

**From:** [Martin, Craig](#)  
**To:** [pharrington@lowerchurchillproject.ca](mailto:pharrington@lowerchurchillproject.ca)  
**Subject:** FW: MF reports  
**Date:** Wednesday, March 16, 2016 10:47:04 AM  
**Attachments:** [.png](#)  
[.png](#)  
[December-Report-2015.pdf](#)  
[LCF Interim Report - FINAL - MASTER 15 03 2016.pdf](#)

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Paul,

I just had confirmation that the plan is to release reports tomorrow, Thursday, March 17, 2016.

Attached is the Final Draft of the EY report and current Draft of MF Oversight. Still some minor proofing ongoing with the MF Oversight report and review of Nalcor comments, but complete from a substantive basis.

I have just forwarded copies to NRCan. Wanted to get these to you in case you wanted to share with Nik.

Regards

Craig

**From:** Krupski, Joseph (NRCan/RNCan)  
[<mailto:joseph.krupski@canada.ca>]

**Sent:** Tuesday, March 15, 2016 4:58 PM

**To:** Martin, Craig

**Subject:** RE: reports

Craig,

Thanks for the update.

Joe

**From:** Martin, Craig [<mailto:CMartin@gov.nl.ca>]

**Sent:** Tuesday, March 15, 2016 3:11 PM

**To:** Krupski, Joseph (NRCan/RNCan)

**Cc:** Kapoor, Anoop (NRCan/RNCan); Morris, Paul J.

**Subject:** RE: reports

Joe,

No release for Wednesday. Waiting on confirmation of release date. Still some edits ongoing.

Will advise as soon as I have confirmation on dates and finalization of reports.

Craig

**From:** Krupski, Joseph (NRCan/RNCan)  
[<mailto:joseph.krupski@canada.ca>]

**Sent:** Tuesday, March 15, 2016 4:33 PM

**To:** Martin, Craig

**Cc:** Kapoor, Anoop (NRCan/RNCan)

**Subject:** reports

Hi Craig,

Any news on those reports? I'm not in the office today, so if you can let me know by email, that would be great.

Thanks,

Joe

**Joseph Krupski**

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# Muskrat Falls Project Oversight Committee

Committee Report – December 2015



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# Introduction



Muskrat Falls Site – Progress on Spillway and Powerhouse – December 2015

The Muskrat Falls Oversight Committee was established by the Government of Newfoundland and Labrador in March 2014 to strengthen the existing oversight of the Muskrat Falls Project (the Project). The Committee's mandate focuses on cost, schedule and risk management for the construction phase of the Project. Reports of the Committee can be located at [www.gov.nf.ca/mfoversight](http://www.gov.nf.ca/mfoversight).

In order to incorporate the most current Project cost and schedule information, the Committee's last report included Project information up to the end of August 2015 as well as an update on the September 2015 revisions to the Project Budget from \$6.99 billion to \$7.65 billion<sup>1</sup>.

This report details the Committee's observations and summarizes the progress reported for the Project to the end of December 2015. For the period ending December 2015, the capital construction cost estimates for the Project are \$7.65 billion, the incurred costs<sup>2</sup> to date were \$4.00 billion (exclusive of interest and other financing costs) and the committed costs<sup>3</sup> totaled \$6.58 billion.

In December 2015, the Government of Newfoundland and Labrador, through the Committee, engaged Ernst Young, LLP (EY) to conduct an independent review of the Project cost and schedule performance, the key associated risks and identification of opportunities for remediation or corrective action.

Nalcor is currently reviewing Project milestones and undertaking a risk assessment to evaluate impacts to cost and schedule. As a result, EY was requested to issue an Interim Report which focuses on a review of the cost and schedule position of the Project as set in September 2015. Once the risk assessment is completed by Nalcor, EY will complete its review of cost and schedule performance and issue a final report. Observations from their interim review and a summary of the recommendations are included in this Committee report as they are relevant to the Project cost and schedule at December 2015. A full copy of the Interim Report and Nalcor's response is available at [INSERT LINK].

- 1 Total Project costs include construction costs of \$7.65 billion plus interest and other financing costs of \$1.4 billion that will be incurred during construction, for an estimated total of \$9.05 billion.
- 2 Incurred Costs represents the total estimated cumulative value of all goods and services provided to the Project up to the point in time regardless of whether it was paid during the current period or will be paid at some future point in time.
- 3 Committed Costs: The estimated value of an obligation made by the Project for the provision of goods or services; represented by a Financial Commitment. Committed costs are captured when a Financial Commitment is made and its value is based upon the original estimate for that Financial Commitment. A Financial Commitment is a legal agreement between Nalcor Energy – Lower Churchill Project (NE-LCP) and a third party which authorizes NE-LCP to proceed with the award/instruction to the third party to provide goods and/or services for an agreed price or in accordance with an agreed pricing structure. The value of the Financial Commitment is represented by the cumulative value of the original amount and any approved variation orders to the contracts or change orders to the purchase order (which may or may not be a Project scope change).



The total Project construction budget of \$7.65 billion is allocated among the three sub-projects as illustrated in Table 1 below. Total incurred costs to the end of December 2015 of \$4.00 billion represent 52.3 per cent of the total budget. Table 1 also outlines the Project budget at Sanction in December 2012.

Table 1  
**Budget and Incurred Costs by Sub-Project** (in \$ thousands)

Muskrat Falls Project: Sub-Project	Percentage of Total Project Budget	Project Capital Budget at September 2015	Incurred Costs as of December 2015	Percentage of Budget Incurred	Project Capital Budget at Sanction Dec 2012
Muskrat Falls Generating Facility	48.1%	\$3,685,966	\$2,037,712	55.3%	\$2,901,158
Labrador-Island Transmission Link	40.4%	\$3,089,378	\$1,372,698	44.4%	\$2,607,749
Labrador Transmission Assets	11.5%	\$877,557	\$593,094	67.6%	\$691,682
Total	100.0%	\$7,652,901	\$4,003,504	52.3%	\$6,202,490

Table 2 shows the Project incurred costs to the end of December 2015 by expenditure category for each of the sub-projects. This table also includes the updated Project Capital Budget, as approved by the Nalcor Energy Board of Directors in September 2015, compared to the Project Forecast Cost.

The Project Forecast Cost at December 2015 remains at \$7.65 billion; however, as outlined in the Committee's last report, as overall progress of the Project is behind schedule, Nalcor is currently reviewing the milestones for the Project. Nalcor is currently assessing project risks and any related impact on the cost and schedule of the Project (Quantitative Risk Assessment). It is anticipated that the Project Forecast Costs and Schedule will increase upon completion of this assessment.

Table 2

**Summary of Project Budget vs. Project Forecast Cost** (in \$ thousands)

Muskat Falls Generating Facility	Project Budget at September 2015	Incurred Costs at December 2015	Project Forecast Cost December 2015	Variance PFC from Budget
Expenditure Category	A	B	C	D=A-C
NE-LCP Owners Team, Admin and EPCM Services	\$408,723	\$302,353	\$408,714	\$9
Feasibility Engineering	\$17,949	\$17,949	\$17,949	\$0
Environmental & Regulatory Compliance	\$25,825	\$18,532	\$25,825	\$0
Aboriginal Affairs	\$13,314	\$7,519	\$13,314	\$0
Procurement & Construction	\$3,121,813	\$1,676,105	\$3,128,002	(\$6,189)
Commercial & Legal	\$25,239	\$15,254	\$25,239	\$0
Contingency	\$73,102	\$0	\$66,922	\$6,180
Total for Sub-project	\$3,685,965	\$2,037,712	\$3,685,965	\$0
Labrador-Island Transmission Link	Project Budget at September 2015	Incurred Costs at December 2015	Project Forecast Cost December 2015	Variance PFC from Budget
Expenditure Category	A	B	C	D=A-C
NE-LCP Owners Team, Admin and EPCM Services	\$221,293	\$166,990	\$221,286	\$7
Feasibility Engineering	\$21,252	\$21,252	\$21,252	\$0
Environmental & Regulatory Compliance	\$14,446	\$10,229	\$14,446	\$0
Aboriginal Affairs	\$2,684	\$614	\$2,684	\$0
Procurement & Construction	\$2,717,326	\$1,160,181	\$2,725,069	(\$7,743)
Commercial & Legal	\$16,490	\$13,432	\$16,490	\$0
Contingency	\$95,887	\$0	\$88,151	\$7,736
Total for Sub-project	\$3,089,378	\$1,372,698	\$3,089,378	\$0
Labrador Transmission Assets	Project Budget at September 2015	Incurred Costs at December 2015	Project Forecast Cost December 2015	Variance PFC from Budget
Expenditure Category	A	B	C	D=A-C
NE-LCP Owners Team, Admin and EPCM Services	\$144,958	\$93,439	\$144,958	\$0
Feasibility Engineering	\$220	\$220	\$220	\$0
Environmental & Regulatory Compliance	\$811	\$811	\$811	\$0
Aboriginal Affairs	\$188	\$1	\$188	\$0
Procurement & Construction	\$709,643	\$496,341	\$709,780	(\$137)
Commercial & Legal	\$3,891	\$2,282	\$3,891	\$0
Contingency	\$17,846	\$0	\$17,709	\$137
Total for Sub-project	\$877,557	\$593,094	\$877,557	\$0
Total Project	\$7,652,900	\$4,003,504	\$7,652,900	\$0

The Project Contingency for the Muskrat Falls Project at December 2015 is \$172.8 million, a draw down of \$14.0 million from the available budget of \$186.8 million established in September 2015. Table 3 below outlines the changes in Contingency by sub-project. Appendix B provides further detail on the main reasons for the changes to contingency budget during this period.

Table 3

**Summary of Change in Project Contingency** (in \$ thousands)

Contingency	Project Budget at September 2015	Contingency at December 2015	Contingency Draw Down \$	Contingency Draw Down %
Sub-Project	A	B	C = B-A	D = C/A
Muskrat Falls Generating Facility	\$73,102	\$66,922	\$6,180	8.5%
Labrador-Island Transmission Link	\$95,887	\$88,151	\$7,736	8.1%
Labrador Transmission Asset	\$17,846	\$17,709	\$137	0.8%
Total	\$186,835	\$172,782	\$14,053	7.5%

# Muskrat Falls Project

## Committee Observations

### Project Schedule

- Progress on the Muskrat Falls Generating Facility is significantly behind schedule. Schedule recovery will not be possible.
- First Power will not be achieved for December 2017. Other Project Milestone dates are impacted and remain under review.
- Critical Path for River Diversion in 2016 remains achievable.
- Construction progress for the Project at the end of December 2015 is 40.5 per cent. compared to planned progress of 49.5 per cent. Variance of 9 per cent behind schedule.
  - Progress on the Muskrat Falls Generating Facility continues to slip with progress on the Powerhouse and Intake 29 per cent behind plan.
  - Progress on the Labrador-Island Transmission Link is 4.1 per cent behind revised plan. EY advises that while recent contractor performance for the HVdc Transmission Line has improved and potential mitigation for some of the schedule risk is available, risks remain to future schedule.
  - Progress on the Labrador Transmission Assets is 5.5 per cent ahead of plan.

