



## DEEP GEOLOGIC REPOSITORY PROJECT JOINT REVIEW PANEL

### RESPONSE TO INFORMATION REQUEST EIS-13-515

#### INFORMATION REQUEST EIS-13-515:

Provide a brief description of the recent incidents at the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. Include an explanation of the relevance of these incidents to worker and public health and safety (both occupational health and safety and radiation protection requirements) at the proposed DGR under normal and accident conditions.

Describe how the consequences of such incidents might or might not fall within what OPG modeled for its analysis of accidents, malfunctions, and malevolent acts.

**RESPONSE:** Section 1 provides an overall summary of CNSC's response to the JRP's IR including a description of the event, and the sources of information reviewed. Section 2 and 3 provide further details of CNSC staff's assessment of the fire event underground and the contaminant release underground respectively.

#### 1. SUMMARY

Consideration of events at nuclear facilities worldwide for their potential relevance to Canadian nuclear facilities form an important part of an operating experience (OPEX) program. CNSC licensees are required, as a part of this program, to have processes that identify such events, consider the causes of these events, and to assess potential improvements to enhance worker safety and the protection of the public and the environment. Licence applicants are also required to consider such operating experience in the development of their project, and include how this experience is being applied in their licensing submissions.

#### Background

CNSC staff has examined information related to the two recent events that is posted by the on the U. S. Department of Energy's (DOE) Waste Isolation Pilot Project website (<http://wipp.energy.gov/wipprecovery/recovery.html>) for the development of their response to the JRP's request. With respect to the fire event on February 5, 2014 and the contaminant release event on February 14, 2014, CNSC staff has considered specifically the following information, which is available on the WIPP website:

- Accident Investigation Report – Underground Salt Haul Truck Fire at the Waste Isolation Pilot Plant February 5, 2014 [1]; and



- Accident Investigation Report – Phase 1 Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014 [2],

Both reports were prepared by an Accident Investigation Board that was appointed by the Deputy Assistant Secretary of Safety, Security, and Quality Programs in the U.S. Department of Energy (DOE), the Office of Environmental Management. Further, updates provided on the WIPP website up to the date of May 5, 2014, were also used to assist in identifying a possible cause for the contaminant release event. It is noted that the Accident Investigation Report – Phase 2 is expected to identify the actual cause of the release and is currently in development.

### CNSC Staff's Assessment

#### i) Health and Environmental Impacts

The WIPP event investigation report assessed the fire event that occurred on February 5, 2014 at the Carlsbad site, New Mexico. The fire event resulted in the exposure of workers to conventional fire hazards underground. There were no significant injuries to underground workers from smoke inhalation as a result of the fire event. The event had no impact on the environment.

The contaminant release event that occurred on February 14, 2014, resulted in the exposure of workers, the public and the environment to radiological contaminants released from packaged wastes located underground. With respect to the contaminant release event, the workers present were at ground surface of the facility and received a small dose, conservatively assessed to be less than 0.1 mSv well below the regulatory limit for workers is 50 mSv per year. Environmental monitoring confirmed there was no contamination of soil and water from the alpha emitting radionuclides (americium-241 and plutonium-238, 239, and 240) that were released from WIPP's transuranic waste. The estimated dose to an off-site member of the public from the release to air ranged from 0.001 to 0.003 mSv, several orders of magnitude below the regulatory dose limit for the public of 1 mSv per year.

#### ii) Comparison to DGR Safety Case

Events similar to the WIPP events (fire and a release from a waste package underground) have been recognized as credible accidents or malfunctions in OPG's Environmental Impact Statement (EIS) for the DGR project. The possible impacts of fire and a release of radionuclides from a waste package due to a variety of causes have been conservatively bounded in the assessments provided in the EIS. Non-radiological releases from a fire were determined to have no significant adverse impact on the public or the environment. Calculated doses to the public from a radiological release associated with a fire or other accident resulting in failure of a waste package (radionuclides associated with the DGR waste are carbon-14 and tritium) are conservatively calculated to range from 0.02 to 0.004 mSv, orders of magnitude below the 1 mSv per year regulatory limit for the public. For workers in close proximity to the release, the doses are expected to vary from 0.01 to 6 mSv, well below 50 mSv per year regulatory limit.



Based on the available information on the WIPP events, CNSC staff is satisfied that there are no new environmental consequences or impacts that OPG should be considering in the DGR project safety case. Similar events were appropriately considered in OPG's assessment of potential impacts to workers, the public, or the environment that has been presented in the EIS. Sections 2 and 3 that follow provide additional details.

### iii) Comparison to DGR Control Measures

Information in the WIPP reports also describes the functioning of systems, equipment, programs, and procedures that are part of the WIPP safety case. No additional necessary control measures and mitigations were identified in the WIPP reports. It is clear from the reports that if the control measures and mitigations already in the WIPP safety case had been fully effective, both events could have been avoided or had reduced consequences.

