The John Hart Generating Station Replacement Project

An Argument
submitted to the
British Columbia Utilities Commission
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Note: This Argument consists of two parts:

Part 1: The John Hart Renewal Project: An Alternative Concept

This section provides a general argument against the CPCN Application as submitted. It then examines an alternative approach to John Hart development which may better address the stated objectives. The discussion includes reference to relevant Applicant Documents and Intervener Documents dated prior to October 2012.

Part 2: The John Hart Renewal Project:
Reviewing the BC Hydro Final Submission

This section serves as an appendix to Part 1, by making specific comments on the text of BC Hydro's Final Submission dated October 11, 2012.

Part 1
The John Hart Renewal Project:
An Alternative Concept

Summary

Renewal of the John Hart power generation facility is necessitated by its aged and worn condition. However, the redevelopment plan as submitted to the BCUC does nothing to significantly improve the capabilities beyond those presently found in the seven-decades old design. It does not adequately even satisfy the three stated drivers behind the proposed redevelopment. Specifically, it does not meet the challenges of matching capacity to the imminent realities of emerging wind and tidal power, nor does it satisfactorily address the likelihood of climate-change induced extremes of wet and dry periods. It diverts the threat of seismic failure of the John Hart Dam, but in no way eliminates it. It does not offer a more uniform river flow below the dam, which is critical for the fish habitat on the lower Campbell River.

A simple alternative concept is described in which the water level in John Hart Lake would be lowered to eliminate the risk of dam failure. A new penstock or penstocks about 7 km long running from McIvor Lake to a new generating station located near sea level would handle the bulk of watershed outflow. This would reduce power generation at the existing Ladore and John Hart generating stations to a level approximately half or less of current capacity; the renewal of these stations is thereby deferred. The new generating station would have significantly higher capacity than those two stations combined, and would be operated to supply power on demand as required by the market. Local topography favours this concept as a simple and cost effective choice. The risks from seismic failure are virtually eliminated, and excessive downstream flows are avoided.

This alternative plan may be significantly cheaper than the proposal submitted by BC Hydro. It obviates the very costly challenges of constructing a penstock tunnel through hardrock, of managing construction on the same site as the current generating station, and of handling river flow during redevelopment. Other benefits of McIvor Lake to tidewater power generation include the ability to match hydro production in real time with emerging wind production on the Island as well as potential tidal power nearby. It would increase power self-sufficiency for Vancouver Island, and reduce infrastructure costs for the mainland-to-Vancouver Island transmission system. The total annual power production of the Campbell River system would be increased because virtually no water would go unused for hydroelectric power. By producing power at times of peak demand, BC Hydro would realize greater profitability, generating power only at the times when the electricity is really worth something on the market. Perhaps most importantly, it opens a path to a fully sustainable energy future for British Columbia, without reliance on gas-fired generation and its attendant greenhouse gas emissions. Only by choosing such a path can BC hope to meet its stated emissions and climate goals.

BC Hydro's John Hart Generating Station Replacement Project

In its application to the BCUC for a Certificate of Public Convenience and Necessity (CPCN), BC Hydro makes a strong case for the necessity of replacing the powerhouse generating equipment and water conveyance system that were brought into service between 1947 and 1953. On that matter, there can be little difference of opinion.

BC Hydro states three main objectives for the redevelopment plan. Briefly, these can be restated as follows:

- To achieve reliable electrical generation, within the provincial mandate for electrical self-sufficiency for the province, with at least 93 percent of electricity coming from clean or renewable sources, while reducing greenhouse gas emissions and realizing maximum benefits from our resources for citizens and hydro ratepayers.

- To reduce or eliminate the recognized risk of seismic failure posed by the dam and generation facilities.
- To construct a bypass facility that will allow a rapid response to any emergency, without risk to public safety or impacts to fish or fish habitat such as fish stranding and riverbed drying.

It is the position of this paper that the proposed project fails to meet all three of these main objectives. Let us examine each of them in turn.

Reliable Electrical Generation

We all expect electrical power to be available whenever we want it. Our society is so dependent on electrical power for all aspects of our productivity, comfort and safety, that all our lives are disrupted to a greater or lesser degree when it is not available.

