Government of Nunavut

Design Brief

Type of Document
Report

Project Name
Coral Harbour Pump House Upgrades

Project Number
OTT-00203694-A0

Prepared By:

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Date Submitted
July 2012

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1 Introduction

The water supply needs for the Hamlet of Coral Harbour (Hamlet) are met using a trucked delivery based system. An essential element of this system is the truck-fill station located adjacent to the water storage reservoir. This truck-fill station includes the following elements:

- A pair of inclined shaft intakes, including submersible pumps and electric heat tracing cables.
- A truck loading arm.
- A chlorine injection system.
- A building that provides protection for the electrical and chlorination equipment.
- A standby generator in an adjacent building.

The Government of Nunavut (GN) has commissioned **exp** Services Inc. (**exp**) to conduct an assessment of the existing truck-fill station. This assessment includes a site visit conducted in late November 2011, a review of the status of the facility with Hamlet representatives and testing of water quality. The assessment provides recommendations regarding opportunities for rehabilitation of the existing facility and the need for replacement of the existing truck-fill station.

Following the completion of the facility assessment, a design brief for new works was prepared. This design brief summarizes the service conditions the new facility should satisfy. Recommendations are provided regarding those works that should be constructed.

The following report summarizes the findings of the site visit and presents recommendations based upon these observations. Recommendations regarding the scope of capital works, together with cost estimates, are provided in this design brief.

2 Community Consultation

Activities within the Hamlet were initiated with a meeting with the SAO and Foreman. During this meeting several concerns were expressed including the following issues.

Regarding the general state of the truck-fill station, the following was noted:

- One of the submersible pumps in the intake from the reservoir is not working.
- Chlorine is measured and logged by the water delivery driver each day. On some occasions unusual chlorine levels are measured. Under some circumstances a portion of the truck contents are drained to adjust chlorine levels. Operational staff is familiar with chlorination with liquid bleach, should the need arise due to the failure of the chlorine metering pump.
- The interior of the truck-fill station is experiencing corrosion. This is specifically an issue with the electrical equipment.

Regarding the truck-fill station site the following issues were expressed:

- No concerns were expressed regarding road access or site drainage.
- There is an abrupt drop-off to the east of the truck-fill that creates a potential for the water delivery trucks to drive over this drop-off.
- It was noted that ravens have recently been observed in the area of the reservoir and truck-fill station.
- Vandalism has not been an issue at the truck-fill station.

The status of the electrical equipment was a specific concern. Specific issues include:

- Much of the electrical equipment is experiencing corrosion. Several items of the electrical equipment are currently not working.
- The external pump control station is no longer working.
- Standby generator starting is no longer automatic and there are challenges with starting the generator due to a questionable battery.
- There are no electricians resident in Coral Harbour. This leads to limited access to assistance to deal with the current electrical issues.

There are no current concerns with the reservoir.

Some comments were provided regarding the reservoir refill system. They included:

- Repairs to the refill pipeline are often required, prior to placing this line into service. In some instances these repairs are required in response to damage by bullets.
- It was noted that the refill pipeline and refiill pump system fall outside the scope of the current assessment.

Near the end of the visit to Coral Harbour a meeting was convened with the SAO. The initial observations and comments developed during the site visit were reviewed. It was noted that the consultant team would be reported to the Government of Nunavut in the immediate future.

3 Facility Assessment

3.1 General Section

The Terms of Reference for this project identified systems and areas of interest, for which an assessment and recommendations are sought. During the site visit these elements of the truck-fill facility were examined. During the course of the site program, some additional issues were noted. The subsequent sections of this report deal individually with these systems. These comments are presented in the form of observations regarding the state of each system, followed by recommendations arising from the observations.

In summary, the existing truck-fill station has been in service for more than 25 years. The building envelopes require some improvements, but they can be considered to be in generally serviceable condition. Almost all of the internal systems and equipment housed within the buildings is in need of upgrade or replacement. The existing buildings do not provide sufficient space to house a water treatment process that meets current drinking water quality guidelines. In view of the scope of the required improvements required for continued operation, combined with the inability to accommodate an appropriate treatment process, complete replacement of this truck-fill facility is felt to be appropriate.

Actions that require immediate action for reasons of worker safety, public health and continuing service have been identified. The need to implement these immediate works is independent of the long term need to replace the facility.

The assessment of the existing facilities includes a review of the mechanical and electrical systems. A more detailed report is attached as Appendix A of this report. The following sections of this report include a summary of the electrical and mechanical issues.

3.2 Site

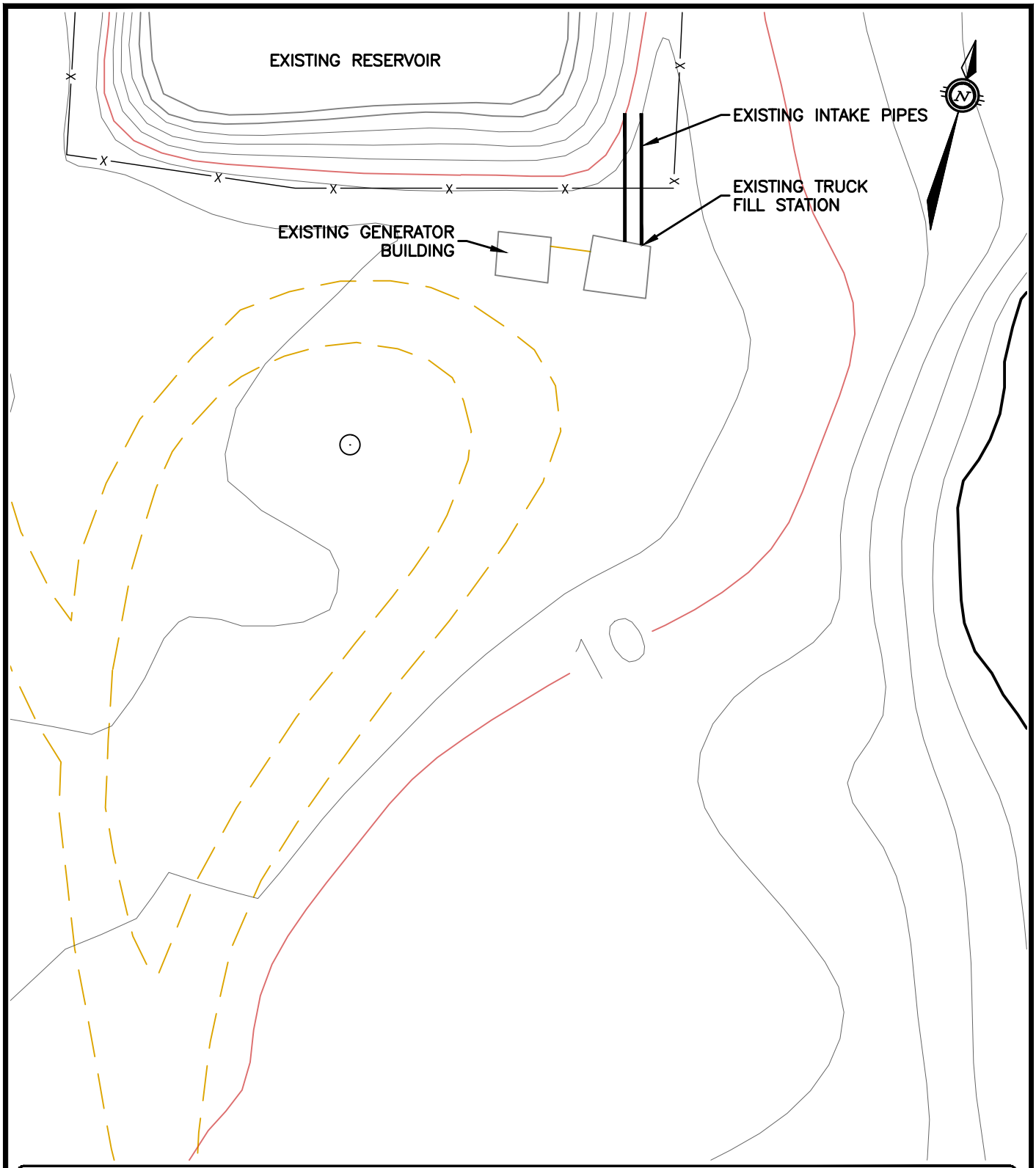
3.2.1 Observations

The truck-fill station is accessed via a turn-around loop that extends from the road connecting the station to the Hamlet as shown on Figure 1. Water service vehicles were observed to easily manage this access to the site. The turn-around loop does not provide direct access by the truck to the loading arm. The truck must advance from the turn-around loop, parallel to the building face, to a point where the loading port on the truck is aligned with the loading arm. This places the front of the truck in close proximity to an unprotected and abrupt drop off. Due to winter conditions during the site visit, the condition of the road could not be observed.

Drainage is generally away from the buildings and reservoir. There are no reports of drainage challenges. Both buildings are sited at a sufficiently high elevation to avoid drainage entry.

3.2.2 Recommendations

In the short term, protection from the drop-off should be provided. This will require the placement of some fill material, together with a substantial barrier. Large rocks might be suitable as a barrier.



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scale 1:500	CLIENT: GOVERNMENT OF NUNAVUT	project no. OTT00203694A
date 30/04/12	TITLE: EXISTING SITE PLAN	FIG1
drawn by S.BUTLER		

3.3 Buildings

3.3.1 Observations

There is a pair of Bally insulated panel buildings, which provides for the separation of the generator from the water handling equipment. Both buildings are mounted on steel skids, which appear to be a variation from the original design drawings, as there is no evidence of a concrete slab being provided. Neither building demonstrated undue distress. All of the walls were generally plumb.

Both buildings, which are each approximately 4.7 metres by 3.5 metres, provided sufficient space for the functions that they currently house, but there is no separation between the chemical handing area and the other functions within the building. There is insufficient space within the buildings to accommodate any additional equipment.

The insulation system of the truck-fill building appears to be adequate, as comfortable temperature were maintained despite outdoor temperature below -25^{0}C. Comments cannot be provided regarding the insulation performance of the generator building as the installed heating is small in capacity and incapable of raising the building temperature to comfortable levels. There is some degree of heat loss between the frames and the doors of both buildings due to missing weather stripping and gaskets. A portion of the insulation in the wall penetration for the intake for pump P2 has been removed.

It was also noted that the original latch on the truck-fill station door had been replace by a locally fabricated mechanism. Much of the paint has peeled from the truck-fill building wall, but the underlying steel appears to be protected by a galvanized coating.

It appears that the generator building has sustained some damage in the south-west corner. This damage has been repaired.

In summary both building are currently meeting requirements.

3.3.2 Recommendations

No immediate recommendations are provided in connection with the existing buildings beyond replacement of the insulation in the wall penetration for P2. The principal issues noted, in connection with the buildings, are the inability to accommodate any additional equipment and the lack of separation of chemical handling from other activities within the buildings. This is independent from the general observation that all of the equipment contained within the building is deteriorated and that most systems require replacement.

3.4 Water Treatment Process

3.4.1 Observations

Water samples were taken during the site visit to confirm water quality and to identify parameters that may have an implication upon the selection of a water treatment process. The analytical findings for these samples are presented in Appendix B of this report. In general, the samples indicate that the raw water can be treated to meet the requirements of the Guidelines for Canadian Drinking Water Quality and no parameters were identified that would have an adverse impact on treatment processes.

Water treatment in Coral Harbour is currently limited to chlorination. The control system for the truck-fill station was design to provide operation of the chlorine metering pump while the water supply pump is in operation. This control system is currently not in service. The truck driver manually starts and stops the metering pump at the beginning and end of each delivery truck refill. Chlorine is measured and logged daily, using a sample taken from the delivery truck. Over the period of November 21 to 23, 2011, the total chlorine was logged as between 0.24 and 0.38 mg/L, and free chlorine was logged as between 0.20 and

0.26. The chlorine solution metering pump was found to be in serviceable condition and appeared to be appropriate for this service. A spare chlorine solution metering pump was noted during the site visit.

The chlorine injection point is situated on the discharge piping, immediately before the point where this piping leaves the building. Thus, there is no meaningful contact time prior to discharge into the delivery truck. The nearest customers are located within 500 metres of the truck-fill station. The resulting short travel time gives rise to insufficient contact time, prior to delivery. There is no opportunity to install storage to assure appropriate contact time prior to dispensing into the delivery trucks, as there is no space available within the existing building for additional equipment.

The Guidelines for Canadian Drinking Water Quality direct that water taken from a surface source should be filtered to meet health-based turbidity limits and that disinfection is provided. No filtration is currently provided, and there is insufficient space within the existing building to provide filtration.

In summary, the existing water treatment process does not meet the requirements of the Guidelines for Canadian Drinking Water Quality and there is insufficient space within the building to accommodate the equipment required to meet these guidelines.

3.4.2 Recommendations

In the short term, sufficient functionality in the control system should be restored to assure automated operation of the chlorine metering pump when the water supply pump is in operation.

Filtration and sufficient contact time must be provided to achieve conformity with the Guidelines for Canadian Drinking Water Quality. There is insufficient space within the current building to provide either of these functions. The development of a design of a water treatment process that conforms with the guidelines will provide the opportunity to evaluate alternative disinfection and filtration processes.

3.5 Mechanical Systems

3.5.1 Observations

The piping within the truck-fill station displayed some modest external corrosion, but was found to be generally serviceable. No specific need for action was noted. It was observed that the piping supplying water to the chlorine mixing tank had been cut off. Reinstatement of this piping would be some convenience to the operator, but it appears that the chlorine mixing tank has been filled from the delivery truck dispensing hose for some period of time. This repair is not viewed to be essential as chlorine solution is mixed on a few occasions each month.

Heating within the truck-fill building was originally provided by infrared radiant heaters. These heaters are not currently in service. Heating is currently provided by an electrical unit heater with an internal fan. The arrangement is capable of heating the building to a comfortable temperature.

There is no ventilation provided in the truck-fill building. This lack of ventilation may be exacerbating corrosion issues associated with dust from the chlorination chemicals.

Within the generator building both of the originally installed electric unit heaters are no longer in working order. A smaller portable electric heater has been installed. In that it is not intended that the generator building be heated to provide a shirt sleeve level of comfort, the current equipment is meeting the heating requirements within this space.

The generator building was provided with an air intake and an exhaust fan. Both the intake and exhaust were also provided with motorized louvers, and this system was integrated into the controls for the generator. The automated controls for the generator are currently not serviceable. The linkages have been removed from both motorized louvers and they have been sealed closed. The required ventilation during generator operation is likely achieved through opening the door.

3.5.2. Recommendations

With regards to the truck-fill building, no short term improvements have been identified. Beyond the short term, the scope of recommended works is tied to the long term fate of the current building. A decision to bring the facility into conformity with current filtration and chlorine contact time criteria would require the provision of a new building. Should the decision be reached to not provide filtration and chlorine contact, then consideration should be given to improving ventilation and dust and vapour management. Better management of the dust and vapour arising from the chlorination chemicals will reduce the rate of corrosion damage to the electrical equipment.

Restoration of the motorized supply and exhaust louvers, together with confirmation of the operation of the exhaust fan is required if automatic operation of the generator is to be restored. These works would be integrated into a program that includes restoration of automatic generator start and transfer functions.