### iv) Lessons Learned on Safety Culture

The accident investigation report for each event includes information on the actions of workers, the available programs and procedures; and the performance of the facility systems and equipment at the time of each event. The reports clearly indicate causes (they may be direct, root, and contributing) of these incidents related to problems with implementation of operating programs and procedures. The WIPP reports make very clear the importance of: a good quality management system; adequate oversight by both management and regulators; the importance of maintaining the operational safety case over the lifetime of the facility; and the importance of worker training and safety culture in all areas of waste repository operations. While the problems experienced at WIPP, as described in the reports, did not result in injury to any worker or impact the public; workers could have been very seriously affected. CNSC staff have already noted in their Licensing PMD 13-P1.2 the importance of the management system (including safety culture) and the importance of treating the DGR as both a waste management facility and an operating underground mine. The lessons learned from the WIPP events have confirmed these areas remain important over the entire life-cycle of a DGR.

## Conclusion

CNSC staff have presented information on the results of their overall assessment of OPG's EIS and licence application in PMDs 13-P1.3 and 13-P1.2 respectively [3][4]. CNSC staff remains satisfied that OPG has adequately assessed the impacts of fire and other accidents and malfunctions, and that radiological releases would not result in significant impacts to workers, the public and the environment. CNSC staff also concludes that the control measures and mitigations identified are appropriate to prevent or reduce the likelihood of such events. The WIPP events do not affect CNSC's assessment that the DGR is not likely to cause significant adverse effects to workers, the public or the environment with the proposed mitigations. Nor do the events affect staff's assessment of the licence application and the conclusion that OPG is qualified to carry on the activity of site preparation and construction requested by the



application, and that adequate provisions will be in place for the protection of the environment, the health and safety of persons and the maintenance of national security.

What the WIPP events provide for the DGR project, if it is licensed, is operational experience that must be assessed and where appropriate, considered in the detailed systems, programs, and procedures developed by the licensee for each phase of licensing. The relevancies from the WIPP events centre on the adequacy of implementation of the programs, and on management oversight of the activities engaged in by their staff and by contractors. Should OPG be issued a licence to prepare the site and construct the DGR, conditions in the proposed licence requires that program details be in place and assessed by the regulator before proceeding with licensed activities. The CNSC will verify during all licensing phases, like the operating phase, how OPG has considered the causes of the WIPP events or other future events, through their operating experience programs and how OPG has addressed related concerns into the DGR project so that similar problems do not occur.

CNSC staff will continue to follow the WIPP website, looking specifically at any further reports on these incidents. CNSC staff will provide an update to the JRP at the planned public hearing should any new information be made available that substantively change the information provided here.

## **2. FIRE EVENT - FEBRUARY 5, 2014**

**Description of the Event and Response:** CNSC staff has summarized the information related to the underground fire event as follows:

### February 5, 2014

- At about 10:48, while in the process of lowering the bed of the dump section of a diesel powered truck used for hauling salt for mine development, the Operator observed a fire between the dump and engine sections. The Operator emptied a portable extinguisher into the area of the fire, and then manually activated the fire suppression system on the vehicle. With smoke present, the Operator notified Maintenance and his Supervisor on a nearby mine phone. On overhearing the conversation, two U/G (underground) services workers left the U/G services office to assist the operator. The workers brought a large, wheeled extinguisher, carbon monoxide monitors, and self-rescuers.
- At 10:51, after a call from the U/G service office, the Central Monitoring Room Operator (CMRO) sounded the emergency evacuation alarm and announced on the U/G public address system there was a fire (no location given) and that personnel were to evacuate via their area egress points. A subsequent announcement identified evacuation by the waste hoist. The alarm and instruction was not heard or understood by all U/G workers, and the activation of emergency egress lights was delayed.



- By 10:52 the Operator, the Supervisor and the two U/G service workers decided the carbon monoxide level near the fire was too high and left the area.
- At 10:58, the CMRO was directed by the Facility Shift Manager (FSM) to change the ventilation system operation to the filtration mode. This changed the direction of smoke and confused many U/G workers making way to the waste hoist. Workers assisted others during the evacuation.
- At 11:01, the first evacuation via the waste hoist was in process.
- At 11:03 the FSM activated the Emergency Operations Centre (EOC) but did not immediately classify the event as an operational emergency.
- At 11:11 am the FSM contacted Mine Safety and Health Administration (MSHA) and the State Mine Inspector; suspended surface waste activities (11:15), and at 11:20 activated the Mine Rescue Team (MRT).
- At 11:25 the second trip of U/G workers to the surface was made.
- At 11:34 the third and last trip, including full accountability of U/G workers was completed.
- At 11:47 the U/G ventilation was secured.
- Beginning at 17:22, mine rescue teams entered the U/G to perform checks of air quality, etc., respond to any evidence of fire, and confirm the fire hazard over.
- By 23:00 pm following discharges of portable extinguishers and foam fire suppressant the fire at the vehicle appeared out.

