

Fact Checking Gordon Edwards.

Gordon Edwards has been active recently making presentations to anyone that will listen as exemplified by this one that he recently gave to the people of Dryden <https://www.youtube.com/watch?v=-YzHT4c4WCc&t=1027s>.

In his presentation he works towards a number objectives

1. To create fear by implanting the idea that radiation/radioactive materials are more dangerous than anything else mankind does.
  - a. Because radiation/radioactive materials are really dangerous
  - b. Because radiation/radioactive materials are unnatural and anything unnatural must be dangerous
2. To create distrust of the nuclear industry by implanting the idea that the nuclear industry does not tell the truth and that there is no oversight of its activities
3. To create fear by associating the civil nuclear industry with things that have a bad reputation like nuclear weapons and fossil fuels
4. To create concerns about the NWMO plans and the nuclear industry in general by suggesting they are not competent and will do dangerous things
5. To establish that nuclear power is not needed

Interspersed with this there is some general scaremongering by reference to events.

But is he telling the truth. This is my fact check of this presentation against the messages he is trying to implant.

Dr Neil Alexander

**IMPLANTING FEAR ABOUT RADIATION AND RADIOACTIVE MATERIALS BY TRYING TO ESTABLISH THAT RADIATION/  
RADIOACTIVE MATERIALS ARE MORE DANGEROUS THAN ANYTHING ELSE MANKIND HANDLES**

**1. Is it well established that even low doses of radiation cause cancer? Has it been proven again and again and is there no doubt about it?**

There is very little evidence that low doses of radiation make any difference whatsoever. If they did, we would see clear patterns of health outcomes related to the regions in which people live, as those regions vary dramatically in the amount of background radiation. But we don't. There is even a lot of evidence to suggest that enhanced levels of radioactivity may actually improve health outcomes, possibly a result of hormesis.

He might squeeze this belief past the post if he had said there is "a faint possibility that low doses of radiation might cause cancer" but to say that there is "no doubt" is without doubt simply wrong.

**2. Is a CANDU Fuel Bundle the "most deadly" object on Earth?**

This is a classic play on words as it depends on how you define "most deadly". He claims that if you stand next to it when a used nuclear fuel bundle is withdrawn from a reactor then it will kill you and it is that which qualifies it as the "most deadly". But how does that deadliness compare with other things. If you decide to stand in the path of a wind turbine blade, for example, that will be even more deadly, even quicker.

This may seem like a silly comparison, but it isn't. The way you avoid being sliced in half by a turbine blade is not to get in the way of one. The way to avoid being killed by radiation from a used fuel bundle is to not stand next to one. The logic is the same.

But there is a big difference in that it is impossible to stand next to a freshly extracted used fuel bundle because there will always be shielding and that creates a physical barrier that people cannot get past. That is why no one has ever died from standing next to a bundle of used nuclear fuel and no one ever will.

It is, however, possible to get in the way of a turbine blade which is why an unfortunate parachutist is no longer with us.

So yes, you might argue used fuel is deadly, but the evidence suggests turbine blades are more deadly...and yes, I could have used exactly the same logic to prove a solar panel is more dangerous by just pointing to the potential to electrocute yourself.

And then there are spiders, snakes, sharks, alligators and even donkeys that are in practice more dangerous than a fuel bundle.

Even if you accept the definition that Dr Edwards creates for himself, the fact is that the conditions he imagines can never exist and it is extraordinarily unlikely that this danger could ever translate to harm.

**3. Does nuclear generation benefit 3 generations and create toxic waste for 300,000 generations?**

By avoiding GHG emissions that will affect everyone that comes after us, nuclear power is clearly benefiting all the generations that follow.

As to toxic waste, many industries produce toxic materials that will be dangerous forever, not just for 300,000 generations and they may only have benefited one generation. These are typically just dumped in the biosphere.

People fixate on this 300,000 generations issue because in Canada we have chosen to use the 1-million-year mark as a point to undertake a safety assessment and demonstrate that at that point it will have done no harm. It's a useful point to pick because around then the radioactivity in the used fuel will be the same as the radioactivity of the uranium from which it was produced. But this is not a measure of either safety nor necessity, as I point out earlier, many things are toxic forever and their presence does us no harm.

**4. Could 54 grams of plutonium overdose 500 million workers?**

This is an attempt to establish the idea that plutonium is very toxic. It is a descendent of the "plutonium is the most toxic material on earth" comment that anti-nuclear campaigners used to use but can no longer use because it is so obviously not true. Plutonium is 10,000 times less toxic than the most toxic material on earth and we use that material in cosmetic treatments anyway.

But yes, plutonium is toxic, and if you took that mass of plutonium and divided it up very carefully and then injected it into 500 million workers you might exceed their regulatory body burdens. But how exactly would this happen when no one can actually get access to the stuff anyway?

And let's remember that this maximum permitted body burden is a conservative level at which there is almost no risk..... so even if we were able to do the impossible what we would have is 500 million people who have almost no risk. Even if it is true it doesn't prove anything.

