

**From:** [Keith Dodson](#)  
**To:** [jasonkean@nalcenergy.com](mailto:jasonkean@nalcenergy.com)  
**Cc:** [Eric Briel](#); [Jack Evans](#)  
**Subject:** Re: Risk Report  
**Date:** Friday, September 7, 2012 11:10:20 AM  
**Attachments:** [.png](#)  
[.png](#)  
[Nalcor Owner's Contingency Report V 4 Sept2012.pptx](#)  
[ATT00001.htm](#)

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Jason,

Attached is the final issue of the report. I made most of the requested changes with my comments below. Please call if you want to discuss.

Best,

Keith

On Sep 6, 2012, at 7:21 PM,  
[JasonKean@nalcenergy.com](mailto:JasonKean@nalcenergy.com)<<mailto:JasonKean@nalcenergy.com>>  
wrote:

Keith,

I hear you have been fishing in Labrador, that is fishing for iron ore developments! We have the energy to feed their needs.

Jack and I have connected over the past couple of days in effort to help me validate if our current status and view of the near term schedule (e.g. award of mass excavation, camp, etc.) would influence the time-risk analysis completed in May.

My speculation was that our base schedule would now be a little higher than the P1 indicated in May, while the P75 would of remains as projected in May. Our recent analysis has not confirmed what I speculated. But it has been a useful exercise to test some assumptions.

I guess at the end of the day it is the performance risk on the large concreting scope combined with the weather window constraints for river diversion that drive the overall schedule. I have requested Jack to prepare a slide for inclusion in the June 12 report to explain this concept a little more.

Regarding the report, I was hoping to get it finalized. I have built upon your Summary Findings to create the attached; please consider this as input into the final version. Otherwise my comments are limited to:

\* Slide 4, Box 3 - insert words "the sustained" before "production rates"

Changed as requested

\* Slide 4 - I would like you to consider adding a new box linking to the potential performance risk mitigation activity that our labor agreement could provide. Perhaps the words "Project labor strategy, if successfully implemented, could mitigate performance risks attributable to rigid demarkation

and indirect requirements." By the way, we have successfully negotiated a "work team" concept in the agreement under negotiation with the building trades. This is a giant leap for megaprojects in NL.

I added a notation of the positive effort on the PLA. The real problem in our view is front line supervision. I know in discussions with Lance you are negotiating hard to include a high percentage of contractor designated foreman and general foreman and that is very positive. The real issue is even if the Building Trades would allow 100% designed is where would they come from. It is a world issue. In our "fishing trip" this was a void beyond any other we have seen in North America. Your project is also large which is always more problematic on this issue.

\* Slide 6 - concrete volume in Powerhouse "and Intake" is 330,000 m3 rather than 300,000. Also suggest rewording bullet 2 as "Seasonality restrictions severely limit time available for closing river for temporary diversion, installation of RCC riverside cofferdam, and impoundment.

The data we received shows 328,000 CMs of structural concrete in the Powerhouse and 62,000 CMs in the Spillway. This is our "over" 300,000 CMs or actually 390,000 CMs  
Mike and I think the degree of flood level is the issue not necessarily the "seasonality." If you get a 50 or 100 year flood, then you have a much greater impact on the work. There is high ground for work with minor flooding.

I trust these comments are self-explanatory and acceptable.  
Otherwise I look forward to receiving the final report.

Regards,

Jason



Westney Consulting  
Group, Inc.



## Nalcor Energy

# *Analysis of Potential Owner's Contingency For Financing of Lower Churchill Project*

May 25, 2012

## Summary Findings

### • Scope / Definition, Estimate and Contingency

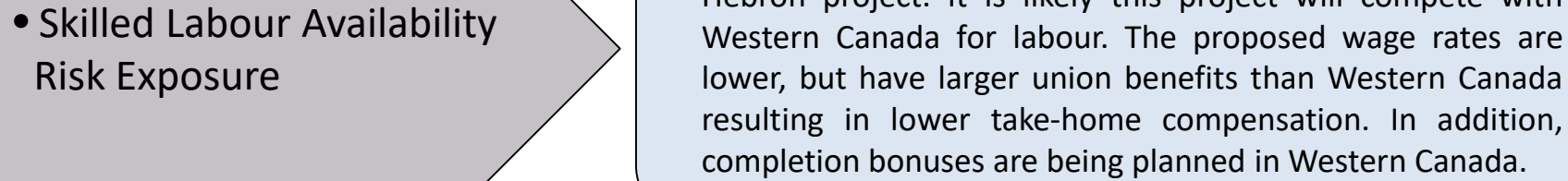
- The scope of the project used for estimating represents design development and information availability consistent with the requirements of a project sanction estimate. The estimating process, quantification, productivity and price development are also project sanction consistent. The calculated estimating contingency of 6.7 % is appropriate for the estimating information. The estimate is achievable if the project can be executed according to plan

### • Schedule Risk Exposure

- There is potential time or schedule risk exposure beyond the plan, due to the weather and the volume of work in the powerhouse. The current schedule assumes aggressive performance in powerhouse concrete, and a few sections of the transmission line are challenging.

### • Performance Risk Exposure

- The performance rates, estimating norms, or productivity used in the estimate including contingency are significantly better than the worst cases currently being experienced in Canada; some of which are in Newfoundland / Labrador. Experienced front-line supervision, a key to performance, is now a world market and will likely experience high demand during this project.



## • Skilled Labour Availability Risk Exposure

- The current estimate is based on labour rates agreed for the Hebron project. It is likely this project will compete with Western Canada for labour. The proposed wage rates are lower, but have larger union benefits than Western Canada resulting in lower take-home compensation. In addition, completion bonuses are being planned in Western Canada.

## Conclusions

The Lower Churchill Project, if sanctioned late Q3 2012, should be slightly ahead of a planned high volume construction activity in Canada / North America. It is also primarily a construction project with minimal engineering and procurement required prior to effective start. A timely start and quick work ramp-up could mitigate risk exposure.

The sheer size of the project and volume of work are in and of themselves a risk exposure with respect to the availability of the skills required.

The current schedule is aggressive, given the weather windows and the sustained production rates required.

Construction productivity has been on a steady decline for twenty-five years. A key element of this is the availability of front line supervision. This project likely has significant performance risk exposure. On the positive side, there has been significant effort to secure a Project Labor Agreement (PLA) that will minimize exposure to labor excesses. While negotiation is not complete, positive concepts like "work teams" have been accepted.

