EB-2015-0277
(related to EB-2015- 0166 and EB-2015-0175)

Responses to Submissions from board staff, Union and Enbridge

On Oct 5, 2015 the Board issued a Notice of Motion to Review and Vary that invited the parties and intervenors for EB-2015-0166 and EB-2015-1075 (re. the NEXUS pipeline) to respond by Oct 13, 2015. Three responses were issued by the Board staff, Union and Enbridge. The Board's Notice required that I reply to those responses by Oct 20, 2015. My replies are identified by "S" for the Board Staff response, "U" for the Union response and "E " for the Enbridge response.

S-1 Does the OEB's *Filing Guidelines for Pre-Approval of Long Term Natural Gas Supply and/or Upstream Transportation Contracts*, preclude arguments that there are alternatives to the pipeline and gas supply that will largely supplant the need for the pipeline within the time frame under consideration (approximately until the year 2032)?

The *Filing Guidelines* were developed in the year 2008 and were published in EB-2008-0280 in early 2009. None of those Filing Guidelines excluded the consideration that the facility under consideration would not be needed. Indeed, **Part II - Needs, Costs and Benefits** asks for: "2.1 *A description of the proposed project that includes need, costs, benefits ... and timelines.*", which are exactly the issues that I have been addressing. When asked what would happen if the pipeline is not built the applicants answered that in that event there will still be sufficient pipeline capacity to meet Ontario's needs, but with reduced security and diversity of supply. My interpretation of their response is that the pipeline is not a necessity (i.e. it is not needed) but would offer certain benefits. I would argue that those benefits will not be needed either if the use of natural gas is phased out.

The first issue for the EB-2015-0166/0175 applications was essentially identical: "*1. Has the applicant adequately demonstrated the need, costs and benefits of the proposed project?"* The evidence that I believe the Board should consider shows that the NEXUS pipeline will not be needed, that the expense of continuing to use natural gas as a primary fuel in Ontario will cost Ontario residents many billions of dollars per year, and that the environmental and safety issues associated with natural gas outweigh any potential benefits. The advantages of employing local energy sources directly impact thermal energy applications and indirectly impact the uses of electricity so both have to be considered - you cannot usefully examine either by itself because they are interdependent.

The second Part II issue under the Filing Guidelines is : "*2.2 An assessment of the landed costs (supply costs+transportation costs including fuel costs) for the newly contracted capacity and/or natural gas supply compared to the landed costs of the possible alternatives.*" **Note that this issue is missing in the issues list of Procedural Order No. 1. It appears that the OEB is not following its own guidelines.**

One of the intents of this particular guideline appears to be to prevent compartmentalization. If the applicant focuses on a particular part of the process (in this case one particular leg of the transportation line) and excludes consideration of the overall costs and the cost of possible alternatives then there is a danger that the overall cost objectives might be lost in favour of relatively trivial cost advantages for the remaining bit. I would suggest that in this case the OEB staff may have erred in omitting this important element of the OEB guidelines. To explain why that is the case I need to bring the documents in question to the Board's attention. The Board's position (in Procedural Order No 2) appears to be that the Filing Guidelines take precedence over the Provisional issues list of Procedural Order No. 1, in

which case overall costs and potential alternatives are valid considerations.

S-2 Filing Guidelines Part IV - Risk Assessment
The Filing Guidelines require "*(4.1) Identification of all the risks (such as forecasting risks, construction and operational risks, commercial risks and regulatory risks)....*" The preliminary issues list in Procedural Order No. 1 does not mention some of the risks identified in the Filing Guidelines such as "future demand, prices, actual landed costs," or regulatory risks which are to include changes in laws or regulations.

Historically energy supply in Ontario has been centrally controlled by a small number of government and private sector companies. Systems that collect, store and deliver locally collected thermal energy are different in that they are built and controlled by the building owners, not any central agency. That imposes a risk that any switchover from centrally controlled supply to distributed systems will not occur according to a timetable, which in turn imposes a risk that the demand forecasts may be substantially in error. Such forecasts also inevitably reflect the long term view of the planner - a planner within a gas company may be inclined to believe that the business will go on forever whereas I believe that the mainstream uses of natural gas will soon disappear, the only real question is when. That makes forecasting a very risky business in this case.