**5. Do radioactive materials produced by the nuclear industry get into the environment and from that into the food chain?**

Yes, this happens. The real question is does it do any harm?

Things get into the environment as a result of many of mankind's activities. Mercury (released into the environment by the making of hydro-electric dams) has no half-life (or an infinite half-life if you like) and is now in the food chain in a way that does cause harm.

But radioactive materials, from the civil nuclear industry are not generally a problem, unless there has been a major accident and then normally for only a short period. The release of radioactive substances from a nuclear power plant is controlled, monitored and trended to ensure they remain below prescribed limits and that they cause no harm. Any deviation, even when it is well below the limits, is investigated and corrective actions are taken.

**6. Are the wastes in Port Hope "quite dangerous"?**

This depends on how you define “quite dangerous”. Its certainly better that they are disposed of properly but let us not forget that people have been living with them in their backyards for decades and the good people of Port Hope (despite being told by another anti-nuclear misinformer that they will all die) have lived happily with a higher life expectancy than the average in the region.

**7. Could an X-ray have a significant effect on an embryo or foetus?**

Yes, an X-ray is a concentrated quantity of radiation delivered over a very short period of time. You should only have an X-ray if you need one (with the risk benefit analysis being that even confirming the state of your teeth may justify that need).

But what Edwards is trying to imply is that the staggeringly small dose from the transport of a used fuel container could have the same effect as an X-ray and that is just scaremongering.

This sort of scaremongering led to Japanese ladies having completely unnecessary abortions following Fukushima and it is not harmless.

**8. Was Litvinenko poisoned with polonium-210 and does that prove alpha emitters are the most dangerous nuclear materials?**

Yes, if you ingest enough polonium, it will kill you. If you ingest enough drain cleaner from under the sink, you will get the same result, but quicker.

It is thought that the reason that Russia used polonium is that it is easy to handle and not particularly dangerous to handle as long as you don't drink it. They likely wanted it to have a slow effect in order that they could escape before anyone noticed anything. If you set out to kill people there are very many options it was just unfortunate that they chose a radioactive material.

Also, of course, polonium exists in nature as do the really “dangerous things” he mentions at the end of this discourse, like radium and radon. We live comfortably in their presence. They aren't good for you but they can't be all that dangerous.

**Conclusion:**

**All Dr Edwards' attempts to create fear of radioactive materials are based on misinformation, manipulation, or avoidance of context.**

IMPLANTING FEAR ABOUT RADIATION AND RADIOACTIVE MATERIALS BECAUSE RADIATION/RADIOACTIVE MATERIALS ARE UNNATURAL AND ANYTHING UNNATURAL MUST BE DANGEROUS

### 9. Before the nuclear industry, were these wastes not found in nature at all?

This is a piece of scaremongering that suggests that if it didn't exist in nature, it is necessarily very dangerous. But that is nonsense. Technecium-99m does not really exist in nature but we make it and it is a fantastic diagnostic tool, used across the world in millions of procedures every year, and it does no harm to the environment whatsoever.

And the idea is also used to suggest that these materials must be much worse than anything in nature but we have many natural analogues of the materials that will go into the repository that are quite common including protactinium and europium. And uranium is quite a common.

But it's a comment that isn't just used inappropriately, it's not even true!

About 99% of what is in a used fuel bundle was dug out of the ground in the first place. There can be no doubt that existed in nature.

And all the fission products have also been produced by nature in the natural reactors at Oklo in the Gabon. These natural reactors operated for hundreds of thousands of years and most of the fission products have now decayed. Most moved only a small distance in the **2 billion** years that have passed despite being in fractured rock through which water used to pass freely. They are a great demonstration of how geology can contain these materials for very long periods of time.

Additionally, plutonium is still produced in very small quantities in uranium ore bodies as a result of the neutron bombardment of the uranium in the ore. It's tiny quantities but it's definitely in nature.

Plutonium also exists in our natural environment today because of the experiments with nuclear weapons and, despite being distributed widely around the world, this plutonium does not appear to have done any harm as life expectancy continued to increase after it happened.

### 10. Do all non-radioactive atoms remain unchanged?

The earth is constantly being bombarded by radiation that changes atoms. The hydrogen atoms he uses as an example may well at some point have been made into radioactive tritium and then have decayed back to helium-3. And today's carbon-14 may well have been stable nitrogen not long ago. These are completely "natural" changes.

This is high-school science and not something an expert should be getting wrong.

## Conclusion

**Things that are unnatural are not necessarily dangerous, nature produces radioactive materials, and the nuclear industry does not produce anything that nature hasn't already produced (except when it is deliberately producing radioisotopes for the good of mankind).**



**11. Did the industry lie about nuclear waste for the 30 years?**

No. The US began producing nuclear power in 1955 and the National Academy of Sciences (praised earlier in the presentation by Dr Edwards) produced a much-discussed public report in 1957.

It may have appeared that the industry hadn't said anything because used nuclear fuel is very easy to manage and caused no problems and so the public took no notice. But no one lied.

