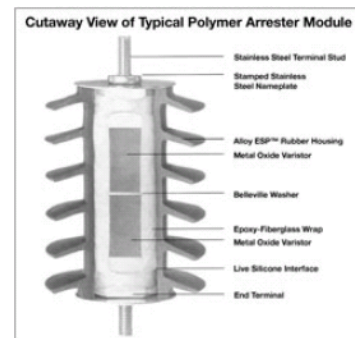




6.19 Lightning Arresters

Lightning arresters are made from high-quality metal-oxide varistors. They are built to withstand a high temporary over voltage and have a surge duty capability.

Some distribution arresters are designed to limit surge voltage by discharging the surge current to ground in under-oil application.



6.20 Neutral Grounding Resistor (NGR)

The prime function of high resistance grounding is to suppress the action of phase-to-ground capacitive coupling of the otherwise undergrounded systems in the development of over voltage conditions between system and ground caused by restriking (arcing) ground faults. Transient line-to-ground overvoltages can be successfully suppressed when the current rating of the neutral grounding resistor (NGR) is made equal to, or slightly higher than the system charging current.

High resistance grounding can be applied to any WYE connected system by connecting a NGR between the WYE point of a transformer and the ground. On DELTA systems connect the grounding resistor between the neutral connection on the Artificial Neutral ground transformer and ground.

The resistor elements are mounted in a ventilated enclosure suitable for surface mounting. Adequate air circulation must be provided to ensure maximum heat dissipation.



The NGR requires no maintenance other than inspection and periodic checking for excessive accumulation of dirt that should be removed at this time. The dirt must be removed with the enclosure cover removed and the unit de-energized.



6.21 Key Interlock

An Interlock System is a series of safety devices applied in such a manner as to prevent or allow operation of the equipment in a prearranged sequence only.

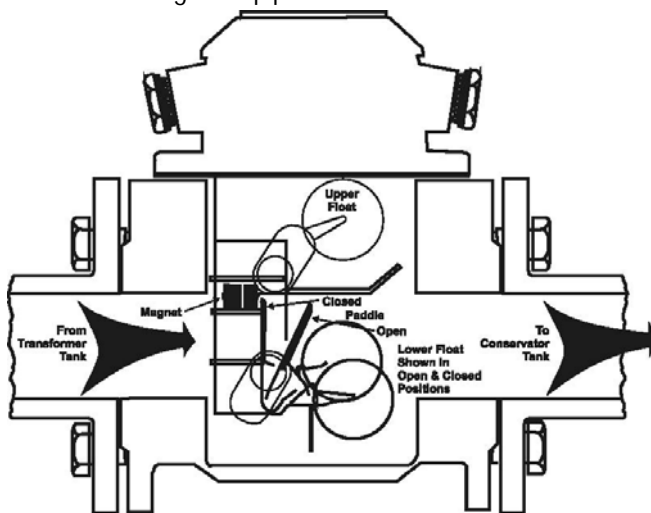
The interlock housings are made of heavy bronze. The locking bolt is 5/8" diameter stainless steel or Everdur rod. The lock is a special 7-pin tumbler lock, simple and of a rugged construction. The lock number is stamped on the face of the lock and also on the key. This serial lock number which applies to the lock and keys provided, and is used as a record for possible replacements and extension of the interlock system.

Each interlock is supplied with a single key. There is no duplicate of this key. The interlock sequence is customized for each application.



6.22 Buchholz Relay (found only on transformers with conservators)

The Buchholz relay has two oil-filled chambers with floats and relays arranged vertically one over the other. If high eddy currents, local overheating, or partial discharges occur within the tank, bubbles of resultant gas rise to the top of the tank. These rise through the pipe between the tank and the conservator.



As gas bubbles migrate along the pipe, they enter the Buchholz relay and rise into the top chamber. As gas builds up inside the chamber, it displaces the oil, decreasing the level. The top float descends with oil level until it passes a magnetic switch which activates an alarm. The bottom float and relay cannot be activated by additional gas buildup.

The float is located slightly below the top of the pipe so that once top chamber is filled; additional gas goes into the pipe and on up to the conservator. Typically, inspection windows are provided so that the amount of gas and relay operation may be viewed during testing. If the oil level falls low enough (conservator empty), switch contacts in the bottom chamber are float. These contacts are typically connected to cause the transformer to trip. This relay also serves a third function, similar to the sudden pressure relay. A magnetically held paddle attached to the bottom float is positioned in the oil-

flow stream between the conservator and transformer tank.

Normal flows resulting from temperature changes are small and bypass below the paddle. If a fault occurs in the transformer, a pressure wave (surge) is created in the oil. This surge travels through the pipe and displaces the paddle. The paddle activates the same magnetic switch as the bottom float mentioned above, tripping the transformer. The flow rate at which the paddle activates the relay is normally adjustable.

Once every 3 to 5 years while the transformer is de-energized, functionally test the Buchholz relay by pumping a small amount of air into the top chamber with a squeeze bulb hand pump. Watch the float operation through the window. Check to make sure the correct alarm point has been activated. Open the bleed valve and vent air from the chamber. The bottom float and switching cannot be tested with air pressure. On some relays, a rod is provided so that you can test both bottom and top sections by pushing the floats down until the trip points are activated. If possible, verify that the breaker will trip with this operation. A volt-ohmmeter may also be used to check the switches. If these contacts activate during operation, it means that the oil level is very low, or a pressure wave has activated (bottom contacts), or the transformer is gassing (top contacts). If this relay operates, DO NOT RE-ENERGIZE the transformer until you have determined the exact cause.



7.0 REPLACEMENT PARTS

When ordering replacement parts, or requesting information regarding an existing transformer, be sure to give the kVA rating and the serial number. This information is on the nameplate and on the supplied drawings. The list of components is on the Outline drawing.

Contact us:

Customer Service
PIONEER TRANSFORMERS LTD
612, Bernard street
Granby, Quebec CANADA
J2G 9H9

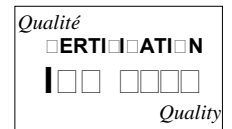
Tel: (450) 378-9018 ext. 302
Fax: (450) 378-0626

E-mail : ilangevin@pioneertransformers.com
Website: www.pioneertransformers.com

“ We make it right the first time ”



TRANSFORMATEURS L.T.E.E.
PIONEER
 TRANSFORMERS LTD.



TRANSFORMERS STANDARD AND SPECIAL WARRANTIES

1. Standard Warranty

Pioneer Transformers (herein called the "Company"), warrants the apparatus contracted for (herein called the "apparatus"), under normal proper use, to be free from defects in material, workmanship and title for a period of one year from the date of shipment by the Company and to be of a kind and quality described in the contract of purchase (or where applicable, the product catalog). The one-year period shall run from the completion of installation, provided such installation is not unreasonably delayed by the Purchaser but in any case shall not exceed 18 months from the date of shipment. In full satisfaction of any claims under this warranty the Company will correct any defect by repair or replacement of defective parts, FOB its factory. The Company shall not be liable under this warranty for any costs, whether direct or indirect, of removing the apparatus to and from the place of repair or reinstallation of apparatus at site, except pursuant to a Special Warranty as hereinafter provided. The conditions of any tests of the apparatus in respect of a warranty claim shall be mutually agreed upon and the Company shall be notified and may be represented at all such tests.

2. Special Warranties

Should the Purchaser's specifications and/or terms and conditions so require, the following Special Warranties may be provided by the Company if agreed to in writing with the Purchaser at the time of entering into the contract of purchase, or at any time prior to shipment.

A. Extended Warranty

The one-year warranty period as stipulated under the Standard Warranty, above, may be extended for an additional period of up to four years, upon the application of the percentage price additions specified in Table A. For periods falling in between those shown in Table A, the next highest percent addition is applied.

B. In/Out Warranty

The direct costs of (i) removing the apparatus from service, (ii) transportation of the apparatus to and from the place of repair, and (iii) re-installation of the apparatus at site, up to a maximum of 50% of the purchase price of the apparatus, may be included under a Special Warranty upon the application of the percentage price addition provided in Table B unless stated otherwise in quote. Under this In/Out Warranty, "direct costs" exclude expenses for removing adjacent apparatus fire walls, installing temporary equipment, incremental costs of supplying service, loss of profits or revenues or any other losses or costs not directly attributable to (i), (ii) or (iii) above. In no event shall the Company be liable under any or all of (i), (ii) and (iii) of this In/Out Warranty for any costs or expenses exceeding in aggregate 50% of the purchase price of the apparatus.

