

**From:** [Paul Harrington](#)  
**To:** [Kean, Jason](#); [lanceclarke@lowerchurchillproject.ca](mailto:lanceclarke@lowerchurchillproject.ca)  
**Subject:** Fwd: Feedback on decks ..urgent  
**Date:** Sunday, March 6, 2016 6:37:58 PM  
**Attachments:** [.png](#)  
[20160306161245.pdf](#)

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FYI

Sent from my iPad

Begin forwarded message:

**From:** Paul Harrington <[pharrington@](mailto:pharrington@)>  
**Date:** March 6, 2016 at 5:34:25 PM NST  
**To:** [j\\_dahl@westney.com](mailto:j_dahl@westney.com), [k\\_dodson@westney.com](mailto:k_dodson@westney.com)  
**Subject:** Feedback on decks ..urgent

Sent from my iPad

Begin forwarded message:

**From:** [PHarrington@lowerchurchillproject.ca](mailto:PHarrington@lowerchurchillproject.ca)  
**Date:** March 6, 2016 at 4:18:30 PM NST  
**To:** "Paul Harrington" <[pharrington@](mailto:pharrington@)>  
**Subject:** test

**Paul Harrington**

**Project Director**


**PROJECT DELIVERY TEAM**

**Lower Churchill Project**

t. 709 737-1907 c. 709 682-1460 f. 709 737-1985

e. [PHarrington@lowerchurchillproject.ca](mailto:PHarrington@lowerchurchillproject.ca)

w. [muskratfalls.nalcorenergy.com](http://muskratfalls.nalcorenergy.com)

You owe it to yourself, and your family, to make it home safely every day. What have you done today so that nobody gets hurt? 



**Comments to Westney****From P Harrington****Date 6 Mar 2016****Introduction**

The following comments are based on a more full-some realization and understanding of the role and scope of EY in the review of the Astaldi situation and Nalcor's planned course of action. The data and analysis that Westney has produced todate has been valuable in forming the Nalcor position. There is however a distinct possibility and indeed likelihood that EY will produce a report that will refer to the Westney reports and statements verbatim and those will be public when the Report is released. To that end there has to be a close examination of the wording used and statements made that might otherwise be considered protected as privileged and confidential to ensure that Nalcor's commercial position is not compromised and to ensure there is alignment between Nalcor and its expert consultants on these important matters.

The requirement for document sent recently V\_3 Risk assessment to Public Document Bridging is superseded by the use of the 3 Separate reports described below

I am sending this to you from my private email address

[Pharrington@](mailto:Pharrington@) [REDACTED]

Please use this in response or for matters of clarification

**Format and Composition of the Reports**

It is vital that we provide a clear and concise report and to ensure there is no confusion to the reader when dealing with complex matters. Therefore the following is required- we need to have separate and distinct Reports dealing with the cases described below. This is an important requirement because we have found that our shareholder needs to have clear reports that deal with the options we have shared with them previously.

**Report #1**

Shall have the following and exclusive scope:

**Report #1- Base Case**

- Base Case = The QRA and supporting analysis shall deal exclusively with the preferred case i.e negotiate with Astaldi. Furthermore the analysis and resultant QRA shall assume that the negotiations are successful and Astaldi work diligently and finish the project according to their schedule.

- Case 1 – assumes the base case with Nalcor contributing \$0M to assist Astaldi in completing the project
- Case 1a – assumes Case 1 with the exception that the Westney time risk analysis P50 date is incorporated for First/Full power
- Case 2 – assumes the base case with Nalcor contributing \$200M to assist Astaldi in completing the project
- Case 2a – assumes Case 2 with the exception that the Westney time risk analysis P50 date is incorporated for First/Full power
- Case 3 – Assumes the base case with Nalcor contributing \$500M to assist Astaldi in completing the project
- Case 3a – assumes Case 3 with the exception that the Westney time risk analysis P50 date is incorporated for First/Full power

**Report #2**

Shall have the following and exclusive scope:

**Report # 2 – Reference case**

- The QRA and supporting analysis shall deal exclusively with the case that assumes there is no successful commercial deal with Astaldi and they are terminated successfully with cause or abandon the Project at L max and Nalcor collect the securities and ultimately Astaldi are replaced with another contractor

