John P. S. Froats
38 Castle Harbour Drive
Port Perry, Ontario,
L9L 1P6

8 August 2011

Dr. Michael Binder
President, Canadian Nuclear Safety Commission
280 Slater Street
Ottawa, Ontario

Subject: Review of Paper, " CANDU technology re-evaluated following Fukushima"

Dear Dr. Binder,

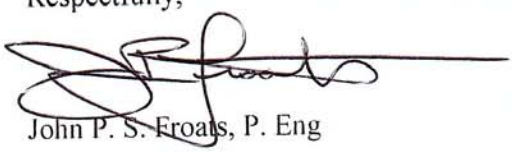
Per your request, I have reviewed the paper which was forwarded from your office, 10 July 2011, titled "CANDU technology re-evaluated following Fukushima", by Professor Michel Duguay of Laval University. Your request was for me to conduct an independent review of the content and to provide your office with my perspective on the document.

Attached you will find a report, summarizing my review and observations. I assume the document is at the draft stage as it does not yet have the normal structure with rigor in references that typifies a paper being published. It is clear that Professor Duguay has done a considerable amount of work assembling information. However, I have found in a number of areas, the content of the document is lacking in contextual accuracy. In other areas documents referenced are somewhat dated, some of the issues raised as areas of concern have been advanced, and in some cases resolved. In the attachment I have attempted to provide constructive, factual information to augment or correct the content of the report.

I note that the document is clearly portrayed as a personal opinion but would offer the view that use of terms such as `worrisome weaknesses'; `dreaded condition'; `plagued by design weaknesses'; are more typical of a press news report than a factual, balanced scientific account. The paper could draw on reference information that would serve to illustrate the authors' points of view in a more wholesome balanced manner. For example, the opinion offered on the electricity supply decisions in Germany fail to discuss socio-economic aspects of the decisions which are not insignificant.

I hope you find the attached remarks of value. Should you require further assistance, please feel free to contact me.

Respectfully,



John P. S. Froats, P. Eng

Associate Professor and Nuclear Engineer in Residence, UOIT

Report Review

"CANDU Technology re-evaluated following Fukushima", Professor Michel Duguay

Comments provided by: John P. S. Froats

August 2011-08-02

The following observations and thoughts are offered as constructive input to the CNSC and the Author. I think we would all agree that the Fukushima event was a tremendous tragedy and that the world as a whole needs to take valuable lessons away from the event. Thousands of lives were lost outside the power plants in towns and country-side in Japan directly as a result of the tsunami, in what is believed by many to have been an avoidable tragedy. In the nuclear sector, action around the world in governments, agencies, Regulatory Bodies and Power Plant operators has been significant and continues. Aspects of lessons clearly apply to the Nuclear sector but also to other domains such as infrastructure and emergency planning.

Our Japanese colleagues have been steadfastly focused on dealing with the human impacts of the earthquake and tsunami in the affected communities. In the affected power plants they continue to focus on control of the plant conditions and understanding of the event at the detailed level. The IAEA has published its initial report which is available on the IAEA website. An Extraordinary meeting of the Convention on Nuclear Safety is planned for August 2012 to ensure dissemination of lessons learned in the nuclear industry and that Member states have responded appropriately.

In Canada, shortly after the event, letters were issued to nuclear facility operators (licencees) by both the Canadian Nuclear Safety Commission and the World Association of Nuclear Operators requiring initial actions in response to the event. At Canadian Nuclear Power Plants, these initial actions confirmed that appropriate measures were in place and the Canadian reactors were safe to operate. Work has continued in both the CNSC and in the Industry via the CANDU Owners Group to probe for opportunities to enhance safety and apply lessons that are continuing to emerge from Japan. A Canadian team will report on Canadian progress at the Convention in August 2012.