Period of Warranty (Years)	Table A Standard & Extended (Percent Adder)	Table B In/Out Warranty (Percent Adder)
1	0	2
2	0.5	2.5
3	1	3
4	2	3.5
5	3	4

Note: Additions from Table A and B are cumulative. Thus, if 5 years In/Out warranty is required, net percent addition would be 3 + 4 = 7%. If a purchaser requires a 5 year warranty, the first of which is to be on In/Out basis, the net percent additions would be 3 + 2 = 5%.

3. Conditions of Warranties

The Standard and Special Warranties are subject to the purchaser's compliance with the following conditions:

- (i) the Company's instructions for storage, erection, oil processing and scheduled maintenance being followed;
- (ii) the Company's appointment, if in its sole discretion it so decides, of an inspector to assure that the Company's recommended procedures are followed during installation and commissioning or during any moving of the apparatus for reinstallation and recommissioning;
- (iii) the apparatus or any equipment connected to it being operated under normal and proper conditions during the applicable warranty period;
- (iv) the Company being notified promptly in writing of any claim under the said warranties

Failure of the Purchaser to comply with any of these conditions shall render at the option of the Company the warranties herein void and of no effect.

4. Arbitration

Disputes in relation to a claim under the said warranties arising between the Company and the Purchaser as to whether the apparatus or equipment connected to it was operated under normal and proper conditions shall be subject to arbitration, and the decision under such arbitration shall be final and binding between the Company and the Purchaser and shall not be subject to appeal.

5. Limitation of Liability

The liability of the Company under the warranties herein shall in no event exceed the cost of the correction of defects and if applicable, the costs of removal from service, transportation and reinstallation, all as provided under the Special Warranty headed "In/Out Warranty" above. In no event shall the Company be liable for any special, indirect or consequential damages even if the Company has been advised of the possibility of such damages and without restricting the generality of the foregoing the Purchaser specifically agrees that the Company will not be liable for loss of profits or for claims against the Purchaser by any other party. The Company shall not be liable under any of the Standard or Special Warranties herein except in respect of defects occurring within the one-year period stipulated under the Standard Warranty above, or, if applicable, within such longer period as may be agreed upon pursuant to the Special Warranty headed "Extended Warranty" above. Except as otherwise expressly agreed in writing by the Company and the Purchaser, the foregoing warranties are in lieu of all other warranties or conditions whether expressed or implied including but not limited to implied warranties or conditions of merchantable quality or fitness

for a particular purpose and shall constitute the sole remedy of the Purchase and the sole liability of the Company in respect of the sale and/or installation of the apparatus by the Company, whether for a claim under warranties herein or otherwise in connection with the

contract of purchase even if for breach or default entitling the Purchaser to rescind or be discharged from the contract of purchase and whether in the nature of a breach of warranty or condition or fundamental term or a fundamental breach or breaches or whether for negligence or otherwise.

SUBJECT TO CHANGE WITHOUT NOTICE



TRANSFORMER TEST REPORT

Serial number : G15474-1

General information

Date of testing :	November 30, 2009	Tested by:	H.B. / P.D.
Customer :	PBW High Voltage Ltd	P.O :	09-91DC68
Project :	Gabae In Waterloo, Ont	Specification :	CSA C2
Nameplate data :	Flat Front Transformer, 4000 kVA, ONAN PROV. ONAF, 65°C rise 27600 Delta - 600Y/347, Taps : 4-2.5% (+2, -2)		

Tests per CSA C2

- Ratio tested within 0.5% at all connection
- Polarity tested : Three phase, Angular displacement
- Applied voltage HV to LV and Grd at 50 kV for 1 minute. (60 Hz)
LV to HV and Grd at 10 kV for 1 minute. (60 Hz)
- Induce Potential at : 2 X 347 times rated voltage at 400 Hz for 18 seconds.
- Oil leakage test at 50 kPa

Resistance measurements (Ω) @ 19°C

Connection	H.V.		
	A	C	E
H1-H2	0.930	0.884	0.841
H2-H3	0.929	0.884	0.841
H3-H1	0.926	0.881	0.838


Connection	L.V.
X1-X2	0.000423
X2-X3	0.000414
X3-X1	0.000423

Results at 100 % V corrected to 85°C

Serial number	No-load losses (Watts)	% Exciting Current	Load losses (Watts)	I _Z %
G15474-1	3881	0.14	30443	8.05

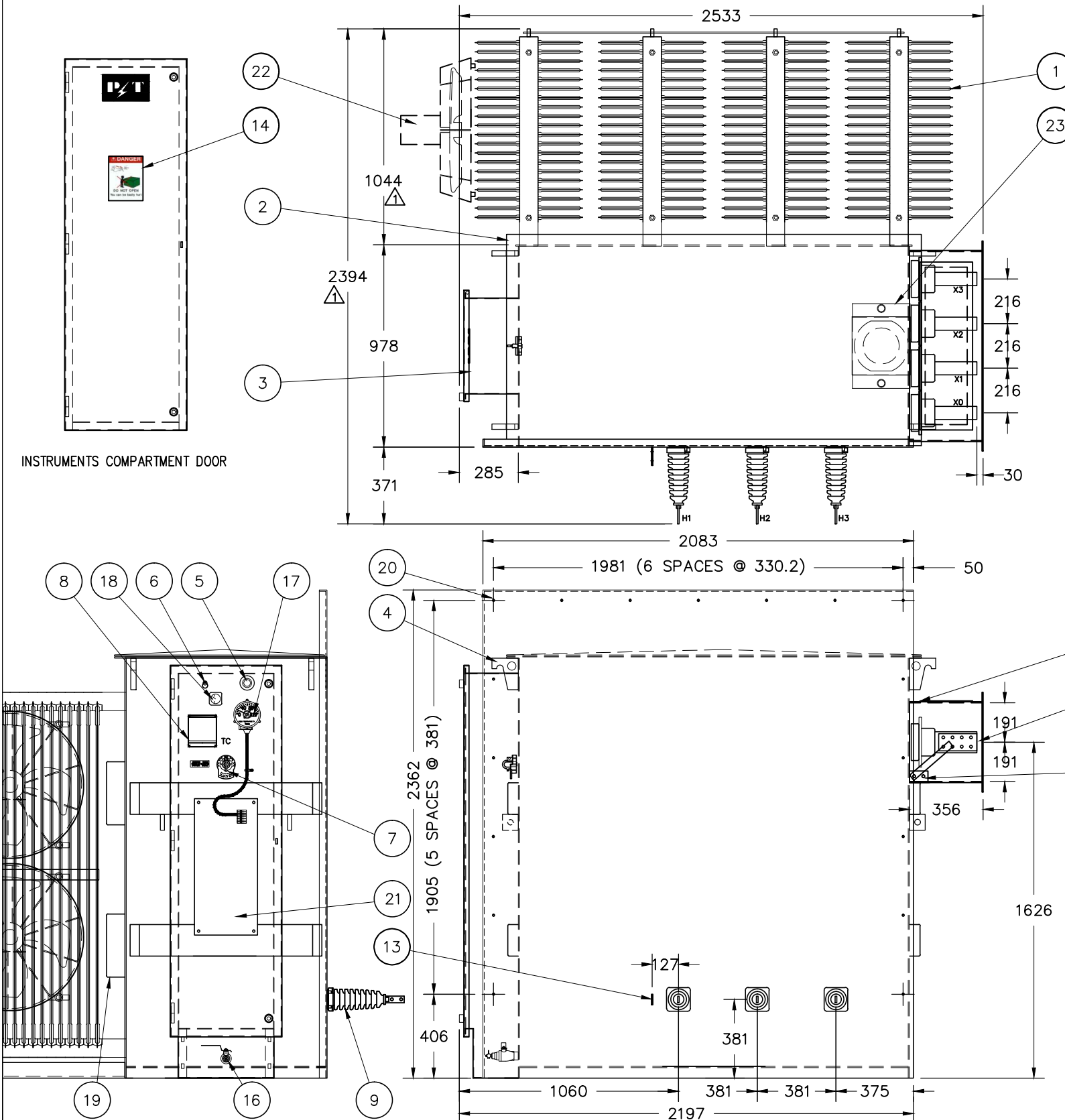
Energy efficiency

Tested efficiency 99.43 % @ 0.50 per unit load
 Minimum efficiency 99.37 % per CSA Standard C802.1-00