**Report #3**

Concrete production and slides related to the Westney review in 2015

**Detailed comments specific to the wording and language used in the Westney Report V-21 see attached scanned slides for specifics**

Slide 2 – see attached scanned slide

Some key points – We need to change the word “productivity” with the words “Production/performance” –



The ICS and its failure are a critical factor to the actual productivity achieved and the loss of the first year because the Project Execution Plan was predicated on a controlled temperature environment in the powerhouse and intake with overhead cranes and concrete distribution systems under cover with HVAC – this was all lost and the impact was major.

The 2<sup>nd</sup> biggest risk statements are not relevant to the base case

Slide 3 See attached scanned slide

If this goes public we need to be circumspect about a back up contractor and use appropriate language

Slide 6 “Predictive Ranges for cost and schedule significantly exceed plan”

This slide does not belong in the Report #1 – please include in Report #2. Report 1 base case 1,2 3 should assume the deterministic date of February 2019

Slide 7 Key time risk Drivers for first power.....

Belongs in Report #2

Slide 8 Cost- Risks largely driven by Astaldi.....

See scanned slide for detailed comments

Key points

We will need a Cost risk slide for case 1 and 1a, 2 and 2a, 3 and 3a- Not sure how best to combine these

- A Schedule delay cost impact should be Feb 2019 in the Base case 1,2, 3
- B “Productivity” to be renamed “Production/performance” and the camp costs which are to Nalcors account should be backed out and shown separately from the \$917M
- C – should be in Report 2 not included in Report 1
- D&E OK
- Risk Adjusted costs to be shown to reflect the above for each Case 1,2, 3
- The probability curves for 1,1a, 2, 2a, 3, 3a should follow this Slide
- 

Slide 9 Time risk delay.

Add for case 1, 2 and 3 the Astaldi proposed schedule of Feb 2019

Slide 10 The MFG Contract with Astaldi.....

See scanned slide – many word changes the statements are accurate but since they could go public we have to avoid statements that can be used against Nalcor

Slides 11 “Astaldi’s initial execution plan was flawed” to Slide 18 “assumptions regarding concrete installation quantities”

Please remove these slides and include as a separate report #3

Slide 19 “Driven by unrealistic production rate assumptions leading....”

See scanned slide- key points

Change the slide title to simply “Concrete placement analysis”

Slide 20 “Replacement of Astaldi...”

This slide does not belong in Report #1

Slide 21 “Astaldi delay has ripple effect...”

OK

Slide 22 “Several Smaller risks....”

OK

Appendix Report #1

Should include only those reference that apply to Report #1



**DRAFT**

# LCP Cost and Schedule Risk Assessment - Muskrat Falls Generation

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Draft

February 2016

*PRIVILEGED AND CONFIDENTIAL IN CONTEMPLATION OF LITIGATION*



# Contents

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*Update to  
reflect  
Report # 1.*

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## An updated, risk-adjusted view of cost and schedule was requested for the Lower Churchill Project

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### Background

- LCMC is in the construction phase of the Lower Churchill Project, which includes Muskrat Falls Generation (MFG), Labrador Transmission Assets (LTA), and Labrador Island Transmission Link (LITL)
- Westney Consulting Group (Westney) has completed cost and schedule risk analyses at several Lower Churchill Project milestones
- An updated cost and schedule analysis was requested to understand how the potential cost and schedule outcomes have evolved

### Objectives

Westney, in conjunction with LCMC, was tasked to:

1. Develop a cost-risk analysis for the MF, LTA, and LITL sub-projects, including identification and quantification of risks most likely to affect the projects
2. Develop a time-risk analysis for the MF, LTA, and LITL sub-projects
3. Identify and recommend potential mitigations to identified risks, as appropriate

This report covers the MFG portion of the Lower Churchill Project only. The LTA/LITL portion is covered in a separate report.



