Attachment 2

REVIEW COMMENT RECORD (RCR)	**Document(s) Reviewed:** OR Radioactive Waste Rulemaking "Part 1 revision"	**Page 1 of 4** **Date (Response Due)** 06/30/2023

Document(s) Reviewer (Name)	**Date (Reviewed)**
Tom Sicilia, Matt Hendrickson, Max Woods	

Item	Commenter	Section	Comments	Comment Resolution
1.	LWV	0006(d)(A)	Comment: I appreciate insertion of a specific requirement at (A) for authorization from the Oregon Health Authority (OHA) certifying that sufficient systems, structures, and processes are in place to ensure safe handling and storage during temporary storage" "...First, I believe that specific reference/emphasis needs to be made to ensuring the inclusion of "appropriate employee training and protection"	Response: Licenses issued by OHA include health and safety provisions and training. ODoE is not responsible for these subjects Action Taken: accepted, refined OHA determination, added language about what should be in the plan -00xx(5)(d)(i)(A-D)
2.	LWV	0006(d)(B)	Comment: I appreciate ODOE's insertion at (B) of an outside limit on this type of storage. I request consideration of the addition of language indicating the consequences of failure to follow the rule, including for failure to effect legal disposal out of state by 180 days.	Response: an unlicensed waste disposal facility under ORS 469.525 would be subject to a notice of violation and subsequent penalties. To avoid this, an entity could apply for an RPS license or legally dispose the material within the allotted time. Action Taken: included 00xx(4) as a clause connecting the rulesets.
3.	OBI	0006(d)(A)	Comment: "leaves the regulated community exposed to meet an unknowable, undefined standard of what "Sufficient systems, structures and processes"	Response: The standards are well established with OHA and RPS authorities. Action Taken: Rephrased 00xx(5)(d) to reflect this for unlicensed facilities only
4.	OBI	0006(d)(B)	Comment: "our reservations relate to the potential that temporary storage of radioactive waste should or could be limited to 90 or even 180 days.." "imposing an inflexible 90 day temporary accumulation deadline" "allow generators to accumulate waste on site for up to one year without prior written authorization"	Response: It is in Oregon's interest that unlicensed radioactive materials be disposed of expediently to minimize negative impacts. Any accumulation of radioactive waste shall be done under a license. Action Taken: accepted, provided that the generator is acting under provisions of a RPS-issued license. Added language to that effect in section 00xx(5)(a)
5.	WM	0006(d)(B)	Comment: WM Proposes changes to the language in (B) as outlined in the changed text to clarify the requirement for authorization to store. WM supports an increase to 1-year in total, as the materials in question pose no significant risk to public health and safety during storage. The 1-year time frame may be necessary to accumulate sufficient quantities for shipment out of state.	Response: see 4 Action Taken: see 4
6.	OBI	050-00X0 Component 1	Comment: "we object to the term "likely"	Response: accepted Action Taken: removed likely, and edited section

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7.	OBI	050-00X0 Component 2	Comment: "reconsider the requirement for a person to report a materials "discovery" as a radioactive waste "as soon as possible , but within 10 days" " "As written, the proposed notice and reporting language will impose new compliance risk and administrative burden on regulated entities that are already doing their part to identify their waste as radioactive "	Response: see 4 Action Taken: edited section to reflect unlicensed facility. Clarified that notification would be expected within 10 business days for more time flexibility.
8.	LWV	00X0	Comment: "There should be a clear and complete description of the procedure the Department *must or will* implement in response to discovery of radioactive materials—to determine all factual matters related to the material, establish an enforceable timeline, and/or other requirements to develop a plan of action in response. The process should be clear, well publicized, timely, enforceable, and effective. The consequences of discovery of such materials without subsequent and timely reporting should also be spelled out"	Response: see 1 and comments on 0006(d) Action Taken: ODOE's Enforcement authority and penalty structure is established in a separate ruleset.
9.	WM	0020	Comment:" WM has expressed on several occasions that the inclusion of a lead-210 limit is costly to the regulated community and does not convey any additional public health and safety protections..." "Pb-210 can be present at a higher activity concentration than Ra-226, such as in some oil and gas waste streams that are concentrated in Pb-210, Pb210 is a low energy beta-gamma emitter, consequently, risks from external exposure are negligible. Generally, Pb-210 is relatively immobile in groundwater due to its tendency to adsorb onto solid particles and sediments." "Further, as Pb-210 is a low energy beta-gamma emitter, it is notoriously difficult to detect. Examining the laboratory data from nearly all pathway exemption reports to date indicates that Pb-210 is detected only ~30% of the time with gamma spectroscopy and ~50%"	Response: While Lead-210 itself is relatively low in radiotoxicity, its daughter product Polonium 210 is extremely radiotoxic and readily accumulates in aquatic organisms. Normally this isotope is regulated under the U-238 standard of 10 pCi/g (which includes daughters, assuming equilibrium). The majority of elevated analytical detection limits in pathway analyses are in samples with elevated Ra-226 and/or U-238. A exemption standard for enriched Lead 210 where common (fossil fuel related refining storage tanks, pipe, etc) is protective to the public, as a plugging of the equilibrium assumption loophole. Action Taken: Narrowed language in 345-050-0020(4) to indicate the exempt concentration applies to materials which have been found to be more commonly enriched in Lead-210.
10.	OBI	0020	Comment: "...lead-210 into the revised tables, OBI requests that ODOE provide this RAC additional time in which to consider any such changes as we are concerned about potential increased monitoring costs to the regulated community without corresponding benefit to public health and safety	Response: The issue of potential wastes enriched with Lead-210 has been discussed since 12/2021. Additional time to provide comment on the revised language will be available in the final 30 day RAC period and in the formal EFSC comment period. Action Taken: see 9

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11.	OBI	0025	Comment:...lead-210 into the revised tables, OBI requests that ODOE provide this RAC additional time in which to consider any such changes as we are concerned about potential increased monitoring costs to the regulated community without corresponding benefit to public health and safety	Response: see 10 Action Taken: see 9
12.	WM	0030	Comment: WM disagrees with the addition of "excluding NORM materials" . WM feels this language is too expansive as NORM is ubiquitous, and WM believes the conditions contained in this section adequately cover the exemption.	Response: agree - the NRC does not regulate NORM and therefore Norm would not be included in an NRC license for consumer products. Action Taken: Removed "Excluding NORM materials"
13.	WM	0030(3)	Comment: WM envisions a system where a site specific Radiological Monitoring Plan would be approved by ODOE in coordination with OHA..." Costs to the regulated entity for holding a transportation asset are significant and unwarranted. Additionally, the risks to the public and particularly the worker health and safety far outweigh the benefits for sorting through the 20 to 25 tons of waste in load to find the material."	Response: We are hopeful that a facility specific plan can find methods of demonstrating compliance to the greatest extent practical without creating undue cost or risk to workers. Action Taken: added 0030(4) and clarified what would be expected in the facility specific plan.
14.	ORRA	0030(3)	Comment: "Although the amount of radioactivity in the municipal waste is often small, detection systems used by solid waste facilities are often sensitive enough to detect radioactive contamination... Such material is deregulated by the NRC and the Department of Transportation (DOT)... In fact, more invasive procedures such as sifting through loads of municipal solid waste present a greater danger to solid waste workers.. common medical radioisotope (e.g., I-131 or Tc-99m) with a half-life of 120 days or less, the facility should be able to process and dispose of the radioactive material."	Response: It is our intention to have the facility-specific plan be readily implementable to document compliance with our rules, so that there is a way to confirm that the anomalous waste is metabolized medical waste. Action Taken: see 13
15.	WM	0035	Comment: At this time WM understands that no further revisions to the current Pathway Exemption process are being contemplated at this time. WM agrees with this approach as we agree these pathway exempt materials do not present significant danger and the current process provides adequate health and safety protections for the facility staff, the public, and the environment. WM therefore does not support any changes to the current pathway exemption process without the recognition of the many protections provided by modern disposal facilities for NORM bearing wastes.	Response: Outside of current scope Action Taken: Will address in future

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16.	OBI	0035	Comment: " Said differently, businesses that already call Oregon home and that safely dispose of pathway exempt materials with ODOE's prior knowledge and approval should not be subject to continued uncertainty as ODOE continues to consider future changes to its pathway exemption rules. Any such changes should be limited in application to businesses or materials not previously evaluated or approved by ODOE for disposal. Businesses operating under current ODOE approved pathway exemptions should be entitled to continue to rely on those exemptions (both at present and on renewal) for materials previously considered safe for disposal by ODOE."	Response: the currently proposed rules exempts wastes that were legally disposed as long as they remain in place. The intent is to provide certainty that if the pathway exemption changes in the future, the waste will not have to be retrieved, provided it was disposed legally. If additional waste is identified that was not legally disposed, the plan of action will be assessed on a site-specific basis. Action Taken: A specific exemption removes legally disposed wastes (disposed under a pathway exemption) from further action provided they remain in place.

Name2	Shirley Weathers	Andrew Lombardo, CHP	Jamie Jones	James Denson	Sharla Moffett	ODOE Response
Is the Pathway Exemption framework still necessary and protective? (Relevant Rules: OAR 345-050-0035 through 0038)	a) Is it still necessary? As I understand it, the Pathway Exemption framework is one of four rule-based exemption mechanisms currently on the books, along with Exempt Concentrations, Exempt Quantities, and a collection of Specific Exemptions. Any or all of these are potentially subject to change as a result of SB 246 [ORS 469.300(23)(b)(A)] through the current rulemaking process. I don't feel adequately informed on the technical/scientific aspects involved to have a strong opinion about which of these mechanisms, including the Pathway Exemption, should be retained, modified, or replaced/eliminated. But one thing stands out as a critical test for this rulemaking process, including as we go through these discussions: Whether the resultant rules conform to the law and most specifically at ORS 469.300(23)(b)(A), i.e., "Materials identified by the council by rule as presenting no significant danger to the public health and safety [emphasis added]." I assume that, although the Attorney General's Opinion referenced in background materials included as a "given" acknowledges that the Legislature did not intend to ban all materials containing radioactivity, the council must 1) be bound in its decisions about "no significant danger" by science, 2) consider the safety of the current and far-future "public," and 3) comply with the long-held interpretation of ORS 469.300(31) that any evaluation of waste material to determine whether or not it qualifies as "radioactive waste" must occur as it is at the point of evaluation. There appears to be some interest in loosening various aspects of exemptions for purposes such as cost-effectiveness, administrative ease, simplicity, convenience, likelihood, etc. But it appears clear that the law requires that no other priorities must be pursued at the expense of the public, now and in the distant and unknowable future. b) Is it protective? There's a significant technical side of this that, again, is beyond my expertise, but for me there' a troubling inadequacy via the Pathway Exemption and across all of the mechanisms that offer exemptions: there appears to be nothing to limit cumulative impacts. This is the subject of Q#13 below, but I will raise it here in my first remarks because cumulative impacts appear to me to be among the most important issues on the table as Division 50 rules are under consideration.	The pathway exemption framework is necessary but needs revised/updated to encompass risk-based regulation revisions that have occurred federally and at the state level since the Oregon rule was last revised. *[Note from ODOE: what specifically is meant by risk-based regulation? Is this referring to the Excess Lifetime Cancer Risk metric described by EPA? In this case, the relevant standard may be 12 mrem/yr to correspond to the upper end of the CERCLA risk range. What is meant by the state-level regulations?]*	Based on information provided during previous RAC meetings, the current Pathway Exemptions do not appear to be protective. However, DEQ defers to ODOE and other experts on this question, and recommends that any changes to current rule ensure clear compliance points.	Yes, the pathway exemption framework is still necessary and is very protective, however revisions are necessary. This basis for the pathway exemptions need updating, see comments below.	Yes, the pathway exemption framework is still necessary and is very protective. Our detailed comments below explain revisions that we propose to the Pathway Exemption framework for consideration in this rulemaking.	Regarding cumulative impacts, two thoughts: 1. For surface disposal (not in a landfill), the impacts from the co-located disposal of multiple pathway exempt wastes are incorporated in the current rule by assumi the waste occupies a semi-infinite plane up which a house is built. [add discussion of assumed thickness of the waste layer and h the dose doesn't change after a certain thickness is reached- from the older discussion]. In essence, each pathway exemption assumes that an entire landfill i composed of that one waste. 2. As described in the February 2022 RAC meeting, the current statutory definition o radioactive waste in Oregon is clearly base on the waste itself, not taking into accoun context of its disposal (e.g., shielding from land cover). The original Division 50 rulemaking documentation supports this interpretation, as well as the concept that t definition of radioactive waste should resu "no permanent commitment of land" from radiological risk perspective. 3. While not allowed in Oregon as described above, the Argonne National Lab study fro 2015 (https://deq.nd.gov/Tenorm/ArgonneStud NL-NDDH%20TENORM%20Landfill%20Study% ANL%20EVS-14_13)%20Final%20Report.pd evaluated the future health risks associate with a residential scenario for a landfill tha had 10% of its volume filled with TENORM. maintain doses below 100 mrem, the concentration limit was 130 pCi/g Ra-226 assuming all waste was buried 2m deep. If depth was increased to 3m, the concentrat limit would increase to 360 pCi/g (Table 6.1 This study bounds the realistic potential cumulative risk in an Oregon landfill, as the real proportion of TENORM waste in landfi is far lower and the depth of disposal is like to be deeper than 3m. 4.

