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Supplementary Information

Oral intervention from Saugeen Ojibway Nation

In the Matter of

Ontario Power Generation Inc.

Proposed Environmental Impact Statement for OPG's Deep Geological Repository (DGR) Project for Low and Intermediate Level Waste

Joint Review Panel

September 16 to October 12, 2013

Renseignements supplémentaires

Intervention orale par Saugeen Ojibway Nation

À l'égard de

Ontario Power Generation Inc.

Étude proposée pour l'énoncé des incidences environnementales pour l'Installation de stockage de déchets radioactifs à faible et moyenne activité dans des couches géologiques profondes

Commission d'examen conjoint

16 septembre au 12 octobre 2013

Canada

Submissions of the Saugeen Ojibway Nation

Hearings for Deep Geologic Repository Project for Low and Intermediate Level Radioactive Waste

Appendix 1: Technical Reports

Geoscience Characterization Issues Raised by SON Regarding OPG's Proposed Geoscientific Verification Plan for the Deep Geologic Repository for Low & Intermediate Level Waste

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I. Introduction and Summary

During the initial phases of the application for the construction of an Intermediate and Low Level Radioactive Waste Respository, the Saugeen Ojibwa Nation (SON) expressed numerous concerns regarding the adequacy of the site characterization by NWMO/OPG of the proposed Deep Geologic Repository (DGR). These site characterization issues predominantly include the Geoscience characterization of the proposed site including the Geology, Geohydrology, and Geotechnical Engineering elements critical to containment of radioactive material transport into the surrounding environment. SON submitted a number of specific additional requests for information (IRs) to the Canadian Nuclear Safety Commission (CNSC) in order to obtain additional clarification about these concerns surrounding the observations, studies and assumptions made by the applicant during the initial site selection and licensing process. Responses to a number of these IRs were considered superficial and did not adequately address important repository performance concerns.

In general, the CNSC, after review of the SON IRs, decided not to forward many of them to the Joint Review Panel for further consideration due to the fact that the issues raised were similar to those CNSC had already issued through IRs to OPG. The CNSC then reviewed NWMO/OPG's responses to these IRs and found the responses adequate in addressing the issue.

The purpose of this document is to document continuing concerns regarding the Geoscience issues and identify where resolution has not been adequately addressed. Many of the identified issues appear to have been resolved based on promised future studies (i.e., Geoscientific Verification Plan) that have only been vaguely described to date.

It is believed that a detailed and extensive engagement will be needed to ensure the types, scopes, and depth of the technical issues are appropriately identified and characterized. Through the current license review process with its IR resolution process, it is not believed that OPG has not adequately addressed an approach for resolving the identified Geoscience concerns regarding assumptions made in its licensing process. The Geoscience assumptions as claimed by OPG, and depended upon to assure no future impact on the environment, remain to be proven, and therefore, will need to be aggressively analyzed prior to and during the construction phase of the repository licensing. All significant DGR assumptions should be tabulated and tested during repository construction prior to any authorization to place licensed material in the DGR. A detailed performance conformance program should be clearly detailed before any license to construct is

considered. OPG has committed to performing further geological and geotechnical verification and monitoring activities during construction to confirm parameter values used in design and construction safety considerations, and permit verification of long-term performance assessments. These plans are addressed in OPG's Geotechnical Investigation and Rock Monitoring during Construction, NWMO DGR-REP-01130-xxxxx), and Geoscientific Verification Plan (NWMO DGR-TR-2011-38). However, much of the specifics and detailed methodology and acceptance criteria remain to be defined. In its review of OPG's responses to a number of SON's IR, CNSC has conceded that the 2011 Geoscientific Verification Plan lacks sufficient detail and that these details must be provided before the time of implementation. As such, it is unclear that OPG's self-directed studies will be sufficient to identify, much less resolve, the concerns. As examples, a minimum the program should include the following:

(a) During construction and operation, a continuing program of surveillance, measurement, testing, and geologic mapping shall be conducted to ensure that geotechnical and design parameters are confirmed and to ensure that appropriate action is taken to inform the public if adverse field conditions are encountered.

(b) Subsurface conditions shall be monitored and evaluated against design assumptions.

(c) As a minimum, measurements shall be made of rock deformations and displacement, changes in rock stress and strain, rate and location of water inflow into subsurface areas, changes in groundwater conditions, rock pore water pressures including those along fractures and joints, and response of the rock mass as a result of development and operations of the geologic repository.

(d) These measurements and observations shall be compared with the original design bases and assumptions. If significant differences exist between the measurements and observations and the original design bases and assumptions, these differences must be reported to the public.

The Geoscientific Verification Plan proposed by OPG is lacking in detail. While the program is proposed as a formal license condition, the scope and details should be subject to review and approval by key stakeholders parties prior to approval of construction activities. In developing this program, the applicant must provide a thorough set of assumptions, testing protocols, studies, and procedures along with the expectations of such testing as it applies to the assumptions made. It is critical that all of the proposed steps of the program be completed and assumptions proven prior to

emplacement of any waste. The proposed process is similar to those contained in international standards and guidance documents as relevant to the Bruce DGR.

II. Geosciences Issues

(a.) Geology

For the purposes of the proposed Geoscientific Verification Plan, the following are considered critical scope issues in the area of Geology:

(1) Provide more and detailed information in the Geotechnical Verification Program on the specific timing, amounts and locations of various testing and geological observations that will be made during the construction phase of the Project.

(2) Provide further information and analysis to explain inconsistencies regarding the presence of faulting in the repository vicinity. Provide Data and analysis aimed at resolving these inconsistencies derived from other seismic reflection technology, additional core borings, construction observation and mapping or other procedures. Provide additional seismic surveys and /or mapping of shaft and repository to confirm the absence of faulting.

(3) Provide further information, studies, demonstrations and analysis of the impact of future glacial isostatic adjustment on the current and future behavior of fractures and joint sets in the repository vicinity. As part of the site characterization all jointing should be mapped continuously during shaft and repository construction with any anomalies to assumptions on fracture sealing being routinely reported and reviewed.

(4) Include mapping as noted by CNSC which calls for additional future action by OPG and noted that, "The sensitivity analysis further confirms the importance of detecting the existence or absence of connected vertical faults near the proposed DGR site during construction." A formal mapping program must be defined to identify and record any faults that are encountered. It was noted in earlier documents that this would be accomplished by photography alone. The plan should include mapping by qualified geologists with supplemental photography as needed.

(5) Provide detailed geologic mapping of the glacial overburden and excavation and shafts to confirm that conditions meet the assumptions made in the limited exploratory phase of the project. This effort should also assure the absence of unexpected groundwater conditions. Since OPG's model driven analysis is highly dependent upon the assumptions made regarding the nature and

behavior of the *in situ* properties of the rock and its structures, especially any and all faults and fractures, validation of the *in situ* geology is extremely critical to all of the geohydrology assumptions and their resultant dose calculations. The extensive experience record of both nuclear power plant and repository construction observations have often found numerous anomalies compared to assumptions made during the exploratory phase.

(6) Provide testing and mapping to confirm that all fractures are sealed and closed, that no new fractures have developed as a result of isostatic adjustment or other factors and that there is no evidence of displacement that has not healed. These detailed and methodical observations must be planned and undertaken before and during construction and independently reviewed to assure that there are no anomalies that would invalidate the extensive assumptions being made for this project.

(b.) *Geohydrology issues For Geoscientific Verification Program.*

For the purposes of the Geoscientific Verification Plan, the following study elements in Geohydrology are critically important:

(1) Provide sufficient additional testing and analysis of pore water obtained during construction to verify that the geochemical characteristics of pore water identified during the site characterization phase and used to support contentions regarding the hydraulic isolation of the Ordovician Shales and Limestones. In its analysis of uncertainties regarding the long-term safety of the project, the CNSC has indicated that the vacuum distillation and leaching techniques used in the pore water analysis result in uncertainties in the estimated pore water solute concentrations and has assessed the level of confidence in the geochemical data as low to medium. The CNSC has further indicated that there are also uncertainties in the reduction and manipulation of the measured data and in the geochemical data. While the CNSC has examined these uncertainties and found that the conclusions regarding the geochemical data are justified, further verification of the geochemical characteristics is necessary to support OPG's contentions regarding the age and migration of the waters in the Ordovician Shales and Limestones. The geohydrologic conceptual model for the site should be adjusted as appropriated based on this additional geochemical data. The expected performance of the DGR should be reevaluated based on any such adjustments to the site conceptual model.

(2) Provide additional testing and analysis, as necessary, to verify the assumptions regarding potential groundwater flow from or into the Cambrian deposits underlying the Ordovician Shales and Limestones in which the repository will be constructed. While the additional modeling and analysis of flow through the Cambrian deposits performed in response to the information requests submitted by Natural Resources Canada appear to address many previous concerns identified by SON regarding flow in the Cambrian, the results of the additional testing and analysis conducted during the site preparation and construction phase should be carefully evaluated to verify that the assumptions used in this additional modeling remain valid. Particular attention should be focused on the results of the geophysical surveys planned in the excavated repository rooms to evaluate unexpected structural anomalies beneath and adjacent to the repository. Should these surveys indicate any features that might impact the hydraulic isolation of the repository from the Cambrian deposits, additional analysis of the groundwater flow from or into the Cambrian deposits underlying the Ordovician Shales and Limestones should be required.

(3) Provide a detailed program of Excavation Damage Zone (EDZ) testing and measurement in the shafts during the construction phase and prior to the emplacement of the shaft seals. Include details on how representative hydraulic conductivities will be obtained in the EDZ, including the number, location, and methods to be used for the permeability test of the EDZ. As indicated in CNSC's evaluation of OPG's response to SON's concerning regarding the lack of detail in the Geoscientific Verification Plan, sufficient detail has not been provided in response to SON's information request. These details should be provided for review prior to beginning construction of the shaft. The results of this testing program should be compared to the characteristics of the EDZ assumed in the performance assessment. The performance assessment should be modified, as necessary, based on the results of this testing program.

(4) Provide additional testing during the construction phase to verify the hydraulic conductivity of the Ordovician Shales and Limestone measured during site characterization using the borehole testing methods. The hydraulic conductivities measured in the DGR boreholes are generally much lower than those values identified in the regional data set. While the lower values

measured in the DGR boreholes may be the result of newer, more sensitive methodologies for measuring low permeability materials, these lower values may not be representative of hydraulic conductivity in the area of the DGR. Hydraulic conductivity values are important parameters in modeling repository performance and should be verified. Currently, the measurements of hydraulic conductivity, including potential long-term measurements, in the EDZ within the shaft are planned in the Geoscientific Verification Plan. Similar measurements of hydraulic conductivity in material located beyond EDZ should be conducted to verify the hydraulic conductivity values determined previously for undisturbed materials previously in borehole tests. In addition to the Ordovician Shales and Limestone, these measurements should be conducted in any strata important to predicting the performance of the repository.

The hydraulic conductivity test should not be limited to the shaft but also conducted in the excavated emplacement rooms. Room scale testing of formation hydrogeologic characteristics is necessary to confirm the results of localized testing in characterization boreholes and the shaft. Testing plans should follow international recommendations for full scale tests successfully completed by other international investigators.

(5) Provide sufficient additional assurances, based on ongoing evaluation of the performance of the shaft seal, that the permeability assumed for the degraded seal in the Severe Shaft Seal Failure Scenario of the Performance Assessment adequately accounts for potential increases in the permeability of the seal that may occur over time. A hydraulic conductivity of 10^{-9} m/sec has been assumed for the degraded seal in this scenario. This hydraulic conductivity value is only 2-3 orders of magnitude below the design value for the seal, and it remains quite low. It is unclear that this value adequately accounts for the potential increase in permeability that may occur in a degraded seal. Potential increases in the permeability of a significantly degraded seal should be carefully evaluated as part of planned evaluation of the long-term performance of the shaft seal. Adjustments to the Performance Assessment should be made as appropriate based on the result of this evaluation. Corresponding adjustments should be made to the intrinsic permeability values used in the modeling of gas migration in the shaft during the Severe Shaft Seal Failure Scenario.

(c.) *Geotechnical Engineering and Constructability Issues*

During the EIS review, CNSC developed Recommendation #19 for the Site Preparation and Construction Phase in which the CNSC staff recommended that OPG develop and conduct a Research and Development program on the longevity of shaft seals that should be conducted during the site preparation and construction phase of the DGR Project. We are in strong agreement with this recommendation and, in addition, we would make the following requests for further investigations during these phases. For the purposes of a Site Characterization Program in the area of Geotechnical Engineering:

(1.) Provide a full scale testing and analysis program to assure that there will be no combined effects of shaft seal failure and other failure modes such as fault movement of excessive joint development and movement. Past observations of shaft excavation and sealing indicate that it has been easy to underestimate the difficulty of adequately sealing shafts similar to that proposed for the DGR. Key examples of previous poor performance in similar projects has occurred including poor performance at the Asse mined geologic repository and the failure of cement seals at the Deep Horizon disaster. Combined effects from faulting and seal failure are not considered in recognition that natural phenomena challenges can exceed design criteria.

(2) Provide a detailed testing program for the performance of the various materials that will be used to seal the shaft. This program should demonstrate the long-term performance of these sealing materials over the stratigraphic column in which they will be emplaced along the shaft. The adequacy of these materials to seal adjacent zones of EDZ should be clearly demonstrated. The Post Closure Safety Assessment relies on an accurate assessment of the DGR sealing materials including those materials used to seal the vertical shaft from the surface to the repository. The Geoscientific Verification Plan (GVP) only outlines a program for evaluating sealing materials at the level of the repository in the Cobourg Formation, and does not provide for a program to test the performance of the sealing materials that will be used to seal the vertical shaft. The testing program should address aging concerns. International experience should be incorporated in the sealing material testing program.

III. Summary

As previously identified, OPG proposes to conduct a Geoscientific Verification Plan during the construction phase for the repository. This plan is only superficially defined at this time and lack many of the details required, including an appropriate review and approval process. It must include information on quality assurance programs that have been applied to the collection, recording, and retention of information used in preparing the plan. Actual subsurface conditions encountered and changes in those conditions during construction and waste emplacement operations must be within the limits assumed in the licensing review.

For the issues listed above, it is necessary that the key assumptions noted by the applicant be identified for follow-up *in-situ* testing and verification during construction and operation. Hold points during construction should be identified for confirmation of key assumptions that are significant to safety conclusions. Also, specifically, emplacement of any ILW should be precluded for at least a decade after first placement of waste. Performance confirmation testing should be required to observe repository performance and confirmation of long term safety predictions prior to closure.

Responsible due diligence is critical for such projects and SON should be fully informed and involved throughout all such studies and analysis.

Bios

Robert E. Jackson is a Senior Consulting Geologist. He has a BS degree in Geology from the University of Rhode Island and Doctorate in Geology from the University of North Carolina at Chapel Hill. Dr. Jackson served as the Branch Chief for Site Assessment for the U.S. Nuclear Regulatory Commission (US NRC) and directed and assisted in the site review studies for numerous nuclear power plants. He is a Registered Professional Geologist, specializing in geologic and seismic hazard assessment. As a Senior Consultant, he also managed major technical support programs for the U.S. Department of Energy (DOE) nuclear waste programs and environmental cleanup programs for the U.S. Environmental Protection agency. He has served as a senior contributor for complex energy projects for more than thirty-five years in the areas of geology, seismology, site assessment, waste management, and emergency management. Dr. Jackson has served as a consultant to the US Nuclear Regulatory Commission (NRC), US Department of Energy (DOE), Korea Atomic Energy Research Institute (KAERI), and the Taiwan Atomic Energy Council (TAEC) regarding nuclear safety and nuclear waste issues.

Richard H. Kuhlthau is a groundwater hydrologist with over 35 years inexperience in the assessment, management, control, and remediation of groundwater contamination. He has a BS in Physics from Georgia Institute of Technology, a MS in Environmental Sciences from the University of Virginia, and a PhD in Civil Engineering from Colorado State University. Dr. Kuhlthau is an expert in site characterization and the modeling and analysis of groundwater flow and contaminant transport. He has extensive experience in the evaluation of disposal options for radioactive waste, including land disposal of radioactive wastes. Dr. Kuhlthau has provided oversight in the licensing of the Waste Isolation Pilot Project (WIPP) and assisted the Yucca Mountain Project in the development of the Saturated Zone Process Model Report (SZ PMR) and Site Recommendation (SR) Report for the Yucca Mountain facility. In addition, he has assisted numerous private concerns with the evaluation of subsurface aspects for management of low and intermediate level radioactive wastes. Dr. Kuhlthau has consulted with Los Alamos National Laboratories, the U.S. Environmental Protection Agency, US Nuclear Regulatory Commission, Nuclear Fuel Services, Babcock & Wilcox, Atlantic Richfield Company (ARCO), Kaiser Aluminum & Chemical, Kerr McGee, and Sequoyah Fuels.

Critique of the OPG EIS and Golder Associates Independent Assessment Study

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1 Introduction and Background

This section provides an introduction and background of the issues related to the Ontario Power Generation Deep Geological Repository Environmental Impact Statement (EIS) with respect to regulatory requirements, the EIS Guidance Document, and the Golder Associates Independent Assessment Study (IAS). It further identifies the key concerns where OPG has not met the intent of the agreed upon EIS Guidance Document requirements.

Ontario Power Generation (OPG) is developing a multiyear planning and regulatory approvals process for a deep geological repository (DGR) for the long-term management of low and intermediate level wastes (L & ILW). The source of the waste is from the OPG-owned power reactors and is currently stored centrally at OPG's Western Waste Management Facility located on the Bruce nuclear site near Tiverton, Ontario. OPG's long-term plan is to manage these wastes in a long-term management/disposal facility. OPG's proposal is referred to as the "DGR Project".

The DGR Project includes site preparation and construction, operations, decommissioning, and abandonment of the DGR site, leaving behind the LLW and ILW in the repository. The DGR will be constructed in sedimentary rock beneath the Bruce nuclear site near the existing WWMF. The underground facilities will include shafts and tunnels, and placement rooms. Surface facilities include the underground access and ventilation buildings, Waste Package Receipt Building (WPRB) and related infrastructure.

1.1 Regulatory Requirements

The Canadian Environmental Assessment Act (CEAA) Section 16 (2) (b) (Ref. 1) requires that the proposed DGR project be evaluated through an Environmental Impact Assessment (EIA) and reported in an Environmental Impact Statement (EIS). This section of the CEAA ensures the project is the best environmentally to fill the need. OPG will be required to obtain a license from the Canadian Nuclear Safety Commission (CNSC) to allow the DGR Project to proceed.

Subsection 24 (2) of the Nuclear Safety and Control Act (Ref. 2) requires the proponent OPG to obtain authorization before it can proceed.

The DGR Project will be referred to a Joint Review Panel for evaluation of environmental impacts.

1.2 EIS Guidelines

EIS Guidelines (Ref. 3) were prepared by the Canadian Environmental Assessment Agency (CEAA) and CNSC, with consultation with Health Canada, Natural Resources Canada, and Environment Canada. After incorporation of comments from the public and Aboriginal groups, the Guidelines were revised and reissued to the Proponent (OPG).

1.3 Concordance Document

For convenience a Concordance Document (Ref. 4) was prepared which maps the EIS Guidelines requirements to the appropriate EIS Section.

The EIS Guidelines require documented transparent and reproducible scientific, engineering, traditional and other knowledge to reach conclusions. Cost estimates are to be detailed as to the source of data used, and the methodology employed in any analyses; i.e., they have to be of high quality for each alternative. Golder Associates (IAS)

OPG retained Golder Associates as their consultant to perform an Independent Assessment Study (Ref. 5) for the project. The purpose of the IAS was to determine the best technological storage alternative for LLW and ILW at the Bruce Nuclear site from among the following alternatives:

- Status quo: no new action
- Enhanced Processing and Storage (above ground)
- Surface Concrete Vaults
- Deep Rock Vault (i.e., the EIS' proposed DGR)

Golder Associates prepared its IAS in February 2004 and OPG adopted it as its foundation for its decision to proceed with licensing of the DGR and its use in its EIS. The Municipality of Kincardine used the IAS for its determination to support the DGR.

1.4 Purpose

The purpose of this critique is to:

- Demonstrate that OPG failed to comply with the EIS Guidelines in the preparation of the EIS

- Challenge OPG's claim that Environmental and Social Feasibility Survey impacts are not significant on the basis that OPG provided no underpinning or documentation to support that claim.
- Demonstrate that the alternatives selected by OPG to consider were not comparable in scope or intent to the proposed project and therefore do not fulfill the need for disposal capacity for both LLW and ILW.
- Demonstrate that Golder Associates failed to provide a quality cost-benefit analysis in its Independent Assessment Study (IAS) of alternatives upon which OPG could rationally select the DRV as the preferred disposal alternative.
- Demonstrate that the Total Expenditures shown in Table 3.3.7-1 of the EIS (Ref. 6) for each of the alternatives (Enhanced Processing and Storage, Surface Concrete Vaults, and Deep Rock Vault – DRV) are too low and not representative of current international experience for similarly sized facilities.
- Demonstrate that the OPG selection of the DRV as the preferred alternative is fatally flawed based on the Golder Associates IAS.

2 Requirements of the EIS Guidelines for DGR – Overview

This section describes the requirements identified in the EIS Guidelines which OPG agreed to for the preparation of the EIS. It is important to note that the Golder IAS preceded the EIS Guidelines, but there was ample time for OPG to request Golder to revise the IAS to comply with the EIS Guidelines.

2.1 Study Strategy and Methodology – Relevant Requirements

The following paragraphs summarize the relevant requirements associated with developing the EIS and conforming to the agreed-upon EIS guidelines prepared by the Canadian regulators.

In accordance with Section 2.6 of the Guidelines for Preparation of the EIS, Proponent shall identify all environmental effects, mitigation measures, and significance of any residual effects. If any matters are not relevant or significant to project, Proponent must clearly indicate with justification why they were omitted.

Proponent must explain/justify methods used to predict impacts on each Value Environmental Component (VEC), including biophysical and socioeconomic components,

component interactions, and relations of these components within the environment. Information presented must be substantiated.

In describing methods, Proponent must document how it used scientific, engineering, traditional, and other knowledge to reach its conclusions. Assumptions made must be clearly identified and justified. All data models and studies must be documented so that the analyses are transparent, and reproducible. The uncertainty, reliability, and sensitivity of the models used to reach conclusions must be indicated. This requires a quantitative Risk Analysis. The sections in the EIS must be prepared using best available information and methods, to the highest standards in the relevant subject area. All conclusions must be substantiated.

The EIS must identify all significant gaps in knowledge and understanding where they are relevant to key conclusions in the EIS.

2.2 Alternatives to the Project (Section 7.2 and 7.3 of Guidelines) – Relevant Requirements

An analysis of alternatives shall be performed by OPG (and Golder Associates as its contractor) including other prospective sites for the location of the DGR and other options in accordance with the EIS Guidelines. The analysis must describe functionally different ways to meet the projects need and purpose from the prospective of the Proponent. The alternatives analysis by OPG must be based on fully supported and documented evidence that such an evaluation was performed to a high level of detail.

EIS must identify any alternatives to the DGR that are within the control and or interests of the Proponent; explain how criteria was developed; provide reasons for rejection of these alternatives, and identify the preferred alternative based on environmental, economic and technical benefits and costs. This must be done to a level of detail that allows the Joint Review Panel to compare the project and alternatives.

2.3 Summary of Findings

The EIS Guidelines to which OPG agreed to comply imposed specific requirements with respect to identifying environmental impacts, mitigation measures and significance of residual effects not only for the direct effects but also for the Valued Environmental Components (VECs). The

Guidelines required OPG to use scientific, engineering, traditional, and other knowledge to reach its conclusions regarding the DGR project, and to ensure the analyses were transparent and reproducible. The uncertainty, reliability, and sensitivity of the models used to reach conclusions had to be indicated. The Guidelines required the analyses of alternatives, including siting of the DGR in a location outside the existing site and other options to include functionally different ways to meet the project's needs and purpose. All alternatives analyzed had to explain the criteria applied, any reasons for rejection of an alternative, and how they identified the preferred alternative based on environmental, economic and technical benefits and costs. The detail provided had to be sufficient to allow the Joint Review panel to compare the project and alternatives. OPG (and Golder Associates) failed to provide this level of detail for all effects to the environmental and to the VECs in accordance with the terms of the EIS Guidelines.

3 Environmental and Social Feasibility

The purpose of an environmental impact assessment is to provide decision makers with the most accurate information as to the expected adverse and beneficial impacts a proposed project would have on people and the environment. A major consideration in the development of the environmental impact assessment is the consideration of alternatives, including the continuation of the status quo (taking no action), alternative designs and technologies that can achieve the same purpose and need of the proposed project, and the consideration of alternative places where the project can be undertaken in a less environmentally harmful manner. This section describes the IAS' Environmental and Social Feasibility Survey and results, which are supposed to estimate all of the impacts—beneficial and adverse—the proposed project may have on the human environment, including:

- Demographic changes the project's construction and operations activities may impose on the existing population
- Potential stresses on local infrastructure, including schools, hospitals, police and fire services, and other social and public services (e.g., utilities)
- Changes in prices that affect housing and other local goods and services (e.g., shortages that cause price increases)
- Local tax effects

In its EIS, OPG stated the DGR may have some impacts on the socioeconomic environment, but those effects would not be significant. However, in contradiction to that assertion, the IAS determined that there was the potential for significant adverse socioeconomic impacts from the construction and operation of the DGR. In a decision that was uncharacteristic of OPG's approach to most of the conclusions in the IAS, OPG ignored the IAS assessment and provided no support to document the EIS's claims. Without a transparent and reproducible methodology, the lack of any underpinning and documentation for those claims renders groundless the EIS's conclusions with regard to the socioeconomic impacts. The EIS shortcomings have their basis in the methodology employed by Golder Associates, because, even though OPG rejected their overall conclusions about socioeconomic impacts in the EIS, they accepted and employed the same process for establishing public approval that was used in the IAS. In fact, the survey methods used by Golder Associates and AECOM/OPG seven years later are identical in scope, conclusions, and their lack of scientific approach. The following criticism of the IAS survey methodology applies equally to that of the subsequent EIS.

3.1 Golder Associates Provided No Information Regarding Their Survey Methodology

According to the Social Assessment discussion in the IAS, the purpose of the Golder Associates survey was to determine "residents' knowledge of and attitudes towards LLW and ILW management at the WWMF as a result of implementing any of the long-term waste management options" (Golder 2004, p. 42). A subset of that assessment was designed to elicit opinions about "how the long-term management options might affect the perceptions and attitudes of . . . tourists visiting Kincardine" (ibid.) These perceptions and attitudes manifest among local residents as either a "halo effect" (positive impressions based on familiarity and economic benefits provided by the project, or as a "stigma" a psychological projection of negative imagery upon a person, place, thing, or technology that may or may not have its foundation in scientific fact. Stigma is an emotional response evoked by emotions, prejudices, lack of knowledge, and a sense of helplessness. Among tourists (who by definition must not be local residents) attitudes and perceptions manifest as a stigma.

Golder Associates performed 751 telephone interviews (400 in Kincardine and 351 in the neighboring communities), 32 interviews with local tourist-related businesses, visiting tourists, and a

roundtable discussion with tourist business operators, and 54 tourists at Inverhuron Provincial Park, Inverhuron Beach, Station Beach, and Tiny Tots Park in Kincardine. Tourists were approached on July 3-6, 2003 and July 18-19, 2003. The following are specific deficiencies identified in the IAS:

- **Sampling bias:** Local interviews have an inherent bias in that they were performed among those groups for whom the presence of a DGR would have the most economic benefit. In other words, Golder Associates specifically sought out the opinions of those who would have a halo effect.

- **Vague and leading questions:** The construction of the different surveys was inadequate in that no external review of the questions was performed to prevent the elicitation of a specific tone of response (leading questions) or that provide too wide a range of possible responses (e.g.: "Would any of the long-term management options affect the community as a place to operate a business?")

- **Lack of proper sample size:** PAR research numbers were stated to have a 95 percent accuracy rate, which appears to be correct, given the population of the area and a 5 percent confidence interval (plus or minus five percent). However, such statistical rigor cannot be attributed to the tourism industry research samples or the tourist samples, because their samples were much smaller and no statistics other than the number of completed surveys was given. In particular, Inverhuron Provincial Park and the three beaches would have been at their peak visitation rates, given the surveys immediately followed July 1 Canada Day (a Tuesday, which would have enticed many long-range visitors, due to the long weekend following the holiday). For instance, Inverhuron Provincial Park records over 50 thousand visitors in 2003. For a 95 percent confidence level and a 5 percent confidence interval, the park alone would have needed to have about 380 visitors respond to the tourist sample instead of 54 for the park and all other sampled venues. The actual confidence interval, had all of the 54 surveys been done at Inverhuron Provincial Park, would have been plus or minus about 13 percent.

