Name: Roger Bryenton

Date: October 10, 2017

Subject: Public Session Oct 5, Vancouver written material

Dear Commission Secretary

Attached is my background material for my submission on Oct 5, 2017 in Vancouver. Thank you for the opportunity To submit updates and additional relevant material, and to correct the error in the Deloitte Report, concerning termination costs. These costs are almost 20% too high due to the use of an inconsistent contingency number of 30%, which should be 10% to be consistent with the Site C cost estimates.

Sincerely, Roger Bryenton, P. Eng (former), MBA
Energy Systems Consultant
Suzuki and SPEC Elder 778 232-1326

BCUC Site C Inquiry

October 6, 2017

Dear Commission Secretary and Committee Chair, Mr. Morton

I am submitting updated and relevant information regarding DSM 9Demand Side Management, Elasticity of Electricity Use, Disruptive Technology and a significan error in determining the cost of Termination of Site C.

The Termination cost error arises because Deloitte used a 30% contingency, while BC Hydro has been using a 10% contingency on the entire project. To be consistent, the Deloitte number must therefore be reduced. It is not $1.2 Billion but in fact $1.02 Billion, a reduction of $186million.

The DSM, Elasticity and Disruptive Technology offer an opportunity to plan a "**Progressive Electricity Strategy for BC**". With electricity use essentially level for the last 10 years, we can implement much greater DSM to intentionally continue this pattern, increasing DSM from 1% of use now, to at least 2%, and perhaps 3% as Massachusetts has done. DSM cost BC Hydro $20/MWh; the IRP estimated $30/MWh. Future DSM is in the range of $50/MWh; Site C - $80 to $120! DSM is clearly a preferred option.

Site C is not needed under any growth conditions imaginable, and if additional power is needed, Columbia Treaty, and during a few hours per year, Burrard Thermal can be used. Renewables offer additional electricity.

Thank you for the opportunity to submit this information to assist in your decision making. The Report follows.

Sincerely, Roger Bryenton, P. Eng. (former), MBA,
Energy Systems Consultant, Suzuki and SPEC Elder

DSM, DISRUPTIVE TECHNOLOGY, PRICE ELASTICITY and COST OF TERMINATION

Roger Bryenton, Oct 6, 2017

British Columbia's Energy Objectives :

(a) to achieve electricity self-sufficiency;

(b) to take demand-side measures (DSM) and to conserve energy, including the objective of the Authority reducing its expected increase in demand for electricity by the year 2020 by at least 66%;

(c) to generate at least 93% of the electricity in British Columbia from clean or renewable resources and to build the infrastructure necessary to transmit that electricity;

(d) to use and foster the development in British Columbia of innovative technologies that support energy conservation and efficiency and the use of clean or renewable resources;

DSM Potential

1. What has BC Hydro projected and what have they accomplished? In the 2013 Integrated Resource Plan BC Hydro (Appendix 3 - RODAT) identified 5 levels of conservation:

   DSM 1 saves 1196MW capacity, 6120GWh/yr at a cost of $32/MWh
   DSM 2 1421MW capacity, 7606 GWh/yr $32/MWh
   DSM3 1511* MW capacity, 8299 GWh/yr $35/MWh
   DSM4 1492* MW capacity, 9466 GWh/yr $47/MWh
   DSM5 1585 MW capacity, 9610GWh/yr $49/MWh

   (It appears DSM3 and DSM4 Capacity numbers may have been inadvertently switched).
   Note that these **DSM savings are roughly ONE-THIRD TO ONE-HALF the cost of SiteC**.

   What have they accomplished? In the 2017 Conservation DSM Report for 2017, actual savings were 1754 GWh/yr at an average cost of $20/MWh, at 2/3 of the projected cost above. Thus there are **an estimated 4366 GWh remaining at the DSM1 level, well below the cost of Site C,** with approximately the same electricity output.

2. What have **other utilities** accomplished? The ACEEE 2107 Report shows **Massachusetts saving over 3%** of electricity sales in a single year. Two others saved over 2%, while 3 saved over 1.5% and 10 more saved more than 1%. Nationally, the US invested 6.3Billion in DSM saving a total of 25,400 GWh. Note that this is about 2/3 the cost of Site C, with roughly 5 times the savings! The prior year 2016 report showed savings of 26,500 GWh, essentially the same. Savings show no sign of slowing. The **Public Service of Colorado** issued DSM Requests for Proposals of 50MW savings, 30 contracts resulted in **$267/kW of capacity savings, and 2.5 cents/kWh of electricity** savings of 110GWh. BC Hydro's capacity cost is $ 8000/kW or 30 times greater!