#### February 6, 2014

- At 00:59 the next day the MRT arrived back at surface.
- By 01:05 the event was terminated. Several workers (6 in total) were treated for smoke inhalation during the event, but no injuries occurred.

#### **Consequences of a Fire Event in the DGR Project Assessment:**

The Malfunctions, Accidents and Malevolent Acts Technical Support Document [5] for the proposed DGR identified a vehicle accident fire during the site preparation and construction phase and the operations phase as a credible non-radiological accident for the DGR project. OPG considered the non-radiological effects on the environment. No on- or off- site adverse effects on the environment were identified. No effects on members of the public were identified. OPG also considered the hazards to workers during a fire and identified applicable mitigations to protect workers.



Although the WIPP fire did not result in radiological releases, a fire scenario with a release of radioactive material was also considered by OPG for the DGR project. The Malfunctions, Accidents and Malevolent Acts Technical Support Document (TSD) identified an underground fire scenario, which includes a vehicle accident fire, during the operations phase as a credible radiological accident related to the DGR project. The scenario was defined as “external fires may cause the contents of some waste packages to ignite and burn, mainly Low Level Waste and unshielded Intermediate Level Waste packages. Shielded Intermediate Level Waste packages are unlikely to ignite, but the heat from an external fire can cause release of steam and volatile species.” This scenario was considered credible, though unlikely with the mitigations and controls proposed. The underground bounding scenario of an In Room Unshielded Waste Package Fire for Non-Processible Drummed Waste and Moderator Resin (Unshielded) Waste had the highest potential radionuclide dose to the public of 0.02 mSv. This is well below the public dose limit of 1 mSv per year. In addition, the underground bounding scenario of a Shielded Intermediate Level Waste Package Steam Release for Moderator Resin had the highest potential radiological dose to workers of 0.3 mSv. This is well below the worker dose limit of 50 mSv per year.

These scenarios are conservatively assessed, and doses from such an event would be lower than calculated. The dose significant radionuclide that could be released from the DGR wastes during a fire event are tritium; forming over 99.9 % of the dose to the public. The radionuclides contributing to the very small amount of remaining dose are Sr-90, Co-60, Cs-137 and C-14. Adopting a high efficiency particulate air filtration system on the underground exhaust, as is present at WIPP, would not reduce the tritium related dose associated with the release in any appreciable way.

OPG plans and commitments in the EIS and licensing submission include control measures and mitigations to reduce the likelihood of a fire event and its possible consequences to workers, the public, and environment. The measures include the following:

- Quality management system (includes defined roles and responsibilities, defined policies and programs, safety culture, etc.)
- Fire hazard analysis;
- Fire detection, and suppression system and equipment;
- Emergency response and mine rescue capability;
- Emergency drills and exercises;
- Minimization of combustible materials and ignition sources;
- Access to refuge stations, multiple exits and safety equipment;
- Emergency communications and annunciation systems;
- Emergency equipment on mobile vehicles;
- Fuel dispensing procedure;
- Housekeeping;



- Hot work permit;
- Safe work code of practice;
- Fire protection program
- Human performance program
- Inspection and maintenance program;
- Change management;
- Worker training (U/G safety, emergency response, equipment use).

OPG's control measures and mitigations closely reflect the ones described for the WIPP facility fire event. The WIPP description included controls and mitigations as: a fire protection program with fire hazard analysis; emergency management program with fire response procedures; safety programs (safety management, conduct of operations implementation, human performance improvement); on-vehicle fire suppression; portable fire extinguishers; mine phone and annunciation systems; fire doors; emergency breathing equipment; filtration on underground exhaust; and an inspection and maintenance program.

#### **Relevance of the WIPP Fire Event to the DGR Project:**

The WIPP fire event provides operational experience (OPEX) that the CNSC expects OPG to consider throughout the various phases of the DGR project. A fire in a vehicle underground is a recognized potential hazard for the DGR that would be strictly a conventional (non-radiological) incident during the construction period, but if occurring during the operational phase when vehicles carry waste packages could include a radiological component with the conventional hazard. The DGR project does not plan to engage in both construction and operational activities simultaneously. In contrast, construction and operational activities do take place simultaneously, at the WIPP. Regardless, CNSC staff have identified during their reviews the importance of considering the DGR both a nuclear facility and an operating underground mine so that conventional and radiological hazards are fully addressed and considered together.

