KENNEY DAM COLD WATER RELEASE FACILITY
MEMORANDUM ON COSTS

Prepared
For

NECHAKO ENHANCEMENT SOCIETY

By

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TABLE OF CONTENTS

1. INTRODUCTION 1
1.1 Terms of Reference 1
1.2 Background 1
1.3 Scope of Work 2
2. FACTORS AGAINST A NEW DETAILED ESTIMATE NOW 4
3. REQUIREMENTS FOR A DETAILED COST ESTIMATE 6
4. UPDATED COST ESTIMATES 8
4.1 General 8
4.2 Basis For Updating 8
4.3 Escalation Rates 10
4.4 Implementation Schedule 13
4.5 Contingencies 13
4.6 Engineering Costs 14
4.7 Interest During Construction (IDC) 15
4.8 Results 15
4.9 Costs Not Included 16
4.10 Hydroelectric Generating Facility 19
5. ADDITIONAL COMMENTS 20
5.1 January 2006 Estimate 20
5.2 Preliminary Schedule 20
5.3 Preliminary Engineering 21
6. REFERENCES 22

1. INTRODUCTION

1.1 Terms of Reference

This memorandum was prepared by Wilson Hydrotechnical Services (WHS) in response to a request from the Nechako Enhancement Society (NES) and provides a commentary on the costs of a Cold Water Release Facility (CWRF) at Kenney Dam.

The memorandum was prepared for the sole benefit of NES. All other parties are third parties.

The memorandum is based on historic cost information provided to WHS by NES, on previous involvement in the engineering aspects of the CWRF, and on cost information available on the Internet. Neither WHS nor NES represents, guarantees or warrants to any third party, either expressly or by implication:

(a) the accuracy, completeness or usefulness of,

(b) the intellectual or other property rights of any person or party in, or

(c) the merchantability, safety or fitness for purpose of,

any information, product or process disclosed, described or recommended in this memorandum.

Neither WHS nor NES accepts any liability of any kind arising in any way out of the use by a third party of any information, product or process disclosed, described or recommended in this memorandum, nor do WHS or NES accept any liability arising by way of reliance by a third party upon any information, statement or recommendation contained in this memorandum. Third party use or reliance on any information, product or process disclosed, described or recommended in this memorandum, is entirely at its own risk.

1.2 Background

In the first quarter of 2001, Klohn Crippen Ltd., now Klohn Crippen Berger Ltd. (KCBL) prepared a Conceptual Layout and Cost Estimate for a Water Release Facility at Kenney Dam for the Management Committee of the Nechako Environmental Enhancement Fund (NEEF). The conceptual layout was a development of an earlier concept, the so-called Case E, which itself stemmed from the deliberations of a 1995 joint Alcan/Province Working Group formed to evaluate alternatives for a water release facility at Kenney Dam following the January 1995 cancellation of the Kemano Completion Project which had included a release facility at Kenney Dam, the so-called Kenney Dam Release Facility (KDRF). The 2001 Conceptual Layout has been the basis for subsequent and ongoing discussions and studies by the Nechako Enhancement Society (NES), an Alcan/Province joint venture, and other interested parties, including the Nechako Watershed Council (NWC).

The 2001 cost estimate was updated by KCBL at the beginning of 2005 (Klohn Crippen, 2005), and again in January 2006 (KCBL, 2006). The updated estimates included increases in labour rates as a result of new collective agreements, increases in material costs, particularly steel and cement, and increases in the costs of consumables, particularly fuel. The updated estimates were based on the 2001 conceptual layout and preliminary quantity take-off, with no further engineering work. The January 2006 cost estimate is now two years old. Faced with the need to provide an interim report on the CWRF, including costs, by the end of March 2008, NES investigated its options, including:

- Having a new cost estimate prepared, which inquiries indicated could cost in the order of $70,000-$100,000, and which could be unreliable due to the conceptual nature of the engineering, and the uncertainty of future cost increases, given the unprecedented escalation of construction costs in British Columbia in recent years; and
- Making judgement-based adjustments to the 2006 cost estimate for now, and plan to complete a new estimate in the future based on appropriate technical input.

NES decided to pursue the second option and asked WHS to undertake the work.

1.3 Scope of Work

NES asked WHS to provide a memorandum with advice and detailed discussion on the following:

- Explain why it may be considered premature or too early to undertake a new detailed estimate at this time;
- Outline in detail the steps, information and expertise required to complete a detailed cost estimate;
- Given that it is the intention of NES to provide the NWC with an Interim Evaluation Report by the end of March 2008, provide advice and recommendations as to what might reasonably be done with the January 2006 estimate, short of undertaking a detailed estimate; and
- If possible, undertake the steps necessary to implement the advice and recommendations provided with regard to the 2006 estimate and include any results in a memorandum.

WHS agreed to provide this memorandum on the understanding that:

- WHS does not currently have the expertise or the software to provide cost estimating or construction planning services; and
- WHS would base its advice and recommendations on its past involvement and experience in the engineering aspects of a water release facility at Kenney Dam,

and on whatever cost information is publically available, primarily via the Internet.

WHS noted that an industry expert recently described the task of staying on top of costing issues as being "analogous to playing some futuristic version of the game of chess in three dimensions".

