

**Risks, Nuclear Safety,
and the
Ontario Nuclear Safety Review**

Energy Probe's Fourth and Final Submission

to

The Ontario Nuclear Safety Review

by

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Risks, Nuclear Safety, and the Ontario Nuclear Safety Review

Introduction

In this, the fourth and last of Energy Probe's formal submissions to the Ontario Nuclear Safety Review, we present some observations on "Economic consequences and liability of severe nuclear accidents", a discussion of the relationship between low-consequence reactor accidents and catastrophes, and some general observations on past Ontario tribunals on reactor safety, and on the challenge facing the ONSR process.

Executive Summary

Economic consequences of severe nuclear accidents.

We are pleased that the Ontario Nuclear Safety Review has reportedly contracted for a run of the computer model CRAC2 (Calculation of Reactor Accident Consequences, the second generation) to predict the consequences of a severe radiation release at Pickering and/or Bruce.

Whatever else the computer models may indicate, a "worst-case scenario" would clearly involve consequences that would greatly exceed the total liability (i.e., \$75 million) of the risk-makers, leaving victims at the mercy of government agencies, federal Parliament, charitable organizations, family, and friends for whatever emergency assistance they were able and willing to provide. We believe that situation is unfortunate, and are offended by the fact that it is the result not of accident, but of explicit (federal) government action — specifically the passage and proclamation of Nuclear Liability Act.

Liability for severe nuclear accidents: "Industry, Reassure Thyself!"

The entire nuclear-safety issue, in our view, hinges on the issue of liability as a mechanism to inspire the prevention and mitigation of catastrophes — and to test the acceptability of the residual possibility of catastrophe. In simplest terms, as long as the risk-makers in the nuclear industry, public and private, are not made to bear the full consequences of the risks they make, they will unavoidably be artificially, unnecessarily inattentive to preventing and mitigating catastrophes in their facilities, and artificially, unnecessarily slow to reject risks that are, in fact, unacceptable. We have referred to this problem throughout our submission on reactor aging, and we could, as well, have brought it into nearly every page of our submission on the AECB: while we obviously support the call for reform of the AECB, and for vastly increased public participation in regulatory decision-making, we believe that a sine qua non of acceptable safety is risk-maker responsibility. That is, we have never seen a regulator in any arena whose procedures, openness, judgment, and enforcement standards were adequate to serve as a proxy for risk-maker responsibility in a potentially catastrophic field like reactor safety, where the risk makers refuse to be responsible for the consequences of their actions, as do the reactor makers, owners, and operators. The thought that the AECB, as presently constituted, might be such an ideal regulator strains credulity.

The federal Nuclear Liability Act excuses nuclear risk-makers from bearing the full consequences of the risks they make. We do not believe this Review can responsibly avoid commenting on the wisdom of excusing nuclear risk-makers from

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responsibility for their actions. (We believe that it is obviously far more important for the Review to discuss the existence of — and the industry need for — the liability limit than the specific dollar level.)

We further believe that on the subject of catastrophic risks of nuclear reactors, there is no significant disagreement between the nuclear industry and the critical public: neither is willing to accept the risks of reactor catastrophes, presumably because the consequences are unacceptably high and the probabilities are non-zero and avoidable — i.e., because both parties are rational and prudent. The real disagreement is between the prudent industry and the prudent public on the one hand, and the imprudent, pseudo-scientific preachers of "risk, the product of probability times consequence" on the other.

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Further, when the public learns that the risk-makers refuse to bear the full risks they make, because of prudent concern about the same catastrophic accidents that concern the public, it is likely that the public will increasingly refuse to bear those risks.

At the very least, we believe the existence of the Nuclear Liability Act presents a fundamental challenge to this Review: At the end of the day, the Review will be called upon (like SCOHA and RCEPP before it) to declare whether or not Ontario's CANDU nuclear reactors are safe enough to continue to operate.

Obviously, a declaration that they are not safe enough to continue to operate — if pursued into policy action — would lead logically to the shutdown of Ontario Hydro's nuclear stations, at least until they were made safe enough to operate. Such a shutdown, in today's Ontario (and even more so in tomorrow's) would carry with it an enormous price tag in lost output from many billions of borrowed dollars of investment. Worst, the benefits of this enormous expense could never be proved.

We simply cannot see how any conclusion can be credible that asserts the "acceptability" of a risk that will not be accepted by those who are most aware of the exact nature of the risk — and who profit by making the stations that create the risk. To put it baldly, if GE, Westinghouse, and Ontario Hydro refuse to stand behind their product (as they do), only a fool would be willing to stand in front of it. We do not believe that the people of Ontario are such fools. Can the Ontario Nuclear Safety Review declare the risks acceptable while these actors, by their actions, declare them unacceptable?