# Risk Adjusted Capital Costs (2012 \$ Canadian)

Expected Cost ex Risk Exposure \$5,833 MM

Estimate	\$5,465 MM
<u>Estimating Contingency</u>	<u>\$368 MM</u>
Expected	\$5,833 MM

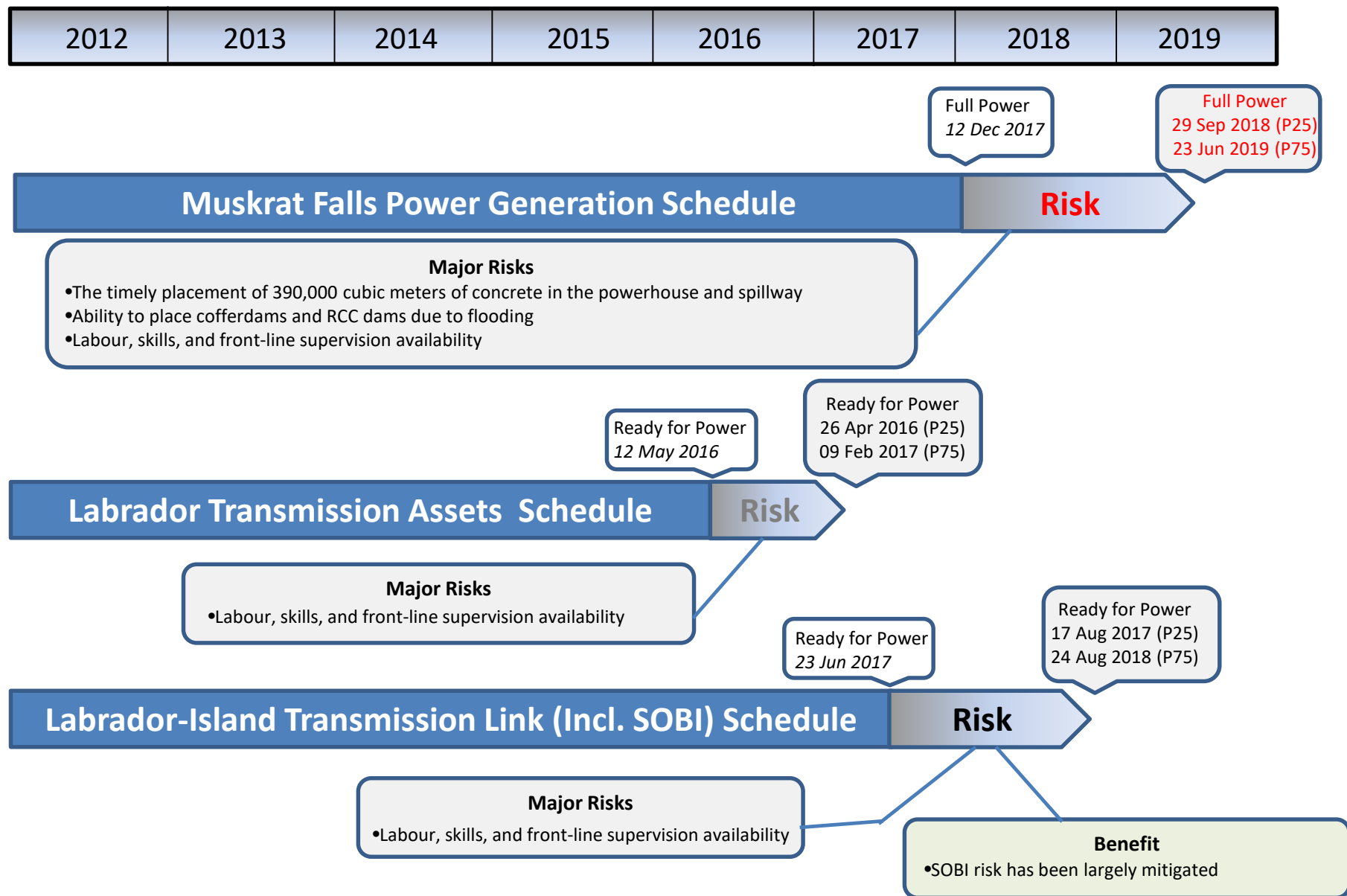
Risk Exposure (Mean Impacts of Completion Risks)	Unmitigated Impact (Millions)
≈ Schedule Risk – Time Extension	\$184
≈ Performance Risk – Productivity	\$161
≈ Skilled Labour – Completion Bonus	\$82
≈ <u>Skilled Labour – Wage Rate</u>	<u>\$70</u>
Total of Mean Values:	\$497

