APPENDIX 2-6

ANDRITZ
Hydro

August 19th, 2015 **AH -Letter– PM- 031**

Muskrat Falls Corporation
Lower Churchill Project Muskrat Falls Corporation
350 Torbay Road Plaza, Suite No. 2
St. John's, NL, A1A 4E1

Attention: Scott O'Brien – Project Manager, Muskrat Falls Generation

Reference: CH0032: Supply and Install Powerhouse and Spillway Hydro-Mechanical Equipment

Subject: 1) Acceleration of Spillway Installation Schedule Proposal - Preliminary

Dear Mr. O'Brien,

Please find attached Contractor's Acceleration of Spillway Installation Schedule Proposal – preliminary version for Company's review and consideration.

Yours truly,

Bill Mavromatis
Project Manager
Andritz Hydro Canada Inc.

ATTACHMENTS: 1) Acceleration of Spillway Installation Schedule Proposal – Preliminary (46 pages)
2) Accelerated Spillway Schedule (1 page)

CC: Frank Gillespie, LCP Deputy Company Representative/Area Manager
Bruce Drover, LCP Package Leader - Hydro Mechanical Equipment
Line Tremblay, LCP Senior Contract Administrator
Nicole Hu - AH Commercial Manager
Jean-Francois Harpin – AH Large Hydro Manager Operations

Andritz Hydro Canada Inc.
6100, aut. Transcanadienne
Pointe-Claire, Qc, Canada, H9R 1B9
Phone: 514 428 6822
Fax: 514 428 6713
www.andritz-hydro.com
william.mavromatis@andritz.com

SUPPLY AND INSTALL AGREEMENT
LOWER CHURCHILL PROJECT
MUSKRAT FALLS HYDROELECTRIC DEVELOPMENT
Agreement No.: CH0032-01

CHANGE REQUEST
ACCELERATION OF SPILLWAY INSTALLATION SCHEDULE

PRELIMINARY

WITHOUT PREJUDICE

Prepared by:

Bill Mavromatis
Project Manager
Large Hydro Division

Andritz Hydro Canada Inc.
6100, aut. Transcanadienne
Pointe Claire, QC, Canada , H9R 1B9

AUGUST 17th , 2015

TABLE OF CONTENTS

1. PROJECT CONTEXT AND PURPOSE OF THIS DOCUMENT

1.1 Overview

The Muskrat Falls Corporation the "Company" awarded a contract the "Agreement" to Andritz Hydro Canada Inc. the "Contractor" for the design, supply and installation of the spillway and powerhouse hydro-mechanical equipment for the Muskrat Falls Hydroelectric Project.

The Agreement established the conditions for the execution of the works, and under the Agreement, Contractor was to start the upstream spillway installation works on February 16, 2015.

Change Order No: 06 issued by the Company on March 18, 2015 directed Contractor to delay the start of the site mobilization on the spillway upstream and subsequent installation phases until a revised schedule was issued by Company. In June 2015, Contractor was advised by Company that the delays in the civil works had delayed the start of the installation work on spillway upstream by approximately 37 weeks.

In order to limit the impact of delays on the project and achieve Company's 2016 river diversion schedule, Company requested Contractor to submit a proposal to execute the spillway works as follows:

(i) start the downstream portion of the works on September 1st, 2015;
(ii) start the upstream portion of the works on November 1st, 2015; and
(iii) implement an accelerated schedule to achieve spillway hydro-mechanical and electric systems readiness for river diversion by July 1st, 2016.

This schedule acceleration program proposal has been developed by the Contractor in response to Company's requests.

1.2 Acceleration and Changed Execution Conditions - Additional Costs

Additional expenditures and costs would be incurred to achieve a schedule reduction in the spillway installation duration. Additional labour, staff and equipment resources, must be applied over a shorter period within the same workspace creating congestion and less efficient labour management. This will result in an overall decrease of labour and staff productivity. Moreover, the change to the spillway installation start date from February 16th 2015 to November 15th 2015 results in more work being performed under less favourable climatic conditions during the installation period, further reducing the expected productivity of the labour and staff. The additional labour costs resulting from the change in climatic conditions have been amalgamated in the total price of this proposal. These costs will be claimed by Contractor separately in the event there is no agreement on the acceleration program.

The detailed calculations of the additional costs supported by industry references are presented in articles 3 and 4 of this proposal.

1.3 Lump Sum Price and Bonus

The acceleration program is quoted on a lump sum basis as presented in article 8 of the proposal. The lump sum would be payable to the Contractor regardless of the actual completion dates of any of the works on the spillway. In addition to the lump sum price, the Contractor proposes a sliding scale performance bonus that will be payable to the Contractor only if the readiness for river diversion partial completion criteria is achieved on or before July 30th, 2016. The bonus proposal is described in article 5 of this proposal.

Payment terms for lump sum are as follows;

- i) 50% payable upon signing of the agreement
- ii) 50% monthly payments based on spillway installation progress

1.4 Open Commercial Topics

Contractor cannot embark on an accelerated program before having reached an agreement in principle for its entitlement resulting from the current project delay (e.g. Change Order No 6). Consequently, the following open commercial topics must be resolved as part of this acceleration agreement.

- i) Confirmation by Company of the Principles behind the Contractor's Extension of Time cost compensation entitlements;
- ii) Any unresolved concurrent delay topics (e.g. Company's notification of late delivery of the spillway tower anchors – letter LTR-CH0032001-039);
- iii) Timely resolution of other related technical or commercial issues (e.g. … Contractor's Control Philosophy and Remote I/O changes)

Note: this acceleration lump sum proposal does not include cost impacts related to the delay to the start of the installation activities, nor does Contractor require that these quanta be agreed in advance; the financial consequences of the delay will be submitted to the Company through a separate Change Order as specified in Change Order No: 6, in accordance with the principles to be agreed per this article.

1.5 Incomplete Proposal - Pricing

The Contractor has contracted the spillway installation work to 3 subcontractors and is in the process of awarding a fourth contract for the installation of the electrical scope;

CANMEC – Mechanical Installation
CRT – 2nd Stage Concrete
GRIMARD – Spillway Electrical Building
TBD – Electrical Installation

The acceleration requested by Company and the changed site conditions affect all four installation subcontractors. Contractor at this time has received pricing details only from mechanical installer, CANMEC. Since CANMEC's installation scope is the most relevant to the schedule critical path and has the earliest start date, Contractor recommended to proceed with the evaluation of the mechanical installation first, and will follow-up with the pricing information from the other installation subcontractors as they become available to complete the proposal. Contractor expects to have the complete proposal pricing for presentation by August 31st, 2015.

2. READINESS FOR RIVER DIVERSION – SPILLWAY PARTIAL COMPLETION CRITERIA

Company has not yet provided ready for river diversion partial completion criteria. In order to proceed with the development of the acceleration plan Contractor has assumed the criteria below. The detailed criteria from the Company will still need to be provided and mutually agreed to by the parties prior to implementation of the acceleration program;

i) Five spillway gates dry testing completed. Gates can be raised and lowered by manual controls and temporary power.
ii) Mechanical and electrical hoist protection systems are operational.
iii) Spillway stoplogs dry testing completed.

The following systems are not considered to be partial completion requisites and can be completed by the adjusted Milestone M4 date;

i) Gate Heating System; all components are installed in gates prior to river diversion readiness but are not operational.
ii) Electrical Load Management System.
iii) Spillway Electrical Building.

3. ADDITIONAL LABOUR, STAFF AND EQUIPMENT COST DETAILS

3.1 Direct Labour Costs

3.1.1 Mechanical Installation (CANMEC)

Labour productivity is dependent upon several factors which affect performance. In order to evaluate the cost impact of these factors, Contractor analysed the factors related to the reduced installation duration and changes in climatic conditions resulting from the change to the installation start date.

a) Change in Climatic conditions

The ability of a worker to carry out a task is optimal when the ambient temperature is between 10°C and 21°C. Any deviation from this zone has an unfavourable impact on productivity.

Many studies have confirmed the negative impact of cold on productivity, including that of the N.R.C. (see Appendix No.1) which proposes different productivity loss coefficients depending on the effective temperature and type of work (involving fine or gross motor skills).

The changes to the execution conditions will result in a larger portion of the work being carried out under winter conditions, compared to that planned under the Agreement schedule. This will result in reduced productivity therefore increased labour costs.

Refer to Table 3.1 of CANMEC Appendix 2 & 3 for the productivity calculations pertaining to the spillway downstream and upstream respectively.

b) Learning curve

The first time a task is carried-out, personnel assigned to this task perform it slower in order to learn the various steps. After repetition, the time necessary to carry out the same task decreases with the number of repetitions (learning curve). To optimize productivity, it is thus preferable to assign tasks repeatedly to the same person rather than change worker.

The phenomenon of learning applies when activities are carried out in sequence, otherwise we observe a phenomenon of unlearning; a greater number of workers having to learn a task, results in a decreased efficiency compared to that which could have been achieved under optimal circumstances.

Several studies have shown the effect of the learning curve on productivity, including the N.R.C. (see Appendix No.1) which offers coefficients for productivity gain based on number of repetitions.

The implementation of acceleration measures in the spillway works will alter the execution sequences of the work and thus deprive the Contractor of a portion of the productivity gain to be obtained through learning.

Refer to Table 3.2 of CANMEC Appendix 3 for the productivity calculations pertaining to the spillway upstream.

c) Effect of increase in resources (overstaffing)

The mobilization of teams larger than the optimal size, as well as the increase in the number of teams, negatively impacts the quality of supervision and thus harms productivity.

To optimize productivity, it is preferable to mobilize a team sized to correspond to the minimum number of workers required to complete a task at the least cost and within the necessary timetable.

Several studies, including the N.R.C. (see Appendix No.1) have confirmed the impact of excess labour (overstaffing) on productivity. The N.R.C. study provides productivity loss coefficients for the extent of increase in resources relative to the optimal staffing.

The implementation of the acceleration plan for the delays in the spillway works require the mobilization of a larger number of workers, as well as an increase in the number of work teams, with a corresponding negative impact on productivity.

Refer to Table 3.3 of CANMEC Appendix 3 for the productivity calculations pertaining to the spillway upstream

d) Crowding

The multiplication of work teams, which must complete their tasks within a limited space, creates congestion and a loss of productivity.

Several studies confirm the impact of crowding on productivity, notably that of the N.R.C. (see Appendix No.1) which proposes different productivity loss coefficients depending upon the degree of crowding.

The implementation of acceleration program require the mobilization of a greater number of workers within the same limited space, thus creating congestion with a negative impact on productivity.