It seems astonishing that the CPCN Application was submitted to the Utilities Commission before even the draft version of BC Hydro's Integrated Resource Plan (IRP) was made available to the general public. The draft IRP makes it very clear that clear the demand for electrical energy will very significantly increase over the coming 20-year period. Inasmuch as the IRP presumes that significant areas of demand reduction are possible through waste reduction, but ignores the fact that a very significant fraction of energy demand could shift from fossil to sustainable sources of electricity (especially for building heating and transportation purposes), and that such demand may be driven by the rising costs of fossil fuels and by the need to constrain carbon emissions, it could be argued the the IRP goals are unrealistically modest and conservative. Although the IRP recognizes a future for electrical generation from wind and other forms of sustainable energy, it seems to view as inevitable that gas-fired generation will be required as backup for periods when these sources are not available (i.e., calm periods when wind energy falters). This ignores the fact that British Columbia is doubtless the best place on Earth to marry the capabilities of wind and water energy. This is because water energy stored in a reservoir does not degrade one iota; it retains its full potential energy until released for power generation. And if downstream effects are avoided by discharge into another reservoir or at sea level, the conversion from potential energy to hydroelectricity *can occur whenever it is needed*.

The availability of hydro power when needed allows us to match it with electrical generation from sustainable but inherently intermittent sources of energy, such as wind. British Columbia has many engineered and natural lakes that are storehouses of energy that may be drawn upon as needed. For the next decade or two, we may have the reserve capacity (in the Peace and Columbia river systems, for example) to meet the vagaries of intermittent wind energy. But somewhere in the 60+ year lifetime of the renewed John Hart power station or its alternative, we will surely need every possible resource capable of meeting electrical demand on an hour-by-hour, minute-by-minute basis.

This requirement, to look more than two decades into the future, is exemplified right now by the situations that have developed in Germany and Denmark. Those countries have at least a two decade lead on British Columbia in their development of wind and solar electrical generation. When these sources provided a few percent of their total supply, there was little problem. Now that they are getting up to 50% of their electrical power from these sources, it is an incredible challenge to balance supply and demand.

The Campbell River watershed is the largest one on Vancouver Island, and a significant player in the provincial energy budget. How has this capability been incorporated into the plans for redeveloping the John Hart facility? It does not appear to have been incorporated at all! The CPCN application calls for a more or less constant output of around 138KW from the rebuilt power station.

Sometime in 2013, the Cape Scott Wind Farm north of Holberg will go online to BC Hydro, supplying up to 99 MW of electrical energy into the grid. The 99 MW is an optimal figure: wind generators typically operate at 20 to 40% of nameplate capacity, so 20 to 40 MW will be more realistic. And on calm days, the output from wind will be negligible. What provision has been made in the John Hart redevelopment plans to match this output in a complementary way? By all appearances, no recognition of it at all!

The Cape Scott wind farm is potentially just the first of what could become dozens of such wind projects on Vancouver Island. Consider also the fact that the world's fastest-flowing tidal waters are found just a few kilometres away from Campbell River, in the channels among the Discovery Islands. They can provide predictable power in perpetuity, but in cycles that peak and wane every six hours. Four times a day, the power from tidal currents will cease. Wave energy may also someday provide significant electrical generation on Vancouver Island's outer coast, again intermittently. Run-of river generation, holding a major fraction of the island's hydro energy potential, again is inconstant although varying daily and seasonally rather than hourly.

So how were all these potential sources of sustainable energy factored into the current proposal? They were not considered at all. The renewal project basically is drawn on exactly the same lines of the original construction 60 years ago! There are very few things one would build today along the identical conceptual lines laid down in the 1940s. To design its operation for a constant output, when all other sources it must be matched with are inconstant beyond our control, seems to be a breathtaking oversight. We have some foresight of how drastically our production and use of energy will change in the coming decades. That the John Hart plan was accepted by BC Hydro's Board even before BC Hydro's Integrated Resource Plan has been finalized (it is due in final form December 2012) is truly astonishing!

The CPCN Application as submitted constrains us to a very stunted sustainable energy future on Vancouver Island. It is not a plan for clean, emissions-free, reliable energy.

Seismic Risk

Both the water conveyance system and the powerhouse are susceptible to failure in a seismic event. This is reflected in the fact that BC Hydro considered – but ultimately rejected – a number of alternatives for lowering the water level at the John Hart Dam, in an effort to lessen the risk of dam failure and resulting deluge.

It is fairly obvious how failure would occur in a major seismic event, should it happen tomorrow. The three aged penstocks – mostly of wooden construction – would be ruptured, with a resulting deluge down the steep direct slope towards the existing powerhouse. The idea behind the CPCN plan is to mitigate the risk by replacing the penstocks with a costly 2 kilometre tunnel through hardrock to the new powerhouse. To reach bedrock from the dam requires a convoluted penstock feeding the tunnel from a hole to be bored in the concrete portion of the mainly-earth-filled John Hart Dam. This penstock would face into the original riverbed, and would be the weakest point in the water conveyance system. In the case of an earthquake, the penstock would burst, releasing the reservoir contents into the route over Elk Falls, so that the deluge will be dispersed somewhat by the time it reaches the City of Campbell River downstream. So this mitigates the risk, but it no way eliminates it. Another scenario which might occur is that the penstock would only partially rupture, so the release of water would be less. In that case, there would still be considerable water pressure behind the earthen dam and the dam might still rupture if the shaking continued for a long time. Saturated earthen landfill will liquify in the case of prolonged seismic shaking.