The first and second tasks are presented in Sections 2 and 3 of the memorandum. The third and fourth tasks are presented in Section 4.

2. FACTORS AGAINST A NEW DETAILED ESTIMATE NOW

The January 2006 cost estimate was based on conceptual-level engineering completed in 2001. Investigations and further engineering are required to establish that the concept is technically feasible, and that the facility will perform as required by the design criteria. If the investigations indicate that the conceptual layout would not perform as required, then modifications would have to be made and tested to achieve an acceptable facility.

In addition to the technical performance of the facility, there are also the issues of constructability and construction methodology. These are particularly important with regard to the deep-water pipelines. Although a conceptual design and construction methodology were developed, as described in the report prepared for the NEEF Management Committee (Klohn Crippen, 2001), the concepts have not been discussed with a contractor experienced in marine construction of the type and in the conditions envisaged at Kenney Dam. A number of different types of conduits were considered during the design of the KDRF, and elevated steel pipelines were ultimately selected to avoid problems associated with the irregular underwater ground profile. However, there are several ways that such pipelines could be constructed, and it will require the input of an experienced marine contractor to develop and price a feasible and cost-effective layout and construction method.

There is also a practical reason for not undertaking a new detailed estimate at this time. The 2001 estimate was prepared using G2 Estimator proprietary software. The software is a database system and contains comprehensive cost data on equipment, materials, and labour, including, where applicable, fringe benefits, trade costs, overtime pay and shift differentials. The data base also includes adjustments to account for site specific conditions. Costs are calculated in worksheets based on crews, equipment, materials and productivity rates input by the estimator based on experience. Once an initial estimate has been prepared, and if there are no changes in the underlying assumptions, such as the scope of the work, quantities or productivity rates, the estimate can readily be updated for changes in the costs of equipment, materials, and labour simply by changing the values in the database. This was how the updated estimates were prepared in 2005 and 2006.

However, since the original estimate was prepared another software system, known as "Heavy Bid" produced by Heavy Construction System Specialists (HCSS) in Houston, Texas, has come into widespread use within the industry, and many estimators now consider it the industry standard, including those approached to update the estimate for the CWRF. Although the HCSS software is also a database system, it is understood that the G2 Estimator files are not transferable to the new system. The detailed worksheets also function quite differently from those of G2 Estimator. One has, in effect, to start from scratch, inputting all the cost data into the new system and then creating entirely new worksheets to compute the costs. Although the CWRF estimate will ultimately have to be transferred to the new system, the work involved will be substantial. If the transfer is done before further engineering work is undertaken to refine the conceptual layout, then most of the work will have to be repeated, because in addition to changes in the costs in the database, there are likely to be changes in the scope (type) and quantities of

the work, i.e. basic changes in the worksheet calculations, as a result of the additional engineering and the contractor's input.

3. REQUIREMENTS FOR A DETAILED COST ESTIMATE

It is envisaged that there will be several stages in the preparation of a detailed cost estimate. Each stage will be based on an increased level of engineering and construction planning.

The earliest that it would be appropriate to develop a new cost estimate would be during the latter portion of the Investigations and Preliminary Engineering phase. For the purpose of this memorandum, this phase is envisaged to commence in July 2008 and to be completed by September 2009. The objective of this phase is to establish a feasible layout that will perform in accordance with the design criteria. This phase may result in significant changes to some, if not all, of the structures, hence it would be imprudent to commence the new cost estimate before these changes have been identified and quantified.

The deep-water pipelines are by far the most challenging and uncertain aspect of the constructability and cost of the facility. However, from a performance perspective, i.e. their ability to withdraw cold water, it is believed that previous studies for the KDRF have shown that intakes of the type and at the depth assumed in the conceptual design would perform satisfactorily, although it is understood that studies are ongoing to confirm this. It is also believed that pipelines of the type envisaged can be constructed, but whether shorter spans with more intermediate supports would be easier and less costly to construct than the long arched spans with only three supports shown on the conceptual drawings is a question that needs to be discussed and evaluated with a contractor. A contractor could also have a different approach altogether. Unless there is concern about the ability of the intakes to withdraw cold water at the existing location, the discussions with a contractor could commence before other features of the facility are fully refined. Inquiries should be made to US and, possibly European, contractors, because they are likely to have more experience than Canadian contractors of deep water construction at relatively high elevations, both of which adversely affect the productivity of divers.

The preparation of the new detailed cost estimate will require:

- The cooperative interaction of experienced engineering staff, a capable construction planner/scheduler/cost estimator used to working with HCSS “Heavy Bid” software and preferably with a contracting background, and at least an experienced marine contractor;
- Refinement of the design to a level that will permit preliminary dimensions and quantities of work and materials to be estimated; and
- Concurrent development of a practicable construction schedule, which should include a decision on the contracting approach, i.e. Owner, Engineer, Contractor relationship or design/build, or some other approach depending upon the constitution of the entity or entities that will finance, construct, own and operate the facility.

It must be recognized that the new cost estimate would still have a relatively low order of accuracy, albeit higher than that of the current estimate. If an Owner, Engineer, Contractor contractual relationship is adopted, then updated estimates would typically be produced at about 30%, 75% and 90% complete final design drawings, as a minimum. If a design-build approach is adopted, then at least one, and probably two further estimates would be prepared as a minimum, depending upon the level of detail to be provided to the bidders.