Refer to Table 3.4 of CANMEC Appendix 3 for the productivity calculations pertaining to the spillway upstream

3.1.2 2nd Stage Concrete (CRT)
(To be submitted later)

3.1.3 Spillway Electrical Building (GRIMARD)
(To be submitted later)

3.1.4 Electrical Installation (ANDRITZ HYDRO)
(To be submitted later)

3.1.5 Others
(To be submitted later)

3.2 Indirect Labour, Staff and Equipment Costs

3.2.1 Mechanical Installation (CANMEC)

The implementation of mitigation measures due to the project delays requires the mobilization of additional resources (indirect labour and equipment) to complete the work compared to the quantity of resources that would have been required under the original Agreement schedule.

Refer to Tables 5, 6 & 7 of CANMEC Appendix 3 for the Indirect Labour, Staff and Equipment cost details

3.2.2 2nd Stage Concrete (CRT)
(To be submitted later)

3.2.3 Spillway Electrical Building (GRIMARD)
(To be submitted later)

3.2.4 Electrical Installation (ANDRITZ HYDRO)
(To be submitted later)

3.2.5 Others
(To be submitted later)

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4. OTHER COST IMPACTS

4.1 Mechanical Installation (CANMEC)

4.1.1 Contingencies

Contractor has determined a large part of the impact costs based on well-known studies by the N.R.C., an independent and objective organization. However, as these studies include a certain degree of uncertainty and Contractor must assume any risk for potential variations in cost. A contingency of 7.5% has been included in the estimate of impact costs.

4.2 2nd Stage Concrete (CRT)
(To be submitted later)

4.3 Spillway Electrical Building (GRIMARD)
(To be submitted later)

4.4 Electrical Installation (ANDRITZ HYDRO)
(To be submitted later)

4.5 Others
(To be submitted later)

5. SUPPLEMENTAL PERFORMANCE INCENTIVE - BONUS

Contractor recommends a bonus amount equal to $50,000/day for each day spillway ready for river diversion readiness is achieved prior to July 30th, 2016. The bonus amount would be capped at $1,500,000.

6. ADJUSTED EXHIBIT 9 MILESTONE DATES FOR SPILLWAY

6.1 Spillway Milestone Dates

The Agreement milestone dates are to be adjusted to reflect the delay in access to the site, which is now expected to be 258 days (February 16, 2015, to October 31, 2015). The adjusted Agreement Milestones per Exhibit 9 are as follows;

MILESTONE I1A – Upstream of Spillway ready for start of hydromechanical works: November 1st 2015
MILESTONE I1B
- i) Downstream of Spillway, Completion of Spillway piers and walls (downstream 1/3) including both Downstream Bridges and Access Ramp Retaining Wall: September 1st 2015
  ii) Completion of North Transition Dam, Northern 2 Monoliths of Center Transition Dam including the Electrical Building Platform: November 1st 2015

MILESTONE M4 – Spillway all hydro-mechanical and electrical systems commissioned and ready for river diversion – October 28th 2016

The date for Liquidated Damages for Delay and Performance Incentive for completion of Milestone M4 as per Article 11 of the Agreement is to be adjusted to 28 Oct 2016

6.2 Concurrency with Powerhouse Installation Work

The implementation of the acceleration program is contingent on the Contractor completing the mechanical installation work on the spillway prior to starting work on the Powerhouse Draft Tube or Intake. Contractor is not making any provisions to perform mechanical installation work on the Spillway and Powerhouse concurrently.

7. ACCELERATED SCHEDULE FOR SPILLWAY

Accelerated schedule will be submitted to Company on August 18th, 2015.

8. LUMP SUM PRICE SUMMARY

	CANMEC	CRT	Grimard	Andritz Hydro	Others
Additional Labour Cost	4 371 586 $	-	-	-	-
Additional Indirect Labour/Staff Cost	703 405 $	-	-	-	-
Additional Equipment Cost	2 602 328 $	-	-	-	-
Other Costs	(96 305 $)	-	-	-	-
Contigencies	674 104 $	-	-	-	-
Contractor's 15% Mark-up	1 238 268 $				
Sub-total Lump Sum Price	**9 493 385 $**	TBA	TBA	TBA	TBA
GRAND TOTAL LUMP SUM PRICE	TBA				

9 APPENDICES

9.1 CANMEC

i) APPENDIX No.1: N.R.C. Study

ii) APPENDIX No.2: Spillway Downstream – Schedule and Cost Impacts

iii) APPENDIX No.3: Spillway Upstream – Schedule and Cost Impacts

CANMEC

ANALYSIS OF IMPACT COSTS
SPILLWAY
(UPSTREAM AND DOWNSTREAM)

APPENDICES

APPENDIX No.1: N.R.C. Study

APPENDIX No.2: Request No.3 - Downstream

APPENDIX No.3: Request No.3 - Upstream

July 27, 2015

SUPPLY AND INSTALL SUBCONTRACT
LOWER CHURCHILL PROJECT
MUSKRAT FALLS HYDROELECTRIC DEVELOPMENT
Agreement No.: CH0032-01

REQUEST FOR COMPENSATION No.3

ANALYSIS OF IMPACT COSTS
SPILLWAY
(UPSTREAM AND DOWNSTREAM)

APPENDIX No.1

N.R.C. STUDY

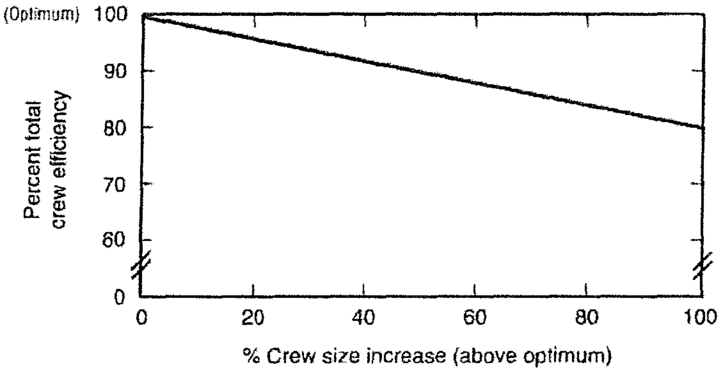
July 27, 2015

work week reduces on-site population, decreases overall time for completion, reduces equipment demands, and avoids fatigue by cycling different groups of employees every 4 days.

3.2.4.2 Overstaffing

Overstaffing occurs when more workers are assigned to a task than are required to work productively. Overstaffing may take the form of increased crew size (for a given operation) or the deployment of multiple crews; in either case, a loss of productivity will occur. Figure 3.1 shows the effect of increasing crew size over the number required to perform a task within the allocated time.

Figure 3.1. Effect of crew overloading (overstaffing)



Adapted from: U.S. Department of the Army Office of the Chief of Engineers. 1979. *Modification Impact Evaluation Guide*. Washington, D.C. 20314, p. 4-14.

Optimum crew size for an activity represents a balance between an acceptable rate of progress and the highest possible level of productivity. Experience shows that on a greatly overstaffed project, the rate of progress may, at times, be improved by reducing the number of workers or equipment on the site. Overstaffing dilutes supervision, slows down material delivery because of competing demands and, in general, affects the morale of the workers.

The optimum crew size is the minimum number of workers required to economically complete a task within the scheduled time frame. As the number of workers is increased or decreased from optimal level, productivity will vary proportionally.

3.2.4.3 Stacking of trades

Stacking of trades (creating congestion) is a problem that develops when different trades, which should be working sequentially, are obliged to work simultaneously in a limited work space. When this occurs, the work area becomes smaller (or at least, appears so) because all trades are trying to bring in the material required for their work. Each trade tries to complete its work but the sequence of their activities is not coordinated. As a result, newly completed work often has to be torn out. Such congestion can also give rise to unsafe practices and conditions and leads to lost productivity in all trades involved.

3.2.4.4 Crowding

Crowding can be considered in a manner similar to the scheduled acceleration of tasks because the contractor attempts to complete more work activities in the same period of time or a designated amount of work in a shorter period of time. More workers are placed in a given space than can function effectively.

Figure 3.2 illustrates the upper limit of the loss in efficiency with the percentage of crowding. The meaning of crowding is subject to a wide interpretation. Crowding occurs when the work space per worker is reduced below a minimum required to work effectively. For example, if 18 workers are in an area that can only accommodate 15, the overcrowding is 3/15 = 20%. According to Figure 3.2, 20% overcrowding results in an 8% efficiency loss, which is equivalent to an 8% increase in the normal duration of all activities being performed in the work area during the period of overcrowding.

(Figures 3.1 and 3.2 are meant to serve only as a general guide; no precise information should be derived from them.)

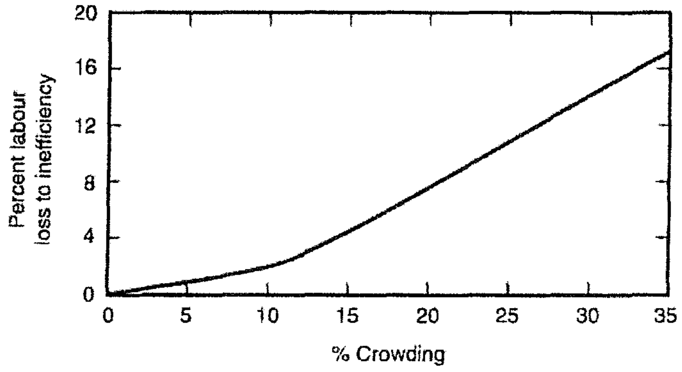
3.2.4.5 Multiple shifts

Introducing multiple shifts is another less distractive way of adding more workers to the workforce. Double- or even triple- shifting can be a reasonably economical method of accomplishing more work within the same period of time, but depending on the type of work, it can also give rise to a chaotic situation. Trades requiring fine motor skills are ill-suited for double-shifting; where activities require high precision, overall output may be even lower with a double shift than it would have been with a single. Gross motor skill trades, on the other hand, and equipment operation, such as bulk excavation or building an earth-fill dam, can be double-shifted very effectively.

A second shift, one that starts after the regular shift (i.e., after 5:00 p.m.) is less productive than the regular shift. People who work shifts face many problems that other workers do not. These problems come from changing eating, sleeping, and working patterns.

When shift cycles are changed, the first several days are periods of change and employees will be less alert, less accurate, and less safe. Sometimes shift rotation is invoked as a means to be fair to all workers, but it is actually unfair. It takes almost a month for the human body to

Figure 3.2 Effect of congestion of trades (crowding)



Adapted from: U.S. Department of the Army Office of the Chief of Engineers. 1979. *Modification Impact Evaluation Guide.* Washington, D.C. 20314, p. 4-14.

adjust to a different schedule. Moving workers back and forth from shift to shift does not let them adjust to a schedule and consequently they will not perform at their best.