The Summary

The summary by Dr. Duguay offers his opinion. If this is the intention then it accomplishes the goal. However, it does not offer a position based on a scientific assessment. It infers that the CANDU technology has somehow been discovered to have the possibility of severe accidents in light of Fukushima. In fact it is well publicized that all reactor designs have some very low probability of severe accidents. International standards from the IAEA define the acceptable risk tolerances and the approaches required to evaluate the risks. Canadian Regulatory Documents such as RD 337 also define these requirements and establish safety goals to be met that ensure nuclear generation risks are lower

than other industries. This is nothing new. It would be factual to state that in the aftermath of the Fukushima event, requirements are being re-examined for adequacy. This is the prudent thing to do – ensure that any opportunities to strengthen safety are understood and acted on – exactly, I believe, what the public would expect.

In the detailed comments that follow, I suggest that the interpretations (opinions) offered on the CNSC decision on Gentilly-2 and the `wisdom' of the decisions made in Germany, should consider additional information and facts to form a basis for the Authors opinion. These should then be reflected in the Summary.

The Introduction

In the second and third paragraphs of the introduction the Author suggests that the result of the Gentilly-2 licence renewal process was that the CNSC granted a licence to operate until 2016 and infers that in doing so the CNSC did not act prudently with respect to the issue of updating the Safety Report. The paragraphs are contextually in error. I think if the Author carefully reviews the transcript of the proceedings he will find that:

- The renewal requires the Gentilly-2 reactor to be shut-down by 31 December 2011
- The renewal requires Hydro Quebec to submit the updated Safety Report by 31 December 2011- an extension of an additional 6 months – with firm statement of no further extension
- There is a requirement in the renewal that Hydro Quebec seeks CNSC approval prior to reloading fuel in the reactor and again for reactor start-up post refurbishment
- The licence renewal also establishes several quality hold points during refurbishment activities

In Canada, a nuclear power plant, even when shutdown with fuel removed requires a licence. It is normal practice to use conditions in the licence as a vehicle to require the licensee to demonstrate adequacy of the safety of the plant before restart after a major refurbishment. This is exactly what the CNSC has done in the case of Gentilly-2. The plant has analysis in place that demonstrates an adequate safety case. It is the reviewers' view that while slippage of committed dates is not desirable, the slippage of this particular date by six months, given the intent to shut-down the plant and refurbish, is not risk significant. The provision in the Act for the CNSC, with due process, to allow non safety significant exemptions is used as the vehicle to maintain the facility with a valid licence. The Authors description of this process as a "dangerous CNSC action" appears to be completely unfounded. In the absence of any facts that indicate the appropriate legal process was not followed the interpretation would be questionable.

The author offers an opinion with respect to the decision made in Germany to phase out nuclear power and cites large geography and low population density as rationale that supports a similar direction in Canada. The issues around energy policy are complex and there is a considerable amount of public information available on the subject. Most energy plans indicate a need for a mix of all forms of energy production including renewable generation and nuclear to meet demand for electrical energy and targets for reductions in greenhouse gas emissions. Factors that need to be considered in deciding on an appropriate energy mix for a country include , climate, cost, grid construct, load profile etc. The

Author could put forward a more compelling picture on which to base his opinion by utilizing facts from various public sources. In suggesting a path forward some of the following could be used to formulate a basis to offer an informed opinion:

- The Ontario Independent Electrical System Operator website shows supply and demand for the Province of Ontario and the contributions of different generation. It shows (based on data on the site for 2 August 2011) that dependent on time of day, there was of the order of 1340 MWe of wind generation available and it delivered between 60 and 151 MWe of capacity. At the same time nuclear capacity available was approximately 9,928 MWe and actual delivered capacity was 9,706 MWe. This illustrates that climatology is a major variable on the utility of wind generation
- Economics of energy delivery is also a key factor in decision making. The IESO web indicated a peak energy demand in Ontario of 25,450 MWe on 1 August and indicates that average weekday pricing in Ontario was about 6.03 cents / kwh. Contracts for wind and solar generation in Ontario are at pricing that is several times the pricing for concentrated generation sources. The implication of movement to a more extensive use of these technologies is a substantive increase in price
- In Germany, the immediate impact of the energy policy decisions to shutdown some nuclear plants was an immediate increase in energy pricing. Information on the Germany energy picture is available on web sites such as www.energy.eu and www.spiegel.de. Debate continues in Germany on the best path forward for the country to meet its future energy needs.