Risk Adjusted Capital Cost  
From Monte Carlo Simulation



(P25 to P75) = \$5,946 MM - \$6,737 MM

# Risk Adjusted Schedule



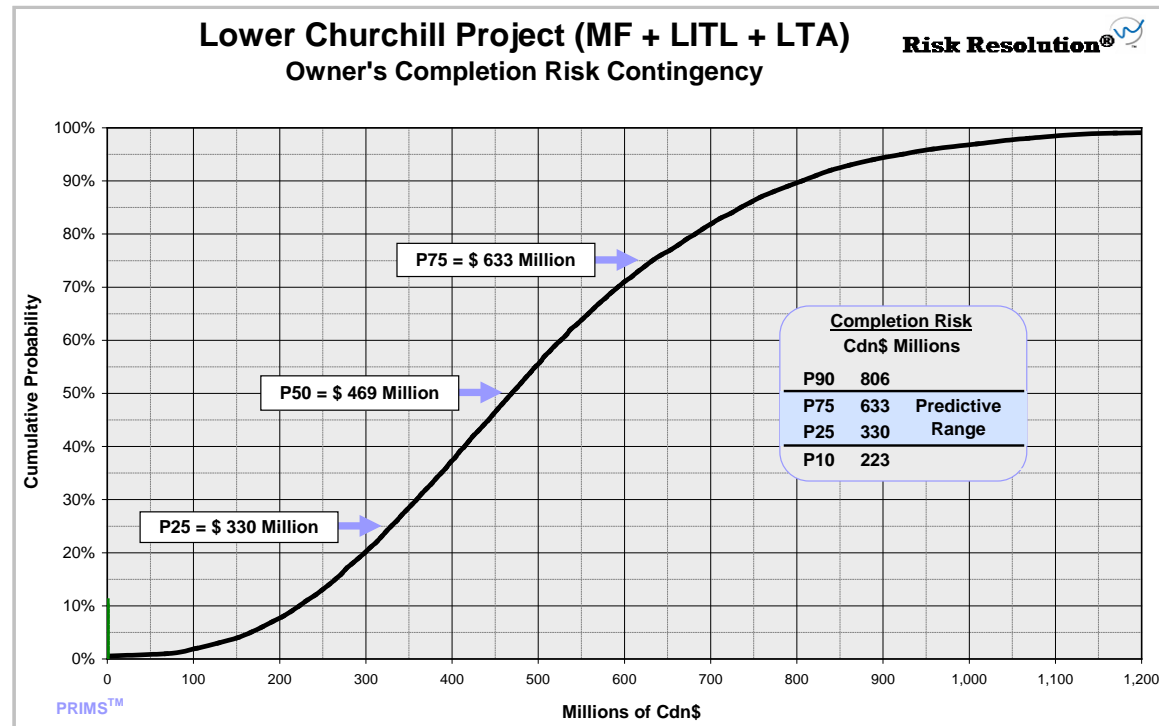


## *Supporting Materials*

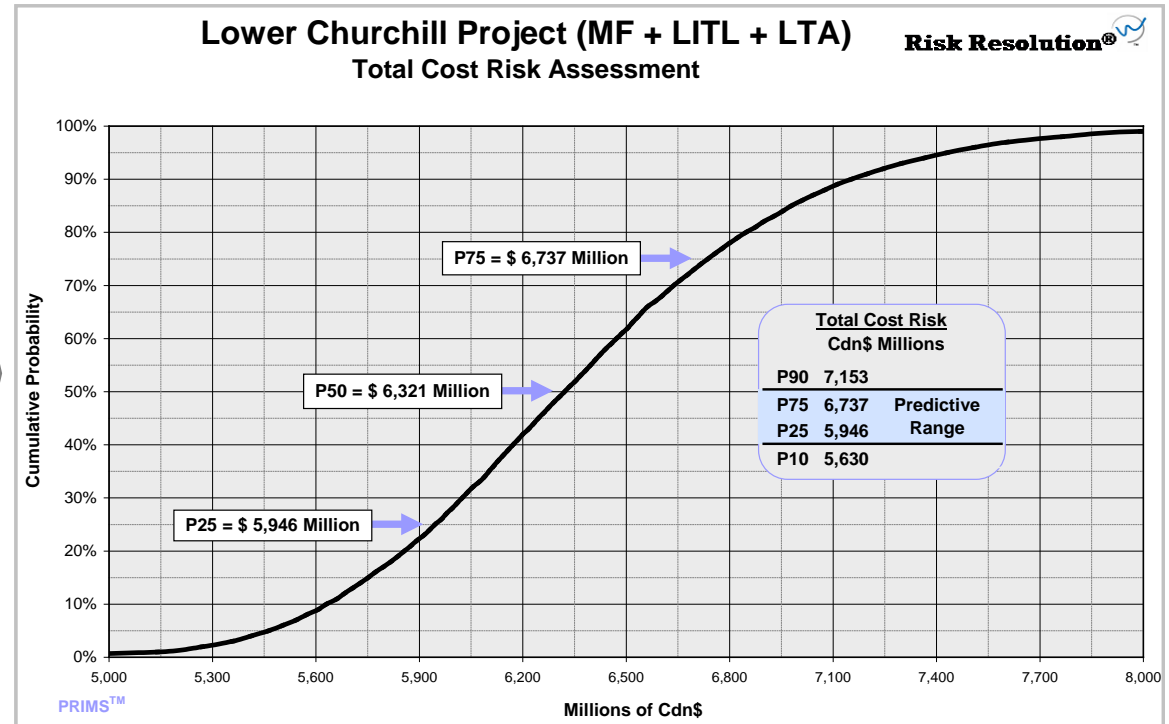
# Owner's Completion Risk Contingency

*The Predictive Range (P25 – P75) for the Owner's Completion Risk Contingency is \$330 MM - \$633 MM. These results are mostly influenced by:*

- *Schedule Risk – Time Extension*
- *Performance Risk – Productivity*



*The Predictive Range (P25 – P75) of the Total Cost Risk Assessment for the Lower Churchill Project is \$5,946 MM - \$6,737 MM. These results reflect the full impact of both the Tactical Risk Assessment and the Owner's Completion Risk Contingency.*



# Owner's Completion Risks

## Description

### *Availability of Skilled Labour*

## Impact

Unmitigated  
(millions)

Mitigated  
(millions)

Cost of Mitigation  
(millions)

- Payment of Completion Bonuses – It is known the Western Canada projects are planning to pay completion bonuses of \$10 per work-hour. Assuming not all workers would achieve the required hours, \$8 is used for impact calculation purposes.

Project Completion  
Bonus

\$ 50 M  
to  
\$ 120 M

- Wage Rate – The Hebron wage rates used in the estimate are roughly \$5 per hour to the person less than the Western Canada rates. The mining projects in the west of the province are currently paying Alberta rates.

Pay Alberta / BC  
wage rates

\$ 0 M  
to  
\$ 150 M

# Owner's Completion Risks

Description	Impact	Unmitigated (millions)	Mitigated (millions)	Cost of Mitigation (millions)
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## *Performance*

- Productivity – The Long Harbour and western Province projects are experiencing poor productivity and some jurisdictional problems. The weather is problematic at this site, compounding the productivity issue.

estimated

More work-hours than  
required to complete the work

\$ 0 M  
to  
\$ 350 M

# Owner's Completion Risks

Description	Impact	Unmitigated (millions)	Mitigated (millions)	Cost of Mitigation (millions)
<i>Schedule / Time Risk</i>				

- Schedule Extension – If weather, logistics, and / or productivity reduce the production rates required to meet the current schedule, a time extension will be the most economical solution to the issue due to the labour concerns in recovery or acceleration scenarios.

