

Disposition Report
Draft Regulatory Guide G-320, Assessing the Long Term Safety of Radioactive Waste Management
Responses to comments received during public consultation: June 2005

	Reviewer Organization	Section or Para. #	Type of comment ¹	Reviewer's Comment (justification for change)	Reviewer's Proposed Change	CNSC Observations
1	K.Klassen, CNSC	3.0, para.3	E	'..., which may require that an environmental assessment <u>to</u> be performed to assess the potential..' is not grammatically correct. The 'to' should come out.	'..., which may require that an environmental assessment be performed to assess the potential..'	Text will be revised
2	K.Klassen, CNSC	3.1, para.3, p. 2	E	Class 1 <u>n</u> uclear facilities and <u>M</u> ines and <u>M</u> ill facilities requires ...'. There seems to be an inconsistency, due to the capitals used for mines and mill facilities, but not for nuclear facilities.	I suggest no capitals as follows 'Class 1 nuclear facilities and mine and mill facilities require ...'	Text removed.
3	K.Klassen, CNSC	3.1, para.4, p. 3	E	The sentence 'Future financial burden could arise from the need for institutional controls and the long term care and maintenance of the wastes that have arisen from the licensed activities' seems to have a problem with tense.	I suggest the following 'Future financial burden could arise should there be the need for institutional controls and the long term care and maintenance of the wastes that have arisen from the licensed activities'.	Text removed.
4	K.Klassen, CNSC	6.2, para.1, p. 6	E	Is it up to the applicant to determine an 'appropriate' approach, or an 'acceptable' approach?		No Change
5	K.Klassen, CNSC	6.2, para. 3, p. 6	E	The second sentence is a bit difficult cause of the use of the word 'demonstrate' for a second time (it was used in the first sentence), too many safety assessment/cases, and the use of the word 'can'.	'When absolute confidence in such a safety assessment cannot be shown, complementary assessments and reasoned arguments to support the safety case may provide additional assurance.'	Text removed
6	K.Klassen, CNSC	6.2, para.4, p. 6	E	The use of the word 'any' in point 4 is not necessary as the list of factors is permissive any way (may include).	'4. third-party peer reviews of the submission; and'	No Change
7	K.Klassen, CNSC	6.3.3, point 8, p. 9	T	The word 'contaminant' is used when you are actually referring to 'containment'.	'8. any number of other calculated parameters that can be shown to indicate the performance of the waste containment and isolation systems.'	Text will be revised
8	K.Klassen, CNSC	7.5.1, para. 2, p. 18	E	The second sentence in the second paragraph is awkward and not very clear.	Some FEPs or scenarios may be excluded from the assessment because they have an extremely low probability of occurrence, or they would result in a trivial consequence.	Text will be revised
9	K.Klassen, CNSC	7.6, para. 5, p. 20	E	'may seldom' is not a usual phrase and may be better expressed as 'is seldom' or 'not often'	'The consequences of intrusion could be reduced by controlling the form of the waste and the waste acceptance criteria, but this is not often possible.'	Text will be revised
10	K.Klassen,	8.1,	E	The second sentence in the second paragraph is not	'The calculated values of the safety indicators	Text will be revised

¹General; Technical; Editorial

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	CNSC	para.2, p. 26		clear. As both 'value' and 'indicator' is plural, should not mean value be plural also? Further, 'mean value with some measure of uncertainty' is awkward.	are typically mean (expectation) values that have some measure of uncertainty ... '	
11	K.Klassen, CNSC	8.1, para. 4, p. 26	E	The end of the last sentence is a bit awkward and could have more clarity.	"For results that are less than the target value, taking the uncertainty and conservatism into account in the interpretation can add to the confidence that the target is unlikely to be exceeded in reality and therefore, there will be no impact.	Text will be revised
12	Bruce W. Goodwin GEACI	2.0	T	It might be useful to describe here the differences between a safety case and a safety assessment. Also the last two paragraphs could be reworked to give examples of assessments covered by this guide (and less emphasis on what is not covered).		No Change
13	Bruce W. Goodwin GEACI	5.2	T	More guidance should be provided on scenarios. For instance, what constitutes a sufficiently complete set of scenarios and what criteria are acceptable in selecting scenarios to be assessed? Two other issues are assigning scenario probabilities and combining scenarios results. These last two issues might be strongly influenced by regulatory criteria (previously covered in R-104).		No Change
14	Bruce W. Goodwin GEACI	6.3	E	Section 6.3 apparently summarizes Sections 6.3.1 to 6.3.3. This and other summary sections sometimes are more contentious than the detailed discussion. It might be better to move the summary to follow the detailed discussions.		Text will be revised
15	Bruce W. Goodwin GEACI	6.3	T	Note that the NEA (and possibly the ICRP) recommends that collective dose might play a role in comparisons of alternatives, but these comparisons are meant for a technical framework. Collective dose is not a suitable endpoint for uses related to obtaining 'public acceptance' and its role should be limited or eliminated.		Text removed
16	Bruce W. Goodwin GEACI	6.3	T	One 'margin of safety factor' should suffice, not multiple factors covering uncertainty etc. and those already in the limits and benchmarks. The profusion of reduction factors has no scientific support and can only obfuscate optimization and understanding.		Text will be revised

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17	Bruce W. Goodwin GEACI	6.3.1	T	The discussion of risk is incorrect. Note that radiological dose is simply a measurement of the energy absorbed per unit mass of tissue exposed to ionizing radiation (given in dimensions such as grays or sieverts per year). Dose is converted to a more conventional health endpoint through the use of a health effect (or 'risk') conversion factor, which is really a 'likelihood' parameter. However the result is NOT risk, but a (likelihood of a) health effect endpoint. Compare with the definitions of risk in R-104 and in CSA (1991; CSA-Q634-91), where risk is the product of scenario probability and consequence (or endpoint). Total risk is the sum over a set of scenarios of the product of the probability and consequence for each scenario. Thus total risk is not proportional to dose. Conditional risk is proportional to dose, but not total risk.		Text will be revised
18	Bruce W. Goodwin GEACI	6.3.1	T	The mathematical manipulations in this paragraph are unclear. Note that the ICRP refers to different health effects or risk endpoints for their health effect/risk conversion factors of 0.02 (ICRP 1977) and 0.073 (ICRP 1991). The dimensions of these two parameters are health effects (of different types) per sievert. In R-104, the risk limit (10^{-6} /a) and risk conversion factor (0.02) leads to an equivalent dose limit of 5×10^{-5} Sv/a. Note that this is actually a conditional dose limit and thus does not factor in scenario probability.		Text will be revised
19	Bruce W. Goodwin GEACI	6.3.1	T	This paragraph has several problems. The first sentence is not clear: is there some confusion with conditional risk? The second sentence is not in line with my understanding: probabilistic calculations of the type described by Atomic Energy of Canada (e.g. AECL-10717, 1994) account for parameter <u>uncertainties</u> . (The notion underlying "the consequence times the frequency of predicting that consequence..." has a restricted context.) The statements related to 'aggregated risk' are confusing, in part because an aggregate implies a summation		Text will be revised

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				and in part because the risk equations in R-104 and CSA (1991) are summed over scenarios.		
20	Bruce W. Goodwin GEACI	6.3.2	T	While it is helpful to identify acceptable benchmarks, this document should provide guidance on how to estimate radiological doses to nonhuman biota.		Text will be revised
21	Bruce W. Goodwin GEACI	6.3.2	T	As in the preceding comment, this document should provide guidance on how to estimate these non-radiological endpoints. Note also that the cited sources of benchmark values are incomplete. That is, objective environmental objectives and guidelines do not exist for many of the potential contaminants of concern (cf. Appendix C.6, AECL 10717, 1994). Thus the proponent must estimate endpoints and guidance would be helpful in this document.		Text will be revised
22	Bruce W. Goodwin GEACI	6.3.3	T	This discussion introduces some very interesting and potentially very helpful ideas. To encourage their use, consider including a brief note with each stating why they are considered to be valid (and valuable) indicators. Possibly organize them into categories so that other possibilities might be uncovered.		Text will be revised
23	Bruce W. Goodwin GEACI	7.0	T	Presumably the five key elements are used to organize the remainder of this section, but that structure is not clearly followed. Note that the related NEA documents have close ties to several actual safety assessment studies and may offer more pragmatic recommendations.		Text will be revised
24	Bruce W. Goodwin GEACI	7.0	T	Describe here the difference between scoping and bounding assessments. A safety assessment typically deals with all 'significant' scenarios (cf. R-104). Note that 'variations of the expected evolution scenario' are more properly described as sensitivity analyses. These analyses may include extreme conditions etc., but in general they cannot be expected to cover all possible events and processes. For instance, the expected evolution scenario could not readily deal with a volcanic event unless volcanism were part of the expected evolution.		Text will be revised
25	Bruce W. Goodwin	7.0	T	Explain the context of "weight of evidence".		Text will be revised

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	GEACI					
26	Bruce W. Goodwin GEACI	7.2.1	T	Clarify the lead sentence. Also define 'conservative' with care and give examples. For instance, it is frequently assumed that 'conservative' applied to a distribution coefficient (K_D) corresponds to using smaller values (which yield faster transport rates). However, this assumption is not necessarily correct and must be proven with reference back to a regulatory criterion.		Text will be revised
27	Bruce W. Goodwin GEACI	7.2.2, 1 st para	E	This sentence does not make sense.		Text will be revised
28	Bruce W. Goodwin GEACI	7.2.3	T	Natural analogues are indeed useful but not a panacea. Some perspective should be provided.		Text will be revised
29	Bruce W. Goodwin GEACI	7.2.3, last para	E	This paragraph seems to be unrelated to the preceding paragraph. Perhaps this section should be partitioned.		Text will be revised
30	Bruce W. Goodwin GEACI	7.2.4	T	There are several argumentative statements in this section. Why is it 'typical' to use a deterministic model with mean values? Why would you select 5 th and 95 th percentiles? How do you know what the mean and various percentile values are? The last sentence in the first paragraph needs clarification. Probabilistic models are very rare. Indeed none were used in AECL's assessments; instead AECL's analysis was probabilistic but made use of deterministic models whose parameters were described using probability density functions (PDFs). These PDFs could be used to extract mean values, 5 th percentiles and so forth. The second, fourth and last sentences of the second paragraph compound several wrongs (or at the least they are not clear). The third paragraph begs for an explanation. I cannot think of any justification for the comparisons, nor what information the comparison would yield. The last		Text will be revised

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				sentence in this paragraph is valid but should be expanded to give guidance!		
31	Bruce W. Goodwin GEACI	7.3	T	Restate the last sentence in the first paragraph.		Text will be revised
32	Bruce W. Goodwin GEACI	7.3.1	T	QA and QC protocols might not be sufficient to guarantee that the data is valid.		No Change
33	Bruce W. Goodwin GEACI	7.3.1, bullets	E	Note that some bullets have 'etc.' while others have none. One might imply that the latter lists are complete.		Text will be revised
34	Bruce W. Goodwin GEACI	7.4.1	T	What is a 'graduated approach'?		Text will be revised
35	Bruce W. Goodwin GEACI	7.4.2	T	Clarify the first sentence (notably the bracketed phrase starting "such as land use ..."). The third bullet seems to restate the lead in, but perhaps the key point relates to 'safety measure'? Clarify the sentence starting "Passive barriers to provide ..."		Text will be revised
36	Bruce W. Goodwin GEACI	7.5	T	The following comments for Section 7.5 pertain only to this 'summary' section and some are resolved by the detail provided in Sections 7.5.1 and 7.5.2. Consider moving these summary comments to the end of Section 7.5. Note that "current and future conditions' pertaining to receptor characteristics implies that the safety assessment is to take into consideration the evolution of humans. All other regulators (including AECB in R-104) have allowed that the characteristics of the receptor are static. Another common bullet would refer to external perturbations. Define 'stylized' and 'failure' scenarios (not an issue if the summary comments is moved to the end of Section 7.5).		Text will be revised

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				More guidance would be helpful. The third bullet on page 3 provides some examples of criteria that are acceptable in excluding scenarios. Can other examples be given? Other issues need guidance. For example (and as noted earlier), what constitutes a sufficiently complete set of scenarios and what is an acceptable method to determine scenario probabilities? It would also be instructive to discuss the underlying requirements for scenarios, to provide guidance for different types of long-term assessments.		
37	Bruce W. Goodwin GEACI	7.5.1	T	. What is an acceptable method to estimate a scenario probability and what value is associated with 'extremely low probability'? How small is a trivial consequence? Give guidance on how scenarios are selected.		Text will be revised
38	Bruce W. Goodwin GEACI	7.5.2, bullets	T	What constitutes a sufficiently complete set of scenarios? Can a top-down process be identified?		Text will be revised
39	Bruce W. Goodwin GEACI	7.5.2	T	Human intrusion should perhaps be excluded from failure scenarios as it forms a unique scenario on its own.		Text will be revised
40	Bruce W. Goodwin GEACI	7.6, fourth paragraph.	T	Is the referenced regulatory limit one that applies to current facilities? The bracketed phrase in this paragraph needs clarification. (Is 'aggregated' risk equivalent to 'conditional' risk?) Why should 'conservatism in the dose limit' be significant?		Text will be revised
41	Bruce W. Goodwin GEACI	7.7	T	Presumably the various receptors do not evolve in time, in contrast to the implication in Section 7.5.		Text will be revised
42	Bruce W. Goodwin GEACI	7.8.1, second paragraph.	T	The last sentence should be reworded. Any simplifications must be justified but the final product must still be a recognizable representation of the system.		Text will be revised
43	Bruce W. Goodwin GEACI	7.8.1, third paragraph.	T	In the first sentence, consider the following changes: "the required level of accuracy of the model and the required degree of		Text will be revised

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				conservatism..." Clarify the last sentence.		
44	Bruce W. Goodwin GEACI	7.8.1	T	Some comments on model validity would be appropriate. For instance, models with a theoretical basis are preferred over those that are empirical. The last paragraph on page 23 has some elements that pertain to models and software. Verification is primarily software QA process whereas validation is more directed at model development.		No Change
45	Bruce W. Goodwin GEACI	7.8.3	T	Well done.		Acknowledged
46	Bruce W. Goodwin GEACI	8.0, second paragraph.	T	What are these sources of uncertainty? In a probabilistic analysis, uncertainty in parameter values is reflected by uncertainty in estimated impacts, and those uncertainties can be interrogated. Uncertainty in conceptual models is possibly unknowable (any known uncertainties would have been taken into consideration). Uncertainty in scenario assumptions is unknown or not quantified unless the effects of removing and keeping the assumptions have been examined. Concerns regarding 'mathematics of the model' are not clear. The last two sentences of this paragraph are not clear.		Text will be revised
47	Bruce W. Goodwin GEACI	8.0, second bullet.	T	See previous comments regarding 'aggregated risk'. Note that results from probabilistic analyses offer far more information when more than just a single value is examined.		No Change
48	Bruce W. Goodwin GEACI	8.0, third bullet.	T	A deterministic result is a single result. It does not have a meaningful confidence interval.		Text will be revised
49	Bruce W. Goodwin GEACI	8.1, second paragraph.	T	It is indeed worthwhile to take into consideration uncertainty and confidence levels. I strongly disagree with the use of a 95 th percentile in place of the mean. The mean value is an unbiased estimator and corresponds to the statistical "expectation"		Text will be revised

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				<p>value. The main role for percentile bands within a comparison is to characterize confidence in a mean. There is no good justification for use of any percentile in place of the mean.</p> <p>Introduction of a 90, 95 or 99th percentile (or whatever) is equivalent to adding another 'margin of safety factor' except the actual magnitude of the factor is unknown until the results are available! What justification do you have for using any percentile instead of the mean?</p>		
50	Bruce W. Goodwin GEACI	8.1, third paragraph.	T	<p>Possibly the first sentence is making a one-to-one connection between 'deterministic result' and 'mean value'. If that is the case, note that a single deterministic simulation using mean values for all parameters will generally NOT yield the same 'mean' result as a probabilistic analysis which draws from the same parameter PDFs. There are several reasons for the difference, one being model non-linearity. The only case that I can think of where a set of mean input values would yield the mean result is when the model is strictly additive and all PDFs are symmetric about the mean.</p>		Text will be revised
51	Kishor Mehta	7.2.4.	T	<p>In paragraph 2, lines 4-5. It mentions that '... the aggregated risk ... not likely adequate ...'. This leaves an impression that for regulatory purposes some consideration would be given to the 'magnitude of a consequence'. The aggregate value tells the total picture, but by the fact that the magnitude is discussed (even along with frequency) gives undue importance to the magnitude. I agree that the disaggregated results should be presented, but I don't see any positive reason for 'discussing' them.</p>		No Change
52	Kishor Mehta	7.2.4.	T	<p>Paragraph 3. 1st sentence. It refers to comparing</p>		Text removed.

