2008 Long Term Acquisition Plan

BC hydro

APPENDIX F4b

Evaluation of the Jorvic Sewage Reclaim Pipeline

1 Introduction

In 2004 Vanport Sterilizers Inc. (**VPS**) submitted a proposal to both the BC Utilities Commission and BC Hydro for the installation of a pipeline and sewage treatment system to move raw sewage from the Capital Regional District's (**CRD**) existing outfalls and discharge the treated effluent into the reservoirs for BC Hydro's Jordan River Hydroelectric Project (**JRHP**). This project was presented as addressing the continuing raw sewage disposal challenges faced by the CRD, while also providing inflows to the generation projects on the Jordan River system, to provide electrical capacity. This VPS project is entitled the Jorvic Sewage Reclaim Pipeline (**JSRP**).

2 Scope of Analysis

BC Hydro requested Powertech Labs Inc. to review the JSRP proposal to determine whether it has merit in providing an innovative and cost effective increase in generation capacity at the JRHP. Powertech reviewed the VPS proposal as it applies to the discharge of treated effluent into the Bear Creek and Diversion reservoirs of the JRHP to determine the electrical capacity benefit of pumping treated sewage to the JRHP for electricity generation. Evaluation of the sewage treatment aspect of the proposal will not be reviewed in detail by Powertech. The CRD received a proposal from VPS in June 1990 and commissioned Associated Engineering (B.C.) Ltd. (**AE**) to perform a detailed review. This review was published in August 1992[1]. The 1990 proposal is very similar to the one submitted to the B.C. Utilities Commission in 2004, with the pipeline and pumping station specifications between the two proposals being identical. Powertech therefore believes that the original AE analysis can be considered sufficient as a review of the sewage treatment aspects of the VPS proposal.

2.1 Overview of the Pumped Storage Hydro Concept

The concept of a treated sewage pipeline terminating at the JRHP has been presented by the proponent, VPS, as a pumped storage hydro project, which also provides a solution for the CRD for handling and treatment of their sewage. Pumped storage hydro projects are similar in concept to a large battery which charges up slowly during periods of low demand and then provides power for a limited time, usually during periods of peak demand. A pumped storage project generally moves water from an upper reservoir to a lower reservoir through a turbine during the peak demand period and then pumps the water from the lower reservoir back up to the upper reservoir during off peak periods, where it is stored until needed to generate power during the next peak period. In general, 70% - 85% of the power consumed by the pumps can be regained during the generation obtained from the pumped storage process. This method is typically used in areas with multiple generation sources, such as hydroelectric generation in conjunction with thermal generation plants. Pumped storage allows thermal generation plants, such as coal-fired or nuclear plants to operate at constant peak-efficiency, using excess generation from these plants during off-peak periods to run pumps, which store water as energy in a hydroelectric reservoir to be used during periods of peak demand. Without a source of excess generation capacity during off-peak periods, pump storage projects are usually not financially viable.

3 Overview of the Jorvic Sewage Reclaim Pipeline

The JSRP proposal outlines the following components integral to the process[2]:

1. **Pipeline and Pumping Stations** – A pipeline and associated pumping stations will be used to divert raw sewage from one or both of the main CRD sewage outfalls, through treatment, with the final, treated effluent discharged into the reservoirs of the JRHP.

2. **Swirl Concentrator –** The raw sewage will be taken from the CRD and first put through a swirl concentrator that uses gravity and centrifugal forces to separate solids from the effluent in preparation for the dry pulverized coal treatment stage.

3. **Dry Pulverized Coal Treatment** – The liquid effluent output of the swirl concentrator is then filtered through dry pulverized coal (**DPC**) layers, with the final, treated effluent discharged into the reservoirs of the JRHP.

4. **Coal-Water-Slurry Power Plant –** The spent DPC will be combusted in a coal-water-slurry plant to generate power for the pumping stations.

The JSRP proposal also includes five related projects, namely[2]

- Conventional pumped storage hydro from Forebay Reservoir to the Bear Creek reservoir and/or Boneyard Lake to a new summit reservoir located at an elevation of 500 metres;
- Pumped brackish/ocean water from offshore to JRHP Forebay Reservoir;
- Uses for any additional power capacity in the electrolytic generation and liquefaction of hydrogen;
- Construction of a breakwater harbour and barge port at Jordan River for export of aggregates, liquid hydrogen, etc.;
- Unrelated discussions on bicycle highway construction.

These five related projects are not reviewed in this report as they are outside the scope of evaluating the benefits of a pump-storage scheme using treated sewage at JRHP[1].

The above projects are not relevant to the efficacy of using treated effluent to increase generation at the JRHP. In addition, the second project involves the introduction of seawater into a fresh water ecosystem and so was not seen as feasible.

3.1 Overview of the Jordan River Hydroelectric Project

The JRHP is located on Vancouver Island within the Capital Regional District, approximately 70 km from Victoria. It is the only major facility on the southwest portion of the Island and contributes up to 35% of the total hydroelectric generation for the

[1] BC Hydro Engineering has undertaken a review of the feasibility of a pumped storage project on the JRHP system and this is available on request.