### Project Cost

- Project capital budget of \$7.65 billion is under review.
- Incurred costs at December 31, 2015: \$4.00 billion.
- Committed costs at December 31, 2015: \$6.58 billion.
- EY advises that contingency level is low for the current stage of completion of the Project and identified delays on the Powerhouse & Intake.
  - Remaining Contingency at December 2015; \$172.8 million.
  - EY advises that contingency for strategic risks are not included in the Project forecast.

## Project Schedule

This section provides information on actual schedule progress compared to planned schedule progress for the period ended December 2015, first on an overall Project basis, and then by each of the sub-projects. It also provides information on the long-term milestones for the sub-projects.

Nalcor monitors and reports schedule progress on all activities, both construction and manufacturing. Construction activities include all those activities occurring at site locations in the province. Manufacturing activities include those supply/install contracts that take place outside the province (e.g. the turbines and generators are being manufactured in China).

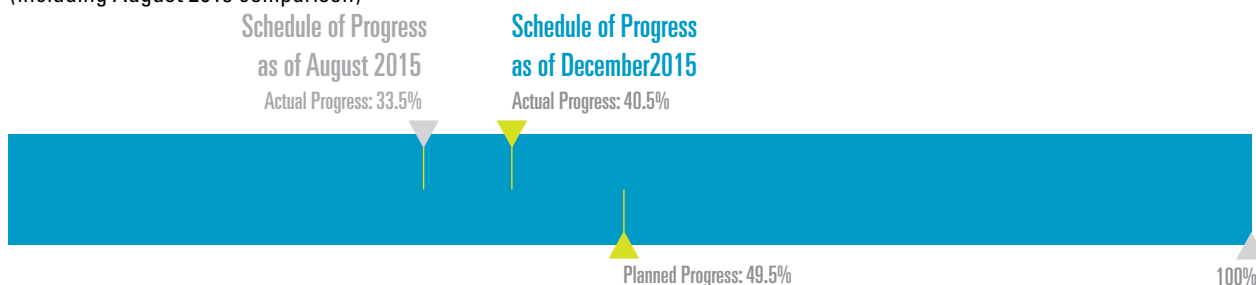
## 1. Construction Activities

Construction activities are mainly monitored and reported on an ongoing installation/ construction progress basis. Construction has continued to advance on the Muskrat Falls Project since August 2015. As outlined in Figure 1 and detailed in Table 4, overall Project schedule progress at the end of December 2015 is 40.5 per cent as compared to a planned schedule progress of 49.5 per cent, a variance of 9.0 per cent lower than planned [August 2015 actual progress was 33.5 per cent].

Figure 1

### Muskrat Falls Project – Schedule of Progress at December 2015

(including August 2015 comparison)



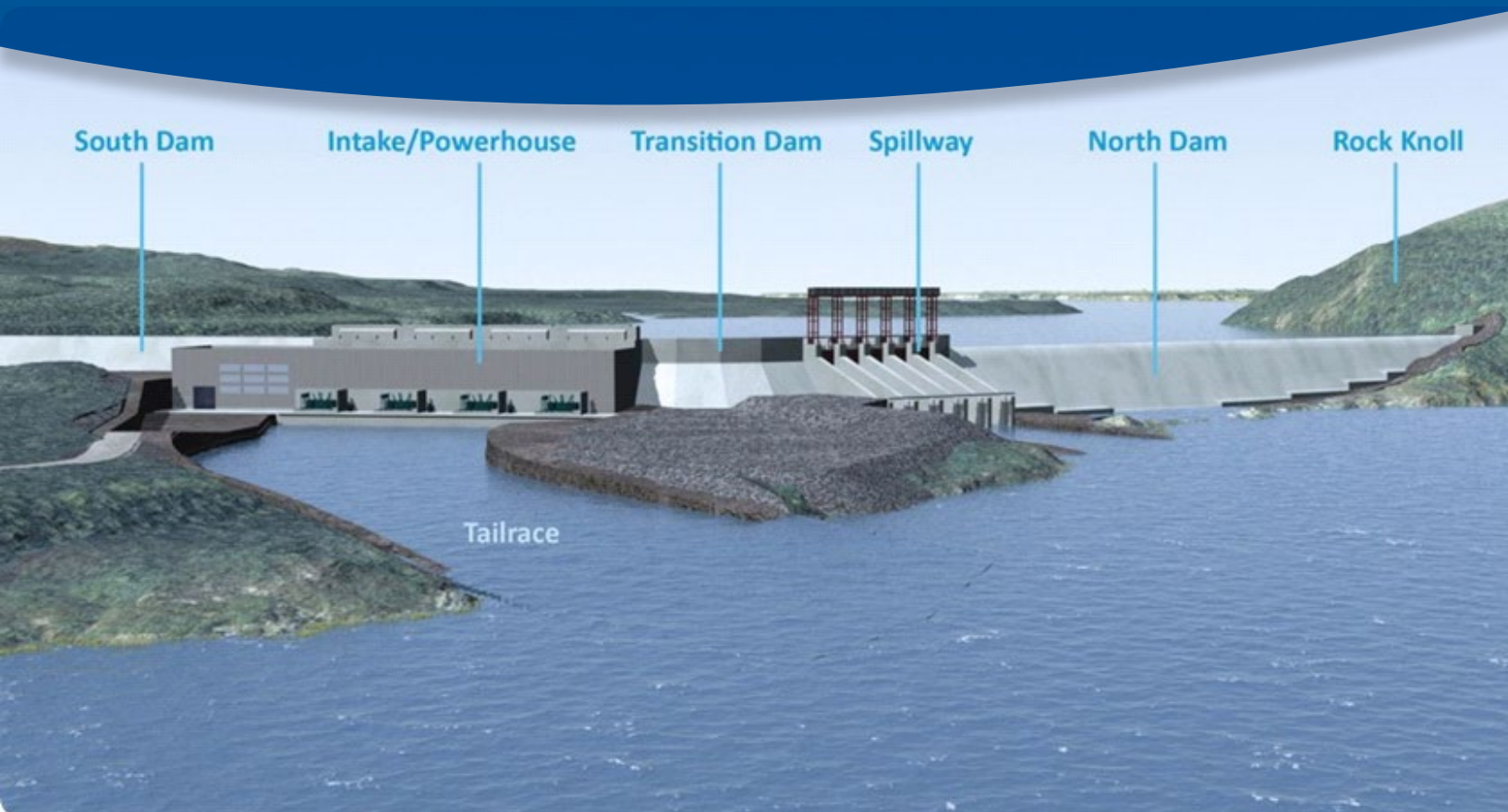
Schedule progress is distributed among the three sub-projects as outlined in Table 4. Progress variance continues to relate primarily to the Muskrat Falls Generating Facility which continues to track behind schedule. Further information regarding the progress schedule is provided in the section below by sub-project.

Table 4

### Planned Construction Schedule Progress vs. Actual Schedule Progress – December 2015

Muskrat Falls Project: Sub-Project	Planned Schedule Progress – December 2015	Actual Schedule Progress – December 2015	Variance December 2015
Muskrat Falls Generating Facility	56.6%	39.7%	-16.9%
Labrador-Island Transmission Link	37.9%	33.8%	-4.1%
Labrador Transmission Assets	63.5%	69.0%	5.5%
Total	49.5%	40.5%	-9.0%

## Sub-Project: Muskrat Falls Generating Facility



Muskrat Falls Generating Facility

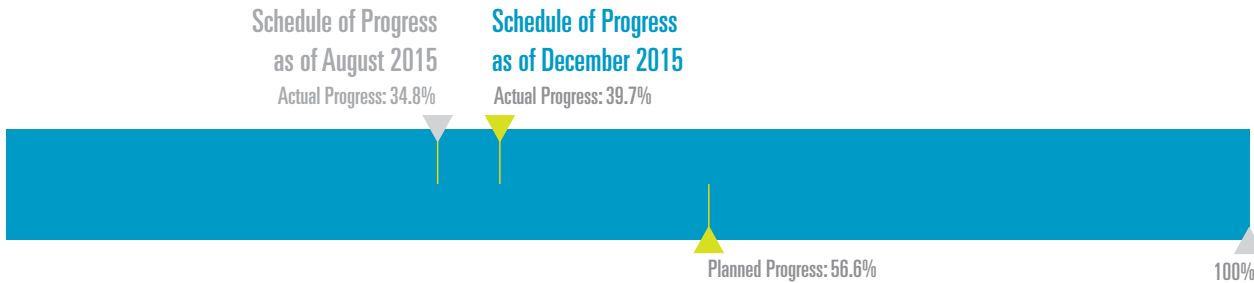
### Current Schedule

As of the end of December 2015, the actual construction progress for the generating facility was 39.7 per cent complete compared to a planned progress of 56.6 per cent complete, a variance of 16.9 per cent behind the planned schedule [August 2015 actual progress was 34.8 per cent].

Figure 2

**Muskrat Falls Generating Facility – Schedule of Progress at December 2015**

(including August 2015 comparison)



The slippage on the Generating Facility is mainly attributable to the work on the Powerhouse & Intake. As of the end of December 2015, the actual construction progress for the Powerhouse & Intake was 23.2 per cent complete compared to a planned progress of 52.2 per cent complete, a variance of 29.0 per cent behind the planned schedule [August 2015 actual progress was 18.5 per cent].

Total concrete poured for the Muskrat Falls Generating Facility at the end of December 2015 was 150,248 m<sup>3</sup> or 42 per cent of total planned concrete placement of 357,438 m<sup>3</sup>. No concrete was placed in December and the current focus for Winter 2016 is on formwork and rebar installation in preparation for concrete pours which began again in March 2016. The integrated cover system was in the process of being removed during December (and was fully removed during the month of February 2016) which will assist readiness for concrete placement resumption.



