

# CCNR Final Submission to JRP -- by Gordon Edwards

## 1. Endorsing Abandonment

The Canadian Coalition for Nuclear Responsibility (CCNR) believes that nuclear power is an immature technology because we still do not have a clearly safe permanent solution to the nuclear waste problem. We know how to package it safely for extended periods. But we do not know how to get rid of it.

In the final analysis, “disposal” of nuclear waste simply means “abandonment”. The “Deep Geologic Repository” or DGR is destined to become a “Deep Underground Dump” or DUD. The Joint Review Panel is being requested by OPG and CNSC Staff to approve the DUD – that is, to recommend the perpetual abandonment of all the nuclear wastes from 20 power reactors (except for irradiated fuel) in a Deep Underground Dump.

If the project is approved, the industry and the regulator can wash their hands of the pesky problem of perpetual management of the wastes by decreeing that no management is required in the DUD, even though the wastes remain radiotoxic for hundreds of thousands or millions of years. These bodies cannot justify abandonment if the wastes are stored as they are at present, in the Western Waste Management Facility.

Abandonment means “forget about it”. Management means “look after it”. Once the regulator gives OPG a “licence to abandon”, OPG is permitted to turn its back on the problem. It is no longer OPG’s problem; if it is still a problem, it is somebody else’s.

Both bodies – the licensing agency and the licensee -- have a corporate interest in abandoning these wastes. CCNR believes that this ulterior motive constitutes a conflict of interest. Indeed, CCNR believes that this is the reason that virtually every independent body in Canada that has studied the nuclear waste problem, such as the Ontario Royal Commission on Electric Power Planning, the Select Committee on Ontario Hydro Affairs and the Seaborn Panel, has identified the need for and strongly urged the formation of a truly independent body to ponder the best way to deal with nuclear wastes.

During these hearings we have heard about the remarkable abilities of the proponent and the regulator to protect the environment and human health by maintaining a high-quality safety culture, by using an adaptive approach that will incorporate lessons learned so as to make constant improvements, to take swift regulatory action when things go wrong, and to use best engineering practice at all times to deal with unforeseen difficulties.

These characteristics will indeed be important in building and operating the DGR, but they will have little or no importance in the DUD. Once the wastes are abandoned there will be nobody home. If there are lessons to be learned, there will be no one there to learn them. Any unforeseen difficulties that arise will also be unobserved and untreated. Leakages will be uncorrected. Safety culture will count for nought in the DUD.

If the JRP is not willing to endorse the DUD concept, if it is not ready to recommend the permanent abandonment of these nuclear wastes, then the JRP can’t approve the project. Abandonment of the wastes is clearly defined as Phase 4 of the project. Abandonment is an inseparable part of the project as presented. To approve the project is to approve the perpetual abandonment of nuclear wastes in a Deep Underground Dump.

# CCNR Final Submission to JRP -- by Gordon Edwards

## 2. The Limits of Prediction

We do not have enough satisfactory experience to be able to assert that the DGR concept for storing nuclear wastes is a tried and tested technology that is indubitably safe in perpetuity. We have had failed repositories. We have had contaminated repositories. We have had abandoned repositories. In fact we do not have a single trouble-free operational DGR for nuclear waste of any description in North America.

The fact that a geological formation has been stable for hundreds of millions of years is no guarantee that it will remain so for millions of years more into the future, even if there is good reason to hope so. But it is not possible to get nuclear wastes into an undisturbed geologic formation without disturbing it. Once disturbed, even small structural weaknesses introduced into the geological formation may lead to large-scale unforeseen consequences over long periods of time, particularly if the engineered barriers prove to be unequal to the task.

Even under the best of circumstances, it is highly questionable that modern science has the ability to forecast accurately – or even approximately – the future behavior of a disturbed geological formation over millennia. Modern discoveries in the field of non-linear mathematical models have shown that chaotic behavior of the model can lead to wildly different results due to even the most minute changes in the input parameters – this is the so-called “butterfly effect”. And it is a very real characteristic of many models.