**12. Are the questions multiplying?**

The title is "Radioactive Wastes: the Questions Multiply". It's designed to imply that questions keep coming up and are doing so in increasing numbers. In fact, throughout the presentation, there are no new questions raised at all let alone an indication that they are multiplying.

Most of the questions that are cited have been answered or will be answered at an appropriate time.

**13. Is Canada importing radioactive wastes and thus NWMO have broken a promise?**

To support this conspiracy theory, Dr Edwards cites an attempt, figure headed by Jean Chretien, to import used nuclear fuel from abroad and store it on the east coast of Canada. He also reminds us that NWMO have said only Canadian used fuel will go in their repository.

The project he cites did not go ahead and no used fuel was imported. So no promise has been broken.

But even if this project had gone ahead it had nothing whatsoever to do with the NWMO anyway. This used fuel even if it had been imported would never have gone to an NWMO facility.

So, no, wastes in the form of used nuclear fuel have not been imported and even if they had NWMO would not have broken their promise because they would not have been the people doing it. There is no evidence whatsoever that NWMO have been anything other than scrupulously honest on this issue.

**14. Are CNSC a "captured regulator" as evidenced by the fact that they have "never refused a licence?"**

I don't have time to go back and confirm whether CNSC have ever refused a licence or not, but regardless it's irrelevant.

The role of the regulator is to approve things that are safe, environmentally acceptable and in the interest of Canadians. If a licence request is put before them they will ask questions to satisfy themselves that their criteria are met or point out where they are not. In the process people may realise that they will not get a license or that the conditions of the license will be too onerous if they do get it and will retract their application. In this situation, have CNSC refused

the licence? No, they have not but the project has not proceeded and that has to my knowledge happened many times.

**15. Will the community lose control if they say yes to the Deep Geologic Repository?**

Contrary to Dr Edwards' answer it is very clear that the community has a lot of control over the process. This is what NWMO say *"This project will be implemented through a long-term partnership involving the community, the larger region in which it is located and the NWMO. It is important that the project be implemented in a way that will help foster long-term well-being and sustainability"*. If you don't trust what NWMO says, then there will also be a legally binding agreement where the host community can specify all conditions applicable to their acceptance.

In his answer to the very next question he talks about the agreement the people of Port Hope negotiated demonstrating clearly that you can negotiate an agreement and therefore can have control even if you say yes .....

**16. Is mass or volume a measure of radioactive risk? Is half-life a measure of radioactive risk?**

He is of course right, neither mass nor volume are a measure of radioactive risk. I have routinely said this in response to the media frenzy about the millions of litres of water stored at Fukushima. The irony is that Dr Edwards was more than happy to let the media use this measure when he thought it would help scare people. It's only now when it is used to calibrate the problem appropriately that he suddenly remembers that it isn't a measure of risk at all.

Only seconds earlier Dr Edwards spent some time deliberately scaring people by quoting half-lives but this is not a measure of risk either. If half-life were a measure of risk, we would be very fearful of potassium-40's 1.3-billion-year half-life but some people sprinkle it on their fries as a health measure.

In fact, the relationship between half-life and risk is quite interesting. Short half-life materials are more radioactive, but for a short time, while long-lived radioactivity is less radioactive but for longer. This is why polonium is more radiotoxic than plutonium. Polonium has been used extensively in antistatic devices.

**17. Is mass or volume an appropriate measure of disposal challenge?**

Small volumes are easy to manage, large volumes are harder to manage. If they are hard to manage, they are more likely to get into the biosphere so the challenge is greater. The industry appropriately used volume to calibrate the challenge and Dr Edwards was wrong to criticize the industry for doing so.

**18. Did the Government really ignore the Seaborn Panel recommendation that it should be an independent Organization?**

No. The Seaborn panel recommended two options, the government chose the second one.

**19. Is there no independence if an environmental review is undertaken by people who have access to the knowledge of experts?**



An interesting question. A better one would be what would be the point of having an independent assessment done by people who don't understand any of the issues?

**20. Have nuclear reactors been largely removed from the new environmental assessment act and as a result do not have to have any kind of environmental assessment at all?**

No. It's a complex situation and I may not have the legalese right but basically the new environmental act defines how the environmental assessments will be carried out. Some classes of reactor, because their consequences are so small, are a provincial responsibility.

Regardless, CNSC remain responsible for ensuring Canadians are protected and that includes harms through environmental damage. It is not correct to say they require no environmental assessment at all.

**21. Was Chretien's project a secret and would it have been kept secret until it was a fait accompli?**

Dr Edwards states, as a fact, that this project would have been kept secret until it was a fait accompli, but a nuclear project cannot go ahead in Canada without a license from CNSC and the CNSC approval process includes public consultation.

It would have been impossible for it to be kept a secret until it was a fait accompli.

**22. Did anyone even try to keep the Chretien supported project a secret anyway?**

Sean Patrick Stensil of Greenpeace publicly reported on the project over ten years before the newspapers picked up on Chretien's involvement. It had had another burst of media attention in 2006 and even had its own publicly accessible website. It was never a secret.