There is a wealth of papers presented on the energy future of Canada. Dr. Lorne McConnell has published on the issue of energy and environmental change. Presentations have been made at many forums such as the CSA Annual Meeting on the subject. The author could use these sources to provide a fact based platform on which to state a personal opinion about energy policy.

It is also worth noting that the complexities of severe environmental events like the earthquake and tsunami in Japan on infrastructure have not yet been distilled. In the 2003 blackout in Ontario power was restored to critical loads in about 5.5 hours – a task involving routing concentrated power sources through transmission corridors to targeted loads. In Fukushima, crews were able to reconstruct 16 km of transmission lines to restore power from a concentrated power source to key loads. A distributed grid complicates restoration procedures greatly. This does not mean it is a bad concept – it simply illustrates that these kinds of changes have far reaching implications that need to be thought through very carefully.

2. Canadian Reaction to Fukushima

In the opening paragraph, the Author points out that the CNSC has “responded by setting up a special task force under the leadership of Greg Rzentkowski”. This is factually correct but the author is likely not aware of the full scope of the Canadian response. A more accurate description of the Canadian response would include;

- The CNSC issued letters to licencees requiring they immediately confirm that the salient design and operating provisions were in place at their facilities. Response (required within 90 days) confirmed provisions were in place
- The Industry responded to similar letters from the World Association of Nuclear Operators
- The CNSC presented the Canadian response to the event at the Convention on Nuclear Safety in Vienna in April 2011 – which was acknowledged as a comprehensive response
- The Industry formed a task group under the CANDU Owners Group to continue to monitor and learn from the event
- The CNSC formed the task force referred to currently in the report
- The CNSC has issued requirements for further work to check the robustness of defence in depth provisions in the plants
- Canada participated in a ministerial Conference in Vienna in June 2011 which laid out the next steps in the international response to the event.
- Canada provided expertice to Japan on request.

The Canadian report to the Convention on Nuclear safety can be found on the CNSC website as a reference.

With respect to the context of the "Challenging Long-held Assumptions" wording on the slide in Dr. Binders talk, I have heard him use the terminology often – always in the context of ensuring we do not become complacent. It is a call to action and reflects the healthy attitude of never being satisfied with the status quo. It applies to our response to all events and opportunities to learn.

In the latter part of this section the author offers a perspective on the merits of distributed power systems. As highlighted earlier, the choices of generation mix and grid structure is a very complex issue. The discussion of pros and cons could well form the basis of a separate paper – one that supports perspectives with facts to enable readers to form an informed opinion on the issue.

3. The failure of Gentilly-1

In this section of the report the author recounts the history of the Gentilly-1 plant in the 1970's. It is factual in its statement but incomplete in its context. The reactor was carefully monitored during the start-up and was shut-down safely when its performance did not meet expectations.
The report fails to acknowledge that the learning from the Gentilly-1 experience, helped to evolve the understanding of the reactor and contributed to the evolution of the CANDU reactor. The CANDU 6 reactor (Gentilly-2, Point LePreau, Cernavoda, Wolsong, Embalse and Qinshan) in particular has an exemplary performance record in both safety and reliability areas – several units ranking in the top performers worldwide.

Fidelity of the computer codes and analysis supporting the safety cases of records has improved considerably over the subsequent 30 years. It is true that this has been the subject of much regulatory scrutiny. Computational power has increased dramatically allowing more sophisticated analysis to be conducted. Operational experience has been accumulated that enabled computer code updates to take

advantage of real plant data. Safety analysis is more comprehensive today and has been repetitively modernized over the ensuing years. The CNSC continues to require Industry to work to further improve the analytical tools it uses and will continue to do so. Any implication that the state of knowledge of reactor performance and the robustness of the tooling today is similar to that of 30 years ago is simply misleading.