4. UPDATED COST ESTIMATES

4.1 General

The cost estimates prepared by KCBL did not include escalation because the timing of the expenditures was not known. The estimates also did not include interest during construction (IDC).

The KCBL January 2006 estimate had first to be updated for the escalation to January 2008. Subsequent escalation in both engineering and construction costs were then calculated based on an assumed implementation schedule. Finally, an amount for interest during construction was calculated.

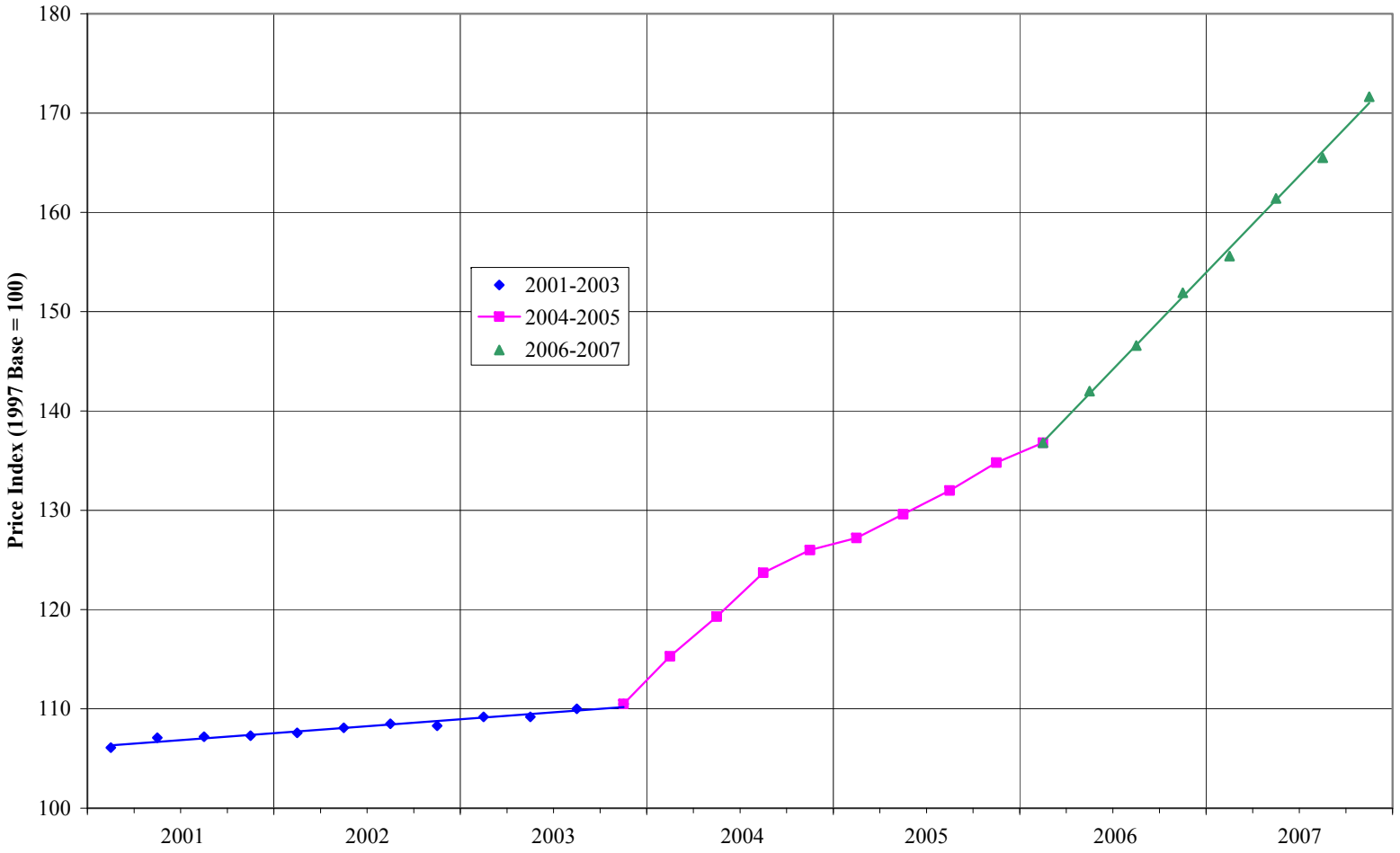
4.2 Basis For Updating

Future trends in construction costs are uncertain and there is a relatively wide range of opinions on allowances that should be made. Several authorities indicate using at least two trends, and this approach has been adopted for the results presented in this memorandum.