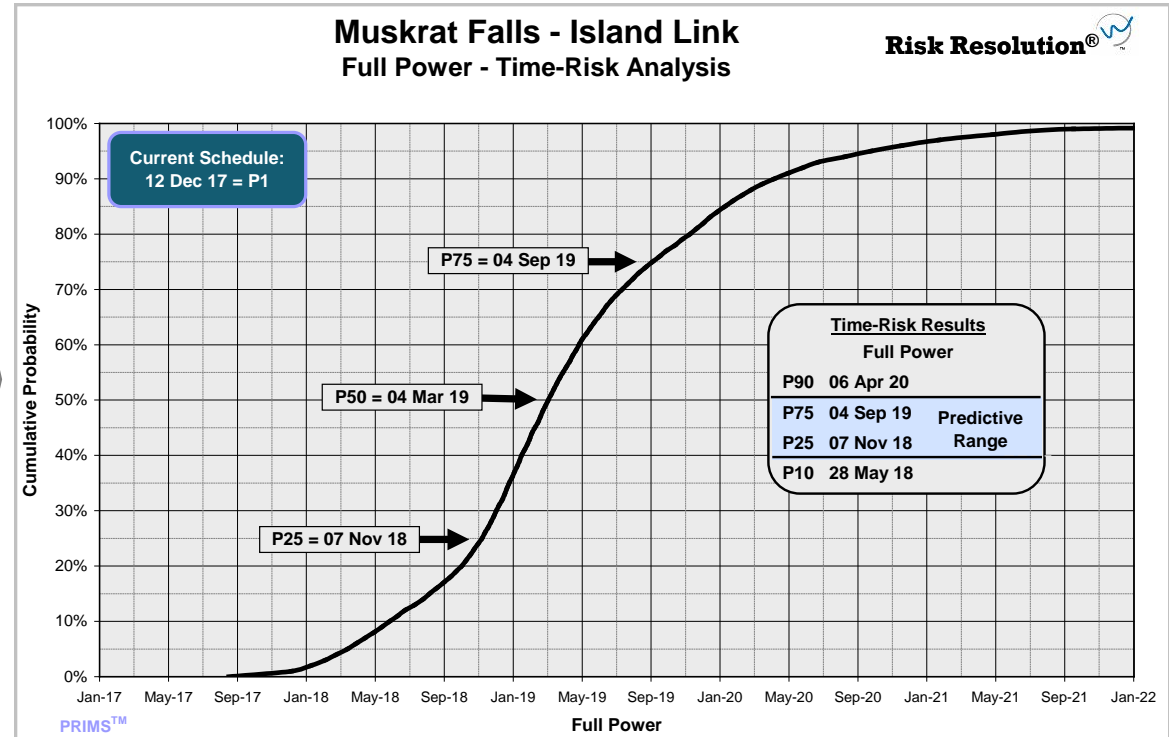
Time Extension

\$ 0 M  
to  
\$ 400 M

# Risk Adjusted Schedule Suggests an 11 to 21 Month Delay for Full Power

*Results are largely driven by timing of Muskrat Falls Generation Facility. Major risks for facility are:*

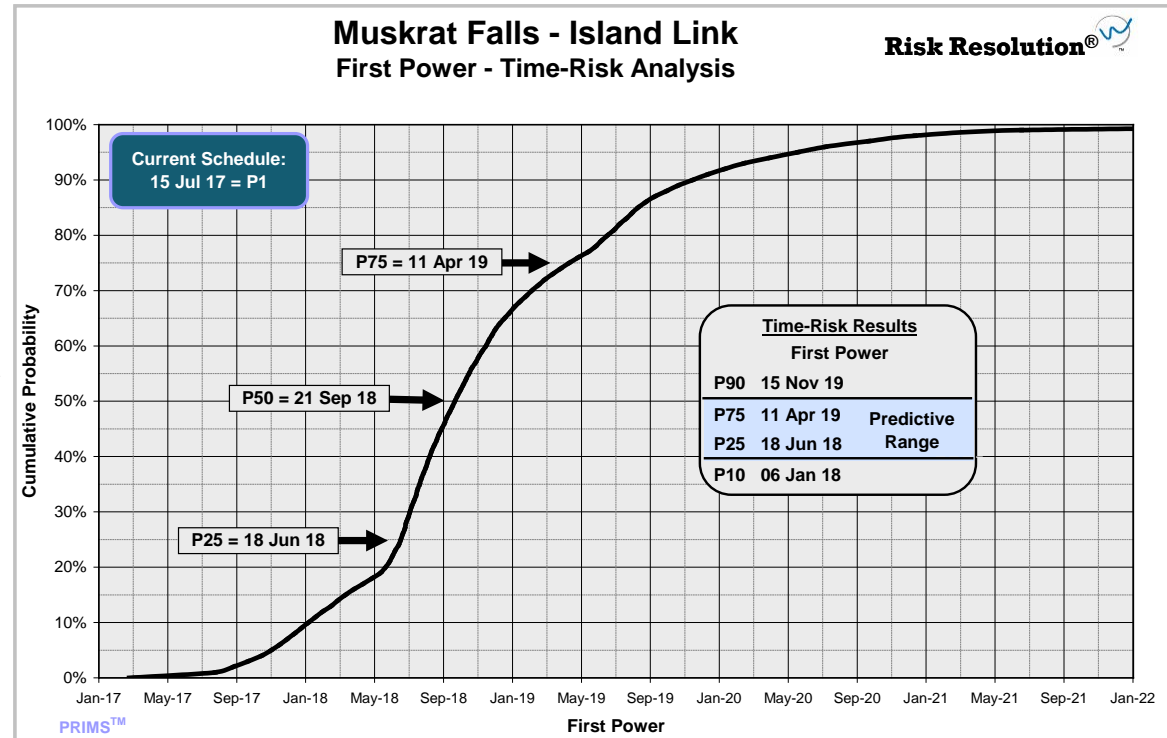
- *timely placement of concrete in powerhouse*
- *ability to place cofferdams and RCC dams while avoiding flooding*
- *availability of labour, skills, and front-line supervision*



# Risk Adjusted Schedule Suggests an 11 to 21 Month Delay for First Power

*Results are still largely driven by timing of Muskrat Falls Generation Facility. Major risks for facility are:*

- *timely placement of concrete in powerhouse*
- *ability to place cofferdams and RCC dams while avoiding flooding*
- *availability of labour, skills, and front-line supervision*