In my telephone intervention on September 9, I quoted Henri Poincaré who was one of the first to realize the enormity of his own prescient discoveries of such shocking unpredictability in even very simple and well-understood mathematical models such as the laws of Newtonian mechanics:

“. . . it may happen that small differences in the initial conditions produce very great ones in the final phenomena. A small error in the former will produce an enormous error in the latter. Prediction becomes impossible . . .”

Poincaré’s discoveries of unpredictability were not widely accepted in the mathematical community until the 1980s, prompting Sir James Lighthill to write in 1986:

“We are all deeply conscious today that the enthusiasm of our forebears for the marvelous achievements of Newtonian mechanics led them to make generalizations in this area of predictability which, indeed, we may have generally tended to believe before 1960, but which we now recognize were false. We collectively wish to apologize for having misled the general educated public by spreading ideas about the determinism of systems satisfying Newton’s laws of motion that, after 1960, were proved to be incorrect.”

*From The Recently Recognized Failure of Predictability in Newtonian Dynamics, 1986*

These quotes can be found in <http://www.math.umn.edu/~rmoeckel/presentations/PoincareTalk.pdf> “Chaos in the Three-Body Problem”, by Rick Moeckel, U of Minnesota, November 2012.

Needless to say, if mathematical unpredictability rears its head in such a well-trodden field as Newtonian mechanics, the same must be expected in the embryonic field of predictive geology.

# CCNR Final Submission to JRP -- by Gordon Edwards

## 3. The Challenge of Non-Homogeneity

A great deal of effort has gone into the analysis of how a DGR containing irradiated nuclear fuel may behave over the very long term. These analyses have proven to very challenging and many surprises have been encountered under intense scrutiny.

Of course irradiated nuclear fuel is vastly more radioactive than the low-level and intermediate-level wastes intended to be placed in the proposed DUD at Kincardine. Questions of thermal loading and possible criticality incidents also intervene in such analyses, which is not the case at the proposed Kincardine DUD.

In many ways, however, the Kincardine situation is far more complicated and difficult to analyze than a DGR for irradiated nuclear fuel. This is because of the bewildering variety of waste forms and the astonishing mix of chemical compounds that will be introduced into the DUD. In the case of a DGR for irradiated nuclear fuel, there is a remarkable degree of homogeneity in the sense that the spent fuel bundles are all to be packaged in the same way and emplaced in geometrically spaced, virtually identical cavities.

By contrast, there is an enormous complexity and, indeed, ignorance as to the ultimate menagerie of waste forms and packages and packing material to be emplaced in the DUD. For example, does anyone know exactly what will happen to the highly radioactive “tube bundles” of the dozens of steam generators that will be segmented into five or more sections before being emplaced in the DGR?

As I testified before the JRP in 2009, and reiterated in my supplemental undertaking No. U-21 [ [http://ccnr.org/CCNR\\_Undertaking\\_final.pdf](http://ccnr.org/CCNR_Undertaking_final.pdf) ] these tubes are filled with many alpha-emitting isotopes including several isotopes of plutonium as well as neptunium, americium and curium. The Panel will recall that these are the isotopes that contaminated the lungs of some 550 workers during the Bruce refurbishment over a period of about four weeks before any action was taken by either the licensee or the regulator to correct the situation.

I do not know if the JRP has heard detailed testimony as to how these alpha-emitting materials are going to be safely contained when the steam generators are segmented prior to being lowered into the repository, both in the short term and in the very long-term (recognizing that some of these alpha emitters have half-lives measured in the tens of thousands of years),

I would venture to say that the problem of predicting the variety of chemical reactions that might be possible and the variety of physical breaches that might occur over the course of many centuries or millennia is probably beyond the scope of OPG's and CNSC's combined expertise and/or resources.

# CCNR Final Submission to JRP -- by Gordon Edwards

## 4. The Need For the Project

It is remarkable that this DUD project was not initiated by OPG until after it was suggested by the Mayor of Kincardine. Apparently OPG did not regard this as a high priority project – or even a low priority project -- until a local political leader requested that it be considered.

This raises the question – what is the exact rationale for the project? OPG has not made the case that the waste currently stored at the WWMF is unsafe there. Nor has OPG argued that there is any urgent need to put the waste deep underground for any discernible environmental or health reason. Perhaps the reason lies elsewhere?