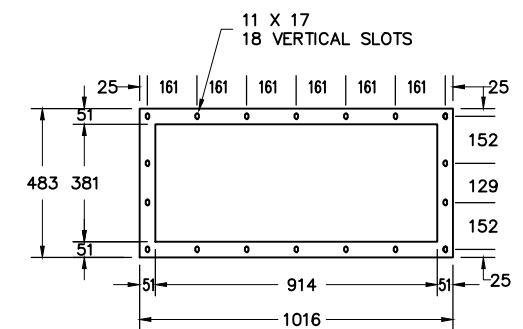
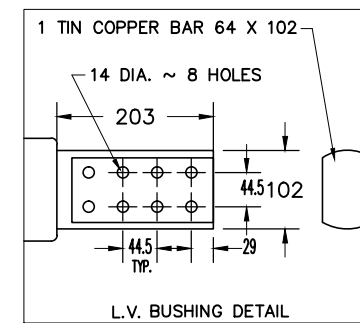
Certified by : 
 Carl Girard, P. Eng.
 Quality Assurance

Date : December 1, 2009

TYPE **ONAN/PROV. ONAF - 3 PHASE PADMOUNT** kVA **4000/PR.5333** H.V. **27600 DELTA** BIL **150 kV** L.V. **600Y/347** BIL **30 kV** TEMP.RISE **65°C** FREQ. **60 Hz.** TAPS. **4- 2 1/2% (2FCAN,2FCBN)** MASS **9790 kg.** OIL **3075 L.**



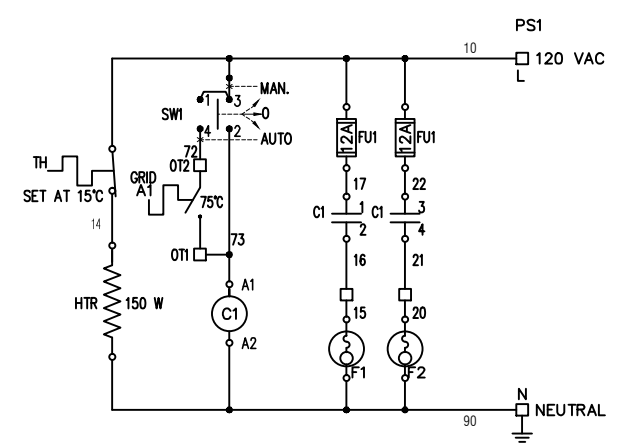
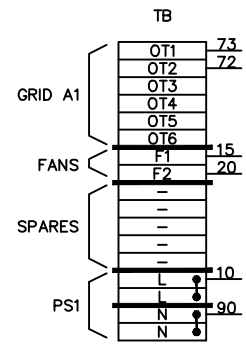
- 1- NON-REMOVABLE COOLING RADIATORS
- 2- BOLTED COVER C/W TAMPERPROOF FLANGES
- 3- TAMPERPROOF CABINET DOOR C/W GROUNDING, PROVISION FOR PADLOCKING AND 2 ~ 1/2"-13 PENTAHEAD BOLTS C/W FIX CUPWASHERS
- 4- TRANSFORMER LIFTING LUGS
- 5- TOP FILTER-PRESS FLANGE, 1" NPT C/W BRASS PLUG
- 6- PRESSURE RELIEF VALVE ~ QUALITROL No. 201-020-08
- 7- EXTERNALLY OPERATED TAP SWITCH HANDLE C/W WARNING DECAL
- 8- AL. NAMEPLATE C/W CONNECTION DIAGRAM
- 9- H.V. BUSHINGS C/W PAD 2 HOLES 9/16" NEMA DRILLING
- 10- L.V. BUSHINGS ~ EPOXY TYPE TIN PLATED C/W 8 HOLES SPADE
- 11- L.V. STAINLESS STEEL BUSHING PLATE (NOT SHOWN)
- 12- X0 S.S. GROUND PAD C/W REMOVABLE STRAPS
- 13- S.S. GROUND PAD
- 14- WARNING LABELS AS PER EEMAC L16-1 ON THE INSIDE & OUTSIDE OF CABINET DOOR
- 15- L.V. THROAT (SEE DETAIL) C/W TAMPERPROOF TOP HANDHOLE (OP.: 762 X 203)
- 16- BRONZE BALL DRAIN VALVE 1" NPT C/W SAMPLING DEVICE
- 17- LIQUID TEMPERATURE GAUGE ~ QUALITROL No. 167-278-01 C/W 2 CONTACTS
- 18- LIQUID LEVEL GAUGE ~ QUALITROL No. 020-031-01
- 19- EXTERNAL STIFFENERS
- 20- 3/8"-16 X 1 1/8" LG. ~ 17 S.S. STUDS
- 21- MOUNTING PLATE FOR FUTURE FAN CONTROL
- 22- FANS, NOT TAMPERPROOF, 24" DIA. 120V, 1 PH., (PROVISION ONLY)
- 23- TAMPERPROOF COVER (USE AT PIONEER FOR VACUUM FILLING)



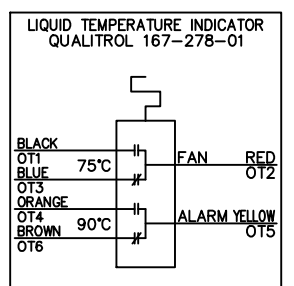
NOTES :
PAINTED FINISH ~ GREY ANSI 70
TRANSFORMER BUILT TO CUSTOMER'S SPECIFICATION
ALL DIMENSIONS IN MILLIMETER
ENERGY EFFICIENCY PER CAN/CSA C802.1-00

△ DIMENSION 1094 WAS 1000 & 2394 WAS 2349, REVISED TOTAL MASS & QUANTITY OF LIQUID. SEP-05-09. P.L.

PBW HIGH VOLTAGE LTD GABAE IN WATERLOO, ONT. 09-91DC68 1 01-079-128 G15474-1 C80-180/TAMPERPROOF AS PER C227.5						
CUSTOMER	CUST. PRODUCT CODE	PURCH. ORDER NO.	ITEM	QUOTATION No.	SERIAL No.	SPEC. No.
ADDITIONS TO THE ABOVE TABLE WILL NOT AFFECT THE REVISION NUMBER OF THIS DRAWING.						
DUP./REF.	TITLE				DWG. NO.	REV.
TOL. ±12mm	TRANSFORMER OUTLINE PADMOUNT FLAT FACE TYPE				G1103B7453	1
SCALE 1 = 22	DESIGNED BY P.L. R:\ACAD\01_103\103B7453.DWG Printed 12/3/09 10:11:44 By Pierre Sévigny					
DRAWN P.L. DATE AUG-19-09	TRANSFORMATEURS LTÉE				PIONEER	
CHECKED P.L. DATE AUG-19-09	TRANSFORMERS LTD					
APP. P.L. DATE AUG-19-09						



NOTE : ACCESSORIES TAGGED WITH A "P" IN THE TABLE ARE NOT SUPPLIED BY PIONEER



A1	A2	A3
A4	A5	A6
A7	A8	A9
A10	A11	A12

— : BARRIER
 ⚡ : JUMPER

ITEM DESCRIPTION	SUPPLIER	CAT. NO.	OTHER INFO.	ITEM	QTY.
FAN 24" DIA.	KRENZ-VENT	A8583 C/W OVERLOAD	1/2 HP, 120 V, 1 PH, 60 Hz	F1-F2	2 P
LIQUID TEMPERATURE GAUGE	QUALITROL	167-278-01		A1	1
POWER SUPPLY	CUSTOMER		120 V.A.C. - 1 PHASE - 60 Hz	PS1	1
THERMOSTAT	HONEYWELL	T498A1927	TEMP. RANGE 0° @ 25°	TH	1 P
STRIP HEATER	WIEGAND	150W120V PTSS	150W, 120V C/A GARDE	HTR	1 P
FUSE	FERRAZ SHAWMUT	ATDR	12A	FU1	2 P
SELECTOR	TELEMECANIQUE	XB4BD33	MAN-0-AUTO	SW1	1 P
CONTACTOR	TELEMECANIQUE	LC1D12G7	1 HP @ 120V, 1 PH - COIL 120 V	C1	1 P
BARRIER	WEIDMULLER	WTW			4
TERMINAL BLOCK	WEIDMULLER	WDU 4		TB	17
GROUND BUS	SCHNEIDER	GLK 12		G	1 P

