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Sent: 2017-05-10 4:34:49 PM
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Subject: Schedule Analysis

Attachments: [Muskrat Falls Andritz C2G Delay Analysis 2017.03.24.pdf](#)

Hi Daniel,

You requested earlier the schedule analysis document that we sent to LCP, here it is

Merci / Thank you

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Subject: Schedule Analysis

Andritz Hydro Canada, Inc. Delay Analysis

Regarding:

Lower Churchill Project Spillway Hydro-Mechanical Construction

Muskrat Falls
NL, Canada

Prepared by:

Alan R. Biddle

March 24, 2017



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 RE: Muskrat Falls Spillway Hydro-Mechanical Construction
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1 Introduction

C2G International, LLC [C2G] was retained by Andritz Hydro Canada, Inc. [Andritz] to complete a project review and schedule analysis of the spillway hydro-mechanical installation at Muskrat Falls Corporation's [Company] Lower Churchill Project [Project]. This review was requested to identify and quantify project delays incurred and subsequent acceleration achieved, if any, relating to the spillway portion of the Andritz Hydro-Mechanical EPC contract.

Specifically, C2G was requested to complete an independent review of the Project installation progress and provide analysis and opinions pertaining to the following topics:

- A. Schedule delays experienced;
- B. Schedule acceleration achieved;
- C. Assess causation for any measured delays;
- D. Assess acceleration measures

To facilitate this analysis, C2G was provided with the following project documents and records by Andritz:

- Contract documents
- Project site plans
- Project photographs
- Andritz and Andritz' sub-contractor [Canmec] Primavera P6 project schedules and schedule updates
- Company acceleration requests and directives
- Andritz Acceleration proposals
- Andritz time extension requests
- Project correspondence
- Meeting minutes
- Andritz and sub-contractor daily reports
- Andritz and sub-contractor requests for compensation submitted to Company

Additionally, C2G conducted interviews with Andritz and Canmec project staff.

The following sections of this report describe the schedule analysis of the Spillway hydro-mechanical work and concludes:

- A. The Start of Andritz critical path upstream work was delayed 258 days by the Company's predecessor civil work.
- B. Company's November 2015 directive to complete work for June 2016 water-up required Andritz to accelerate its work by more than 4 months.

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- C. After November 1, 2015, change order work, ongoing civil construction, lack of agreement on acceleration, winter conditions, and other issues delayed the start of guide alignment by 2 additional months.
- D. Andritz added resources and worked additional manpower, equipment, shifts and multiple work fronts concurrently to achieve the Company acceleration directive allowing for Company's preparations for river diversion by July 17, 2016.
- E. After Company's river diversion, the remaining Andritz work was greatly interrupted and extended by the unanticipated working conditions.

Andritz has outlined its position pertaining to the Company directive to accelerate in its previously submitted requests for compensation documents. This report will not restate those positions, but is intended to determine the magnitude of the acceleration effort and the resulting benefit to the Project and the Company.

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2 Analysis of Project Progress

The following analysis of project progress was completed to identify and measure the schedule delays and delay reductions that occurred in the completion of the spillway hydro-mechanical work by Andritz and their sub-contractors. The starting point of this analysis is review and understanding of the baseline schedule, or the Andritz As-planned schedule, which was developed by Andritz and its sub-contractors over time and prior to the start of work. We then compare that with the periodic project progress and the As-built performance to identify and quantify the critical path delays and acceleration achieved.

2.1 Andritz Baseline Schedule

Andritz prepared and submitted its initial Baseline Schedule, with data date November 25, 2014, to the Company on January 9, 2015.¹ At that time the schedule did not include detailed input from Canmec, who had been subcontracted to complete mechanical installation work, which was the critical driving scope of work. **Figure 1** below summarizes the overall sequence and durations for the work in the Andritz November 2014 Baseline schedule.

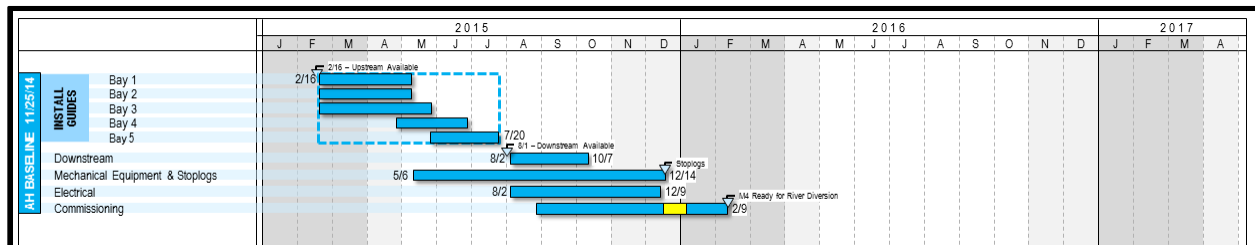


Figure 1: Summary of Andritz Baseline Schedule

The EPC contract between Andritz and Company anticipated a start date of February 16, 2015 based on upstream spillway availability when the civil contractor was to be complete and clear from the entire upstream spillway area. The downstream work was planned to be available on August 1, 2015. The gates and mechanical equipment work followed by electrical installations would start following the guide installation, and would be complete with stoplogs installed by December 14, 2015. Commissioning was to take place during the winter between late November 2015 and February 2016 such that Andritz would be complete with its scope and ready for river diversion by February 13, 2016.

¹ Exhibit 1 - Andritz Baseline Schedule, dated November 25, 2014

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The Andritz planned schedule and price for the work anticipated using the full 12-month contract duration, working a single shift per day, to complete its scope of work for the spillway portion of the contract.

2.2 Canmec Preliminary Schedule

Canmec submitted its detailed preliminary schedule to Andritz in December 2014 for incorporation into the Andritz overall project schedule.² **Figure 2** below provides a summary comparison of the Andritz Baseline schedule with the Canmec preliminary schedule.³

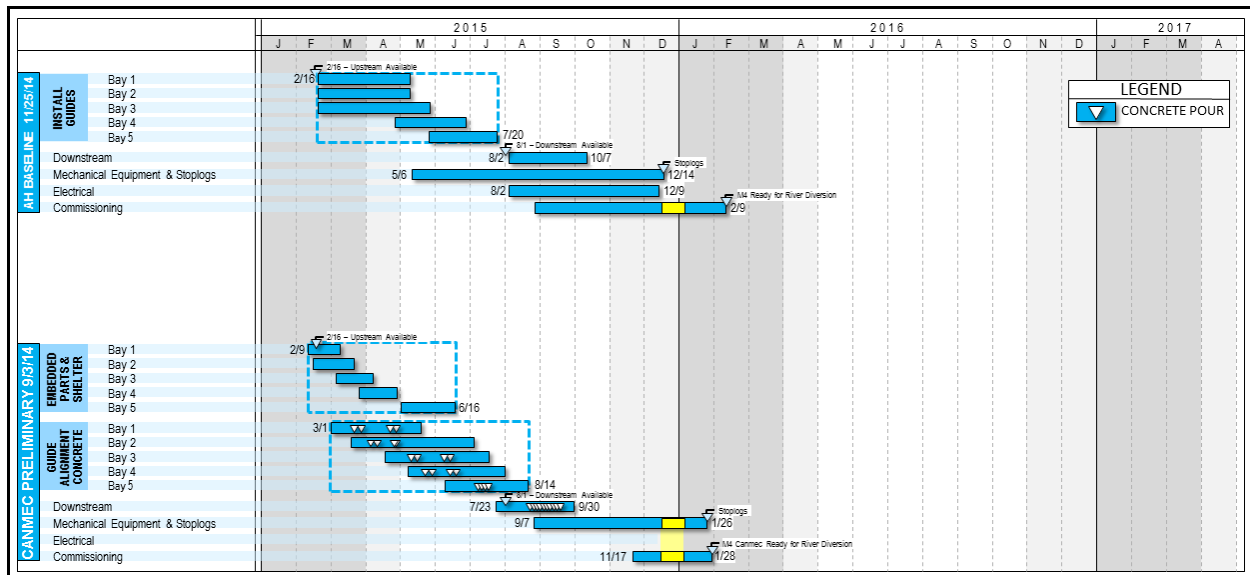


Figure 2: Andritz Baseline Schedule vs. Canmec Preliminary Schedule

The Canmec Preliminary Schedule also anticipated utilizing the 12-month contract duration to perform its work with a single 10-hour work shift, 7 days per week. Canmec’s plan was to begin mobilizing in early February 2015 to begin setting embedded parts in Bay 1 when the spillway would become available on February 16, 2015.