3.2.4.6 Stop-and-go operation

Stop-and-go operation occurs when an essential component of an activity is not available when it is required. The component might be a drawing, a decision about a contemplated change, the acceptability of workmanship, pre-purchased material, or equipment. The activity is halted temporarily and the crew moved elsewhere to a new task. Breaking the rhythm, taking time to make a decision on the next step (usually referred to as reaction time), packing up tools, moving to the next activity, unpacking, orientation, and obtaining the required supplies, are all non-productive activities. Additional labour input is required without a corresponding increase in output, resulting in a net loss of productivity. At times, losses can be in the order of 30 to 40%.

3.2.5 Absenteeism and turnover

The major reasons for absenteeism, listed here in order of importance in the construction industry, are:

1. personal or family illnesses
2. poor overall management
3. poor supervision
4. excessive travel distance to the job site
5. excessive rework
6. unsafe working conditions.

The major reasons for turnover in the construction industry, also listed in order of importance, are:

1. inadequate tools and equipment
2. excessive owner surveys of on-site work
3. poor planning
4. poor overall management
5. mediocre supervision
6. overtime available on another job site
7. unsatisfactory relationship with boss.

Many of the reasons for absenteeism and turnover can be affected by management. By simply being aware of their major causes, supervisors may be able to make improvements on their sites.

Absenteeism and turnover have the following negative effects on productivity:

- Crew members waste time waiting for replacements.
- Time is spent transporting replacements to and from other work locations.
- Supervisors lose time in reassigning work activities and in locating replacements.

Other losses are incurred from not having the workers available, administrative costs (payroll, personnel, etc.) for terminating and hiring people and the disruption to fellow workers.

On average, it is estimated that 24 p-hs of paid time are wasted for each resignation.

3.3 Human Factors Related to Productivity

Human factors related to productivity fall into two groups:

- Individual factors, such as personal attributes, physical limitations, the learning curve, teamwork and motivation;
- The worker's environment, such as climate, work space, and noise.

Since construction work is labour-intensive, site workers clearly play a major role in the construction process. Although human factors are often not given much consideration, they strongly influence job site productivity and are key to the success of any project.

3.3.1 The individual as a factor affecting productivity

Persons with an optimistic and positive attitude are likely to have more initiative and think of imaginative solutions to various problems. A caring, considerate, and friendly person with a sense of humour can help increase productivity. Humour in the workplace puts people in good spirits, relieves stress, and develops teamwork.

A safe and healthy person is more productive. Respect for safety and safe practices must be encouraged, not only for the well-being of the workers, but to minimize 'down-time' on a project.

A creatively thinking person can contribute to increased productivity. Often it is the workers who come up with the best solution to a problem. Workers who demonstrate leadership skills should be encouraged to develop their potential because construction crews need good leaders to be successful and productive. Leadership skills include such characteristics as honesty, responsibility, good judgment, co-operation, being organized, and being a good listener.

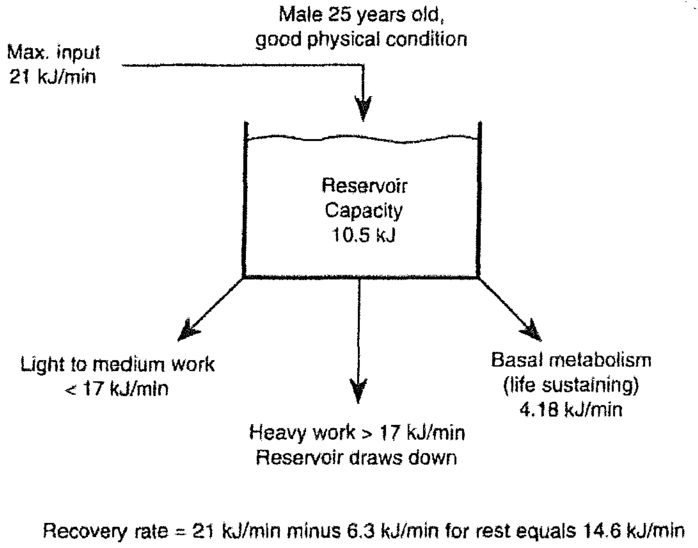
Finally, experience plays an important role in the productivity of a worker.

3.3.2 Physical limitations

Humans are somewhat like machines in the sense that they require fuel to operate and produce energy (the capacity to do work), and they become exhausted if they are not looked after properly. Many construction tasks are physically demanding.

The type of work that persons are performing will dictate how frequently they need to rest and regain energy to continue working. Figure 3.3 illustrates this with a water reservoir analogy. An average young male adult can develop approximately 21 kJ (5 kcal.) of energy per minute, of which approximately 4.18 kJ (1 kcal.) per minute is needed to sustain life and the rest is available for expenditure in the form of work. If workers perform light work, then the energy reservoir remains full and they can continue working for long periods of time. However, if the work requires more than 17 kJ (4 kcal.) of energy per minute, the reservoir will drain and when it empties, they require rest to refill it with energy.

Figure 3.3 Water-tank analogy of the human body's energy storage-replenishment capacity (Ogelsby et al., 1989)



> "For an average construction task requiring 6 kilocalories [25 kJ] per minute including basic metabolism, work at this pace could continue for no longer than 25 minutes before the worker becomes exhausted. An average male, sawing and hammering with an energy demand of 8.1 kilocalories [34 kJ] per minute, must rest after about 8 minutes." (Ogelsby *et al.*, 1989)

To avoid short-term fatigue, tasks should be designed to avoid activities such as holding heavy loads or pushing hard against non-moving objects. Use tables, supports, props, jigs, fixtures and tools or other devices as a substitute for muscular effort.

The right amount and type of tools can increase productivity. Cutting and welding torches and welding-rod holders should be positioned to reduce effort and make work more visible. Sanders, grinders, drills, hacksaws and similar tools should have good weight balance and handgrips. Wheelbarrows and buggies should be designed so weights are balanced, thus requiring little lifting. Pneumatic tires increase ease in pushing and guiding.

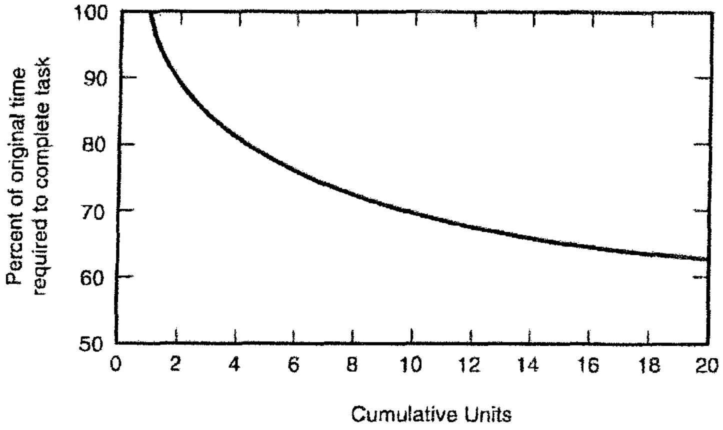
If a worker has to put himself in an awkward position to perform a particular task, it can lead to discomfort and even injury. Persons working in an uncomfortable position are more likely to take breaks and work less productively. Working overhead tires the arms and can put the back in odd positions. Constant bending also puts unnecessary strain on the back. Back injuries are very common in the construction industry and these could be avoided if more work were done at waist-height.

3.3.3 The learning curve

The first time any person performs a certain task, they will work slowly because they are learning how to do it. With additional repetitions, the time needed to perform the same or similar tasks will decrease. It is therefore desirable, where possible, to have the same person perform a task several times rather than making personnel changes along the way. After a considerable number of repetitions, the learning curve approaches a plateau that reflects the minimum time required to perform a task (Figure 3.4).

This principle applies to highly repetitive manual operations. If delays occur between repetitions, the 'unlearning curve' effect can be noted as the worker gets out of practice and can no longer perform the task as well. It

Figure 3.4 The learning curve

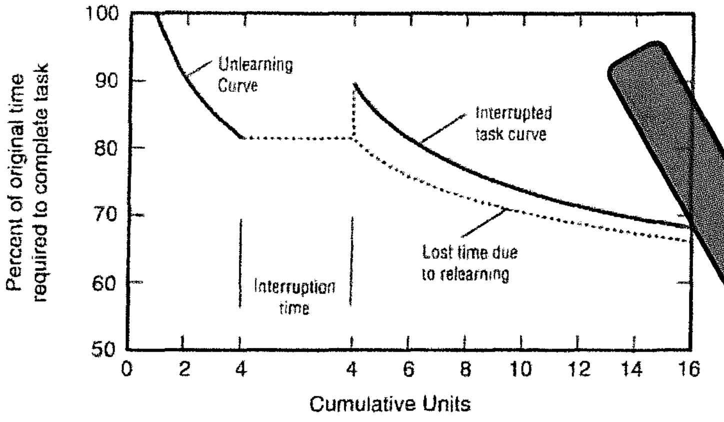


takes time for the worker to re-learn how to do the task. The same effect will be noted after personnel changes are made as the new workers must learn what to do. The unlearning curve is illustrated in Figure 3.5.

3.3.4 Crews and teamwork

Construction usually requires that a group of diverse workers act as a team with specific objectives. Teamwork can be maintained or improved by good, open, two-way communication. In that vein, workers should be asked for suggestions and solutions. Not only does this make workers feel that their opinions are valued and important, but it usually results in a solution to the problem.

Figure 3.5 'Unlearning' curve



This idea was developed in Japan through the use of quality circles. Groups of workers would meet and develop solutions to problems in their work, which would then be presented for management action. Supervisors and managers should aim to produce a productive environment and set goals for the team.

People enjoy not only the challenge of meeting and exceeding production targets but also contributing to solutions to problems. Mild competition in production objectives is also healthy and useful, i.e., productivity competitions between crews or between shifts. Supervisors can achieve higher levels of productivity by appealing to a worker's pride, competence, sense of duty, and team play.

3.3.5 Environmental factors

"Other things being equal, human beings perform relatively continuous physical or mental work most effectively when the temperature falls between 10 and 21°C at a relative humidity (R.H.) of 30 to 80%, under dry conditions, with the atmosphere clear of dust and other atmospheric pollutants, and without excessive noise. Departures from these conditions have adverse effects on productivity, comfort, safety and health" (Ogelsby et al., 1989).

3.3.5.1 Weather conditions

Workers must slowly become acclimatized to working in hot weather. Heat stress occurs at temperatures above 49°C (120°F) at an R.H. of 10% and 31°C (88°F) at an R.H. of 100%. Above these temperatures, heat injuries can occur, which include sunburn, heat cramps, heat exhaustion, and heat stroke. These illnesses can be prevented by using acclimatization, adequate rest periods, proper clothing, and adequate water and salt intake.

Similarly, the ill effects of cold weather can be warded off by wearing proper clothing and having temporary shelters near the work area; heaters may be installed as long as they are well ventilated. The optimal temperature appears to be 5°C. At this temperature the productivity of indoor work is not greatly affected.