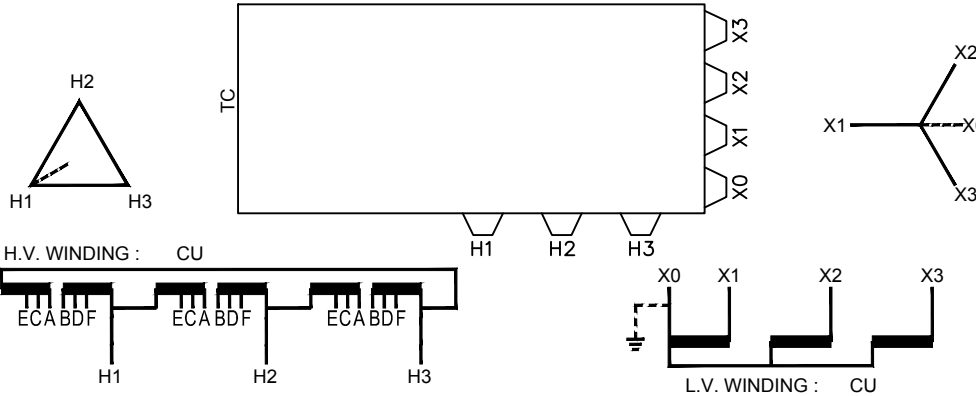
"P" = PROVISION ONLY
 (THIS MEANS THAT THE ACCESSORY IS NOT SUPPLIED BY PIONEER)

→ ITEMS ON TRANSFORMER
 → ITEMS IN INSTRUMENTS COMPARTMENT

PBW HIGH VOLTAGE LTD	CABLE IN OVERLOAD, ONE	09-91DC68	1	01-079-128	G15474-1	
CUSTOMER	CUST. PRODUCT CODE	PURCH. ORDER NO.	ITEM	QUOTATION No.	SERIAL No.	CUST. SPEC. No.
NOTE: ADDITIONS TO THE ABOVE TABLE WILL NOT AFFECT THE REVISION NUMBER OF THIS DRAWING.						
MAT.	TITLE				DWG. NO.	REV.
DUP./REF.	WIRING DIAGRAM POWER TRANSFORMER				G1339C2785	0
SCALE	DRAWN P.L. DATE AUG-19-09				TRANSFORMATEURS LIFE	
CHECKED	DATE AUG-19-09				PIONEER	
APP.	DATE AUG-19-09				TRANSFORMERS LTD	

PADMOUNT TYPE ONAN/PROV. ONAF 60Hz, 65°C

3 PH. 4000/PR. 5333 kVA SERIAL No. G15474-1
 IMPEDANCE AT 85°C (TESTED VALUE) % VOL. OF COOLANT 3075 L
 INSULATION LEVEL 150 kV BIL TOTAL MASS 9790 kg
 H.V. 27600 DELTA V X V
 L.V. 600Y/347 V X V
 COOLANT NON-PCB, CLASS B, TYPE II, MINERAL OIL



OFF-CIRCUIT TAPSWITCH CONNECTIONS (TC)					
POS.	A	B	C	D	E
% V	105%	102.5%	100%	97.5%	95%
VOLTAGE	28980	28290	27600	26910	26220

WARNING! DE-ENERGIZE TRANSFORMER BEFORE CHANGING TAPSWITCH POSITION

P.O. No. 09-91DC68 DATE OF MANUFACTURE 2009

BUILT TO CAN/CSA C88-M90/TAMPERPROOF AS PER C227.5 REF. No.: G1103B7453

G2102A4334-R1



ENERGY EFFICIENCY PER CAN/CSA-C802.3-01

IMPEDANCE :

MINIMUM IMPEDANCE : 7.25%
 MEASURED IMPEDANCE WILL BE STAMPED ON PLATE AFTER TEST

159.2 mm

143.2 mm

⚠ IMPEDANCE WAS 6.26% CALCULATED, REVISED VOL. OF COOLANT & TOTAL MASS. SEP-15-09. P.L.

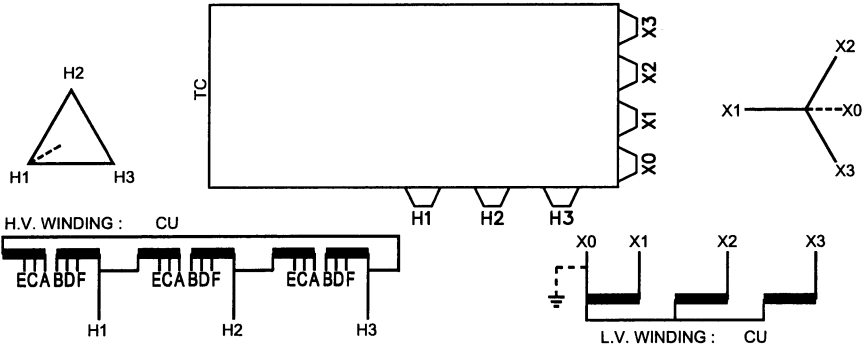
PBW HIGH VOLTAGE LTD	GABAE IN WATERLOO, ONT.	09-91DC68	1	01-079-128	G15474-1	C88-M90/TAMPERPROOF AS PER C227.5	G1103B7453
CUSTOMER	CUST. PRODUCT CODE	PURCH. ORDER NO.	ITEM	QUOTATION No.	SERIAL No.	SPEC. No.	REF. No.

ADDITIONS TO THE ABOVE TABLE WILL NOT AFFECT THE REVISION NUMBER OF THIS DRAWING.

MAT. ANODIZED ALUMINUM 0.8 mm	TITLE	DWG. NO.	REV.
DUP./REF.	NAMEPLATE PADMOUNT AS PER C88/C227.2 DESIGNED BY P.L. R:\ACAD\NP_102\102A4334.DWG Printed 12/3/09 10:11:35 by Pierre Sévigny	G2102A4334	1
SCALE 1=1			
DRAWN P.L. DATE SEP-15-09			
CHECKED P.L. DATE SEP-15-09			
APP. P.L. DATE SEP-15-09			

PADMOUNT TYPE ONAN/PROV. ONAF 60Hz, 65°C

PH. kVA SERIAL No.
 IMPEDANCE AT 85°C % VOL. OF COOLANT L
 INSULATION LEVEL kV BIL TOTAL MASS kg
 H.V. V X V
 L.V. V X V
 COOLANT



OFF-CIRCUIT TAPSWITCH CONNECTIONS (TC)					
POS.	A	B	C	D	E
% V	105%	102.5%	100%	97.5%	95%
VOLTAGE	28980	28290	27600	26910	26220

WARNING! DE-ENERGIZE TRANSFORMER BEFORE CHANGING TAPSWITCH POSITION

P.O. No. DATE OF MANUFACTURE

BUILT TO CAN/CSA C88-M90/TAMPERPROOF AS PER C227.5 REF. No.:

G2102A4334-R1 TRANSFORMATEURS Ltée

ENERGY EFFICIENCY PER CAN/CSA-C802.3-01

PIONEER
TRANSFORMERS LTD

IMPEDANCE :