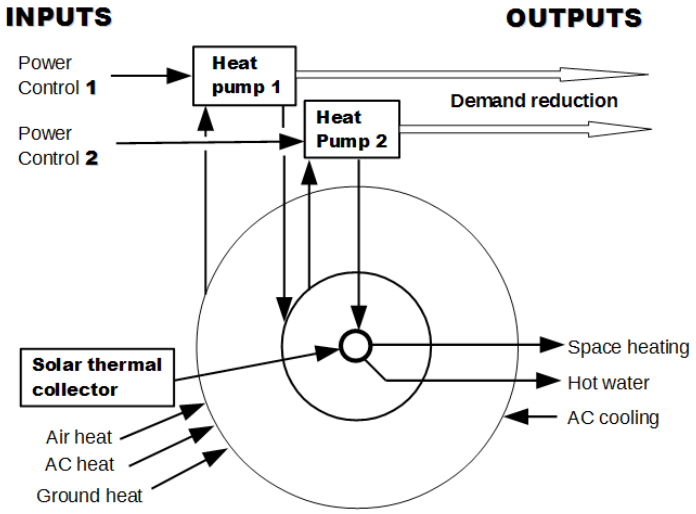
Timing - The Staff Submission incorrectly states that I had not raised the United States regulatory risk until Sept 29, 2015, whereas in fact I had raised it in my questions at the Technical Conference of Sept 9, 2015 (page 112), which I believe was the correct time to ask the question.

S-3 Relevance
The argument has been put that the alternative that I have outlined is not relevant to the NEXUS case because it relates "largely to broader questions of the future of electricity supply and demand in Ontario". Exergy stores do not generate any electricity at all and they would not require the construction of any additional electricity generators to meet the electricity demands of the exergy stores. They are fully compatible with present Ontario policies, offering a way to lower the costs of both thermal and electrical energy plus a means of greatly reducing greenhouse gases, all of which are in line with government goals. What they do is provide a means of phasing out the use of natural gas, providing an alternative that is cheaper, safer, cleaner, more environmentally responsible, and that does not depend on creating government agencies to implement or promote their spread. The question is thus completely relevant to the need for NEXUS and is only indirectly relevant to electricity supply and demand in that it creates a market for utilizing wasted generation capacity at night and during the low demand seasons.

S-4 Needs that might be met by either NEXUS or exergy stores.
In Ontario natural gas has four primary applications: for space heating, domestic hot water, peak power generation and smoothing of electricity demand and supply fluctuations. All four applications can be met much more efficiently by using local thermal energy sources but the thermal applications require that the exergy of the local heat sources must be boosted so that the temperature will be high enough, hence the need for using heat pumps to boost the exergy with minimal consumption of electricity.

S-5 Exergy stores are not new.
There are millions of heat pumps and exergy stores in use presently in Ontario. Some are very large, such as the Enwave system. Some are small such as the refrigerators in our kitchens. Some (like Enwave) use the air as the source, others (like the UOIT campus) use the summer heat extracted from

the buildings, many others use ground heat, and some use solar heat. The general concept diagram previously depicted (see below) encompasses all of those variants. What has been missing has been the simple concept that if we use the wasted generation capacity of our existing power grid then we can boost the exergy of low grade heat sources like the heat from the ground to make the heat useful for applications like space heating and hot water. That does not require new equipment or R&D - the technology is well known and the equipment is available - but it does require that we stop compartmentalizing our review processes under which that the thermal and electrical energy supply systems are examined independently instead of being considered together because they are interactive. In particular, we need to stop spending billions of dollars on wasteful projects like NEXUS and power generators that chase the demand peaks.



To illustrate the principle consider a refrigerator that is reasonably well insulated. If you put a timer on the compressor so that it only runs from midnight to 5 AM then you can run it at night and store the cold, and you will be shifting the power demand from the high demand period to the low demand period. If the cost of power at night is nearly zero then you have reduced the cost of operating the refrigerator almost to zero. If we all used such refrigerators then we might switch 100 MW of power from day to night.

A more practical application is a ground source heat pump. If the heat pump is run at night the boosted heat can be stored in the ground, again shifting the power demand to the night and raising the exergy (temperature) to a value that is high enough to heat a house. Such systems have two other advantages: the cold outer ring ensures that the heat always flows towards the center, eliminating radial heat losses, and chilling that ring permits other heat sources (the air, AC heat) to be collected and have their exergy boosted. Such systems can utilize any combination of the five energy input sources so they provide a permanent, clean and inexpensive method of meeting home energy needs, for which 88% is thermal in Ontario. The key element of the concept is the timing. Electricity is drawn only when electricity is abundant and cheap, while the high-exergy stored heat can be used throughout the day. There is an essentially unlimited amount of thermal energy around our homes and other buildings so such systems can permanently, safely, cleanly and inexpensively provide the heating (and cooling) that we need and at the same time it achieves electricity demand reduction in the winter and summer plus demand peak shifting every day. None of those adjectives or functions could be applied to natural gas.