A critical analysis of the relationship between low-consequence reactor accidents and catastrophes

The Canadian regulatory approach to reactor design and operation (and, to a lesser extent, siting) routinely allows the licensee to ignore accidents forecast to recur below a certain arbitrary frequency, regardless of their consequences. It is important to note that this approach, however convenient it is and however sensible it sounds, is one whose validity simply cannot be established as fact.

In fact, the evidence to date suggests that operationally reliable stations may actually be more prone to catastrophic failures than less reliable stations! For example, Three Mile Island Unit 2 and its twin Unit 1 were consistently among the U.S. leaders in availability and annual capacity factor. Similarly, the RBMK design of Chernobyl has consistently been among the top world performers in

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operational reliability. And Chernobyl-4 ran the best of all the RBMK-1000 reactors. In fact, even in Canada, the most costly accident — on August 1, 1983 at Pickering Unit 2 — occurred at one of our most "reliable" units.

While the experience to date is more anecdotal than statistically significant, it at least suggests that concentrating on operational reliability — i.e., the avoidance of small mishaps — as a means to avoid catastrophic accidents may be misguided. Of course, the luxury of ignoring potential and (distant) actual catastrophes, as the Canadian nuclear industry and its regulator clearly do, is the reserve of those who are not responsible for the catastrophic harm they create.

The Risks Facing the Ontario Nuclear Safety Review

Past Ontario Nuclear Reviews — The Sorry Record.

One of the unfortunate realities facing the Ontario Nuclear Safety Review, and all non-nuclear-industry participants in the Review, is the simple and inescapable history of Ontario-government-sponsored reviews of Ontario Hydro and of Ontario Hydro's nuclear policies in particular. In short, many sensible and overdue recommendations have been made — some recommendations that would directly improve the safety of Ontario's nuclear reactors and others that would significantly increase public access to information and decision-making in this field. Both changes would, in our opinion, indirectly improve the safety of Ontario's nuclear reactors.

Alas, the vast majority of these recommendations have been ignored by the Ontario Government, Ontario Hydro, AECL, the AECS, etc., despite the lengthy hearings, discussions, and cross-examinations that led to these recommendations. They have primarily gathered dust on library shelves. It will be a challenge to the Ontario Nuclear Safety Review to influence nuclear safety in Ontario more effectively than its predecessors.

Whatever changes to the nuclear-safety status quo the ONSR decides to recommend, it must take notice of the sorry records of its predecessors and take steps to maximize the effectiveness of its recommendations. Failure in this crucial task will render all the Ontario Nuclear Safety Review's other successes academic in every sense of the word, and will constitute a disservice to the participants and especially to the public as a whole, which bears the brunt of the risk of nuclear catastrophes, and does so increasingly unwillingly.

1. The Risks of Nuclear Reactor Accidents

1.1 Economic consequences of severe nuclear accidents.

We are pleased that the Ontario Nuclear Safety Review has reportedly contracted for a run of the computer model CRAC2 (Calculation of Reactor Accident Consequences, the second generation) to predict the consequences of a severe radiation release at Pickering and/or Bruce. We note that predictions done for the U.S. Nuclear Regulatory Commission (USNRC) have shown consequences varying very strikingly from site to site in the extent of property damage and the number of "prompt [i.e., first-year] fatalities", and varying less strikingly in the number of delayed fatalities.¹ For the largest release contemplated — known as SST1 — combined with the least favourable weather pattern (contaminated rain over a nearby city), the US results ranged as follows, from "best" site to "worst":

Prompt fatalities:	173 to	102,000
Early injuries:	3130 to	610,000
Cancer deaths:	3180 to	40,000

We will not venture to predict the results of that computer run, except to indicate that (1) Based on population densities, we would expect the consequences of a release at Pickering (and less so at Bruce) to be much nearer the high end of consequences in the USNRC study than the low end, and (2) We would expect those predicted consequences (assuming a source term comparable to USNRC's SST1 and least favourable weather patterns) to be catastrophically large, and likely to lead (in the absence of legal or economic barriers) to successful claims for injury, death, property damage, loss of income, suffering and anguish, etc., in the range of billions of dollars, if not tens, hundreds, or thousands of billions of dollars.²

Whatever else the computer models may indicate, it is undeniable that a "worst-case scenario" would clearly involve consequences that would greatly exceed the total liability (i.e., \$75 million) of the risk-makers, leaving victims at the mercy of government agencies, federal Parliament, charitable organizations, family, and friends for whatever emergency assistance they were able and willing to provide. We believe that situation is unfortunate, and are offended by the fact that it is the result not of accident, but of explicit (federal) government action — specifically the passage and proclamation of the Nuclear Liability Act.

