HALIFAX
REGIONAL MUNICIPALITY

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Environment & Sustainability Standing Committee
May 2, 2013

TO: Chair and Members of Environment & Sustainability Standing Committee

Original Signed

SUBMITTED BY: Jane Fraser, Director, Planning & Infrastructure

DATE: March 8, 2013

SUBJECT: **Surplus Energy Sale from Alderney 5 Project**

INFORMATION REPORT

ORIGIN

Environment & Sustainability Standing Committee, March 7, 2013, Item 6.3.1: Motion directing "staff to prepare a report on the status of the geothermal site and the possibility for external stakeholders to access heating and cooling capacity. MOTION PUT AND PASSED"

LEGISLATIVE AUTHORITY

HRM Charter, 79, (x) Power to expend money, lands and buildings required for a municipal purpose.

BACKGROUND

Alderney 5:
The Alderney 5 Energy Project is a $3.6 million energy-efficiency retrofit of five municipal buildings on the Dartmouth, Nova Scotia, waterfront: Alderney Gate, Alderney Landing, Alderney Library, Ferry Terminal Building, and the former Dartmouth City Hall Building (90 Alderney). The heating plant is fully operational in Alderney Gate, Alderney Landing, Ferry Terminal and the Alderney Library. The cooling system is operational at Alderney Gate, Alderney Landing, and the Alderney Library.

It was expected that the Alderney 5 Energy Project would save $350,000 per year in energy costs, avoid $800,000 in future replacement costs and significantly reduce maintenance with the new heating and cooling systems.

The project consisted of five elements:

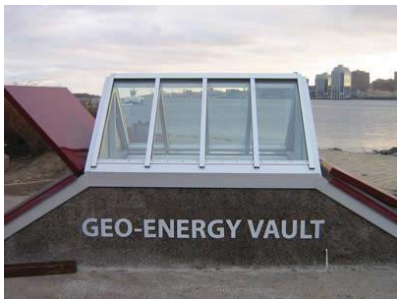
1. Lighting retrofits
2. District Heating and Cooling Piping
3. High efficiency natural gas boilers
4. Seawater cooling system
5. Underground borehole cold energy storage system

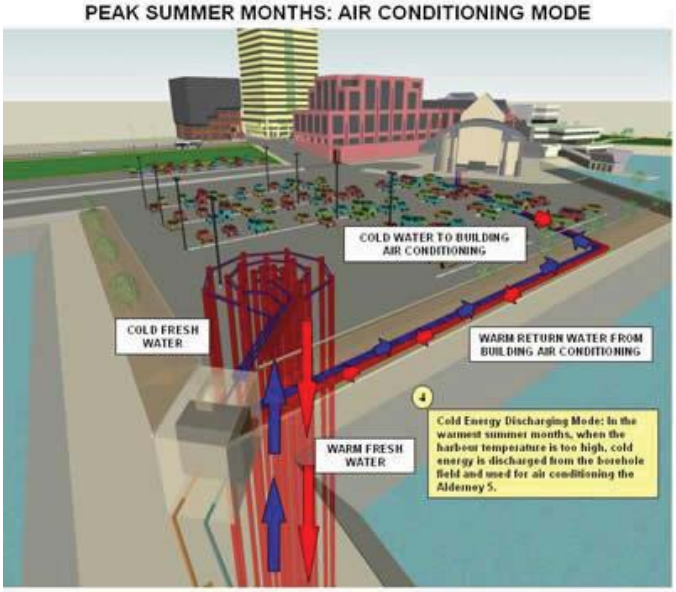
The Alderney 5 project is the first large-scale application of geothermal seasonal cold-energy storage anywhere in the world. The geothermal borehole system uses a patented heat exchanger design that is 300% more efficient than traditional U-tube designs. This breakthrough borehole design is the key that enables cold energy to be stored in the rock mass, and then used directly for air conditioning without using heat pumps. When operating properly, the revolutionary cooling system eliminates the need for supplementary cooling systems using compressors or cooling towers by harvesting cold energy from seawater during winter months to chill an underground rock mass, and then using the stored thermal energy to meet air conditioning needs in warmer months by using 100% renewable energy. The project was initiated in 2005 and completed in 2009.