The seismic failure of the penstocks themselves is not really an intractable problem. Shutoffs for penstocks that are activated by a certain threshold of accelerative forces during an earthquake can and have been engineered and built. They can be fail-safe against loss of electrical power, being activated for example purely by the mechanical strength of the materials holding the gates to the penstocks open. The intractable part of the problem is rather the failure of the earthen portion of the dam itself. And the only practical way to address that threat is to reduce the water load bearing against the dam.

John Hart Lake is large enough to represent a very real and present danger to all those in the City of Campbell River below it, but small enough to be a negligible part of the overall reservoir capacity of the Campbell River system. On page 9 of the BC Hydro booklet “Project Description for JHT Project” dated April 2011, a comparison is made of the three reservoirs in the watershed feeding the John Hart station. The Buttle/Upper Campbell reservoir, the Lower Campbell/McIvor reservoir, and John Hart Lake are likened respectively to “a bathtub, a bucket, and a tea cup”. Given this analogy, does it make sense to draw the water supply from the tea cup, which must be constantly refilled? The mean water retention times in the three reservoirs are 3.9 months, 1.1 month and 1.5 days respectively. Their respective storage capacities are 823, 321 and 3.3 (all in million cubic metres).

The 3.3 million cubic metres of water impounded behind the John Hart Dam is currently a sword hanging over the community of Campbell River. The BC Hydro proposal will only deflect, not remove, that sword. The sword needs to be disarmed to where it is safe.

River Flow and Fishery Considerations

Seismic risk is not the only threat to the John Hart dam. The uncertainties of climate change raise questions about excess water flows around the dam, and about the effects of high river flow below the power station.

A recent poll indicates 98% of Canadians believe global climate to be real. While this is not the place to explore the vast topic of climate change, current thinking suggests that the lessening of equator to pole temperature differences has weakened the jet streams of atmospheric circulation, resulting in extremes of wet and dry periods outside of historic norms.

When BC Hydro began testing the integrity of the John Hart Dam several years ago, they did so on the rationale that climate change has resulted in greater extremes of precipitation, with attendant increase in the risk of dam failure. Snow loads and snowpack melt have been unusually high in recent years, and it's fair to assume this trend will continue into the future. Certainly June 2012 saw extreme flows in the Campbell River due to rapid snowpack melt; all this excess runoff was wasted for power generation, and will doubtless show negative impact on salmon returns to the river.

A search of the internet for recent instances of dam failures around the world yields many examples where engineered earthen structures failed during extreme precipitation events. Between climate risks and seismic risks, reliance on the ability of the present John Hart dam to protect Campbell River from deluge seems ill-placed. The only real way to reduce this threat is to reduce the amount of water contained behind that structure. Here's the paradox: the amount of water behind that dam is too little to be a significant part of the hydro reserve capacity, but too great to remain an acceptable risk should rupture occur.

Because of its smallness, John Hart Lake/Reservoir has very little latitude to maintain hydraulic balance through the system during extreme weather events. This is becoming a real problem as such events become more common, apparently as the result of climate change.

The reality of global climate change is underscored by some compelling events and numbers that have occurred this year. On September 16, 2012, the Arctic Ocean polar ice cover reached an all-time historic low of just 3.41 million square kilometers – demonstrably the lowest extent in the past 1450 years, and probably in many millennia. Regional atmospheric carbon dioxide levels have surpassed 400 ppm in some parts of the world, and they will do so globally in early 2014; that is the highest concentration in a million years and possibly much longer. Locally, in recent years snowpack accumulations on the mountains of Vancouver Island have been far in excess of their historic norms. This in turn is reflected by the fact that in June 2012, river flow volume below the John Hart Power Station was 23% above the seasonal norm. The flood danger caused erosion of river shoreline, loss of trees into the river, and closure of the entire area to the public for about a month.

The reality of extreme precipitation events and periods seems to have been given little account in BC Hydro's plan to redevelop John Hart. Instead, provision is being made to bypass excess water around the generating station. Does it make any sense to waste this free energy? Would an oil company, faced with a glut of petroleum from its wells, just burn it off? Off course not – they would find a way to harvest it - as we must responsibly do with this surplus of water energy.

