MANITOBA HYDRO
2010 – 2011 GENERAL RATE APPLICATION

CONSUMER ASSOCIATION OF CANADA (Manitoba Branch) and MANITOBA SOCIETY OF SENIORS

YELLOW BOOK OF DOCUMENTS

Kubursi/Magee Cross Examination

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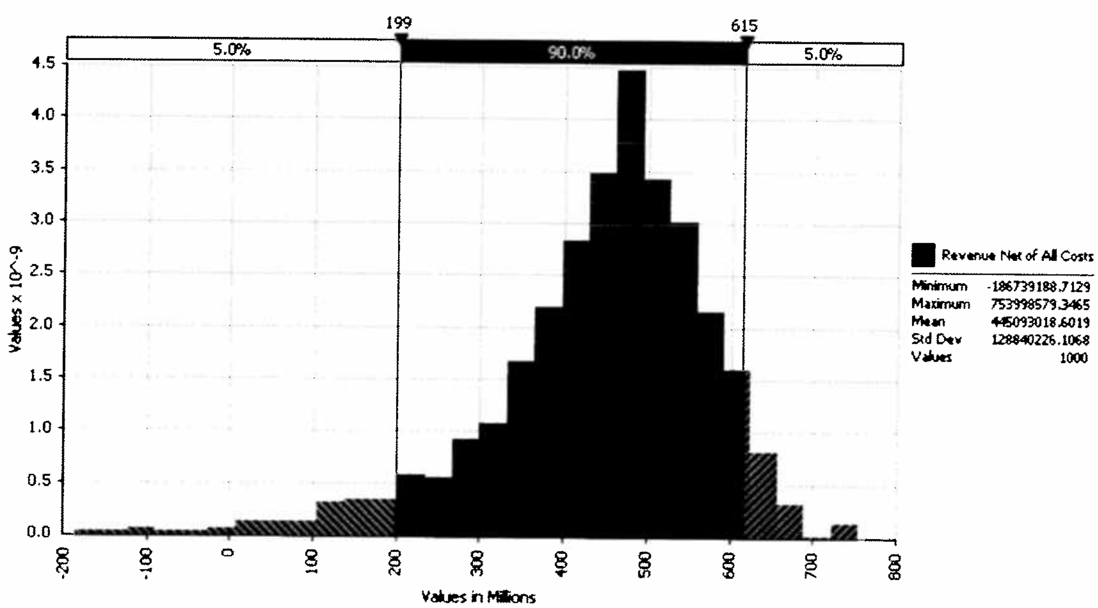
Net revenues were calculated before interest costs and after as the case required, but most of our calculations except in the case where interest rate changes were analyzed, deal with net revenue without deducting interest charges.

In total we have estimated the risk exposure of 15 different variables on MH's net revenue. We started with defining a Base Case to benchmark the behaviour of the system under average conditions that prevailed between 2001 and 2007. The averages are simple averages calculated from the data in Table 6.1.

Using these averages and the selected probability distribution functions for each one of them in the calculation of net revenue, we generated using Monte Carlo simulations (1000 iterations) the mean, low and high values of net revenue at the 5% and 95% confidence levels. The choice of the appropriate probability density function was based on the Chi-Square scores of the different distributions (lower values were preferred to higher values) and their match of the actual numbers under consideration in Table 6.1. The selected density functions are presented in figures 6.17 to 6.43.

Figure 6.1 – Net Revenues, Base Case, Average Flows



The base case net revenue has a mean of about $445 million, a low of -$187 and a maximum of $754 million. The distribution is tight around the mean but not symmetrical with a thick left tail. Net revenue is positive with $199 million at 5% confidence level and $615 million at the 95% confidence level.

simulation to make statements about the probability that this happens, but we're illustrating how the two (2) variables interact with each other by seeing what would the average result be if this happened, without saying -- trying to say how often it happens.

MS. ANITA SOUTHALL: This might be an over-simplistic way to characterize your finding on this point, but is it fair to say that the -- the combination, based -- based on your analysis, the combination of a drought at the level of 1940 with high import prices is a very unlikely scenario but could -- could actually happen?

DR. LONNIE MAGEE: Yes, we believe it -- it could happen. It's -- but we're -- we're not trying to pin down a probability.

(BRIEF PAUSE)

MS. ANITA SOUTHALL: Dr. Magee, then -- this may be your question, but of course either of the doctors, please respond. And I -- and I think we'd be looking at, if I'm correct, Figure 6.1, which is on the prior page of your report, page 228 of the KM Report. There was talk of the -- the -- and I'm sorry, I don't know how to describe it, but the scenario being way out

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in the tail of the distribution, and that it represents a low probability. Is that correct? Have I described it properly?

DR. LONNIE MAGEE: Of the scenario in line 4?

MS. ANITA SOUTHALL: Yes.

DR. LONNIE MAGEE: Yeah. Yeah, but -- well, linking it to Figure 6.1, Figure 6.1 you can think of as summarizing the net revenues if we let all of the random -- all of the variables be random: the water flows, the net exports, everything. So suppose we're predicting eighty (80) years ahead. We don't know anything about any of these numbers. Let them all be random, but assume the world was still kind of the way it is in -- in the model, this is the set of results we -- we could expect to see in that case.

So -- but the situation changes a lot if you know that you're in a drought and with high import prices, and to -- to ask the question, How would it change, doesn't require saying how likely it is it would change. It's -- it obviously would -- would be -- is important to think about that second question, How likely is it. But that's not what we're trying to do right in this specific table; we're just saying what would happen if.

DR. ATIF KUBURSI: If I can add one (1) thing, just about what this graph represents, we can say easily that if all these variables other than the amount of water were changing randomly, there is a chance here, that -- a 95 percent probability that it would be higher than a hundred ninety-nine (199), all right? And if 5 percent, being less than six hundred fifteen (615). So you could see that it would map all the possible values of net revenue that could arise from keeping that fixed number on water and everything else changes.

(BRIEF PAUSE)

MS. ANITA SOUTHALL: And, Doctors, if you did do a joint probability analysis between the 1940 drought levels and high import prices, and then you applied the Monte Carlo analysis to that, how might that change the cost implications of a drought or the -- the analysis that you would derive from that particular sequence of steps.

DR. ATIF KUBURSI: Counsel, let -- let me ask you, I mean, what we really did here is that we fixed the amount of water at its minimum level, the price of imports at its high level, and we looked at the -- how the net revenues would change, allowing all other are not -- not going to remain at such low levels, and this would have, especially if you're going into a major investment activity with large component of debt, that's something to take very serious. So this is really what -- what I have to say.

MR. GAVIN WOOD: Thank you. Dr. Magee, you -- I'd -- I'd asked you to get ready to comment on Table 6.2 as well. Would -- would you, please?

DR. LONNIE MAGEE: Yes. There was some discussion earlier in the -- the hearings that we saw in the transcripts about focussing on line 4 of Table 6.2 that Atif was also talking about.

And I think -- I just want to expand on that a bit. I think there is a lot of common ground between our view and what was expressed earlier in the hearings. So as -- the -- the -- I think the -- the simple way of putting what was being said earlier was that line 4 where the net revenue stands out as being the biggest loss, minus 755 million, was, according to our own model, very -- based on a scenario that's very unlikely.

And they figured that out in a, I thought, kind of a clever way by just based on the diagrams that we had given, and -- and counting standard deviations, and so on. And I -- I think they're right. That is,

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according to the way we specified our model, a very unlikely scenario. However, what our -- the probability of that scenario is -- although it's unlikely in our -- our own -- according to our own model, is also way out in the tail, and it's -- but not -- not so far out to be a Black Swan event.

I think it's, you know, quite plausible just on intuitive grounds that you could have a drought at 1940 flows and import prices at the level that -- that we'd specified. It's just that when you get way out -- that far out in the tail, your -- your probability estimates may not be that accurate.

However, there's so many variables, so many combinations that when you combine unlikely events, you may happen to hit on something that just happened to not occur in the data, but could -- you know, just on intuitive grounds could -- could have plausibly happened.

So what we're basically just trying to show there, as -- as Atif mentioned, is that that particular combination of drought and high import prices is -- is one (1) -- the one (1) that we -- we think is the, you know, the one (1) to focus on as being something that could happen. We can't say exactly how likely, but the -- when you go up to the second row, the -- the impact on net revenue of the drought 1940 flows, where it doesn't say anything about what the level of high import prices was, that one (1) differs from the fourth line because the second line allows for import prices to be whatever they could be according to the distribution.

So even by -- so it's -- it's as if you took the fourth line, but you said, No, let's not say it's high import prices, let's say it could be any of the import prices according to our procedure. You go up to the second line, so the average net revenue averaging across all the different import prices possibilities would be a loss of minus three forty-three (343). So anyway, I think that's...

MR. GAVIN WOOD: Thank you. Dr. Kubursi, at the -- at the bottom of -- just below that Table 6.2 at I believe it's page 59 now of the direct examination, there's a reference to a probability of drought, and I believe here that ties back to page 13 of the direct examination where the -- there was an explanation of a -- a change in the calculations that you talked about yesterday.

Could I ask you just to summarize that again, please?

DR. ATIF KUBURSI: Yeah, yes. I think it's -- it's helpful if I would go through these calculations and reaffirm them for the record.

This base case is for one average year and sets the stage for evaluating losses from major and simple events. The first case is that of a drought that is representative of the actual minimum of water flows over the period between 1912 and 2005. When this minimum is introduced it drives generation lower and necessitates adjustments to meet firm exports and the Manitoba load.