**23. Does CNSC "refuse to look at" the costs of waste disposal until the reactor's end of life?**

There is some truth to this in that the CNSC do not license anything on the basis of cost, focusing instead on safety and nuclear safeguards. However, as part of licensing, before the project begins, they do require estimates of all the end-of-life costs including waste management. They use this to determine the financial guarantees they will require. They study this issue in detail.

Dr Edwards raises this issue in the specific context of the approval of containers and the fact that the containers for "unorthodox" wastes have not been approved yet. This is no surprise as CNSC will not feel the need to licence the container until such a time as the container needs licensing because they know designing a container is a perfectly feasible engineering task that has been done many times before.

**24. Does the industry refuse to hear from Frank Greening?**

No. Frank Greening has intervened multiple times at CNSC hearings and has been paid amply to do so by the CNSC through its participant funding program. It may be that no one acts on what he says because what he says is wrong.

**25. Has the nuclear industry said that used fuel has to be moved somewhere else because the people who run the reactors don't want the used fuel nearby?**

No obviously not. All of the municipalities surrounding Bruce Power volunteered as part of the NWMO's process and the other site currently being considered is in the region of Bruce Power.

**26. Is it impossible to determine whether it's a wise decision because all the resources are in the hands of the NWMO?**

Obviously no...because all the resources are not in the hands of the NWMO ...they are in universities and other independent research institutes all around the world that peer review the NWMO and produce papers that the NWMO then make available on the internet. The NWMO work will then be independently assessed by the CNSC who will use their own independent advisors and allow intervenors to draw attention to issues during the review process.

**27. Does Canada have no independent capacity for peer review?**

Canada has universities, research institutes, national laboratories and think tanks that are peer reviewing and publishing technical reports, all of the time. Canada could also commission offshore organizations to peer review. CNSC even pay individuals and organizations to do peer reviews and Gordon Edwards knows this as he has been a beneficiary (by the way doing biased, factually inaccurate peer reviews for anti-nuclear organizations pays much better than being in the nuclear industry and having to produce information that is scrupulously accurate).

**28. Does the Government of Canada really not have the capacity to scrutinize the activities of the Canadian Nuclear Laboratories?**

In addition to having to satisfy the CNSC that they are in compliance with their licence, CNL is overseen by AECL who exist primarily to do that oversight.

**29. Did Linda Keen predict the Fukushima accident?**

Gordon answers this question himself. He notes that the earthquake did not directly lead to any problems at the Fukushima nuclear plant it was the tsunami. Linda Keen did not envisage a tsunami at Chalk River and so she clearly did not predict the incident.

**30. Did the nuclear industry have Linda Keen fired?**

The pressure to restart the reactor did not come from the nuclear industry which hardly used the NRU reactor any longer. The pressure came from the international medical community where physicians knew that without it their capability to diagnose some serious conditions was substantially diminished and people would die.

**Conclusion**

**He presents no evidence of any actual lies and all the attempts to implant the idea that the nuclear industry cannot be trusted are fabricated.**

**31. Is a nuclear plant fundamentally the same as a coal-fired plant?**

Yes, nuclear is a thermal process like coal, but then so is thermal solar power. Perhaps he should have said nuclear power is fundamentally the same as solar power, a statement that is even true of solar panels that are collecting energy from a nuclear reaction as well!

It might also have been appropriate to mention the other ways that nuclear and fossil fuel plants are similar. Reliability, low cost, small footprint etc. These are more relevant than the engineering of the power conversion.

But if there is anything really relevant to say it would be that fossil fuels are disliked not because they are thermal plants but because of their pollution including GHG emissions and that nuclear is fundamentally different ..... because nuclear plants do not emit GHGs.

So basically, where it matters, nuclear plants are fundamentally different to coal fired plants.

**32. Does a discourse on nuclear weapons have anything to do with questions about nuclear waste in Canada or the Deep Geologic Repository?**

No. The used nuclear fuel going into the repository had no role whatsoever in the production of nuclear weapons.

If anything, raising concerns about proliferation strengthens the case for a repository because it would make the used fuel difficult to access and it greatly weakens the case for rolling stewardship so Dr Edwards has in effect criticized his own argument.

**33. Does the fact that a small amount of radioactive materials were used in a bomb that caused a lot of damage mean that small amounts of radiation will cause a lot of damage?**

No, the two things have nothing to do with each other. Does the fact that you can make fertilizer into a bomb make it dangerous to spread fertilizer on your lawn. Billions of gardeners think not.

**34. Does the civil nuclear industry cause proliferation?**

While it is theoretically possible that the existence of a civil nuclear could increase proliferation there is no evidence of this being the case and some evidence that access to nuclear power may discourage nations from having weapons.

In any case civil nuclear power produces mostly the wrong type of plutonium rendering it unsuitable for weapons so that if a country wants nuclear weapons, it will either enrich uranium (as Iran has done despite having civil nuclear power) or will build a research reactor (as North Korea has done without having a civil nuclear program).