- **Misinterpretation of results:** For the surveys dealing with local attitudes, Golder Associates concluded "The majority of both Kincardine and neighboring municipality respondents indicated that none of the management options would have an adverse effect on their feelings of personal security or satisfaction with the community" (ibid, p. 45). However, given that nearly half of the respondents to the telephone survey indicated they were very or somewhat aware of the WWMF, it appears the survey group was comprised primarily of people who worked for, had a

family member or neighbor who worked for, or in some other way had an economic link to the Bruce Nuclear site. In other words, the surveyors sampled the halo effect and extrapolated from that to the total population. This problem is again evident from the tourism research surveys, which failed to provide separate detailed results for the tourist business owners and tourists.

3.2 Golder Associates Ignored Important Socioeconomic Cost Categories in Their IAS

Section 5.1 of the IAS states:

"Costs related to the options include the capital and operating costs of the facilities (including payroll costs), and spending on purchases of services and materials. Economic benefits experienced by the Kincardine and the neighboring municipalities include direct and indirect jobs associated with the facility and the direct and indirect expenditures in their communities. In addition, taxes for the facility are paid to Kincardine as to the host municipality."

The public is not limited to just the range of benefits outlined in the IAS. Instead, the public surrounding the proposed site (the host community of Kincardine—the Local Study Area of the EIS, and the surrounding communities that form the Regional Study area of the EIS—will experience important social costs, such as

- additional road congestion as large vehicles service the construction site and workers commute to and from it
- additional crowding in schools, stores, and recreational venues from new workers and their families
- increased housing costs as in-migrating workers bid up the price of shelter
- reduced demand for harvested whitefish from the area, the Great Lakes' most important commercially harvested species, and
- significant changes in the quantity and quality of the tourist visits to the area as environmentally sensitive and anti-nuclear tourists seek recreation elsewhere due to stigma.

Failure to include these cost categories (and emphasizing the monetary benefits that could be available) placed an intentionally overoptimistic forecast in front of the Steering Committee for the

Municipality of Kincardine and, as expected, resulted in Kincardine's petition to be the host community for the proposed DGR.

4 Attributes of a Quality Cost Estimate

This section describes the attributes of internationally accepted quality cost estimates for use in obtaining approval of projects, and for comparing alternatives.

4.1 Quality Cost Estimate Guides

International cost estimating practice generally follows guidance documents developed, reviewed, and adopted by certified cost estimators who are experts in their field. The guides provide a rigorous basis upon which costs and schedules may be developed in a consistent and well documented manner. Within each country standards organizations publish guidance documents for use by cost estimators.

4.1.1 Canadian Guidance

The Canadian government has developed and provided specific guidance for the preparation of cost benefit analyses, business cases, and cost estimate definitions. The following are examples of cost guidance that Golder Associates should have used in developing the cost benefit analyses of the four alternatives selected and the others which they rejected:

1. Transport Canada, "Guide to Benefit-Cost Analysis" TP11875E, September 1994 (Ref. 7)
2. Canadian Cost-Benefit Analysis Guide, Regulatory Proposals (2007) (Ref. 8)
3. BC Ministry of Transportation – "Guidelines for Preparing MoT Business Cases, Appendix 5, Project Cost Estimating Guidance," September 2006 (Ref. 9)
4. Canadian Treasury Board, Public Works and Government Services Canada, "Cost Estimate Definitions." (Ref. 10)

4.1.2 International Cost Estimate Guidance

Alternatively, Golder could have used the following guidance for developing quality cost benefit analyses of alternatives:

1. Royal Institute of Chartered Surveyors [RICS new rules of measurement NRM 1: Order of cost estimating and cost planning for capital building works - Section 2.19.5, Second Edition, April 2012] (Ref. 11)

2. Association for the Advancement of Cost Engineering International [AACE International Recommended Practice No. 34R-05 "Basis of Estimate TCM Framework: 7.3 – Cost Estimating and Budgeting," July 28, 2010 (Ref. 12)

3. US Department of Energy [US DOE "Cost Estimating Guide," DOE G 413.3-21, May 9, 2011] (Ref. 13)

4. US General Accounting Office [US GAO, "GAO Cost Estimate and Assessment Guide – Best Practices for developing and Managing Capital Program Costs," GAO-09-3SP, March 2009] (Ref. 14)

4.1.3 Canadian Cost Classifications

For the purpose of identifying a project's definition (completeness), quality of the data and accuracy it is common practice to classify cost estimates in accordance with a recognized set of criteria. In Canada, the Canadian Treasury Board has adopted a classification system which it requires for the submission and approval of budgetary actions. Canadian government agencies as well as commercial organizations have adopted this classification system in preparing budgets and proposals. The paper "Estimate Classes: An Explanation," by A. Huxley (Ref. 15), Table 1 shows the classification system used by the Canadian Treasury Board.

Table 1 – Cost Estimate Classification Summary – Estimate Attributes					
	Primary Attribute	Secondary Attributes			
Estimate Classification	Project Definition	Intended Purpose	Methodology	Level of Precision	Preparation Effort
Class A	High (completed working documents)	Compliance with effective project approval (budget)	Measured, priced, full detail quantities	High	High
Class B (Substantive)	Medium (completed design development)	Seeking effective project approval	Mainly measured, priced, detail quantities	Medium	Medium
Class C (Indicative)	Low (project plan)	Seeking preliminary project approval	Measured, priced, parameter quantities, where possible	Low	Low
Class D	Lowest (described solutions)	Screening of various alternative solutions	Various	Lowest	Lowest

4.1.4 Project Approvals

From a capital expenditures standpoint, the DGR Project is a major effort and the Guidelines require a detailed well documented cost-benefit analysis. For purpose of seeking effective project approval, a Class B or Class A cost estimate should have been provided.

4.2 Elements of a Quality Cost Estimate

As an indication of the quality of a cost estimate expected for the DGR Project, the following attributes are listed in summary. These attributes constitute the Basis of Estimate, which is the foundation upon which a quality cost estimate and schedule are developed.

4.2.1 Basis of Estimate

In accordance with the AACEI Recommended Practice No. 34R-05 "Basis of Estimate TCM Framework: 7.3 – Cost Estimating and Budgeting," (Ref. 12) for example, the AACEI states the Basis of Estimate should include the following attributes:

A well prepared basis of estimate will:

- *Document the overall project scope.*
- *Communicate the estimator's knowledge of the project by demonstrating an understanding of scope and schedule as it relates to cost.*

- *Alert the project team to potential cost risks and opportunities.*
- *Provide a record of key communications made during estimate preparation.*
- *Provide a record of all documents used to prepare the estimate.*
- *Act as a source of support during dispute resolutions.*
- *Establish the initial baseline for scope, quantities and cost for use in cost trending throughout the project.*
- *Provide the historical relationships between estimates throughout the project lifecycle.*
- *Facilitate the review and validation of the cost estimate.*

This RP is intended to be a guideline, not a standard. It is understood that not all organizations that prepare estimates employ the same processes and practices, and therefore, may opt to use this information either in part or in its entirety[1].

On the basis of this guidance, for the DGR Project the Basis of Estimate should have included:

- Assumptions and Exclusions
- Boundary Conditions and Limitations
- Alternatives Evaluation
- Selection of Preferred Alternative & Basis
- Operational Costs and Considerations
- Decommissioning Alternatives Evaluation
- Decommissioning Preferred Alternative and Basis
- Stakeholder Input/Concerns - Aboriginal groups & others
- Facility Description and Site Characterization
- Waste Management
- Sources of Data Used

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- Cost Estimating Methodology used - bottom-up, specific analogy, etc.
- Contingency Basis
- Discussion of Techniques and Technology Used
- Description of Computer Codes or Calculation Method Used
- Schedule Analysis
- Uncertainty and Management of Risk
- WBS Levels
- WBS Dictionary
- Projects Phases - Design, Licensing, Pre-construction, Construction, Operations, Decommissioning
- Project Management Approach - OPG or Contractor
- Risk Analysis - Cost, Schedule, Contingency - Quantitative Uncertainty, Reliability and Sensitivity of Risks

4.3 QA Program Applied

Of equal importance in preparing a quality cost estimate is to follow rigorous quality assurance program principles. Engineering and cost estimating consultants may follow their own company specific QA program, or may model one after such recognized sources as the ASME (NQA-1 Certified) Quality Assurance Program (Ref. 16). The purpose of a QA program applied to cost estimation is to ensure the quality of the data used in the estimate, provide documentation of all analyses, reproducibility of results, and final checking.

4.4 Benchmarking

Benchmarking is commonly used to validate the results of cost estimates by comparison against other known or estimated costs to assure reliability of any conclusions drawn from the estimate. International experience when available can be a valuable resource for benchmarking. The cost estimator needs to ensure comparability and basis of estimate to those of the benchmark. Often, adjustments may need to be made for differing applications, capacities, and assumptions. With respect to the proposed DGR, the alternatives analysis clearly calls out for benchmarking, as the technologies involved are either untried or rare.

4.5 Conclusions and Recommendations

Conclusions and recommendations developed from the results of the cost estimate need to be rational and reasonable for the purpose intended. Specific citations where conclusions were drawn from a given analysis should be included. Recommendations, improvements, or the need for additional studies should be clear and unambiguous.

4.6 References

All references relied upon in the development of a cost estimate or cost benefit analysis should be listed as an integral part of the cost estimate. Optionally, additional background reading information may also be provided.

4.7 Summary of Findings

The EIS Guidelines require well documented analyses in support of the evaluation of alternatives and the selection of a preferred alternative. This section identified several cost estimating guidance documents available in Canada and in the international arena, with specific guidance aimed at performing cost-benefit analyses for project approvals. The Canadian Treasury Board recommends a cost classification system based on the degree of project definition available at the time the estimate was prepared. For purpose of seeking effective project approval, a Class B or Class A cost estimate should have been provided. A quality cost estimate should include a thorough Basis of Estimate, with appropriate documentation to support the analysis and its conclusions. As part of the validation of cost estimates experienced cost estimators prepare comparisons to benchmarked facilities with appropriate adjustments for differences. These benchmarks are valuable tools to confirm the conclusions of an estimate. A quality estimate should also include all references upon which the estimate is based as part of the delivered final cost estimate report.

OPG through its consultant Golder Associates failed to provide quality cost estimates for any of the alternatives it considered in the OPG EIS. All that was provided was a bottom-line cost for each selected alternative without any supporting documentation.

5 The Golder Associates Independent Assessment Study Inadequacies

This section describes the inadequacies of the Golder Associates IAS for use as a basis of the OPG EIS for the DGR Project.

5.1 Golder Associates Retained by OPG

OPG retained Golder Associates for the preparation of the IAS and the EIS. As such, the independence of Golder Associates comes into question as to whether they were truly impartial.

With respect to the preparation of the EIS alternatives cost estimate (and schedule), multiple organizations were involved in developing the cost estimates.

Golder - Cost Estimate for Long-term Repository Deep Vaults (DGR)

SGN - Cost Estimate for Enhanced Processing and Storage

OPG - Cost Estimate for Status Quo & WWMF Operations

Three different estimating organizations and bases were used to assess the alternatives. Without supporting underpinning to review, it is questionable whether the same level of detail was applied for each alternative, or whether consistent assumptions and boundary conditions were used.

5.2 Golder Associates IAS Report Fails to Meet the EIS Guidelines Standard

The Golder Associates IAS report, although prepared in February 2004 prior to the preparation EIS Guidelines, fails to meet the Guidelines standard. While the IAS preceded the EIS, its publication did not precede the publication of the CNSC's Draft Guidelines. There was adequate time for a revision to the cost estimates in the IAS in accordance with the Guidelines before they were made public. The IAS Report claims it is based on a number of more detailed background studies relating to the long-term management of LLW & ILW. No references are provided. For DGR Project approval purposes, the IAS is inadequate documentation to justify its conclusions of the DRV as the preferred alternative.

5.3 Specific Listing of IAS Cost Estimate Shortcomings

The Golder Associates IAS contains numerous cost estimate shortcomings. These shortcomings are broken down into specific requirements of the EIS Guidelines, conformance with a quality estimate, QA program applied, benchmarking, and references.

5.3.1 Requirements of the EIS Guidelines

1. Failed to include ILW considerations in the cost estimate and did not address reasons/justifications for not including ILW.

2. Failed to address VECs with respect to socioeconomic components for each alternative. No substantiation was provided.

3. Failed to document how scientific, engineering, traditional, and other knowledge was used to reach its conclusions of the DGR preference.

4. Failed to provide supporting underpinning documentation for transparency and reproducibility.

5. Failed to provide a quantitative Risk Analysis to address uncertainty, reliability, and sensitivity in cost models for each of the four alternatives.

6. No evidence that the "best available information and methods to the highest standards and relevant subject area" were used in any analyses to justify conclusions.

7. No description of significant gaps in knowledge and understanding (ILW) was provided relevant to key conclusions in the EIS.

8. Per Section 7.2 of the Guidelines, no (detailed) analyses of costs of alternatives described the functionally different ways to meet the Project's needs and purpose from the prospective of the Proponent.

9. With respect to alternatives to the DGR within the control and/or interest of the Proponent OPG:

No explanation of how the criteria was developed; for example design life of 100 years, dose rates, package selection, surface concrete vault institutional control for 300 years and closure design, DGR closure design.

No reasons for rejection of alternatives (deep concrete vaults, deep rock cavern vaults, shallow concrete vaults, and shallow rock cavern vaults) as not technically feasible.

No discussion as to why alternative sites were not considered. Although Golder Associates conducted a superficial survey of the local populace, no other in-depth investigative analysis and evaluation of alternative sites was conducted. An investigation of alternative sites is common practice internationally, and would clearly have been within the control and interest of the Proponent.

5.3.2 Conformance with a Quality Cost Estimate

1. Failed to provide a Basis of Estimate as described in Section 4.3.1.
2. Included only nine (9) assumptions; for an estimate of this magnitude more detailed assumptions should be provided.
3. Failed to provide boundary conditions and limitations.
4. Failed to justify the selection of the Preferred Alternative (DRV).
5. Failed to provide detailed substantiation of design, pre-construction, licensing, and approvals cost.
6. Failed to provide detailed substantiation of operating costs for all alternatives and bases.
7. Failed to provide a detailed description of the cost basis for decommissioning design/plan cost estimate, nor selection of preferred design.
8. Failed to address stakeholder (Aboriginal nations) concerns and costs (land rights, fishing, sacred grounds, etc.). This is partly a function of the identified study area, which was intentionally limited to only those areas where (1) a large part of the general population has an economic link to the nuclear site, and (2) lands outside

the Saugeen and Nawash reserves—i.e., limiting the need for Aboriginal involvement, even though the Bruce site is on SON traditional land.

9. Failed to address ILW alternative costs if another facility is required for storage/disposal.

10. Failed to provide sources of cost estimating and scheduling data used in any alternative analyses.

11. Failed to indicate the cost estimating methodology used (bottom up, specific analogy, ratio, etc.).

12. Failed to identify any amount of contingency included, nor method of selection of contingency (lump sum, built up, or Risk Analysis).

13. Failed to provide an adequate description of techniques and technology for construction (bore drilling, shaft sealing & and reinforcement, ventilation equipment).

14. Failed to provide a description of any computer codes used in the cost/schedule estimates.

15. Failed to provide a detailed schedule analysis – schedule and costs are interrelated.

16. Failed to provide any discussion/analysis of uncertainty and management of risk.

17. Cost estimate details should be provided in terms of WBS levels.

18. Failed to provide a WBS dictionary.

19. Failed to breakdown the project(s) into phases.

20. Failed to identify in detail how the project(s) would be managed - OPG versus contractor interface.

21. Failed to provide a quantitative Risk Analysis for cost and schedule - uncertainty (P 50/P 80 analysis of risk probability), cumulative probability, and sensitivity analysis of costs and schedule issues.

5.3.3 QA Program Applied

1. Failed to describe the QA Program used by Golder Associates for cost and schedule estimates.

2. Failed to identify the quality of the data – source and verification.

3. Failed to describe the checking and data process used by Golder Associates

5.3.4 Benchmarking

1. Failed to provide cost estimate benchmarks from international experience at Forsmark SFR - Sweden, Olkilouto Onkalo - Finland, El Cabril - Spain, Carlsbad, NM WIPP - USA, etc.

2. Failed to address differences in international experience relative to DRV and other alternatives.

5.3.5 References - failed to provide any references.

5.4 Summary of Findings

As a contractor to OPG, Golder Associates was responsible to meet the requirements of the EIS Guidelines to the same extent as was OPG. The foregoing extensive list of Golder Associates failures to comply with the EIS Guidelines undermines the quality of the work performed, the Basis of Estimate, the cost estimate results, and the credibility of the conclusions drawn by Golder Associates and subsequently adopted by OPG regarding the selection of the Deep Rock Vault as the preferred alternative. The cost estimates are clearly unsupported by any of the quality attributes expected to be provided in such an analysis, and appears to favor the DRV alternative.

6 The EIS Inadequacies

This section describes the inadequacies of the Final EIS resulting from OPG relying on the Golder Associates IAS.

6.1 The "Final" EIS

The "Final" EIS was issued in March 2011 (Ref. 6), seven years after the Golder Associates IAS was prepared. There was certainly adequate time for Golder Associates and OPG to provide a

Class A or Class B cost estimate in support of the EIS, as well as to incorporate the requirements of the Guidelines. As recently as July 23, 2013, (OPG's submission to the JRP) OPG continues to rely on this seriously flawed Golder report as a basis for proceeding with the DGR.

From a cost estimation standpoint, the EIS contains several inadequacies, which do not support the Deep Rock Vaults as the preferred alternative for the DGR project. In particular, the EIS Summary Table 3.3.7-1 contains the following flaws:

- Costs of alternatives are addressed in a single table
- There is no documentation or so-called " underpinning" in support of the estimates in the EIS
- Costs for each of the alternatives considered are for LLW only
- No costs are included for special considerations for ILW, even though the EIS title is for LLW and ILW
- Construction and lifetime operations costs are included for each alternative, but decommissioning costs are provided for only Surface Concrete Vaults and Deep Rock Vaults
- No Pre-construction costs were included for design, licensing, and stakeholders including Aboriginal nations
- None of the cost estimate EIS Guidelines attributes as described in the previous sections are addressed in the EIS

6.2 Summary of Findings

OPG's reliance on the analysis and conclusions of the inadequate Golder Associates IAS resulted in the Final EIS being inadequate for compliance with the EIS Guidelines, and inappropriate for use as the basis for requesting approval of the DRV alternative for the DGR project.

7 EIS Summary of Results – Table 3.3.7-1

This section describes the Summary of Results provided in the EIS Table 3.3.7-1, which was provided by OPG without support of the underpinning of calculations or documentation upon which the costs were based. OPG provided neither its own detailed analysis nor that of Golder Associates to justify the costs for each of the alternatives considered. This section also includes

examples (benchmarks) of international actual cost experience of similar facilities for deep geological repositories and surface concrete vaults.

7.1 Total Expenditures for Surface Concrete Vaults and Deep Rock Vault

The EIS Table 3.3.7-1 provides a summary of results of the Golder Associates Independent Assessment Study. A lifetime Economic Analysis total expenditures for each alternative are as follows:

Parameter	Status Quo	Enhanced Processing and Storage	Surface Concrete Vaults	Deep Rock Vault
Total Expenditure	$648 million	$776 million	$923 million	$927 million

OPG and Golder Associates provided no support or underpinning documentation for these cost estimates. In fact, the costs are only for LLW and reflect construction and lifetime operating costs. There are no costs associated with facility design, licensing, site preparations, and stakeholder considerations including Aboriginal Nation concerns. No cost provision was included for dealing with ILW for the cases of Status Quo, Enhanced Processing and Storage and Surface Concrete Vaults. Although the EIS states the Deep Rock Vault would be capable of handling ILW, no cost provisions are included in this estimate.

The Golder Associates IAS states that for each of the alternatives shown in Table 3.3.7-1, the assumed current annual operating costs for the Status Quo based on OPG experience are $21.2 million. This cost which represents the operation of the WWMF which will continue to be used for all alternatives, must be included along with the construction, operating phase, facility annual operating, and decommissioning costs for each of the alternatives to account for the total costs. Although the IAS states that the operating period of each alternative varies from 25 years to 28 years, a constant value of 35.5 years was used for the annual operating costs of the WWMF with no explanation. The IAS estimated costs for post licensing construction, operations and WWMF annual operating costs (for an assumed 30.5 years – with no explanation) are shown in the following table:

Item	Enhanced Processing and Storage, $kCAD (2002)	Surface Concrete Vault, $kCAD (2002)	Deep Rock Vault, $kCAD (2002)
Post licensing construction	39,943	39,561	91,934
Operating phase	87,824	231,153	178,716
Annual operating costs	648,000	648,000	648,000
Decommissioning	Not shown	3,871	7,826
Total expenditure	775,767	922,585	926,476

This table does not include costs for evaluating the Kincardine site and other sites which historically have been an expensive and exhaustive proposition. There are no costs identified for pre-construction licensing, which can also be an expensive part of the licensing process. As noted earlier, there are no costs for disposal of ILW for each of these alternatives. As ILW presents more difficult shielding problems for a Surface Concrete Vault (and special considerations even for a Deep Rock Vault), the costs should have been included and documented.

7.2 International Experience at Similar Facilities

While there are not a large number of similar facilities operating, planned, or under construction internationally, an examination of existing facilities world-wide indicates costs are substantially greater than those estimated by Golder Associates.

7.2.1 SFR Sweden

The actual costs for construction of this 63,000 m^3 LLW and ILW 60 meter deep geological repository facility including licensing, siting, pre-studies, and borehole investigations was $174.6 M USD in 1988 dollars. (Ref. 17). Accounting for inflation from 1988 to 2002 (the year of the Golder

Associates estimates) at 3% per year would be $264.1 USD ($1.03^{14}$ x $174.6MUSD = $264.1 MUSD). Converting this cost to Canadian dollars at an exchange rate of 1.03, the cost would be $272 MCAD. Relating this cost to the Deep Rock Vaults of the DGR with a proposed 115,000 m^3, the cost of construction only of the Deep Rock Vaults would be 115,000/63,000 x $272 MCAD = $496.5 MCAD instead of the Golder Associates IAS value for construction of $91.9 million, or a factor of 5.4 greater.

7.2.2 Onkalo Finland

The cost of construction of the first phase of 8,432 m^3, 70-100 meter deep geological Low Level Waste facility at Olkiluoto was $35.6 MUSD in 1992 USD (Ref. 17), or approximately $36.7MCAD. Accounting for inflation from 1992 to 2002 at 3% per year would be $49.3 CAD ($1.03^{10}$ x $36.7MUSD = $49.3 MUSD). Relating this cost to the Deep Rock Vaults of the DGR, the cost of construction only of the Deep Rock Vaults would be 115,000/8,432 x $49.3 MCAD = $672.7 MCAD instead of the IAS $91.9 million, or a factor of 7.3 greater.

7.2.3 WIPP - Carlsbad, NM - USA

The actual cost of construction of this 168,500 m^3 deep geological repository for transuranic wastes was $6 billion (Ref. 18). Relating this cost to the Deep Rock Vaults of the DGR, the cost of construction only of the Deep Rock Vaults would be 115,000/168,500 x $6 billion = $4.1 billion instead of the IAS $91.9 million, or a factor of 44.6 greater.

7.2.4 El Cabril – Spain

The cost of construction of this 100,000 m^3 near surface concrete vault repository for low and intermediate level waste was $126.6 MUSD in 1992 dollars (Ref. 17), which included planning, licensing and construction. Accounting for inflation from 1992 to 2002 (the year of the Golder Associates estimates) at 3% per year would be $126.6 USD ($1.03^{10}$ x $126.6 MUSD = $170.1 MUSD). Converting this cost to Canadian dollars at an exchange rate of 1.03, the cost would be $175.2 MCAD. Relating this cost to the Surface Concrete Vaults with a proposed 115,000 m^3, the cost of construction only of the Surface Concrete Vaults would be 115,000/100,000 x $175.2 MCAD = $201.5 MCAD instead of the Golder Associates IAS value for construction of Surface Concrete Vaults $39.561 million, or a factor of 5.1 greater.

7.3 OPG Alternatives Selected for Study Not Comparable

The OPG alternatives selected for study by Golder Associates are not comparable in scope or extent. As noted in the IAS no costs were included for design, licensing, or stakeholder meetings, and considerations including Aboriginal nations.

ILW disposal costs were not accounted for in the Enhanced Processing and Storage, Surface Concrete Vaults, and the Deep Rock Vault alternatives, yet the EIS claims to address LLW and ILW.

The costs for decommissioning the Enhanced Processing and Storage alternative were not included in the estimate.

No comparable time frame across alternatives.

No discussion of costs post abandonment and decommissioning of the above ground structures.

7.4 Summary of Findings

The EIS Table 3.3.7-1 Summary of alternative costs, lacking any supportive underpinning or documentation and therefore cannot be considered a "transparent and reproducible" analysis of the data models and studies evaluated for each of the alternatives. There is no evidence that either OPG or Golder Associates used "scientific, engineering, traditional, and other knowledge to reach its conclusions."

The inconsistencies and failures to include site investigation costs, pre-construction licensing costs, and ILW disposal costs undermines the credibility of the conclusions drawn that the Surface Concrete Vaults and Deep Rock Vaults are approximately the same costs.

A benchmark extrapolation of the Golder Associates post-licensing construction costs of the Deep Rock Vaults and the Surface Concrete Vaults to international actual costs of licensing and construction of similar facilities shows factors of costs for facilities similar to the Deep Rock Vaults ranging from 5.4 for Sweden's SFR to 44.6 times greater for the US WIPP facility than those estimated by Golder Associates, and costs for Spain's El Cabril a facility similar to the Surface Concrete Vault is 5.1 times greater than estimated by Golder Associates. These comparisons indicate a significantly higher cost than provided by Golder Associates, and brings into question

whether the Golder Associates IAS can be relied upon as the basis for the EIS alternative evaluations. In fact, it appears that Golder Associates intentionally presented only the costs that would favor the DRV as the preferred alternative.

As noted earlier, the OPG alternatives selected for study by Golder Associates are not comparable in scope or extent as no costs were included for design, licensing, or stakeholder meetings, and considerations including Aboriginal nations. ILW disposal costs were not accounted for in the Enhanced Processing and Storage, Surface Concrete Vaults, and the Deep Rock Vault alternatives, yet the EIS claims to address LLW and ILW. The costs for decommissioning the Enhanced Processing and Storage alternative were not included in the estimate.

8 Conclusions

This section summarizes the conclusions discussed in each of the previous sections and offers a recommendation for re-evaluation of each alternative, including those that were eliminated by Golder Associates and OPG.

1. The EIS Guidelines required OPG to identify environmental impacts, mitigation measures and the significance of residual effects. The Guidelines required OPG to use scientific, engineering, traditional, and other knowledge regarding its conclusions on the DGR project, and that the analyses must be transparent and reproducible. Levels of uncertainty, reliability, and sensitivity of the models used to reach conclusions must be indicated. This implies a quantitative Risk Analysis be performed. The analyses of alternatives, as well as other locations for the DGR and other options must include functionally different ways to meet the project's needs and purpose. All alternatives analyzed should explain the criteria applied, reasons for rejection of an alternative, and identify the preferred alternative based on environmental, economic and technical benefits and costs. The detail provided should be sufficient to allow the Joint Review panel to compare the project and alternatives.

OPG failed to provide this level of detail required under the terms of the EIS Guidelines.

2. The Environmental and Social Feasibility study in the IAS is insufficient and does not fully address the full extent of socioeconomic impacts necessary for a full alternatives analysis. However, the IAS reached a conclusion that the DRV alternative had the most concern among respondents among all survey groups. This conclusion was not relied upon by OPG, who chose to

ignore that caveat and concluded, instead, that there would be no significant socioeconomic impacts from the DRV, and therefore, the DGR. OPG provided no support to document these claims.

3. There are cost estimating guidance documents available in Canada and in the international arena that provide specific guidance for performing cost-benefit analyses for project approvals. The Canadian Treasury Board recommends a cost classification system based on the degree of project definition. For project approvals, a Class B or Class A cost estimate should have been provided. The classification of costs provided by Golder Associates for the IAS was comparable to a Class D estimate, appropriate for screening of alternative solutions but not for selection and regulatory approvals of a preferred alternative.

A quality cost estimate should include a thorough Basis of Estimate, with appropriate documentation to support the analysis and its conclusions. To validate the cost estimates, experienced cost estimators use benchmarks of other similar facilities with appropriate adjustments for differences. A quality estimate should also include all references upon which the estimate is based as part of the delivered final cost estimate report.

4. OPG's use of the inadequate Golder Associates IAS resulted in the Final EIS being inadequate for compliance with the EIS Guidelines, and inappropriate for use as the basis for requesting approval of the DRV alternative for the DGR project.

5. OPG through its consultant Golder Associates failed to provide quality cost estimates for any of the alternatives it considered in the OPG EIS. All that was provided was a bottom-line cost for each selected alternative without any supporting documentation. The Golder Associates IAS provided no evidence that the good practice standards established in the industry were followed by any measure of accountability.