Progress on the Powerhouse at the Muskrat Falls Site – January 2015

In the August 2015 report the Committee identified that the Project Milestone Dates for the Muskrat Falls Generating Facility and Critical Path to first Power were under review. Nalcor has advised that while concrete placement levels have improved, schedule recovery is not possible. First Power will not be achieved by December 2017 and the revised Milestone Date remains under review.

For the period August to December 2015, Nalcor continued to make progress on the Spillway and Gates sub-project. As of the end of December 2015, the actual construction progress was 66.1 per cent complete compared to a planned progress of 63.0 per cent complete, a variance of 3.1 per cent ahead of the planned schedule. Nalcor has advised and EY confirms that Spillway work continues to allow for achievement of River Diversion in 2016. Construction also progressed on the North Spur Stabilization Works (4.4 per cent ahead of schedule as of December 2015) and excavation activities on the upstream and downstream embankment continued until early December, at which time work for the 2015 season shut down. Nalcor advises that activities are scheduled to resume in spring 2016.



Progress on the Spillway at the Muskrat Falls Site – January 2016





Route for the Labrador-Island Transmission Link by Segment

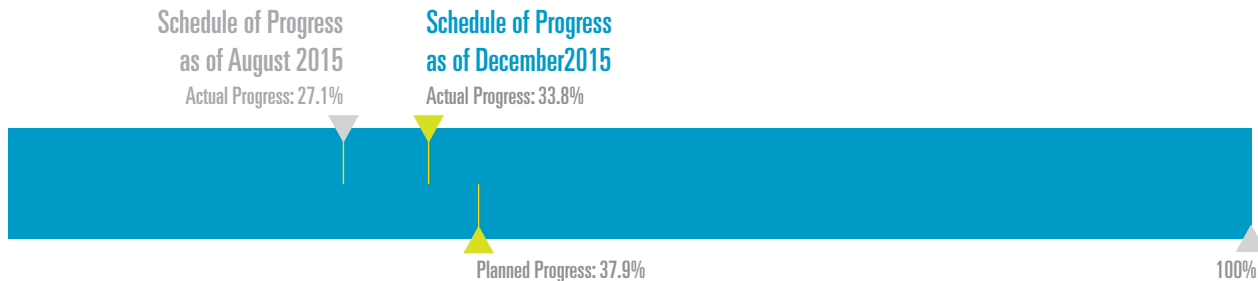
## Current Schedule

As of December 2015, the actual construction progress for the Labrador-Island Transmission Link was 33.8 per cent compared to a planned progress of 37.9 per cent complete, a variance of 4.1 per cent behind planned schedule [August 2015 actual progress was 27.1 per cent].

Figure 3

**Labrador-Island Transmission Link – Schedule of Progress at December 2015**

(including August 2015 comparison)



As shown in Table 5, this slippage has been primarily attributable to the progress on the Transmission Lines.

Table 5

**December 2015 – Construction Activity for the Labrador Island Transmission Link**

Planned Progress vs. Actual Progress

Construction Activity	December 2015 Cumulative %		
	Planned	Actual	Variance
HVdc Transmission Line Segment 1/2	47.4%	44.8%	-2.6%
HVdc Transmission Line Segment 3/4/5	14.1%	8.0%	-6.1%

In outlining the above progress measures, the Committee highlights that since the August report, the planned schedule progress baseline was adjusted in September 2015 to reflect revised project execution plans for certain activities. Table 6 outlines the adjustments for the HVdc Transmission Line. This is important in recognizing that the variance from plan reported in Table 5 is based on the revised September 2015 plan progress measures as shown in Table 6.

Table 6

**December 2015 – Construction Activity for the Labrador Island Transmission Link**

Planned Progress vs. Actual Progress

Construction Activity	Planned August 2015	Revised Planned September 2015	Variance
HVdc Transmission Line Segment 1/2	36.4%	31.4%	-5.0%
HVdc Transmission Line Segment 3/4/5	20.1%	6.3%	-13.8%

under the HVdc transmission line contract has been only 50% of plan. Nalcor advises and EY concurs that recent contractor performance has improved and that potential mitigation for some of the schedule risk may be available by mobilizing additional skilled crews from the successful execution of the Labrador Transmission Assets HVac contract which is being executed by the same contractor. There is also an ability to work on multiple work fronts which can also improve progress. It is noted that schedule risks remain to future schedule performance, including contractor performance, weather conditions and areas requiring a higher proportion of more complex foundation installations.



Progress on the HVdc Transmission Line (Labrador-Island Transmission Link) – December 2015

# Sub-Project: Labrador Transmission Assets



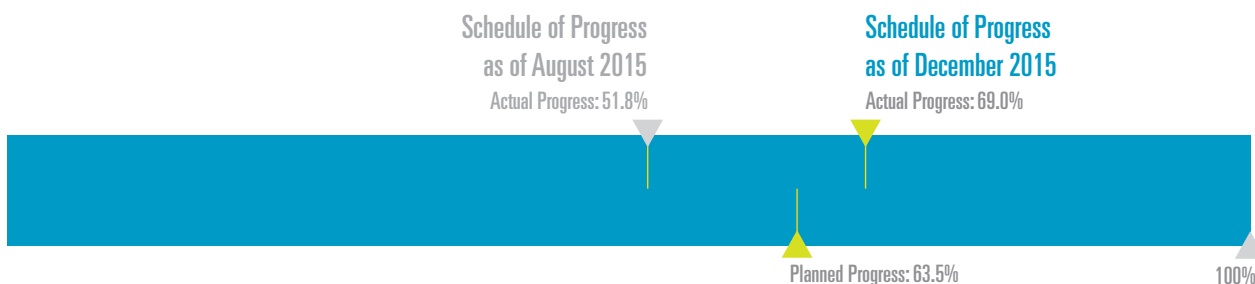
Route for the transmission line for the Labrador Transmission Assets

## Current Schedule

As of the end of December 2015, the actual construction progress for the Labrador Transmission Assets was 69.0 per cent complete as compared to a planned progress of 63.5 per cent complete, a variance of 5.5 per cent ahead of planned schedule [August 2015 actual progress was 51.8 per cent].

Figure 4  
**Labrador Transmission Assets – Schedule of Progress at December 2015**

(including August 2015 comparison)



Nalcor advised that progress is tracking ahead of schedule due to a conscious effort by the Project management team and the contractor to accelerate completion of this activity in order to move resources over to the Labrador-Island Transmission Link construction effort. The Project management team is actively managing resources and work priorities across the two sub-projects to optimize progress on both.

EY advises that the contract is currently forecasting to complete three months ahead of schedule. Based on past performance and elimination of key project risks with respect to the right of way, access and foundation installation, this schedule appears to be achievable.



Muskrat Falls Switchyard – October 2015

## 2. Manufacturing Activities

Manufacturing activities that are taking place outside the province are generally monitored and reported based on a Milestone and/or delivery date basis. The six material manufacturing supply and install contracts awarded to date are as follows:

1. Turbines and Generators;
2. Spillway and Powerhouse Hydro-Mechanical Equipment;
3. HVdc Convertors and Transition Compounds;
4. Submarine Cable for the Strait of Belle Isle crossing;
5. AC substations; and
6. Synchronous Condensers for the Soldiers Pond Switchyard.

A summary of progress on these manufacturing activities is outlined as follows:

- 7. Turbine and Generators** - the contract continues to track behind the original contract schedule. The December 2015 contractor report indicates that actual progress is 45.83 per cent complete compared to a planned progress of 61.29 per cent, representing a variance of 15.46 per cent (13.2 per cent in July 2015). The Contractor report notes that manufacturing is behind plan but this does not have a significant impact on subsequent phases of work (ie. delivery, installation and commissioning). In its Draw Certificate dated January 26, 2016, the Independent Engineer notes that continued monitoring of this activity is important since this is a significant contract to complete in accordance with the Integrated Project Schedule. Nalcor advises that while the baseline schedule is under review, completion of manufacturing remains on track to meet the required site installation dates.
- 8. Spillway and Powerhouse Hydro-Mechanical Equipment** – the contract continues to track behind the original contract schedule. The December 2015 Contractor report indicates that actual progress is 37.03 per cent complete compared to a planned progress of 60.43 per cent, representing a variance of 23.4 per cent (14.4 per cent in June 2015). The report indicates that the variance is primarily caused by a delay in logistics (delivery to site) and



Turbines and Generators Manufacturing (China) – October 2015

installation activities. The logistics delay is a management decision to store the components at the manufacturing site and not deliver these components until the spillway and powerhouse site is ready for installation. The Contractor now has full access to the work areas for the spillway and is now working an accelerated plan to meet the River Diversion Milestone. Nalcor advises and EY concurs that the River Diversion Milestone for November 2016 remains achievable. The baseline schedule for the Powerhouse is under review but the completion of manufacturing remains on track to meet required site installation dates.

**9. HVdc Convertors and Transition Compounds** - the contract continues to track behind the original contract schedule. The December 2015 Contractor report indicates that actual progress is 23.6 per cent complete compared to a planned progress of 48.5 per cent, representing a variance of 24.9 per cent (6.8 per cent in May 2015). The report indicates that the slippage is primarily due to delays in engineering and procurement activities.

The contractor has identified a 2 month delay. EY noted that even allowing for this two month delay, the contractor would have to more than double the overall earned progress per period. Nalcor advises that it is working with the contractor to implement a recovery plan to mitigate risk and recover this delay. It will be important to monitor progress of this contract as installation and commissioning of this equipment is required for First Power.



Final Subsea Cable Manufacturing (Japan) – October 2015

- 10. Submarine Cable for the Strait of Belle Isle Crossing** - the contract is generally on track to the original contract schedule. The December 2015 contractor report indicates that actual progress is 60.75 per cent complete compared to a planned progress of 61.72 per cent, representing a variance of 0.97 per cent (3.92 per cent in August 2015). Nalcor advises that the land cable is complete and has been installed, and the submarine cable is complete and in transit to site as of the end of December 2015. Overall this program is ahead of critical path requirements.
- 11. AC Substations** - the contract is tracking behind the original contract schedule. The December 2015 contractor report indicates that actual progress is 38.04 per cent complete compared to a planned progress of 63.11 per cent, representing a variance of 25.07 per cent (0.3 per cent ahead of schedule in May 2015). The report notes that procurement has been a challenge, and therefore, immediate project management priority and additional human resources is being committed to support the sourcing and procurement process. Nalcor advises that while the current contractor schedule shows no overall delay, there is potential that procurement and construction delays will result in a delay to the overall schedule. Nalcor advises that it is working with the contractor to implement a recovery plan to mitigate risk of schedule slippage.
- 12. Synchronous Condensers for the Soldiers Pond Switchyard** - the contract continues to track behind the original contract schedule. The December 2015 contractor report indicates that actual progress is 30.6 per cent complete compared to a planned progress of 62.6 per cent, representing a variance of 32.0 per cent (11.4 per cent in June 2015). The contractor has identified a 59-day total overall schedule delay on the Static Commissioning of Units 1 and 2 due to procurement delays with delivery of the Stator Frame units. Nalcor is working with the contractor to implement measures to mitigate any schedule variances.

