



To: Managing Directors, Manitoba Hydro
From: Judah Rose, ICF International
Date: December 7, 2009
Subject: Response to McCullough Memorandum

I. INTRODUCTION

The following is ICF's response to the memorandum of Robert McCullough dated December 2, 2009 entitled "Review of the ICF Report on Manitoba Hydro Export Sales". The title of the ICF report is "Independent Review of Manitoba Hydro Export Power Sales and Associated Risks," dated September 11, 2009. Overall, ICF concludes Mr. McCullough's review is inaccurate and misleading.

II. MR. McCULLOUGH'S TWO KEY CLAIMS

The first claim of Mr. McCullough is that the ICF report spends little time analyzing the underlying risk of future droughts or Manitoba's Hydro's planning methodology.¹ He specifically states that "the ICF report does not address the issue of drought"², and "the only real discussion of the risk of drought occurs on page 108"³. This claim is also the predicate to his second claim. Namely, "the ICF report does not address the issue of drought and cannot be said to have findings that are "diametrically opposed".⁴

These claims are incorrect and misleading. The broad ranging report addresses six items mentioned in the Manitoba Hydro Terms of Reference for ICF's assignment, three of which explicitly mention drought issues⁵. Of the remaining three, all address drought risk to some degree even though the item's title does not.⁶ Four of the items address risk topics and one of the items addresses long-term business strategy. Specifically, the six items in the Terms of Reference ("TOR") for the ICF assignment are:

- I. *the appropriateness, from a long-term business strategy and risk exposure perspective, of Manitoba Hydro entering into long-term firm contracts 20 or 30 years into the future;*
- II. *the adequacy of price that Manitoba Hydro derives (or will derive) from export sale transactions (both long-term firm and short-term opportunity sales);*

¹ McCullough, Page 1.

² Page 4, *ibid*

³ Page 4, *ibid*. Note, page 108 is the first of 13 pages in a chapter entitled "Analysis of Reasonableness of Manitoba Hydro's Quantification of Risk Related to an Extended Drought." Thus, his statement is, at a minimum, highly misleading.

⁴ McCullough, Page 3.

⁵ Page 1, ICF report See Terms of Reference III, V, and VI.

⁶ For example, see Terms of Reference (TOR) I discussion in the Executive Summary page 5, TOR II discussion page 12, and TOR V discussion page 19.

- III. *the risks assumed by Manitoba Hydro in selling long-term firm energy from dependable resources (in consideration of the requirements to meet firm sale commitments during periods of drought);*
- IV. *the extent to which Manitoba Hydro should be involved in pure merchant energy trading transactions;*
- V. *the reasonableness of Manitoba Hydro's quantification of risk exposure related to an extended (5-year) drought; and*
- VI. *the adequacy of Manitoba Hydro's drought risk mitigation measures.*⁷

The ICF report mentions the word drought 406 times in over 132 pages⁸. Some of the principal conclusions directly address the risk of drought and are diametrically opposed to claims that Manitoba Hydro is unreasonably addressing its key drought related risks. These conclusions include (bold in the original):

The reasonableness of Manitoba Hydro's quantification of risk exposure related to an extended (5-year) drought: *The quantification is reasonable. It is based on an adequately stressful event (close to a 95 percent confidence interval stress level), and the quantification is appropriate. Manitoba Hydro is involved in activities to further improve quantification, and as discussed below, they should be pursued.*

The adequacy of Manitoba Hydro's drought risk mitigation measures. *The Corporation's drought risk mitigation measures are adequate. The firm contracts provide protection against drought and lower prices.⁹ There are protections against the risks related to firm contracts including the ability to decrease firm volumes during droughts. The Corporation also has a reasonable targeted equity cushion. Work in this area should continue.*

The risks assumed by Manitoba Hydro in selling long-term firm energy from dependable resources (in consideration of the requirements to meet firm sale commitments during periods of drought): *There are risks to selling long-term firm; they are identified and discussed. These risks, however, are greatly mitigated in the proposed contracts relative to the existing contracts. This is driven by improved volume flexibility and price provisions. There are also benefits such as lower volatility of revenues. Overall, the risks are reasonable.*¹⁰

⁷ ICF Report page 1

⁸ Excluding Table of Contents. This is more than 3 times per page.

⁹ The context indicates the discussion addresses proposed contracts. Note, all Manitoba Hydro existing firm contracts expire by 2016. See page 82, ICF Report.