Table 3.2 shows the reduction of work efficiency in cold weather. It is assumed that efficiency is 100% at 21°C (70°F).

Table 3.2 Reduction in work efficiency in cold weather

Temp. °C	Loss in Efficiency (%) Gross Skills	 Fine Skills
4	0	15
-2	0	20
-7	0	35
-13	5	50
-18	10	60
-23	20	80
-28	25	90-95+ (probably can't work)
-34	35	—

SUPPLY AND INSTALL SUBCONTRACT
LOWER CHURCHILL PROJECT
MUSKRAT FALLS HYDROELECTRIC DEVELOPMENT
Agreement No.: CH0032-01

REQUEST FOR COMPENSATION No.3

ANALYSIS OF IMPACT COSTS
SPILLWAY
(UPSTREAM AND DOWNSTREAM)

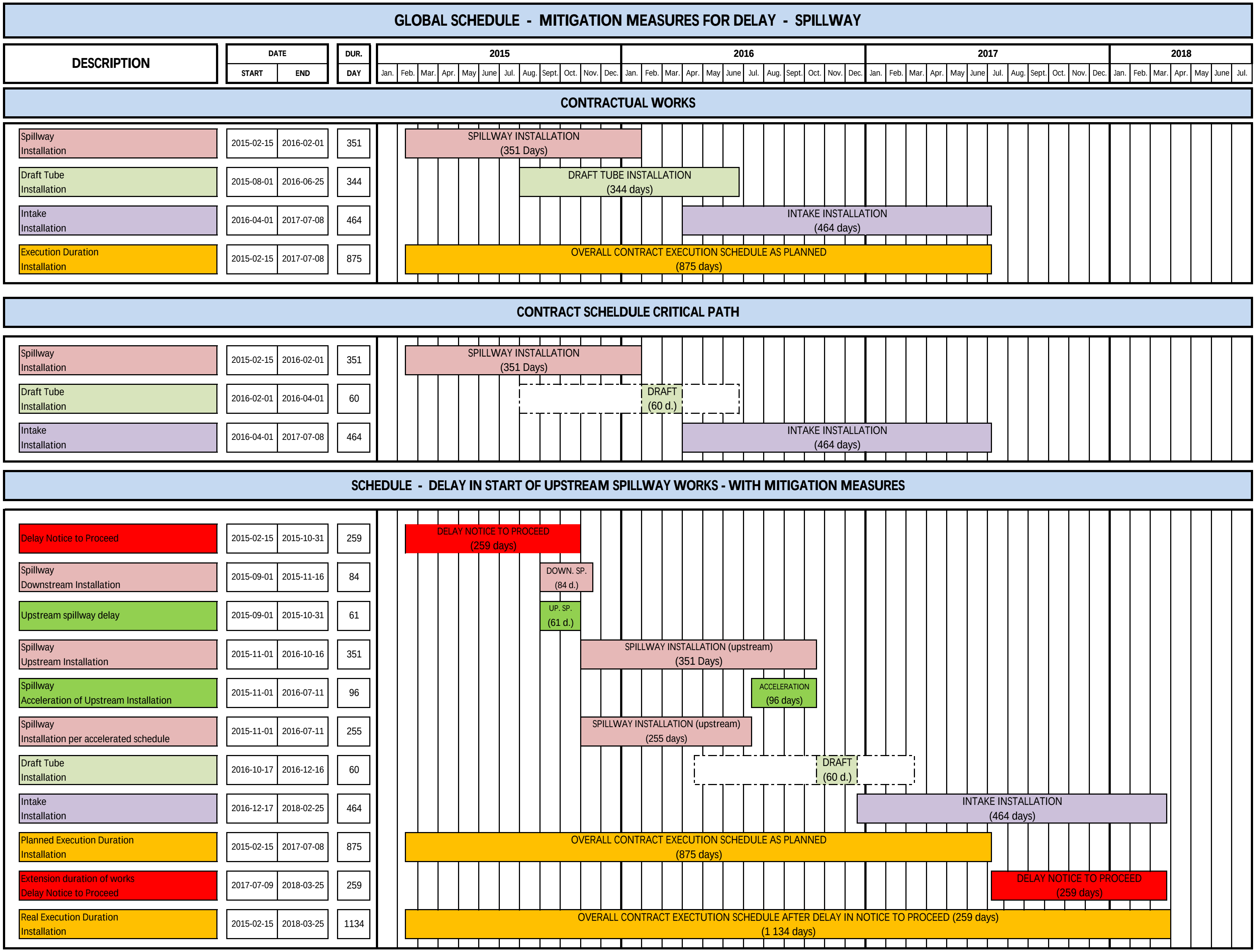
APPENDIX No.2

REQUEST No.3 - DOWNSTREAM

July 27, 2015

REQUEST No : 3 - DOWNSTREAM

Table No 1.1



GLOBAL SCHEDULE - MITIGATION MEASURES FOR DELAY - SPILLWAY

CONTRACTUAL WORKS

DESCRIPTION	DATE START	DATE END	DUR. DAY	2015 / 2016 / 2017 / 2018 (Jan. – Dec.)
Spillway Installation	2015-02-15	2016-02-01	351	SPILLWAY INSTALLATION (351 Days)
Draft Tube Installation	2015-08-01	2016-06-25	344	DRAFT TUBE INSTALLATION (344 days)
Intake Installation	2016-04-01	2017-07-08	464	INTAKE INSTALLATION (464 days)
Execution Duration Installation	2015-02-15	2017-07-08	875	OVERALL CONTRACT EXECUTION SCHEDULE AS PLANNED (875 days)

CONTRACT SCHELDULE CRITICAL PATH

DESCRIPTION	DATE START	DATE END	DUR. DAY	2015 / 2016 / 2017 / 2018 (Jan. – Dec.)
Spillway Installation	2015-02-15	2016-02-01	351	SPILLWAY INSTALLATION (351 Days)
Draft Tube Installation	2016-02-01	2016-04-01	60	DRAFT (60 d.)
Intake Installation	2016-04-01	2017-07-08	464	INTAKE INSTALLATION (464 days)

SCHEDULE - DELAY IN START OF UPSTREAM SPILLWAY WORKS - WITH MITIGATION MEASURES

DESCRIPTION	DATE START	DATE END	DUR. DAY	2015 / 2016 / 2017 / 2018 (Jan. – Dec.)
Delay Notice to Proceed	2015-02-15	2015-10-31	259	DELAY NOTICE TO PROCEED (259 days)
Spillway Downstream Installation	2015-09-01	2015-11-16	84	DOWN. SP. (84 d.)
Upstream spillway delay	2015-09-01	2015-10-31	61	UP. SP. (61 d.)
Spillway Upstream Installation	2015-11-01	2016-10-16	351	SPILLWAY INSTALLATION (upstream) (351 Days)
Spillway Acceleration of Upstream Installation	2015-11-01	2016-07-11	96	ACCELERATION (96 days)
Spillway Installation per accelerated schedule	2015-11-01	2016-07-11	255	SPILLWAY INSTALLATION (upstream) (255 days)
Draft Tube Installation	2016-10-17	2016-12-16	60	DRAFT (60 d.)
Intake Installation	2016-12-17	2018-02-25	464	INTAKE INSTALLATION (464 days)
Planned Execution Duration Installation	2015-02-15	2017-07-08	875	OVERALL CONTRACT EXECUTION SCHEDULE AS PLANNED (875 days)
Extension duration of works Delay Notice to Proceed	2017-07-09	2018-03-25	259	DELAY NOTICE TO PROCEED (259 days)
Real Execution Duration Installation	2015-02-15	2018-03-25	1134	OVERALL CONTRACT EXECTUTION SCHEDULE AFTER DELAY IN NOTICE TO PROCEED (259 days) (1 134 days)

REQUEST No : 3 - DOWNSTREAM

Table No 1.2

MITIGATION MEASURES FOR DELAY - SPILLWAY - DOWNSTREAM - SCHEDULE

DESCRIPTION			**2015**												**2016**						
WORK	**PLANNING**	**week**	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.
DOWNSTREAM EMBEDDED PARTS	Planned	12								🟥	Planned	🟥									
	Executed	12									🟩	Executed	🟩								

REQUEST No : 3 - DOWNSTREAM

Table No 2.1

DIRECT LABOUR - CONTRACTUAL SCHEDULE - SPILLWAY DOWNSTREAM

MONTH	Feb'15	Mar'15	Apr'15	May'15	June'15	Jul'15	Aug'15	Sept'15	Oct'15	Nov'15	Dec'15	Jan'16	
Week/month	4	4	4	5	4	4	5	4	5	4	4	5	
FOREMAN													
Foreman							350	560	490				**1 400**
CRAFT													
Craft							1750	2520	2240				**6 510**
OPERATOR													
Teamster/operator							350	280	280				**910**
SUMMARY													
TOTAL							2450	3360	3010				**8 820**

REQUEST No : 3 - DOWNSTREAM

Table No 2.2

DIRECT LABOUR - ACCELERATED SCHEDULE - SPILLWAY DOWNSTREAM

MONTH	Sept'15	Oct'15	Nov'15	Dec'15	Jan'16	Feb'16	Mar'16	Apr'16	May'16	
Week/month	4	5	4	4	5	4	4	4	5	
FOREMAN										
Foreman	350	560	490							**1 400**
CRAFT										
Craft	1750	2520	2240							**6 510**
OPERATOR										
Teamster/operator	280	350	280							**910**
SUMMARY										
TOTAL	2380	3430	3010	0	0	0	0	0	0	**8 820**

REQUEST No : 3 - DOWNSTREAM

Table No 3.1

PRODUCTIVITY LOSS - DIRECT LABOUR - SPILLWAY DOWNSTREAM
IMPACT OF WINTER CONDITIONS

PRODUCTIVITY LOSS - WINTER CONDITIONS - DIRECT LABOUR - CONTRACTUAL TIMETABLE

LABOUR CURVE BASED ON THE CONTRACTUAL TIMETABLE

Month:	-	Feb'15	Mar'15	Apr'15	May'15	June'15	Jul'15	Aug'15	Sept'15	Oct'15	Nov'15	Dec'15	Jan'16	TOTAL
Direct hours (TAB No 2.1):	A	0	0	0	0	0	0	2450	3360	3010	0	0	0	**8 820**

PRODUCTIVITY LOSS - WINTER CONDITIONS - CONTRACTUAL TIMETABLE

Coefficient productivity loss (TAB No 3.2):	B	42.5%	27.5%	15.0%	7.5%	0.0%	0.0%	0.0%	5.0%	7.5%	17.5%	35.0%	50.0%	TOTAL
Productivity loss:	C = A * B	0	0	0	0	0	0	0	168	226	0	0	0	**394**