BC Hydro has payed a lot of attention to developing an ability to maintain a minimum flow in the riverbed, but has ignored the damaging effect of excess river flows to the fishery. Salmonids don't need just water, they need a constant and uniform flow of water over their gravel spawning beds. This argument can be expounded in great detail, but here I will briefly confine it to two examples, the Adams River and the Puntledge River.

The most productive salmon river in the world is the Adams River in the interior of British Columbia. In the interior plateau, extreme precipitation events are rare, and the presence of Adams Lake upstream moderates the river flow to a high degree of constancy. For 11 km along the river from Adams Lake to Shuswap Lake, some ten million sockeye salmon spawn in peak years. That number is approximately *equal to the total number* of Atlantic salmon that entered *all* the rivers emptying into the *entire* North Atlantic at the *peak* of that now decimated fishery. So the Adams river is special indeed, thanks to the constancy of river flow over its gravel beds. Sockeye salmon don't fight their way up 400 kilometres from the sea through Hell's gate because there isn't water enough in the Fraser and Thompson Rivers; they migrate there to get to the clean, silt-free gravel spawning grounds washed by the uniform and predictable flow of fresh water.

The waters of the northern Salish Sea around the estuary of the Puntledge/Courtenay River were famous for their abundance of summer Coho until the 1990s, when the species virtually disappeared. Several theories have been offered for their disappearance, but it occurred around the time that BC Hydro began a regular program of flushing the Puntledge River with raging pulsed outflows up to 20 times a year. This is especially devastating to Coho, which need to spend their first year of life in fresh water, and will die if discharged into salt water before smolting occurs. Of the 0.8 to 1.3 million Coho fry that Department of Fisheries and Oceans puts into Comox Lake each year, we know that only 0.5% survive the short descent to the river estuary. Almost none return to spawn.

In Exhibit B-4-2, PDF page #454, BC Hydro has provided figures on annual returns to the lower Campbell River for six species of salmonids over the period 1990 to 2010. Coho are no longer a significant population in the river – presumably because of their need to spend their first year in the river, which is no longer possible with the pulsed river outflows.

If the Campbell River is to remain a great salmonid-spawning river, the flow of water in lower 7 kilometres must be kept at a more uniform level than current practice or proposed plans would allow.

This can only be done by physically separating, as much as possible, the two main resource functions of the river, for hydroelectricity and for the fishery.

An Alternative Redevelopment Plan

A concept to separate the hydroelectric and fishery demands on the river was outlined in a paper entitled "The John Hart Power Renewal Project: Opportunity Lost or Gained?", which was submitted to BC Hydro on February 23, 2012 by the undersigned. This document is included in Exhibit B-4-2, PDF page numbers 354-360. This proposal is also available online at:

http://dreamgreen.ca/johnhart.html

The concept is briefly outlined in what follows.

From the easternmost point of McIvor Lake to the present John Hart station is about 5.5 km; from the Lake to the junction of the Quinsam and Campbell Rivers about 6 km. If a penstock was built from McIvor Lake along the route of Argonaut and Quinsam Roads to the confluence, it would descend at a uniform gradient around 2.5% over gravelled terrain in less than 7 km. The vertical descent from McIvor to almost sea level would be 175 meters, the operating head for a new power station. The beauty of this route is that natural topography provides a thick natural barrier to the waters of the reservoir above it, eliminating all risk of seismic failure associated with engineered earthfill structures. The outlet of McIvor Lake at the Ladore Station is secure, being a concrete dam set in a narrow rock canyon. Construction of the penstocks along the Argonaut-Quinsam route would be simple, safe and relatively inexpensive. Earthquake-triggered gates to the penstocks would protect against their possible rupture in a seismic event.

A new generating station could be built at or near the confluence of the rivers. Accepting all the watershed outflow, it could average something close to 200 MW, a little more than the combined output of the Ladore and proposed Hart stations, because it would have a slightly greater vertical descent than those two combined. Suppose then it was actually fitted to provide twice (as example) that average power, 400 MW, and operated about half the time. The overall water use would be improved, as there would be no waste of power in flood conditions, and the capacity to match something like 400 MW of intermittent power from wind is achieved.

Because of the need to maintain river flow through the original riverbed for fisheries reasons, some fraction of the total watershed discharge must still pass through the Ladore and Hart dams and generating stations. It is premature to define the relative flows of the Argonaut-Quinsam route versus the Ladore-Hart route. Importantly, the latter would be a constant or slowly seasonally varying flow, while the new route would be highly variable and subject to water supply and electrical market demand. As a suggestion, perhaps the Ladore and Hart stations would produce a third to a half of their present levels of generation, allowing most of their generator capacity to be offline at any given time.

The CPCN Application as submitted by BC Hydro has two main work aspects:

- water conveyance work, to replace the main water intake at a concrete portion of the dam, and to construct a rock tunnel to replace the above-ground penstock structures.
- powerhouse work, to replace the powerhouse, generators and associated equipment.