4. New post-Fukushima context

In the first paragraph of this section the author suggests there should be a re-evaluation of CANDU technology. I think we all agree that after an event the magnitude of the earthquake and tsunami in Japan that re-evaluation of nuclear reactors, emergency preparedness and infrastructure is prudent. As I have indicated earlier there is a hierarchy of re-evaluation going on to meet this need. Again:

- IAEA international assessment work is ongoing
- CNSC and other Regulatory bodies around the world are reviewing adequacy of nuclear facilities. The CANDU reactors are not only being reviewed in Canada but also in other countries like Romania, Korea, China, and Argentina
- Industry in Canada and elsewhere are conducting reviews
- Japan is conducting multiple reviews for lessons learned
- All Nuclear Power Plant Countries will meet at the Extraordinary meeting of the Convention on Nuclear Safety to account for their reviews and actions and share learning in August 2012 in Vienna

The Author is certainly entitled to his own opinion about the adequacy of the review processes underway, but it is the reviewers' perspective that he should acknowledge what is being done and make any points about his perspective of adequacy against that backdrop.

In the second paragraph, the author states that Mario Desilets, in a Radio-Canada documentary aired 15 May 2011 "asserted that the CANDU cannot be operated safely beyond 30 years". This statement is made in contextual error. The actual statement made was in reference to pressure tubes. The current safety case demonstrates that pressure tubes can be operated for approximately 30 years. Work is underway to demonstrate they can be operated even longer. However, until such time as the safety case for longer operation is made and accepted by the CNSC, the pressure tube life will be conservatively assumed to be the approximate 30 years. Once changed during refurbishment, extended safe operation with new pressure tubes can be assured. The report should accurately reflect the context of the reference remark.

The Author suggests weaknesses in adequacy of independence of the CNSC in its decision making. Adequacy of independence is one of the areas that is reported on routinely at the Convention on Nuclear Safety. In this forum, international challenge to adequacy of the Regulatory independence is the norm. Canada meets the expectations in this area as laid out in the Convention and as judged by this international forum. In addition in 2009 the CNSC was subject to an international review by a team of international experts during an IAEA Integrated Regulatory Review Service (IRRS) mission. The review

found several strengths in the Canadian system of nuclear regulation and found the framework to be well developed. Details are available on the CNSC website. With all due respect to the author, I would suggest that the results of international review by experts in the field of regulation should be strongly considered before making a personal judgement based on what might be a very limited set of facts and experience base.

The last paragraph in this section concludes with the statement; " This letter has yet to receive a reply from these two high-level CNSC managers." I believe it is a true statement that Mr. M. Leblanc responded to the 6 Dec 2010 letter referred to in this paragraph, on 22 Dec 2010, on behalf of the CNSC indicating that the author and the other co-signatures of the 6 December 2010 letter could represent their views on the second day of the Gentilly-2 public hearings. While the statement made in the current draft is not incorrect, it infers that the CNSC did not respond which is incorrect. I would suggest that if the authors' intent is to represent a factual account of the transaction, he should include the full set of facts. Of course, he has the right to state his opinion as to the adequacy of the response, but should not represent the situation as one where the CNSC did not respond.

COMMENT ON THE FAILURE TO RESPOND TO THE 6 DEC LETTER TO CNSC WAITING INFO FROM CNSC

5- Fukushima taught that shutdown can be followed by meltdown

With respect to the issue of decay heat in reactors after shutdown, the reviewers' perspective is that the allegation of the CNSC "not paying sufficient attention to scientific objectivity" is simply unfounded. Discussions around shutdown heat sink requirements and management have featured prominently in many public hearings. Educational institutions have and continue to teach the fundamentals of nuclear energy including management of decay heat. Web sites like the public CANTEACH website have relevant information available to the public. Licensees discuss the concept of decay heat and its management routinely with staff and the public and information is available at information centers. Again the author is entitled to his opinion about the adequacy and effectiveness of public education and information systems, however there is ample data available to indicate a large effort in public awareness has been made.

