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**REPORT TO SAANICH PENINSULA WASTEWATER COMMISSION
MEETING OF THURSDAY, NOVEMBER 15, 2012**

**SUBJECT SAANICH PENINSULA WASTEWATER TREATMENT PLANT THERMAL
ENERGY RECOVERY SYSTEM – OPERATIONS UPDATE**

ISSUE

At the meeting on September 20, 2012, Saanich Peninsula Wastewater Commission directed staff to provide information on alternatives and options for improving performance of the Saanich Peninsula wastewater treatment plant (SPWWTP) heat recovery system for the November budget meeting.

BACKGROUND

The SPWWTP heat recovery system was commissioned in February 2011 and has supplied treatment plant effluent waste heat to the Panorama Recreation Centre (PanRec) for heating its swimming pools since then. The project history of the SPWWTP thermal energy recovery system is attached as Appendix A. The heat recovery system Operating and Maintenance (O&M) cost recovery arrangement with PanRec is based on the market rate for the natural gas being displaced minus the carbon tax.

Since this is a pilot project for implementing and testing the viability of a very new and innovative technology, it is also considered a learning process for the system operations and equipment maintenance. The ongoing review and optimization of the heat recovery system performance has highlighted four areas of interest:

1. Project Benefits – net savings and greenhouse gas (GHG) reductions
2. Financial Update
3. Waste Heat Billing Accuracy
4. Integration of Heat Recovery System and Pool Heating System

Project Benefits Summary

The estimated net savings and GHG reductions that were provided by engineering studies prior to commissioning of the pilot project in 2011 are included in the following table. The actual amounts recorded for 2011 and those projected for 2012 yearend are also included below.

Date	Information Source	Estimated Net Saving (\$)	Estimated GHG Reduction CO ₂ e (tonnes)
February 2008	EarthTech (AECOM)	\$123,000	450
April 2008	EarthTech (AECOM)	\$108,000	443
December 2009	Dayton & Knight / DEC	\$65,000	561
September 2010	CRD	\$44,425	561
December 2011	CRD	\$35,406 (actual)	285 (actual)
December 2012 (projected to yearend)	CRD	\$15,175	442

Financial Update

The revenue and expenditures for 2011 and 2012 are summarized as follows:

Date	PanRec Billing Revenue	O&M Budget	O&M Expenditures	Net Revenue
2011 (Feb-Dec)	\$70,318.93	\$50,000	\$34,912.72*	\$35,406.21
2012 (Jan-Oct)	\$84,935.00	\$37,500	\$74,523.00	\$10,412.00
2012 (Nov-Dec)**	\$21,440.00	\$12,500	\$16,677.00	\$4,763.00
2012 (projected yearend)	\$106,375.00	\$50,000	\$91,200.00	\$15,175.00

* The electricity cost of approximately \$3,000 was not included in the yearend O&M expenditure.

**The 2012 projection was based on November-December 2011 revenue and costs history.

The monthly billing revenue generated in 2012 has been comparable with 2011, but the O&M costs have been significantly higher as compared with 2011. These higher costs are related to the following:

- costs in dealing with maintenance requirements (after the warranty period)
- contracting out specialized equipment maintenance to the equipment supplier (Trane)

- electricity costs increased due to increases in BC Hydro costs (step rates, demand charges and power factor charges)
- higher energy cost in operating the heat pump due to operating problems which reduced the heat pump efficiency
- labour consumption (including trouble-shooting, system improvement investigation and SCADA programming for system control integration)

It is anticipated that the O&M costs will remain high through 2013, since the pilot project is still in its learning stage with the overall system performance yet to be optimized. Assuming PanRec's energy demand remains similar to that of 2012, the net revenue for 2013 should also be similar to that of 2012. However, once the system is "debugged" and performance optimized, the O&M costs should decrease and stabilize. A cost benefits analysis should be conducted at this time to determine if this heat recovery system operation is sustainable or not.

Waste Heat Billing Accuracy

The billings to PanRec are based on the energy meter reading at the mini-plant. In late September 2011, it was determined that the meter, which is located at the inlet side of the mini-plant heat pump, should actually be located on the outlet side of the heat pump where the heat is transferred to the PanRec pool system. When contacted for an explanation, the design consultant (DEC Design) indicated they did not fully understand how the two Capital Regional District (CRD) services (PanRec and SPWWTP) interact on a financial basis. They thought that as one overall organization, the CRD would be interested in the amount of energy extracted from the effluent rather than the energy consumed by PanRec, which would mean the energy meter was installed in the correct location.