1.2 Liability for severe nuclear accidents: *"Industry, Reassure Thyself!"*

1.2.1 *The relationship of risk-maker liability and responsibility to the avoidance and containment of catastrophes*

The issue of liability as a mechanism to recompense victims of nuclear accidents after the fact, as interesting as it is, is not one that Energy Probe would like to discuss as part of this Review. On the other hand, to us, the entire nuclear-safety issue hinges on the issue of liability as a mechanism to inspire the prevention and mitigation of catastrophes — and to test the accept-

ability of the residual possibility of catastrophe. In simplest terms, as long as the risk-makers in the nuclear industry, public and private, are not made to bear the full consequences of the risks they make, they will unavoidably be artificially, unnecessarily inattentive to preventing and mitigating catastrophes in their facilities, and artificially, unnecessarily slow to reject risks that are, in fact, unacceptable. We have referred to this problem throughout our submission on reactor aging, and we could, as well, have brought it into nearly every page of our submission on the AECB: while we obviously support the call for reform of the AECB, and for vastly increased public participation in regulatory decision-making, we believe that a *sine qua non* of acceptable safety is risk-maker responsibility. That is, we have never seen a regulator in any arena whose procedures, openness, judgment, and enforcement standards were adequate to serve as a proxy for risk-maker responsibility in a potentially catastrophic field like reactor safety, where the risk makers refuse to be responsible for the consequences of their actions, like the reactor makers, owners, and operators. The thought that the AECB, as presently constituted, might be such an ideal regulator strains credulity.

Energy Probe and others (The Corporation of the City of Toronto and eleven individuals, including ten prominent scientists and one retired insurance executive who served also as Deputy Reeve of Pickering) are currently challenging the constitutionality of the federal Nuclear Liability Act, which excuses nuclear risk-makers from bearing the full consequences of the risks they make. It is of course not our intent to ask this Review to comment on the legality of that Act, nor would it be appropriate for the Review to do so. However, we do not believe this Review can responsibly avoid commenting on the wisdom of excusing nuclear risk-makers from responsibility for their actions. (We believe that it is obviously far more important for the Review to discuss the existence of — and the industry need for — the liability limit than the specific dollar level.)

1.2.2 The relationship of risk-maker liability and responsibility to risk acceptance by the public

We further believe that on the subject of catastrophic risks of nuclear reactors, there is no significant disagreement at all between the nuclear industry and the critical public: neither is willing to accept the risks of reactor catastrophes, presumably because the consequences are unacceptably high and the probabilities are non-zero and avoidable — i.e., because both parties are rational and prudent. The real disagreement is between the prudent industry and the prudent public on the one hand, and the imprudent, pseudo-scientific preachers of "risk, the product of probability times consequence" on the other.³

Further, when the public learns that the risk-makers refuse to bear the full risks they make, because of prudent concern about the same catastrophic accidents that concern the public, it is likely that the public will increasingly refuse to bear those risks.

1.2.3 The relationship of risk-maker liability and responsibility to the challenges faced by the Ontario Nuclear Safety Review

At the very least, we believe the existence of the Nuclear Liability Act presents a fundamental challenge to this Review: At the end of the day, the Review will be called upon (like SCOHA and RCEPP before it) to declare whether or not Ontario's CANDU nuclear reactors are safe enough to continue to operate. Obviously, a declaration that they are not safe enough to continue to operate —

if pursued into policy action — would lead logically to the shutdown of Ontario Hydro's nuclear stations, at least until they were made safe enough to operate. Such a shutdown, in today's Ontario (and even more so in tomorrow's) would carry with it an enormous price tag in lost output from many billions of borrowed dollars of investment. Worst, the benefits of this enormous expense could never be proved. (Imagine an official in the Ukraine ordering the shutdown of the Chernobyl station before — and instead of — the accident.) On the other hand, a proclamation that the reactors are safe enough (perhaps coupled with recommendations for improvements in several areas) contains no such immediate price tag, is far more consistent with the *status quo*, and — especially given that all parties agree that catastrophic accidents are relatively infrequent events — is likely to be subjected to far less scrutiny.

In other words, a recommendation for a continuation of today's nuclear policies, with or without some reforms, will obviously be subjected (especially by the nuclear industry and two levels of government) to a much lower "burden of proof" than a recommendation that the Ontario government refuse, on its citizens' behalf, to accept the risks of the continued operation of the CANDU reactors.