Commented [BJ*O1]: The big idea (saved for posterity)
- •Requires statutory change
- •Name the waste you don't want (e.g., fracking waste) rather than prohibit based on radioactivity?
- •Create a path for risk-based management of landfills. Define "NOT radioactive waste landfills" that can nonetheless accept radioactive materials so long as they won't cause the landfill to become radioactive.
  - ○25 mrem or 12 mrem standard (using Argonne study as basis, 25 mrem equivalent = 32.5 pCi/g if assuming 2m of cover material; 90 pCi/g if assuming 3m). 12 mrem standard with 3m cover = 45 pCi/g.
  - ○^above concentrations would allow most Oregon zircon wastes but prevent the OWL fracking waste example based on weighted average in that case.
  - ○Restrict % of TENORM allowed (Argonne study assumed 10%)
  - ○Include a well driller scenario to ensure no "permanent commitment of land" from the original basis documents. May affect concentrations described above b/c the Argonne study did not include a driller above the waste.
- •Restrict to new landfills only? Addresses the % of TENORM uncertainty from past practice and reassures current host communities.
- •Designate TENORM a special waste subject to DEQ oversight?
- •ODOE retains responsibility for approving waste acceptance criteria to ensure the dose limit is not exceeded.

Commented [BJ*O2]: Notes to self to incorporate in rule draft:
- •Add lead-210 to Table 1
- •Clarify Table 1 footnote re: equilibrium
- •Convert units in Table 3
- •Clarify that all NORM nuclides need to be analyzed and fractioned in the leach test 0038.
- •Compare radon risk of crawlspace model vs. default foundation in RESRAD – which is more restrictive?
- •Discuss air changes per hour in radon model
- •Clarify blending and averaging rule

Should additional exposure pathways be included in the Pathway Exemption rules? (e.g., plant uptake, livestock) (Relevant Rules: OAR 345-050-0035)	In view of the supremacy of the charge to protect the public health and safety, if there are pathways that pose risk that are currently outside of the scope of required evaluation of waste for safety, the answer would seem to need to be yes. Beyond that, I'm not clear enough about the science and therefore can't anticipate what additional pathways might look like. More information, including perhaps scenarios indicating how these or other radionuclide-bearing materials potentially affect the public on the ground, would be helpful. For now, though, I noted that the discussion in RAC #3 around this particular subject matter seemed to trigger expressions of interest in developing different set of exemption standards for landfills and land spreading (some scenarios of what that entails could be helpful). But would evaluating radioactivity levels based on the means of disposition rather than as is at the time of evaluation comply with the law? (See Q#3 and Q#11 below.)	Yes. Consistent with the current federal and state risk-based regulation revisions, the public exposure limit of 100 mrem per year Total Effective Dose Equivalent (TEDE) and the dose (risk) assessment methodology associated with the risk-based limit, to convert from 100 mrem TEDE to concentrations of specific radionuclides may be implemented. The dose (risk) assessment includes up to nine environmental pathways (including the 3 used in current pathway exemption methodology) as applicable. This framework allows for up to 100 mrem/year of public exposure sum-total of all relevant pathways. *[ODOE Note: How would specifying a TEDE materially change the current pathway exemption? Would it require combination of the three existing pathways, plus potentially others including inhalation and ingestion? For reference, surface disposal of 5 pCi/g of Ra-226 and Pb-210 in a RESRAD default scenario would result in 368 mrem/yr to a resident, 278 mrem of which comes from radon. Plant ingestion accounts for an additional 55 mrem, and gamma adds 32 mrem.]*	DEQ recommends all potential exposure pathways be included.	From our perspective, a landfill disposal scenario must be recognized that incorporates risk-based analyses of the protections that safe landfill disposal of these materials affords. If pathways such as soil ingestion, plant ingestion following plant uptake, etc., are to be considered, the exposure pathways need to be evaluated for both the land application scenario and landfill disposal using a risk-based approach. This risk-based analysis should consider environmental fate and transport properties of the radionuclide in question, taking into account the pertinent environmental setting and realistic receptor exposure scenarios.	Additional exposure pathways should be included provided the current approach is modified accordingly, e.g., allowances for the landfill disposal scenario. As is, the current approach is very conservative, and the consideration of additional pathways within the existing framework would be needlessly prohibitive. The pathway exemption framework should either be maintained as is or modified in its entirety to include additional pathways of exposure while also acknowledging when pathway exempt wastes are disposed of in landfills that have covers and other barriers that prevent exposures. The current approach considers external gamma radiation (OAR 345-050-0036) and indoor radon inhalation (OAR 345-050-0035(5)) exposure pathways. In addition, OAR 345-050-0038, the water pathway, assesses ingestion of radioactive material present in effluents. It is not clear if the derivation of the OAR 345-050 Table 3 limits included multiple exposure pathways beyond direct ingestion, such as plant uptake of the effluent followed by human consumption, animal consumption of the effluent and/or plants followed by human consumption, etc. The limiting pathway however would be direct consumption of the effluent. The federal guidance related to effluent concentration limits (e.g., Table 2 of Appendix B in 10 CFR 20) can be used to demonstrate this. Given how conservative the current approach is, consideration of additional pathways would need to be analyzed extensively to determine if they would be limiting or inconsequential. For example, if the OAR 345-050 Table 3 values are not currently inclusive of additional water pathways (such as plant uptake and ingestion), an analysis would need to demonstrate that pathways beyond direct effluent consumption can have a consequential effect on dose. Additionally, the methods and assumptions used in developing these limits should be fully transparent, like the federal Appendix B Table 2 limits referenced above. If pathways such as soil ingestion, plant ingestion following plant uptake of soils, etc., are to be considered, a new set of concentration limits would need to be determined for the environmental soil medium. These limits should be realistic and based on resulting soil concentrations at a site and not on waste concentrations. Table 3 limits are compared to the leachate concentrations where the ability of a radionuclide to leach out of the waste is dependent on both the elemental properties of the radionuclide and the waste form in question. If soil-based pathways are to be considered, a similar analysis used to determine Table 3 values would need to be performed for soil concentrations. As with Table 3, these limits would apply to environmental media and not the waste itself. This analysis should consider environmental fate and transport properties of the radionuclide, assumed site characteristics of a typical landfill (such as caps, spreading, etc.), and realistic	The ODOE interpretation of OSR 469.525 and ORS 469.300, including the historical underpinnings of the Division 50 ruleset, provide clear guidance that under the current statutory structure we are not able to use the features of the disposal facility (e.g., land cover or liners) as a basis to determine that the waste itself is not radioactive. Once Oregon determines that a waste is not radioactive, its disposal is not limited to certain depths within landfills even though the reality is that most pathway exempt wastes have been disposed in landfills.

Commented [SO3]: what about a waiver to plant based uptake if an aquatic tox report from a lab indicates that the material can not sustain plants- but otherwise a cumulative assessment must pass gamma, water, and uptake at less than 100, and pass radon- basically the same pathway tests we have now plus plant uptake taken from resrad at default parameters?

Commented [BJ*O4R3]: I don't think the material has to sustain plant roots for the radioactivity in the material to migrate and be uptaken. Now what if we performed some kind of plant uptake analysis based on the leachate lab results instead of based on the concentrations in the waste? I don't know how it's done (or if RESRAD already approximates this), but it might get closer to the true pathway of concern.

Also let's remember that in 99% of cases, plant uptake is not physically viable unless the entire landfill is overturned. Regulating to this standard across the board is a pretty severe move.

					receptor exposure scenarios.As an example, the current Ra-226 concentration in waste is 5 pCi g−1 (OAR 345-050-0030(2)). This value likely comes from the EPAs 40 CFR 192.12 limit of 5 pCi g−1 for residual radioactive materials from inactive uranium processing sites. This limit is based on a total effective dose equivalent (TEDE) of 100 mrem yr-1 from all exposure pathways related to Ra-226 (excluding radon). However, the EPA's use of the 5 pCi g-1 limit is different than that used by the state of Oregon. The EPA applies this limit to the top 15 cm of soils averaged over 100 m2 whereas Oregon applies it directly to waste concentrations. The EPA is accounting for dilution from native soils and averaging over a given area, allowing for a more realistic analysis of potential exposure pathways. It would be overly conservative to assume that the Ra-226 concentration in a waste is equivalent to the environmental soil concentration used in exposure pathways for which a hypothetical receptor would be exposed to externally, grow and consume crops from, etc.	

Commented [BJ*O5]: This is true because we assume the waste is spread in a semi-infinite plane. It essentially becomes the soil and is therefore equivalent to the EPA limit.