## Long-term Schedule

The August 2015 Committee report identified that schedule pressures continued to be experienced at the Muskrat Falls Generating Facility's Powerhouse & Intake and that Nalcor was establishing new baselines for the Project schedule, including Milestone Dates for First Power from Muskrat Falls.

Nalcor has advised that the re-baselining of the Muskrat Falls Generating Facility schedule is still ongoing, however, schedule recovery is not possible and Nalcor confirms that First Power will not be achieved by December 2017.



Table 7 outlines the Milestone Dates at December 31, 2015.

Table 7

**Milestone Schedule – As of December 2015**

Muskrat Falls Generating Facility	Previous Planned Date	Actual/Forecast December 2015
Project Sanction	December 2012	Complete
North Spur Works Ready for Diversion	September 2016	September 2016
River Diversion Complete	November 2016	November 2016
Reservoir Impoundment Complete	November 2017	Under review
Powerhouse Unit 1 Commissioned - Ready for Operation	December 2017	Under review
First Power from Muskrat Falls	December 2017	Under review
Powerhouse Unit 2 Commissioned - Ready for Operation	February 2018	Under review
Powerhouse Unit 3 Commissioned - Ready for Operation	April 2018	Under review
Powerhouse Unit 4 Commissioned - Ready for Operation	May 2018	Under review
Full Power from Muskrat Falls	May 2018	Under review
Commissioning Complete - Commissioning Certificate Issued	June 2018	Under review
Labrador-Island Transmission Link	Previous Planned Date	Actual/Forecast December 2015
Project Sanction	December 2012	Complete
SOBI Cable Systems Ready	October 2016	October 2016
MF Switchyard and Converter Station Ready for Operation	July 2017	September 2017
HVdc Transmission Line Construction Complete and Connected	July 2017	July 2017
Soldier's Pond Switchyard & Converter Stn. Ready for Operation	July 2017	September 2017
Ready for Power Transmission	September 2017	November 2017
Soldier's Pond Synchronous Condenser Ready for Operation	June 2017	July 2017
Commissioning Complete - Commissioning Certificate Issued	June 2018	Under review
Labrador Transmission Assets	Previous Planned Date	Actual/Forecast December 2015
Project Sanction	December 2012	Complete
Hvac Transmission Line Construction Complete	September 2016	September 2016
Churchill Falls Switchyard Ready to Energize	May 2017	May 2017
Muskrat Falls Switchyard Ready to Energize	May 2017	May 2017
Ready for Power Transmission	May 2017	May 2017
Commissioning Complete - Commissioning Certificate Issued	June 2018	Under review

# Muskrat Falls Project Costs

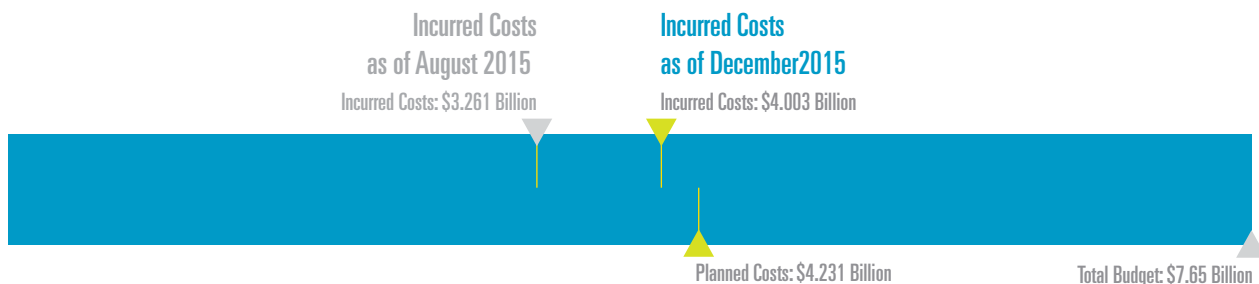
This section provides information on costs incurred compared to planned costs for the period ended December 2015, first on an overall Project basis, and then by each of the sub-projects.

## Current Cost – Overall Project Basis

Cumulative to the end of December 2015, the incurred costs for the Muskrat Falls Project totaled \$4.003 billion as compared to the planned costs of \$4.231 billion, a variance of \$227.5 million or 5.4 per cent lower than planned [August 2015 incurred costs were \$3.261 billion].

Figure 5  
**Muskrat Falls Project - Incurred Costs at December 2015**

(including August 2015 comparison)



Additional details of the incurred costs as of December 2015 by Sub-Project are provided below.

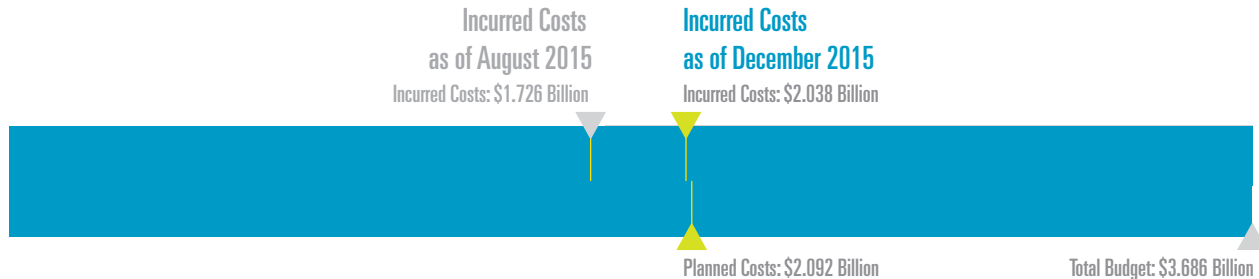
## Muskrat Falls Generating Facility

The Muskrat Falls Generating Facility comprises 48.1 per cent of the total Project budget. As of the end of December 2015, the incurred costs for the generating facility totaled \$2.038 billion as compared to the planned costs of \$2.092 billion, which was \$54.5 million or 2.6 per cent lower than planned [August 2015 incurred costs were \$1.726 billion].

Figure 6

**Muskrat Falls Generating Facility - Incurred Costs at December 2015**

(including August 2015 comparison)



Nalcor advises that there are two main factors contributing to the lower than planned expenditures. First, progress on the Turbines and Generators manufacturing continues to be slower than planned and this has resulted in a reduced rate of incurred costs on these manufactured items. Secondly, the Project management team has continued its strategy to defer start-up of the Reservoir Clearing upstream of Muskrat Falls, thereby deferring associated costs.

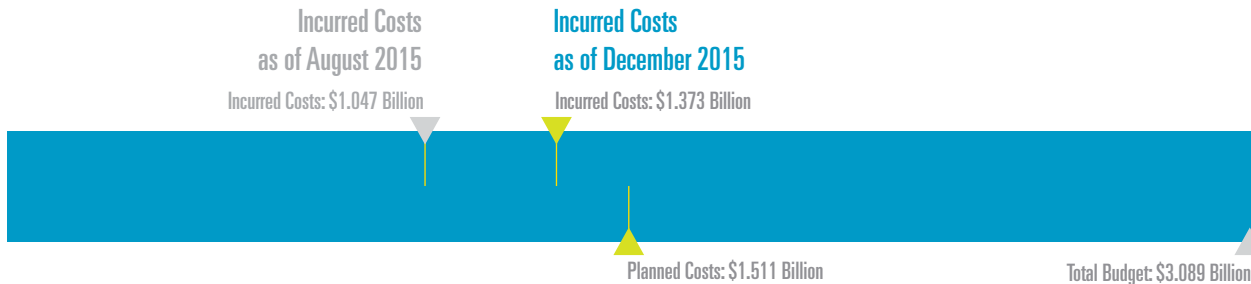
As noted in the above section on the Current Schedule, progress on the Powerhouse and Intake is significantly behind schedule. The payment mechanism for this contract, as well as the contract for the Spillway and Gates is based upon person-hours worked rather than cubic meters of concrete poured. In their report, EY advises that as of December 2015, the proportion of contract value paid to the contractor is significantly greater than the proportion of the concrete that had been placed. Thus, although significantly behind schedule, the costs based upon person-hours worked are incurred. Nalcor advises the contract was designed in this manner to realize possible savings in construction labour productivity and to also protect from possible labour cost overruns that might be experienced by the contractor as the contract included a maximum labour cost component. The contract decoupled labour from the units of physical work (e.g., m<sup>3</sup> of concrete placement) and provided a shared savings incentive to the contractor if work was accomplished under the labour budget.

## Labrador-Island Transmission Link

The Labrador-Island Transmission Link comprises 40.4 per cent of the total Project budget. As of the end of December 2015, the incurred costs for the Labrador-Island Transmission Link totaled \$1.373 billion as compared to the planned costs of \$1.511 billion, which was \$138.2 million or 9.1 per cent lower than planned [August 2015 incurred costs were \$1.047 billion].

**Figure 7**  
**Labrador-Island Transmission Link - Incurred Costs at December 2015**

(including August 2015 comparison)



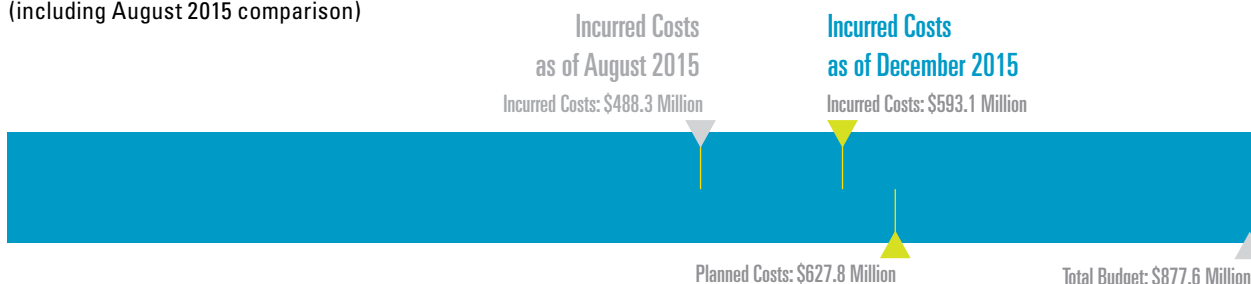
Nalcor advises that progress on some of the procurement and manufacturing activities associated with the HVdc Specialties is slower than planned and this has affected the rate of incurred costs on these items; for example, delays in procuring equipment for the Synchronous Condensers has resulted in lower incurred costs. In addition, Nalcor notes that incurred costs associated with the HVdc transmission line construction is also tracking behind plan due to slower than expected progress, as previously outlined. Nalcor expects that incurred costs will realign with planned cost in the future, as the Project management team is actively working with contractors to ensure delivery dates on procurement and manufacturing activities are met and schedule slippage on the HVdc transmission line construction is recovered.