6. As OPGs contractor, Golder Associates was responsible to meet the requirements of the EIS Guidelines to the same extent as was OPG. Golder Associates failed to comply with the EIS Guidelines thereby undermining the quality of the work performed, the Basis of Estimate, the cost estimate results, and the credibility of the conclusions drawn by Golder Associates and subsequently adopted by OPG for the selection of the Deep Rock Vault as the preferred alternative.

7. OPG's reliance on the inadequate Golder Associates IAS resulted in the Final EIS being inadequate for compliance with the EIS Guidelines, and inappropriate for use as the basis for requesting approval of the DRV alternative for the DGR project.

8. The EIS Table 3.3.7-1 Summary of alternative costs lacked any supportive underpinning or documentation and cannot be considered a "transparent and reproducible" analysis of the data models and studies evaluated for each of the alternatives. There is no evidence that either OPG or Golder Associates used "scientific, engineering, traditional, and other knowledge to reach its conclusions."

a. The inconsistencies and failures to include site investigation costs, pre-construction licensing costs, and ILW disposal costs undermines the credibility of the conclusions drawn that the Surface Concrete Vaults and Deep Rock Vaults are approximately the same costs.

b. An order-of-magnitude comparison of the Golder Associates post-licensing construction costs of the Deep Rock Vaults and the Surface Concrete Vaults to international actual costs of licensing and construction of similar facilities shows factors of costs for facilities similar to the Deep Rock Vaults ranging from 5.4 to 44.6 greater than estimated by Golder Associates. Costs for a facility similar to the Surface Concrete Vault were 5.1 greater than estimated by Golder Associates. These comparisons indicate the Golder Associates estimates are underestimated, and indicate the Golder Associates IAS cannot be relied upon as the basis for the EIS alternative evaluations.

c. As noted earlier, the OPG alternatives selected for study by Golder Associates are not comparable in scope or extent as no costs were included for design, licensing, or stakeholder meetings, and considerations including Aboriginal nations. ILW disposal costs were not accounted for in the Enhanced Processing and Storage, Surface Concrete Vaults, and the Deep Rock Vault alternatives, yet the EIS claims to address LLW and ILW. The costs for decommissioning the Enhanced Processing and Storage alternative were not included in the estimate.

9. It is recommended that OPG retain a truly independent contractor to re-evaluate all of the alternatives on a consistent basis using state-of-the-art cost estimation methods and documentation to select a preferred alternative. The re-evaluation should consider all options including alternative sites, and all stakeholder issues including those of the Aboriginal nations.

9 References

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2. Nuclear Safety and Control Act (NSCA)
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4. Concordance Document of the EIS Guidelines
5. Golder Associates, "Independent Assessment Study," February 2004
6. Final Environmental Impact Statement for OPG's Deep Geologic Repository Project for Low & Intermediate Level Waste, March 2011
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12. Association for the Advancement of Cost Engineering International [AACE International Recommended Practice No. 34R-05 "Basis of Estimate TCM Framework: 7.3 – Cost Estimating and Budgeting," July 28, 2010
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14. US General Accounting Office [US GAO, "GAO Cost Estimate and Assessment Guide – Best Practices for developing and Managing Capital Program Costs," GAO-09-3SP, March 2009]
15. Anthony L. Huxley, "Estimate Classes: An Explanation," Construction Economist, June 2002
16. "Quality Assurance Requirements for Nuclear Facilities Applications," ASME (NQA-1), 2012
17. "Low-Level Radioactive Waste Repositories," Organization for Economic Cooperation and Development/ Nuclear Energy Agency, 1999, Paris, France

18. Christopher Helman, Forbes Staff Writer, "Nuke us: the Town That Wants America's Worst Atomic Waste," February 13, 2013.

10 Bios

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Stigma and the Deep Geologic Repository: Consequences for the Saugeen Ojibway Nation

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Introduction

Before deciding whether to recommend the approval of the proposed Deep Geologic Repository, the Canadian Nuclear Safety Commission (CNSC) and the Joint Review Panel must have full information regarding the project's consequences. A significant part of that information is the *Canadian Environmental Assessment Act* (*CEAA*) requirement for an estimation of the project's potential environmental and societal impacts. Ontario Power Generation has failed to provide such information regarding the DGR's potential to stigmatize surrounding communities. There is copious evidence to suggest this stigma will be serious and suffered acutely by the Saugeen Ojibway Nation. Until OPG provides adequate, defensible analysis of the DGR's potential stigma, the Panel lacks sufficient information to make its decision.

Background

On 2 December 2005, Ontario Power Generation (OPG) petitioned the CNSC for a permit to construct and operate a Deep Geologic Repository (DGR) approximately one kilometre from the shore of Lake Huron at the Bruce Nuclear site (BNS) in the Municipality of Kincardine, Ontario. According to the application, the proposed DGR would receive only low- and intermediate-level radioactive waste, including waste stored at the BNS and produced at other OPG-owned generating stations at Bruce, Pickering, and Darlington. The application states that high-level nuclear waste and spent nuclear fuel would not be stored at the DGR.[1]

In support of its application, OPG presented an Environmental Impact Statement (EIS)[2] and related Socioeconomic Technical Support Document (TSD)[3], the latter describing the methodologies and processes used in the EIS. The purpose of these two documents was to estimate the socioeconomic impacts of the proposed DGR, including the potential for the proposed DGR to stigmatize the BNS and surrounding areas.

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[1] OPG, 2011a, *Ontario Power Generation's Deep Geologic Repository For Low and Intermediate Level Waste: Environmental Impact Statement*, Volume 1: Main Report, 00216-REP-07701-00001-R000, March 2011, prepared by Golder Associates Ltd. ("OPG 2011a"), pp. 2-9.

[2] OPG's Deep Geologic Repository for Low & Intermediate Level Waste Environmental Impact Statement (March 2011).

[3] OPG's Deep Geologic Repository for Low & Intermediate Level Waste Socio-economic Environment Technical Support Document (March 2011).

The EIS estimates minimal socioeconomic impact—including from nuclear-related stigma—to the area immediately surrounding the proposed DGR, including "all of the Bruce Nuclear site and the lands within the Municipality of Kincardine closest to it, as well as the area of Lake Huron adjacent to the facility" (identified as the Local Study Area or LSA). The same conclusion is reached for the so-called Regional Study Area (RSA), a broader area encompassing the LSA and the remainder of Bruce County "with the exception of the peninsula communities of the Town of South Bruce Peninsula and Northern Bruce Peninsula Municipality".[4]

SON's concerns

OPG's conclusion that the proposed DGR will create minimal stigma for the BNS and surrounding areas is neither credible nor defensible. A voluminous body of research indicates that virtually all nuclear projects generate significant stigma. Case studies from around the world—even the BNS—demonstrate near-universal aversion to the risks involved in nuclear energy, especially nuclear waste. These include two previous attempts to construct a DGR-type facility, both of which were abandoned because of anticipated stigma.

OPG's EIS reaches its conclusions regarding stigma without reference to any of this research or any of these case studies; in effect, without considering the experience of *anyone, anywhere, ever.* Instead, OPG's stigma analysis is perfunctory and superficial, its technical deficiencies so crude and pervasive that it's unclear OPG fully understands its responsibility to the Canadian government and the communities surrounding the proposed DGR.

Outside the Municipality of Kincardine, which has a long, close relationship with both OPG and the BNS, the community most directly affected by any DGR-related stigma is the Saugeen Ojibway Nation.[5] While Kincardine benefits from nuclear-related economic activity, SON depends on tourism to the Bruce Peninsula and a fishery in Lake Huron for its livelihood and cultural identity. Notwithstanding the BNS is within SON's traditional territory, OPG's stigma analysis excludes SON from the communities potentially affected.

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[4] OPG 2011a. Bruce Peninsula includes four townships. In Bruce County along the eastern side of the peninsula are the townships of North Bruce Peninsula and South Bruce Peninsula, with the Chippewas of Saugeen First Nation #29 Reserve occupying a thin strip of land along the shores of Lake Huron for 12 to 15 km along the southern shore of the peninsula. Within the peninsula, Bruce County also includes the Chippewas of Nawash Unceded First Nation #27 Reserve (Cape Croker) on the western side along Georgian Bay, Grey County has one township on Bruce Peninsula: the northern portion of Georgian Bluffs above Provincial Highway 21. This report will refer to these areas collectively as "Bruce Peninsula."

[5] The Saugeen Ojibway Nation (SON) is comprised of two independent bands: The Chippewas of Saugeen First Nation (SFN), and the Chippewas of Nawash Unceded First Nation (Nawash).

The result is almost perfect disregard for the community with the most to lose from the proposed DGR. SON's traditional territory is central to its members' self-identity. Damage to this territory, either physical (via contamination) or economic (via stigma), is irremediable to SON. Failing to consider the DGR's potential to stigmatize SON's traditional territory is grossly imprudent.

Structure of this report

Section One explains that stigma is an intensely emotional response to complexity. Where the risks attending a particular choice are difficult to understand and highly uncertain, individuals default to social norms, emotional ('gut') reactions, and especially third party authority. For nuclear projects, this means generalized fear of catastrophic risks amplified by recursive media: stigma that's pernicious and durable, almost totally immune to rational refutation.

Section Two reviews numerous shortcomings with OPG's analysis of DGR-related stigma, finding the entire process grossly deficient. OPG's surveys deployed biased questions, biased and inadequate sampling, and were overly narrow in scope. The analysis fails on its own terms and is wholly inadequate to the present circumstances.

Sections Three and Four explain how stigma from the proposed DGR falls primarily on SON's fishery and tourism economy. Case studies make clear how food products are rapidly stigmatized, especially by serious environmental damage, which poses acute risks to SON's self-sufficiency and, more importantly, cultural identity. Case studies are also clear about the potential for nuclear facilities to stigmatize nearby tourist economies, even where triggering events occur at distant and unrelated nuclear sites.

Section Five recapitulates this report's basic claim: nuclear-related stigma is real and very serious but OPG failed to treat it as such. The proposed DGR cannot proceed without a defensible, comprehensive analysis of the DGR's potential to stigmatize surrounding communities, especially the SON.[6]

[6] Every effort has been made to convert dollar amounts in the text of this report to Canadian dollars. This involved converting foreign currency to Canadian dollars and translating historic amounts into current (*i.e.*, 2012) dollars. Unless otherwise indicated, amounts in the text have been so converted.

Section One: Stigma & Nuclear Projects

Stigma is an intensely emotional response to uncertainty. When people face choices involving risks that are uncertain and difficult to understand, they default to social norms, emotional ('gut') reactions, and especially third party authority. For nuclear projects, this means generalized fear of catastrophic risks amplified by recursive media: stigma that's pernicious and durable, almost totally immune to rational refutation.

A voluminous and detailed literature makes clear that nuclear projects generally, and nuclear waste projects especially, are heavily stigmatized.[7] Inexplicably, none of this research is discussed or even identified in the EIS. The EIS also makes no reference to any relevant case studies, including two previous attempts to establish DGR-type facilities—in Cumbria County, U.K. and Yucca Mountain, Nevada—both of which were abandoned amidst fears the facilities would stigmatize local economies. The EIS even overlooks recent experience of nuclear waste-related stigma *at the BNS itself*: when an attempt to transport 16 decommissioned steam generators through the Great Lakes was scuttled by public opposition, notwithstanding each generator contained just four grams of radioactive material and posed minimal risk to public or environmental health.

How stigma works

Faced with multiple possible outcomes, people normally choose the alternative with the highest expected value: the alternative that, under the circumstances, has the greatest chance of yielding the greatest benefit.

For choices that are complex and technical, however, where potential outcomes are uncertain and difficult to understand, the ordinary decision-making process breaks down. When individuals can no longer process relevant information—either because it's unavailable or too complex—they substitute imperfect heuristics for rational thinking.[8]

In the case of highly technical choices—including all choices involving nuclear technology—most people lack the time, resources, and technical expertise to evaluate the expected value of

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[7] Easterling, Douglas and Howard Kunreuther, 1995, *The Dilemma of Siting a High-Level Nuclear Waste Repository,* Kluwer Academic Publishers, Boston, p. 137. ("Easterling and Kunreuther, 1995").

[8] Mitchell, Gregory, 2002-2003, "Why Law and Economics' Perfect Rationality Should Not Be Traded for Behavioral Law and Economics' Equal Incompetence," The Georgetown Law Journal V91:N67, pp. 67-167 ("Mitchell, 2002-2003"): "Individuals systematically fall prey to a host of 'cognitive illusions' that lead to predictable nonrational behaviors."

relevant costs and benefits.[9] Instead, most people fall back on social norms, emotional ('gut') reactions, and third party—especially media—authority. When the sum of these imperfect heuristics is loud and negative, the result, over time, is stigma.

Overreliance on media authority is especially important to the development and dissemination of stigma.[10] The effect is known as "social amplification of risk": when a perceived risk materializes (a triggering event occurs) and authorities report its consequences, these reports are repeated by media organizations and interest groups *but for specific rhetorical effect*—usually to elicit emotional (keep watching) or behavioral (do something) responses. The result is a kind of feedback loop: each round of reporting amplifies the perceived risk and its negative consequences.[11] The effect is exacerbated by just those types of communication characteristic of media broadcasts:

- *Large volumes of information*: where stories are reported in great detail by multiple sources the perceived risk is amplified; it is literally everywhere, with competition for viewers tending towards sensationalized coverage.
- *Disputes over factual information*: when experts disagree—as they often do on the potential effects of nuclear accidents—an uninformed public loses confidence in *all* information sources. Heightened uncertainty leads to increased fear of the subject matter.[12]
- *Emotional language*: where prominent authorities use colourful language to describe circumstances—compare "deep geological repository" with "nuclear waste dump"—public perceptions are also tainted, often indelibly.[13]

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[9] For nuclear technology, the required complexity is clearly prohibitive to generalized understanding: when evaluating the need for retrofitting an existing nuclear reactor, for example, regulators use something called *probabilistic safety analyses* to determine the retrofit's expected value (where 'value' equals the avoidance cost of increased protection expressed in terms of lower core damage frequency). Alternatively, consider whether a layperson could produce—let alone read—the EIS and TSD.

[10] Kasperson, Roger E., Nayna Jhaveri, and Jeanne X. Kasperson, "Stigma and the Social Amplification of Risk: Toward a Framework of Analysis," in *Risk, Media, and Stigma: Understanding Public Challenges*, James Flynn, Paul Slovic, and Howard Kunreuther, eds., Earthscan Publishers, London, pp. 9-30. ("Kasperson, 2001"): Given a lack of personal knowledge on a subject, "secondary accounts or media information will often be principal sources of image information."

[11] Smith, Denis and Jo McCloskey, 1998, "Risk Communication and the Social Amplification of Risk," Public Money and Management, October-December, pp. 41-50 ("Smith and McCloskey, 1998"); Kasperson, Roger E.; Orwin Renn, Paul Slovic, Halina S. Brown, Jacque Emel, Robert Gobel, Jeanne X. Kasperson, and Samuel Ratick, 1988, "The Social Amplification of Risk: A Conceptual Framework," Risk Analysis, V8:N2, pp. 177-187 ("Kasperson, 1988").

[12] *N.B.* the recent example from Japan's Fukushima Daiichi Nuclear Power Plant. In the wake of the 2011 disaster—discussed further *sub.*—different levels of Japanese officials issued different damage assessments, producing "anxiety about radiation risks [and] leading to the collapse of local communities." (Murayama, Takehiko, 2012, "Social Impacts Induced by Radiation Risk in Fukushima," IAIA12 Conference Proceedings, Energy Future The Role of Impact Assessment, 32nd Annual Meeting of the International Association of Impact Assessment, 27 May - 1 June 2012, Porto, Portugal, p. 3).

Stigmas are pernicious because they develop notwithstanding of rational refutation. Sensationalized fear is limited only by individual imagination—the capacity to be nervous, uncertain, and profoundly risk-averse. It follows that once established, stigmas are extremely difficult to remove or even diminish.

Stigma associated with nuclear projects

The foregoing framework helps to understand why nuclear technology is heavily stigmatized. The technology is difficult to understand and poses enormous risks, the consequences of which are disproportionately significant compared to potential benefits.[14] Indeed, despite so much positive operating history for nuclear projects generally, recent research indicates that nuclear technology remains the subject of generalized fear, even dread:

> Among various potentially hazardous facilities, nuclear related facilities have been considered some of the most dreadful to the general public. This is because nuclear facilities are regarded as highly involuntary, unknown, delayed, new [unproven], uncontrollable, and potentially fatal and catastrophic.[15]

Imperfect heuristics are the norm with nuclear projects. While nuclear technology is generally arcane and extremely complex—radiological health, dosimetry, half-lives, iridium, isotopes, nuclides, fission—DGR technology is almost totally unknown to the general public.[16] The attendant fear of dangerous, unfamiliar technology is exacerbated by the inevitability of human error: while highly trained technicians operate nuclear facilities, *accidents still happen*, increasing public feelings of

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[13] Kasperson, 2001; see also Flynn, James, Paul Slovic, and Howard Kunreuther, 2001, *Risk, Media, and Stigma: Understanding Public Challenges,* Earthscan Publishers, London ("Flynn, 2001").

[14] A useful way to unpack how stigma attends perceived hazards: the hazard threatens consequences that (i) are terrible, (ii) violate a perceived natural order (e.g., parts of the biosphere), (iii) are distributed unequally, (iv) are unbounded in time and cost, and (v) are contingent on human error. Gregory, Robin S., James Flynn, and Paul Slovic, 1995, "Technological Stigma", American Scientist, 83, pp. 220-223 ("Gregory, 1995")

[15] Chunga, Ji Bum; Kim, Hong-Kyu; 2009, "Competition, economic benefits, trust, and risk perception in siting a potentially hazardous facility," Landscape and Urban Planning, V91 pp. 8–16. ("Chung, 2009"); See also: Dunlap, Riley E., Michael E. Kraft, and Eugene A. Rosa (eds), 1993, *Public Reaction to Nuclear Waste: Citizens' Views of Repository Siting,* Duke University Press, Durham NC. ("Rosa et al, 1993"), p. 317; Weart, S.R., 1988, *Nuclear Fear: A History of Images,* Harvard University Press, Cambridge, MA ("Weart, 1988"); Hinman, George W., Eugene A. Rosa, Randall R. Kleinhesselink, and Thomas C. Lowinger, "Perceptions of Nuclear Power and Other Risks in Japan and the United States," Risk Analysis, V13:N4, pp. 449 - 455. ("Hinman, 1993"), on fears of nuclear being universal (cross-cultural).

[16] As the EIS acknowledges, the proposed DGR is "unique in North America at the time of writing... relatively unknown and unfamiliar to the residents of the Local and Regional Study Areas". (OPG 2011a, p 7-181).

fear and helplessness.[17] Research also indicates the moral qualms people feel toward nuclear weapons generalize to anything nuclear, including nuclear waste;[18] that stigma with moral overtones is especially difficult to overcome;[19] and that the stigma associated with nuclear power is still less than the stigma associated with nuclear waste.[20]

Example: Hanford Nuclear Site

A good, recent example of how nuclear waste-related stigma develops and is sustained by media coverage involves the Hanford Nuclear Site in Benton County, Washington. The Hanford Site currently holds two-thirds of U.S. high-level radioactive waste: approximately 53 million gallons in 177 underground storage tanks.

On February 22, 2013, federal and state officials announced leaks in six underground storage tanks at the Hanford Site. The official announcement indicated the leaks were small, posed no immediate threat to public safety or the environment, and that cleanup efforts were underway.

Media coverage,[21] however, described at length the site's history of contamination and generally portrayed the site as totally, almost permanently unsafe:

- *Evocative, emotional language:* "Six underground tanks that hold a brew of radioactive and toxic waste at the nation's most contaminated nuclear site are leaking, federal and state officials said Friday."

- *Conflicting signals from experts and officials:*

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[17] William R. Freudenburg, 1992, "Nothing Recedes Like Success? Risk Analysis and the Organizational Amplification of Risks," RISK -Issues in Health & Safety 1 [Winter 1992] ("Freudenberg, 1992"), discussing the Three Mile Island accident as being the result of human error.

[18] Easterling, Douglas and Howard Kunreuther, 1995, *The Dilemma of Siting a High-Level Nuclear Waste Repository,* Kluwer Academic Publishers, Boston ("Easterling and Kunreuther, 1995"). Research also indicates that any classifications in the public mind between and amongst kinds of nuclear waste—low-, intermediate-, or high-level waste—break down beyond low-level waste (i.e., dental and medical x-rays): Eurobarometer, 2005, *Radioactive Waste,* prepared for the Directorate General Energy and Transportation, European Commission ("Eurobarometer, 2005"), p. 50.

[19] *I.e.*, that nuclear accidents are unnatural and wrong, bad, imposing moral culpability: Rozin, Paul, 2001. "Technological Stigma: Some Perspectives from the Study of Contagion," in *Risk, Media, and Stigma: Understanding Public Challenges to Modern Science and Technology*, James Flynn, Paul Slovic, and Howard Kunreuther, eds., pp. 31-40. Sterling, V.A., Earthscan Publishing Ltd., London.

[20] Easterling, Douglas and Howard Kunreuther, 1990, *The Vulnerability of the Convention Industry to the Siting of a High-Level Nuclear Waste Repository,* for the State of Nevada Agency for Nuclear Projects, Nuclear Waste Project Office, NWPO-SE-031-90. ("Easterling and Kunreuther, 1990").

[21] CBC News (citing The Associated Press), "Washington's Hanford Nuclear tanks leaking waste, again", 22 February 2013, at: http://www.cbc.ca/news/world/story/2013/02/22/us-washington-hanford-nuclear-leak.html.

- "Washington Gov. Jay Inslee said the leaking material poses no immediate risk to public safety or the environment because it would take a while—perhaps years—to reach groundwater."
- "[Tom Carpenter of Hanford Challenge, a Hanford watchdog group, said] 'None of these tanks would be acceptable for use today. They are all beyond their design life. None of them should be in service… And yet, they're holding two-thirds of the nation's high-level nuclear waste.'"

- *Human error:* "[F]alling waste levels in the six tanks were missed because only a narrow band of measurements was evaluated, rather than a wider band that would have shown the levels changing over time. 'It's like if you're trying to determine if climate change is happening, only looking at the data for today'."
- *Exorbitant costs and distant resolution:* "Cleanup is expected to last decades and cost billions of dollars."
- *Association with nuclear weapons:* "The federal government built the Hanford facility at the height of the Second World War as part of the Manhattan Project to build the atomic bomb. The remote site produced plutonium for the bomb dropped on Nagasaki, Japan, and continued supporting the nation's nuclear weapons arsenal for years."

The Hanford example illustrates how even minor nuclear incidents are portrayed to a public with neither time nor capacity to evaluate, much less temper, media claims. It is this kind of information that people call to mind when thinking about nuclear projects—not technical analyses of the actual risks involved—because this is the kind of information people readily understand.[22]

Stigma and past DGR development efforts

Two recent attempts to construct DGR-type facilities were abandoned amidst concerns the facilities would stigmatize local economies. The experiences at Cumbria County, U.K. and Yucca Mountain, Nevada, are the most relevant case studies available in connection with the proposed DGR, yet neither case is discussed in the EIS.

[22] Related to this, note that it doesn't matter that Hanford's storage facility is dated and uses much different technology than the proposed DGR. The Hanford example will contribute to DGR-related stigma simply because Hanford's an example of *what can happen when nuclear waste is stored underground.*

Cumbria County, United Kingdom

In 2008, England's Managing Radioactive Waste Safely process identified West Cumbria as a potential host community for a spent nuclear fuel repository. Cumbria is a rural county in Northwest England, on the coast of the Irish Sea, and has a number of similarities with Kincardine and the Regional Study Area used in the EIS:

- The town of West Cumbria is the host community for the Sellafield nuclear processing site, an offshoot of the original nuclear reactor site at Windscale, which latter is being decommissioned.
- The nuclear presence in West Cumbria is long established and local opinion of the nuclear power plant is favorable.
- West Cumbria already hosts a low-level nuclear waste repository, at Drigg, in addition to the waste facility at the Sellafield site.[23]
- The nuclear site in West Cumbria is owned and managed by the U.K.'s Nuclear Decommissioning Authority.
- Cumbria County is rural, its economy comprised of three main elements:[24]
    - A £1 billion tourism industry employing over 36,000 and serving visitors to the Irish Sea, the Isle of Man, numerous natural attractions, holiday parks, and the Lake District National Park. (The latter is England's largest national park, receiving approximately 16 million visitors annually and more than 23 million day visitors.)
    - Direct and indirect economic activity related to the nuclear site (over 10,000 direct workers at the site plus support workers in the city of Carlisle)
    - BAE Systems Submarine Solutions, one of England's most important naval shipbuilders
- Cumbria is the location of many of England's most ancient artifacts, including religions stone circles dating to before the Bronze Age.
- Over half of Cumbria County is designated as a national park or an "Area of Outstanding National Beauty",[25] and the Lake District specifically is being considered for UNESCO World Heritage designation.[26]

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[23] BEC, 2012, *West Cumbria Economic Blueprint: Realising the Potential of Britain's Energy Coast,* British Energy Coast.

[24] Marston, Revecca, 2009, "Cumbria's Economy Set to Stay Afloat," BBC News, 27 November 2009, accessed at: http://news.bbc.co.uk/2/hi/business/8374179.stm, 10 May 2013 ("Marston, 2009").

Initially, the hosting offer was supported by local officials, unions, and the Labor Party, all of whom had a vested interest in the site's development, especially as the global economic downturn dampened local growth. Moreover, because most of the U.K.'s high-level nuclear waste is already stored at Sellafield, local council approval seemed likely.

In November 2012, however, shortly before the council's vote, the U.K.'s National Audit Office (N.A.O.) disclosed "Significant risk to people and the environment" from deterioration at existing nuclear waste storage facilities.[27] Coupled with rising disapproval amongst people without an economic link to the Sellafield site, the announcement prompted a series of public protests. Opposition to the repository mounted over the next eight weeks, including:

- In Keswick, a community in the Lake District National Park area, voted 497 to 3 against the repository. This reversed an earlier vote on the same issue, in February 2012, wherein the Keswick Town Council split 5 to 5 and the mayor, citing economic opportunity, cast the deciding vote in favor of the repository.[28]
- Four days before the Cumbria Council vote, hundreds of residents marched in protest through the valley and town of Ennerdale, following the route spent nuclear fuel would travel to the repository.
- Residents gathered 54,000 signatures (roughly 10 percent of the county population) petitioning the government to stop considering Cumbria County as a potential host community.
- A survey of residents south of Cumbria indicated they were less likely to visit the Lake District if the used fuel repository was constructed.[29]

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[25] Cumbria, 2013a, The Cumbrian Economy, Cumbria County Council, accessed at: http://www.cumbria.gov.uk/business/cumbrianeconomy/cumbrianeconomy.asp, 10 May 2013. ("Cumbria 2013a").

[26] UNESCO.org, England's Lake District, at: http://whc.unesco.org/en/tentativelists/5673/. The Bruce Peninsula is part of a UNESCO World Biosphere Reserve encompassing the entire Niagara Escarpment. (See Section Two, *sub.*)

[27] Cumbria, 2013b, "30/1/2013 – Cumbria Says "No" to Underground Radioactive Waste Repository," Cumbria County Council, accessed at: http://www.cumbria.gov.uk/news/2013/January/30_01_2013-150007.asp, 10 May 2013 ("Cumbria 2013b").

[28] RFL, 2012, "Keswick Town Council Votes for a Nuclear Dump," Radiation Free Lakeland (RFL), 22 February 2012, accessed at http://mariannewildart.wordpress.com/2012/02/22/keswick-town-council-votes-for-a-nuclear-dump/, 2 May 1012.

[29] Wainwright, Martin, 2013, "Lake Distric Park Authority "Concerned" Over Radioactive Waste Burial," The Guardian, 28 November 2012, accessed at: http://www.guardian.co.uk/environment/2012/nov/28/lake-district-radioactive-waste-grave, 2 May 2013 ("Wainwright 2013").

Opposition to the repository called the plan "short-sighted" and run by local councils that received financial compensation in exchange for their support. Especially relevant to OPG's proposed DGR, much of the Cumbrian opposition came from the local tourist industry.[30] The Lake District is widely associated with conservation, wildlife management, pristine wild areas, and environmentally friendly tourist opportunities (such as hiking, biking, canoeing, and climbing). In this context, the proposed repository risked irremediable stigma. "We have 15 million people coming to the park every year, and the prospect of having the world's largest nuclear waste dump could make that considerably less," said Bill Jefferson, Chairman of the Lake District National Park.