The relevance of the various causes identified by the Investigation Board for the WIPP fire event to the DGR project will be affected by differences in: the stage of development; the facility management and regulatory frameworks; the radioactive wastes; and in the pre-closure safety cases. The CNSC expects OPG to review and apply the relevant lessons learned from the WIPP fire incident to the DGR project. CNSC staff has completed a preliminary examination of the causes identified in the investigation report and has made preliminary comments on relevance to the DGR project. This information is summarized in Table 1 of this response. Should OPG be issued a licence the CNSC will verify the application of OPEX, in particular OPG's assessment and application of the various lessons learned from the WIPP fire event to the DGR project.



**TABLE 1 – CNSC Staff Preliminary Comments regarding the Identified Causes of the February 5, 2014 Underground Fire Event at WIPP and Possible Relevance to the Proposed DGR Project**

| Causes   | Description of Cause from WIPP Investigation Report   | CNSC Preliminary Comments of Relevance to the DGR Project  |
|--|---|--|
| <b>Direct Cause</b> – immediate event or condition that caused the accident  |   |  |
| 1.   | The direct cause was identified as contact between flammable fluids and hot surfaces on the salt truck.   | <ul style="list-style-type: none"> <li>• Vehicle susceptibility to fire has possible relevance to the DGR construction, operation, and decommissioning phases.</li> <li>• OPG identifies a quality management system that includes procurement. Procurement processes include specifications for equipment.</li> <li>• Under the licence and part of OPEX, the regulatory expectation is appropriate consideration is given to susceptibility of fire in equipment specifications for procurement.</li> </ul>  |
| <b>Root Cause</b> – causal factors that if corrected, would prevent recurrence   |   |  |
| 1.   | The root cause was linked to the failure of the operating contractor to recognize and mitigate the hazards regarding fire in the underground including: recognize and remove combustibles during inspection and preventative maintenance; decision to deactivate on- vehicle automatic fire suppression system. | <ul style="list-style-type: none"> <li>• Contractor qualification has relevance, particularly in construction as OPG plans to contract, though in operation OPG plans to be the operator.</li> <li>• OPG identifies a quality management system to CSA N286 that includes procurement. Procurement processes include specifications for contractor qualifications.</li> <li>• OPG and the licence require contractors to apply a quality management system to CSA N286.</li> <li>• Under the licence and as part of OPEX, the regulatory expectation is appropriate consideration is given to contractor qualifications and contractor programs and procedures in areas as inspections and maintenance.</li> </ul>                               |
| <b>Contributing Causes</b> – events or conditions that collectively increased the likelihood or severity of the accident but individually did not cause the accident |   |  |
| 1.   | The preventive and corrective maintenance programs did not prevent and correct the buildup of combustible fluids.   | <ul style="list-style-type: none"> <li>• Contractor oversight of workers has relevance, particularly in construction as OPG plans to contract the construction; as the licensee in construction OPG also has an oversight role.</li> <li>• OPG identifies a quality management system to a nuclear standard (CSA N286) that applies to OPG and to Contractors requires oversight of workers that includes surveillance, verification, self- assessment, audits, performance review and management review</li> <li>• Under the licence and as part of OPEX, the expectation is that appropriate consideration is given to human performance elements as safety culture, training and procedural development and use by the contractor.</li> </ul> |



| Causes | Description of Cause from WIPP Investigation Report   | CNSC Preliminary Comments of Relevance to the DGR Project  |
|--------|---|--|
| 2.     | The fire protection program was less than adequate as indicated by: changes occurring to vehicle fire suppression system; procedural implementation; accumulation of combustibles over Fire Hazard Assessment (FHA) and incomplete scenarios in fire analysis | <ul style="list-style-type: none"> <li>• The adequacy of the fire protection program and hazards assessment in change management has relevance to construction, operation, and decommissioning whether conducted by OPG or by contractors.</li> <li>• OPG identifies a quality management system to CSA N286 that applies to OPG and to Contractors requires hazard assessment and change management.</li> <li>• Under the licence and as part of OPEX, the fire protection program and FHA will reflect lessons learned and are to be provided to the CNSC for acceptance.</li> </ul> |
| 3.     | The training and qualification of the vehicle operator was inadequate to ensure proper response to fire.  | <ul style="list-style-type: none"> <li>• The adequacy of a human performance management program and a training program as it relates to fire protection and emergency response has relevance to construction, operation, and decommissioning whether conducted by OPG or by contractors</li> <li>• Under the licence and as part of OPEX worker qualifications and training will reflect lessons learned.</li> </ul>   |
| 4.     | Central Monitoring Room Operations response, including evaluation and protective actions, to the fire was less than adequate.   | <ul style="list-style-type: none"> <li>• The adequacy of the emergency response program and procedures has relevance to construction, operation, and decommissioning whether conducted by OPG or by contractors.</li> <li>• OPG identifies an emergency response program and mine rescue teams.</li> <li>• Under the licence there will be adequate training, demonstrated proficiency thought drills and exercises, documented agreements for on-site and other service providers, appropriate responses and notifications to emergencies and deficiencies.</li> </ul>                |
| 5.     | Elements of the emergency/preparedness and response program were ineffective (use of self-rescuers, communications, compliance with instructions, etc.).  | <ul style="list-style-type: none"> <li>• Relates to point 4 above</li> </ul>   |
| 6.     | A nuclear versus mine culture exists.   | <ul style="list-style-type: none"> <li>• No parallel construction and operation activities planned for the operational phase of the DGR.</li> <li>• During construction, activities of construction (mining) underground are not to adversely affect long term, DGR performance</li> </ul>   |