A frequently quoted basis for escalation is the Non-Residential Construction Price Index, a quarterly series prepared by Statistics Canada, measuring the changes in contractors' selling prices of non-residential building construction for six census metropolitan areas (Halifax, Montréal, Toronto, Calgary, Edmonton, and Vancouver) and the Ontario part of the Ottawa-Gatineau CMA, and a composite of these seven areas. Selling prices include costs for materials, labour, equipment, provincial taxes, and contractors' current overhead and profit and market conditions. Value Added Taxes such as the Federal Goods and Services Tax, the Quebec Sales Tax and Harmonised Sales Tax are excluded. The indexes relate to both general and trade contractors' work and exclude the cost of land, land assembly, design, development and real estate fees. The Non-Residential index is itself a composite of separate indexes for three types of building construction, namely Industrial, Commercial and Institutional. The Industrial index is based on a light factory building, which does not involve the same type of heavy civil construction as a cold water release facility, but it was deemed to be the most representative of those available, and adjustments were made as discussed below. There are so-called heavy construction indexes published by a variety of sources, but these are primarily US based, such as Engineering News Record and RS Means, and did not appear to reflect recent trends, particularly in British Columbia.

The trend of the Industrial component of the Non-Residential Construction Price Index for Vancouver from 2001 to 2007 is shown on Figure 4.1. The figure shows a modest annual increase of approximately 2.8% from 2001 to 2003, a sharp increase in 2004, reducing slightly in 2005 for a two year average of approximately 8.9%, and a further sustained increase of approximately 12.8% annually during 2006 and 2007.

Figure 4.1
Trend of Industrial Component of Non-Residential Construction Price Index For Vancouver



In addition to the Non-Residential Construction Price Index, various studies of future trends in construction prices have been prepared by a number of firms specializing in economic and financial consulting. In particular, BC Hydro Engineering retained MMK Consulting, a Vancouver-based firm, to prepare reports every six months to forecast construction cost escalation. A summary of recommended allowances produced by BC Hydro in September 2007 based on MMK Consulting's last report was obtained on the Internet. The author of the recommendations, John Boots, P.Eng., was contacted and indicated that the information was in the public domain and could be used.

The allowances recommended by BC Hydro, by fiscal year were:

FY2008	6%
FY2009	5%
FY2010	5%
FY2011	4%
FY2012 on	3%

4.3 Escalation Rates

4.3.1 Up To January 2008

The trend of the Industrial component of the Non-Residential Construction Price Index was compared with the increase in the costs estimated by KCBL for the same periods. For the period from 2001 to the end of 2004, the Industrial component increased by 19.9%, while the KCBL estimate increased by 13.8%, approximately 70% of the Industrial component. For 2005, the Industrial component increased by 7.5%, while the KCBL estimate increased by 5.3%, again approximately 70% of the Industrial component. Based on the consistent differences between the Industrial component and KCBL estimates, the increase in the costs of a CWRF that could have been experienced in 2006 and 2007 were deemed to be 70% of the increase in the Industrial component in those years, namely 8.9% annually.

4.3.2 After January 2008 - High Rate

The unprecedented increases in costs since the beginning of 2004 are only partially a reflection of increased material costs and wages. Indeed the price of hot-rolled steel products, which increased by more than 50% during the latter part of 2004, appears to have now declined to levels comparable to those immediately before the sharp increase. Prices of copper and nickel (a component of stainless steel) have also moderated from their astronomic increases in 2007, but are still relatively high. A substantial proportion of the increases are considered to be a reflection of:

- a shortage of skilled labour, leading to higher premiums for skilled trades people, and a reduction in overall productivity;

- simple supply and demand, the volume of potential work exceeding available resources (experienced contractors), resulting in expectations of greater margins after the poor market in the 1990s, and increased allowances to reduce risk.

The construction of the Canada Line and the 2010 Winter Olympics facilities, together with the development projects triggered by these projects, are significant contributors to the total volume of work. Many authorities believe that these and other projects will continue to fuel cost increases at least through the end of 2009. It is noted that, in its 2007 budget, the Provincial government allowed a contingency of 9.5% annually for cost increases for 2007/08, 2008/09, 2009/10 over and above the contingencies included in project budgets, although it is also noted that the contingencies appear to have been reduced to 5% annually in the 2008 budget.

It is not known to what extent cost increases in the Lower Mainland will be reflected in the Prince George/Nechako area.

For the "high" escalation, it was assumed that costs would increase through to the end of 2009 at the same rate as that assumed for 2006-2007, namely 8.9%, and that this would be followed by a two year period of downward adjustment, to 5.9%, two-thirds of the previous rate, in 2010, and to 4.45%, half of the previous rate, in 2011. Thereafter, the annual rate was assumed to be 3%, the same as that recommended by BC Hydro in September 2007.

4.3.3 After January 2008 - Intermediate Rate

The escalation rates recommended by BC Hydro were used, but on a calendar year basis rather than on a fiscal year basis. The rates were therefore:

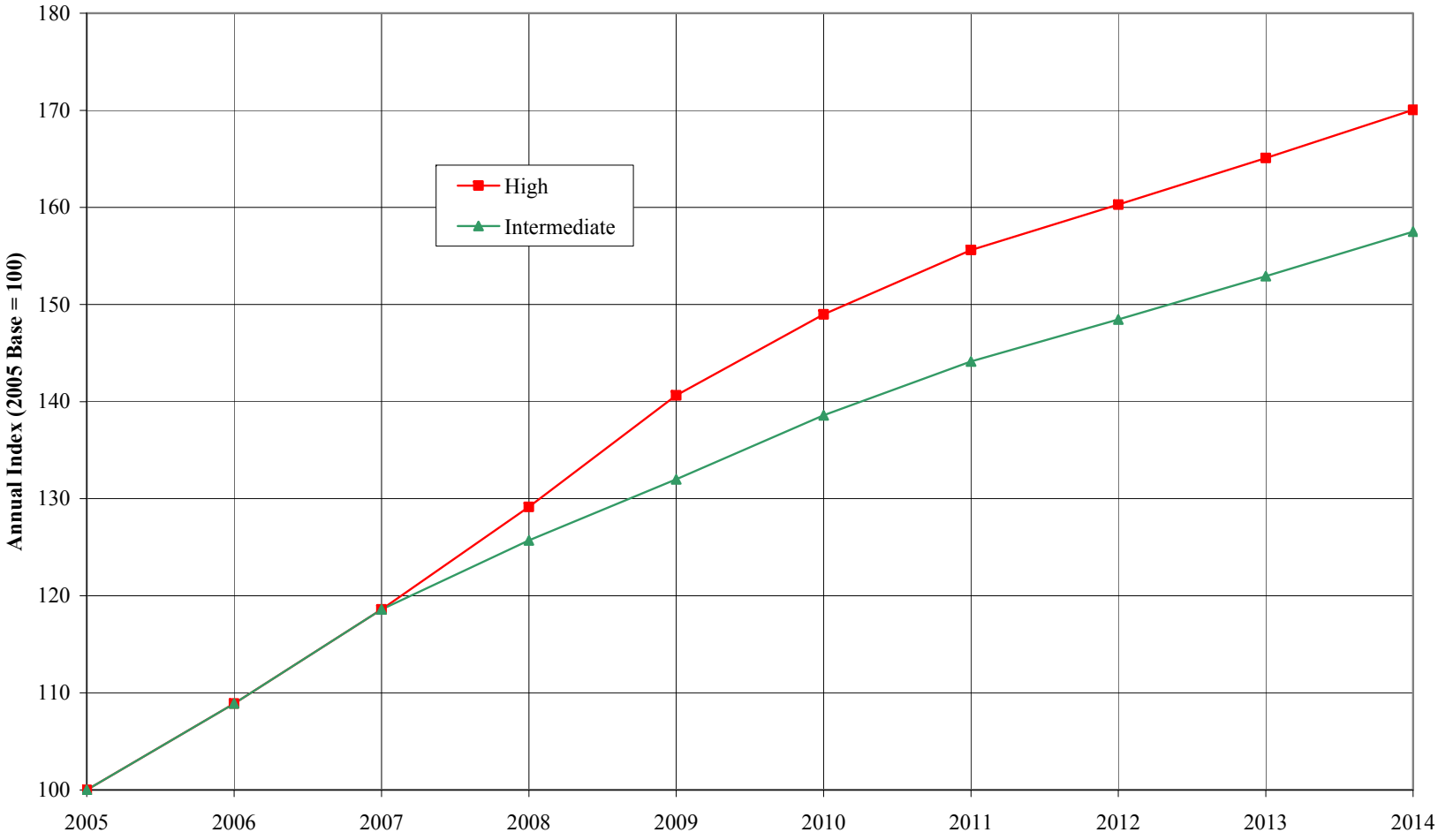
2008	6%
2009	5%
2010	5%
2011	4%
2012 on	3%

4.3.4 Effect of Escalation

The effect of the assumed high and intermediate rates of escalation are shown on Figure 4.2 in the form of an index with a base of 100 at the end of 2005, deemed to be equivalent to the KCBL January 2006 cost estimate.

The construction costs were escalated annually until the start of construction, and thereafter monthly at a rate equivalent to the nominal annual rate according to an approximate cash flow (See Section 4.7). A contractor would also allow for escalation during the assumed 30 month construction period in its bid, but whether it would use a monthly or annual approach is not known.

Figure 4.2
Assumed Annual Cost Escalation Index



4.4 Implementation Schedule

The assumed implementation schedule was based on one prepared in early 2002 jointly by the NWC, Alcan, the Provincial government and the Fraser Basin Council with input from KCBL and Triton Environmental Consultants Ltd. The original schedule assumed tendering and construction by a contractor of a design prepared by an owner's engineer, although the possibility of a design/build type of contract was also acknowledged. The durations of the activities envisaged in 2002 were retained, but adjustments were made to the start and finish dates to allow for the time that has elapsed since the original schedule was prepared. In addition, to avoid delaying the construction, the detailed engineering was extended beyond the start of construction. This could be accomplished by issuing representative concrete reinforcement drawings with the tender documents and completing the remaining drawings after the award of the construction contract. If a design/build form of contract is ultimately selected, then the design and construction would inevitably overlap. The schedule assumed for this memorandum is shown in Table 4.1.

Table 4.1

Assumed Schedule

Activity	Duration (Months)	Start Date	Finish Date
Preliminary Engineering	15	July 2008	September 2009
Environmental Review and Permitting	18	July 2009	December 2010
Detailed Engineering	21	October 2010	June 2012
Construction	30	March 2012	August 2014

A number of issues were identified during review of the schedule, and these are discussed in Section 5.