> There are growing and increasingly widespread concerns that a repository below the national park or indeed a perception of such a proposal would not be in the long-term interests of the Lake District, its farming and resident communities and visitor economy. Evidence suggests a potential risk to the Lake District's brand image, and on communities that rely on this brand. The lengthy process, necessary for considering such a facility, could exacerbate this risk. While we do not know what precise impacts a repository under the national park would have on its special qualities, I am concerned such a proposal could adversely affect the Lake District's brand image, its national and international standing, reputation and integrity, prejudicing the delivery of the vision to the detriment of the Cumbrian tourism economy and our statutory responsibilities.[31]

In response to mounting protests, the Cumbria County Council voted to reject the repository project:

> Cumbria County Council's Cabinet has decided that West Cumbria should no longer be considered as a potential location for a deep geological repository to dispose of higher activity radioactive waste and the two districts of Copeland and Allerdale should be excluded from further consideration in the Government's Managing Radioactive Waste Safely process. At a meeting in Carlisle on 30 January, the 10 members of the county council's Cabinet also agreed that the council will encourage the Government to make the necessary investment to improve the existing surface storage facilities at Sellafield so that there is a more robust surface storage arrangement in the decades to come while the Government finds a permanent solution for the country's higher activity radioactive waste.[32]

Fear of potential stigma resulted in West Cumbria and nearby districts being withdrawn from consideration in the Managing Radioactive Waste Safely process.

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[30] See Section Four, discussing the DGR-related risks to SON's tourist business.

[31] Wainwright 2013. (Emphasis added.)

[32] Cumbria 2013b.

Yucca Mountain, Nevada

In 1982, the U.S. Congress, through the *Nuclear Waste Policy Act* (*NWPA*), authorized the Department of Energy to identify, construct, and begin operation of a permanent underground repository for high-level radioactive waste by the mid-1990s. The *NWPA* provided funding to candidate states for socioeconomic and environmental assessments of a repository's potential impacts.

A primary contender for the repository was Yucca Mountain, Nevada, approximately 160kms northwest of Las Vegas. The proposed repository was actually approved by the U.S. Congress in 2002 but then terminated—in 2010, for "political reasons"—notwithstanding over US$12 billion invested in the project to that date.[33]

More than two dozen surveys of residents in Nevada (directly affected by nuclear stigma), Arizona and California (highly probable tourists), national populations (possible, long distance tourists), and organizations (users of convention facilities), disclosed respondents had extremely negative associations with nuclear waste.[34] Other surveys indicated a repository would make nearby places "less desirable" for both tourism and investment, suggesting proximity of 50 or even 100 miles would alter decisions.[35] Still other research concluded that "our society's strong response to mishaps involving nuclear power and nuclear wastes" ensured that nuclear incidents anywhere in the world were widely disseminated, brought to public attention, and thereby contributed to respondent perceptions.[36]

Surveys also found that a repository would change visitation choices and that a nuclear waste repository would inflict greater stigma than a prison, nuclear reactor, or hazardous waste

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[33] New York Times, "GAO: Death of Yucca Mountain Caused by Political Maneuvering," 10 May 2011, at: http://www.nytimes.com/gwire/2011/05/10/10greenwire-gao-death-of-yucca-mountain-caused-by-politica-36298.html?pagewanted=all.

[34] Metz, William C., 1996, "A Historical Application of Social Amplification of Risk Model: Economic Impacts of Risk Events at Nuclear Weapons Facilities?" For the U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Argonne National Laboratory, ANL/DIS/PP-54035 ("Metz, 1996").

[35] Easterling, Douglas and Howard Kunreuther, 1990, *The Vulnerability of the Convention Industry to the Siting of a High-Level Nuclear Waste Repository,* for the State of Nevada Agency for Nuclear Projects, Nuclear Waste Project Office, NWPO-SE-031-90.

[36] Slovic, Paul, 1987, "Perception of Risk," Science, New Series, V236:N4799, pp. 280 - 285. *Q.v.* the discussion of Hanford *infra* and Asse II, *sub*: whenever and wherever nuclear incidents occur, local nuclear projects become more dangerous and more heavily stigmatized.

incinerator.[37] A separate study of residents of Clark County (Las Vegas' home county) disclosed fears that a nuclear waste repository would reduce business investment in the area.[38]

The general conclusion of much of the *NWPA*-funded research was that the presence of a nuclear waste repository was likely to stigmatize Nevada generally, and Las Vegas specifically, amongst potential visitors, investors, and residents.[39] The conclusion from almost three decades of research was that "people who associate nuclear images with Nevada tend to be less likely to want to vacation there [and] the waste facility might well lead to substantial economic losses for Nevada."[40]

Even more compelling is the sheer volume of research supporting this conclusion: Appendix N of the Yucca EIS is a paper by Robert E. O'Connor, "Are Fear and Stigmatization Likely, and How Do They Matter?". It describes the existing body of knowledge as "extensive" and cites a 1995 study by the Nuclear Waste Technical Review Board that found "80 or 90" highly reliable articles on

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[37] Easterling, Douglas and Howard Kunreuther, 1990, *The Vulnerability of the Convention Industry to the Siting of a High-Level Nuclear Waste Repository,* for the State of Nevada Agency for Nuclear Projects, Nuclear Waste Project Office, NWPO-SE-031-90: respondents indicated they would "probably" or "definitely" would not attend a convention located 160kms away from a nuclear waste repository.

[38] *Ibid.*

[39] (Kasperson, Roger E.; Orwin Renn, Paul Slovic, Halina S. Brown, Jacque Emel, Robert Gobel, Jeanne X. Kasperson, and Samuel Ratick, 1988, "The Social Amplification of Risk: A Conceptual Framework," Risk Analysis, V8:N2, pp. 177-187; Slovic, Paul, Mark Layman, James H. Flynn, James Chalmers, and Gail Gesell, 1991, "Perceived Risk, Stigma, and Potential Economic Impacts of a High-Level Nuclear Waste Repository in Nevada," Risk Analysis, V11:N4, pp. 683-696; Mushkatel, Alvin H. K. David Pijawka and Marilyn Dantico, 1990, "Risk-Induced Social Impacts: The Effects of the Proposed Nuclear Waste Repository on Residents of the Las Vegas Metropolitan Area," for the State of Nevada Agency for Nuclear Projects Nuclear Waste Project Office, NWPO-SE-032-90; Flynn, James, William Burns, C.K. Mertz, and Paul Slovic, 1992. "Trust as a Determinant of Opposition to a High-Level Radioactive Waste Repository: Analysis of a Structural Model," Risk Analysis, V12:N3, pp. 417-430; Slovic, Paul, Mark Layman, James H. Flynn, James Chalmers, and Gail Gesell, 1991, "Perceived Risk, Stigma, and Potential Economic Impacts of a High-Level Nuclear Waste Repository in Nevada," Risk Analysis, V11:N4, pp. 683-696; Easterling, Douglas and Howard Kunreuther, 1995, *The Dilemma of Siting a High-Level Nuclear Waste Repository,* Kluwer Academic Publishers, Boston; Flynn, James, William Burns, C.K. Mertz, and Paul Slovic, 1992. "Trust as a Determinant of Opposition to a High-Level Radioactive Waste Repository: Analysis of a Structural Model," Risk Analysis, V12:N3, pp. 417-430; Easterling, D., 1997, "The Vulnerability of the Nevada Visitor Economy to a Repository at Yucca Mountain," Risk Analysis, V17, N5, pp. 647.)

[40] Mushkatel, Alvin H. K. David Pijawka and Marilyn Dantico, 1990, "Risk-Induced Social Impacts: The Effects of the Proposed Nuclear Waste Repository on Residents of the Las Vegas Metropolitain Area," for the State of Nevada Agency for Nuclear Projects Nuclear Waste Project Office, NWPO-SE-032-90; Easterling, Douglas and Howard Kunreuther, 1990, *The Vulnerability of the Convention Industry to the Siting of a High-Level Nuclear Waste Repository,* for the State of Nevada Agency for Nuclear Projects, Nuclear Waste Project Office, NWPO-SE-031-90., Metz, William C., 1992, "Perceived Risk and Nuclear Waste in Nevada; A Mixture Leading to Economic Doom?" Impact Assessment Bulletin, V10:N3, pp. 23-41, Metz, William C., 1994, "Potential Negative Impacts of Nuclear Activities on Local Economies: Rethinking the Issue," Risk Analysis, V14:N5, pp. 763-770; Jenkins-Smith, Hank C., 1994, Stigma Models: Testing Hypotheses of how Images of Nevada Are Acquired and Values Are Attached to Them, prepared for Argonne National Laboratory, ANL/DIS/TM-17; Easterling, D., 1997, "The Vulnerability of the Nevada Visitor Economy to a Repository at Yucca Mountain," Risk Analysis, V17, N5, pp. 647; Metz, William C., Tim Allison and David E. Clark, 1997, "Does Utility Spent Nuclear Fuel Storage Affect Local Property Values?" Radwaste Magazine, May 1997, pp. 27-33; Gregory, Robin S., and Therese A. Satterfield, 2002, "Beyond Perception: The Experience of Risk and Stigma in Community Contexts," Risk Analysis, V22:N2, pp. 347-358.

risk perception. O'Connor's own paper has 56 citations.[41] In 1990, researchers at the Argonne National Laboratory published an annotated bibliography of work dealing with the socioeconomic impacts of risk perception—mostly dealing with Yucca—containing 152 entries.[42]

Inexplicably, OPG's EIS and TSD make almost no reference to this enormous, readily available and highly relevant body of literature. This oversight demonstrates a total collapse of methodological rigor.

Stigma and the Bruce Nuclear Site

In 2010, Bruce Nuclear sought a license from the CNSC to transport 16 decommissioned steam generators to a recycling facility in Sweden. The generators would follow a route through the Great Lakes and St. Lawrence River. Each generator would contain just four grams of radioactive material and Bruce Power was explicit that the risks involved were minimal, almost infinitesimal:

> If the very unlikely scenario occurred where the ship sank and the vessels were somehow breached, the very low levels of radiation would be diluted even further by the large volume of water and would result in a level of radiation that we believe would not even be measurable.[43]

Notwithstanding the clear communication of minimal actual risk, the proposal faced enormous public opposition. Public hearings on the license application heard from 77 interveners, including opposition from mayors, U.S. senators, First Nations communities, residents, and environmental groups. Over 60 NGOs called for the proposal to be deferred pending a full environmental impact assessment. While the CNSC ultimately issued a license in February 2011 (citing negligible risks to human and environmental safety), Bruce Nuclear *still declined* to proceed with the shipment, instead allowing the license to expire (in February 2012).[44]

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[41] O'Connor, R.E., 2001, "Are Fear and Stigmatization Likely and How Do They Matter: Lessons From Research on the Likelihood of Adverse Socioeconomic Impacts from Public Perceptions of the Proposed Yucca Mountain Repository," Appendix N in the Yucca Mountain SFEIS.

[42] Nieves, L.A., D.R. Wernette, R.C. Hemphill, R.C., S. Mohiudden and J. Corso, 1990, "Identification and Estimation of Socioeconomic Impacts Resulting from Perceived Risks and Changing Images: An Annotated Bibliography," Policy and Economics Group, Environmental Assessment and Information Services Division, Argonne National Laboratory, ANL/EAIS/TM-24.

[43] Toronto Star, July 11, 2010, at: http://www.thestar.com/news/ontario/2010/07/11/critics_slam_proposal_to_ship_nuclear_waste_through_lake_ontario.html. The article's lead also evinces the same evocative, emotional language used to describe the Hanover leaks (discussed *supra*). The article characterizes Bruce Nuclear's plans thusly: "The Bruce Nuclear Generating Station plans to ship 1,760 tonnes of radiation-laced steel through Lake Ontario…"

[44] Owen Sound Times, "Deadline passes for steam generators", 3 February 2012, at: http://www.owensoundsuntimes.com/2012/02/03/deadline-passes-for-steam-generators.

Clearly, both Bruce Nuclear and OPG have direct experience with the public's deep mistrust, fear, and confusion about nuclear waste. In the case of the steam generators, Bruce Nuclear recognized this fear and chose to delay, indefinitely, its plans to recycle the generators. It is inconceivable that OPG is unaware of Bruce Nuclear's experience and response; nevertheless, OPG concludes the proposed DGR—designed to store exponentially more radioactive material than what was in the contaminated generators—poses a minimal risk of stigma for the BNS and surrounding communities.

Conclusion

Extensive research indicates nuclear projects generally, and nuclear waste projects specifically, are heavily stigmatized. Nuclear stigma is intensely emotional, immune to rational refutation, and increases *everywhere* when a nuclear incident occurs *anywhere*. Numerous case studies, including two failed attempts to construct a DGR-type facility and Bruce Nuclear's own experience of widespread popular fear of nuclear waste clearly indicate the proposed DGR could stigmatize the BNS and surrounding areas.

Notwithstanding the material reviewed in this section is readily available and clearly apposite, it appears nowhere in the EIS or TSD. The effect is that OPG purports to reach conclusions on DGR-related stigma without considering the research or experience of *anyone*, *anywhere*, *ever*. This approach is inexplicable, grossly deficient, and raises serious questions about OPG's competence and reliability.

Section Two: OPG's Analysis of Stigma

Notwithstanding the research and case studies reviewed in the previous section—all of which suggest a real risk of significant stigma from the proposed DGR—OPG's EIS concludes "there are no strong indications that the DGR Project would result in a stigma".[45]

With respect, OPG's stigma analysis is superficial and of little, if any, probative value. There is no evidence that any relevant research or case studies were considered, either directly or as counterpoints to OPG's own findings. OPG's conclusion that the proposed DGR will result in minimal stigma is directly contrary to *virtually all experience* with nuclear waste facilities, yet nowhere in the EIS is there a discussion of why this might be the case.

This section suggests that OPG's results are anomalous because its analysis is deeply flawed. Specifically, this section explains how OPG surveyed the wrong population, deployed biased questions, utilized inadequate sample sizes, and unduly limited both the geographic and qualitative scope of the regions and amenities potentially stigmatized. Taken together, these deficiencies completely undermine the reliability—and so usefulness—of OPG's conclusions regarding DGR-related stigma.

OPG's survey methodology

Section 7.10.1.3 of the EIS begins by identifying the potential for DGR-related stigma:

> The DGR Project as a whole (considering the likelihood of measurable changes in public attitudes and behaviours attributable to the DGR Project) may result in a measurable change to land use and community character through the potential attribution of a stigma.[46]

Section 7.10.2.5 then states:

> [N]otwithstanding the link between Inverhuron Provincial Park and the Bruce Nuclear site in terms of their proximity, there are no strong indications that a "stigma" already exists. The results of interviews conducted as part of this socio-economic assessment across the Local and Regional Study Areas support the conclusion that the Regional and Local Study Areas have not been stigmatized by the ongoing presence of the Bruce Nuclear site or the WWMF. Surveys of tourists at Provincial parks and conservation areas also support this conclusion. [...] Therefore, no adverse effects on Provincial parks or the tourism industry as a whole are expected during the DGR Project".[47]

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[45] OPG 2011a, Section 7.10.2.11, p. 7-181.

[46] OPG 2001a, p. 7-151.

[47] OPG 2011a, p. 7-170.

Finally, OPG concludes:

> Therefore, there remains some potential for this new facility to be a source of stigma, as it is relatively unknown and unfamiliar to the residents of the Local and Regional Study Areas. However, there are no strong indications that the DGR Project would result in a stigma.[48]

These conclusions are based on a series of interviews and surveys with members of the public, stakeholders, community leaders, and tourists at provincial parks and conservation areas.[49] The data collected was as follows:

- public attitude research (809 telephone surveys—401 in LSA, 408 in RSA—conducted randomly in the study areas during 4-14 November 2009)
- stakeholder interviews (76 telephone interviews—34 in LSA, 42 in RSA—conducted October and November 2009)
- community leader surveys (23 telephone interviews conducted October 2009)[50]
- Inverhuron and MacGregor Point Provincial Parks tourist/day user surveys (103 personal "roving" interviews—51 at Inverhuron Provincial Park, 52 at MacGregor Point Provincial Park—conducted 24 September 2009)
- Brucedale and Stoney Island Conservation Areas tourist/day user surveys (personal interviews, two interviewers for each park, conducted 26 September 2009 and 10 October 2009: 18 day users interviewed at Brucedale, no surveys completed at Stoney Island)
- site neighbour surveys (13 personal interviews, November 2009 to January 2010)[51]

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[48] OPG 2011a, Section 7.10.2.11, p. 7-181.

[49] OPG 2011a pp. 7-169-170. engaged the consulting firm AECOM Canada Ltd. to collect this data as part of its work in preparing the Technical Support Document.

[50] Community leaders are defined in the TSD as "[L]ocal and regional figures, including Mayors and Councillors [*sic.*], Provincial and Federal politicians representing the areas, municipal administrators, local business owners and representatives of business associations, representatives of community service organizations (e.g., health and tourism), media representatives, and community events co-ordinators." OPG, 2011c, *Ontario Power Generation's Deep Geologic Repository For Low & Intermediate Level Waste: Socio-economic Environment Technical Support Document,* NWMO DGR-TR-2011-08, March 2011, prepared by AECOM Canada Ltd. ("OPG 2011c"), p 47.

[51] OPG 2011c, pp. 45, 47-48.

Problems with OPG's surveys and conclusions

Biased sampling

A central flaw in OPG's survey methodology is the use of biased samples. Much of OPG's survey data reflects the opinion of people predisposed to favour the DGR, either because they experience a 'halo effect' or have a vested interest in the local nuclear industry.

Halo effect

Instead of discovering minimal stigma, OPG's surveyors measured the cognitive bias known as *halo effect*: the tendency for an impression created in one area to influence opinion in another area.[52] A relevant example from the Yucca Mountain research:

> In contrast to what one might expect, individuals living directly adjacent to Yucca Mountain (in the town of Beatty) are *more* accepting of the repository than are those living further away, [a function of] geographic variation in the expectation of risk and benefits.[53]

Halo effects are well documented in the risk perception literature, especially in connection with property value effects at weapons facilities and nuclear power plants.[54]

In the context of a geologic repository for nuclear waste, research[55] indicates that halo effects result from:

- *Desensitization*: Prolonged contact with the risk source can attenuate adverse impressions.[56]
- *Refutation*: Fear of close proximity to a risk source is refuted by the failure of such risk to materialize.[57]

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[52] Metz, William C., 1994, "Potential Negative Impacts of Nuclear Activities on Local Economies: Rethinking the Issue," Risk Analysis, V14:N5, pp. 763-770.

[53] Easterling, Douglas and Howard Kunreuther, 1995, *The Dilemma of Siting a High-Level Nuclear Waste Repository,* Kluwer Academic Publishers, Boston. (Emphasis added.)

[54] See e.g., Holm, Judith A., A.W. Thrower, Derek A. Widmayer, and W.E. Portner, 2003, "Property Valuation and Radioactive Materials Transportation: A Legal, Economic, and Public Perception Analysis," WM-03 Conference, February 23-27, 2003, Tucson, AZ; Gawande, Kishore and Hank C. Jenkins-Smith, 2001, "Nuclear Waste Transport and Residential Property Values: Estimating the Effects of Perceived Risks" Journal of Environmental Economics and Management, V42, pp. 207-233; Metz, William C., Tim Allison and David E. Clark, 1997, "Does Utility Spent Nuclear Fuel Storage Affect Local Property Values?" Radwaste Magazine, May 1997, pp. 27-33.

[55] Metz, William C., 1994, "Potential Negative Impacts of Nuclear Activities on Local Economies: Rethinking the Issue," Risk Analysis, V14:N5, pp. 763-770.

[56] Bassett, Gilbert and Ross Hemphill, 1991, "Comments on "Perceived Risk, Stigma, and Potential Economic Impacts of a High-Level Nuclear Waste Repository in Nevada," Risk Analysis V11:N4, pp. 696-700: A halo effect "can be attributed to several factors, such as a person's familiarity with the facility over time, the fact that they volunteered to locate there, their heightened safety training, and the fact that they have more information engendered through their or their neighbors' employment at the facility."

- *Utility maximization*: Where proximity to a risk source provides benefits (*e.g.*, property taxes, employment, or infrastructure improvements), the realization of these benefits offsets negative impressions.[58]

Halo effects undermine OPG's survey results because the EIS surveyed individuals *within* the RSA and LSA. (That is, there was no attempt to control for, or otherwise segregate respondents based on geographic location.) To assess potential stigma, which is imposed from *outside* the stigmatized community, surveyors should have polled individuals *who did not live in the study areas.* One would expect individuals with a long experience of close proximity to nuclear power—and especially an economic tie to OPG—to have more favorable impressions of nuclear programs than those with no experience of, or ties to, nuclear energy.[59]

Because "people who live near a place with a risk potential have a better sense of that place than people who live far away,"[60] a major challenge for siting nuclear waste storage facilities is balancing different risk perceptions in differently proximate communities.[61] Failing to account for potential halo effects only exacerbates the problems caused by biased survey questions (discussed *sub.*).

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[57] Gregory, Robin S., James Flynn, and Paul Slovic, 2001, "Technological Stigma," in *Risk, Media, and Stigma: Understanding Public Challenges,* James Flynn, Paul Slovic, Howard Kunreuther, eds., Earthscan Publishers, London: "Technological stigma should be seen as a rational social response to the multiple influences that produce it and therefore as subject to a variety of rational solutions."

[58] Metz, William C., Tim Allison and David E. Clark, 1997, "Does Utility Spent Nuclear Fuel Storage Affect Local Property Values?" Radwaste Magazine, May 1997 ("Metz et al. 1997"), pp. 27-33: "[Over time,] any perceived risk, negative imagery, or stigma that may exist is overwhelmed by accessibility effects associated with a desire to reside close to the workplace or other local economic or environmental influences."

[59] A related problem is that perceptions of nuclear *power* are more positive than nuclear *waste*: "The valences attached to images of nuclear power and nuclear waste show considerable variation [...] Images of a nuclear waste repository had valences that were significantly more negative [than those for a nuclear power plant]. (Jenkins-Smith, Hank C., 1994, Stigma Models: Testing Hypotheses of how Images of Nevada Are Acquired and Values Are Attached to Them, prepared for Argonne National Laboratory, ANL/DIS/TM-17.) Alternatively, halo effects resulting from Bruce Nuclear's existing *temporary* storage of nuclear waste may not attend its storage of nuclear waste *permanently.* There's no evidence OPG controlled for these sorts of confounding effects.

[60] Metz *et al.* 1997.

[61] Research indicates that stigma's magnitude is inversely correlated with distance from the stigma's source: Kasperson, Roger E.; Orwin Renn, Paul Slovic, Halina S. Brown, Jacque Emel, Robert Gobel, Jeanne X. Kasperson, and Samuel Ratick, 1988, "The Social Amplification of Risk: A Conceptual Framework," Risk Analysis, V8:N2, pp. 177-187; Metz, William C., 1994, "Potential Negative Impacts of Nuclear Activities on Local Economies: Rethinking the Issue," Risk Analysis, V14:N5, pp. 763-770; Ihlanfeldt, Keith R., and Laura O. Taylor, 2004, "Externality Effects of Small-Scale Hazardous Waste Sites: Evidence From Urban Commercial Property Markets," Journal of Environmental Economics and Management, V47, pp. 117-139; *Venables, N., Pidgeon, N., Parkhill, K., Henwood, K., and Simmons, P., 2012, "Living With Nuclear Power: Sense of Place, Proximity, and Risk Perceptions in Local Host Communities," Journal of Environmental Psychology, V32, pp. 371-383.

A striking example of attitudes outside the study area is the letter writing campaign following a radio broadcast detailing OPG's plans. In response to a short broadcast, residents of Northern Michigan submitted 232 letters opposing the DGR, nearly half of which came from elementary school children. Concerns included the risks posed to the Great Lakes region (representing one-fifth of the world's fresh water supply); procedural abnormalities, including the appointment of CNSC members to the EIS's Technical Review Panel;[62] perceived stigma; safety and security concerns; and health issues. Over half the letters indicated the writer had visited Bruce County in the past and almost a third visited regularly. All visitors stated their reluctance to return if a DGR were built.

Vested interest in nuclear projects

A related problem is that most of the people in the LSA, and a significant number of people in the RSA, either work for the local nuclear power plant or have a relative, friend, or neighbor who works there.[63] In other words, a significant portion of people surveyed by OPG has a vested interest in the success of the local nuclear industry.

A relevant Canadian case study illustrates the possible effect of this kind of bias. Researchers in Saskatchewan surveyed residents in three towns and an affected First Nation about their attitudes towards a potential nuclear waste repository.[64] Critically, the company that would manage the proposed repository did not dominate the economy in the surveyed areas.

The results indicated "overall support for the proposed nuclear waste repository was low. Close to three-quarters of the sample (73%) indicated they would vote against the repository in a referendum, whereas only 10% indicated that they would vote in favor".[65] This conclusion is almost perfectly opposite OPG's findings, that "PAR [public attitude research] results indicate that 9% of Local Study Area residents and 10% of Regional Study Area residents reported that they might experience reduced feelings of personal health and safety as a result of the DGR project."[66]

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[62] … which one writer characterized thusly: "In law, I have yet to hear of a judge appointed to hear an appeal of his own lower court decision. The CNSC should therefore assert its independence and recuse itself from these hearings, or forever lose all credibility in the eyes of the Canadian public."

[63] Rubenstrunk, Rebecca L., 12012, "Assessing Contention: Understanding Nuclear Waste Storage Opposition in the U.S. and Canada," Master of Public Policy Thesis, Oregon State University, submitted 23 May 2012.

[64] Hine, Donald W.; G Craig Summers, Mark Prystupa, and Antoinette McKenzie-Richer, 1997, "Public Opposition to a Proposed Nuclear Waste Repository in Canada: An Investigation of Cultural and Economic Effects," Risk Analysis, V17:N3, pp. 293-302. (The towns of Massey, Kirkland Lake, and Sudbury, and the Waterhen First Nation Reservation at Meadow Lake.)

[65] *Ibid.*, p. 297.

[66] OPG 2011a, p. 7-158.

The Saskatchewan research also found "respondents consistently rated benefits as less important and less likely to occur than costs. For importance ratings, the highest rated benefit (improved local economy) was rated lower than the lowest rated cost (sabotage)."[67] Again, this conclusion is opposite OPG's conclusion that "the vast majority of residents look forward to the employment and other financial benefits associated with the DGR Project".[68]

The Saskatchewan study differs in another important way from OPG's work: the explicit recognition of Aboriginal peoples' history regarding negotiations with, and promises from, Canadian governments:

> Our results indicate aboriginal respondents were less trusting of regulators, had less faith in science and technology, and associated greater costs with repository than nonaboriginal respondents, and that these three variables contributed to the strong opposition to the repository exhibited by this group [...] stewardship over the earth is an important component of aboriginal identity [...] 'The Native People believe that this land was given to them by their creator and that they were given this land to live off and to pass it on to future generations in pretty well the same condition that they got it.' This perceived responsibility for future generations may be a distinguishing feature between aboriginal and nonaboriginal respondents, and an important contributor to aboriginals' strong antirepository response.[69]

Failing to control for vested interests undermines OPG's conclusions and totally elides the specific interests of local Aboriginal communities.

Biased framing of survey questions

Reliable surveys are careful to avoid framing questions in ways that bias responses.[70] Omitting relevant information, for example, can change what respondents think they are responding to:

> The question itself: "Do you support the establishment of a **facility** for the long-term management of low and intermediate level waste at the Western Waste Management Facility?" doesn't even mention that the plan includes to bury all of Ontario's radioactive

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[67] Hine, Donald W.; G Craig Summers, Mark Prystupa, and Antoinette McKenzie-Richer, 1997, "Public Opposition to a Proposed Nuclear Waste Repository in Canada: An Investigation of Cultural and Economic Effects," Risk Analysis, V17:N3, pp. 293-302, p. 297.

[68] OPG 2011c, p. 259.

[69] Hine, Donald W.; G Craig Summers, Mark Prystupa, and Antoinette McKenzie-Richer, 1997, "Public Opposition to a Proposed Nuclear Waste Repository in Canada: An Investigation of Cultural and Economic Effects," Risk Analysis, V17:N3, pp. 293-302, p. 300 (quoting Chief Charles Fox, Nishnawbe Aski Nation, during a meeting on the Nuclear Fuel Waste Disposal Concept).

[70] Martin, Elizabeth, 2006, *Survey Questionnaire Construction*, United States Census Bureau Research Report Series (Survey Methodology #2006-13), Washington D.C.

> operational waste from new and existing nuclear generation facilities, which includes refurbishment and research laboratory waste, about 0.5km away from Lake Huron.[71]

Research also indicates that giving respondents more information about a topic increases approval of that topic. For example, researchers surveying potential host communities for a nuclear waste repository in Sweden observed:

> One of the questions in [the] surveys is worded as follows: "If it were decided that the best place for storage of high-level nuclear waste was in your municipality, could you or could you not accept storage in your own municipality?" The answers to this question have been quite stable: slightly more than 50 percent would accept and not quite 50 percent reject. However, if the wording is changed to the following: "What is your attitude towards final storage of high-level nuclear waste in your own municipality?", less than 10 percent are positive.[72]

Notice how the two questions provide different amounts of information. The first question creates the impression that serious study determined which municipality is the best place for nuclear waste storage; the selection is a *fait accompli.* The second question, by contrast, makes no such assertions but simply asks for the respondent's attitude.

