The Ibbs Consulting Group, Inc.

Astaldi Cost Control and Productivity Analysis Reports: Observations and Recommendations

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Introduction and Purpose

Astaldi and Nalcor retained The Ibbs Consulting Group, Inc. in November 2014 to investigate issues on the Lower Churchill Falls project and to provide recommendations that will help the parties improve labor productivity on the project. That investigation led to a February 2015 report, and led to a Phase 2 study.

Over the past three months, Ibbs has conducted this Phase 2 investigation by reviewing project reports and data, participating in an onsite workshop, and conducting on-going discussions with Astaldi and Nalcor. This report summarizes our findings and recommendations.

Analysis and Observations To-Date

To understand and evaluate the Astaldi cost control system and its LCP productivity, I reviewed the May 23, 2015 Astaldi cost control report and discussed it with Gerio Castracani, Ricardo Rocci, Steve Kent, and Georges Bader. I agreed the labor projections contained in that monthly report and several preceding monthly reports were not accurate and reliable, so Astaldi subsequently provided updated information that I have used to prepare this report. That new information is more reliable but I would like to review the details with Astaldi in a face-to-face meeting as discussed later in this report.

Table 1A displays the project's status To-date and Estimate-at-Completion for a "best case" scenario. Table 1B displays the same information for a "worst case" scenario. These are two risk management scenarios that Astaldi is conducting.

	To-Date Comparison to Budget		Estimate-at-Completion Comparison to Budget	
	Labor-Hours	$	Labor-Hours	$
Direct craft labor	-589,896	-$49,335,324	-2,814,681	-$262,259,723
Indirect craft labor	-1,171,034	-$96,254,948	-2,275,684	-$196,545,161
Staff	171,322	$18,171,440	-126,786	$10,647,235[1]
Total	-1,589,608	-$127,418,832	-5,217,151	-$448,157,649

Table 1A

Lower Churchill Labor-Hour & Cost Performance To-Date and Forecast Remaining – Best-Case Scenario

	To-Date		Estimate-at-Completion	
	Labor-Hours	$	Labor-Hours	$
Direct craft labor	-589,896	-$49,335,324	-3,751,580	-$350,104,254
Indirect craft labor	-1,171,034	-$96,254,948	-2,476,219	-$211,458,540
Staff	171,322	$18,171,440	-287,834	-$2,748,214
Total	-1,589,608	-$127,418,832	-6,515,633	-$564,311,008

Table 1B

Lower Churchill Labor-Hour & Cost Performance To-Date and Forecast Remaining – Worst-Case Scenario

The following are my observations about Astaldi's cost and labor performance to-date, as captured in Tables 1A and 1B:

1. The project is 10.5% complete by earned value measurement of the direct labor-hours.[2]
2. Astaldi currently has an overrun of 1,589,607 labor-hours and $127,418,831.
3. ***The project is anticipated to have an end-of-job overrun of between 5,217,151 and 6,515,633 labor-hours and $448,157,649 and $564,311,008.***

[1] Even though Astaldi will overrun its budget for staff labor-hours, it will realize a positive cost balance for this staffing cost account because of favorable hourly wage rates. The $10.6 million positive balance has been checked and is correct.

[2] Page 16 of May 2015 progress report.

4. To-date Indirect Craft Labor has an overrun of 1,171,034 hours, which accounts for 74% of the total labor-hour overrun. This overrun in indirect hours is projected to double at job completion – between 2,275,684 (best-case) and 2,476,219 (worst-case) labor-hours.
5. Direct Craft Labor currently has an overrun of 589,896 hours. This accounts for 37% of the total labor overrun. Astaldi is forecasting the Direct Craft Labor overrun will worsen between 2,814,681 (best-case) and 3,751,580 (worst-case) labor-hours by job end.
6. The number of indirect labor-hours will increase 1.7x over the bid labor-hours and the direct labor-hours 2.2x over the bid labor-hours. Such increases are problematic. The fact that the direct labor-hours will increase much more than the indirect labor-hours (2.2x vs. 1.7x) is not unusual.[3] It merits further, deeper investigation of the details with Astaldi project controls personnel.
7. Astaldi currently has an underrun of 171,322 hours for staff labor-hours. This underrun partially compensates for the 74% indirect craft labor and 37% direct craft labor overrun. This staff position is forecast to worsen to a loss of 287,834 labor-hours and a loss of $2,748,214 at job completion.