The thrust of my initial proposal was to challenge BC Hydro to look beyond the existing engineered and natural watercourses, to see if it wouldn't be beneficial in terms of achievable peak capacity, and for ease of construction, to build the new water conveyance and generating structures in some other nearby location. The old facilities would then become an adjunct to the new. The old penstocks and generators would be still need replacement ultimately, but at about one-third capacity, and probably much less than one-third cost.

BC Hydro's rebuttal to my initial submission in the Exhibit B-4-2 document is mostly along the lines of "this raises a lot of uncertainty and would require a lot of regulatory hurdles". Precisely true! But these do not constitute reasons against striving for for the safest operational system, with the most efficient use of the hydroelectric resource, and the lowest energy unit cost.

During the evidentiary period of this hearing, from examination of the information requests and responses provided, it has became apparent that there are two deep flaws inherent in the John Hart dam and reservoir, flaws which remain with the BC Hydro's proposed project:

- The dam, which is really six separate structures, may never be made safe. We need to acknowledge that a significant part of the John Hart reservoir containment is engineered, steep-sloped, and inherently subject to failure. There are six dam structures involved in water containment. The dam underwent extensive repairs during the years 1986-88, and again within the past few years. It would certainly require further repairs of unknown cost after the proposed CPCN work is completed. Its position above the city of Campbell River makes it a real and present danger. This danger is reflected in BC Hydro's various alternative (but discarded) scenarios to decommission the dam. Surely the volume of impounded water behind the dam needs to be reduced. Decommissioning the dam or lessening the impoundment does mean that hydroelectric energy need be lost: it just needs to be harvested elsewhere. That would be from the McIvor Lake part of the Lower Campbell Reservoir. Its containment boundaries are largely natural (the concrete Ladore dam being an exception); its containments are low-sloped, and seismically impregnable.
- The relative sizes of the three reservoirs in the system (the smallest being John Hart Lake) make the system intrinsically unstable against hydraulic imbalances. We have two huge reservoirs upstream discharging into a small reservoir with very little capacity to absorb surge flows. This problem was recognized long ago: from 1970 to 1973, BC Hydro considered expanding the flow capacity through the John Hart system as a remedy. We still have the situation that stability can only be achieved at the price of a lot of wasted water (energy), and by inflicting damage to fish habitat downstream.

So in this version of my alternative proposal (as compared to the proposal I submitted to BC Hydro in February), importance is given to drawing down the load behind the John Hart Dam, and to harvesting surge flows as useful power, while minimizing flood risks.

I am in no position to define the exact parameters that would yield the maximum benefit and minimum risk. But here are some suggested steps to understanding what might be the optimal division of water flow between the existing watercourses and a new outlet from McIvor Lake to tidewater.

A first step in the conceptual design of an optimized system would be to determine the amount of flow necessary to ensure a vibrant fishery in the Campbell River from Elk Falls down to the confluence with the Quinsam River. A Department of Fisheries and Oceans report (Fisheries and Aquatic Sciences Report #2093, dated 1991) entitled “Impacts of the Operation of Existing Hydroelectric Developments on Fishery Resources in British Columbia”, the following statements are noted (pages 225-226):

> “The water licence for the John Hart scheme permits a maximum diversion of 88 m^3/s (3100 cfs). DFO records (e.g. DFO 1966) suggest an informal agreement by B.C. Hydro to limit discharges to a maximum of 120 m^3/s (4300 cfs) and a minimum of 28 m^3/s (1000 cfs), but no such stipulations appear in the water licenses and present spills exceed these limits.”
>
> The flow regime within the 5 km river reach b between John Hart

> Dam and the river mouth is totally controlled by releases through the dam and powerhouse. Daily dis charges through the turbines from January 1984 through December 1987 (Figure 36.2) ranged from about 50 to 110 m^3/s (1700 to 3900 cfs). Spill releases in 1986 and 1987 were sudden, and ranged from zero to as high as 340 m^3/s (12,000 cfs) within the space of a few days. The reservoir provides a minimal amount of storage and drawdowns have seldom exceeded more than 0.5 m within any one month.

These figures suggest a constant flow through the John Hart Power Station around 30 cubic meters per second would be reasonable, with all surplus flow being taken direct from McIvor Lake.

