Cheakamus Turbine Upgrade

Expenditure Authorization Request Assessment

Oversight Summary – Supporting Commentary

Technology and Methodology

The technology and methodology to be adopted for the project are well know and frequently used in BCH. Similar to the work recently completed at Bridge River turbine upgrade project on units 1 to 6, GMS unit 7, Stave Falls Redevelopment and Seven Mile unit 4.

Alignment

Cheakamus is a "strategic" generation resource. Aligns with the Resource Smart program initiative as one of four strategies to meet the growing electricity needs of British Columbia

Evaluation of Alternatives

The Identification Phase of the Cheakamus Unit Upgrade Project (documented in the Cheakamus G.S. Plant Evaluation Report No. MEP360) concluded that an upgrade of the Cheakamus units would be economically attractive. The recommended alternative specified an upgrade of the turbine, generator and transformer to increase the turbine rated output from 70MW to nominal 75 MW with a maximum output of 85MW. No other options are considered at this stage. The option is to implement the project now or defer it to a later time. Given its attractive economic performance the preference is to implement the project now.

It would also have been preferable to implement the project earlier, but other projects with larger gains at a lower cost of energy were advanced in preference. As these projects require a long outage there is a limit to the number of projects that can proceed at any one time because if there are too many project out of service then there are concerns about have adequate resources to supply load and meet trade opportunities.

Outages

Outages will be required and have been planned for the period 15 November 2003 to 15 April 2004 for the first unit and a corresponding period a year later for the second unit. Outages have been coordinated with Resource Management and timed to minimize the cost impact on system generation. It is estimated that each outage will have a system opportunity cost of $300 000.

During the outages maintenance work will be carried out. The outage is a long one for this plant and presents an opportunity to schedule maintenance and some capital equipment replacement (sustaining capital) into the outage and avoid the need for shorter outages over the next several years. The maintenance and sustaining capital work envisioned includes;

OMA work at an estimated cost of $200 000/unit includes;

- Generator cleaning.
- Rotor inspection
- Turbine Inlet Value repair

Capital work at an estimated cost of $800 000/unit includes;

- Cooling water-piping replacement.
- Bearing and bearing pot upgrades.
- Fire protection upgrade.
- Station service upgrade.

- Protection upgrade.
- Unit braking system upgrade.
- Governor replacement.

These OMA and specific capital requirements are not included in this CAR. However they are included in the economic evaluation of the project , see Sensitivity below.

Provision for the costs will be included in the facility Service Plan. Specific capital approval will be carried out by Power Facilities through their CAR approval process.

The outage period was chosen to minimize additional spill at Daisy Lake Dam. With one unit out of service and unable to pass water there could be increased discharge from Daisy Lake Reservoir to the Cheakamus River of water that would otherwise have been passed through the unit. During the outage period there is a risk of flash floods due to heavy rain or rain on snow event(s). With one unit out of service these floods would be less attenuated, by 30 cms the discharge capacity of the unit, than would have been the case with two units operational.

Flash flood events of significant magnitude, typically over 200 cms, (maximum on record 373 cms) could negatively impact the fisheries resource in the Cheakamus River (e.g., bank erosion, substrate displacement, displacement of developing ova, etc. An Environmental Management Plan (EMP) will be prepared prior to commencement of work at the plant.

Once in-service the runner upgrades will not result in a change in the water budget for either the Cheakamus plant or the Cheakamus River.

The EMP will be made available to the appropriate regulatory bodies and public stakeholders.

Sensitivity

The project success is sensitive to the cost and benefit of implementing the project. The project has been structured accordingly with the definition phase objectives of establishing the costs and benefits of the project.

The project benefits, i.e. energy gain have been confirmed through the turbine model test carried out in the definition phase of the project under the General Electric Strategic Partnering Agreement (GE SPA). The energy gain is expected to exceed 46 GWh/year.

The cost of the project, including capital sunk to date is estimated at $9.8 million fully loaded. The majority of the implementation cost will be in the provision and installation of the turbines. The cost of this work has been provided by GE through the SPA. The estimate includes contingencies. A risk assessment analysis of the estimate indicates that it falls within the 90% confidence interval, that is there is a 90% chance that the project cost will not be exceeded.

