ASTALDI CANADA Inc.

LOWER CHURCHILL PROJECT – MUSKRAT FALLS

CH0007: CONSTRUCTION OF INTAKE AND POWER HOUSE, SPILLWAY AND TRANSITION DAMS

Muskrat Falls Corporation
350 Torbay Road, Suite 2
St. John's, NL Canada

30-May-2015

ACI / MFC – 0297

Attention: Mr. Scott O'Brien
Company Representative

Subject: **LCP Muskrat Falls Contract No. CH0007**
Construction of Intake Powerhouse, Spillway and Transition Dams
Concrete Temperature Monitoring, Heating and Hoarding

Dear Mr O'Brien,

Please refer to your letter LTR-0385, regarding the subject and in particular Item 4 of the *"Synopsis of Specification Thermal Requirements"* that was provided with said letter, under which Company instructed us that "*For the duration of the curing period the Specification requires to maintain a minimum ambient temperature of 10°C*". The issue of maintaining *10°C* inside the hoardings was discussed during weekly meetings and the Company has always confirmed its stance in this respect.

On the other hand, the Contractor's position has been and still is that once limits are set for the minimum concrete surface temperature (5°C per Technical Specification) and temperature differentials between core to surface (<20°C) and surface to ambient (per Table 21 of CSA A23.1-09), there is no point setting a minimum ambient temperature limit for the curing. That is why the minimum ambient temperature requirement was not discussed in our first submission of the *Hoarding, Heating and Concrete Temperature Monitoring Method Statement* (MFA-AT-SD-0000-CS-K24-0011-01). However, Company maintained their stance and in fact, advised us to "prescribe" this in the next revision of this method statement (Comment 22).

Despite our disagreement with the Company on this issue, the Contractor always followed Company instructions and targeted 10°C ambient temperature during the curing period.

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Maintaining 10°C inside the hoarding during the 10 day curing period is no less than a challenge so far because of the extreme winter conditions. As a result of maintaining this 10°C, the concrete surface temperature was generally around 20°C (about 10°C higher than ambient), despite the fact that Technical Specification only requires a minimum concrete surface temperature of only 5°C. In other words, the concrete surface was heated more than what was required by the specification resulting into slow cooling down of the concrete mass meaning prolonged protection.

Furthermore, maintaining 10°C ambient temperature during curing period is not only a challenge during winter but also an additional burden during spring and fall, as the only period where the average ambient temperature (outside air) of 10°C is recorded is between July and September (three months only), this being the only period where concreting activities can be performed without either protecting the concrete with insulating blankets or hot air. So we will end up protecting the concrete for 9 out of 12 months every year.

Contractor wishes to record that this is not only impractical but also an additional time and cost burden for the project.

It should be noted that both CSA A23.1-09 and ACI 306 refer to concrete surface temperature as the curing temperature and do not set any limit on ambient conditions. We understand that the mention of 10°C in Table 20 of CSA A23.1-09 was considered by Company as being the ambient temperature. In this respect, Contractor points out that, as per CSA A23.1-09, Page 29, curing is defined as *"maintenance of a satisfactory moisture content and temperature in concrete for a period of time immediately following placing and finishing so that desired properties can develop."* In other words, it is the **temperature in concrete** that matters during curing period and not the ambient conditions (especially true for mass pours). So, the 10°C requirement in Table 20 is actually referring to concrete surface temperature and not the ambient temperature.

Similarly, ACI 306.1-90 (Reapproved 2002), Clause 3.4.4, recommends maintaining the **surface temperature of concrete** (also see Table 3.2.1, Column 2 - *Minimum temperature of **concrete** as placed and maintained during the protection period).*

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In light of the above, it is our view that there should be no requirement for minimum ambient temperature and that the only parameters that should matter in this regard are

1. minimum concrete surface temperature;
2. temperature differential between core and surface; and
3. the temperature differential between surface and ambient (this will dictate the ambient temperature requirements).

Contractor's respectfully reiterates its request for Company to reconsider its position taking into account Contractor's position illustrated above.

Please be informed that Contractor is monitoring the effects of Company's instructions on this subject, as they will have a significant impact on the Project cost and schedule.

Yours sincerely,

Astaldi Canada Inc.

Don Delarosbil
Project Manager

Lower Churchill Project – Muskrat Falls

Cc: Contractor – Mr. G. Orsatti, Mr. S.Azab, Mr. H. Raza; Mr. G.Bader, Mr. R. Rocci, Mr. E. Mongili
Nalcor – Mr. B. Hallock; Mr. M. Harris; Mr. A. Kelly; Mr. M. Melhem

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