3.6 Truck-Fill Arm

3.6.1 Observations

The truck-fill arm was noted to be in good condition. It did not display obvious damage to vehicle traffic. The electrical heat trace appeared to be functional. No operating challenges were reported by Hamlet officials or operating staff.

3.6.2 Recommendations

No recommendations for short term action are provided in connection with the truck-fill arm. In the long term, a new truck-fill arm will be required as part of the replacement truck-fill station.

3.7 Electrical Equipment

3.7.1 Observations

Comments within this section are limited to the power supply equipment. The control portions of the electrical system are dealt with in other sections of this report.

The main supply circuit breaker, a pair of panel boards and the generator automatic transfer switch are located in the generator building. All of this equipment appears to be part of the original installation. With the exception of the transfer switch, this equipment appears to be in serviceable condition. Within the transfer switch there was evidence of internal damage that included black residue on the enclosure door and blackening of the insulation on some of the internal wiring. The functionality of the transfer switch could not be confirmed as the generator could not be started.

The standby generator could not be tested during the site visit, and it was reported that the starting battery was dead. This generator has accumulated 1846 hours of running time since being placed in service in 1985. It was also noted that the engine block heater was cold and that there was no battery blanket. No logs of generator tests or servicing were available.

A pair of panel boards in the truck-fill station is fed from the generator building. One of these panel boards supports the heating loads within the truck-fill station, while the second supplies all of the remaining loads. A contactor has been installed, which disconnects the heating loads when the water pumps are in operation, or when the station experiences a loss of power. The panel boards and the contactor are replacements of the equipment that was originally installed. All of the electrical equipment in the truck-fill building is displaying corrosion that is likely due to the disinfection chemicals. It is reported that original equipment was replaced because of excessive internal corrosion. The existing electrical equipment has a limited remaining service life.

There is a pair of motor starters for pumps P1 and P2. It is reported that pump P2 is not serviceable. It was also reported that the starter for pump P1 had failed and that the internal parts from the starter for pump P2 had been transfer to the enclosure of the starter for pump P1. At the time of the site visit, the starter for pump P1 was not functionally properly. Pump operation was achieved by opening the enclosure of the starter and mechanically closing the contactor with a metal rod. The pump was then started by closing the appropriate circuit breaker. This represents a worker safety hazard that should be addressed at the first opportunity. This is independent of the risk of damage to the pump due to a lack of overload protection.

The alarm system is currently not serviceable. There is no remote indication of power status or building heating failure.

3.7.2 Recommendations

Repairs to the starters for both pumps P1 and P2 are required immediately. These repairs should be coordinated with repairs to the controls, which are examined in a subsequent section of this report.

Surveillance of the panel board within the truck-fill building is required as corrosion within these panel boards is ongoing. Timing of the need for replacement of these panel boards is challenging as rate of corrosion and its impact upon the serviceability of this equipment is difficult to predict. A long service life should not be expected for the electrical equipment within the truck-fill building.

The long term serviceability of the standby generator and transfer switch is questionable. Replacement of both is in order if the existing facility is to remain in service for an extended period of time. As has been noted above, provision of a water treatment process that conforms to current standards would require the construction of a larger building. This new building should incorporate a new standby generator. In the short term there are two alternative responses. The existing generator can be decommissioned. This would deprive the community of a water supply, both domestic and fire, during a power failure. The extend of freeze damage, in the event of a power failure, would likely be limited to the chlorination system as the water supply piping drains to the reservoir. Should it be concluded that the generator should remain in service, a new battery, battery blanket, block heater, transfer switch and generator controls should be acquired and the functionality of the generator must be confirmed.

An alarm system, complete with an autodialer and external strobe light should be provided. This system should monitor the power status of the facility and the internal temperature within the truck-fill station.

3.8 Controls

3.8.1 Observations

Independent control systems have been provided for water pump operation, heat trace control and automatic generator start.

The controls associated with the water loading pumps are a relay based system that is currently not in service. The functionality and serviceability of these controls could not be confirmed during the site visit. This was due, in part, to the condition of the pump starters, which are currently engaged manually using a metal bar. This mode of operation represents a worker safety hazard that should be addressed at the first opportunity. The lack of a functioning control system requires entry into the building to start and stop the water pumps, as the external control station is no longer in service. This operating methodology has also removed the programmed time delay between pump cycles that was provided to assure complete pump drainage prior to the restarting of the pump.

Independent heat trace controllers have been provided for pumps P1 and P2. The heat trace for pump P1 was energized, but there are no thermistors along the piping to sense temperatures. Thus, the heating cable is energized, but the rate of heat input is not controlled. The heat trace controller for pump

P2 was energized, but there is currently no heat trace cable connected to this controller. As in the case of the controls for P2, there are no thermistors. Both the heat trace and pump P2 are currently out of service. The current installation will not provide control, should the associated heat trace be returned to service.

It was not possible to confirm the status of the controls for the standby generator. It is reported that the generator no longer starts automatically, but the reason for this issue could not be defined. It was noted that the generator starting battery is dead. It was also noted that the automatic transfer switch is in a questionable state, and that it no longer transfers load automatically.

As a general observation, all of the controls located within the truck-fill building have experienced significant internal corrosion. This was observed in the form of corrosion at the various connection points. The degree of observable corrosion suggests that the internal contacts, such as those within the relays, have been affected.

3.8.2 Recommendations

In the short term a rudimentary control system that resolves the worker safety hazard and permits push button starting of the pumps should be provided. This system could take the form of an external and an internal push button control station with running lights and a key lock for the external station. These works can be integrated with the repairs to the pump starters. These works should be conducted at the first opportunity to resolve the worker safety issues.

Although it is noted that the heat trace controllers are not functional, it is noted that the heat trace for pump P1 is still in service. This arrangement can remain in service until the various issues associated with pump P2 are resolved. At that time both heat trace controllers should be replaced as their remaining life is impossible to predict.

Actions associated with the generator controls are driven by the decision regarding the ongoing necessity for a standby generator. Retaining the generator in service will require the replacement of the controls and transfer switch. Long term actions in regards to the controls will be driven by the long term status of the truck-fill station. The deterioration of the equipment housed in the truck-fill station, together with the water treatment issues will likely lead to the decision to replace the existing facility, which would include a new control system. Should the current facility be retained, a new control system must be provided.

3.9 Intake

3.9.1 Observations

There is a pair of inclined shaft intakes that extend down a ramp in the north-east corner of the reservoir. These shafts were constructed using HDPE piping that is protected from freeze by factory installed polyurethane insulation and an external jacket. For safety reasons, the field party did not climb down the ramp or onto the ice surface. Comments are based upon visual observations made during winter conditions.

The intakes do not display indications of movement and the ballast blocks appear to be intact. The piping and insulation jacket did not display signs of distress or vandalism. Comments cannot be provided regarding the condition of any intake screens.

3.9.2 Recommendations

No short term recommendations are presented as regards the intakes. A future reconstruction of the truck-fill station may require extension of these intakes. The existing intakes are suitable for incorporation into the design of a new truck-fill station.

3.10 Intake Pumps and Heat Tracing

3.10.1 Observations

3.10.1.1. Pumps

Both intake pipelines contain a submersible pump located near the bottom of the intake casing. These pumps cannot operate simultaneously as the Tech-Taylor valve on the discharge piping permits flow from only one pump at any given time.

The drawing and operations and maintenance manual reports these pumps to be Grundfos model SP-45-2, 2-stage, equipped with 5 HP 208 volt 3 phase motors. The reported performance of these pumps is 1000 L/min at 215 kPa.

Pump P1 is currently in service and pump P2 was reported to have failed. Thus, there is currently no redundancy against failure of the remaining water supply pump.

Nameplates for the electric motors of both pumps have been affixed to the truck-fill station wall. The nameplate for pump P1 was blank. Discharge from pump P1 was measured through the timed filling of an estimated volume into the delivery truck. The estimated pump discharge was 770 L/min. This estimated discharge, together with the measured pump motor running current suggest that P1 is comparable to the pump originally specified. There is a high likelihood that pump P1 is an original pump.

Pump P2 is a replacement of the original equipment. The nameplate information for the electric motor indicates that this is a 7.5 HP pump. The nameplate also notes that this is a 230 volt 3 phase motor. The supplied electrical power within the truck-fill station is 208 volts, 3 phase. Ongoing operation at low voltage may have had an implication in the failure of pump P2. It has been reported that a replacement for pump P2 has been ordered. No information has been made available regarding the technical features of this replacement.

3.10.1.2. Heat Tracing

Each intake was initially provided with a pair of heat trace cables, with one cable in service and the second available as standby. For pump P1, one heat trace cable was in service. The measured current was consistent with the heat trace load indicated on the as-built drawings. The measured resistance of the standby heat trace cable was lower than anticipated. This suggests that this standby cable may be faulted and is likely not serviceable.

The intake for pump P2 is currently equipped with a single heat trace cable. It is likely that a single cable was provided when the pump was replaced. This cable was not in service. Measured resistance of the cable suggested that it may currently be an open circuit. During the field visit the consultant team did not connect this cable to test its function, as there was some uncertainty of the potential impact upon the heat trace controller.

Earlier in this report is was note that the control thermistors were no longer in place and that the heat trace controllers had experienced significant internal corrosion.

3.10.2 Recommendations

The ongoing operation of pump P1 should be monitored. The ongoing deficiencies with the starter for this pump place the pump at risk of failure. Resolution of the issues with the starter is especially important, in that this is the only water supply pump that is currently serviceable.

Pump P2, together with the associated heat tracing requires replacement. This may prove to be challenging under winter conditions as there is likely a plug of ice in that portion of the casing within the ice on the surface of the reservoir. It should be confirmed that voltage requirements of the replacement

pump are compatible with the electrical supply in the truck-fill station. The starter and station controls must be repaired as part of the pump replacement program.

New heat trace controllers should be provided for both intakes as part of the program to replace pump P2. The heat trace for pump P2 should be replaced as part of the pump replacement program.

The challenges anticipated with the replacement of pump P2 emphasize the need to resolve the issues with the starter for pump P1.

In the longer term, replacement of both pumps will be required. This will be determined during the course of the design based upon hydraulic losses along the new water treatment process, together with the discharge requirements dictated by domestic and fire supply demands.

3.11 Fuel System

3.11.1 Observations

The fuel system is limited to that equipment required to provide a supply to the standby generator. The fuel system includes an external tank at the generator building and some internal piping. The external tank has been placed within a welded steel box with an open top. The box appears to be large enough to contain the tank contents, subject to the tank not being filled with ice, snow or water. During the site visit it was noted that the tank was filled with ice and snow to between ¼ and ⅓ of its depth. It was also noted that the globe on the tank gauge was broken.

Within the generator building the fuel system is limited to piping along the building floor and flexible tubing at the generator. There is a modest amount of fuel staining on the generator building floor. There is no means to contain a fuel spill within the generator building. No spill containment materials were noted during the visit.

The risk of a fuel spill is an especially sensitive issue as the generator is adjacent to the community water source.

3.11.2 Recommendations

The recommendations regarding the fuel system are driven by the requirement to mitigate the public health risk arising from the potential for a fuel spill in close proximity to the Hamlet water supply. There are two alternative means of managing this risk. The generator can be decommissioned and all fuel removed from the site, or a new fuel system that conforms to current code requirements can be provided. Decommissioning of the existing generator should also include a replacement method of providing electrical power in the event of a power failure.

3.12 Summary

The preceding sections of this report have provided a “snap shot,” of the current condition of the truck-fill facility in Coral Harbour. In general, the buildings continue to provide service that is consistent with the intent of the original design. All of the systems within the buildings demonstrate substantial deterioration, and restoration of the originally functionality would require replacement of all of the internal systems. It is also noted that the existing truck-fill building cannot accommodate any additional equipment. Thus, the existing facility cannot be brought into conformity with current guidelines in terms of chlorine contact time or the health-based turbidity parameters as set out in the Guidelines for Canadian Drinking Water. On this basis a complete replacement of the truck-fill station, including all of the internal systems and the supply pumps situated in the inclined shafts, is recommended.

Independent of the general observations presented above, issues that require more immediate attention have been identified. The need for immediate attention arises from concerns for public health, worker safety and the desire to maintain service. The following tables summarize the issues requiring immediate attention.

Table 3.1 - Actions Required Immediately

System	Nature of Risk or Issues	Action
Fuel system	Public health risk due to potential fuel spill	Decommission generator, or replace fuel system
Starter for pump P1 and P2	Worker safety	Replace damaged starters
Water supply pumps and heat trace	Loss of service	Replace pumps; replace heat trace
Alarm system	Faults unreported outside of working hours	Replace alarm system, including dialer and strobe.

Table 3.2 - Short Term Improvements

System	Nature of Risk or Issues	Action
Pump controls	No exterior pump controls	Provide simplified pump control system
Heat trace controllers	Loss of service	Replace controllers (P1 and P2)

Table 3.3 - Long Term Improvements

System	Nature of Risk or Issues	Action
Truck-fill facility	• Extensive system deterioration • Cannot provide required treatment	Provide new truck-fill facility

4 Design Brief

4.1 Introduction

An essential element of the water supply system in Coral Harbour is the water delivery truck-fill station. The existing station, which is adjacent to the water reservoir, was constructed in 1985. A recent assessment of this facility has determined that replacement is the most appropriate strategy. The following report is a design brief for a new truck-fill station for Coral Harbour.

The scope of this design brief is limited to the truck-fill station, and an assessment of the existing water reservoir has not been undertaken.

4.2 Service Conditions

4.2.1 General

The service conditions that the truck-fill station must respond to have been identified. These included the anticipated population, water consumption, water quality requirements and truck loading requirements.

4.2.2 Population

The Nunavut Bureau of Statistics has published population estimates for the various communities in Nunavut. Table 4.1, presented later in this section, summarizes the Bureau of Statistics estimates over the design period.

4.2.3 Water Consumption

The Water and Sewage Facilities Capital Program Standards and Criteria (July 1993) provides criteria for the estimation of water consumption. For communities that make use of trucked water and sewage services, the base water consumption rate is assumed to be 90 litres per capita day (l/c/d). In addition an allowance must be made for non-residential water uses such as commercial, institutional and industrial demands. The total community water use per capital is estimated using the following formula.

PCC = RWU (1.0+0.00023 x Population)

Where: PCC is per capita consumption, and

RWU is the residential water consumption (90 l/c/d)

The truck-fill station must meet the maximum day demands of the community. The maximum day factor is a function of the service population. A maximum day factor of 2.75 has been assumed when the population is less than 1,000. The maximum day factor is reduced to 2.50 when the population exceeds 1,000.

The proposed truck-fill station must have sufficient capability to fill sufficient numbers of trucks to meet the needs of the community during a working day. This requires that an estimate of the number of truck-loads required during a day be prepared. In the development of this estimate, it has been assumed that each delivery truck will have a capacity of 12,700 litres. These trucks are somewhat larger than the current trucks, but there has been an on-going general movement towards larger trucks as a method to improve delivery system efficiency.

The following Table 4.1 summarizes the assumptions relating to population, water use and the required numbers of truck fill over the design period.