The following are my observations and conclusions about the cost accounts with the largest overruns, as shown in Table 2A and Table 2B.

1. These seven cost categories account for 93% of the labor-hour overrun to-date (1,475,237 divided by 1,589,608 found in Table 1A).
2. They will continue to be main problem going forward, representing between 83% and 88% of the forecasted total labor-hour loss (4,554,5551 divided by 5,217,151 and 5,707,042 divided by 6,515,633).
3. Most of the loss to-date has occurred in the Indirect Labor accounts; e.g. Site Installation, Winter Protection, and Attendant Labor. The Winter Protection and Attendant Labor accounts will continue to be serious problems in the future.
4. The Direct Labor is projected to worsen dramatically. The Productivity Factor, PF will improve, but there will continue to be major challenges such as formwork placement productivity rate. This is especially true when Astaldi undertakes even more of the powerhouse forming and concreting work than is presently the case.
5. The labor-hour position of concrete production is anticipated to improve in the future but not enough to offset the historic formwork, concrete placement, and rebar installation problems.

[3] This is due to the fixed cost, variable cost nature of construction costs.

6. Column 10, PF to-date, is averaging around 0.30. That is, Astaldi is spending 3.33 times as many hours as estimated to accomplish these tasks.
7. Column 11, PF @ Completion, is a projection of what Astaldi's cumulative PF will be for these various tasks at the end of the project.
8. Column 12 is the percentage increase over the PF to-date that will be necessary to meet that PF @ Completion target. For these seven cost accounts, Astaldi is targeting a PF in the 0.39 to 0.45 range (worst-case to best-case).
9. ***Productivity and production projections for May, June, July, and August 2015 are being met or exceeded. Thus, new projections are feasible and reliable.***

The following are my observations and conclusions about Astaldi's labor force headcount, concrete production, and labor productivity, as shown in Table 3A and Table 3B.

1. The direct labor workforce is projected to average around 1100 people over the next couple months (worst-case with low production) then decline substantially in the winter period. Astaldi's best-case scenario calls for the headcount to be as high as 1500 people over the next couple months (with high production) then reduce to a couple dozen people during the winter months while the ISC is removed.
2. Concrete production ranges between 12,000 m3 and 24,000 m3 between May and October 2015.[4]
3. Labor productivity will increase by roughly 10% (12.87 to 11.83 labor-hours/m3 and 15.34 to 14.04 labor-hours/m3) if Astaldi places concrete without the current heating regime in place.
4. ***A target range of 11.50 to 12.00 labor-hours/m3 is, in my professional judgment, conceivable for favorable-weather concreting operations in the future.*** However, this target range will not be possible if large amounts of cold weather concreting are undertaken this winter.

Recommendations

Astaldi's productivity to-date on the Lower Churchill project (LCP) is notably worse than the productivity rate anticipated in its tender. Even updated forecasts, based on my preliminary analysis, suggest that challenges – such as sufficient quantities of qualified labor and good project management by both Astaldi and Nalcor – will persist, and make it difficult for Astaldi to make major strides in closing the planned vs. actual productivity gap. I therefore recommend the following steps:

[4] Note that the data for all these months, including May-August, are projections based on best-case and worst-case scenarios; they are not actual, historical data.

