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Supplementary Information

Oral presentation

Written submission from the Canadian Coalition for Nuclear Responsibility

Renseignements supplémentaires

Exposé oral

Mémoire du Regroupement pour la surveillance du nucléaire

In the Matter of the

New Brunswick Power Corporation, Point Lepreau Nuclear Generating Station

Application for the renewal of NB Power's licence for the Point Lepreau Nuclear Generating Station

Commission Public Hearing Part 2

May 10 to 12, 2022

À l'égard de la

Société d'Énergie du Nouveau-Brunswick, centrale nucléaire de Point Lepreau

Demande de renouvellement du permis d'Énergie NB pour la centrale nucléaire de Point Lepreau

Audience publique de la Commission Partie 2

10 au 12 mai 2022

Canada

To: Canadian Nuclear Safety Commission
From: Canadian Coalition for Nuclear Responsibility
Date: April 27 2022
Re: **Supplementary submission** on PLNGS Licence renewal

On March 28, 2022, the Canadian Coalition for Nuclear Responsibility (CCNR) filed a written submission related to serious unresolved reactor safety issues and inadequate emergency planning measures in the event of a severe core accident at the Point Lepreau Nuclear Generating Station. In that submission we made three key recommendations:

Recommendation 1

CCNR recommends that the Commissioners not grant a PROL licence for Point Lepreau for a period of more than 3 years, during which time the Point Lepreau staff and CNSC staff can work together with emergency measures people and first responders to consolidate and improve the off-site emergency plan in accordance with best practice as recommended by the IAEA. This will necessitate close collaboration with appropriate authorities in Nova Scotia and Maine.

Recommendation 2

CCNR recommends that the Commission order an independent assessment of the CNSC source term of 100 terabecquerels of cesium-137 following a severe fuel melting accident compared with the IAEA source term of 7,000 terabecquerels of cesium-137.

Recommendation 3

CCNR recommends that the Commission not approve a Power Reactor Operating Licence (PROL) for Point Lepreau for a period in excess of three years, and that the Commissioners task the CNSC staff to report back to the Commission on the merits and demerits of the 18 safety enhancements suggested by Dr. Nijhawan at the next relicensing hearing (within 3 years) for the Point Lepreau NGS.

ERRATUM*: Due to a clerical error, the list of 18 items given in CCNR's March submission and sent to the CNSC was the wrong list! Here is the correct one:*

Dr. Nijhawan's list is taken from a presentation he put together on October 1 2018. It can be accessed at : www.ccnr.org/Nijhawan_CANSAS_2018.pdf

Possible design enhancements to be considered in CANDUs to diminish the likelihood and dampen the consequences of a severe nuclear accident

1. Passive makeup of feedwater by steam driven auxiliary feedwater pumps; de-aerator location and control enhancements for automatic provision of coolant to boilers

2. Heat Transport System [HTS] overpressure protection enhancements for avoidance of uncontrolled ruptures

3. High pressure makeup of HTS inventory loss by boiloff; improved reliability of loop isolation – or means for HTS

4. Calandria vessel overpressure protection enhancements to prevent accidental voiding; moderator makeup

5. Calandria vessel structural design enhancements for retention of core debris

6. Calandria vault overpressure protection enhancements to avoid structural failure

7. Calandria vault heat removal capacity enhancements for retention of debris in CV

8. Containment penetration reinforcement for avoidance of overpressure failures

9. Containment pressure suppression improvements: intelligent dousing, local sprays and external support to coolers

10. Use of containment dousing water pool for core debris heat sink purposes in calandria vault and reactor vault

11. Instrumentation enhancements for detection of important accident parameters

12. Better PARs (Passive Autocatalytic [hydrogen] Recombiners) with alternate heat sinks and modulated recombination

13. Improved filtered venting from containment to avoid imminent structural failures

14. Emergency hookups for water and power to critical safety systems (e.g. water makeup to the boilers, reactor cooling system, moderator system, and reactor vault)

15. Improved Class 1 batteries; better definition of anticipated loads over prolonged periods of loss of AC power

16. External water makeup to a stranded fuelling machine after a LOCA

17. External water makeup and heat removal from the spent fuel bay

18. Off-site measurements of releases and correlating them to source terms; development of tools to predict doses at unmonitored locations

Inadequate Overpressure Protection

CCNR has been impressed with the writings of Dr. Nijhawan on issues bearing on severe accidents in CANDU reactors, and we are convinced that all of them are worth careful and detailed examination. As an example, we call the Commissioners' attention to item #2: overpressure protection to prevent uncontrolled ruptures in the primary heat transport system.