# Westney has supported the Lower Churchill Project at several critical points

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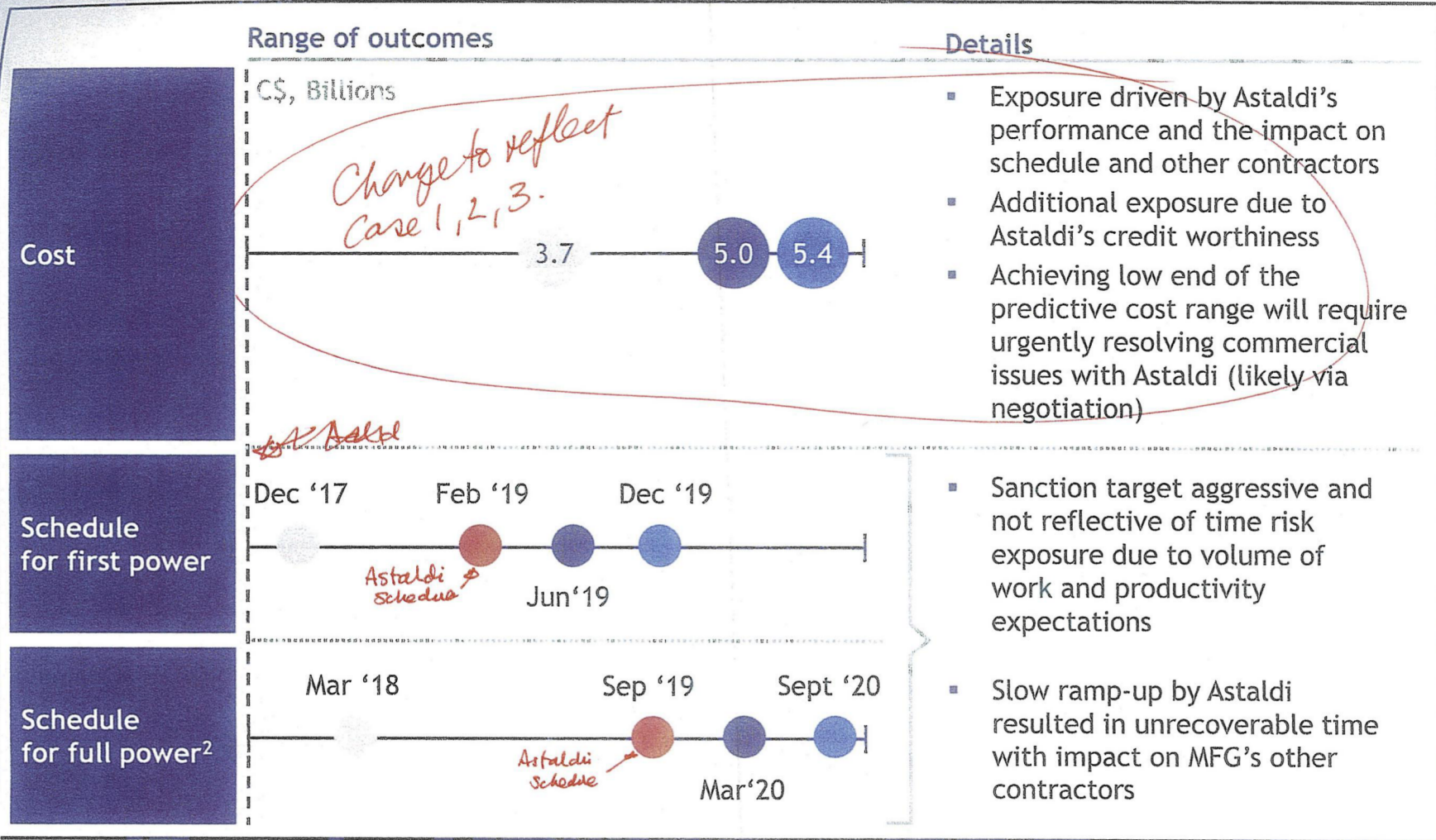
Scope of Westney support on risk analyses has varied slightly from year to year						
Scope of support	Projects included in analysis		Analysis completed			
	MF	LTA/LITL	Cost	Schedule	Other	
2008-11 <ul style="list-style-type: none"> <li>Front-end planning support providing a risk-adjusted view of cost and schedule (Westney's Risk Resolution®)</li> <li>Scope included detailed risk frames, key risks, and mitigations</li> </ul>	✓	✓	✓	✓		
2010 <ul style="list-style-type: none"> <li>EPCM mobilization readiness initiative to ensure owner's responsibilities were understood</li> </ul>	✓	✓			✓	
2012 <ul style="list-style-type: none"> <li>Project sanction support to check estimate accuracy and assess appropriate level of contingency</li> </ul>	✓	✓	✓	✓		
2015-16 <ul style="list-style-type: none"> <li>Updated view of risk-adjusted cost and schedule given current construction status</li> <li>Additional support evaluating Astaldi construction capability and cost to complete</li> </ul>	✓	✓	✓	✓	✓	