The low flow (drought) scenario results show a drastic loss in net revenue; the mean losses are in the order of $343 million, but when compared to the base case this represents a loss of $788 ($343 million plus $445 million) million and this is the first year (Table 6.2 and Figure 6.2). We did not examine the results of a five or seven year drought as we did not have and did not think that the actual series would produce the best correlation given that our estimate came from a statistical simulation exercise. We could use our estimates of a five year drought from Chapter 4 but for comparison purposes we calculated these losses only for the representative year.

Table 6.2 – Quantification of Manitoba Hydro Risks (Millions of Dollars)

Scenario	Impact on Net Revenue Without Interest Costs	Net Impact
Base Case	$445	
Drought (1940 Flows)	-$343	-$788
Drought (More Severe than 1940) (Minimum at 2.5% Quantile, with Curtailment)	-$277	-$722
Drought (1940 Flows, High Import Prices)	-$755	-$1,200
Drought (1940 Flows, High Export Prices)	$114	-$331
Base Case with Wind Variation	$445	$0
10% Increase in Load with Average Import Prices	$448	$3
10% Increase in Load with High Import Prices	$48	-$397
10% Increase in Wage Costs	$416	-$29
10% Increase in Fuel Prices	$442	-$3
10% Increase in Purchased Materials Costs	$443	-$2
10% Increase in Cost of Purchased Electricity	$425	-$20
10% Exhange Rate Depreciation of Canadian Dollar	$478	$33
10% Exhange Rate Appreciation of Canadian Dollar	$412	-$33

Source: Table 6.1 and @Risk Model

Figure 6.30 – Weibull Probability Distribution of Imports from Other Provinces

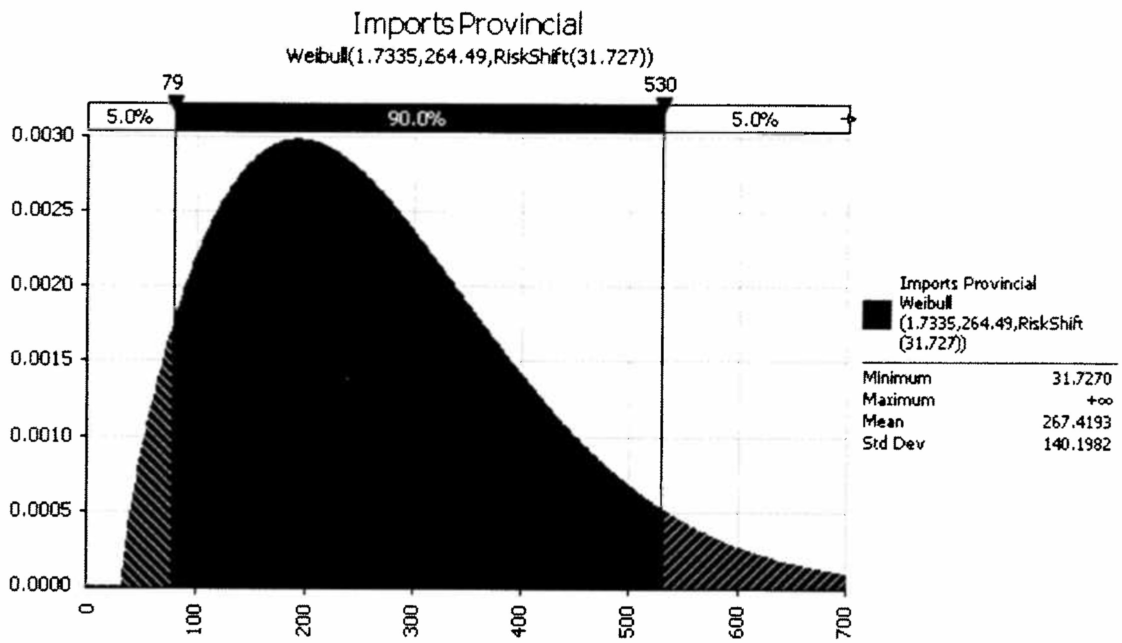


Figure 6.31 – Extreme Value Probability Distribution of Imports from US

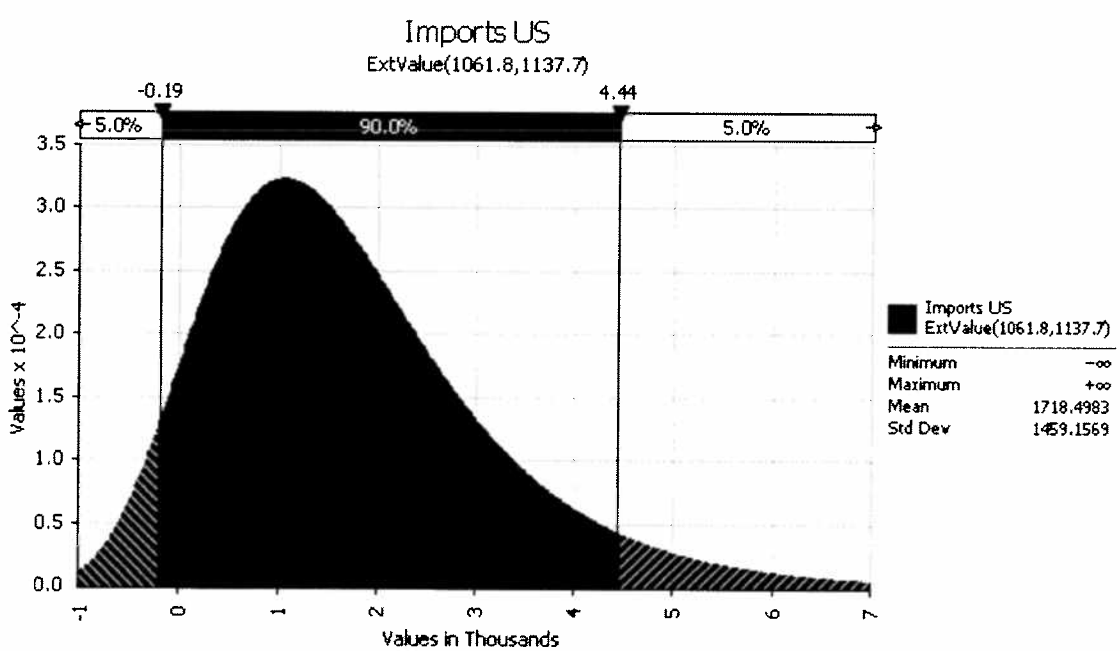


Figure 6.32 – Weibull Probability Distribution of Prices for Imports from Other Provinces

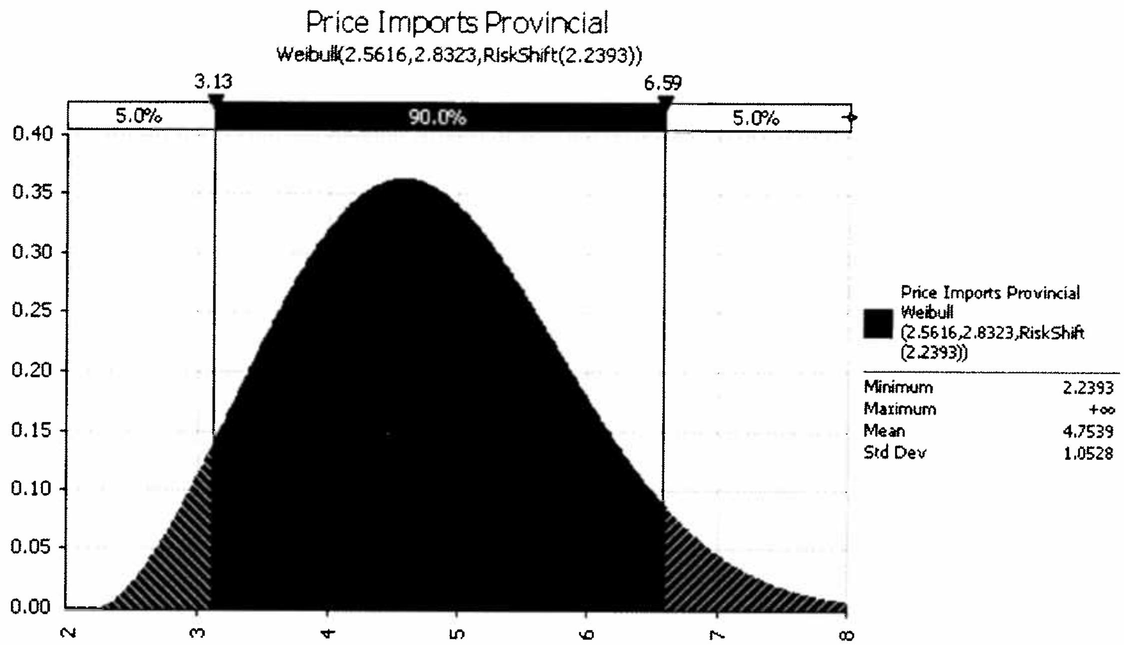
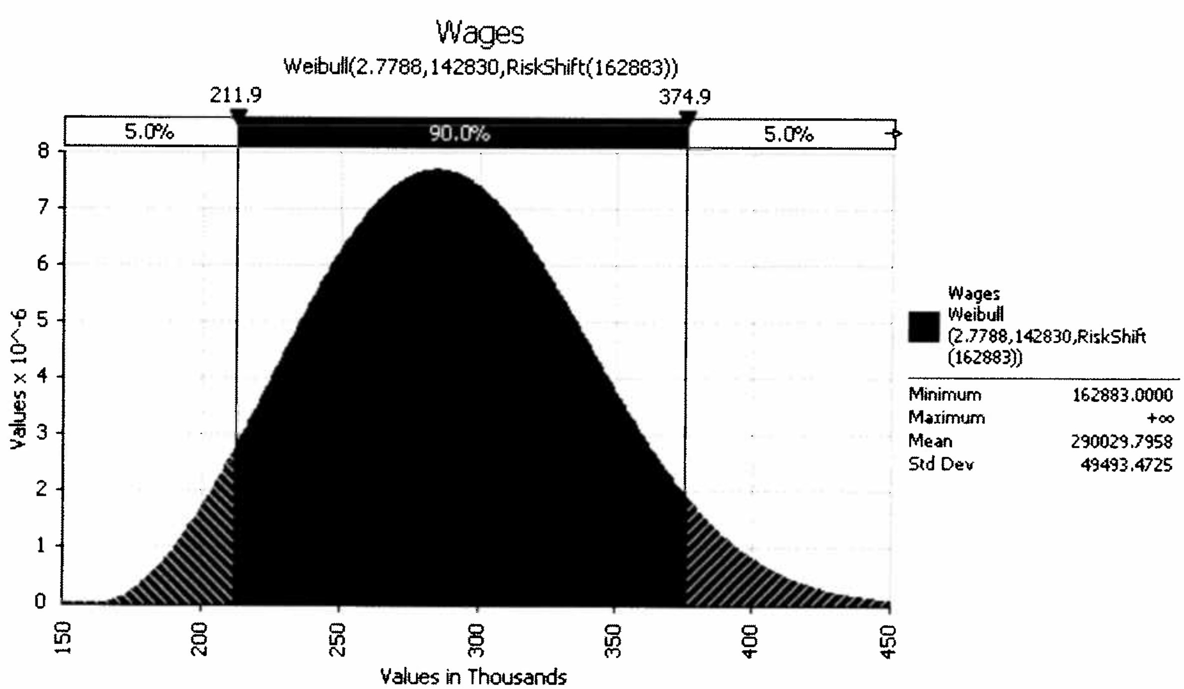