MINIMUM IMPEDANCE : 7.25%
MEASURED IMPEDANCE WILL BE
STAMPED ON PLATE AFTER TEST

159.2 mm

143.2 mm

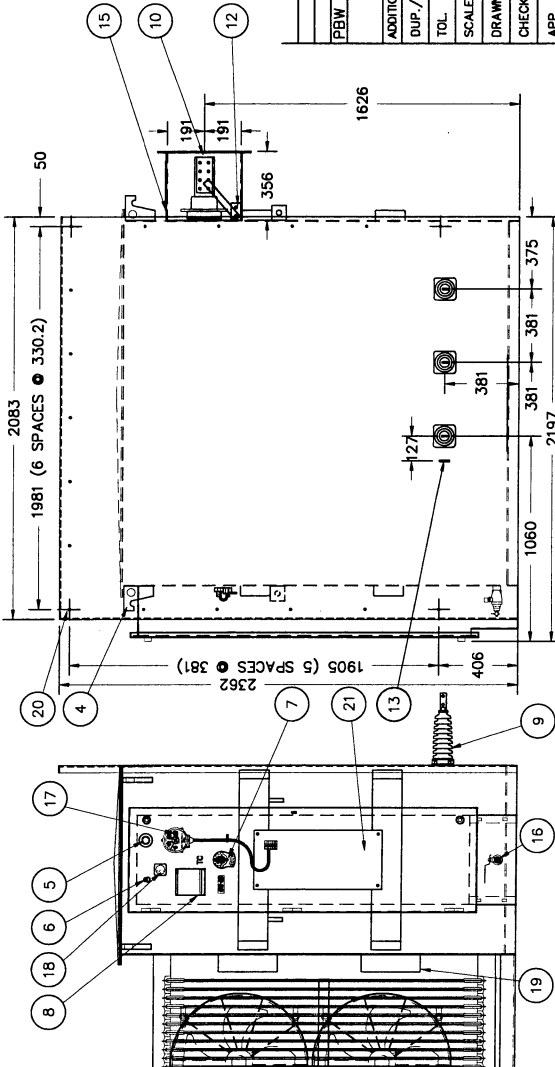
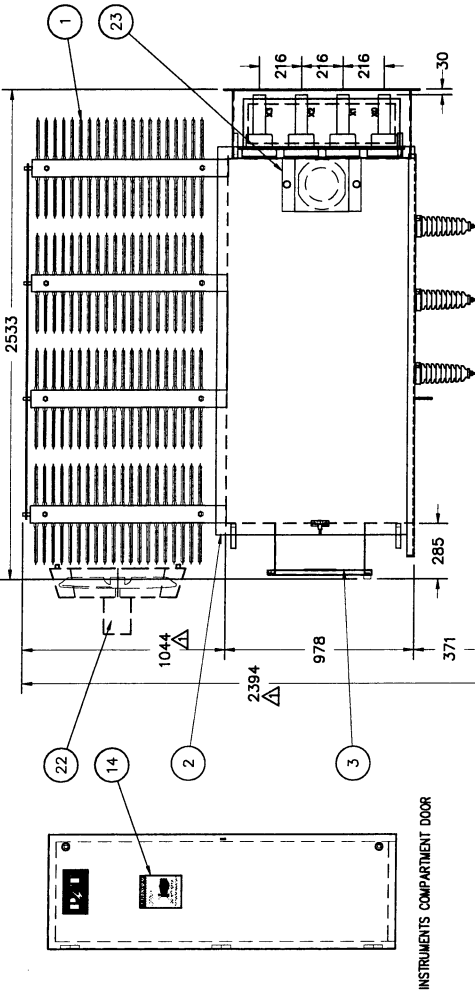
⚠ IMPEDANCE WAS 6.26% CALCULATED, REVISED VOL. OF COOLANT & TOTAL MASS. SEP-15-09. P.L.

PBW HIGH VOLTAGE LTD	GABAE IN WATERLOO, ONT.	09-91DC68	1	01-079-128	G15474-1	C88-M90/TAMPERPROOF AS PER C227.5	G1103B7453
CUSTOMER	CUST. PRODUCT CODE	PURCH. ORDER NO.	ITEM	QUOTATION No.	SERIAL No.	SPEC. No.	REF. No.

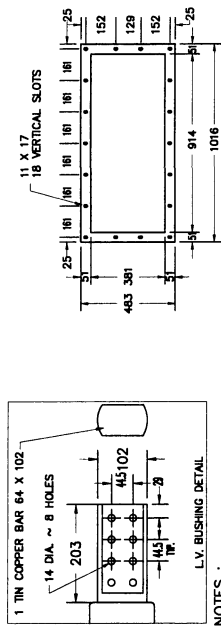
ADDITIONS TO THE ABOVE TABLE WILL NOT AFFECT THE REVISION NUMBER OF THIS DRAWING.

MAT. ANODIZED ALUMINUM 0.8 mm		TITLE		DWG. NO.	REV.
DUP./REF.		NAMEPLATE		G2102A4334	1
SCALE 1=1		PADMOUNT AS PER C88/C227.2			
DRAWN P.L. DATE SEP-15-09		DESIGNED BY P.L. C:\TEMP\102A4334.DWG Printed 9/15/09 2:27:08 by Pierre Loiselle			
CHECKED <i>PL</i> DATE 9/15-09		TRANSFORMATEURS Ltée TRANSFORMERS LTD			
APP. <i>PL</i> DATE 9/15-09					

TYPE **OWA PROJ. DWG - 3 PHASE PUMP/MOT** kVA **4000/PR.5333** H.V. **27600 DELTA** BIL **150 kV** L.V. **600V/347** BIL **30 kV** TEMP. RISE **65°C** FREQ. **60 Hz** TAPS. **4-2 1/2% (2FCAN, 2FCBN)** MASS **9790 kg.** OIL **3075 L**



- 1- NON-REMOVABLE COOLING RADIATORS
- 2- BOLTED COVER C/W TAMPERPROOF FLANGES
- 3- TAMPERPROOF CABINET DOOR C/W GROUNDING, PROVISION FOR PADLOCKING AND 2 ~ 1/2"-13 PENTAHEAD BOLTS C/W FIX CUPWASHERS
- 4- TRANSFORMER LIFTING LUGS
- 5- TOP FILTER-PRESS FLANGE
- 6- PRESSURE RELIEF VALVE ~ QUALITROL No. 201-020-08
- 7- EXTERNALLY OPERATED TAP SWITCH HANDLE C/W WARNING DECAL
- 8- AL. NAMEPLATE C/W CONNECTION DIAGRAM
- 9- H.V. BUSHINGS C/W PAD 2 HOLES 9/16" NEMA DRILLING
- 10- L.V. BUSHINGS ~ EPOXY TYPE TIN PLATED C/W 8 HOLES SPADE
- 11- L.V. STAINLESS STEEL BUSHING PLATE (NOT SHOWN)
- 12- X0 S.S. GROUND PAD C/W REMOVABLE STRAPS
- 13- S.S. GROUND PAD
- 14- WARNING LABELS AS PER EEMAC L16-1 ON THE INSIDE & OUTSIDE OF CABINET DOOR
- 15- L.V. THROAT (SEE DETAIL) C/W TAMPERPROOF TOP HANDLE (OP.: 762 X 203)
- 16- BRONZE BALL DRAIN VALVE ~ NPT C/W SAMPLING DEVICE
- 17- LIQUID TEMPERATURE GAUGE ~ QUALITROL No. 167-278-01 C/W 2 CONTACTS
- 18- LIQUID LEVEL GAUGE ~ QUALITROL No. 020-031-01
- 19- EXTERNAL STIFFENERS
- 20- 3/8"-16 X 1 1/8" LG. ~ 17 S.S. STUDS
- 21- MOUNTING PLATE FOR FUTURE FAN CONTROL
- 22- FANS, NOT TAMPERPROOF 24" DIA. 120V, 1 PH., (PROVISION ONLY)
- 23- TAMPERPROOF COVER (USE AT PIONEER FOR VACUUM FILLING)



NOTES:
 1. PAINTED FINISH ~ GREY ANSI 70
 2. TRANSFORMER BUILT TO CUSTOMER'S SPECIFICATION
 3. ALL DIMENSIONS IN MILLIMETER
 4. ENERGY EFFICIENCY PER CAN/CSA C802.1-00
 5. DIMENSION 1084 WAS 1000 & 2384 WAS 2346, REVISED TOTAL MASS & QUANTITY OF LIQUID. SEP-05-09. P.L.

