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Presentation from

Xylene Power Ltd.

In the Matter of

Ontario Power Generation Inc.

OPG's Deep Geological Repository (DGR) Project for Low and Intermediate Level Radioactive Waste

Joint Review Panel

September 2014

Présentation de

Xylene Power Ltd.

In the Matter of

Ontario Power Generation Inc.

Installation de stockage de déchets radioactifs à faible et moyenne activité dans des couches géologiques profondes

Commission d'examen conjoint

septembre 2014

Canada

GRANITE DGR PRESENTATION

1. This presentation focuses on reasons why the DGR should be high, dry, accessible and formed in granite instead of low, wet, inaccessible and formed in limestone as is currently advocated by NWMO and OPG.

2. The atmospheric CO2 concentration is rising. When the atmospheric CO2 concentration reaches 650 ppmv to 800 ppmv there will be a life threatening rise in atmospheric temperature due to a rapid fall in planetary albedo. This temperature increase will be irreversible due to CO2 released via ocean warming;

GRANITE DGR PRESENTATION

3. Prevention of this temperature rise requires abandonment of fossil fuels. Widespread application of nuclear power will be required to provide replacement energy;

4. Only U-238 fueled fast neutron breeder reactors are able to provide sufficient energy for sustainable total replacement of fossil fuels at an acceptable price;

5. Fast neutron breeder reactors require high, dry and long term accessible granite DGRs for fuel and material recycling;

GRANITE DGR PRESENTATION

6. The work necessary to replace fossil fuels with nuclear power is large but is manageable if started now. The biggest single obstacle is education.
7. Off-peak non-fossil electricity generation capacity must be used for displacement of fossil fuels and synthesis of hydrocarbons from water and biomass instead of being constrained off as at present;
8. Presently in Ontario there is a potential cash flow of about $22 billion per year available to pay for this work. ($2 billion displacement, $20 billion synthesis)

PHYSICAL LAWS

1. Physical laws are reliably independent of position and time;
2. Physical laws supersede government policy and political directions;
3. An important physical law is the Law of Conservation of Energy;
4. Many parties, including politicians and OPG executives, are confused by misleading media advertising funded by fossil fuel producers.

RESPONSIBILITY

1. It is the responsibility of professional engineers employed by OPG and the NWMO to advise their superiors in writing when the directions that the engineers receive are not consistent with physical laws and / or public safety;
2. There is no excuse for lack of relevant knowledge. Just because the relevant branch of physics was dropped from the engineering curriculum does not relieve professional engineers of responsibility for public safety;

RESPONSIBILITY

3. The energy plans of both the Canadian federal government and the Ontario government are not consistent with CO2 emission reductions required for continuing human life on this planet, but still OPG and NWMO employees blindly follow their respective political directions.
4. OPG and the NWMO should abandon their irresponsible plans for dumping unprocessed and inadequately contained nuclear waste into inaccessible holes that over time will become waterlogged toxic messes.

UNIFORMED DECISIONS

The proposed DGR locations were selected by NWMO and OPG without proper consideration of:

1. Use of fast neutrons to reduce nuclear waste half life 1000 X and increase energy capture from uranium 100 X. The FNRs need accessible DGRs.
2. Long term exclusion of water. The practical problems that occur if the DGR floods and water mixes with radioactive material have been demonstrated at Fukushima Daiichi.

UNINFORMED DECISION

3. Input with respect to atmospheric locally stable states and the approach of the state transition point of rapid temperature increase which occurs at an atmospheric CO2 concentration in the range 650 ppm to 800 ppm.(nominally 722 ppm);
4. The consequences of the resulting rapid temperature increase, including polar icecap melting and human extinction.

LOCAL STABILITY

1. A physical system can have multiple states of local stability. eg Railway train, ship.
2. Demonstration of multiple locally stable states using a rubber ball, a saucer and a dinner plate.
3. The Earth's atmosphere has two locally stable states, the normal state and the PETM like warm state.
4. Normal state CO2 = 280 ppmv, T ~ 269 K

Warm state CO2 ~ 2200 ppmv - 2800 ppmv, T ~278 K

5. On dry land warm state ~ 17 C higher than normal

STATE SPLITTING

1. Primary cause of state splitting is change in planetary albedo Fr at emission temperature T = 273.15 K
2. Secondary cause of state splitting is the strong dependence of atmospheric CO2 concentration on average ocean temperature. As ocean warms 10 degrees C atmospheric CO2 concentration rises ~10 X and ocean emits CO2 gas similar to warming of a soda drink.
3. A rapid temperature increase commences at the transition point between the two locally stable states

WARM STATE

Paleocene-Eocene Thermal Maximum (PETM) 55.5 million years ago is revealed by mass spectrometry of fossils and ocean sediments

-20,000 years warm

-200,000 year time constant for recovery

-500,000 year recovery

-polar icecaps completely melted

-extinction of all animals larger than a mole

-bio-matter and fossil fuels burned to become CO2

CONCLUSION

In order to keep the atmospheric CO2 concentration under 650 ppm and hence prevent a global extinction HUMANS MUST ABANDON FOSSIL FUELS

Many people are in agreement but they have no comprehension of the practical steps that are necessary to achieve that goal.