¹⁰ Page 25, Executive Summary.

III. MR. McCULLOUGH'S CLAIMS ABOUT THE HISTORICAL HYDROLOGICAL RECORD

Mr. McCullough devotes a large portion of his December 2, 2009 memorandum to the issue of whether Manitoba correctly characterizes the historical record with respect to drought and therefore, whether it has an adequate basis for its risk management approach.¹¹ While it is true that ICF did not conduct detailed research or review of paleoclimate information, I believe Manitoba Hydro has a reasonable treatment of the historical record and a reasonable risk management approach in this regard. This is based on:

- First, Manitoba Hydro uses 97 years of data (1912 – 2008) to quantify drought risk. It is ICF's understanding that this data includes all available data that reasonably meets the data requirements for simulating the performance and operation of the Manitoba Hydro system (e.g., storage, output, etc.). This data is graphically summarized on pages 21 and 112 of the ICF report. While pre-1912 data exists, ICF's understanding is that this data lacks the detail needed to conduct the simulation. Mr. McCullough, trying to have it both ways, points this out problem, but offers no solution. Mr. McCullough refers to his use of paleoclimatic data as "illustrative." He continues, "there needs to be an extensive effort to determine whether the paleoclimatological data has been developed sufficiently." He states "use of this (paleoclimatic) data is certainly speculative."¹²
- Second, we have not found any other North American utility organization regularly conducting quantitative operational and risk analyses involving significantly more historical hydrological data than Manitoba Hydro. Apparently, neither has Mr. McCullough.
- Third, we have found that many companies and industries desire more historical data. However, this desire cannot be satisfied due to the lack of data. Indeed, part of the basis of ICF conclusions that the quantitative analysis is reasonable is that Manitoba Hydro is dealing with this issue in a manner comparable to other companies and industries.¹³ For example, Manitoba Hydro's data set and methodology is similar to BC Hydro's HYSIM and SO models.¹⁴
- Fourth, Manitoba Hydro analyzes the financial impacts of a prolonged drought by assuming a repeat of the historic five year drought between April 1987 and March 1992. As stated in the ICF report:

"Manitoba Hydro estimates that over the five year period, such a severe drought has the potential to reduce baseline retained earnings by nearly 90 percent...the estimate of impact on net revenue is \$2.7 billion. It is estimated an annual rate of increases of 3.8 percent in addition to the rate increase assumed...would be required."¹⁵

Effectively, Manitoba Hydro has chosen approximately a 95 percent confidence interval for its analysis. There is only one longer drought on record, the 1937 to

¹¹ More than four of McCullough's 12 pages of text are on this issue, see pages 9-12.

¹² See McCullough, pages 9, and 10. The parenthetical is added.

¹³ ICF report, pages 115-117.

¹⁴ See ICF, page 21.

¹⁵ Page 109 to 110.

1943 seven year drought which if used as the basis is equivalent to adopting a 98 percent confidence interval.¹⁶ ICF concludes that basing financial planning for drought on approximately on 95% confidence interval is reasonable. Mr. McCullough criticizes this as a rule of thumb.¹⁷ However, he provides no alternative recommendation, e.g., a different significance level for the confidence interval. Moreover, confidence intervals are standard practice when dealing with uncertain events.

- Fifth, Manitoba Hydro is well aware that there is the potential for droughts worse than the worst on record. This is based in part on interviews with Manitoba Hydro staff. This is also implied by Manitoba Hydro probabilistic simulation and statistical analysis and it is also supported qualitatively by paleoclimatic studies. Manitoba Hydro has correctly undertaken steps to manage these risks in a reasonable fashion. A key ICF conclusion is that Manitoba Hydro has been wise to plan extensively for events worse than is contained in the 97 year historical record.¹⁸ The steps undertaken by Manitoba Hydro and extensively described in the ICF report include:
 - planning to bolster transmission interconnections with other power systems to ensure Manitoba Hydro can import more power during extreme drought and extreme cold, including for droughts worse than the worst on record,
 - formulating its new proposed export contracts to provide very extensive relief in the event of extreme droughts worse than the worst on record,
 - limiting its exports to levels consistent with severe droughts,
 - planning for capacity expansions within the Province,¹⁹
 - reviewing research on hydrological conditions,
 - increasing its risk management capabilities, and
 - conducting reasonable assessments of the consequences of extended droughts as part of its financial and operational planning and criteria, etc.²⁰

Mr. McCullough, with one exception, does not discuss these steps and policies and procedures. Regarding the one exception discussed below, he incorrectly states Manitoba Hydro does not recognize this risk of deeper or more frequent droughts than the recent data might indicate²¹.