Should pathway limits be assessed individually, or as a cumulative impact? If cumulative, should radon be included, or as a standalone, separate assessment?	Cumulative impacts appear to me to be among the most important issues on the table as Division 50 rules are under consideration. From my lay perspective, the extraordinary duration of the dangers of radioactivity and the quantities of radioactive waste that are generated and need to be disposed of, I have deep concerns that individual assessments are largely meaningless in terms of their ability to protect the public health and safety unless the rules are augmented to include some way to address accumulation of radioactivity. Unless I'm missing something, while Oregon's overall approach is superior to other states, it still appears all of the current rules used to evaluate whether waste is exempt versus radioactive (illegal) apply to individual quantities at the time of evaluation, without any regard to accumulation of similarly exempted waste over time. What this seems to mean is that Oregon's overall waste disposal regulatory construct, allowing for exemptions of radioactive material as it does, simply fails the test of ensuring "no significant danger to the public health and safety." The absence of a response to accumulation of exempted radioactive waste level also seems to open the door to strategic manipulation by producers, shippers, etc., of such waste. In a hypothetical case involving presentation at the gate of a landfill, assume one truck just barely passes muster under whatever Pathway Exemption may be devised. But what if that truck is actually the first in a convoy of trucks all with similar loads, managing somehow to present themselves as individual loads? What if another similar convoy appears the following day, the day after that, the week after that, and so on? And I don't believe we can just look at the potential for accumulations in landfills. (See also answer to Q#13 below.)	The public exposure risk-based limit combined with risk assessment to determine concentrations of individual radionuclides (see number 4) framework allows for up to 100 mrem/year of public exposure sum-total of all relevant pathways.	DEQ defers to ODOE and other experts on this question, and recommends that any changes to current rule ensure clear compliance points.	We support limits being developed based on cumulative impact to the affected receptor as this is how the exposure impacts the receptor, with the exception of radon. Radon is regulated separately as indoor radon is the most important source of radiation exposure to the public and is therefore appropriately regulated separately by most regulatory bodies.	For simplicity, the current approach should be maintained or limits should be assigned and assessed on a cumulative basis, with the exception of radon. The EPA regulates radon separately through 40 CFR 192.02 with a limit on the release to atmosphere of 20 pCi m-2 s-1. They also remove radon and its progeny from the 40 CFR 190.10 RGP of 25 mrem yr-1 to any member of the public as the result of radioactive material discharges to the environment from the uranium fuel cycle operations. There are two important scientific and technical reasons for the distinction between radon and other radionuclides. First, radon is the only naturally occurring radionuclide that is an inert gas. Its emanation from radium-bearing soil, rock, and building materials results in substantial exposures in indoor environments from the inhalation of the short-lived radon progeny which is responsible for most of the dose to the lung. As a result, it is unique among the radionuclides with regard to the importance of this exposure pathway. As a result, indoor radon is the most important source of radiation exposure of the public. More importantly though, the relationship between exposure to short-lived decay products of radon in air and the associated risks (i.e., lung cancer) can be estimated, with some uncertainty, from epidemiologic studies in various groups of uranium miners. Therefore, the risk posed by exposure to indoor radon can be estimated without the need to develop models for estimating doses to radiosensitive tissues of the lung from irradiation by alpha particles after inhalation and without the need to apply assumptions about the dose per unit intake and the risk per unit dose. Radon is unique among the radionuclides in this regard is therefore appropriately regulated separately by most regulatory bodies.	Re: Weathers: The concept of the comment is a valid concern, which sparked deeper reflection. Because the current rule envisions a semi-infinite plane of material, in a sense it already assumes a "landfill" full of just that one waste in question. Therefore, the pathway exemption evaluation of a waste at X pCi/g of Ra-226 is already built on the assumption that an entire convoy of trucks could have disposed material at that concentration on the ground surface. The reality is that such wastes are commingled with less concentrated non-NORM bearing wastes when disposed in landfills. See also the prior comment about the Argonne study and the 10% TENORM inventory assumption. No landfill in Oregon has come close, but we could potentially adjust the "expected period of waste generation" to include consideration of multiple streams to the same facility. This gets into regulating a facility instead of regulating the waste, however, and it creates differing definitions for a given waste stream depending on whether it is going to a hypothetical landfill that has already accepted large quantities of NORM in the past vs. one that has very little NORM. Staff agrees with the comments that advise keeping the regulation of radon exposure separate from the cumulative exposure pathw dose, consistent with federal regulations.

Commented [SO6]: this is an interesting thought experiment. if all the pathway wastes in a landfill pass the leachability test (including the leachate itself), is there really a risk of accumulating radium in water? lead would be the potential problem, but that has a short ish half-life, no?

Commented [BJ*O7R6]: Agreed. I don't know why this hadn't occurred to be before when we pondered cumulative effects of multiple pathway streams.

Is the 7-day deadline for disposing radioactive waste appropriate? What alternatives should be considered? (Relevant Rules: OAR 345-050-0006)	There seems to be some agreement that seven days is inadequate/unrealistic and the flowchart presented seems to demonstrate that, as well. I'll look forward to seeing alternatives agency staff present, but at the same time, it seems clear that the prohibitive intent of the current rule and the law it implements are deliberate. The previous RAC on Division 29 rules focused concerted attention on reinforcing the state's prohibition on radioactive waste. Part of that effort stemmed from a commitment to greater clarity about Oregon's commitment to accepting/storing radioactive waste. Among other actions, violation of the current OAR-050-0006 was upgraded to a Class II violation and made punishable by fines and other costs. No one would advocate for retaining an unachievable deadline to eject offending waste from the state, but whatever is devised to replace the current rule must not send a message to external producers or transporters of this waste either. When unacceptable waste is identified, the state's response must be reasonable, but at the same time, it must be clear that it must be gone as soon as reasonable possible after discovery/assessment as such. Another potential issue that hasn't really been considered is that a "we'll work with you" approach could result in administrative and/or storage nightmares for agencies, landfills, and possibly private landowners or public land managers.	7 days is not sufficient to arrange for transportation and disposal of the waste- suggest replacing the 7 day provision in the rule with a 45 days- longer hold times should be allowed if the generator can demonstrate active efforts to arrange for proper disposal.	DEQ defers to ODOE and other experts on this question.	As outlined in the RAC meetings in the presentation, 7 days is not sufficient to arrange for Transportation and Disposal of their wastes. We suggest the removal of the 7-day provision in the rule and replace it with a 45-day period, longer hold times should be allowed if the generator can demonstrate active efforts to arrange for proper disposal to the agency.	As it is currently worded, OAR 345-050-0006 to applies to the management of radioactive wastes when disposed. The he current rule language does not regulate how long a waste can be temporarily accumulated at the site of its generation or use (e.g., at a facility exempted from or operating under a specific or general radioactive materials license) prior to its disposal. Instead, we understand this rule applies once a material that has been properly characterized as Oregon radioactive waste is removed from its place of generation or use, for disposal. In short, this rule makes clear that radioactive waste being processed for disposal has 7 days to leave the state of Oregon for management at a licensed radioactive waste disposal site. We see no reason to reconsider or revise that requirement.	Staff proposes a limit of 90 days until waste classified as radioactive waste must exit the state for disposal, though longer hold times may be allowed if the generator can demonstrate to the department that action has been taken to remove the waste as soon as reasonably possible after the determination that the waste is not lawful for disposal in state. This proposed limit is based on the realistic quarterly milk-run schedule, and "no greater than 90 day storage" under RCRA being allowed before you become a hazardous waste storage/treatment facility.

Does the 500 millirem gamma dose limit adequately protect public health and safety? Should an alternative dose limit be used for the gamma pathway test, such as aligning with federal limits? If so…	Staying within currently accepted dose and effluent levels appears to call necessarily for a reduction in the annual millirem limit at least to 100 to correspond with current federal standard of health and safety. However, I would appreciate discussion of an even lower exposure limit. Jeff mentioned 25 mrems have been seemed necessary "in some unrestricted uses." I don't see that there was further discussion of that, but would like to see it pursued. Also, the EPA limits for restoration of Superfund Sites could warrant exploration. If the federal agency calls for these limits to protect public health and safety under Superfund circumstances, might we want or even feel compelled to meet those limits? Acknowledging that significantly lower limits may not be popular for some of the reasons I named in the last paragraph of Q#3a above, the law mandates that public health and safety come first. During RAC#3, there was mention of an option to lower the mrem limit to 100, but then simultaneously raising the concentration limit above the current 5 pCi/g. I believe I understood the motivation there to be some kind of technical consistency, but returning to the issue of messaging, might there be a potential for unintended consequences if we make Oregon' allowable concentration ceiling higher than other minimal TENORM-producing states? While we cannot ban "fracking waste" per se, the Department, Legislature, and the public got fully behind the statutory and rulemaking effort we are currently engaged in specifically to prevent illegal dumping like what occurred at Arlington from ever happening again and to give the state effective mechanisms to enforce and respond if it does. Retaining the current 5 pCi/g is another key safeguard we have against attracting unsafe waste—a measure consistently understood across other states. Oregon does not want to become known as having recently decided to raise its limit. It is also a demonstration of commitment to the consensus around passage of SB 246. Another option for change that has been raised—setting one exposure limit rather than retaining the current three (for land, water, and air). Acknowledging the complex technical aspects of this, including why such a change would somehow be preferable, I nonetheless don't believe the overall RAC (and ultimately the council) has had adequate information on how this would work and why it would fulfill the legal responsibility to best protect the public health and safety from significant danger. Ingestion from air versus water seems to have different medical implications, as well.	Consistent with federal and other state regulations, a public exposure limit of 100 mrem/year TEDE may be used.	DEQ defers to ODOE and other experts on this question. However, DEQ recommends considering not just federal limits.	Given the land application basis and the highly conservative other assumptions specifically incorporated into OAR 345-050-0036(1)(b) that tie the gamma survey results to the yearly dose limit the 500 mrem per year, the dose limit threshold is protective of public health and safety especially if the disposal scenario is a landfill. If the new rules to limit the gamma exposure to 100 mrem per year, updated exposure assumptions that are more consistent with a landfill environmental setting (nearest resident vs house on waste) and engineered environmental protections need to be recognized and included. Container geometries included in the regulations should be expanded to include containers that are more representative of those actually used in the state, e.g., supersacks or 20-40yard steel containers. This can and has been done by developing correction factors using software such as MicroShield®.	OAR 345-050-0036(1), which is used to determine compliance with OAR 345-050-0035 (the Pathway Exemption), requires that the disposed naturally occurring radioactive material (NORM) cannot result in a dose to individuals greater than 500 mrem per year. As stated in OAR 345-050-0036(1)(b), evaluations against the 500 mrem dose limit are completed by taking actual field gamma radiation surveys and comparing the results to the levels provided in OAR 345-050-0036(2). As outlined in OAR 345-050-0036(2), the limiting radiation survey result has been determined to be 18 mR per hr above background and is based on a survey at 1 foot from a standard 55-gallon drum or a box measuring 1.5 x 1 x 2 feet (H x W x L). The underlying assumptions specifically incorporated into OAR 345-050-0036(1)(b) that tie the survey results to the yearly dose limit include: (1) a person lives in a house above the waste; (2) that person spends 90 percent of their time in the house; and (3) the house is built on a homogeneous, semi-infinite slab of NORM with a two-foot crawl space and a two-inch wooden floor. The exposure to individuals inside the house is assumed to occur at a height of one meter above the wooden floor. Given these pessimistic assumptions, the 500 mrem per year dose limit is reasonable. An alternative would be to reduce the gamma exposure limit to 100 mrem per year with updated exposure assumptions that are more consistent with reality. This could include allowances for the environmental and engineered factors applicable to landfills to be taken into account and applying the concept of a nearest resident rather than a home built on top of the waste. Further, we recommend expanding the geometries included in the regulations from the 55-gallon drum and the box described above to containers that are more representative of those actually used in the state, e.g., supersacks. This can be done by deriving correction factors using software such as MicroShield®.	Because the OHA public dose limit is 100 mrem/yr, it seems most appropriate to maintain this limit for consistency with federal regulation and other existing standards in Oregon that represent no significant danger to public heal or safety. This standard is conservative for the vast majority of wastes that in reality will be disposed in a landfill and therefore present far lower doses at the surface – likely to be indistinguishable from background radiation levels. Consistent with other RAC feedback, the 100 mrem/yr standard should be inclusive of all pathways excluding radon. RAC members should be aware that if this alternative is pursued, the Pathway Exemptio becomes **moot** because the corresponding concentration of Ra-226 will be approximatel pCi/g when not taking landfill cover into acco See prior response for discussion of this point If in the future an alternative is pursued that would allow credit to be taken for landfill protective measures such as land cover, staff would advocate the dose limit for the landfill for purposes of setting waste acceptance criteria should be based on 25 millirem/yr (the unrestricted land use standard for NRC nuclea site decommissioning) or 12 millirem/yr (the upper bound of the CERCLA risk range per EP/

Commented [BJ*O8]: Rule actually says accumulation of material, not disposal.

