Comments on the CNSC Action Plan (INFO-0828) on the CNSC Fukushima Task Force Recommendations

by Gordon Edwards, Ph.D., President, Canadian Coalition for Nuclear Responsibility

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The Canadian Coalition for Nuclear Responsibility (CCNR) respectfully submits the following comments on the CNSC Action Plan.

In general, we find that the CNSC Staff have not shown sufficient imagination in grasping the true dimensions of an unforeseen nuclear catastrophe such as the horrifying sequence of events that took place at Fukushima Dai-ichi reactors number 1, 2, 3, and 4.

The Task Force Report is hampered by a failure to honestly state and elucidate the fact that catastrophic accidents in CANDU reactors are in fact possible and may in fact occur, no matter what precautions are taken ahead of time. The nature of a catastrophic nuclear accident is that it is a totally unforeseen event and hence nothing can be ruled out ahead of time as a possibility. To deny this is to be blind to the lessons of Fukushima.

In order to profit from the lessons of Fukushima, one must begin with a frank admission that nuclear power is inherently dangerous -- as a number of responsible bodies have done in the past. We provide four examples in the appendix.

In the appendix we have included excerpts from the 1978 Report of the Ontario Royal Commission on Electric Power Planning, entitled “A Race Against Time”; from the 1980 Report of the Select Committee on Ontario Hydro Affairs, entitled “The Safety of Ontario’s Nuclear Reactors”; from the 1982 Report by the Department of Energy, Mines and Resources, entitled “Nuclear Policy Review Background Papers”; and from a 1989 submission to the Treasury Board of Canada by the Atomic Energy Control Board, the predecessor of the Canadian Nuclear Safety Commission.

These documents all frankly admit that CANDU reactors can suffer catastrophic failures.

Now is the time for the CNSC to publicly admit that this is the case. The law that established the CNSC does not give it a mandate to provide b;and assurances of safety based on factually incorrect statements. Rather, the CNSC is obliged by law “to disseminate but “to disseminate objective scientific, technical and regulatory information to the public concerning . . . the effects, on the environment and on the health and safety of persons” of licensed nuclear facilities. [Nuclear Safety and Control Act, Article 9(b)].

Yet we read in the Task Force Report that "The main objective in submitting the *Task Force Report* to the public for comment was to assure Canadians that nuclear power plants in Canada are safe and able to withstand the conditions that led to the Fukushima nuclear accident . . . " Here the CNSC is admitting that its main motive is not to arrive at the truth, not to protect the public and the environment, not to disseminate objective information, but to give assurances that nuclear power plants are safe. In our view, this means that this whole exercise is being conducted in bad faith.

Indeed, the sentence quoted above is blatantly incorrect and profoundly misleading. As Dr. Rzentzkowski has publicly admitted (during the recent Point Lepreau licensing hearings held in Saint John) CANDU reactors cannot necessarily "withstand the conditions that led to the Fukushima nuclear accident". On the record, he stated:

> . . . even if we will experience an extremely high magnitude earthquake here in Point Lepreau, approaching the level of that in Fukushima, the reactor will shut down safely; however, there will be some consequences. Definitely, the core will melt. Now the question is, if the molten fuel will be contained in the calandria. Probably not. It may be, but it cannot be guaranteed. So the worst-case consequence would be some level of unfiltered releases [of radioactivity] to the environment after maybe four to five days from the accident. That's the worst-case scenario. . . . which also includes large releases [of radioactivity], because we cannot preclude this if we have a seismic activity of that magnitude.

The Task Force Report has concentrated attention too narrowly on the machinery: equipment maintenance and the potential for equipment failures. While these are undoubtedly important aspects of accident prevention, they do not address the onsite and offsite consequences of an unanticipated catastrophe resulting in core melting, partial or complete containment failure, and massive releases of radioactive materials into the environment. In the absence of such considerations, we are simply not dealing with the lessons of Fukushima.

There is in the Task Force Report no realistic assessment of the sheer magnitude of the problems that will have to be dealt with under catastrophic circumstances. In this document we delineate some of the many aspects that we feel have been overlooked.

(1) CONTAINING RADIOACTIVELY CONTAMINATED WATER

During the Fukushima Dai-ichi accident, enormous volumes of contaminated water were dumped into the ocean adjacent to the plant. Yet the Task Force Report does not even address the question of what might happen with similar huge volumes of contaminated water in the event of an analogous catastrophic accident at a CANDU reactor.

During the Point Lepreau licensing hearings in Saint John it was stated by the licensee that any contaminated water used to reflood the core of a badly damaged CANDU reactor could be recycled – pumped back through the core of the reactor over and over again,

without releasing that water to the outside environment. But is this actually possible? Has CNSC carefully studied this scenario? What about the temperature build-up? What about the debris?

At Fukushima Dai-ichi, recycling water through the core was not possible for a very long time. The debris-clogged water could not be pumped back through the core of the reactor until a special filtration and decontamination system was installed, and that was not accomplished for many months following the accident. In the meantime, there was nowhere to store the filthy contaminated water so it had to be dumped into the nearby receiving waters, which were ocean waters, while the core continued to be flooded with ocean water or fresh water taken from an uncontaminated and unclogged source.