Figure 6.33 – Weibull Probability Distribution of Wages



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MIPUG - KM 5 **Quantification of MH's Risks**

(a) Do Drs Kubursi and Magee intend the analysis discussed on pages 228-229 to be predictive in absolute terms of the dollar values of potential risks to Manitoba Hydro or is the analysis instead intended to indicate the relative risk exposure for different conditions (without attempting to specifically quantify the risk exposure) please discuss.

(b) Please provide more details on the analysis described on page 228. In particular please explain:

i. Which 15 variables were used to assess impacts on MH's net revenue.

ii. How were the estimated risk exposures and probability distributions for these variables developed? Please provide the estimated risk exposures and probability distributions used in the analysis.

iii. Please explain why the period 2001-2007 (a period including the 2003/04 drought) was selected as a base case? Is this period intended to reflect an "average" operating risk scenario for MH? Please discuss.

iv. With respect to Figure 6.2 on page 230, please explain how the curtailment of exports (reduced by 29%) was arrived at? Why did Drs Kubursi and Magee choose to reduce exports by this percentage for a curtailment scenario?

v. Please discuss how the figures on pages 247 through page 260 were derived and how they relate to this analysis.

Answers:

a) The quantification of risks is both illustrative and given the data in Table 6.1 is anchored on real data and can be used to parameterize and compare risk exposure.

b) i-The variables included in the calculation of net income include: Generation, firm and non firm exports to the US and to other provinces, domestic load, imports (firm and non firm) from other provinces and from the US, prices (domestic rates, firm exports (contract prices), opportunity prices), operating costs include:

Wages and salaries
Cost of fuel used
Cost of materials used
Cost of purchased services
Cost of repairs and maintenance
Royalty expenses
Indirect taxes
Electricity purchased
Other expenses
Depreciation

Interest on debt
Foreign exchange rate

ii- The exact density functions for the stochastic variables are given Chapter 6 in graphs 6.18 to 6.44. The choice of the distribution was made on the basis of their Chi-Square score, mean and variance concordance with the actual series.

iii- This data is produced by Statistics Canada and is part of the public record. The period includes both low flow and high flow years.

iv- This is the 2/7 (the weekend curtailment provision) in most of the term sheets. This is equal to 29%, but we used a lower number to reflect the actual share of the curtailment in total generation.

v- This is discussed in subsection ii above.

//

Total Delivered Power

$$TD_t = \left(\sum_i hE_{it} + \sum_j gE_{jt} + \sum_k dE_{kt} + \sum_p wE_{pt} \right)(1 - \eta - \mu - \varepsilon - \alpha) + \sum_m IE_{mt}(1-\varphi) + \sum_n DSM_{nt} \quad (10)$$

Where

η is the percentage of transmission losses

μ is the percentage of distribution losses

ε is the percentage of transformation losses

α is the percentage of HVDC conversion losses

φ is the loss on imports of electricity

Total Demand for Electricity

Manitoba Load

$$MED_t = \sum_s mED_{st} \quad (11)$$

Where

mED_{st} is the power demand of sector s at time t

Export Demand

$$EED_t = \sum_q eED_{qt} \quad (12)$$

Where

eED_{qt} is the power export demand of market segment q at time t the fitted model. In both cases the coefficients are also drawn afresh according to the estimated sampling distribution of the OLS estimators for each replication.

Table 4.5 - Single-Year Minimum Over 94-Year Period (Kcfs)

Simulation Method	Actual Minimum	Mean of Simulated Minima	2.5% Quantile of Simulated Minima	Median (50% Quantile) of Simulated Minima	97.5% Quantile of Simulated Minima
AR(3) method A	54.378	57.802	29.451	----	80.197
AR(3) method B	54.378	63.019	38.862	----	82.831
EVT method (u=80)	54.378	----	38.576	60.881	76.506
EVT method (u=90)	54.378	----	42.210	63.043	77.066
EVT method (u=100)	54.378	----	39.351	61.391	76.703

Some notable results are:

1) The actual minimum lies roughly in the middle of the 95% intervals

The actual minimum is not unusually small or large compared to the estimated range of likely minima. Because this estimated range is constructed using the one data set from which the actual minimum is observed, the procedure itself will have an unavoidable tendency to have this property. Still, this result suggests that on one hand the practice of taking the actual 94-year minimum, 54.378, and using it as a worst-case scenario, does not capture the fact that the next 94-year minimum, and the one after that, may be very different. On the other hand, this actual minimum is not horribly biased one way or another.

6.5 Probability Distributions of Financial Variables Defining Net Revenue

Figure 6.18 – Triangular Probability Distribution of the Exchange Rate

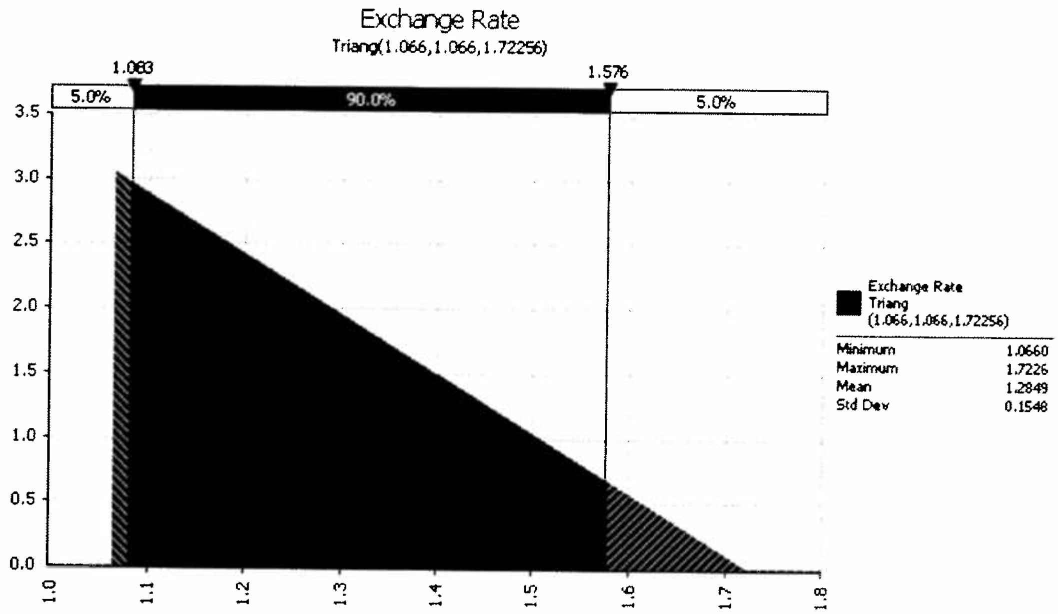
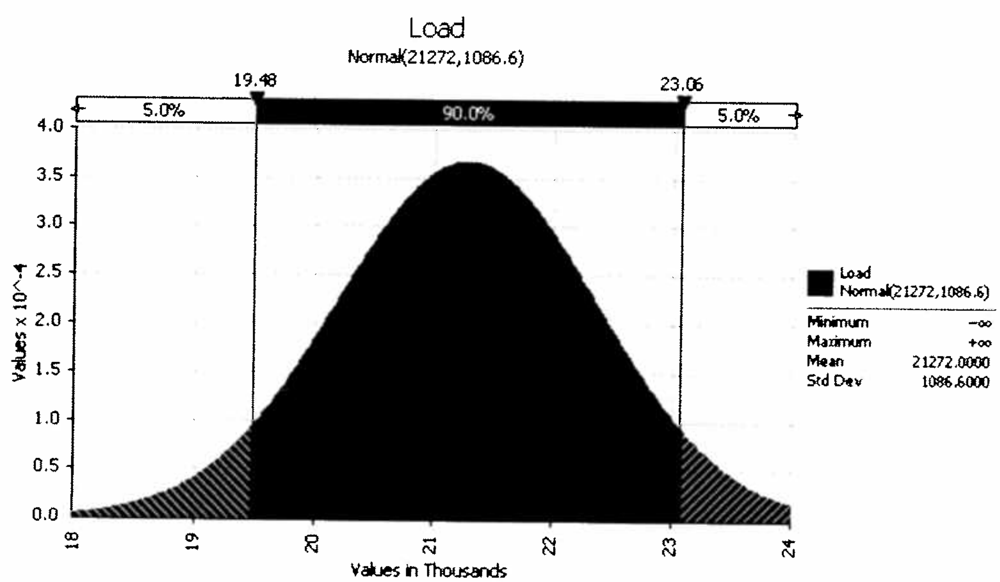


Figure 6.19 – Normal Probability Distribution of Load



CAC/MSOS/KM-44

Reference: Page 247, Figure 6.18

Question:

a) Please explain the period and frequency of data used to determine this distribution.

b) Please explain what alternative distributions were considered.

c) Are recent experiences of the Canadian dollar, including parity with the U.S. dollar in 2010, consistent with this distribution?

d) Are medium-term forecasts for the Canadian exchange rate consistent with this distribution?