Commented [BJ*O11]: For example, if your leachate is at 50% of its standard when multiplied by 20, that is the equivalent of 12.5 mrem assuming the leachate is a drinking water source. This would leave 87.5 mrem to apportion between direct gamma and plant uptake if the latter is included as a new pathway. The easiest way to do this however is to simply fall back to 5 pCi/g for any surface disposal consistent with the UMTRA rule and the plant uptake + gamma RESRAD run performed for the February 2022 meeting.

Commented [BJ*O9]: Basically how ODOE justified 500 back in 1993. Now we have to ask, do you keep a high dose with pessimistic assumptions, or a lower dose with more realistic assumptions, or the most stringent of both and a lower dose with pessimistic assumptions?

Historic land spreading is a case wherein someone might have opportunity to build a house on soil with wastes above 5 pCi/g if future zoning did not prohibit it. This might be a good case study example when discussing these responses at the next RAC meeting.

Commented [BJ*O10]: I would not advocate a nearest resident approach. This assumes a landfill could never be built upon, and we know there are examples where this has been the case. It also relates to the "permanent commitment of land" concept and the idea that rad should not be the committer. This all of course assumes we had the ability to take credit for land cover.

Are the current methods for estimating the potential gamma pathway exposure appropriate, specifically, the use of a standard container-geometry and 18 microroentgen per hour threshold and the asso…	Likely a critical issue, but I don't believe I have enough of an understanding to comment.	The current methods are antiquated and difficult to apply to a variety of scenarios. Using the 100 mrem/year TEDE limit and Department of Energy (DOE) developed and widely used dose assessment software RESRAD, default concentrations for key radionuclides can be derived and used for waste generators and landfills that do not want to invest time/resources into a site -specific assessment. These can be included in the rule change. The option to perform a site-specific assessment and submit to the State for approval can also be included, similar to the current pathway exemption method.	DEQ defers to ODOE and other experts on this question.	See Question #7. Current methods should be updated to be more consistent with current practice, e.g., updated building codes and practices, landfill exposure scenarios, new waste geometries, etc. For landfill disposal the environmental setting and engineered protections need to be recognized. While institutional controls are likely to be lost at some point in the future, a common-sense approach must be exercised in making assumptions that a person might build their house directly on top of 55-gallon drums that are visible. The gamma exposure measurements of industrial wastes over the last several years show that containers of industrial wastes exhibit wide variability. Thus, we propose employing averaging of the gamma measurements on an individual container versus the current practice of using the highest reading. Averaging logic is currently supported in several aspects of the pathway exemption process. Finally, from a gamma exposure measurement standpoint, the gamma exposure pathway cannot be reduced to 100 mrem yr-1, while simultaneously not recognizing the model assumptions need to account for real world environmental protections. Applying the 100 mrem yr-1 threshold using the current model would require the measuring of gamma exposure rates at or below 3.6 µR hr-1 above background. This measurement and all others below it cannot be accurately and confidently distinguished above background.	See #7 above. Current methods should be updated to be more consistent with reality, e.g., updated building codes and practices, landfill exposure scenarios, new waste geometries, etc. In particular, landfill characteristics should be accounted for. While it may be reasonable to assume that institutional controls will not be maintained forever, the Department's rules should apply a measure of common sense. For example, it is not sensical to assume that a person could build directly on top of 50-gallon drums that are still visible. And if the assumption is that these waste containers are no longer distinguishable as wastes thereby causing an individual to unknowingly build on them, then one should also be able to assume that the waste constituents have been mixed with 1 https://radiationsoftware.com/microshieldsurrounding environmental media such as soil, thereby diluting the radionuclide concentrations. In addition, the gamma radiation readings taken for purposes of OAR 345-050-0036 should be consistent with the ultimate purpose of controlling annual doses from representative waste materials to below the limit (currently 500 mrem yr-1). Toward that objective, rather than evaluating field gamma radiation exposures by reference to the highest reading measured around the container in use, the Department's rules should authorize multiple readings to be taken and averaged over pre-determined locations on the approved waste containers. This type of logic is used in EPA regulations for Ra-226 concentrations (40 CFR 192.12) where the concentration is averaged over 100 m2. More importantly, this same logic is already used by the Department when determining compliance with OAR 345-050-0038 effluent concentrations. At least four representative samples of the waste steam are analyzed using EPA. Method 1312 according to OAR 345-050-0038(1)(b). The 18 µR hr-1 limit is directly correlated to the 500 mrem yr-1 gamma exposure radiation protection guides (RPG) from an infinite source at the same concentration located under a resident's home. In selecting the highest reading off the waste container, no credit is given to un-even source distribution and volumetric averaging within a given container. As a result, the maximum dose possible is 500 mrem yr-1, with an average or likely dose being something less. Combining this logic with the assumption that one builds directly on the exposed waste container creates a point of compliance that is unrealistic to meet if a lower gamma exposure limit were proposed without the use of a more realistic exposure model. A more realistic exposure model would lead to a higher allowable exposure rate reading on a waste container, and make compliance measurements more	One purpose of the gamma pathway interpretive rule was to allow a field screening method to demonstrate compliance without requiring frequent laboratory analysis to demonstrate that derived concentrations continue to be met. A threshold value of 5 pCi/g already exists for 226 in the specific exemptions of the rule, and concentration-based limits for other radionuclides also exist in Table 1 of the rule. While the 55-gal drum is used for rule purpos the rule is not built on the assumption that waste is packaged in drums. Therefore it is reasonable to consider that a house might be built on NORM material that is indistinguisha from regular soil. The point about a 100 mrem/yr standard not being distinguishable from background is true the barrel test used in the current pathway exemption. In a standard 20-yd box, the equivalent of 100 mrem/yr would be between uR/hr to 19 uR/hr (based on Jeff's PPT, but ne to be confirmed in Microshield). These levels have been demonstrated to be detectable by portal alarm at CWM as confirmed by hand screening equipment.

Commented [BJ*O14]: Drums aren't forever. Majority of waste we know of was not in drums.

Commented [BJ*O12]: There is considerable uncertainty about the mixture of waste in a large box like a rolloff, so keeping to the highest point does make sense to me as a responsible precaution. The rule allows a person to mix their container if they get a hot spot, which is a physical version of "averaging" in that box.

Commented [BJ*O15]: Interesting line of argument that may hold true in a landfill credit scenario that has been uncovered after waste was mixed during disposal. However, if there is a layer of contaminated soil in an as-found condition, the mixing would have already occurred prior to the point of determination.

Commented [BJ*O13]: This is only true of a 55-gal drum. In a larger box, the equivalent of 100 mrem/yr would be between 11 uR/hr to 19 uR/hr in a 20-yd box (needs to be confirmed in Microshield). These levels have been demonstrated to be detectable by the portal alarm at CWM as confirmed by hand wanding.

Commented [BJ*O16]: Does this assume the entire 100m2 is accessible? Different from a 20-yd box that is self-shielding the waste in the center of the box. In a drum, there is less self-shielding involved, so an average in this case may be reasonable but likely not all that variable in so small a geometry.

Commented [BJ*O17]: In practical terms, we approve an exempt concentration (e.g., 20 pCi/g) based on an annual average from the facility, then derive a uR/hr screening value that assumes all waste in the box is at that concentration (e.g., 50 uR/hr). One small area containing 20 pCi/g would appear lower than this screening value due to gamma dilution from the other waste in the box. A hotspot significantly higher than 20 pCi/g might appear to exceed the 50 uR/hr threshold, necessitating additional investigation and reasoning why this box of waste is consistent with the facility's pathway exemption.

If the pathway exemption goes away, then the uR/hr limit for a box would be ~11 uR/hr assuming that whole box contains waste at 5 pCi/g. if any part of the box exceeds 11 uR/hr, then an isolated area of the box clearly contains waste exceeding 5 pci/g enough to shine through. If we assume a semi-infinite plain containing the contents of this heterogeneous box, then some averaging of screening results may be appropriate **or else we risk declaring a box full of radioactive waste that on average would not exceed 5 pCi/g**.

OTOH, a hot bucket in an otherwise clean load is just the kind of red flag that portals are often intended to catch.

The Rule allows physical mixing of a box to "average out" the waste.

… [1]

					feasible. If the gamma exposure pathway was reduced to 100 mrem yr-1 and the model assumptions remained the same, one would need to be capable of measuring exposure rates at or below 3.6 µR hr-1 above background. According to the Health Physics Society (https://hps.org/publicinformation/ate/faqs/radiation.html), typical background radiation levels are ~10 µR hr-1, but can vary considerably. Given the presence of statistical fluctuations in survey instrumentation readings, it is nearly impossible to accurately and confidently distinguish 3.6 µR hr-1 above background.	

Commented [SO18]: yet the portal monitor seems to do this regularly.

Commented [BJ*O19R18]: Agreed, but the portal might read 3 while a hand measurement would show 10 or 15 at the hottest spot.

Are the current methods for estimating the potential air and water pathways appropriate? Would you suggest any alternative methods to those described in rule? (Relevant Rules: OAR 345-050-0035 and...	No comment.	See answer to number 8. RESRAD includes modeling of all air and water pathways.	DEQ defers to ODOE and other experts on this question.	The current methods for estimating air and water pathways are overly conservative and therefore highly protective, but should be updated as described in #7 and 8. Per #5, if the regulatory framework is updated to require pathway specific limits, then the pathways need to be clearly defined and new, updated models for calculating doses allowed.	The current methods are overly conservative and therefore protective, but should be updated as described in #7 and 8. Per #5, if the regulatory framework is updated to require pathway specific limits, then the pathways need to be clearly defined and new, updated models for calculating doses allowed.	The RESRAD modeling for water pathways would require consideration of the depth to the water table, Kds for waste in soil, and other site-specific factors of the disposal location, and therefore is less conducive to standardized testing based on the waste itself. In addition, the existing 0038 rule was benchmarked against RESRAD at the time of its writing and was found to correlate well with the results of the SPLP test. The RESRAD assumed 100 pCi/g of Ra-226 with varying key parameters to evaluate a range of values and assess model sensitivity. The SPLP results correlated reasonably well with the anticipated concentrations in a shallow aquifer 100 meters downgradient from the source. The benchmarking did not account for a thicker vadose zone or a lower precipitation rate consistent with a landfill cap. Staff propose to keep the existing 0038 methodology, with minor modifications and clarifications.

Are the current methods for estimating the potential radon pathway appropriate? Would you suggest any alternative methods/parameters to those described in rule? (Relevant Rules: OAR 345-050-0035)	No comment.	See answer to number 8. RESRAD includes modeling of radon pathways.	DEQ defers to ODOE and other experts on this question.	The current method is appropriate however the input parameters, e.g., house characteristics and air exchange rates, should be updated to reflect current industry standards which might affect radon diffusion into the structure. Direct correlation between Ra-226 concentrations and Rn-222 indoor air concentrations cannot be made due to wide ranges in material-specific radon emanation rates, therefore using current radon emanation measurement techniques should be continued	The current method is appropriate however the input parameters, e.g., house characteristics and air exchange rates, should be updated to reflect current knowledge as discussed below. Currently, Oregon requires that wastes do not produce an indoor Rn-222 concentration greater than 3 pCi L-1, or one-thirtieth (1/30) of a working level (WL) in ahome built directly on the waste site (OAR 345-050-0035, Table 3). This limit is consistent with the EPAs limit of 0.03 WL (40 CFR 192.12). The evaluation assumes that any house built on ground contaminated with Ra-226 has an 8-foot-high ceiling on the first floor, has one complete air change per hour, and has a foundation constructed to meet the Structural Specialty Code (State of Oregon Uniform Building Code) in effect on March 1, 1979, without allowance for any special construction or treatments designed to reduce radon diffusion into the structure. The application of these building codes should be revaluated and the hypothetical house should be updated accordingly. The evaluation also bases the relation between radon-emanation rate and radium concentration upon experimental measurements on material intended for disposal. This practice should continue as a direct correlation between Ra-226 concentrations and Rn-222 indoor air concentrations cannot be made due to wide ranges in material-specific radon emanation rates.	RESRAD as designed assumes a concrete slab construction. A crawlspace construction as described in the original rule is difficult to model using the RESRAD code without additional parameter research. The existing ODOE radon model is sufficient to demonstrate compliance with the radon portion of the rule.