² Exhibit 2 – Canmec Preliminary Schedule, dated September 3, 2014

³ The dates indicated on the schedule summary bars in the Figures in this analysis, at times, are different than dates referenced on schedule charts and attachments included in the Andritz February 16, 2017 Request for Compensation, (e.g. Canmec Document 4A and Andritz Document 2B). This is due to not including certain non-productive work, such as unloading materials or demobilization activities after productive work. The summary bars included here represent the durations for productive permanent installation work.

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The Canmec Preliminary Schedule included more detailed activities than the Andritz baseline and allows a better understanding of Canmec's plan and intended crew-flow sequence. The 1st set of blue summary bars on **Figure 2** for the Canmec Preliminary Schedule include Canmec's initial activities of rough setting the embedded parts and installation of the shelters in each bay. Canmec's plan was to proceed with this work with the same crew of craft labor starting with Bay 1 working in sequence toward Bay 5.

The second set of summary bars includes the survey, rough guide alignment, precision guide alignment, concrete pours, rectification, and verification surveys all performed inside shelters on the upstream side. This work was also planned by Canmec to be performed by craft labor moving from Bay 1 in sequence to Bay 5. Each step of the process was planned to be performed by the same craft labor such that once learned, the work would be repetitive and done at greater efficiency in successive bays.

Canmec planned to complete the final pours on the upstream side by late July 2015, then crew-flow the craft labor to the downstream side to perform the same work there on a much smaller scale. Once all the upstream and the majority of the downstream guides were complete, Canmec planned to mobilize its large crane to set all gates, towers, hoists, and mechanical equipment between September 7, 2015 and November 30, 2015, a 12-week period. Canmec's dry commissioning would take place thereafter until January 28, 2016.⁴ Note that the Canmec Preliminary Schedule does not include the Andritz electrical commissioning responsibilities that would be performed concurrent with Canmec and continue beyond January 28, 2016 for approximately two weeks until the Ready for River Diversion date in February 2016.

When comparing the Andritz Baseline Schedule with Canmec's Preliminary Schedule on **Figure 2**, it can be seen that Canmec's sequence in its Preliminary Schedule aligns with the overall sequence for the work contained in the Andritz Baseline Schedule and with the total duration of this work. Thus, Canmec's plan was reasonable and fit well within the Andritz schedule parameters to be completed in the 12-month contract duration.

2.3 Andritz Schedule as of June 25, 2015

It is well documented that the start of Andritz work was delayed due to late completion of the predecessor civil work. Andritz submitted an updated schedule to Company on July 8, 2015 with data date June 25, 2015. This schedule now incorporated Canmec's detailed preliminary schedule activities and anticipated a 258 calendar day late start of upstream work on November 1, 2015, as had been communicated to

⁴ Canmec's original planned approach to the work is explained further in Section 4 of the Andritz February 16, 2017 Request for Compensation Volume 1: Demonstration of CHO-010's Consequences on the Spillway Work.

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Andritz. The schedule also maintains Canmec’s critical path sequence and crew-flow for the work described above.

Figure 3 includes the Canmec Preliminary Schedule adjusted to start November 1, 2015, as compared to the June 25, 2015 schedule update.

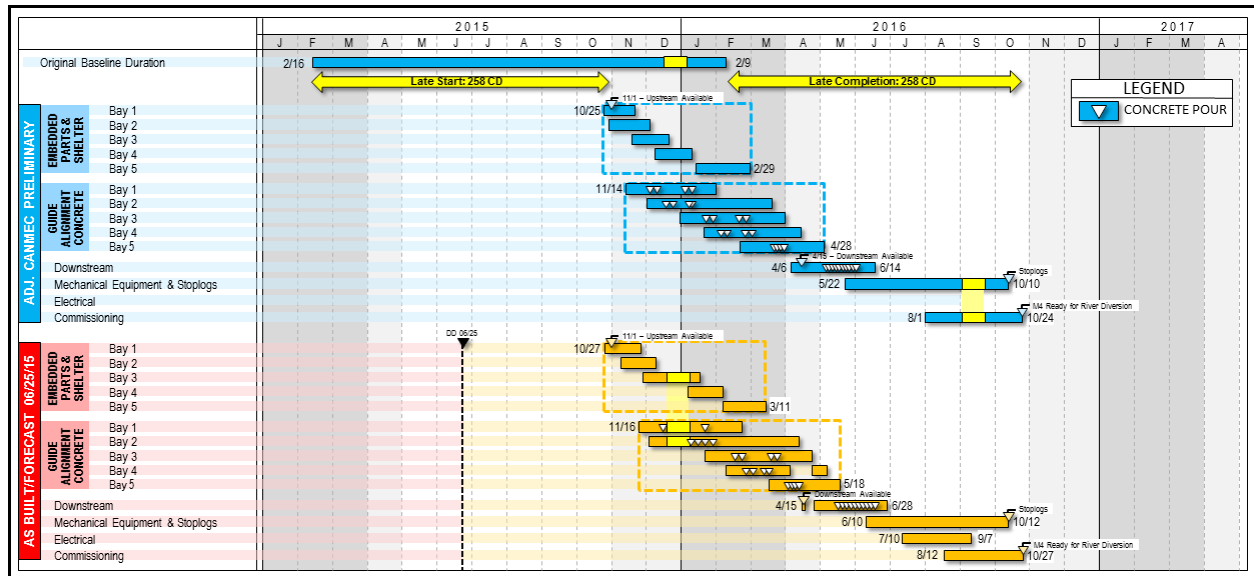


Figure 3: Canmec Preliminary Schedule Adjusted vs. Andritz June 25, 2015 Schedule Update

The June 25, 2015 schedule update submitted by Andritz is simply its Baseline Schedule with Canmec’s detailed activities incorporated and shifted to the revised start date of November 1, 2015. It can be seen Andritz’ June 25, 2015 schedule update aligns with the detailed Canmec Preliminary Schedule in terms of activity durations and sequence.

The Andritz updated schedule does not include any adjustment for seasonal shifts or projected inefficiencies anticipated when performing a greater volume of work in the severe winter conditions period between January and March. This is apparent since the completion date was forecast to be October 27, 2016, 261 calendar days later than planned, a day-for-day shift with the start date. Had Andritz forecast winter impacts in this updated schedule, the duration of the guide installation activities during winter would have been significantly longer and would have resulted in a completion date more than 258 days late.⁵

⁵ Andritz submitted an analysis in response to Company’s Change Order No. 6 requesting an additional 100 days of time extension due to projected winter impacts based on the start date moving to November 1, 2015.

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Because the June 25, 2015 schedule update was the Andritz plan to complete the work under the contractually anticipated conditions, (i.e. all conditions of Contract Section I.1.A and I.1.B. are met) using the original planned resources for Andritz and its sub-contractors, this June schedule update gives the appropriate baseline for comparison to the as-built schedule to facilitate the quantification of total delays and accelerations that took place completing the spillway hydro-mechanical work.

2.4 The As-Built Schedule

Figure 4 gives a comparison of the June 25, 2015 updated schedule and the As-built schedule.⁶