ANSWER:

a) The period used for information on the exchange rate was 2000 to 2008. Parity was not included.

b) Several different distributions were considered. Actually 33 distributions are estimated by @RISK using the time series on the exchange rate between 2000 and 2008, KM picked the triangular given its statistical properties and its Chi Square score.

c) No. Only the annual calculated rates in existence between 2000 and 2008 were considered.

d) No attempt was made to look at more recent forecasts. Only in the simulations KM considered parity as a possible value.

precisely what we've done. We looked at these variables, and each one has its own probability distribution. We combined them, then ran the impact on net revenue in combination, allowing all these possible interactions to come, and we looked at the mean that would -- the average that would come. That's what we did.

MS. ANITA SOUTHALL: And -- and so was there a result that derived from that?

DR. ATIF KUBURSI: Yeah. This is the result that you see in Table 6.2, the fourth line.

MS. ANITA SOUTHALL: And so -- and if I'm stating this incorrectly or summarizing it incorrectly, please correct me. So the fourth line being drought 1940 flows/high import prices, where the impact on net revenue without interest costs is $755 million loss, and then the net impact against the base case of one billion two hundred million dollars ($1,200,000,000). Is that the line you were referring to?

DR. ATIF KUBURSI: Yeah, precisely.

DR. LONNIE MAGEE: Can -- can I add just something briefly? The --

MS. ANITA SOUTHALL: Yes, please.

DR. LONNIE MAGEE: The simulations that Atif's referring to are -- in each replication or each one of them, those two (2) values that -- that -- in --

in that line 4, those two (2) values, the drought and the export price numbers are the same every time, and what changes are all the other random numbers.

So what -- what you're looking at there is what would happen if all the other things changed around, letting them change, but what if in the special case, where those two (2) things were -- we knew that they were at those two (2) numbers, what would the average outcome be. So the averaging is -- is with respect to all the other random va -- variables.

MS. ANITA SOUTHALL: Thank you. Could you comment, and, again, either one of Drs. Kubursi or Magee, on the question: Is the use of a Monte Carlo simulation of combining the 1940 drought with high import prices a good substitute for doing a joint probability?

DR. LONNIE MAGEE: It -- it's a different exercise. It would be really great to know both, but -- and in order to do our exercise, there is implicitly some joint probability built in there because we have to specify probabilities for everything.

But because that particular one is concerning the edges of two (2) of the dis -- of the variables on uncommon occurrences, they don't happen often enough to get a very accurate estimate of the probability. So we're -- we're not comfortable using the enough to turn to page 7 of your rebuttal document now. And, again, you -- the -- you see there, sir, at the sec -- start of the second paragraph it says:

"MH claims that even if KM had used the correct Manitoba Hydro data, results would still be unreliable due to flawed methodology."

Could you -- could you go through the -- the work you've done for us there in -- in terms of your response to the -- those claims of flaw.

DR. LONNIE MAGEE: Atif spoke about the first point already about the seven (7) years, I think, using --

MR. GAVIN WOOD: But -- but you -- you -- please, you -- you reinforce if you wish.

DR. LONNIE MAGEE: Okay. I think we would have been happy to use more years, and we had to make a judgment of whether to go with what we had from Statistics Canada or to possibly have more years of Hydro data. And, as I said before, we might have ended up with better data covering a longer period using the second approach. But we thought, given our roles as independent consultants, it would be more appropriate to use the -- the Stat. Can. data. And we're hoping that if there is some concerns about having done this, that we're flagging an issue that would be constructively dealt with in -- in the long-run by improving the Stat. Can. methods.

And, also, just to repeat what Atif said, that this -- it's only seven (7) years, but it's not seven (7) years of -- that consists entirely of extremely low or extremely high water; there -- there's a mix there.

MR. GAVIN WOOD: thank you. And then going on.

DR. LONNIE MAGEE: Yes, the second -- that's the second point.

MR. GAVIN WOOD: Then -- then going on --

DR. LONNIE MAGEE: Yes.

MR. GAVIN WOOD: -- to the second point, please.

DR. LONNIE MAGEE: So the second point -- I -- I think what might be -- the second point is that we've treated some variables as random that are not random. And I think what might be behind this concern is -- is -- it's a tendency with working with observational data, things that would have happened anyways.

If they can't be predicted, economists are quite comfortable saying, if we don't what it is and we can't easily find out exactly what it is, like future values, we'll treat it as a random variable even if

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BEFORE THE

MANITOBA PUBLIC UTILITIES BOARD

MANITOBA HYDRO

2010/11 & 2011/12 GENERAL RATE APPLICATION

DIRECT TESTIMONY OF

JONATHAN WALLACH

ON BEHALF OF

RESOURCE CONSERVATION MANITOBA

AND

TIME TO RESPECT EARTH'S ECOSYSTEMS

Resource Insight, Inc.

DECEMBER 13, 2010

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Exhibit JFW-1 Professional Qualifications of Jonathan F. Wallach

Q: Does the KPMG Report provide any indication of the likelihood that losses would approximate those estimated in the KPMG analysis?

A: The KPMG Report does not indicate the likelihood that losses will approach those estimated in the various KPMG sensitivities. More critically, the KPMG analysis does not provide information regarding the extent to which, or the probability that, losses might exceed those forecasted in the various sensitivities. In other words, there is no indication of how much worse Manitoba Hydro's risk exposure might be than forecast in these "worst-case" scenarios.

As the KPMG Report observes, this limitation is not unique to KPMG's (or the Company's) sensitivity analyses of risk exposure:

> Stress tests are scenario exercises to determine financial losses that might occur under unlikely but plausible circumstances. Traditional stress testing is conducted on a stand-alone basis and the stress test results are highly subjective because they depend on scenarios chosen by the stress tester. As a result, the value of stress testing depends on scenario choice and skill of the modeler. A related problem is that stress test results are difficult to interpret because the scenarios are not probabilistic.[19]

Q: Are there alternative approaches to risk quantification that overcome the limitations of stress testing?

A: Yes. In particular, Monte Carlo simulation techniques allow for an explicit quantification of probability distributions around forecasts of expected outcomes (e.g., net revenues, retained earnings.)

As noted above, stress testing involves making substantial, discrete changes to one or more input assumptions (e.g., water flows, market prices) in order to forecast outcomes (e.g., retained earnings) under unlikely conditions that are considered to be "worst-case." In contrast, Monte Carlo simulation represents key inputs not as single, expected values, but as probabilistic

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[19] KPMG Report, p. 242.

distributions around expected values.[20] A Monte Carlo simulation model will generate multiple (typically 1,000) forecasts of outcomes, with each forecast relying on a random draw of input values from the probability distribution for each input value. Thus, the Monte Carlo simulation generates a distribution of forecast outcomes, with the expected outcome value reflecting the average over the entire distribution of outcomes and probabilities of extreme outcomes defined by the distribution of outcomes.

Monte Carlo simulation thus offers a number of advantages over sensitivity analysis with respect to the quantification of risk exposure. In particular, Monte Carlo simulation:

- allows for complete specification of uncertainty in input assumptions;
- fully captures the combined impact on forecasted outcomes of uncertainty in multiple independent input variables; and
- allows for measurement of risk exposure at pre-defined tolerance limits (e.g., earnings loss at 95% confidence level; average of 10% worst outcomes.)

Q: Should Manitoba Hydro incorporate Monte Carlo simulation techniques in its analyses of risk exposure?

A: Apparently, the Company already has the capability to undertake Monte Carlo simulations of risk exposure with its PRISM model. Based on what little documentation is publicly available, it appears that PRISM uses Monte Carlo simulation techniques to generate five-year forecasts of expected net revenues, and distributions around expected net revenues, by repeated, random sampling

[20] These input distributions are typically derived based on historical fluctuations in the value of the input parameter.

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Reference: Chapter 6 - Pages 227, 229 and 242

a) MH cannot reconcile significant portions of the detailed information on Manitoba Hydro provided in Table 6.1. For example, Manitoba Hydro cannot reconcile the "Firm (US) Export Price" of 14.63 cents per kWh or the "Firm (CDN) Export Price" of 15.72 cents per kWh in 2007 which are critical in defining the export price probability distributions. Please provide copies of the Statistics Canada reports used along with any calculations or adjustments made to that information to produce Table 6.1.

b) If it is found that the information in Table 6.1 is inaccurate, please confirm that the quantification of the various risks through utilization of the modeling process would produce results that are not representative of actual risks, and therefore the analysis in this chapter should be considered as only illustrative of the process that could be used to understand/quantify MH's risks.

c) Please confirm that the various risk factors quantified in Table 6.2 do not take into consideration the correlation and interrelationship between the risks, nor do risk measures and recommendations take into account the risk mitigation actions currently performed by Manitoba Hydro. In addition, please clarify that the probability of occurrence of each risk must be considered in assessing the relative ranking of Manitoba Hydro's risk factors.

d) Please confirm that the worst case scenario described on Page 242 is only indicative of how a worse case scenario could be constructed/calculated and as such cannot be relied upon as an accurate quantification of MH's overall risk

ANSWER:

(a) The information set out in Table 6.1 is a product of Statistics Canada. None of the information set out in Table 6.1 is provided by KM. The information set out is from the internet as referenced in Table 6.1.