## Labrador Transmission Assets

The Labrador Transmission Assets comprise 11.5 per cent of the total Project budget. As of the end of December 2015, the incurred costs for the Labrador Transmission Assets totaled \$593.1 million as compared to the planned costs of \$627.8 million, which was \$34.7 million or 5.5 per cent lower than planned [August 2015 incurred costs were \$488.3 million].

**Figure 8**  
**Labrador Transmission Assets - Incurred Costs at December 2015**

(including August 2015 comparison)



The monthly Project reports indicate that construction activities on the Labrador Transmission Assets has been tracking ahead of schedule, and incurred costs were also proportionately higher than planned in October and November, 2015. However with the winter shutdown, rate of expenditure dropped off which resulted in lower than planned expenditure for the period ending December 2015. Nalcor advises that as construction activities resume in 2016 it is expected that incurred costs will realign with planned.

# Project Risks

Given the size and complexity of the Project, it is important that any risks continue to be proactively identified and monitored and that mitigation measures are implemented as appropriate. The Committee continues to review Nalcor's monthly risk report and meets regularly with Nalcor officials to discuss major project risks and mitigation strategies. The Committee also considered the findings and recommendations from the EY Interim Report.

Based on these activities the Committee focused on providing updates with respect to the following risks:

## 1 Risk for Project schedule delays

In the report for August 2015, the Committee noted that it would be critical for the civil contractor to sustain the production improvements to avoid further schedule slippage and may require additional efforts from certain Project contractors. It was also identified that the Project Milestone Dates for the Muskrat Falls Generating Facility and Critical Path to first Power were under review. Nalcor has advised and EY concurs that schedule recovery is not possible. First Power will not be achieved by December 2017 and the revised Project Schedule remains under review.

EY has also noted the risk reported by a contractor of a multiple month delay to completion of the HVdc Transmission Line as a result of a number of delivery challenges that have been experienced to date and the risk associated with the remaining scope, where full mitigation may not be possible. EY also noted the contractor for the HVdc Converter is reporting a two month delay with a potential further one to two month delay to the overall schedule resulting from engineering and procurement delays in the contract. Mitigation plans are being implemented to maintain the forecast and recover this delay however the contractor would be required to more than double their rate of progress to date to maintain the forecast schedule. Nalcor further advises that there are measures in the contract to incentivize the contractor to meet their delivery dates. It will be important to monitor progress of this contract as installation and commissioning of this equipment is required for power transfer (recall power) from Churchill Falls to the Island currently scheduled for late 2017.

## 2 Risk of Project Cost Escalation

### 1. Unawarded Contracts

As noted in the August 2015 Committee report, all major Project contracts have been awarded with the exception of the Mechanical and Electrical auxiliaries supply and installation contract which is proceeding through advanced evaluation. While this contract has not been awarded, Nalcor advises that bids are in line with the September 2015 Forecast.

### 2. Contractor Performance

The August 2015 Committee report identified that delays on the Muskrat Falls Generating Facility could impact costs beyond the Project execution risk contingency that has been established. As noted, schedule recovery on the Powerhouse & Intake will not be possible and First Power will be delayed. EY advises that the direct and indirect consequences of this delay are expected to have material impacts on cost and schedule. For example, for each month completion is delayed, additional Owner Management Team and Camp Operations costs of approximately \$12.5 million will be incurred. Additionally EY has noted this delay will also have a “knock on” effect to costs of other impacted contracts. These types of additional costs are not reflected in the September 2015 Forecast.

### 3. Project Contingency

EY notes that major capital projects include both tactical and strategic risks – the latter are those considered to be outside of the controllable scope of the Project team. The following risks were classified by Nalcor at Project Sanction as strategic:

- Schedule risks - relating to bad weather, to the volume of work required to deliver the powerhouse, (particularly given the challenging performance assumptions for powerhouse concrete), and schedule challenges for certain sections of the transmission line;
- Performance risks – the risks of not being able to achieve the performance rates and productivity assumed in the schedule estimate and the challenges associated with being able to attract the quality of experienced front-line supervision required to manage performance; and
- Skilled labour risks – risks of budgeted labour rates being exceeded.

EY notes that a quantitative assessment of 'strategic risks' was made and documented at the time of the sanction process but no explicit allowance was made in the form of a quantified reserve in the sanction budget. Thus, the contingency included in the Project Budget includes the tactical risks but does not include a quantified reserve for the strategic risks.

EY has expressed the opinion that the crystallization of risks classified as strategic was the main driver for the cost increases seen to date on the Project. Risks which would be classified as strategic are expected to continue to impact the remaining scope of the Project.

EY noted that Nalcor has identified and documented risks with all remaining scope including commissioning and integration and regularly evaluates potential cost and schedule impacts of these risks; however, Nalcor does not develop, on a periodic basis, an aggregate position, compare it to contingency levels or integrate it into the Project forecast to provide a risk adjusted forecast. EY notes that the impact of these risks on cost and schedule are not adequately reflected in the September 2015 Forecast.

EY notes that there is opportunity to mitigate some of these risks and the contract structures in place provide some protection for cost and schedule risk. Nalcor is currently undertaking a Quantitative Risk Assessment (QRA) that should be used to inform the amount of contingency required.

The current contingency remaining at the end of December 2015 was \$173 million, which represented 4.7 per cent of the cost to complete or 2.3 per cent of total costs. EY considers that this is low for the current stage of completion of the Project. More than 50 per cent of the work on the Project has now been completed, and just over 40 per cent of the construction work has been finished. EY advises that while the majority of the design, engineering and procurement work is complete, there is a significant amount of physical construction work remaining that will be followed by commissioning and integration. This construction work is challenging in terms of its scale, time and geography and as such is exposed to a wide range of execution risks.



# Other Oversight Activities

The Committee provides the following update with respect to additional oversight activities.

## Independent Engineer

The Independent Engineer attended a briefing and participated in site visits and meetings on the Project during September 21 to 24, 2015. The Independent Engineer's report on the site visit was issued on November 21, 2015. The report indicates that, in general, most of the ongoing work at Soldier's Pond, slope stabilization measures at the North Spur, and concrete works in the spillway structures conforms to current schedules. However, the Independent Engineer noted that progress on the powerhouse construction is behind schedule and that this work is on the critical path and directly impacts initial power generation at Muskrat Falls.

The Independent Engineer, accompanied by Committee representatives, also made a site visit from November 2 to 6, 2015. The report was issued on February 5, 2016. The report indicated that works at the North Spur site are proceeding well and are generally ahead of schedule and work on the spillway is at a very advanced stage with 100 per cent of the concrete placement of the main structure being completed. The Independent Engineer also noted that there has been schedule slippage at the Powerhouse and Intake and Nalcor is working with the contractor to update the schedule by the end of March 2016.

The Independent Engineer's official report relating to the September 2015 and the November 2015 site visits can be found on the Committee's website at: [www.gov.nl.ca/mfoversight/engineer/](http://www.gov.nl.ca/mfoversight/engineer/) or, on Nalcor's website at: <https://muskratfalls.nalcorenergy.com/newsroom/reports/>

## Other Assurance Reviews

In fulfilling its mandate, throughout the construction period the Committee will examine issues such as whether management processes and controls are well designed and followed. The Committee provides the following update:

### **1. Project Controls for Cost and Schedule**

On December 21, 2015 the Committee released a report completed by Ernst & Young (EY), in its role as consultant to the Committee, titled "Review of Muskrat Falls Cost and Schedule Management Processes and Controls" ("the Report").

The scope of the review included an assessment of the:

- Adequacy of Nalcor's cost and schedule management processes and controls as it manages and reports on the execution of the Project;
- Consistency of Nalcor's use of those processes and controls in key areas of the Project; and,
- Extent of reliance the Oversight Committee could place on Nalcor's management reporting forecast and schedule forecasts.

EY made the following observations with respect to the Project's Management and Control systems:

1. Key project control process have been developed, including:
  - a. Core project management and control processes for cost and schedule, including the development of an Integrated Program Schedule (IPS) for the program, identification of baseline, committed and incurred costs as well as linkage of cost and schedule baselines to change management processes and controls;
  - b. A Project Execution Plan defining the basis of the schedule and the estimate, and key assumptions supporting Project baseline cost and schedule; and
  - c. Coordination procedures for administration, execution control and management of the contractors' cost and schedule.
2. Project reporting summarizes key information on construction cost and schedule, including:
  - a. Schedule forecast and progress leveraging the IPS, including critical path and float review; and
  - b. Cost forecasting, including Estimate To Complete, Estimate At Complete, variances and trends, as well as basic contingency forecasting.
3. Nalcor's continued efforts to work with contractors on maintaining a disciplined approach to project management, control and reporting.
4. Proactive measures were being taken to manage potential claims.
5. Cost and schedule issues and risks arising during the Project were subject to active formalized management.
6. A matrix organization structure has been established, responsible for managing the Project as a whole. Key roles in this organizational structure had been staffed with resources experienced in cost and schedule management.

EY further made the following observations with respect to key aspects of the management processes and controls that were not fully developed and deployed at the time of their review:

### **Key schedule management process and control risks and issues**

1. Certain baseline documents defining contractor schedules as well as the documents defining the control of project schedules were not yet complete.
2. Contractors' schedule updates were not being systematically rolled up into the Nalcor Integrated Project Schedule (IPS) that forms the basis of reporting to the Oversight Committee.
3. A completion date had not been established for finalizing an integrated baseline of contractor and IPS schedules to correct the issues noted in #1 and #2 above.
4. The IPS development and maintenance process is not fully documented.

