Glacier Howser Project
Overview of Feasibility

Subsequent to previous comments submitted, additional data has been reviewed resulting in the additional comments below:-
Significant unique features of this project lead to concern as to its feasibility. These are summarized in the following:-

- The combination of high head and low flow rate of water results in the need to use Pelton wheel turbines for power generation. Such machines are normally connected to low-voltage systems to supply local loads in view of their limited MVAr output.
- In this instance a high-voltage transmission line, rated 240kV, must be utilized in order to interconnect to the nearest BCTC substation at Invermere. Under abnormal conditions this can result in the transmission system being subject to very high power frequency over voltages, resulting from lack of voltage control and the risk of self excitation of the generations resulting in severe damage
- Studies have been made by BCTC to identify the impact of the GH development upon the performance of the network. They confirmed the need for installation of shunt reactors at Invermere, together with identifying network conditions that would lead to full load rejection, and the need for high-speed excitation systems, and power system stabilizers. However, they did not identify stresses and operating requirements for equipment located in the AXOR portion of the network.
- The development of Hydro generation and associated transmission facilities have NOT been designed to withstand a single contingency condition, either planned or unplanned. The availability of power can be severely impacted by the nature of such a condition, particularly with respect to the mean time to repair (MTTR) of the faulted item.
- It is essential that the system is available for service during the spring runoff period, otherwise the opportunity to earn revenue will be missed.
- Power will only be generated during the spring run off period of approximately 5 months. For the remaining period the high-voltage line will serve only to provide local supplies for the Hydro generation facilities.
- The physical point of interconnection between BCTC and AXOR is at Invermere substation but from a network point of view it is at Cranbrook. The generating plant at GH will be tripped for virtually any contingency in the network emanating from Invermere and Cranbrook. This will require a comprehensive remedial action scheme,(RAS), together with a duplicate communications link in order to ensure reliable operation, i.e. microwave and fiber optic links.
- Tripping of the generators when operating at full load output will result in an overspeed condition which will only be relieved by operation of a bypass valve on each of the generators. The consequences of maloperation should be stated by AXOR as this is the limiting condition for the Pelton turbine.
- Contrary to AXOR claims, GH generation is not capable of ensuring stable operation in the event it is islanded from the BCTC network, together with local load in the Invermere area.

- A 240kV junction substation is proposed to interconnect Glacier, Howser and Invermere. This can be eliminated by the use of a three terminal network with appropriate protective relaying.
- Availability of generated output from GH is governed by the performance of the 240 kV. the transmission line to Cranbrook. In order to withstand a single contingency condition of a single line ground fault BCTC are to convert operation to single pole auto-reclose made feasible by the design of power transmission tower installed. However this is not practical with the AXOR line section because of the triangular configuration of phase conductors within the tower window.
- The principal tower configuration utilized by AXOR is that currently in operation between Castlegar and Trail. Climatic conditions and hence design criteria for the line crossing the mountainous terrain to Invermere, will be much more severe than experienced on this short route and together with the need to allow for low relative air density, need to be radically changed. Design criteria for the transmission line must therefore comprise:-
  - -physical loading corresponding to environmental conditions at high elevations
  - -revised tall window so as to facilitate detection of single line ground faults in the application of single pole auto reclose.
  - -increased electrical clearance within the tower window to allow for reduced air density at higher elevations.
- Transmission line will be exposed to significant lightning storms during its operation and together with the RAS schemes, exposing the GH generators to the impact of full load rejection, i.e. overspeed and self excitation.
- Significant risk factors exist during the development of the project from initial design through to in-service operation of the various components:-
  - -adequacy of line design criteria to reflect mountainous routing
  - -possible geological fault conditions encountered during tunnel operations
  - -ability to meet the planned construction as a result of climatic conditions and the remote site location
  - -availability of generation capacity as governed by annual snowfall conditions
  - -failure of key components within the Hydro/transmission portions of the work for which neither redundancy nor spares are available.
- Security risk of damage to facilities at remote location
- Economic risk factors. Limit to the ability to generate power is dictated by the annual snowfall. Reference is frequently made to the total capacity of installed generation is a variable quantity fluctuating from year-to-year. The project provides a source of energy but not capacity but even this is limited to a period of five months. In order to meet increasing demand a separate source of power generation is required to make capacity, together with the energy requirements when output is not available from GH Hydro Plant.
- BCTC must make significant changes to the transmission system from Cranbrook to Invermere in order to incorporate the GH development, at a cost of $20 million in 2007 estimates of which $6 million would constitute stranded assets in the event project was not completed.

Restoration of the area once the end of life has been reached will prove impractical, as a major damage area will remain, particularly in the case of the tunnel.

While a comprehensive environmental review of the project is being made there does not appear to be a similar review of the engineering developments required. This is considered essential in order to verify the practicality of the complete development recognizing the concerns expressed with respect to the experience of the proponent.

Similarly a risk analysis should be made of the various components of the development in order to quantify that an adequate source of reliable energy will be available.

The cost of installed generation is $3100 per kilowatt for a commodity which does not contribute to firm installed capacity and provides energy for only a limited period of the year. For these reasons, plus the major environmental concerns, the scheme cannot be considered as a justifiable investment.