(b) KM are not in a position to declare that Statistics Canada's information is incorrect.

(c) KM agrees that Table 6.2 is only for a 1 year period. KM agrees that the probability of an occurrence of each risk must be considered in assessing the relative ranking of Manitoba Hydro's risk factors. KM have estimated the cost of five year and a seven year drought using the embedded auto-correlations in the water flows. The five year mean drought cost in net revenues is put at $3,342.6 million and the seven year drought at $4,548.3 million. Both of these estimates were calculated using @RISK and the average benchmark values in Table 6.1.

d) KM agrees. Manitoba Hydro cannot plan its operations on the basis of the worst case scenario but should plan its risk management on it.

the risks in the -- in the long run, just watched its net revenue number bounce around, as long -- you know, and this is very hypothetical, but if -- if it could be set up so that everyone thought, well, it's set up right, there wouldn't be this kind of constant concern from one year to the next based on variations in -- in water flows.

THE CHAIRPERSON: Well, once you have a certain particular set -- set of assets, then what follows, follows. But again, returning to what -- the subject I was saying was that if you were dealing with a -- a company that had a certain amount of capital and no assurance that it would be restored --

DR. LONNIE MAGEE: M-hm.

THE CHAIRPERSON: -- you'd be dealing with a different kind of animal, wouldn't you -- wouldn't you? You -- you might have some restraints when you were trying to determine what -- what is an adequate capital structure?

For example, my understanding is is if you're a private utility you tend to have a debt-equity ratio somewhere in the ratio of 60:40 --

DR. LONNIE MAGEE: M-hm. M-hm.

THE CHAIRPERSON: -- where everyone, you know, all the parties in this room have been somewhat comfortable, at least to date, without getting into the issue of a decade of investment, with a 75:25 --

DR. LONNIE MAGEE: M-hm.

THE CHAIRPERSON: -- guaranteed by the province with the rating agencies not seeming too -- too concerned.

DR. LONNIE MAGEE: Well, yeah, I think what makes this situation different, there -- there are -- you know, the -- it would depend which private company, but it -- in the private sector there's competition, there's changes in demand for a company's products, you know, GM, maybe over time the demand for their products falls whereas -- and -- and that's possible to a lesser extent with -- with hydro, but it's -- it's a monopoly. We know people are -- are going to need energy ten (10), twenty (20) year -- thirty (30) years from now.

So there is more, I think, long-run stability on the demand side. And, you know, I can't imagine how -- exactly how it would play out if it was a private sector company, but I think I would be more confident about the long run demand for the product of a private sector company that was a monopoly in this sector.

DR. ATIF KUBURSI: If I may. I mean, but no question about it. No matter how you turn it around the market is more vicious than the government and -- and would punish without recourse. No question about it that it would make a difference, and that the private companies would have to be reliant on their own assets and capital adequacy in far greater details and zeal than a public company. And this is part of the moral hazard we're talking about.

THE CHAIRPERSON: Thank you.

CONTINUED BY MS. ANITA SOUTHALL:

MS. ANITA SOUTHALL: Drs. Kubursi and Magee, do you agree with ICF that Manitoba Hydro can offset worse-than-recorded droughts by securing additional transmission access to the United States? I -- I think you spoke about the issue of transmission rights are a form of mitigation or -- or --

DR. ATIF KUBURSI: Yeah.

MS. ANITA SOUTHALL: -- conversely a benefit to Manitoba Hydro.

DR. ATIF KUBURSI: Yeah, but -- but let me assert it this way, there are more than one (1) way to deal with this. I mean you can't just say, Okay, transmission alone I'm going to. But as -- as part of a portfolio, part of a combination of things, yes, I -- I can see easily -- along three (3) counts, 1) that you get service, and high barriers (technical, legislative, financial) to entry. Some utility activities (e.g. network operation, system control, etc.) can be carried out only by a single entity, and others (e.g., power generation, water production, customer service, metering and billing) have such economies of scale that it is unlikely that there will be more than one supplier of these services in a small market. Public regulation is premised on simulating competitive market conditions that force the natural monopoly to moderate its market power and charge prices reflective of marginal costs. This is often done through a hard budget constraint imposed on the utility where it has to explain and justify any rate change by justifiable cost increases and where it has to demonstrate that its cost of service is minimal and all efficiency requirements are met.

Economic, or price and service quality, regulation is not required when the service is provided by government entities, but it becomes necessary as the service provider moves out from direct government control; and it is absolutely essential to control the activities of independent service providers seeking to make profits. The Crown Corporation structure in Canada places MH, as seen above, in two categories at the same time. Firstly, it has a business operating structure like any other business. Secondly, its shareholders are the people of Manitoba, and it is subject to a complicated governance regime with many overlapping jurisdictions. These special characteristics set it apart from the general run of Canadian business. It is also important to note that the workability of the competitive market place, which is relied upon to set the terms of trade in other businesses, is generally absent in the case of public utilities. This duality of character creates a principal agent problem because of information asymmetries between the principal (the public) and the agent (MH).[1] The government or its agencies and bodies are interested in overcoming information asymmetries with the operator and in aligning the operator's interest with those of the public. The information asymmetry arises in the context of utility regulation because the operator knows far more about its abilities and effort and about the utility market than does the regulator or the public.[2]

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[1] Baldwin, Robert, and Martin Cave, Understanding Regulation: Theory, Strategy, and Practice, Oxford: Oxford University Press, 1999, Chapters 2-3. and, Kahn, Alfred. The Economics of Regulation: Principles and Institutions. Cambridge, MA: MIT Press, 1988, Reissue Edition, vol. I, Chapter 1.

[2] Newbery, David M., Privatization, Restructuring, and Regulation of Network Industries. Cambridge, MA: MIT Press, 1999, Chapters 1 and 4.

In general, utility regulation can occur for several reasons. Common arguments in favour of regulation include the desire to control market power, facilitate competition, promote investment or system expansion, or stabilize markets and overcome information asymmetries.[3] These objectives can be met through:

- Setting the rates levied by the regulated entities for certain prescribed services, to ensure that they are fair and reasonable.
- Safeguarding the financial health, reliability and safety of industry.
- Monitoring and regulating customer service standards achieved by the utilities to ensure a balance between consumer and producer interests.
- Hearing and determining any serious customer complaints against the utility organisations (if unresolved by the utility organisations themselves).
- Providing relevant information (operational and financial) on the industries it regulates to consumers, government, and other stakeholders and maintaining transparency.

The dual structure of the utility in Manitoba presents challenges and difficulties for MH but it also confers some critical advantages. MH is able to borrow at preferred interest rates, to expand its operations with greater access and ease to capital markets, to pursue environmental and social objectives, and to be liberated from an undue short term focus in favour of long term objectives (creating jobs, maintaining balanced relationships with First Nations, taking environmentally friendly initiatives, and so on). However, this structure also insulates MH from strict and direct shareholder scrutiny and it may constrain it to compromise business objectives in favour of social and environmental goals.

The public guarantees of debt can tempt a public utility to undervalue risk and behave more recklessly than if it were to bear alone the consequences of its risky behaviour.[4] This temptation is further complicated by a regulatory regime that may set rates to cover

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[3] Garfield, P.J. and W. F. Lovejoy, Public Utility Economics. Englewood Cliffs, New Jersey: Prentice Hall Inc.1964, Chapter 2, pp. 15-26.

[4] Mas-Colell, A., M. Whinston, and J. Green, Microeconomic Theory. Chapter 14, 'The Principal-Agent Problem', 1995, p. 477, and B. Holmstrom, 'Moral Hazard and Observability'. Bell Journal of Economics, 1979, pp. 74-91.

the public utility costs and errors, and that allows it to pass the costs of its mistakes, inefficiencies and risks to domestic consumers.

Profit optimization is not necessarily consistent with revenue optimization. The former would require higher prices, lower output, and lower employment. Socioeconomic and environmental concerns can trump some efficiency criteria. The fact that the residents of Manitoba are the owners of the utility and that the government guarantees the utility's loans may prompt MH to tolerate more risks than the shareholders would like it to or are willing to support. This proclivity to engage in risky behaviour or to accept different tolerance for risk between the residents of Manitoba and MH is a crucial problem for the regulators as they attempt to align the two interests and dispositions and minimize the tolerance differential between them.

Put differently, the real issue is for the regulators to align the risk exposure and tolerance of MH to match that of the citizens on behalf of whom the government and/or the Public Utility Board typically act. Citizens, in general, are risk averse, and Manitobans are likely no exception. Roughly speaking, this means that they would prefer to take on financial risk only if the probability of gain outweighs the probability of loss. MH tolerance and acceptance of risks may be different from that of the public. The issue is, then, one of a potential lack of alignment between the two and the extent to which regulators are forced to govern the risk tolerance and appetite of MH to match that of the shareholders (the people of Manitoba). This misalignment in risk tolerance arises not only because of different appetites for risk but also from the fact that the public assumes the costs of any losses either in higher electricity rates (if PUB allows it) or through debt payment charges, whereas the potential rewards of the risk-taking are internalized within MH.