1. Reduce the size and complexity of the monthly progress reports. Instead of just reporting data, as is generally the current case, provide more analysis and interpretation of the data. Outline steps that will correct negative trends. [5]
2. Meet with Astaldi personnel to delve even more deeply into recent cost and schedule data and reports, and the best-case/worst-case conditions.
3. Though I have not conducted an in-depth analysis of the issue, it is important that Astaldi and Nalcor reach agreement on the proper balance between production (output) productivity (output/labor-hour). Overemphasizing production will help project schedule but hurt project profitability. Conversely, overemphasizing productivity will help Astaldi's cost position but impair schedule. ***Striking this balance is important and is one of the issues I would like to discuss with Astaldi, then with Astaldi and Nalcor together in face-to-face meetings.***
4. Update the project baseline schedule by including productivity rates that more accurately reflect Astaldi's experience to-date.
5. Once the baseline schedule has been updated (see item #4 above), develop and implement a protocol for periodically reviewing achieved productivity and using that information to update the project schedules.
6. Review the suggestions offered in the Ibbs March 2015 report and determine which of those suggestions still have viability. In particular, consider:
    a. Change the work shifts so that the gap is reduced between them. For example, change from 7:00 am to 5:30 pm (day shift) and 7:00 pm to 5:30 am (night shift), to 7:00 am to 5:30 pm (day) and 5:30 pm to 4:00 am (night). This will improve the hand-off between the two shifts and may reduce overtime incurred by the day shift.[6]
    b. Move from a 14 days-on/7 days-off rotation to a 20/10 or 28/14 cycle. This will improve work rhythm.[7]
    c. Develop and use more detailed cost control codes. In particular develop codes that will track quality and rework so that the Non-Conformance Review (NCR) incidents are reduced.[8]

[5] Pages 165-166 of the May 2015 progress report. There are errors in this report; for example it shows that the work is 100% complete for the Site Installation of Temporary Buildings as of May 2015 but also projects that another 451,949 labor-hours will be needed by project end.

[6] I understand that Astaldi has unsuccessfully discussed this matter with the labor unions, but I recommend that they consider re-opening such discussions with the unions because current economic conditions may now favor the Astaldi.

[7] Similar to the point I made above, I understand that Astaldi has unsuccessfully discussed this matter with the labor unions, but I recommend that they consider re-opening such discussions with the unions because current economic conditions may now favor the Astaldi. The potential cost savings for these two points will run into the $millions.

Summary

In summary, LCP is in distress from a labor productivity point of view. The low productivity rates earned to-date clearly have implications to both Astaldi and Nalcor in terms of cost and project completion date.

As indicated several times in tis report, I strongly recommend that I meet in face-to-face sessions with Astaldi and Nalcor project personnel to continue 1) investigating the project's productivity, cost, and schedule problems, and 2) developing and implementing mitigation measures.

[8] Astaldi has informed me that the number of rework hours is not significant. I personally would like to investigate this further.

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Act. Description (1)	Budget L-Hrs @completion (2)	% complete (3)	Earned L-Hrs (4)	Actual L-Hrs (5)	Variance to-date (6)	Estimate to complete (7)	Estimate at completion (8)	Variance at completion (9)	PF to-date (10)	PF @ completion (11)	Necessary increase (12)
Indirect Cost accounts											
Site Installation	71,519	100%	71,519	329,447	-257,928	31,400	360,847	-289,328	0.22	0.20	-9%
Winter Protection	68,850	39%	26,714	374,726	-348,012	404,160	778,886	-710,036	0.07	0.09	24%
Attendant Labour	736,610	35%	255,610	640,862	-385,252	939,600	1,580,462	-843,852	0.40	0.47	17%
Subtotal	876,979	40%	353,843	1,345,035	-991,192	1,375,160	2,720,195	-1,843,216	0.26	0.32	23%
Direct Cost accounts											
Concrete production	421,219	12%	48,835	109,831	-60,996	321,400	431,231	-10,012	0.44	0.98	120%
Formwork placement	1,000,890	12%	117,424	390,228	-272,804	2,056,368	2,446,596	-1,445,706	0.30	0.41	36%
Embedded parts	76,942	3%	2,610	38,770	-36,160	344,408	383,178	-306,236	0.07	0.20	198%
Concrete placement	586,712	13%	73,498	160,530	-87,032	1,087,567	1,248,097	-661,385	0.46	0.47	3%
Rebar installation	655,215	11%	72,947	129,671	-56,724	813,540	943,211	-287,996	0.56	0.69	23%
Subtotal	2,740,978	12%	315,314	829,030	-513,716	4,623,283	5,452,313	-2,711,335	0.38	0.50	32%
Total	3,617,957	18%	669,157	2,174,065	-1,504,908	5,998,443	8,172,508	-4,554,551	0.31	0.44	44%