Table 4.1 - Population and Water Demand Estimate

Year	Population	Daily Water Demand				Truck-Loads
		RWU (l/c/d)	PCC (l/c/d)	Average Demand (l/d)	Max Day (l/d)	
2012	887	90	90.2	80,011	220,030	17
2017	977	90	90.2	88,150	242,411	19
2022	1076	90	90.2	97,106	242,766	19
2027	1172	90	90.3	105,796	264,490	21
2032	1274	90	90.3	115,033	287,583	23

4.2.4 Water Quality

The water provided by the new truck-fill station should meet the Guidelines for Canadian Drinking Water Quality. The Guidelines direct that water taken from surface water sources be filtered with the target of providing finished water with a turbidity of less than 0.1 NTU. The Guidelines also direct that the drinking water be subject to a disinfection process prior to loading into delivery vehicles.

4.2.5 Truck Fill Rates

The most demanding truck loading rates arise from the requirements to fill trucks during firefighting operations. A minimum truck fill rate of 1,000 L/min is typically stipulated for this service. In some communities a lower truck refill rate is provided during normal operations. Assumption of this lower refill rate carries the advantage of reducing the size of some elements of the truck-fill station, but this is offset by an ongoing operational penalty of longer truck refill times. This is exacerbated by a general movement towards larger water delivery trucks. Combining a refill rate of 500 L/min with the larger water trucks leads to a refill time of approximately 30 minutes. Increasing the normal truck fill rate to 1,000 L/min will improve operational efficiency as less time will be required to fill water trucks, leaving more time available to service buildings.

A truck loading rate of 1,000 L/min will be assumed for the design of the new truck-fill station.

4.3 Proposed Facilities

4.3.1 General

The following sections examine the proposed water supply, treatment and delivery equipment, together with the building and buildings services required in support of these water supply systems.

4.3.2 Water Supply

It is proposed that the existing pair of inclined shaft water intakes be retained. The existing intakes appear to be in good condition and they are large enough to accommodate pumps capable of providing 1,000 L/min. A short extension of the intakes into the new truck-fill station will be required.

New water supply pumps and heat trace cables will be required. New pumps are required because of both the increased design flow (1,000 L/min) and the added hydraulic resistance of the filtration equipment that must be provided. It is initially estimated that a pair of 15 HP submersible pumps operating at 1,000 L/min (265 USGPM) into 46 metres (150 feet) of head will be required. The final selection of these pumps will be confirmed during the course of detailed design.

4.3.3 Water Treatment

4.3.3.1 General

The Guidelines for Canadian Drinking Water Quality direct that water taken from surface sources be filtered and that disinfection is required. The following sections examine both of these water treatment processes.

4.3.3.2 Filtration

The Guidelines for Canadian Drinking Water Quality direct that water taken from surface water sources be filtered with the target of providing finished water with a turbidity of less than 0.1 NTU. Incorporation of filtration into the design of this truck fill station raises some unique and large challenges. The Guidelines present various filtration technologies, including chemically assisted filtration and membrane filtration. All of the technologies presented give rise to process wastewater, such as backwash, that must be managed. The handling of this process waste water would entail storage within the truck-fill station and disposal into the community sewage lagoon. The management of these process wastewater streams is viewed to be currently beyond practical achievability. Thus, a filtration strategy that does not give rise to process waste water must be identified. Based upon these constraints it is proposed that a series of cartridge filters be used with increasingly finer cartridges in sequence. The proposed sequence of filters would include 20 microns, followed by 5 microns, followed by 1 micron filters as shown on Figure 2.

4.3.3.3 Disinfection

There are two potential methods of disinfection, ultraviolet (UV) irradiation and chlorination. UV is a flow through process that has proven effective as a method of inactivation of virus and giardia, but this method leaves no residual in the treated water. There is no experience with UV in truck-fill stations in Nunavut. Issues associated with UV treatment include start-up times for the lamps, short lamp life due to frequent starting and the on-going need for disassembly and cleaning to assure reliable disinfection. The use of UV for disinfection does not obviate the need for chlorination as UV provides no residual for protection of the distribution system following treatment. Thus, a chemical disinfectant, such as chlorine, must be added to assure continued bacteriological quality during distribution. Based on these issues, combined with the requirement for subsequent chlorination due to delivery system requirements, UV is not recommended at this time.

There is good operational familiarity with chlorination in Coral Harbour. The operators in the community have successfully operated this type of equipment for many years, and there is a history of the necessary testing.

Based on the above comments it is recommended that chlorination be selected as the preferred disinfection method for this project.

The Guidelines present the CT concept for the evaluation of the effectiveness of chlorination as a disinfection process. The under-lying premise is that water and a chlorine solution of sufficient concentration must remain in contact with each other for the full length of the prescribed contact time prior to the water being considered potable. The concept integrates contact time, concentration, temperature and the characteristics of the chlorine contact facility.

The CT value is used as a measurement of the combined effect of disinfectant concentration and the period of length of time that the disinfectant and water have an opportunity to remain in contact. Standards have been developed that correlate the amount of CT with the amount of pathogen inactivation due to chlorination. The CT value is calculated as follows:

CT = (Chlorine concentration, mg/L) (Contact time, minutes)

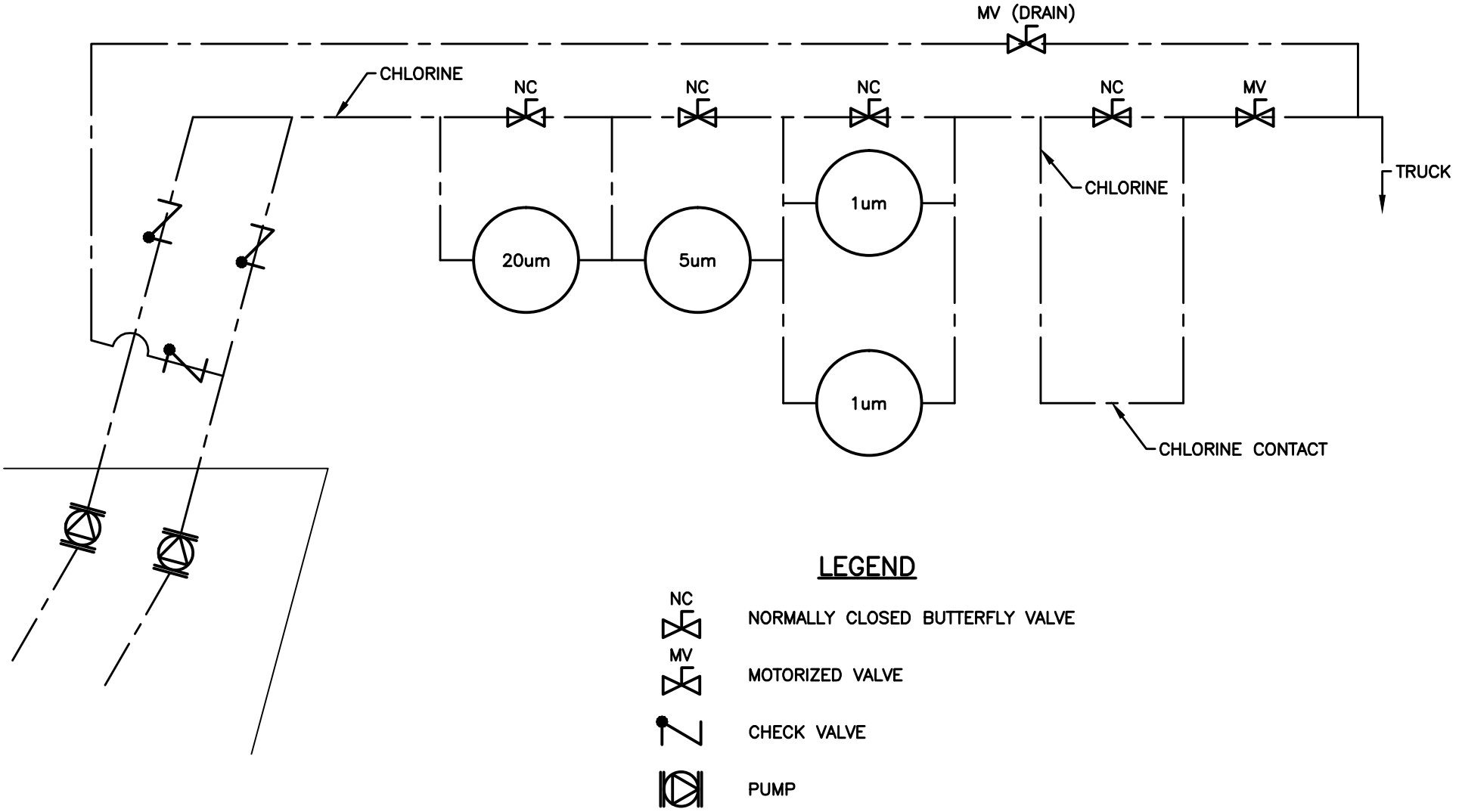
For water at 0.5^0C, the literature indicates a CT of 12 mg-min/L is appropriate for 4 log inactivation of virus. A CT of 12 mg-min/L can be obtained by maintaining a chlorine concentration of 1.0mg/L for 12 minutes. The required contact time would decrease with an increase in chlorine concentration, however we believe 1.0 mg/L is the upper limit that would be acceptable to the Hamlet

The physical characteristics of the chlorine contact facility are incorporated into the evaluation of the CT value through adjustment of the time (and thus volume) to account for the potential of mixing. Mixing enhances the risk of short circuiting, which reduces the assurance that the treated water has remained in contact with the chlorine solution for the required time prior to delivery. For a tank or reservoir with large amounts of mixing, such as a truck filled from an overhead loading arm, complete mixing would be assumed. Therefore as there is no method assuring that this incompletely treated water is not among the first delivered. The time for loading the truck cannot be counted as part of the disinfection time in determining the CT Value. An operational decision to wait the required contact time prior to starting deliveries would provide the required contact time. However it is optimistic and impractical to expect this as an on-going operational practice. It is proposed that the chlorine contact requirements be achieved prior to loading into delivery trucks, and that required contact time be achieved using facilities incorporated into the truck-fill station.

Based upon a pump flow rate of 1,000 L/min, a minimum CT of 12 and chlorine concentration of 1.0 mg/L the minimum volume of the chlorine facility is calculated as 12,000 litres. The actual volume of the facility incorporated into the truck-fill station must be adjusted inconsideration of the physical characteristics of the facility and the potential for mixing. The alternative of a contact tank, and a contact pipe have been examined.

The alternative of a chlorine contact tank would take the form of a tank with internal baffles. Despite the baffling, some mixing is inevitable, and this mixing must be considered during the sizing of the tank. The required volume to reliably achieve a CT of 12 mg-min/L would be 24,000 to 36,000 litres. Incorporation of this tank within the truck-fill station building envelope would substantially increase the size of the facility. Provision of contact in an external tank represents a mechanically complex system that would include separate truck loading pumps, stored water circulation and re-heating.

A contact pipe provides a very good approximation of a plug flow due to large length to diameter ratio, low velocity and very limited opportunity for longitudinal mixing. The required volume within a contact pipe is 12,000 litres. This can be accomplished within the truck-fill station building envelope. The resulting mechanical arrangement is less complex than a contact tank, as no additional pumping, circulation or re-heating is required. In view of the reduced contact volume and simplicity of installation, it is recommended that chlorine contact be accomplished within a section of piping.



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scale: N.T.S	CLIENT: GOVERNMENT OF NUNAVUT	project no.: OTT00203694A
date: 27/04/12	TITLE: CHLORINE SCHEMATIC	FIG2
drawn by: S.BUTLER		

4.3.4 Truck Loading

It is proposed that a single conventional truck loading arm be provided. Provision of a second loading arm is not recommended. Two loading arms provide the opportunity for simultaneous filling of a pair of trucks, but this is offset by the requirement for doubling of chlorine contact volume and pumping capacity.

4.3.5 Building Space

The current building lacks the space required to accommodate the required water filtration and disinfection process. A suitably sized building must be provided. Figure 3 and 4 presents the floor plan for the proposed building. This building incorporates a separate room for the electrical equipment and generator, as well as a separate room for the chlorination equipment. A separate room is proposed for chlorine handling and dispensing to reduce operation problems from corrosion arising from the chlorination chemicals.

4.3.6 Building Services

4.3.6.1 Electrical Power

A three phase electrical supply will be required by the proposed pumping equipment. There is an existing 120/208 volt supply available at the site. Standby power will be required.

4.3.6.2 HVAC

It is recommended that a simple heating and ventilation system be provided. Oil fired unit heaters can provide appropriate heating. Avoidance of an external chlorine contact chamber sets aside the need for boilers, circulation pumps, heat exchangers and controls.

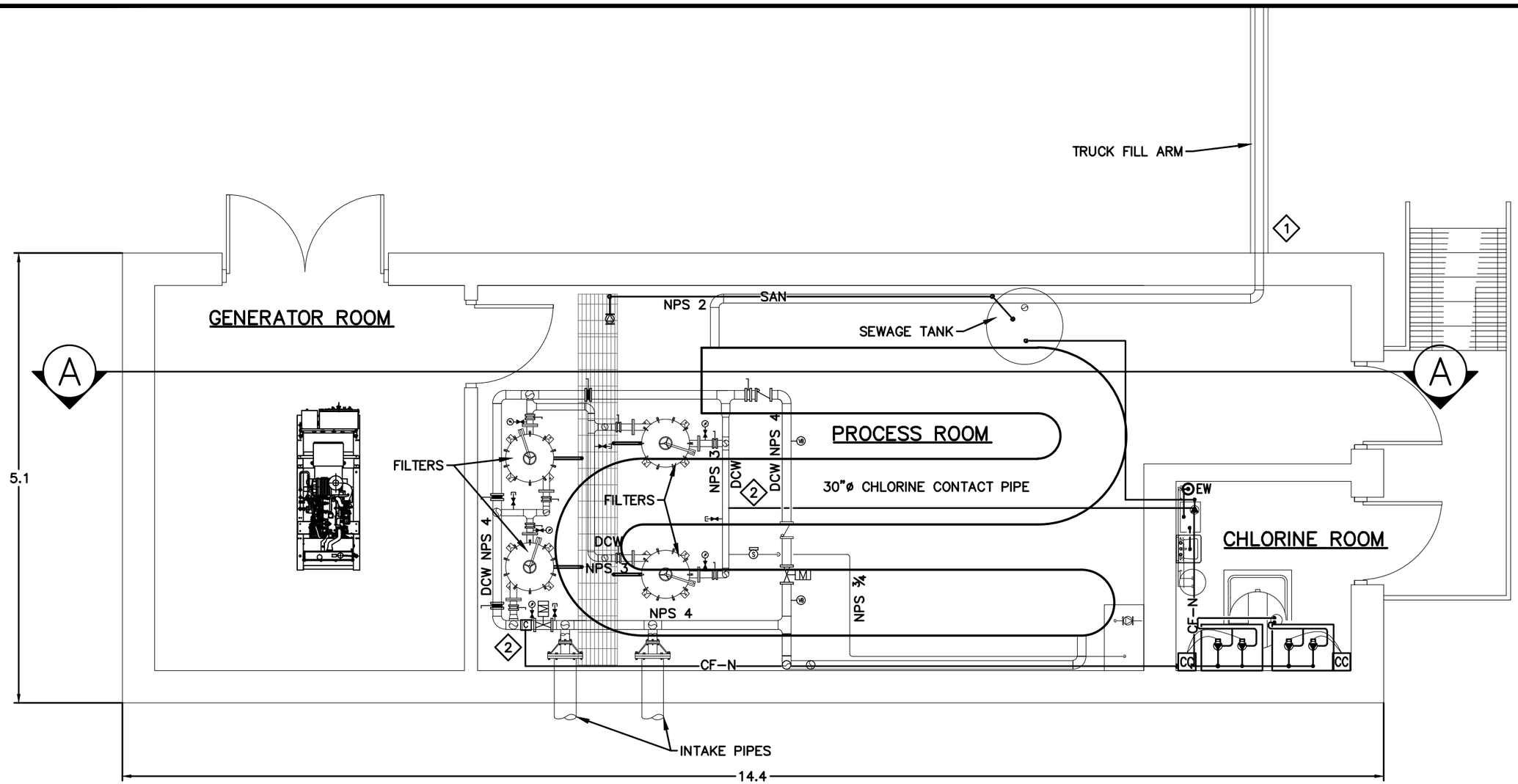
Ventilation will be required for the chlorine handling room to avoid corrosion damage to the equipment within the truck-fill station. Appropriate ventilation will be required for cooling and combustion air for the proposed standby generator.