A second step would be a determination of how much the level of John Hart Lake should be lowered to nullify any risk of seismic failure of the dam. In the BC Hydro document dated September 2011 entitled “John Hart Generating Station Replacement Project – Scope for Environmental Assessment”, pages 39-40 contain a number of ways the dam could be partially decommissioned by notching or piercing the dam. Because John Hart Lake is basically a flooded river canyon, the lake bottom profile is narrow and deep, with a wide, shallow surface. A small drop in the water level produces a huge drop in reservoir capacity; such capacity is really unneeded here anyway. It could be that, for example, that a 5 to 10 meter lowering of lake level would will have little effect on the system generating capacity, while reducing the risk of seismic failure to near zero.

A third step in conceptual design would be to determine the optimal (in terms of cost and benefit) generation capacity to be placed on the McIvor Lake outflow via the Argonaut-Quinsam branch of the system, keeping in mind that the duty cycle of this branch would be far below 100%. Construction of this branch could be scalable, with additional penstocks and generators to be added as they are needed.

By 2025, BC Hydro will require more than an additional 6000 MW of integration capacity (that is, discretionary supply side capacity that can be turned off and on rapidly) in order to accommodate the growth of wind energy. Some 2000 MW of this capacity will come from new generators being added at Mica and Revelstoke dams. But perhaps 300 to 500 MW could be provided by John Hart replacement generators operated so as to complement interruptable sources and to match market demand.

By building the Argonaut-Quinsam project first, any necessary rebuilds at the Ladore and Hart stations would be greatly simplified. In the current BC Hydro proposal for rebuilding John Hart, great complexity and cost are invoked by the conflicting logistics and timelines. These require working around operating penstocks, surge towers, transmission towers, transmission lines, switchyard, and buildings, while replacing or moving all of them, without disrupting power generation or river flow. There are fiber optic lines through the construction site, and a natural gas main. The city of Campbell River's drinking water supply must not be disrupted. The risk of catastrophic rupture of the old penstocks during construction is itself a threat. The combined disturbance and danger to the human population of the area from these threats is significant.

Constructing new penstocks on the Argonaut-Quinsam route to a new generating station downstream largely circumvents all these problems. For one thing, the penstocks can be laid into or on abundant gravel, rather than being bored through rock as in the original proposal. Switchover and commissioning of a new powerhouse is vastly simplified. Significantly, this route adds a bypass facility that the existing Hart powerhouse lacks, solving that problem with its inherent threats to the fishery. The need for a bypass was one of the key drivers of the original renewal project.

Conclusion

BC Hydro is to be applauded for undertaking a rebuild of the power generation facilities on the lower Campbell River system. However, their proposal as submitted for approval by BCUC appears to take very little account of the demands that will arise even within the next 20 years, and which most certainly will arise beyond that time frame. It does not take into account the full costs associated with upgrading the dam, the transmission system, the advent of sustainable but interruptable power sources, and the uncertainties of local climate change.

The three stated goals of their project are to achieve optimal use of the hydroelectric resource, to protect against dam failure, and to protect the fish habitat in the river. It does none of these things in an acceptable manner. There is a alternative which can deliver.

I urge the commission to deny the application as submitted.

Respectfully submitted,
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Part 2
The John Hart Renewal Project:
Reviewing the BC Hydro Final Submission

In what follows, I quote specific passages from BC Hydro's argument submitted October 11, 2012, entitled “Counsel's Final Written Submission on Behalf of BC Hydro and Power Authority”. Page and line numbers are given as in that document.

After each extracted statement, my comment follows in italics, with indentation.

Page 2, lines 1-2:
“BC Hydro submits that the Project is in the public convenience and necessity and should be certificated.”

> *Actually, what the the Project would do is lock BC Hydro into an obsolete, inflexible power generation model for the next century. It will not provide and the lowest Unit Energy Cost. It will drive us to gas-turbine generated electricity to meet market demand, increasing the production of carbon dioxide into the atmosphere.*
>
> *Arguably, the Project is illegal, since it demonstrably violates the objectives set out in sections 2(a), 2(c), 2(d), 2(f), 2(g), 2(h) and 2(m) of the 2010* ***Clean Energy Act*** *of BC.*

Page 3, line 12 and following:
“There are six John Hart Facility dam structures impounding John Hart Reservoir: (1) the concrete main dam; (2) the concrete spillway dam; (3) the concrete power intake dam; (4) the earth filled north dam; (5) the earth filled middle dam; and (6) the earth filled south dam (referred to collectively as the **Dam**). The March 2012 John Hart Deficiency Investigation (**DI**) identified significant seismic vulnerabilities with respect to the existing intake structure, the aboveground penstocks, and the north and middle dams. The seismic withstand of the north dam has been improved as part of the John Hart North Dam Interim Seismic Upgrade Project, while the Project eliminates some of the larger seismic vulnerabilities by relocating the intake to pass through the main dam, plugging the existing intake bays at the power intake dam and removing the aboveground penstocks.”