S-5 Wasted capacity
According to the IESO Ontario has a nuclear generation capacity of 12,978 MW but during low demand periods many of the reactors are shut down, reducing their output to as low as 7,100 MW. Shutting down the reactors does not greatly reduce their operating costs or the capital cost that is passed on to the consumers - it is just a very large waste of money.

The IESO says that Ontario's hydro capacity is 8,462 MW but sometimes the demand falls to about 2,500 MW and that again represent a big waste of potential and an expense that is passed on to the consumers.

On most nights of the year Ontario generates more electricity that it can use so the surplus is effectively dumped by giving it away, quite frequently at a loss.

These three wasted capacities add up to about 15,000 MW during periods of low demand. If that amount of wasted energy were used to drive exergy stores it could collect energy from the local thermal sources at a rate of up to 75,000 MWt (the amount depends on the design details). When the heat is recovered from the store it can be extracted at a much higher rate so the supply capacity is much higher than 75,000 MW - it functions much like a car battery that can be charged slowly but discharged very rapidly. The point is that a system that relies mostly on when you run the heat pump would be capable of meeting Ontario's entire thermal energy load. That implies that it could eventually displace the use of natural gas for space heating and DHW. Since the timing of the heat pump operation is controllable such a system can also modulate the grid demand, serving the same function as natural gas-fired generators that deal with grid supply and demand fluctuations. Since the stored heat meets the seasonal thermal demands such systems also remove the need for using gas-fired generators for periods of seasonal peak electricity demands. In short, the thermal stores are serving all of the purposes of natural gas for both thermal and electrical applications.

Note that if, as proposed, the OEB limits the discussion to just thermal applications or just electrical applications then our ability to explain how it works would be crippled. I submit that the rationale that the considerations should not include the impacts on Ontario's electricity grid is not valid.

S-6 Evidence
The staff report suggests (pg 3) that it would be possible for me to "*ask the companies' witness panels questions about the contents of the reports (providing the questions are in scope). The witness may or may not have helpful answers, but it would be open to Mr. Tolmie to ask. The reports themselves may not be evidence, but the companies' answers would be.*" That is a tidy way of highlighting the problem. It leaves the reports buried and inaccessible to the Board members, and the suggested opportunity will not exist at all if no witness panel is called.

Union response

The Union response repeats the same points: that proposing an alternative is "out of scope", that it relates to electricity generation, and it proposes a new technology.

Procedural Order No. 2 lays out four grounds for a motion to vary the Order:

I error in fact
II change in circumstances

III new facts that have arisen
IV facts that were not previously placed in evidence in the proceeding and could not have been discovered by reasonable diligence at the time

I The term "out of scope" is too vague to be dealt with as a fact but it shows a considerable level of misunderstanding. The alternative is essentially a ground source heat pump system that limits the operation of the heat pump to the middle of the night, and especially to the seasons when excess power is available. That serves two purposes: it shifts the power demand from peak demand periods to excess supply periods (which effectively stores electricity), and it raises the exergy (temperature in this case) of the local thermal energy source to a value that makes it a useful replacement for natural gas as the heat source. The output energy is entirely in the form of heat, not electricity, and one end result is the displacement of natural gas for heating. The other end result is that both the winter and summer electricity demand peaks are reduced (and could be eliminated), which means that the required peak power generation is much smaller, leading to a reduction in the capital cost of existing power generators and distribution grids.

It is the logic that has changed, not the technology. The components of an exergy store are the same as those of a ground source heat pump but the cycle sequence is different. The end result is that cities that use exergy stores do not need natural gas for space heating, cooling or DHW and you do not have to re-invent any wheels to build the exergy stores. The electrical advantages are substantial but they are indirect. There are many variants of the concept that are possible (some of which are currently in use), with a choice of five normally-wasted energy sources, four outputs and numerous choices for the heat storage media and exergy boosting means. Explaining all of the variants would be lengthy but in this case the relevant outcome is that the natural gas (and hence NEXUS) are not needed.

These functions are explained in considerably more detail in the documents that I would like to file for the Board's consideration.