### **Key cost management process and control risks and issues**

1. The conditions and processes for rebaselining cost and schedule are not defined in the Project's control processes and procedures. The Oversight Committee's understanding of such conditions and processes is an important foundation as it conducts its oversight activities.
2. Nalcor uses a relatively basic approach to its updating of forecasted contingency requirements which in the experience of EY is not consistent with the expected practices for a project of this scale and complexity. Given this, it is not clear whether the cost contingency as forecasted in reports for the Project will be adequate.
3. The Project does not define thresholds for variance management, reporting, and escalation purposes. EY would normally expect these to be in place as they assist in giving clear indications of the severity of issues and the need to escalate to key stakeholders, such as the Oversight Committee.
4. Fully quantified risks or trends have not been documented for certain significant challenges on the project. The scale of potential challenges is also not quantified in the summary reporting made available to the Oversight Committee.

EY recognized that Nalcor is using many conventional management processes and controls for the Project. However, while certain contractor Earned Value data is being collected, Nalcor is not reporting using a full Earned Value Management System across the whole of the project. Reporting on Earned Value performance would however, provide additional useful data and information to the Oversight Committee on both individual contractor and overall Project performance where available.

Until such time as the management process and controls risks and issues identified in this report and the detailed supplementary report are addressed, the completeness and accuracy of Project cost and schedule status reporting to the Oversight Committee cannot be fully verified.

## Key recommendations

EY recommended that the Oversight Committee:

1. Work with Nalcor to obtain management response for each of the findings noted in this report and the detailed supplementary report with defined corrective action, responsibility and anticipated completion dates. Given the volume of Project activity, timeliness of action is critical. Therefore, the Oversight Committee should actively monitor status and verify completion of management response to its expectations.
2. Consider conducting detailed assessments of the cost and schedule status of the Project on an ongoing basis until Nalcor's corrective action addressing key risks and issues noted in this report is complete to the Oversight Committee's satisfaction. This ongoing assessment should include the basis and accuracy of the forecasts for completion at the contractor level, as well as the quantification of cost and schedule risk.

The Report and Nalcor's response are available at [www.gov.nl.ca/MFOversight/](http://www.gov.nl.ca/MFOversight/).

The engagement of EY in December of 2015, as discussed further below, is consistent with the recommendations above.

## 2. Project Cost, Schedule and Associated Risk

In December 2015, the Government of Newfoundland and Labrador, through the Committee, contracted with EY to conduct an independent review of the Project cost and schedule performance, the key associated risks and identification of opportunities for remediation or corrective action. Nalcor is currently re-baselining for the Project, so EY could not complete its review at this time. As a result, EY was requested to issue an Interim Report. The findings in the Interim Report have been incorporated throughout this report. A full copy of the Interim Report and Nalcor's response are available at [INSERT LINK].

The key recommendations from the Interim Report are as follows:

- the Project should revise its planning and forecasting processes to explicitly include the regular reporting of a fully risk adjusted final forecast of cost and schedule;
- the Project Contingency should make appropriate allowances for all risks including strategic, at a confidence level reflecting stakeholders required cost certainty. EY would recommend consideration be given to use of a conservative P80 confidence level for setting Project contingency, based on a thorough Quantitative Risk Assessment;
- the sufficiency of the Project Contingency should be reviewed quarterly to assess whether it appropriately covers all risks, taking account of the effectiveness of mitigation plans and the likelihood of risks crystalizing;
- there should be separation of the Project Contingency into an amount to be managed by the Project team and an amount to be managed at a higher level of governance;

In course of conducting the Review, EY has observed that governance and reporting arrangements to date have not been effective in giving stakeholder confidence on forecast Project costs and schedule. In EY's opinion, there is a need to strengthen Project governance and reporting to provide more effective oversight and constructive challenge to Project performance and execution, key decisions and forecasting.

- Project governance and independent oversight should be re-evaluated by Government and strengthened at the Project, Nalcor Board and Government levels; and
- Project reporting should be enhanced to support senior management focus on key risks and issues, to communicate more clearly how key risks are reflected in the forecast and to enable more effective Government oversight.

# Next Report

The Committee will continue its oversight of the construction of the Project in accordance with its mandate and the Oversight Framework.

# Appendix A

## Project Budget Summary Expenditure Categories

The summary expenditure categories are described as follows:

**NE-LCP Owners Team, Admin and EPCM Services:** includes the labor, facilities and overhead costs of the LCP Project team as well as costs of SNC Lavalin.

**Feasibility Engineering:** includes the cost of early stage engineering activities which are now complete.

**Environmental & Regulatory Compliance:** includes costs associated with environmental assessment, permits, licenses and similar such costs.

**Aboriginal Affairs:** includes costs associated with activities in the aboriginal communities along with obligations under the Impact and Benefits Agreement.

**Procurement & Construction:** includes costs associated with the major construction activities and the award of contracts.

**Commercial & Legal:** includes costs associated with insurance, legal and other commercial activities.

**Contingency:** provision for additional expenditure, if required.

# Appendix B

## Contingency Changes, Period September – December, 2015

The reasons for the changes to the Project Forecast Contingency budget and the net decrease of \$14.0 million from September to the end of December 2015 were reported as follows:

### **Muskrat Falls Generating Facility**

The \$6.2 million contingency drawn for the Muskrat Falls Generating Facility related primarily to:

- increased costs associated with professional concrete services being conducted under the contract for construction of the Intake, Powerhouse, Spillway and Transition Dams;
- schedule acceleration costs related to contract for supply and installation of hydro-mechanical equipment; and,
- additional costs associated with construction of bulk excavation works within the Muskrat Falls Generating Facility sub-project.

### **Labrador-Island Transmission Link**

The \$7.7 million contingency drawn for the Labrador-Island Transmission Link related primarily to:

- a requirement for extra anchors and foundations;
- an increase in costs associated with geotechnical field investigations and micropile foundation studies related to construction;
- markup costs associated with the transfer of scope from the civil contractor for HVdc Specialties to the contractor for construction of AC Substations; and
- additional third party quality inspection costs for foundations.

### **Labrador Transmission Assets**

The \$137,000 contingency drawn for the Labrador Transmission Assets related primarily to:

- markup costs associated with the transfer of scope from the civil contractor for HVdc Specialties to the contractor for construction of AC Substations;
- an increase in costs associated with Churchill Falls camp usage by staff and contractors;
- an increase in costs associated with the Muskrat Falls Switchyard due to layout changes;
- an increase in costs associated with electrical installation and the construction of temporary pads for the Churchill Falls autotransformer; and
- requirement for additional anchors; and,

Offset by some savings associated with the contract for clearing of the HVac Transmission Line.



Muskrat Falls Oversight Committee  
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# Muskrat Falls Project

Review of project cost, schedule and related risks

Interim report

March 15, 2016



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March 15, 2016

## Muskrat Falls Project review of project cost, schedule and related risks

Ms. Mullaley,

EY has completed an interim report as part of the review of the Muskrat Falls Project's cost, schedule and related risks (the "Engagement"). Our Engagement is being performed in accordance with the statement of work dated 14 January 2016 between EY and Her Majesty in Right of Newfoundland and Labrador.

The objective of the Engagement is to assess the reasonableness of the Muskrat Falls Project's cost and schedule forecast and to identify opportunities to address any material/critical risks. As requested, this interim report will assess the reasonableness of the Project's most recent approved cost and schedule forecast, with a final report to be provided after Nalcor Energy Ltd. ("Nalcor") completes its ongoing reforecasting process. This interim report:

- ▶ informs the Provincial Government on current material risks and issues not reflected in the September 2015 forecast;
- ▶ provides recommendations that Nalcor should consider as it completes its Quantitative Risk Assessment and re-baseline activities; and
- ▶ informs the EY final review, enabling it to be completed in a timely fashion.

The field work for this interim report was completed in January and February 2016 and consisted of reviewing project data and documentation, as well as enquiries and discussions with senior management and representatives of Nalcor, the Independent Engineer and the Provincial Government. The services provided by EY in this report are advisory in nature.

EY has not developed its own cost, schedule and risk forecast but instead assessed the reasonableness of that prepared by Nalcor.

We would like to express our appreciation for the cooperation and assistance provided to us by Nalcor, the Independent Engineer and the Provincial Government.

Yours sincerely,

Ernst & Young LLP



## Disclaimer

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This report is intended solely for the information and use of Her Majesty in Right of Newfoundland and Labrador as represented by the Executive Council and is not intended to be and should not be used by any other parties. In preparing this report, EY relied on information provided by its client and by Nalcor. EY has not audited, reviewed or otherwise attempted to verify the accuracy or completeness of such information. This report has not considered issues relevant to third parties and is subject to certain limitations. We shall have no responsibility whatsoever to any third party that obtains a copy of this report. Any use such a third party may choose to make of this report is entirely at its own risk. We disclaim all responsibility for loss or damage, if any, suffered by any third party as a result of reliance on, decisions made or actions taken based on this report.

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## 1 Executive summary

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- 1.1 The Government of Newfoundland and Labrador (“the Provincial Government”) engaged EY to assess the reasonableness of the Muskrat Falls Project’s (“the Project”) cost and schedule forecast and to identify opportunities to address any material/critical risks.
- 1.2 The most recent cost forecast for the Project was set in September 2015. At this time the Project schedule was not updated but was described as “under review”. This cost and schedule position (“the September 2015 Forecast”) forms the basis for the EY review to date (“the Review”) and is summarized in the table below:

Total forecast cost, including contingency	\$7.653b
Ready for sustainable power transfer Labrador to Newfoundland	November 2017
First power from Muskrat Falls	December 2017 <sup>1</sup>

- 1.3 The overall conclusion of the Review is that the September 2015 Forecast is not reasonable. The principal reasons for this conclusion are as follows:
- ▶ the Muskrat Falls Generation (“MFG”) contract for civil construction is significantly behind schedule in the Powerhouse and Intake areas. The direct and indirect consequences of this delay are expected to have material impacts on cost and schedule that are not reflected in the September 2015 Forecast;
  - ▶ the current contingency level representing 4.7% of the cost to complete<sup>2</sup>, or 2.3% of total cost, is low for the current stage of completion of the Project. More than 50% of work on the Project has now been completed, and just over 40% of the construction work has been finished. The majority of design, engineering and procurement work is complete; however, there is a significant amount of physical construction work remaining that will be followed by commissioning and integration. This construction work is challenging in terms of its scale, time and geography and as such is exposed to a wide range of execution risks; and
  - ▶ there is a risk of multiple-month delay to completion of the HVdc transmission line contract as a result of a number of delivery challenges that have been experienced to

<sup>1</sup> At the time of the September 2015 Forecast, Nalcor communicated that first power in 2017 was not achievable

<sup>2</sup> As at the 31 December 2015 reporting period compared to the September 2015 Forecast



# Muskat Falls Project

## Review of project cost, schedule and related risks

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date and the risks associated with the remaining scope, where full mitigation may not be possible.

