Muskrat Falls Generation Project

Dam Safety Weekly Monitoring Summary Report

September 9 to September 15, 2019

nalcor energy
LOWER CHURCHILL PROJECT

Purpose

This report provides a summary of the monitoring and instrumentation readings for the Muskrat Falls hydroelectric generating facility. The report will be issued weekly during impoundment of the Muskrat Falls reservoir.

Dam Performance Monitoring Overview

The safety of our dams and facilities is our priority. The Muskrat Falls facility has been built to the highest standards of dam safety and is constructed and monitored to meet Canadian Dam Association (CDA) Dam Safety Guidelines.

We have a comprehensive Dam Safety Program for Muskrat Falls developed by SNC-Lavalin. This program includes detailed inspections, monitoring, analysis and reporting for all dams and water retaining structures at the Muskrat Falls site. In addition, our Dam Safety Management Program has been independently reviewed and audited by Hatch Inc. In its fourth Dam Safety Review & Audit (April 2019) Hatch noted that the Dam Safety Management Program is in compliance with the CDA guiding principles and continues to meet or exceed good industry practice.

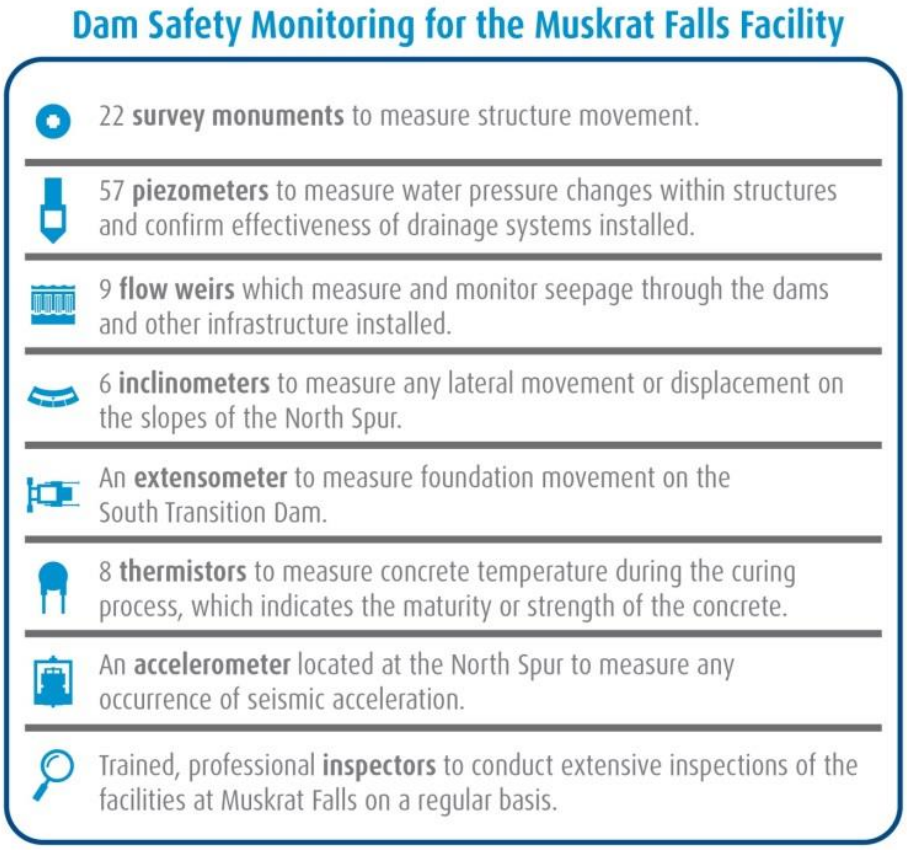
Our dam safety monitoring is designed to assess the effects of the force or pressure of the water from the reservoir on permanent structures including the South Dam, Powerhouse, Spillway, North Dam, North Spur and three Transition Dams. The following illustration shows the various structures and explains their function.

South Dam	Powerhouse	Intake & Tailrace	Spillway	Transition Dams	North Dam	North Spur
Conventional rock-fill till-core dam that closes the south part of the reservoir between the south bank and Powerhouse.	Houses the four generating units.	The Intake draws water from the river into the Powerhouse. Water exits the Powerhouse through the Tailrace.	Primary function is to pass the water that is not required to generate electricity in the Powerhouse.	Concrete dams to make the connection between the South Dam & Powerhouse; Powerhouse & Spillway; and Spillway & North Dam.	Concrete dam used to close the north part of the reservoir.	This is a natural dam that has been reinforced.