Table 2A

Labor-Hour Variance and Productivity Factor for Selected Cost Accounts – Best-Case Scenario

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Act. Description (1)	Budget L-Hrs @completion (2)	% complete (3)	Earned L-Hrs (4)	Actual L-Hrs (5)	Variance to-date (6)	Estimate to complete (7)	Estimate at completion (8)	Variance at completion (9)	PF to-date (10)	PF @ completion (11)	Necessary increase (12)
Indirect Cost accounts											
Site Installation	71,519	100%	71,519	329,447	-257,928	31,400	360,847	-289,328	0.22	0.20	-9%
Winter Protection	68,850	39%	26,714	374,726	-348,012	549,555	924,281	-855,431	0.07	0.07	5%
Attendant Labour	736,610	35%	255,610	640,862	-385,252	963,200	1,604,062	-867,452	0.40	0.46	15%
Subtotal	876,979	40%	353,843	1,345,035	-991,192	1,544,155	2,889,190	-2,012,211	0.26	0.30	15%
Direct Cost accounts											
Concrete production	421,219	12%	48,835	109,831	-60,996	348,400	458,231	-37,012	0.44	0.92	107%
Formwork placement	1,000,890	12%	117,424	390,228	-272,804	2,492,149	2,882,377	-1,881,487	0.30	0.35	15%
Embedded parts	76,942	3%	2,610	38,770	-36,160	471,184	509,954	-433,012	0.07	0.15	124%
Concrete placement	586,712	13%	73,498	160,530	-87,032	1,414,882	1,575,412	-988,700	0.46	0.37	-19%
Rebar installation	655,215	11%	72,947	129,671	-56,724	880,164	1,009,835	-354,620	0.56	0.65	15%
Subtotal	2,740,978	12%	315,314	829,030	-513,716	5,606,779	6,435,809	-3,694,831	0.38	0.43	12%
Total	3,617,957	18%	669,157	2,174,065	-1,504,908	7,150,934	9,324,999	-5,707,042	0.31	0.39	26%

Table 2B

Labor-Hour Variance and Productivity Factor for Selected Cost Accounts – Worst-Case Scenario

Month	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Remainder of project
Direct workforce (People per day)	1,032	1,534	1,518	1,499	1,204	983	378	305	22	23	
Concrete production (m3/month)	12,886	25,390	23,486	24,390	19,877	15,284	4,177	2,638	225	280	267,992 m3[9]
Productivity w/ heating (Labor-hours/m3)	16.02	12.09	12.92	12.29	12.11	12.86	18.09	23.13	46.16[10]	38.15	12.87
Productivity w/o heating (Labor-hours/m3)	16.02	12.09	12.92	12.29	12.11	12.86	15.09	17.13	40.16	32.15	11.83

Table 3A
Concrete Production and Productivity – Best-Case Scenario

[9] The concrete production projected in this best-case scenario differs from the projected production volume in the worst-case scenario because of the May 2015-February 2016 monthly projected projections.
[10] The January and February productivity rates are skewed because of small headcount numbers and should be considered as outliers.

Month	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Remainder of project
Direct workforce (People per day)	980	1,200	1,198	1,381	1,118	1,008	653	598	288	315	
Concrete production (m3/month)	11,661	15,496	14,005	17,157	15,848	12,273	6,223	4,632	2,062	2,137	294,885 m3
Productivity w/ heating (Labor-hours/m3)	16.81	15.49	17.11	16.10	14.11	16.43	20.99	25.84	30.89	32.33	15.34
Productivity w/o heating (Labor-hours/m3)	16.81	15.49	17.11	16.10	14.11	16.43	17.99	19.84	24.89	26.33	14.04

Table 3B
Concrete Production and Productivity – Worst-Case Scenario