- 1.4 Nalcor Energy Ltd. (“Nalcor”) has identified and documented contract risks including those above. However, the potential impacts of these risks on cost and schedule are not adequately reflected in the September 2015 Forecast. Nalcor is currently undertaking a risk assessment to evaluate the impacts of all Project risks, including the above, and will use the results of this process to prepare a revised forecast.
- 1.5 We have the following observations relevant to the conclusion in 1.3 above:
  - ▶ risks defined by Nalcor as strategic are not allowed for in the financial forecast;
  - ▶ the potential cost and schedule impacts of all individual risks are recorded in the Project’s risk register but are not systematically reflected in the overall reported forecasts for cost and schedule; and
  - ▶ some anticipated material cost variances have only been reflected in the forecast cost when they are contractually committed.
- 1.6 From the above conclusion and observations, EY recommends that:
  - ▶ the Project should revise its planning and forecasting processes to explicitly include the regular reporting of a fully risk-adjusted final forecast of cost and schedule;
  - ▶ the Project contingency should make appropriate allowances for all risks, including strategic, at a confidence level reflecting stakeholders’ required cost certainty. EY recommends that consideration be given to the use of a conservative P80 confidence level for setting Project contingency, based on a thorough Quantitative Risk Assessment;
  - ▶ the sufficiency of the Project contingency should be reviewed quarterly to assess whether it appropriately covers all risks, taking account of the effectiveness of mitigation plans and the likelihood of risks crystallizing; and
  - ▶ there should be separation of the Project contingency into an amount to be managed by the Project team and an amount to be managed at a higher level of governance.
- 1.7 In the course of conducting the Review, EY has observed that governance and reporting arrangements to date have not been effective in respect of the Project’s cost and schedule forecasts. There is a need to strengthen Project governance and reporting to provide more effective oversight and constructive challenge to Project performance and execution, key decisions and forecasting.



# Muskat Falls Project

## Review of project cost, schedule and related risks

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- 1.8 From these further observations, EY recommends that:
- ▶ Project governance and independent oversight should be re-evaluated by the Provincial Government and strengthened at the Project, Nalcor Board and Provincial Government levels; and
  - ▶ Project reporting should be enhanced to support senior management focus on key risks and issues, to communicate more clearly how key risks are reflected in the forecast and to enable more effective Provincial Government oversight.
- 1.9 EY will work with the Provincial Government to fully develop options in relation to the design and implementation of the above recommendations.





# Muskrat Falls Project

## Review of project cost, schedule and related risks

### 2 Introduction

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2.1 The Project is a multi-billion dollar program involving design, procurement, manufacture and construction over a period of more than five years, across multiple continents and with construction across multiple remote sites in Newfoundland and Labrador. There are three main sub-projects:

- ▶ Labrador Transmission Assets: includes a 315-kV HVac transmission interconnection from Muskrat Falls to Churchill Falls and HVac switchyards;
- ▶ Labrador Island Transmission Link: includes a ±350-kV HVdc transmission connection from Muskrat Falls to Soldiers Pond (over 1,050 km of transmission line), HVac to HVdc converter stations, shore electrodes, and 30 km of 350-kV HVdc cable crossing at the Strait of Belle Isle; and
- ▶ Muskrat Falls Generation Facility: includes 4 x 206-MW (totalling 824-MW) turbine/generators, dams/spillways, river diversion, North Spur stabilization, reservoir, access road and buildings.



2.2 The Project is being delivered through multiple separate contracts. Nalcor performs its role through an integrated project team of approximately 400 people. SNC Lavalin was originally engaged as the Engineering, Procurement & Construction Management contractor. From November 2013, Nalcor moved to an integrated management model utilizing Nalcor staff, SNC Lavalin resources and other third-party consultants.



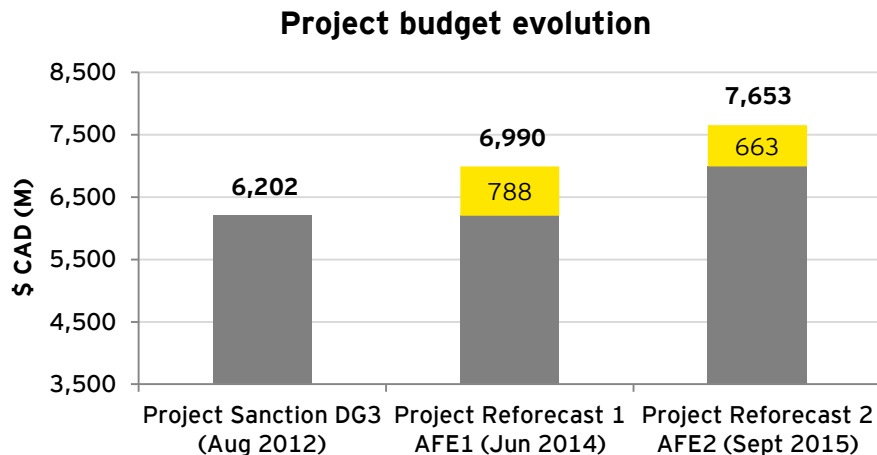
# Muskrat Falls Project

## Review of project cost, schedule and related risks

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- 2.3 The Project deploys proven technology, but the delivery is of a significant scale and subject to challenging terrain and weather conditions. For example, the HVdc transmission line, whilst using standard technology, is one of the longest such constructions in North America, with a route that includes hundreds of kilometres of remote terrain with no existing access and will be exposed to extreme weather conditions during construction and operation.
- 2.4 More than 50% of work on the Project has now been completed, and just over 40% of the construction work has been finished. The Project has been through two major cost reforecasting processes since sanction, shown in the chart below:



- 2.5 The main drivers reported by Nalcor for these cost movements were:
- ▶ market conditions and market pressures;
  - ▶ reliability improvements and design enhancements; and
  - ▶ contractor performance and project management execution.
- 2.6 The key target milestone dates in the September 2015 Forecast have not changed since the Project was sanctioned. However, Nalcor also stated as part of the September 2015 reforecast that the target dates related to the Muskrat Falls Power Generation facility will not be met and are under review.



### 3 Objective and scope

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- 3.1 The objective of the Review, as described in the statement of work, is to assess the reasonableness of the Project's<sup>3</sup> cost and schedule forecast and to identify opportunities to address any material/critical risks.
- 3.2 At the start of the Review, Nalcor informed EY that it was engaged in commercial discussions with the MFG civil works contractor and that EY would not receive forecast information related to this contract during January 2016.
- 3.3 During the Review, Nalcor advised EY that the commercial discussions in relation to the MFG civil works contract would not be completed within the time frame of the Review and that Nalcor would be engaging in QRA and re-baselining activities subsequent to the completion of those discussions.
- 3.4 As a result, this interim report will assess the reasonableness of the Project's most recent approved cost and schedule forecast - namely the September 2015 Forecast shown below:

Total forecast cost, including contingency	\$7.653b
Ready for sustainable power transfer Labrador to Newfoundland	November 2017
First power from Muskrat Falls	December 2017

- 3.5 Many key risks and issues referenced in this interim report have already been identified and documented by Nalcor. Nalcor is currently undertaking a risk assessment to evaluate the impacts of all Project risks, including the above, and will use the results of this process to prepare a revised forecast. This interim report gives Nalcor the opportunity to reflect EY's conclusions and recommendations in its upcoming forecast process.
- 3.6 EY will assess the reasonableness of Nalcor's reforecast cost and schedule once it is completed and will update this report accordingly, drawing on the work already completed in preparing this interim report.

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<sup>3</sup> Does not include the Maritime Link



## 4 Approach

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- 4.1 The Review has been based on data and information provided by Nalcor. EY has not sought to independently verify this data. EY has had access to the Nalcor team; we have not had direct access to contractors. EY has not conducted any engineering review, physical inspection or validation of construction process. Primary sources of data have been:
- ▶ Nalcor and contractor monthly reports;
  - ▶ management presentations and follow-up discussions;
  - ▶ meeting with the Independent Engineer;
  - ▶ specific data requests; and
  - ▶ interviews with members of the Nalcor project team.
- 4.2 Due to the scale of the Project and the timeline and scope of this review, EY has focused on areas likely to be material to the overall cost and schedule of the Project. We have selected 10 major contracts based on the following criteria:
- ▶ total monetary value;
  - ▶ spend to complete;
  - ▶ potential to impact other contracts; and
  - ▶ potential to impact critical path.
- 4.3 For each of these contracts, cost and schedule risk has first been considered at the individual contract level. Individual contract risks may be partially or wholly mitigated at the Project level through cost or schedule contingency. EY has assessed whether the contract risks are appropriately reflected in the Project's September 2015 Forecast.



## 5 Material cost and schedule risks

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### Context for risk assessment

- 5.1 Large projects such as the Muskrat Falls Project involve diverse and complex risks, which change through the phases of design, procurement and construction. Part of the role of the Nalcor project team is to identify, evaluate and, where possible, mitigate risks.
- 5.2 Nalcor invested heavily in upfront design and engineering to proactively manage risk in the early phases of the Project. This approach has resulted in a low degree of engineering change through the Project to date.
- 5.3 The scale, complexity and time frame of the remaining Project scope mean that significant risk still exists. Nalcor has processes in place to identify, evaluate and mitigate project risks.

### Risks to cost and schedule

- 5.4 The Review has highlighted risks in each of the following areas that are relevant to the reasonableness of the September 2015 Forecast:
  - ▶ MFG civil works contract;
  - ▶ HVdc transmission line contract;
  - ▶ HVdc converter stations contract; and
  - ▶ contingency level.

These are explained in more detail below.

### MFG civil works contract

- 5.5 The MFG civil works contract is the highest dollar value contract. This contract involves construction of a number of areas: Intake and Powerhouse, Spillway and Transition Dams. The deliverables on this contract are required to allow progress on other contracts, e.g. installation and commissioning of the turbines and generators, installation of spillway and intake gates and the balance of plant contract.



