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Supplementary Information

Oral presentation

Presentation from Anna Tilman

Renseignements supplémentaires

Exposé oral

Présentation de Anna Tilman

In the Matter of

Ontario Power Generation Inc.

Application to renew the Power Reactor Operating licence for the Darlington Nuclear Generating Station

Commission Public Hearing
Part 2

November 2-5, 2015

À l'égard de

Ontario Power Generation Inc.

Demande concernant le renouvellement du permis d'exploitation pour la centrale nucléaire de Darlington

Audience publique de la Commission
Partie 2

2-5 novembre 2015

Canada

Oral Presentation to the Canadian Nuclear Safety Commission (CNSC)

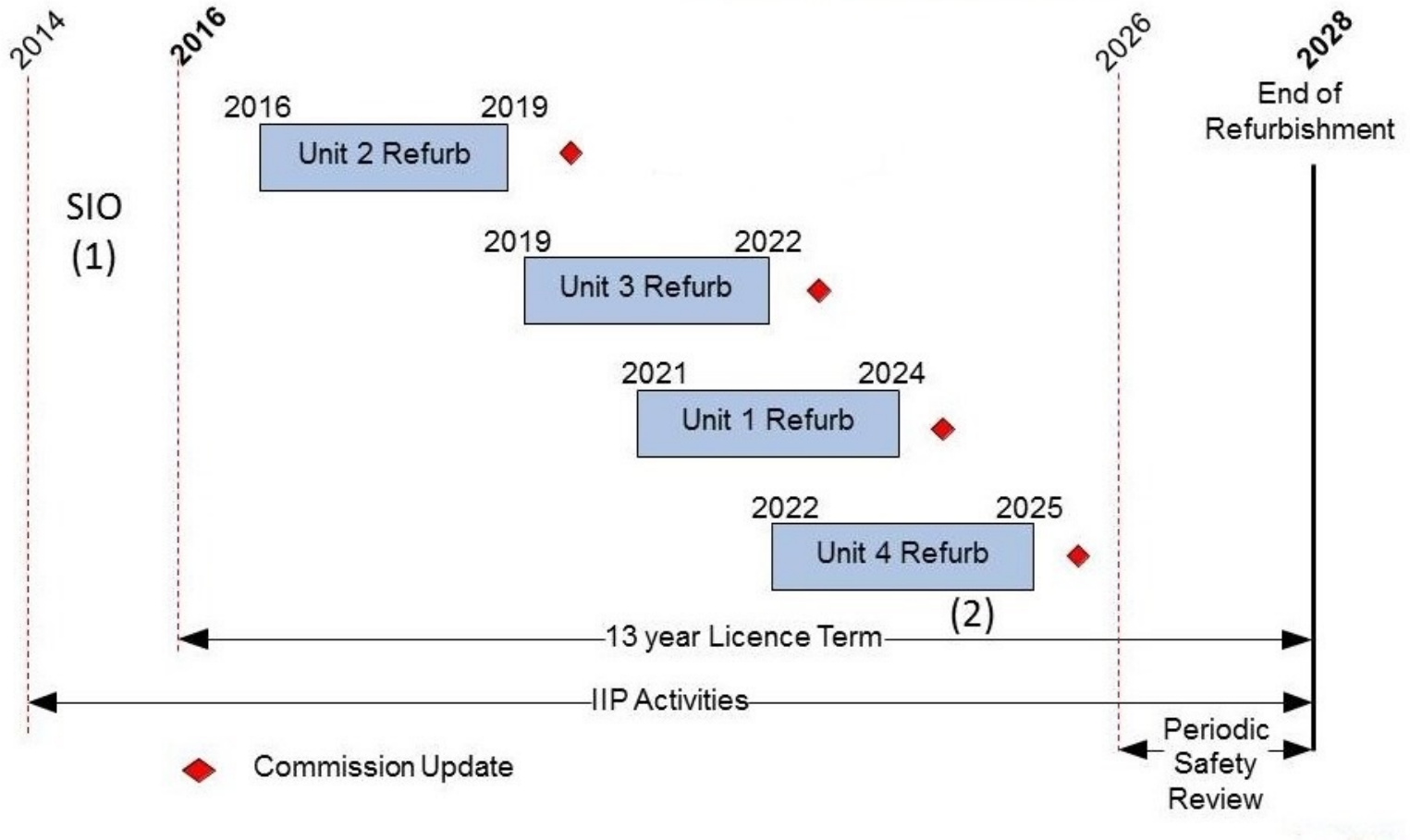
Re OPG's Application for:

Renewal of the Operating Licence for the Darlington Nuclear Generating Station for a 13-year term

November 4, 2015

Anna Tilman and R. Gordon Albright

Refurbishment Timelines



Scope of Refurbishment

- **OPG: Key activities include: replacement of fuel channels, feeders, calandria tubes, and end fittings; turbine generator upgrades; and cleaning the steam generators.**

  The goal is to enable the Darlington station to operate for an additional 25 to 30 years.

