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July 15, 2003
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RE: Resolute Bay Utilidor Assessment

Dear Mr. Slifka;

The purpose of this report is to outline our findings on the utilidor system at Resolute Bay and to make recommendations as to the upgrades needed to make immediate repairs to the system and to minimize future freeze-ups of the system.

This utilidor system has been the subject of two earlier reports, one by UMA in 1995 and one by Dillon Consulting in 1998. Reference is made to those reports. Differences between those reports and current operation are outlined herein

Char Lake

The Dillon report indicated that water production from Char Lake was typically at 34,000 Igal/day (153,000 L/day made up of 123,000 L/day for bleeders and 30,000 L/day of consumption). The water supply from Char Lake was typically maintained at 24 Igal/minute by operating one jockey pump on a continual basis and one of the large pumps on a demand basis. Heat trace was off unless an emergency occurred. Wet well temperatures of 10ºC are typically maintained. The Char Lake building does not heat properly and is very cold.

Currently water production from Char Lake is typically in the 70,000 to 80,000 Igal/day range. This water supply rate is accomplished by continuously operating both jockey pumps which supplies about 60 Igal/min on a continuous basis plus the large pumps are brought in on a demand basis. Heat trace was run continuously during the winter. The system is struggling to maintain wet well temperatures of 5ºC. The Char Lake building does not heat properly and is very cold.

Thus compared with 1998, water production rates have more then doubled. In 1998, water for the airport sites was not taken from the municipal systems. Today water is taken from the municipal system at a truck fill at the water treatment plant. This quantity of water is estimates at 10,000 Igal/day, which would increase daily production to about 44,000 Igal/day. However actual water consumption has increased to about double the 44,000 Igal/day figure. This increase is due to a substantial increase in the number of bleeders in use.

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A thermal analysis of the Char Lake facility reveals that the boilers do not have sufficient heating capacity to heat the reservoir when water production is in the 70,000 to 80,000Igal/day range. Heating requirements are approximately:

	System in 1998	Maximum Using Current Boiler	Current Operation
Average Daily Water Produced At Char Lake (Igal/day)	34,000	55,000	80,000
Average Pumping Rate (Igal./min)	24	38	55
Required boiler size to heat makeup water to 10ºC (Btuh)	350,000	493,000	713,000
Total required boiler size including building heat	405,000	543,000	768,000
Existing Boiler Size	612,000	612,000	612,000
Wet Well Water Temperature	10ºC with lots of spare capacity	10ºC with a little spare capacity	7ºC at best

Our conclusion is that the problems with the wet well temperature at Char Lake are the result of excess water production. In order to properly heat the water in the wet well, average daily flow needs to be reduced to 55,000 Igal/day. If the current rate of water consumption is to be maintained, a new boiler needs to be added to the Char Lake Pumphouse. This new boiler should be sized to provide an additional 200,000 Btuh of heating to the wet well.

Char Lake Pumphouse Heating System

A thermal analysis of the building heat loss at Char Lake was done. To maintain 21ºC indoor temperatures the building heating system should be sized to provide 55,000 Btuh of heat. The unit heaters in the building are sized for about 84,000 Btuh therefore the heating system should be adequate.

The heating system at the pump house uses a Hydrotherm MO-770 boiler system with a boiler module having a gross output capacity of about 612 MBH. The boilers partially gravity feed to a Superhot tankless copper coil hot water heater. Each coil has a capacity of about 249 MBH if fed with 26 gpm of boiler water.

A single circulation pump draws water through the tankless coil and supplies heat to the unit heaters. The circulation pump is an Armstrong S25 with a capacity of about 20gpm at 6 feet of head.

During our period on site it was noted that the wet well was not up to temperature, even though the boilers were not firing 100% of the time. This implies that the heat transfer system attached to the boiler is not large enough to transfer all of the heat that the boiler is capable of delivering. From the above analysis, it is likely the low capacity of the circulation pumps and the arrangement of the Superhot tankless water heaters in a gravity arrangement that causes this shortfall.

The arrangement of the heating supply first running through the Superhot tankless heaters and then to the unit heater, means that the unit heaters will get both low flow and low temperature heating water. This reduces the heating capacity of the unit heaters and is probably the cause of the low building temperatures. The low building temperatures are made worse by the increased water production as this lowers the boiler temperatures further and causes the unit heater capacity to be further lowered.

We recommend that the boiler system be changed to have larger boiler pumps that supply both the unit heater and the domestic hot water heaters. The new boiler bump should have a capacity of about 60gpm.

The insulation systems on the building walls are very poor. Heating of the building would be improved substantially if the insulation systems were upgraded.

Supply Lines from Char Lake to the Water Treatment Plant

In the Dillon Report it was noted that the supply to Signal Hill ran without major problems. The heat tracing system was off unless problems were encountered.

Currently the system is operating with the heat trace on. The maintainer indicates that if the heat trace is turned off that he immediately starts having problems with low temperature and freezing of the system.

A thermal analysis of the water supply line between Char Lake and the Signal Hill Water Treatment Plant was conducted. The line is a 6" line with 2" of insulation. Assuming a ground temperature of –23ºC, the heat loss along the 2 km line is 105,000 Btuh. The heat loss along the pipeline from Char Lake to Signal Hill is about 72,000 Btuh. This will result in a temperature drop of between 1.1 to 2.5ºC depending upon the flow rate. This temperature drop is minor and should not require the heat trace to be used.