¹⁶ ICF, page 112.

¹⁷ McCullough Page 5

¹⁸ ICF page 113. ICF's Report refers to these events as "Black Swan" events. See also ICF, page 5. Ironically, this conclusion is inaccurately considered criticism of Manitoba Hydro by Mr. McCullough. See McCullough, page 5.

¹⁹ See ICF Report, page 33.

²⁰ ICF Report page 14, see discussion of Manitoba Hydro Drought Preparedness Plan. See page 15 for discussion of Operations Planning Criteria. See also page 16 for discussion of Drought Financial Management Working Group.

²¹ McCullough page 9

IV. TRANSMISSION

Mr. McCullough only discusses one of the above mentioned risk management steps, policies and procedures: the use of imports to firm inflows²². Mr. McCullough claims that reliability should be determined without reference to imports, and to do otherwise is “leaning on your neighbors and the practice is generally discouraged”. Mr. McCullough refers to the California crisis of 2000 and 2001 as a basis for the claim. This recommendation is highly inappropriate, and is in fact the exact opposite of what is required:

- First, it is standard practice in the electric utility industry to factor in reasonable levels of import potential in the determination of the targeted reliability reserve margins. One of the main reasons for having interconnected electric power systems is to increase reliability.²³ Significantly, no evidence was presented that Manitoba Hydro’s treatment of imports was inappropriate. ICF concludes that the treatment was appropriate.
- Second, proper attention to import potential is a key to achieving reliable operations. A critical goal of Manitoba Hydro is and should be increasing transmission interconnections with other systems. As the ICF Report states,

“Manitoba Hydro is relatively isolated from the rest of the North American grid, is heavily reliant on hydroelectric production, and faces relatively high hydro-electric supply variability compared to other hydro electric oriented companies. Also, electric supply is crucial during the winter peak season. Increasing its ability to import power will increase the reliability of Manitoba Hydro’s domestic supply during unexpectedly extreme events, for example, a historically unprecedented drought. combined with rare internal transmission problems.”²⁴

This is especially the case for Manitoba Hydro because: (1) the principal transmission interconnection, MISO, is primarily a fossil based system rather than hydro based system, and hence, is much less subject to drought risks; (2) MISO is a summer rather than winter peaking system like Manitoba Hydro,²⁵ and therefore, MISO will very likely have large amounts of excess capacity during the winter available to help Manitoba Hydro during extreme winter conditions, and (3) MISO is a much larger system than Manitoba Hydro; the larger the power system, the lower the likelihood that individual problems create reliability problems, all else equal.

- Third, the reliance of Manitoba Hydro on imports is small as a percentage of the total firm supply at 10 percent.²⁶ Also, Manitoba Hydro is actively seeking to construct new power plant capacity in the Province.

²² Pages 6 and 8

²³ This is the same principal underlying insurance and pooling of risks.

²⁴ ICF, page 9.

²⁵ ICF report page 9

²⁶ ICF Report, page 14. The 3 TWh involved is also small compared to the size of MISO alone. A very rough indication is that MISO’s summer peak is approximately 20 GW higher than its winter peak. Manitoba Hydro’s winter peak is approximately 5 GW.