PRODUCTIVITY LOSS - WINTER CONDITIONS - DIRECT LABOUR - ACCELERATED SCHELDULE

LABOUR CURVE BASED ON THE ACCELERATED SCHEDULE

Month:	-	Sept'15	Oct'15	Nov'15	Dec'15	Jan'16	Feb'16	Mar'16	Apr'16	May'16	TOTAL
Direct hours (TAB No 2.2):	D	2 380	3 430	3 010	0	0	0	0	0	0	**8 820**

PRODUCTIVITY LOSS - WINTER CONDITIONS - ACCELERATED SCHEDULE

Coefficient productivity loss (TAB No 3.2):	E	5.0%	7.5%	17.5%	35.0%	50.0%	42.5%	27.5%	15.0%	7.5%	TOTAL
Productivity loss:	F = D * E	119	257.25	526.75	0	0	0	0	0	0	**903**

PRODUCTIVITY LOSS - INDIRECT LABOUR
IMPACT OF WINTER CONDITIONS

Productivity loss based on accelerated schedule:	G	Tab. No 3.1	903
Productivity loss based on contractual schedule:	H	Tab. No 3.1	394
Additional productivity loss caused by acceleration:	I = G - H	Tab. No 3.1	**509**
Weighted hourly rate:	J	Tab. No 4.1	89.74 $
Additional cost caused by productivity loss:	K = I * J	Tab. No 3.1	45 698 $
Contingencies (7.5%):	L = 7.5%	Tab. No 3.1	**7.5%**
Additional cost caused by productivity loss:	H = K * (1 + L)	Tab. No 3.1	**49 125 $**

REQUEST No : 3 - DOWNSTREAM

Table No 3.2

COEFFICIENT OF PRODUCTIVITY LOSS - WINTER CONDITIONS - N.R.C. STUDY

MONTH	AVERAGE TEMPERATURE			COEFFICIENT OF PRODUCTIVITY LOSS		WEIGHTED COEFFICIENT OF PRODUCTIVITY LOSS		
	2013	2012	AVERAGE (2012-2013)	GROSS MOTOR	FINE MOTOR	GROSS MOTOR	FINE MOTOR	WEIGHTED FACTOR
	°C	°C	°C	%	%	%	%	
	A	B	C=(A+B)/2	D (NRC)	E (NRC)	F	G	H=D*F+E*G
Jan	-21.2	-23.6	-22.4	20%	80%	50%	50%	50.0%
Feb	-19.7	-20.6	-20.15	15%	70%	50%	50%	42.5%
Mar	-7.6	-17.3	-12.45	5%	50%	50%	50%	27.5%
Apr	-6	-4.6	-5.3	0%	30%	50%	50%	15.0%
May	0.1	1.4	0.75	0%	15%	50%	50%	7.5%
Jun	5.2	10	7.6	0%	0%	50%	50%	0.0%
Jul	11.3	12.5	11.9	0%	0%	50%	50%	0.0%
Aug	9.6	12.9	11.25	0%	0%	50%	50%	0.0%
Sep	4.5	7.3	5.9	0%	10%	50%	50%	5.0%
Oct	0.8	1.5	1.15	0%	15%	50%	50%	7.5%
Nov	-7.1	-5.3	-6.2	0%	35%	50%	50%	17.5%
Dec	-20.9	-13.3	-17.1	10%	60%	50%	50%	35.0%
Average:	-4.3	-3.3	-3.8	-	-	-	-	-

REQUEST No : 3 - DOWNSTREAM

Table No 4.1

WEIGHTED HOURLY COST - DIRECT LABOUR - SPILLWAY

May 2015 to April 2016

DESCRIPTION	SALARY COSTS									AIRLINE TICKET COST		HOURLY COST	
	DISTRIBUTION OF HOURS (TAB No 4.2)	TIME 40 hrs/week 57.14%		TIME AND A HALF 10 hrs/week 14.29%		DOUBLE TIME 20 hrs/week 28.57%		SALARY AMOUNT	NUMBER (1/210h)	COST (660$/ticket)	TOTAL AMOUNT	WEIGHTED RATE
		HOURS	HOURLY RATE	HOURS	HOURLY RATE	HOURS	HOURLY RATE					
	A	B=A*57.14%	C	D=A*14,29%	E	F=A*28.57%	G	H = B*C + D*E + F*G	I = A / 210	J = I * 660$	K = H + J	L = K / A
Foreman	1 400	800	71.24 $	200	103.37 $	400	137.01 $	132 471 $	7	4 400 $	136 871 $	-
Steelworker	6 510	3720	64.09 $	930	92.94 $	1860	123.12 $	553 855 $	31	20 460 $	574 315 $	-
Operator	910	520	64.09 $	130	92.94 $	260	123.12 $	77 421 $	4	2 860 $	80 281 $	-
Total:	8 820	5040	-	1260	-	2520	-	763 746 $	42	27 720 $	791 466 $	**89.74 $**

REQUEST No : 3 - DOWNSTREAM

Table No 4.2

DIRECT LABOUR - ACCELERATED SCHEDULE

MONTH Week/month	Sept'15 4	Oct'15 4	Nov'15 5	Dec'15 4	Jan'16 4	Feb'16 4	Mar'16 5	Apr'16 4	May'16 4	
FOREMAN										
Foreman	350	560	490	0	0	0	0	0	0	**1 400**
Sub-Total	1 400						0			1 400
CRAFT										
Craft	1 750	2 520	2 240	0	0	0	0	0	0	**6 510**
Sub-Total	6 510						0			6 510
OPERATOR										
Teamster/operator	280	350	280	0	0	0	0	0	0	**910**
Sub-Total	910						0			910
SUMMARY										
HOURS	2 380	3 430	3 010	0	0	0	0	0	0	**8 820**
Sub-Total	8 820						0			**8 820**

REQUEST No : 3 - DOWNSTREAM

Table No 5.1

OVERHEAD AND PROFIT
ADDITIONAL COST OF MITIGATION MESURES FOR DELAY
SPILLWAY

DESCRIPTION	REFERENCES	FORMULAS	AMOUNT
Total cost for the mitigation measures:	Tab. No : 3.1	A	49 125 $
Portion for overhead costs and profits:	Tab. No : 5.1	B	18.56%
Overhead and profit amount:	Tab. No : 5.1	C = A * B	**9 118 $**

Note : To avoid double dipping, overhead and profit are ajusted with the evolution of the contract: (i) total term of Contract and (ii) additional contract revenue paid as overhead and profit.

SUPPLY AND INSTALL SUBCONTRACT
LOWER CHURCHILL PROJECT
MUSKRAT FALLS HYDROELECTRIC DEVELOPMENT
Agreement No.: CH0032-01

REQUEST FOR COMPENSATION No.3

ANALYSIS OF IMPACT COSTS
SPILLWAY
(UPSTREAM AND DOWNSTREAM)

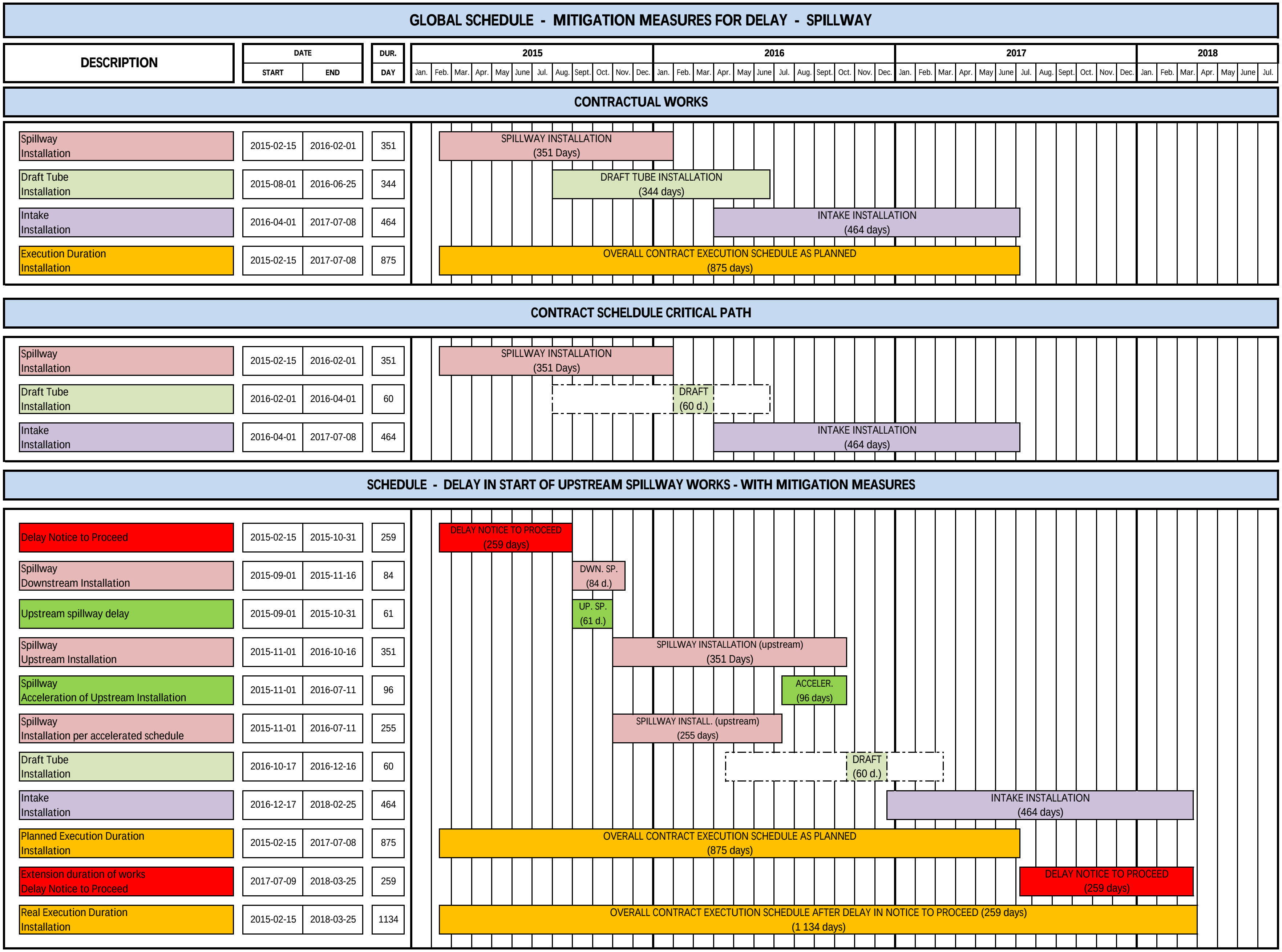
APPENDIX No.3

REQUEST No.3 - UPSTREAM

July 27, 2015

REQUEST No : 3 - Upstream

Table No 1.1



GLOBAL SCHEDULE - MITIGATION MEASURES FOR DELAY - SPILLWAY

CONTRACTUAL WORKS

DESCRIPTION	DATE START	DATE END	DUR. DAY
Spillway Installation	2015-02-15	2016-02-01	351
Draft Tube Installation	2015-08-01	2016-06-25	344
Intake Installation	2016-04-01	2017-07-08	464
Execution Duration Installation	2015-02-15	2017-07-08	875