In the second paragraph it is more technically accurate to describe the sequence of events as one where the Fukushima Daiichi Power Plant shutdown automatically in response to the earthquake and plant emergency systems responded. In fact all of the available emergency diesels (except one that was out of service for maintenance) started. This tended to show plant robustness to the seismic challenge. Disabling of off-site power and the subsequent damage to the Plant and the surrounding communities by the large tsunami was the factor that rendered many plant systems and equipment inoperable. Details are available on the IAEA website that would help the author give a more accurate depiction of the actual sequence of events. As well points 2 and 3 in this section would benefit from being informed with the information that is available publically on the web.

6. April 7th 2008: the CNSC rejects OPG's safety report and criticizes CANDU Technology

While I have not checked the accuracy of the references to correspondence, I will assume them to be correct. The 2008 rejection of the submissions by OPG is indicative that the CNSC demands a high quality of documented safety case to support decisions for life extensions and refurbishments. The OPG submissions were made at a time where the expectations for this type of submission were being established.

The approaches and content of reports referred to in this section, that summarize and categorize CANDU safety issues, have also been subject to international expertise review. The context of the documents was an exercise to ensure that all historical issues were captured, and systematically reviewed as a basis to judge future reactor adequacy. Categorization of the safety significance of the issues was used as a means to determine which issues should receive continuing study and evaluation and which did not need further work. This generated a work program that has served to provide adequate information to resolve several of the issues and this program continues. Status of this work has been reported at public CNSC meetings.

7. Difficult computer control of the neutron cloud

The author is correct in his statements that the control of nuclear reactors is a complex control challenge. CANDU reactors have been controlled by digital control computers very successfully for of the order of 50 years. Performance data on frequency of transients and reactor trips and transients are typically reported on in Licencee Company reports and in CNSC annual reports and can be used as a factual source on which to base comments. The control systems are based on the principles that hardware will fail and human beings will occasionally make mistakes. The designs have a great deal of redundancy and independence in them. The defence in depth principle is used extensively in establishing the requirements. The designs have had many reviews done. Both the reviews and the actual performance indicate that the reactor control systems in CANDU are robust and doing the job extremely well. Any failures are reported and corrective action is taken, even if the failure affects only one of the many layers of defences and redundancies. Operators are trained to shutdown reactors if there is any doubt and the two independent shutdown systems are poised to act if parameters deviate from the envelope of acceptability. The World Association of Nuclear Operators (WANO) conducts PEER reviews at the Stations on a 2 year cycle and monitors for adequacy in performance in reactivity control as well as the CNSC. Many other countries take lessons from the strong performance of the digital control application in CANDU.

The author also refers to change of properties including dimensions due to neutron irradiation. These changes are slow and cumulative effects take a long time. Extensive monitoring and inspection programs are used to confirm physical parameters stay within specifications and take corrective measures should any approach defined limits. I suppose an analogy could be used to help illustrate. As the braking system on your automobile ages, the dimensions of the break-pads change with time. Periodic inspection by the garage mechanic and comparison against technical requirements is done to

ensure that the breaking system remains adequate. The discussion could be made clearer perhaps by separating the issues and addressing them each in turn with technical information.

8. Large-break loss of coolant accident (LBLOCA), narrow safety margins

In the second paragraph of this section, the author makes a statement that “enough thermal energy can be deposited to start a partial core meltdown. Once core components start melting, core cooling functions are impaired and a severe accident could follow. ” . This statement is technically incorrect. CANDU reactors are designed to ensure that in the unlikely event of a LOCA event, either of the two independent, physically separate shutdown systems will act to shut the reactor down before damage to fuel or reactor structures result. Each system must be demonstrated to be fully effective to respond to the power increase that results from the reduced cooling condition should a LOCA occur in order for a plant to be licenced. To be deemed fully effective, the reactor must be able to shown to shut-down safely – without fuel melting.

The author has taken statements from a number of sources and put them together to describe the issue of CANDU void reactivity and margin. This has resulted in the section in the report not fully reflecting the full picture of the void reactivity issue today.