OPG's survey questions evince just these types of biased framing. When surveying local property owners, OPG's questionnaire featured a lengthy preamble that placed OPG, nuclear power, and the proposed DGR in a highly favorable light. The text appeared on the questionnaire in substantially similar form to what's recreated below: boldface type in a bright green box.[73]

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[71] Splettstoesser, Jutta, 2012, Submission to the Joint Review Panel #712, 12 September 2012. (Emphasis in original)

[72] Sundqvist, Göran, 2002, "The Bedrock of Opinion: Science, Technology and Society in the Siting of High-Level Nuclear Waste," Götenborg University, Section of Science and Technology Studies, Kluwer Academic Publishers, Dordrecht. (Emphasis in original.)

[73] OPG 2011c, p. 7 of 14 of the Site Neighbor Survey, Appendix C.

At the Bruce Nuclear site, Ontario Power Generation (OPG) has been safely managing radioactive waste from Ontario's nuclear generating stations for over 30 years.

At present, the Western Waste Management Facility (WWMF) at the Bruce Nuclear site provides processing and interim storage for all of the low and intermediate level radioactive wastes produced by OPG's nuclear generating stations. Currently, wastes are processed and stored in above-ground buildings.

The Bruce Nuclear Site and the proposed DGR site is your neighbour. AECOM would like to understand whether this site currently affects you and your use and enjoyment of your property, and if so, how.

For surveys of visitors to Inverhuron and MacGregor Point Provincial Parks, the following text was read to respondents at the beginning of each interview:

> Ontario Power Generation currently stores low and intermediate level radioactive wastes produced by all of Ontario's nuclear generating stations at its Western Waste Management Facility on the Bruce Nuclear site in the Municipality of Kincardine. This existing facility is regulated by the Canadian Nuclear Safety Commission and has been operating safely for more than 30 years. Low level waste includes such materials as rags, clothing, and floor sweepings that have become slightly contaminated during routine maintenance. They can be safely handled without radiation protection. Intermediate level waste includes used reactor core components, retube parts, and resins and filters used to keep reactor water systems clean. It requires shielding to protect workers during handling. Wastes are stored in above-ground buildings and structures, and also within in-ground structures. These storage methods, while very safe, are considered to be interim only, until a long term management facility is implemented. Ontario Power Generation's proposal, which is supported by the Municipality of Kincardine, for the long term management of low and intermediate level radioactive waste is a Deep Geologic Repository on the Bruce Nuclear site near the Western Waste Management Facility.
>
> A Deep Geologic Repository for low and intermediate waste only would involve the management of the waste in rooms built into the rock approximately 680 metres underground on the Bruce Nuclear site. Ontario Power Generation is undertaking geoscientific characterization and safety studies, along with an Environmental Assessment for the Deep Geologic Repository project. The Environmental Impact Statement and site preparation and construction licensing support documentation will be reviewed by a Joint Review Panel. This proposed DGR will not store used nuclear fuel.[74]

[74] OPG 2011c, p. 2 of the Inverhuron and MacGregor Point Provincial Park Tourist/Day User Survey, Appendix C.

The foregoing preambles—the latter essentially a 268 word public relations piece about OPG's nuclear program—condition positive responses to subsequent questions. The preambles deploy positive images ("OPG has been safely managing radioactive waste...for over 30 years", and the proposed DGR "is your neighbor"); allude to government oversight (the CNSC) and support for the proposed DGR (by the Municipality of Kincardine); and offer assurances that nuclear waste storage technology is "very safe".[75] The preambles also include language that emphases that nuclear waste is already stored at the BNS, further assuaging potential respondent concerns. The preambles are patently biased in favour of the proposed DGR and, critically, *provide respondents with information that actual visitors to, outside consumers of local products of, or investors in, the Bruce Peninsula region will not have.* Responses to such biased survey questions are totally unreliable.

Inadequate sample size

AECOM's survey of just 51 visitors to Inverhuron Provincial Park purports to represent the DGR-related opinions of the park's 65,000 annual visitors.[76] (In 2009, 65,383 people visited the park.) A sample size of 51 out of a population of 65,383 people yields a 99% confidence level with an 18 percent margin of error. (That is, 99% of the time a sampled response will be within 18 percentage points (plus or minus) of the population's response.) This is patently inadequate for *any* kind of conclusion. For results accurate to within five percentage points (plus or minus)—the baseline for statistical reliability—AECOM should have surveyed 659 independent visitors, or *thirteen times* the number of visitors actually surveyed.[77]

AECOM's survey results for MacGregor Point Provincial Park are similarly deficient: surveying just 51 of the park's 107,000 annual visitors[78] (106,668 in 2009) yields, again, a 99%

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[75] Note that it's irrelevant whether the surveys' draftsperson intended any of these implications. This is one reason survey language is extremely difficult to get right, and why reliable surveys are tested on a sample group, revised, then re-tested, before being deployed on the survey's target population. Neither the EIS nor TSD discloses any of this preparatory work.

[76] OPG 2011c, p. 79.

[77] Creative Research Systems 2013, Sample Size Calculator, accessed at: http://www.surveysystem.com/sscalc.htm, 12 June 2013. Note that OPG has elsewhere stated its surveys deployed a confidence interval of 5% (plus/minus), which is difficult to reconcile with the analysis in this section.

[78] OPG 2011a, p. 6-258.

confidence level with an 18 percent margin of error (plus or minus). For results accurate to within five percentage points (plus or minus), AECOM should have surveyed 662 independent visitors.[79]

Verifying survey methodologies

A related problem with AECOM's sampling efforts is that they are impossible to verify, notwithstanding this is an explicit requirement for the EIS:

> All data, models and studies must be documented so that the analyses are transparent and reproducible. All data collection methods must be specified. The uncertainty, reliability and sensitivity of models used to reach conclusions must be indicated. The sections in the EIS regarding the existing environment and the potential adverse environmental effects predictions and assessment must be prepared, using best information and methods, to the highest standards in the relevant subject area.[80]

Officials at Inverhuron and MacGregor Point Provincial Parks have no record AECOM representatives were present on 24 November 2009 (the day Tourist and Day User surveys were apparently conducted). In the course of its analysis of the EIS and TSD, SON representatives contacted park officials and also learned that actual tourist counts on 24 November 2009 were as follows: Inverhuron (21 Tourist Groups and zero Day Visitors) and MacGregor Point (18 Tourist Groups and two Day Visitors). Assuming this is correct, and notwithstanding there being no park record of AECOM's attendance, sampled individuals must have come from within the same tourist groups, potentially confounding results.

Also problematic is the amount of time and manpower required to complete over 50 surveys in two separate locations on a single day. The TSD estimates that each survey would take "between 10 and 15 minutes" to complete,[81] which seems unlikely. It takes roughly seven minutes to read the survey straight through. In the field, additional time is required to locate respondents, introduce the surveyor, explain the survey and otherwise put the interviewee at ease. Once the survey begins still more time is required to clarify and repeat questions, transcribe longer answers, and to accommodate various interruptions (interviewee gets a phone call, etc). All of which brings the time required for each interview closer to 25-30 minutes, the implications of which are thus: if an AECOM staff member arrived at either park at 9am and took no breaks (for lunch or other rest),

[79] Creative Research Systems 2013, Sample Size Calculator, accessed at: http://www.surveysystem.com/sscalc.htm, 12 June 2013.

[80] CNSC, Canadian Nuclear Safety Commission, 2008, *Guidelines for the Preparation of the Environmental Impact Statement for the Deep Geologic Repository of Low- and Intermediate-Level Radioactive Wastes,* April 2008, s. 2.6.

[81] OPG 2011b.

they could perform between 12 to 14 interviews each (assuming survey staff worked continuously from 9am to 5pm). To complete 102 surveys (assuming no respondents declined to participate, necessitating a search for additional respondents), at least five AECOM staff at each park would be necessary to collect the reported responses.

With respect, given the general inadequacy of AECOM's data collection and analysis (discussed throughout this Section Two), the patent underestimation of how long it would take to do each survey, and the absence of any public records indicating AECOM staff attended the parks on the relevant day, we are skeptical that sufficient survey staff was indeed dispatched.

While it's possible that AECOM collected its survey results faithfully as described in the EIS and TSD—and we would welcome a detailed explanation of this—the EIS Guidelines are explicit that:

> All data, models and studies must be *documented* so that the analyses are *transparent* and *reproducible.* All data collection methods must be *specified.* The uncertainty, reliability and sensitivity of models used to reach conclusions must be *indicated.* (Emphasis added.)

There is no good reason why the EIS and TSD should not contain sufficient information for qualified third parties to assess and validate the methodologies deployed. OPG's failure to provide such information means that we cannot validate the analysis contained in the EIS and TSD—the analysis is literally indefensible. This is a serious methodological failure and totally inappropriate in the present circumstances.

Triangulation

Another problem, also related to sampling procedures, involves OPG's purported use of triangulation to enhance the reliability of its results given the limited available sample sizes. During the JRP's Socioeconomic Technical Information Session on 20 March 2013, JRP member Dr. Stella Swanson asked whether OPG/AECOM believed their methodology resulted in a reliable sample. AECOM representative Tom Wlodarczyk replied that they believed their results were reliable because they *triangulated* their results to accommodate the small number in their sample.[82] Mr. Wloardaczyk described OPG's survey methodology as:

> [S]ometimes the confidence comes from the statistical availability of the public attitude research. Other times it comes from the confidence we have in the modeling of air and

[82] JRP, 2013, "Transcripts of the 20 March 2013 Joint Review Panel Socioeconomic Technical Information Session," pp. 87, 181. Transcription Services By: International Reporting Inc.

> noise. Other times, we have -- confidence comes from case studies and where effects have or have not occurred in other places in similar circumstances. We call this a process of triangulation; we try to look at the effects in various ways, from various sources.[83]

There are two major problems with this approach. First, this is the only mention OPG or AECOM made regarding its use of triangulation; the term appears nowhere in the EIS or TSD, nor was it mentioned in AECOM's prepared remarks to the JRP.[84] Given that triangulation is used as a kind of methodological gap-fill (*i.e.*, when circumstances are such that ordinary, preferred sampling methodologies are unavailable),[85] it's unclear why AECOM and OPG did not affirmatively discuss the use of triangulation in connection with the stigma-related surveys.

Second, it's simply unclear how AECOM could have triangulated its results given what we know about its data collection:

- Relevant survey data was collected in the same general time and from the same biased population (discussed above), making data triangulation impossible.
- AECOM collected all the data, making it impossible to triangulate findings from different investigators.
- The EIS and TSD contain no discussion of multiple survey methodologies being deployed, eliminating the possibility of theory triangulation.

Under these circumstances, to the extent AECOM employed triangulation to enhance the reliability of its surveys, the effort was inadequate and ineffective.

Overly narrow scope of potential impacts

Geographic scope

OPG's discussion of the EIS's geographic scope begins by asserting compliance with the CNSC's *Guidelines for the Preparation of the Environmental Impact Statement for the Deep Geologic Repository of Low- and*

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[83] JRP, 2013, "Transcripts of the 20 March 2013 Joint Review Panel Socioeconomic Technical Information Session," p. 87. Transcription Services By: International Reporting Inc.

[84] JRP, 2013, "Transcripts of the 20 March 2013 Joint Review Panel Socioeconomic Technical Information Session," pp. 13-18. Transcription Services By: International Reporting Inc.

[85] See generally: Gorard, Stephen, 2004, "Judgement-Based Statistical Analysis," presented at the British Educational Research Association Annual Conference, University of Manchester, 16-18 September 2004; and Weyers, M.L., H. Strydom, and Hulsamen, 2008, "Triangulation in Social Work Research: The Theory and Examples of Its Practical Application," Social Work.Maatskaplike, V44:N2, pp. 207-222.

Intermediate-Level Radioactive Wastes,[86] which established the baseline boundaries for the LSA and RSA. OPG does not defend its RSA size, however, notwithstanding the Guidelines explicitly contemplate an expansion of the basic RSA:

> The geographic study areas for the EIS must encompass the areas of the environment that can reasonably be expected to be affected by the project, or which may be relevant to the assessment of cumulative environmental effects.[87]

The *Guidelines* then define the *proposed* LSA and RSA, to be expanded as warranted:

> [T]he Local Study Area includes all of the Bruce Nuclear site and the lands within the Municipality of Kincardine closest to it, as well as the area of Lake Huron adjacent to the facility. The boundaries may change as appropriate following a preliminary assessment of the spatial extent of potential impacts. . . [the Regional Study Area] includes lands, communities and portions of Lake Huron around the Bruce Nuclear site that may be relevant to the assessment of any wider-spread effects of the project.[88]

The geographic range defined in the *Guidelines* was intended as a baseline only—for the purposes of getting work started—not for uncritical adoption:

> [The RSA] includes lands, communities and portions of Lake Huron around the Bruce Nuclear Site that may be relevant to the assessment of any wider-spread effects of the project. This area may also include communities in the North Channel of Lake Huron, Manitoulin Island, the North Shore of Lake Huron, Georgian Bay and the French River.[89]

The Bruce Peninsula, along with Manitoulin Island, the chain of small islands north and west of Manitoulin Island, and the easternmost tip of the Upper Peninsula of Michigan, form a distinctive arc that separates Georgian Bay from Lake Huron. The prevailing current in Lake Huron travels northward from Windsor in the Southern Basin, along the western side of Bruce Peninsula and then up to Manitoulin Island and the North Channel[90]—the same potentially affected locations identified in the *Guidelines*. This is why the *Guidelines* define the RSA expansively: to accommodate important local variations like prevailing currents.

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[86] CNSC, Canadian Nuclear Safety Commission, 2008, *Guidelines for the Preparation of the Environmental Impact Statement for the Deep Geologic Repository of Low- and Intermediate-Level Radioactive Wastes,* April 2008.

[87] *Ibid.*, section 9.1.

[88] *Ibid.*

[89] *Ibid.*, p. 21.

[90] Interview with Paul Jones, Chippewas of Saugeen First Nation, 25 April 2013.

Moreover, the Bruce Peninsula is part of the UNESCO World Biosphere Reserve encompassing the entire Niagara Escarpment. The Reserve *in its entirety* is administered by a separate body (Niagara Escarpment Commission), and the designation:

> ...recognizes the Niagara Escarpment as an internationally significant ecosystem for its special environment and unique environmental plan. The designation puts Ontario's Niagara Escarpment in the company of other well-known biosphere reserves such as the Galapagos Islands, Africa's Serengeti and the Florida Everglades.[91]

Notwithstanding the Bruce Peninsula is part of a well-known and internationally recognized biosphere, OPG made no effort to expand its study area to reflect this context.

Qualitative scope

OPG's surveys made no attempt to canvass the full range of Bruce Peninsula's tourism appeal and thus to appreciate the total potential cost of DGR-related stigma. Several features of the AECOM interviews are telling.

First, the surveys covered only the late summer season, when extended family vacations would be improbable (after the start of school term). This suggests family-oriented activities were under-represented, if not totally overlooked, by OPG's methodology. The timing of the surveys—quite late in the season for long-distance visits—also suggests respondents were disproportionately from areas close to Inverhuron and MacGregor Point Provincial Parks (and so liable to the biases described earlier).

Second, the surveys covered just two Provincial parks and one conservation area, while the Bruce Peninsula and Grey/Bruce County generally host numerous venues (and lodging) for tourists. Overlooked attractions include: thirteen lighthouses, the Bruce Peninsula National Park, the Fathom Five National Marine Park at Tobermory,[92] Cape Croker Indian Park (3,000 to 4,000 visitors annually), and the Cape Croker Tent and Trailer Park (277 campsites).

Finally, none of the park surveys were conducted on holidays, when larger crowds—and thus more reliable results—would be available.

The four areas surveyed constitute only a small portion of the attractions available in Bruce County temporally, geographically, and experientially. The Bruce Peninsula attracts tourists year

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[91] http://www.escarpment.org/biosphere/designation/index.php.

[92] Tobermory is known as the "fresh water SCUBA diving capital of the world" because of numerous shipwrecks in the surrounding waters.

round, with almost one hundred special events and festivals between early May and early October, including vendor markets, theatrical performances, fireworks displays, and seasonal festivals.[93] Winter activities include skating, bird watching, cross-country skiing, and snow mobile riding, and the Bruce Peninsula hosts a world-class ski resort at Blue Montain. There are two national parks, eight provincial parks, and four Federation of Ontario Naturalists Parks located on the Bruce Peninsula. All of this is north of where the EIS focused its stigma analysis.

The exclusion of Bruce Peninsula from the EIS excludes a thriving economic base approximately two-thirds the size of the RSA population. Bruce Peninsula has a population of about 25,000 people, compared to the RSA's population of 39,300,[94] and is a much larger tourist draw than Kincardine. Given the proximity of the proposed site to the communities on the Bruce Peninsula north of the BNS, exclusion of these communities is patently inconsistent with the CNSC's *Guidelines*' requirement to include "lands, communities and portions of Lake Huron around the Bruce Nuclear site that may be relevant to the assessment of any wider-spread effects of the project."

Conclusion

OPG's conclusion that the proposed DGR will result in minimal stigma is directly contrary to *virtually all experience* with nuclear waste facilities. The EIS, however, makes no effort to defend, or even acknowledge, this anomalous result.

With respect, OPG's stigma analysis is wholly inappropriate to the seriousness of its objective: to determine the location for a *permanent nuclear waste repository.* OPG either surveyed the wrong population or, where it addressed the correct population, did so using biased questions, grossly inadequate sample sizes, and an overly narrow view of the areas and activities potentially stigmatized. Most troubling, OPG appears totally unaware that its stigma analysis is so comprehensively deficient. In fact, OPG's EIS contains no reliable evidence whatsoever regarding the potential for DGR-related stigma.

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[93] Francis, John and Marianne Wood (eds), 2012, *Bruce Peninsula Daytrip Companion*, Tobermory Press, Tobermory ON.

[94] Bruce County has about 13,600 residents on the peninsula (Bruce County, 2009, *Bruce County Census Update,* Bruce County Housing Services, Affordable Housing Division, prepared by SHS Consulting, February 17, 2009)—about a quarter of the total Bruce County population—and there are an additional 10,000 Grey County residents. The Regional Study Area includes four townships in Bruce County (Saugeen Shores, Kincardine, Arran-Elderslie, and Brockton).

Interim Conclusion

The discussion to this point makes clear that OPG's stigma analysis is fundamentally deficient. While SON is acutely sensitive to these inadequacies—by reason of the proposed DGR being located *within* SON's traditional territory—all stakeholders should be concerned by the lack of sound reasoning and basic diligence underwriting this aspect of OPG's proposal.

The discussion in Section One highlighted the voluminous body of research investigating stigma and nuclear projects. This research is extensive, detailed, and readily available, yet appears nowhere in the EIS or TSD. It simply cannot be that OPG is unfamiliar with this body of work or would fail to appreciate the importance of a comprehensive literature review in assessing the DGR's potential impacts.

Section One also discusses recent experience with DGR-type projects. The two case studies most relevant to OPG's proposed DGR—Cumbria County, U.K., and Yucca Mountain, Nevada—appear nowhere in the EIS or TSD. In other words, *the two most recent attempts to do exactly what OPG is proposing were ignored*, notwithstanding both projects were abandoned amidst fear of potential stigma. Even more troubling is OPG's failure to consider, or even acknowledge, its own experience with nuclear waste-related stigma, when Bruce Nuclear was forced to abandon plans to ship contaminated steam generators through the Great Lakes.

In effect, OPG purports to reach conclusions about DGR-related stigma without considering the experience of *anyone, anywhere, ever.* Instead, OPG relies on a collection of variously biased opinion research. Part of OPG's survey work addresses the wrong population (respondents who are predisposed to support the DGR); the balance deploys biased questions across too small sample populations and unduly limits the scope of areas and activities potentially stigmatized.

The methodological errors identified in Section Two are so crude and pervasive that it's unclear OPG understands its responsibility to the CNSC or the communities surrounding the proposed DGR. It is simply inappropriate for an organization seeking permission to build a permanent nuclear waste repository to make the kinds of basic analytical errors that OPG makes in its stigma analysis.

The sum of the discussion in Sections One and Two is that OPG has manifestly failed to provide the JRP or CNSC—or any stakeholder—with material information about the potential for DGR-related stigma. The current public record makes an informed decision impossible and a poor decision almost inevitable.

This report's final two sections explain how SON bears most of the risks associated with OPG's inadequate and, with respect, inappropriate analysis of the potential for DGR-related stigma.

Section Three: Nuclear stigma & food products

Research and case study evidence presented in Section One makes clear that nuclear projects generally, and nuclear waste projects in particular, attract significant, durable stigma. This section applies and expands that discussion to SON's commercial whitefish fishery.

Even a cursory review of the literature demonstrates that food products are easily stigmatized. Case studies reviewed in this section illustrate food stigma's rapid development, durability, susceptibility to media hype, and wholly irrational content. While the most relevant example of nuclear-related food stigma is still unfolding—the Fukushima Daiichi Nuclear Power Plant, in Japan—copious research investigates the stigma effects of a comparable environmental disaster: oil spills. The conclusions of this literature are unambiguously negative: oil spills destroy the demand for potentially affected food supplies, especially fisheries.

Even a minor accident involving the proposed DGR would have profound consequences for SON's whitefish fishery. The consequences would be spiritual as well as economic—the former totally irremediable—and because stigma attends the *perceived risk* of negative consequences, SON's fishery will suffer whenever and wherever a nuclear incident occurs. Notwithstanding a substantial literature detailing how and where food stigma develops, OPG made no effort to consider these potential impacts.

Food products are easily stigmatized

Stigma is a durable and pernicious kind of fear, especially in the case of food products: the primary source of human comfort, safety, and survival. Food stigma is especially pernicious because food is sustenance that humans ingest, orally, with many intimate, personal connotations. The following features of stigma generally are especially acute for food products.

Rapid development and substantial economic impact

Food-related stigma and its economic consequences develop rapidly. Partly this reflects our experience of foods being so intimate and visceral; partly the prevalence of intensive media coverage.[95] A good example is the British experience of Mad Cow Disease (*bovine spongiform*

[95] Recall here the discussion of "social amplification of risk", in Section One, how recursive, competitive media tends to sensationalize reported consequences.

encephalopathy, or BSE). On 20 March, 1996, the British Health Secretary announced the deaths of ten young adults from Creutzfeldt-Jacob Disease and "the possibility of a link" between CJD and BSE—dubbed Mad Cow Disease after the media ran footage of afflicted cows—after which pathologists theorized a possible connection between BSE and the use of rendered offal (entrails, hoofs, scrap and discarded meat products; a kind of "industrial cannibalism"[96]). On 25 March 1996—just five days later—the European Union banned all British beef imports, and by month's end 4.5 million cattle were destroyed as Japan joined the ban on British beef.

Canada's experience with BSE cost its beef industry C$18 million per day in lost exports and price reductions.[97] Researchers studying the British experience described how the stigma developed:

> [T]he expert community determined that the (estimated) probabilities of hazard from eating beef were low. Despite this, public concerns remained high, perhaps because of media coverage of the consequences of, rather than the probabilities of, contracting [the disease].[98]

Potential durability

In 1989, a boycott of New England's apple crop followed news that agricultural chemical Alar (used to aid apple ripening) was potentially carcinogenic. A CBS *60 Minutes* report sensationalized a possible collusion between the apple industry and United States Food and Drug Administration, leading to a grassroots ban on apples that reduced that season's wholesale prices by one-third and industry revenues by C$146.3 million.[99]

In 1987, two people died and ten people became ill after eating contaminated Vacherin Mont d'Or cheese, a seasonal cheese made in the Jura Mountains on both sides of the French-Swiss border. The contaminated cheese came from a Swiss producer, and Swiss officials recalled all cheese from market. Nevertheless, sales of the *French* version of the cheese—connected to the

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[96] Powell, Douglas, 2001 "Mad Cow Disease and the Stigmatization of British Beef," in *Risk, Media, and Stigma: Understanding Public Challenges to Modern Science and Technology,* J. Flynn, P. Slovic and H. Kunreuther, eds., pp. 31-40. Sterling, V.A., Earthscan Publishing Ltd., London. http://www.foodsafety.ksu.edu/course/videos/fsriskanal/bsestig.pdf.

[97] Forge, Frédéric, 2005, "Mad Cow Disease and Canada's Cattle Industry," 12 July 2005, Science and Technology Division, Jean-Denis Fréchette, Principal, Economics Division, Parliament of Canada, PRB 03-01E.

[98] Smith, Denis and Jo McCloskey, 1998, "Risk Communication and the Social Amplification of Risk," Public Money and Management, October-December, pp. 41-50.

[99] Friedman, SM, K Villamil, RA Suriano, and BP Egolf, 1996, "Alar and Apples: Newspapers, Risk, and Media Responsibility," Public Understanding of Science, V5 N1, p. 1-20.

contaminated Swiss version in name only—fell by more than 25 percent before eventually recovering.[100]

While stigmatization in these two cases was relatively short, the EU's ban on British beef lasted ten years[101] and in some cases the stigma can be permanent: in 1981, the Homestead Dairy in Colorado discovered the contaminant PCB in its milk, which discovery—despite slaughtering two thirds of its herd and extensive decontamination—reduced public consumption from 3,000 litres per day to less than 20 litres p. d. before the dairy's closure and subsequent bankruptcy.[102] More recently, targeted media attention stigmatized lean finely textured beef—LFTB, commonly called "pink slime"—approved as a food additive in 2001. Media reports, celebrity aspersion, and grassroots opposition forced fast food restaurants to cease using LFTB in favor of higher priced, less healthy meat substitutes, after which the product's manufacturer closed three quarters of its processing plants and laid-off 650 employees (just one week after the first news stories).[103] Two months later—far too late—LFTB was again declared safe for human consumption.

Susceptibility to media hype

Even where media sources are well-intentioned in reporting risk consequences, the structure of reported communications—a kind of translation for mass engagement—threatens negative outcomes: for example, a U.S. Environmental Protection Agency ban on pesticide in 1984 reduced sales of grain-based products by up to 13 percent after inexpert media misreported technical information to the general public. Researchers summarized the problem thusly:

> [N]ewspapers and other news media attempt to translate technical information into forms that readers can understand. This process involves substantial subjective interpretation, especially when messages from the regulatory agency are insensitive to the information

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[100] Fabricant, Florence, 1987, "Swiss Halt Production of Tainted Cheese," New York Times, December 2, 1987, at http://www.nytimes.com/1988/01/01/world/french-and-swiss-fight-about-tainted-cheese.html; Greenhouse, Steven, 1988, "French and Swiss Fight About Tainted Cheese," January 1, 1988, New York Times, at http://www.nytimes.com/1988/01/01/world/french-and-swiss-fight-about-tainted-cheese.html.

[101] CBS News, 2008, "Mad Cow Timeline," CBS News On line, accessed at: http://www.cbsnews.com/elements/2003/12/29/in_depth_health/timeline590569.shtml 12/8/2012; Kuzmin, Victor, "Russia Lifts Ban on British Meat, " Russia Beyond the Headlines On-Line Newspaper, November 26, 2012, accessed at http://rbth.ru/articles/2012/11/26/russia_lifts_ban_on_british_meat_20427.html 12/8/2012.

[102] Edelstein, Michael R., 201, "Crying Over Spilled Milk: Contamination, Visibility, and Expectation in Environmental Stigma," in Flynn, James, Paul Slovic, and Howard Kunreuther, 2001, Risk, Media, and Stigma: Understanding Public Challenges, Earthscan Publishers, London, pp. 41-68.

[103] Greene, Joel L., April 6, 2012, "Lean Finely Textured Beef: The "Pink Slime" Controversy," CRS Report for Congress, Congressional Research Service, 7-5700, www.crs.gov, R42473.

> demands of ordinary people [...] The result is often that press reports appear as garbled and distorted accounts of the agency's message [about risk].[104]

This is precisely what happened to the New England apple industry, the British beef industry, and most recently to the manufacturers of LTFB: intensive, amplified and subjective media coverage rapidly created damaging stigma disproportionate to the actual risk.

Resistant to rational refutation

People who are afraid are inherently less trusting, and scientific or technical refutations of a food product's stigma are inevitably more complicated and opaque—thus more suspect—than the oversimplification that produced the stigma. The basis for generalized understanding is often media reports—necessarily oversimplified and frequently sensationalized—contributing to misunderstanding, confusion, and even more stigma.

The New England apple scare was fuelled primarily by media *allusions* to corruption and collusion between the chemical industry and government officials.[105] The only real problem with LFBT was its sobriquet—*pink slime*—which, combined with pervasive media attention and uninformed celebrity aspersion, more than overwhelmed expert claims that LFBT was perfectly safe and, because of its low fat content, created a *healthier* beef product.

More recently, in 2004, Canadian officials announced a single case of bird flu on a chicken farm. The announcement indicated the strain was of the H5 variety (commonly found in migratory birds, with no human health implications) and *not* the dangerous H7 variety (responsible for 22 then-recent deaths in China). Nevertheless, the E.U., China, and Brazil banned Canadian poultry products and the identified farm was forced to destroy 16,000 chickens and be quarantined.[106]

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[104] Johnson, F. Reed, 1988, "Economic Costs of Misinforming About Risk: The EDB Scare and the Media," Risk Analysis, V8:N2, pp. 261-269.