- **The greatest causes of problems in CANDUs:**

  Aging of fuel channels

  Steam Generators

Steam Generators (SGs)

- **SGs are the primary radioactive/non-radioactive barrier. If the integrity of this barrier is broken, radionuclides will be released to environment.**
- **After 25 years of operation, SGs are degraded - clogging of pipes, fretting, corrosion, cracking, etc.**
- **OPG is not intending to replace the SGs. Instead, it is relying on routine maintenance and cleaning (waterlancing) to keep them operating.**
- **There is no evidence that this approach will work.**
- **What is the rationale for not replacing the SGs? Is it financial? Technical? What happens if they need to be replaced at a later stage?**

Pressure Tubes (PTs)- Fitness for Service

- Prone to aging from weight of fuel bundles, high temperatures, pressure, and radiation fields.
- Over time, tubes increase in length and diameter (creep), walls thin out and sag, and can contact outer calandria tube.
- Embrittlement of the metal walls due to corrosion and absorption of hydrogen causes delayed hydride cracking (DHC), and an increased chance of rupturing.

Pressure Tube Safety

- According to OPG, the PTs are safe to operate to at least 235k EFPH (which is beyond the target service life of 210k EFPH).
- CNSC concurs – 235k EFPH is not a “cliff-edge”.
- What data support this contention?
- Safety issues in extending the EFPH:
  - Inspections that require shutdowns increase the likelihood of fracturing.
  - Prior damage to PTs: (e.g., Unit 2 is the oldest unit, but has the least number of EFPH).
  - Delays in the refurbishment schedule could lead to exceeding 235k EFPH (e.g., Units 1 and 4).

Radiation Dose Limits

- **A no-threshold response to radiation means there is no threshold dose below which the risk of tumor induction is zero (BEIR VII Report). Any level of exposure to ionizing radiation can cause harm.**
- **Regulatory limits of exposure to radiation:**

  Public: 1 mSv/year

  Nuclear Energy Worker (NEW): 100 mSv/year, maximum of 50 mSv per year.

  These limits are <u>allowable</u> levels of exposure - <u>not</u> health limits.

- **Administrative Dose Limits (ADLs) - OPG:**

  Contract workers: 40 mSv/year, double the ADL for NEWs.

Worker Health & Safety

- All phases of refurbishment impact heavily on workers.
  - Routine maintenance and repair work will need to be carried out on pressure tubes, feeder pipes, garter springs, etc, with increasing frequency as these components age.
  - Some of the most dangerous work may need to be done manually, for example, the cutting and grinding of feeder tubes, and inspections of the feeder pipes.
  - Because the reactors will be shut down for a short time (6 months to a year) before refurbishment, radiation fields will be much higher than when the refurbishment was done at Bruce A (~ 9-year shutdown).
- All this can result in greater external and internal exposure of workers to ionizing radiation.

Worker Health & Safety

- **The majority of the refurbishment work for each of the four reactors would be carried out by contract workers, who will likely be doing these jobs repeatedly. This could result in high total exposures to radiation.**
- **What training will the contract workers receive? Will the hazards of the work and the potential for accidents be addressed? Will the risks of exposure to radiation be properly explained?**
- **Will these workers have the option to opt out of a task if they feel that it is too dangerous?**

Nuclear Waste
An Insurmountable Problem

- **Refurbishment waste: Retube waste, which will contain significant amounts of ILW, similar to HLW, is to be stored in a re-tube facility on site for 25 years and then transferred to OPG's WWMF and then….OPG's *proposed* DGR?**
- **Decommissioning waste: L&ILW to be stored in the proposed DGR (which will have to be at least doubled in capacity); Spent fuel (HLW) – stored in bays on site and then shipped to a yet-to-be determined site???**
- **Operational waste: Thirty more years of all types of radioactive waste will be generated …..**

and no safe solution has yet been found

CNSC Study
Consequences of a Hypothetical Severe Nuclear Accident

Findings:

- **For all scenarios, doses would decrease rapidly with distance from a plant;**
- **For some scenarios, evacuations up to 3 km would be needed;**
- **Childhood thyroid cancer was the only radiation-induced cancer distinguishable from baseline levels.**

Comments on CNSC Study

- **The study was based on an unrealistic "source term" that predicts radioactive releases that are far below those for a severe nuclear accident, such as Chernobyl and Fukushima.**
- **The consequences could be far more severe than the study indicates, especially considering that 10 reactors are close to a very large population.**
- **These findings give a false sense of security to communities in close proximity to the reactors.**

Probabilistic Safety Analyses (PSAs) - Limitations

- **It is impossible to foresee everything that could cause a serious nuclear accident.**

  WIPP: failed to consider the possibility that a container could be breached by a reaction within it.