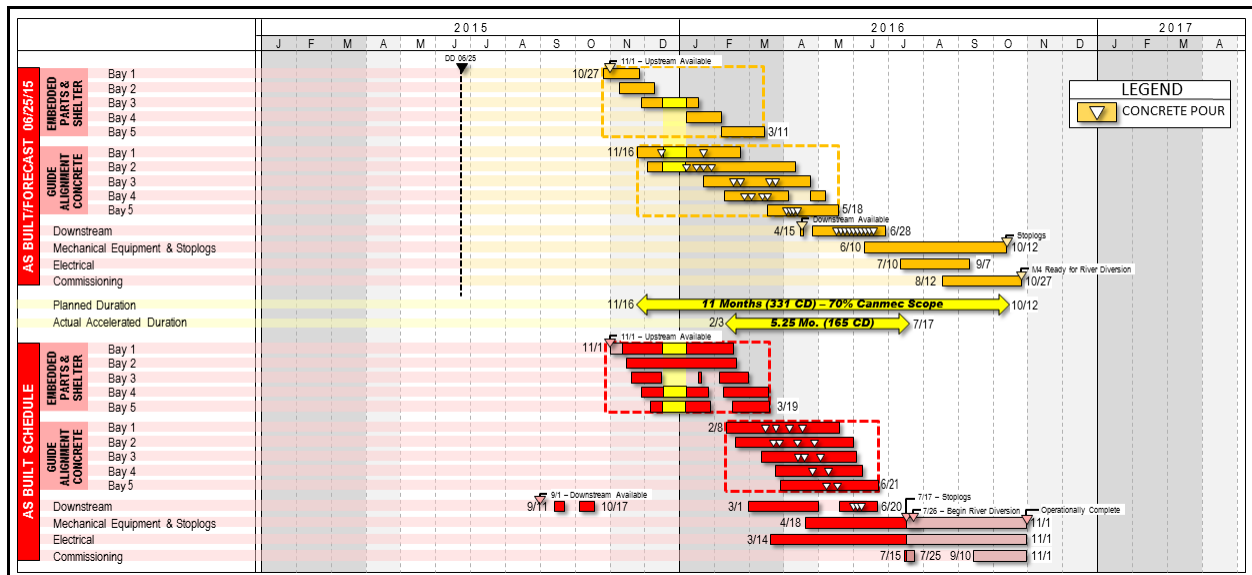


Figure 4: Andritz June 25, 2015 Schedule Update vs. As-Built

As shown, Andritz and its subcontractors accelerated the critical path gate guide alignments, concrete embedment pours, and mechanical equipment installations by over 5 months, completing that work in less than 50% of the originally planned duration. This allowed for the river diversion work to start on July 17, 2016, 102 days earlier than planned in the June 25, 2015 schedule update had Andritz and Canmec continued with the planned sequence of work, work shifts and resource levels and without accounting for winter impacts. There was then work to be completed after river diversion which was originally anticipated to be complete before river diversion in Company’s CHO-010 and in Andritz’ submitted acceleration proposals.

⁶ Exhibit 3 – Andritz As-built Schedule Update, dated November 21, 2016

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Section 2.5 below further examines the progress of work to measure the critical path delays experienced and accelerations achieved.

2.5 Analysis of Delays and Acceleration

2.5.1 Progress as of December 16, 2015 – Start of Shelter Installation

Figure 5 measures the progress of work as of December 16, 2015, when Canmec started work installing brackets for the shelter installation in Bay 1.

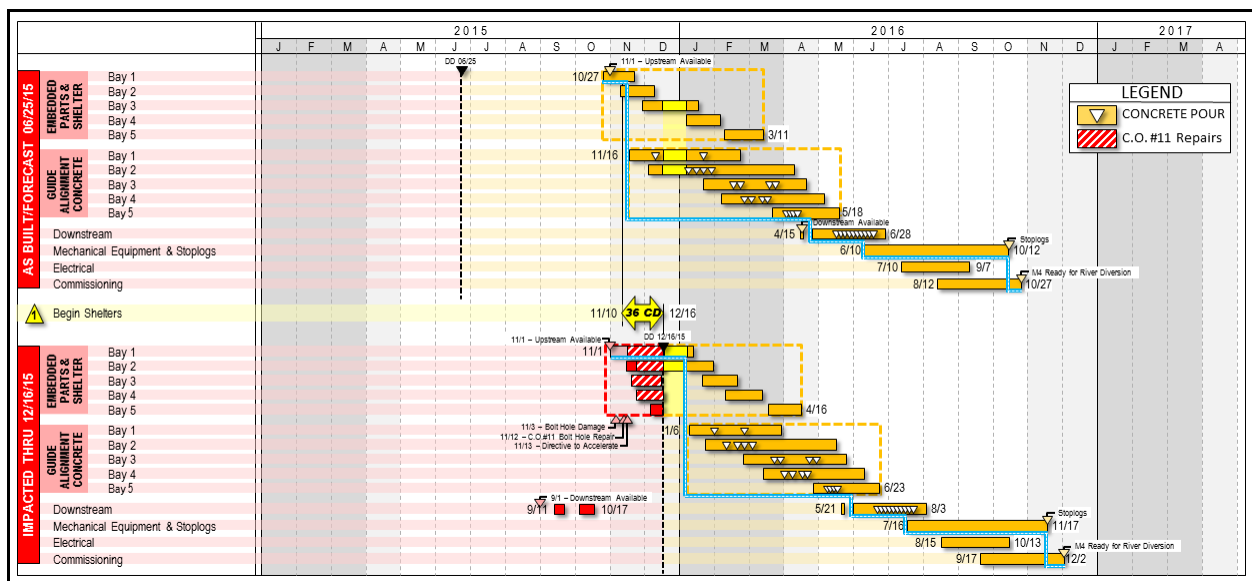


Figure 5: Andritz June 25, 2015 Schedule Update vs. December 16, 2015 Progress

Delay No. 1: Start of Shelter Installation

Delay Period 1: 11/1/2015 – 12/16/2015

Calendar Days (CD) Delay: 36 CD Period Delay, 36 CD Total Delay

Per the June 25, 2015 Updated schedule, Canmec was scheduled to begin the installation of the shelter in Bay 1 on November 10, 2015, which is 10 days after the start of hydro-mechanical work in the spillway. The June 25, 2015 schedule update allocated the initial 10 days for the erection and bolting of the embedded guide parts, which must be complete before the shelter brackets and panels could be installed.

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Canmec actually began the installation of the Bay 1 shelter 36 days later than planned, on December 16, 2015.⁷ The delay to the Bay 1 shelter was caused by additional work issued under Change Order No. 11 Spillway Gate Guide Bolt Hole Damages, which was required to be complete before installing the embedded guide parts and the subsequent shelter installation.

Andritz discovered the damaged bolt holes and issued an inspection report dated November 3, 2015.⁸ This condition was identified almost immediately after the spillway was made available to Canmec. Canmec began the Change Order No. 11 repair work immediately after the Company issued a Change Request to Andritz on November 14, 2015.⁹

Figure 5 shows the June 25, 2015 schedule update compared to the impacted updated schedule, which incorporates actual progress through December 16, 2015. The Change Order No. 11 anchor bolt repair work delayed the start of critical path guide installation work by 36 days, from November 1, 2015 when the spillway was initially available until the change order work was completed on December 6, 2015.¹⁰ The subsequent work erecting and bolting the embedded guides was achieved within the 10-day duration planned for in the June 25, 2015 schedule update, despite interferences from Company's civil contractor.

Company's civil contractor's presence each day on the bridge and in various bays affected Canmec's productivity in November and December 2015. In Bay 1 specifically, Company's civil contractor impact to the critical embedded guide installation was as follows:

- On December 8th and 9th, Canmec was delayed by Company's civil contractor's tower crane by at least four hours each day. As shown in **Figure 6**, the tower crane positioned in the upstream spillway hindered the use of Canmec 180-ton crane used for erecting the guides.¹¹
- On December 12th, Company's civil contractor damaged the hydro-mobile platform used to erect and bolt the embedded parts, by dropping an object during overhead work.¹²

⁷ P6 Schedule Activity IDs CE13970, CE 14200 and CE14410 for shelter installation, starting December 16, 2015

⁸ Exhibit 4 - Andritz Inspection Notes, Inspection of spillway roller gate primary anchors Bay1 south, dated November 3, 2015

⁹ Exhibit 5 - Change Request – Supply Gate Guide Bolt Holes Damages – Line A – G1, G2, G3; dated November 12, 2015; Transmittal letter dated November 14, 2015

¹⁰ P6 Schedule Activity IDs CO36003, CO36002 and CO36001 B1 Inspection and Repair of Anchor Guide Bolt Holes (CO#36) indicate that the work was finished on December 7, 2016. Canmec's analysis states that the work was completed one day earlier, on December 6, 2015, which was the date used in this analysis.

¹¹ Exhibit 6 - Canmec Site Daily Reports dated December 8th and 9th, 2015.

¹² Exhibit 7 - Canmec Site Daily Report dated December 12, 2015

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Figure 6: Civil Contractor Tower Crane Positioned in the Spillway, dated December 9, 2015

As of December 16, 2015, the Change Order No. 11 and guide erection work in Bay 1 was complete and initial work installing shelter brackets commenced, 36 days later than shelter installation would have started based on a November 1, 2015 start date under original contract conditions.

It is important to note that Company directed acceleration of the work on November 10, 2015 when it issued CHO-010 directing Andritz to accelerate its work to be complete for river diversion by June 15, 2016. This was issued 10 days after the start of the critical path upstream spillway work and three days before issuing Change Order No. 11. Andritz then issued the corresponding acceleration directive CHO-003 to Canmec on November 13, 2015.

Canmec and Andritz did not agree with the conditions imposed by Company to accelerate its Work, or that the pre-conditions for beginning hydro-mechanical work had been met. Nonetheless, after Company directive, and after some preliminary acceleration proposals and failed negotiations, Canmec had modified its downstream shelter panels for use on the upstream Bay 1 by December 9th, prior to the completion of the embedded guide installation. The availability of the panels did not control the start of the critical path shelter installation. This issue will be addressed further in Section 2.5.2 below.

