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Resource use

Arrow Lakes, Canada

Innovative power station design at Keenleyside Dam, Canada, enabled the Arrow Lakes Power Company to build a viable power station where previous investigations had deemed development of the site uneconomical. The scheme creates additional energy without additional regulation of the Columbia River system.

Overview

The Columbia River is the fourth largest in North America. It drains an area of 670,520 km² of which 102,260 km² are in Canada. The Columbia River Valley is typical of British Columbian valleys formed by glacial advances and retreats.

The 1964 Columbia River Treaty (the "Treaty") between Canada and the United States of America was an agreement regarding joint development of the Columbia River System. The treaty precipitated the construction of a dam near the downstream end of Lower Arrow Lake in south-eastern British Columbia. Arrow Dam raised the level of two natural lakes to form Arrow Lakes Reservoir and was subsequently renamed Keenleyside Dam.

Keenleyside Dam is comprised a combination of concrete gravity and earthfill structures. Discharge is facilitated through four spillway bays controlled by vertical lift gates and four low level outlets located on each side of the spillway.

Scheme Specifications

Dam Name

Scheme operator
Arrow Lakes Power Company

Size of scheme (MW)
185

Country
Canada

Catchment area
102 260 km^2

River
Columbia

Effective reservoir capacity
8.8 x 10^9 m^3

Construction years
1996 to 2002

Reservoir size
51,600 ha

External Recognition

- IHA Blue Planet Prize Winner 1995
- Association of Consulting Engineers of Canada 2003. Canadian Consulting Engineering Awards – Award of Excellence – Category: Project Management
- CEBC 2003 Awards for Engineering Excellence – Lieutenant Governor's Award for Engineering Excellence
- CEBC 2003 Awards for Engineering Excellence – Award of Excellence

Details

Keenleyside Dam was initially constructed for the dual purpose of mitigating flood damage in Washington and Oregon during the spring months, and storing water for use by US power stations on the Columbia River.

During the initial design and construction, it was determined that the relatively low head at the site would make installation of a power plant uneconomical, hence no provision for future installation was made. A decade later, a series of studies were undertaken to determine the feasibility of installing a 240MW powerhouse at the end of the concrete dam. This was found at the time to be uneconomical and the plans were terminated.

In 1996, fresh studies into the feasibility of constructing a powerhouse at Arrow Lakes were undertaken. Rather than construct a powerhouse at the end of the concrete dam, this study proposed the use of a lined approach channel of 1500m length to convey water to a powerhouse situated on bedrock 400m downstream of the dam. This approach was estimated to cut construction times from 7 years to less than four, reduce capital costs by 40%, and reduce the unit cost of energy production by more than 30%.

Construction of the project commenced in March 1999, with the first turbine commissioned in February 2002, on budget and 7 months ahead of schedule.

The innovative design of the Arrow Lakes Generating Station has very economically created an additional 185MW of energy generation potential on a system for which it was initially thought uneconomical to do so. The project was retrofitted to existing dam structures and doesn't alter the release patterns from those structures, hence represents very efficient use of a resource that would otherwise have been untapped.

Other aspects

Environmental assessment and monitoring
The construction of the power plant was preceded by intensive environmental

investigations. Among the potential challenges for which mitigation measures were developed and effectively implemented were:

- Storage level fluctuations
- Hydropeaking in the downstream environment
- Increased downstream water temperatures
- Altered hydrological regimes
- Geomorphic impacts
- Entrainment of fish through the power plant
- Loss of fish habitat

Multiple use benefits

Fertilisation programs and fish habitat creation have improved the salmon fishery in the Arrow Lakes region.

Erosion and Sedimentation

It was recognised that the use of coffer dams during the construction of the power plant may deleteriously influence geomorphic processes, hence earth fill and solid rock plugs were employed as alternative. Strategic sediment release and other mitigation strategies were employed at the commissioning of the project. Potential for erosion resulting from hydropeaking operation of the power plant was mitigated through the implementation of rock groynes and fill in strategic locations.

Distribution and sharing of benefits

The project showed a commitment to employing the local labour force and engaging local services. A close working relationship with First Nation representatives also ensured the values of indigenous groups were respected throughout the project.

Local Capacity building

Capacity building programs enhanced capability and opportunities for local communities and First Nation people, increasing skills bases for future employment.

Water Quality

The addition of a powerplant to the Keenleyside Dam significantly reduced the passage of water over the spillway, resulting in reduced incidences of dissolved gas supersaturation downstream of the dam and significant reductions in fish mortality.

Further Information

http://www.hydroquebec.com/visit/virtual_visit/index.html

Nunn, J.O.H., Fidler, L.E. and Northcott, P. 1993, “Investigation of Changes to the Operation of Keenleyside Dam to Reduce Supersaturation of Dissolved Gases Downstream”, CSCE Annual Conference, Fredericton NB.

Nunn, J.O.H. “Evolution and Challenges of the Keenleyside Powerplant Project”, Canadian Dam Association 2002 Annual Conference.

Baxter, W., Ross, W.A. and Spaling, H. 2001, “Improving the practice of cumulative effects assessment in Canada”, Impact Assessment and Project Appraisal, volume 19, number 4, December 2001.