4.3.7 Cost Estimate

A Class D cost estimate has been prepared for the replacement of the truck-fill station. This estimate is presented in Table 4.2.

Table 4.2 – Cost Estimate

Description	Amount
Mobilization & Demobilization	$200,000
Demolition and Removal of existing Truck-fill station and generator building, and salvaging of existing equipment	$80,000
Site work, connection to existing water line from reservoir , re-grading access road and underside of new building	$80,000
Substructure construction	$50,000
Superstructure (Architectural, Structural)	$225,000
Process and mechanical work and equipment	$400,000
Chlorine contact pipe	$150,000
Electrical, instrumentation and control	$475,000
Subtotal	$1,660,000
20% Contingency	$332,000
Total	$1,992,000



GENERAL NOTE:

LAYOUT OF CHEMICAL FEED PIPING IS SHOWN SCHEMATICALLY FOR CLARITY. COORDINATE FINAL LAYOUT ON SITE.

DRAWING NOTES:

1. CONNECT PIPE TO TRUCK FILL ARM WITH FLEXIBLE JOINT.
2. CONNECT CHEMICAL FEED PIPE TO WATER PIPE.

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scale 1:50	CLIENT: GOVERNMENT OF NUNAVUT	project no. OTT00203694A
date 30/04/12	TITLE: WATER FILL – PLAN VIEW	FIG3
drawn by S.BUTER		

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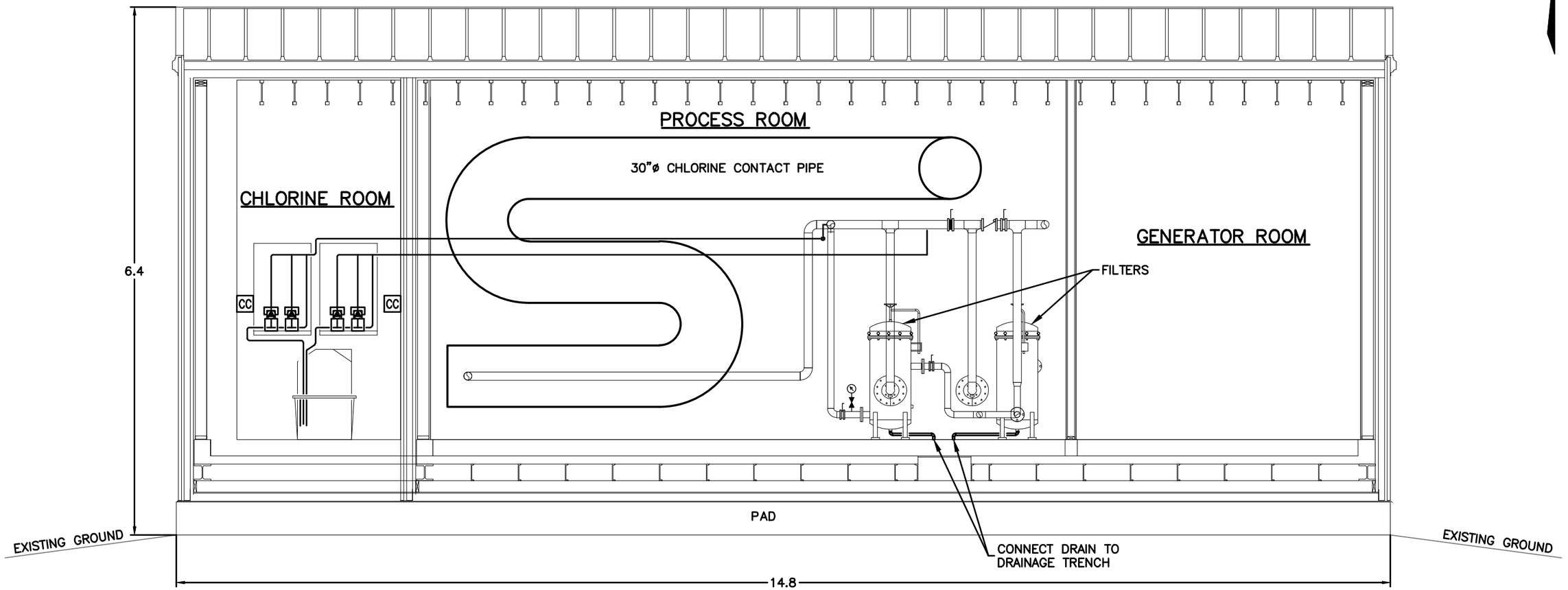

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scale 1:50	CLIENT: GOVERNMENT OF NUNAVUT	project no. OTT00203694A
date 30/04/12	TITLE: WATER FILL – SECTION A–A	FIG4
drawn by S.BUTLER		

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5 Summary

The various findings and recommendations can be summarized as follows.

1. Replacement of the existing truck-fill station is the most appropriate strategy to meet the long terms needs of the community.
2. Table 4.1 of this report provides the design population and water demands for the period 2012 to 2032.
3. Treated water should meet the requirements of the Guidelines for Canadian Drinking Water Quality.
4. A truck fill (loading) rate of 1,000 L/min is proposed.
5. Filtration, in the form of cartridge filters is proposed. The sequence of filters should incorporate 20 micron, followed by 5 micron, followed by 1 micron cartridges.
6. Chlorination is proposed as the disinfection method.
7. Disinfection requirements, including contact time have been evaluated using the CT concept. A chlorine contact reactor, in the form of a pipe, with a volume of 12,000 litres is proposed.
8. A single truck loading arm is proposed.
9. Figure 4.1 depicts a floor plan for the proposed truck-fill station.
10. The Class D estimated cost for a replacement of the truck-fill station is $1,992,000.

Appendix A – WBBP Technical Memos

Department of Community & Government Services, GN

Pump House Upgrades

Coral Harbour, Nunavut

GN Project #11_3018

Table of Contents

1.0 Introduction

The following report includes a detailed review of the condition of the electrical and mechanical infrastructure installed at the Coral Harbour Truck-Fill Station. The station consists of two separate buildings: the generator enclosure and the truck-fill station itself. The generator enclosure houses the incoming service and the emergency generator. The truck-fill station includes the controls for the pumps and the water treatment system.

A two-day site visit was conducted on November 23rd to 24th to review the electrical and mechanical condition of the equipment installed at the site. The following report includes our observations of site conditions as well as comment on the remaining life of the equipment and recommendations for system improvement. This report will also highlight any health and safety or code compliance issues as found on the site.

Refer to the attached Appendix A which includes photographs of the truck fill station and the generator enclosure, including all equipment.

2.0 Condition Review

2.1 Generator Enclosure Building

Please refer to photos 1 – 18 in Appendix A for photographs of the generator enclosure building and its equipment.

2.1.1 Electrical Systems

Main Service

Electrical service to the site is provided by the local utility at 100A, 120/208V via a service mast mounted on the southwest corner of the generator enclosure. A utility meter is mounted on the exterior of the enclosure in front of any disconnecting means. Refer to Photo 3 in Appendix A.

Comments

- The existing electrical service to the site is of adequate size and is in good condition for the existing installation.

Recommendation

- The service size may need to increase to allow for future fire pumps and station load growth.

Main Breaker

The Hydro service enters the building via a 100A, 120/208V Square D self-enclosed main breaker. The breaker supplies a splitter which feeds the building's ATS and heating panels. The breaker cover does not feature a gasket and the type 3R enclosure is not air tight. The main breaker is still fully operational and appears to be in good condition. Refer to Photo 4 in Appendix A.

Comments

- The existing main breaker and enclosure are in good condition.

Recommendation

- Existing main breaker to remain in service if load to pumping station does not increase.

Emergency Generator

Emergency power is supplied to the truck lift station from a 25 kW, 120/208V emergency generator installed within the generator enclosure. The generator is the original unit installed in 1984. The generator is powered by a Lister HR3 diesel engine. The alternator is a LIMA SER 208V, 3 phase model. It has a runtime of 1840 hours. Refer to Photo 6 in Appendix A.

It was not possible to start the generator during our visit as no electrician was available. The batteries are dead and the generator has to be started with jumper cables. The battery heating blanket was removed. The generator oil heater is also non-operational. The oil level in the generator was correct although the condition of the oil could not be determined. It appears as though some oil or diesel fuel leakage has occurred in the area of the generator due to staining on the floor.

It could not be determined if the generator controls are fully functional as the generator could not be started.

Comments

- The generator is no longer fully functional.
- The unit is 25+ years old and is reaching end of life.
- There are no longer any parts distributors in Manitoba or Alberta.
- The generator may not be large enough to support fire response pump loads and new filtration loads.

Recommendation

- Repair generator in the short term to ensure emergency power supply to the station.
- Replace emergency diesel generator with new diesel generator sized to suit future pump and filtration loads.

Automatic Transfer Switch

The emergency power transfer switch supplies power to the Subfeed and Lighting Panel from the normal power or the generator. The automatic transfer switch (ATS) in the generator enclosure is rated at 100A, 208V. It is a Cutler Hammer LRO Robonic breaker-style ATS and is part of the original installation. The enclosure does not have a gasket and is not liquid or air tight. There are signs of infestation from flies during the summer. Refer to Photos 5 and 7 in Appendix A.

The ATS should operate by sensing loss of power or poor power quality conditions on the normal feed into the generator enclosure. It would then start the emergency generator and would transfer the load onto generator power once it was running. The ATS for the generator enclosure has failed and is no longer automatically operable. There is a damaged relay, blackened neutral wire and evidence of damage due to overheating and arcing in the enclosure. Since it is a Robonic breaker-type transfer switch it has been possible for operators to manually transfer the load to emergency power after starting the generator manually. This process involves operating the transfer switch with the cabinet open meaning that the operator is exposed to live wiring.

Comments

- The existing transfer switch is no longer fully operational and does not have automatic transfer.
- The transfer switch is a safety hazard to operators as it must be transferred with live conductors exposed.

Recommendation

- Replace with new automatic transfer switch of same capacity or larger to reflect anticipated future load growth in the pumping station.

Subfeed and Lighting Panel

The Subfeed and Lighting panel is supplied from the 100A, 120/208V Automatic Transfer Switch which is supplied with emergency and normal power. The Subfeed Panel is a Square D 125A, 120/208V panel equipped with the following breakers:

- 100A 3P Truck Lift Station Subfeed
- 15A 1P Generator Battery Charger
- 15A 1P Receptacles
- 15A 1P Receptacles
- 15A 1P Interior Lighting

The Subfeed Panel is original to the generator enclosure installation based on the original O&M manuals and information provided by staff. We did not open the Subfeed Panel since it was in operation, but the exterior of the panel appears to be in good condition and there is very limited electrical damage in the generator enclosure. The panel cover does not feature a gasket and the type 3R enclosure is not air tight. The panel and all breakers are still fully operational. Refer to Photos 4 and 8 in Appendix A

Comments

- The existing subfeed panel and enclosure are in good condition.

Recommendation

- Existing panel to remain in service.
- Panel to be replaced if supply to pumping station is to increase in the future.

Heating Panel

The Heating is supplied from the 120/208V Splitter which is fed by the 100A Main Breaker. The Heating Panel is a Square D, 120/208V panel equipped with the following breakers:

- 20A 2P Unit Heater
- 20A 2P Unit Heater
- 15A 1P Temporary Unit Heater Plug

The Heating Panel is also original to the generator enclosure installation. We did not open the heating panel although its exterior appears to be in good condition. The panel cover does not feature a gasket and the type 3R enclosure is air tight. The panel and all breakers are still fully operational. Refer to Photos 4 and 9 in Appendix A

Comments

- The existing heating panel and enclosure are in good condition.

Recommendation

- Existing panel to remain in service.

Generator Battery and Charger

The generator battery is non-operational and will not carry a charge. It must be boosted in order to start the generator. The battery charger is original to the installation. It is a Mechron charger; model CR2F120-012-110B. It is rated for 120V AC input and 12V DC output. It is currently operating on DC equalize mode with 0.4A DC charging at 14V DC. It could not be determined if the battery charger was operating properly on site since the battery is dead. Refer to Photos 5 and 10 in Appendix A.

Comments

- The existing generator battery is dead and will not hold a charge.
- The existing battery charger is operational and appears to be functioning properly.

Recommendation

- Provide new generator battery.
- Test battery charger to ensure proper operation. Replace if required.

Heating System

The generator enclosure was originally heated by two ceiling-mounted electric unit heaters. One of these unit heaters has been disconnected electrically from the heater panel. The second original unit heater is not operational. The unit turns on and off instantly without producing heat. A third plug-in style electric unit heater has been provided in the generator enclosure. It is self regulated by an integral thermostat. At the time of our arrival, the fan in the temporary unit was not operating and the generator enclosure was below 0°C. System operators provided a new temporary unit heater while we were on site.

According to the original design, the heating system in the generator was not supposed to operate unless the building was occupied for repairs or maintenance. The unit heaters were to be controlled manually by the thermostats. The generator and batteries were to be heated via the engine oil heater and a battery blanket. The engine oil heater is non-operational and the battery blanket is removed.

Comments

- The heating systems in the enclosure are non operational and do not protect the generator.

Recommendation

- Provide one 1.5 kW unit heater in the space controlled by internal temperature control.
- Provide new battery blanket to warm battery.

Lighting

The lighting in the generator enclosure consists of two incandescent fixtures mounted to the ceiling of the space, controlled by a switch beside the main door. At the time of review only one of the lights was functioning. Emergency lighting is provided by a wall-mounted emergency battery unit with two remote heads. The EBU tested operational.

Comments

- The lighting in the enclosure is partially functional.

Recommendation

- Replace the light bulb in the generator enclosure. If fixture is broken, replace fixture.

Receptacles

There are 2 general duplex receptacles installed in the generator enclosure. The receptacles appear to be in fair condition. They are still in operation. A third duplex receptacle is dedicated for the emergency battery unit and a fourth receptacle is dedicated for the temporary unit heater, and is connected off of the Heater Panel which does not have emergency power.

Comments

- The receptacles in the enclosure are functional.

Recommendation

- No recommendations.

2.1.2 Mechanical Systems

Ventilation

There is only 1 air intake in the room. The outside air damper is permanently shut and the crank arm connecting the damper leafs to the actuator has been removed. There is currently no combustion air provided to the generator. Refer to Photo 11 in Appendix A.

The generator cooling system consists of a ducted exhaust from the outlet of the generator radiator to the outside. The exhaust duct appears to be in fair condition. However, there is currently no fresh air introduced to the room when the generator is in operation.