**predictive ranges for cost and schedule significantly exceed plan** DRAFT

Current AFE / sanction schedule ● Current forecast<sup>1</sup> ● Bottom of Predictive Range (P25) ● Top of Predictive Range (P75)



<sup>1</sup>Current forecast based on Astaldi's Jan 2016 schedule    <sup>2</sup>Unit 4 available





# Summary for Muskrat Falls Generation - *Case*

DRAFT

Westney Consulting Group (Westney), assisted by the LCMC project team, completed a risk-adjusted view of cost and schedule for Muskrat Falls Generation (MFG)

- Predictive range<sup>1</sup> (P25 - P75) for cost is ~~C\$5.0 to C\$5.4 billion compared to the current AFE of C\$3.7 billion~~ *REPLACE THIS RANGE WITH CASE 1.*
- Predictive range (P25 - P75) for schedule (first power) is June 2019 to December 2019, which is 18 to 24 months beyond the sanction target of December 2017

The primary cost and schedule risk driver of ~~craft productivity~~ *production/performance* remains consistent with Westney's pre-sanction analysis for the project, however this has been further complicated due to Astaldi's performance *& failure of their Project Execution Plan,* (potential impact of C\$600 to C\$1300 million)

In hindsight, the performance rates and productivity upon which Astaldi bid the project could not be executed. Globally, there has been a steep slide in construction productivity in the last decade, and, based on our analysis, it does not appear that either the LCMC base estimate or Astaldi's bid considered these declining trends. The trend is driven by a number of factors, including lack of experienced front-line craft supervision. *next*

The fact that the ~~best alternative bid~~ *was* was reasonably close to Astaldi's provides ~~proof~~ *evidence* that both contractors believed that the ~~productivity~~ *person hours in the bid* bid was possible, even to the point of guaranteeing rates. The high degree of confidence from the bids provided assurance to LCMC that Astaldi's proposal was sound. With Astaldi assuming most of the risk with guarantees, and appearing to be able to absorb a major loss given the financial data submitted, LCMC's confidence seemed justified. *without the Integrated Cover Structure (ICS)*

Due to the sheer volume and weather dependency of the work, combined with uncertainty of labor availability, Astaldi (and several other bidders) proposed an execution plan that relied upon an Integrated Cover Structure (ICS) over the powerhouse. The plan, in theory, would enable the aggressive concrete production required to support the project schedule. However, Astaldi's plan around the ICS proved to be flawed; construction began, but the structure was never completed. The cumulative effect was a significant amount of additional expenditure, ~~and~~ *year round* a loss of forward project momentum, *and a major unplanned change to Astaldi's Project Execution Plan, which was predicated on year round concrete placement in a controlled environment*

Astaldi's performance improved in 2015; however, the schedule slippage is not recoverable, and has had significant impact on the MFG's other contractors. *Anchitz and the Balance of Plant (yet to be awarded)*

The 2<sup>nd</sup> biggest risk is Astaldi's ability to absorb the financial loss associated with the impact of the global decline in craft labor productivity, as well as their creditworthiness, given their weakened financial position (potential impact of C\$100 to C\$300 million)

Astaldi's recent concrete production performance is actually quite good, following interventions by LCMC that led to a new team and improved planning.