3. **What Could BC Hydro save at 3% in a single year? - 1/3 of Site C!** At present output of approximately 50,000 GWh/yr, **a 3% savings would be 1,500 GWh, in a single year;** roughly **1/3 the projected output of Site C! This is a serious and possible goal.**

4. **The Financial Benefit of Stopping Site C.** Demand forecasts from BC Hydro, to be used for the Site C Inquiry, show a projected DSM peaking at 1970 GWh, plus an additional DSM peaking at 5100GWh, for a total of 7070 GWh/year savings by 2036. Compared to the above values in points 1 and 2, **this would correspond to a 90% level of DSM2** (.9x7606**), at $32/MWh, 1/3 the cost of Site C and more electricity**. Increasing to a DSM 3 regime would increase savings by 693GWh/yr for 10% more cost. "Deep DSM", or DSM 5 would be another 1311GWh at the cost of $49/MWh. This would be roughly ¼ the output of Site C at roughly half the cost. For DSM 5, the **overall 9610 GWh/yr is approximately double the output of Site C, at roughly half the cost.**

   Instead of Spending $8.8 Billion on Site C, generating electricity at $120/MWh, the same electricity could be provided (saved by DSM) for $35 or less, according to BC Hydro; an annual savings of $433 million.

5. **DSM and Pricing Awareness** - For Capacity and Demand Response, a Carnegie Mellon study showed by using real-time pricing, that a **1% shift in peak demand could result in a 3.9% demand cost savings** due to the low capacity factor for peaking plants. A 1% shift of 12,000MW would be 120 MW.

6. A **Time-of-Use** study by the Environmental Defence Fund for California showed that a **13% to 15% demand savings** could be achieved. Thus the potential for BC could be a 14% saving, which on 12,000 MW would be a 1,680 MW saving. This **is more than 50% greater than Site C** would produce.

7. Some "Aggressive" utilities are **spending up to 4% of annual revenue on DSM**, on $5,874 Billion that would amount to $235 million per year. BC Hydro spent less than half of that amount, or $97 million in 2017; even then it was $16 Million or 14% below budget. Net incremental savings were 602 GWh/yr. Analysis shows that for $97 million, saving 602 GWh/yr, or 14 cents/kWh/yr, which if sustained for 5 years would be **less than 3 cents/kWh**. (BCH Report on DSM for fiscal 2017).

8. Pacific Gas and Electric - Specific building savings of 859kW and 2,928 MWh were accomplished for $240,000 in incentives. A second example saved 3.2 MW of capacity and 16GWh for $400,000 incentives. Baltimore Gas and Electric sent personalized letters to customers and saved 5% of peak load, by engaging with customers, at essentially zero cost.

9. **BC Hydro's 2016 – 2017 Residential DSM results were 35% greater** than planned. Most effective were **low income and retail (lighting savings) with 48% and 80% savings** respectively greater than expected.

10. **BCH's Commercial** sector savings were in line with reduced spending, over 20% due to delays. This sector may be worth substantial additional effort.

11. **BCH's Industrial DSM** results were **27% greater than expected with 13% less expenditure**. This would indicate substantial future savings can readily be achieved.

12. According to BC Hydro's F-1-1 submission to the Site C Inquiry, p. 75, terminating Site C will result in BC Hydro increasing DSM spending by $700 million by 2024, over 7 years; $100 million additional per year. **Anticipated savings would be 1,300 GWH/year plus 175 MW of capacity.** To compare to Site C output of 5,100 GWh/yr, that quantity of electricity would require only $2.7 Billion, vs almost $9 Billion for Site C; or **less than 1/3 the cost of Site C**.

13. Net-Zero Buildings – "Deep DSM". The "new generation" of housing and other buildings, in response to concerns over greenhouse gas emissions and climate change, are already being designed and built, as are "local housing utilities" within BC cities. The end result is **dramatic reduction in electricity** and heating energy use. **New housing** will be built, with very **little impact on overall electricity consumption**, despite an expanding population.

Smart Meters and Disruptive Technology

14. Smart Meters and DSM. At or near the cost point where DSM or new supply equals the cost of Transmission and Distribution, which a proxy is roughly 9% of delivered power cost, customers will elect to become self-suppliers, using either advanced DSM or such alternatives as solar, or other self-generation. At this point, the Utility will "lose control" over customers' behaviour, and "Disruptive Technology" will have occurred. Such a case would be for electric vehicles being able to charge at night or off-peak, while supplying the stored electricity back into the grid at peak times.

    Such a combination of a "storage power-wall with wheels" will revolutionize the grid. Already fixed power-walls are being implemented in locations with very large and expensive peak loads. As storage costs decline, according to Dr. Tony Seba, well within the time frame of this projected analysis, such disruptions will certainly occur, with or without utility incentives. Should adaption be severely under-estimated such as ATT's projections on cell-phones, BC Hydro may have to play "catch-up" instead of "leader".

