Keeyask Column Extenders

HG Acres Seminar– April 3rd 2018
Agenda

1. Project Background
2. Review of the Original Powerhouse Design
3. Construction Schedule Issues
4. Column Extender Design Concept
5. Implementation Challenges
6. Design Achievements
7. Video – April 2018 Construction Update
8. Q & A
Keeyask Project – Background Information

- 695 MW hydroelectric generating station under construction on the Lower Nelson River
- Includes a 7-unit powerhouse, a 7-bay spillway and 2 km of dams across the Gull Rapids
- In late 2016, it was clear the powerhouse concrete works defined the critical path to project completion
Vicious Circle of Subarctic Concrete Construction

1. Concrete Works Progressing Slowly
2. Cannot Erect nor Enclose the Superstructure
3. Must Work Outdoors in Subarctic Climate
4. Extremely Short Concreting Season
Problem Statement

- Modify the powerhouse design to provide for erection and enclosure earlier in the construction sequence, allowing for concreting operations to proceed through the winter in a temperature controlled environment.
Design Concept – Column Extenders

Upstream Column Extenders

EL. ???

Downstream Column Extenders

EL. ???

How low can we go?
Rail to Rail Differential Deflection (R2RDD)

- Crane Manufacturer Association of America (CMAA) specification 70 provides permissible deflections of crane rails
- COH manufactured the crane to tolerate extra R2RDD
- The threshold R2RDD which was to control many aspects of the design was 35mm
Column Extender Bracing Concept

Upstream Column Extenders

EL. 154.40
Column Extender Bracing Concept

Upstream Column Extenders

EL. 154.40

Kicker Brace
Column Extender Bracing Concept

Upstream Column Extenders

EL. 154.40
EL. 151.20
EL. 131.50

Kicker Brace

Downstream Column Extenders
Column Extender Bracing Concept

Upstream Column Extenders

EL. 154.40
EL. 151.20
EL. 131.50

Kicker Brace
Horizontal Brace
Downstream Column Extenders
Column Extender Bracing

Kicker Brace
- Aligned with intake piers
- Braces the upstream crane rail
- Connected via a canted beam

Horizontal Brace
- Ties downstream columns into the intake headblock
- Located below the service bay floor elevation
- Features an opening to allow for installation of the stay ring and draft tube
Manitoba Hydro Construction Update – November 2017

https://www.youtube.com/watch?v=jVPXKhRmqc
# Accelerated Schedule

<table>
<thead>
<tr>
<th>Activity</th>
<th>Month of 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptualization</td>
<td>January</td>
</tr>
<tr>
<td>IFC Drawings</td>
<td>March</td>
</tr>
<tr>
<td>Procurement / Shop Drawing Review</td>
<td>Summer</td>
</tr>
<tr>
<td>Installation</td>
<td>Fall</td>
</tr>
<tr>
<td>Enclosure</td>
<td>November</td>
</tr>
<tr>
<td>Crane Commissioned</td>
<td>December</td>
</tr>
</tbody>
</table>
3D Modelling & Changes to the Substructure

- Important to recognize the substructure design team
- Massive modifications to concrete reinforcing, piping & HVAC required
- 3D modelling and clash detection helped eliminate conflicts before they became issues on site
- Precast panels on the downstream face of the intake headblock helped facilitate concrete in close proximity to an active crane
Manitoba Hydro Construction Update – December 2018

https://www.youtube.com/watch?v=bPKJaJQ95mQ
Design Achievements

- Provided for the commissioning of the powerhouse crane in December of 2018
- Construction savings estimated to be in excess of $0.5B
- ACEC Manitoba Award of Excellence recipient in the Energy Resource Development category
- Improved relationship with the contractor
Questions?

KEEYASK GENERATING STATION
COLUMN EXTENDER PROJECT

PROJECT DETAILS

CLIENT: Keeyask Generating Station

PROJECT TEAM:
- Hatch
- Keeyask Generating Station Limited Partnership

DESIGN TEAM:
- Hatch
- Keeyask Generating Station Limited Partnership

CONSTRUCTION:
- Hatch
- Keeyask Generating Station Limited Partnership

PROJECT DESCRIPTION

The project involved the design and construction of a steel structure to support the column extender. The structure was designed to withstand the loads and stresses generated by the column extender. The project team worked closely with the client to ensure that the design met the functional requirements and that the construction process was executed efficiently.

DESIGN ACHIEVEMENTS

- Utilization of BIM technology for design and coordination
- Implementation of lean construction principles
- Effective project management resulting in schedule adherence

HATCH

Manitoba Hydro

Keeyask Generating Station Limited Partnership