| Causes | Description of Cause from WIPP Investigation Report   | CNSC Preliminary Comments of Relevance to the DGR Project   |
|--------|---|---|
|        |   | <ul style="list-style-type: none"> <li>• CNSC regulation includes both radiation and conventional safety with the expectation that workers, the public and the environment are adequately protected from the potential impacts of both.</li> </ul>  |
| 7.     | Contractor Assurance System was ineffective in identifying the condition and maintenance program inadequacies associated to the event.  | <ul style="list-style-type: none"> <li>• Contractor oversight of workers has relevance, particularly in construction as OPG plans to contract.</li> <li>• OPG identifies a quality management system to nuclear standard CSA N286 that applies to OPG and to Contractors requires quality in the development of programs and procedures and oversight of workers</li> <li>• Under the licence and part of OPEX, the appropriate consideration will be given to the contractor quality management system and oversight of workers.</li> </ul>  |
| 8.     | Ineffective implementation of line management oversight programs and programs that would allow for the identification of contractor weaknesses and conditions related to the root cause of the event. | <ul style="list-style-type: none"> <li>• Roles, responsibilities and oversight of activities as it relates to the licensee and to contractors has relevance to construction, operation, and decommissioning phases of the DGR project.</li> <li>• OPG identified a quality management system to nuclear standard CSA N286 that applies to OPG and to Contractors, and to OPG’s oversight of their contractor for construction. OPG’s oversight includes surveillance, verification, self-assessment, and audits (performance review and management review).</li> <li>• Under the licence and as part of OPEX, the expectation is that the lessons learned will be reflected in the oversight of contractors.</li> </ul> |
| 9.     | Identified deficiencies in emergency management, fire protection, maintenance, oversight, work planning and control remained unresolved over periods of time.   | <ul style="list-style-type: none"> <li>• The adequacy of human performance management and worker and contractor oversight has relevance to construction, operation, and decommissioning.</li> <li>• Relates to point 8 above.</li> </ul>  |



| Causes | Description of Cause from WIPP Investigation Report  | CNSC Preliminary Comments of Relevance to the DGR Project  |
|--------|--|--|
| 10.    | Elements of programs for the operation of the facility lack rigor and discipline commensurate with a waste repository. | <ul style="list-style-type: none"> <li>• The adequacy of a quality management system to the development of programming for a nuclear facility is relevant to the construction, operation, and decommissioning of a DGR.</li> <li>• OPG identified a quality management system to nuclear standard CSA N286 that applies to OPG and to Contractors.</li> <li>• Under the licence and as part of OPEX, the expectation is that lessons learned will be reflected in the development of programs and procedures for the DGR.</li> </ul> |

**3. CONTAMINANT RELEASE EVENT – FEBRUARY 14, 2014:**

**Description of the Event and Initial Response:** CNSC staff has summarized the information related to the underground contaminant release event as follows:

February 14, 2014

- At 23:13 the continuous air monitor (CAM) located at the Waste Panel 7 exhaust drift alarmed on the central monitoring system. This is the monitor closest to the open waste panel, where wastes are being placed into underground storage during daylight hours. In response to the alarm, the ventilation system automatically switched to filtration mode; meaning dampers closed the exhaust ducts. The acting Facility Shift Manager (FSM) made the manual change so air from the underground was redirected through a bank of high efficiency filters (HEPA filters) before being released through a monitored stack to the environment. It was 56 seconds from the alarm to flow being directed into the HEPA exhaust filter.
- The eleven employees, on the night shift at the time of the alarm, were all on surface. The employees implemented the procedures for the underground ventilation system alarm response and for a radiological system alarm response. Two additional employees arrived on-site.
- At 23:42 the Central Monitoring Room Operator (CMRO) disabled the CAM at Waste Panel 7 due to a malfunction indication.

February 15, 2014

- The CMRO notified the Radiological Control Manager (RCM), the DOE Facility Representative, and the Operations Manager, between 02:38 and 03:30.