- **It is impossible to determine the probabilities of all accident scenarios that are foreseen.**

  In any case, the probability of a given event does not predict when it will happen.

Emergency Preparedness

If a severe worst-case nuclear accident happened today, are essential emergency measures in place?

- **Are public alarm systems adequate and fully functioning?**
- **Are evacuation plans able to safely evacuate and provide shelter quickly, especially if there is an early release?**
- **Is the sheltering sufficient and safe (i.e., airtight) to protect against external radiation?**
- **Has the evacuation of thousands more workers on site during refurbishment been taken into account?**
- **Are there adequate provisions and trained personnel to provide safe food and water, and health care?**

Emergency Preparedness

- **Are the emergency planning zones (10, 50 km radius) adequate or appropriate in the event of a major accident?**
- **No one can predict how far a radioactive cloud could spread. Does emergency planning take into account changes in wind direction, dispersion and deposition of radiation beyond these zones that would require further evacuation, as happened at Fukushima?**
- **Will KI pills be made available beyond 50 km in time to cover the most vulnerable, especially children, affected by radiation?**

  Chernobyl – higher than expected thyroid cancer rates were found more than 200 km from the nuclear plant.

Emergency Preparedness

- **A lesson from Fukushima:**

  “There was an implicit assumption that such a severe accident could not happen and thus insufficient attention was paid to such an accident by authorities.”

  Toshimitsu Homma, Japan Atomic Energy Agency
  IAEA Regulator`s Conference, Ottawa, April 2013

- **Darlington:**

  The current state of emergency preparedness is far from adequate, because the danger of a severe nuclear accident is not being taken seriously.

Previous Refurbishments

Bruce A Unit 1

Alpha Contamination Incident – 2009

- **Over 550 trades workers internally exposed to alpha radiation.**
- **Cutting & grinding feeder pipes – airborne radioactive particulate released.**
- **Not required to wear respiratory protection, no alpha monitoring in place.**
- **Independent review (19 recommendations).**

Bruce A Unit 1 (cont'd)

Root causes of Incident:

- **A fuel channel crushing accident in 1979 during re-fuelling resulted in a large deposition of fission products, causing a five-fold increase in radiation fields.**
- **Inadequate oversight. Mindset that "*alpha is always a very small fraction of beta/gamma hazard*" delayed response. Overall absence of a strong safety culture.**

Costs:

- **Duncan Hawthorne, CEO Bruce Power stated that " he recalled saying that in 2005 the project would come in on time and on budget. Instead, it took twice as long and cost twice as much."**

Point Lepreau

- **Faulty (leaky) new calandria tubes, needed to be replaced twice.**
- **Alpha contamination confirmed at Pt. Lepreau Feb. 2009 during refurbishment: (CNSC hearing Dec. 2009) - not reportable to the CNSC because the predicted dose was below NBPN action levels.**
- **Did not include full replacement of steam generators –the weakest link in the primary cooling circuit.**
- **Refurb waste – greater volumes than anticipated**
- **Delays and cost overruns, negative effects on workforce, community.**

Pickering

- Re-tubing (essentially refurbishment) done twice for two reactors
- Not worth the exorbitant cost
- As a result:
  - 2 units (Pickering A) taken out of service
  - Decision not to refurbish Pickering B

Refurbishment Experience
Lessons?

- A long history of cost overruns and delays.
  - Estimates are always unrealistic
  - Darlington (6-12 billion? Probably much more.)
  - Hidden costs – breakdowns, lengthy delays, replacement power, human health & environment
- Adds to the intractable problem of radioactive waste.
- Ultimately the costs are borne by the public.

Concluding Remarks

Refurbishing the Darlington units to keep them operating for another thirty years is not an option.

- **It is a very dangerous, extremely costly undertaking, and very unlikely to be done in the timeframe that OPG indicated. The longevity and safety of refurbished units is highly questionable.**
- **It is unnecessary. It impedes the shift to renewable energy alternatives and conservation measures, all of which are far cleaner, safer and much less costly, and do not produce the legacy of waste that nuclear energy does.**

Recommendations

Therefore, we urge the Commission to reject OPG's proposal for a 13-year licence renewal that includes the refurbishment of its 4 reactors.

Instead, we recommend that the Commission issue OPG an operating licence for 4-5 years, during which time decommissioning plans are to be further developed to prepare for the closure of the Darlington Nuclear Generating Station.