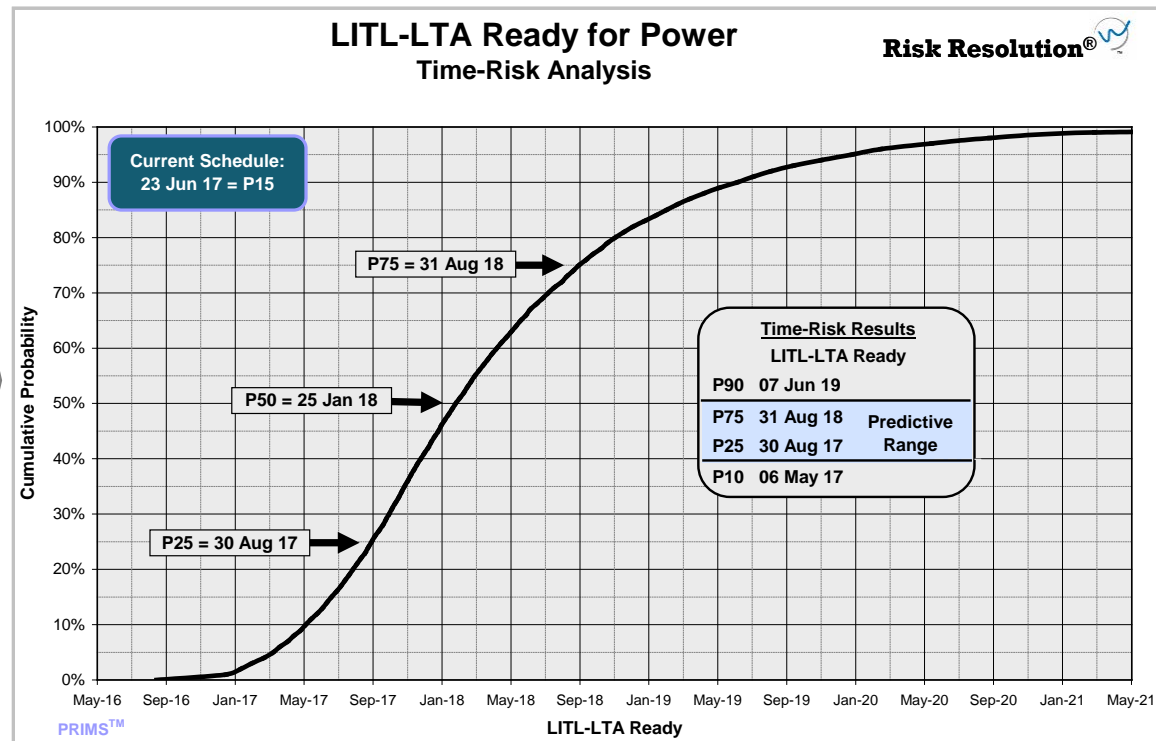


# Risk Adjusted Schedule Suggests a 2 to 14 Month Delay for Transmission Capability

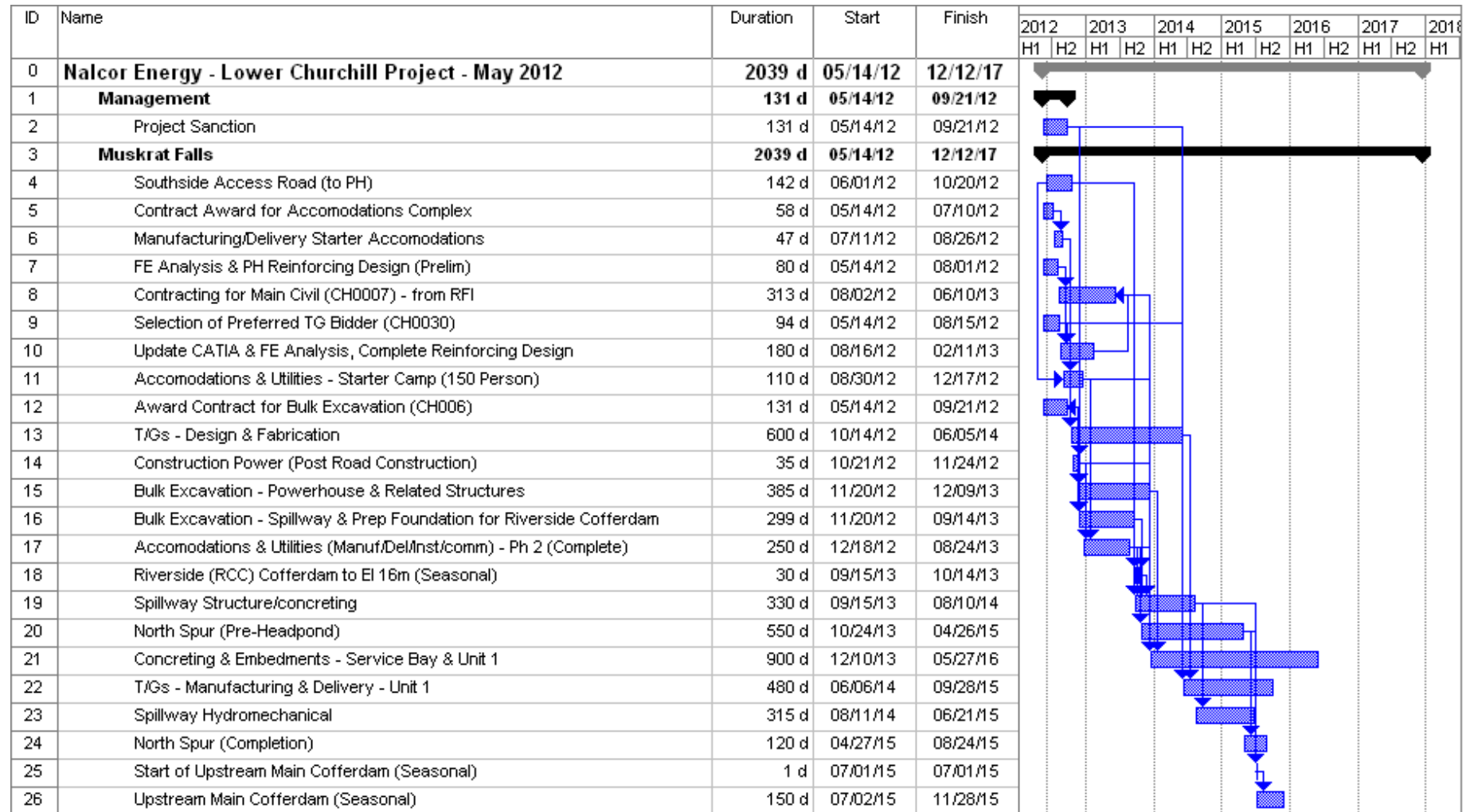
*Results are driven by timing of Labrador – Island Transmission Link (including SOBI Crossing). Major risks for transmission capability are:*