In order to avoid the cost of relocating the meter to the outlet side of the heat pump, it was decided that a similar result could be achieved by altering the system monitoring program to provide calculated energy consumption readings based on the existing inlet meter readings adjusted using engineering principles. The energy meter compensation calculation is considered to be a reasonable approach, but does represent a level of uncertainty in billing amounts to PanRec. The calculated billings cannot, therefore, be considered 100% accurate.

Since there is insufficient room within the mini-plant to accommodate the relocation of the energy meter to the outlet side of the heat pump, the energy meter would need to be installed inside the PanRec mechanical room at an estimated cost of about \$30,000.

The new energy meter would then provide actual energy consumption readings that could be compared with the calculated consumption numbers. Adjustments to the cost recovery billings could then be made if warranted.

Staff is also currently investigating what the percentage of uncertainty in the billing amounts is likely to be in order to determine whether or not it makes economic sense to proceed with the installation of the new energy meter.

Integration of Heat Recovery System and Pool Heating System

The PanRec pool is heated via an in-house hot water conveyance loop which receives waste heat from the ice rink, the pool ventilation system (the waste heat from these two sources is elevated to suitable temperature by heat pumps) and gas boilers which operate as backup in periods of peak demand. These heat sources are brought online, as needed, by the pool's DDC programmable control system using various temperature sensors, pressure sensors and automated control valves.

The SPWWTP heat recovery system also supplies heat into the PanRec pool heating loop from its mini-plant heat pump located adjacent to the facility. The mini-plant is programmed to operate at various output capacities to meet the heat demands of the pool heating loop.

The design intent was to harmonize the heat recovery system with the existing pool heating system. The intended operational sequence to satisfy the demand for heat at the pool was for the ice rink heat pumps to come online first, the HVAC heat pump second, the effluent waste heat system third and then the gas boilers as final backup, if needed.

It became apparent, however, that the pool heating system and the heat recovery system had not been integrated properly causing operational difficulties which have negatively impacted the overall heating system performance.

After the trouble-shooting investigation in November 2011, it was decided that the ice rink and HVAC heat pumps would be taken offline and the effluent heat recovery system would be used as the primary heat source for the pool with the pool gas boilers providing backup.

Due to the two energy/cost saving heat pumps at PanRec not being able to run simultaneously with the heat recovery system, there is a concern that the heat recovery system may have contributed to an increase in overall energy consumption at the PanRec recreation complex. PanRec, CRD Operations and Environmental Engineering staff have had numerous meetings with the PanRec electrical/control contractor (Houle Controls), mechanical contractor (Bayside Mechanical), system design consultant (DEC Design), waste heat recovery system supplier (Trane) and system installer (Knight Contracting) to come up with a solution to the problem. To date, no definitive answer has been identified or implemented.

In order to resolve this dilemma, both PanRec and Environmental Engineering staff agree that an independent assessment of the pool mechanical/control system and the integration of waste heat supply from the mini-plant should be done. This assessment should be performed by an independent consultant with considerable experience in similar system design and operations.

The first phase of this assessment should include a cost benefit analysis to determine which mode of operation will provide the best value to PanRec (i.e., the full utilization of effluent waste heat source or a combination of heat sources including the ice rink and HVAC heat pumps). The integration of the ice rink and HVAC heat pumps at PanRec with the heat recovery system may not be necessary.

Based on similar studies conducted by consultants for other CRD projects, the cost of this assessment is estimated to be \$40,000 (including staff time) which could potentially be cost-shared between PanRec and SPWWTP.

ALTERNATIVES

1. Retain a consultant to conduct an independent cost benefits analysis and an assessment of the integration of the pool and mini-plant systems to optimize overall system performance at an estimated cost of \$40,000, subject to cost-sharing with PanRec.
2. Wait for the yearend 2012 net revenue amount to be confirmed and decide what can be done within the surplus.
3. Not to proceed with either of the above.

FINANCIAL IMPLICATIONS

The net revenue generated to date from the waste heat recovery system is limited. Alternative 1 would need additional funding from the SPWWS Sewer Debt Reserve Fund, which has \$1,029,391.72 remaining as of October 31, 2012. Alternative 2 would be based on the net revenue generated by yearend to determine what can be done with the amount.