4.5 Contingencies

In view of the conceptual nature of the layout and structures, and the fact that the structures would occupy some areas outside those previously investigated for the design of the KDRF, contingencies have been added to allow for changes during final design and for the conditions encountered. A contingency of 50% has been added to the escalated cost of the marine works, and a contingency of 20% has been added to the escalated cost of the other facilities and works. These contingencies are essentially the same as those provided in previous estimates by KCBL. (The text of the 2001 report states that the marine contingency was 30%, but this must be a typographic error, because the amount shown in the estimate was 50%.)

4.6 Engineering Costs

4.6.1 Preliminary Engineering

The January 2006 cost estimate included an allowance of $1,500,000 for Investigations and Preliminary Engineering. The key areas requiring investigation and preliminary engineering include:

- Dissolved gas measurements at an existing flip bucket spillway and a physical hydraulic model study of the same flip bucket spillway to enable the gas transfer characteristics of a flip bucket spillway to be evaluated empirically, so as to evaluate the gas transfer performance of the proposed spillway;
- Physical hydraulic model studies of the surface water intake channel, low-level intake, regulating structure and spillway, to evaluate the withdrawal characteristics of the facility so as to evaluate the capability to control the release water temperature, and to evaluate and confirm the hydraulic performance and dimensions of the various components, including the mixing capability of the spillway chute;
- Refinement of the conceptual layout of regulating structure, road bridge and upper section of the spillway chute, and
- Sub-surface investigations in locations outside those areas covered by investigations for the KDRF to establish the geotechnical conditions and design parameters.

The costs of sub-surface investigations have increased substantially in the last two years due to the large volume of work that has been generated in Alberta. The demand and large returns from work in Alberta have also made it extremely difficult to find companies willing to do relatively small programs, particularly those involving in-hole testing, as opposed to production drilling.

Physical hydraulic model tests have also shown a substantial increase in cost due to the increased value of the space that they occupy.

The later stages of the preliminary engineering would also be the first practical opportunity to develop a new cost estimate for the facility, an activity that was not specifically identified in the original scope.

In view of the foregoing, and the fact that a detailed estimate of the work has not been prepared, the allowance has been increased to $2,250,000 for January 2008, and then escalated at 8.9% annually assuming a uniform expenditure over 15 months.

4.6.2 Detailed Engineering and Construction Services

Each of the previous cost estimates has included percentage allowances for detailed engineering and engineering services during construction, based on the estimated construction costs, the approach typically adopted for conceptual-level estimates. This

approach assumes that the value of the construction contract accurately reflects the extent of engineering required. However, if escalation in construction costs is driven by factors that are not directly related to the engineering complexity, for example by material prices or contractor's margins, then the percentage approach is open to question. In addition, the majority of the detailed engineering could occur before the final construction cost is known. It was therefore decided to escalate the estimated construction cost to January 2008, and calculate allowances for engineering costs as percentages of that cost, and then escalate the engineering allowance at a fixed rate per year. The initial percentage allowances were 4.5% for detailed engineering and 5.5% for services during construction, somewhat higher than the previous estimates, but in line with current estimates prepared by other consultants. These allowances were then escalated at 4% annually, the average rate of increase in engineering salaries published by the Association of Professional Engineers and Geoscientists of BC for the period 2002-2006. As a check, the allowances were also calculated as percentages based on the escalated construction cost. The increase in the allowances for engineering using the latter method was slightly more than $2,000,000 for the "high" construction cost escalation, and slightly less than $1,000,000 for the "intermediate" escalation. These differences may be significant to an engineering firm, but are considered to be insignificant when viewed in the context of the potential variation in the overall cost.

4.7 Interest During Construction (IDC)

An approximate cash flow was prepared based on the breakdown of the individual costs provided in the January 2006 KCBL estimate, and on the Preliminary Construction Schedule (Figure 4) presented in Report No. KC-155 (Klohn Crippen, 2001). The total monthly cash flow was then escalated using the rates previously described, and contingencies for civil and marine works were added as previously described. Finally, a percentage allowance was added for the contractor's profit.

Interest during construction was then calculated and compounded monthly based on a nominal annual rate of 6.5%. It is understood that the financing arrangements that would be employed for the facility have yet to be decided, particularly with regard to the proportions that might be equity and debt financed. The calculation therefore assumed that the entire construction cost would be debt financed, and that monthly payments to the contractor would be drawn from an interest-only line of credit or similar loan, the interest being calculated to the end of the construction based on the accumulated funds withdrawn at the end of each month.

4.8 Results

Previous estimates prepared by KCBL included a summary table of estimated project costs broken down into the direct costs associated with the individual structures and the fixed and variable indirect costs for the overall project. A breakdown of the escalated costs has not been prepared for this memorandum because the escalation was applied to the total monthly cash flow rather than to individual items of work.

The results for the common escalation to January 2008, and for the "intermediate" and "high" escalation rates to the completion of construction are shown in Table 4.2, together with the corresponding amounts from the 2001, 2005 and 2006 estimates. IDC is shown separately from the Construction Cost, but it might be considered a capital cost in an asset valuation.

The approximate calendar year quarterly cash flow for the "intermediate" and "high" escalation rates is shown in Table 4.3. The sub-totals are for a fiscal year from 1 April to 31 March. The IDC is included as a lump sum in the final quarter of construction.