Since our submission was filed in March, it has become clear to us that the Point Lepreau reactor is not equipped with an adequate pressure relief system in the event of a severe overpresssurization of the primary heat transport system (HTS). This is what Dr. Nijhawan's second item refers to.

In other words, a reactor accident that causes sustained overpressurization of the HTS will lead to a rupture in the primary heat transport system due to the plant's inability to relieve that pressure. Such a rupture will make it impossible to remove the radioactive decay heat rapidly enough to prevent severe core damage, resulting in massive radioactive releases into the reactor building – through the ruptured pipes – and into the environment.

This is such a serious shortcoming that the reactor should not be allowed to operate at all until the necessary large pressure relief valves are installed. The existing valves are too small; they are unequal to the task of keeping the pressure in the HTS no more than 10 to 20 percent above the design pressure, as stipulated by the American Society of Mechanical Engineers (ASME) recommendations.

To be specific, it is well known that immediately after shutdown, the radioactive "decay heat" generated by the irradiated nuclear fuel in the core of the reactor is about 7 percent of full power heat – that is, close to 7 percent of 1800 megawatts of heat, which is 126 megawatts of heat. After two hours, the decay heat has dropped to about 20 megawatts of heat.

However, in the absence of other heat sinks (in the case of boiler dryout), the existing valves in the HTS of the Point Lepreau reactor – known as the "Degasser Condenser Relief Valves" (DCRVs) – are only able to remove about 4 megawatts of that 20 megawatts of heat that is being produced by radioactive decay, even two hours into the accident situation. Those valves are simply too small to do the job of removing all that surplus heat. This of course guarantees that there will be overheating of the fuel, overpressure of the HTS, and a rupture somewhere in the HTS.

So where will the system rupture? During the refurbishment of the reactor core, the pressure tubes and calandria tubes have all been replaced. But the Lepreau steam generators have not been replaced. Accordingly, it may well be that any ruptures in the primary cooling system due to overpressurization will occur at the “weakest link” in the chain – inside the aging steam generators.

Of course, overpressure rupture in the steam generators coupled with severe core damage would lead to uncontrolled atmospheric releases of radioactivity. The feedwater that passes through those same steam generators will carry the fission products and other radionuclides from the damaged core outside the containment boundary of the reactor, bypassing the normal filtering mechanisms.

Alternatively, if the ruptures were to take place in the core itself, due to bursting pressure tubes, the sudden pressurization of the calandria could have a devastating impact. The calandria vessel and the reactor vault are not designed to withstand such violent overpressurization. It is known that the reactor vault at Point Lepreau is already leaking, and has been leaking for many years now, so the integrity of the reactor vault subjected to such an unusual stress cannot be taken for granted.

The requirement for overpressure protection of the heat transport system is not peculiar to any particular reactor design, it depends only on the heat generated in the primary heat transport system. It is a fact that every other non-CANDU reactor in the western world has a much greater capacity to relieve pressure than the Point Lepreau reactor has, being equipped with much larger pressure relief valves. We are talking about an orders-of-magnitude difference here: two, or even more, orders of magnitude.

Until much larger and more effective relief valves are installed in the Point Lepreau reactor’s primary heat transport system, no operating licence should be granted by the CNSC Commissioners.

The regulator’s primary concern must continue to be the health and safety of Canadians and the environment. In our view, it would be unconscionable for CNSC to grant a Power Reactor Operating Licence (PROL) to Point Lepreau NGS knowing that the reactor has inadequate protectrion against HTS rupture caused by an accidental overpressurization of the system.

The basic facts outlined above can be verified by the Commissioners if they simply question those CNSC staff people who have a specialized and detailed knowledge of the existing pressure relief valves in the Point Lepreau reactor, their placement and their characteristics.

Recommendation 4

CCNR recommends that the Commission not approve a Power Reactor Operating Licence (PROL) for Point Lepreau unless and until fully adequate pressure relief valves are installed in the primary heat transport system – valves that are in complete accordance with ASME recommendations.

Sunil Nijhawan. Opportunities and need to further upgrade CANDU reactors for improved severe accident mitigation and reduction of risk. Proceedings of ICONE-23 23rd International Conference on Nuclear Engineering, May 17-21, 2015, Chiba, Japan. www.ccnr.org/Nijhawan_Paper_2015.pdf

Whittier, Black, and Boss. CANDU CHANNEL DECAY POWER. AECL-5704. January 1977. See the graph on page 5 for decay heat as a function of time after shutdown.