Achieving the low-end of the cost range will require urgently resolving the commercial issues with Astaldi (likely via negotiation)

<sup>1</sup> The predictive range is the probabilistic range of most likely outcomes, typically from 25% probability (P25) to 75% (P75) probability



*THIS IS NOT RELEVANT TO BASE CASE*



## There are a 4 key mitigations to consider for MFG's most significant risks

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*Ensure planning and preparations in case of Astaldi failure to complete the contract.*

- ① Resolve Astaldi commercial issue
- ② ~~Ensure back-up contractor is ready if required~~
- ③ Continue to work with Astaldi on <sup>production/</sup> performance enhancement efforts
- ④ Perform aggressive interface management efforts (e.g., value engineering) to minimize potential schedule impacts

~~Cost-risks, driven largely by Astaldi's struggles, have the potential to increase cost by ~C\$1.4-1.8 billion above the AFE~~

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*Base case 1 & 2a. plus 2 & 2a plus 3 & 3a*

Risk	Mean impact C\$ Millions	Best case-worst case <sup>1</sup> C\$ Millions	Details
Un-risked cost	3,620		<ul style="list-style-type: none"> <li>Current AFE Rev.2 exclusive of remaining contingency<sup>2</sup></li> </ul>
<b>A</b> Schedule delay cost impact	235	170 - 310	<ul style="list-style-type: none"> <li>Carrying cost to maintain LCMC and MF site services/infrastructure</li> </ul>
<b>B</b> Productivity	917	600 - 1,300	<ul style="list-style-type: none"> <li>Potential range of outcomes for work-hours for remaining work</li> </ul>
<b>C</b> Astaldi loss/credit-worthiness	192	100 - 300	<ul style="list-style-type: none"> <li>Net cost for replacing Astaldi</li> </ul>
<b>D</b> Astaldi impact on other contractors	108	80 - 140	<ul style="list-style-type: none"> <li>Ripple effect of Astaldi's schedule slippage on contractual plans/commitments w/ other contractors</li> </ul>
<b>E</b> All other risks	121	80 - 160	<ul style="list-style-type: none"> <li>Cost exposure range for all open risks</li> </ul>
Risk adjusted cost (P25 to P75)		4,978 - 5,370	<ul style="list-style-type: none"> <li><del>C\$1.4-1.8 billion over AFE Rev.2</del></li> </ul>