[105] Note that collusion, corruption, or other high level wrongdoing does not have to be directly linked to the stigmatized product. A generalized lack of trust in "big government" or "big corporations" can lead to the stigmatization of an otherwise innocuous product.

[106] Foodproductiondaily.com, 2004, "Canadian Poultry Ban," FoodProduction.com, accessed at: http://www.foodproductiondaily.com/Supply-Chain/Canadian-poultry-ban, 17 January 2013.

Stigma and damage from past disasters

The disaster at Fukushima Daiichi

On 11 March 2011, a massive earthquake and subsequent tsunami caused a series of equipment failures at Japan's Fukushima Daiichi Nuclear Power Plant. These failures led to fires, a nuclear meltdown, and the release of radioactive materials. Experts estimate airborne radiation releases up to one-tenth the releases from Chernobyl, the site of a 1986 nuclear reactor meltdown.

One month later, ocean water at the plant's wastewater discharge reached radiation levels 45 million times the concentration immediately before the accident. Levels stabilized at 10,000 times pre-accident levels by June 2011, leading experts to suspect ongoing leaks of radioactive groundwater.[107] A year later, scientists detected cesium radiation "thousands of times higher than would be expected naturally" over 300km off Japan's coast, prompting worries of radiological contamination reaching western coasts in Canada and the U.S.[108]

The accident has thus far crippled Japanese agriculture and fishing. The five affected prefectures (analogous to Canadian provinces) account for roughly one-fifth of Japan's fisheries and mariculture production, one-sixth of all agricultural output, one-fifth of Japan's hog and poultry production, and one-tenth of its cattle and dairy herds. The U.S. Congressional Research Service estimates the Fukushima-related damages to the fisheries, agriculture, and forestry sectors at C$21.9 billion. Of this, C$11.2 billion is attributed to losses in Japan's fisheries sector, along with C$9.3 billion in damages to agricultural lands and crops, and another C$1.4 billion in damages to forested lands and facilities. About one-seventh of Japan's compound feed industry was damaged, as well as the country's northern coast, which hosts vital wild seedbeds for scallops and oysters.[109]

Elevated levels of radiation have been observed over 1400km from the Fukushima Daiichi site by Japanese officials, prompting fears at the Japanese Health Ministry that the radiation will "damage all the [Kobe, Sendai, and other top quality brands of beef] and people won't buy any of it, even if it is safe".[110] Critically, the radiation itself is not the problem, but the *perception* of contamination. The nearest high-end beef ranch to the Fukushima Daiichi site is in Kobe, about

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[107] Patel, Prachi, 2012, "Fukushima's Impact on the Ocean Analyzed," Institute of Electrical and Electronics Engineers, IEEE Spectrum, accessed at http://spectrum.ieee.org/energy/environment/fukushimas-impact-on-the-ocean-analyzed.

[108] Jesse Emspak, 2012, "Fukushima Radiation Tracked Across Pacific Ocean," LiveScience, 02 April 2012 accessed at: http://www.livescience.com/19419-fukushima-radiation-pacific-ocean.html , 2/8/2013.

[109] Johnson, Renée, 2011, "Japan's 2011 Earthquake and Tsunami: Food and Agriculture Implications," Congressional Research Service Report to Congress # 7-5700, 18 May 2011.

[110] McDonald, Mark, 2011, "Food Contamination Fears Could Harm Japanese Brands," New York Times, 19 March, 2011, accessed at: http://www.nytimes.com/2011/03/20/world/asia/20food.html?pagewanted=all&_r=1& 2/4/2013.

580km away, yet it is the center of the Health Ministry's concern. High quality beef cattle in Japan can sell for as much as C$51,000 each, and only about 3,000 head each year are certified as Kobe.

The Tsukiji Fish Market is the world's largest auction market for seafood. Prior to the earthquake, Tohoku, the coastal center of the earthquake, accounted for about ten percent of the 2.2 million kg of seafood handled by Tsukiji Fish Market each day (primarily scallops, seaweed, bonito, and shark fin). The quality of the Tohuko fishing industry (*i.e.*, its brand) was "formidable." After the earthquake, however, Tohuko fisheries stopped providing fish to the Tsukiji Fish Market: "At least for now, the brand is finished. Gone. Hopeless."[111]

Oil spills

While the full consequences of Fukushima won't be known for several years—itself a source of fear—an extensive body of research documents the socioeconomic impact of oil spills, the consequences of which include most of what's already, and potentially, affected by Fukushima: wildlife habitat and biodiversity, sensitive coastal waterways and estuaries, beaches and other recreational and naturalist venues, employment, and tax bases.

The following examples help to illustrate the potential scale of consequences for even a minor accident involving the proposed DGR. Note that in all cases a significant portion of the damage is the result of stigma (not physical destruction or contamination), notwithstanding damage information being infrequently disaggregated. The stigma effects are transmitted via geographic risk perceptions (people fear areas generally, not specifically contaminated sites) and temporal risk perceptions (generalized fear dissipates much more slowly than what technical evidence could otherwise sustain). Note also that stigmatized areas never fully recover; rather, they become even more susceptible to stigma arising from subsequent trigger events.

The Deepwater Horizon Oil Spill (Gulf of Mexico)

On 20 April 2010, the Deepwater Horizon oilrig exploded in the Gulf of Mexico, leaking 780 million liters of oil (roughly 20 times the volume leaked by the EXXON *Valdez* spill, discussed *sub*). Research suggests the public's *generalized* concerns over food safety could cost the Gulf's commercial fisheries C$1.2 billion over the next seven years—this includes fish from areas like Corpus Christi, Texas, the shore of which was completely unaffected by the Deepwater spill. Researchers also

[111] *Ibid.*, quoting the market's general manager.

estimate that recreational fisheries could lose over C$1.9 billion. Shrimpers and other crustacean fishermen would suffer almost 85 percent of the spill's total economic impact. Secondary economic losses include revenue, profit, wages, and as many as 22,000 jobs.[112]

EXXON *Valdez* Oil Spill (Alaska)

On 24 March 1989, the tanker EXXON *Valdez* struck Bligh Reef in Prince William Sound and spilled 41.6 million liters of heavy crude oil. The oil spread more than 750km to the southwest along the Kenai Peninsula, Kodiak Island, and the Alaska Peninsula, contaminating 1,990km of pristine shoreline for over a decade.[113]

Salmon mortality spiked for over four years as incubating eggs were contaminated, and the spill's environmental and economic impacts extended into the early 2000s. Scientists expect gastropods (mussels, clams, oysters) will continue to be contaminated for up to 30 years,[114] and explained thusly why some species experienced prolonged economic impacts:

> [T]he oil industry typically touts the quick recovery of organisms to an 'untainted state' as evidence of the safety of seafood after an oil spill. However, after the *Exxon Valdez* spill, fisheries for salmon, herring, crab, shrimp, rockfish, and sablefish were closed, with some commercial fisheries remaining closed through 1990. Herring and salmon species in the region have never fully recovered ecologically or economically. *One of the main reasons for this is the public perception of contamination from seafood.*[115]

In 1991, Exxon settled lawsuits with seven Alaskan seafood producers for C$107.5 million. Also in 1991, the Chugach Alaska Corporation, located on the Prince William Sound, filed for

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[112] Sumaila, U. Rashid, Andrés M. Cisneros-Montemayor, Andrew Dyck, Ling Huang, William Cheung, Jennifer Jacquet, Kristin Kleisner, Vicky Lam, Ashley McCrea-Strub, Wilf Swartz, Reg Watson, Dirk Zeller, and Daniel Pauly, 2012, "Impact of the Deepwater Horizon Well Blowout on the Economics of US Gulf Fisheries," Canadian Journal of Fisheries and Aquatic Sciences, V 69 ("Sumaila et al, 2012"), pp. 499-510.

[113] Peterson, Charles H., Stanley D. Rice, Jeffrey W. Short, Daniel Esler, James L. Bodkin, Brenda E. Ballachey, and David B. Irons, 2003, "Long-Term Ecosystem Response to the Exxon Valdez Oil Spill," Science, V302, December 19 2003, pp. 2082—2086: via chronic persistence of oil, biological exposures, and populations impacts to species closely associated with shallow sediments; delayed population impacts from sub-lethal doses compromising health, growth, and reproduction; and indirect effects of trophic and interaction cascades, all of which transmit impacts well beyond acute-phase mortality.

[114] Graham, Sarah, 2003, "Environmental Effects of *Exxon* Valdez Spill Being Felt," Scientific American, 19 December 2003, accessed at http://www.scientificamerican.com/article.cfm?id=environmental-effects-of, 18 February 2013.

[115] Sumalia et al, 2012. (Emphasis added.) See also the public relations efforts of the Alaska Seafood Marketing Institute to offset negative imagery associated with Alaskan fishing: advertisements featuring celebrity Ben Stein reminding people that Alaskan seafood is plentiful and healthy, and to "grab a fork, there's lots more out there". (ASMI, 2006, "Alaska Seafood Marketing Institute TV ads for Food Network," accessed at: http://www.alaskaseafood.org/tv_ad/, 2 March 2013)

Chapter 11 bankruptcy protection following the collapse of the local marine population (principally clams, herring, and seals) and losses of over C$107.9 million.[116]

Santa Barbara Oil Spill (California)

On 28 January 1969, Union Oil's Platform Alpha suffered a blowout 1,100 meters below sea level, 10km off the coast of Southern California. Within ten days, 11.4 million liters of crude oil spilled into the water and onto the beaches of Santa Barbara County from Goleta to Ventura, also the shores of four northern Channel Islands. It was the first major environmental accident to receive media saturation and was a primary impetus for the first Earth Day in November 1969. Public awareness was so high that an organization called Get Oil Out—*GOO*—collected over 100,000 *paper* signatures on a petition to ban offshore drilling. The spill fouled roughly 57km of coastline and killed thousands of sea birds, as well as dolphins, elephant seals, and sea lions. Commercial fishing was suspended in the affected area, and tourism suffered a precipitous drop. Most ocean-related industries were affected in some way.[117] Owners of hotels, beachfront homes, and other facilities damaged by the spill received C$40.7 million in compensation and the commercial fishing interests received C$8.1 million.[118]

Stigma from perceived risks of contamination

While even a minor accident at the proposed DGR would have serious consequences for SON's whitefish fishery—discussed in more detail *sub*—it's important to remember that DGR-related stigma will affect the fishery as soon as the DGR is constructed. The reason is that stigma is a function of *perceived* risk—in turn a function of total potential harm—which risk increases whenever and wherever nuclear incidents occur.

In terms of perceived risks, underground nuclear waste storage poses peculiar challenges for detecting and repairing leaks. The Hanford Nuclear Site (discussed in Section Two) is a good example of this, as officials have consistently struggled to detect and contain leaks in the site's 177

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[116] Kalytaik, Tracy, 2010, "Chugach Alaska: From Bankruptcy to $1 billion Gross," April 2010, Alaska Business Monthly, Alaska Business Publishing Company, pp. 82-85.

[117] Clarke, Kenneth C. and Jeffrey J. Hemphill, 2002, "The Santa Barbara Oil Spill: A Retrospective," Yearbook of the Association of Pacific Coast Geographers, Darrick Danta, ed., University of Hawaii Press, Vol. 64, pp. 157-162.

[118] PEW Research, 2010, "Santa Barbara Oil Spill—January 28, 1969," The Pew Environmental Group, accessed at http://www.pewenvironment.org/uploadedFiles/PEG/Publications/Fact_Sheet/PEG_SantaBarbaraSpill_May2010.pdf, 10 January 2013. Costs are in 2013 dollars. Actual compensation to hotels was $6.5 million in 1969 dollars, and $1.3 million to commercial fishing interests.

underground tanks. It's perhaps unsurprising that when Hanford was considered as a site for permanent underground storage of U.S. high-level nuclear waste and spent nuclear fuel, a survey of the Tri-Cities area (where most of the Hanford workers live) revealed 40% of respondents felt such a repository could "somewhat or very likely" lead to radioactive contamination of the nearby Columbia River. Moreover, 51% of respondents believed the facility would stigmatize local fruits and wines (as being potentially contaminated). [119] Hanford was ultimately dropped from consideration because of public resistance.

Another example of failed underground storage is the Asse II nuclear waste facility, in Germany, discussed in Section Four.

Consequences of the DGR on SON's fishery

Economic consequences

Clearly, the risk of DGR-related stigma is high and would arise irrespective of an actual accident. The foregoing discussion also makes clear that any such stigma would quickly, and significantly, affect the region's food products—primarily, SON's whitefish fishery.

In his affidavit, Mr. Paul Jones, a Nawash councilor and fisherman, describes the SON fishery in detail, including recent agreements with the Government of Ontario containing fishery resource protection mechanisms, as well as mechanisms for the economic redevelopment of the SON fishery.[120] Mr. Jones explains that the fishery at Saugeen and Nawash has suffered decades of degradation due to government policy, legislation and action, as well as preferential use by non-aboriginal fishermen.

In the last 20 years, however, SON has carried out legal and political action to have its rights to a commercial fishery recognized and protected, which has resulted in negotiated agreements with government to achieve these goals. As Mr. Jones explains, SON believes that they now have the legal foundation to rebuild their fishery and "return it to its place at the center of the SON culture and economy".[121] It should be noted that SON's right to a commercial fishery is an *exclusive* right—theirs is the only commercial fishery in the waters around the Bruce Nuclear site and the Bruce Peninsula.

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[119] Dunlap, Riley E., Michael E. Kraft, and Eugene A. Rosa (eds), 1993, *Public Reaction to Nuclear Waste: Citizens' Views of Repository Siting,* Duke University Press, Durham NC.

[120] **[Affidavit of Paul Jones, sworn XXX]**

[121] **[pinpoint cite]**

The economic consequences of perceived contamination are not difficult to foresee: consumers seeking to avoid contaminated food products will avoid products from areas in close proximity to the prosed DGR. Since the SON fishery is contiguous to the proposed DGR, the stigma would affect the SON almost exclusively.[122]

The significance of these consequences is two-fold. First, SON's fishery has significant potential for growth and profitability tied to consumer demand for sustainable, locally harvested food products. While SON's whitefish are currently sold primarily "in the round" for roughly $2 per pound ("in the round" being the lowest commercial rate: fish that are scaled and gutted but with heads, fin and tail still attached), fishmongers in Toronto regularly sell branded Georgian Bay whitefish for up to $25 per pound. This potential has been recognized by SON and the Government of Ontario, and is reflected in the creation of an economic and capacity working group (under the SON Fishing Agreement) that is tasked with developing a vertically integrated and expanded SON fishery to maximize value to SON and its members.[123] It is rightly noted by Mr. Jones that concerns about the potential for the development of a DGR on SON traditional waters could even impact SON's ability to secure the investments it needs to rebuild its fishery.[124] DGR-related stigma is a clear threat to the development of profitable, viable, commercial fishery.

Second, as explained in the affidavit of Paul Jones, the SON have a long history of interdependency with their territorial waters and fishery that are not easily understood by a Western conception of economy. The ancestors of the SON were in many ways defined by their relationship to the water and their fishery. It was considered an economy in the sense that SON has always relied on fishing to live and make a living. "To keep from starving before winter was over… men and women labored mightily throughout the summer and fall to store enough food to last them until spring. Work was the chief ethic."[125] SON have always fished to feed their families, and to make money to acquire goods to provide for their families. The goal of SON's recent efforts at

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[122] It goes without saying that inevitable protests of the DGR specifically and nuclear waste generally will only amplify perceived risks and therefore stigma. An example of the kind of protests one should expect is the Tooth Fairy Project, an activist organization incorporating cancer, children, and unreliable science. Notwithstanding the results of the Tooth Fairy Project have been found to be unsubstantiated by numerous academic groups, it continues to be cited as a leading example of the dangers of nuclear technology. For a detailed discussion of the project, see http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/tooth-fairy.html.

[123] **[Pinpoint cite from affidavit]**

[124] **[pinpoint cite to aff'd]**

[125] Johnston, Basil, 1995, The Manitous: The Spiritual World of the Ojibway, Minnestoa Historical Society Press, St. Paul.

reestablishing a commercial fishery has been to protect the right of every SON member to fish to make a living. SON's whitefish fishery is in this way critical to its economic independence—independence that's clearly threatened by the proposed DGR.

Cultural consequences

DGR-related stigma associated with a traditional food item also threatens SON's cultural identity. For centuries, the Anishinaubae lived in northern climates, often near starvation; consequently, food is central to most of the Anishinaubae's traditional practices. Like most of the North American Aboriginal people, the sharing of food is a sacred thing. In the past, the harvesting of a game animal was an occasion for communal celebration. Celebrations of all kinds centered on gathering, preparing, and consuming meals for social as well as symbolic purposes. Sharing one's food became an important emblem of respect and unity.

Currently, the Saugeen and Nawash communities meet and collaborate with Federal and local leaders, other First Nations, local non-Aboriginal people, and international visitors through annual Pow-Wow ceremonies. Protocol dictates the presentation of gifts as a sign of respect. Often that gift is the most important component of the band's existence: locally acquired, personally prepared foodstuffs.[126] Among the SON, fresh smoked whitefish is a delicacy received graciously by guests. If the proposed DGR stigmatized local whitefish, what would happen to SON's presentation of its catch? Would there be hesitancy or shame on the part of the presenter? Reluctance or revulsion for the recipient? Remove the whitefish as a gift and the community is separated from its cultural identity.

On an individual level, the stigmatization of the whitefish as a subsistence and traditional food would be equally devastating. Social anthropologists have coined the term "traditional ecological knowledge" (TEK) for the process by which North American Aboriginal people apply traditional practices and experiences.

> [TEK is] community-specific, place-based (i.e., geographically-specific) and accumulates over time by shared experiential knowledge across generations. Communities change their TEK through a progressive accumulation of experiences and adaptive responses to internal (i.e., within the community) and external (i.e., macro-level) economic, political, social and ecological change".[127]

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[126] Interview with Paul Jones, Saugeen Reserve member, on 25 April 2013.

[127] Reo, Nicholas James and Kyle Powys Whyte, 2011, "Hunting and Morality as Elements of Traditional Ecological Knowledge," Human Ecology (2012) 40:15-27.

In other words, the TEK process is a dynamic mode of survival because a society's environment changes over time. TEK represents an intricate relationship amongst spiritual and moral values, accumulated experiences and skills, trial-and-error learning of best practices, and community.

Subsistence hunting and fishing are a practical and efficacious way for a community member to express his connection to the TEK. The TEK identifies who the individual should be to conform to the community's cultural standards, and the overt actions of subsistence show the community that he recognizes and embraces that definition. A useful example is the conflict faced by a tribe of Swinomish Indians.[128] In response to a Washington State announcement that the sediments and shellfish of Puget Sound contained bioaccumulative chemical contaminants, the Swinomish faced a dilemma: abandon their traditional practices and foods (and thereby avoid contamination), or ignore the government's warnings and surviving as a culture (but risk illness and death from eating the contaminated shellfish).

Critical to understanding this dilemma is the Swinomish concept of "health", which differs from the Western conception. For the Swinomish, health is a community measure of well being, incorporating not just individual health but social, mental, cultural, and spiritual aspects. For instance, cultural health may be partly represented by the number of people attending a Council meeting.

The Swinomish relationship to its traditional practices and food was thus summarized as follows:

> During one interview an expert was asked for an explanation of the importance of seafood and ceremonies to community health. The expert paused and collected his thoughts, then answered, imparting an eloquent response to both the direct question and to meaning of traditional knowledge as both knowledge *and* practice in relation to seafood, ceremonies and the community food sharing network.
>
> *'...wherever you go to procure food, there's a proper way to doing it, of gathering that, being respectful to nature, thanking the spirit of, say, the animal or the fish that we caught to bring home, to provide for us... at the same time, there is a proper way to fix it when you get home... all these little things that need to be done to make sure that when it was prepared that it was prepared in a good way, in a healthful way. The old people say that if you do a lot of this with good thoughts and with prayers, that it adds to the strength of the food that you're sharing with your family or your guests and your visitors, whatever it may be, or yourself. So,*

[128] Donatuto, Jamie, 2008, *When Seafood Feeds the Spirit Yet Poisons the Body: Developing Health Indicators for Risk Assessment in a Native American Fishing Community,*" A thesis submitted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy in Resource Management and Environmental Studies, The University of British Columbia, Vancouver.

when you pray when you gathered it, when you pray when you prepare the food, this all adds to the strength that we receive when we partake in this.[129]

For the SON, analogous to the Swinomish, the whitefish fulfill a member's spiritual hunger for inclusion in something larger and eternal: membership in the Anishinaubae people. If the SON were no longer able to harvest and consume whitefish, or were reluctant to do so, its members' cultural identity would diminish irremediably.

Conclusion

Food products are easily stigmatized. Case studies illustrate that stigma develops rapidly, is durable, susceptible to media hype, and resistant to rational refutation. Past experience with oil spills and ongoing experience from the Fukushima disaster makes clear that even a minor accident at the proposed DGR would have significant negative consequences for local food products. Moreover, because stigma is a function of *perceived* risk, local food products will be stigmatized as soon as the DGR is built.

SON's fishery will suffer heavily, and exclusively, any DGR-induced food stigma. A stigmatized fishery has no economic value and, because the Lake Huron whitefish is central to SON's cultural identity, would threaten SON's very existence. Notwithstanding the BNS is within SON's traditional territory and SON has the most to lose of any potential stakeholder, OPG failed to consider any of the risks discussed in this section.

[129] *Ibid.* (Emphasis in original.)

Section Four: Nuclear stigma & tourism

Introduction

Copious research and relevant case studies make clear the potential for nuclear facilities, especially nuclear waste facilities, to stigmatize surrounding areas. The general public is fearful of a technology it doesn't understand beyond the threat of catastrophic damage. Two previous attempts to construct DGR-type facilities—in Cumbria County, U.K. and Yucca Mountain, Nevada, both discussed in Section Two—were abandoned amidst concern over what this fear would mean for regional tourism.

This section discusses specific ways in which nuclear-related stigma affects tourism. Case studies reviewed in this section illustrate tourist stigma's sensitivity, durability, relationship to other triggering events, and susceptibility to perceptions of site mismanagement.

Tourism's importance to SON cannot be overstated. While the economic costs of DGR-induced stigma would be severe, the real consequence is spiritual, existential: tourism is a primary means by which SON supports itself in its traditional territory. If the proposed DGR stigmatizes tourism in the Bruce Peninsula, there is a serious risk the SON will lose a primary economic base on which they survive.

Tourist destinations are readily stigmatized

Nuclear facilities, especially nuclear waste facilities, stigmatize the surrounding area.[130] People do not visit places they believe may cause them harm,[131] and research indicates the least acceptable industrial facility to have built near one's home is a nuclear waste facility.[132] Specifically, while 35 to 40 percent of people would live near a nuclear power plant, just 25 to 30 percent of people would live near a nuclear waste facility.[133] More recent work corroborates these findings:

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[130] Jenkins-Smith, Hank C., 1994, Stigma Models: Testing Hypotheses of how Images of Nevada Are Acquired and Values Are Attached to Them, prepared for Argonne National Laboratory, ANL/DIS/TM-17.

[131] Intuitively, at least, this avoidance tendency will be strongest for families, significant because so many of the Bruce Peninsula's tourist attractions are family-oriented. (See Section Three.)

[132] Lindell, Michael K. and Timothy C. Earle, 1983, "How Close Is Close Enough: Public Perceptions of the Risks of Industrial Facilities," Risk Analysis, V3:N4, PP. 245-253.

[133] *Ibid.*

> [M]ore people are worried about waste management than about the operation of nuclear plants. In a Swedish survey, the general public assessed nuclear waste as one of the four most threatening environmental problems.[134]

The following features of stigma generally are especially acute for tourist destinations.

Sensitivity

Various factors amplify the nuclear-related stigma attaching to a tourist destination, including the event's severity (compare a transportation accident involving nuclear materials with an underground leak of waste storage receptacles), the intensity of media coverage, and the evocative nature of the images portrayed to the public (images of environmental damage—the nuclear equivalent of oil-fouled shorelines—are especially persistent and damaging). As discussed in Section Two, media attention tends towards more negative and severe coverage of incidents.

A relevant case study is stigma-induced economic consequences of the accidental discovery and exposure of a small amount of caesum-137 in Goiânia, Brazil. In 1987, two scavengers mistook a shielded piece of caesum-137 for a trinket whilst hunting in the location of a former health clinic.[135] The item was sold and later disassembled and its pieces sold as decoration and jewelry, exposing at least 244 people to measurable radioactive contamination; of these, ten needed serious treatment and four died.

While affected individuals suffered serious injury, media coverage was totally disproportionate: *Time* magazine called the incident one of the world's worst nuclear disasters since Chernobyl;[136] the *New York Times* called the incident an "intangible plague" and "radiophobia"; rather than images of Goiânia or of nuclear medicine, images of Three Mile Island (discussed *sub*) dominated the news; and the U.S. government removed American exchange students.[137] Researchers summarized the response thusly:

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[134] Sundqvist, Göran, 2002, "The Bedrock of Opinion: Science, Technology and Society in the Siting of High-Level Nuclear Waste," Götenborg University, Section of Science and Technology Studies, Kluwer Academic Publishers, Dordrecht.

[135] IAEA, The International Atomic Energy Agency, 1988, *The Radiological Accident in Goiania*, IAEA, Austria.

[136] Patently hysterical: Chernobyl's nuclear meltdown, in 1986, remains the world's worst nuclear accident: 200 people hospitalized, 31 dead, the site evacuated to a 30km perimeter, and approximately 220,000 people permanently relocated. (Munro, Alistair, 2011, "Notes on the Economic Valuation of Nuclear Disasters," Prepared for the Environmental Economics course for the Masters in Public Policy at the National Graduate Institute for Policy Studies, 7-22-, Roppongi, Minato-Ku, Tokyo, 106-8677, Tokyo.)

[137] Simons, Marlese, 1987, "Radiation Fears Infect Brazil after Accident," New York Times, 2 December 1987, accessed at: http://www.nytimes.com/1987/12/02/world/radiation-fears-infect-brazil-after-accident.html, 2/2/2013.

> The comparison with Chernobyl was immediately made. Panic began to envelop the city. The official information was contradictory, and showed a large lack of technical knowledge about how to control the situation. The government of the state of Goias used all means of communication to avert panic. Because of the lack of confidence of the citizens in governments, which they believed consistently did not tell them the truth, rumors were rampant.[138]

It took almost a year for Goiânia's regular tourist economy to recover from a single, trinket-sized exposure.

Durability

Stigmas persist until the underlying cause is resolved in the public's mind. Accordingly, while some triggering events at the proposed DGR could induce relatively short-lived stigma, others could be permanent. For example, a transportation accident during the delivery of nuclear waste could produce intense, but short-lived stigma that would dissipate once the accident has been cleaned up. However, if storage casks in the repository begin to leak—as recently occurred at the Hanover Nuclear Site in Washington and at the Asse II repository in Germany—the problem could go undetected for decades and, once the repository is sealed, be virtually irremediable. The stigma associated with a more serious accident would, in that case, be permanent.

Relevant case studies include the 1979 partial meltdown of the Three Mile Island Nuclear plant in Harrisburg, Pennsylvania. The worst nuclear accident in U.S. history released radioactive gasses into the local atmosphere and caused school closures, residential and agricultural quarantines, and the evacuation of pregnant women and small children within a 32km radius of the TMI facility. Studies estimated the short-term loss of tourist revenue at C$15.8 million, and a 50 percent reduction in summer tourist visits to Harrisburg and nearby Lancaster Counties. The economic damage was minimized, however, by the limited scope of the meltdown: no loss of life, and no external damage to facilities for media broadcast.[139]

It's still unclear how the disaster at Japan's Fukushima Daiichi Nuclear Power Plant (in March 2011, discussed further in Section Three) will resolve for local and regional economies. Officials estimated the decline in foreign visits *nationally* at 60% immediately following the disaster,

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[138] Liete, Marco A.S. and L. David Roper, 1988, "The Goiânia Radiation Incident, A Failure of Science and Society," Universidade Federal de Goias, accessed at: http://arts.bev.net/roperldavid/gri.htm, 2/2/2013.

[139] Intertech Services, 1993, *Tourism Impacts of Three Mile Island and Other Adverse Events: Implications for Lincoln County and Other Rural Nevada Counties Bisected by Radioactive Waste Transport Corridors,* for the Joint City/County Impact Alleviation Committee.

with declines continuing through the summer travel season. (This is despite the fact that the incident had no physical or environmental effects for the majority of the island.) By the end of 2011, estimated tourists visits remained at 70% of the previous year's total, a loss of direct tourist expenditure of C$6.1 billion.[140] A more localized example is Akagi Onuma, a mountain lake located 180km from Fukushima that typically receives 25,000 fisherman visitors annually. After government officials reported contaminated fish were found in Akagi Onuma, tourism to the region declined 90% from its 2011 level.[141]

Relationship to other triggering events

An especially pernicious feature of stigma, especially nuclear-related stigma, is the interconnectedness of triggering events. Nuclear incidents anywhere in the world reinforce the risks faced by local populations everywhere. This means that the proposed DGR's perceived risk to surrounding areas is contingent upon the management of *all* nuclear facilities *anywhere* in the world.