- *availability of labour, skills, and front-line supervision*

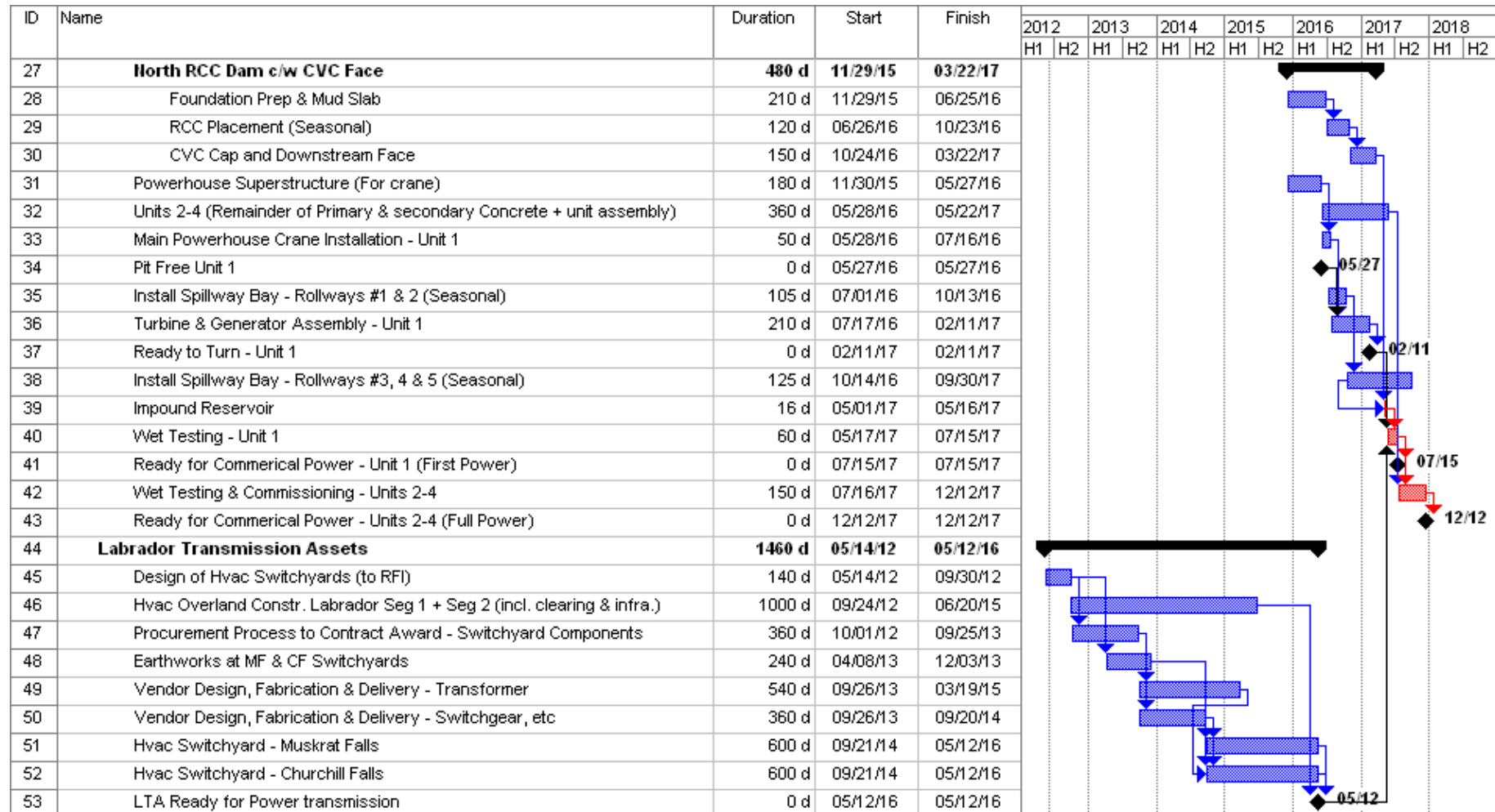
*Note: Key risks associated with SOBI Crossing have been largely mitigated.*