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				the mean values calculated by probabilistic model and deterministic model. I don't see the value in doing that since these are quite different quantities. In probabilistic model, I believe the mean risk is the aggregated risk value, and in arriving at that value all the subtle combinations of various variables have been considered. While the mean risk for the deterministic model is calculated by using mean values of all the input variables (as stated in paragraph 1). But this set of values cannot reflect all the various combinations.		
53	Michel Duguay U of Laval	A. 6.2	T	The fourth paragraph reads: "Consideration of long term safety assessments submitted to support licence applications may include the following factors: ".....4. Any third-party peer reviews of the submission."	I would suggest that "may include" be strengthened to "will include". In support of this suggestion I note that papers submitted for publication in scientific journals, and applications for research funding by federal and provincial granting agencies require peer review.	No Change
54	Michel Duguay U of Laval	A. General	T	As a general comment on the draft, it seems to me that this guide is vague on many important points. As an example the definition given in the glossary (p. 31) for the expression "long term" is this: "In radioactive waste disposal, a period of time that exceeds the time during which active institutional control can be expected to last." It seems to me that in addressing the public, as well as in carrying out a scientific analysis, the only notion that makes sense is a given number of years. I would think that the precisely known half-lives of the radioactive elements involved, and the required low degree of mobility of these elements in a radwaste disposal site, will determine the number of years of long term storage.		No Change

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				The vagueness of several parts of this guide runs the risk of attracting controversy regarding plans submitted in the future for the implementation of radwaste disposal.		
55	Anar Baweja Health Canada	S. General	E	It is an interesting document, attempting to provide guidance on the long term safety for the management of radioactive wastes by the licensees and other stakeholders who may have an interest in this area. As written, the document appears to be a review of international literature on the subject of managing radioactive wastes, and provides no specific guidance as will be required under the regulatory regime in Canada. Hence, in its present form this document will be of limited use to the Canadian licensees and other stakeholders.		Text will be revised
56	Anar Baweja Health Canada	S. General	T	The Canadian Nuclear Safety Commission regulates radioactive wastes under the authority of the <i>Nuclear Safety & Control Act</i> . Under this Act, several kinds of wastes are described, such as low level radioactive wastes, uranium mine tailings ensuing from the processing of uranium ore, and high level radioactive waste (nuclear spent fuel). However, this document does not describe the wastes to which this guidance would apply. It is well known, that the nature of the hazard will vary depending upon the kind of waste; hence, the radioactive wastes for which this document provides guidance should be described.		Text will be revised
57	Anar Baweja Health Canada	S. 2.0	T	It is stated that this guide does not address social acceptability or economic feasibility. Radiation exposure/dose is one of the criteria used to assess the safety of radioactive waste management. The ALARA principle states that the doses should be As Low As		No Change

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				Reasonably Achievable, social and economic factors taken into consideration. Hence, it would be desirable not to exclude the social and economic factors in this guidance.		
58	Anar Baweja Health Canada	S. 6.3.1	T	The concept of "constrained dose" is described for design optimization purposes. Firstly, this concept is not generally used under the Canadian regulatory regime, and secondly the doses may be quite variable depending upon the nature of wastes being managed. A target dose of no more than one-third of the regulatory limit may not always be achievable.		No Change
59	Anar Baweja Health Canada	S. 7.0	T	Performing Long Term Assessments describes the context and assessment methodologies, including site characterization. Most of examples cited relate to high level radioactive waste, and are generic in nature. The Canadian Environment Assessment Act describes in detail the methodologies that must be followed to assess the projects for safety in the long term. Hence, it would be desirable to follow this approach rather than a generic one.		No Change
60	Shawn Patrick Stensil Greenpeace	1.0	T	Under section 1.0 (Purpose) of the draft regulatory guide it states that the "purpose of this Regulator Guide is to assist licensees and applicants assess the long term safety of storage and disposal of radioactive wastes." Greenpeace Canada believes that the aforementioned statement should be amended to include "stakeholders" or "Canadians." The CNSC should be at the service of Canadians and not the nuclear industry. Regulatory guides should be developed and written in such a way to assist Canadians and non-industry stakeholders in evaluating whether the CNSC is fully carrying out its mandate to protect the environment and human	Changes to this effect should be made where appropriate throughout the document.	No Change

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				health.		
61	Shawn Patrick Stensil Greenpeace	2.0	T	<p>Under section 2.0 of the draft regulator guide it states that "...this guide does not address social acceptability or economic feasibility of long term management methods, or the assessment of facility operations."</p> <p>Greenpeace Canada does not believe that any assessment of the long term safety of radioactive waste can be made without ensuring the social acceptability of any chosen waste management strategy. The current guide is, therefore, unacceptable in absence of a legitimate and accountable methodology for assessing and the social acceptability of waste management strategies.</p> <p>It must be noted that in spite of the guide's declaration that it does not address social acceptability, numerous references are made to the necessity of social acceptability in assessing the safety of radioactive waste management options throughout the document. For instance, under section 6.1 (Long Term Safety Assessments in Design Optimization) it states that "The underlying notion of collective dose – the number of individuals that could be affected – may play a part in public acceptance of a facility, or in determining a publicly-acceptable factor of safety for the design optimization." Further, it states under section 7.1 (Assessment Context) that "[t]hese can be targets derived from applying a safety factor to regulatory limits and objectives, from socially-acceptable limits for identified contaminants of concern to ecosystem components, or from analysis of parameters that indicate a level of system performance that ensures safety." Under section 7.4.2 (Institutional Controls) it lists "...acquiring societal acceptance of the system..." as one of the goals in designing a radioactive waste management system.</p> <p>Other allusions to the need for social acceptability are</p>		No Change

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				made throughout the draft regulatory guide. Greenpeace Canada does not accept any radioactive waste management assessment process that does not assure the social acceptability of a chosen waste management strategy in a transparent and publicly accountable manner... Given that this guide fails to address this issue, Greenpeace Canada does not view the current guideline document as acceptable.		
62	Shawn Patrick Stensil Greenpeace	3.0 and 3.1	T	<p>Section's 3.0 and 3.1 discuss relevant regulatory requirements and legislation concerning nuclear waste. Section 7.1 (Assessment Context) also discusses relevant regulatory requirements.</p> <p>In section 7.1, for instance, it states that "[t]he assessment context should describe the regulatory framework under which the assessment is conducted. This description should demonstrate that the applicant understands the federal and provincial regulatory requirements and any international obligations that apply to the project. It could also include a cross-reference table or "road map" that identifies the part of the documentation that discusses how each regulatory requirement is being met."</p> <p>Nowhere in the current guidelines, however, is there an acknowledgement that there may be instances when there are no federal or provincial regulatory requirements, policies or guidelines for certain types of wastes (for instance, long-lived high level non-fuel wastes). This is naïve and a significant omission from the guide.</p> <p>The CNSC should acknowledge that there may be gaps and omissions in the current legislation, regulations and policies governing nuclear waste in Canada. It should be made explicit in the current regulatory guide that any assessment context must also acknowledge, describe and discuss the</p>		No Change

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				<p>implications of any gaps and or omissions in current legislation, regulations and policies governing nuclear waste management.</p> <p>In the same manner, there should be a discussion of the potential need for the CNSC to refer such gaps and omissions in existing legislation, regulations or policies back to the federal government for consideration and direction.</p>		
63	Shawn Patrick Stensil Greenpeace	7.3.1	T	<p>Section 7.3.1 discusses the requirements for site Characterization.</p> <p>It states that baseline environmental information should include climatic conditions and hydrology. Greenpeace Canada believes that such descriptions should not be static but include historical climate trends as well as the anticipated impacts of climate change on the site for the radiological life-time of the wastes to be managed at the site.</p> <p>Similarly, section 7.3.1 requires a discussion "existing land use". This should be expanded to include historical land use (and its potential environmental and social significance) as well as a discussion of aboriginal titles and claims to the region.</p>		No Change.
64	S.(Ziggy) Kleinau, Coordinator, CFRE	General	T	<p>At the outset we must insist that there should be separate Regulatory Guides assessing the Long Term Safety of Radioactive Management for Mine and Mill Facilities and for the Class I and II facilities because of the distinct difference in wastes created. There is a clear possibility of watering down the safety requirements of the nuclear facilities.</p>		No Change
65	S.(Ziggy) Kleinau, Coordinator, CFRE	2.0		<p>We do not concur with the scope of the document in providing numerous waivers for proponents and the assessor to downgrade needs for certain assessment components.</p>		No Change

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66	S.(Ziggy) Kleinau, Coordinator, CFRE	7.2.3		Several times reference is made to take natural analogues into account when assessing concepts for safe long-term management of radioactive wastes. It is a fallacy to compare any natural analogues with the long-term safe management/disposal of these man-made wastes. Realizing that the fission process creates dozens of anthropogenic components in nuclear reactor wastes there can be no comparison with how nature has preserved components over thousands of years!		Text will be revised
67	S.(Ziggy) Kleinau, Coordinator, CFRE	7.8		Under Assessment Models (7.8) we come across a description on how computer models are used to predict future conditions for comparison of safety targets. This was the main stumbling block which brought the Seaborn Panel to the conclusion that, while the technical aspect of AECL's Deep Disposal Concept might be feasible, the social aspect was not acceptable to the public. The slightest aberration in programming those computer models could throw the final results completely out of kilter. The same public reaction and rejection will meet with this Guide's regulations. We noticed the disclaimer that this guide does not address social acceptability or economic feasibility of long term management methods, but is the Regulator not bound to involve the public in its regulatory decisions? We herein touch only on the most important concerns regarding the Draft form of this Regulatory Guide. We see the need to stress in the strongest terms that the Precautionary Principle is applied to all the regulations in the final form of this Guide.		No Change
68	Steve Coupland Canadian Nuclear	General		The document does not use the "best-estimate" concept of estimating exposures as promoted and practiced in probabilistic safety analyses but instead promotes the concept of using stacked conservatisms		Text will be revised

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	Association			which will in our view overestimate exposures and result in a design target that is a small fraction of regulatory dose limits.		
69	Steve Coupland Canadian Nuclear Association	General		There needs to be clear guidance on the roles of the methodologies identified to develop a basis for the safety case to provide assurance that the regulatory requirements for long-term safety can be met.		Text will be revised
70	Joanne Young Toronto	3.0	G	In Section 3.0 "Relevant Legislation" you point out that "several requirements are imposed by the act and its regulations, including...2. persons and the environment must be protected from unreasonable risk arising from the production and use of nuclear energy..." I note that the terms "reasonable" and "unreasonable" are used frequently to describe precautions to be taken by licensees. From the early 1930's to the late 1970's, the management of Eldorado Mining and Refining Co. Ltd., a crown company in Port Hope, Ontario, followed this requirement carefully, even though not at that time subject to guidance from CNSC or its predecessor AECB. The difficulty was that, at a time when other jurisdictions observed a maximum annual exposure for a worker of 1 rem, the Canadian government considered a maximum annual exposure of 26 rem to be reasonable. Consequently many workers in that plant were ill; some died of cancer. Perhaps terms such as "reasonable" should be carefully defined and enforced by the legislation.		No Change
71	Joanne Young	2.0	G	While you do mention that Canada recognizes the regulatory radiological dose limit for public exposure of 1 mSv/a, and in 6.3.1. point out the radiological risk is 0.14 mSv/a, one wonders how these exposures are measured today. The dosimeters in use earlier have been shown to be so wildly inaccurate as to be useless, and "measured" only gamma, when alpha, which is extremely difficult to measure even today, was the more serious problem.		No Change
72	Joanne Young	2.0	G	You do mention in Section 2.0 "Scope" "This guide		No Change

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	Toronto			does not address social acceptability or economic feasibility of long term management methods or the assessment of facility operations." Surely these issues are important to the population. Are they addressed in some other document? Perhaps information on measurement and on the very arbitrary limits set would be helpful in G-320.		
73	Joanne Young Toronto	General	G	While extensive regulations are described in G-320 there appears to be no information about follow-up to ensure enforcement. An analogy could be drawn with Ontario's problems in supplying safe water: even when we know how to ensure a safe water supply, we sometimes fail to take the trouble to do it. They say familiarity breeds contempt, and we take our safety for granted. As you state in section 7.8.3 "The long term predictions made in assessment models cannot be confirmed." We don't quite know what we are doing. Small errors could be devastating to large sections of the population.		No Change
74	Joanne Young Toronto	5.2	G	In 5.2 "Long Term Management" you state: "Concepts for long term management are based on containment and isolation of the wastes..." But the 40,000 tonnes of high level nuclear waste already accumulated by Canadian nuclear reactors preclude safe removal and burial in the near future, even if a sufficiently "robust" disposal system were available. The necessary "long term management" involves containment and isolation for up to one million years! There is no way in which we can guarantee such disposal today, if only because of unforeseen changes in climate and population distribution, as well as earthquakes, volcanic eruptions, floods, etc. which are certain to expose future generations to radioactive and hazardous wastes. The evidence indicates that containment can be achieved only temporarily. The wastes can never be made completely safe from interaction with the environment.		No Change
75	Joanne Young Toronto	6.0	G	Section 6.0 "Aspects of Long Term Safety Assessments." Again, in section 6.1 "Long Term		No Change

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				<p>Safety Assessments in Design Optimization”, without defining “reasonable” you state that “The General Nuclear Safety and Control Regulations require a licensee to “take all reasonable precautions to protect the environment and the health and safety of persons.” .. and then we are introduced once more to that frightening ghost of the late 70’s and early 80’s, the ALARA principle, requiring a programme to keep radioactive exposures “as low as reasonably achievable, social and economic factors being taken into account.” ... and “The typical approach to optimization is to modify the facility design until the end points in the long term assessment achieve pre-determined design targets or optimum cost-benefit relationships.” Apparently then “economic factors” and “cost-benefit relationships” are to have major influence on the design of radioactive waste disposal facilities. This may lead to the use of dangerous decisions in planning these facilities.</p> <p>The ensuing verbiage points out the importance of performing the assessment of each option with “the same rigor and level of detail.” i.e. if you assessed the first option down in the bar or Saturday night, you must do so for all options!</p> <p>Again, “The underlying notion of collective dose may play a part in public acceptance of a facility” appears to be a warning to prospective to watch their public relations, if not their provisions for the health and safety of the population and welfare of the environment.</p> <p>One notes throughout the document that “measures will be taken to prevent or mitigate“certain effects. Who would bother to try to prevent these effects when it would be much easier to mitigate them?</p>		
76	Joanne Young Toronto	7.8	G	<p>In 7.8 “Assessment Models” you state “the site and waste management system conceptual models that have been developed should be simplified to correspond to the limitations of the mathematical equations and the capabilities of the computational tools.” and again in 7.8.1 “Mathematical</p>		Text will be revised

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				representation of the conceptual models usually requires additional simplifications to make the equations amenable to solution. ... The necessity of simplifying the processes and conditions included in an assessment model may impose some restrictions on what can and cannot be addressed by the model." Would not such simplifications and limitations in the model lead to neglect or misinterpretation of some aspects of the planning? Surely simplifications in models will affect the systems upon which we propose to rely for thousands of years!		
77	Joanne Young Toronto	General	G	Clearly there is an innate contradiction in the use of the term "long term safety" in association with the term "Radioactive Waste Management." The best of present day science has failed in the effort to find a safe method of disposal of radioactive wastes. It is most important that no more such waste be produced until a safe method of disposal is found.		No Change
78	David J. Crome Clarington	General	G	The draft Guide should provide a definition of 'long term' that more accurately reflects the guidance provided. As such, the definition should be expanded beyond the disposal of radioactive waste to also encompass long term storage. It is also not appropriate to associate the definition of 'long term' with the institutional control period since some storage facilities could require active institutional control for several hundred years until the waste is ultimately disposed of in a permanent facility. For example, the new Port Granby Waste Management Facility is a storage facility and the waste will need to be relocated after several hundred years when the new facility reaches the end of its active life.	the definition should be expanded beyond the disposal of radioactive waste to also encompass long term storage.	No Change
79	David J. Crome Clarington	General		The draft Guide does not provide specific guidance regarding the minimum facility life required before the Guide is triggered. It makes very little distinction between the assessment requirements for 'storage' and 'disposal' facilities, although the differences in time frames can be substantial as evidenced by the Port Granby Project (several hundred years) and the		No Change

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				<p>NWMO process (100,000 + years). This lack of distinction could be significant, since presumably the assessment for a disposal facility would require a greater degree of sophistication. As a result, a licensee may over-estimate the assessment requirements for a storage facility. Alternatively, the licensee may under-estimate the assessment needs for a storage facility in terms of active systems, operation and maintenance, and waste retrieval requirements.</p> <p>Similarly, the draft Guide does not specifically define how the differing hazard level between high level waste (used nuclear fuel rods) and low level waste would affect assessment requirements. For example, the document does not discuss heat removal and the thermo-mechanical effects on structures and geology which are significant assessment issues for high-level waste related to either storage or disposal.</p> <p>The benefit of requiring that ALARA assessments be carried out for the comparison of options is questionable. In most instances, ALARA optimization can only be done when the design has advanced to a detailed stage, as there may not be adequate information during the screening of options. This requirement would put excessive requirements onto the facility design at the concept selection stage with unnecessary implications on project costs with questionable added benefit.</p> <p>The discussion in the draft Guide on the decommissioning plan should recognize that the plan is based on current technology and not assumptions with regard to future technology. It should also recognize the inability to predict the future plan in precise terms particularly where the decommissioning could be several hundred years or more into the future. In such cases, decommissioning plans could be provided only at a conceptual level and consideration would be required regarding financial requirements and viability of financial guarantees over the long term.</p>		

