North and South Dams Project Overview

- Construction performed by Barnard Pennecon LP
- Mobilized in late-2015
- Anticipated Completion in mid-2019

Major Features of Our Contract Include:
- Diversion of Churchill River Through Spillway Structure
- Construction of RCC North Dam
- Construction of Zoned Embankment South Dam
The Challenges of Dams in Cold Climates
Design, Construction, Permitting and Environmental Issues
Fall 2017 Workshops and Field Tours
Project Highlights

- Churchill Cofferdam
  - 550,000 m$^3$ Zoned Embankment (70% placed in-the-wet)
- Single-Groin Closure
Project Highlights

• Churchill Cofferdam
• Grouting Program During Water-Up
Project Highlights

- North Dam
  - 13,500 m² of Foundation Preparation
  - 13,000 m³ of Dental/Leveling Concrete
  - 220,000 m³ of Roller-Compacted Concrete
  - 35,000 m³ of Conventional Concrete
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Project Highlights

• North Dam
Project Highlights

• South Dam
  • 125,000 m³ Overburden Excavation to Bedrock
  • Curtain Grouting
  • Foundation Preparation
  • 150,000 m³ Zoned Embankment
Project Highlights

• Crushing and Screening
  • 750,000 Metric Tons of Crushing for Concrete Aggregates
  • 300,000 Metric Tons of Screening for Embankment Filters
Project Highlights

• Onsite Concrete Production
  • Dual Side-by-Side Central Mix Plants with 4.5 m$^3$ Twin Shaft Mixers
  • Shared CVC and RCC Discharge System
  • 50,000 m$^3$ of Conventional Concrete
Project Highlights

- Concrete and Aggregate Production Layout
Project Schedule

- 2015 (September – December)
  - Start Mobilization
  - Intake Cofferdam
  - Temporary Spillway Bridge Abutments
  - Start South Dam Excavation
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Project Schedule

• 2016 (March – December)
  • Finish Mobilization
  • Crusher and Batch Plant Setup and Commission
  • Finish South Dam Excavation and Start Embankment
  • Churchill River Diversion
  • RCC Test Section
  • Start North Dam Foundation Preparation
Project Schedule

• 2017 (April – November)
  • Churchill River Cofferdam Grouting Program
  • Complete South Dam Embankment
  • Finish North Dam Foundation Work
  • Start North Dam RCC
Project Schedule

• 2018 (Planned April - November)
  • Finish RCC
  • Gallery Grouting and Drains
  • North Dam Gallery, Flip Bucket, and Crest Concrete
  • Start Powerhouse Tailrace Rock Plug Removal
Project Schedule

• 2019 (Planned April - July)
  • Finish Powerhouse Tailrace Rock Plug Removal
  • Demobilize
Project Weather and Location Challenges

- Historical Weather Data Near Site
Project Weather and Location Challenges

• Cold Weather Challenges
  • Maintaining Access Around Site
• Cold Weather Batching
• Heating and Hoarding
• Increased Inefficiencies
• Safety Issues
Project Weather and Location Challenges

- Winter Shutdown
  - Re-training Craft at the Start of Each Season
- Scaling Back on Staff During Winter Shutdown and Staff Retention
Project Weather and Location Challenges

- Travel and Accommodation Logistics
  - Remote Site
- Craft and Staff Work Rotations
Project Weather and Location Challenges

- Material Procurement Challenges
  - Cement and Flash
- Others
Project RCC Considerations

- Mix Design
  - High Paste (220 kg/m$^3$ cementitious; 1.05 w/c ratio)
  - Low Vebe (Targeting 8-12 seconds)
  - Retardation (10-21 hours for initial set)
  - Air Entrainment (4-7%)
Project RCC Considerations

- Placement Requirements
  - Surface Temperature > 40° F
  - RCC Temperature between 40° and 60° F
  - 98% Compaction
- Joint Classifications
  - Hot Joint
  - Warm Joint
  - Cold Joint
Project RCC Considerations

• Placement Methods
  • Drive-On/Off
Project RCC Considerations

- Placement Methods
- Drive-On/Off
Project RCC Considerations

- Placement Methods
- Slope Layer
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