4.9 Costs Not Included

The estimated costs shown in Table 4.2 and Table 4.3 do not include Owner's costs, including administration costs, long-term financing costs, and any costs associated with federal and provincial environmental review and permitting, including associated environmental studies, and GST, if applicable to the Proponent.

The costs also do not include costs associated with the design and construction of the works at the Cheslatta Fan, commissioning costs associated with the flushing of the Nechako Canyon, and the subsequent costs for operation of the facilities and adaptive management.

Table 4.2

Estimated and Escalated Capital Costs

Description	Estimated Costs 2001 ($1,000)	Estimated Costs 2005 ($1,000)	Estimated Costs Jan 2006 ($1,000)	Estimated Costs Escalated To Jan 2008 ($1,000)	Estimated Costs Escalated To Completion "Intermediate" ($1,000)	Estimated Costs Escalated To Completion "High" ($1,000)
Contractor's Direct and Indirect Costs	70,797	80,895	87,595[1]	100,741	126,472	136,223
Contingency for Civil Works (20%)	11,000	12,000	12,000	14,052	17,598	18,959
Contingency for Marine Works (50%)	6,000	7,000	7,500	9,101	11,530	12,411
Sub-total Estimated Construction Cost	**87,797**	**99,895**	**107,095**	**123,894**	**155,600**	**167,593**
Interest During Construction (IDC)					11,047	11,905
Investigations and Preliminary Engineering	1,250	1,400	1,500	2,250	2,581	2,581
Detailed Engineering (4.5% Jan 2008)	3,600	4,000	4,300	5,575	6,308	6,308
Construction Services (5.5% Jan 2008)	3,300	3,750	4,000	6,814	8,272	8,272
Total Estimated Project Cost	**95,957**	**109,045**	**116,895**	**138,533**	**183,808**	**196,659**

Notes:

1. The cost shown is the original reported amount. The cost was reduced by $2,000,000 before escalation to January 2008 (see Section 5).
2. The estimated and escalated costs shown in this table and Table 4.3 include PST, but do not include the costs described in Section 4.9.

Table 4.3

Approximate Cash Flow

Calendar Year and Quarter		Preliminary Engineering ($1,000)	Detailed Engineering ($1,000)	Construction Services ($1,000)	Construction "Intermediate" ($1,000)	Total "Intermediate" ($1,000)	Construction "High" ($1,000)	Total "High" ($1,000)
2008	Q3	490				490		490
	Q4	490				490		490
2009	Q1	534				534		534
Sub-total FY08/09		**1,514**				**1,514**		**1,514**
	Q2	534				534		534
	Q3	534				534		534
	Q4					-		-
2010	Q1					-		-
Sub-total FY09/10		**1,067**				**1,067**		**1,067**
	Q2					-		-
	Q3					-		-
	Q4		861			861		861
2011	Q1		896			896		896
Sub-total FY10/11			**1,757**			**1,757**		**1,757**
	Q2		896			896		896
	Q3		896			896		896
	Q4		896			896		896
2012	Q1		932	266	1,537	2,734	1,658	2,856
Sub-total FY11/12			**3,619**	**266**	**1,537**	**5,422**	**1,658**	**5,543**
	Q2		932	797	13,283	15,011	14,331	16,060
	Q3			797	11,712	12,509	12,632	13,429
	Q4			797	8,871	9,668	9,564	10,361
2013	Q1			829	11,516	12,345	12,411	13,240
Sub-total FY12/13			**932**	**3,220**	**45,381**	**49,533**	**48,938**	**53,090**
	Q2			829	13,663	14,492	14,720	15,549
	Q3			829	15,938	16,767	17,164	17,993
	Q4			829	34,867	35,696	37,535	38,364
2014	Q1			862	32,280	33,142	34,739	35,601
Sub-total FY13/14				**3,349**	**96,748**	**100,097**	**104,158**	**107,507**
	Q2			862	6,809	7,671	7,325	8,187
Incl. IDC	Q3			575	16,172	16,747	17,418	17,993
Sub-total FY14/15				**1,437**	**22,981**	**24,418**	**24,743**	**26,180**
GRAND TOTALS		**2,581**	**6,308**	**8,272**	**166,646**	**183,808**	**179,498**	**196,659**

4.10 Hydroelectric Generating Facility

The escalated estimates provided above include the construction of a skeleton bay adjacent to the downstream portal of the dam construction diversion tunnel, and work inside the tunnel, to facilitate the addition of a future small hydroelectric generating station. Because of potential disruption of access to the diversion tunnel required to complete and commission the low-level outlet, the preliminary construction schedule prepared in 2001 shows construction of the skeleton bay after the completion of the work in the diversion tunnel. That schedule would probably place the earliest completion date for a hydroelectric generating facility at about the end of September 2015, more than seven years from now.

In its 2006 letter report, KCBL estimated that a hydroelectric generating facility of about 20 MW could be constructed for about 1,000-1,200$/kW, i.e. for about $20-$24 million, in addition to the costs for the skeleton bay already included in the estimate. This was a reasonable allowance based on recently completed Independent Power Producer (IPP) projects of comparable net head and installed capacity, bearing in mind that the facility would only involve a short penstock connection to the pipeline stub already included in the low-level outlet, completion of the powerhouse, and construction of a switchyard.