- During the early morning the Station A filters on the air monitor located in the exhaust shaft, upstream of the HEPA filters were changed out (06:37) and observed to have an orange tint.
- From 06:00 to 07:00, the night workers were released without contamination surveys and the day shift arrived on site.
- At 07:15 the Station A filter was assessed by the RCM as being contaminated by alpha particles, suggesting the presence of transuranics.
- Further tests were taken at Station A and at Station B, downstream of the HEPA filters. At 09:15 the results at Station B indicated contamination by alpha and beta.
- At 09:34 the public address (PA) announcement was made directing all site personnel to shelter-in-place. The announcement was repeated at 09:51. All staff was fully accounted for by 11:04.
- The FSM attempted to activate the Joint Information Centre (JIC) at 10:07 and activation was completed by 10:31. The Operations Assistance team was activated at 10:19.
- Shelter-in-place PA announcements were repeated at 11:20, 12:21, and 12:50. At 13:00 the procedures for a radiological events response were implemented and the announcement was made activating the alternate emergency operations centre (AEOC), which is located off-site in Carlsbad.
- On-site surveys and monitoring of the WIPP site continued throughout the day and by 15:12 readings from off-site air samples indicated no releases. A PA announcement was made at 16:35 releasing non-essential personnel from the site once individuals were surveyed clean. Personnel continued to monitor, collect and analyze filters from emission monitoring stations.

#### February 16, 2014

- Bioassay of potentially most affected workers commenced.
- At 19:17 the JIC and the AEOC were deactivated. A total of 21 workers were determined by bioassay sampling following the event to have been contaminated a very low levels. The doses reported (less than 0.1 mSv) are well below the level that would cause health concerns.

#### **Consequences of a Radiological Release Event in the DGR Project Assessment**

At the time of CNSC staff's review of the information available to May 5, 2014, the exact cause of the contaminant release event was not confirmed. Observations made following the fire event (February 5, 2014) eliminated fire as a cause of the release. In late April 2014, pictures were taken in Panel 7 where the release had been confirmed, by the presence of contamination, to have occurred did not indicate a rock fall. Further, there were no readily visible signs of failed rock bolts causing a breach of a waste package. The heavy magnesium



oxide packages that were placed on top of the waste packages were observed to be displaced suggesting that a rupture of a waste package from the inside may be a possibility.

The Malfunctions, Accidents and Malevolent Acts TSD for OPG's DGR project also identified four underground accident scenarios involving a breach of low and intermediate level waste packages. Two scenarios involve a high energy container breach. In these scenarios the cage with containers, falls down the shaft causing all the containers to breach and release their entire content. The dose to workers and to the public off-site has been ascertained for various types of wastes (e.g., bottom ash, moderator IX resin, and retube waste (end fittings)). The resulting doses to workers vary from 0.01 to 6 mSv depending on the type of waste packages. The resulting doses to the public, for the same scenarios, are generally 0.004 mSv or less.

The other two underground accident scenarios consist of waste containers being damaged as a result of their handling and transfer within the underground DGR facility. The types of event sequence that would cause the breach considered in these scenarios include vehicle crashes, forklift impact, and container drop during stacking. In each of the accident scenarios two containers were considered to be damaged. The resulting doses to workers are 2.8 mSv or less, while the doses off-site are 0.001 mSv or less.

These scenarios are conservatively assessed, and doses from such an event would be lower than calculated. The dose significant radionuclide that could be released from the waste packages is tritium; forming over 99.9 % of the dose to the public. The radionuclides contributing to the very small amount of remaining dose are Sr-90, Co-60, Cs-137 and C-14. Adopting a high efficiency particulate air filtration on the underground exhaust, as is present at WIPP, would not reduce the tritium related dose in the release in an appreciable way.

OPG plans and commitments in the EIS and licensing submissions include control measures and mitigations to reduce the likelihood of contaminant release events from waste packages and the possible consequences to workers, the public, and environment. The measures include the following:

- Quality management system (includes defined roles and responsibilities, defined policies and programs, safety culture, etc.)
- Management and control of radioactive waste from power reactors over its lifecycle
- Human factors program, validation and verification
- Waste package transfer program and procedures
- Change control management
- Human performance program
- Equipment inspection and maintenance
- Ground support inspection and maintenance
- Radiological monitoring and alarm systems



- Effluent monitoring and alarm systems
- Emergency communications systems
- Emergency response program for radiological releases
- Radiation protection program
- Worker training (U/G safety, radiation safety, emergency response, equipment use)

OPG's control measures and mitigations closely reflect the ones described for the WIPP facility, with the exception of the availability of HEPA filters on the air exhaust system which are not planned in the DGR

### **Relevance of the WIPP Contaminant Release Event to the DGR Project:**

As with the other event, this event provides operational experience (OPEX) that the CNSC expects OPG to consider throughout the various phases of the DGR project. A radiological release event underground is a recognized potential hazard for the DGR that could occur during the operational phase when waste packages containing radionuclides are transferred into emplacement rooms in the DGR.

The relevance of the various causes identified by the Investigation Board for the WIPP release event to the DGR project will be affected by differences in: the stage of development; the facility management and regulatory framework; the radioactive wastes (nature of the waste, type of radionuclides, etc.); and the pre-closure safety case . The CNSC expects OPG to review and apply the relevant lessons learned from the WIPP contaminant release event to the DGR project.