- 5.6 Contractor performance fell significantly behind plan at the start of the contract and the rate of concrete placement volume, whilst now much improved, has continued to be below original plan levels. As a result, the volume of concrete placed is below plan in all areas, most notably in the powerhouse and powerhouse intake areas. There have been a number of contributory factors identified by Nalcor, including but not limited to:
- ▶ slower than required contractor's mobilization and ramp up;
  - ▶ inadequate planning and establishment of required infrastructure;
  - ▶ lower than planned concrete placement rates;
  - ▶ number of contractor's project manager replacements and contractor's project management personnel changes;
  - ▶ quality of contractor's management resources for the first 15 months of the contract;
  - ▶ overall contractor performance, management and supervision for the first 15 months of the contract; and
  - ▶ a key feature of the contractor's execution plan was the contractor's Integrated Cover System (ICS), designed to enable winter working on the powerhouse. The ICS was not successfully delivered, which significantly impacted the ability to place concrete during the winter months. The ICS has now been removed.
- 5.7 Concrete placement rates improved significantly after Q1 2015, in part due to intensive contractor performance management by Nalcor. Progress on this contract is significantly behind the original contract schedule.
- 5.8 The contract structure was designed to realize possible savings in construction labour productivity and also to protect Nalcor from any labour cost overruns that might be experienced by the contractor. It was intended that this would be achieved by including in the contract a maximum value for labour that Nalcor would have to pay to the contractor. However, the payment mechanism is based on person-hours expended rather than m<sup>3</sup> of concrete poured. This mechanism did not capture the potential for poor contract management of labour and the consequent decoupling of labour paid for from work completed (measured by m<sup>3</sup> of concrete poured). As at December 2015, the proportion of contract value paid to the contractor is significantly greater than the proportion of the concrete that has been placed.
- 5.9 The impacts of these risks and issues to both cost and schedule were identified by Nalcor, but not fully reflected in the September 2015 Forecast. Nalcor indicated this was due to the ongoing discussions between Nalcor and the contractor.
- 5.10 The work to be performed under this contract is on the Project's critical path, so the known schedule delay will directly impact overall Project milestones. This delay will also have a



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knock-on impact to Nalcor's Project costs and to costs of other impacted contracts. The scale of this aggregate cost impact is in excess of the Project contingency level.

### HVdc transmission line contract

- 5.11 The HVdc transmission line contract is the second largest contract by dollar value and involves the construction of a 1,050 km HVdc transmission line from Muskrat Falls to Soldiers Pond near St. John's. This route crosses remote and challenging terrain, for example the Long Range Mountains. The same contractor is also nearing completion on the construction of the HVac transmission line connecting Muskrat Falls to Churchill Falls under a separate contract.
- 5.12 In the first nine months of the 32-month contract duration, actual progress has been only 50% of plan.
- 5.13 Recent contractor performance has improved, and potential mitigation for some of the schedule risk may be available by mobilizing additional skilled crews from the successful execution of the HVac contract. The physical distribution of the work also means that it is possible, at the contractor's own cost, to work on multiple work fronts to improve progress. The contractor is incentivized through the terms of the contract to minimize delay.
- 5.14 However, risks exist to future schedule performance, including continued below plan performance from the contractor, weather conditions and areas requiring a higher proportion of more complex foundation installations.
- 5.15 Performance to date and the ongoing risks described above create potential for a multiple-month delay to the contract schedule. This potential delay could be greater than the time contingency included in Nalcor's Project schedule and so presents a risk to overall Project milestones.

### HVdc convertor stations contract

- 5.16 The HVdc convertors are situated at either end of the HVdc line and convert the AC current used in the existing distribution grid to the DC current used to transport power from Muskrat Falls to Soldiers Pond and back again to AC current. Nalcor and the contractor are currently forecasting delays to the mechanical completion of the convertor stations, with the Muskrat Falls delay being approximately two months. Mitigation plans are being implemented to maintain the forecast and recover this delay; however, the contractor would be required to more than double its rate of progress to date to maintain the forecast schedule.
- 5.17 Nalcor expects improved progress and the contractor is incentivized through the terms of the contract to minimize delay. Nevertheless, based on past performance and the proposed work



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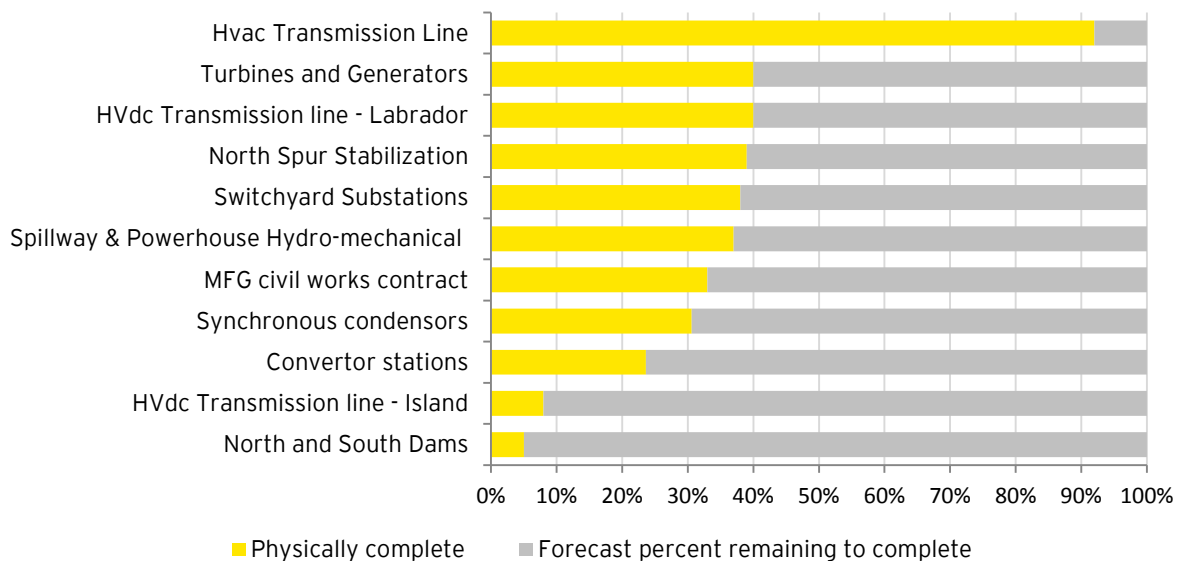
forecast for this contract, there is a risk of additional schedule delay, which would directly impact the Project milestones for the power transfer from Labrador to Newfoundland.

### Contingency

- 5.18 The amount of the contingency remaining at 31 December 2015 was \$173m, which represented 4.7% of the cost to complete, or 2.3% of total cost.
- 5.19 This contingency amount must cover any cost increases resulting from budget overruns or schedule delays. The extent of Project completion and the complexity of the remaining Project scope are relevant to the calculation of the appropriate level of contingency the Project should hold.
- 5.20 The Project is more than 50% complete overall, with just over 40% of construction now completed. Design and engineering are almost complete and procurement is over 90% complete.
- 5.21 Nevertheless, the scale, complexity and time frame of the remaining execution mean that there is potential for significant risk. This is illustrated by the scope of work to be completed on major contracts, as shown in the chart below<sup>4</sup>:

#### Selected major contracts

Physical progress as at 31 December 2015



<sup>4</sup> HVdc transmission line contract has been separated into two scopes for the purposes of the chart





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- 5.22 Commissioning and integration activities have not yet started. These are a frequent source of risk in major power projects. However, planning for these activities is underway.
- 5.23 Nalcor has identified and documented risks associated with all remaining scope, including commissioning and integration, and there is opportunity to mitigate some of these risks. In addition, the contract structures in place provide some protection for cost and schedule risk.
- 5.24 Nevertheless, EY has concluded that the current contingency level is low based on the remaining scope of work to complete and the degree of execution risk. Nalcor is currently undertaking a QRA that should be used to inform the amount of contingency required.



## 6 Other observations

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### Planning for strategic risks

- 6.1 The Project defines risks to be either tactical or strategic - the latter are those considered by Nalcor to be outside of the controllable scope of the Project team. A quantitative assessment of strategic risks was made at the time of the sanction process, but no explicit allowance was made in the form of a quantified reserve in the sanction budget.
- 6.2 The contingency in the September 2015 Forecast was only deemed to include the tactical risks, and there is no quantified reserve held elsewhere to allow for the strategic risks.
- 6.3 The following risks are classified by Nalcor as strategic:
- ▶ Schedule risks - relating to bad weather, to the volume of work required to deliver the powerhouse (particularly given the challenging performance assumptions for powerhouse concrete) and schedule challenges for certain sections of the transmission line;
  - ▶ Performance risks - the risks of not being able to achieve the performance rates and productivity assumed in the schedule estimate and the challenges associated with being able to attract the quality of experienced front-line supervision required to manage performance; and
  - ▶ Skilled labour risks - risks of budgeted labour rates being exceeded.
- 6.4 The crystallization of risks classified as strategic was the main driver for the cost increases seen to date on the Project. Risks that would be classified as strategic are expected to continue to impact the remaining scope of the Project.

### Inclusion of risk quantification in the forecast

- 6.5 Nalcor estimates the potential cost and schedule impact of individual risks and records them in the Project risk register. The Project team develops and monitors risk mitigation plans.
- 6.6 Nalcor regularly evaluates potential cost and schedule impacts of these risks, but does not develop an aggregate position, compare it to contingency levels or integrate it into the Project forecast to provide a risk-adjusted forecast.
- 6.7 Nalcor also seeks to identify and manage specific material cost variances, but some potential variances are only reflected in the forecast when they are contractually committed or near to certain.



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### Project governance and reporting

- 6.8 In the course of conducting the Review, EY has observed that governance and reporting arrangements to date have not been effective in respect of the Project's cost and schedule forecasts. There is a need to strengthen Project governance and reporting to provide more effective oversight and constructive challenge to Project performance and execution, key decisions and forecasting.



## 7 Recommendations

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7.1 The recommendations arising from the Review are as follows:

- ▶ the Project should revise its planning and forecasting processes to explicitly include the regular reporting of a fully risk-adjusted final forecast of cost and schedule;
- ▶ the Project contingency should make appropriate allowances for all risks (including strategic). EY recommends that consideration be given to the use of a conservative P80 confidence level for setting Project contingency, based on a thorough QRA;
- ▶ the sufficiency of the Project contingency should be reviewed quarterly to assess whether it appropriately covers all risks, taking account of the effectiveness of mitigation plans and the likelihood of risks crystallizing;
- ▶ there should be separation of the Project contingency into an amount to be managed by the Project team and an amount to be managed at a higher level of governance;
- ▶ Project governance and independent oversight should be re-evaluated by the Provincial Government and strengthened at the Project, Nalcor Board and Provincial Government levels; and
- ▶ Project reporting should be enhanced to support senior management focus on key risks and issues, to communicate more clearly how key risks are reflected in the forecast and to enable more effective Provincial Government oversight.

EY will work with the Provincial Government to fully develop options in relation to the design and implementation of the above recommendations.

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