However, a hydroelectric turbine-generator unit and the associated mechanical and electrical equipment are composed primarily of steel, stainless steel and copper. Soon after the 2006 estimate was made, the prices of copper and of nickel, an important ingredient of stainless steel, increased substantially. By mid-2006, the price of copper was approximately US$4/lb, almost double the price at the beginning of 2006. The price of nickel at the beginning of 2006 was approximately US$7/lb, but reached a peak of almost US$25/lb in May 2007. Largely as a consequence of the rise in the price of nickel, the price of stainless steel almost tripled over the same period. Although prices had eased by the end of 2007, particularly nickel, the prices continue to show considerable volatility. As a consequence, it is understood that manufacturers of metal products are unwilling to quote more than a few months in advance, and can add surcharges to firm orders. It is not considered possible to reliably estimate what the price of these materials, and hence what the cost of a turbine-generator unit and the associated equipment might be in six or seven years from now.

Nevertheless, the addition of a hydroelectric facility of about 20 MW could provide a substantial revenue stream, whereas the release facility on its own would only be an ongoing source of costs. There will be ample time closer to the actual construction to consider and price the addition of a hydroelectric generating facility. However, solely for the purpose of providing a "ball park" estimate for this memorandum, the 2006 estimate was escalated to the third quarter of 2015 using the "high" rate. The major mechanical and electrical equipment would probably be ordered at least 18 months beforehand, but the supplier(s) would include escalation through to delivery and installation. The resulting range of escalated estimated cost would be $35-$42 million. Adding a contingency of 30% would increase this range to $46-$55 million.

5. ADDITIONAL COMMENTS

5.1 January 2006 Estimate

During the preparation of this memorandum, it was noted that the increase in the labour cost component of the Variable Indirect Costs in the January 2006 estimate was substantially out of proportion with the general level of other labour increases. The disproportionate increase was traced to the estimated cost of on-site staff management, which showed an almost 50% increase compared with the 2005 estimate, whereas other increases ranged between about 5% and 8%. The cost was considered to be in error by about $2,000,000, and this amount was deducted from the estimate before the costs were escalated.

5.2 Preliminary Schedule

The preliminary schedule presented in Figure 4 of the 2001 report is generic, in so far as it only shows construction by numbered months, rather than by specific calendar months.

Two issues, one minor, and one important, were identified when specific calendar months were assigned.

To enable commissioning activities involving the necessary flushing of accumulated sediments from the Nechako Canyon, completion of the CWRF should be timed to coincide with the large freshet flows during June and July to minimize potential downstream impacts. For the assumed 30 month construction schedule, this would mean mobilizing the contractor in March. Load restrictions are typically applied on the roads leading to Kenney Dam from early March to at least mid-May, and although these have most impact on logging traffic, they would affect a contractor's ability to move heavy construction loads into the site. Accordingly, it is desirable that the heavy equipment mobilization occur in January or February, before the restrictions are imposed. This is a minor issue which can be resolved by advancing the start by a couple of months.

The important issue is the installation of the deep-water pipelines. This work is not on the critical path of the preliminary schedule, and the activities have a lot of float, but even if all the float is removed and installation is postponed to the latest possible date, the assembly and launching of the pipes would have to commence in April to enable the canyon flushing to occur in July. The Nechako Reservoir is typically ice covered until early May. Although measures, such as bubblers, could be implemented to maintain ice-free conditions in limited areas, the presence of ice would complicate the work. Furthermore, the float in the schedule for the pipelines allows for the modification of the floating equipment to accomplish several different tasks. If the float is removed, then additional floating equipment would probably have to be mobilized.

There is at least one potential solution to this issue other than trying to maintain ice-free conditions and mobilizing additional equipment, but it requires further study of the scheduling of critical items, particularly the constraint placed on the completion of the surface water intake channel by the need to maintain public access, and the assumed

single shift working to construct the regulating structure. The conceptual design of the deep-water pipelines requires the removal of the rock plug at the entrance to the surface water channel before the pipelines can be installed. The rock plug cannot be removed until all of the works in the surface water channel have been completed and all the gates in the regulating structure and low-level outlet intake have been installed and dry tested, and the structures have reached a stage of completion which renders them structurally capable of withstanding the full head of the reservoir. The scheduling should be reviewed as part of the preparation of the new cost estimate during the preliminary engineering.

5.3 Preliminary Engineering

The assumed July 2008 start for the preliminary engineering was the latest that could be accommodated for completion of the facility in 2014, given the elapsed times for subsequent activities assumed in the 2002 work plan. The date is probably optimistic given the approvals, planning and tendering required for implementation, and the potential difficulty in procuring contractors and consultants to undertake the work given current market conditions. The seasonal timing is also not ideal, because there will only be about three and a half to four months available for field work prior to the onset of freezing weather conditions, and the next suitable opportunity for field work will not occur until the last few months of the program. Ideally, all the fieldwork should be completed first. However, if the start of preliminary engineering is postponed until the spring of 2009, then appropriate adjustments would have to be made in the remainder of the schedule to avoid delaying the construction by one year.

Wilson Hydrotechnical Services, Inc.

Original signed and sealed by C. J. Wilson, P.Eng. 24 March 2008

6. REFERENCES

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