CNSC staff has completed a preliminary examination of the causes identified in the Phase 1 investigation report and has made preliminary comments on relevance to the DGR project. This information is summarized in Table 2 of this response. Additional information is expected in the Phase 2 report which will include information addressing issues like the mechanism for the TRU waste container breach. Should OPG be issued a licence, CNSC staff will verify the application of OPEX, in particular OPG's assessment and application of the various lessons learned from the WIPP contaminant release event to the DGR project.



**TABLE 2: CNSC Staff’s Preliminary Comments regarding the Identified Causes of the February 14, 2014 Underground Contaminant Release Event (Phase I) at the WIPP on the Proposed DGR Project**

| Causes   | Description of Cause from WIPP Investigation Report   | CNSC Preliminary Comments of Relevance to the DGR Project  |
|--|---|--|
| <b>Direct Cause</b> – immediate event or condition that caused the accident  |   |  |
| 1.   | The direct cause was a breach of at least one TRU waste container; the mechanism by which it happened is not yet determined.  | <ul style="list-style-type: none"> <li>• Breaches to waste packages have relevance to safety and environmental protection in the DGR operational and decommissioning phases.</li> <li>• OPG has assessed the impacts of radiological releases to the public and the environment from underground accidents and events.</li> <li>• Under the licence and part of OPEX, the regulatory expectation is appropriate consideration is given to the mechanism of the breach once it is determined (Phase 2 report which is to come).</li> </ul>  |
| <b>Root Cause</b> – causal factors that if corrected, would prevent recurrence   |   |  |
| 1.   | The root cause was linked to a failure of management to understand, characterize, and control the radiological hazard through ventilation system design and operability, safety programs, safety culture, event response. | <ul style="list-style-type: none"> <li>• The qualification of contactors and OPG workers has relevance to construction, operation and decommissioning phases of the DGR.</li> <li>• OPG identifies a quality management system to CSA N286 that includes procurement. Procurement processes include specifications for contractor qualifications.</li> <li>• OPG and the licence require contractors to apply a quality management system to CSA N286. Hazard analysis, programming, change control management, etc. are part of a quality management system.</li> <li>• Under the licence and as part of OPEX, the regulatory expectation is appropriate consideration is given to the lessons learned for contractor qualifications and contractor programs and procedures and to OPG’s qualifications and oversight.</li> </ul> |
| <b>Contributing Causes</b> – events or conditions that collectively increased the likelihood or severity of the accident but individually did not cause the accident |   |  |
| 1.   | The contractor’s Conduct of Operation program was not fully compliant with implementation requirements in the regulations.  | <ul style="list-style-type: none"> <li>• The compliance of contractor program’s with the regulations has relevance to construction, and possibly to other phases of the DGR project.</li> <li>• OPG identified a quality management system to nuclear standard CSA N286 that applies to OPG and to Contractors.</li> </ul>   |



| Causes | Description of Cause from WIPP Investigation Report   | CNSC Preliminary Comments of Relevance to the DGR Project   |
|--------|---|---|
|        |   | <ul style="list-style-type: none"> <li>Under the licence OPG and their contractors are to comply with regulatory requirements, and as part of OPEX, the expectation is that lessons learned will be reflected in the programs and procedures for the DGR.</li> </ul>  |
| 2.     | <p>The Radiological Protection Program did not effectively address all regulatory requirements in areas such as training, qualification and requalification, equipment and instrumentation, and audits.</p> | <ul style="list-style-type: none"> <li>The radiological protection program has particular relevance during the operational phase of the DGR project.</li> <li>OPG identifies a radiological protection program as a control measure that would include worker qualification and training, for the operational phase. OPG's quality management system would include review and self-audits of programs like radiation protection.</li> <li>Under the licence and as part of OPEX, the expectation is that lessons learned in radiation training, qualifications and instrumentation will be reflected in the programs and procedures for the DGR.</li> </ul> |
| 3.     | <p>The maintenance program was not effective, affecting the ventilation system, air monitoring, and status display.</p>   | <ul style="list-style-type: none"> <li>The inspection and maintenance program has relevance during the construction and operational phases of the DGR project.</li> <li>OPG identifies an inspection and maintenance program as a control measure.</li> <li>Under the licence and as part of OPEX, the expectation is that lessons learned in an effective maintenance program will be reflected in the programs and procedures for the DGR.</li> </ul>   |
| 4.     | <p>The nuclear safety program was not effective at maintaining the safety basis for the operating facility.</p>   | <ul style="list-style-type: none"> <li>The adequacy of programs to maintain the safety case for the pre-closure and post closure periods of the facility has relevance for the DGR project.</li> <li>OPG has identified programs to ensure the safety case is maintained, and include hazards assessment, engineering design control and change control management, geoscientific verification, inventory verification, and others.</li> <li>Under the licence and as part of OPEX, the expectation is that lessons learned in maintaining the safety case will be reflected in the programs and procedures for the DGR over its various phases.</li> </ul> |