Dam Safety Monitoring of the Muskrat Falls Facility

Our dam safety team uses a combination of manual and automated processes to frequently monitor the generation facilities to confirm that the structures are performing as designed.

Our trained staff frequently walks around the structures inspecting, observing and recording the structures' behaviour. They also travel by helicopter to survey the entire reservoir area. Our automated monitoring includes a variety of instruments that measure and record conditions such as water pressure and seepage, structure movement, water level and temperature. The image below lists the instruments installed for the generation structures and the conditions they monitor.



Summary of Dam Safety Monitoring Observations

Our monitoring indicates that all of the structures are behaving as expected in response to reservoir impoundment. There are no safety concerns with the Muskrat Falls dams and facilities.

Noteworthy observations or conditions that changed during this reporting period are summarized in the following tables.

Observations (September 9 to September 15, 2019)				
Weather & Water Levels	**Conditions**	**Average**	**Maximum**	**Minimum**
	Temperatures (Muskrat Falls MET; reference NLENLC0006)	10°C	16°C	4°C
	Reservoir (Churchill River Above Upper Muskrat Falls; reference 03OE001)	el. 38.9 m	el. 39.0 m	el. 38.8 m
	Inflow to reservoir	2260 m^3/s	2370 m^3/s	2000 m^3/s
	Spillway discharge	2230 m^3/s	2390 m^3/s	1970 m^3/s
	Downstream water level (6.15 km below the Muskrat Falls facility; reference 03OE014)	el. 3.0 m	el. 3.2 m	el. 2.8 m

Structure	Summary of Dam Safety Observations	Comments	Action
Reservoir Rim	• Reservoir survey is done every day during initial impoundment, and every other day thereafter until operational level achieved. As expected, superficial sloughing was observed on the sandy slopes.	No change to the reservoir rim	No action required
North Spur	• Water levels in piezometers are as expected. • Average Kettle Lake flow was 1.9 m^3/min. • No accelerometer trigger during this period. • No deformation[i].	As expected	No action required
North Dam and North Transition Dam	• Water levels in the piezometers have stabilized as expected. • In total, drainage gallery seepage is less than 1 litre/s. • The seepage is lower than the accuracy of the weir flow measurement device. • No deformation observed[1].	As expected	No action required
Spillway	• Water levels in both piezometers are stable. • No deformation observed[1].	As expected	No action required
Centre Transition	• Water levels in the piezometers have stabilized as expected.	As expected	No action required

[1] No deformation measurements were planned for concrete structures during this reporting period.

Structure	Summary of Dam Safety Observations	Comments	Action
Dam (CTD)	• Total seepage from the drainage is less than 1 litre/s. • Seep between the CTD and powerhouse requires an average of 3.5 pump cycles per hour. • No deformation observed[1].		
Powerhouse	• Average intake gallery seep rate was approximately 2.0 litres/s in total. Water is clear, turbidity[ii] is 1. • Seepages from joints and cracks in the concrete noted in the Intake drainage gallery, and along the north and south walls of the northernmost and southernmost stairs of the Powerhouse have not changed. • Intake drainage gallery efflorescence[iii] deposit remains unchanged. • Dewatering gallery flow is 16 litres/s on average and still includes leakage from temporary bulkheads in Units 3 and 4. • No deformation observed[1].	As expected	No action required
South Transition Dam (STD)	• No flow within South Transition Dam gallery. • Water levels in the piezometers are stabilizing, as expected. • No deformation.	As expected	No action required
South Dam	• Average flow from drainage along South Dam is 2.4 litres/s. Water is clear, turbidity is 1. • No deformation observed[2].	As expected	No action required

[i] Deformation/deflection is when there is a change in shape of the structure following the application of pressure or force from the load of the water levels.
[ii] Turbidity is the cloudiness or haziness of a fluid caused by suspended solids that are usually invisible to the naked eye.
[iii] Efflorescence deposit is the migration of a salt to the surface of a porous material where it forms a coating.

[2] No deformation measurement was planned for the South Dam during this period.

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