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Table 1 summarizes the critical 36-day delay caused by Change Order No. 11 Spillway Gate Guide Bolt Hole Damages, which is the responsibility of the Company.

Table 1: Delay through December 16, 2015

Delay Issue	Description	Total Delay	Period Delay	Responsibility	
				Company	Andritz
1	Delay to Start of Bay 1 Shelter				
	a. C.O. #11 Spillway Gate Guide Bolt Hole Damages		36	36	
	Total Delay Issue No. 1:	36	36	36	-

2.5.2 Progress as of February 3, 2016 – Start of Guide Alignment

Figure 7 measures the progress of work as of February 3, 2016, when Canmec started guide alignment in Bay 1 after the shelter was substantially complete.

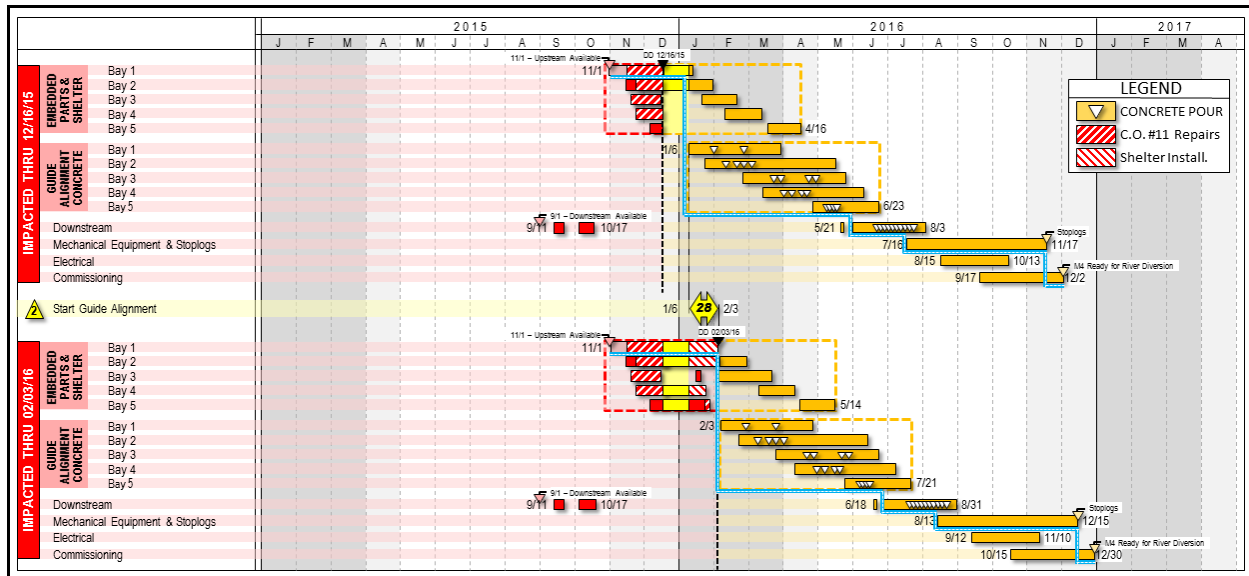


Figure 7: December 16, 2015 Progress vs. February 3, 2016 Progress

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Delay No. 2: Start of Guide Alignment

Delay Period 2: 12/16/2015 – 02/03/2016

Calendar Days (CD) Delay: 28 CD Period Delay, 64 CD Total Delay

Per the June 25, 2015 schedule update, which was based on all contractual preconditions being met as explained above, the critical guide alignment work would begin 6 days after the shelter work had begun.¹³ Based on this originally planned sequence and duration, with the actual start of shelter installation on December 16, 2015 and considering the planned holiday period, the guide alignment would have begun on January 6, 2016.¹⁴

Canmec actually substantially completed the shelter in Bay 1 to allow the start of guide alignment on February 3, 2016, 28 days later than planned.¹⁵ The Bay 1 shelter was not entirely completed until February 15, 2016, however, the critical path shifted to the guide alignment work once Canmec surveyed the guides to begin rough alignment on February 3, 2016. This extended duration for shelter design, procurement, and installation, specifically the top panels and roof, is partially due to the cumulative effect of Company's late directive to accelerate and the lack of pre-conditions being met.

Had it not been for the directive to accelerate the work on November 10, 2015, Canmec and Andritz would have waited for the preconditions of the upstream spillway to be met before starting the upstream work. During the 2015 discussions with the Company about potential acceleration, Canmec communicated that it required 60 days notice to be in position to accelerate their work. Instead, Canmec and Andritz were forced to immediately shift their attention to the upstream area after November 10, 2015 when work had been ongoing in the downstream area where the contractual preconditions were also not met. This lack of notice by the Company caused a delay to the engineering and manufacturing of the shelter roof design, which was completed January 26, 2016, and delayed the completion of the installation.

Additionally, according to Canmec, time was lost while preparing to shut down the site for the holiday period, as well as when they returned to find the site covered in snow. The project baseline, shown in **Figure 1**, anticipated the holiday period to occur after nearly all the work was complete and only commissioning was underway, whereas the holiday period occurred while Canmec were working on the shelter installation, Change Order No. 11 bolt hole repairs and staging for the guide erection. The resulting

¹³ June 25, 2015 Schedule Update Activity ID CE13990 'B1 Survey of CPV Embedded Parts' was scheduled to begin on November 16, 2015, which is 6 days after start of CE13970 'B1 Shelter Installation for CPV Embedded Parts', starting on November 10, 2015.

¹⁴ The January 6, 2016 forecast includes 15 holiday days that were planned for in the June 25, 2015 schedule, from December 19 until January 3, 2016. The start of shelters on December 16th, plus the holiday period, plus the six work days results in the January 6, 2016 forecast date for the start of guide alignment work.

¹⁵ P6 Activity ID CE14430 Survey of CPPS2 Embedded Parts

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lost production was more than would have been incurred per the Baseline by the commissioning team. Canmec’s focus on the day prior to the holiday was shutdown preparations and the first day after the holidays was snow clearing so that they could return to productive work.

Canmec explains in Section 4 of the Andritz February 16, 2017 Request for Compensation that it is responsible for 1,444 manhours of additional work installing the Bay 1 hoarding in January 2016. Canmec spent approximately 4,000 manhours in January installing the hoarding, therefore 36% of the hours and duration (1,444/4,000 = 36%) are due to Canmec’s additional work. This amounts to approximately 11 days of the 28-day additional duration completing the critical shelter installation.

Considering the above, 11 days of the extended duration are due to Canmec’s extra work and the remaining 17 days of delay are the responsibility of the Company as the direct consequence of its predecessor delays, failure to deliver the preconditions stated in the contract, and failure to come to timely agreement on acceleration proposals.

Table 2 summarizes the total delays as of February 3, 2016

Table 2: Delay through February 3, 2016

Delay Issue	Description	Total Delay	Period Delay	Responsibility	
				Company	Andritz
	Total Delay Issue No. 1:	36	36	36	-
2	Delay to Begin Bay 1 Guide Alignment				
	a. Installation of Shelter		28	17	11
	Total Delay Issue No. 2:	28	28	17	11
	Total Delay Issues 1 & 2:	64		53	11

2.5.3 Progress as of March 14, 2016 – First Guide Embedment Pour

Figure 8 measures the progress of work as of March 14, 2016, when Andritz’ other sub-contractor [CRT] poured the first concrete for the Bay 1 guide embedment.

