CCNR Comments on the Project Description of the MMR (Micro Modular Reactor) proposed to be constructed and operated at the Chalk River site.

The Canadian Coalition for Nuclear Responsibility (CCNR) has concluded that the existing Project Description is extremely simplistic and entirely unsatisfactory, amounting to little more than a cursory overview of the project in a very superficial manner. Measurements and dimensions of the fuel and details of the core geometry are absent, quantification of pressures, temperatures, and rates of flow are missing, even the level of enrichment of the fuel is unspecified. There are few details given regarding the construction of the MMR, when it is non-radioactive, but there is no detail at all provided for the much more challenging job of dismantling the radioactive structure without benefit of a decades-long cooling-off period that has been advocated by Canadian utilities such as Ontario Power Generation, Hydro Quebec and NB Power, prior to the dismantling of their reactors. The Project Description also fails to discuss the behaviour of the reactor core under any specific accident scenarios.

A far more detailed project description should be required by the CNSC, along the lines of the 2009 CNSC regulatory document entitled **CONSTRUCTION LICENCE APPLICATIONS FOR NUCLEAR POWER PLANTS: GUIDELINES** dated June 2009. There should unquestionably be a thorough environmental assessment of this MMR, the first reactor of its kind ever proposed for Canada or indeed anywhere.

Given the paucity of information in the wholly inadequate Project Description, CCNR will limit is comments at this time (pending a more detailed Project Description) to some general comments about reactor safety, since the greatest negative environmental impact would result from a major release of radioactivity.

Nuclear Safety

As is well known, conventional fission reactors possess unique features that pose a threat to the health and safety of humans and the environment due to the enormous and highly diverse inventory of radioactive materials that are created in the core area of the reactor. The majority of these human-made radioactive elements (radionuclides) were never found in nature prior to 1939.

The radioactive waste products created by all fission reactors are of three types: (1) fission products (e.g. cesium-137, iodine-131, strontium-90), of which there are hundreds of varieties; (2) transuranic actinides (e.g. plutonium, neptunium, americium, curium), of which there are dozens, some of them remaining highly toxic for hundreds of thousands of years; (3) activation products (tritium, carbon-14, cobalt-60, radioactive isotopes of iron and nickel, and many many more). Many of the activation products that are created in the structural materials surrounding the core of the reactor have half-lives measured in the thousands or even millions of years (for example, carbon-14 has a half-life of almost 6000 years). For a list of 211 post-fission radionuclides in 10-year old spent nuclear fuel, identified by AECL, see www.ccnr.org/hlw_chart,html .

If a significant fraction of these radioactive waste materials are released to the environment enormous long-lasting damage can be done. For this reason, the Government of Canada has enacted the Nuclear Liability and Compensation Act that limits the financial liability of any nuclear reactor owner or operator in case of radioactive contamination of persons or property due to accidents or other activities undertaken at a nuclear reactor site. This law was considered necessary because insurance companied will not cover such damages – every insurance policy in North America and Europe contains a "Nuclear Exclusion Clause" that voids coverage in case of radioactive contamination caused by a nuclear accident or any other kind of radioactive release.

The CNSC has identified a severe accident in a nuclear reactor as one that releases 100 terabecquerels or more of cesium-137 to the environment. It does not matter how such a large release takes place, the harmful consequences can be severe. In a conventional power reactor, such a large release could occur as a result of a loss of primary coolant and emergency coolant, even if the fission reaction is terminated, due to leakage of airborne radioactive vapours escaping from the elaborate containment system. Alternatively, a powerful explosion damaging the core of the reactor and impairing the containment system could lead to a large release of radioactivity. Malicious acts of sabotage or warfare could also bring about large radioactive releases.

The world's first major nuclear accident took place at Chalk River in 1952, when Canada's famous nuclear research reactor, the NRX (the National Research EXperimental reactor), underwent a series of violent explosions that blew the four-tonne gasholder dome four feet through the air where it lodged in the superstructure, destroying the core of the reactor and resulting in large volumes of radioactively contaminated water being poured into sandy trenches on the Chalk River property. The NRX reactor at that time had a rated power of less than 20 megawatts of heat generation.

In Switzerland, the Lucens nuclear reactor blew itself to kingdom come in January 1969. It was another small reactor, a little more powerful than the NRX – it was designed to produce 28 megawatts of heat. The Lucens reactor was the first gas-cooled reactor to undergo a catastrophic accident. The cavern that housed the reactor had to be decontaminated and the reactor dismantled over the next few years. The plant was totally decommissioned in 1988 but the last of the radioactive waste debris was not removed until 2003 – 34 years after the accident. The reactor operated for just a few months before it self-destructed.