Yet, any other conclusion — i.e., any conclusion that claims that the risks of continued CANDU operation is acceptable — must surely explain how those risks can be acceptable to the potential victims of a nuclear catastrophe, yet completely and absolutely unacceptable to the industry — private and public alike — that creates the risk. We simply cannot see how any conclusion can be credible that asserts the "acceptability" of a risk that will not be accepted by those who are most aware of the exact nature of the risk — and who profit by making the stations that create the risk. To put it baldly, if GE, Westinghouse, and Ontario Hydro refuse to stand behind their product (as they do), only a fool would be willing to stand in front of it. We do not believe that the people of Ontario are such fools, although we acknowledge that only a small minority of them presently know of the existence and nature of the Nuclear Liability Act, or know that the large multi-national companies that build reactors and reactor components throughout the Western world (GE, Westinghouse, Babcock & Wilcox, Combustion Engineering, etc.) have always required complete absolution from all responsibility for nuclear accidents as a condition of that involvement. Can the Ontario Nuclear Safety Review declare the risks acceptable while these actors, by their actions, declare them unacceptable? In our view, the actions of the reactor makers indicate that in their view the residual risk of a catastrophe at a CANDU reactor, after all the safety systems are installed and tested, is simply too great for a prudent company to accept. We agree with their view in this regard, and we will not willingly accept the risk of nuclear reactor catastrophes until the makers and owners of the reactors (or their insurers) accept the financial equivalent of that risk.

1.3 A critical analysis of the relationship between low-consequence reactor accidents and catastrophes.

As outlined in other sections of our submission, the Canadian regulatory approach to reactor design and operation (and, to a lesser extent, siting) routinely allows the licensee to ignore accidents forecast to recur below a certain arbitrary frequency, regardless of their consequences. For example, "triple-mode failures" have never been analyzed for Canadian designs. The regulatory requirements for Darlington and later reactors include a more probabilistic cutoff, below which accidents simply need not be analyzed.

This approach is obviously convenient to the analysts, as it avoids a great deal of relatively speculative analysis of relatively unlikely accidents, some of which could obviously have catastrophic consequences — and some of which may well occur. It is also apparently justified in the regulatory literature by the premise that — since every catastrophe presumably begins with or includes one or more minor accidents — a sensible way to avoid catastrophes is to avoid (and/or contain) minor accidents.

It is important to note that this approach, however convenient it is and however sensible it sounds, is one whose validity simply cannot be established as fact, given the nuclear industry's lack of significant statistics on catastrophic accidents.

It is also important to compare this convenient approach to avoiding catastrophes with the more straightforward alternative approach, of avoiding catastrophes by avoiding catastrophes — i.e., by studying them in detail and preventing their occurrence or mitigating their consequences.

In this connection, it is certainly striking that the evidence to date suggests that operationally reliable stations may actually be more prone to catastrophic failures than less reliable stations! For example, Three Mile Island Unit 2 and its twin Unit 1 were consistently among the U.S. leaders in availability and annual capacity factor.⁴ Similarly, the RBMK design of Chernobyl has consistently been among the top world performers in operational reliability. And Chernobyl-4 ran the best of all the RBMK-1000 reactors.⁵ In fact, even in Canada, the most costly accident — on August 1, 1983 at Pickering Unit 2 — occurred at one of our most "reliable" units.⁶

While the experience to date is more anecdotal than statistically significant, it at least suggests that concentrating on operational reliability — i.e., the avoidance of small mishaps — as a means to avoid catastrophic accidents may be misguided. Although the record is incomplete, and the relationships complex and unpredictable, there are several factors that make an inverse relationship plausible, between "routine safety" and "catastrophic safety":

- In most catastrophic and near-catastrophic accidents to date, human error has been implicated at least in part. A plant's high routine reliability may foster an attitude that is less prudent than in a plant that breaks down more frequently. At Chernobyl, in fact, it would seem that the station's operational reliability led in at least two different ways to the operating staff behaviour that precipitated the accident: (1) Generally, the staff seems to have had such faith in the inherent reliability of the plant that they were not alarmed early enough; and (2) Specifically, the pressure to get the test finished was compounded by the expectation that the station's high reliability would make another outage (and another opportunity for the test) unlikely for another year and a half.
- It is at least conceivable that the practice and experience of minor failures may lead to lessons that make catastrophes less likely. For example, a minor accident at the operationally unreliable Davis Besse plant taught its staff about a problem with control-room reporting of water flow through the pressurizer — a lesson that staff at TMI did not learn until too late.
- Because a nuclear reactor is most at risk of LOCA, LOR, fuel failure, fuel

melting, etc., when operating at full power — and is least at risk when in protracted cold shutdown — "reliable" stations spend more time at risk of major accidents than "unreliable" stations. By analogy, a car that won't start is not likely to be involved in a head-on collision!