> *This description encapsulates the difficulty of making the John Hart structures safe under a full hydraulic load. There is no pretence that the Project will remove seismic vulnerabilities. The seismic vulnerabilities of the penstocks are gone, but those of the dam structures remain.*
>
> *The billion-dollar pricetag of the submitted Project is only a first step. There would remain a requirement for further upgrades to the John Hart Dam structures, the cost and viability of which has not been detailed. Considering that BC Hydro did remedial work to the dam in the 1980s, and again in the past few years, which have not yet made the dam structure safe, suggests it may be impossible, or impossibly expensive, to do so.*

Page 4, line 5:
“BC Hydro proposes to proceed with the Project prior to undertaking future seismically-related upgrade work at the north and middle dams because: (1) the Campbell River System upgrades are being undertaken in the most logical sequence in view of constructability, cost and risk reduction, and in these terms, the

Water Conveyance Work is next to be undertaken.”

The risk from the north and middle dams would be eliminated sooner by developing generating capacity directly from McIvor Lake, while reducing hydraulic load on John Hart Dam. This alternative offers potentially significant cost savings.

Page 8, line 2:
“There has been no BC Hydro IRP approved by the B.C. Cabinet pursuant to section 4 of the *CEA* at this time.”

Does this not indicate that the Project application is premature? Why is the Project not being fitted to the Integrated Resource Plan?

Page 8, line 9:
“There are four relevant British Columbia’s energy objectives: the legislated requirement for BC Hydro to be self-sufficient; the 93 per cent clean or renewable generation target; ensuring BC Hydro ratepayers receive the benefits of the Heritage Assets; and the legislated greenhouse gas (**GHG**) targets.”

We will only achieve self-sufficiency if (1) we do not waste water/energy (as happens with dam generator bypasses), and (2) we develop our hydro systems to work complementarily with wind and other sustainable but intermittent sources.

Unless we design and build for better supply management of hydroelectric power (matching hydro production to demand in real time), the goal of 93 percent clean or renewable generation will always end up in direct conflict with the goal of meeting the legislated greenhouse gas targets. We are throwing away our opportunity to meet both goals with the proposed Project. A high capacity, variable output generating station is required to meet both.

Page 13, line 15:
“Pursuant to section 5 of the *Hydro and Power Authority Act*, the Board is charged with supervising the management of BC Hydro, including the responsibility to choose the preferred alternative.”

BC Hydro did not perform due diligence in examining or assessing alternatives. They constrained their alternatives to those using the existing river and hydro watercourses. At one of the spring 2012 public information sessions held in Campbell River, I asked a BC Hydro representative (who was later to present on the engineering aspects of the proposed penstock-replacement tunnel) the following question: “why not draw the water from McIvor Lake instead of John Hart Lake?” The stunning response I received was “where is McIvor Lake?” It is quite evident that no options for water conveyance and generation outside their current locations were given consideration.

Page 17, line 22:
“BC Hydro set out two decommissioning-related alternatives to the Project from a GHG perspective: (1) The most likely alternative consists of decommissioning the John Hart Facility and replacing the Project’s 835 GWh/year of average energy with intermittent, clean or renewable IPPs and the Project’s 128 MW of dependable capacity with a natural gas-fired Simple Cycle Gas Turbine (**SCGT**).”

This statement is appallingly misleading, inasmuch as it implies the energy would just *disappear without the John Hart Facility. With or without the generating stations on the Campbell River system, the gravitational energy of falling water is released. One cubic meter of water descending a distance of one meter releases 2.7 Watt-hours of gravitational energy into some other form of energy, regardless of where you are on Earth. The relevant question for our purpose is whether we choose to harvest that released energy as hydroelectricity or not. The statement attempts to imply there is no alternative to harvesting the hydroelectricity other than a powerhouse on the present site, which is ludicrous.*

Page 22, line 7:
"Due to the "Extreme Consequence" classification, the intake and water conveyance structures must be capable of withstanding a MDE corresponding to a 1/10,000 year earthquake."

But no claim is made that the dam itself can or ever will be made to withstand a 1 in 10,000 year event. Would it withstand a 1 in 100 year event?

Page 30: Table of Alternatives:

The McIvor Lake water conveyance option is given in the last line of the table, and classified as "not viable – screened as part of the Information Request process." BC Hydro's response to my February 23, 2012 proposal is given in section 20 of Exhibit B-4-2 (page 351 of the PDF file). Their reaction to my initial submission in the Exhibit B-4-2 document is mostly along the lines of "this raises a lot of uncertainty and would require a lot of regulatory hurdles". Precisely true, but that in no way indicates that it is not viable.