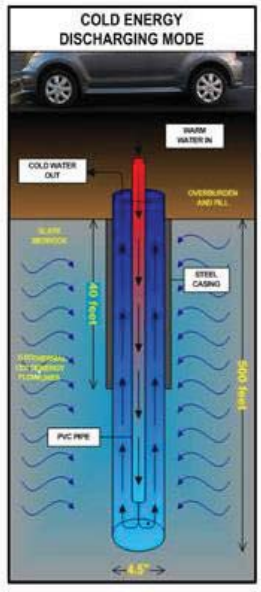
The original project relationship consisted of a private firm developing the project and leasing it to HRM over a twenty year term. The firm went into receivership mid-project. The municipality completed the project on its own and now owns it.

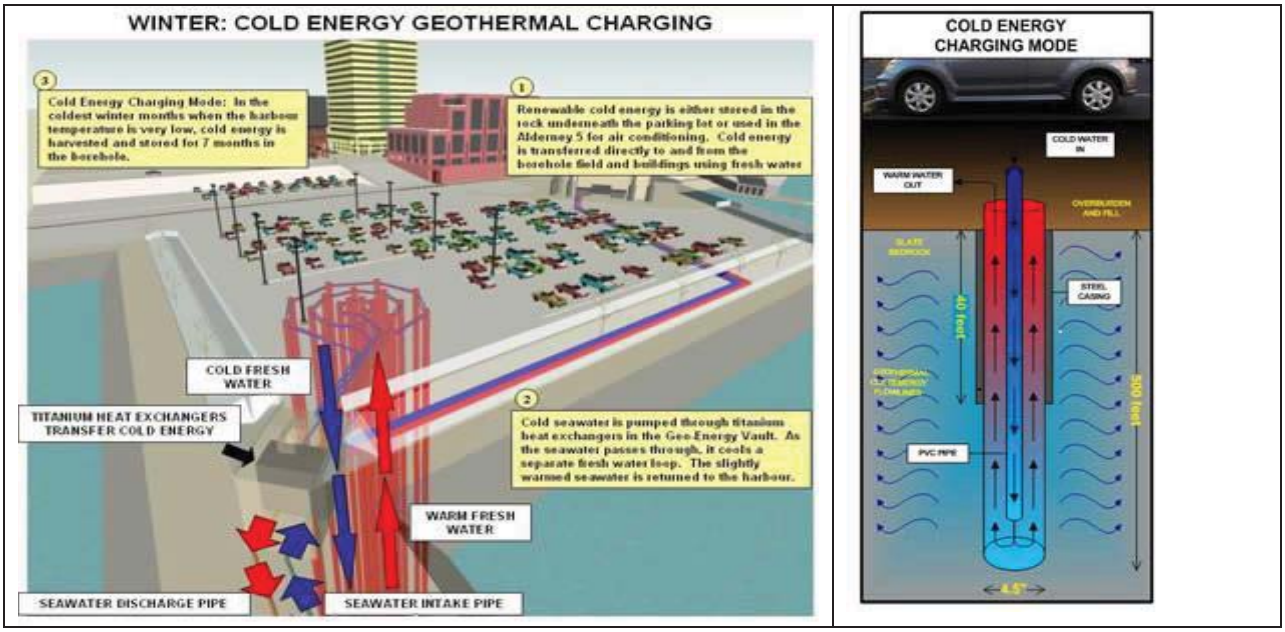
How it Works: The seawater cooling and geothermal energy storage system is a fairly simple concept. In essence, the geothermal energy system acts as a battery but instead of electricity, cold energy is stored. This geothermal cold 'battery' uses a volume of rock the size of a 40 storey building and over 30km of piping underground. Shown in the diagrams below are simplified versions of a typical borehole in charging and discharging modes.

The GeoEnergy Vault is the the heart of a revolutionary geothermal cold storage system. Below are titanium heat exchangers used to extract cold energy from the Halifax harbour in the wintertime. This cold energy is stored for 7 months in a geothermal borehole field underneath the adjacent parking lot. This seawater cooling and cold storage system is used to provide 100% renewable energy for the air conditioning of five major buildings on the Dartmouth waterfront. The geothermal energy storage system has 85 boreholes. Each has a diameter of 4½ inches and is 500 feet deep.









Plant Capacity: The current plant was designed as a demonstration project for the five buildings on the Alderney Campus. The piping was upsized by 50% to enable future expansion. The heat exchangers have a capacity to add additional plates to create approximately an additional 150 tonnes of cooling.