The generator exhaust is old and might be leaking. The insulation installed on the exhaust pipe is not rated for this application and does not cover the entire length of the pipe. Refer to Photos 12 and 13 in Appendix A for the generator exhaust interior and exterior installation.

Comments

- Supply of combustion air to the generator is a minimum code requirement. There is potential for the generator to choke without adequate fresh air supplied in the room.
- The generator cannot be properly cooled.
- Exhaust fumes may leak in the room. Combined with poor space ventilation, this is a potential life threatening problem

Recommendation

- Re-instate fresh air damper actuator and configure the damper so that fresh air may be supplied at all times to the generator.
- Ensure exhaust duct is properly sealed.

Fuel System

The existing fuel system consists of a single wall outdoor tank installed in a secondary containment basin. Fuel is drawn directly by the generator and returned to the tank. An oil filter is installed upstream of the generator fuel supply.

The tank appears to have a capacity 250 US gallons. It is currently not vented and the level meter is broken. The fill port is also too close to the surface of the tank, increasing the risk of water and snow spilling in the tank during filling. Refer to Photos 14 – 18 in Appendix A for details of the fuel system installation.

Comments

- There are signs of fuel leaks on the floor.
- The system appears to be in poor condition.
- The existing tank does not store the required amount of volume by GN design standards (2 weeks of uninterrupted operation).

Recommendation

- Replace fuel system.

2.2 Truck Fill Station

Please refer to photos 19 – XX in Appendix A for photographs of the truck fill station and its equipment.

2.2.1 Electrical Systems

Electrical Service

Electrical service to the truck fill station is provided via underground TECK cable between the generator enclosure and the truck fill station. The cable enters and exits the buildings at junction boxes which are showing signs of wear due to exposure to environmental conditions. Refer to Photo 21 in Appendix A.

Comments

- The junction boxes are rusting but still operational.

Recommendation

- No recommendations.

Panel A

Panel A is supplied from a 100A breaker in the Subfeed Panel in the generator enclosure. Panel A is a Cutler Hammer, 125A, 120/208V panel equipped with the following breakers:

- 70A 3P main breaker
- 50A 3P Panel B contactor
- 40A 3P Pump P1
- 40A 3P Pump P2
- 15A 2P Truck Fill Arm Heat Tracing
- 15A 1P Unknown
- 15A 1P Interior Lights
- 15A 1P Panel B Contactor Controls
- 15A 1P Control Circuit
- 15A 1P 9 kW heater
- 15A 1P Door Frame Heat Trace
- 15A 1P Truck Fill Arm Strobe Light
- 15A 1P Exterior Light
- 15A 1P Receptacles for Chlorinator
- 15A 1P General Receptacles

Panel A is not original to the truck fill station based on the original O&M manuals and information provided by staff. We could not determine when the panel was replaced. We did

not open Panel A, but since it is of the same type and age as Panel B, it is assumed that the interior of the panel is beginning to show corrosion damage due to exposure to chlorine powder. The panel cover does not feature a gasket and the type 3R enclosure is not air tight. At this time the panel and all breakers are still fully operational. Refer to Photo 22 in Appendix A for a picture of the panel front.

Comments

- Panel A is in deteriorating condition.

Recommendation

- Replace Panel A with new panel featuring NEMA Type 4X enclosure.
- Size Panel A for future load in the pumping station facility, and to allow both pumps to operate at the same time.

Panel B

Panel B is supplied by Panel A via a 50A breaker which feeds into a 100A contactor. This contactor turns off power to Panel B when either of the pumps is in operation or when normal power to the station has failed. Panel B is also a Cutler Hammer 125A, 120/208V panel of the same model as Panel A. It is equipped with the following breakers:

- 50A 3P Main Breaker
- 30A 2P Heat Trace P1
- 30A 2P Heat Trace P2
- 15A 2P Unit Heater 1.2 kW
- 15A 2P Unit Heater 1.2 kW (Spare –Off)
- 30A 2P 240V Heaters

Panel B is also not original to the truck fill station and was replaced at the same time as Panel A. The interior of the panel was examined. It is showing signs of corrosion due to exposure to chlorine powder. The panel cover does not feature a gasket and the type 3R enclosure is air tight. Wire terminations are green and the bus bars are beginning to fur. At this time the panel and all breakers are still fully operational. Refer to Photos 23 and 24 in Appendix A for panel front and interior details.

Comments

- Panel B is in deteriorating condition.

Recommendation

- Replace Panel B with new panel featuring NEMA Type 4X enclosure.
- Size Panel B for future load in the pumping station facility, and to allow heat trace to operate on emergency power when required.
- Relocate alarm panel supply from Panel B to Panel A.

Panel B Contactor

The 100A contactor which supplies Panel B is a Siemens Contactor, Model 3TF46, 120/208V which interrupts the power supply from Panel A to Panel B. It is not part of initial installation and it cannot be determined when it was installed. The enclosure is showing signs of corrosion while the contactor itself appears to be in acceptable condition. It could not be determined if the enclosure has a gasket or is air tight to prevent exposure to chlorine powder. The purpose of the Panel B Contactor is to turn off power to Panel B in the event of normal power failure and whenever pumps P1 or P2 are in operation. Refer to Photo 25 in Appendix A.

Comments

- The Panel B Contactor is in deteriorating condition.
- Control wires for the pump starters have been routed through Panel B which is a Code violation – distribution cabinets are not to be used as junction boxes.

Recommendation

- Replace the Panel B Contactor with a new contactor of sufficient size to allow heat trace to operate on emergency power when required.
- Reroute the control wires for the P1 and P2 starters in direct conduit from Panel A to the starters.

Pump P1 Starter

The Pump P1 Starter is an Eaton/Cutler-Hammer motor combination starter which is supplied by a 40A breaker in Panel A. The model of the starter is C799B84. It is installed in a NEMA Type 12 enclosure which has a gasket and which appears to be in good condition. Refer to Photo 26 in Appendix A for details of the starter in use. It is currently in operation supplying Pump P1. It was originally installed in December of 2009 as the starter for Pump P2. When Pump P2 failed in late summer of this year, the starter was relocated to pump P1 since the Pump P1 starter had previously failed.

The starter itself is in poor condition. Cable terminations are showing a great deal of corrosion and the device is not being used as intended. At this time, in order to start pump P1, operators jam the contactor in the starter closed so as to prevent it from tripping open. The starter is kept in hand or manual mode. The operators then throw the supply breaker to the starter in Panel A. This then starts the pump in operation. If the operator does not prevent the starter from tripping then it will continuously try to open and close until he does jam it closed. This represents a Code violation as the pump is no longer provided with overload protection.

It could not be determined if this behaviour on the part of the starter was due to a problem from Pump P1. The overload trip setting on the starter is set to 18.7A, which is the lowest setting. When we recorded the load on Pump P1 in operation we measured values in the range of 12 – 14A. It was not possible to measure the starting current, but according to the shop drawings pump P1 is 5 hp, 208V, with an SFA of 17.9A.

It is possible that the starter was damaged when it was initially installed with Pump P2. It was noted that Pump P2 was a larger pump than was initially installed. It was rated at 7.5 HP for operation at 230V. Its rated amps was 23A with an SFA of 26.4 A. The maximum setting on the starter was for 30.7A at 208V.

Comments

- The Pump P1 Starter is no longer fully operational and presents a safety risk to the operators of the pumping station.
- The starter must be operated with live parts exposed in its current configuration.
- The operator is over-riding the starters over load protection for Pump P1 which is a Code violation.
- The starter may fail completely at any time and represents a high risk to the continued operation of the facility.

Recommendation

- Replace the Pump P1 Starter immediately with a starter sized appropriately to the installed pump.
- Re-terminate all wires leading to the starter to ensure that there is no corrosion at the terminals. Replace the wiring if the leads are not long enough.

Pump P2 Starter

At this time there is no starter in the cabinet for pump P2. It was relocated to the enclosure for starter P1 as described above. A new starter must be installed before Pump P2 can be commissioned. The enclosure is in good condition although the wire terminations are showing signs of corrosion. Refer to Photo 27 in Appendix A for a photo of the empty enclosure.

Comments

- There is no starter for Pump P2 installed in the starter cabinet.

Recommendation

- Replace the Pump P2 Starter immediately with a starter sized appropriately to the installed pump.
- Re-terminate all wires leading to the starter to ensure that there is no corrosion at the terminals. Replace the wiring if the leads are not long enough.

Power Supply to Pumps P1 and P2

Pumps P1 and P2 are supplied with 40A, 208V, 3 phase power directly from the pump starters. Wire is run in conduit around the interior of the truck fill station. In the southwest corner of the building the conduit is corroded due to direct contact with the chlorine solution. The conduit and wiring terminate in twist lock receptacles which are connected to flexible wiring installed in liquid-tight flexible conduit which supplies the pump. The type of cord cap is incorrect for the liquid-tight flexible conduit and has placed stress on the connection point. The flexible conduit is separating from the plug. Refer to Photos 28 to 30 in Appendix A for power connection details.

Comments

- The conduit is damaged in one corner and requires repair.
- The flexible conduit is terminated in the wrong type of receptacle.

Recommendation

- Repair or replace the section of damaged conduit.
- Replace the receptacle and re-terminate the liquid-tight flexible conduit with a suitable receptacle.

Heat Trace Pump P1

The heat trace for pump P1 is supplied by a 30A, 2 pole breaker in Panel B. The heat trace controller is mounted directly above the piping entrance on the North side of the building. Refer to Photos 29, 31 and 32 for details of the Pump P1 heat tracing.

The heat trace controller is designed for 25W/m for a total of 975W at 208V. The heat trace cable and the controller appear original to the installation. The control panel is in very poor condition. The fuse has been bypassed and there is severe corrosion throughout the control panel. The temperature control thermistor is no longer connected to the control panel. It does have a high limit temperature thermistor installed although it is uncertain if the relay for the high limit functions. It appears as though the heat trace may operate continuously at high level.

A spare heat trace cable is installed in the pipe. It has a phase to phase resistance of 9 Ohms. The trace cable in use has a measured amperage of 4.2 A, which is in line with the designed 975W of heat tracing.

Comments

- The heat trace control system is non-operational at this time. It is in very poor condition and heavily corroded.
- The temperature control thermistor is no longer installed.
- The heat trace is functioning but does not have a spare trace cable available and does not have temperature control.

Recommendation

- Install a new heat trace system of the same size with spare heat trace, temperature and high limit controls.

Heat Trace Pump P2

The heat trace for pump P2 is supplied by a 30A, 2 pole breaker in Panel B. The heat trace controller is mounted directly above the piping entrance on the North side of the building. Pump P2 is no longer in operation and the heat tracing for pump P2 is not plugged in. The controller for the heat trace is in the same condition as for pump P1 and the system is in extremely poor condition. The fuse has been bypassed and there are no longer any control or high limit temperature thermistors installed in the pipe. There is a single heat trace cable (no spare) which is not plugged in. Its plug appears to be damaged and when we resistance tested the tracing cable there was infinite resistance across the phases. The heat tracing does not appear to be functional. Refer to Photos 30 – 32 for details of the heat trace controller and its connections.

Comments

- The heat trace system is non-operational at this time.
- The temperature control thermistor and the high temperature limit are no longer installed.
- There is no spare heat trace cable.
- The heat trace is not functioning.

Recommendation

- Install a new heat trace system of the same size with spare heat trace, temperature and high limit controls.

Heat Trace Door Frame

The heat trace in the door frame is fed from a 15A, single pole breaker in Panel A. We found the breaker in the tripped position. When we turned the breaker on, it could not be determined if the heat trace was functioning by measuring amperage. The box was cool to the touch and heavily corroded. We left the breaker in the off position since we were uncertain what may have caused it to trip.

Comments

- The door frame heat tracing is non operational.

Recommendation

- System to remain as is until building is replaced.

Heat Trace Truck Fill Arm

The truck fill arm heat trace is fed from a 15A, single pole breaker in Panel A. We measured a current of 0.4 amps at 120V. This would correspond to a 500W tracing. It appears to function properly. The enclosure has slight corrosion.

Comments

- The truck fill arm heat tracing is operational.

Recommendation

- System to remain as is until building is replaced.

Enclosure Heating

The building heating system consists of one unit heater and three radiant heaters. The unit heater is the only functioning heater in the space. It is not original to the installation and is self-regulated with its own thermostat. It is supplied by a 15A, 2 pole Breaker in Panel B. There is a second 15A, 2 pole Breaker in Panel B for another 1.2 kW unit heater. This breaker is in the off position and marked “Spare”. The second unit heater has been uninstalled. The radiant heaters appear to be in fair condition but are not functioning. This may be due to internal corrosion or faults in the wiring or it may be due the condition of the thermostats within the building which

are in very poor condition. Each of the three radiant panels has a single individual thermostat which appears to be original to the installation.

At this time, the single remaining unit heater is adequate to heat the truck fill station. It should be noted that in the event of failure of this unit, there is no low temperature alarm in the building and no spare unit heater to replace it.

Comments

- Only one of the 5 heaters in the truck fill station is operational.

Recommendation

- Provide spare or install second heater in the building to ensure that the building is heated appropriately.

Lighting

The interior lighting consists of two 64W fluorescent industrial two lamp fixtures. The equipment is functioning properly and is controlled by a switch adjacent to the door.

Exterior lighting consists of a single wall pack style light mounted on a short mast above the building to allow for light at the top of the truck. It does not appear to have a switch other than the breaker in Panel A. It is operational.

The building emergency lighting is provided by a two-headed emergency battery unit. The unit tests well. No testing logs were found on site for the emergency lighting.

Comments

- All lighting is functioning properly.

Recommendation

- No modifications necessary at this time.

Receptacles

There are 4 general duplex receptacles throughout the pumping station. The receptacles appear to be in fair condition. They are still in operation.

Comments

- The receptacles in the enclosure are functional.

Recommendation

- No recommendations.

2.2.2 Mechanical Systems

Chlorinator

The chlorinator is a Siemens mixer which injects a chlorine solution into the water as it is pumped through the truck fill station. It is fed by a 15A, single pole breaker in Panel A and plugged into a dedicated receptacle. It is no longer operated by the control system in the building and is turned on by plugging it into its receptacle in the wall while the pump is running and unplugging it when the pump is turned off. The chlorinator appears to work well although there have been issues with uneven chlorine levels in the water. The community has managed this by performing daily testing and logging of the chlorine levels and dumping out the water if the chlorine levels are poor. Refer to Photo 33 in Appendix A.

Comments

- The chlorinator is functional but no longer has controls.

Recommendation

- Reconnect the chlorinator to the new control system to ensure that the chlorinator is on while the pumps are running.
- Continue performing chlorine level checks to ensure continued operation.

Chlorine Mixer

The chlorine mixer could not be identified. It is fed by a 15A single pole breaker in Panel A and plugged into a dedicated receptacle. The mixer creates the chlorine solution from chlorine powder and water. According to operations staff the solution is mixed bi-weekly and the mixer is still in operation. The nameplate is illegible and the condition of the equipment appears to be fair. Refer to Photo 34 in Appendix A.

Comments

- The mixer is functional.

Recommendation

- No recommendations.

Ventilation

The truck fill station is currently not ventilated.

Comments

Significant signs of corrosion are visible throughout the building. This is a result of the chlorine gas released from the chlorination system and the lack of ventilation in the space.