The chemical industry's response to Bhopal — largely prompted by liability for catastrophic releases — would seem to be more subtle, more direct, and more fruitful in many ways than the nuclear industry's response to TMI and Chernobyl — largely prompted by regulation and public inquiries. For example, while at least the larger chemical companies have embarked upon important campaigns to limit the hazardous inventories at their plants (a direct attack on the consequence of the worst accident that can occur at the plant), the nuclear industry in Canada has spent most of its efforts reassuring itself, the government, and the public, that it had nothing to learn in the first place.⁷

Even where improvements have been made in CANDU safety design over the years, they have never been in areas of safety as fundamental as reduction of toxic inventories. In fact, they have almost always been primarily in the area of probability improvements rather than consequence improvements — as if Dow and Union Carbide had responded to Bhopal by installing more computers or thicker-walled tanks.

It would appear that the luxury of ignoring potential and (distant) actual catastrophes, as the Canadian nuclear industry and its regulator clearly do, is the reserve of those who are not responsible for the catastrophic harm they create. Even so, there are interesting differences between the Canadian approach and, for example, the U.S. approach, where the regulator has long taken much more interest than the AECB in the consequences of catastrophic releases of large fractions of the inventory of volatile radionuclides in a reactor core.

It is of course not easy to establish that an alternative approach to catastrophe aversion would actually mean changes in hardware or procedures, and it is far more difficult to prove that the alternative would actually be safer. Yet it would at least seem noteworthy that, between the U.S. and Canada, the country that does less analysis of catastrophic radiation releases is also the country with the smaller emergency planning zones and less elaborate emergency planning, and the hundred-fold lower liability limits for accidents.

It is obviously beyond the scope of this analysis to probe the relationship between the safety approach taken and the public-relations image of the industry. It would appear logical that a public airing of projections of nuclear catastrophes and emergency measures to be taken in response would raise public concerns and decrease public acceptance of the reactors that carry the threat. Yet it is interesting to see that Ontario's Emergency Planning Office suggests, in recent documents, that the relationship may go in the opposite direction.⁸

In either case, we are offended by the appeal to the public-relation needs of the nuclear industry in a discussion about nuclear emergency planning. Whether better preparedness is judged to be good P.R. or bad, should not, in our view, influence the availability of warning sirens, Potassium Iodide pills, or an evacuation zone at least as large as Chernobyl's. When these factors are being weighed behind closed doors by a group of individuals (i.e., Working Group #8 — more at p.7) much more representative of the needs of the nuclear industry than the needs of the population at risk from nuclear reactors, we despair of seeing anything legitimate come out of the exercise.

2. The Risks Facing the Ontario Nuclear Safety Review

2.1 Past Ontario Nuclear Reviews — The Sorry Record.

One of the unfortunate realities facing the Ontario Nuclear Safety Review, and all non-nuclear-industry participants in the Review, is the simple and inescapable history of Ontario-government-sponsored reviews of Ontario Hydro and of Ontario Hydro's nuclear policies in particular. In short, many sensible and overdue recommendations have been made — some recommendations that would directly improve the safety of Ontario's nuclear reactors and others that would significantly increase public access to information and decision-making in this field. Both changes would, in our opinion, indirectly improve the safety of Ontario's nuclear reactors.

Alas, the vast majority of these recommendations have been ignored by the Ontario Government, Ontario Hydro, AECL, the AECB, etc., despite the lengthy hearings, discussions, and cross-examinations that led to these recommendations. They have primarily gathered dust on library shelves. Secondarily, they have been quoted in part by both sides of the nuclear debate — perhaps most frequently by the nuclear industry and government, who quote primarily the conclusion that Ontario's nuclear reactors were safe enough to keep running. The rest of their findings and recommendations have served only to strengthen the arguments of those who would criticize the nuclear status quo — but those arguments were already strong enough to lead the tribunal to make these recommendations for change, over the less convincing objections of the guardians of the nuclear status quo: the Ontario Government, Ontario Hydro, the AECB, etc. It will be a challenge to the Ontario Nuclear Safety Review to influence nuclear safety in Ontario more effectively than its predecessors.

In this context, it is illustrative to review some of the more important unimplemented recommendations from earlier tribunals, especially (1) RCEPP — the Royal Commission on Electric Power Planning (also known as the Porter Commission) — final report published February 1980 (88 recommendations, including 28 on Nuclear Power, 10 on Decision-Making, and many that would affect the need for nuclear generating capacity), and (2) SCOHA — the Select Committee on Ontario Hydro Affairs, *Final Report on The Safety of Ontario's Nuclear Reactors*, published June 1980 (24 recommendations). Also worthy of attention (although non-governmental) is the brief and thoughtful November 1985 *Final Report* of IPPANI — the *Interfaith Program for Public Awareness of Nuclear Issues* — especially pp. 1-17: "Week I: Report of the Panel: Canada's Domestic Nuclear Issues".