In fact, the civil nuclear power industry has done a great deal to reduce stocks of accessible Russian weapons material by down blending it and using it as fuel; effectively reversing proliferation.

And this answers the question without even having to mention the very tight controls on proliferation that are imposed around the world.

**35. Does all re-use of nuclear fuel require the separation of plutonium and therefore make bomb making easier?**

No, it never has and it is unlikely to. Plutonium comes in a number of forms and a civil reactor makes too much of the wrong stuff so even if you did separate it you couldn't use it to make weapons without going through a further very difficult process. This is why people don't use civil nuclear reactors for bomb production but build specific reactors for military use or upgrade uranium which they could get from the sea if they wanted

**36. Was the Moltex process developed "precisely to take plutonium out of CANDU used fuel bundles"?**

The Moltex reactors do not need the plutonium to be purified so that unlike earlier reprocessing processes the Moltex process doesn't separate out plutonium at all. What the Moltex process does is remove unwanted elements leaving plutonium along with many other fission products.

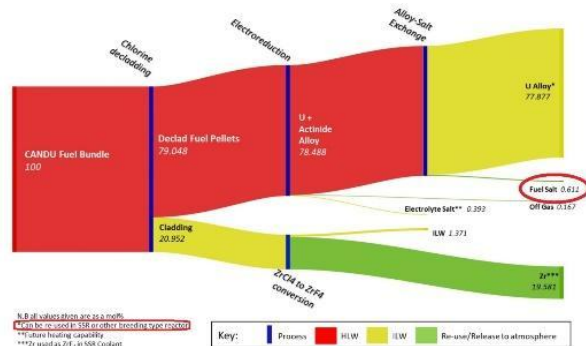


Figure 12: Sankey diagram showing the various constituents of spent fuel as they go through the various stages. All numbers are in mol%.

**37. Is the firewall removed and does this mean we are giving nuclear weapons to other countries?**

Dr Edwards correctly posits that the radiation from a fuel rod creates a firewall that prevents people making weapons. He then says that the Moltex process removes that firewall so that we will give nuclear weapons to many other countries.

We have already established that plutonium is not separated out and so the firewall is not removed.

**Conclusion**

The whole issue had no relevance to the subject matter whatsoever and was just designed to scaremonger but nothing that was said was correct anyway.

**38. Most Canadians do not know what a thousand years is but Indigenous people know it very well?**

This not only very obviously wrong but it's insulting. Many Canadians or their families may not have lived in Canada for long, but they likely hail from nations with long storied histories of their own, many with buildings, structures and cultural memories that are thousands of years old or more. I used to live near Stonehenge, a living embodiment of 5,000 years of history (and to the ability of rock to endure and of the capability of humans to engineer things that endure). The UK has books like the Magna Carta that still speak to its modern-day legal system. And my Canadian friends that hail from Africa, Asia and Arabia laugh at the youth of the nation from which I hail.

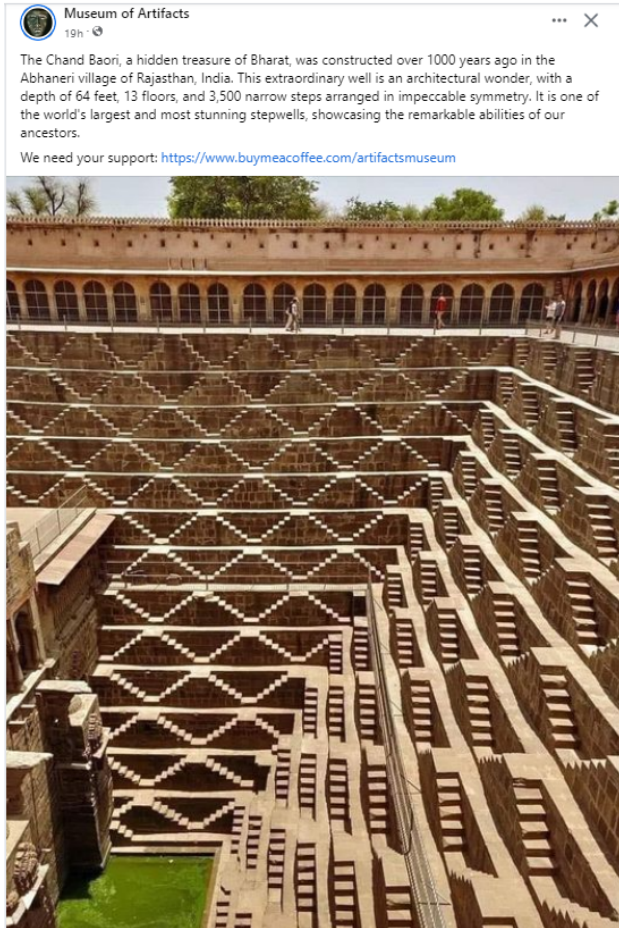
We all likely have a good feel for the amazing changes that can take place on the surface in a period of a 1,000 years.