Recommendation

Ensure the space is ventilated. Future renovations should make provisions for the installation of a new mechanical ventilation system.

Water Piping System

One of the main pumps is out of service. The other pump has reached the end of its useful life and must be replaced immediately.

The water piping displays extensive signs of rust.

Comments

- There is currently no redundancy for water pumping. If the existing pump fails, the system will not be able to operate.
- The operational pump has a limited flow rate. The time required to fill a truck is approximately 20min. This is especially important in case of fire.

Recommendation

- Purchase and store a back-up pump on site to minimize system downtime in case of failure of the remaining operational pump.

2.2.3 Control Systems

Pump Controller and Relay Panel

The pump controller and relay panel is installed above the pump starters on the South wall of the truck fill station. It is not original equipment to the station and it cannot be determined when the enclosure was installed. Refer to Photos 35 and 36 in Appendix A for exterior and interior views of the pump controller and relay panel.

The pump controller features the following features:

- Pump P1/Off/Pump P2 Selector Switch
- Truck T1 Timer – 0 to 12 minutes (Could not verify operation)
- Truck T2 Timer – 0 to 12 minutes (Could not verify operation)
- Relay 1 – Power to chlorinator relay (Relay 4)
- Relay 2 – Pump P1 On (Not in operation)
- Relay 3 – Pump P2 On (Not in operation)
- Relay 4 – Chlorine Pump On (Does not function)
- Flow Meter Indicator in panel front (disconnected from flow meter)
- Flow Switch to turn off pump (could not verify operation)

There used to be indicating lights or pushbuttons in the front of the enclosure as follows:

- Truck T1
- Truck T2
- Run
- (Blank)

These indicating lights or push buttons have been removed at some point. The only part of the control and relay panel that can be verified as operational was the P1/Off/P2 selector switch, which currently allows P1 to turn off. The pump starter is only ever operated in Hand or Manual mode so it could not be determined if many of the controls would function, although we were informed by operating staff that they did not.

The system was originally designed to be operated by one man with a start and stop button installed along the truck fill arm. This control system was removed at some time and not replaced.

The Truck T1 and Truck T2 timers would have been used to stop the pumps and to allow enough time for the water in the system to flow backwards into the reservoir before starting the pumps again. This system is non-operational in the current configuration.

Comments

- The control system is non-operational due to the configuration required to start pump P1 at this time.
- However, the controls have been non-operational for some time and the wiring is corroded and damaged.

Recommendation

- Replace the existing control scheme with a simplified system.
- The new control scheme would feature a new outdoor control panel adjacent to the door to allow the operators to turn on and off the pump remotely.
- A selector switch inside the main control panel would determine which pump would operate.
- An auxiliary control panel inside the door of the control station would provide a secondary ON-OFF point with indicating lights.

Exterior Pump Controls

The exterior pump control panel contains the indicating lights and pushbuttons which would be used by the operators to start and stop the truck fill operation remotely. The pushbuttons and indicator lights are connected back to the pump controller and relay panel inside of the building. Refer to Appendix A, Photos 37 – 39 for details of the exterior controls.

It features the following buttons and indicators:

- Pump Start Button
- Truck T1 Timer Button
- Truck T2 Timer Button
- Pump Stop Button
- Pump On Light
- Two Red Lights which were unidentified but which may have been indicator lights for T1 and T2 timers or P1 off and P2 off
- A Batch flow meter which cannot operate since the flow meter is not connected

The exterior pump controls have not been in operation since late summer 2011. It is possible that they no longer work since the pumps have to be turned on manually due to the issues with the starter for pump P1. However, the pushbuttons and indicator lights are in poor condition due to exposure to the environment and the enclosure is rusted.

Comments

- The control system is non-operational due to the configuration required to start pump P1 at this time.
- However, the controls have been non-operational for some time and the wiring is corroded and damaged.
- The exterior control panel has significant damage to the indicator lights and the enclosure itself.

Recommendation

- The new control scheme should feature a new outdoor control panel adjacent to the door to allow the operators to turn on and off the pump remotely.

Auxiliary Pump Controls

Inside of the building a small control panel was installed and connected to the main pump control and relay panel. It features three push buttons:

- Pump Start
- Truck T1 Timer
- Truck T2 Timer

It does not include any indicating lights but could be used to start the pumps and then to turn them off via the timers. It could not be determined when this controller was installed, although its condition appears to be good. It is not currently in operation as the pump starter for P1 is being used in hand or manual mode. Refer to Photo 40 in Appendix A.

Comments

- The control system is non-operational due to the configuration required to start pump P1 at this time.
- However, the controls have been non-operational for some time and the wiring is corroded and damaged.

Recommendation

- An auxiliary control panel inside the door of the control station would provide a secondary ON-OFF point with indicating lights.

Alarm System

The alarm system in the truck fill station is fed from a 15A, single pole breaker in Panel B. This is not a proper installation as in the current configuration the alarm system is turned off by the contactor every time the pumps are operated. There is a back-up battery but the power indicator light turned off whenever the pumps were running, indicating that the battery was dead. Refer to Photo 41 in Appendix A.

The alarm system monitors the building low temperature alarm. The thermostats associated with this system are non operational and have suffered from heavy corrosion. There did not appear to be a connection to the emergency power system or the pump control and relay panel.

The alarm panel triggers a strobe light mounted on a mast on the exterior of the pumping station. It is also connected directly to the phone line which runs into the fill station. There is no autodialer so it is not evident if this connection is in operation. However, the condition of the telephone termination box is very poor with a large amount of corrosion from the chlorine powder.

Comments

- The existing building alarm system is not operational and does not meet the requirements for remote monitoring of the facility.

Recommendation

- Replace the alarm system with a new alarm panel connected to Panel A. Provide a connection from the ATS and Generator to indicate when the system is on emergency power or without power.
- Provide a new low temperature thermostat designed for installation in hazardous locations for the low temperature alarm.
- Provide an autodialer and repair the telephone connection to the facility.
- Connect the new alarm system to the existing exterior strobe light.

Department of Community & Government Services, GN

Pump House Upgrades

Coral Harbour, Nunavut

Appendix A - Photographs

GN Project #11_3018

Photo 1 - Generating Station

Photo 2 – Generating Station

Photo 3 – Generator Building Electrical Supply

Photo 4 – Main Disconnect, Splitter and Panels

Photo 5 – Automatic Transfer Switch and Battery Charger

Photo 6 – Generator Building Generator

Photo 7 – Interior of Automatic Transfer Switch with Visible Damage

Photo 8 – Generator Building Subfeed Panel to Truck Fill Station

Photo 9 – Generator Building Heating Panel

Photo 10 – Generator Battery Charger

Photo 11 – Generator Air Intake Damper

Photo 12 – Generator Ducted Exhaust Interior

Photo 13 – Generator Exhaust Pipe Exterior

Photo 14 – Generator Outdoor Fuel Tank

Photo 15 – Broken Fuel Tank Level Meter

Photo 16 – Fuel Tank Fittings

Photo 17 – Fuel Line to Generator

Photo 18 – Fuel Line to Generator with Signs of Leaking

Photo 19 – Truck Fill Station

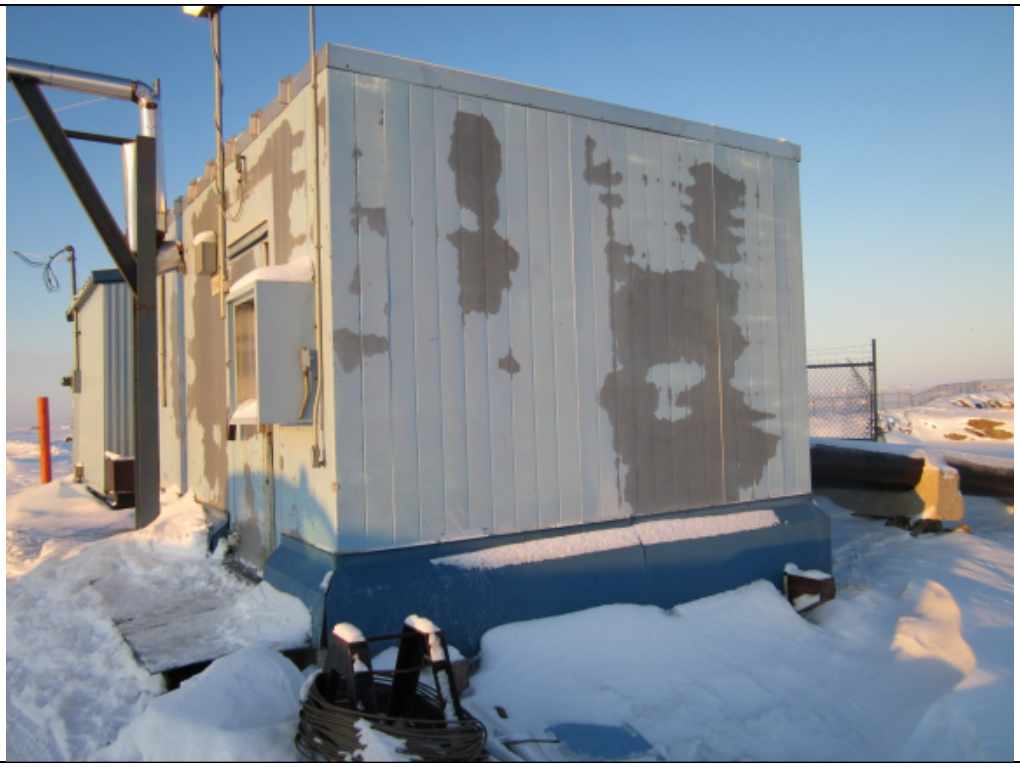

Photo 20 – Truck Fill Station

Photo 21 – Exterior Junction Boxes for Electrical Service to Truck Fill Station

Photo 22 – Panel A

Photo 23 – Panel B Front

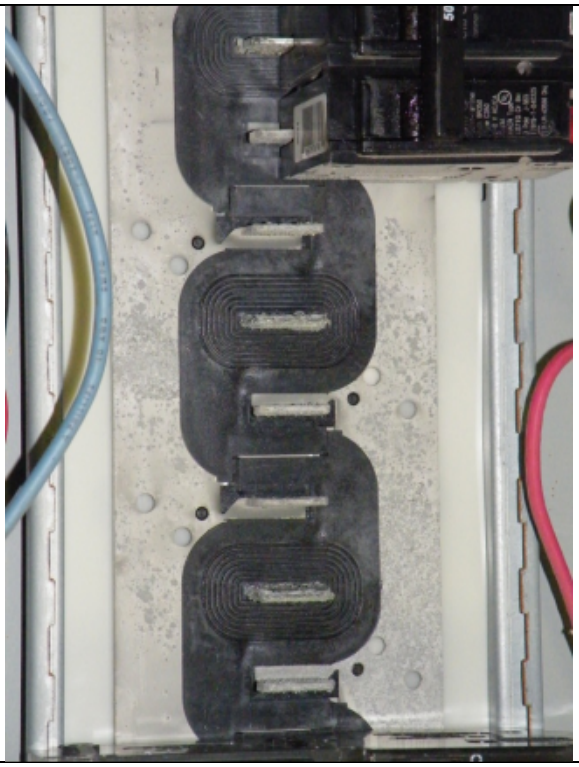

Photo 24 – Panel B Interior Showing Deterioration Due to Corrosion.

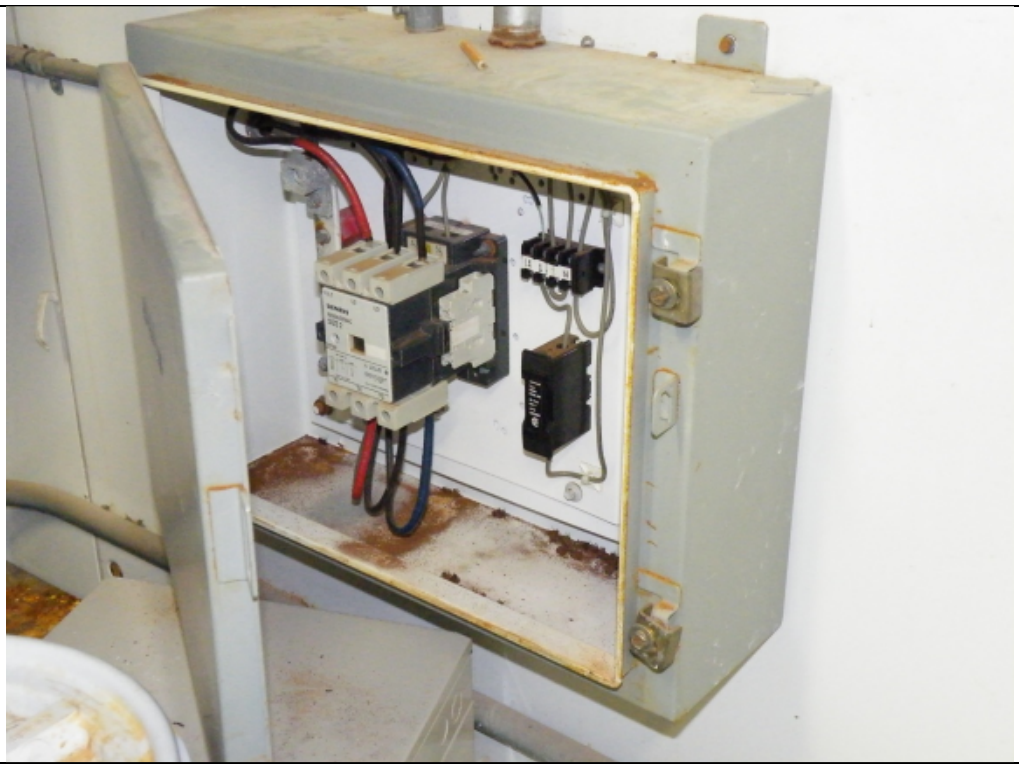

Photo 25 – 100A Contactor in Truck Fill Station

Photo 26 – Pump P1 Starter in Operation with Steel Rod Blocking Trip Unit

Photo 27 – Pump P2 Starter Enclosure without Starter

Photo 28 – Corroded Power Supply Conduit in Corner of Station

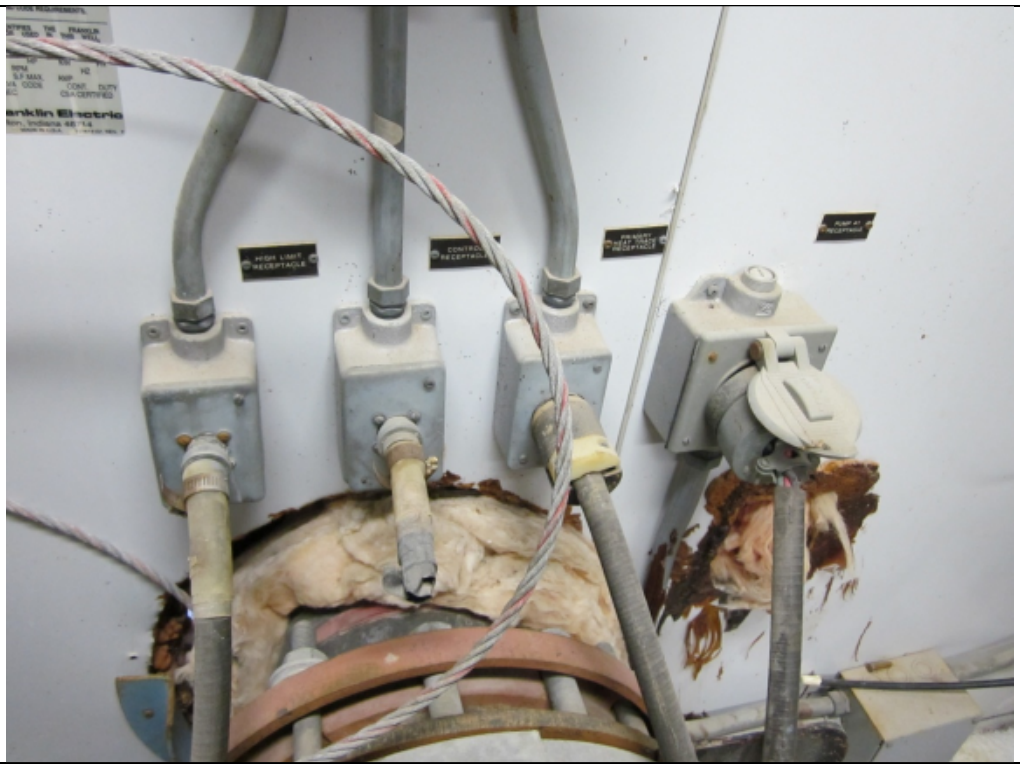

Photo 29 – Pump P1 Receptacle and Separating Flexible Plug with Exposed Wiring on Right. Heat Trace Connections to Pump P1 with Removed/Broken Control Connection