II There is also a substantial change in circumstances, and new facts. In 2008, when the Filing Guidelines were written, hydraulically fractured shale gas was not used in Canada and was just beginning to come into use in the US. Little was known about the escape of methane or about its effects on the environment. While the OEB's review does not deal with the environmental concerns the cost consequences related to that escape are substantial. In 2008 the GWP (Global Warming Potential) of methane was believed to be about 10. Currently the IPCC puts the value at 86 (25 year averaging) so if only a tiny amount of the methane escapes that methane can readily produce more GHG than is produced by burning the gas. Over that 7 year period research has been done on the delayed methane that eventually reaches the surface as a consequence of the large amount that is released from its imprisonment in the shale but is not captured by the fracking pipeline. Recent aerial and satellite surveys over shale gas deposits have shown that over 10% of the amount of recovered gas escapes. When multiplied by 8.6 the resultant GHG emissions are likely to be so large that they make shale gas an unacceptable energy source, many times worse than coal or other fossil fuels. At the present time these numbers are too preliminary in nature to draw firm conclusions but regulatory agencies should be aware of the results, which represent a substantial potential hazard. Papers on these topics have been written by agencies like NASA and NOAA.

The Union response states that I have not made a presentation "that brings into question the ruling of the Board". Might I point out that under the terms of Procedural Order No. 2 I have not been permitted to make such a case. I would respectfully suggest that Union, Enbridge and the Board should read the evidence before arriving at their conclusions.

Enbridge

The numbers follow the numbers of the comments in Enbridge's response (preceded by an "E"). Some comments do not require a response.

E-3 The Board's Filing Guidelines do not exclude the comments that I have made (or would like to make). Both the Filing Guidelines and the Provisional Issues List of Procedural Order No.1 ask for comments on the need, costs, and benefits of the project and on the associated risks. The Filing Guidelines go further than the Issues list by requiring an assessment of the overall costs rather than the segregated transportation costs and also an evaluation of the forecasting and regulation risks.

E-6 I expressed concerns about the **costs** associated with the greenhouse gas emissions, which is a valid concern in the light of using an alternative that produces no greenhouse gas.

E-7 We now have a new federal government that promises to be much more reluctant to continue to use fossil fuels, particularly for applications (like those for natural gas) for which cleaner and cheaper alternatives are available. I assume that Enbridge will conform to government policies of both the federal and provincial governments. Since the pipeline and the gas suppliers will be in the US they will also be obliged to follow US prices (which may include some form of carbon tax) and regulations. The US federal government is currently evaluating the means that it should follow to reduce methane emissions by 40 to 50% below the 2005 level. Since that date precedes the switch to higher-GHG shale gas it is likely to impose severe limits on the production of shale gas and particularly on the export of natural gas. The US is rapidly switching from coal to natural gas for power production so there will be competition for what can be produced within a limit imposed by the emissions so I believe that this needs to be more carefully evaluated.

E-8 My letter of Sept 17, 2015 stated my intention to provide evidence on the cost consequences of the NEXUS pipeline, including evidence that the pipeline is not needed, would lead to excessive energy costs in Ontario, and would suffer from major drawbacks. Natural gas is used for both heating and power generation so the consideration of both applications is required.

E-10 It is within the OEB's mandate to approve or decline the applicant's proposals. I did not propose that the OEB should do anything more than decline the proposals for reasons that are sketched out above and that would be more fully explained in the evidence that I would like to submit.

E-13 (and 14) Other than the Appeal/Motion that I submitted on Sept 29 the correspondence dealt with the question of what evidence would be submitted, not the argument to be presented.

E-16 I did not ask the OEB to redefine the government's policy. I would like to present an adequately documented case for why the OEB should not approve the applicants' request. Included in that case would be an explanation of why shale gas should be considered to be a new fuel and why relying on an energy source from the US that is juggling with the need to switch its power generation supply sources while reducing the consequent emissions will put Ontario consumers at risk.

E-17 (and 18) My comment on the Motion terminology was just that - a comment, not a complaint.

E-19 See the reply to the Union response.

E-21 to 23 Legal hair-splitting. As things stand Ontario residents are being obliged to pay (via the fuel

rates) for the facilities for distributing natural gas (like NEXUS) plus the GHG-consequential costs of using that fuel, plus the cost of importing the fuel itself, plus the costs of nuclear power stations that are nearly half idle much of the time, plus the costs of a hydro system that has an even lower utilization factor, plus the cost of an expensive grid system, all of which are problems that could be progressively fixed if Ontario made use of local energy sources. If you add all of the excess costs together the total runs to many billions of dollars.

What is the threshold for waste that would warrant considering this evidence? $10 billion per year? $20, billion per year?

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