In the column "Average Energy Gwh/year", the response "not estimated as not viable" is misleading and insincere. The answer is obviously "more than 835 Gwh/yr", since the same volume of water is descending the same vertical distance (actually more for the Argonaut-Quinsam route), with a higher capture efficiency than the Project (or the present generating stations) would deliver.

The footnote at the base of page 30 which reads "The Project also has the lowest UEC" is completely unjustified. The Unit Energy Cost of the Argonaut-Quinsam approach would almost certainly be lower, since the technically challenging aspects of BC Hydro's proposal are avoided (thereby lowering the total cost), while the actual power produced would likely be greater than in their proposal. Additionally, the outside-of-project costs related to dam strengthening, to building or buying additional capacity for peak demand periods, and for additional transmission infrastructure for addressing peak periods will all be dramatically reduced. There are potential savings of hundreds of millions of dollars in future costs that can be realized.

Page 36, line 2:
"Given the number of regulatory approvals required, and the need to complete project design sufficient for these approval processes and to undertake First Nation consultation and public engagement, it is unlikely that BC Hydro could implement Mr. Aikman's 23 February 2012 proposal by the subsection 6(2) Amended SD 10 mandated date of 2018 to provide the required 806 GWh/year of firm energy and 128 MW of dependable capacity."

There is no doubt that the Gwh/year and dependable capacity limits would be met and exceeded. After all, we would be harvesting the same river flow – without waste – over the same or slightly greater mean vertical drop. Indeed, a main driver of this alternate proposal is *to provide for increased capacity.*

Yes, it would take some time and a lot of additional engineering to get all the parameters right. And, truthfully, there would be additional regulatory hurdles to clear. These do not constitute reasons against pressing on for the safest operational system, with the most efficient use of the hydroelectric resource, and the lowest energy unit cost. The construction period could be considerably shortened, by avoiding the need to work around the existing generating system without disrupting it. This would translate into cost savings.

Page 51, line 5:
"From a technical perspective, it is feasible to size the generation and water conveyance facilities larger than the Project's 138 MW nameplate capacity (128 MW of dependable capacity). Given that additional capacity can only be used for peaking operation during 1 January-15 February, BC Hydro considers that the discharge capacity of the Project has been optimized to effectively capture the available inflows for generation. Assuming that 100 per cent of the available annual inflow (net of fishery release) could be passed through the generating units, an additional approximately 36 GWh/yr of average energy could theoretically be available. It would require a high installed capacity to capture 100 per cent of the available inflow, as spill most commonly occurs in response to short duration, high magnitude inflow events, and the occurrence of large magnitude storm inflows to the Campbell River System would continue to result in spill at the John Hart Facility. It is estimated that the installation of 41 m3/s additional discharge capacity (similar to a fourth unit, resulting in a total nameplate capacity of about 184 MW) would only capture 2 m3/s of the available spill, providing incremental generation of approximately 18 GWh/yr of average energy. BC Hydro did not pursue this alternative way of carrying out the Powerhouse Work any further given the small energy contribution from a re-sizing and the regulatory barriers described in the response to BCUC IR 1.11.2.1."

Surely these comments illustrate the basic weakness of the existing Campbell River reservoir system, namely that it is very hard to maintain hydraulic equilibrium in the system. The system is inherently unstable because the holding capacity of the John Hart reservoir is so drastically less than the two higher reservoirs supplying it. The solution is to partially bypass and to substantially degrade the role of the John Hart reservoir.

Additionally, it should be noted that peak discharge does not occur only in the period 1 January to 15 February. It can and does occur during spring snowmelt runoff.

Page 66, line 5:

Approximately 95 per cent of the Campbell River flow passes through the powerhouse. As a result, BC Hydro depends on the reliability of the powerhouse units to maintain flows in the Campbell River downstream of the John Hart Facility.

The 95% figure might be true in times of normal river flow. However, from Mid-May into July 2012, BC Hydro was exceeding its water licence limits by about 30% or more. This implies that a considerable amount of hydroelectric potential was being wasted during this peak runoff period. With an alternative generation route, this power would be harvested, without the considerable damage that was done to fish habitat in June-July 2012.

Page 69, line 16:

“The Project will result in no change to how the John Hart Facility is currently operated as there will be no change to either the Campbell River Interim Flow Management Strategy or the WUP, whichever is in place at the time the Project is commissioned.”

> *Which is precisely the problem: there is no allowance for improvement in water use; there is no provision for the altered realities climate change might bring. In a time of climate change, we must expect the unexpected.*

Page 69, line 21:
“BC Hydro expects negligible annual discharge changes and some seasonal shifting of discharges to the Campbell River System study area as a result of climate change.”

> *This statement is highly questionable. No one fully knows what the implications of climate change might be.*

Respectfully submitted,
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