- Fourth, changes have occurred in MISO that directly address many of the issues raised during the 2000 to 2001 California crisis. They are discussed in the ICF report and they are highly significant vis-a-vis reliability. MISO is now subject to newly enforceable Electric Reliability Organization (ERO) rules, and failure to meet these requirements can result in a million dollar per day per violation fine. MISO has recently instituted explicit generation capacity reliability requirements and a MISO market for planning reserve capacity started functioning several months ago. Indeed, these new rules are so stringent as to threaten Manitoba Hydro's ability to export on a firm basis without expanded transmission ties²⁷.
- Fifth, Mr. McCullough endorses the claim that US export contracts are a huge contributor to Provincial risk.²⁸ This is a misleading and incomplete characterization of the situation. In fact, proposed export contracts are important parts of Manitoba Hydro's program to increase reliability, and avoid the consequences of extreme unprecedented drought. This is because without these contracts, it is very unlikely U.S. utilities will build the lines in the U.S. needed for Manitoba Hydro to interconnect to MISO. As noted, this greater interconnectedness is exactly what one should do if one is concerned about a combination of very severe drought and very cold winter conditions. Also, these proposed contracts contain adequate safeguards in the event of droughts. Manitoba Hydro can curtail deliveries in the event of extreme droughts worse than the worst experienced if delivery curtailment is required to serve high priority domestic load or in the event of catastrophic failure of its DC transmission system.²⁹ Also, Manitoba Hydro can make power delivery reductions during droughts with severity within the historical record.³⁰ Thus, Mr. McCullough's characterization is so misleading and incomplete as to threaten a key part of the solution to the very problem he claims to care about: namely, the construction of additional transmission.
- Sixth, the proposed contracts themselves create some risks, but also help manage other risks. For example, they are an important risk management action separate from their key role in decreasing Manitoba Hydro's isolation from the rest of the grid. This is because they decrease reliance on financial hedging and spot market price volatility.

V. COMPUTER MODELING

Mr. McCullough states that ICF only addresses computer modeling capability on pages 118 to 120. However, pages 108 to 120 of the ICF Report address the reasonableness of Manitoba Hydro's quantification of risk related to an extended drought. The ICF Report also concludes that the basic approach of using historic hydrologic conditions to simulate risks pursued by Manitoba Hydro is also being pursued by other utilities. Similarly, Manitoba Hydro's new Monte Carlo simulation tool is also similar to those used elsewhere.

²⁷ ICF Report page 5

²⁸ See the claim on page 16, and his endorsement on page 12.

²⁹ ICF Report, page 18.

³⁰ ICF Report pages 17 and 18.

VI. BI-POLE III

The claim is made that the ICF report did not address bi-pole III except to assume it was firmly planned.³¹ This is largely true.³² This does not minimize the importance of Manitoba Hydro grid enhancements. ICF was never told that these enhancements were not important. Rather, we were informed that there was internal consensus on following through on this important firm project, and it was not part of our scope.

VII. “RUBBER STAMP REPORT”

The claim is made that the ICF report is a rubber stamp consultant report.³³ This claim is false. The fact is that ICF found considerable management attention and resources devoted to risk management, especially management of potential droughts. Overall, these risk management provisions are reasonable. It is interesting that Mr. McCullough omits mention of ICF’s recommendations for improvements on pages 26 and 27. These recommendations cover such areas as the Drought Preparedness Plan, documentation of risk management, risk management infrastructure, and quantification of operational and financial impacts.

VIII. “HASTILY PREPARED REPORT”

Mr. McCullough claims the ICF report appears to be a hastily prepared redraft of an earlier document and “repurposed” from an earlier study.³⁴ This is not true. ICF responded to a RFP with the same terms of reference mentioned above, signed a contract to address these terms of reference, and delivered the report dated September 11, 2009. It was not “repurposed” from an earlier study. With respect to the claim that it was hastily prepared, this appears to be a Freudian slip on the part of Mr. McCullough. As evidence, ICF cites a comparison between his 16 page memorandum filled with inaccuracies and numerous errors and ICF’s 132 page report.

IX. CONCLUSIONS

In conclusion, we note it is true that the ICF report did not directly address the risk manager’s report and is not fully congruent in scope to the issues apparently raised. However, the broad ranging ICF report directly addresses drought management and many other aspects of risk management as part of its scope. ICF concludes that Manitoba Hydro is reasonably addressing drought risks. In light of the fact that drought risk management and risk management generally are important issues for Manitoba Hydro’s situation, ICF does not find these issues to be usefully advanced by either Mr. McCullough’s memorandum or the letter from a risk consultant attached to his memorandum. Just the opposite. Many of their recommendations are diametrically opposed to what ICF found and to what Manitoba Hydro should be doing. Therefore, they endanger rather than enhance reliability.

³¹ See ICF Report, page 33 showing Bi-Pole II as firmly planned.

³² In addition to explicitly assuming it is firm on page 33, the above quote from page 9 of the ICF report presented above alludes to it: “rare internal transmission problems.” The quote for page 18 discusses a catastrophic system failure.

³³ McCullough page 2.

³⁴ McCullough pages 1, and 4. He uses the term “repurposed.”