1.2.2 MH is Hydro-Oriented

MH is also unique in that over 95% of its total power generation is hydro. This characteristic is not shared with many other power generators in North America or the world. This heavy dependence on hydrological conditions subjects MH to severe volumetric risks embedded in droughts and weather related determinants with unknown probabilities and wide fluctuations. The lack of alignment of risk tolerance between the shareholders and management of MH is compounded by these large volumetric risks with substantial consequences in terms of reliability and profitability. The shareholders will bear the costs of any risk undervaluation and errors without being directly able to impose their risk tolerance on the management of the utility in the same manner that shareholders of private entities are believed to be able to do.

1.2.3 MH is Export-Oriented

MH sells a large share of its generation outside Manitoba. This share exceeded 31% in 2007. Complications arise due to the resulting dependence of MH's revenues on markets over which Manitobans have little or no control. Exports to the US constitute the largest share in these exports of about 80%. The utility is subjected to the vagaries of market fluctuations and competition which it is insulated from in the domestic market. In tight situations MH is more likely to be able to pass its costs to domestic consumers, whereas it acts as a price taker in the competitive export market.

1.2.4 Summary

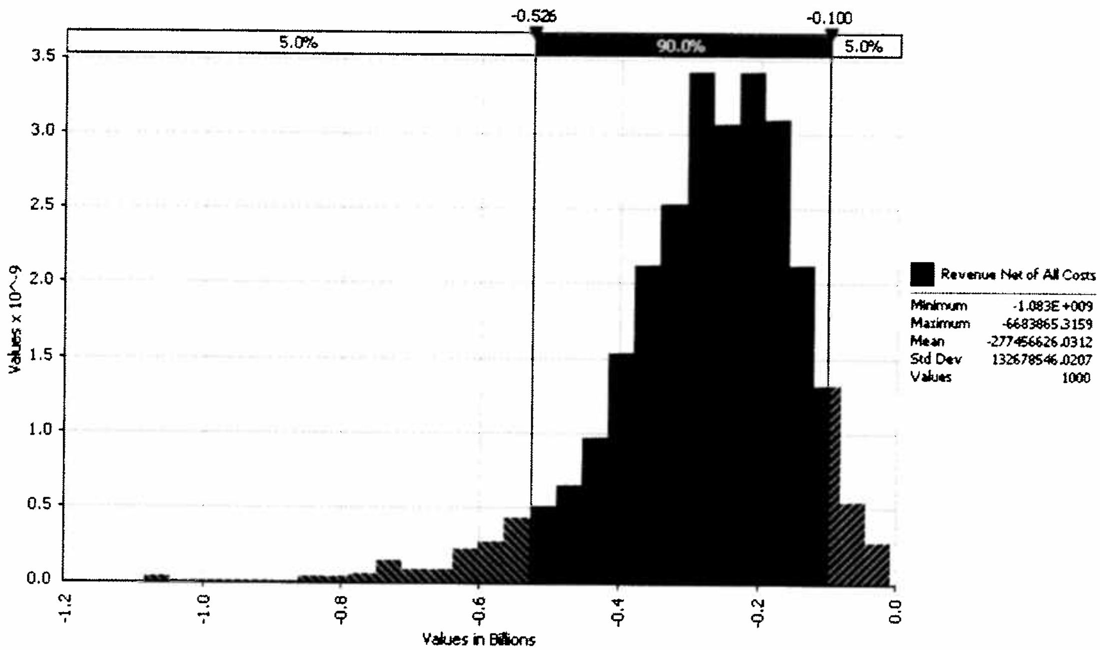
Information asymmetries, principal-agent problems, moral hazard and risk tolerance misalignment issues raise serious challenges for regulators and for shareholders. These problems exist in business corporations but they are far more prevalent in public corporations, particularly those in monopoly positions facing soft budget constraints.

1.3 The Historical Record

There are a few historical characteristics of MH that distinguish it from other utilities and private corporations in Canada and North America: low rates, high exports, and sensitivity to drought. A brief account of these salient features is undertaken here to situate the analysis that follows.

MH has one of the lowest electricity rates in Canada—a rate that is perhaps lower than most of the rates in North America. In 2007 MH's electricity rate averaged 5.1 cents per

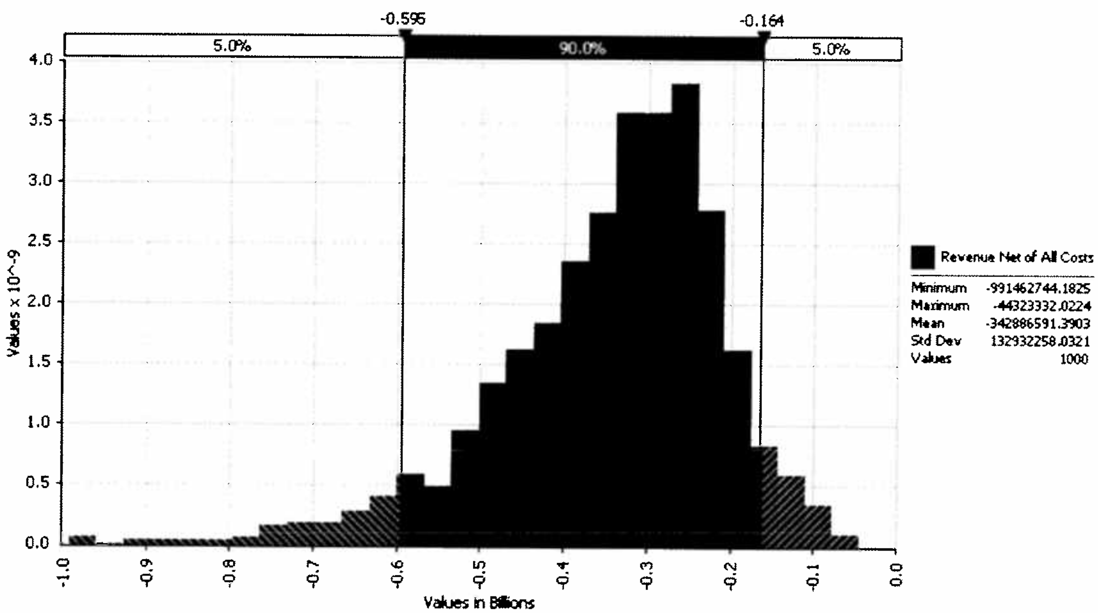
Figure 6.3 – Net Revenues, 2.5% Quantile Minimum with Export Curtailment



Risks can be expected to be compounded, that is one risk is augmented by another. In the next scenario we address the costs of a drought equal in severity to the one in 1940 but also impose high import prices (at about $120 MWh). The mean losses rise quickly to $755 million and the opportunity losses to $1.2 billion (Table 6.2 and Figure 6.4)

It is interesting that the mean losses almost approximate the actual losses in 2003/04 but this resemblance is coincidental. The next scenario involved constructing a case with lower water flows (we used the water flows from our statistical series at the 2.5% quantile of all minima). But we also allowed curtailment of exports (reduced by 29%); all other variables were left at their average values and the appropriate distributions. It is highly interesting that the mean losses are lower than those associated with actual minimum. The mean losses are $227 million and at an opportunity cost of $722 million. This is lower than the actual minimum costs by over $66 million (Table 6.2 and Figure 6.3).

Figure 6.2– Net Revenues, Actual Minimum



see that there is an internal responsibility matrix that we would be looking at.

What I really want to see is the use of risk tools, risk procedures, statistical methods, variance, covariance, value at risk, all these techniques and matrix that are typically used to assess the risk exposure of activities and events.

And this -- you could talk about them in qualitative terms, but they would remain very nebulous and would not be taken as seriously and we would not get a handle on them unless you're able to quantify them and put the stress test and the confidence levels on them.

So what we're asking here is for quantification, the use of statistical tools and risk tools and getting these estimates in the proper language that risk managers and risk management would entail.

MR. ROBERT MAYER: Dr. Kubursi, the Chair and I have just been going over the tab that Board counsel referred us all to, Tab 6 of the book of documents, Hydro's organizational chart. And we have noticed with interest that the corporate planning is as you say it shouldn't be, right along that line of vice-presidents, second from the extreme right.

We also appear to note that corporate risk management doesn't even have a box around it, and we're major criticisms that have been voiced by KPMG, by ICF, and we concurred with it, is that long-term contracts involve risks, and these risks should be identified, measured, quantified, and strategies to deal with them, whether it is allocation of risk capital or whatever the way one would deal.

This is a very crucial element of risk, and if the middle office is going to be entrusted with the authority and responsibility for risk management, then it can't possibly be excluded from this position. It has to be involved in identifying the kind of exposure, measuring this exposure, and dealing with ways and evaluate even contracts in terms of whether they address and sufficiently capture what would it take and what would be an appropriate response to the risk exposure.

MS. ANITA SOUTHALL: You've spoken a few times about the concept of value at risk. Are you able to comment as to the -- describe the concept and what value that particular analysis brings to the risk measurement?

DR. ATIF KUBURSI: Yeah. Actually, we have a discussion of this in chapter 2 of our report, but let me briefly -- and in layman's terms, what you try to do is to find that side of the distribution where the largest exposure of risk is likely to be, and you try to give a confidence interval within which this risk is, like exposures, lies, and the probability of it happening. And then this would also give you a chance to see what would it entail in terms of your risk management.

Okay. Take a corporation, for example, and distribute all its returns. Anything positive you're happy with, you're not going to be worried about. What would grab your attention is the possibility that your returns are going to be negative. So you plot all these frequencies where you expect that your returns could be negative. And then you would like to see that you don't want to be negative by more than, say, 4 percent that you could tolerate. Then you'd like to know in what confidence level does this 4 percent exposure and loss lies. And then you would really know that you have a 95 percent confidence that you're going to get a return higher than it.