Until the Kincardine DUD was proposed, the only previous discussion of a DGR for nuclear wastes in Canada has been in the context of irradiated nuclear fuel, which is – under federal law – the sole responsibility of the Nuclear Waste Management organization (NWMO).

In fact, the Canadian nuclear establishment began producing irradiated nuclear fuel (high-level nuclear waste) in 1945. But it was not until 1977 – more than three decades later – that the Government of Canada published the famous Hare Report, “The Management of Canada’s Nuclear Fuel Wastes”. That report was the first official acknowledgement that nuclear fuel wastes constitute a serious unresolved problem.

Thus, for over thirty years, most Canadians, including most politicians, were quite unaware of the nature of the nuclear waste problem. When the subject of nuclear waste arose, spokespersons for the nuclear industry sometimes stated that nuclear waste disposal is not a technical problem, but a public relations problem.

(Even then, “nuclear wastes” were identified solely in terms of irradiated nuclear fuel – what we now call the “high-level” nuclear waste. There was still little or no public discussion from official quarters about the large volumes of intermediate level waste, such as refurbishment and decommissioning wastes, that constitute a significant part of the radioactive legacy of the nuclear age.)

This is a significant lapse, since all of Canada’s existing nuclear power reactors were ordered by 1978. Thus Ontario’s commitment to nuclear power was made at a time when the nuclear waste problem was not at all well understood. This lapse reflects a failure on the part of Canada’s nuclear establishment to properly educate and inform Canadians about a very serious multi-generational problem associated with nuclear technology. In retrospect, CCNR sees this as a betrayal of public trust. Decision-makers were led to believe that the permanent safe disposal of nuclear fuel wastes would be a relatively simple matter that need not cause undue concern.

In 1976, the Flowers Report from the UK said that it would be irresponsible and morally wrong to commit this and future generations to nuclear power technology unless there is at least one method of safely disposing of the high-level wastes.

## CCNR Final Submission to JRP -- by Gordon Edwards

In 1978, the Ontario Royal Commission on Electric Power Planning echoed the conclusions of the Flowers Report, saying that a moratorium on new nuclear reactors should be considered if the nuclear waste problem has not been adequately addressed by 1985.

In 1978 the Governments of Canada and Ontario launched a 15-year, \$750 million research effort involving an Underground Research Laboratory in Manitoba to “validate” the geological disposal concept.

In 1988 the Seaborn Panel was tasked with conducting an Environmental Assessment into the DGR concept, and after ten years of work involving public hearings in 5 provinces, the Panel concluded that **“The concept in its current form does not have the required level of acceptability to be adopted as Canada's approach for managing nuclear waste.”**

CCNR believes that OPG and NWMO and CNSC are hoping that this panel, the JRP for OPG’s proposed DUD for low-level and intermediate-level waste, will do what the Seaborn Panel would not do – endorse the concept of a DGR in which radioactive wastes will be abandoned for all time as an acceptable approach for “managing” (or rather not managing) Canada’s nuclear waste.

We urge the Panel not to do this. We believe that you, the Panel members, are being misled by the nuclear representatives into prematurely endorsing a concept that is still very much in question around the world.

If the JRP approves this project for a DUD less than a mile from Lake Huron, CCNR fears that that approval will be used by nuclear proponents around the world to justify other projects, likewise very close to precious water supplies, that the JRP would never want to recommend.

### 5. Conclusion

This project is not necessary, and is ill-advised.

CCNR does not trust CNSC when it says that it will never compromise public safety, because it has already done so without any sense of shame or apology in the absolutely needless and entirely preventable exposure of over 500 workers to plutonium-laden dust.

The Bruce supervisors and CNSC inspectors did not act to keep radiation exposures as low as reasonably achievable, they did not perform due diligence to determine the risks, they did not even take daily air samples to find out what contaminants were in the air until four weeks had passed.

The most shameful thing about this regrettable episode is the fact that no one has been held accountable for this frightful lapse in radiological hygiene, and the complete lack of remorse on the part of the regulator and the licensee.

We ask the JRP to reject OPG’s proposal on the grounds that there are too many unanswered questions and an inadequate rationale for the project at this time.