It is true that as the knowledge of the phenomenon of the power pulse after a loss of coolant event improved over time, the estimated power pulse was shown to be larger than originally predicted. As a result, the analysis for such events was redone using the updated information and the large safety margins established as part of the early safety analysis, was predicted to become smaller. Each operating reactor was required to take steps to restore safety margins either by design change or reduction of operating power. The industry was also directed by the CNSC to examine opportunities to further enhance safety margins. In all cases, evidence was presented that showed that the plants were safe to operate.

The CANDU Owners Group published a study in 2007 authored by Dr. Aj Muzumdar and Dr. Dan Menely that showed that part of the prediction portrayed in the analysis was founded on analytical assumptions that, in comparison to those used in other countries, while simple and conservative, were overly conservative and greatly exaggerated the predicted power pulses. For example, to ease analytical modelling, large pipes were assumed to shear in half instantaneously – a physical impossibility. The report demonstrated that if analytical parameters were set that had a physical basis rather than simplifications historically used for ease of analysis or in the absence of scientific information,, the pulses were greatly reduced and estimated safety margins increased substantively. The report also demonstrated that the CANDU reactor met international requirements as laid out in IAEA documents and in the CNSC RD 337 requirements document. It also confirmed the likelihood of this kind of event is controlled to a very low level. Results of the report have been published in papers such as the one presented by Dr. A. Muzumdar and Dr. D. Menely at the Canadian Nuclear Society Conference.

The results outlined in the report have had international scrutiny and of course rigorous review by the CNSC and other international CANDU regulators. At the 5th Convention on Nuclear Safety in Vienna in April 2011, Canada reported on the work on the void reactivity and as a result no actions were assigned to Canada in this area.

Work continues to further optimize the analysis parameters based on solid scientific information. All parties view the current analysis and limits to be appropriate for safe operation while the remaining work is completed.

The author should be aware of the actions taken and the enhancements in insights and knowledge on the subject so that the opinion and picture he portrays is accurate and based on best available information.

9 Dangerous build-up of uranium oxide fuel damage

The statement in this section "Accumulated fuel damage in a pressure tube may impair cooling..." is not contextually correct. Unfortunately, I am not clear from the text in this section, on what point the author is intending to make. Fuel performance in CANDU's has been very reliable. A distinct advantage of the CANDU design with respect to other reactor designs in the area of fuel performance, is that fuel bundles can be and are removed routinely from the reactor routinely during normal operation. Fuel that experiences in service degradation is typically able to be found via monitoring for trace increases in radio-nuclides in the primary coolant. This physical phenomenon is used as a detection means to identify the fuel, so that it can be removed from the core before it's condition has adverse impacts of any significance.

The author makes reference to Generic Action Item 94G02 in this section based on a talk given in October 2010. The author should be aware that this generic action item has been closed for most licensees, indicating satisfactory resolution. I do not have ready access to the status for Hydro Quebec, but I am aware that Hydro Quebec had completed the work on the GAI and had submitted a request for closure to the CNSC some time ago. The aging mechanisms referred to for fuel and pressure tubes are well understood and surveillance program are in place based on CSA standards and CNSC requirements to ensure the aging mechanisms are adequately dealt with.

The author compares pressure tube thicknesses to pressure vessels in other reactor designs. On its own this design difference does not have significance. Pressures and temperatures in the various designs are different. The fuel is different. The powers are different. To draw conclusions, a rigorous review of the various design codes standards and defence in depth approaches would be required.

The author is correct that there was a failure of a pressure tube at Pickering Unit 2 in August 1983. It is important to note that the unit was shut-down safely. The event was contained within the station. The consequences of a pressure tube failure are far different than the rupture of a pressure vessel in a light water design. The scientific information and learning from the event in 1983, 28 years ago, has been

built in to the modern codes and standards that govern operation today and pressure tube reliability in service has been exemplary since that event. Extensive inspection and surveillance programs are in place based on the standards to ensure the tubes are safely operated and changed before aging phenomenon results in degraded performance that encroachs on limits.