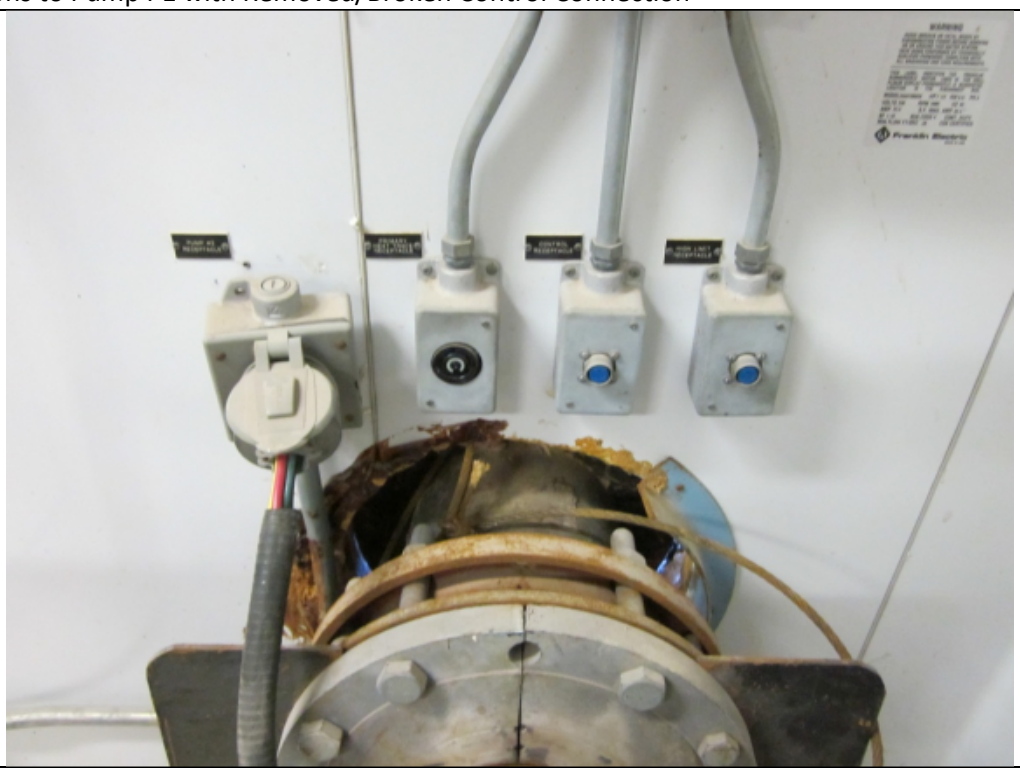

Photo 30 – Pump P2 Receptacle and Separating Flexible Plug with Exposed Wiring on Left. No Heat Trace Connections for Pump P2.

Photo 31 – Heat Trace Controller Enclosure

Photo 32 – Interior of Pump P1 Heat Trace Controller

Photo 33 – Truck Fill Station Chlorinator

Photo 34 – Truck Fill Station Chlorine Mixer

Photo 35 – Pump Controller and Relay Panel with Missing Push Buttons

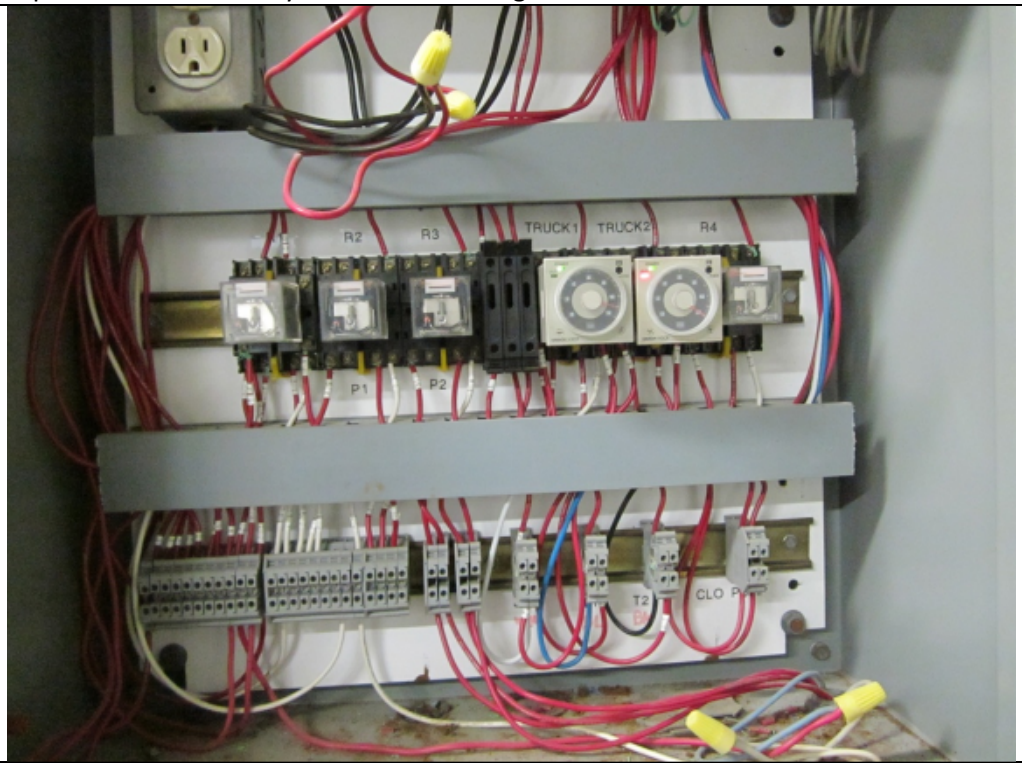

Photo 36 – Interior of Pump Station Controller and Relay Panel

Photo 37 – Exterior Pump Controls

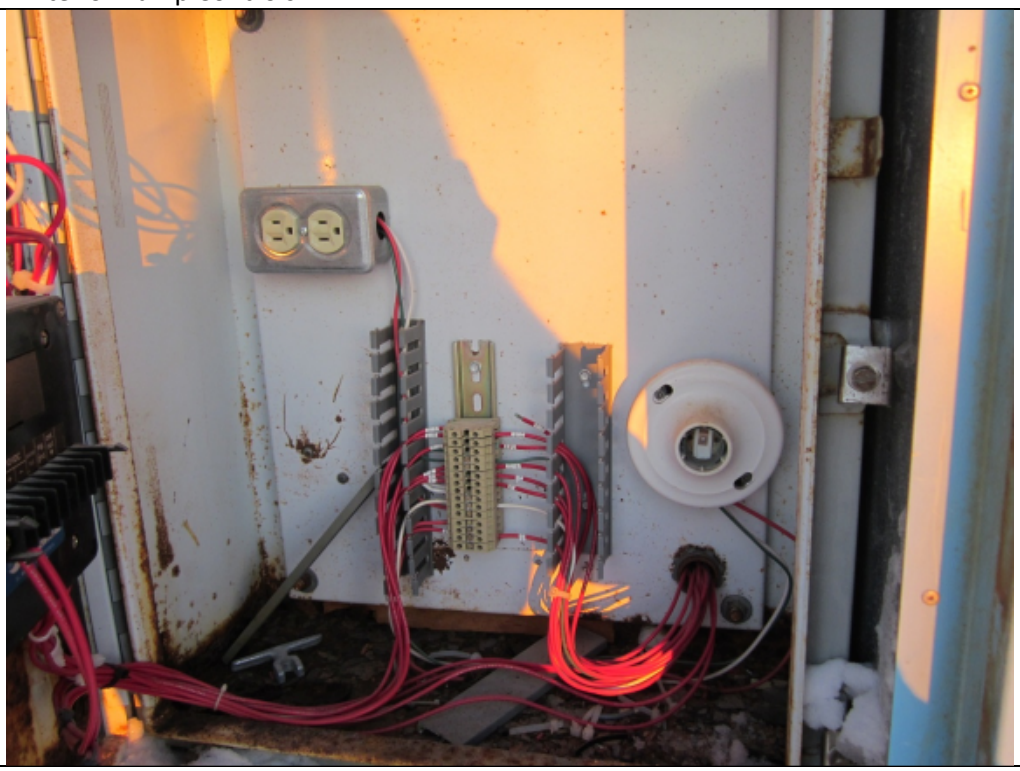

Photo 38 - Exterior Pump Controller Interior of Enclosure

Photo 39 – Exterior Pump Controller Door Mounted Devices

Photo 40 – Auxiliary Pump Controls by Doorway

Photo 41 – Truck Fill Station Alarm Panel

Appendix B – Water Quality

The new identity of ***Trow Associates Inc.***

Memorandum

To:	Steve Burden, P.Eng.	From:	Robert Renaud, P.Geo.
Date:	December 23, 2011		
Project No.:	OTT-00203694-A0		
Subject:	Water Quality Results, Sampling Event Undertaken by Farrell McGovern		
Distribution:			

On November 22, 2011, Mr. Farrell McGovern, P.Eng, representing **Exp** Services Inc. (**exp**), travelled to the Hamlet of Coral Harbour (Hamlet), Nunavut. The Government of Nunavut (GN) has commissioned **exp** to conduct an assessment of the Hamlet's existing truck-fill station. The assessment included a review of the status of the facility with Hamlet representatives and testing of water quality.

On November 23, 2011, Mr. McGovern collected duplicate treated water samples from the truck-fill station. The purpose of the water sampling program was to determine the quality of the treated water and to verify its compliance with the Guidelines for Canadian Drinking Water Quality (guidelines).

The water samples were returned to Ottawa, Ontario and submitted for laboratory analysis of various water quality parameters including organic, inorganic and general chemical parameters. The full list of water quality parameters measured can be found in Table A1.

In general, the analytical results indicate that the water samples meet the requirements of the Guidelines for Canadian Drinking Water Quality and no parameters that would have an adverse impact on human health were identified.

It should be noted that the Guidelines for Canadian Drinking Water Quality direct that water taken from a surface source should be filtered to meet health-based turbidity limits and that disinfection must be provided. No filtration is currently provided.

exp Services Inc.

Attachments:

Table A1 – Water Quality – Truck Fill Station
Laboratory Certificate of Analysis

100-2650 Queensview Drive, Ottawa, ON K2B 8H6, Canada
T: +1.613.688.1899 • www.exp.com

Table A1 - Water Quality - Truck Fill Station
Coral Harbour, Nunavut
November 2011

Parameter	Guideline[1]	Units	Sample #1	Sample #2
Sample Date (dd/mm/yyyy)			23/11/2011	23/11/2011
Hardness (as $CaCO_3$)	NV	mg/L	67	66
Alkalinity (as $CaCO_3$)	NV	mg/L	56	56
Conductivity	NV	µmho/cm	156	160
Colour	≤15	TCU	2	2
pH	6.5 - 8.5	pH Units	7.68	7.76
Turbidity	0.3/1.0/0.1[2]	NTU	0.3	0.3
Fluoride	1.5	mg/L	< 0.1	< 0.1
Chloride	≤250	mg/L	9	9.1
Nitrite (N)	NV	mg/L	< 0.1	< 0.1
Nitrate (N)	45	mg/L	0.1	0.1
Sulphate	<500	mg/L	7	7
Calcium	NV	mg/L	22.7	22.4
Magnesium	NV	mg/L	2.39	2.39
Sodium	≤200	mg/L	5.7	5.7
Potassium	NV	mg/L	1	1
Iron	≤0.3	mg/L	0.017	0.012
Manganese	≤0.015	mg/L	< 0.001	< 0.001
Silica	NV	mg/L	1.15	1.15
Ammonia (N)-Total	NV	mg/L	< 0.01	< 0.01
Total Kjeldahl Nitrogen	NV	mg/L	0.1	0.08
Organic Nitrogen	NV	mg/L	0.1	0.08
Dissolved Organic Carbon	NV	mg/L	2.1	2
Sulphide	≤0.05	mg/L	< 0.01	< 0.01
Phenolics	NV	mg/L	< 0.001	< 0.001
Tannins and Lignins	NV	mg/L	0.2	< 0.1
UV transmittance	NV	%	91.2	91.5
Anion Sum	NV	meq/L	1.53	1.52
Cation Sum	NV	meq/L	1.61	1.59
% Difference	NV	%	2.43	2.06
Ion Ratio	NV	AS/CS	0.952	0.96
Sodium Adsorption Ratio	NV	-	0.306	0.305
TDS (ion sum calc.)	NV	mg/L	82	81.5
Conductivity (calc.)	NV	µmho/cm	162	161
TDS (calc.) / EC (actual)	NV	-	0.526	0.51
EC (calc.) / EC (actual)	NV	-	1.04	1.01
Langelier Index (25°C)	NV	S.I.	-0.564	-0.494

Notes:

NV = No criteria exists for this parameter.

1. Guidelines for Canadian Drinking Water Quality, Health Canada, December 2010

2. The Guidelines[1] direct that water taken from a surface source should be filtered to meet health-based turbidity limits and that disinfection is provided. No filtration is currently provided.

Shaded cells indicate MDL > applicable standard (see Note 2 above).

Bold values with shaded cells indicate an exceedance of applicable standard.