So it would give you a partitioning of the level at which your concern can be bracketed, at what level of frequency it will happen, and what is that maximum level that you have to worry about. So in -- in one (1) way, this value at risk is a quantitative measure of the exposure, the extent of which, and the probability of it happening.

MS. ANITA SOUTHALL: What is the actual output of a value at risk calculation? What is the result?

DR. ATIF KUBURSI: Counsel, if I may ask you to look at our report, there is a page in which I can probably walk you through the example.

MS. ANITA SOUTHALL: Yes, please.

(BRIEF PAUSE)

MR. ROBERT MAYER: Don't let it be page 302.

DR. ATIF KUBURSI: Page 41. The example is on page 42. We look at a company on the ticker tape and look at their returns at the particular time. The month was March, 1999, and there were fourteen hundred (1400) points, and you look at the frequency distribution. And you can see that the average is about the 1 percent level. And then you get negative returns and you get positive returns.

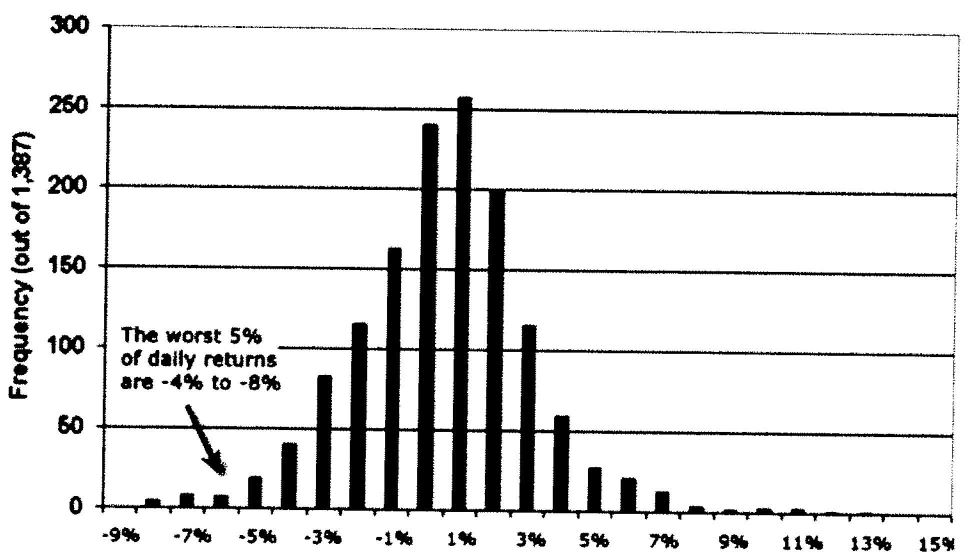
You don't find it to be something you worry about if you have positive returns, so you're going to only look at the tail to the left of the 1 percent. And there, you're going to look and see the worst 5

Value at Risk (VaR) is a technique that helps estimate these three attributes. There are three methods for estimating this parameter.

Method 1 focuses on the real data as observed in the market place, groups it in a set of convenient categories, and then computes the sought attributes from the observed data. This method is known as the historical data approach and it is used to predict the future on the assumption that the future will reflect the past (Figure 1).

For example, assume that QQQ started trading in Mar 1999, and if we were to calculate each daily return, we would produce a rich data set of almost 1,400 points. Assembling this data in a histogram that compares the frequency of return over time, we would have a clear idea of the distribution of these returns over time. For example, at the highest point of the histogram (the highest bar), there were more than 250 days when the daily return was between 0% and 1%. At the far right, you can barely see a tiny bar at 13%; it represents the one single day (in Jan 2000) within a period of five-plus years when the daily return for the QQQ was a stunning 12.4%.

Figure 2.7 – Distribution of Daily Returns, NASDAQ 100 Ticker: QQQ



Source: David Harper. An Introduction To Value at Risk (VaR). http://www.investopedia.com/articles/04/092904.asp

The red bars are in the "left tail" of the histogram. These are the lowest 5% of daily returns. The red bars run from daily losses of 4% to 8%. Because these are the worst 5%

percent of these daily returns. You're going to find them into that area to the left of the 5 percent, okay. And you'll find there they go between 4 percent and 8 percent. Can you see that?

MS. ANITA SOUTHALL: Yes.

DR. ATIF KUBURSI: All right. I wish it -- if you have it in colour it would really be nice, but if it's not in colour, it's all right. So the la -- the lowest 5 percent to daily returns are in this, and you could have seen them if it was in colour. If anybody has in colour, it is in red; everything else is in green.

And then you know that you can you say that with 95 percent confidence that the worst daily loss will not exceed 4 percent.

MR. GAVIN WOOD: He's on page 43 at the top now.

DR. ATIF KUBURSI: Yeah. I mean, this would really tell you that if you are worried about your exposure to loss, that you have 95 percent confidence that your losses will never be larger than 4 percent. I mean, that's a very important piece of information to know. You really want to know what's your downside risk, and you want to bracket it at what level of confidence can you say I would not slip into that downside risk.

So value at risk is basically a

quantification of the confidence interval, the likelihood of a particular loss, and the magnitude of this loss. In that respect, I mean, this is useful. Now, there are lots of provisos about this. This is a frequency distribution. Some people say, Well, can we generalize it. And some people -- it so happens here it looks so beautifully it's standard normal distribution, and standard normal distribution is a beautiful distribution. You only need two (2) parameters to characterize everything: the average, the mean, and the standard deviation.

And there is something called Chebychev inequality that will tell you that the mean plus one point nine six (1.96) of the standard deviation would capture 67 percent of the observations. And if you took three (3) standard deviations from it, which would be really on the left, your worst, worst case, you're 99 percent confident that it would not really be more than that.

No, three (3) is ninety-nine (99), right?

DR. LONNIE MAGEE: Even -- even more than that.

DR. ATIF KUBURSI: Even more than that.

DR. LONNIE MAGEE: Yeah, even more than that.

DR. ATIF KUBURSI: Even more; ninety-nine point (99.) something, yeah. So these are the kind of issues your manager -- you're dealing with risk. You would like to know what's your worst situation to be and at what level of confidence you'd like to be that you would not slip into this kind of loss.

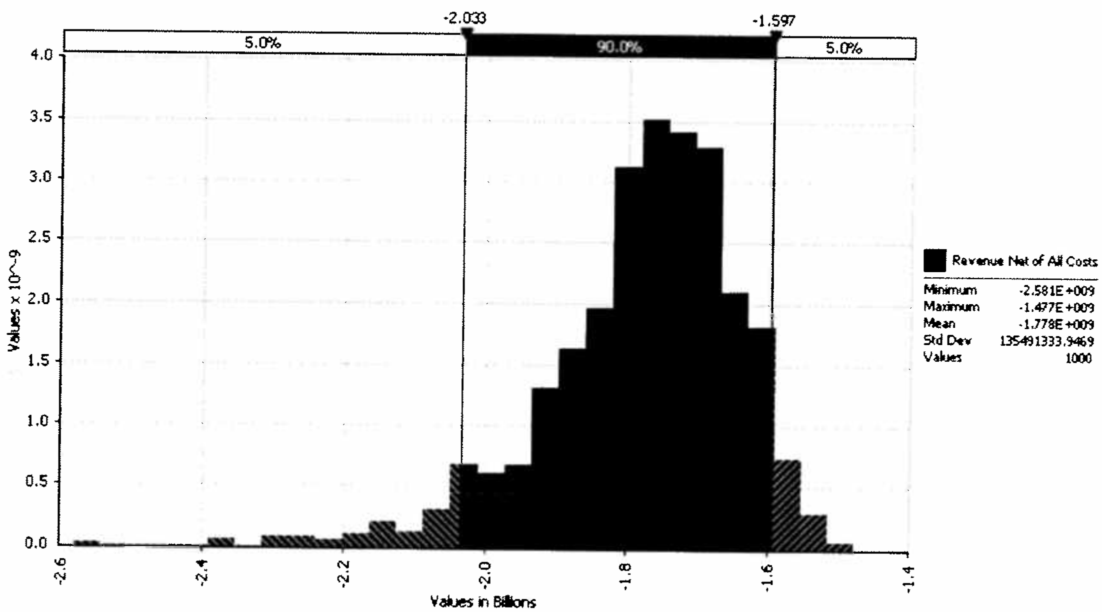
Some people say, Well, the VAR is very much contingent on the distribution, and sometimes the assumption of a normal distribution is too far-fetched for it, unless there is sy -- symmetry in the way the returns fall, as in this simple case.

Some people say that even VAR is a short-term thing; you can't really use it. Systems are so unstable, and you could get them to be stable within a very bracketed short period, that if you extend this analysis to cover all time and all eventualities, it breaks down. No.

But with these provisos all what we're really saying here is that we'd like to see some metrics. We'd like to see some tools. We'd like to see PRISM used more. We'd like to variance/covariance estimation. And any statistician, even just with a undergraduate degree, would be quite helpful. What we have asked for are two (2) things. We said that this middle office should have a statistician or actuarial people, and we'd like them to

A worst case scenario is constructed to include a low water flow (at the worst drought on record), high import prices at the upset price, average export prices, an interest rate that is 200 basis points above average interest and the dollar at parity. This scenario results in $1.8 billion loss in Net Revenue (Figure 6.17). The opportunity losses rise to $2.2 billion. This means that accumulates net revenues of MH could be wiped out in one year. This scenario has a very low probability of occurrence, especially if it can be argued that these events are independent. Even when some of these events are not independent, the joint probabilities are low.