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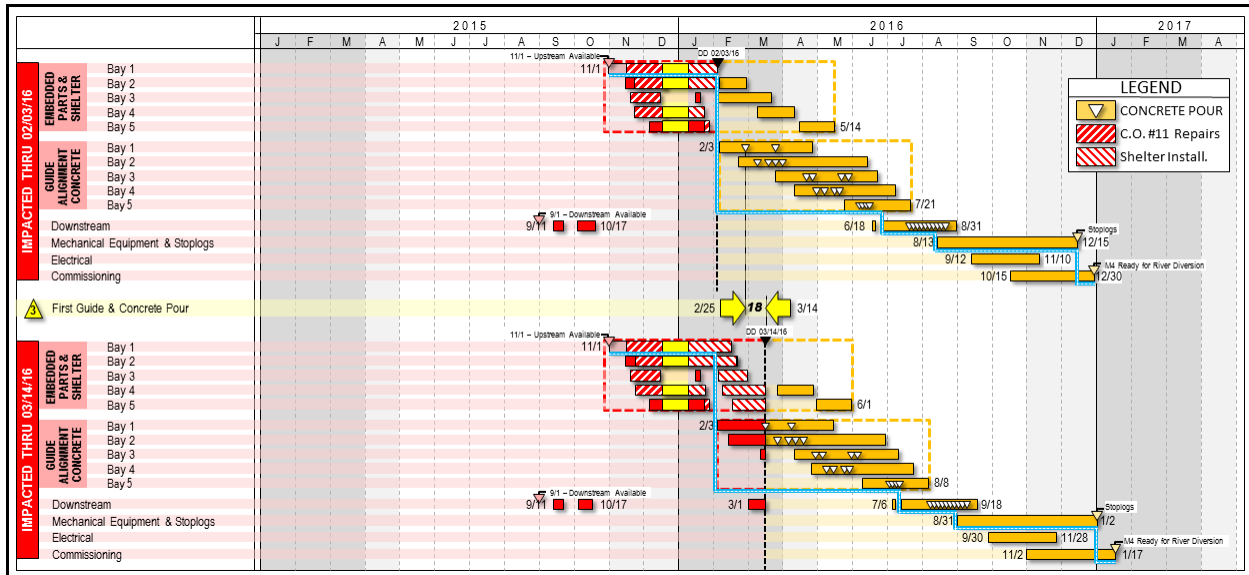


Figure 8: February 3, 2016 Progress vs. March 14, 2016 Progress

Delay No. 3: Complete First Guide Embedment Pour (CPPS2)

Delay Period 3: 02/03/2016 – 03/14/2016

Calendar Days (CD) Delay: 18 CD Period Delay, 82 CD Total Delay

The June 25, 2015 schedule update adjusted for progress through February 3, 2016 anticipates the first two critical path concrete embedment pours in Bay 1 would take place on February 25, 2016, 23 days after starting the guide survey and alignment. CRT actually started the first Bay 1 guide embedment pour on March 14, 2016, 18 days later than planned.¹⁶ Review of detailed critical work activities completed in this period indicate that the extended duration was due to:

- A. 6 days due to pier movements which prolonged the precision alignment activities for the first pour by 6 days.¹⁷ This issue was identified by Canmec and documented in 16 NCR’s and letters to the Company as further discussed in Section 2.5.4 below.
- B. 6 days due to CRT’s added preparations and changed means and methods for concrete acceleration in winter conditions including installation of the concrete truck enclosure and trunks

¹⁶ Note that the June 2015 schedule update intended to pour the roller gate embedded parts first, whereas the as-built schedule shows that the upstream temporary stoplog guides were the first guides poured. For the purposes of this analysis, which measures progress toward the first guide embedment concrete pour, the specific pour is inconsequential.

¹⁷ P6 Schedule Activity ID CE14450, B1 Precision Alignment of CPPS2 Guides, which had an original duration of 4 days and an actual duration of 10 days.

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and hoppers for winter concrete work.¹⁸ This delay was quantified by reviewing the duration allocated in the June 25, 2016 schedule update for sill alignment and pre-pour measurements prior to performing the first planned concrete pour (8 days),¹⁹ and comparing to the actual duration (14 days).²⁰ The extended period for performing these activities was because CRT had occupied the shelter for several days to prepare for pouring concrete in winter conditions.

- C. The remaining 6 days of delay is due to Canmec’s extended duration completing the survey and rough alignment work which was caused by prolonged heating of the Bay 1 shelter.

Table 3: Delay through March 14, 2016

Delay Issue	Description	Total Delay	Period Delay	Responsibility	
				Company	Andritz
	Total Delay Issues 1 & 2:	64		53	11
3	Delay to First Concrete Pour				
	a. Shelter Heating / Canmec Rough Alignment		6		6
	b. Movement of Piers during Precision Alignment		6	6	
	b. CRT Winterization		6	6	
	Total Delay Issue No. 3:	18	18	12	6
	Total Delay Issues 1 - 3:	82		65	17

2.5.4 Progress as of May 20, 2016 – Complete Guide Alignment and Concrete

Figure 9 measures the progress of work as of May 20, 2016 when CRT poured the last concrete for the upstream gate guide.

¹⁸ See Section 3 of the Andritz February 16, 2017 Request for Compensation, Volume 1: Demonstration of CHO-010’s Consequences on the Spillway Work.

¹⁹ Per the June 25, 2015 schedule update, Activity IDs CE14020 – B1 Alignment of CPV Sill Beam and CE14040 - B1 Prepour Measurements of CPV Embedded Parts were planned to start on November 30, 2015 and finish on December 7, 2015, a combined duration of eight calendar days.

²⁰ Per the as-built schedule, CE14460 – B1 Alignment of CPPS2 Sill Beam and CE14480 – B1 Pre-pour Measurements of CPPS2 Embedded Parts started on February 29, 2016 and finished on March 13, 2016, combined duration of 14 calendar days.

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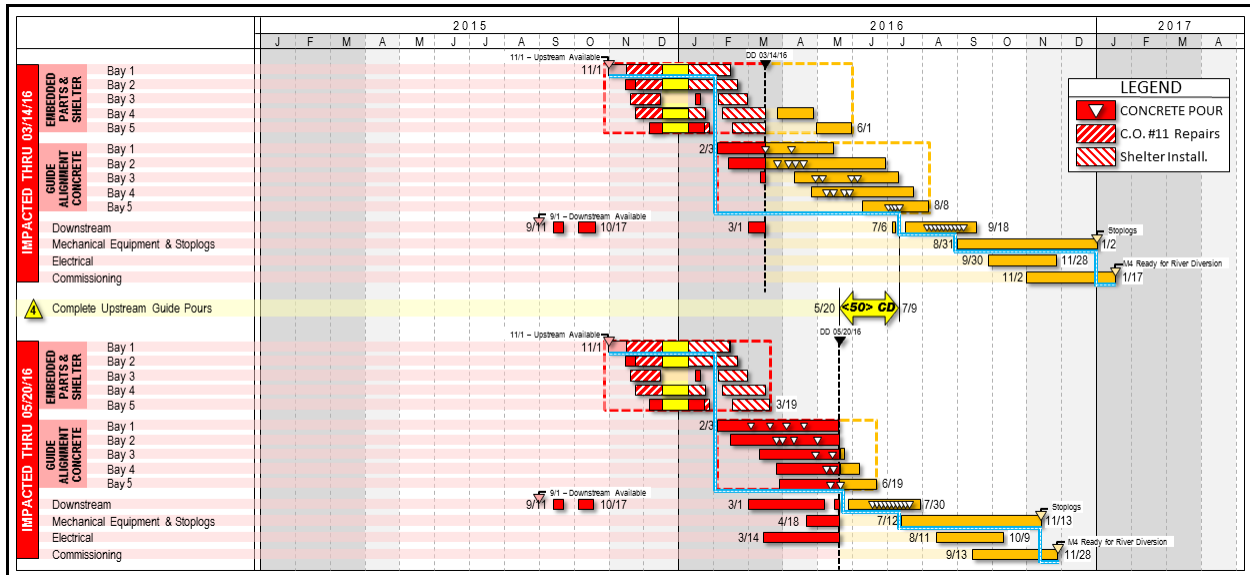


Figure 9: March 14, 2016 Progress vs. May 20, 2016 progress

Delay No. 4: Complete Guide Alignment and Concrete

Delay Period 4: 03/14/2016 – 05/20/2016

Calendar Days (CD) Delay: <50> CD Period Delay Reduction, 32 CD Total Delay

Per the June 25, 2015 schedule update, the upstream guide alignments and concrete embedment pours for all bays was planned to be completed within 117 days of the first concrete pour. Therefore, based on the Bay 1 S2 sill beam and guide embedment pours made on March 14, 2016, the remainder of the upstream concrete guide work would have been completed on July 9, 2016 working in the planned sequence with the originally planned resources one shift per day.

The final upstream concrete pour was actually completed May 20, 2016, meaning that the acceleration efforts employed by Andritz, Canmec, and CRT resulted in completing this critical path work 50 days faster than planned. Andritz, Canmec and CRT applied several strategies to achieve Company’s desired acceleration, including a significant increase in manpower and supervision, night shifts, overtime, and mobilization of additional equipment. In addition, according to Canmec, this period was least affected by hindrances of the Company (i.e. presence of the civil contractor). Andritz’ February 16, 2017 Request for Compensation describes the acceleration measures and quantifies the associated acceleration costs, including massive labor and equipment inefficiencies experienced as would be expected under acceleration of this magnitude.