Where he has a bit of a point is that few of us can appreciate what a thousand years in deep geology is like, because basically in a thousand years nothing noticeable may happen at all. That is hard for surface dwellers to understand and is why we must avoid imposing our lived experience on our understanding of time in deep geology.

Used fuel is carefully managed throughout its entire life. It is all pretty much the same and is all handled in pretty much the same way. The unexpected is, as a result, almost impossible as everything is very much as expected.

**39. Does the fact that the weather changes regularly and we can't predict it mean that we can't predict what will happen in deep geology?**

Deep geologic deposits do not have weather! They also do not have political change, wars, pandemics, famines, or tidal waves. They don't have fires, hurricanes, plane crashes or any of the man-made disasters we have on the surface, either.



Sure, we can't be absolutely certain as to what will happen deep underground but we do have billion-year long histories in which there has been no change, and we can be certain none of these surface things will happen.

That is precisely why deep geology is a good place to out used fuel.

**40. Are there no scientific principles that we can use to make predictions?**

Of course there are. For one we can date the rock and know how old it is and how long it has remained stable for. We can even study the way the tectonic plates are moving to enable us to predict the shape of the earth's surface (the Great Lakes will be long gone before anything at all could realistically reach the surface). We also understand corrosion, chemistry, engineering etc that allow us to make predictions.

I can't tell you that that this guarantees that nothing totally unexpected, on a scale that would make a difference, might happen, but if something hasn't changed significantly for a billion years, chances are its not going to change anytime soon.

And if anything big enough to make a difference does happen I sure as hell wouldn't want the stuff under rolling stewardship near the surface!

**41. Will it just be luck if it doesn't leak?**

Hardly, the whole project is being meticulously planned. It will be extraordinarily unlucky if it does "leak". And anyway, it doesn't really matter if it does "leak" as long as it has no impact on the biosphere, which it won't.

But "leak" isn't an appropriate word to use anyway. Used fuel is largely a solid ceramic...a bit like a plate.....so water would have or permeate through the rock, penetrate the self-sealing water-resistant bentonite, corrode the outer container, fill the inner container, corrode the zirconium tubes, contact the fuel, and then dissolve this largely insoluble ceramic. Then that dissolved fuel would need to diffuse all the way back out before getting to the rock itself, which will in all probability scavenge all those materials and stop them moving.

At some point some activity may escape the repository but is that "leaking" in any conventional sense of the word? I think not.

**Conclusion**

**Yes, there are uncertainties, but things are nowhere near as uncertain as Dr Edwards makes them out to be and those uncertainties really only arise in extreme circumstances where we would be thankful that we had used Deep Geologic Disposal.**

**42. Is Gordon Edwards' "Rolling Stewardship" better than a Deep Geologic Repository?**

The nuclear industry has demonstrated that rolling stewardship works. It's what we do today and it has never given rise to an incident or any environmental harm of any significance. This is why the nuclear industry can go on and expand in order to help reduce GHGs regardless of whether it has a repository or not.

But is it better? Obviously not. As Gordon Edwards has been at pains to tell us....when these materials are on the surface they are a proliferation risk. In a DGR that negligible risk is reduced still further. And unpredictable stuff happens all the time on the surface and so creates unexpected circumstances through which rolling stewardship may be hard to maintain.

**43. Is there really no good explanation as to why Canada is using 3mm of copper and Finland is using 50mm?**

The fuel bundles in Finland are much larger than a CANDU fuel bundle and their containers were designed before the NWMO containers. NWMO had the benefit of an easier bundle to contain and the technological advances that took place. As a result, the copper in the Finnish design is used not just for corrosion resistance but also for structural strength. In the Canadian design it only needs to provide corrosion resistance.

To be specific they are using a separate copper container, as opposed to having the copper electroplated onto a thick steel structural vessel: a separate copper container 3mm thick would collapse even with normal handling. Other national programs are now looking at the benefits of the NWMO's electroplated approach.

**44. Did the NWMO really forget about galvanic corrosion?**

No. I found papers that established clearly that NWMO had identified this potential challenge and had researched it in detail.

**45. Would you need every welder in New York in order to weld a repair on a fuel bundle?**

If a worker did have to stand next to a fuel bundle, they would get a big dose and would need to be replaced. But the New York story, if it is true (I have not checked), would have been about a repair in a reactor pit, not a fuel bundle.

A fuel bundle will be in a hot cell. A worker could just affect any mitigating measure using manipulators. Even if it weren't in a hot cell because, unlike the reactor pit, access would be easy, it would be done remotely. But likely no repair would ever be needed and in the case a problem did arise it would likely be solved by remotely removing the bundle and putting it in a new container.

And Gordon seems to have forgotten that the lids are welded onto the Dry Storage Containers when they are full of used nuclear fuel anyway. So no, it does not look like you would need all the welders in New York for this task.