*Assume Feb 2019 in case 1 and P50 for 1a etc.*

*Back out Nalcor Corp costs & show separately.*

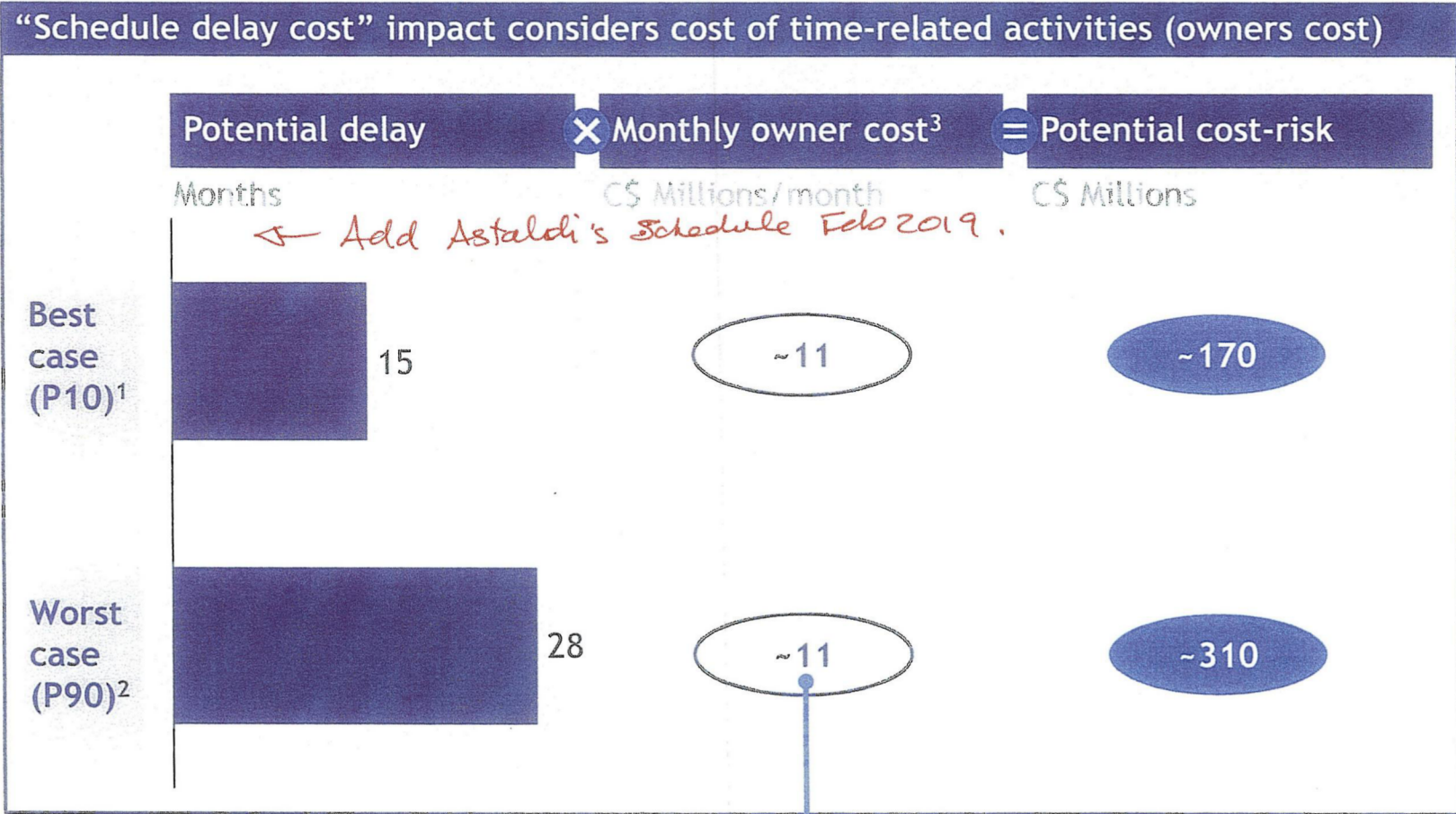
*Not in Report #1*

<sup>1</sup> Best/worse case values are over and above the current AFE Rev. 2 estimate <sup>2</sup> AFE Rev.2 including contingency is C\$3.686 billion

A

Time-risk delay of ~~15-28~~ months from plan leads to a ~~~C\$170-310~~ cost-risk

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<sup>1</sup> Dec 2017 to Mar 2019  
<sup>2</sup> Dec 2017 to Apr 2020  
<sup>3</sup> Based on historic monthly owner cost

Contractor's time-related cost not included to avoid "double-dipping" with productivity risk





B/C

# The MFG contract with Astaldi encompasses the most significant risks to the Lower Churchill Project

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MFG experienced several execution challenges, driven primarily by Astaldi's performance	Details
Much effort has been made to mitigate the potential impact	<p><i>The bid</i></p> <ul style="list-style-type: none"> <li>In hindsight, Astaldi <del>underbid</del> <i>aggressive</i> the contract and utilized <del>unachievable</del> <i>presumably on the use of the LCS to provide all year round concrete placement</i> concrete production rates (although the best alternative bidder also used similar rates)</li> <li>External engineer/project support contractor ensured LCMC the Astaldi bid was sound <i>Nalcor's estimate of Astaldi's bid was reviewed by external estimators and was deemed reasonable.</i></li> <li><del>While</del> <i>At least one</i> Astaldi's plan to install a cover over the powerhouse had the potential to reduce labor demand and maintain a high level of production during the winter, the level of effort ultimately required made the plan uneconomic <i>would have provided all year round concrete placement in a temperature controlled environment complete with lighting, HVAC &amp; concrete distribution systems. This was never realized and was impacted Astaldi's performance significantly.</i></li> <li>Additionally, Astaldi has had a lack of focus on cost management and reporting and exhibited poor labor planning /management <i>Astaldi also had multiple project managers in the first years.</i></li> </ul> <p><i>Construction</i></p> <ul style="list-style-type: none"> <li>LCMC ensured Astaldi made significant changes to improve performance (e.g., new execution plan, new leadership)</li> <li>Significant effort has also been made to assess whether Astaldi can complete the job and to identify alternative contractors</li> </ul>
Significant risk remains	<p><i>Production Performance.</i></p> <ul style="list-style-type: none"> <li>The 2 largest risks, "<del>productivity</del>" and "Astaldi loss/credit-worthiness" (Risk B and C) are directly tied to the Astaldi MFG contract</li> </ul>