2.1.1 Ontario Government Responsibilities

Fortunately, many areas where nuclear-energy policies can be improved are in the domain of the Ontario provincial government, which has sponsored the Ontario Nuclear Safety Review. Of the unfulfilled recommendations that the Ontario government could itself implement, the following are among the most important and relevant:

■ A new division [of Ontario Hydro] devoted exclusively to nuclear power safety, ... should be established." (Royal Commission on Electric Power Planning [RCEPP], recommendation 5.2.

Simply never done.

■ "All aspects of contingency planning should be assessed in the light of the experience at Three Mile Island [not to mention Chernobyl], and a comprehensive plan for each nuclear facility should be made publicly available. The public must be aware of these plans, which must be rehearsed regularly if they are to be credible.... (RCEPP, recommendation 5.10.)

Some plans of course do exist, but they are grossly inadequate, not readily available, and not regularly rehearsed with the public. They are still prepared and reviewed by nuclear-energy insiders, rather than by those whose responsibilities are first for public health and safety.⁹ Like the AECB, the Working Group has (for the first time ever) asked for submissions from the public, but will, as usual, meet in private.

One anecdote: An earlier Working Group recommended over two years ago to Ontario's Emergency Management Office that potassium iodide pills (useful in reducing biological uptake of radioactive iodine, if taken within three or four hours of exposure) be distributed to Pickering residents in advance of an accident, just in case. (At present, they are stored in bulk for distribution after an accident begins.) Ontario Hydro responded with a report¹⁰ that claimed that the theoretically estimated probability of needing the pills was so low that pre-distribution of the pills could not be justified. The E.M.O. decided against pre-distribution. (For more comments on emergency planning, see Energy Probe's submission on the subject.)

■ The (federal) Atomic Energy Control Board, or, failing that, The Province of Ontario, should "commission a study to analyze the likelihood and consequences of a catastrophic accident in a CANDU reactor. The study should be directed by recognized experts outside the AECB, AECL and Ontario Hydro." (Select Committee on Ontario Hydro Affairs [SCOHA], recommendation X.)

In arguing for such a study (against the nuclear industry and the AECB), the Select Committee referred specifically to "the public's need to know the risk it is accepting in allowing nuclear power plants to operate in Ontario." (SCOHA, p.36.) It is Energy Probe's hope that some of the research commissioned by the Ontario Nuclear Safety Review will effectively fulfill this unfulfilled recommendation, more than seven years after it was made.

■ "A council should be formed by the Government of Ontario with given terms of reference and representation from within and outside the nuclear establishment to provide an institutional forum for public participation and a focus for concerns about radiation problems in Ontario, to build up Ontario-based technical knowledge and to oversee as much epidemiological work as is necessary to decide what the standards should be for the health and safety of people in Ontario.

"The council should review particular problems of radiation associated with operating or planned reactors, independent of Ontario Hydro and the Ontario Government. The council should work toward the establishment of a Federal-Provincial working group to coordinate the national standards with the work and findings of the provincial group. The powers of the council should be that of making independent and public recommendations to an appropriate minister." (SCOHA, recommendation III)

"One of the first tasks the council should take on and give high priority to is an independent review of the adequacy of current proposed release limits for

Carbon-14 and Tritium, taking into account both local and global concerns."
(SCOHA, recommendation IV)

No Council has been established, no Federal-Provincial Working Group, no independent review.

NB: While this recommendation has languished unimplemented for over seven years, it recommends an interesting policy initiative at the *Provincial* level to correct a perceived failing of the *Federal* regulatory regime.

2.1.2 *Federal Government Responsibilities*

For the following areas where nuclear-energy policies can be improved, the key arena is the **Federal government**. However, it must be noted that the Ontario government has a number of means available to control Ontario Hydro, if it chooses, and no nuclear power plant in Ontario can operate without Ontario Hydro. In other words, each Federal reform could, if the Province chose, be made a **Provincial** requirement for (for example) Ontario Hydro to continue operating its nuclear plants.

■ See above for SCOHA recommendation X, for a study to analyze the likelihood and consequences of a catastrophic accident in a CANDU reactor.

■ "The Government of Canada should ensure the separation of the promotional and regulatory aspects of nuclear power ... as a matter of the highest priority. This would ensure that the Atomic Energy Control Board and Atomic Energy of Canada Limited would report to separate ministers, thereby avoiding public confusion and possible conflicts of interest of the sort that have in the past strained public confidence in the regulatory process." (RCEPP, recommendation 5.27.)

■ "The AECB should report to the house of commons through a minister other than the minister responsible for AECL [Atomic Energy of Canada Limited]." (SCOHA, Recommendation XXI)

The problem here is simply that the agency responsible for preserving the health of the public from radiation and nuclear accidents reports to the Minister of Energy, Mines & Resources, who is responsible for preserving the health of the nuclear industry. The conflict is clear, and could be remedied by making the AECB report to either the Minister of Environment or the Minister of Health.