CADUCEON™ ENVIRONMENTAL LABORATORIES
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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: DW 44683 **REPORT No. B11-31265**

Report To:

EXP Services Inc. (TROW)
2650 Queensview Drive, Suite 100
Ottawa ON K2B 8H6 Canada
Attention: Robert Renaud

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 28-Nov-11
DATE REPORTED: 06-Dec-11
SAMPLE MATRIX: Drinking Water

JOB/PROJECT NO.: OTT-00203691-AO
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		Sample #1	Sample #2		
			Sample I.D.		B11-31265-1	B11-31265-2		
			Date Collected		23-Nov-11	23-Nov-11		
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Hardness (as CaCO3)	mg/L	1	SM 3120	30-Nov-11/O	67	66		
Alkalinity (as CaCO3)	mg/L	5	SM 2320B	28-Nov-11/O	56	56		
Conductivity	µmho/cm	1	SM 2510B	29-Nov-11/O	156	160		
Colour	TCU	1	SM 2120C	28-Nov-11/O	2	2		
pH	pH Units		SM 4500H	30-Nov-11/O	7.68	7.76		
Turbidity	NTU	0.1	SM 2130	01-Dec-11/O	0.3	0.3		
Fluoride	mg/L	0.1	SM4110C	28-Nov-11/O	< 0.1	< 0.1		
Chloride	mg/L	0.5	SM4110C	28-Nov-11/O	9.0	9.1		
Nitrite (N)	mg/L	0.1	SM4110C	28-Nov-11/O	< 0.1	< 0.1		
Nitrate (N)	mg/L	0.1	SM4110C	28-Nov-11/O	0.1	0.1		
Sulphate	mg/L	1	SM4110C	28-Nov-11/O	7	7		
Calcium	mg/L	0.02	SM 3120	30-Nov-11/O	22.7	22.4		
Magnesium	mg/L	0.01	SM 3120	30-Nov-11/O	2.39	2.39		
Sodium	mg/L	0.2	SM 3120	30-Nov-11/O	5.7	5.7		
Potassium	mg/L	0.1	SM 3120	30-Nov-11/O	1.0	1.0		
Iron	mg/L	0.005	SM 3120	30-Nov-11/O	0.017	0.012		
Manganese	mg/L	0.001	SM 3120	30-Nov-11/O	< 0.001	< 0.001		
Silica	mg/L	0.02	SM 3120	30-Nov-11/O	1.15	1.15		
Ammonia (N)-Total	mg/L	0.01	MOEE 3364	29-Nov-11/O	< 0.01	< 0.01		
Total Kjeldahl Nitrogen	mg/L	0.05	MOEE 3367	01-Dec-11/O	0.10	0.08		
Organic Nitrogen	mg/L	0.05	MOEE 3367	02-Dec-11/O	0.10	0.08		
Dissolved Organic Carbon	mg/L	0.2	EPA 415.1	29-Nov-11/O	2.1	2.0		
Sulphide	mg/L	0.01	SM4500-S2	02-Dec-11/K	< 0.01	< 0.01		
Phenolics	mg/L	0.001	MOEE 3179	30-Nov-11/O	< 0.001	< 0.001		
Tannins and Lignins	mg/L	0.1	N/A	06-Dec-11	0.2 [1]	< 0.1 [1]		
UV transmittance	%	0.1	N/A	06-Dec-11	91.2 [1]	91.5 [1]		
Anion Sum	meq/L		Calc.	02-Dec-11/O	1.53	1.52		

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

CADUCEON™ ENVIRONMENTAL LABORATORIES
Client committed. Quality assured.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: DW 44683 **REPORT No. B11-31265**

Report To:

EXP Services Inc. (TROW)
2650 Queensview Drive, Suite 100
Ottawa ON K2B 8H6 Canada
Attention: Robert Renaud

Caduceon Environmental Laboratories
2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244

DATE RECEIVED: 28-Nov-11
DATE REPORTED: 06-Dec-11
SAMPLE MATRIX: Drinking Water

JOB/PROJECT NO.: OTT-00203691-AO
P.O. NUMBER:
WATERWORKS NO.

			Client I.D.		Sample #1	Sample #2		
			Sample I.D.		B11-31265-1	B11-31265-2		
			Date Collected		23-Nov-11	23-Nov-11		
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				
Cation Sum	meq/L		Calc.	02-Dec-11/O	1.61	1.59		
% Difference	%		Calc.	02-Dec-11/O	2.43	2.06		
Ion Ratio	AS/CS		Calc.	02-Dec-11/O	0.952	0.960		
Sodium Adsorption Ratio	-		Calc.	02-Dec-11/O	0.306	0.305		
TDS(ion sum calc.)	mg/L		Calc.	02-Dec-11/O	82.0	81.5		
Conductivity (calc.)	µmho/cm		Calc.	02-Dec-11/O	162	161		
TDS(calc.)/EC(actual)	-		Calc.	02-Dec-11/O	0.526	0.510		
EC(calc.)/EC(actual)	-		Calc.	02-Dec-11/O	1.04	1.01		
Langelier Index(25℃)	S.I.		Calc.	02-Dec-11/O	-0.564	-0.494		

1. Subcontracted to Exova Accutest Labs

Greg Clarkin , BSc., C. Chem
Lab Manager - Ottawa District

M.D.L. = Method Detection Limit
Site Analyzed=K-Kingston,W-Windsor,O-Ottawa,R-Richmond Hill

CADUCEON

DRINKING WATER FACILITY CLASSIFICATION

- [ ] Municipal
- [ ] Non-Municipal
- [ ] Reg. 170/03
- [ ] Large
- [ ] Small
- [ ] Reg. 318/08 & 319/
- [ ] Residential
- [ ] Non-Residential
- [ ] Reg. 243/07
- [ ] Seasonal
- [ ] Year-Round
- [x] Private Well Water
- [ ] Other:

REPORT NUMBER (Lab Use)

B11-31265

Indicate Laboratory Samples are Submitted to

- [ ] Kingston
- [x] Ottawa
- [ ] Richmond Hill
- [ ] Windsor

Company: exp Services Inc.	Waterworks Address:	Invoicing Address (if different): exp Services Inc. 100-2650 Queensview Dr. Ottawa, ON K2B 8H6	
Contact: Robert Renaud			
Tel: 613-688-1859 Hours Tel:	Fax: 613-225-7337 Public Health Unit:	Waterworks No.:	Project Name/No.: OTT-00203694-A0
Email: robert.renaud@exp.com		Quote No.:	P.O. No.:

ANALYSES REQUESTED

Microbiological					Chemical								Other	
Total Coliform / E.coli	Background	Heterotrophic Plate Count	Fecal Coliforms	P/A (Total Coliform / E coli)	Sodium	Lead	Fluoride	Trihalomethanes	Nitrite, Nitrate as N	Sch. 23 Inorganics	Sch. 24 Organics	Private Well Package (+30 bact)	UV Transmittance	
•												X	X	

TURNAROUND TIME REQUESTED

- [ ] Rush 24 Hr 100% Surcharge
- [ ] Rush 48 Hr 50% Surcharge
- [ ] Rush 72 Hr 25% Surcharge
- [x] 5-7 Day Standard

Specific Date:

* Sample Matrix Legend: TW = Treated Water DW = Distribution Water GW = Raw Groundwater SW = Raw Surface Water UGW = Untreated Groundwater (Drinking Water/Distribution) GUDI = Groundwater under the influence of surface water PR = Plumbing Residential PNR = Plumbing Non-Residential

Sample Source and/or Sample Identification	Watertrax S.P.L.	Sample Matrix *	Date Collected (yy-mm-dd)	Time Collected	Adverse Resample	Chlorine Free	Chlorine Total	# Bottles/ Sample
Sample #1		TW	11-11-23	12:00				6
Sample # 2		TW	11-11-23	12:00				6
Sample # 3		TW	11-11-23	12:00				6
Sample # 4		TW	11-11-23	12:00				6

HOLD

HOLD

→ Cancelled by Robert. SZ

Has Lab Service Notification (LSN) Form been completed & submitted to the MOE/PHU? [ ] Yes [ ] No [x] Not Applicable

Laboratory Analysis will not commence until all Notification information is received and the Submission form is appropriately completed

SAMPLE SUBMISSION INFORMATION	Sampled by:	Submitted by:
Print:	Farrell McGovern	Alex Roblin
Sign:		Alex Rob.
Date (yy-mm-dd)/Time:	Nov. 23/11 12:00	Nov. 28/11

SHIPPING INFORMATION

- [ ] Courier (Client account)
- [ ] Courier (Caduceon account)
- [x] Drop Off
- [ ] Caduceon (Pick-up)
- [ ] Invoice
- # of Pieces

REPORTING / INVOICING

- [ ] Results by Fax
- [x] Results by Email
- [x] Invoice by Email
- [ ] Invoice by Mail

SAMPLE RECEIVING INFORMATION (LABORATORY USE ONLY)

Received By (print): Jasina Signature:

Date Received (yy-mm-dd): NOV. 28 11 Time Received: 13:32

Laboratory Prepared Bottles: [x] Yes [ ] No Comments:

Sample Temperature °C: 13.3 °C Labeled by:

Comments: 4 DOC 4 BABY 4 NP glass 4 H_2S 4 M 4 PET

Ontario Laboratory Locations/ Shipping Addresses

Kingston Lab - 265 Dalton Ave., Kingston, ON K7K 6Z1, Tel: (613) 544-2001 Fax: (613) 544-2770 Email: contactkingston@caduceonlabs.com

Ottawa Lab - 2378 Holly Lane, Ottawa, ON K1V 7P1, Tel: (613) 526-0123 Fax: (613) 526-1244 Email: contactottawa@caduceonlabs.com

Richmond Hill Lab - [illegible] West Beaver Creek Rd., Richmond Hill, ON L4B 1J9, Tel: (289) 475-5442 Fax: (866) 562-1963 Email: contactrichmondhill@caduceonlabs.com

Windsor Lab - 45-3201 Marentette Ave., Windsor, ON N8X 4G3, Tel: (519) 966-9541 Fax: (519) 966-9567 Email: contactwindsor@caduceonlabs.com

White (Laboratory Copy) Pink (Client Copy)

Appendix C - Photographs

Photo 1: Truck Fill Station

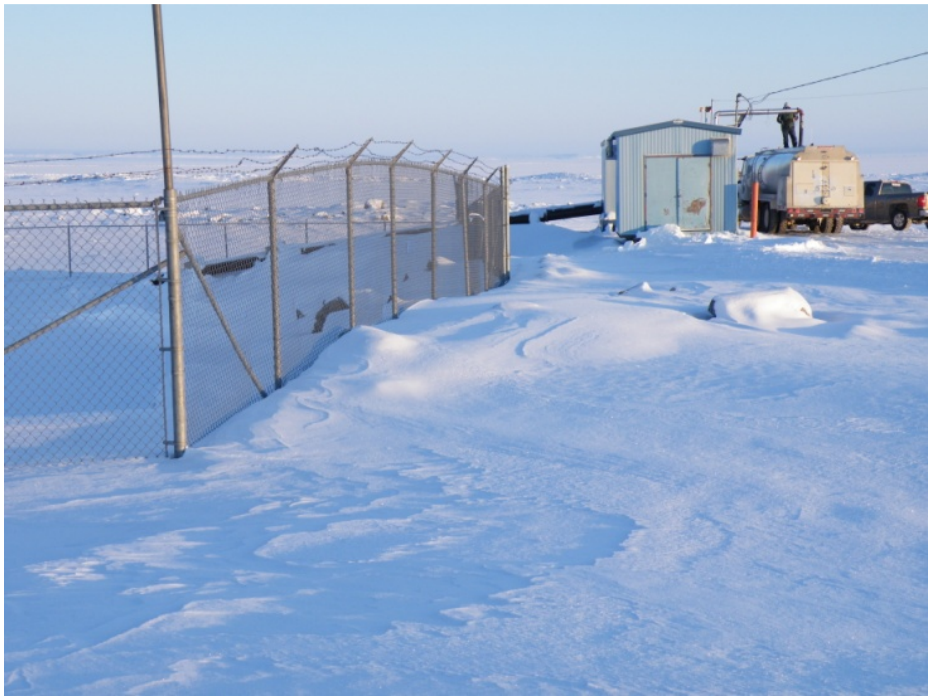

Photo 2: External view looking north

Photo 3: Fill Station and Loading Arm

Photo 4: External Fuel Tank

Photo 5: Chlorine Tank and Metering Pump

Photo 6: Supply Piping Entry

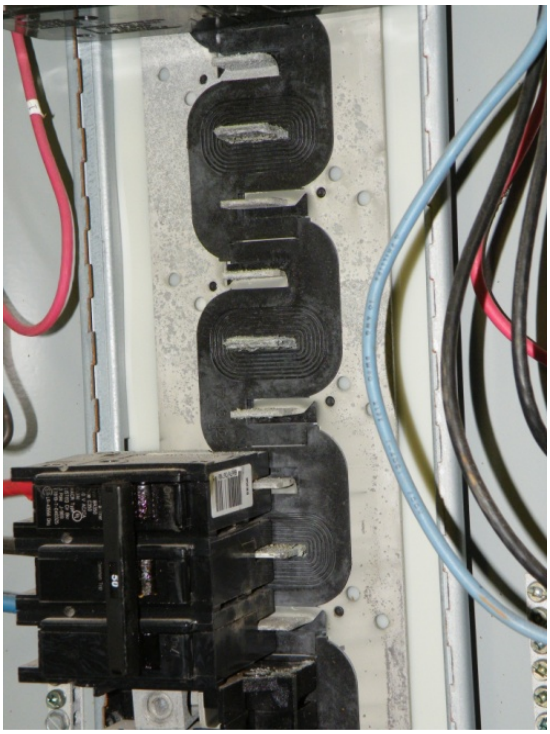

Photo 7: Internal Corrosion within Panel Board

Photo 8: Operation of Contactor with Metal Rod

Photo 9: Heat Trace Controller Internal Conditions

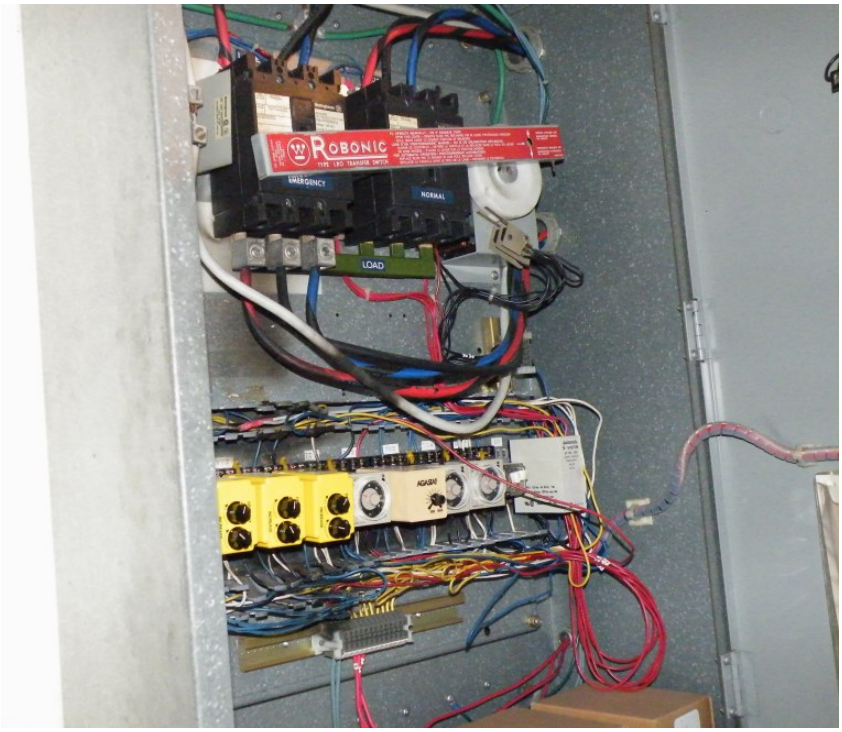

Photo 10: Transfer Switch Internal Condition

Photo 11: Generator and Fuel Piping

Photo 12: Unserviceable Intake Damper