Commented [BJ*O21]: Benchmark a basement scenario and a slab construction scenario to make sure the crawlspace is the limiting model?

Commented [BJ*O20]: Agree that we should do this. Manufactured homes?
https://www.oregon.gov/bcd/codes-stand/Documents/md-2010omdisc-codebook.pdf

https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/HEALTHYNEIGHBORHOODS/RADONGAS/Documents/Appendix%20F_Radon%20Control%20Methods.pdf

(radon mitigation required in some places, but not statewide)

Considering existing statutes, should protection via land cover as a result of disposal be given credit when making a pathway exemption determination? (Relevant Rules: ORS 469.300(23) and ORS 469.525)	Is making this dramatic departure from the current rules under consideration? The 1978 Attorney General's Opinion stated that, "5. The rule must define the material, not how it is disposed; that is, the definition cannot be written such that the material changes from radioactive to non-radioactive by placing a fence around it, covering it with dirt, or moving it from one place to another." Current ODOE staff appear to have made it clear that this interpretation is still applicable. Since suggestions for switching to waste management techniques have come up relatively frequently during RAC meetings, I will state now that, if there is a way within the law to do so, we should not go in that direction. Doing what is easier, more cost-effective for industry, etc., now in hopes that negative consequences in the future may not occur threatens the current and future public, as well as landfill personnel. In my view, it also appears to depart from the ORS 469.300(23)(b)(A) in its sole criteria for exemption from the ORS 469.525 ban on disposal materials determined to be safe for public health and safety. Emphasizing the importance of that, ODOE staff has reiterated the fact that, under Oregon law, exemption rules will be applied to materials that will NOT necessarily be disposed of in a landfill, rather they will be classed as NOT radioactive waste at all and can therefore be disposed of anywhere by anyone.	Minimum landfill design should be considered in risk-assessments referenced in Number 8.	DEQ defers to ODOE and DOJ on whether this is allowable under current statute.	As described previously it is imperative that the ultimate disposal location of exempt materials is explicitly considered. The requirements for meeting a pathway exemption must be designed to provide reasonable assurance to the public including disposal workers that they are protected when coming in contact or working around NORM-bearing materials. Risk-based analysis of waste specific doses for appropriate exposure pathways including indoor radon must be accounted for. A thorough analysis must include the waste concentrations, waste forms, facility design, geological conditions, environmental conditions, multiple exposure scenarios, and plausible exposure pathways. Solid waste permitting for a landfill in Oregon requires a final cap at the time of closure, consideration of this and other site-specific features and protections should be included in the pathway exemption process	Yes, the ultimate disposal location of exempt materials should be explicitly considered. Currently, material can be exempt regardless of ultimate disposal location. A detailed discussion follows. The pathway exemption process should be considerate of where waste is being disposed. Oregon law is explicit in stating that the disposal of radioactive material is prohibited in the state of Oregon (OAR 345-050-0006). To regulate waste containing lowlevel amounts of naturally occurring radioactive materials (NORM) and technically enhanced naturally occurring radioactive materials (TENORM), Oregon uses a twopronged approach to determine if the material is "non-radioactive waste" and therefore safe for disposal in Oregon. The first type of exemption essentially declares material exempt from licensing, cleanup requirements, and disposal restrictions based on the material's measurable source content. These exemptions are listed in OAR 345-050-0020, OAR 345-050-0025, and OAR 345-050-0030. If not, the second type of exemption, or pathway exemption, may be sought. The requirements for meeting a pathway exemption are outlined in OAR 345-050-0035 and are designed to provide reasonable assurance that members of the public are protected when coming in contact with the radioactive materials. Disposal of radioactive waste at waste disposal facilities is regulated though 10 CFR 61. The performance objectives in 10 CFR 61.40 state that "land disposal facilities must be sited, designed, operated, closed, and controlled after closure so that reasonable assurance exists that exposures to humans are within the limits established in the performance objectives in §§ 61.41 through 61.44." Oregon clearly prohibits radioactive disposal sites in the state, however, through the pathway exemption process, they do allow for the disposal in Oregon of wastes containing naturally occurring radioactive materials (e.g., NORM/TENORM) that are not explicitly exempt under OAR 345-050-0020, OAR 345-050-0025, and OAR 345-050-0030. Wastes that require a pathway exemption are subjected to a similar performance objective process as 10 CFR 61.40 for radioactive waste facilities. Waste specific doses from inhalation, external gamma exposure, direct consumption of liquid effluents, and indoor radon must be shown to be in compliance with radiation protect guides (RPG). Meeting performance objectives within 10 CFR 61.40 requires a thorough performance assessment that takes into account the waste concentrations, waste forms, facility design, geological conditions, environmental conditions, multiple exposure scenarios, all plausible exposure pathways, etc. Obviously, the components in the respective waste streams arequite different, but the two processes and structure for demonstrating	Staff agrees with the interpretation of Ms. Weathers that Oregon statute and DOJ interpretation precludes the possibility to account for land cover in the determination whether a waste constitutes "radioactive waste" under Oregon law. Because the allowable dose standard has changed, and disposal in a landfill may not be assumed, reduction of the basis for pathway exemption to 100 mrem/yr or lower will effectively render the pathway exemption framework no longer applicable to most if not all wastes that currently have exemptions. This will have material effects to NORM generators that have until now been legally disposing of wastes in landfills in a manner that is not a danger to public health and safety.

					compliance are quite similar with the main differences being that 10 CFR 61 is site specific and takes facility design into account. To the extent that the Department proposes to revise the pathway exemption framework to add complexity, include additional points of compliance or incorporate more restrictive RPGs into OAR 345-050-0035, those proposals should be infused with realism and specificity in the models used to demonstrate compliance. If the licensing of a landfill in Oregon requires a cover at the time of closure, or any other type of safeguard to ensure members of the public or the environmental are protected, these site-specific features should be considered in the pathway exemption process.	

Commented [BJ*O22]: Because it is explicitly a radioactive waste disposal facility licensed by the NRC or an agreement state.

Under the current pathway exemption, the average annual NORM/TENORM waste from a facility can be considered. Is this an appropriate evaluation period for pathway exemption determinations? Is any f...	I'm not sure I understand the question and I may have missed any discussion of this during RAC meetings. To what kind of facility does it refer? A generator of waste or disposal facility? If the former, how is it measured and how well is it monitored? If the latter, how is the measure applied for materials disposed of outside of a landfill?	Since NORM/TENORM waste streams contain long-lived radionuclides, the risk-assessments and software discussed in number 8 should be run for a significant time after disposal, e.g. 100 or 1,000 years. RESRAD provides for the assessment of risk over thousands of years post placement of waste.	DEQ defers to ODOE and other experts on this question.	We agree that averaging a facilities various waste streams based on each waste's mass and concentration is appropriate for the pathway exemption framework, as the averaged facility's waste stream is representative of the actual waste stream as disposed. The rules need to be clarified to reflect the averaging of all solid wastes a facility produces or only the NORM-bearing wastes. Further, the annual average waste stream should be representative of the actual waste stream as disposed.	An annual average is appropriate for the pathway exemption framework. Note, however, that the current pathway exemption rules apply to the annual average waste stream, not specifically to the annual average of NORM/TENORM-bearing materials only. The updated rules should preserve this approach to evaluating average annual average waste streams as it would not make policy sense to only evaluate the portions of the waste streams that may contain radioactive material. Further, the annual average waste stream should be representative of the actual waste stream as disposed. Details below. The use of annual average concentrations is supported by the assumed modeling that supported the derivation of the Table 3 effluent values in OAR 345-050-0035. The Oregon Table 3 effluent limits are analogous to the Table 2 annual average effluent limits in Appendix B of 10 CFR 20 (see question 2). These effluent concentrations are equivalent to the radionuclide concentrations which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent (TEDE) of 50 mrem. And per 10 CFR 20.1302(b)(2)(i) these Table 2 limits are to be compared to the annual average concentrations released in gaseous and liquid effluents at the boundary of the unrestricted area.	If we default to 5 pCi/g, would we still allow waste averaging from a facility? Would we maintain that only NORM-bearing waste may be blended together? Does that concept still wo... with a standard so low? Would we qualify a waste as "NORM bearing" if it contained 2 pC... 1 pCi/g? Can this be reliably distinguished fro... non-NORM wastes? Would we average in a rolloff box? Would we find it acceptable to average the entirety of waste accepted in a landfill? In a way, this is what the Argonne study did. It said the "landfill average" could be 13 pCi/g to achieve 100 mrem/yr, then assumed the landfill was 10% full of TENORM spread homogenously, resulting in a concentration limit of 130 pCi/g for individual wastes. (https://deq.nd.gov/Tenorm/ArgonneStudy/ANL-NDDH%20TENORM%20Landfill%20Study%20(ANL%20EVS-14_13)%20Final%20Report.pdf). If we go with the Argonne route and assume 5 pCi/g average in an entire landfill (equivalent to ~38 mrem/yr in a residential scenario), 10% full of TENORM waste, the allowable concentration is . . . 50 pCi/g. This assumes 2m of land cover though, crucially. Again we run into the statutory limitation. Landfills are safety tools of society in a way, so long as the land is available for unrestricted use from a rad perspective based on all reasonably foreseeable future site uses once institutional control is lost.

Commented [BJ*O23]: Note to consider whether the rule should include certification and monitoring requirements.