| Causes | Description of Cause from WIPP Investigation Report  | CNSC Preliminary Comments of Relevance to the DGR Project   |
|--------|--|---|
| 5.     | The emergency response to a radiological event was not effective in recognizing the nature of the event, or implementing adequate protective measure in a timely manner. | <ul style="list-style-type: none"> <li>• The adequacy of the emergency response program and procedures to a radiological event has relevance to the operational and decommissioning phases of the DGR project whether conducted by OPG or by contractors.</li> <li>• OPG has identified programs to ensure adequate emergency response, and include an emergency preparedness and response programming which will include radiological events, worker training, drills, etc.</li> <li>• Under the licence and as part of OPEX, the expectation is that lessons learned in emergency response will be reflected in the programs and procedures for the DGR over its various phases.</li> </ul>                           |
| 6.     | There is a lack of safety culture in questioning and reporting in the work environment, and in oversight.  | <ul style="list-style-type: none"> <li>• Safety culture has relevance to the construction, operation and decommissioning phases of the DGR project.</li> <li>• OPG has identified safety culture and human performance as important to their quality management system.</li> <li>• Under the licence and as part of OPEX, the expectation is that lessons learned in safety culture and the oversight of safety culture will be reflected in the programs and procedures for the DGR over its various phases.</li> </ul>  |
| 7.     | On-site oversight by management was ineffective.   | <ul style="list-style-type: none"> <li>• Roles, responsibilities and oversight of activities as it relates to the licensee and to contractors has relevance to construction, operation, and decommissioning phases of the DGR project.</li> <li>• OPG identified a quality management system to nuclear standard CSA N286 that applies to OPG and to Contractors, and to OPG's oversight of their contractor for construction. OPG's oversight includes surveillance, verification, self-assessment, and audits (performance review and management review).</li> <li>• Under the licence and as part of OPEX, the expectation is that the lessons learned will be reflected in the oversight of contractors.</li> </ul> |
| 8.     | Oversight by line management at headquarters was ineffective.  | <ul style="list-style-type: none"> <li>• Roles, responsibilities and oversight of activities as it relates to the licensee have relevance to construction, operation, and decommissioning phases of the DGR project.</li> <li>• OPG identified a quality management system to nuclear standard CSA N286 that applies to OPG.</li> </ul>   |



| Causes | Description of Cause from WIPP Investigation Report | CNSC Preliminary Comments of Relevance to the DGR Project   |
|--------|---|---|
|        |   | <ul style="list-style-type: none"> <li>• OPG’s self- assessment includes surveillance, verification, self- assessment, and audits (performance review and management review).</li> <li>• Under the licence and as part of OPEX, the expectation is that the lessons learned about internal oversight will be reflected in the management programs.</li> </ul> |

## REFERENCES

- [1] U.S. Department of Energy, Office of Environment Management. Accident Investigation Report – Underground Salt Haul Truck Fire at the Waste Isolation Pilot Plant February 5, 2014. March 2014. <http://www.wipp.energy.gov/Special/AIB%20Report.pdf>
- [2] U.S. Department of Energy, Office of Environment Management. Accident Investigation Report – Phase 1 Radiological Release Event at the Waste Isolation Pilot Plant on February 14, 2014. April 2014. [http://www.wipp.energy.gov/Special/AIB\\_Final\\_WIPP\\_Rad\\_Release\\_Phase1\\_04\\_22\\_2014.pdf](http://www.wipp.energy.gov/Special/AIB_Final_WIPP_Rad_Release_Phase1_04_22_2014.pdf)
- [3] CNSC. Panel Member Document regarding Ontario Power Generation’s Proposed Environmental Impact Statement for OPG’s Deep Geologic Repository (DGR) Project for Low and Intermediate Level Waste, July 2013. E-docs: 4169376, CEAR# 1250
- [4] CNSC. Panel Member Document regarding A New Licence for Site Preparation and Construction of the Ontario Power Generation Inc. (OPG) Deep Geologic Repository (DGR) Project for Low- and Intermediate-Level Waste (L&ILW). July 2013. e-Doc: 4174318, CEAR# 1249
- [5] Ontario Power Generation. 2011. OPG’s Deep Geologic Repository for Low and Intermediate Level Waste – Malfunctions, Accidents and Malevolent Acts Technical Support Document. Prepared by AMEC NSS Ltd. March 2011. NWMO DGR-TR-2011-07. [http://www.ceaa.gc.ca/050/documents\\_staticpost/17520/49819/malfunctions-tsd.pdf](http://www.ceaa.gc.ca/050/documents_staticpost/17520/49819/malfunctions-tsd.pdf)