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It should be noted that this acceleration of the gate guide work was achieved despite guide alignment difficulties experienced because of movements of the concrete piers. The resulting out-of-tolerance was not discovered until May 12, 2016, after concreting, and during the final measurements of Bay 1 guides. Although the issue was unknown during the alignment work, the resulting difficulty in completing the critical path guide alignments added time and inefficiency to the work. These issues were memorialized in a series of sixteen Canmec non-conformance reports (NCRs) ranging from NCR-174-188-13 through NCR-174-188-30, and have been acknowledged by Company as their responsibility.²¹

In addition to the acceleration of the gate guide work, during this period beginning in March 2016 Andritz began performing mechanical equipment, electrical, and downstream guide installation concurrently with completion of the upstream guide work. This was not anticipated in the Baseline schedule or resource planning. The benefit of this concurrent performance of work on multiple work fronts and locations resulted in further acceleration is discussed and quantified in Section 2.5.5 below.

Table 4: Delay through May 20, 2016

Delay Issue	Description	Total Delay	Period Delay	Responsibility	
				Company	Andritz
	Total Delay Issues 1 - 3:	82		65	17
4	Schedule Recovery to Completion of Upstream Guide Pours				
	a. Canmec/CRT Guide Alignment and Concrete Acceleration Effort		(50)		(50)
	Total Delay Issue No. 4:	(50)	(50)	-	(50)
	Total Delay Issues 1 - 4:	32		65	(33)

2.5.5 Progress as of July 17, 2016 – Ready for River Diversion

Figure 10 measures the progress of work as of July 17, 2016, when Andritz and Canmec demobilized from the upstream area to allow for the Company’s river diversion preparation activities to proceed per Company’s direction.

²¹ Exhibit 8 - LTR-CH0032001-0415; “Company would like to clarify that pursuant to NCR-174-1888-13, verticality alignment rather than overall condition rests only with the company.”

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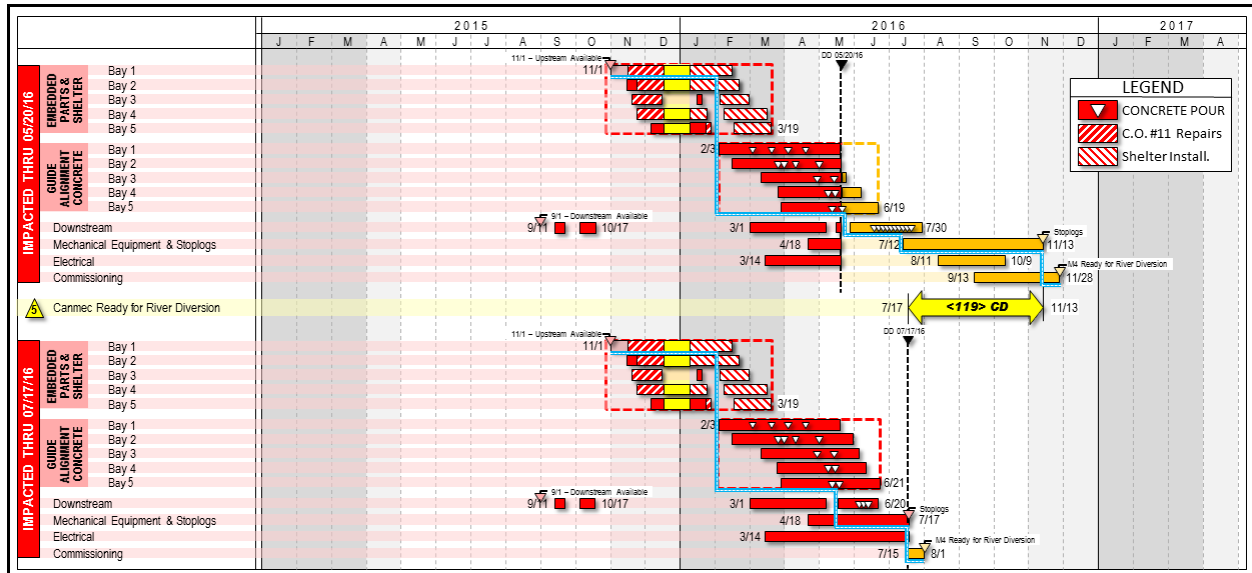


Figure 10: May 20, 2016 Progress vs. July 17, 2016 Progress

Delay No. 5: Complete Mechanical Equipment for River Diversion

Delay Period 5: 05/20/2016 – 07/17/2016

Calendar Days (CD) Delay: <119> CD Period Delay Reduction, <87> CD Total Delay

Per the June 25, 2015 schedule update, the critical path installation of all mechanical equipment and stoplogs prior to river diversion was scheduled to be accomplished 177 days after the gate guides were complete and after the final upstream concrete pour. **Figure 10** shows that based on the Bay 5 upstream concrete pour on May 20, 2016, the stoplogs would be expected to be installed on November 13, 2016 had Andritz performed in the planned sequence with the planned resources and conditions rather than accelerate the work.

Canmec actually completed the majority of the mechanical equipment, the downstream guides, and installed the Bay 5 stoplogs on July 17, 2016, which is 119 days sooner than anticipated in the updated June 25, 2015 schedule, and thus allowed for river diversion activities to proceed. This time savings was primarily achieved by completing much of the roller gates, towers, hoist and bridge erection concurrently with completion of the accelerated upstream guides and downstream guides. Performing all of these work fronts concurrently, on two shifts, and while the guide work was still underway was never contemplated in Andritz’ or Canmec’s plan or accommodated in the budget for the project.

The downstream work was completed earlier than scheduled and off the critical path by 1) erecting and bolting the guides during September and October 2015 and 2) erecting the shelter panels concurrently

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with the upstream guide alignment and concreting work. The overall result of the resequencing was to remove 53 days from the spillway critical path shown in the updated June 25, 2015 schedule²².

On May 29, 2016, the Company’s civil contractor’s crane collided with the upper tower section installed by Canmec. Critical path mechanical work was suspended while Canmec removed the damaged tower section so that civil contractor’s crane could be dismantled, which hindered progress by delaying the installation of other tower sections and roller gates. Critical mechanical equipment erection work with the crane did not resume until 10 days later on June 8, 2016.

The mechanical erection work was accelerated by starting at Bay 1 immediately after the final Bay 1 upstream concrete pour was made on April 18, 2016, rather than waiting until all the concrete work in all the upstream and downstream bays were complete. This work was performed concurrently with ongoing guide installations in Bays 2 through 5. Canmec’s efforts to re-sequence and accelerate the mechanical work overcame the crane collision delay and improved the schedule by 76 days.

To accomplish the acceleration, Canmec maintained the manpower levels that were more than double the budget, and continued night shifts and overtime as described and quantified in the Andritz February 16, 2017 Request for Compensation.

Table 5: Delay through July 17, 2016

Delay Issue	Description	Total Delay	Period Delay	Responsibility	
				Company	Andritz
	Total Delay Issues 1 - 4:	32		65	(33)
5	Schedule Improvement to Ready for River Diversion				
	a. Resequencing Downstream Work		(53)		(53)
	b. Crane Collision with Tower		10	10	
	c. Accelerated Mechanical Equipment and Stoplogs		(76)		(76)
	Total Delay Issue No. 5:	(119)	(119)	10	(129)
	Total Delay Issues 1 - 5:	(87)		75	(162)

2.5.6 Progress as of November 1, 2016 –Operational Completion of Spillway

Figure 11 shows the as-built progress of the work through November 1, 2016, when Andritz achieved operational completion of the spillway.²³

²² The June 25, 2015 schedule update included 53 days between completing the Bay 5 concrete pours on April 18, 2016 and beginning the mechanical work on June 10, 2016. The schedule depicts a workflow where the upstream alignment and concrete crews move to the downstream guides.