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				The glossary provided at the back of the draft Guide should be expanded to include definitions for 'Class I facilities', 'Class II facilities', 'decommissioning', and 'environment'. These definitions are particularly important to the proper interpretation of the Guide.		
80	David J. Crome Clarington	7.3.1		The requirements for site characterization emphasize the physical environment, with no mention of the social or economic environment that may be affected. Since the assessment is intended to evaluate the response of the site to the disruption caused by the waste management facility, the socio-economic environment should be included in the description of the site. As well, given the time frames contemplated for long term facilities, 'current and foreseeable uses' should be described rather than 'existing land use'.		Text will be revised
81	David J. Crome Clarington	7.3.2		The draft Guide defines 'waste management system' as "a system for collecting, transporting, receiving, treating, processing, storing or disposing the wastes that are produced as a result of a licensed activity. " However, the guidance provided in the document largely focuses on the actual waste management facility. It should provide more guidance on the other activities involved in radioactive waste management, such as waste characterization, waste transportation, monitoring and surveillance, and waste retrieval. It is not clear how the updating and refinement of assessments over the project life cycle will be carried out in practice. If the assessments turn out to be inadequate as the project moves through the lifecycle, the implications could be enormous and unacceptable. To pre-empt this possibility, all issues must be resolved early before the construction licence is issued. Following construction, only follow-up monitoring would be of value to confirm the findings of the assessment and ensure safety. There may also be instances where assessments could be verified through a "demonstration" phase prior to full-scale construction of the facility.		No Change
82	David J.	7.6		The generic approach to the discussion on human		No Change

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	Crome Clarington			<p>intrusion in the draft Guide does not recognize that the nature of the intrusion and the extent of the exposure may be different for deliberate and inadvertent intrusions, and therefore should have different assessment requirements. The Guide should also recognize that deliberate intrusions may have either a criminal intent (e.g. terrorism) or a less malicious intent (e.g. vandalism).</p> <p>The Guide indicates that the risk to an intruder from exposure to the contamination should be ignored. This approach would not appear to be warranted, given that not all planned intrusions may have criminal intent.</p> <p>Facility safety in the post-intrusion phase should also be assessed, particularly if the intruder goes undetected. As well, lesser intrusions could also occur external to the facility, such as the digging of wells in the surrounding areas, which may have radiological and environmental impacts.</p>		
83	David J. Crome Clarington	Glossary		The definition of 'receptor' should be expanded to include "human beings and their socio-economic and cultural circumstances". The existing terms 'environmental entity' and 'population' could potentially limit the analysis of impacts on people who may be affected.	The definition of 'receptor' should be expanded to include "human beings and their socio-economic and cultural circumstances".	No Change
84	Catherine Beck Clarington Community Environmental Planner	General		We note that there is very little distinction made between storage and disposal with respect to assessment requirements. There are no exceptions stated (i.e., is there a minimum life of the facility for the ~ to trigger?). There is a significant potential for a licensee to "overestimate" assessment requirements for storage facilities that may not require the same degree of sophistication as for long-term disposal facilities. It is also plausible that the licensee may underestimate assessment needs in terms of storage-related items such as in the safety assessment of "active" systems, operation and maintenance, and waste retrieval requirements for storage facilities.		No Change
85	Catherine	General		In keeping with the definition of "waste management",		No Change

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	Beck Clarington Community Environmental Planner			we feel that the document should provide some guidance to various activities involved in radioactive waste management besides the facility development. Such activities include waste characterization, waste transportation, monitoring and surveillance, and waste retrieval. We found the document largely focuses on the facility per se.		
86	Catherine Beck Clarington Community Environmental Planner	General		The document does not discuss heat removal and thermo-mechanical effects on structures and geology, which are significant assessment issues for high-Level waste related to either storage or disposal.		No Change
87	Catherine Beck Clarington Community Environmental Planner	General		The document does not seem to explicitly discuss assessments needed with regard to acts of terrorism and potential breach of international safeguards		No Change
88	Catherine Beck Clarington Community Environmental Planner	3.1		The discussion on the decommissioning plan should recognize that the plan be based on current technology (and not assumptions with regard to future technologies). It should also recognize the inability to predict the future plan in precise terms particularly where the decommissioning could be several hundred years into the future. In such cases, decommissioning plans could be provided only at a conceptual level and consideration would be required as to the financial requirements and viability of financial guarantees over the long term.		No Change
89	Catherine Beck Clarington Community Environmental Planner	6.1		The expectation with respect to system optimisation is necessitated by the Radiation Protection Regulations as well (i.e., ALARA).		No Change
90	Catherine Beck Clarington	6.1		Please explain why collective dose is not a regulatory criterion.		No Change

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	Community Environmental Planner					
91	Catherine Beck Clarington Community Environmental Planner	6.1		It is questionable if the ALARA assessments should be carried out for the comparison of options as implied in the text. In most instances, ALARA optimisation can only be done when the design has advanced to a detailed stage, as there may not be adequate information during the screening of options. In requiring ALARA optimisation during the comparison of options, we feel that the ~ would be putting excessive requirements onto the facility design at the concept selection stage with unnecessary implications on project costs and questionable additional benefit.		No Change
92	Catherine Beck Clarington Community Environmental Planner	6.2		It is stated that reasoned arguments can include reliance on institutional controls to ensure safety if design features and passive safety features are not adequate. This statement is necessarily contingent on the length of the institutional control period that would be acceptable for the subject case (several hundred years?). Obviously perpetual institutional control would not be meaningful. Some clarification on the institutional control period would be useful.		No Change
93	Catherine Beck Clarington Community Environmental Planner	6.2		Independent analysis by the CNSC staff and expert judgement based on CNSC staff training and experience would not be available to the licensee until the licence application is made, unless the CNSC intends to pro-actively involve itself in the preparation the license application.		Text will be revised
94	Catherine Beck Clarington Community Environmental Planner	5.1		The term "post-decommissioning" is ambiguous ("restoration of the site" may be a better term).		Text removed
95	Catherine Beck Clarington	5.1		The assessment of waste management systems should include selecting a suitable site as one of the goals. Site selection, characterization and site-related		Text will be revised

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	Community Environmental Planner			safety assessments are significant activities for most long- term waste management systems.		
96	Catherine Beck Clarington Community Environmental Planner	Glossary		We suggest that the terminology be expanded to include definitions for Class I and Class II facilities, decommissioning and environment. These definitions are particularly important in properly interpreting the Guide.		No Change
97	Catherine Beck Clarington Community Environmental Planner	6.3.1		Nowhere in the report is it mentioned that the radiological public dose limit of 1 mSv/a is over and above the natural background.		Text will be revised
98	Catherine Beck Clarington Community Environmental Planner	6.3.1		In earlier regulatory guides on geological disposal, the CNSC appears to have used 10 ⁻⁶ as the radiological risk criterion. It may be useful to put the new risk criterion in proper context with respect to the earlier figure. Furthermore, why is the CNSC prescribing an acceptable target (0.14 mSv/a)? Should this not be left to the licensee to decide based on the specifics of the design?		No Change
99	Catherine Beck Clarington Community Environmental Planner	6.3.2		It is necessary to state that the assessment end points reflect the effects of the project on the environment rather than the net effect (i.e., There may be instances where non-radiological status of the environment exceeds assessment end points to start with).		No Change
100	Catherine Beck Clarington Community Environmental Planner	6.3.3		Are these really "alternative" indicators, or are these additional indicators? Some of these look like starting assumptions rather than indicators.		No Change
101	Catherine Beck Clarington Community	7.0		The assessment tools and techniques could include comparable licensed benchmarks and international benchmarking studies.		No Change

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	Environmental Planner					
10 2	Catherine Beck Clarington Community Environmental Planner	7.1		The limits for identified contaminants of concern are based on ' environmental legislations/ guidelines rather than on social acceptability.		Text will be revised
10 3	Catherine Beck Clarington Community Environmental Planner	7.2.1		The value of the computed result determines whether the model structure and input data are conservative." This seems like circular reasoning. How does one know "a priori" what the result should be. It seems to me that one should apply conservative models and inputs, and the computed result is then the result of upstream conservatism, not a determinant of whether the models and inputs were conservative.		Text will be revised
10 4	Catherine Beck Clarington Community Environmental Planner	7.3		It is not clear how the updating and refinement of assessments over the project lifecycle will be carried out in practice. If the assessments turn out to be inadequate as the project moves through the lifecycle, the implications could be enormous and unacceptable. To pre-empt this possibility, it is necessary that all issues be resolved early before the construction license. Following construction, only follow-up monitoring would be of value to confirm the findings of the assessment and ensure safety. Furthermore, there may be instances where assessments could be verified through a "demonstration" phase prior to full-scale construction of the facility.		No Change
10 5	Catherine Beck Clarington Community Environmental Planner	7.3.1		Item 6 on the list cites "existing land use". The Municipalities associated with the Port Hope Area Initiative have found the term ' , ..current and foreseeable uses. ..' to be much more effective in developing scenarios pertaining to site characterization. The concept of current and foreseeable land-use would also assist in providing a complete interpretation of assessment results, in Section 8.0. In our view, baseline environmental		Text will be revised.

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				information required for site characterization should also clearly include the "...socio-economic environment..." as a new Item 7.		
106	Catherine Beck Clarington Community Environmental Planner	7.4.1		The reasons for maximum impact to occur at an interim period of time could be mentioned (e.g., radioactive progeny build-up and decay, design life of engineered barriers, thermo-mechanical properties, etc.). There may be a need to assess potential for inadvertent criticality which may be an issue for high level waste.		No Change.
107	Catherine Beck Clarington Community Environmental Planner	7.4.2		The first two lines are contradicting each other. Furthermore, does the CNSC advise relying on institutional controls beyond a few hundred years for on-ground mine and mill tailings? The document should give more consistent advice irrespective of the facility under consideration.		Text will be revised.
108	Catherine Beck Clarington Community Environmental Planner	7.5.2		Microbiological effects and geochemical factors (such as colloidal transport) could also be relevant in the development of certain scenarios.		No Change.
109	Catherine Beck Clarington Community Environmental Planner	7.6		Why is the exposure to a direct intruder excluded (only inadvertent human intrusion is mentioned)? It may also be necessary to assess the facility safety in the post-intrusion phase (particularly if the intrusion goes undetected). Furthermore, lesser intrusions could also occur external to the facility , such as digging of wells in the surrounding areas, which may have radiological and environmental impacts.		Text will be revised.
110	Catherine Beck Clarington Community Environmental Planner	7.8.1		It is stated, "complex models should not be used if there is insufficient data to support them". We feel that that this is a restrictive statement. There may be instances where complex models are required to support assessments and data may have to be generated to develop the models.		No Change.
111	Catherine Beck Clarington	Glossary		The definition of the term "institutional controls" is stated as, "The control of residual risks at a site after it has been decommissioned". Decommissioning is a		No Change

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	Community Environmental Planner			term usually associated with a facility, not a site. Why is the definition of "long-term" limited to radioactive waste disposal? The definition should encompass long-term storage as well. Given that institutional control can be expected to be available for a few hundred years or even longer for tailings management (as stated in the document), associating the definition of long term to the institutional control period may be inappropriate. We would recommend the expansion of the definition of the term "receptor" to include "...human beings and their socio-economic and cultural circumstances...". The existing terms '...environmental entity ...and...a population...' have in the past functioned to limit the analysis of impacts on people who may be affected.		
11 2	Hydro Québec Robert Lemieux	General		Le guide G-320 n'encourage pas le processus de prise de décision basée sur la connaissance du risque. Cependant, le document P-299 " Principes fondamentaux de réglementation » est clairement orienté vers cette approche.		No Change.
11 3	Hydro Québec Robert Lemieux	2.0		Ce guide décrit les façons types d'évaluer les répercussions des méthodes d'entreposage et d'élimination des déchets radioactifs sur l'environnement et sur la santé et la sécurité des personnes selon la liste présentée. Cependant, les directives ne s'appliquent pas à chaque évaluation. Il n'y a pas de guide qui peut être utilisé pour savoir quelle partie peut être utilisée et dans quelle situation. Qui est la personne qui effectue l'évaluation ? Les demandeurs de permis ou la CCSN ?		No Change.
11 4	Hydro Québec Robert Lemieux	3.1		Le guide statue que toutes les installations doivent disposer d'un plan de déclassement. Il est nécessaire de clarifier davantage le cas des installations d'éliminations des déchets (glossaire "élimination" : Mise en place ou enfouissement de déchets sans intention de les récupérer).		No Change.
11 5	Hydro Québec Robert Lemieux	5.1		Il n'est pas clair quel est l'objectif de cette section. Cependant, la classification des déchets peut être utile si on établit les interrelations plus étendues entre		No Change.

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				le niveau de détails, la portée de l'évaluation et la catégorie.		
11 6	Hydro Québec Robert Lemieux	6.3.1		La terminologie utilisée n'est pas exacte et diffère des références reconnues : -" dose contrainte » (anglais « constrained dose » G-320) est normalement une « contrainte de dose » (anglais « dose constraint » (ICRP 81)); -« facteur de conversion du risque » (anglais « risk conversion factor » G-320) est défini comme « coefficient de probabilité nominal pour des effets stochastiques » (ICRP 60). L'interprétation des références utilisées est questionnable : ICRP 81 propose des limitations sous forme de contrainte de dose ou contrainte de risque, mais non pas un mélange des deux. Cette section introduit les notions du risque « global » et « conditionnel » qui mélange les deux (la version anglaise du document utilise « aggregated risk » et « conditional risk »). Ce concept crée une certaine confusion. Des références dans le domaine du risque, incluant la norme canadienne CAN/CSA-0850-97 (2002) définissent le terme « risque ».		Text will be revised.
11 7	Hydro Québec Robert Lemieux	7.2.1		La section est en partie en contradiction avec le document P-299. Le guide G-320 suggère les calculs conservateurs. Ceci pourrait mener à une surévaluation du risque et par conséquent exiger des mesures de sa réduction coûteuses non justifiables. En utilisant l'approche proposée dans P-299, les mesures de réglementation seraient établies en fonction du risque. Les exigences de cette section devraient être harmonisées avec celles de la section 7.2.4.		Text will be revised.
11 8	Hydro Québec Robert Lemieux	7.2.4		Section 7.2.4 suggère l'utilisation 95e et 5e percentiles. Cette approche est trop restrictive. L'intervalle de confiance dépend de plusieurs facteurs et il se détermine selon les règles de l'art habituelles dans les statistiques.		Text will be revised.
11	Hydro Québec	General		It should be clarified that the document does not		No Change.

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9	Robert Lemieux			apply to current interim storage. With respect to application to long-term storage: the 'Purpose' section of the document states that it addresses both storage and disposal. However, there are a number of areas where the guidance seems primarily focussed on disposal, and where additional guidance specific to long-term storage could be useful. It seems appropriate that long term storage should be assessed and licensed in the same way as interim storage is now, but with specific factors such as intention for retrieval, need for repackaging, design lifetime, ageing and institutional control addressed with reference to the longer timescales; requirements for this to be subject to guidance from CNSC.		
120	Hydro Québec Robert Lemieux	General		There should be a distinction between the Safety Case and the Safety Assessment. This would allow clearer discussion of the roles of the site descriptive model (geosynthesis) and of natural analogs, for example. Site characterisation activities will last many years, during which time the data will be collected and interpreted to create a conceptual descriptive site model. This conceptual model is a key element in justifying the safety assessment model approach, and not well described in the document. Requirements both for the site characterisation plan and for development of the conceptual model should be clarified. We understand that guidance on site characterisation is under preparation. If available in a separate document, this additional guidance should be referenced but not described in this document, rather than have an incomplete or inconsistent description here.		Text will be revised.
121	Hydro Québec Robert Lemieux	General		Expectations or recommendations for regulatory involvement during development and/or execution of the safety assessment plan would be useful.		Text will be revised.
122	Hydro Québec Robert Lemieux	6.3.1		There is a lack of coherence between the derivation of the radiation protection criterion and the methodologies for safety assessment described. The derivation of the criterion should take into account the		Text will be revised.

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				context of the overall Safety Case. The requirement that a reduction factor be applied to regulatory requirements (or ICRP dose constraint) is not useful and would underestimate the calculated safety margin, given that the models are expected to be developed to provide conservative estimates of impacts. It is preferred that the criterion be true endpoints and that uncertainties be addressed in the safety assessment calculations.		
12 3	Hydro Québec Robert Lemieux	6.3.1		The value of quantitative optimisation by comparison of design options, in the case of a facility where doses for the reference design are orders of magnitude below criteria, is questionable. A qualitative consideration of optimisation, as described by ICRP, should be allowed for.		No Change.
12 4	Hydro Québec Robert Lemieux	7.6		It is implied that all intrusion scenarios, not only inadvertent intrusion, should be analysed. This would differ from international recommendations and practice, which considers that it is not possible to protect future societies from the consequences of actions taken deliberately with knowledge of the nature of the material in a repository. Further guidance as to scenarios would be required.		Text will be revised.
12 5	Hydro Québec Robert Lemieux	General		The guidance in G-320 does not promote the "best-estimate" concept of estimating exposures to the public and the environment as is the approach promoted/practiced in probabilistic safety analyses (PSA), but instead the guidance promotes the concept of using multiple (stacked) conservatisms to overestimate exposures in order to provide additional/maximal protection of the public and the environment (e.g., Section 7.2.1). PSAs once used the conservative approach but evolved (matured) to the best- estimate approach because it is only through the best-estimate approach that the "margin" between estimated safety and the applicable safety criterion is clearly quantified (enabling informed optimization, etc). Related to this point, the guidance in G-320 also does not promote the concept of		Text will be revised.