Also, it should be noted that the nuclear industry uses the principle of as low as reasonably achievable so the scenario Dr Edwards tries to suggest would never occur,

**46. If the fuel bundle is broken will radioactive materials escape?**

Of course, if the containment of a fuel rod is breached there will be volatiles and possibly some particulates that will escape the fuel rod and it is theoretically possible that there could be a release. But in reality, protections, including filtration, will be in place that will prevent any escapes of any significance.

But it's very unlikely to occur anyway. The fuel rods are all checked before they go into storage and alternative arrangements made for the rare faulty fuel rod.

**47. Should the repackaging of the used fuel take place where the money or power is?**

This is an opinion that Dr Edwards expresses based on his narrative that repackaging creates risk. But it doesn't really. What it does create are benefits in the form of safe, well paid, comfortable jobs and these benefits are not mentioned when they should be.

**48. Is a vertical shaft a crazy idea and bad engineering?**

Vertical shafts are used in mining all the time, so I am happy to trust the mining engineers on this. A vertical shaft is a way of minimizing the damage to the point where it is irrelevant removing a previous concern he has expressed about damage to the rock. The Finnish design that Dr Edwards references as an alternative includes a shaft!

**49. Will there be unexpected chemical reactions?**

An example of a Carlsbad (New Mexico) waste drum is used to suggest that an unexpected reaction might occur in a used nuclear fuel repository. But it's an inappropriate example. Carlsbad was dealing with a diverse range of legacy wastes from weapons production that were produced by many different processes and included a variety of different waste forms including liquids such as nitric acid.

Used fuel comes in a very limited number of forms and is very precisely managed throughout its entire life. It is largely a contained solid ceramic so chemical reactions of the type that took place in New Mexico would not occur.

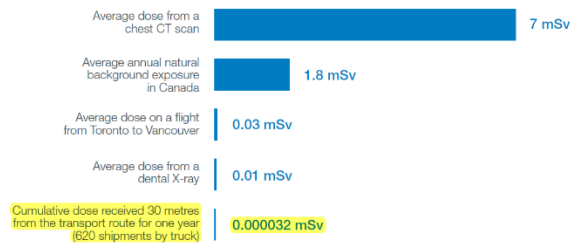
We should also remember that the repository did not cause the reaction, it would have occurred anyway. But the fact that it did occur in the repository meant that the consequences were substantially mitigated.

**50. Will everyone along the route be irradiated and will the accumulated dose be a danger?**



This is amply covered in NWMO reports and basically, yes people will be exposed to tiny amounts of radiation for very short periods of time. I suspect that math goes something like this, an individual living next to the highway for the full 50 years, who is always in when the truck passes could offset the dose they received by not sleeping with their partner one night every two or three years. But even that measure wouldn't be necessary as it appears that low levels of radiation do not harm health anyway.

How Does This Compare to Other Sources of Radiation?



And to calibrate the risk, even if that were not the case, let's remember that there is a faint possibility that there will be a driver in the vehicle, and they won't even get a dose that would harm them even though they sit right next to the container for multiple journeys.

**51. Will the repository “definitely” be filled with water?**

No, the repository will be filled with containers and bentonite clay and any gaps will then be backfilled and sealed. There won't be any space for it to “fill” with water. And while the rock may fracture, bentonite clay self-seals.

Will some water be present. Yes, tiny quantities will be present, but it won't be flowing through magical rivers of conveniently fractured rock. It doesn't work like that.

**52. Is there stuff about geology that we need to know?**

It would be lovely to understand geology better but do we need to know it? We have very little idea of how gravity works but it hasn't stopped us doing things on the basis that we know it will always be there.

**53. Will the unorthodox geometry, heat generation, chemical composition and potential for an accidental criticality change the dynamics of the DGR?**

In this section of the presentation there are some statements that are correct as all the issues he raises will have an effect, however they will all have to be satisfactorily dealt with in order to meet the NWMO's waste acceptance criteria (WAC). The need to comply with the WAC will ensure that the actual dynamics of the DGR will not be changed in any way that noticeably alters its overall performance.

**54. Is rolling stewardship better because engineers can get in and fix it?**

It doesn't follow does it. Engineers could get in and fix the repository if they needed to after all they built it in the first place and are not doing anything irreversible. Likely this will become easier as society develops and if society doesn't develop, we would want it deep underground anyway.

**Conclusion**

No actual evidence is presented that NWMO are anything other competent as they have anticipated every circumstance in which Dr Edwards has questions. Dr Edwards' own idea on what should be done proves that solutions exist but is not as good a solution as Deep Geologic Disposal.

**55. Should we close our reactors because we don't have a solution for the disposal of used fuel and is it true we do not have a solution?**

We have already answered this one.....Gordon told us it. Rolling stewardship is a solution that he thinks is OK. He has said it a dozen times and has carefully outlined how it would work with information being passed from generation to generation.

So that is our solution and as a result we do not need to close any reactors.

The question is why does he now suddenly say there is no solution when he has told us what the solution is?

What his presentation has actually identified is that while we have a perfectly good solution a DGR would be a better solution.