PBW HIGH VOLTAGE LTD	OWA PROJ. DWG - 3 PHASE PUMP/MOT	09-91DC68	1	01-079-128	G15474-1
CUSTOMER	QST. PRODUCT CODE	PURCH ORDER NO./ITEM	QUOTATION No.	SERIAL No.	SPEC. No.
ADDITIONS TO THE ABOVE TABLE WILL NOT AFFECT THE REVISION NUMBER OF THIS DRAWING.					
DUP./REF.	TITLE				
TOL	TRANSFORMER OUTLINE				
SCALE	PADMOUNT FLAT FACE TYPE				
DRAWN	P.L.	DATE	TRANSFORMATEURS snc		
CHECKED	P.L.	DATE	PIONEER TRANSFORMERS LTD		
APP.	P.L.	DATE	TRANSFORMERS LTD		
DWG. NO.		REV.			
G1103B7453		1			

Appendix D

Frey Building Contractors Health and Safety Manual

**Frey Building Contractors
Health and Safety Manual
Table of Contents**

Section	Description
1	Health & Safety Policy Statement
2	Health and Safety Responsibilities
2.1a	Owner & Employer Responsibilities
2.1b	Manager Accountabilities
2.1c	Supervisor Responsibilities
2.1d	Supervisor Accountabilities
2.1e	Worker Responsibilities
2.1f	Worker Accountabilities
2.1i	Sub-Contractor Responsibilities
2.1j	Sub-Contractor Accountabilities
2.1k	Visitor Responsibilities
3	Posted Health & Safety Materials
4	Health & Safety Standards and Procedures
4.1a	Work Environment Health & Safety Standards
4.2a	Injury/Illness Reporting Procedure
4.2b	Hazards Reporting
4.2c	Emergency Evacuation Plan
4.2d	Emergency Equipment
4.2e	Refusal to Work
4.2f	Lock-out / Tag-out
4.2i	Equipment Purchases/Replacement
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4.2l	Working after hours
4.2m	Violence & Harassment Policy
4.2n	Heat Stress
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6.1b	Worker Training Verification Review
6.1c	Workplace Hazardous Materials Information WHIMIS
6.1e	Certification Policy
6.1g	Employee Orientation

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- 7 First Aid Requirements (Regulation 1101)**
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- 8 Health and Safety Inspections**
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- 9 Preventative Maintenance**

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- 11 Senior Management**
- 11.1a Developing an Action Plan
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- 11.1d Program Review Procedure
- 11.1e Senior Management Inspections

- 12 Early and Safe Return to Work**

Title: **Health and Safety Policy Statement**

Number: 1

Frey Building Contractors

Date of Issue: Oct 2010

Approved by: Sr. Management

Purpose:

To proclaim to all of our employees, subcontractors and clients that at Frey Building Contractors, the safety of our workers is our highest priority.

Responsibilities:

Employer: Every reasonable precaution shall be taken to provide a safe working environment.

Supervisor: All Supervisors on our sites are expected to carry out their responsibilities in a manner which ensures that workers under their authority have the knowledge, training or experience to perform their assigned tasks in a safe manner. All supervisors must ensure that their workers are familiar with the actual and potential hazards of the job to which they are assigned.

Worker: It is mandatory that everyone be familiar with and follow our Health and Safety Program. We welcome any suggestions regarding the improvement of this program.

Your co-operation in achieving these goals for a safe work place is a credit to you as a professional and demonstrates respect for fellow workers and the owners for whom you are working.

SAFETY IS PRIORITY NO. 1

Frey Building Contractors

Ryan Martin, C.E.T.
President

Purpose:

To provide a procedure that outlines the health and safety responsibilities of the owner / employer.

1. Responsibility is defined as an individual's obligation to carry out assigned duties.
2. Prescribed refers to a section of the Occupational Health and Safety Act and Regulations that apply to the work locations.

Roles and Responsibilities:

Employer: As listed in section 25 & 26 of the OHSA an employer must ensure that:

- 25.1. (a) Equipment, materials and protective devices as prescribed are provided.
 - (b) Equipment, materials and protective devices are maintained in good condition.
 - (c) Prescribed measures and procedures are carried out.
 - (d) Equipment, materials and protective devices are used as prescribed.
 - (e) All areas of the workplace capable of supporting all loads to which it may be subjected without causing the materials therein to be stressed beyond the allowable unit stresses established under the Building Code Act.
2. Without limiting the strict duty imposed by subsection 1, an employer shall
 - (a) Provide information, instruction and supervision to a worker to protect the health and safety of the worker.
 - (b) In a medical emergency for the purpose of diagnosis or treatment, provide upon request information in the possession of the employer, including confidential business information, to a legally qualified medical practitioner and to such other persons as may be prescribed.
 - (c) when appointing a supervisor, appoint a competent person.
 - (d) Acquaint a worker or person in authority over a worker with any hazard in the work and in the handling, storage, use, disposal and transport of an article, device, equipment or a biological, chemical or physical agent.

- (e) Afford assistance and co-operation to a committee and a health and safety representative in the carrying out by the committee and the health and safety representative of any of their functions.
 - (f) Only employ in or about the workplace a person over such age as may be prescribed (16 years of age)
 - (g) Not knowingly permit a person who is under such age as may be prescribed in or about a workplace.
 - (h) Take every precaution reasonable in the circumstances for worker protection
 - (i) Post in the workplace, a copy of the Occupational Health and Safety Act and any explanatory material prepared by the Ministry, both in English and the majority language of the workplace, outlining the rights, responsibilities and duties of workers.
 - (j) Prepare and review at least annually a written occupational health and safety policy and develop and maintain a program to implement that policy
 - (k) Post at a conspicuous location in the workplace a copy of the occupational health and safety policy.
 - (l) Provide to the committee or to a health and safety representative the results of a report respecting occupational health and safety that is in the employer's possession and, if that report is in writing, a copy of the portions of the report that concern occupational health and safety.
 - (m) advise workers of the results of a report referred to in clause (l) and, if the report is in writing, make available to them on request copies of the portions of the report that concern occupational health and safety.
- 26.1. Additional duties of employers – In addition to the duties imposed by section 25, an employer shall,
- (a) Ensure that such facilities as are prescribed are provided
 - (b) any facilities prescribed to be provided are maintained as prescribed
 - (c) the workplace complies with the regulations, and no workplace is constructed, developed, reconstructed, altered or added to except in compliance with this Act and the regulations

- (d) where so prescribed, furnish to a Director any drawings, plans or specifications of any workplace as prescribed
- (e) where so prescribed the owner/employer shall not begin an development, alteration, addition or installation to or in a workplace until the drawings, layout and specifications thereof and any alterations thereto have been filed with the Ministry for compliance with the Act and the regulations
- (f) Keep a copy of the drawings as reviewed in a convenient location at or near the workplace and such drawings shall be produced by the owner or employer upon the request of an inspector for his or her examination.

Communication:

The responsibilities for health and safety will be communicated through the health and safety manual, position descriptions and regular training.

Training:

Training for senior management will be conducted by the health and safety committee or designate. The training is to be completed and reviewed every two years.

Evaluation:

This policy will be reviewed annually as part of the complete Health and Safety Manual review.

Title: **Manager Accountabilities**

Number: 2.1 (b)

Frey Building Contractors

Date of Issue: May 2010

Approved by: Sr. Management

Purpose:

It is essential for the effective operation of Frey Building Contractors that the performance of all employees with management responsibilities be assessed annually and that training requirements and promotions be tied to the effective execution of those responsibilities.

Procedures:

Annually during the spring, the senior management team will perform appraisals on management and supervisory staff under their direct control using forms provided by the company. The individuals who are being reviewed, will also perform a self evaluation using a similar form that will be used for comparison purposes and goal setting.

Responsibilities:

Manager conducting review:

Prior to the review, obtain a copy of the current job description, hazard analysis for the position and last appraisal for the individual. Review specific examples of job performance such as project reports, comments from supervisors, incident investigation reports and reviews of specific project profitability and overall company profitability.

The reviewing management team will take the time to meet with the individual and discuss all details of the review and the resulting implications.

Purpose:

To provide a procedure that outlines the health and safety responsibilities of the supervisor.

1. Responsibility is defined as an individual's obligation to carry out assigned duties.
2. Prescribed refers to a section of the Occupational Health and Safety Act and Regulations that apply to the work locations.

Roles and Responsibilities:

Supervisor: As listed in section 27 of the OHSA a supervisor must ensure that a worker:

- 27.1 (a) works in the manner and with the protective devices, measures and procedures required by this Act and the regulations.
- (b) Uses or wears the equipment, protective devices or clothing that the worker's employer requires to be used or worn
- (c) Advise a worker of the existence of any potential or actual danger to the health or safety of the worker of which the supervisor is aware
- (d) where so prescribed, provide a worker with written instructions as to the measures and procedures to be taken for protection of a worker
- (e) take every precaution reasonable in the circumstances for the protection of a worker
- (f) hold periodic safety meetings with his/her crew and provide minutes of these meetings to management for review
- (g) Investigate all accidents/incidents promptly and provide a written report of the findings with corrective measures to prevent a recurrence to Frey Building Contractors head office immediately
- (h) Create and have easily accessible a first aid treatment log book and ensure that the appropriately trained people are identified on each job site as those responsible for administering first aid.