In Canada, an analogous situation would result in large volumes of heavily contaminated water being dumped into Lake Huron, or Lake Ontario, or the St. Lawrence River, or the Bay of Fundy. This would be an environmental catastrophe of the first order. The drinking water for millions of people could be seriously affected, not to mention the contamination of aquatic biota.

Why has the Task Force not even addressed this question? Are there any plans at all to temporarily store huge volumes of debris-filled radioactively contaminated water to prevent it from going into our precious waterways in the event of a catastrophic CANDU accident? If not, why not?

(2) AIRBORNE RELEASES FROM SPENT FUEL POOLS

During the Point Lepreau licensing hearings in Saint John it was admitted by the licensee that uncovering and overheating of the irradiated fuel in a CANDU spent fuel pool could trigger a strongly exothermic chemical reaction between the zirconium cladding and the steam. This would produce both heat -- driving the temperature upwards rapidly -- and hydrogen gas – setting the stage for a possible chemical explosion -- as well as liberating substantial amounts of fission products in the form of gases and vapours. These fission gases and vapours would enter the outside atmosphere relatively easily due to the lack of any carefully designed containment envelope or any sophisticated atmospheric filtration system for the spent fuel pool.

Why has the Task Force not required a negative pressure containment envelope for all CANDU spent fuel pools?

Has CNSC staff even studied the potential unfiltered atmospheric releases from a catastrophic overheating incident in the spent fuel pool? Can CNSC staff provide any assurance that the potential unfiltered atmospheric radioactive releases from a fuel pool overheating may not far exceed the potential unfiltered atmospheric radioactive releases from overheating of the core of the reactor?

(3) ZIRCONIUM FIRES IN SPENT FUEL POOLS

During the Point Lepreau licensing hearings in Saint John the licensee denied the possibility that an actual zirconium fire might take place involving the zirconium cladding of the uncovered and overheated irradiated fuel in a damaged spent fuel pool.

While zirconium is known to be highly pyrophoric and even explosive in a finely divided state – which is why zirconium is used as the combustible material in the old-fashioned "flash cubes" that were popular for cameras in years gone by – it appears that CNSC staff and CNSC licensees are oblivious to the very real possibility of an extremely energetic fire starting in an overheated spent fuel bay – with or without steam – at temperatures close to 1000 degrees C.

This possibility has been studied by the U.S. National Academy of Sciences in their report entitled *Safety and Security of Commercial Spent Nuclear Fuel Storage: Public Report.* In Finding 3B, the authors point out that encountering a "partially or completely drained spent fuel pool could lead to a propagating zirconium cladding fire and the release of large quantities of radioactive materials to the environment. Details are provided in the committee's classified report."

The National Academy's Report, cited above, includes the following recommendations:

> RECOMMENDATION: The Nuclear Regulatory Commission should undertake additional best-estimate analyses to more fully understand the vulnerabilities and consequences of loss-of-pool-coolant events that could lead to a zirconium cladding fire . . . .
>
> RECOMMENDATION: . . . the Nuclear Regulatory Commission should ensure that power plant operators take prompt and effective measures to reduce the consequences of loss-of-pool-coolant events in spent fuel pools that could result in propagating zirconium cladding fires.

It is amazing that the Task Force makes no mention of this important phenomenon. It is alarming that neither the CNSC Staff nor the licensees seem to even regard zirconium fires as a genuine possibility. Surely this hazard requires very close and serious attention.

It should be noted that the heat generated by a self-propagating zirconium fire can be roughly equivalent to the heat load from freshly discharged LWR fuel assemblies, which in turn is considerably greater than the heat load from freshly discharged CANDU fuel bundles. Thus an uncontrolled zirconium fire can drive the temperature of irradiated fuel bundles up very quickly, and may even trigger episodes of fuel melting.

It should also be noted that zirconium fires can also take place in an overheated CANDU core. This possibility should be an important part of the analysis of any severe core damage scenario in CANDU reactors. In this connection it is important to note that there is far more zirconium in the core of a CANDU than in any comparable LWR core.

CORE MELTDOWNS IN CANDU REACTORS – KNOWN FACTS

compiled by G. Edwards Ph.D., President, Canadian Coalition for Nuclear Responsibility

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QUOTATIONS FROM:
The Safety of Ontario's Nuclear Reactors (1980)
by the Select Committee on Ontario Hydro Affairs (Ont. Legislature)

"It is not right to say that a catastrophic accident is impossible . . . . The worst possible accident . . . could involve the spread of radioactive poisons over large areas, killing thousands immediately, killing others through increasing susceptibility to cancer, risking genetic defects that could affect future generations, and possibly contaminating large land areas for future habitation or cultivation."