Examples of this stigma effect are numerous. Relicensing of the Vermont Yankee Nuclear Plant was hindered not only by mismanagement and plant safety issues but also by a near breach in the Davis-Besse Nuclear Plant in Ohio, almost 900km away.[142] In 2013, efforts to relicense the aging San Onofre Nuclear Generating Station near Santa Barbara, California, failed in the face of public opposition following the Fukushima Daiichii accident in Japan.[143]

Recent leaks in the waste receptacles at Hanover Nuclear Site are sure to figure in protests and perceptions of the proposed DGR. Even more pertinent is the Asse II facility in Germany: a subterranean nuclear waste management facility that's already leaking and threatens to be the most expensive contamination cleanup effort in the world. When additional leaks materialize, Asse II will inevitably remind visitors to the Bruce Peninsula of the risks involved.

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[140] Birmingham, Lucy, 2011, "Is Post-Fukushima Japan Safe for Tourists?" Time Magazine, 10 November 2011, accessed at http://www.time.com/time/world/article/0,8599,2099119,00.html, 14 January 2013.

[141] Sadakuni, Seiko, 2012, "Lingering radiation means continued chill for some tourist hotspots," The Asian Shimbun, 29 October 2012, accessed at http://ajw.asahi.com/article/0311disaster/fukushima/AJ201210290085, 10 January 2013.

[142] New York Times, "A judge rules Vermont can't shut nuclear plant," 19 January 2012, at: http://www.nytimes.com/2012/01/20/science/earth/vermont-cant-shut-down-nuclear-plant-judge-rules.html?_r=0.

[143] New York Times, "Californians consider a future without a nuclear plant for a neighbor," 25 July 2013, at: http://www.nytimes.com/2012/01/20/science/earth/vermont-cant-shut-down-nuclear-plant-judge-rules.html?_r=0

Asse II

In 1969, the German government opened Asse II, a former salt mine that became a deep geological repository licensed to receive low- and intermediate-level radioactive waste. Asse II holds 125,787 storage vessels, each containing between 100 and 400 liters of low-level waste, deposited between 1967 and 1978. The containers were stored in a series of chambers roughly 750 meters underground. Between 1972 and 1977, an additional 1,293 containers of intermediate-level waste were stored in a chamber at a depth of 511 meters.

Originally, the public was told that Asse II was an experimental site to study how nuclear waste reacted in a geological repository. The German government, however, began using the site for permanent storage of a variety of low-, intermediate-, and even high-level nuclear waste. When the truth was discovered, grassroots efforts and protests forced government action.[144]

The mine operated until 1995, when the caverns excavated to receive the waste were filled with salt. By early 2008, reports emerged that the salt barrier had been breached and roughly 12,000 liters of groundwater had leaked into the mine daily, accumulated over the years in front of an emplacement chamber, and become contaminated.[145] On 8 September 2008, local and federal governments decided to replace the company operating the mine with Germany's Federal Office for Radiation Protection; close the mine; and follow international nuclear law instead of mining laws to ensure the mine's nuclear safety.[146]

The Asse II mine cleanup has been fraught with scandal and the sort of evocative imagery that fuels stigma: an article in National Geographic called the problem "due to poor recordkeeping" and "too dangerous for workers".[147] Further exacerbating the problem of public perception, the media revealed that between 1972 and 1982, the operations of the repository had suffered from lax procedures, resulting in the *Kernforshungsanlange Jülich,* the official form reporting the contents of each

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[144] Fröhlingsdorf, Michael, Udo Ludwig, and Alfred Weinzierl, 2013, "Abyss of Uncertainty: Germany's Homemade Nuclear Waste Disaster," Spiegel On-Line, February 21, 2013, accessed at: http://www.spiegel.de/international/germany/germany-weighs-options-for-handling-nuclear-waste-in-asse-mine-a-884523.html, 5 March, 2013.

[145] Moore, Michael Scott, 2009, "Salting it Away (and Other Problems with Nuclear Waste)," July 29, 2009, Pacific Standard, accessed at: http://www.psmag.com/science-environment/salting-it-away-3558, 5 May 2013.

[146] Speigel, 2008, "Dealing with Asse : Where Should Germany Store Its Nuclear Waste?" Speigel Online International, 8 September, 2008, accessed at: http://www.spiegel.de/international/germany/dealing-with-asse-where-should-germany-store-its-nuclear-waste-a-577018.html, 2 May 2013

[147] National Geographic, 2010, "Photos: Leaking Nuclear Waste Fills Former Salt Mine," July 8, 2010, accessed at: http://news.nationalgeographic.com/news/2010/07/photogalleries/100708-radioactive-nuclear-waste-science-salt-mine-dump-pictures-asse-ii-germany/#/salt-mine-nuclear-waste-asse-germany-loader-barrels_23154_600x450.jpg.

container, being rated "poor," with sloppy entries of "now" for the reference date and the generic term "waste" used to describe the type of waste declared.[148] The German people consider Asse II "the largest cleanup operation in mining history" with a cost of C$ 5.16 billion.[149]

> Investigative journalists have observed with regard to the Asse II problem:
>
> On the one hand, there are the engineers who want to plan everything, who have to plan everything, who are not allowed to endanger anyone, who have to adhere to the rules of the Atomic Energy Act, who have to implement the government's plans and who should take into consideration the concerns of local residents. And, on the other hand, there are the forces of nature at work in a mine that does whatever it wants.[150]

If internationally respected engineers could err as catastrophically as the German scientists who designed, created, and operated Asse II, the anti-repository argument that the technology remains unproven—especially in the long-run—must be given more serious consideration and will definitely contribute to how individuals perceive the risks involved with the proposed DGR.

Perceptions of site mismanagement

As discussed in Section Two, a serious source of nuclear technology's perceived risk is the potential for facility mismanagement and human error. Enormous public trust underwrites every nuclear project: the public understands that nuclear accidents are devastating but that they (the public) are unable to evaluate the competence of people operating nuclear facilities. The result is extreme sensitivity around site management and operational competence:

> Under risk avoidance theory, the potential for economic losses increases if the repository is plagued by mishaps or mismanagement. However, even in the absence of serious incidents, the public may view the risk as sufficiently high, particularly if repository-related concerns are highlighted by the media or interest groups.[151]

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[148] Möller, Kai, 2009, "New Developments in LILW Management, 3rd Annual RadWaste Summit, Federal Office for Radiation Protection, Germany, September 8 – 11, 2009, Las Vegas, Nevada.

[149] Schwartz, Michael O., 2010, "Clearing Out Asse II," Nuclear Engineering International, 24 August 2010, accessed at: http://www.neimagazine.com/features/featureclearing-out-asse-2, 6 May 2013.

[150] Spiegel, 2008.

[151] Jenkins-Smith, Hank C., 1994, Stigma Models: Testing Hypotheses of how Images of Nevada Are Acquired and Values Are Attached to Them, prepared for Argonne National Laboratory, ANL/DIS/TM-17. See also research by Hine, Donald W.; G Craig Summers, Mark Prystupa, and Antoinette McKenzie-Richer, 1997, "Public Opposition to a Proposed Nuclear Waste Repository in Canada: An Investigation of Cultural and Economic Effects," Risk Analysis, V17:N3, pp. 293-302, indicating people perceive large institutions as lacking accountability and social responsibility. See also NRC (National Research Council), 1989, *Improving Risk Communication,* Committee on Risk Perception and Communication, Commission on Physical Sciences, Mathematics, and Resources, Commission on Behavioral and Social Sciences and Education, National Research Council, National Academy Press, Washington D.C.

A separate SON submission details evidence suggesting the proposed DGR—intended to hold low- and intermediate-level nuclear waste—is in fact a stalking horse for an expanded and permanent repository for Canada's high-level nuclear waste, including used nuclear fuel. This is precisely the sort of behavior that erodes public confidence in site management, increasing the risk, and stigma, associated with the proposed DGR.

Bruce Peninsula's tourist appeal

SON's tourist business (discussed *sub*) clearly depends on the appeal of the Bruce Peninsula generally. As noted in Section Two, that appeal is much wider than OPG allowed in its EIS: almost one hundred special events and festivals between early May and early October, including vendor markets, theatrical performances, fireworks displays, and seasonal festivals.[152] Winter activities include skating, bird watching, cross-country skiing, and snow mobile riding. There are two national parks, eight provincial parks, and four Federation of Ontario Naturalists Parks located on the Bruce Peninsula. In 2010, almost 1.5 million people made visits to Bruce County and spent roughly $169-million.[153]

Also clear is that the Bruce Peninsula's tourist appeal depends entirely on the region's natural beauty. Parks Canada, for example, describes the region thusly:

> In the heart of a World Biosphere Reserve, the 'Bruce' is place of global significance. Thousands of visitors come each year to experience the massive, rugged cliffs of the park, inhabited by thousand year old cedar trees, overhanging the crystal clear waters of Georgian Bay. The park is comprised of an incredible array of habitats from rare limestone barrens to dense forests and clean lakes.[154]

In addition to the Bruce Peninsula proper, SON has an extensive interest in Sauble Beach, the future value of which depends entirely on the quality of the region's natural environment. Indeed, other groups have recently invested heavily in the Bruce Region, indicating significant potential growth for all area tourism.[155]

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[152] Francis, John and Marianne Wood (eds), 2012, *Bruce Peninsula Daytrip Companion*, Tobermory Press, Tobermory ON.

[153] Statistics Canada, 2010, *International Travel Survey*, accessed at: http://www5.statcan.gc.ca/bsolc/olc-cel/olc-cel?lang=eng&catno=66M0001X, 15 February 2013; Statistics Canada, 2010, *Travel Survey of Residents of Canada*, accessed at: http://www5.statcan.gc.ca/bsolc/olc-cel/olc-cel?lang=eng&catno=87M0016X, 15 February 2013; Statistics Canada, 2010, *Travelers to Canada by country of origin, top 15 countries of origin* (2010), accessed at: http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/arts38a-eng.htm, 15 February 2013.

[154] http://www.pc.gc.ca/eng/pn-np/on/bruce/index.aspx.

[155] Blue Mountain ski resort has invested millions in a four-season resort. (Blue Mountain, 2012, *2012-2013 Mountain & Resort Winter Guide*, Blue Mountain Resorts Limited.)

DGR-related stigma directly threatens all of this potential growth in tourism. Nevertheless, OPG's EIS ignores this threat entirely, an omission especially troubling in light of the clear similarities between the Bruce Peninsula region and Cumbria County, U.K. As discussed in Section One, Cumbria County is home to world-class national parks and a large part of the local economy relies on tourism. Notwithstanding an established nuclear presence (at Sellafield), public fear that the region's environmental quality would be stigmatized led to the rejection of a DGR-type facility.

SON's tourist business in the Bruce Peninsula

A separate report describes SON's tourism business in detail. Briefly, though, the SFN operate a profitable cottage leasing business, with over 1,200 cottages available on or nearby the shore of Lake Huron. Rental rates range between C$750 and C$1,250 per week. The business generates C$33 million in private incomes annually and additional C$7.4 million in revenues to the SFN. SFN's cottage income represents approximately 30 percent of SFN's annual budget, and individual members have limited alternative income sources on the Reserve.

The Chippewas of Nawash have approximately 500 cottages for lease along the shore of the Georgian Bay, as well as the Cape Croker Indian Park camping grounds, which attracts between 3,000 and 4,000 visitors annually. The Nawash cottages rent for between C$650 and C$1,000 per week. Park rates range from C$30 to C$40 per night for campsites and cabins are C$65 per night. In 2012, the Park accommodated about 125 seasonal campers, 5,000 to 10,000 overnight campers, and 1,000 to 2,000 weekly visitors.[156] Fron all sources, the Nawash generated approximately C$1 million in personal income.

The average occupancy rate for Saugeen and Nawash cottages is about 75 percent, centered on the mid-summer season.

Tourism is clearly important to SON's economy but also, critically, to SON's cultural identity and survival as a people. The Anishinaubae literally do not exist outside their traditional lands in and around the Bruce Peninsula. After centuries of negotiations and accommodations, their traditional lands have been reduced to a few hundred square kilometers. If that land were abandoned—either because nuclear stigma destroys the local economy, or a nuclear accident makes the land uninhabitable—the SON would cease to exist.

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[156] Chegahno, Arlene, 2013, "Questions for Tourism," email correspondence with the Chippewas of Nawash Unceded First Nation tourism representative.

Conclusion

An extensive literature indicates nuclear facilities stigmatize surrounding areas. Research and case studies illustrate that people's perceptions are highly sensitive to media presentation, durable, and amplified by other triggering events, especially site mismanagement. SON's tourist business in and around the Bruce Peninsula is a primary means of supporting the community in its traditional territory. The presence of a DGR risks stigmatizing the Bruce Peninsula as a tourist destination and thereby threatens SON's very existence.

Conclusion

On 2 December 2005, Ontario Power Generation (OPG) petitioned the CNSC for a permit to construct and operate a Deep Geologic Repository (DGR) approximately one kilometre from the shore of Lake Huron at the Bruce Nuclear site (BNS) in the Municipality of Kincardine, Ontario.

In support of its application, OPG presented an Environmental Impact Statement (EIS) and related Socioeconomic Technical Support Document (TSD), the latter describing the methodologies and processes used in the EIS. The purpose of these two documents was to estimate the socioeconomic impacts of the proposed DGR, including the potential for stigmatization of the BNS and surrounding areas. OPG's conclusion was that the potential for DGR-related stigma was minimal.

This report has demonstrated OPG's conclusion is neither credible nor defensible. By any measure, OPG's stigma analysis is strikingly inadequate, demonstrating total disregard for the seriousness of its proposal and the potential consequences for affected communities, in particular the Saugeen Ojibway Nation.

A voluminous and detailed literature makes clear that nuclear projects generally, and nuclear waste projects especially, are heavily stigmatized. Inexplicably, none of this research is discussed or even identified by OPG. OPG also ignores relevant case studies, including two previous attempts to establish DGR-type facilities—in Cumbria County, U.K. and Yucca Mountain, Nevada—both of which were abandoned amidst fears the facilities would stigmatize local economies. OPG even overlooks recent experience of nuclear waste-related stigma at the BNS itself: when an attempt to transport 16 decommissioned steam generators through the Great Lakes was scuttled by public opposition, notwithstanding each generator contained just four grams of radioactive material and posed minimal risk to public or environmental health.

There is no excuse for ignoring so much clearly apposite and readily available information. The effect is that OPG draws conclusions about DGR-related stigma without considering the research or experience of *anyone, anywhere, ever*. This approach is totally inadequate, raising serious questions about OPG's competence and reliability.

OPG's conclusion that the proposed DGR will result in minimal sigma is directly contrary to *virtually all experience* with nuclear waste facilities. This conclusion is questionable on its face and totally undermined by methodological flaws in the underlying survey research. OPG surveyed the wrong population using biased questions, grossly inadequate sample sizes, and an overly narrow

view of the areas and activities potentially stigmatized. OPG then presented its findings in such a way that third party verification was impossible, making the analysis literally indefensible. OPG made no effort to discuss, explain, or even acknowledge the deficiencies in its stigma analysis.

The consequences of OPG's failure to investigate the potential for DGR-related stigma will fall squarely, almost exclusively, on the SON. Research and case studies make clear that food products are rapidly and durably stigmatized, meaning the DGR poses a clear threat to SON's whitefish fishery in Lake Huron. OPG reached its conclusions on stigma without considering any of this research and none of these case studies; in other words, without considering the potential impact on SON's fishery, notwithstanding the proposed DGR will be located *within* SON's traditional territory.

Research and case studies are also clear about the potential for nuclear facilities to stigmatize tourist economies, even where triggering events occur at distant and unrelated tourist sites. OPG also ignored this body of literature and all relevant examples—even the fact that the Bruce Peninsula is part of a UNESCO World Biosphere Reserve encompassing the entire Niagara Escarpment.

While the economic consequences of DGR-related stigma are substantial, especially for tourism in the Bruce Peninsula region, for the SON these consequences are also spiritual. SON's existence is bound up with its traditional territory. The community cannot leave in the event of DGR-related accidents or stigma. OPG's proposal totally elides the serious risks posed to SON by the DGR project: a stigmatized fishery or tourist business means not just financial but existential losses for SON. The First Nation would cease to exist if it could not support itself in traditional ways on its traditional territory.

To be clear: it is entirely possible that the proposed DGR could be constructed and operated in such a way that stigma effects were minimized or even eliminated. The problem is that OPG has made no effort to investigate this possibility. There is no reliable evidence on the public record to support OPG's conclusions regarding DGR-related stigma. In the absence of such evidence, it is impossible for the JRP or CNSC to make an informed decision about the proposed DGR facility.

Bios

Daniel Charles Mussatti has a Master of Science in Environmental and Natural Resource Economics from the University of Alaska Fairbanks, and a Master of Arts in Environmental Economics from the University of Maryland, College Park, and a Ph.D. candidate in Environmental Economics at The American University in Washington D.C. He has over 25 years of experience in the assessment of the socioeconomic and environmental impacts of projects and regulations with a special emphasis on power utility issues. He has worked extensively with the United States Environmental Protection Agency and Nuclear Regulatory Agency on environmental justice and Native American issues. He was the co-author and editor of the seminal costing manual, The EPA Air Pollution Control Cost Manual, for ten years and has been an expert witness and offered testimony on environmental economics and cost engineering issues for the EPA, The U.S. Department of Justice, and the U.S. NRC. He is a member of the International Association for the Advancement of Cost Engineering.

John Greeves is a Senior Regulatory Safety Consultant. He has a BS degree and Graduate studies in Civil Engineering from University of Maryland. Mr. Greeves retired from the U. S. Nuclear Regulatory Commission (US NRC) as Director, Office of Nuclear Materials Safety and Safeguards, Division of Waste Management and Environmental Protection in 2004. He is a Registered Professional Engineer and has more than thirty-five years of experience with government and commercial siting, design, construction and remediation of critical infrastructure facilities including: nuclear power plants, dams, radioactive and hazardous waste disposal facilities. Mr. Greeves has served as a consultant to the US NRC, US DOE, IAEA and a number of international clients regarding nuclear safety issues.

Table 1. OPG's DGR Aquatic Environment Technical Support Document – Extractions and Questions

Page	Section	Extraction	Questions/Uncertainties
vii	Executive Summary	*Although residual adverse effects on VECs in the South Railway Ditch are identified, these effects do not represent an adverse effect on* ***renewable resources***	It is unclear how 'renewable resources' are defined or determined
15	2.4.2 Spatial Boundaries	*Whole page*	A regional, local, site study, and project area boundary are defined on this page. What is measured at each scale is unclear. Does resolution have an influence on '*significance*'?
30	Table 4-1: VECs Selected for the Aquatic Environment	*Variable Leaf Pondweed (Potamogeton gramineus)* *An indicator of habitat type/quality*	Why is this species selected over other primary production? How responsive to stress is it?
31	Table 4-1: VECs Selected for the Aquatic Environment	*Lake Whitefish(Coregonus clupeaformis) May be affected by changes in surface* ***water quality***	Yes, water quality would have an effect on Lake Whitefish, but what about other attributes, such as temperature, flow and water levels/quantity? Does this not have an influence on spawning habitat?
30-32	Table 4-1: VECs Selected for the Aquatic Environment	*Entire Table:* ***Measures- Change in habitat quality and quantity***	What will be 'measured' for each VEC is the, 'change in habitat quality and quantity'?
33	4.1.1 VEC	*Burrowing crayfish are important in assessing potential project effects on the habitat available in the Site Study Area as their territory is localized (i.e.,they can provide insight into local effects).*	Is rational for VEC selection data driven? Is there a preference for 'localized' VEC species over species that are migratory or are at the regional level? This is a question of scale.
34	4.1.2 Indicators	*In this assessment, habitat is divided into two broad categories, namely non-critical and critical. Changes to habitat conditions such as water quality, channel morphology, sedimentation, flow, refuge and availability of forage have the potential to affect the habitat suitability for VEC species.*	Two things: 1) There is no map or guideline of how critical and non-critical habitat is defined or which habitats are designated critical; 2) in the 'measures' section water quality is mentioned – but will these other conditions (*channel morphology, sedimentation, flow, refuge and availability of forage)* be assessed?
34	4.1.3 Measures	*Habitat quality is the suitability of the habitat to the requirements of each VEC. This can be measured as the availability of suitable spawning substrates, cover and food resources.*	How is *availability of suitable spawning substrates, cover and food resources* assessed?
35	5. Description of the	*For the purposes of this TSD, "existing conditions" are defined as those generally present at the site and may*	The study discusses regional, local, site study area, and project area at the beginning of the TSD. Based on this

	Existing Environment	*reflect effects of the Bruce A and B nuclear generating stations, activities at the WWMF*	statement which scale is being used for the assessment? It appears that only site study area or project area are under review in terms of existing environment.
35	5.1 Existing Environment	*The aquatic environment component of the EA **uses the Regional, Local and Site Study Areas and Project Area** (defined in Section 2.4.2) to characterize the existing conditions. The Project Area is the portion of the Bruce nuclear site that is being proposed as the location for the DGR Project. The Project Area specifically includes the WWMF because of its proximity to the DGR Project and shared drainage pathways.*	This somewhat contradicts what is being said above. What is the scale being used for the assessment?
35-36	5.1.1 Sources of Existing Data	*For the purposes of characterizing the aquatic environment, the following documents were included in the compilation and review of existing information:* *· Bruce A Refurbishment for Life Extension and Continued Operations Project Environmental Assessment [11];* *· Western Waste Management Facility Refurbishment Waste Storage Project Environmental Assessment and TSDs [12;13];* *· Bruce Nuclear Power Development Ecological Effects Review [14];* *· Bruce A Refurbishment for Life Extension and Continued Operations Project – Technical Support Document: Aquatic Environment [15];* *· Assessment of the Crayfish Species and Populations Offsite and at the Western Waste Management Facility [16]; and* *· Bruce Nuclear Power Development Bioinventory Study [17].*	All existing data sources used for this assessment are from past Environmental Assessments, specifically for Bruce Power. Why were no other studies used (e.g. MNR documents).
36	5.1.2 Field Studies	*On July 9, 2007 **samples** were taken from the South Railway Ditch, a man-made ditch, from the sections adjacent to the proposed DGR Project to the confluence with Stream C, as shown on Figure 5.1.2-1.*	What kind of samples, how were they sampled?
36	5.1.2 Field Studies	*Fish collection effort was concentrated in areas of **suitable habitat** for both juvenile and adult fish.*	How is suitable habitat defined?
36	5.1.2 Field Studies	*All captured fish were released after handling. The estimated length of the surveyed reach was 1,100 m with **5,560 seconds** of electro-fishing conducted.*	5,560 seconds is about an hour and a half. Displaying the information in seconds may be misleading, making the reader think that sampling effort is

			lengthy, when in fact it is not.
36	5.1.2 Field Studies	*This work consisted of a repeat visit to areas surveyed in 2006 to conduct a **visual survey** and confirm the continued presence of burrowing crayfish in this area based on visual observations of burrows (i.e., chimneys).*	Is this a presence/absence study? Or was abundance measured?
36	5.1.2 Field Studies	*Habitat parameters such as channel morphology, presence of groundwater indicators (seeps, watercress) and fish habitat conditions were recorded.*	How are these measured? I.e. what are the measures of habitat conditions?
39	5.3 Aquatic Habitat and Biota	*At the regional scale, the major watersheds are the Saugeen River watershed and the Sauble River watershed. These watersheds are naturally diverse, supporting a variety of both natural and anthropogenic (man-made) habitats, including wetlands, warm and coldwater streams, springs, ponds and inland lakes. All watercourses and waterbodies ultimately empty into Lake Huron.*	Saugeen River watershed and Sauble River watershed are mentioned here. This includes many cold and warm water streams, wetlands, ponds and inland lakes. Yet the only water bodies assessed in the EA are the South Railway Stream, Stream C, Baie du Dore, and MacPherson Bay. It is not presented to the reader why these other habitats are not included in the assessment of the existing environment. Listing these water bodies here may be misleading; making some readers think they are being considered when in the reality they are just being listed.
39	5.3 Aquatic Habitat and Biota	*The Local Study Area includes both the Stream C and **Underwood Creek** drainage areas.*	There is no mention of Underwood Creek in the remainder of the assessment.
39	5.3 Aquatic Habitat and Biota	*The **North Railway Ditch** is frequently dry within the Project Area and does not contain fish habitat.*	At which temporal scale is dryness measured? Is this true at all seasons? The North Railway Ditch is not mentioned as a habitat in the remainder of the assessment; this may not be appropriate depending on the answers to the above questions.
41	5.3.1 South Rail Ditch	*The dominant aquatic macrophyte in the South Railway Ditch is cattail (Typha spp.). In areas of the ditch that appeared to have been recently dredged, five other macrophyte species occur: muskgrass (Chara sp.), variable leaf pondweed, sago pondweed (Stuckenia pectinata), floating leaf pondweed (Potamogeton natans) and water plantain (Alisma plantago-aquatica). All the aquatic macrophyte species observed are common and widespread throughout southern Ontario.*	Why is variable leaf pondweed selected as a VEC over these species? Also, is this a presence/absence evaluation?
41	5.3.1 South	*Six fish species were identified in the*	Some of these species are not selected

	Rail Ditch	*South Railway Ditch during the 2007 field studies (see Appendix C), including brassy minnow (Hybognathus hankinsoni), brook stickleback (Culaea inconstans), central mudminnow (Umbra limi), creek chub, fathead minnow (Pimephales promelas), and redbelly dace. These fish represent a mix of species that are typical of warmwater creeks and wetland conditions, and are tolerant of a wide range of environmental conditions. These species are common and wide-spread throughout central and southern Ontario.*	as VEC's, what is the rational for that?
41	5.3.1 South Rail Ditch	*Observations of crayfish chimneys in the Project Area during 2006, 2007 and 2009 field investigations (Figure 5.3.1-1).*	Is this how crayfish are measured, by 'chimney's'? Later text states that chimneys were not being used and so there was no measurable effect. This presents a conflict – how is the existing state of this VEC actually being determined?
41	5.3.1 South Rail Ditch	*Crayfish chimneys were observed in all drainage ditches in the Project Area including the North and South Railway Ditches and the abandoned railway spur.*	North Railway Ditch is not included in the remainder of the assessment, but this segment states that it is in fact VEC habitat.
41	5.3.1 South Rail Ditch	*The two burrowing crayfish species (O. immunis and F. fodiens) are ranked S4 by the Natural Heritage Information Centre (NHIC), which is a section of the Ontario Ministry of Natural Resources (OMNR) [23]. A rank of S4 indicates that they are secure species in Ontario and the NHIC describes them as common species in Ontario. The World Wildlife Fund and the Canadian Nature Federation have offered the opinion that they feel F. fodiens is threatened in Ontario [24].*	Which agencies' assessment of species risk is used by the DGR?
42	Upstream of Abandoned Rail Bed	*The reach upstream of the abandoned rail bed (see Figure 5.1.2-1) consists of a shallow, braided channel through low-lying areas dominated by cedar and cattails. The main channel that enters the approximately 1.2 m wide culvert under the abandoned rail bed is shallow (11 to 20 cm deep) and averaged 2 m wetted width at the time of the survey (August 12, 2009). The channel has approximately 20% shading by herbaceous wetland vegetation in this reach.* *Substrates are a mix of cobble, gravel, silt and sand. Watercress was observed in-*	Does not state whether fish are present. Other sections make it clear when it is not fish habitat. This rail bed is not referred to in the remainder of the assessment.

		stream at the culvert, which may indicate groundwater seeps.	
45	5.3.2.4 Fish Community	*A total of 14 different fish species were captured*	Are there any measures of abundance? This section is for Stream C.
45	5.3.3 Lake Huron and the Embayment	*Within Lake Huron, near the Bruce nuclear site, there are two main habitats: the nearshore and offshore. The nearshore habitat consists mainly of rocky areas that are exposed to the wind and wave action of the Lake Huron shoreline (e.g., MacPherson Bay, Figure D-1 in Appendix D) and sheltered bays such as Baie du Doré, which provide a more constant environment, protected from wave and current action. Offshore habitat consists of the deep, cool, open waters of Lake Huron.*	This text and the text that follows describe the MacPherson Bay as poor fish habitat. Is this really the case (as 14 species were recorded as being present), or are the authors of the TSD posing the Bay in this way as it will experience the greatest amount of adverse effects (later in the report we see that it is this Bay that experiences changes in water quality and water flow the most)
45	5.3.3 Lake Huron and the Embayment	*In the open waters of Lake Huron, the species encountered are those that are well adapted to the cold water and utilize open lake or deeper coastal habitats for the majority of their life cycles or the majority of the year. Species included in this category are round whitefish (Prosopium cylindraceum), lake whitefish, lake trout (Salvelinus namaycush) and deepwater sculpin (Myoxocephalus thompsoni). Most make use of the nearshore areas only during spawning and prefer offshore deeper waters, particularly during the warmer summer months. Studies focusing on lake whitefish and round whitefish spawning in the vicinity of the Bruce nuclear site indicated that larvae of both species are present in the spring, but in lower numbers than at reference sampling sites located north of the Bruce nuclear site, where extensive spawning shoals exist [26].*	Again this reads as rational for not assessing certain species (because they don't feed near shore... But lake trout often do).
45	5.3.3 Lake Huron and the Embayment	*The exposed nearshore environment of MacPherson Bay is continually being swept out by wave action allowing for large coarse substrates to persist and fine substrates to be transported out of the bay to open water. By comparison, Baie du Doré is a calmer environment with depositional areas in the inner portion where fine sediments (sand) accumulate. The deposition of fine sediments allows for an increase in productivity because of the establishment of primary producers*	Similar to above, this reads as rational for not assessing this habitat fully as it is not adequate habitat for VEC – but there isn't a lot of mention of sampling for this area. Also, course substrate areas are good for spawning Lake Whitefish - which would be this habitat.