Communication:

The responsibilities for health and safety will be communicated through the health and safety manual, position descriptions and regular training.

Training:

Training for supervisors will be conducted by the health and safety committee or designate. The training is to be completed and reviewed every two years.

Evaluation:

This policy will be reviewed annually as part of the Health and Safety Manual review.

Title: **Supervisor Accountabilities**

Number: 2.1 (d)

Frey Building Contractors

Date of Issue: May 2010

Approved by: Sr. Management

Purpose:

It is essential for the effective operation of Frey Building Contractors that the performance of all employees with Site Supervisor responsibilities be assessed annually and that training requirements and promotions be tied to the effective execution of those responsibilities.

Procedures:

Annually during the spring, the senior management team will perform appraisals on Site Supervisory staff using forms provided by the company. The individuals who are being reviewed, will also perform a self evaluation using a similar form that will be used for comparison purposes and goal setting.

Responsibilities:

Manager conducting review:

Prior to the review, obtain a copy of the current job description, hazard analysis for the position and last appraisal for the individual. Review specific examples of job performance such as Communications, Workplace Inspections, Training, Incident Investigation, Safety Talks, Safety Practices and comments and reviews from staff.

The reviewing management team will take the time to meet with the individual and discuss all details of the review and the resulting implications.

Frey Building Contractors will add the above underlined topics to our Annual Review of Site Supervisor package to adequately cover the pertinent health and safety aspects of the Supervisor review.

Communication:

The health and safety focused annual review package will be introduced for the 2011 annual review of Supervisors.

Title: **Worker Responsibilities**

Frey Building Contractors

Number: 2.1 (e)

Date of Issue: May 2010

Approved by: Sr. Management

Purpose:

To ensure that workers and associates are aware of their legal and Frey Building Contractors Health and Safety responsibilities.

1. Responsibility is defined as an individual's obligation to carry out assigned duties.
2. Prescribed refers to a section of the Occupational Health and Safety Act and Regulations that apply to the work locations.

Roles and Responsibilities:

Worker: As listed in section 28 of the OHS Act a worker shall:

- 28.1 (a) work in compliance with the provisions of this Act and the regulations
- (b) use or wear the equipment, protective devices or clothing that the worker's employer requires to be worn or used
- (c) report to his or her employer or supervisor the absence of or defect in any equipment or protective device of which the worker is aware and which may endanger himself, herself or another worker
- (d) report to his or her employer or supervisor any contravention of this Act of the regulations or the existence of any hazard of which he or she knows
- (e) Not remove or make ineffective any protective device required by the regulations or by his or her employer, without providing an adequate temporary protective device and when the need for removing or making ineffective the protective device has ceased, the protective device shall be replaced immediately.
- (f) not use or operate any equipment, machine, device or thing or work in a manner that may endanger himself, herself or any other worker
- (g) not engage in any prank, contest, feat of strength, unnecessary running or rough and boisterous conduct
- (h) Exercise his/her right to know and undertake the precautions to be taken when working with hazardous materials in the workplace, by reviewing the material safety data sheets for particular material in question and following the instructions outlined, in addition to any further measures for his/her protection.

- (i) Obtain first aid promptly and notify their Supervisor of any first aid situation which becomes a medical aid condition so proper authorities can be notified.
- (j) Practice good housekeeping by maintaining an orderly workplace and placing waste and garbage in receptacles or places provided.

Communication:

The responsibilities for health and safety will be communicated through the health and safety manual, position descriptions, regular training and the orientation process.

Training:

Training for workers will be conducted by the health and safety committee or designate. The training is to be completed and reviewed every two years.

Evaluation:

This policy will be reviewed annually as part of the overall Health and Safety manual review.

Title: **Worker Accountabilities**

Frey Building Contractors

Number: 2.1 (f)

Date of Issue: May 2010

Approved by: Sr. Management

Purpose:

It is essential for the effective operation of Frey Building Contractors that the performance of all employees be assessed annually and that training requirements and promotions be tied to the effective execution of those responsibilities.

Procedures:

Annually during the spring, the senior management team, along with site supervisors will perform appraisals for all staff using forms provided by the company. The individuals who are being reviewed, will also perform a self evaluation using a similar form that will be used for comparison purposes and goal setting.

Responsibilities:

Manager conducting review:

Prior to the review, obtain a copy of the current job description, hazard analysis for the position and last appraisal for the individual. Review specific examples of job performance such as Personal Protective Equipment, Housekeeping, Training, Safety Talks, Safety Practices.

The reviewing management team and site supervisors will take the time to meet with the individual and discuss all details of the review and the resulting implications.

Frey Building Contractors will add the above underlined topics to our Employee Annual Review package to adequately cover the pertinent health and safety aspects of the review.

Communication:

The health and safety focused annual review package will be introduced for the 2011 annual review of all staff. A formal review of our on site accountability policy will be conducted and included as part of the annual review process.

Traffic

1. All vehicles must be driven with caution and posted signs observed.
2. Trucks and other vehicles must not be allowed to stand with engine running while in any building or near any entrance to a building.
3. Mobile cranes and their operators must be licensed as required under provincial legislation.

Housekeeping

1. Aisles, walkways and doorways must be kept clear at all times.
2. Sub-contractors are required to maintain working areas in a reasonably clean and tidy condition. Nails in lumber must be removed or clinched. Material must be piled or stacked. The worksite must be cleaned up daily. Upon completion of the work, the worksite must be cleaned to the satisfaction of Frey Building Contractors site supervisor.
3. Unless specific arrangements to the contrary are made, sub contractors are expected to arrange for removal of their own refuse.

Hazardous Materials

1. All sub-contractors and their employees shall handle potential hazardous material in a manner so as not to cause injury or overexposure. Sub-contractor's employees must be informed on the safe handling procedures of materials with which they will be working.
2. Hazardous material must be handled according to the Federal Area of Labour and the Provincial Ministry of Environment guidelines.

Communication:

The responsibilities for health and safety will be communicated through issuing of this program to all sub-contractors. This is to be issued yearly to all sub-contractors.

Training:

Training us the responsibility of the individual sub-contractor.

Evaluation:

The program will be evaluated through site inspections by Frey Building Contractors site supervisor and/or management staff.

2. Before any work is performed, all sources of energy, and/or motions (including but not necessarily limited to, electrical, mechanical, steam, gas, air, hydraulic etc.) must be made safe and locked out by sub-contractors.
3. The standard method of isolating equipment against operation shall be a tag and padlock by the contractor and company personnel.
4. All locks must be identified with the name of the lock owner, and that of his firm and date and time of the lock being installed.

Personal Protective Equipment and Clothing

1. Sub-contractors will supply their own protective breathing apparatus where required, and ensure that their employees are trained in such equipment.
2. All sub-contractor's employees must wear CSA approved (green patch) safety footwear, hard hats and appropriate eye protection according to the work being performed.
3. When working above a floor surface or when operating an aerial lift, approved safety lines and harnesses must be used, and/or approved secured platform which would prevent one from accidentally falling. All employees who may be working above a floor surface or who would be operating an aerial lift shall have appropriate training in the basics of fall protection and carry their certification card with them at all times.
4. Proper personal protective equipment depends upon the nature of the exposure. This may range from chemical eye and face protection, gloves, to complete body covering. If there is the potential of exposure to a toxic substance or a lack of oxygen, appropriate fresh air breathing apparatus shall be provided and used by competent, trained employees.
5. Reflective clothing may be required in the workplace by sub-contractors.

Services

1. If it is necessary to disrupt any services for construction or installation purposes, prior notice must be given to Frey Building Contractors site supervisor.
2. Qualified workmen must make connections to and disconnection of all services.

Overhead Cranes and Crane Runway & Hoists

1. Under no circumstances is anyone permitted to work or walk on a crane or crane runway, or work in the path of a crane cab, until effective procedures have been established between the sub-contractor and Frey Building Contractors personnel for isolation and lock out
2. Do not, under any circumstances, walk or stand under a suspended load whether moving or stationary.