CONTRACT SCHELDUE CRITICAL PATH

DESCRIPTION	DATE START	DATE END	DUR. DAY
Spillway Installation	2015-02-15	2016-02-01	351
Draft Tube Installation	2016-02-01	2016-04-01	60
Intake Installation	2016-04-01	2017-07-08	464

SCHEDULE - DELAY IN START OF UPSTREAM SPILLWAY WORKS - WITH MITIGATION MEASURES

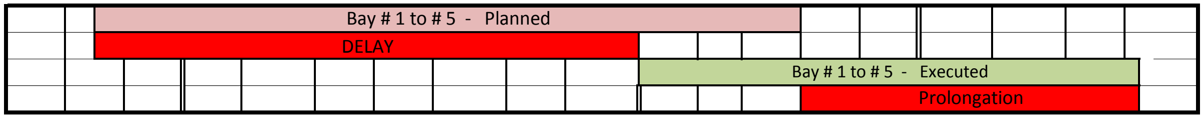
DESCRIPTION	DATE START	DATE END	DUR. DAY
Delay Notice to Proceed	2015-02-15	2015-10-31	259
Spillway Downstream Installation	2015-09-01	2015-11-16	84
Upstream spillway delay	2015-09-01	2015-10-31	61
Spillway Upstream Installation	2015-11-01	2016-10-16	351
Spillway Acceleration of Upstream Installation	2015-11-01	2016-07-11	96
Spillway Installation per accelerated schedule	2015-11-01	2016-07-11	255
Draft Tube Installation	2016-10-17	2016-12-16	60
Intake Installation	2016-12-17	2018-02-25	464
Planned Execution Duration Installation	2015-02-15	2017-07-08	875
Extension duration of works Delay Notice to Proceed	2017-07-09	2018-03-25	259
Real Execution Duration Installation	2015-02-15	2018-03-25	1134

REQUEST No : 3 - Upstream

Table No 1.2

MITIGATION MEASURES FOR DELAY - SPILLWAY - SCHEDULE

B-1 to B-5	Planned	48
	Delay	37
	Executed	34
	Prolong.	23



REQUEST No : 3 - Upstream

Table No 2.1

DIRECT LABOUR - CONTRACTUAL SCHEDULE - SPILLWAY

MONTH	Feb'15	Mar'15	Apr'15	May'15	June'15	Jul'15	Aug'15	Sept'15	Oct'15	Nov'15	Dec'15	Jan'16	
Week/month	2	4	4	5	4	4	5	4	5	4	4	5	
FOREMAN													
Foreman	280	280	560	1050	840	840	700	280	700	280	210	140	**6 160**
CRAFT													
Craft	1120	2240	3360	5600	4480	4480	3850	1960	3920	2240	1260	560	**35 070**
OPERATOR													
Teamster/operator	560	560	560	700	560	560	350	280	420	560	420	560	**6 090**
SUMMARY													
TOTAL	1960	3080	4480	7350	5880	5880	4900	2520	5040	3080	1890	1260	**47 320**

REQUEST No : 3 - Upstream

Table No 2.2

DIRECT LABOUR - ACCELERATED SCHEDULE - SPILLWAY

MONTH	Nov'15	Dec'15	Jan'16	Feb'16	Mar'16	Apr'16	May'16	June'16	Jul'16	
Week/month	4	4	5	4	4	4	5	4	4	
FOREMAN										
Foreman	590	320	650	1210	970	970	810	320	320	**6 160**
CRAFT										
Craft	3160	2590	3890	6480	5190	5190	4460	2270	1840	**35 070**
OPERATOR										
Teamster/operator	790	790	790	980	790	790	490	390	280	**6 090**
SUMMARY										
TOTAL	4540	3700	5330	8670	6950	6950	5760	2980	2440	**47 320**

REQUEST No : 3 - Upstream

Table No 3

SUMMARY - PRODUCTIVITY LOSS - DIRECT LABOUR
MITIGATION MEASURES FOR DELAYS - SPILLWAY

DESCRIPTION	TABLES	FORMULA	HOURS
Winter conditions	TAB. No 3.1	A	6 587
Loss of learning	TAB. No 3.2	B	4 388
Overstaffing	TAB. No 3.3	C	7 098
Crowding	TAB. No 3.4	D	23 660
Total (hours):	TAB. No 3	E = A + B + C + D	**41 733**
Weighted hourly rate:	TAB. No 4.1	F	**89.46 $**
Cost (productivity loss):	TAB. No 3	G = E * F	**3 733 558 $**

REQUEST No : 3 - Upstream

Table No 3.1

PRODUCTIVITY LOSS - DIRECT LABOUR
IMPACT OF WINTER CONDITIONS

PRODUCTIVITY LOSS - WINTER CONDITIONS - DIRECT LABOUR - CONTRACTUAL TIMETABLE

LABOUR CURVE BASED ON THE CONTRACTUAL TIMETABLE

Month:	-	Feb'15	Mar'15	Apr'15	May'15	June'15	Jul'15	Aug'15	Sept'15	Oct'15	Nov'15	Dec'15	Jan'16	TOTAL
Direct hours (TAB No 2.1):	A	1960	3080	4480	7350	5880	5880	4900	2520	5040	3080	1890	1260	**47 320**

PRODUCTIVITY LOSS - WINTER CONDITIONS - CONTRACTUAL TIMETABLE

Coefficient productivity loss (TAB No 3.1a):	B	42.5%	27.5%	15.0%	7.5%	0.0%	0.0%	0.0%	5.0%	7.5%	17.5%	35.0%	50.0%	TOTAL
Productivity loss:	C = A * B	833	847	672	551	0	0	0	126	378	539	662	630	**5 238**

PRODUCTIVITY LOSS - WINTER CONDITIONS - DIRECT LABOUR - ACCELERATED SCHELDULE

LABOUR CURVE BASED ON THE ACCELERATED SCHEDULE

Month:	-	Nov'15	Dec'15	Jan'16	Feb'16	Mar'16	Apr'16	May'16	June'16	Jul'16	TOTAL
Direct hours (TAB No 2.2):	D	4 540	3 700	5 330	8 670	6 950	6 950	5 760	2 980	2 440	**47 320**

PRODUCTIVITY LOSS - WINTER CONDITIONS - ACCELERATED SCHEDULE

Coefficient productivity loss (TAB No 3.1a):	E	17.5%	35.0%	50.0%	42.5%	27.5%	15.0%	7.5%	0.0%	0.0%	TOTAL
Productivity loss:	F = D * E	794.5	1295	2665	3684.8	1911.3	1042.5	432	0	0	**11 825**

PRODUCTIVITY LOSS - INDIRECT LABOUR
IMPACT OF WINTER CONDITIONS

Productivity loss based on accelerated schedule:	G = F	11 825
Productivity loss based on contractual schedule:	H = C	5 238
Additional productivity losses caused by acceleration:	I = G - H	**6 587**

REQUEST No : 3 - Upstream

Table No 3.1a

COEFFICIENT OF PRODUCTIVITY LOSS - WINTER CONDITIONS - N.R.C. STUDY

MONTH	AVERAGE TEMPERATURE			COEFFICIENT OF PRODUCTIVITY LOSS		WEIGHTED COEFFICIENT OF PRODUCTIVITY LOSS		
	2013	2012	AVERAGE (2012-2013)	GROSS MOTOR	FINE MOTOR	GROSS MOTOR	FINE MOTOR	WEIGHTED FACTOR
	°C	°C	°C	%	%	%	%	
	A	B	C=(A+B)/2	D (NRC)	E (NRC)	F	G	H=D*F+E*G
Jan	-21.2	-23.6	-22.4	20%	80%	50%	50%	50.0%
Feb	-19.7	-20.6	-20.15	15%	70%	50%	50%	42.5%
Mar	-7.6	-17.3	-12.45	5%	50%	50%	50%	27.5%
Apr	-6	-4.6	-5.3	0%	30%	50%	50%	15.0%
May	0.1	1.4	0.75	0%	15%	50%	50%	7.5%
Jun	5.2	10	7.6	0%	0%	50%	50%	0.0%
Jul	11.3	12.5	11.9	0%	0%	50%	50%	0.0%
Aug	9.6	12.9	11.25	0%	0%	50%	50%	0.0%
Sep	4.5	7.3	5.9	0%	10%	50%	50%	5.0%
Oct	0.8	1.5	1.15	0%	15%	50%	50%	7.5%
Nov	-7.1	-5.3	-6.2	0%	35%	50%	50%	17.5%
Dec	-20.9	-13.3	-17.1	10%	60%	50%	50%	35.0%
Average:	-4.3	-3.3	-3.8	-	-	-	-	-

REQUEST No : 3 - Upstream

Table No 3.2

PRODUCTIVITY LOSS - DIRECT LABOUR IMPACT OF LEARNING CURVE

LEARNING CURVE FACTOR (N.R.C. Coefficient)

DESCRIPTION	CONTRAT TIMETABLE A	ACCELERATED TIMETABLE B
Bay # 1	1.00	1.00
Bay # 2	0.90	0.90
Bay # 3	0.85	0.85
Bay # 4	0.80	1.00
Bay # 5	0.75	0.90
Total:	4.30	4.65

PRODUCTIVITY LOSS CALCULATION - LOSS OF LEARNING

Coefficient according to contract timetable:	A	4.30
Coefficient according to accelerated timetable:	B	4.65
Productivity loss due to learning curve factor:	C = B /A	1.0814
Productivity loss due to learning curve factor (in %):	D = C (%)	8.14%
Direct hours according to contract:	E (TAB. No 2.1)	47 320
Productivity loss due to winter conditions:	F (TAB. No 3.1)	6 587
Hours affected by loss of learning:	G = E + F	53 907
Productivity loss due to learning curve factor:	H = D * G	**4 388**