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				carrying out sensitivity analyses to characterize the uncertainties in the best-estimate analyses. These broad methodological concepts should be promoted, or at least be presented as an alternative to the existing guidance concerning the use of conservative assumptions and parameters to compensate for uncertainties, etc.		
12 6	Hydro Québec Robert Lemieux	General		The scope of the document is specified as including radioactive waste storage and disposal facilities, but there is vague reference made in several locations in the report about the application of the methodology to residual contamination that will be left by the decommissioning activities. This application of the methodology is important in evaluating the safety case for the "in situ disposal" of surface and near-surface LLW burial facilities, as well as in evaluating the safety case for residual contamination in surface or subsurface soil/sediments.		Text will be revised.
12 7	Mark Wittrup Cameco	General		Our primary concern regards the guidance provided in G-320 for developing safety design targets. The suggested approach is meant to compensate for the uncertainties in the assessment model and future human action, resulting in a design target that is a small fraction of the regulatory dose limits. The proposed methodologies present an additional and unnecessary layer of conservatism over and above that which is more than adequately provided for in the assessment approach. Consequently, the design target may ultimately not be achievable and hence will require some form of qualitative rationalization in order for the determined end points to be accepted. Such an outcome would diminish the robustness of the assessment process.		No Change.
12 8	Mark Wittrup Cameco	6.2		The methodologies detailed in the references cited are intended to provide a reasonable level of assurance that the regulatory requirements for long term safety and protection can be met. We support the CNSC's decision to not adopt "those publications as its own criteria for its regulatory functions."		Text will be revised.

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				However, the factors which the CNSC may include when considering the robustness and rigor of the licence applicants safety assessment (Section 6.2), raises concerns about the level of discretion afforded CNSC staff and the degree of acceptance of an applicant's assessment. We recommend that there should be some mechanism for reviewing CNSC staff judgement calls.		
129	Mark Wittrup Cameco	6.3.1		<p>Section 6.3.1 appears to provide guidance to licence applicants for four distinct types of safety assessments. Clearer guidance would be helpful by differentiating these types according to the following categories:</p> <ol style="list-style-type: none"> 1. Normal releases 2. Radiological risk 3. Potential Exposures 4. Environmental Protection <p>Of more concern to Cameco however, is the way in which a factor of safety below the regulatory limits has been suggested to account for the uncertainty in making long-term predictions. While G-320 clearly endorses a process by which licence applicants propose and justify their application of the guidance provided by G-320, prescriptive safety target values for normal releases and potential exposures (i.e. 0.14 mSv/a) suggests the contrary.</p> <p>To address the possibility of exposure to multiple sources, the ICRP has provided clear guidance in this area in terms of the constraint of 0.3 mSv/a. Such a dose constraint: <i>"excludes from further consideration any protection options that would cause the dose to a member of the critical group to exceed the constraint"</i> (ICRP 77 paragraph 41).</p> <p>However, a reduction factor to account for the uncertainty in the assessment model is an unnecessary compounding of pessimisms. Conservative assumptions, regarding the representative individual of the critical group (discussed in Section 7.7) and the system description (Section 7.3), are conventionally built into the</p>		Text will be revised.

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				<p>assessment model in a stylized manner. Uncertainty in the predictions is further accounted for, as discussed in the following sections of G-320:</p> <ul style="list-style-type: none"> ➤ As is stated in Section 7.2.1, "conservative calculations intentionally over-estimate future consequences to provide an additional factor of safety". ➤ As noted in Section 7.3, as the assessment model is updated and refined as the facility moves through its lifecycle, conservatism will be reduced and realism increased, and hence become more reliable. ➤ In Section 7.8, it is acknowledged that, although the accuracy of predictions made in long-term assessments cannot be checked, rigorous testing and evaluation (according to benchmarks) of the assessment models is addressed in the development of assessment models, computing tools and confidence determinations. ➤ Section 8.0 recommends that a formal uncertainty analysis be performed to identify any discrepancies or unexpected assessment results. Such uncertainties, it is stated, "can be compensated by the conservatism inherent in the conceptual model, the assessment model and the input data and assumptions." ➤ Section 8.1: The calculated values of the safety indicators have an associated measure of the uncertainty built in via the: standard deviation, confidence interval, maximum or minimum bounding values, etc. As is suggested, for example, using the 95th percentile confidence level for the comparison, instead of the mean value, provides added assurance that the target will not likely be exceeded. ➤ Finally, G-320 goes on to state that 		

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				<p>"...Exceeding a target for a safety indicator or having a risk quotient greater than one does not necessarily mean that there will, in reality, be an effect."</p> <p>Therefore, it is our position that setting safety design targets below the design constraint recommended by the ICRP of 0.3 mSv/a is unnecessary given the compound layers of conservatism already built into the process. In fact, an argument could be made that when all of the conservatisms are considered, there is an unrealistic safety factor built into the process.</p>		
130	Mark Wittrup Cameco	6.3.2		It is recommended that the term risk quotient be changed to hazard quotient, as this process does not allow us to make determinations of risk. Risks need to provide a perspective on a more regional basis, and include considerations of likelihood, while also taking into consideration economic and societal values.		Text removed.
131	Mark Wittrup Cameco	6.3.3		<p>Given the detailed nature of the site specific characteristics suggested in this section, it is recommended to revise the first paragraph to read: "Site specific characteristics and any other parameters that provide an indication of safety <i>and/or performance</i> of the system can also be adopted as assessment end points. These characteristics <i>may</i> include:"</p> <p>It is further recommended to remove item 8, which then becomes redundant.</p>		Text will be revised.
132	G.H. Archinoff AECL	General		The guidance document presents useful information on the general methods of evaluating human and ecological risks, but for a number of reasons the guidance does not seem to align itself with a "risk-informed" management process, whereas the "risk-informed" approach is clearly promoted in the CNSC Policy P-299, Regulatory Fundamentals. For example, the guidance promotes the use of multiple conservatisms, which, in overestimating exposures and risks, makes risk-informed decisions more difficult to carry out than if risks estimated on a "best-estimate" basis. Also, the guidance attempts to		No Change.

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				converge two very different types of existing, well-established risk assessment methodologies (human and ecological) that have different assessment end-points (protection of human individuals versus protection of ecological populations), and that likely have different levels of conservatism (protection) inherent to the methodologies. Lastly, what appears to be missing in the document is any discussion as to how decision-makers will ultimately interpolate the two types of risks estimated in order to arrive at an overall decision regarding acceptability.		
13 3	G.H. Archinoff AECL	General		In general, this document provides very generic guidance based on Canadian and, in some areas, international practice or guidance. Except for guidance on dose limits for human exposure, the guide is at times ambiguous and ~ will likely be subject to much debate regarding its interpretation. Based on our experience with Regulatory Guide, G-219 for instance, it can be expected that any submission to the CNSC based on this guide will be the object of considerably subjective evaluation by the Regulator. With regard to human exposure to non-radioactive contaminants, there appears to be very little guidance that will allow evaluating risks on the same basis as that used for nuclear substances. As well, guidance for the evaluation of risks to non-human biota is overly simplified compared to existing methodologies -the guide should simply point at existing ecological risk assessment methodologies.		No Change.
13 4	G.H. Archinoff AECL	General		The frequent reference to "a level of effort appropriate to the purpose of the assessment" is of concern to AECL. This suggests that the assessment is considered to be a living assessment that will need to be revised/ updated at the various stages of the life of the facility. This certainly does not respect the spirit of the Canadian Environmental Assessment Act where the principle of one project assessment is entrenched. Also, it should be noted that previous assessments of disposal facilities (e.g., CNFWM		No Change.

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				concept, IRUS) included both the pre- and post-closure assessments as part of the safety case.		
13 5	G.H. Archinoff AECL	General		Overall, the guidance document would be of greater benefit if it were written as an outline of a safety assessment report giving the section titles and indicating what the recommended contents of those sections should be. This approach is taken in other safety assessment guidance documents (e.g., Health Canada's <i>Human Health Preliminary Quantitative Risk Assessment</i> (PQRA) methodology document).		No Change.
13 6	G.H. Archinoff AECL	General		The guidance in G-320 does not promote the "best-estimate" concept of estimating exposures to the public and the environment, as is the approach promoted/practiced in probabilistic safety analyses (PSAs), but instead the guidance promotes the concept of using multiple (stacked) conservatisms to overestimate exposures in order to provide additional/maximal protection of the public and the environment (e.g., Section 7.2.1). Probabilistic safety analyses once used the conservative approach but evolved (matured) to the best-estimate approach because it is only through the best-estimate approach that the "margin" between estimated safety and the applicable safety criterion is clearly quantified (enabling informed optimization, etc.). Related to this point, the guidance in G-320 also does not promote the concept of carrying out sensitivity analyses to characterize the uncertainties in the best-estimate analyses. These broad methodological concepts should be promoted, or at least be presented as an alternative to the existing guidance concerning the use of conservative assumptions and parameters to compensate for uncertainties, etc.		Text will be revised.
13 7	G.H. Archinoff AECL	General		Previous point aside, the guidance in G-320 for estimating and evaluating exposures to humans is generally reasonable (as this is a well-established/mature methodology), but the guidance for estimating and evaluating exposures to non-human biota (NHB) may not be appropriate in that the		Text will be revised.

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				attempt in G-320 to evaluate NHB impacts using the same general approach as for human impacts is not consistent with the current, established methodologies such as Environment Canada's ecological risk assessment (ERA) methodology. For example, the assessment end-points differ (individual human risk versus NHB population effects, ultimately), and the risk criteria likely differ (a unity hazard quotient for NHB is likely not equivalent to 7E-OS risk to humans). As well, the methodology for estimating and evaluating exposures to NHB is more of an emerging science than is the case with human exposures (e.g., ENEVs are still being developed for some parameters). Our preference would be to separate the risk assessment methodology for humans from NHB, and to simply refer to existing protocols for assessing ecological risks.		
138	G.H. Archinoff AECL	General		The scope of the document is specified as including radioactive waste storage and disposal facilities, but there is vague reference made in several locations in the report about the application of the methodology to residual contamination that will be left by the decommissioning activities. This application of the methodology is important in evaluating the safety case for the "in-situ disposal" of surface and near-surface low-level waste burial facilities, as well as in evaluating the safety case for residual contamination in surface or subsurface soil/sediments.		Text will be revised.
139	G.H. Archinoff AECL	3.1, 6.1 and possibly others		The document discusses "identifying and evaluating effects on the environment and the health and safety of persons". 3.1, 6.1 and In general, it is likely important to ensure the protection of both humans and the environment, but it is unclear why identifying and evaluating the effects on the environment is being listed before the health and safety of humans in the G-320 document. In general, if methodologies are being developed to protect both humans and the environment, it is not necessarily reasonable to weight protection of the environment more heavily		No Change.

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				than protection of humans (as might .be suggested by listing environmental protection first), nor would it even necessarily be reasonable to weight protection of humans and the environment the same. In managing and assessing risks to human and non-human receptors, current practice is that a greater degree of protection is applied to humans, as is evident by the difference in receptor groupings normally applied in risk assessments (i.e., protection of humans is at the individual level), whereas protection of non-human biota at the level of the population, in most cases.		
140	G.H. Archinoff AECL	General		What appears to be missing in the document is any discussion as to how, ultimately, decision makers will come to grips with the output from two well established processes for the very different assessment methodologies (i.e., human versus NHB ecological receptors), and somehow interpolate the two in order to arrive at an overall decision. The document should acknowledge the fact that such a process needs yet to be established, especially given the "times of potential geologic impacts" (10,000's of years).		No Change.
141	G.H. Archinoff AECL	Glossary		Define the terms "isolation" and "performance assessment".		No Change.
142	G.H. Archinoff AECL	1.0		While recognizing that this guideline is for assessing the long-term safety of storage and disposal of radioactive -wastes, the safety assessment should also cover (by default, and as indicated Section 3.1), all phases of such a facility. However, the guidance given appears to exclusively cover the assessment of the storage/disposal after closure (i.e., the post -operational/filling (post -closure) phase).		No Change.
143	G.H. Archinoff AECL	3.1		This section appears to suggest that the driver for assessing the long-term risks of a disposal facility is related to the decommissioning plan (see last paragraph). The bottom line is that a disposal facility will be a Class I facility and that regulatory approvals will be based on safety and environmental		Text will be revised.

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				assessments. Reference to Class II facilities is irrelevant.		
14 4	G.H. Archinoff AECL	3.1		To enhance the usefulness of this guidance, it is imperative that either the "Limits applicable" are listed explicitly or the relevant legislation and regulations are referenced explicitly.		Text will be revised.
14 5	G.H. Archinoff AECL	3.1		The document states "information should be provided to enable the Commission to determine whether adequate provision will be made to protect the environment". Will similar provisions also be made to ensure the protection of humans?		Text will be revised.
14 6	G.H. Archinoff AECL	5.0		At CRL, we have what is commonly referred to as "intermediate-level" waste. This waste classification represents waste that requires shielding for operational safety reasons, but that is non-heat generating. We also have wastes that are considered high level that are non-heat generating but also require shielding for operational safety reasons. These wastes are stored in tile-holes at CRL.		Text will be revised.
14 7	G.H. Archinoff AECL	5.0		Item 2- the tile holes at AECL-CRL are not used for low-level radioactive wastes, but are used for the storage of intermediate-Level and high-Level wastes.		Text will be revised.
14 8	G.H. Archinoff AECL	5.0		If the document intends that "the nuclear industry" includes organizations like AECL, the third bullet should mention that nuclear fuel waste is also stored in concrete canisters and modular above-ground vaults (i.e., MACSTOR), which are AECL technologies used at many sites. The need for a decommissioning plan for a disposal facility seems unreasonable. Any concerns about the post- closure phase will have been assessed in support to the proposal. Regarding Bullet 4: there is no reference to post- decommissioning in CEAA.		Text will be revised.
14 9	G.H. Archinoff AECL	5.2		The term "safety system" is not entirely appropriate in the context of assessing the safety performance of an engineered waste repository -should instead refer to "engineered barriers" (e.g., waste form, waste container, buffer material, containment structure, etc.).		Text removed.

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150	G.H. Archinoff AECL	6.1		In a number of sections, the draft G-320 document discusses the uncertainty related to future human activities and the possibility that the waste management system being assessed will not be the only source of contaminants to which the receptor is exposed in the future. In the case of nuclear facilities, it is expected that activities that would contribute radiological and non-radiological contaminants to the environment would undergo a rigorous Environmental Assessment (EA) under the Canadian Environmental Assessment Act, with evaluation of the potential cumulative effects of associated stressors. Such an EA would involve a critical review by Responsible Authorities, such that the resultant activities would need to comply with regulations under a licence. In addition, in cases where waste is being stored or disposed of over long time frames, it is likely that waste management facilities will be designed such that the waste is retrievable. Therefore, the relevance of applying additional conservatism related to changes in human activities is unclear.		No Change.
151	G.H. Archinoff AECL	6.1		The G-320 document states, "when comparing options, it is important that the assessment of each option is performed to the same rigor and level of detail". Should this statement be modified to say "the same rigor and level of detail should be applied at least initially in the process"? For example, should a multi-tiered approach, similar to the one that is typically applied in Ecological Risk Assessment (ERA) not be applied, whereby initial screening is conducted based on highly conservative assumptions, with more detailed work being done only in cases where there may be risk? If the amount of effort applied is not based on an evaluation of the relative risks or the chance that risk may occur, it is possible that key issues may not be addressed to the level of detail required due to resource constraints that would likely occur.		Text removed.
15	G.H. Archinoff	6.3		A reference to regulatory requirements for		Text will be revised.

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2	AECL			environmental concentrations of hazardous substances should be provided.		
15 3	G.H. Archinoff AECL	6.3		In Section 6.3 and in a number of other sections, the draft G-320 discusses the need to add additional reduction factors, safety factors, etc. to account for uncertainties in the assessment model; however, would this not depend upon the types and assumptions of the assessment models being applied? For example, in the case of models that are based on upper bound calculations, relatively high levels of conservatism are inherently applied to estimate "worst-case" scenarios. It is not clear that additional factors are needed for models that are already highly conservative, as opposed to realistic, in nature.		Text will be revised.
15 4	G.H. Archinoff AECL	6.3, 6.3.1		Section 6.3 introduces the concept of "reduction factor" to account for uncertainties and multiple sources. Section 6.3.1 adds the concept of "constrained dose". Arbitrary reductions in acceptance value are not warranted. , The estimated future radiological dose for the particular facility under study, including the associated uncertainty, should be compared to the target acceptance value based on supplementary individual radiation dose, and not to some arbitrary fraction of it.		Text will be revised.
15 5	G.H. Archinoff AECL	6.3.1		To be complete, the safety assessment should also include the assessment of doses and hazardous substance exposures to facility personnel, other on-site personnel, members of the public and environmental impacts from routine operations and potential accidents during the operational/filling phase of the facility.		No Change.
15 6	G.H. Archinoff AECL	6.3.1		This section, especially with respect to the use of the terms "risk" and "radiological risk", is very confusing. There is no technical reason for selecting one approach over the other. It is suggested that it be simplified by referring to one approach only. In either methodology, it is important to identify the risk from single events as well as the total risk (sum of all		Text will be revised.