9. Personnel must always be on the alert for the movement of material handling equipment.
10. Under no circumstances are sub-contractors to use a designated substance as defined by Ontario Ministry of Labour without the prior written consent of Frey Building Contractors supervision.
11. All equipment used must have appropriate guarding.
12. In case of a fire or any emergency contact a Frey Building Contractors supervisor.
13. All electrically powered tools and equipment must be adequately grounded, as per CSA standards.
14. Frey Building Contractors may ask at any time for the training records/certification of the sub-contractors employees.
15. The sub-contractor will supply upon request copies of workplace inspections and safety committee meetings.
16. A copy of the sub-contractors Health and Safety Policy and procedures manual shall be readily available.
17. At no time is the sub-contractor to sub-contract any work without the written permission of Frey Building Contractors.

Hot Work Requirements

1. Sub-contractors are to provide their own 'fire watch' personnel during all welding and burning process. At least (2) 10lb ABC dry chemical extinguishers and a fire blanket must be made available in the immediate area where such process is taking place.
2. Oxygen, acetylene or other similar types of cylinders are not to be left free standing. They must be kept in an upright position and chained or leashed to prevent upsetting. Caps must be in place when cylinders are not in actual use. When cylinders are not attached to the gauges, a firewall or at least 25 feet must separate acetylene and oxygen.
3. During and after welding or cutting operations, a close watch for fire must be observed. The area shall not be vacated until all sparks or smouldering material has been extinguished. All combustible material must be removed from the welding or burning area or covered with fire blankets.
4. Roofing contractors will provide a minimum of (1) 20lb dry chemical extinguisher at the tar pot location and (1) 20lb dry chemical extinguisher at the site of application. Tar pots must not be located within 10 feet of any building or combustible material.
5. Access to all locations of Frey Building Contractors job site must be maintained for emergency vehicles.

Isolation Lockout

1. Sub-contractors must notify the site supervisor of equipment requiring isolation.

Title: **Sub-Contractor Responsibilities**

Number: 2.1 (i)

Frey Building Contractors

Date of Issue: May 2010

Approved by: Sr. Management

Purpose:

1. To ensure that Frey Building Contractors safety rules and the Occupational Health and Safety Act and applicable regulations are adhered to.
2. To ensure the safety of all employees
3. To safeguard the assets of the Company.

Procedures:

Prior to signing an agreement with an outside contractor, the Project Manager from Frey Building Contractors will:

1. Ensure that documents on 'Contractors Safety Practices' have been signed.
2. Sub-Contractors are expected to know, understand and carry out their safety responsibility while at all Frey Building Contractors facilities as indicated by signature on the 'Contractors Safety Practices' document.
3. Receive a copy of the WSIB Clearance Certificate.

General Requirements

1. All sub-contractors in each trade must show proof of good standing according to the Workplace Safety and Insurance Act of Ontario
2. No work shall commence on Frey Building Contractors property until the sub-contractor and the project manager has signed a 'Frey Building Contractors General Safety Work Permit.'
3. The sub-contractor must notify the project manager/site supervisor before any work is started and clearance is obtained.
4. Depending on the nature of the site, sub-contractors employees must not go into any other area than where they are working.
5. Sub-contractor's employees are not allowed on the premises of Frey Building Contractors under the influence of alcohol or incapacitating drugs or medication, nor are such substances to be brought onto the premises.
6. Sub-contractor's employees must not ride in, or on any material handling equipment unless a specific request has been submitted and approved by Frey Building Contractors site supervisor or project manager.
7. All Frey Building Contractors regulatory signs must be observed and adhered to, as well as specific direction given by Frey Building Contractors personnel.
8. Tools and materials must not be left overhead at any time. Frequent thorough inspections must be carried out and documented to prevent the hazard of falling objects.

Training

The site supervisors will train their health and safety representatives on how to properly administer this policy to offending individuals.

Evaluation

This policy will be evaluated annually as part of our overall evaluation of the health and safety manual.

Title: On-site Accountability Policy

Number: 2.1 (j)(i)

Frey Building Contractors

Date of Issue: May 2010

Approved by: Sr. Management

Purpose:

The purpose of this policy is to ensure that everyone that is working on one of our jobsites, adheres to our Health and Safety polices and procedures, with no exceptions.

Procedures:

- Site supervisors shall have this health and safety policy available on-site at all times for reference
- This policy is provided to the offices of all sub trades that are employed on our job sites.
- Prior to commencing work on the site, the supervisor or delegated safety rep, will review with every individual, this policy and the appropriate sections of the health and safety manual making clear reference to the actions that will be taken if not followed.
- Upon becoming aware of an infraction by an individual, the site supervisor or delegated safety rep. will issue a verbal warning, clearly outlining which specific section of our health and safety manual that was not being followed, and demand immediate correction by that individual. The site supervisor will document the nature of the verbal warning that was given and explain to the individual what the consequences are for a repeated infraction.
- If a repeated infraction by an individual or a general disregard by employees of a specific company occurs, a written citation will be issued by the site supervisor to the individual or individuals in contravention. Frey Building Contractors will also send a letter outlining the nature of the infraction, the individual's names and our next course of action to that individuals head office.
- Following the issuance of a written citation, a further infraction will result in those individuals being removed from the site using a written dismissal letter which is also forwarded to the individual's head office. It will be at the discretion of Frey Building Contractors whether the individual will be allowed back onto the job site.

This accountability policy shall be imposed upon anyone who enters our job sites including, but limited to, sub-trades, owners, consultants and any other administrative staff.

Communication

This policy will be communicated through worker orientation and through tool box talks and postings.

Title: **Sub-contractor Accountabilities**

Number: 2.1 (j)

Frey Building Contractors

Date of Issue: May 2010

Approved by: Sr. Management

Purpose:

It is essential for the safe operation of all Frey Building Contractors job sites, that the responsibilities outlined in 2.1 (i) relating to Sub-contractors, be followed and that Frey Building Contractors has measures to hold our sub-contractors accountable for them.

Procedures:

A copy of our Discipline and Accountability Policy which outlines our progressive discipline structure, will be distributed to all sub-contractors prior to them signing our 'Sub-contractor's general safety work permit' document.

Responsibilities:

The site supervisor is responsible for initiating the progressive discipline structure, beginning with a verbal, then a written, followed by removal from site. It is assumed that the head office of the sub-contractor has received a copy of both the sub-contractor responsibilities document as well as our discipline and accountability policy, prior to the sub-contractor commencing work on our job sites.

Communication:

Policy 2.1 (i) and 2.1 (j) along with our discipline and accountability policy will be distributed to all current sub-contractors by September 30, 2010.

Communication:

This program will be communicated through displays at the reception area and by verbal direction from the site supervisor on the job sites.

Training:

Training is to be through the displays and the person signing the visitor's log book.

Evaluation:

The visitors log will be reviewed periodically by the health and safety committee.

Title: Visitor Responsibilities

Frey Building Contractors

Number: 2.1 (k)

Date of Issue: May 2010

Approved by: Sr. Management

Policy:

It is the policy of the company to require that all visitor(s) to Frey Building Contractors facilities and job sites comply with the safety rules and regulations established for employees working at these locations.

Purpose:

A visitor is a non-employee of Frey Building Contractors. Salesperson, consultant, inspector and contractors visiting any company facility. Family members of employees and all part-time employees visiting any Frey Building Contractors facilities where they are not full-time employees are also bound by this policy.

Application:

Visitors will be advised of rules and regulations as they apply to the area of their visits.

Frey Building Contractors is committed to providing and maintaining a safe and healthy work place.

The following rules must be adhered to while at our facilities or job sites:

1. Visitors must check in with reception or site supervisor
2. Warning signs must be obeyed at all times.
3. All visitors to Frey Building Contractors office and/or shop area must remain in the centrally travelled areas and stay clear of any equipment or tools that may be present.
4. All visitors to Frey Building Contractors job sites must wear protective footwear (closed toe shoes) and a hardhat for the duration of their visit.
5. When notified of an emergency the visitor will leave by the nearest exit. The visitor is required to report to the nearest meeting area and report to the person/employee conducting the head count. The designated meeting area for the office/shop is the parking lot across from the office beside Mary Ann's Country Cupboard.
6. Report any hazards or unsafe conditions to the person they are visiting.
7. Report immediately any injuries.

Responsibility:

It will be the responsibility of the management/site supervisor of Frey Building Contractors to enforce this policy.

Attention:

Please note that these documents included are a summary of the document. If certain documents are required contact Frey Building Contractors for a complete copy of the Frey Building Contractors Health and Safety Manual.