**56. Are wind and solar cheaper than nuclear?**

This is a classic trick that has led to the renewables industry doing untold and unnecessary socioeconomic and environmental damage and it's really quite surprising that it is still being repeated in 2023.

The issue is this. Wind and solar and nuclear have different utility and so have different values. Wind and solar are available when nature allow them to be, but we need electricity and power all of the time, so that if you want reliable electricity with wind and solar you have to also pay for a back-up system. That is why, while wind and solar costs may be lower, grids with a lot of wind and solar are expensive. So expensive in fact that unless fossil fuels are your back-up, no one has ever managed it. People that talk of storage being the solution are dreamers that have no knowledge of weather patterns whatsoever, not for that matter the challenges of storing large amounts of energy.

Nuclear is available when we need it, so the same level of back-up is not needed, and nuclear based systems end up being cheaper.

**57. Could we have avoided refurbishing Darlington by finishing the renewables projects that Doug Ford cancelled?**

Doug Ford cancelled 758 projects that would have provided 440 MWe of power that may or may not have been available when we needed it. Darlington provides 3,500MWe of power that is under our control. You cannot replace 3,500MWe of reliable power with 440MWe of unreliable power without your system collapsing.

**58. Is the Ford government not representing our interests?**

The Ford government campaigned on a promise of reversing the consequences of the Green Energy Act building on the dissatisfaction expressed by the people with the costs and environmental damage it caused.

The Ford government was absolutely representing the interests of the people.

**59. Is Germany crazy for shutting down its nuclear reactors?**

This one depends on whether you believe in climate change or not and also whether you support unnecessarily killing your own population. If you do not believe in climate change and don't mind people dying, then Germany is not crazy. Personally, I like Ontario where smog doesn't kill me and I have one of the lowest power generation carbon footprints of anywhere in the world. But I guess that could just be me.

**60. Is Germany just ahead of the game?**

If the game is to have one of the most emission intensive electricity systems in Western Europe, then Germany would appear to be ahead of it.

**Conclusion**

**There are adequate solutions to used nuclear fuel management, so it isn't necessary to curtail the planned growth of the industry which appears to be necessary as nuclear is a major tool in our emissions reduction tool box.**

**60. Was anything constructive achieved by the “400 municipalities” he claims protested and got the shipment of the steam generators stopped?**

Its possible Dr Edwards is being a bit modest when he talks about the steam generator recovery and recycling project that was derailed by protests as he was active in riling up all these municipalities with a tour of misinformation similar to the one he is on now.

Was anything constructive achieved, well they did stop almost 64 grams of radioactive material being shipped....although they did continue to allow the coal industry to ship 168 tonnes of uranium in the form of coal through the same channel. Radioactive material that would have been far more bioavailable than the 64 grams in the 5-inch-thick sealed containers. Rumina Velshi (President of the CNSC), also pointed to the 481,000 tonnes of gasoline, almost 21,000 tonnes of sulphuric acid, 3,200 tonnes of fertilizer (also radioactive), 14,000 tonnes of biofuels and a further 638,000 tonnes of road fuels and petroleum oils that they did not stop and which were far more hazardous.

Did anything destructive occur? Yes, obviously a whole load of material had to be consigned as waste for no good reason, more iron ore had to be dug up and fossil fuels used to turn the ore into metal. I remember vividly that one of the larger environmental organizations back-tracked on this one many years later and accepted that stopping the shipment had been a mistake....but I can't find the article where they were quoted. If anyone has it, please let me know.

**61. Is used fuel stored in oils drums?**

A picture paints a thousand words so it's important that the images used are correct as well as the words. Dr Edwards shows a picture of an oil drum with a radioactive symbol painted on it implying that this is how used fuel is managed. Used fuel is never stored in oil drums it is always stored in appropriately engineered environments or containers.

Also used fuel is a solid contained within a fuel rod. There are tiny quantities of volatiles and particles but the bulk is a ceramic that cannot flow, spill or leak.

**62. Does everything in a nuclear reactor end up as radioactive waste and can nothing be decontaminated and reused?**

In his comments about the steam generators which were to be shipped to Sweden to be decontaminated and the steel recycled steel and reused he confirms that this statement is not true. Decontaminating, reusing, and recycling goes on all the time. It's safe and environmentally friendly.

**63. Were they really going to just melt the steam generators and make zippers radioactive?**

No of course not, they wouldn't be allowed to do this even if they wanted to, which they did not. Recycling involves decontaminating the metal until it is at level where there was no risk to the public, a task that would not have been very difficult since they were not heavily contaminated.

**64. Did the contamination from the Carlsbad drum “drift downstream” to the town?**

Yes, it appears that some radioactivity escaped the plant, but it was such a small quantity that if it did drift downstream into the town (there is no evidence that anything detectable did do that) it would have made no difference to anything. The escape of americium (used in smoke detectors) and plutonium were below detectable limits.

**Conclusion**

**In his attempts to scaremonger by citing examples he not only proves that scaremongering leads to poor decision making and bad outcomes but has reminded us of the harm his own previous tours of misinformation have done.**