Without doubt, the core of any nuclear reactor capable of generating one megawatt of heat or more will eventually contain far more than 100 terabecquerels of cesium-137, and is therefore ***a priori*** capable of causing a release of more than 100 terabecquerels of cesium-137, in one form or another. Yet there is no discussion of accident scenarios at all in the MMR Project Description, other than one paragraph on page 15, where we read:

"Fully Ceramic Micro encapsulated (FCM) fuel . . . ensures containment of radioactivity during operations and accident conditions, which means that almost no fission products are released out of the fuel. Compared to most current operating reactor technologies which rely on highly specialized and complex safety systems to prevent and mitigate further releases of fission products that escape their fuel in case of postulated accidents, the MMR's fuel itself already performs the function of containing fission products during such accidents."

In other words, the proponent claims that the elaborate – and very expensive – containment systems employed in commercial power reactors, ranging from the toroidal pressure suppression chambers in the Fukushima Daichi reactors that melted down in 2011, or the stainless steel containment vessels surrounding the core, or the gigantic vacuum buildings used in all of Ontario's nuclear power stations, are not needed because the fuel itself plays all the containment functions for any conceivable circumstance.

Such a claim cannot be accepted at face value, it must be thorouighly documented and subject to extensive questioning In a public environmental assessment process.

Other Concerns

The Canadian Coalition for Nuclear Responsibility (CCNR) also considers the MMR 'Project Description' to be totally inadequate, as it does not address in any meaningful way the decommissioning of the facility at the end of its useful lifetime, nor the ultimate disposition of the various waste streams. This, despite the clear statement of intent on page 6:

"The purpose of the document is to provide the Canadian Nuclear Safety Commission (CNSC) with the information necessary to make an Environmental Assessment Determination under the Canadian Environmental Assessment Act (CEAA) 2012 [1] and to establish the requirements for the project." [emphasis added]

and again on page 15:

"The proposed Project involves the site preparation, construction, operation, and decommissioning of one MMR nuclear reactor and supporting infrastructure on a site on CRL property in Ontario." [emphasis added]

The proposed reactor will generate post-fission radioactive wastes of all kinds, from high-level waste (irradiated nuclear fuel) to a wide variety of low and intermediate level wastes. All of these waste streams will involve many varieties of human-made radioactive poisons including fission products and/or transuranic actinides and/or activation products, as previously discussed.

Since the proposed reactor is intended to serve as a prototype for eventual deployment in many isolated locations in Canada, ("in small and/or remote communities and near mines", p. 16) the details of dismantling the radioactive structure, protecting the workers, preventing the spread of long-lived radioactive dust (i.e. particulates of carbon-14 and/or alpha-emitting plutonium and other actinides) in the community, as well as packaging the wastes and shipping them off-site, must all be spelled out. Without knowing the details, how can one assess the potential for environmental contamination by the mishandling or inadequate storage of radioactive waste materials? Just as one small but very important detail: what roadway or railbed requirements will be required to accommodate the safe and secure transport of massive spent fuel flasks (70-tonnes or more) over great distances to some (unspecified) final repository?

The anticipated time delay between permanent shut-down and final final removal of all radioactive waste materials must be spelled out, along with anticipated measures to monitor and protect the radioactive wastes in the interim.

The proponent must clearly indicate any intention it may have of following the highly contentious option of "in-situ" decommissioning -- an approach that is currently envisioned for the NPD and WR-1 reactors, despite very explicit warnings from the IAEA not to utilize such a procedure except in extreme circumstances.

Summary

CCNR concludes: a full environmental assessment of this project is required, and it must be based on a much more detailed project description. Science is not a matter of wishful thinking. Environmental assessments cannot be dispensed with on the basis of untested assertions or assumptions, no matter how ardently they may be espoused by the proponents or, for that matter, by the regulatory staff.

It must be borne in mind that there have been a number of serious nuclear accidents involving small reactors (such as the NRX accident in 1952 and the Lucens reactor accident in Switzerland in 1969) where significant long-term contamination of the surroundings has occurred.

It is entirely inappropriate for CNSC or the proponent's sponsors to prejudge the environmental case without a full public examination of the potential that exists for long-term contamination of the local environment, whether that local environment is at Chalk River or at some as yet unidentified remote northern community.

Submitted on behalf of the Canadian Coalition for Nuclear Responsibility by Gordon Edwards, PhD, President, September 2019