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An Activity Concentration-Based Proposal for Radon Management in NORM Workplaces

Jing Chen, Debora Quayle

Radiation Protection Bureau, Health Canada, Ottawa, Ontario, Canada

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Abstract: The Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (the NORM Guidelines) have been developed to manage radiation doses received from NORM in NORM workplaces, such as mineral extraction and processing, oil and gas production, metal recycling or water treatment facilities. This management strategy works well for most NORMs in NORM workplaces, with the exception of radon. Because background radon cannot be distinguished from radon generated by a practice, the need for radon management programs cannot be decided using thresholds based on incremental dose. Drawing from lessons learned through implementing the current NORM Guidelines, we propose decoupling the decision thresholds for NORM management (excluding radon) and radon management so that the two are considered separately, and quantifying decision-points for managing occupational radon exposure as average annual activity concentrations, with no requirement for dose calculations. Proposed application of this approach in the updated Canadian NORM Guidelines is described.

Introduction

Radon is a naturally occurring radioactive gas generated by the decay of uranium-bearing minerals in rocks and soils. Epidemiological studies have confirmed that exposure to radon increases the risk of developing lung cancer. Exposure to indoor radon has been determined to be the second leading cause of lung cancer after tobacco smoking [1].

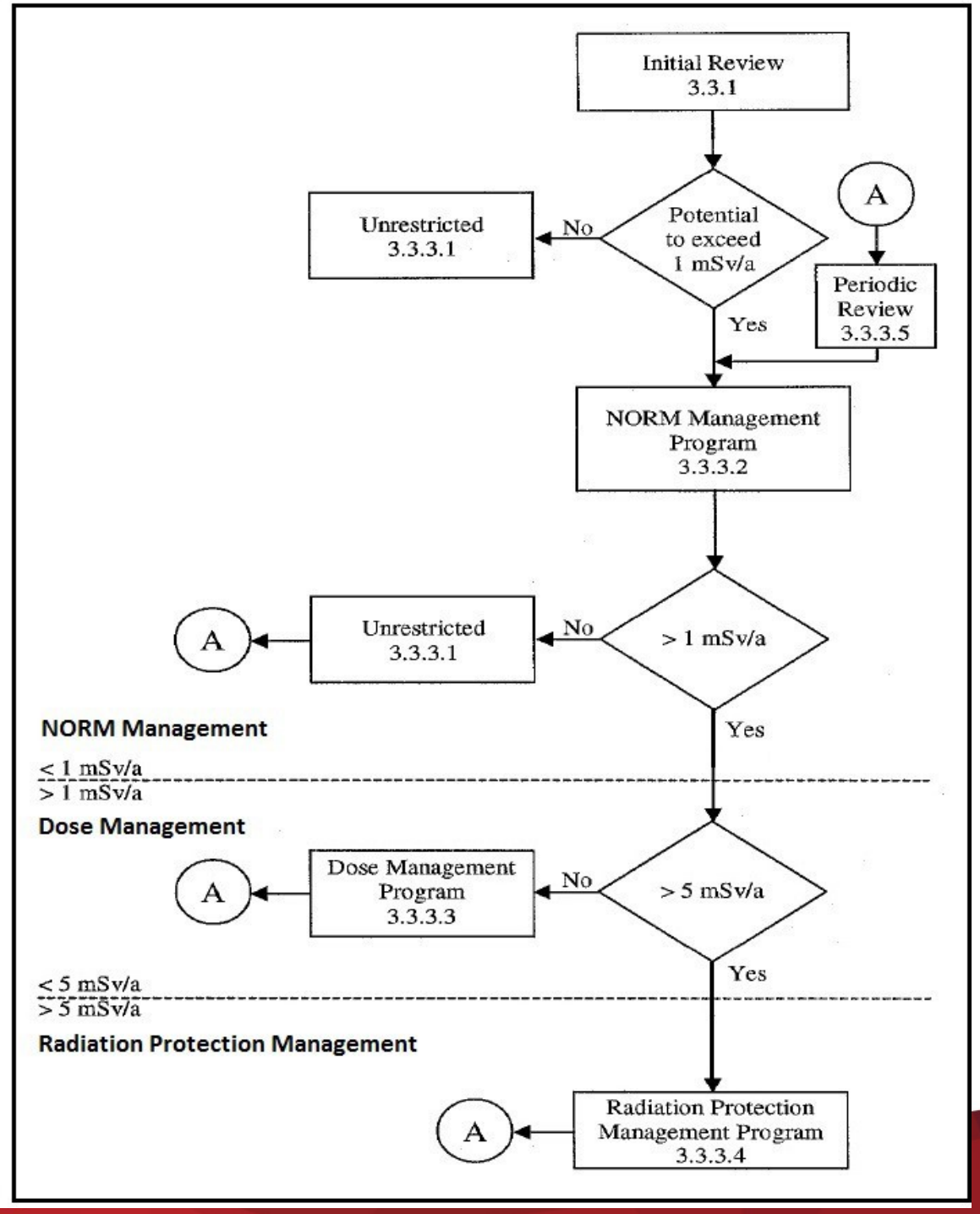
Canada has also developed the Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (the NORM Guidelines) [2], specifically for managing radiation exposure caused by industries that are not licensed nuclear facilities but are engaging in activities where there is a risk that occupational or off-site public doses from NORM could exceed 1 mSv/a. For the remainder of this paper, these will be referred to as “NORM workplaces.” Non-uranium mining, mineral extraction and processing, oil and gas production, metal recycling, water treatment facilities, and fish hatcheries all fall within the category of NORM workplaces.