Island. The hydroelectric system is made up of three dams: Bear Creek, Jordan Diversion, and Elliott.[2]

The JRHP generates 170 megawatts (**MW**) of capacity and 242 gigawatt-hours (**GWh**)/year of energy (2004 data) utilizing a 7.2 km tunnel and penstock from the Elliott Headpond. The facility is fed by two storage reservoirs (Bear Creek and Diversion Reservoirs) totaling 28 million m^3 (approx. 7.4 billion gallons). The Diversion Reservoir is the primary storage for the hydroelectric system, as Bear Creek is not actively managed for power generation. Precipitation and runoff accumulates in Bear Creek like a natural lake. No water is released past the Elliott dam with the exception of seasonal spills.[3]

The licensed diversion through the turbine powerhouse is a maximum of 80 m^3/sec or 6.9 million m^3/day.[3]

4 Review of the VPS Pumped Storage Proposal

As noted, the primary intention of pumped storage hydro is to provide short term supplies of electricity (i.e., capacity) during periods of peak demand. The proposed VPS project uses treated sewage and so does not take advantage of the benefits of pumped storage hydro because a sewage plant is operated constantly and would require constant pumping of the effluent into the reservoir regardless of the electrical demand at the time. Therefore, the 24/7 operation of the sewage pumps means that this proposal, as outlined, would not qualify as a pumped storage project. In order to operate as a pumped storage system, the project would need to suspend pumping of the sewage during peak periods through the use of a large holding tank, which would store the sewage until off-peak periods when it would be pumped into the JRHP system. Given the continuous, large volume of sewage flowing from the CRD, it is likely not desirable and may not be practical to build such a large storage facility. Moreover, VPS proposes to utilize BC Hydro's existing generators located at the JRHP. Unless these generators are not operating due to very low reservoir elevations, additional water into the reservoir would not provide any additional generation capacity and would be better classified as an energy project. As an energy project, the 1992 AE report on the VPS Proposal concluded that "The proposed project would not result in any overall extra energy as a result of pumping CRD wastewater to the Jordan River system for the generation of electrical energy." The AE Report further concludes that "the R.G. Tennant and Associates Jordan River proposal would likely have a net energy consumption… As a result, the proposal should be rejected as a net source of electrical energy."

Powertech acknowledges that the current JRHP has an increased capacity of 170MW in comparison to 26.5MW, which was the capacity at the time of the AE report in 1992. However, the change in capacity at JRHP does not change the outcome of the AE assessment of the Tenant Proposal, which concludes with a net-negative energy impact on the BC Hydro system.

5 Conclusions

The proposal submitted by Vanport Sterilizers Inc. to the BC Utilities Commission and BC Hydro in 2004 is not materially different than the one submitted to the CRD in June 1990, which was analysed by Associated Engineering in their August 1992 report[1]. In addition to other findings, AE concluded that the pumped storage portion of the VPS proposal was not viable since municipal wastewater flow regimes follows human activity (i.e., active during the day during peak periods and inactive at night during off-peak periods), which is opposite to that of pumped storage. Powertech also found that the VPS proposal is not conducive to operation as pumped storage, because it would provide a constant flow of effluent into the JRHP system, through the use of large pumps operated on a continuous basis. A pumped storage project relies on intermittent pumping. The benefit of a pumped storage project relies on consuming power during off-peak or low load periods and generating power at peak or high load periods. By coupling this concept with a sewage treatment option, it eliminates the fundamental advantage of pumped storage by requiring the pumping stations to operate continuously.

The project is therefore probably better characterized as an energy project, similar in concept to a stream/river diversion. Even if this is an energy project, however it still has significant challenges. More specifically, as identified in the AE report[1], the continuous pumping of the effluent, would mean that the VPS project would use more energy than would be generated with the additional effluent discharged into the JRHP system and so would have a net negative energy impact on BC Hydro's system. The only way the JSRP could be a positive energy producer would be if the pumps were run from energy generated by the project's coal-water-slurry power plant. However, this coal-fired power plant would need to meet the requirement of the 2007 BC Energy Plan[4] and be zero emission, which is a significant hurdle and not addressed in the proposal. Moreover, if VPS was able to construct a zero emission, coal-fired power plant, it would be more efficient to generate this power and sell it directly to BC Hydro, rather than use the power generated to operate pumps, to then pump treated effluent into the JRHP system, to then generate electricity.

In summary, the current VPS proposal is not materially different in terms of the pipeline and pumping station specifications to the proposal submitted to the CRD in 1990. Powertech concurs with the 1992 AE analysis that this JSRP proposal is not suitable for consideration as either a pumped storage or energy project.

6 References

[1] Associated Engineering (B.C.) Ltd. Review of the R.G. Tennant and Associates Jordan River Wastewater Treatment and Reuse Proposal. August 26, 1992.

[2] Tennant, Richard. Collection of documents provided Attn: Robert J. Pellat, BC Utilities Commission. By facsimile. November 20, 2006

[3] Consultive Committee Report. Executive Summary of the Jordan River Water Use Plan. http://www.bchydro.com/rx_files/environment/environment30824.pdf. Accessed on June 20, 2007.

[4] 2007 BC Energy Plan, Electricity Policy #20, Government of BC, http://www.energyplan.gov.bc.ca