²³ Exhibit 9 - Andritz letter AH-Letter-PM-320 re: Ready for Winter Headpond Operation

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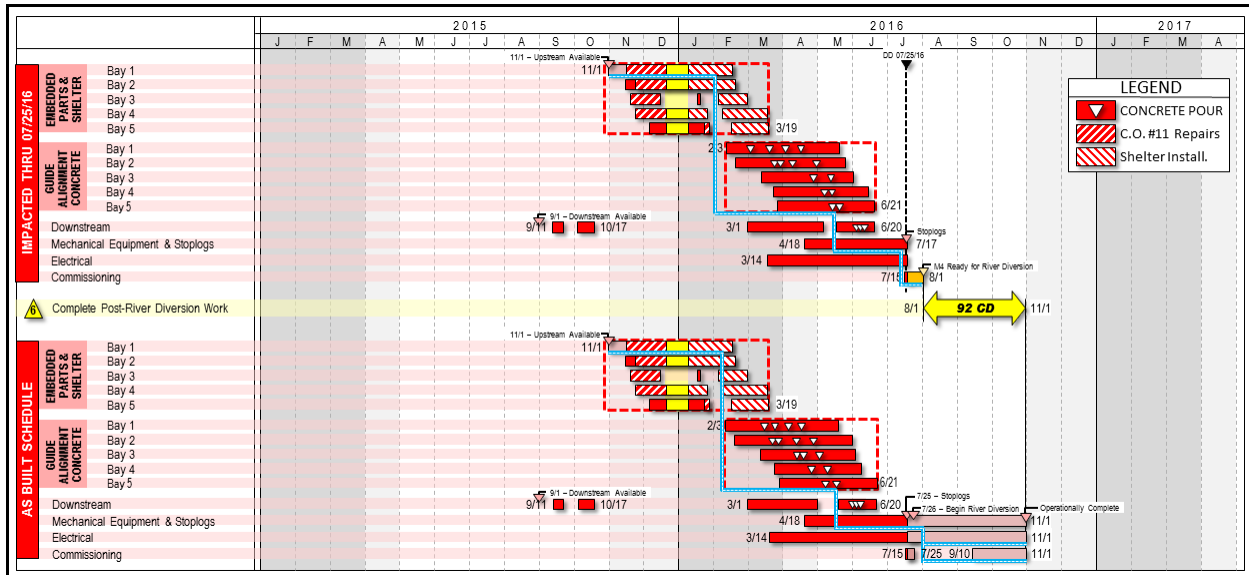


Figure 11: July 17, 2016 Progress vs. As-built

Delay No. 6: Achieve Operational Completion of Spillway

Delay Period 6: 07/17/2016 – 11/1/2016

Calendar Days (CD) Delay: 92 CD Period Delay, 5 CD Total Delay

Per the June 25, 2015 schedule update, the installation, dry commissioning and storage of the stoplogs was planned to be the final Canmec work prior to river diversion. The schedule included additional time, 13 calendar days, for Andritz to complete remaining commissioning and perform final walk-down inspections prior to achieving Milestone M4 Ready for River Diversion.²⁴

Actually, as shown in **Figure 11**, the electrical and commissioning work continued beyond river diversion in August through October 2016, and Operational Completion was achieved on November 1, 2016 upon meeting the requirements for winter headpond. This equates to a 92-day extension of the work beyond river diversion.

On November 10, 2015, Company issued Change Order No. 10, Acceleration of Spillway Installation Schedule to Meet River Diversion Requirements On/Or Before 15 June 2016, which introduced the concept of dividing Milestone M4 into two phases 1) Partial Completion for River Diversion by June 15, 2016, and 2) Completion of Milestone M4 Requirements by October 31, 2016. Andritz and Company could

²⁴ Schedule Activity ID AH001 'AH Check – M4' starting October 14, 2016 thru October 27, 2016.

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not settle on the cost or terms of the acceleration, and the M4 Minimum was not incorporated into the contract.

Although Andritz accelerated at Company’s direction and mitigated months of Company’s delay, as demonstrated above, Andritz was not entirely complete with the minimum scope for river diversion on June 15, 2016, as defined in CHO-010 and in the submitted Andritz acceleration proposals. Andritz notified the Company on July 10, 2016, that they would not be complete with this work and ready for river diversion until August 5, 2016. **Figure 12** depicts the schedule update presented to the Company, dated July 10, 2016, which forecast four weeks of work before Andritz would be ready for river diversion, with exception of the trash cleaning machine, electrical building and gate heaters, which would be complete by November 20, 2016.

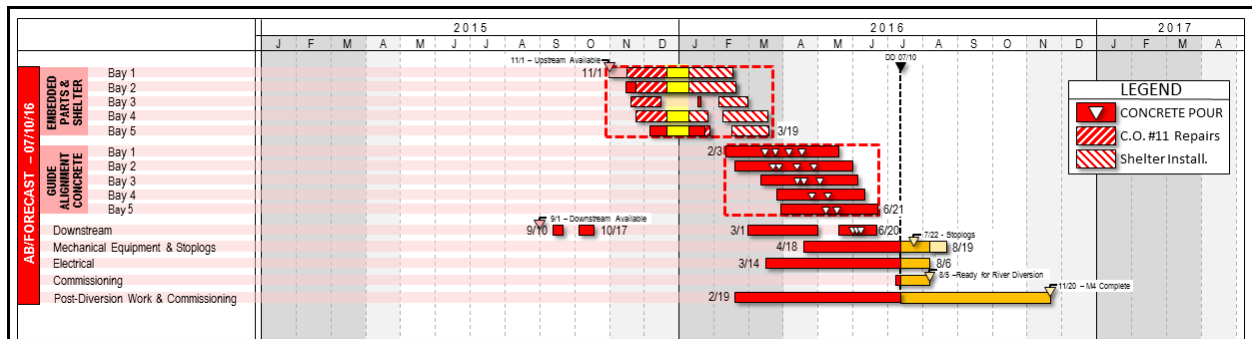


Figure 12: Summary of July 10, 2016 Schedule Update

On July 13, 2016, Company informed Andritz that start of the watering up of the spillway will take place on July 17, 2016 regardless of the work remaining. Accordingly, Andritz continued the night shift and acceleration of mechanical equipment erection and stoplog dry commissioning to be mechanically complete and removed all equipment and supplies from the upstream spillway by the Company’s mandated July 17, 2016 date. The Company then proceeded to make its preparations clearing the spillway and commenced diverting the river between July 26, 2016 and August 3, 2016.

Between July 17 and July 26, 2016 Canmec moved the large crane to the downstream side and continued with the tower and hoist installation activities, where possible, while the Company worked clearing and preparing the upstream spillway. All remaining work was completed from the bridge and with water flowing through the spillway, conditions that were never anticipated in the contract.

The work after August 3, 2016 was no longer performed in an accelerated fashion. Since 95% of Canmec’s work was complete, their manpower was reduced to a minimum and single shifts were worked. The remaining critical work was electrical and commissioning work. With the spillway being operated, this work was protracted and disrupted greatly do to only a single bay being available for closure at a time,

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Company’s gate operations to control water flow, and mandatory means and methods changes to perform all work from the bridge, over the water, greatly congesting access.

During the post-river diversion period, Canmec performed welding and repair work related to the dogging devices in each bay. Although this work is not the responsibility of Company, the execution of this work was complicated by the early river diversion and the availability of gate closures. Regardless, this work did not impact the critical path which was in the completion of the electrical building and commissioning activities.

Andritz’ February 16, 2017 Request for Compensation, Section 6.4, describes in detail the impacts and added scope required after the premature watering up of the spillway. Due to the drastically changed and unanticipated conditions the during this last period after water up and the lack of access to Bays, the progress of completing the electrical and commissioning required for operational completion was extended three months. During this final three months, the Company was proceeding with its critical work outside of the spillway, but the consequence was greater expense to Andritz.

The premature water-up was the Company’s choice based on its overall Project priorities. Therefore, rather than allowing Andritz to complete the commissioning work in three weeks to a month working in multiple bays, the Company chose to change the conditions, which increased Andritz costs and added 92 days to the period of performance.

Table 6: Delay through November 1, 2016

Delay Issue	Description	Total Delay	Period Delay	Responsibility	
				Company	Andritz
	Total Delay Issues 1 - 5:	(87)		75	(162)
6	Achieve Operation Completion of Spillway				
	a. Early River Diversion / Working Above Spillway		92	92	
	Total Delay Issue No. 6:		92	92	-
	Total Delay Issues 1 - 6:	5		167	(162)

2.5.7 Summary of Delays and Acceleration

Table 7 summarizes the delay and acceleration achieved after the initial 258-day delay to start of the critical path upstream work on November 1, 2015.

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Table 7: Summary of Delays and Acceleration

Delay Issue	Description	Total Delay	Period Delay	Responsibility	
				Company	Andritz
1	Delay to Start of Bay 1 Shelter	36	36	36	-
2	Delay to Begin Bay 1 Guide Alignment	64	28	17	11
3	Delay to First Concrete Pour	82	18	12	6
4	Schedule Recovery to Completion of Upstream Guide Pours	32	(50)	-	(50)
5	Schedule Improvement to Ready for River Diversion	(87)	(119)	10	(129)
6	Achieve Operation Completion of Spillway	5	92	92	-
Total Delay Issues 1 - 6:		5		167	(162)

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3 Analysis of Acceleration Achieved

Andritz and its subcontractors accelerated the work at the Company’s direction. After the anchor bolt change order work and shelter installation, the critical path guide alignment, concrete pours, mechanical equipment installations were performed in 50% of the original planned duration as described above and summarized in **Figure 13** below. With this acceleration, the Company’s directive of river diversion was accomplished in July 2016.