RECOMMENDATIONS

That the Saanich Peninsula Wastewater Commission approve Alternative 1 and direct staff to:

1. retain a consultant to conduct an independent cost benefits analysis and an assessment of the integration of the pool and mini-plant systems to optimize overall system performance at an estimated cost of \$40,000, subject to cost-sharing with PanRec;
2. all expenditures be charged to the SPWWS Sewer Debt Reserve Fund, which has \$1,029,391.72 remaining as of October 31, 2012; and
3. report back to the Commission with the energy meter investigation with recommendation.



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Concurrence

AL:jt
Attachment: 1

Saanich Peninsula Wastewater Treatment Plant Thermal Energy Recovery System

Project History

Background

Since 2007, the Saanich Peninsula Wastewater Commission (the Commission) has been actively involved and supportive of the vision to recover and use waste heat energy from the Saanich Peninsula wastewater treatment plant (SPWWTP). This waste heat energy can be used to reduce natural gas consumption for heating at various facilities located nearby.

In November 2007, EarthTech (Canada) Inc., a major international environmental engineering consultant, was retained to carry out a feasibility study.

At the April 17, 2008 Commission meeting, EarthTech presented the SPWWTP Energy Recovery Feasibility Study Final Report. The report confirmed the findings from the preliminary review and further identified the two most feasible options. Option 4 was selected by the Commission, i.e., size the transmission piping to enable maximum energy capture from the SPWWTP effluent. This option would also provide capacity for future expansion at the four potential customer sites: SPWWTP; Panorama Recreation Centre (PanRec); The Centre for Plant Health; and a new elementary school being constructed nearby. The cost and benefits of this option is summarized in the following table:

Table 1 – Cost and Benefits Summary
(Based on Feasibility Study)

Option	Capital Cost	Annual Energy Saving	Payback Period (years)	GHG Reduction CO ₂ e (tonnes)
4	\$3,491,000	\$107,600	20	443

A grant application based on the above Option 4 was submitted.

In October 2008, the SPWWTP received a funding approval of \$2,989,500 or 100% of the actual eligible costs of the Saanich Peninsula wastewater thermal energy recovery project.

At the February 2009 Commission meeting, the Commission approved the contract awarded to Dayton & Knight Ltd. and DEC Mechanical Consultant Ltd. team for the design phase of this project.

The construction tenders were received on November 12, 2009; the low tender was \$2,919,199 (excluding GST). This tender price was approximately \$400,000 over the Dayton & Knight and DEC Design team estimated budget for the construction portion of this project.

The Commission directed staff to prepare a summary of the project history and business case for their discussion and consideration.

Various construction alternatives were analyzed. The following alternative was approved by the Commission:

“That the scope of the Contract be reduced to the amount of \$2,520,000 and be awarded to the low bidder Knight Contracting Ltd., with additional funding in the amount of \$291,463 needed for the remaining consultant services, staff management costs and construction contingency allowance through to project completion.”

The \$291,463 was funded from the unspent capital funds remaining in Bylaws #2376 and #2176 and the SPWWS Sewer Debt Reserve Fund.

The mini-plant to serve the SPWWTP was to be constructed, in compliance with the original scope of project specified in the Grant Agreement, from the revenues generated from the sale of heat energy to PanRec after the payback of the reserve fund for the additional project costs.

Based on the business case analysis, the cost and benefits of effluent waste heat utilization at PanRec are presented below:

Table 2 – Annual O&M Cost versus Benefits

Waste Heat Utilization Location	Annual Energy Savings	Annual O&M Costs	Net Annual Cost Savings	Annual GHG Reduction (tonnes)	Annual GHG Savings @ \$25/tonne
PanRec Pool	\$112,223	\$47,067	\$65,156	560.5	\$14,094

On September 16, 2010, the Commission approved the following:

- the waste heat energy cost recovery be based on the market rate for natural gas without the carbon tax;
- the cost will be recovered monthly from the PanRec annual budget; and
- the waste heat energy cost recovery arrangement be presented to the Peninsula Recreation Commission for approval and inclusion in the 2011 PanRec annual operating budget.

On October 21, 2010, the Peninsula Recreation Commission approved the above arrangement.

The heat recovery system was commissioned in February 2011 and has supplied treatment plant effluent waste heat to PanRec for heating its swimming pools since then.