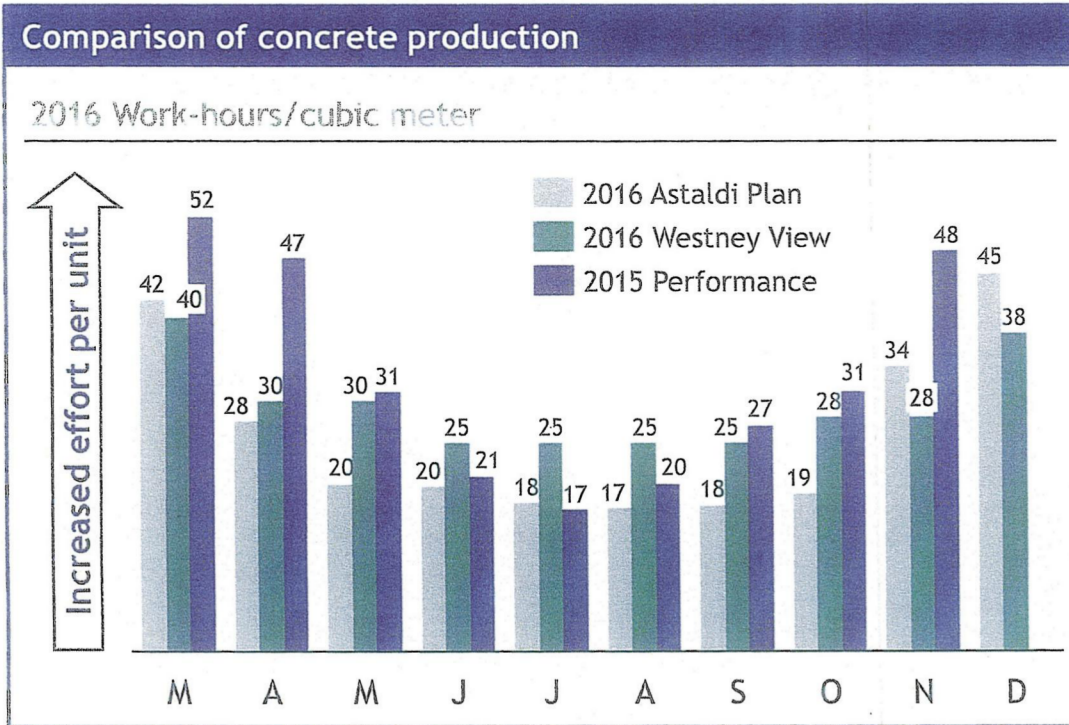


B

... driven by unrealistic production rate assumptions, leading to a ~C\$600-1,300 cost-risk

*Concrete Placement Rates  
P-Proposition Analysis*

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### Comparison of total work-hours

	Astaldi Plan W-hrs, M	Westney View W-hrs, M
2016	3.4	3.3
2017	2.7	3.8
2018	.8	1.5
Total	7.0	8.6

Remaining concrete pours for 2016-17 are smaller (average ~206 m<sup>3</sup> for remaining pours vs. ~258 m<sup>3</sup> in 2015) and more complex than what has been completed to-date. These factors should increase the number of work-hours per unit of concrete due to reduction in economies of scale.

Likely work-hour range is between 7.0 and 11.8 million work-hours, leading to ~C\$600 - \$C1,300 cost risk potential<sup>12</sup>.