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				single events) from all events. The phrase "disaggregated into conditional risk and associated probabilities for interpretation" is very unclear as to its meaning.		
157	G.H. Archinoff AECL	6.3.1		The document describes an "aggregated" approach that can be taken, whereby "high consequence scenarios with low probability can have the same aggregated risk as low consequence scenarios with high probability". It is unclear what is meant by "low" versus "high" consequences.		No Change.
158	G.H. Archinoff AECL	6.3.1		It is currently unclear how environmental protection should be dealt with, based on the information being provided in the draft G-320 document. It seems that it is being inserted into the scope, but the linkages between protection of humans versus the environment are unclear and the differences inherent to human versus environmental protection are also unclear.		Text will be revised.
159	G.H. Archinoff AECL	6.3.1		The text suggests an arbitrary reduction in assessment target of factor seven to account for uncertainties in assessment model predictions and for possible multiple sources. It is inappropriate for the guide to recommend a reduction factor as this should be based on uncertainties in the assessment models used (if applied at all). General comment -the use of a reduction factor to account for uncertainty in predictions and possible multiple sources is confusing and introduces redundancy into the assessment as uncertainty in assessment is addressed in both the "safety targets" and in comparison of the assessment predictions with the safety targets (Section 8.1). It would be more appropriate to address uncertainty in the final comparison of assessment predictions with targets.		Text will be revised.
160	G.H. Archinoff AECL	6.3.1		This paragraph introduces the idea of "likelihood" rather than consistently using the term "probability". "Likelihood" is a well-defined mathematical term and is different from "probability". The section also uses the frequency interpretation of probability, but this is a		Text will be revised.

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				debatable use of the frequency idea (there will only be one future facility). The "degree of belief" interpretation of probability is a more accurate description of the interpretation to be placed on assessment results. The same problem of interpretation arises in Section 7.2.4, paragraph 2.		
16 1	G.H. Archinoff AECL	6.3.1		Should include mention of the use of sensitivity analyses to assess/address uncertainties.		No Change.
16 2	G.H. Archinoff AECL	6.3.1		Existing methods for assessing ecological risks should be referenced here.		Text removed.
16 3	G.H. Archinoff AECL	6.3.2		The use of risk quotient is only the starting point of an ERA and is not the assessment end-point. This section would be an appropriate place for a reference to ERA methodologies such as the CCME framework: <i>A Framework for Ecological Risk Assessment: General Guidance</i> , and <i>A Framework for Ecological Risk Assessment: Technical Appendices</i> .		Text removed.
16 4	G.H. Archinoff AECL	6.3.2	Last	Existing methods for assessing ecological risks should be referenced here -an attempt to combine the very different assessment methodologies (i.e., human and ecological receptors) will end up with confusion and duplication of the effort put into environmental assessments, etc.		Text will be revised.
16 5	G.H. Archinoff AECL	6.3.3		To use site characteristics as end-points negates the need to consider potential receptors. Some additional contextual information is needed in that section.		Text will be revised.
16 6	G.H. Archinoff AECL	7.2		It is reasonable that assessment models, level of detail and degree of conservatism and confidence in results used should be dictated by the purpose of the assessment. It is recommended that the guide explicitly recognize that a higher level of conservatism and assessment detail is required for human safety assessments than for protection of environmental receptors.		Text will be revised.
16 7	G.H. Archinoff AECL	7.2.1		The final sentence is incorrect. The model results (i.e., output) do not determine whether it is conservative or not. It is the model inputs and assumptions that determine this.		Text will be revised.
16	G.H. Archinoff	7.2.1		A discussion should be added promoting the concept		Text will be revised.

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8	AECL			of the "best-estimate" approach. Regulatory Guide G-320 promotes the use of multiple conservatisms (stacked), which would result in over-estimates of exposures and risks, and loss of visibility between estimated risk and the acceptance criteria.		
169	G.H. Archinoff AECL	7.2.1		Section 7.2.1 discusses "conservative" calculations. There is a risk in trying to overestimate doses from all points of view. For example, an assumption about a vault design that may lead to a high dose estimate from one point of view can lead to an underestimate from another point of view. Instead, different assumptions may be made about the vault design, depending on the release path being analyzed, but then the results cannot properly be combined because the underlying assumptions are incompatible. (If the results are combined, then the total result will be both logically incoherent and over-conservative.) This point is essentially made in the last paragraph of Section 7.8.1.		No Change.
170	G.H. Archinoff AECL	7.2.4	1	In this paragraph, sensitivity analyses are described, but the term is not used - please add the term.		Text will be revised.
171	G.H. Archinoff AECL	7.2.4	3	Delete this paragraph - the method is not being promoted, so why introduce the discussion?		Text removed.
172	G.H. Archinoff AECL	7.3		Further to General Comment #2, it may not make sense to repeat/confirm the original assessment once the waste has been emplaced in a disposal facility. Can it be realistically expected that the waste will be moved if new data lead to potentially higher risks than those originally estimated? This brings up the subject of adaptive management, which will be called upon if environmental assessment follow-up activities reveal some emerging issues. The guide is mute on that topic.		No Change.
173	G.H. Archinoff AECL	7.3.1		Some environmental baseline information mentioned in that section is of little value in the context of long-term assessments (e.g., atmospheric conditions, existing land use, and biosphere ecosystem).		No Change.
174	G.H. Archinoff AECL	7.3.2	2	Provide more guidance associated specifically with storage rather than disposal. For example, in Section		No Change.

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				7.3.2, the second paragraph discusses the components of the "Waste Management System" only as elements of a disposal system, not a storage structure.		
17 5	G.H. Archinoff AECL	7.4		Item 1 -The hazardous lifetime of certain non-radiological contaminants is essentially infinity - guidance should be given as to the reasonable assessment timeframe for these types of contaminants.		No Change.
17 6	G.H. Archinoff AECL	7.4.2		It is somewhat surprising to recognize the role of institutional controls without any mention of the principle of optimization, which was mentioned in R-104. It is recognized that it may be difficult to mention the word "optimization" without touching the subject of societal acceptance of any proposed long-term management practice.		Text will be revised.
17 7	G.H. Archinoff AECL	7.5.1	1	There is an implication that event trees and fault trees are the only formal hazard/initiating event and accident scenario identification and evaluation techniques. It is recognized that these can be quantitative methodologies. , However, there are many other formal systematic and structured methodologies that are qualitative and semi-quantitative that can be used. Examples of these are Preliminary Process Hazard Analysis (PPHA), Hazard and Operability (HAZOP) Studies, and Failure Modes and Effects Analysis (FMEA).		Text removed.
17 8	G.H. Archinoff AECL	7.7		This section should provide some guidance on how to consider the evolution of human lifestyles when such long timelines are considered. Likewise, for the long-term, the use of current VECs is highly questionable. In the context of changes occurring due to global warming and that a possible glaciation within the next 10,000 years, how can one be concerned with species currently at risk for instance? Again some guidance on how to account for the changes to ecological systems would be of benefit in this guidance document.		No Change.
17	G.H. Archinoff	7.8		See Comment 35 -this comment refers also to this		Text will be revised.

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9	AECL			section. Here it is (section 6.3.3): To use site characteristics as end-points negates the need to consider potential receptors. Some additional contextual information is needed in that section.		
180	G.H. Archinoff AECL	7.8.2		The last paragraph of Section 7.8.2 discusses calibrating models. It should be noted that if data are used to calibrate a model, then the same data could not also be used to verify or validate the calibrated model.		Text will be revised.
181	G.H. Archinoff AECL	8.0		The fifth line of the first paragraph of Section 8.0 has a typo: "know" should be "known".		Text will be revised.
182	G.H. Archinoff AECL	1.0	1	The opening sentence should read "...licensees and applicants in assessing the long term..."		Text will be revised.
183	G.H. Archinoff AECL	3.0	Last	From second line, remove "to": "...that an environmental assessment to be performed..."		Text will be revised.
184	G.H. Archinoff AECL	7.4.2	1	Sometimes a facility will be constructed to consolidate waste within engineered barriers as an alternative to relying on institutional control for wastes being left in-situ. For such a situation, it would be reasonable to acknowledge that the role that institutional control plays in providing the safety of the waste management system would be limited to the few hundred years considered in current international practice.		No Change.
185	Charles McCombie McCombie Consulting	General		The most surprising aspect of the guidance document, however, may be that no specific numerical compliance criteria are given. The discussion on dose and risk implies indirectly that 0.14mSv/a or a risk of 10 ^{-5/a} may be the limits, and reference to other documents infers that concentration limits may be found there. Explicit specification of limits is, however, usual in a regulatory guide. Another novel aspect of the discussion of compliance with limits is that it appears to be acknowledged that exceeding these does not automatically lead to disqualification. This is a sensible approach and could be stated more explicitly. A further unusual feature in the compliance discussions is that "factors of safety", specifying how		Acknowledged.

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				<p>far below stated targets one should be, are referred to often – but never with an indication of the expected or recommended factor. This could lead to controversial discussions during public debates on licensing.</p> <p>In national and international debates on long-term safety, further critical issues that are frequently raised concern a) timescales for assessments and b) human intrusion. Concerning the former, G-320 specifies that assessments should continue until “maximum impact is predicted”, i.e. no absolute time cut-off is specified. For some scenarios the maximum impact may be at many millions of years. Although the increasing uncertainties with time are discussed, it could be useful to specify that continued calculations beyond a specified time (e.g. 1Ma or 10Ma) is not needed.</p> <p>For human intrusion several suggestions are unusual and potentially problematic. The direct impact on an intruder is considered and implicitly required to be within the given limits. This will be difficult or impossible. A more common approach is to exclude the intruders themselves and look at the consequences on the public of repository damage caused by intruders. It is also implied that the consequences of intrusion can be weighted by the probability of this scenario. Many programmes have encountered problems defining such probabilities, unless they are set in a stylised way by the regulator (as in the WIPP case). An alternative is to separate out the entire human intrusion scenario from the other classes and allow a flexible discussion. The overall opinion of the draft is that:</p> <ul style="list-style-type: none"> • it reflects much of the recent debates, discussions and studies on long term safety • it avoids being specific on some of the most debated topics, such as dose/risk limits, timescales for assessment, use of subsystem criteria, times over which institutional control can be assumed to be maintained • it allows the regulator great flexibility in making 		

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				<p>his judgement on acceptability of a project</p> <ul style="list-style-type: none"> because it leaves many issues vaguely or incompletely defined, the implementer will have a difficult task in himself assessing whether an assessment he has performed will be acceptable to the regulator. 		
18 6	Charles McCombie McCombie Consulting	General		<p>It is important to note that the document provides only guidance, by indicating acceptable ways of meeting CNSC requirements expressed in legally enforceable documents such as the regulatory standards and acts (the key Act is in Appendix A). The document is a draft circulated with an invitation to all interested parties to provide comments within ~2 months. It covers the long-term safety of storage and disposal of all long-lived wastes – including those from uranium mining and milling, which is a particular issue in Canada, because the country is the world's largest producer.</p>		Acknowledged.
18 7	Charles McCombie McCombie Consulting	General		<p>The focus is on assessment of long-term safety (methodologies, structure, approaches). The Guide does not cover social acceptability or economic feasibility. This is at first sight unexpected since the Seaborn report that led to the upheaval of the Canadian programme concluded that technical safety aspects were in order but that societal confidence in safety was insufficient in Canada. In practice societal aspects are mentioned at various points (e.g. in connection with analogs, institutional controls).</p>		Acknowledged.
18 8	Charles McCombie McCombie Consulting	General		<p>Licenses are required for 1) siting, 2) construction, 3) operation, 4) decommissioning and 5) abandonment (the 1st two can sometimes be combined). Environmental Assessments may be required for 3), 4) and 5). All facilities must have a decommissioning plan identifying end state. There appear to be no regulatory processes directly affecting siting studies leading up to site selection.</p>		Acknowledged.
18 9	Charles McCombie McCombie	5.2		<p>§ 5.2 specifies that assessment timescales must extend to "encompass the period of time when maximum impact is predicted to occur" and that</p>		Acknowledged

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	Consulting			impacts can be "no greater than those permissible in Canada at the time of the regulatory decision". The former can imply extremely long times for deep repositories. The allowable future impacts are not lowered below current limits by some arbitrary factor, as is done in some national programmes to allow for the fact that current generations have the benefits. This could give higher dose limits for repositories than the 0.1mSv/y figure used in various programmes. On the other hand, even very far future doses are included and for erosion scenarios (especially from tailings, etc) this could be challenging. The increased realism in allowing limits equal to today's is compromised by the later requirements for "safety factors" (see points 9 and 10 below).		
190	Charles McCombie McCombie Consulting	General		<p>7) The safety concept requires</p> <ul style="list-style-type: none"> • "multiple engineered (<i>my emphasis</i>) barriers providing defence in depth", • isolation by proper site selection and • institutional controls. <p>The issue of numbers or redundancy of barriers is not addressed. Even in those national regulations that stipulate "multiple barriers", this is interpreted to be engineered <u>plus</u> geological barriers. Will all long-lived wastes (e.g. tailings) have multiple engineered barriers. The redundancy issue is not directly addressed in the text, but the definition of "defence in depth" could be interpreted to mean complete independence of the barrier function – which is difficult or impossible in geological disposal. The term "reasonable assurance" is used in discussing compliance. This term, taken originally from US licensing regulations is appropriate and avoids discussions on "absolute proof".</p>		Acknowledged
191	Charles McCombie McCombie Consulting	6.2		<p>§ 5.2 recognizes to some extent – without using the terminology – that a multiple lines of arguments, such as analogues, can be used. § 6.2 has more on this point. It recommends a "safety case" that consists of complementary</p>		Text will be revised.

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				assessments and reasoned arguments to support a safety case. This implies that the safety case does not include the basic analyses – thus differing from NEA/IAEA usage and, in part, from the definition given in the glossary.		
19 2	Charles McCombie McCombie Consulting	6.1		9.) An unusual feature is the specific advice given in Chapter 6 on the application of long-term safety assessments in design optimisation. § 6.1 on optimisation could be difficult to implement, since it is not clear if formal optimisation processes are a requirement and, importantly, “some factor of safety” is recommended, but with no indication of its expected magnitude.		Text will be revised.
19 3	Charles McCombie McCombie Consulting	6.2		10.) An interesting aspect in § 6.2 is that CNSC allows reliance of institutional controls as part of the safety case – but that “such controls should not be invoked unless long term safety cannot be ensured by design features and passive safety features”. This formulation appears to leave the door open for dependence on institutional controls. The implications of this are most significant for tailings piles and mining wastes. See also note 14) below.		Acknowledged.
19 4	Charles McCombie McCombie Consulting	6.3		The principal safety indicators are dose and environmental concentrations but other targets are also required. The text in the introduction to § 6.3 again requires a “reduction factor” on target values, without any explicit guidance on its size. This could lead to contentious debates. The discussion on dose constraints mentions the ICRP approach of introducing a factor 1/3 for design targets but not compliance. Thereafter, in the risk discussion, a factor of 7 is arbitrarily inserted and this is fed back into the dose figure to give 0.14mSv/a. If risk is used, then disaggregated figures of dose and consequence are required; this is in accordance with the latest practice elsewhere.		Text will be revised.
19	Charles	6.3.1		The problem of protection of non-human biota is		Text will be revised.

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5	McCombie McCombie Consulting			passed on to the organisations IAEA and NCRP by quoting their reports. Whether compliance with both, either or neither is required, is not explicitly stated. For hazardous substances, the effective limit is given by allowable concentrations given in other Canadian legislation. No additional "factor of safety" is explicitly required here, in contrast to the radiological part.		
19 6	Charles McCombie McCombie Consulting	7.0		The assessment approaches recommended are based on IAEA and NEA documentation. Emphasis is properly placed on documenting comprehensively the context of the safety case. The approaches described are 1) conservative calculations, 2) scoping and boundary assessments, 3) natural analogs and data, 4) deterministic and probabilistic models. It is emphasised correctly that the repeated assessment of increasing reliability should be made throughout the facility life-cycle.		Acknowledged.
19 7	Charles McCombie McCombie Consulting	7.4.2		14.) § 7.4.2 explicitly acknowledges that "for some types of wastes in certain site-specific situations there may be no realistic alternatives to disposal in a manner that requires long-term institutional controls as a safety feature". This explicit recognition of this problem is unusual in national regulations – but is in reality necessary.		Acknowledged.
19 8	Charles McCombie McCombie Consulting	7.5.2		Scenarios are classified as 1) normal evolution, 2) extreme conditions and 3) containment failure, including intrusion. Inclusion of specific disruptive events in category 2) is stated to depend on their probability – but no numerical guidance is given.		Text will be revised.
19 9	Charles McCombie McCombie Consulting	7.6		For intrusion scenarios, one is required to consider the exposure to an inadvertent intruder. It is recognised that intrusion doses can be greater than regulatory limits and that the likelihood should then be considered – but again, no specific criteria are given. "Design		Acknowledged.