The economic performance of the project has been evaluated with the benefits and costs determined in the definition phase as described above. The evaluation demonstrates a positive net benefit of proceeding with implementation of the project. The cost of electricity from the project is estimated to cost $28/MWh based on the expected operating regime of the facility as recommended by the WUP process for approval. The evaluation is based on the following economic assumptions;

- Direct project cost (P 50) of $8 146 000.
- Previously approved sunk costs of $1.49 million are included in the analysis.
- Retirement cost of $330 000, i.e. the dismantling salvage cost as appears in the CRA.
- Two outage costs of $300 000 each.
- A conservative allowance of PV $200 000 and PV $300 000 for advancing OMA and specific capital work planned to be done to take advantage of the long unit outages (See Outages above). The OMA and

specific capital are identified in the facility Service Plan and approvals will be separate from this CAR and CRA approval.

- Overhead rate of 3%.
- Real discount rate of 8% to approximate the corporate nominal discount rate.
- A 20 year life, with no recognition that the efficiency gains will likely have a life that could extend fifty years.
- Only energy benefits attributable to the efficiency gains of the unit are included in the analysis, benefit of any potential peak capacity gains are not included.
- The efficiency gains of the first unit, for the period to the end of the project, i.e. a year while the second unit is being upgraded, are not included in the analysis. Also the cost savings (value) of future outage that would be avoided because OMA and specific capital work is being advanced to the upgrade outage, have not been included.

As a sensitivity case the above assumption were assumed but the (p 90) direct cost estimate of $8 889 600 was used. This gave a cost of energy of $30/MWh.

In a second sensitivity case it was assumed the existing operating regime prevails and the proposed WUP operation is not adopted for the 20 year life of the project. Under this case the energy gain would be 35 GWh/year with a resulting cost of electricity of $35/MWh, b/c 1.7 over twenty years. This is still considered as economically attractive.

Payback Period

Based on the assumptions described in "Sensitivity" above the payback is estimated at six years after project completion.

Tax Impact

None

Supplier/Business Partner

The turbine will be procured through the GE SPA.

Community/Public Support

Strong public support for Resource Smart projects. Also see "outages" above with regard to the EMP.

First Nations

See "Community/Public Support" above.

Employees

None

Legal or Regulatory Impact

The EMP (See "Outages" above) will be sent agencies as required for licenses and permits. In the case of the Department of Fisheries and Oceans (DFO) the EMP will be sent for information as there is no explicit permit or license required. It is not anticipated that DFO will impose additional monitoring, mitigation or permitting requirements.

Environmental Impact

See discussion under "Outages above".

Implementation Time

The project is scheduled for completion by October 2005. The outage periods of five months have been scheduled to minimize system outage costs. (See "Outages") The outage is planned to be taken from 15 November through to 15 April. In the event of a delay in the return to service of the unit, and the delay is caused by GE SPA , then provisions for a penalty payable to BCH of $10 000/day up to a maximum of $250 000 per unit will apply. Delays that extend to the freshet run-off period, late may or early June, will cause spill to significantly increase with a cost of estimated at $1.8 million for the month of June. The present schedule allows for four to six weeks of delay before the onset of the freshet and high losses experienced.

Complexity

This is usual technology for BCH.

Employee Resources

The work will be carried out using Engineering shared services. Resources have been identified through the completion of the project plan for the implementation phase of the project.

Scope

The work is defined and the scope summarized in the SOO. The detailed scope is outlined in the User Requirement document.

Benefit Identification

The potential for the efficiency gain has been confirmed in the definition phase of the project through the completion of turbine model testing carried out under the GE SPA. The actual efficiency gains will be confirmed by measurement at site of the efficiency of the new turbine and this will be compared to the measured efficiency of the existing turbine. The energy gains will be estimated based on the current operating regime of the facility and the measured incremental efficiency gain of the new turbine. This will determine the energy benefit of the project.

A project completion report will be completed prior to the completion of the project scheduled for October 2005.

Measurement

Once the new efficiency curve is determined there will be no need to continue tracking as the design life of the turbine could be up to 50 years.