Should changes to the rule be considered to account for potential long-term accumulation of pathway-exempt NORM/TENORM in landfills? (Relevant Rules: OAR 345-050-0035 through 0038)	Absolutely. Cumulative impacts from NORM and TENORM production and disposal appear to me to be among the most important issues on the table as Division 50 rules are under consideration. Unless I'm missing something, while Oregon's overall approach is superior to other states, it still appears that all of the current rules evaluate waste to determine whether it's exempt from the ban or not apply only to individual quantities at the time of evaluation, without regard to potential impact on the public health and safety stemming from the accumulation of similarly exempted waste over time. What this seems to mean, is that Oregon's overall waste disposal regulatory construct, by allowing for exemptions of radioactive material that remain dangerous for hundreds/thousands of years simply fails the test of "no significant danger to the public health and safety" by any definition of "significant" may be accepted as carrying out the intent of the Legislature to protect the public. (See also answer to Q#5 above.)	RESRAD accounts for the buildup and the decay of radionuclides overtime. See number 8.	DEQ is unclear about the potential risk(s) and additional monitoring/actions needed to address the implied risk(s) in this question.	We do not believe this is necessary as landfills are constantly being filled with other non-NORM-bearing wastes, typically at a rate much greater than the acceptance of the NORM-earing wastes.	The current models for radon and external gamma already account for accumulation. The water pathway model is already extremely conservative and does not warrant the need for long-term accumulation assessments. See below for more details. OAR 345-050-0035 The model used to determine indoor radon concentration currently assumes that the Ra-226 source material is infinitely present at its measured concentration. This is effectively saying that the long-term accumulation at the disposal site will continue with this waste stream until at capacity. The model then computes the resulting indoor radon concentration based on this assumption. The radon emanation of waste streams can vary considerably creating a situation where one waste stream is permitted to have a higher Ra-226 concentration than another stream given its lower radon emanation. Despite this varying degree of Ra-226 concentrations, the resulting indoor radon concentration will always be less than the limit given the assumption of an infinite source for each waste stream. Long-term accumulation is irrelevant since it is assumed in the calculation of the limit.OAR 345-050-0036 The same concept of an "infinite" source is applied to the external gamma exposure. A home is assumed to be built on a semi-infinite plane of a given waste stream (i.e., directly on top of the disposal site). Based on this assumption, further accumulation of NORM/TENORM is not possible. If the model assumed the house was built on a diluted amount of NORM/TENORM (i.e., void space is filled with native soils, not TENORM) and the amount of dilution was dependent on the long-term accumulation of waste (i.e., total inventory/volume at time of closure), then the rule should account for such accumulation. OAR 345-050-0038 The water pathway exemption rule in OAR 345-050-0038 is written for the release of effluents to water and uses the annual average effluent concentrations produced by NORM wastes. The Oregon Table 3 effluent limits are analogous to the Table 2 annual average effluent limits in Appendix B of 10 CFR 20 (see question 2). These effluent concentrations are equivalent to the radionuclide concentrations which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent (TEDE) of 50 mrem. Direct consumption of the effluent originating 100% from NORM/TENORM waste is ultra conservative and highly unlikely. The use of Table 3 limits for the pathway exemption process does not take into account the presence of non-NORM waste and assumes that the drinkable leachate originates from a disposal site filled with the NORM/TENORM waste in question. Long-term accumulation should only be considered if the underlying models and assumptions are	See response to #5 regarding cumulative impacts. Staff agrees with the points made by OBI and WM that accumulation is presently accounted for in the existing pathway exemption ruleset. The Table 3 values were originally based on the 10 CFR 30.70 exempt concentration limits for occupational exposure, with a 10x factor to make them equivalent to 500 mrem/yr. A notable exception is Ra-226, which is currently in Table 3 at a concentration equivalent to a 25 mrem/yr dose per the 10 CFR 20 method. Staff recommend revising Table 3 as necessary to ensure consistency with 10 CFR 20 Appendix B, but transform the values to be consistent with a 100 mrem/yr equivalent expressed in pCi/L for ease of review. The table could be split between NORM and non-NORM nuclides for further ease of reference, consistent with RAC feedback.

Commented [BJ*O24]: See benchmarking of the rule using RESRAD performed at time of rule adoption.

Commented [BJ*O25]: True.

					revisited and re-evaluated with less conservatism and more realism.	

Are there additional waste forms or types that warrant a specific exemption under OAR 345-050-0030? If so, please list the waste and describe the basis for the proposal in as much detail as possib...	I was not able to attend the first two meetings of the RAC, but I see from the video that the group was asked to name items that could be considered in addition to those already in the cited rule. Presumably, if items are known to contain measurable levels of radioactivity and there is interest in disposing of them within the state, some type of safe level would need to be set, below which a quantity of that material would be exempt from the ban/defined as not radioactive waste and could be stored anywhere by anyone. Is that correct? Again, I struggle with the issue of expanding the field of waste that is actually radioactive by additional exemptions. One concern is cumulative impacts. Additionally, discussion reference to the approach of other states—if what is meant is levels defined as "safe" for disposal—seems inappropriate. I'm unsure how what other states are classing as "safe" can apply here. Is it not true that various states have demonstrated that they are comfortable with accepting even significantly higher levels of radioactivity than would comply with the public health and safety requirement (no significant danger) in general? Also, other states set their acceptable disposal levels under assumptions of waste management such as burial and capping, automatically making their levels higher than ours could ever safely be. To the main point of identifying and adding new items to exempt, I can only believe caution is essential. I don't believe I have adequate information about where this line of discussion is going—RAC #2 appears to have been somewhat of a brain-storming session. But did the AG's opinion (1978) determine somehow that the Council was free to develop exemptions on the basis of convenience due to circumstances or situations that existed at the time of rulemaking? If that's the case, fast-forwarding to the task at hand now, how cautious do we need to be with regard to add-ons to OAR 345-050-0030 due to product development during the intervening years? Acknowledging that certain industries and businesses do face economic challenges, it seems to me that OAR 345-050-300 as amended by SB 246 does not change the fact that the Legislature is placing a burden on the Council to focus solely in its exemptions to the ban in ORS 469.525 on the public's health and safety.	This section, as written, contains at least two obvious conflicts. Not sure of how it is implemented, i.e. if you meet any one of the exemptions is your waste accepted? Or do you have to meet all that may apply? Not sure how compliance with this section is demonstrated. I don't recommend any additions.	DEQ defers to ODOE and other experts on this question.	We would support specific exclusions for the following materials: Zircon sand bearing wastes, i.e., sanding belts, grinding disks, Ceramic and zircon containing dental amalgams Industrial sandblast grits Reagent materials specifically used for treatment of wastes Bentonite clay materials The specific exemptions for Ra-226 and Ra-228 should be re-examined, for example, the Ra-226 limit in OAR 345-050-0030(2) likely originates from EPAs 40 CFR 192.12 limit of 5 pCi g-1. This limit is likely based on uranium mill tailings radon-emanation coefficients, solubilities, and other tailing specific characteristics. The chemical and physical forms of the radionuclides in various TENORM waste can greatly influence their environmental mobility and biologic availability. Exposure assessments should consider the effects these different chemical and physical forms have on overall risk. Similarly, the uranium limits in Table 1 of OAR 345-050-0025 should be re-visited. As with the Ra-226 limit, the uranium is likely based on uranium mill tailings radon-emanation coefficients, solubilities, and other tailing specific characteristics and may not be representative of industrial TENORM.	Yes, in particular zircon sands materials should be reexamined, see details below. The specific exemptions for Ra-226 and Ra-228 should be re-examined as they were likely adapted from regulatory limits that pertained to Ra-226/Ra-228 present in uranium mill tailings. For example, the Ra-226 limit in OAR 345-050-0030(2) likely originates from EPAs 40 CFR 192.12 limit of 5 pCi g-1. However, the EPAs limit is based on radon-emanation coefficients, solubilities, and bioavailabilities from uranium mill tailings. The chemical and physical forms of radionuclides in TENORM can greatly influence their environmental mobility and biologic availability. For example, leaching of radionuclides from zircons is quite low in comparison to radium and other radionuclides in uranium mill tailings. Whereas uranium-mill tailings tend to have radon-emanation coefficients of about 10-40%, the values for zircons tend to be less than 5%. Exposure assessments for TENORM should consider these factors. As such, any limit that has been adapted from regulations originally created for a specific source of radioactive material (such as the OAR 345-050-0030(2) 5 pCi g-1 Ra-226 limit) should be revisited. Similarly, the uranium limits in Table 1 of OAR 345-050-0025 should be re-visited. Uranium-238 accounts for roughly 50% of the activity concentration in natural uranium (with U-234 making up the other 50%). Therefore, if equilibrium is assumed in NORM/TENORM, radium-bearing materials with a Ra-226 concentration of 5 pCi g-1 will have a U-238 concentration of 5 pCi g-1, a U-234 concentration of 5 pCi g-1 and a natural uranium concentration of ~10 pCi g-1. An NRC Technical Position discussing the disposal of natural uranium was published in the Federal Registrar Vol. 46 No. 205 (page 52061). In that publication, they set the concentration limit for the surface disposal of naturaluranium (U-238 plus U-234) at an "acceptably low" concentration of 10 pCi g-1. They provided this concentration in reference to the EPA's Ra-226 value of 5 pCi g-1 and based on the discussion above. As with the Ra-226 limit, the uranium limits are likely derived from radon-emanation coefficients, solubilities, and bioavailabilities from uranium mill tailings and may not be representative of industrial TENORM. As an additional note, when comparing isotopic analyses of TENORM to Table 1 values, one should account for the presence of U-234 when interpreting analytical results for U-238. In other words, if U-238 concentration is determined to be 7.5 pCi g-1, one should also assume that U-234 is present at roughly 7.5 pCi g-1. Therefore, when applying the sum of ratios (SOR) dictated by Note 2 of Table 1, one would get a SOR of 1.5. The U-238 (and U-234) limit in Table 1 is effectively 5 pCi g-1, which again, is consistent with	Staff would support a concept by which a specific waste could be exempted following a substantial amount of supporting data (e.g., three successive years of laboratory data or pathway testing showing the wastes consistently meet exemption criteria). Such generic material-specific determinations could be made at staff discretion outside the scope of the rulemaking and documented as they are granted. At present, no additional waste forms or types have sufficient supporting data, but some such as the reagents with multiple years of profile data and wastewater treatment plant grit wastes may in the near future qualify. Regarding survey responses about radon emanation from different uranium-bearing wastes such as zircon sands, staff concurs tha such wastes likely produce less radon (assumi the waste is not in a weathered state), but th proposed revisions to the pathway exemptio standards would make gamma emission and plant uptake significant contributors to total dose. Therefore, the expected lesser radon emanation of zircon sands alone do not quali these materials for a generic exemption. Regarding the comment about U-234 and U-2 values in Table 1 of the rule, Note 1 indicates that the limit for the parent isotope (e.g., U-2 takes into account the daughters (U-234). The SOF method in Note 2 would not apply to a NORM chain of parents and daughters. Additional clarification can be added to the Table 1 footnotes to specify the applicability of the SOF approach.

Commented [BJ*O26]: Ah, so he is saying that 5 pCi/g may not always equal 100 mrem/yr depending on radon emanation of zircon or different gamma rates based on density, etc. In this case, retaining a 100 mrem/yr pathway exemption might still make sense, but I'm not sure if it'd practically affect the present pathways and their viability.

For example, if they are saying that the 500 mrem equivalent for SSBO is 55 uR/hr in a rolloff, then the 100 mrem equivalent is still around 11. This could be for wastes as high as 8 pCi/g I think based on the old OSU study, but it's a little murky without more empirical data to back it up.

Commented [BJ*O27]: I want to hear more on this. What is being proposed specifically? How would such a reevaluation occur?

Commented [BJ*O28]: What specific exemption then would be appropriate as a screening value for "obviously not radioactive"? It seems this is reasonable to keep since it is based on a conservative waste relative to "industrial TENORM" as they define it (to say nothing of fracking tenorm).

					the Ra-226 limit when equilibrium assumptions are assumed.		