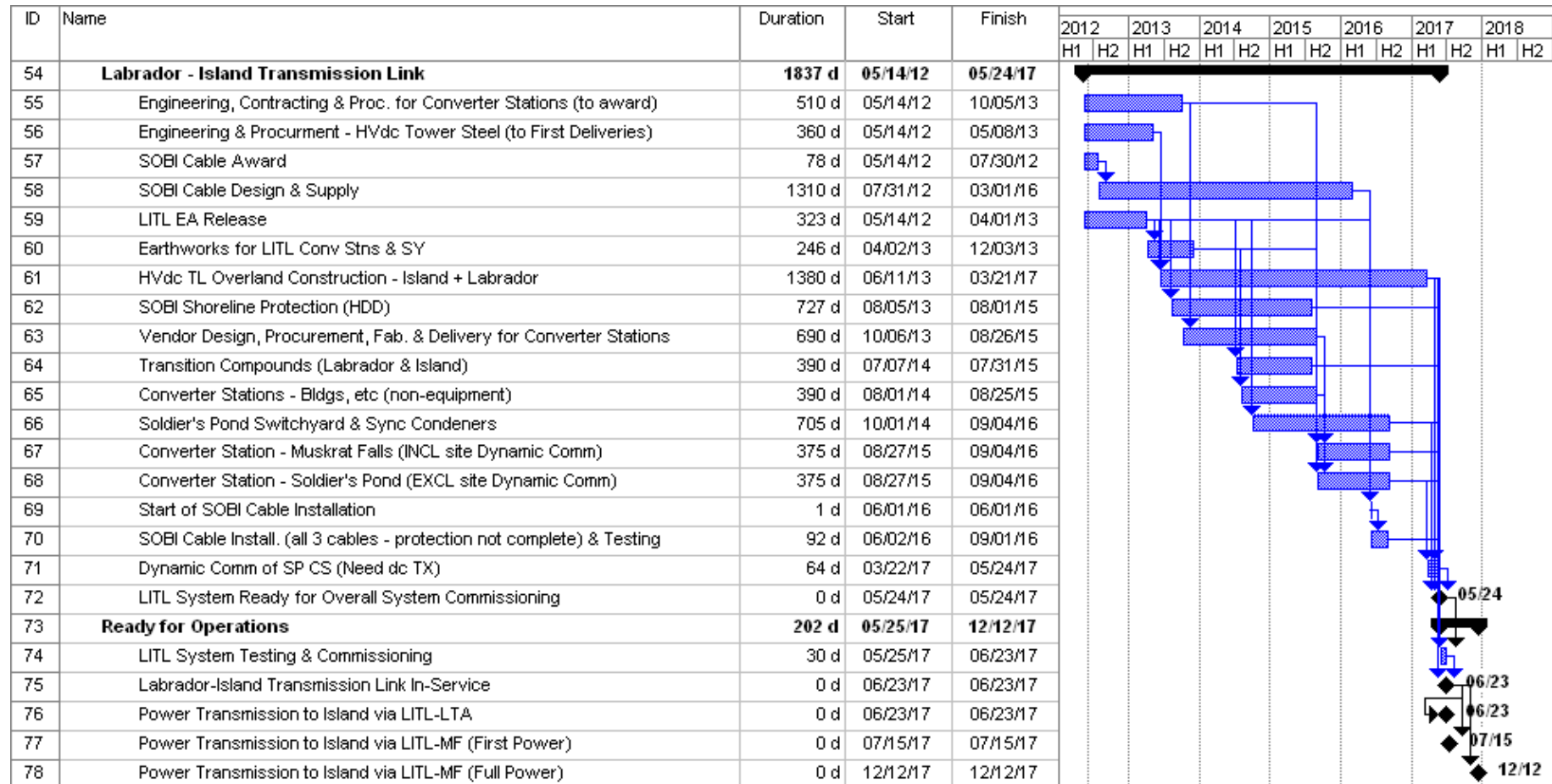
# Time-risk Model



# Time-risk Model (cont.)



# Time-risk Model (cont.)



Lower Churchill Project Time-Risk Assessment Ranging Sheet						
Time-Risk Model					Task Duration	
ID	Task Description	Duration	Start	Finish	Best	Worst
01	<b>Management</b>	<b>131 d</b>	<b>14-May-12</b>	<b>21-Sep-12</b>		
02	Project Sanction	131 d	14-May-12	21-Sep-12	131	191
03	<b>Muskrat Falls</b>	<b>2039 d</b>	<b>14-May-12</b>	<b>12-Dec-17</b>		
04	Southside Access Road (to PH)	142 d	1-Jun-12	20-Oct-12	135	172
05	Contract Award for Accomodations Complex	58 d	14-May-12	10-Jul-12	118	178
06	Manufacturing/Delivery Starter Accomodations	47 d	11-Jul-12	26-Aug-12	40	61
07	FE Analysis & PH Reinforcing Design (Prelim)	80 d	14-May-12	1-Aug-12		
08	Contracting for Main Civil (CH0007) - from RFI	313 d	2-Aug-12	10-Jun-13	313	403
09	Selection of Preferred TG Bidder (CH0030)	94 d	14-May-12	15-Aug-12	87	120
10	Update CATIA & FE Analysis, Complete Reinforcing Design	180 d	16-Aug-12	11-Feb-13	150	220
11	Accomodations & Utilities - Starter Camp (150 Person)	110 d	30-Aug-12	17-Dec-12	89	150
12	Award Contract for Bulk Excavation (CH006)	131 d	14-May-12	21-Sep-12	116	161
13	T/Gs - Design & Fabrication	600 d	14-Oct-12	5-Jun-14	480	660
14	Construction Power (Post Road Construction)	35 d	21-Oct-12	24-Nov-12	28	42
15	Bulk Excavation - Powerhouse & Related Structures	385 d	20-Nov-12	9-Dec-13	325	475
16	Bulk Excavation - Spillway & Prep Foundation for Riverside Cofferdam	299 d	20-Nov-12	14-Sep-13	269	389
17	Accomodations & Utilities (Manuf/Del/Inst/comm) - Ph 2 (Complete)	250 d	18-Dec-12	24-Aug-13	220	320
18	Riverside (RCC) Cofferdam to EI 16m (Seasonal)	30 d	15-Sep-13	14-Oct-13	25	40
19	Spillway Structure/concreting	330 d	15-Sep-13	10-Aug-14	285	450
20	North Spur (Pre-Headpond)	550 d	24-Oct-13	26-Apr-15	490	640
21	Concreting & Embedments - Service Bay & Unit 1	900 d	10-Dec-13	27-May-16	810	1,300
22	T/Gs - Manufacturing & Delivery - Unit 1	480 d	6-Jun-14	28-Sep-15	420	540
23	Spillway Hydromechanical	315 d	11-Aug-14	21-Jun-15	270	360
24	North Spur (Completion)	120 d	27-Apr-15	24-Aug-15	105	150