The November 1985 report by the *Interfaith Program for Public Awareness of Nuclear Issues* echoes this recommendation. In fact, the IPPANI report suggests further that the *setting* of standards and the *enforcement* of standards should also be separated into two separate agencies, reporting to two separate ministers [*ibid.*, pp. 6f].

■ "The Atomic Energy Control Board should expand its membership to include a broad representation of the general public as well as members of the scientific and technical community." (RCEPP, recommendation 5.28.)

■ "The AECB [Atomic Energy Control Board] should broaden its membership to include representation from the general public as well as the informed technical community." (SCOHA, Recommendation XIX)

In addition to criticizing the AECB's membership (too technical and narrow), the Select Committee criticized the AECB's role (too limited), its secrecy (too great), its powers (too few), its procedures (too cozy and open-ended), and its staffing (too narrow and limited).

Two reports recently prepared for the Nielsen Task Force on the AECB have also recommended broadening the membership of the AECB. Both reports specifically recommend the inclusion of full-time members representing "industry, labour, and public interests." Although we have not read the reports, it is certainly not clear that representation from industry (assuming that means the nuclear industry) is appropriate.

■ "The AECB should make its proceeding of decision more widely known. its meetings should be open to the public unless there is a reason for keeping one closed." (SCOHA Recommendation XXII)

No AECB meeting has ever been open to the public. Minutes of meetings have recently been released in extremely limited circulation, only after a determined two-year effort under Access to Information. And the AECB has made it plain that current minutes will contain less specific information than the earlier ones, which were never intended for public distribution.

■ "The rules under which the Board operates, including specific licensing criteria, should be the subject of public hearings when formulated or changed. The AECB should have general powers of interpretation and the power to grant exemptions. Interpretations and exemptions must, however, be publicly explained in a timely manner in the Board's reasons for a particular decision." (SCOHA, Recommendation XXIV)

The AECB has never held a public hearing. Further, the AECB, unlike most regulatory agencies, has never issued "Reasons for Decisions" documents concerning any of its rules, criteria, standards, or licensing decisions.

2.2 Recent Experience: What if they made recommendations and nobody cared?

As indicated above, the foregoing is a small and somewhat arbitrary selection of important recommendations from a much larger set of unimplemented recommendations, most of them still capable of improving nuclear safety in Ontario.

It is perhaps not too obvious to mention that the Ontario government that established this Ontario Nuclear Safety Review had over two years to implement some of the foregoing recommendations, and, to our knowledge, implemented none. Along those lines, it is also notable that in establishing this Ontario Nuclear Safety Review, and permitting the completion of the Darlington Nuclear Generating Station, the Ontario government adopted a total of two (2) of the twenty-six (26) recommendations of the all-party Select Committee on Energy (SCE), which spent a great deal of time and effort weighing the substantial submissions of Ontario Hydro and others on issues related to "A Balanced Electricity System". Several recommendations, if implemented, would limit the number of nuclear reactors operating in the Province, thus influencing the safety of the province from nuclear catastrophes. Aside from the direct and indirect relevance to nuclear safety of SCE's recommendations, the fact that the Ontario government adopted less than 8% of its recommendations must give this Review and its participants pause.

Whatever changes to the nuclear-safety status quo the ONSR decides to recommend, it must take notice of the sorry records of its predecessors and take steps to maximize the effectiveness of its recommendations. Failure in this crucial task will render all the Ontario Nuclear Safety Review's other successes academic in every sense of the word, and will constitute a disservice to the participants and especially to the public as a whole, which bears the brunt of the risk of nuclear catastrophes, and does so increasingly unwillingly.

Notes

¹For a clear and accurate report of the studies and their background, see "The Consequences of a Nuclear Reactor Accident" in Union of Concerned Scientists' *Nucleus*, Vol. 4, No. 4, Winter 1983. The official reports (cited in the above) are NUREG/CR-2239 = SAN81-1549 on human consequences, and NUREG/CR-2723 = SAND82-1110 on financial consequences.

²For a thoughtful discussion of some consequences not adequately quantified in the aforementioned studies or adequately dealt with by current emergency measures, see "Consideration of Resource Privation by Severe Reactor Accidents", by T.E. McKone, J.M. Griesmeyer, and W.L. Baldewicz, in *Nuclear Safety*, Vol. 25, No. 4, July-August 1984, pp. 472-482.

³For a further development of this point of view, and an analysis of the contradictions and imprudence that flow from the linear and so-called "rational" model of risk espoused by nuclear-industry spokespeople (but not followed by their companies), see "Probability Times Consequence: Rational and Scientific, or Just Imprudent?" forthcoming in *Energy Alternatives: Benefits and Risks*, H.D. Sharma, ed., Waterloo: University of Waterloo Institute for Risk Research, 1987.