	System in 1998	Maximum Using Current Boiler	Current Operation
Average Pumping Rate (Igal/min)	24	38	55
Temperature Drop To Signal Hill (ºC)	2.5	1.6	1.1

It is possible that because of the high water production volumes, the water temperature levels in the wet well were low which resulted in concerns of freezing in the pipe which were resolved by running the heat trace. If heating levels are resolved in the Char pumping station then the heat trace should be able to be turned off.

Signal Hill Treatment Plant

Water enters the Signal Hill Plant reservoir from Char Lake. Heat is added from the boilers to raise the water temperature in the reservoir to 10ºC. Water from the reservoir is pumped through the utilidor system consisting of 8" diameter insulated pipes. Approximately 300 gpm are recirculated back to the Treatment Plant to ensure the water system does not freeze.

Water enters the sewage system from domestic water use and from bleeders. Each house has a bleeder set at about 1 litre/hour each. Also, main bleeders are located at seven locations in the manholes at about 7.3 gpm each.

The Dillon report remarked that there were only 3 main bleeders each having a very high bleed rate. The number of bleeders and rate of bleed is incorrect.

A thermal analysis was conducted of the reservoir, the building, the water utilidor system and the sewage utilidor system as follows:

Water Production Rate (Igal/day)	34,000	55,000	80,000
Building Heat Loss (Btuh)	84,000	84,000	84,000
Temp Water from Char Lake (ºC)	7.5	8.4	6.4
Heating of Char Lake Water to 10ºC (Btuh)	64,000	64,000	216,000
Reservoir Heating (Btuh)	46,000	46,000	46,000
Utilidor Heating (Btuh)	223,000	223,000	223,000
Total Heating (Btuh)	417,000	417,000	569,000
Temperature of Water Returning from Utilidor (ºC)	9.4	9.4	9.2
Temperature of Water To Sewer Outfall (ºC)	2.1	5.0	6.1

As can be seen from the above table, flows have increased to 80,000 Igal/day. The load on the Treatment Plant boilers has increased substantially to reheat the water being supplied from Char Lake. Despite the increased load the boiler plant should be capable of maintaining the system at 10ºC. This has not happened probably because of the poor circulation through the boilers.

It was suggested that a new boiler be installed into the Water Treatment Plant. We do not believe this is necessary. A new boiler should be installed at Char Lake. This will eliminate most of the load problems at the Water Treatment plant. In addition, we suggest enlarging the circulation pump capacity at the Treatment plant. This will result in better performance of the heat transfer elements.

Utilidor Heat Losses

The thermal analysis indicates that the heat loss along the utilidor should be about 223,000 Btuh or a temperature drop of only 1ºC maximum.

The maintainers indicate that over the last winter they were showing a temperature drop of up to 3 or 4ºC in the utilidor system. High temperature drop in the utilidor system can be explained by either a low circulation rate or by a failure of the pipe insulation systems.

The circulation pumps were designed to operate at 370 gpm at 70 feet of head. Currently they operate with a shutoff head of about 74 feet and an operating head of about 40 feet. We did not examine the pumps in detail, but the pump seems to be operating correctly and probably is supplying approximately the design amount of water.

A failure of the insulation system also seems unlikely. The insulation is a polyurethane insulation. Under some conditions it will degrade over time. However under most conditions the insulation will retain its thermal properties.

If repaired areas were not re-insulated as they were repaired, then over time more and more of the piping system would become uninsulated. We have no knowledge of the condition of the repaired sections.

One of the ideas discussed on site was to install a reheat station near manhole AV-6. The calculations would suggest that the installation of a reheat station at this point would do little good. If the insulation systems are only allowing a 1ºC temperature drop in the system, then the reheat station will serve no purpose. If the pump circulation is low, then it would be best to resolve the problem by increasing pump circulation. If the insulation systems are poor, then the temperature drop to AV-6 would be 2ºC and the temperature rise from a 200MBH boiler would be only 0.7ºC. The 0.7ºC increase would not resolve the problem.

We recommend that the system be corrected by installing a new boiler at Char Lake and by reducing the bleeder rate in the system to lower water usage to about 55,000 Igal./day maximum.

Utilidor Repairs

The following utilidors require repairs during this summer:

- Utilidor between AV27 and AV-28. The system needs to be dug up and the 90degree elbow replaced. The flanges in the manholes in AV27 need to be replaced as there is a leak at the flange.

- Utilidor between AV-10 and AV-9. Replace the watermain between AV-9 and AV-10. The flanges in the manholes do not need replacing.

- Utilidor between AV-8 and AV-9. The condition of this water main is unknown and may require replacement.

- Utilidor AV-6 to AV-7. Replace the water main between AV-6 and AV-7. The flanges in the manholes do not require replacement.

Summary

We recommend that the system be corrected by installing a new boiler at Char Lake and by reducing the bleeder rate in the system to lower water usage to about 55,000 Igal./day maximum. We also recommend installing larger circulation pumps in the boiler systems and revising the circulation systems. We further recommend that the rate of circulation from the water treatment plant be checked and that the utilidor watermains be repaired as outlined above.

Lowering water usage is to be done by lowering the main bleeder rate at the seven bleeders (AV17, 19, 25, 2, 4, 27 and 28) to a flow rate of about 4gpm each. House bleeders may stay at 1 litre/hour each.

The above outlines our observations and recommended course of action to correct the problems with the utilidor system at Resolute Bay. The observations need to be examined by others to ensure that we have accurately expressed the current operation and problems with the system.

Once you have had time to review the report we suggest a phone call with the concerned parties to review this report and adopt a course of action.

Sincerely,
A.D. Williams Engineering Inc.

Brian George, P.Eng.
Senior Mechanical Engineer