<sup>1</sup>Assumes \$150/hr "all-in" wage rate. See build-up of all-in wage rate shown on slide 35 of the Appendix <sup>2</sup> Additional detail on work-hour range calculation shown on slide 33 of the Appendix

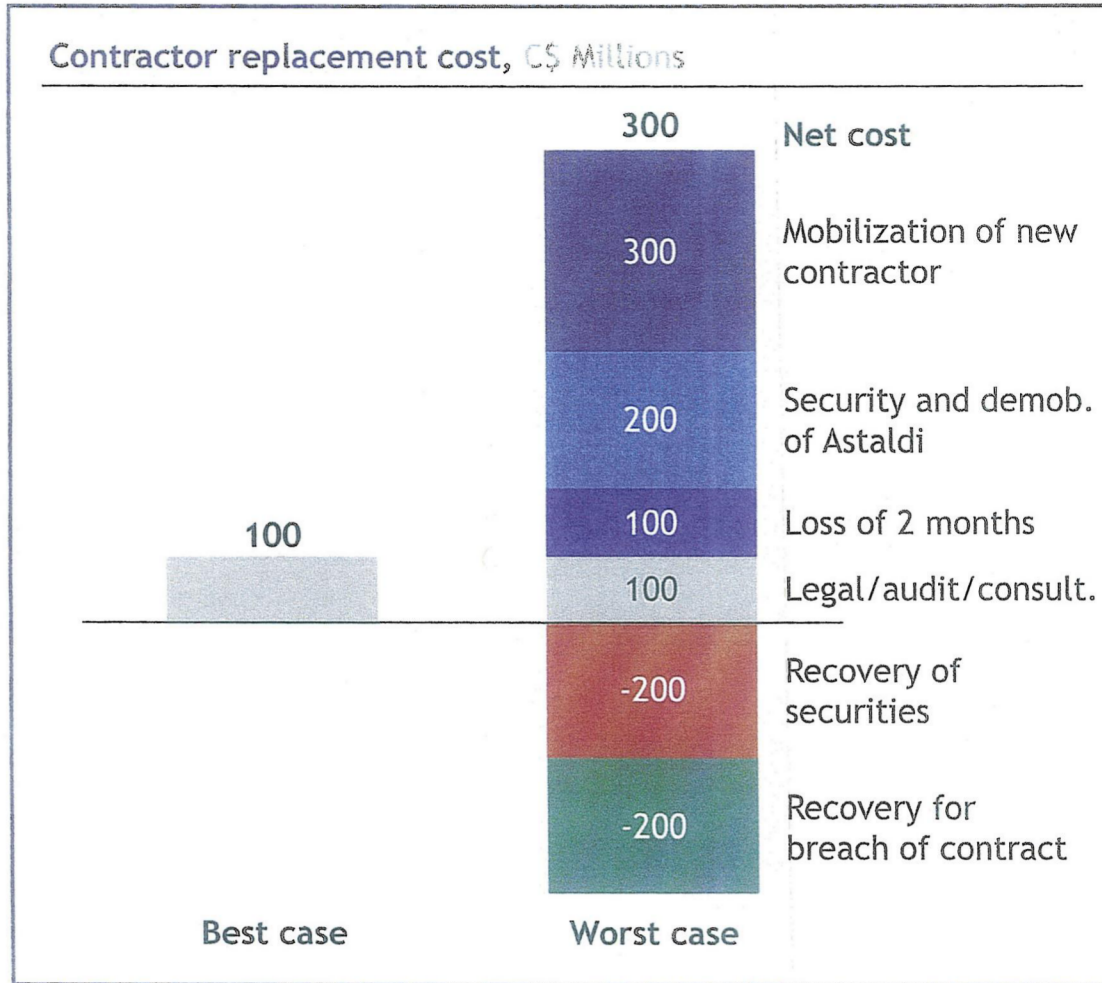
*This includes the Nalcor  
Camp costs - there need to  
be backed out!  
- assume cost calculation*





# Replacement of Astaldi could add a cost of C\$100 - C\$300 million

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- There is a chance that Astaldi may be unable or unwilling to complete MFG
- In the worst case, Astaldi will have to be replaced, and thus several costs will be incurred
- In the best case, LCMC will instill incur legal, audit, and consulting fees associated with preparing for the worst case

*Put into Report # 2.*

<sup>1</sup> Cost is above and beyond the C\$600-C\$1,300 productivity risk shown on the previous slide