Commented [SO29]: flagged for followup

Should any changes to the rule be considered to change or clarify how out-of-equilibrium NORM wastes (i.e., decay products without parents) are addressed? Note: Footnote 1 of Table 1 in OAR 345 Di…	I don't feel qualified to comment.	RESRAD accounts for the buildup and the decay of radionuclides overtime. See number 8.	DEQ defers to ODOE and other experts on this question, and recommends that any changes to current rule ensure clear compliance points.	We recommend that Table 1 values for uranium decay products be expressly limited to natural uranium (U-238, U-234, and U-235); natural thorium (Th-228 and progeny to Ra-228, Th-232); and radium (Ra-226 and progeny, Ra-228). Pb-210 is a low energy beta-gamma emitter and as a result is difficult to measure by gamma spectroscopy. Based on the fact PB-210 is a low energy beta-gamma emitter the risks from external exposure are negligible. Lead-210 should not be included or should have a significantly higher Table 1 value than that currently assumed (e.g., 10 pCi/g). The assumption of equilibrium for the U-238 decay chain should be assumed until the isotopic data indicates otherwise. We recommend the use of the current pathway exemption strategy which contemplates situations where secular equilibrium cannot be assumed. Defining this approach within the Oregon regulatory structure would be advantageous and could help eliminate confusion in the future.	Yes, in particular zircon sands materials should be reexamined, see details below. The specific exemptions for Ra-226 and Ra-228 should be re-examined as they were likely adapted from regulatory limits that pertained to Ra-226/Ra-228 present in uranium mill tailings. For example, the Ra-226 limit in OAR 345-050-0030(2) likely originates from EPAs 40 CFR 192.12 limit of 5 pCi g-1. However, the EPAs limit is based on radon-emanation coefficients, solubilities, and bioavailabilities from uranium mill tailings. The chemical and physical forms of radionuclides in TENORM can greatly influence their environmental mobility and biologic availability. For example, leaching of radionuclides from zircons is quite low in comparison to radium and other radionuclides in uranium mill tailings. Whereas uranium-mill tailings tend to have radon-emanation coefficients of about 10-40%, the values for zircons tend to be less than 5%. Exposure assessments for TENORM should consider these factors. As such, any limit that has been adapted from regulations originally created for a specific source of radioactive material (such as the OAR 345-050-0030(2) 5 pCi g-1 Ra-226 limit) should be revisited. Similarly, the uranium limits in Table 1 of OAR 345-050-0025 should be re-visited. Uranium-238 accounts for roughly 50% of the activity concentration in natural uranium (with U-234 making up the other 50%). Therefore, if equilibrium is assumed in NORM/TENORM, radium-bearing materials with a Ra-226 concentration of 5 pCi g-1 will have a U-238 concentration of 5 pCi g-1, a U-234 concentration of 5 pCi g-1 and a natural uranium concentration of ~10 pCi g-1. An NRC Technical Position discussing the disposal of natural uranium was published in the Federal Registrar Vol. 46 No. 205 (page 52061). In that publication, they set the concentration limit for the surface disposal of naturaluranium (U-238 plus U-234) at an "acceptably low" concentration of 10 pCi g-1. They provided this concentration in reference to the EPA's Ra-226 value of 5 pCi g-1 and based on the discussion above. As with the Ra-226 limit, the uranium limits are likely derived from radon-emanation coefficients, solubilities, and bioavailabilities from uranium mill tailings and may not be representative of industrial TENORM. As an additional note, when comparing isotopic analyses of TENORM to Table 1 values, one should account for the presence of U-234 when interpreting analytical results for U-238. In other words, if U-238 concentration is determined to be 7.5 pCi g-1, one should also assume that U-234 is present at roughly 7.5 pCi g-1. Therefore, when applying the sum of ratios (SOR) dictated by Note 2 of Table 1, one would get a SOR of 1.5. The U-238 (and U-234) limit in Table 1 is effectively 5 pCi g-1, which again, is consistent with	It is a standard of practice in current pathway exemptions that when a waste contains only Pb-210 absent parents, the Department only requires the applicant to perform the leachability test (because the lead does not emit gamma or radon). Note to consider: Dial down the U-238 and U-234 concentrations in Table 1 to 5 pCi/g each to maintain equilibrium assumptions with Ra-22… and account for the fact that U-238 includes a contribution from U-234 also, per the survey comment. Another option: Include a mass-based standard for natural uranium to correspond to 10 pCi/g natural uranium. Add a Table 1 value for Th-232? 20 pCi/g consistent with the Ra-228 exemption value?

Commented [SO30]: might check concurrence requests here. <5% have detection issues?

Commented [BJ*O31]: Agreed, but we are seeing leachability in the lead that is surprising. One was at 50% of limit for lead with 15 pCi/g, for reference sake.

					the Ra-226 limit when equilibrium assumptions are assumed.	

Are there circumstances when waste blending (i.e., mixing NORM-bearing wastes with non-NORM-bearing wastes for purposes of waste determination) should be allowed? (Relevant Rules: OAR 345-050-0035)	It seems to me that this would amount to opening the door to strategic packaging/transport for purposes of manipulation of readings for individual loads.	As realistic inputs as possible should be used when performing risk assessments.	DEQ defers to ODOE and other experts on this question.	There are situations where mixed wastes are generated at a facility that contain both NORM-bearing wastes and industrial wastes. These potential mixtures of waste represent the whole of the volume being disposed at the facility. Including the mixture of these wastes aligns with the actual exposure risk of what and how materials are deposited in the landfill.	There are situations where waste blending makes sense from an environmental and human health perspective. The response to question 8 addresses our concerns to the extent the Department does not consider averaging of data (whether over time or over the entire waste stream being managed). Similar concerns apply where prohibiting waste blending can, in some circumstances, create an unrealistic and overly restrictive waste management scenario. Although there may be circumstances in which waste blending should not be allowed, blending should be permitted (i) when the non-NORM bearing waste has similar physical and geochemical properties as the NORM-bearing wastes, or (ii) when the NORM and non-NORM bearing materials comprise a single waste stream , as managed for disposal; such as when the non-NORM material is mixed with NORM material at the facility and then the mixtureis disposed of in the mixed form (e.g., the annual average waste stream noted in #12). For example, if zircon sands are blended with a similar sand that does not contain elevated NORM and will behave similarly in terms of environmental fate and transport, then blending of this nature should be permitted.	Note to self to review the supreme court case re: Rossman's Landfill and PCC (box in the office in my cube)

Should changes to the rule be considered in order to evaluate protection of waste disposal workers?	I'm unclear about this question. Whatever thresholds are put in place need to be consistent with Oregon's law that seeks to be protective of the public at large, regardless of where the waste is disposed of. Waste disposal workers should be safe to work around any waste that meets that criterion. [ODOE Note: The purpose of this question is to address whether the risk to waste handlers at landfills or transportation workers face a higher risk than the risk to future residents from disposal, such that the pathway exemption value should be adjusted to account for the most sensitive receptor both during and after the disposal. For example, the North Dakota limit was dialed down to 50 pCi/g from 130 pCi/g to account for a limiting dose to workers.]	Worker exposure assessments should be considered. Historically the results are very low due to the low exposure times and relatively low activity concentrations of waste.	DEQ recommends consideration of Senate Concurrent Resolution 17 (2021 legislature) https://olis.oregonlegislature.gov/liz/2021R1/Downloads/MeasureDocument/SCR17	No changes to the current rules would be needed as the current rules set more restrictive exposure limits than those applicable to a worker scenario.	No changes to the current rules are needed to evaluate worker protection. If the State of Oregon is adequately protecting the public with the conservative assumptions used in the current pathway exemptions process (i.e., they build a house directly on top of exposed waste), then workers, who are permitted to receive a higher occupational dose (5,000 mrem yr-1), would be adequately protected.	Based on the other revisions to rule, staff concurs that no additional measures are needed for worker safety.

Commented [SO32]: this is EJ legislation-a standard for workers that is less restrictive than that for the public could adversely impact communities immediately adjacent to the disposal facility, which is good to keep in mind.

Commented [BJ*O33R32]: Interesting concept. I think the rationale has been that occupational dose is voluntary for pay, so there is benefit alongside risk. This assumes the worker has alternative options for employment and that the work opportunity is itself not built on structural inequity.

Commented [BJ*O34]: This is for rad workers, not disposal workers.

What kind and frequency of verification/recertification should be required for pathway exemptions?	I don't recall this matter being discussed.	If the framework described in numbers 4, 5 and 8 is adopted this would not be necessary.	DEQ would like to discuss this question with ODOE.	Gamma scan data on containers of waste sent for disposal should be supplied annually by generators to certify that the exempted wastes are still in compliance. The pathway itself should be re-evaluated if significant changes to the waste stream(s) occur or if any new information about the accepted waste that could alter its acceptance under the existing pathway exemption is found. In the event that TENORM processes change or conditions of accepted TENORM waste change, the pathway exemption criteria would need to be re-certified.	Gamma scan data should be supplied annually by generators to certify that the exempted wastes are still in compliance. The pathway itself should be re-evaluated if significant changes to the waste stream(s) occur that alter the anticipated NORM concentrations, waste chemical or physical forms, or if any new information about the accepted waste that could alter its acceptance under the existing pathway exemption is found. In the event that NORM/TENORM waste generating processes change or conditions of accepted NORM/TENORM waste change, the pathway exemption criteria would need to be re-certified.		

Commented [BJ*O35]: Should this be discussed individually as a topic?

Should there be specific tracking or reporting requirements for in-state exempted NORM disposal or out of state radioactive waste disposal from Oregon generators? If so, please specify.	I'm not sure of the implications of this. Has it been discussed? Might this be intended to allow some kind of check to ensure that waste subjected to exemption testing winds up where it's supposed to? More information needed. *[ODOE Note: if the waste is exempt assuming a semi-infinite plane, then does it matter if we track where it goes?]*	There should be tracking but without a mechanism to monitor for radioactivity how does a landfill know if they are accepting NORM?	DEQ defers to ODOE and other experts on this question.	We do not believe separate tracking of waste origination is required, tracking the generation location does not add value to assessing the risk of a particular waste.	No, this only adds to the administrative burden for the generators.	

Are there isotopes that should be specifically added to Table 1 of OAR 345 Division 50? (Relevant Rules: OAR 345-050-0025, Table 1)	I don't feel qualified to answer this.	Oregon Table 1 and Table 2 values should mirror those listed in Schedule A of 10 CFR 30.70. Table 1 in OAR 345-050-0025 and 10 CFR 30.70 Schedule A are similar in both radionuclides listed and corresponding limits for by-product materials that are exempt from NRC licensing requirements and not be regulated for disposal under 10 CFR 20.2001. NORM and TENORM are not byproduct materials as defined in 10 CFR 30.4.	DEQ defers to ODOE and other experts on this question.	We suggest that Oregon Table 1 and Table 2 values be aligned with those listed in Schedule A of 10 CFR 30.70. Table 1 in OAR 345-050-0025 and 10 CFR 30.70 Schedule A are similar in both radionuclides listed and corresponding limits for by-product materials that are exempt from NRC licensing requirements and not be regulated for disposal under 10 CFR 20.2001. Because NORM and TENORM are not byproduct materials defined by 10 CFR 30.4, and Table 1 of OAR 345-050-0025 lists naturally occurring radionuclides of uranium (U-234, U235, and U-238), concentration limits for uranium may need to be included in the rule as a separate table or paragraph within OAR.	No additional isotopes need to be in Table 1 at this time. However, it may be helpful to ensure that the radionuclides listed in Table 1 are still consistent with those listed in Schedule A of 10 CFR 30.70 as Schedule A may have changed since Table 1 was developed. Similarly, Table 2 was likely developed from Schedule B of 10 CFR 30.70 and should also be cross-checked for consistency. Table 1 in OAR 345-050-0025 is essentially the same as 10 CFR 30.70 Schedule A in both radionuclides listed and corresponding limits. Schedule A provides concentrations of by-product materials that are exempt from NRC licensing requirements and would therefore not be regulated for disposal under 10 CFR 20.2001. The main difference is that Table 1 of OAR 345-050-0025 lists naturally occurring radionuclides of uranium (U-234, U235, and U-238). However, NORM and TENORM do not fall under the definition of byproduct material as defined in 10 CFR 30.4. It may make more sense to identify the concentration limits for uranium in a separate table or paragraph within OAR. If this were done, the process for how one can address equilibrium can be further defined (see question 15).	

Commented [BJ*O36]: @SICILIA Tom * ODOE

Commented [SO37]: flagged- table 1a?