⁴A 1975 ad, by Gilbert Associates, Inc., architect/engineer of TMI, has acquired an unintended macabre humor since it was written: **"THREE MILE ISLAND UNIT 1: PERFORMANCE TO BE PROUD OF. You've heard about the real and imagined ills of nuclear power plants. Some of it's true; a lot isn't. We'd like you to hear about one of those nuclear plants that doesn't make the news — a smooth-running station. —"** At the end of 1978, Three Mile Island ranked 13th in the Western world (and 5th in the U.S.) in lifetime capacity factor. *World power reactor performance*, Ontario Hydro flier, June 1979

⁵See, for example, B.A. Semenov, "Nuclear power in the Soviet Union", in *International Atomic Energy Agency Bulletin*, Vol. 25, No. 2, June 1983, esp. Table 4 — Operating results of RBMK-1000 reactors — and corresponding text.

⁶Pickering-2 had been Canada's most reliable CANDU until Bruce-3 and -4 started up. At the end of 1982, Pickering-2 was still 4th in the Western world and 3rd in Canada in lifetime capacity factor. *World power reactor performance*, Ontario Hydro flier, April 1983. Pickering-2 also reportedly held the world record for longest period at full power, and was close to breaking its own record when the pressure tube ruptured.

⁷In addition to newspaper articles and television interviews by industry officials stressing the "It can't happen here" angle, see, for example, the more technical *Chernobyl — A Canadian Perspective*, by V.G. Snell and J.Q. Howieson (AECL Candu Operations, December 1986).

⁸ For example, in F.B. Ali, *Chernobyl: A Report on the Accident and its Implications* (E.P.O. February 1987), the author suggests that poor emergency planning — like that at Three Mile Island, in his view — "can practically strangle the whole industry. That is a risk that Ontario cannot afford to take." (p. 14) Similarly, the Terms of Reference of Working Group #8 suggest that public acceptance of nuclear energy will increase as emergency preparedness increases.

⁹ For example, Working Group #8, recently established to review some aspects of current nuclear-emergency plans, consists of six members, at least four of whom fall clearly within the pro-nuclear fringe of Canadian society: One each from the Ontario Ministry of Labour, Ontario Hydro, Atomic Energy of Canada Limited, and the Atomic Energy Control Board; one — the author of the current inadequate plan — from Emergency Planning Ontario; and the sixth member and chairman, a University of Toronto Professor of great distinction whose heroic public support for nuclear power and his open scorn for public concerns about radiation releases from nuclear generating stations have, in our view, compromised his ability to represent the public in the forum of Working Group #8.

¹⁰ *The Assessment of Radiation Dose to the Public Arising from Postulated Accidents at Pickering NGS as an Input to Emergency Planning*, Report No. 85088, Ontario Hydro, Design and Development Division, Nuclear Studies & Safety Department, February 1985.

1. The Risks of Nuclear Reactor Accidents

1.1 Economic consequences of severe nuclear accidents.

We are pleased that the Ontario Nuclear Safety Review has reportedly contracted for a run of the computer model CRAC2 (Calculation of Reactor Accident Consequences, the second generation) to predict the consequences of a severe radiation release at Pickering and/or Bruce. We note that predictions done for the U.S. Nuclear Regulatory Commission (USNRC) have shown consequences varying very strikingly from site to site in the extent of property damage and the number of "prompt [i.e., first-year] fatalities", and varying less strikingly in the number of delayed fatalities.¹ For the largest release contemplated — known as SST1 — combined with the least favourable weather pattern (contaminated rain over a nearby city), the US results ranged as follows, from "best" site to "worst":

Prompt fatalities:	173 to	102,000
Early injuries:	3130 to	610,000
Cancer deaths:	3180 to	40,000

We will not venture to predict the results of that computer run, except to indicate that (1) Based on population densities, we would expect the consequences of a release at Pickering (and less so at Bruce) to be much nearer the high end of consequences in the USNRC study than the low end, and (2) We would expect those predicted consequences (assuming a source term comparable to USNRC's SST1 and least favourable weather patterns) to be catastrophically large, and likely to lead (in the absence of legal or economic barriers) to successful claims for injury, death, property damage, loss of income, suffering and anguish, etc., in the range of billions of dollars, if not tens, hundreds, or thousands of billions of dollars.²

Whatever else the computer models may indicate, it is undeniable that a "worst-case scenario" would clearly involve consequences that would greatly exceed the total liability (i.e., \$75 million) of the risk-makers, leaving victims at the mercy of government agencies, federal Parliament, charitable organizations, family, and friends for whatever emergency assistance they were able and willing to provide. We believe that situation is unfortunate, and are offended by the fact that it is the result not of accident, but of explicit (federal) government action — specifically the passage and proclamation of the Nuclear Liability Act.