REQUEST No : 3 - Upstream

Table No 3.3

PRODUCTIVITY LOSS - DIRECT LABOUR - IMPACT OF OVERSTAFFING

DESCRIPTION	UNITS	REFERENCES	FORMULAS	FACTOR
COEFFICIENT FOR OVERSTAFFING RELATED TO REDUCTION IN EXECUTION PERIOD				
Delay according to contract timetable	Week	TAB No 1.2	A	48
Delay according to accelerated timetable	Week	TAB No 1.2	B	34
Coefficient for overstaffing	Factor	-	C = 1 + (A-B)/B	1.41
COEFFICIENT FOR OVERSTAFFING RELATED TO PRODUCTIVITY LOSS FOR WINTER CONDITIONS				
Direct hours according to contract timetable	Hours	TAB No 2.1	D	47 320
Productivity loss due to winter conditions	Hours	TAB No 3.1	E	6 587
Coefficient for overstaffing	Factor	-	F = 1 + E/D	1.14
COEFFICIENT FOR OVERSTAFFING RELATED TO PRODUCTIVITY LOSS FOR LEARNING				
Direct hours according to contract timetable	Hours	TAB No 2.1	G	47 320
Productivity loss due to learning curve	Hours	TAB No 3.2	H	4 388
Coefficient for overstaffing	Factor	-	I = 1 + H/G	1.09
CUMULATIVE COEFFICIENTS FOR OVERSTAFFING				
Reduction in execution period:			J = C	1.41
Additional winter conditions:			K = F	1.14
Learning lost:			L = I	1.09
Overall coefficient for overstaffing:			M = J * K * L	1.76
PRODUCTIVITY LOSS ON DIRECT LABOUR DUE TO OVERSTAFFING				
Overall coefficient for overstaffing:			N = M	1.76
Overall coefficient for overstaffing (in percentage):			O = N (%)	76%
Coefficient for productivity loss (N.R.C.) in percentage (Figure 3.1):			P	15%
Direct hours according to contract timetable:			Q = D	47 320
Productivity loss due to overstaffing:			R =P * Q	**7 098**

REQUEST No : 3 - Upstream

Table No 3.4

PRODUCTIVITY LOSS - DIRECT LABOUR - IMPACT OF CROWDING

DESCRIPTION	UNITS	REFERENCES	FORMULAS	FACTOR
COEFFICIENT FOR CROWDING DUE TO REDUCTION IN EXECUTION PERIOD				
Delay according to contract timetable	Week	TAB No 1.2	A	48
Delay according to accelerated timetable	Week	TAB No 1.2	B	34
Coefficient for crowding	Factor	-	C = 1 + (A-B)/B	1.41
COEFFICIENT FOR CROWDING RELATED TO PRODUCTIVITY LOSS FOR WINTER CONDITIONS				
Direct hours according to contract timetable	Hours	TAB No 2.1	D	47 320
Productivity loss due to winter conditions	Hours	TAB No 3.1	E	6 587
Coefficient for crowding	Factor	-	F = 1 + E/D	1.14
COEFFICIENT FOR CROWDING RELATED TO PRODUCTIVITY LOSS FOR LEARNING				
Direct hours according to contract timetable	Hours	TAB No 2.1	G	47 320
Productivity loss due to learning curve	Hours	TAB No 3.2	H	4 388
Coefficient for crowding	Factor	-	I = 1 + H/G	1.09
PRODUCTIVITY LOSS DUE TO OVERSTAFFING				
Direct hours according to contract timetable	Hours	TAB No 2.1	J	47 320
Productivity loss due to overstaffing	Hours	TAB No 3.3	K	7 098
Coefficient for crowding	Factor	-	L = 1 + K/J	1.15
CUMMULATIVE OF COEFFICIENTS FOR CROWDING				
Reduction in execution period:			M = C	1.41
Additional winter conditions:			N = F	1.14
Learning lost:			O = I	1.09
Overstaffing:			P = L	1.15
Overall coefficient for crowding:			Q = M*N*O*P	2.02
PRODUCTIVITY LOSS DUE TO CROWDING				
Overall coefficient for crowding:			R = Q	2.02
Overall coefficient for crowding (in percentage):			S = R (%)	102%
Coefficient for productivity loss (N.R.C.) in percentage (Figure 3.2):			T	50%
Direct hours according to contract timetable:			U = D	47 320
Productivity loss due to crowding:			V = T * U	**23 660**

REQUEST No : 3 - Upstream

Table No 4.1

HOURLY WEIGHTED COST - DIRECT LABOUR - SPILLWAY

May 2015 to April 2016

DESCRIPTION	SALARY COSTS								AIRLINE TICKET COST		HOURLY COST	
	DISTRIBUTION OF HOURS (TAB No 4.1)	TIME 40 hrs/week 57.14%		TIME AND A HALF 10 hrs/week 14.29%		DOUBLE TIME 20 hrs/week 28.57%		SALARY AMOUNT	NUMBER (1/210h)	COST (660$/ticket)	TOTAL AMOUNT	WEIGHTED RATE
		HOURS	HOURLY RATE	HOURS	HOURLY RATE	HOURS	HOURLY RATE					
	A	B=A*57.14%	C	D=A*14,29%	E	F=A*28.57%	G	H = B*C + D*E + F*G	I = A / 210	J = I * 660$	K = H + J	L = K / A
Foreman	4 710	2 691	71.24 $	673	103.37 $	1 346	137.01 $	445 669 $	22	14 803 $	460 472 $	-
Steelworker	26 500	15 142	64.09 $	3 787	92.94 $	7 571	123.12 $	2 254 555 $	126	83 286 $	2 337 840 $	-
Operator	4 930	2 817	64.09 $	704	92.94 $	1 409	123.12 $	419 432 $	23	15 494 $	434 927 $	-
Total:	36 140	20 650	-	5 164	-	10 325	-	3 119 656 $	172	113 583 $	3 233 239 $	**89.46 $**

May 2016 to April 2017

DESCRIPTION	SALARY COSTS								AIRLINE TICKET COST		HOURLY COST	
	DISTRIBUTION OF HOURS (TAB No 4.1)	TIME 40 hrs/week 57.14%		TIME AND A HALF 10 hrs/week 14.29%		DOUBLE TIME 20 hrs/week 28.57%		SALARY AMOUNT	NUMBER (1/210h)	COST (660$/ticket)	TOTAL AMOUNT	WEIGHTED RATE
		HOURS	HOURLY RATE	HOURS	HOURLY RATE	HOURS	HOURLY RATE					
	A	B=A*57.14%	C	D=A*14,29%	E	F=A*28.57%	G	H = B*C + D*E + F*G	I = A / 210	J = I * 660$	K = H + J	L = K / A
Foreman	1 450	829	71.24 $	207	103.37 $	414	137.01 $	137 202 $	7	4 557 $	141 759 $	-
Steelworker	8 570	4897	64.09 $	1 225	92.94 $	2 448	123.12 $	729 114 $	41	26 934 $	756 049 $	-
Operator	1 160	663	64.09 $	166	92.94 $	331	123.12 $	98 690 $	6	3 646 $	102 336 $	-
Total:	11 180	6388	-	1 598	-	3 194	-	965 006 $	53	35 137 $	1 000 143 $	**89.46 $**

HOURLY WEIGHTED COST - DIRECT LABOUR

DESCRIPTION	DISTRIBUTION OF HOURS (TAB No 4.1)	TOTAL AMOUNT	WEIGHTED RATE
May 2015 to April 2016	36 140	3 233 239 $	89.46 $
May 2016 to April 2017	11 180	1 000 143 $	89.46 $
Total:	47 320	4 233 382 $	**89.46 $**

REQUEST No : 3 - Upstream

Table No 4.2

DIRECT LABOUR - ACCELERATED SCHEDULE

MONTH	Nov'15	Dec'15	Jan'16	Feb'16	Mar'16	Apr'16	May'16	Jun'16	Jul'16	TOTAL
Week/month	4	4	5	4	4	4	5	4	4	
FOREMAN										
Foreman	590	320	650	1 210	970	970	810	320	320	6 160
Sub-Total	4 710						1 450			6 160
CRAFT										
Craft	3 160	2 590	3 890	6 480	5 190	5 190	4 460	2 270	1 840	35 070
Sub-Total	26 500						8 570			35 070
OPERATOR										
Teamster/operator	790	790	790	980	790	790	490	390	280	6 090
Sub-Total	4 930						1 160			6 090
SUMMARY										
HOURS	4 540	3 700	5 330	8 670	6 950	6 950	5 760	2 980	2 440	**47 320**
Sub-Total	36 140						11 180			**47 320**

REQUEST No : 3 - Upstream

Table No 5

ADDITIONAL COST - INDIRECT LABOUR - ACCELERATED SCHEDULE

DESCRIPTION	NUMBERS			ADDITIONAL COST			
	CONTRACT TIMETABLE A	ACCELERATED TIMETABLE B	VARIATION C = B - A	DURATION (Weeks) D	HOURS E = C*D*70*2/3	HOURLY RATE F	AMOUNT G = E * F
Engineer	1	2	1	34	1 587	104.00 $	165 013 $
Supervisor	1	2	1	34	1 587	137.31 $	217 865 $
HSE	1	2	1	34	1 587	137.31 $	217 865 $
				Sub-Total:	4 760	126.21 $	**600 744 $**

REQUEST No : 3 - Upstream

Table No 6

ADDITIONAL COST - EQUIPMENT OVER $1500 - SPILLWAY

DESCRIPTION	NUMBER OF UNITS			ADDITIONAL COST		
	CONTRACT TIMETABLE	ACCELERATED TIMETABLE	ADDITIONAL	MONTHLY RATES	ALLOCATION PERIOD	TOTAL AMOUNT
	A	B	C	D	E	F = C * D * E
Scaffolding (Hydro Mobile F-300 Platform)	8	12	4	11 000 $	7.0	308 000 $
Shelter panels 10'x45'	108	165	57	1 200 $	7.0	478 800 $
Electrical heaters 600V/30 KVA	8	16	8	300 $	7.0	16 800 $
PureHeat system 8 diffuseurs	1	2	1	5 850 $	7.0	40 950 $
Oil heater 500 000 Btu	4	6	2	770 $	7.0	10 780 $
Electrical distribution center	1	2	1	7 143 $	7.0	50 001 $
Micrometer	8	12	4	500 $	7.0	14 000 $
Welding machine 350A electric	8	14	6	408 $	7.0	17 136 $
Feeder LN25	8	14	6	245 $	7.0	10 290 $
Hammer drill SDS Max	2	3	1	225 $	7.0	1 575 $
Pick up F-250	3	6	3	1 550 $	7.0	32 550 $
12'x60' Complex	2	3	1	1 330 $	7.0	9 310 $
Dry house container 8'x20', per month	1	2	1	260 $	7.0	1 820 $
Pickup F-150	4	5	1	1 350 $	7.0	9 450 $
Bus 15 passagers	1	2	1	2 082 $	7.0	14 574 $
Tool box container 8'x20', per month (all tools included)	2	3	1	1 500 $	7.0	10 500 $
Electrical container 8'x 20', per month	1	2	1	1 000 $	7.0	7 000 $
Manlift 85'	1	2	1	7 955 $	7.0	55 685 $
					Total:	**1 089 221 $**