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				modifications" to reduce intrusion likelihood (as well as siting measures) are explicitly required. This is an unusual feature to be explicitly included in regulations.		
200	Charles McCombie McCombie Consulting	7.7		An ICRP-type critical group is recommended for dose calculations. The requirements for dealing with non-human receptors given in § 7.7 appear very detailed and complex – as well as difficult to implement (e.g. assessing the “value to stakeholders or society as a whole”).		Text will be revised.
201	Charles McCombie McCombie Consulting	7.8.1		The text in § 7.8.1 sensibly addresses the issues of choosing conceptual and calculational models. In particular, alternative models must be considered and “justification for rejecting alternate (sic) interpretations” must be given.		Acknowledged.
202	Charles McCombie McCombie Consulting	7.3.1		QA/QC procedures are explicitly required for siting work (§ 7.3.1) and for software development (§ 7.8.2). No specific QA standard is specified, only “an acceptable QA standard such as CSA N286.7”. It is surprising that more general QM/QA/QC requirements are not explicitly required for programme management, facility operation, etc.		No Change.
203	Charles McCombie McCombie Consulting	7.8.3		Confidence in models is addressed sensibly in § 7.8.3, with advice given on approaches to assuring “an acceptable level of confidence”. No indication is given of how the acceptability will be judged. Given the history of the Canadian programme it might have been useful to tackle this difficult issue by, at least, explaining that, in the scope of a licensing process, the acceptability is a technical decision or judgement of the regulator. A “formal uncertainty analysis” is required in § 8.0 and this will presumably be a major input to the regulators’ confidence finding. Confidence in the public will be determined		No Change.

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				by the regulators' judgement as well as the implementers' submitted project.		
20 4	Charles McCombie McCombie Consulting	8.1		Numerical compliance: § 8.1 discusses comparisons with targets for safety indicators. It appears to accept that in some cases these will be exceeded. The implication is that exceeding even the primary indicators (dose, risk and hazardous concentration ratios) will not automatically result in disqualification. This is a sensible approach allowing flexibility; it could be stated more explicitly.		Text will be revised.
20 5	Charles McCombie McCombie Consulting	Glossary		<p>"long-term" – defined as "a period of time that exceeds the time during which active institutional control can be expected to last". This clashes with the text of § 7.4.2 where "long-term institutional controls" are mentioned.</p> <p>"defence in depth" definition implies full redundancy</p> <p>"natural analogues" – spelling changed to UK</p> <p>"risk" – more complex definition than the usual consequences x probability</p> <p>"risk quotient" – when applied to radioactive substances implies that there is a level of radiation which is a "no effect value". This is, of course, a hotly debated issue</p> <p>"safety case" – includes safety assessment "nominally". This like is the usual definition; it is contradicted by the usage in §6.2. The difference appears to result from the interpretation of the NEA definitions in § 7.0. The "integration of arguments" referred to in the safety case usually is understood to <u>include</u> the safety assessment itself.</p>		No Change.
20 6	K.E. Nash, Nuclear Waste Management, OPG	General		It should be clarified that the document does not apply to current interim storage. With respect to application to long-term storage: the 'Purpose' section of the document states that it addresses both storage and disposal. However, there are a number of areas where the guidance seems primarily focussed on disposal, and where additional guidance specific to long-term storage could be		No Change.

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				useful. It seems appropriate that long term storage should be assessed and licensed in the same way as interim storage is now, but with specific factors such as intention for retrieval, need for repackaging, design lifetime, ageing and institutional control addressed with reference to the longer timescales; requirements for this to be subject to guidance from CNSC. (See "Comments on Scope", compiled separately below.)		
207	K.E. Nash, Nuclear Waste Management, OPG	General		There should be a distinction between the Safety Case and the Safety Assessment. This would allow clearer discussion of the roles of the site descriptive model (geosynthesis) and of natural analogs, for example. (See comments on Sections 5.2, 7.3 and 7.8.1.)		Text will be revised.
208	K.E. Nash, Nuclear Waste Management, OPG	General		1.Site characterisation activities will last many years, during which time the data will be collected and interpreted to create a conceptual descriptive site model. This conceptual model is a key element in justifying the safety assessment model approach, and not well described in the document. Requirements both for the site characterisation plan and for development of the conceptual model should be clarified. We understand that guidance on site characterisation is under preparation. If available in a separate document, this additional guidance should be referenced but not described in this document, rather than have an incomplete or inconsistent description here. (See comments on Section 7.3.1.)		Text will be revised.
209	K.E. Nash, Nuclear Waste Management, OPG	General		Expectations or recommendations for regulatory involvement during development and/or execution of the safety assessment plan would be useful.		Text will be revised.
210	K.E. Nash, Nuclear Waste Management, OPG	General		There is a lack of coherence between the derivation of the radiation protection criterion and the methodologies for safety assessment described. The derivation of the criterion should take into account the context of the overall Safety Case. The		Acknowledged.

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				requirement that a reduction factor be applied to regulatory requirements (or ICRP dose constraint) is not useful and would underestimate the calculated safety margin, given that the models are expected to be developed to provide conservative estimates of impacts. It is preferred that the criteria be true endpoints and that uncertainties be addressed in the safety assessment calculations. (See comments on Sections 6.3, 8.0 and 8.1.)		
21 1	K.E. Nash, Nuclear Waste Management, OPG	General		The value of quantitative optimisation by comparison of design options, in the case of a facility where doses for the reference design are orders of magnitude below criteria, is questionable. A qualitative consideration of optimisation, as described by ICRP, should be allowed for. (See comments on Section 6.1.)		No Change.
21 2	K.E. Nash, Nuclear Waste Management, OPG	General		It is implied that all intrusion scenarios, not only inadvertent intrusion, should be analysed. This would differ from international recommendations and practice, which considers that it is not possible to protect future societies from the consequences of actions taken deliberately with knowledge of the nature of the material in a repository. Further guidance as to scenarios would be required. (See comments on Section 7.8)		Text will be revised.
21 3	K.E. Nash, Nuclear Waste Management, OPG	General		We note the change in title from that in previous versions of CNSC's Regulatory document framework. The title now appropriately reflects the stated scope and current contents of the document		Acknowledged.
21 4	K.E. Nash, Nuclear Waste Management, OPG	General		It is sometimes not clear which statements are guidance and which represent discussion material. Guidance could be prefaced by "The CNSC expect that...", as in Section 6.1, paragraph 2, or by a clear statement upfront in each section, as suggested in our clarification comment on 7.4.2 (In R-104, for example, the guidance was clearly indicated in italics.)		Text will be revised.
21 5	K.E. Nash, Nuclear Waste	General		The use of the term "reasonable assurance", in several places, is useful in clarifying CNSC		Acknowledged.

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	Management, OPG			expectations, and is consistent with international discussion		
21 6	K.E. Nash, Nuclear Waste Management, OPG	Glossary		The nomenclature used is not consistent within the document; i.e. words such as facility, method, and waste management system appear to be used interchangeably. "Waste management system" as defined in the glossary has a scope which is far too broad and therefore is not appropriate for this document. This could be clarified if two terms were defined: System (or disposal system, or waste management system), following the ISAM usage (see comment on Glossary, below), and Facility – definition consistent with the NSCA, and referring to a long-term storage or disposal facility which is the subject of a licence or a licence application		Text will be revised.
21 7	K.E. Nash, Nuclear Waste Management, OPG	3.1 para 3 line 3		Present words imply a "plan" is required. We suggest changing this to "Class I nuclear facilities and Mine and Mill facilities require a <i>description of the site evaluation process and of the investigations and preparatory work that have been and will be done on the site and in the surrounding area</i> to obtain a site preparation licence." (Words from Section 4(a) of the Class I facilities regulations.)		Text removed.
21 8	K.E. Nash, Nuclear Waste Management, OPG	5.1		This section appears to be missing a 5th point, in which the goal of the assessment is to satisfy CNSC licensing requirements, as described in Section 3.1 (for site preparation, construction, operation, decommissioning, and abandonment).		Text will be revised.
21 9	K.E. Nash, Nuclear Waste Management, OPG	5.2, para 2 and 3		A distinction should be made with respect to the roles of Safety Assessment and the Safety Case. In this context it would be the Safety Case that puts forward the complete set of reasons and evidence for understanding future waste facility performance. Major contributions to the Safety Case would be made by Safety Assessment, but also by Geoscience arguments and other complementary arguments. Currently, this section refers only to		Text will be revised.

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				safety assessment. It is suggested that an additional section or sub-section be used to describe the Safety Case, for example in Section 6 (see comment on Section 6.0, below).		
220	K.E. Nash, Nuclear Waste Management, OPG	5.2 para 4 bullet 4 (see also Section 7.0)		Assessment of natural analogs would generally constitute either: <ul style="list-style-type: none"> - part of the validation of the safety assessment model and/or code, or - a complementary argument contributing to multiple lines of reasoning in the Safety Case. However, this section implies that it should be included in the set of scenarios developed for safety assessment of a site/design. Adding a section on the Safety Case would allow natural analogs to be discussed in a more appropriate context.		Text will be revised.
221	K.E. Nash, Nuclear Waste Management, OPG	6.0		Safety Assessment is used in section headings for 6.0, 6.1 and 6.2. However, the text implies demonstrating safety in the context of a Safety Case. The section headings could be revised to 6.0 'Demonstration of Long-term Safety', 6.1 'Design Optimization' and 6.2 'Licensing of Facilities for Long-term Management of Waste'. In addition, this might be a suitable place to include a description of the Safety Case, perhaps as an additional section up-front. This new section could draw in the material from Section 6.2 paragraph 4.		Text will be revised.
222	K.E. Nash, Nuclear Waste Management, OPG	6.1, para 3		Calculated annual doses for geological repositories may for some types of facility be orders of magnitude below criteria. The value of quantitative optimisation is therefore questionable. ICRP describe a more qualitative process, which should be allowed for in the current document (ICRP 81, paragraphs 50 – 52).		No Change.
223	K.E. Nash, Nuclear Waste Management, OPG	6.1, para 3, line 9-10		The meaning of "publicly-acceptable factor of safety" is not clear. The last clause ("or in determining....optimization") should be deleted		Text removed.
22	K.E. Nash,	6.1, para 4		The wording of this paragraph could result in some		Text will be revised.

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4	Nuclear Waste Management, OPG			<p>confusion between:</p> <ul style="list-style-type: none"> - factor of safety - need for optimisation in the ICRP sense of keeping all exposures as low as reasonably achievable, within a range below the regulatory limit - addressing uncertainty in scenarios arising from possible future multiple sources - addressing uncertainties in modelling, knowledge of future exposure conditions, and long-term behaviour of engineered and natural (geological) systems. <p>To ensure clear and transparent safety assessment, contributing to a robust Safety Case, these aspects should be addressed separately.</p> <p>As a suggestion, the first clause of the first sentence of paragraph 4 ("A waste management system...limits;") could be moved up to the top of 6.1, and the remainder of the paragraph could be deleted. Factor of safety is addressed in Section 8.0.</p> <p>See also related comments on Section 6.3.</p>		
22 5	K.E. Nash, Nuclear Waste Management, OPG	6.3 para 3 also 7.1 para 4		<p>It would be better to use the ICRP dose constraint directly, as is now done internationally. The discussion of the acceptable "margin of safety" with respect to, e.g., the ICRP dose constraint, would be an integral part of the assessment context of the Safety Case.</p> <p>Reduction of the criterion to take account of uncertainty is not appropriate. The focus should instead be on ensuring that the safety assessment:</p> <ul style="list-style-type: none"> - is sufficiently conservative - takes account of uncertainty by means such as "what-if" scenarios and multiple lines of reasoning - shows a margin of safety compared with regulatory requirements. <p>The requirement that a reduction factor be applied to</p>		Text will be revised.

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				regulatory requirements would result in an underestimation of the true safety margin, given that the models are expected to be developed to provide conservative estimates of impacts, conservative input data are to be used, and the uncertainty in the estimates will be examined (as described elsewhere in G-320). See related comment under 6.1 paragraph 4.		
226	K.E. Nash, Nuclear Waste Management, OPG	6.3 para 3 – 4 and 6.3.1 para 3		We understand from this text that the target derived in Section 6.3.1 is to be seen as an example, and not as a requirement. This interpretation is consistent with Section 6.3 paragraph 4. Please clarify the text if this understanding is not correct.		Text will be revised.
227	K.E. Nash, Nuclear Waste Management, OPG	6.3.2		It appears from the introduction to 6.3 that a reduction factor is also to be applied to criteria for non-human biota. Please clarify. (As noted in the comment above on Section 6.3, it is our view that a reduction factor is not appropriate.)		Text will be revised.
228	K.E. Nash, Nuclear Waste Management, OPG	6.3.1 para 1 lines 8 - 12		As noted in our comments under 6.1, the need for reduction in the assessment target should be considered in the light of how uncertainty is dealt with in the Safety Case and the conservatism in the assessment.		Text will be revised.
229	K.E. Nash, Nuclear Waste Management, OPG	6.3.1 paragraph 4		The term “aggregated” risk is not used in its usual sense here (e.g. as used by ICRP, in ICRP 81 paragraphs 56 - 57. where it means the total risk over all or a number of scenarios). Radiological risk times the probability of occurrence is simply a “probability-weighted risk”. The meaning of “conditional” risk should be defined.		Text removed.
230	K.E. Nash, Nuclear Waste Management, OPG	6.3.3		This list of examples does not include the two parameters recommended in the recent EC evaluation of alternative indicators, notably radiotoxicity concentration in surface water and radiotoxicity flux to surface. Could the list be organized into categories so that these or other possible parameters could be linked to these		Text will be revised.

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				guidelines?		
23 1	K.E. Nash, Nuclear Waste Management, OPG	7.0 paragraph 5 ("The "weight of evidence" ...")		It could be noted that there are other elements in the Safety Case (e.g. arguments from the geological setting), per ref 15. This text could be moved to the Safety Case discussion previously recommended (see comments on 6.0).		Text will be revised.
23 2	K.E. Nash, Nuclear Waste Management, OPG	7.2.3 paragraph 1		Examination of natural analogs is generally used as part of a multiple-lines-of-reasoning approach to the Safety Case, or as part of model verification, rather than as part of the safety assessment itself. This section would be better moved to the Safety Case discussion previously recommended (see comments on Section 6).		Text will be revised.
23 3	K.E. Nash, Nuclear Waste Management, OPG	7.2.4 paragraph 2		<p>The requirements for use of probabilistic models are not clear. A clear distinction could be made between:</p> <ul style="list-style-type: none"> - the use of probabilistic assessment to take account of uncertainties in data or in precise conditions, which is useful to examine both the expected value for a particular scenario, and its estimated variability, and - use to take account of different scenarios, and uncertainty in scenarios. <p>In the former case, the results will include the expectation value of an endpoint. This may be a good representation of the value of the endpoint, and may therefore be appropriate for comparison with an assessment target. In the latter case, if aggregated results are presented, they should also be presented and discussed as the magnitude... (words as at present).</p>		Text will be revised.
23 4	K.E. Nash, Nuclear Waste Management, OPG	7.2.4 paragraph 3, first sentence		Recommend deleting this sentence. This first sentence implies that it is useful to do <u>both</u> probabilistic and mean/5/95th deterministic calculations to disaggregate the risk, and in particular to compare the "percentile tail" results. However, we believe that it is generally sufficient to use only one approach to disaggregate the risk.		Text removed.

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				Further, the usefulness of allowing "the mean and 90% confidence interval of the distributed consequences to be compared to the mean and 5 th and 95 th percentiles of the results of deterministic assessments" is not clear.		
23 5	K.E. Nash, Nuclear Waste Management, OPG	7.2.4 paragraph 3 second sentence		Recommend separating this point in a new paragraph. This second sentence implies there is no approach for accounting for uncertainties in conceptual model, nature of model, nor scenarios, since it rules out both deterministic and probabilistic approaches. This is an unnecessarily sweeping claim. It would be helpful to give some guidance on how such uncertainties can in fact be usefully addressed by evaluating different conceptual models, different model approaches and different scenarios.		Text will be revised.
23 6	K.E. Nash, Nuclear Waste Management, OPG	7.3.1		Requirements for a site characterisation plan should be clarified. In disposal programs site characterisation activities will last many years during which time geoscientific data will be collected and interpreted to create a conceptual descriptive site model and understanding of uncertainty. As this conceptual model is a key element in justifying the safety assessment model approach the expectation for regulatory involvement during development and/or execution of the multi-year site characterisation plan would be useful. Furthermore, the System Description is a key component in the assessment of safety. Understanding of the system, leading to development of the System Description, is directly linked to the assessment of safety, in the sense that the end product is a defensible conceptual descriptive site or facility model that underpins Safety Assessment, both in terms of selecting appropriate predictive modelling tools and qualitative arguments supporting the predictive modelling results.		Text will be revised.