    Smart meter integration into DSM – Up to **18% of electricity consumption** can be saved using smart meters, while peak **demand can be reduced up to 20%** according to "smartgrid" estimates**.** (https://www.smartgrid.gov/files/The_Smart_Grid_Promise_DemandSide_Management_201003.pdf pages 39 and 42). With such savings, up to 11,000 GWh presently, **double the output of Site C of electricity could be saved, with a demand reduction of 2,400 MW**, again **more than double the Site C project.** Measures as simple as "over-sized water heaters" during replacement, or "intelligent" clothes dryers can have their electricity use reduced or increased by the utility when necessary. Commercial refrigeration and building air conditioning can be cycled or adjusted slightly during peak periods. Within the time frame of this projection, 10 to 20 years,

"Intelligent Housing" will incorporate appliance interconnections with the "SmartGrid" allowing utilities and customers direct control over power use.

15. The power of **Utility Incentives**. A previous presenter to the Inquiry, who works with solar technology in BC described how a 25% incentive for 200,000 homes would leverage $9000 per home additional from homeowners, for a total of $1.9 Billion in new investment, along with thousands of new jobs. Future cost reductions and efficiency improvements in the next 10 years will have a substantial impact on utility operations.

16. Cumulative Impact and a "**Plausible 10 to 20 year DSM Scenario**" – **Zero Net Growth**. With DSM savings of 14%, Smart meter savings of up to 20%, and Disruptive Technology saving electricity while contributing new supplies, the **demand for capacity and electricity will shrink at least 1%/ year**. A greater commitment will accelerate savings to as much as 3% per year. As experienced over the past 10 years, **future growth will continue to be zero**.

    CONCLUSION - There is no conceivable scenario in which Site C will be needed within the next 20 years, and probably beyond from DSM alone.

Price Elasticity

17. In BC, from 2007 to 2017 **residential** electricity use increased by 9%, the number of customers increased by 15%, thus electricity use per customer declined by 6%. With a 73% price increase over that time, the **elasticity is -.08**. a 10% increase in price resulted in an almost full percentage drop in use.

18. **Commercial** use increased by 4% over the same period, while the number of customers increased by 7%. Electricity use per customer dropped by 3%, thus with a 70% price increase the **elasticity is -.04**.

19. The greatest change in use was in the **industrial sector**, a decline of 14%, which does not bode well for retaining heavy industry in BC. Although there was a 31% increase in the number of customers, the per customer use of power declined by 35%. With a 66% increase in the price of power, the **elasticity is thus -.525**, a troublesome number for a utility interested in selling additional electricity. Using the overall sector numbers such as not to distort use by a great increase of customer numbers, the 14% sector decline results in a sector wide **elasticity of -.21**. With heavy industry such as pulp and paper mills, electro-chemical plants, smelters, and sawmills reliant upon low-cost electricity for profitable operations, increasing power costs will cause them to seek alternative locations where power costs are lower.

20. **BC Hydro's use of a standard elasticity of -.05 is not a correct value across all sectors**. In fact, disaggregation of elasticity coefficients within each sector, and possibly from customer to customer may assist in more accurate prediction of demand given various price increases. Some loads such as water heaters and clothes dryers may have distinctly different elasticities from computers, lighting or refrigeration. Elasticities may not be constant with time, further complicating the demand forecasting.

21. **Step function elasticities** occur with technological innovation, such as LED lighting. From incandescent to LED the 90% savings are not price dependent, and some utilities provide LED's for free due to the low marginal cost of both capacity and energy that they provide; almost an infinitely large negative elasticity. The compact fluorescent to LED change is price influenced, with a 30% savings. For residential use, where lighting heat is useful to meet winter loads, the elasticity is different from hospitals, restaurants, and grocery store freezers which have a net heating effect and a cooling load is associated with lighting. Here LED's provide a major "double benefit" of reducing both the lighting load and the HVAC cooling load. The elasticity is very large due to the relative insensitivity to electricity price. **LED's have created a "technology disruption**", a step-function in the elasticity where suddenly all illumination used more than 12 hours/day is immediately beneficial to change. Such elasticities need to be better incorporated into forecasting models.

CONCLUSION – By using conventional and advanced DSM approaches, not only does BC Hydro NOT recognize that there is no need for power from Site C, but DSM also provides dramatically less expensive power.

In addressing demand forecasts, BC Hydro does not appear to be back-testing existing elasticity values, nor disaggregating to a sufficient level of detail to enable accurate forecasting.

Technological Disruption, especially with DSM will accelerate, and a huge 1,100MW, 5,100 GWh/year "solution" to providing electrical services is neither "incremental" nor "least cost", two tenets formerly used by BC Hydro's planners.

COST OF TERMINATION ERROR

In the Deloitte Report, page 83, the cost of Termination is shown as $1,203 million. This is in error by almost $200 million, because a 30% contingency was used, and is inconsistent with BC Hydro's methodology. BC Hydro used a 10% contingency, (page 15) of 8,335 million, including a $795 contingency. To be consistent, the **termination cost** must also use 10% which on $925 million means a **final cost of million $1,017**, not 1,203, which is **$186 million lower cost than reported.**

Point 21 Reference: The Long Run Demand for Lighting: Elasticities and Rebound Effects in Different Phases of Economic Development, Roger Fouquet and Peter J.G. Pearson