Are the existing threshold quantities and concentrations of radium-226 or radium-228 (OAR 345-050-0020 and 0025) appropriate? (Relevant Rules: OAR 345-050-0020 and 0025; Table 1, Table 2)	Again, in terms of protecting the public and since the cumulative impact of radioactivity is such a problem in my view, I've seen no compelling reasons to raise threshold quantities or concentrations currently in place. The intent of the law seems to call for limiting disposal as much as possible—perhaps more protective levels should be considered, although this would likely be difficult to achieve.	If the framework described in numbers 4, 5 and 8 is adopted this would not be necessary.	DEQ defers to ODOE and other experts on this question.	We support the reexamination of the current threshold quantities for Ra-226 and Ra-228, as these were likely derived from regulations originally developed for uranium processing sites. The EPA approach applies limits to the top 15 cm of soils, Oregon applies limits directly to waste concentrations. The EPA approach accounts for dilution from native soils and averaging over a given area, allowing for a more robust and realistic analysis of potential exposure pathways. We believe it is overly conservative to assume that the exposure to a waste's Ra-226 concentration is equivalent to the actual environmental exposure when placed in a modern landfill. We believe the strategy suggested in Question 4 also applies to Ra-226 and Ra-228 limits; the exposure pathways need to be evaluated for both the land application scenario and landfill disposal using a risk-based approach. This risk-based analysis should consider environmental fate and transport properties of the radionuclide in question, taking into account the pertinent environmental setting and realistic receptor exposure scenarios. Any limits that have been adapted from regulations originally developed for a specific source of radioactive material should be revisited to align with the concept of industrial TENORM wastes.	The existing threshold quantities for Ra-226 and Ra-228 should be reexamined, as these were likely derived from regulations originally created for a specific source of radioactive material, e.g., uranium processing sites. Details below. The current Ra-226 concentration is 5 pCi g-1 (OAR 345-050-0030(2)). This value likely comes from the EPAs 40 CFR 192.12 limit of 5 pCi g-1 for residual radioactive materials from inactive uranium processing sites. This limit is based on a TEDE of 100 mrem yr-1 from all exposure pathways for Ra-226. However, the EPA's use of the 5 pCi g- 1 limit is different than the State of Oregon's use. The EPA applies this limit to the top 15 cm of soils averaged over 100 m2 whereas Oregon applies it directly to waste concentrations. The EPA is accounting for dilution from native soils and averaging over a given area, allowing for a more robust and realistic analysis of potential exposure pathways. It would be overly conservative to assume that a given waste's Ra-226 concentration were equivalent to the environmental concentration for which a hypothetical receptor would be exposed to externally, grow and consume crops from, etc. The above argument was provided in response to questions 4 (additional pathways). The application of the 5 pCi g-1 limit to waste forms as opposed to soils results in a high level of conservatism where environmental mixing is ignored. Moreover, the EPAs 40 CFR 192.12 limit of 5 pCi g-1 is based on radon-emanation coefficients, solubilities, and bioavailabilities from uranium mill tailings. The chemical and physical forms of radionuclides in TENORM can greatly influence their environmental mobility and biologic availability. For example, leaching of radionuclides from zircons is quite low in comparison to radium and other radionuclides in uranium mill tailings. Whereas uraniummill tailings tend to have radon-emanation coefficients of about 10-40%, the values for zircons tend to be less than 5%. Exposure assessment for TENORM should consider these factors. As such, any limit that has been adapted from regulations originally createdfor a specific source of radioactive material (such as the OAR 345-050-0030(2) 5 pCi g-1 Ra-226 limit) should be revisited.	

Commented [BJ*O38]: What's the practical numerical implication of following this advice if we don't take credit for land cover? Isn't this basically my "RESRAD default" powerpoint slide, turned into the one true new standard? People could still try to use the pathway exemption process, pegged to 100 mrem, if there are wastes that have very low leachability or don't shine as much gamma due to their density, but the difference in allowable concentration I expect would be slight.

Should lead-210 receive a specific exemption or be covered under the 10 pCi/g limit for uranium-238 (assuming equilibrium)? (Relevant Rules: OAR 345-050-0025, Table 1)	Not qualified to comment beyond my standard priority.	If the framework described in numbers 4, 5 and 8 is adopted this would not be necessary.	DEQ defers to ODOE and other experts on this question.	See question 15 for how Pb-210 can be addressed. The currently applied limit of 10 pCi g-1 is unrealistic and causes frequent issues that are time consuming and costly	See question 15 for how Pb-210 can be covered. The currently applied limit of 10 pCi g-1 is unrealistic and causes frequent issues.	

Are any additional standards or rules necessary to prevent disposal of radioactive waste in Oregon, consistent with ORS 469.525 and 469.300 (2021 version)?	Same as all above reference to the issue of accumulation as it relates to public risk. As noted, radioactive waste is generated in-state and it can be anticipated that the lowest-cost disposal structure (via exemptions) is popular and generates the bulk of discussion. However, the long-term, cumulative impact of all that is exempted from the in-state disposal ban must be limited to protect the public, now and in the distant future, both in landfills and outside of them. And we need to remain diligent, including via our rulemaking efforts, to prevent out-of-state interests looking to dispose of momentous quantities of largely fracking waste from being able to utilize our rules to do so here. Is more discussion from the perspective of how these largely highly technical rules under development can be structured to prioritize protection of the public to the greatest extent warranted? I also wonder, after reviewing Jeff's email in response to questions I raised about the Covanta landfill, might there be a need to somehow ensure that all landfills across the state receive the same explicit message about procedures regarding radioactive waste you provided to them? I don't know if it would fit as part of whatever educational process is devised to notify operators of this entire body of Division 50 rules (during comment period and then after they are final). I also don't know if that would be enough, considering that ODOE required Covanta to include specific information in their plan. But it seems that, if Covanta needed to receive the information and be held accountable, all would.	The current rule and the proposed revisions cover a lot of types of radioactivity however there is no methodology for identifying waste streams and/or monitoring for them. So the method of compliance is needed.	DEQ would like to discuss this question with ODOE.	We believe the revisions to the rule set adequately protect against disposal of radioactive wastes in Oregon. However, efforts to raise industry (Generator, Transporter, and Disposal) awareness levels must be undertaken. More importantly, development of an established process for review of wastes being disposed in Oregon from a radiation perspective must be accomplished. This waste review process must not create burdensome requirements that cause delays which cripple the generators' ability to dispose of their wastes in a timely manner.	None that we are aware of.	

Commented [BJ*O39]: @SICILIA Tom * ODOE

If the pathway exemption process were to no longer be available in Oregon, how would that affect the interests you represent? Can you estimate the cost of sending wastes that would currently be pa...	The League of Women Voters' position on these rules is compliance with the law that calls for protection of the public health and safety. To the extent that the responses of others whose bottom-line considerations call for less protective standards are taken into account in the rules, even though that would simultaneously increase the risk to the public, I expect that the League would be resistant, although my official comments on draft rules will need to be approved by League leadership.	Cost of transportation and disposal of radioactive waste streams, including NORM and TENORM are dependent on the permitted facility, the volume, the required packaging, the type of transportation and the distance. All that considered, out of state disposal of RAM is going to cost 10 to 100 times the cost of disposal in an Oregon landfill.	If pathway exemptions were eliminated, DEQ believes compliance points for our permittees would be easier to determine.	Our best estimate is the generator's transportation and disposal costs would likely quadruple based on the transportation distance differential and other factors. More importantly, current waste transportation assets are limited and would not be expected to be able to move the volumes we see out of state in a timely manner. We support Oregon in developing rules that do not force wastes to other states while simultaneously protecting Oregonians.	Eliminating the pathway exemption process would severely negatively impact Oregon businesses without any corresponding environmental or human health benefit. Oregon businesses would be asked to operate at a severe competitive disadvantage compared to states where NORM/TENORM wastes may be properly managed. Oregon generators report that transporting wastes to out of state radioactive waste disposal sites results in a cost increase of at least 7 times the in-state disposal costs. Further, there is an increase in carbon emissions and transportation risks from trucking wastes out-of-state unnecessarily.	ODOE concurs that the current disposal of NORM-bearing wastes from generators that possess pathway exemptions, and for which the wastes have been disposed in landfills, are protective of public health and safety standards. This determination of safety, however, does rely on the shielding provided by land cover for wastes disposed in landfills, despite that land cover not being taken into account when the wastes qualified for the pathway exemption. For situations in which wastes are left at the land surface, staff remain concerned that the current gamma dose limit of 500 mrem/yr is not protective in the event of a future resident on site. This results in a policy conundrum whose resolution staff believe lies outside the authority of this rulemaking, if the goal is indeed to both protect Oregonians from involuntary radiation exposure and to prevent negative impacts to Oregon businesses without corresponding environmental or health benefit.

Will any potential rule changes have a fiscal impact, what will the extent of those impacts be, and will there be a significant adverse impact on small businesses?	With all due respect, I don't know how this question can be answered at this point without having a sense of what kinds and extent of changes might be able to be considered. But beyond that, if the answer to this question with regard to any rule change that might be considered were to be "yes," if relaxing or otherwise modifying it to make it more innocuous for small business, but it also stands to increase the potential danger to the public health and safety, should we recommend it to the council as in compliance with the law? Or perhaps this question is included as a conversation starter(?) [ODOE note: This question is intended to understand the industry costs and impacts if the pathway exemption were to not be available and the rule were instead to default to 5 pCi/g. We are trying to understand the effects of such a policy change, which would constitute a significant tightening of the standard in order to bring the gamma dose limit down to current federal limits.]	See number 24.	Rule changes may have an impact.	We have experienced significant fiscal impacts in the management of TENORM-bearing wastes disposed in Oregon. We have been required to add 3 FTEs at one facility, and additional FTEs will be required if current requirements are extended to our other facilities. Third party scientists' oversight and reviews, portal equipment, handheld measurement equipment, emanation chambers, and laboratory analysis costs are significant. Finally, larger generators will be required to add FTEs to manage disposal of their wastes and the increased costs for laboratory analysis is significant for some generators. Property availability for on-site storage of wastes pending approval is also an important consideration.	The pathway exemption process is already very costly, and the costs of compliance are borne disproportionately by small businesses that may have to manage NORM/TENORM, as there is no scaling of costs.	

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In practical terms, we approve an exempt concentration (e.g., 20 pCi/g) based on an annual average from the facility, then derive a uR/hr screening value that assumes all waste in the box is at that concentration (e.g., 50 uR/hr). One small area containing 20 pCi/g would appear lower than this screening value due to gamma dilution from the other waste in the box. A hotspot significantly higher than 20 pCi/g might appear to exceed the 50 uR/hr threshold, necessitating additional investigation and reasoning why this box of waste is consistent with the facility's pathway exemption.

If the pathway exemption goes away, then the uR/hr limit for a box would be ~11 uR/hr assuming that whole box contains waste at 5 pCi/g. if any part of the box exceeds 11 uR/hr, then an isolated area of the box clearly contains waste exceeding 5 pci/g enough to shine through. If we assume a semi-infinite plain containing the contents of this heterogeneous box, then some averaging of screening results may be appropriate **or else we risk declaring a box full of radioactive waste that on average would not exceed 5 pCi/g**.

OTOH, a hot bucket in an otherwise clean load is just the kind of red flag that portals are often intended to catch.

The Rule allows physical mixing of a box to "average out" the waste.

NEED TO MICROSHIELD SOME EXAMPLES TO PLAY OUT THESE SCENARIOS WITH HOTSPOTS AND SEE HOW HOT OF A SPOT IT WOULD TAKE IN OTHERWISE CLEAN WASTE TO LOOK LIKE 11 UR/HR.