ASTRO-PHYSICAL CONSTRAINTS

1. Present atmospheric conditions: (CO2 = 402 ppmv, emission temperature = 270.5 K);
2. Present rate of increase of atmospheric CO2 concentration (~3 ppmv / year);
3. Global warming (emissivity): 3 deg C / (2X CO2);
4. Change in phase of water at 273.15 K = 0.00 C;
5. Change of locally stable state (thermal runaway) due H2O phase change and hence albedo change of dominant clouds.

TIME TO RAPID TEMPERATURE INCREASE

At present rate of increase of atmospheric CO2 concentration:

(722 ppmv – 402 ppmv) / (3 ppmv / year) = 106.6 years

At projected rate of increase of atmospheric CO2 concentration:

(722 ppmv – 402 ppmv) / (5 ppmv / year) = 64 years

FAILURE TO MEET THIS TIME CONSTRAINT MEANS THAT EVERYONE DIES

DISPLACEMENT OF 80 X 10^6 Barrels Per Day Of Petroleum Now

WORLD WIDE: 20X existing installed nuclear capacity

ONTARIO: 3X existing installed nuclear capacity.

IN 60 YEARS:

WORLD WIDE: 40 X existing installed nuclear capacity

ONTARIO: 7X existing installed nuclear capacity

REACTOR CONSTRAINTS

- Not practical to locate 14 new DGRs in Ontario every 60 years, dilution of pollution not sustainable
- Not enough U-235 in the world to sustain 40X present nuclear power production
- New reactors must run with U-238 fuel which is 140X more available than U-235, also Th-232
- Requires new robot assembled FNRs with fuel & neutron irradiated material recycling
- Requires liquid metal pool reactors to maximize reactor life and minimize formation of Ca-41 and Cl-36

PROBLEM ISSUES TO BE FACED

Transportation of highly radioactive materials

~ 11 tonnes of plutonium per reactor

Th-232 breeding yields concentrated U-233

Olympic swimming pool volume of liquid sodium requiring ongoing exclusion of air and water

Prevention of smart bomb and like attacks

Prevention of plutonium theft (need He-3)

Public & specialist education

Procrastinating politicians

SPECIALIST TRAINING

A huge problem facing implementation of breeder reactors and related DGRs is training of senior engineers. Due to 50 years of Canadian government under funding the best people have pursued parallel careers in microelectronics, control engineering, biomedical engineering, patent law, etc. Those who have directly relevant experience in FNR design and related radio chemistry are already past retirement age. Educating a new team will be an expensive and time consuming challenge.

FNR DGR OPERATIONAL ISSUES

Need secure accessible categorized storage of:

-Existing spent CANDU fuel

-Existing radioactive Ni steels

-Existing zirconium

-existing H-3 / He-3

-Extracted uranium

-Extracted actinides including plutonium

-Low level waste

-Long lived low atomic weight isotopes

DGR SITE REQUIREMENTS

Secure against malevolent attack;

400 m of top rock for glacier protection;

300 m above local water table;

Need a land accessible crack free granite core mountain for long term structural stability and to provide backup radio isotope isolation;

Affordability;

Need agreement with host province/aboriginal organization.

SITE SELECTION CONSIDERATIONS

- Geophysically Jersey Emerald is the best DGR site in Canada – 5000+ documented drill cores through limestone cover into granite
- Due to failure by OPG / NWMO to make a $2 million deposit in 2013 control of the mine workings has been acquired by Margaux Resources (Hong Kong investors)
- Margaux Resources now seeks a LOT MORE than the $67.5 million sought by Sultan Minerals Inc. in 2013

NUCLEAR WASTE CONTAINERS

- Main barrier to radio isotope escape
- Extremely long life
- Durable
- Individually remotely monitored
- Double wall steel inside porcelain construction with radiation resistant oil dielectric
- ~ 10 tonnes per container

STORAGE CONTAINER