## Lower Churchill Project Time-Risk Assessment Ranging Sheet

Time-Risk Model					Task Duration	
ID	Task Description	Duration	Start	Finish	Best	Worst
25	<b>Start of Upstream Main Cofferdam (Seasonal)</b>	<b>1 d</b>	<b>1-Jul-15</b>	<b>1-Jul-15</b>		
26	Upstream Main Cofferdam (Seasonal)	150 d	2-Jul-15	28-Nov-15	100	150
27	<b>North RCC Dam c/w CVC Face</b>	<b>480 d</b>	<b>29-Nov-15</b>	<b>22-Mar-17</b>		
28	Foundation Prep & Mud Slab	210 d	29-Nov-15	25-Jun-16	180	240
29	RCC Placement (Seasonal)	120 d	26-Jun-16	23-Oct-16	90	150
30	CVC Cap and Downstream Face	150 d	24-Oct-16	22-Mar-17	60	180
31	Powerhouse Superstructure (For crane)	180 d	30-Nov-15	27-May-16	150	210
32	Units 2-4 (Remainder of Primary & secondary Concrete + unit assembly)	360 d	28-May-16	22-May-17	330	420
33	Main Powerhouse Crane Installation - Unit 1	50 d	28-May-16	16-Jul-16	43	57
34	<b>Pit Free Unit 1</b>	<b>0 d</b>	<b>27-May-16</b>	<b>27-May-16</b>		
35	Install Spillway Bay - Rollways #1 & 2 (Seasonal)	105 d	1-Jul-16	13-Oct-16	90	135
36	Turbine & Generator Assembly - Unit 1	210 d	17-Jul-16	11-Feb-17	165	255
37	<b>Ready to Turn - Unit 1</b>	<b>0 d</b>	<b>11-Feb-17</b>	<b>11-Feb-17</b>		
38	Install Spillway Bay - Rollways #3, 4 & 5 (Seasonal)	125 d	14-Oct-16	30-Sep-17	110	170
39	Impound Reservoir	16 d	1-May-17	16-May-17	9	23
40	Wet Testing - Unit 1	60 d	17-May-17	15-Jul-17	30	90
41	<b>Ready for Commerical Power - Unit 1 (First Power)</b>	<b>0 d</b>	<b>15-Jul-17</b>	<b>15-Jul-17</b>		
42	Wet Testing & Commissioning - Units 2-4	150 d	16-Jul-17	12-Dec-17	120	210
43	<b>Ready for Commerical Power - Units 2-4 (Full Power)</b>	<b>0 d</b>	<b>12-Dec-17</b>	<b>12-Dec-17</b>		

## Lower Churchill Project Time-Risk Assessment Ranging Sheet

Time-Risk Model					Task Duration	
ID	Task Description	Duration	Start	Finish	Best	Worst
44	<b>Labrador Transmission Assets</b>	<b>1460 d</b>	<b>14-May-12</b>	<b>12-May-16</b>		
45	Design of Hvac Switchyards (to RFI)	140 d	14-May-12	30-Sep-12	140	200
46	Hvac Overland Construction Labrador Seg 1 + Seg 2 (Incl Clearing & infrastruc	1000 d	24-Sep-12	20-Jun-15	960	1,100
47	Procurement Process to Contract Award - Switchyard Components	360 d	1-Oct-12	25-Sep-13	300	420
48	Earthworks at MF & CF Switchyards	240 d	8-Apr-13	3-Dec-13	150	270
49	Vendor Design, Fabrication & Delivery - Transformer	540 d	26-Sep-13	19-Mar-15	390	720
50	Vendor Design, Fabrication & Delivery - Switchgear, etc	360 d	26-Sep-13	20-Sep-14	300	450
51	Hvac Switchyard - Muskrat Falls	600 d	21-Sep-14	12-May-16	420	690
52	Hvac Switchyard - Churchill Falls	600 d	21-Sep-14	12-May-16	420	690
53	<b>LTA Ready for Power transmission</b>	<b>0 d</b>	<b>12-May-16</b>	<b>12-May-16</b>		

## Lower Churchill Project Time-Risk Assessment Ranging Sheet

Time-Risk Model					Task Duration	
ID	Task Description	Duration	Start	Finish	Best	Worst
54	Labrador - Island Transmission Link	1837 d	14-May-12	24-May-17		
55	Engineering, Contracting & Procurement for Converter Stations (to award)	510 d	14-May-12	5-Oct-13	330	600
56	Engineering & Procurement - HVdc Tower Steel (to First Deliveries)	360 d	14-May-12	8-May-13	300	480
57	SOBI Cable Award	78 d	14-May-12	30-Jul-12	18	138
58	SOBI Cable Design & Supply	1310 d	31-Jul-12	1-Mar-16	1,160	1,370
59	LITL EA Release	323 d	14-May-12	1-Apr-13	293	413
60	Earthworks for LITL Conv Stns & SY	246 d	2-Apr-13	3-Dec-13	186	306
61	HVdc TL Overland Construction - Island + Labrador	1380 d	11-Jun-13	21-Mar-17	1,200	1,745
62	SOBI Shoreline Protection (HDD)	727 d	5-Aug-13	1-Aug-15	667	907
63	Vendor Design, Procurement, Fabrication & Delivery for Converter Stations	690 d	6-Oct-13	26-Aug-15	600	810
64	Transition Compounds (Labrador & Island)	390 d	7-Jul-14	31-Jul-15	330	480
65	Converter Stations - Bldgs, etc (non-equipment)	390 d	1-Aug-14	25-Aug-15	300	450
66	Soldier's Pond Switchyard & Sync Condensers	705 d	1-Oct-14	4-Sep-16	525	765
67	Converter Station - Muskrat Falls (INCL site Dynamic Comm)	375 d	27-Aug-15	4-Sep-16	315	435
68	Converter Station - Soldier's Pond (EXCL site Dynamic Comm)	375 d	27-Aug-15	4-Sep-16	315	435
69	Start of SOBI Cable Installation	1 d	1-Jun-16	1-Jun-16		
70	SOBI Cable Install. (all 3 cables - protection not complete) & Testing	92 d	2-Jun-16	1-Sep-16	62	137
71	Dynamic Comm of SP CS (Need dc TX)	64 d	22-Mar-17	24-May-17	54	94
72	LITL System Ready for Overall System Commissioning	0 d	24-May-17	24-May-17		
73	Ready for Operations	202 d	25-May-17	12-Dec-17		
74	LITL System Testing & Commissioning	30 d	25-May-17	23-Jun-17	20	90
75	Labrador-Island Transmission Link In-Service	0 d	23-Jun-17	23-Jun-17		
76	Power Transmission to Island via LITL-LTA	0 d	23-Jun-17	23-Jun-17		
77	Power Transmission to Island via LITL-MF (First Power)	0 d	15-Jul-17	15-Jul-17		
78	Power Transmission to Island via LITL-MF (Full Power)	0 d	12-Dec-17	12-Dec-17		



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It is important to note that the scope of work for Westney Consulting Group was for Westney to guide and facilitate the Risk Resolution® Process, using the consultants' experience to ask the right questions and, where appropriate, challenge the Nalcor Energy participant's thinking. This resulted in an outcome of the analysis that represented the best thinking and efforts of both the Nalcor Energy participants and the consultants from Westney.