10. Aging of equipment and structures

The author does not have a technically sound description of fuel management in this section. Detection systems and methods are in place in CANDU reactors that have been demonstrated to be able to detect fuel sheath failures at a very early stage. Because CANDU reactors can change fuel readily on line, damaged fuel can be removed quickly and replaced with new fuel bundles. So damaged fuel is not left in the core to deteriorate, it is promptly taken out and studied to understand why it failed. This is quite different from light water reactors that use enriched uranium fuel and can only change fuel during extended outages.

The natural uranium fuel used in CANDU is the subject of an extensive quality assurance program for design and manufacture and handling. CANDU fuel has had a very stable design and has had a long track record of good performance. The bundle failure rate is very low.

With respect to the issues highlighted in the section about the ejection of hot molten fuel into the moderator, I think that if the author furthers his research for the paper, he will find that the scientific experiments necessary to disposition this concern have been completed. I believe this GAI has been closed, indicating the results of the experiments were satisfactory both to the Licensees and the CNSC.

The section goes on to discuss uncertainties in `post dry-out ‘ behaviour of fuel. It is important to put this in the correct context. Design of the fast acting shutdown systems in the CANDU are focused on ensuring the shutdown of the plant is sufficiently fast that fuel never gets to this point. The safety assessments on which the plants are licenced show that the likelihood of severe accidents that might take the plant into these conditions are very low. Risk is assessed to be in line with the internationally established safety goals for the plants. Nevertheless, the CNSC continues to expect understanding of the phenomenon in these extreme conditions to be the subject of continuing research targeted at continually improving understanding.

11. Software issues

As highlighted earlier in this review, much has changed since 2009 with respect to the issue of treatment of the LOSS of Coolant events. Review of the subsequent work on several of the areas raised would lead the author to quite a different set of conclusions. Reviews of the appropriateness of the approach to NOP/ROP set-points have been completed and the methods used are concluded to be appropriate. The division between large LOCA events that need to be considered as part of the design basis of a plant has been advanced, bringing approaches used to be more in line with international practices. As highlighted earlier, I believe GAI 95G01 has been satisfactorily resolved and is now closed. Rather than repeat

comments made earlier, I would simply state that this whole section would benefit from being revised to include a more factual assessment based on current information.

The CNSC via RD 360 and other regulatory documents require plants seeking approvals to do life extensions and refurbishments to do extensive assessments and analysis of plants including reviews of plant adequacy against the modern day codes and standards. The approaches are well aligned with international practices.

The approach to the Gentilly-2 licencing decision has been commented on earlier. The allegations made in this section about failure of the CNSC to focus on safety reflect either a lack of understanding of the processes involved or the full context of the decision. Several statements in the section appear to be not based on the available facts and purely speculative in nature. Quite contrary to the views put forward by the author, the reviewers experience has been that the CNSC, is viewed internationally as a strong Nuclear Regulator and has been consistently focused on their mandate – the safety of the facilities they regulate.

Conclusion

In his concluding remarks, Professor Duguay provides his opinion of the risks and performance of the Canadian Nuclear Power Plants. I would agree that the Fukushima event is certainly just cause for extensive reflection and review. I have pointed out that Industry and the CNSC as well as other world organizations responded quickly and prudently in that regard. With respect to performance of the Canadian fleet, one must say that the safety performance has been exemplary. Performance data supports this conclusion.

With respect to the reliability, predictability and economics I suppose depending on your vantage point the facts can be seen as either a cup half full or cup half empty picture. Certainly Ontario has reaped huge benefit from the cheap reliable energy it has received from the grid and the approximately 50% nuclear capacity over the last several decades. It is equally true that CANDU plants outside Canada have performed at higher capacity factors and several are performing among the best in the world. Facts on performance are readily available. I would encourage the author to make best use of them to support whatever perspective he should like to take – to convey an informed, fact based perspective for readers of the paper.

Conclusions about the possibilities of new technologies and re-newables, as stated earlier, fail to seek available facts on which to base the conclusion. A more credible conclusion on adequacy of future supply and appropriateness of energy mix could be crafted using available data and papers from experts in the energy policy field.