REQUEST No : 3 - Upstream

Table No 7.1

ADDITIONAL COST - LIFTING EQUIPMENT - SPILLWAY

EQUIPMENT DESCRIPTION	ADDITIONAL RENTAL COST					ADDITIONAL COST (MOB. & DEMOB.)					ADDITIONAL COST
	TIME USED (TAB. No 7.2)			ADDITIONAL COST		NUMBER (MOB. & DEMOB.) (TAB. No. 7.2)			ADDITIONAL COST		
	CONTRACT TIMETABLE	ACCELERATED TIMETABLE	ADDITIONAL	HOURLY RATE	AMOUNT	CONTRACT TIMETABLE	ACCELERATED TIMETABLE	ADDITIONAL	RATE	AMOUNT	
-	A	B	C = B - A	D	E = C * D	F	G	H = G - F	I	J = H * I	K = E + J
Crane 90 tonnes	1098	1728	630	200 $	126 000 $	1	1	0	10 650 $	0 $	126 000 $
Crawler 130 tonnes	1830	2880	1050	390 $	409 500 $	1	2	1	222 000 $	222 000 $	631 500 $
Crawler 300 tonnes	660	840	180	440 $	79 200 $	1	2	1	296 600 $	296 600 $	375 800 $
										Total:	**1 133 300 $**

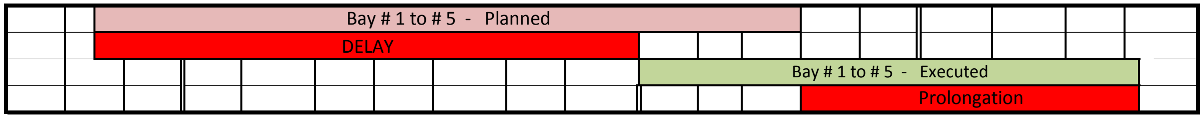
REQUEST No : 3 - Upstream

Table No 7.2

USE OF LIFTING EQUIPMENT - SPILLWAY

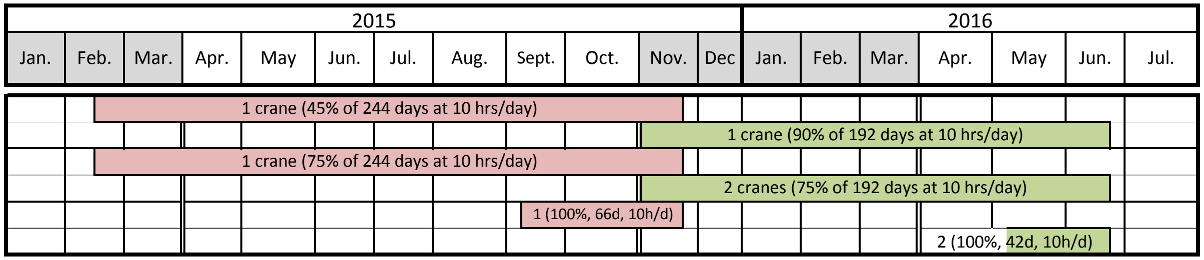
SPILLWAY SCHEDULE

B-1 to B-5	Planned	48
	Delay	37
	Executed	34
	Prolong.	23



USE OF LIFTING EQUIPMENT

DESCRIPTION		
WORK	PLANNING	Hrs
Crane 90 tonnes	Planned	1098
	Delay	1728
Crawler 130 tonnes	Planned	1830
	Delay	2880
Crawler 300 tonnes	Planned	660
	Delay	840



REQUEST No : 3 - Upstream

Table No 8

CREDIT - ORIGINAL CONTRACT INFLATION - SPILLWAY - DELAY REDUCTION

DESCRIPTION	INSTALLATION VALUE (SPILLWAY) A	INDEXATION RATE		NUMBER OF DAYS RECOVERED D = 50% of 96 D	AMOUNT RECOVERED E = - (A * C * D)
		ANNUAL B	DAILY C = B/365		
3.0 Original contract inflation (installation part)					
Contract (installation part)	16 152 791 $	3.872%	0.01061%	48	-82 249 $
				Total (Inflation credit):	**-82 249 $**

REQUEST No : 3 - Upstream Table No 9

ADDITIONAL COST SUMMARY - MITIGATION MEASURES FOR DELAY
SPILLWAY

ADDITIONAL COST DESCRIPTION	REFERENCES	FORMULAS	AMOUNT
Productivity loss related to direct labour	Tab. No : 3	A	3 733 558 $
Additional indirect labour	Tab. No : 5	B	600 744 $
Additional cost for equipment over 1 500$	Tab. No : 6	C	1 089 221 $
Additional cost for lifting equipment	Tab. No : 7	D	1 133 300 $
Inflation credit	Tab. No : 8	E	-82 249 $
Mitigations measures cost:	Tab. No : 9	F = A+B+C+D+E	**6 474 573 $**
Contingencies (7.5%):	Tab. No : 9	G = 7.5%	7.5%
Mitigation measures cost:	Tab. No : 9	H = F * (1 + G)	**6 960 166 $**

REQUEST No : 3 - Upstream

Table No 10.1

OVERHEAD AND PROFIT
ADDITIONAL COST OF MITIGATION MESURES FOR DELAY
SPILLWAY

DESCRIPTION	REFERENCES	FORMULAS	AMOUNT
Demande No 5	Tab. No : 9	A	6 960 166 $
Portion for overhead costs and profits:	Tab. No : 10.1	B	18.56%
Overhead and profit amount:	Tab. No : 10.1	C = A * B	**1 291 807 $**

Note : To avoid double dipping, overhead and profit are ajusted with the evolution of the contract: (i) total term of Contract and (ii) additional contract revenue paid as overhead and profit.

Muskrat Falls-Gates-Spillway Diversion Acceleration Schedule.mpp

ID	Task Name	Duration	Start	Finish
1	**Spillway Acceleration Schedule Spillway Diversion**	**346 days**	**Mon 7/20/15**	**Wed 7/13/16**
2	**Administrative tasks**	**88 days**	**Mon 7/20/15**	**Thu 10/15/15**
3	Cost evaluation	29 days	Mon 7/20/15	Mon 8/17/15
4	Commercial agreement	59 days	Tue 8/18/15	Thu 10/15/15
5	**Upstream Embedded Parts**	**164 days**	**Sun 11/01/15**	**Tue 4/26/16**
6	Bay #1	131 days	Sun 11/01/15	Thu 3/24/16
7	Bay #2	128 days	Wed 11/11/15	Thu 3/31/16
8	Bay #3	126 days	Sat 11/21/15	Fri 4/08/16
9	Bay #4	125 days	Tue 12/01/15	Sun 4/17/16
10	Bay #5	124 days	Fri 12/11/15	Tue 4/26/16
11	**Gates**	**66 days**	**Wed 4/06/16**	**Fri 6/10/16**
12	Bay #1	30 days	Wed 4/06/16	Thu 5/05/16
13	Bay #2	30 days	Sun 4/10/16	Mon 5/09/16
14	Bay #3	29 days	Thu 4/14/16	Thu 5/12/16
15	Bay #4	29 days	Tue 5/10/16	Tue 6/07/16
16	Bay #5	28 days	Sat 5/14/16	Fri 6/10/16
17	**Towers**	**47 days**	**Mon 4/18/16**	**Fri 6/03/16**
18	Bay #1	20 days	Mon 4/18/16	Sat 5/07/16
19	Bay #2	20 days	Wed 4/20/16	Mon 5/09/16
20	Bay #3	19 days	Fri 4/22/16	Tue 5/10/16
21	Bay #4	19 days	Sun 5/15/16	Thu 6/02/16
22	Bay #5	18 days	Tue 5/17/16	Fri 6/03/16
23	**Hoist Bridge, Hoist & Hoist House**	**82 days**	**Fri 4/15/16**	**Tue 7/05/16**
24	Bay #1	52 days	Fri 4/15/16	Sun 6/05/16
25	Bay #2	52 days	Wed 4/20/16	Fri 6/10/16
26	Bay #3	51 days	Mon 4/25/16	Tue 6/14/16
27	Bay #4	51 days	Thu 5/12/16	Fri 7/01/16
28	Bay #5	50 days	Tue 5/17/16	Tue 7/05/16
29	**Electrical Building**	**178 days**	**Sun 11/01/15**	**Tue 5/10/16**
30	Electrical Building-Grimard	120 days	Sun 11/01/15	Sun 3/13/16
31	Electrical Building-Hemi	100 days	Mon 2/01/16	Tue 5/10/16
32	**Dry commissioning Mech & Elec**	**74 days**	**Sun 5/01/16**	**Wed 7/13/16**
33	**Gate and Hoist**	**38 days**	**Mon 6/06/16**	**Wed 7/13/16**
34	Bay #1	8 days	Mon 6/06/16	Mon 6/13/16
35	Bay #2	6 days	Tue 6/14/16	Sun 6/19/16
36	Bay #3	6 days	Mon 6/20/16	Sat 6/25/16
37	Bay #4	6 days	Sat 7/02/16	Thu 7/07/16
38	Bay #5	6 days	Fri 7/08/16	Wed 7/13/16
39	**Upstream Stoplogs**	**30 days**	**Sun 5/01/16**	**Mon 5/30/16**
40	Bay #1	6 days	Sun 5/01/16	Fri 5/06/16
41	Bay #2	6 days	Sat 5/07/16	Thu 5/12/16
42	Bay #3	6 days	Fri 5/13/16	Wed 5/18/16
43	Bay #4	6 days	Thu 5/19/16	Tue 5/24/16
44	Bay #5	6 days	Wed 5/25/16	Mon 5/30/16
45	**Downstream Stoplogs**	**15 days**	**Tue 5/31/16**	**Tue 6/14/16**
46	Bay #1	3 days	Tue 5/31/16	Thu 6/02/16
47	Bay #2	3 days	Fri 6/03/16	Sun 6/05/16
48	Bay #3	3 days	Mon 6/06/16	Wed 6/08/16
49	Bay #4	3 days	Thu 6/09/16	Sat 6/11/16
50	Bay #5	3 days	Sun 6/12/16	Tue 6/14/16
51	**Comissioning**	**93 days**	**Mon 3/14/16**	**Tue 6/14/16**
52	Roller Gates Hoist Bay 1 to 5, 125% load tests / verification of overload protection (ON HOLD)	0 days	Mon 6/06/16	Mon 6/06/16
53	Commissioning of electrical building-Grimard	15 days	Mon 3/14/16	Mon 3/28/16
54	25 KV temporary ready	0 days	Fri 4/15/16	Fri 4/15/16
55	Commissioning of electrical building - AC/DC & Local Control - Andritz Hemi	25 days	Wed 5/11/16	Sat 6/04/16
56	Commissioning of electrical building - AC/DC & Common Control - Andritz Hemi	10 days	Sun 6/05/16	Tue 6/14/16
57	Remaining Installation activities	105 days	Sat 7/16/16	Fri 10/28/16