"The AECB should commission a study to analyze the likelihood and consequences of a catastrophic accident in a CANDU reactor . . . directed by recognized experts outside the AECB, AECL and Ontario Hydro*." [NOTE: this study has never been done]*

QUOTATIONS FROM:
A Race Against Time – Report on Nuclear Power in Ontario (1978)
by the Ontario Royal Commission on Electric Power Planning

"When we talk about the safety of a nuclear reactor, we are referring essentially to how effectively the fantastic amount of radioactivity contained in the reactor core can be prevented from escaping into the ground and atmosphere in the event of major malfunctions."

"Clearly, if a major release of this accumulated radioactivity occurred, as discussed in the previous section, the consequences would be extremely serious and could involve several thousand immediate fatalities and many more delayed fatalities."

"Assuming, for the sake of argument, that within the next forty years Canada will have 100 operating reactors, the probability of a core meltdown might be in the order of 1 in 40 years, if the most pessimistic estimate of probability is assumed."

QUOTATIONS FROM:
Submission to the Treasury Board of Canada (1989)
by the Atomic Energy Control Board (predecessor of the CNSC)

"When modern nuclear power plants were being designed in Canada two decades ago, their complexity and potential for catastrophic consequences were recognized. . . ."

". . . through the combination of a series of comparatively common failures which, on their own, are of little consequence, accidents can develop in a myriad of ways (as demonstrated most vividly at Three Mile Island and Chernobyl). This makes the calculation of consequences of potential accidents very difficult."

"The consequences of a severe accident can be very high. The accident at Chernobyl has cost the Soviet economy about $ 16 billion including replacement power costs. The accident has generated anti-nuclear sentiment in the USSR and throughout the world. Three Mile Island has cost the USA $ 4.8 billion . . . ."

"The likelihood of serious accidents cannot be judged from statistics . . . and CANDU plants cannot be said to be either more or less safe than other types."

QUOTATIONS FROM:
Nuclear Policy Review Background Papers (1982, Report ER81-2E)
by the Dept of Energy Mines and Resources, Government of Canada

"Core meltdown accidents of the type to be described here have never occurred in any commercial power reactor, although the sequence of events at Three Mile Island went partway along the path. Nor has any study on core meltdown accidents been done for the CANDU reactor. . . ."

". . . if the ECCS *[EMERGENCY CORE COOLING SYSTEM]* failed to act, melting of metallic components of the core and eventually

of the uranium oxide fuel itself would probably occur. . . . [or] if the reactor fails to shut down or the decay heat removal systems fail, melting of the core would ensue."

"Much larger consequences could be associated with core meltdowns which also cause failures in the containment structure above ground. If the containment sprays malfunction or are damaged by flying debris (generated by a LOCA *[LOSS OF COOLANT ACCIDENT]* or transient) the steam being released from the reactor core would not be condensed."

"This steam, along with various vapours and noncondensible gases, could cause failure of the containment structure due to overpressurization. Hot zircaloy from the fuel sheaths and steel would also react with water to produce large volumes of hydrogen. Detonation of this hydrogen (reacting with oxygen) might damage the containment or, if not, the heat of combustion combined with high steam pressure would at least add to the pressure loads on the structure."

"A further contributor to containment pressurization would be the large quantities of carbon dioxide generated as the molten core melts through the concrete base slabs. Another possibility is one in which the molten fuel falls into the pool of water in the bottom of the reactor vessel with the formation of flying debris which could, in turn, damage the containment structure. All post-meltdown occurrences which threaten todamage or breach the containment structure can result in the release of substantial amounts of radioactive material to the environment."

"The Reactor Safety Study *[by the U.S. NRC]* calculated the health effects and the probability of occurrence for many possible combinations of radioactive material release magnitude, weather conditions, and population exposure *[see the next page]* . . . . In addition to these health effects, a nuclear accident may contaminate the surrounding area and require relocation of the populace."

SOME BACKGROUND ON:
The Rasmussen Report (1974, "Reactor Safety Study", WASH-1400) by the U.S. Nuclear Regulatory Commission

G.A. Pon, Vice President of AECL Power Projects, said of WASH-1400:

> **"Although the study was prepared in the U.S. assessing the risks associated with their light water nuclear power plants, the findings should not be significantly different for the CANDU reactor."** ***Porter Commission, Exhibit 28 (1977), p.5***

In sworn testimony before the Cluff Lake Board of Inquiry into Uranium Mining in Saskatchewan, Dr. Norman Rasmussen -- the principal author of WASH-1400 -- commented about CANDU meltdown possibilities:

> **"although the Canadian design philosophy differs in some of its approaches . . . it achieves, in my judgment, about the same safety level as far as I can tell."** ***Transcript, Cluff Lake Inquiry, (1977)***

Worst case consequences as reported in WASH-1400 (1974):

45,000 cases of radiation sickness (requiring hospitalization)
3,300 prompt deaths (due to acute radiation sickness)
45,000 fatal cancers (over 50 years)
250,000 non-fatal cancers (over 50 years)
190 defective children born per year after the accident
$14 billion in property damage (1974 dollars; not insurable)

FOR MORE INFORMATION SEE http://ccnr.org