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				<p>In this respect, in section 7.3.1, regulatory expectations for review, involvement and/or documentation associated with the development of the System Description, particularly during site characterisation activities should be fully addressed, <u>or</u> reference made to additional guidance under preparation which is not included in the scope of G-320, <u>or</u> a note made that the scope does not include development of the Site Characterisation Plan and related material. This would result in the removal of the material in paragraphs 2 and 3 of 7.3.1, i.e. "The evaluation and characterisation plan should include....to the perturbations caused by the licensed activities".</p> <p>However, the role of performance assessment or geoscience modelling which serves as a framework during Site Characterisation to test and explore conceptual site model sensibility and realism should be recognised in section 7.3.1.</p>		
23 7	K.E. Nash, Nuclear Waste Management, OPG	7.3.1		This section should be re-named "Site Characteristics", to form a parallel section to 7.3.2.		Text will be revised.
23 8	K.E. Nash, Nuclear Waste Management, OPG	7.4.1 paragraph 2		This material could usefully be related to that in Section 6.3.3. It could also be expanded to explain that because of increasing uncertainty in projections that emphasis is increasingly placed on indicators and arguments which are less subject to uncertainty.		Text will be revised.
23 9	K.E. Nash, Nuclear Waste Management, OPG	7.5 paragraph 2 Second list		The items listed are not all examples of "techniques and criteria used to derive scenarios". It is not clear if this paragraph is saying that these scenarios should be included in the set or range of scenarios analysed, or if it is saying that, if included, they should be justified. Some, such as "stylized scenarios and failure scenarios" are described better in subsequent subsections and should not be included here. We think there should be discussion here on legitimate criteria to select or exclude scenarios, including: low-probability, low-consequences, within institutional		Text will be revised.

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				control period, outside of time frame, outside of scope, a subset of /smaller impact than another scenario, smaller impact receptor than critical group.		
240	K.E. Nash, Nuclear Waste Management, OPG	7.5.1 paragraph 2		Guidance is needed on the probability or dose level below which a scenario can be excluded from further analysis.		Text will be revised.
241	K.E. Nash, Nuclear Waste Management, OPG	7.5.2 paragraph 3		This reference to "include site evolution" could imply that the biosphere should have time-dependent properties. Please clarify if this is the intent.		Text will be revised.
242	K.E. Nash, Nuclear Waste Management, OPG	7.6 paragraph 2		<p>The text implies that the public and environmental impact of deliberate human intrusion needs to be evaluated. This needs to be clarified.</p> <p>If this means deliberate intrusion to recover materials, then this would be inconsistent with international practice, which considers that it is not possible to protect future societies from the consequences of actions taken deliberately with knowledge of the nature of materials in a repository. Since the intention/skill of the intruders and the regulatory framework under which they would be operating would not be known (or could only be guessed at) it would be difficult to predict the impacts of the intentional human intrusion scenario on future generations, i.e., uncertainties would be very large.</p> <p>Further guidance as to scenarios would be required. If the intent of this text is to include terrorist type activities, which attempt to damage the facility so as to cause local contamination, then it would be useful to state this specific class of intrusion.</p> <p>If such intentional intrusion scenarios are to be considered, then the discussion in the subsequent two paragraphs should be generalized to apply to all intrusion scenarios and not just inadvertent intrusion. The use of a small number of stylized scenarios</p>		Text will be revised.

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				should also be recognized as an acceptable approach to address human intrusion..		
24 3	K.E. Nash, Nuclear Waste Management, OPG	7.6 paragraph 4		The factors to be considered in interpreting results from analysis of human intrusion scenarios should include number of people affected, and the spatial and temporal extent of impacts.		No Change.
24 4	K.E. Nash, Nuclear Waste Management, OPG	7.8		<p>The expectations for the development and justification of the site descriptive model should be explained. It would seem sensible that the adequacy of the mathematical assessment model would be linked to the 'degree of believability' in the conceptual model.</p> <p>Further, the notion that 'conceptual models that have been developed should be simplified to correspond to the limitations of the mathematical equation ...' should be discouraged. The mathematical models used in the assessment should be demonstrated to be adequate to the intended purpose, as stated in the first sentence in section 7.8.1. One suggestion would be to delete the last sentence of paragraph 2 in 7.8. See also comments under Section 7.8.1 paragraphs 3 and 4.</p>		Text will be revised.
24 5	K.E. Nash, Nuclear Waste Management, OPG	7.8 paragraph 3		<p>While in a strict sense the 'accuracy' of long-term assessment model predictions cannot be checked, it would seem reasonable that such models could be compared against site-specific evidence to instil confidence that predicted results are demonstrably conservative and have embodied uncertainty. Ideally this expectation should be described in the last sentence (with further explanation/examples as how to achieve in subsequent sections).</p> <p>It could also be recognised that most disposal facilities have operating and active monitoring periods covering decades, if not a century. There are processes that are expected to occur (or not) during such periods, and predictions <u>can</u> be checked during this period. Part of the acceptance of a safety</p>		No Change.

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				assessment might be based on a commitment to such checking.		
24 6	K.E. Nash, Nuclear Waste Management, OPG	7.8.1 paragraph 2		The description of the 'conceptual model' in paragraph 2 would be better positioned earlier in the document. One suggestion would be to describe the descriptive model in preceding sections related to the Safety Case, or the Facility (System) Description and/or Site Characterisation. The role of the conceptual model in establishing a reasoned basis to develop assessment scenarios, assessment timeframes, receptor/critical groups, and a means to assess confidence in assessment models should be explained.		No Change.
24 7	K.E. Nash, Nuclear Waste Management, OPG	7.8.3 paragraph 2		While the discussion here is strictly true, it should be clearly stated that all such comparisons are useful for providing confidence in the assessment models and are to be encouraged. For example, they should be listed in the bullet list in paragraph 5.		No Change.
24 8	K.E. Nash, Nuclear Waste Management, OPG	8.0 paragraph 2 - 3		<p>There is confusion over two terms here - "conservatism" and "safety factor". They should be discussed as separate topics.</p> <p>With respect to conservatism, it should be stated that it is not in general possible to estimate the degree of conservatism, only whether or not results are likely to be conservative based on knowledge of model and data. If it can be clearly argued that results are conservative, then it should not be necessary to evaluate how conservative.</p> <p>With respect to safety factor, we view this as the margin between target value or criteria and the assessment value, typically evaluated as "target value"/ "predicted value" (or vice versa, as appropriate). This usage would be consistent with normal engineering practice.</p> <p>We further observe that a more conservative assessment would tend to have a smaller calculated</p>		Text will be revised.

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				<p>safety factor.</p> <p>Please also clarify the last sentence of paragraph 2. Given that the assessment in question is likely more accurate than bounding assessments on the same scenario, it is unlikely that comparing results to bounding assessments, as suggested, will provide any information on conservatism in the former results, because the latter are in effect even-more-conservative models.</p>		
249	K.E. Nash, Nuclear Waste Management, OPG	8.0 paragraph 4 Bullet 3		We suggest this bullet is replaced with "The presentation of deterministic results should include a discussion of confidence in the results e.g. from sensitivity analysis." Sensitivity analysis would be the usual method of examining confidence.		Text removed.
250	K.E. Nash, Nuclear Waste Management, OPG	8.1 paragraph 2 line 7 - 8		Use of the 95th percentile confidence level would represent a conservative approach detracting from a transparent presentation of the expected consequences. When added to the conservatisms in scenarios, modelling, data selection, and in the target itself, the consequences would likely be highly overstated. It might be more desirable to the presentation of the overall Safety Case, providing reasonable assurance, to instead require these data to be presented so that they can be taken into account.		Text removed.
251	K.E. Nash, Nuclear Waste Management, OPG	3.0 paragraph 1, 3 rd bullet	C	It would be helpful to clarify what specific international obligations apply to the radioactive waste management.		No Change.
252	K.E. Nash, Nuclear Waste Management, OPG	3.1 paragraph 2 line 5 - 6	C	Please clarify the last sentence. What other legislation and regulations does this refer to? Generally, Canadian Water Quality Guidelines are used, as noted in Section 6.3.2, but these are not specified in legislation.		Text removed.
253	K.E. Nash, Nuclear Waste Management, OPG	5.0 paragraph 2 last sentence	C	The term "containment facility" is not defined. If this is a preferred term, its usage could be clarified versus the defined term "disposal" used in IAEA documents cited and the term "Deep Geologic(al) Repository" in common use. A possible rewording is: "Long-term		Text will be revised.

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				waste management approaches that are under consideration include indefinite storage in facilities located at or near ground surface, and disposal in near-surface and deep geologic repositories." This covers all the approaches currently being considered by AECL (e.g. IRUS), OPG and the NWMO.		
25 4	K.E. Nash, Nuclear Waste Management, OPG	5.1 title and 1 st sentence	C	Should read "Assessment of Waste Management Facilities".		Text will be revised.
25 5	K.E. Nash, Nuclear Waste Management, OPG	5.2 paragraph 2 line 3	C	It is not clear if the phrase in parentheses, "multiple engineered barriers providing defence-in-depth", is a definition of "robust" or of a "disposal or storage system".		Text will be revised.
25 6	K.E. Nash, Nuclear Waste Management, OPG	5.2 paragraph 2 last sentence	C	This appears to be a separate point from the first 3 sentences of this paragraph. It might be better moved into 5.1.		Text will be revised.
25 7	K.E. Nash, Nuclear Waste Management, OPG	5.2 paragraph 3	C	The generic definition of safety assessment in the second sentence of paragraph 3 is different than that in the glossary, which may lead to confusion in the guidance document.		Text removed.
25 8	K.E. Nash, Nuclear Waste Management, OPG	6.0	C	Organisation suggestion: 6.1 and 6.2 address the roles and purposes of safety assessment with respect to CNSC's regulatory requirements. 6.3 addresses criteria. It would be helpful to separate these two aspects under separate section headings (rather than sub-section headings).		Text will be revised.
25 9	K.E. Nash, Nuclear Waste Management, OPG	6.1 paragraph 2	C	Please clarify use of the term "options" to avoid confusion with "management options" as used in Section 5.1, point 1 (e.g. use the term "design options").		Text removed.
26 0	K.E. Nash, Nuclear Waste Management, OPG	6.1 paragraph 2 last sentence	C	It is not clear why all options should be assessed to the "same rigor and level of detail." For example, it is common for a pre-screening or simple analyses to eliminate some options, with the remaining options then subjected to more analyses.		Text removed.
26 1	K.E. Nash, Nuclear Waste	6.1 paragraph	C	It is not clear how barrier degradation rates would be derived from the regulatory limits.		Text removed.

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	Management, OPG	3 line 6				
26 2	K.E. Nash, Nuclear Waste Management, OPG	6.2 paragraph 4	C	In section 6.2, the listed factors relate to consideration of a Safety Case and not per se (strictly) to a safety assessment. This could be clarified by creating a new section as suggested in comments on Section 6.0, above.		Text will be revised.
26 3	K.E. Nash, Nuclear Waste Management, OPG	6.2 paragraph 3	C	The point on reasoned arguments could be made a separate paragraph.		Text removed.
26 4	K.E. Nash, Nuclear Waste Management, OPG	6.2 paragraph 4	C	This is presumably "Consideration by CNSC of long term safety assessments...".		Text will be revised.
26 5	K.E. Nash, Nuclear Waste Management, OPG	6.3 and 7.3	C	Usage of the word "system" is appropriate here, provided the glossary term is clarified as suggested below.		Acknowledged.
26 6	K.E. Nash, Nuclear Waste Management, OPG	6.3 paragraph 1	C	The legislation specifying environmental concentrations could be specified (see also comment on 3.1 paragraph 2).		No Change.
26 7	K.E. Nash, Nuclear Waste Management, OPG	6.3 paragraph 2	C	Examples of the parameters to be calculated might help make this guidance clearer.		Text will be revised.
26 8	K.E. Nash, Nuclear Waste Management, OPG	6.3 paragraph 3 line 6	C	Please clarify the last sentence. Does this refer to the regulatory limits and benchmarks? Does the word "benchmark" refer to guidelines for chemical contaminants?		Text removed.
26 9	K.E. Nash, Nuclear Waste Management, OPG	6.3.1 paragraph 1 line 6 - 7	C	ICRP do not use the term "constrained dose" in this sense. Instead, it might be clearer to make use of the ICRP term "dose constraint" (the upper limit of acceptable dose below which optimisation takes place).		Text will be revised.
27 0	K.E. Nash, Nuclear Waste Management,	6.3.1 paragraph 5	C	The methodology and criteria for assessment for non-human biota and ecosystems are currently under development (e.g. CNSC G-296). Any guidance		Text will be revised.

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	OPG	and 6.3.2		given here should be consistent with any forthcoming regulatory guidance of general applicability. It might be better to restrict guidance to reference to suitable methodologies, as is done, for example, in G-296.		
27 1	K.E. Nash, Nuclear Waste Management, OPG	6.3.1 paragraph 5 line 3 - 5	C	The second part of this sentence appears to refer to methodology set out for PSL assessment in Ref. 11. It could be clarified if this methodology is suggested for use in long-term assessments.		Text removed.
27 2	K.E. Nash, Nuclear Waste Management, OPG	6.3.2 paragraph 1	C	Reference 10, the 2004 PSL2 Assessment, gives benchmarks for <u>radiological</u> exposures. This reference therefore belongs in Section 6.3.1, not 6.3.2.		Text will be revised.
27 3	K.E. Nash, Nuclear Waste Management, OPG	6.3.2 paragraph 2	C	The methodology described, using RQs, is linked with the use of tiered assessments using tier-appropriate EEVs. See also Comment on 6.3.1. If this methodology is suggested, then perhaps a separate section on assessment for non-human biota addressing assessment for both radiological exposure and hazardous substances would be appropriate.		Text will be revised.
27 4	K.E. Nash, Nuclear Waste Management, OPG	6.3.3 paragraph 1 line 2	C	The description of the use of alternative indicators could be clarified. Alternative indicators are valuable as <u>complementary</u> indicators particularly for long time scales. They are also useful as supporting evidence in a Safety Case consisting of multiple lines of reasoning. Mention of this context would be helpful. Useful alternative, or complementary, indicators which should be added are radiotoxicity concentration and radiotoxicity flux (see e.g. Becker et al., Testing of Safety and Performance Indicators (SPIN), European Commission Report FIKW-CT2000-00081).		Text will be revised.
27 5	K.E. Nash, Nuclear Waste Management, OPG	6.3.3 paragraph 1 bullet 5	C	Please clarify. Does this mean the degree of dilution at the discharge?		Text removed.
27 6	K.E. Nash, Nuclear Waste Management,	6.3.3 paragraph 1	C	Please clarify if the term "contaminants of concern", as used here, includes both radionuclides and chemical contaminants.		Text will be revised.

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	OPG	bullet 7				
27 7	K.E. Nash, Nuclear Waste Management, OPG	7.0 paragraph 1	C	In the reference to the IAEA ISAM methodology, it could be explicitly stated that the methodology is useful for other disposal facilities besides near surface.		Text will be revised.
27 8	K.E. Nash, Nuclear Waste Management, OPG	7.0 paragraph 3 - 5	C	The material on Safety Case is good but it detracts from the flow here and might be better given in a separate section.		Text will be revised.
27 9	K.E. Nash, Nuclear Waste Management, OPG	7.1 paragraph 4 line 5	C	The last clause, "analysis of parameters that indicate a level of system performance that ensures safety" might be clarified. Presumably it means that criteria may include, for example, criteria for barrier performance or for groundwater travel times.		Text will be revised.
28 0	K.E. Nash, Nuclear Waste Management, OPG	7.2.1 paragraph 1 lines 1 - 2	C	The first sentence appears to confuse conservatism and inherent uncertainty in projection into long time scale, and could be deleted.		No Change.
28 1	K.E. Nash, Nuclear Waste Management, OPG	7.2.1 paragraph 2 last line	C	The last sentence ("The value of the computed result... conservative.") is not clear and might be better deleted.		Text will be revised.
28 2	K.E. Nash, Nuclear Waste Management, OPG	7.3.1 paragraph 1 line 5	C	Does "collective" here mean "cumulative"?		Text will be revised.
28 3	K.E. Nash, Nuclear Waste Management, OPG	7.3.1 paragraphs 2 and 3	C	For clarity, the site characterization plan and conceptual model development required for long term management concepts such as geological disposal should be distinguished from the evaluation plan required for a CNSC site preparation licence. Information required for the latter may not need to be specified here since it is common for all facilities. The term site characterization plan should be used. If this material is retained, the lists should be clarified: the second bullet list on Baseline Environmental information overlaps information in the first bullet list. It appears that in some places the data are labelled as subsurface and surface characterization, and in		Text will be revised.

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				others as baseline geological and baseline environmental conditions.		
28 4	K.E. Nash, Nuclear Waste Management, OPG	7.3.1 paragraph 2 First list, Bullet 4	C	The term "conceptual model evolution" is ambiguous (could refer to dynamic conditions in the long term) and could be replaced as follows: "Data integration and analysis, and incorporation of new data into the conceptual model ".		Text will be revised.
28 5	K.E. Nash, Nuclear Waste Management, OPG	7.3.1 paragraph 3 point 2	C	Are "element fluxes" the rates at which the chemical elements enter the local biosphere from the geosphere? (This would require a knowledge of the groundwater composition and groundwater flow rates into the biosphere.)		Text removed.
28 6	K.E. Nash, Nuclear Waste Management, OPG	7.3.1 paragraph 3 points 4 - 6	C	Given that long-term assessments may be based on reference biospheres, or on a projection of general current conditions, detailed site surface characterisation may not be required for the long-term safety assessments used for optimisation or submitted in the earlier licensing stages. The information listed will in any case be required for EA and licensing submissions as part of the description of the project, its setting and potential impacts. It would not necessarily, however, be integrated with the site characterisation for safety assessment. It might be appropriate to make reference to these other site information needs but not to list the information required here.		Text will be revised.
28 7	K.E. Nash, Nuclear Waste Management, OPG	7.4.2 paragraph 2 and 3	C	It would be helpful to move the sentence : "A submission from a licence applicant should identify the role that institutional controls play in providing the safety of the waste management system, and how that role is taken into account in the safety assessment." to the front of this section. In addition, these paragraphs, as written, do not address (may possibly exclude) indefinite storage.		Text will be revised.
28 8	K.E. Nash, Nuclear Waste Management, OPG	7.5.2 paragraph 4 line 2 and	C	We suggest that the term "evolution scenarios" should be replaced with "scenarios", to avoid confusion with the <u>normal</u> evolution scenario.		Text will be revised.