		(e.g. aquatic macrophytes such as variable leaf pondweed) in Baie du Doré and a more stable/productive temperature regime for many species. It has been previously noted that Baie du Doré is the most important rearing and nursery area in the Local Study Area,	
45	5.3.3 Lake Huron and the Embayment	*Because MacPherson Bay is not sheltered from coastal effects, its function as fish habitat is restricted.*	A sheltered embayment is one characteristic that may be used to describe good fish habitat. However, is the TSD assuming that this isn't good fish habitat based on this characteristic, or are they testing this?
46	5.3.3 Lake Huron and the Embayment	*During the 2007 aquatic field program, 14 species of fish were caught in the shallow nearshore waters of MacPherson Bay, seven of which are generally regarded as nearshore species.*	This contradicts the above statement. Despite it being 'poor fish habitat' 14 species are present – the same number as the high quality habitat of Stream C. This number is not insignificant
48	Table 5.4-1	*Spawn at sites with cobble, boulder and gravel substrates at depths greater than 2 m, outside the shallow nearshore littoral zone*	This section describes what Lake Whitefish need to spawn, sounds very similar to the existing conditions of MacPherson Bay
51	6.1.1 Identification of Project-Environment Interactions	*The analyses are based on the experience of the technical specialists supported by information collected from field studies and information from earlier EAs carried out for projects at the Bruce nuclear site.*	Data is secondary to expert opinion in this EA
52	6.1.1 Identification of Project-Environment Interactions	*The abandonment and long-term performance phase is not considered in the assessment as no activities are expected to occur during this phase.*	What about potential groundwater leaching?
52	6.1.1 Identification of Project-Environment Interactions	*Similarly, Stream C, and its associated VECs (redbelly dace, creek chub, brook trout, spottail shiner and benthic invertebrates), is located at least 500 m from all disturbances associated with the works and activities of the DGR Project. Therefore, no potential direct interactions with the aquatic VECs in these habitats are possible and they are not considered further.*	Only South Rail Ditch is considered as a direct effect. 500m doesn't seem that far, seems like there is potential for direct interaction.
55	6.2.1.9 Waste Management	*Decommissioning waste management may include management of conventional and construction wastes, along with very small quantities of hazardous and radioactive wastes. This work and activity would not directly interact with the aquatic environment*	Seems uncertain that, 'a very small quantity of hazardous and radioactive wastes' would not have a direct impact on the habitat of VEC's. The possible outcomes of this should be explored further.

		VECs as it does not involve any direct alteration of aquatic habitat and its associated plant and fish species. Therefore, waste management is not considered further.	
64	7.2.2.1 Changes in vibration levels	*The predicted maximum ground vibration during shaft sinking is predicted to be **8.4 mm/s**...* As described in Section 7.2.2.1, aquatic VECs may be affected by blasting activities during construction. MacPherson Bay is located at least 1 km from the ventilation and main shafts (main areas of blasting). Therefore, even with a charge of 20 kg, the setback distance between the blasting and the aquatic habitat within MacPherson Bay is far enough to protect aquatic life. Therefore, no measurable change to the aquatic habitat and VEC species supported in MacPherson Bay (and Lake Huron) from blasting are predicted. Accordingly, no further consideration is warranted.	What is this founded on/how was this prediction made? Please provide the study (or studies) that examine the effect of blasting on aquatic biota in this area. SON is also concerned about the potential effects of blasting on fish that migrate seasonally past the site.
64	7.2.2.2 changes in surface water quality	*Surface runoff and underground sump water from the DGR Project will be directed to the stormwater management pond.*	This is the first mention of the pond, where is it? Is it an aquatic habitat? Does it pose any risks?
66	7.4.2.2 Changes in Surface Water Quality	*Changes in surface water quality are predicted in the Hydrology and Surface Water Quality TSD. The stormwater management system will discharge to Lake Huron, via an existing drainage ditch at Interconnecting Road.* **Stormwater pond discharge water will be sampled and compared against predetermined criteria (as described in the Hydrology and Surface Water Quality TSD).** *Provided that the criteria are met, no measurable changes to surface water quality are expected from the DGR Project in MacPherson Bay. Therefore, no changes to the aquatic VECs in MacPherson Bay are likely and no further consideration is warranted.*	When will the storm water pond be tested? What are the *expected* outcomes to this pond? More detail is required.
66	7.4.2.3 Changes in Water Quality	*Flow in the drainage ditch at Interconnecting Road (see Figure 5.1.2-1) is predicted to increase by **114%** during construction and 61% during operations. This increase in flow is not likely to be measurable at the discharge to MacPherson Bay. Because of the nature of the habitat within MacPherson Bay*	How is this not significant? What would be a significant change?

		(exposed to wind and wave action and therefore mixes readily with lake water) and its extent (approximately 40 ha), the increase in surface flows is not expected to result in a detectable alteration in the habitat.	
67	7.5.1 Direct changes	*Burrowing crayfish were not found to be using the chimneys in this area when burrowing crayfish* ***habitat use surveys were conducted*** *(Section 5.1.2), so the construction is not expected to result in crayfish mortality [16].*	Previous text states that the assessment the presence of burrowing crayfish is determined via the sighting of chimneys, and when chimneys were observed it was assumed that the crayfish were there. This statement contradicts this initial assessment of the existing environment and present state of VEC's.
67	7.5.1 Direct changes	*This loss represents a small portion of the benthic invertebrate habitat available within the Project Area.*	What is the numerical loss of habitat? Why is this loss deemed insignificant? What thresholds is significance based on?
74	8.2.2 In-design Mitgation	*The rail bed crossing will minimize effects on the South Railway Ditch through incorporation of appropriate design features (e.g., embedded culvert for fish passage), specific mitigation measures (e.g., management of surface water runoff) and best management practices (e.g. erosion and sediment control) both during and after construction.*	This is vague, more detail would be useful
75	8.2.4 Additional Mitigation Measures	*Isolate and dewater the section of the South Railway Ditch wherein the culvert will be placed. Prior to dewatering the work area, fish salvage and relocation will be conducted so as to avoid harming any fish during construction.*	What if the measures done to mitigate effects actually create potential adverse effects? For examples, what are the possible consequences of relocating fish? To both the fish and the environment?
76	8.5.2 In-design Mitgation	*Therefore, although the design of the project successfully avoids most of the identified crayfish habitat in the Project Area, including protection of the marsh in the northeast portion of the Project Area, some burrowing crayfish could be disturbed. Since the majority of the existing burrowing crayfish habitat will be unchanged by the DGR Project, affected individuals may relocate to more favourable conditions.*	Same as above but for crayfish.
77	8.6.2 Application of Traditional Knowledge in the Assessment	*In the Aquatic Environment TSD, Aboriginal traditional knowledge and traditional ecological knowledge has been built into the assessment, where available. Some of the VECs chosen (e.g., lake whitefish) are important to Aboriginal communities and were*	This TSD provides no examples of how Traditional Knowledge has been incorporated into the assessment.

		considered explicitly in the effects assessment. No other input from Aboriginal peoples was available relative to the aquatic environment at the time this report was prepared.	
91	Table 11.1-1	*Frequency- Low-Conditions or phenomenon causing the effect occur infrequently (ie several times per year)*	Yes, lower frequencies of stress should have less of an impact than continual stress. However, the time at which these events occur is imperative. If stress overlaps with life cycle events such as spawning these infrequent events can cause significant effects.
92	11.1 Assessment methods	*Then the social and/or ecological importance of the VEC being affected is considered to determine the overall significance of the effect.*	Should this not be considered when selecting VECs? This is part of the definition of what a VEC is. If there is ranking of the importance of VECs that is fine, but it hasn't been transparent and needs to be at the beginning and not decided now based on convenience.
92	11.1 Assessment methods	*The level of significance is assigned by using a decision tree model illustrated on Figure 11.1-1.*	There needs to be a lot more discussion on how criteria are ranked. There are VEC that are considered scored HIGH under certain criteria, but the criteria are too far down the decision tree to ever be considered. For example, if the VEC gets a low score for the first criteria 'Magnitude', than all other criteria is not considered (see table 11.2-1 for evidence of this)
99	13. Preliminary Follow Up program	*The guidelines stipulate that the need for, and the requirements of, any follow-up program for the DGR Project be identified. A follow-up program **may be required** to determine that the environmental and cumulative effects of the DGR Project are consistent with predictions reported in the EIS.*	Based on this statement it is unclear if monitoring *will* happen or *may* happen
100	Table 13.1-1	*This table describes the proposed monitoring process*	Nothing in this table describes how the existing environment (present day) in terms of VEC health, abundance, presence/absence will be compared to future VECs

SON and Tourism

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This report describes SON's tourist business in the Bruce Peninsula region to provide additional context for the stigma effects discussed in the primary submission, "Stigma and the Deep Geologic Repository: Consequences for the Saugeen Ojibway Nation".

The Status of the SON Cottage Leasing Industry

The following data apply to Bruce County as a whole, compiled by Statistic Canada. I assume for purposes of this initial assessment of the stigma effects of a DGR on the economy of the SON that there is no significant difference between the visitation patterns exhibited in the Bruce County data and the subset of it for the SON's enterprises.

Bruce County Tourism Statistics: Table 1 displays the following information about Bruce County tourism that comes from Statistics Canada (2010): in 2010, there were almost 1.5 million person visits[1] to Bruce County, about 93 percent from Ontario, another 1.3 percent from elsewhere in Canada. Foreign visitors accounted for 5.6 percent of all visitors, 4.7 percent coming from the United States and slightly less than one percent coming from overseas. All tourists spent a total of C$169 million in the county, C$41 million while on accommodations while on vacation in Bruce County. The average Canadian overnight tourist spent 2.8 days in Bruce County, and foreign overnight visitors spent 3.6 days (US) and 5.3 days (Overseas), which one would expect. **The farther a tourist has to go to visit a location, the longer that person would stay to make their trip worthwhile.** North American visitors were consistent in their choice of tourist activities. Based on dollars spent, whether the visitor was from Ontario, elsewhere in Canada or from the United States (41 percent), their agenda was similar. Outdoor sports and other activities were the most popular tourist choice (about 60 percent of Canadians and about 41 percent of US citizens), with park visits ranking second (about seven percent of Canadians and about 21 percent of US citizens) and historic site visits ranking third (about 11 percent of Canadians and about 32 percent of US citizens). Among overseas visitors, however, the first choice for their Bruce experience was visiting museums and galleries (53 percent). Second on the overseas tourist agenda was to visit local historic sites (56 percent); visiting National/Provincial parks ranked third (25 percent).

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1 Person-visits are defined as any individual who visits the park for purposes of heritage appreciation. Persons re-entering on the same day and persons staying overnight do not constitute new person visits. If a person leaves the park and returns on a subsequent day, this would constitute a new person-visit. (SOM Inc. 2008)

Table 1: Bruce County Tourism in 2010

Category	Total	Canada	Ontario	US	Overseas
Total Visits					
Total Unweighted	527	424	416	77	26
Total Household/Party Visits	971,992	930,681	918,368	33,836	7,476
Total Person Visits (Weighted)	1,485,240	1,401,451	1,383,189	69,715	14,075
Main Purpose of Trip (Person					
Pleasure	842,833	798,452	792,493	41,810	2,571
VFR	548,063	519,135	509,952	18,432	10,496
Business	29,055	23,983	20,864	4,422	649
Meetings	4,422	N/A	N/A	4,422	-
Conventions & Conferences	3,019	3,019	3,019	-	-
Other Business	21,613	20,963	17,845	-	649
Other Personal	65,290	59,881	59,881	5,050	359
Accommodation Type (Person					
Commercial cottage/cabins	57,925	47,860	47,860	5,413	4,652
Private cottages	346,083	330,182	321,231	15,901	-
Number of Nights					
Average nights of total visits	2.1	2.1	2.0	3.1	5.3
Average nights of overnight visits	2.9	2.8	2.8	3.6	5.3
Number of Nights by					
Nights in commercial	363,638	317,534	317,534	13,762	32,342
Nights in private cottages	1,026,422	963,260	912,905	63,162	-
Activities Participated (Person					
Museums/Art Galleries	76,256	56,863	53,737	11,874	7,519
Zoos/Aquariums/Botanical	13,776	8,034	6,925	997	4,744
National/Provincial Nature Parks	196,556	164,186	157,876	22,409	9,961
Historic Sites	125,120	102,420	102,420	14,892	7,808
Any Outdoor/Sports Activity	818,699	786,650	772,712	28,510	3,539
Total Visitor Spending	168,965,808	148,449,232	141,914,619	17,259,078	3,257,498
Accommodation Spending	41,017,296	35,731,316	34,161,009	4,426,786	859,194
Source: Statistics Canada microdata in the Travel Survey of Residents of Canada and the International Travel Survey.					

From these statistics, some important characteristics of Bruce County emerge. First of all, **the majority of visitors to the Bruce Peninsula are considered "eco-tourists"—the outdoor nature-related amenities in Bruce County are a significant tourist draw.** With its hiking, biking, and other physical outdoor activities, the Bruce Peninsula offers a recreational experience that is affordable, accessible, and well regarded. Physical outdoor recreation can be found almost anywhere and can be done relatively inexpensively. Hence, while over 25 percent of all overseas person visits were for outdoor activities, it ranked fifth out of the ten recreation categories listed in

their survey results. Among all visitors, boating ranked first among all outdoor subcategories (about 13 percent for Canadians, almost 12 percent for overseas visitors, and almost 12 percent for US citizens); and fishing ranked second (slightly more than six percent of Canadian visitors and 2.5 percent of US citizens), indicating the experience of Lake Huron's pristine waters was the primary reason many visitors considered Bruce County a highly valued attraction.

Eco-tourists, by definition, tend to be the least philosophically receptive to environmental degradation. While environmental degradation is a concern to all tourists, it is a fundamental aspect of the recreational experience of an eco-tourist. Contamination (or even the perception of contamination) of pristine landscapes and "one-fifth of the world's fresh water supply," as many public comments pointed out, would decrease the expected enjoyment of the Bruce Peninsula to such a point that even the idea of a visit would be heavily tainted by the dread and fear described by Weart and others. Consequently, any perceived or actual contamination from the proposed DGR would affect the commerce of Bruce County, and more importantly, it would have a disproportionately adverse impact on the tourist interests of the SON.

Bruce County (and even more so, the SON) would lose its eco-tourism commerce, as visitors choose other very similar ecological opportunities that do not have a nuclear waste presence.

Second, as indicated by Table 1, personal reasons account for the majority of the reasons why visitors came to Bruce County, regardless of point of origin. Among North Americans, roughly 60 percent of all visitor days were for pleasure (57 percent among Canadians, 60 percent among US citizens). Overseas visitors traveled 18 percent of the time to Bruce County for pleasure, with their primary purpose--about 75 percent of all overseas person days—to visit friends or relatives (VFR). If the national trend for overseas visitors to Canada holds for the Bruce County (see Table 2), then of the overseas visitors, 22.6 percent came from the United Kingdom and 14 percent came from France. Business trips accounted for slightly less than two percent of all person days, with US and overseas visitors accounting for two to four times the percentage of Canadian responders.

Table 2: 2010 Overnight Trips to Canada from Top 10 Other Countries

Country of origin[1]	Trips ('000s)	Nights ('000s)	Spending in Canada (C$ million)
United States	11,749	47,247	6,254
United Kingdom	661	8,909	811
France	408	6,657	527
Germany	316	5,515	476
Japan	215	3,046	330
Australia	202	3,024	353
China	193	5,401	315
South Korea	157	4,232	257
India	150	3,250	145
Mexico	116	2,584	157

1. May include more than one country.

Source: Statistics Canada, Tourism and the Centre for Education Statistics, accessed at http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/arts38a-eng.htm, 15 February 2013.

Tourists made 404,008 person visits using private and commercial cottages for shelter. Bruce County visitors spent roughly a quarter of all expenditures, about C$ 41 million, on accommodations—slightly more than C$ 100/person visit. Ontario residents accounted for over 83 percent of that total. US citizens spent C$ 4.4 million on accommodations and overseas visitors spent slightly less than C$ 1 million. All of the commercial cottage rentals in 2010 that were done by Canadians were done by residents of Ontario, at less than C$ 100/person visit. US citizens paid the most for accommodations, at over C$ 202/person visit. About one-sixth (12.9 percent) of all Bruce County accommodations income came from non-Canadians, who accounted for about 26,000 person nights of shelter. Overseas visitors stayed in about 18 percent of the cottages rented to non-Canadians, but none stayed in a private cottage. Over sixty percent of the cottage rentals to non-Canadians were to US citizens for privately owned cottages.

Tourism Statistics for the Saugeen Ojibway Nation: The Saugeen Ojibway Nation is comprised of two independent bands: The Chippewas of Saugeen First Nation, and the Chippewas of Nawash Unceded First Nation.[2] On the western side of Bruce Peninsula, the Saugeen Reserve has 279 full time resident homes and an additional 1,240 seasonal cottage homes, half of which are along the shore of Lake Huron, the remainder within a two- to five-minute walk of the beach (Roote 2013).

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2 For clarity, this paper will refer to the governmental entity of the Chippewa of Saugeen First Nation as "SFN" and that of the Chippewa of Nawash Unceded First Nation as "Nawash." The reserve of the SFN will be referred to as "Saugeen" and Nawash reserve as "the Cape." When discussing the unified entity of the SFN and the Nawash, this report will use the term SON.

The typical Saugeen lease rate is between $750 and $1,200 per week, with an average of about $1,000 per week, depending on amenities. All but a few of the houses and cottages on the Reserve are owned by members of the Band, and the SFN owns the rest.

Almost all of the homes and cottages have electric heat and all have private wells and septic systems. From personal observation while visiting the Saugeen Reserve it appears that most homes are built on slab—a solid poured concrete floor—and have no basements or crawl spaces. Lot sizes vary, but in general, the typical home or cottage lot is about a third of an acre or smaller. Most of the homes and cottages are more than twenty years old, but some of the older structures have been torn down and replaced by larger and more modern homes. Building sizes vary from perhaps 80 square meters (these would be the oldest of the houses) to over 140 square meters for the homes currently under construction. Most of the houses do not have garages, but the pad size on some of the new construction sites is large enough that garages may be soon be a standard feature. The quality of the homes and cottages, maintenance and upkeep, curb appeal and landscaping on the Reserve are on par with that found in Saugeen Shores or other communities along the lakeshore.

Table 3: Origin of Visitors at Cape Croker Indian Park in the Summer of 2012

VISITOR ORIGIN	BOOKINGS	Percent
MAY		
All Visitors	121	
Ontario	115	95.0%
United States	2	1.7%
Europe	1	0.8%
JUNE		
All Visitors	377	
Ontario	336	89.1%
Other Canada	2	0.5%
United States	1	0.3%
Europe	1	0.3%
JULY		
All Visitors	673	
Ontario	590	87.7%
Other Canada	5	0.7%
United States	10	1.5%
Europe	11	1.6%
AUGUST		
All Visitors	855	
Ontario	764	89.4%
Other Canada	6	0.7%
United States	6	0.7%
Europe	10	1.2%
SEPTEMBER		
All Visitors	301	
Ontario	285	94.7%
Other Canada	1	0.3%
United States	1	0.3%
Europe	5	1.7%
OCTOBER		
All Visitors	91	
Ontario	85	93.4%
United States	3	3.3%

Establishing a value for the inventory of Reserve homes and cottages must be done by comparing Saugeen properties with those with similar amenities in other local communities. From a review of current Sauble Beach listings, houses range between $150,000 and $750,000 in value, with the average home valued around $250,000 (Point2homes.com, 2013). This would indicate the SFN have a total inventory value of about $380 million. From this base, the SFN collects a service fee of about $1 million, and a "rent" of about $6.4 million from Band member owners, for a total SFN cottage income of about $7.4 million, about 30 percent of the total SFN annual budget (Roote 2013). Cottage owners receive about $33 million annually in income from leasing their property to visitors.

Neyaashiinigming (Cape Croker), is the traditional territory of the Chippewas of Nawash Unceded First Nation. Cape Croker is encompassed within the Niagara Escarpment, a highly valued geological formation, and is surrounded on north, east, and south by Georgian Bay. The Cape is a widely recognized place of extraordinary beauty and cultural significance, and a focal point for the area's eco-tourism (Chegahno 2013).

While the Neyaashiinigming is more isolated than the lands of the Saugeen, the cottage leasing industry at the Cape is still an important part of the Reserve's economy. A visit to Cape Croker revealed the Cape's cottages are similar in style, age, maintenance and upkeep, and visual appeal to those found at the

Table 4: Most Bookings by Origin at Cape Croker Indian Park in the Summer of 2012

VISITOR ORIGIN	Bookings
MAY	
GTA	12
Hamilton	8
Guelph	7
Waterloo	6
JUNE	
GTA	31
Kitchener	19
Wiarton	15
Brampton	13
JULY	
GTA	59
Owen Sound	37
Mississauga	24
Waterloo	21
AUGUST	
GTA	84
Kitchener	41
London	27
Wiarton	27
SEPTEMBER	
GTA	27
Owen Sound	27
Kitchener	17
Cambridge	10
OCTOBER	
GTA	9
Hamilton	7
Guelph	6
Kitchener	4

Saugeen Reserve. The only difference between the Saugeen cottage industry and that of the Cape is in quantity and the proximity of amenities. Primarily along Little North Bay the Nawash have about 60 privately owned cottages.[3] The cottages lease for between $700 and $1,000 per week—slightly less than those of the Saugeen because of the greater isolation of the Cape. The average lease rate is about $900 per week. In addition to the cottage leasing industry at the Cape, the Nawash operate Cape Croker Indian Park, a popular camping spot for eco-tourists visiting the area.

Nine out of ten tourists visiting the Bruce Peninsula come from Ontario. About 80 percent of the park's visitors come from over 160km away; about 75 percent are repeat visitors (Chegahno 2013). More visitors from outside Ontario go to Cape Croker Indian Park in the middle of the summer than in the earlier or later months of the season, but at no time do the number of visitors from outside Ontario total more than about one eighth (12.5 percent) of the total visitor pool. Table 3 displays the bookings for the 2012 season of Cape Croker Indian Park.

Similar to the Statistics Canada data, the visitors to Cape Croker Indian Park participate in the same activities as those exhibited in the Ontario statistics: hiking, boating, swimming, and biking are the visitor's primary activities (Chegahno 2013). The Greater Toronto Area (GTA—about 225km away by road),[4] consistently had the most visitors to Cape Croker Indian Park in 2012, ranking or tied for first all six months the park was open. Kitchener (180km) was one of the top four origins five times, and Cambridge (190km) also ranked in the top four.[5] Table 4 lists the most common points of origin to the Cape Croker Indian Park in 2012.

Given the frequency of visits from the eastern cities in Ontario, it is reasonable to assume these most important cities would play a larger role in the effects of negative imagery and stigma on the Bruce Peninsula than other cities. Unlike visitors from other provinces and other countries, news about Bruce County is, to some extent *local* news, and would receive a greater percent of any media coverage. Therefore, an incident, no matter how minor, if it were to receive media attention, it would be heard in the GTA.

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3 Chippewas of Nawash Unceded First Nation is currently in litigation over lands in Hope Bay, where an additional 26 lots have been developed. However, until the litigation has been resolved, they are not considered a part of this analysis.

4 The Greater Toronto Area is a metropolitan area of Canada, defined as the City of Toronto and the four regional municipalities of Durham, Halton, Peel, and York. It had a 2011 total population of over 5.6 million people.

5 All distances are from mapquest.com, from Wiarton (about halfway between the territories of the Nawash and the Saugeen), to "name of town" Ontario, for example to: "Toronto Ontario" without a specific destination requested.

While boating was one of the primary draws for tourists to Cape Croker, it could not have been the boating experience by itself that was the draw for these three cities. Toronto rests on the shores of Lake Ontario, Cambridge and Kitchener are only 65km away from Lake Ontario. If a boating experience were the only amenity involved in the visitor's choice, then traveling to Lake Ontario instead of Lake Huron would have made more economic sense. Yet even for tourists less than an hour from Lake Ontario, boating and water activities on Lake Huron were among visitors' most important activities. The difference between a Lake Ontario boating experience and that on Georgian Bay or Lake Huron appears to be the other eco-tourist amenities of the area—uncrowded beaches and waters, pristine landscapes, and a broad scope of other outdoor activities. Because of the density of population near Toronto, such amenities may not be as readily available.

The Effects of a DGR Stigma on SON Cottage Leasing

The SFN have a profitable private cottage leasing industry, with over 1,200 cottages available either on the shore or within less than a five minute walk from the shore along Lake Huron. Rental rates range between C$ 750 per week and C$ 1,250 per week, depending on amenities. The industry generates C$ 33 million in private incomes each year and an additional C$ 7.4 million in revenues to the SFN. Band members have limited alternative sources of income available on the Reserve: there are approximately 25 small businesses (primarily smoke shops and fast food outlets) and the local commercial fishing industry employs between 20 and 40 people. The Chippewas of Nawash Unceded First Nation has about 500 cottages for lease on the opposite side of the Bruce Peninsula, along the shores of the Georgian Bay, as well as the Cape Croker Indian Park camping grounds on their land, which attracts between 3,000 to 4,000 visitors each year. The Nawash cottages rent for between $650 and $1,000 per week, depending on amenities. Park rates range from C$ 30 to C$ 40 per night for campsites, depending on amenities (electrical hook-ups, water), and cabins rent for C$ 65 per night. In 2012, the Park accommodated about 125 seasonal campers, 5-10 thousand overnight campers and between 1-2 thousand weekly visitors (Chegahno 2013), for an estimated C$ 1 million. The average occupancy rate for Saugeen and Nawash cottages is about 75 percent, centered on the mid-summer season.

Also important is that the SON's cottage leasing business is located within the Bruce Peninsula, itself a part of the Man and Biosphere Program of the United Nations Educational, Scientific and Cultural Organization (UNESCO), and was designated in 1990 as one of the UN's World Biosphere Reserves—an important international designation that establishes the Niagara

Escarpment as an important collaborating entity in a global effort to achieve balance between mankind and the environment.[6] The Biosphere Reserve encompasses 190,270 hectares—the entire Canadian portion of the Niagara Escarpment. The Biosphere Reserve *in its entirety* is administered by a separate body (Niagara Escarpment Commission), and the designation "…recognizes the Niagara Escarpment as an internationally significant ecosystem for its special environment and unique environmental plan. The designation puts Ontario's Niagara Escarpment in the company of other well-known biosphere reserves such as the Galapagos Islands, Africa's Serengeti and the Florida Everglades."[7] Being part of the biosphere (a) enhances the tourist appeal for the entire region (indeed, SON's cottages become a base for exploring the biosphere), and (b) further enhances the long-term growth prospects for regional tourism. The biosphere's UNESCO status ensures international recognition through an exclusive, well-established tourist brand.

The Future of the Cottage Industry in the Saugeen and Cape

There are many reasons to expect that the future of the cottage industry should be characterized by growth and prosperity. Lands at the Cape have not been so fully exploited, and, if litigation proves favorable at Hope Bay, 26 developed sites would become available for additional cottages. While the SFN cottages occupy almost all of the available land, there are strategies available that could make the utilization of the current land more efficient. For instance, SFN could allow leases for a longer period. With the new ski lodge in Blue Mountain, attracting winter tourists who want a skiing experience but do not want to be a part of the structured life of a formal resort could find cottages an attractive alternative. Inverhuron and MacGregor Point Provincial Parks also have aggressive winter activities scheduled, as do a number of townships in Bruce and Grey Counties (Rouse, 2012). Second, owners could replace older homes with newer ones where leases for larger rates can be justified by the amenities of a newer, larger, more modern dwelling. And finally, Band members could replace single-family structures with multi-family structures so that more than one lease can be executed on the same lot at the same time.

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6 http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/world-network-wnbr/

7 http://www.escarpment.org/biosphere/designation/index.php

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Bio

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