It is important to note that had the Company not directed acceleration, therefore had it not forced Andritz to add resources, the schedule would have been impacted by as much as 100 days due to the shift of the critical volume of work into the winter period and further due to Change Order No. 11.²⁵ This means that the acceleration by Andritz measured below is actually understated by measuring to the unimpacted June update schedule.

Additionally, this analysis does not quantify the productivity losses and labor inefficiencies experienced during the acceleration effort. The resulting inefficiencies caused by the directed acceleration had to be overcome to reduce the period of performance as measured in **Figure 13**.

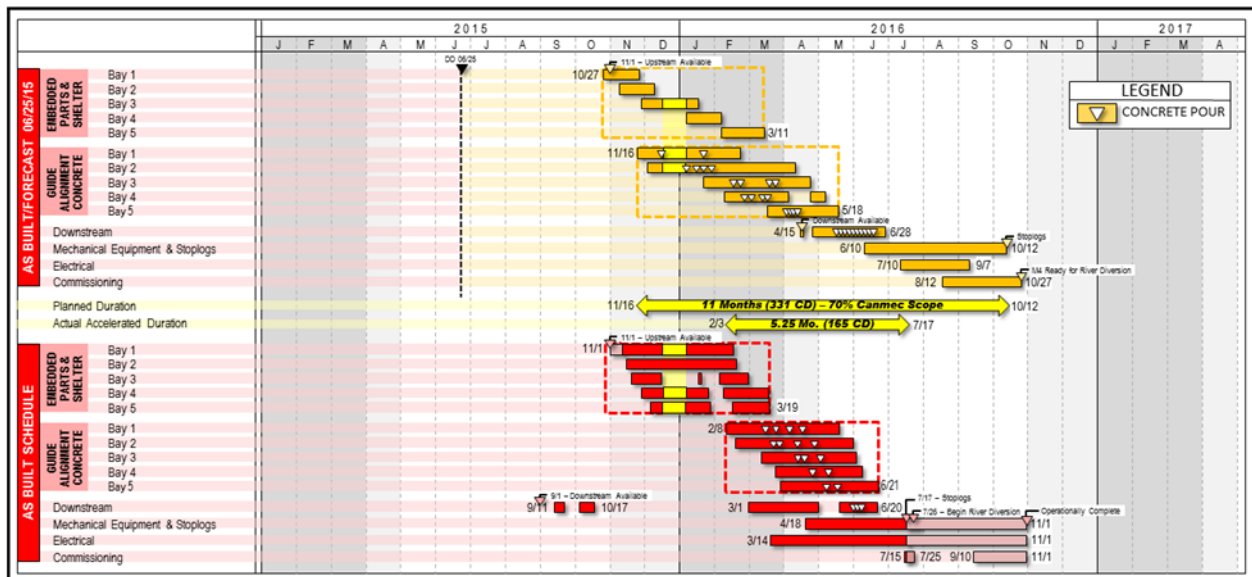


Figure 13: Andritz June 25, 2015 Baseline Schedule Update vs. As-Built

The Company’s directive was to complete all work required for river diversion by June 15, 2016. Andritz prepared a proposed preliminary acceleration schedule in December 2015 for attempting to accomplish

²⁵ See Andritz Extension of Time Request

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this directive. This schedule included the Change Order 11 work, and forecasted the required acceleration to meet the Company’s directive. The December proposal and schedule also laid out the assumptions and prerequisites required to facilitate the acceleration. The prerequisites were also outlined by Canmec and Andritz during the discussions of potential acceleration. Even though the prerequisites were not provided by the Company, counter to the assumptions in the December proposal schedule, a comparison of the acceleration forecast in December to meet the Company’s directive with the actual acceleration achieved is necessary and useful.

Figure 14 compares the December 2015 proposal schedule with the as-built schedule.

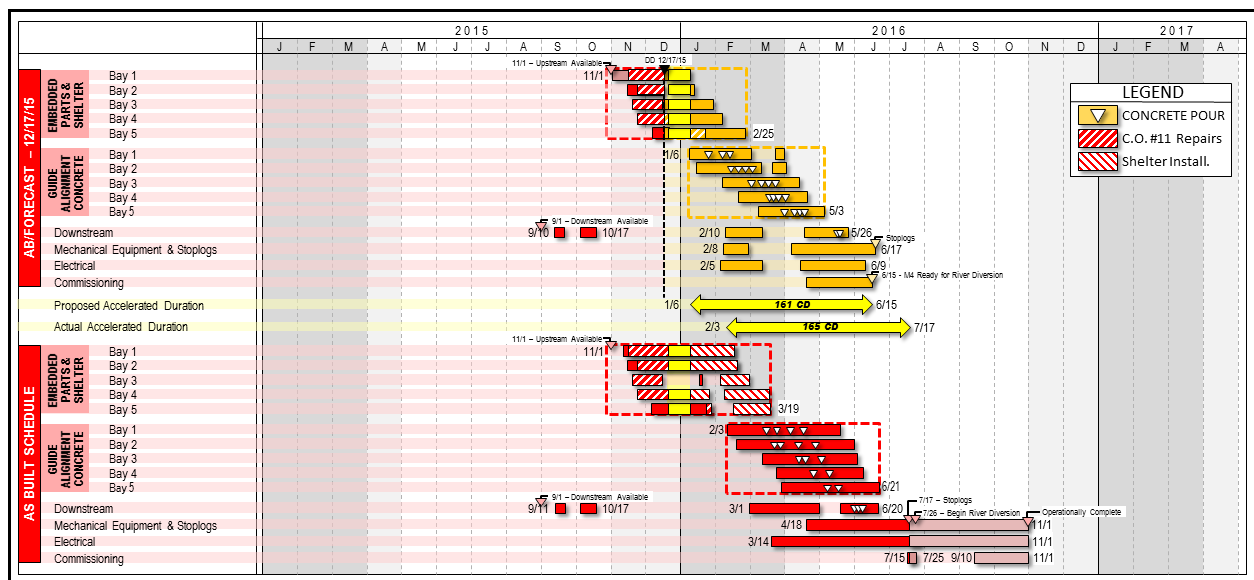


Figure 14: December 2015 Preliminary Acceleration Proposal vs. As-Built

The top portion of Figure 14 summarizes the December proposal schedule and measures that in order to achieve the Company’s directive, the critical path work starting with guide alignment in January 2016 through installation of mechanical equipment and dry commissioning, which was 70% of Canmec’s work, would need to be completed in 161 calendar days. This would facilitate preparation for river diversion by June 15, 2016.

In the as-built schedule, first, the Company did not provide the required 60 day notice or the prerequisite conditions outlined by Canmec and Andritz (i.e. all civil work complete and clear from the spillway), and second, the start of the guide alignment work was delayed until February 3 for the reasons discussed in Sections 2.5.1 and 2.5.2 above. Once started on February 3, one month late, the critical path work starting of guide alignment through installation of mechanical equipment and dry commissioning was completed,

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but for a very small but crucial amount of work, in 165 days and by July 17, 2016, one month later than the original directive.

The Andritz February 16, 2017 Request for Compensation details the lack of preconditions that were accounted for in the submitted acceleration proposal schedules. The accelerated duration directed by the Company removed all float and flexibility from the schedule and work sequences, which added schedule risk for all parties. This meant that issues and occurrences during construction of the project that would not normally effect overall progress had a direct impact on both progress and productivity because there was no room to absorb as there would have been in the original plan. Additionally, on this project, Andritz had to regularly and continually modify its daily work plan to accommodate instructions or information received from Company, further disrupting Andritz' coordination, planned work activities and progress.

Even with these additional factors hindering progress, Andritz accomplished the directive to accelerate the critical work to a duration of 165 days, it was just started and completed one month later than forecast for the reasons outlined in this document.

Therefore, the acceleration effort and associated costs were expended in accordance with the original directive to accelerate. Meaning that Andritz and Canmec would have still expended the acceleration costs and experienced the associated inefficiencies to reduce the critical path duration to 161 days between January and June 15, 2016 without the additional duration for the installation of the hoarding in January 2016. The actual critical path duration for that work was nearly exactly that, 165 days, but started and finished one month later and with additional unforeseen impacts and greater inefficiencies experienced and overcome.