Figure 6.17 – Worst Case Scenario



6.3 Summary of the Findings

Major losses can be expected from low water flows and a rise in import prices or a decline in export prices. Volumetric, price changes and interest rate changes are the major causes of risk for MH. Changes in labour cost, material cost, purchases of electricity costs and wind have only limited Impacts.

Statements About Probability and Correlation

In Chapter 6 we quantify the drought risk under both MH conditions and more stringent ones. Our numbers are close to MH or even higher. We also include multiple risk factors working in combination and assess the probability of their occurrence.
(p. 191)

In the exercises to follow, we wish to demonstrate the usefulness of these risk analysis tools by applying them to data published by Statistics Canada on financial parameters of MH.
(Chapter 6, 265)

There are, however, some major transactions and events that have high probability of occurrence and large consequences. Droughts, long term contracts, and expansions of capacity have major consequences on net revenue and have reasonably high probabilities of occurrence. Major events and therefore large risks may occur in clusters. The drought in 2004 was accompanied by high import prices. Risks must then be quantified separately and in combinations having regard for their correlations and inter-relationships.
(Chapter 6, pp. 225)

The list of these risks has already been discussed. We move in this Chapter to quantify these risks and define both their likelihood and consequences. (Chapter 6, pp. 225)

We did not examine the results of a five or seven year drought as we did not have and did not think that the actual series would produce the best correlation given that our estimate came from a statistical simulation exercise. We could use our estimates of a five year drought from Chapter 4 but for comparison purposes we calculated these losses only for the representative year.
(Chapter 6, pp. 229)

This scenario has a very low probability of occurrence, especially if it can be argued that these events are independent. Even when some of these events are not independent, the joint probabilities are low. (Chapter 6, pp. 242)

CAC/MSOS/MH I-62

Subject: **Financial Forecast – Risk Analysis**
Reference: **Appendix 5.2, pages 20-22**

g) **Page 21 states that the impact of the drought was calculated using import costs based on expected market conditions. Please explain the extent to which a drought on Manitoba Hydro's system is expected to impact market conditions for purchases in MISO.**

ANSWER:

There are two types of pricing effects related to market conditions - shortage pricing and congestion pricing. Shortage pricing can occur during tighter supply and demand situations when there is a premium over normal prices. There was the potential for shortage pricing prior to 2005 when there was no central market in the MISO footprint. During this time Manitoba Hydro was obligated to transact directly with counterparties for the purchase of power. These counterparties could extract a premium price once Manitoba Hydro was in severe drought and required large quantities of purchased power. Shortage pricing occurred during the 2003/04 drought when large quantities of purchases were required by Manitoba Hydro.

Since the establishment of a central market in MISO in 2005, the issue of shortage pricing has been mitigated to a large degree since purchases can now be made from the market at a transparent market clearing price. The MISO footprint, consisting of approximately 138,000 MW of generation capacity owned by many suppliers, is currently very large relative to the Manitoba Hydro system. Manitoba Hydro's firm transmission import capacity of about 700 MW from the MISO market represents less than 1% of the peak MISO market load. Hence, in most hours up to 700 MW of imports from the MISO market has a relatively minor effect on the MISO market, assuming no transmission constraints within the market.

The second type of pricing effect related to market conditions is called congestion pricing. Under most system conditions, when no transmission limits (called constraints) are binding, there is said to be no congestion on the system and the market price at each location (node) is the same except for transmission loss charges. In any given hour, a transmission outage (a constraint), or a forced generation outage can alter the local supply versus demand situation and create temporary congestion pricing. The degree of congestion can be aggravated during severe drought in the Manitoba Hydro system when large quantities of imports are required. Congestion pricing is expected to have less of an effect on Manitoba Hydro import prices compared to shortage pricing prior to 2005.

2008 GRA

PUB/MH II-71

Reference: Coalition/MH I-70 (a)

d) **Please explain why import prices during an energy shortage [drought] would not reflect a high [premium] price situation.**

ANSWER:

The factors that influence high market prices versus shortage pricing are very different, and consequently the price premiums are different. High electricity prices were derived from a scenario of a combination of possible North American market conditions and were used in the sensitivity analysis to electricity prices during drought conditions. A high electricity price scenario could be characterized by the following factors in varying degrees and combinations: high economic growth and high growth in energy demand, increased capital costs due to higher lending rates, a move to fully competitive power markets, increased natural gas and coal prices relative to those assumed in the expected forecast, stringent U.S. environmental policies, and the U.S. ratifying a Kyoto-like agreement on GHG's after 2012.

Shortage pricing is assumed to arise in a specific set of market conditions and reflects a local increase in import price once market players realize that they are able to extract a premium due to dire need of a counterparty.

Since the drought of 2003, Manitoba Hydro's US market has changed following MISO Day 2 on April 1, 2005. As a result of the structure and rules of the market, Manitoba Hydro is able to transact more anonymously in the MISO market which should provide significant benefits in future shortage conditions.

However, these changes have not eliminated all the price risk since there remains significant transmission bottlenecks for large scale low cost energy flows to Manitoba. Therefore until major additional transmission investment is made in the US which would allow distant energy to flow to the northern MISO region, Manitoba Hydro will not fully benefit from the broader U.S. market.

CAC/MSOS/KM-29

Reference: KM Report, page 65

Question:

a) Please clarify whether KM are suggesting that MH should not use its market power to maximize rents exclusively for domestic sales? exclusive for export sales? for both? Please explain.

b) Why isn't it appropriate for MH to be maximizing "rents" when it comes to the planning and scheduling of exports?

c) Would changing the objective function to "minimization of generation cost" still permit MH to extract the maximum value from export sales? If yes, please explain.

ANSWER:

a) For all practical purposes MH is a regulated natural monopoly in the domestic market. It is a price-taker in the MISO export market. As a regulated public utility its rates are subject to GRAs in the domestic market. It is too small to influence prices in the MISO market. The issue of using market power in both of these markets is not relevant or is very difficult if not impossible.

b) MH is simply not in a position to maximize rent in the opportunity MISO market. In this market it is a price taker. It has more room to manoeuver in the bilateral negotiations with its counter-parties but there it has to remain competitive with alternatives open to these counter-parties.

c) Minimization of cost targets efficiency or a point on or close to the minimum long run average cost. This is an overall target that KM believe serves best the interest of MH and Manitobans than trying to maximize net export revenue. Given a firm revenue from firm contracts, minimizing cost would result in maximum net revenue from this segment and given that MH is a price taker in the opportunity market, minimizing cost given the quantity of exports would be equivalent to maximizing net export revenue of the given volume. The emphasis here is on the quantity being given.

CAC/MSOS/KM-30

Reference: KM Report, page 67

Question:

a) Unlike it did for MOST, KM has not expressed any concerns regarding the fact HERMES uses "maximizing profits" as its objective function (per page 67). Please explain why.

ANSWER:

Both maximize net revenue and the same issues objected to by KM apply to both systems. In the domestic market MH must meet the domestic demand. It does not choose the generation volume nor does it choose the price. In the export market, it has a firm commitment determined in terms of price and quantity. It has a small room to manoeuver with counterparties, but this is not a serious one that allows it to choose the output that maximizes profit. The only room for MH to optimize is in the opportunity market and there it is a price taker. It would be more reasonable and more consistent with its mandate for MH to minimize the cost of the given volume it has to deliver. This way it would raise its rent and would pursue efficiency than directly profits.

MH-KM - 8

Reference: Chapter 1 - Page 15

"The capacity to export is significantly constrained by transmission availability, cost and capacity. The fact that transmission capacity can be used by both exporters and importers is a strong argument for validating the importance and contribution of exports and imports. This is all the more important when the export and import markets do not peak at the same time. It becomes a serious problem when shortages develop, causing exports to dry up and imports to rise at a time when prices are high."

a) Please clarify the meaning of the statement "when the export and import markets do not peak at the same time".

b) Please clarify the meaning of the statement "It becomes a serious problem when shortages develop, causing exports to dry up and imports to rise at a time when prices are high."

c) How significant are each of the following factors in terms of their impact on MISO market prices? Please provide a detailed explanation.

- US natural gas and coal prices;
- MISO load demand;
- MH export activities;
- MH import activities; and
- Drought in MH watersheds.

ANSWER:

(a) The export market may peak in the summer and the import market may peak in the winter. If this is not the case because of any climatic or other developments, the risk exposure of long term contracts would rise.

(b) It is meant that there can be a serious problem both by way of physical limitations and by the potential financial costs when shortages develop. This arises when Manitoba Hydro is called upon to satisfy its firm export requirements by either importing power or by thermal production or even through book-outs.

(c) (1) In the recent past higher gas prices raised peak demand electricity prices and coal price increases tend to raise base load prices.

(2) Any increase in MISO load demand above the existing capacity would automatically raise MISO prices to ration the excess demand. The open access market MISO represents and the bidding structure is designed to determine a market clearing price. This price is quite sensitive upward to excess demand and downward to excess supply.

(3) MH exports are a very small fraction of the entire MISO market and therefore it is not likely that MH exports would exert a significant pressure on prices. MH is too small to be but a price-taker in the MISO market.

(4) Theoretically MH imports are a small fraction of total MISO supply and should not qualify MH as anything but as a price-taker.

(5) A drought in MH's watersheds would decrease exports and raise imports. It should not exert any significant pressure on imports. Being a price-taker it accepts the market price. There has been a suggestion that counter-parties have exploited the drought to charge higher prices for US exports to MH. This is not to be ruled out as some of the US suppliers to MH may be able to influence the price in that spatial node that cannot be moderated by arbitrage.