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		4				
289	K.E. Nash, Nuclear Waste Management, OPG	7.5.2	C	A distinction should be made between the "normal evolution" scenario and "what if" scenarios used to test robustness of the repository system. Discussion of the criteria for acceptability of "what if" scenario results would be useful.		No Change.
290	K.E. Nash, Nuclear Waste Management, OPG	7.6 paragraph 3	C	This paragraph states that acceptability of results of human intrusion scenarios will be judged taking into account likelihood and that doses could be higher than the regulatory limit. This implies that human intrusion scenarios are to be judged separately from normal evolution. For clarity, this could be mentioned in Section 6.3.1.		No Change.
291	K.E. Nash, Nuclear Waste Management, OPG	7.7 paragraphs 1 and 4	C	The discussion of non-human receptors covers both site-specific identification of specific receptors, and stylised approaches (which may use reference representative biota). Possibly a statement such as that in the last sentence of paragraph 3 (where it refers to human critical groups) could be added to allow for both approaches (perhaps according to the stage at which the assessment takes place, and the timescale of the potential impacts).		Text will be revised.
292	K.E. Nash, Nuclear Waste Management, OPG	7.7 paragraph 3	C	Phrasing is somewhat inconsistent. First sentence says that critical group should be chosen based on consideration of site/region-specific information, while the second sentence says that is optional. This should be clarified.		Text will be revised.
293	K.E. Nash, Nuclear Waste Management, OPG	7.8 paragraph 2 line 7	C	The wording "should be simplified" could perhaps be replaced by some wording suggesting that the level of sophistication in the modelling should be consistent with the limitations. It is possible that the conceptual models would not require simplification (e.g. if they were already simple enough), or that future developments in methods and computing techniques may make highly sophisticated computation possible.		Text will be revised.
294	K.E. Nash, Nuclear Waste Management, OPG	7.8.1 paragraph 3-4	C	The discussion in these paragraphs focuses on conceptual model abstraction/simplification as required for implementation in the assessment model. It would seem a basic requirement be that the analyst		No Change.

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				demonstrate that the predictive assessment model is adequate for the purpose in terms of representing repository system geometries, property distributions and spatial correlation and boundary conditions (evolution) (i.e. attempt is made to apply/select predictive methods that remain as faithful as possible to requirements of the site-specific conceptual model). This is somewhat contrary to the current guidance that the conceptual model fit the assessment model rather than the assessment model should be adequately demonstrated to approximate the conceptual model.		
29 5	K.E. Nash, Nuclear Waste Management, OPG	8.0 paragraph 4, bullet 2	C	This is not clear. Please clarify the second clause of this bullet starting "... the predicted consequence that may or may not occur ..." vis-à-vis Section 6.3.1. Does this refer to the consequence distribution? Probabilistic results can be presented in a number of ways, from various aggregate statistical quantities of either consequences or risk, to the distributed quantities themselves. If the selected target is risk based, then clearly an aggregate risk parameter would be a useful output. However, if the selected target is a consequence (e.g. dose), then it may be more useful to present an aggregate dose parameter (e.g. average dose).		Text removed.
29 6	K.E. Nash, Nuclear Waste Management, OPG	8.1 paragraph 5 line 11	C	Please clarify the last sentence.		Text removed.
29 7	K.E. Nash, Nuclear Waste Management, OPG	9.0 paragraph 2 line 2	C	Please clarify if the model referred to is the conceptual model or the mathematical and software model.		No Change.
29 8	K.E. Nash, Nuclear Waste Management, OPG	9.0	C	This section does not discuss expectations or guidance for description of the conceptual site/repository model. As this conceptual model serves as a basis for justifying assessment model adequacy it would seem a pre-requisite to a meaningful assessment of long-term safety. Ideally,		Text will be revised.

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				<p>guidance should be provided on the expectations for conceptual model(s) development/documentation.</p> <p>The three items listed at the end of section 9.0 are arguably parts of the Safety Case, which goes beyond the noted safety assessment in assembling all evidence to support confidence in the understanding of long-term performance. Guidance related to Assessment Documentation should include recognition of all the reports contributing to the understanding/ confidence of repository/facility Safety Case.</p>		
299	K.E. Nash, Nuclear Waste Management, OPG	9.0 paragraph 2 point 1	C	We read "limiting" here to mean the upper and lower bounds of the data. Please clarify.		Text removed.
300	K.E. Nash, Nuclear Waste Management, OPG	Glossary – alternative indicator	C	Alternative indicators are generally complementary end-points; this is not reflected in this definition. The last sentence could be added to by some words such as: "and as surrogates for exposure where habits are not known".		No Change.
301	K.E. Nash, Nuclear Waste Management, OPG	Glossary – collective dose	C	Collective dose may not include radiation exposure to <u>everyone</u> . For example, collective dose to a particular group such as those occupationally exposed may be useful, or the collective dose may be truncated, or given in dose ranges or temporal ranges. Based on wording is given in ICRP 60, paragraph 34, the following might be a suitable definition: "Collective dose is the total radiation exposure to everyone in an exposed group affected by an activity. It is the product of the number of exposed individuals in the exposed group and the average dose to those individuals. If several groups are involved, the total collective dose is the sum of the collective dose for each group. "		Text removed.
302	K.E. Nash, Nuclear Waste Management, OPG	Glossary – institutional controls	C	Suggest a wider definition. Institutional control could be used to prevent access even if not needed to control risks. Suggest use IAEA definition: Control of a waste site by an authority or institution. This control		Text will be revised.

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				may be active (monitoring, surveillance and remedial work) or passive (land use control).		
303	K.E. Nash, Nuclear Waste Management, OPG	Glossary - model	C	A model can also represent or synthesise an understanding of a system, e.g. a geological system. Suggest use IAEA definition. Qualitative model and quantitative model are not defined.		Text removed.
304	K.E. Nash, Nuclear Waste Management, OPG	Glossary - waste management system	C	<p>The definition of "waste management system" in the glossary does not appear consistent with usage here, e.g. Section 7.3.2. Perhaps two terms should be defined:</p> <p>System (or disposal system, or waste management system), using the ISAM meaning: The disposal system can be considered to consist of the following components:</p> <ul style="list-style-type: none"> — The near field — the waste, the disposal area, the engineered barriers of the disposal facility including the disturbed zone of the natural barriers that surround the disposal facility. — The geosphere — the rock and unconsolidated material that lies between the near field and the biosphere. It can consist of both the unsaturated zone (which is above the groundwater table) and the saturated zone (which is below the groundwater table). — The biosphere — the physical media (atmosphere, soil, sediments and surface waters) and the living organisms (including humans) that interact with them. <p>(Section 3.2 of <i>Safety Assessment Methodologies for Near Surface Disposal Facilities, Results of a co-ordinated research project - Volume 1, IAEA 2004.</i>)</p> <p>Facility – definition consistent with the NSCA, and referring to a long-term storage or disposal facility which is the subject of a licence or a licence</p>		Text removed.

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				application.		
30 5	K.E. Nash, Nuclear Waste Management, OPG	General	E	Editing is required throughout for: 1. Grammar (Sometimes it is not clear what is proposed, e.g. Section 7.5, paragraph 2, see above. Generally we have <u>not</u> included specific comments on this.) 2. Repetition 3. Use of terms (e.g. "aggregated"). 4. Reference numbers and dates. 5. Consistency of reference style in the footnote with that in the text. (HL) 6. All footnotes should be checked to confirm that they are included in the References (e.g. 7.5.2 footnote includes A Design Basis Glacier Scenario, OPG 2001. However, this is not listed in the Refs). 7. Typos e.g. extra words presumably from previous editing. 8. Paragraph breaks to help identify the separate points made e.g. Section 5.2, paragraph 2, last sentence, regarding residual contamination.		Text will be revised.
30 6	K.E. Nash, Nuclear Waste Management, OPG	2.0 paragraph 1	E	This could be reworded ".....the potential long-term impacts that radioactive waste storage and disposal may have on..."		Text will be revised.
30 7	K.E. Nash, Nuclear Waste Management, OPG	3.1 paragraph 1 line 2	E	The types of facilities could be specified (presumably Class I facilities, and uranium mines and mills).		No Change.
30 8	K.E. Nash, Nuclear Waste Management, OPG	5.0 paragraph 1 point 2	E	Should read ".....stored in above-ground and shallow in-ground structures; and"		Text will be revised.
30 9	K.E. Nash, Nuclear Waste Management, OPG	5.0 paragraph 1 point 3	E	Should read "...in water-filled bays or various types of dry storage structures." Each waste owner uses a different type of dry storage structure; OPG – casks, AECL & NBP – silos and HQ – vaults. Should state "...or in dry storage casks or vaults. "		Text will be revised.
31	K.E. Nash,	6.2	E	This sentence ("Safety assessments...future.") would		Text removed.

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0	Nuclear Waste Management, OPG	paragraph 3 line 1 – 3		benefit from expansion, perhaps using words from ICRP 81, paragraph 41.		
31 1	K.E. Nash, Nuclear Waste Management, OPG	6.2 paragraph 4 bullet 4	E	Suggest drop word "Any".		No Change.
31 2	K.E. Nash, Nuclear Waste Management, OPG	6.3.1 paragraph 2 line 1	E	Grammar: This could be written: "Another way of measuring compliance with radiological protection requirements is to use radiological risk...".		Text will be revised.
31 3	K.E. Nash, Nuclear Waste Management, OPG	6.3.1 paragraph 3 line 2	E	Please clarify. Does the second sentence mean "This results in equivalence of the statutory dose limit to a radiological risk of about..."?		Text will be revised.
31 4	K.E. Nash, Nuclear Waste Management, OPG	6.3.3 paragraph 1 bullet 8	E	(Spelling) "Contamination" should be "containment".		Text will be revised.
31 5	K.E. Nash, Nuclear Waste Management, OPG	7.0	E	Since the ISAM approach appears to be the recommended approach to long-term assessments, it would seem appropriate to consider structuring the subsections of Section 7 as per the 5 key elements listed in the introductory paragraph of Sec 7. Specifically the five subsections should be: 7.1 Assessment Context, 7.2 System Description, 7.3 Assessment Scenarios, 7.4 Assessment Models, and 7.5 Analysis of Assessment Results. The existing information in Section 7 could be reorganized into these five subsections.		Text will be revised.
31 6	K.E. Nash, Nuclear Waste Management, OPG	7.2.3 paragraph 2	E	This paragraph would fit better in the intro to Section 7.2. "The data used..." does not appear to belong under Section 7.2.3. Suggest moving to Section 7.2 after 1 st paragraph. More discussions are needed in Section 7.2.3.		Text will be revised.
31 7	K.E. Nash, Nuclear Waste Management,	7.3.2 paragraph 2	E	"Contaminants" should be "waste". At sufficiently long times, small quantities of contaminants may enter the accessible environment via natural transport		Text will be revised.

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	OPG	bullet 4		processes.		
318	K.E. Nash, Nuclear Waste Management, OPG	Glossary – calibration	E	This should be given as “calibration, model” (to distinguish from equipment calibration).		No Change.
319	K.E. Nash, Nuclear Waste Management, OPG	Glossary-deterministic model	E	Suggest use IAEA definition: A simulation of the behaviour of a system utilizing one set of parameters, events and features.		Text removed
320	K.E. Nash, Nuclear Waste Management, OPG	Glossary – event tree analysis and fault tree analysis	E	The definitions of “event tree analysis” and fault tree “analysis” differ in irrelevant wording only, and do not provide a clear distinction.		Text removed.
321	K.E. Nash, Nuclear Waste Management, OPG	Glossary – probabilistic model	E	Probabilistic model – Suggest using the word “represented” rather than “replaced” in first sentence.		Text removed
322	K.E. Nash, Nuclear Waste Management, OPG	Glossary – qualitative assessments	E	The example of natural levels is quantitative.		Text removed
323	K.E. Nash, Nuclear Waste Management, OPG	Glossary – risk quotient	E	The last line could be changed to “...the contaminant may be of concern...”. Depending on the tier of the assessment, an RQ greater than one may just indicate that the model was too conservative.		Text removed
324	K.E. Nash, Nuclear Waste Management, OPG	Glossary – additions	E	Definitions for assessment model and conceptual model should be added to the glossary.		No Change.
325	K.E. Nash, Nuclear Waste Management, OPG	Glossary – additions containment and isolation.	E	May also consider adding definitions for containment and isolation.		No Change.
326	K.E. Nash, Nuclear Waste Management,	General	Scope	In several places, the guidance appears to be specific to disposal rather than including long term storage concepts. Examples include Section 6.1, paragraph		Text will be revised.

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	OPG			3; Section 5.2, paragraph 4; Section 6.3.3; Section 7.4.1 paragraph 2; 7.5.2, paragraph 3.		
327	K.E. Nash, Nuclear Waste Management, OPG	3.1 paragraph 4	Scope	The relevance of the last two sentences (financial guarantee and future financial burden) to the purpose of the current document is not clear.		Text removed.
328	K.E. Nash, Nuclear Waste Management, OPG	5.0 paragraph 1 first sentence	Scope	This should not be limited to the "nuclear industry". Medical and industrial activities can also generate relevant waste. Possibly also non-nuclear mining activities?		Text will be revised.
329	K.E. Nash, Nuclear Waste Management, OPG	5.0 paragraph 1 point 2	Scope	Add "... from nuclear research facilities, <u>and industrial and medical applications...</u> "		Text will be revised.
330	K.E. Nash, Nuclear Waste Management, OPG	5.0	Scope	This section should address legacy wastes, e.g. contaminated soil per Port Hope.		Text will be revised.
331	K.E. Nash, Nuclear Waste Management, OPG	5.2 paragraph 2 ^{1st} sentence	Scope	The concept of isolation is of questionable applicability to a long-term storage facility. (See definition for storage in glossary.) This paragraph should be reworded as necessary.		No Change.
332	K.E. Nash, Nuclear Waste Management, OPG	5.2 paragraph 2	Scope	The reference to multiple engineered barriers may not be appropriate to long-term storage systems. For example, current designs for interim storage of used fuel incorporate defence in depth, provided by a robust waste form, monitored containment, a secure site, and ongoing inspection and maintenance. However, these barriers might not all be regarded as "engineered barriers".		No Change.
333	K.E. Nash, Nuclear Waste Management, OPG	6.3.1	Scope	Use of risk and a risk target (as opposed to the current dose limit) may not be appropriate for storage, where because of the need for ongoing inspection, maintenance and monitoring, uncertainties may be less and where scenarios can be more clearly defined.		No Change.
334	K.E. Nash, Nuclear Waste	6.3.1 paragraph	Scope	For long-term storage facilities, where monitoring can be used to confirm compliance with regulatory		No Change

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	Management, OPG	1 line 7 - 8		requirements, and where development can be controlled, the requirement for a dose constraint below the regulatory dose limit, to be applied to analyses which are already conservative, may not be appropriate.		
335	K.E. Nash, Nuclear Waste Management, OPG	7.3.2	Scope	There is a heavy emphasis on disposal; the guidance should be generalized to information about long-term storage and disposal of all types of radioactive waste.		No change.
336	K.E. Nash, Nuclear Waste Management, OPG	7.4 intro	Scope	Some consideration as to how the requirement for repackaging could be addressed in assessments of long term storage would be useful.		No Change.
337	K.E. Nash, Nuclear Waste Management, OPG	7.4.2 point 2	Scope	Societal acceptance is not part of the scope, as described in 2.0 Scope		Text removed.
338	K.E. Nash, Nuclear Waste Management, OPG	7.4.2	Scope	Some consideration as to how the requirement for ongoing institutional controls could be addressed in safety assessment of long term storage and what the issues might be would be useful. In addition, these paragraphs, as written, do not address (may possibly exclude) indefinite storage.		Text will be revised.
339	K.E. Nash, Nuclear Waste Management, OPG	7.6 paragraph 5	Scope	Guidance on optimisation with respect to intrusion for assessments of long term storage, which by definition remains accessible, might be useful		No Change.
340	K.E. Nash, Nuclear Waste Management, OPG	8.1 paragraph 2	Scope	The suggestion that the 95th percentile should be used may not be appropriate for storage, where uncertainties may be less, as noted above.		Text removed.
341	K.E. Nash, Nuclear Waste Management, OPG	Glossary – long term	Scope	This definition is not applicable to safety assessment of concepts for long term storage. The glossary definition for both 'long-term' and 'storage' should be checked and generalised to ensure compatibility with the stated purpose of the document.		Text will be revised.