Seawater Cooling for Buildings: Buildings in the Halifax Regional Municipality have progressively used seawater cooling since Historic Properties did it in the 1970's, Purdy's Wharf in the 1980's and, more recently, the Federal Governement BIO building. The Alderney 5 Geothermal project is designed to use the cooling ability of the rock mass, to be charged during the very cold winter months, to supplement the normal summer seawater cooling, to get through the peak summer period, without mechanical cooling system operation. The Alderney location, without the geothermal cold storage system, is not deep enough to get enough cold water to enable operation without the use of a mechanical system.

DISCUSSION

On behalf of the owners of Queens Square, a local consultant/architect has approached the Halifax Regional Municipality seeking to develop a previously discussed opportunity to participate in a district energy project connecting to Alderney 5.

Performance Data and Experience: After three years of operation, four of the five project elements are working very well. The lighting retrofits have realized great energy savings, the district heating and cooling piping has reduced maintenance and operating costs, and the natural gas boilers have exceeded cost saving projections (due to the low price of natural gas). The cooling system, which includes the innovative geothermal component, has worked well for two

of three summers. This past summer (2012), the system did not function to expectations during a two week period in August.

Preliminary Assessment of 2012 Cooling Season Challenges: There is a year to year variance in the water temperature in the harbour. Therefore, several years of data will need to be compiled in order to understand the relationship between plant capacity and water temperature. The data and experience will also identify plant and expansion capacity within the design footprint. Three years of experience and data is insufficient. It appears that in 2012, the system did not optimize the winter cooling of the rock mass by operating the cold storage system properly in the winter months, due to a combination of mechanical (pump intake design), environmental (excessive mussel growth), and human (new staff) factors; cooling was only being generated from the seawater, which resulted in inadequate cooling in the complex.

Technical Review: Transportation and Public Works and Citigroup (the property manager) have contracted a technical review of the Alderney 5 project. With three cooling seasons of experience, the review will identify any equipment requirements and technical expectations. In November 2012, staff received the review, which contained three primary findings:

1. Changes to seawater intake/pumping system
2. Miscellaneous hardware changes
3. Operational re-commissioning

Staff has reviewed the report and are engaged with consultants on examining solutions to remedy the apparent restriction of the system, based on the intake/pumping system. The primary restriction is getting enough cold water (quantity and coolness) to the heat exchangers. Solutions may simply require better maintenance/cleaning of mussel growth, to some minor technical re-design, to changing the pumping system. Anticipated solutions are not cost prohibitive.

Seawater pump prior to installation

Seawater pump pulled for cleaning 2012

The original design capacity of the plant, as demonstrated by the 50% capacity on the heat exchanger, would enable consideration of expansion to other facilities, whether those be HRM owned or a third party such as Queens Square. However, before staff is able to make a confident recommendation or consider such an expansion, it is important that the operation of the system prove the capacity and sustainability required. Another two cooling seasons are required to achieve a confident assessment.

Queens Square Opportunity: The municipality is open to exploring options once the system has proven to be stable and facility objectives are met. Potential options are represented in the table below:

Potential District Energy Framework Options with Queens Square:

Option	Pros	Cons
Municipality assumes risk, constructs piping, and sells energy to Queens Square	Highest revenue potential	Operation of system is outside core expertise; Assumes technical and financial risk
Queens Square assumes risk and constructs project; Energy sold at rate reflective of risk and cost avoidance	Avoided risk; Avoided Capital Cost	Low revenue opportunity
Private sector develops project and creates contracts between HRM and developer and Queen's Square and developer	Avoided cost; Risk mitigated	Risk with respect to selection of developer
HRM does not enable connection to excess energy	No risk	Lost opportunity to meet Community Energy objectives

Staff Liaison to Potential Surplus Energy Customers: The Director of Planning & Infrastructure has responsibility for the Facility Development, Energy & Environment, and Real Estate Departments of the municipality and is the point of contact for such opportunities. The delay in responding to the 2011 request to the municipality was a result of the lack of surety with respect to the operation and capacity of the system. The recently completed technical review and upcoming operational assessments and re-commissioning, will put staff in a position to make recommendations to Regional Council.

FINANCIAL IMPLICATIONS

This report creates no financial implications to the 2013/2014 operating or project budgets.

COMMUNITY ENGAGEMENT

This report responded to a request to present to the Environment & Sustainability Standing Committee.

ATTACHMENTS

None

A copy of this report can be obtained online at http://www.halifax.ca/commcoun/cc.html then choose the appropriate Community Council and meeting date, or by contacting the Office of the Municipal Clerk at 490-4210, or Fax 490-4208.

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