Current NORM Guidelines

The management strategy is driven by decision-points tied to incremental effective dose projections.

It works well for most NORMs but not for radon, for reasons:

- background radon cannot be distinguished from radon generated by a practice, so the need for radon management programs cannot be decided using thresholds based on incremental dose;
- the dose from radon at the national guideline level would push the total projected effective dose over the threshold for “NORM management” in many NORM workplaces, placing unfair burden on these employers.



Drawing from lessons learned through implementing the current NORM Guidelines, we propose decoupling the decision thresholds for NORM management (excluding radon) and radon management so that the two are considered separately.

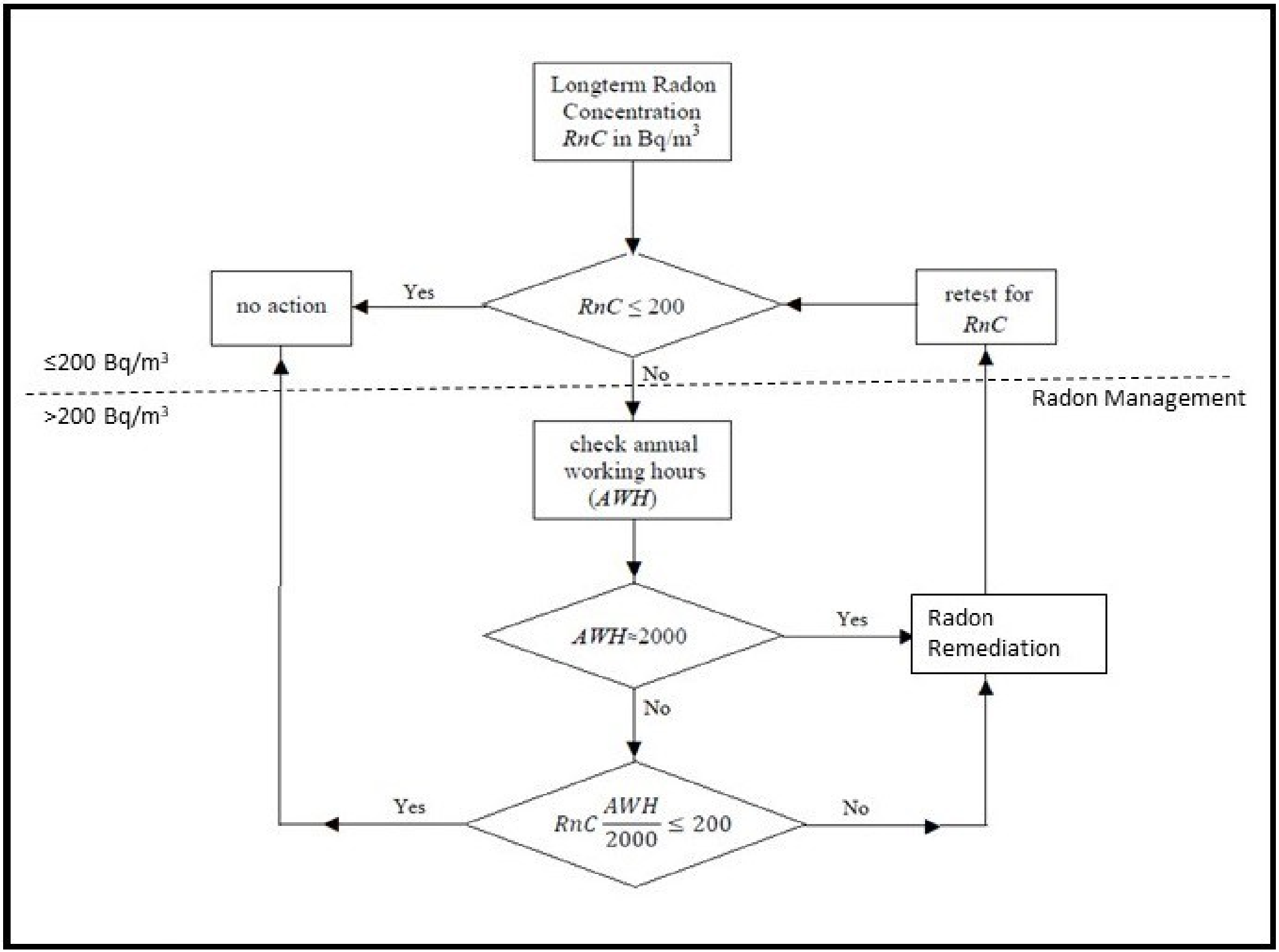
Further, we propose that the threshold and strategy for occupational radon exposure management in Canada be based on average annual activity concentrations, with no requirement for dose calculations.

A separate, stand-alone Radon Management threshold of 200 Bq/m^3 is proposed, in consistency with Canada's national radon guidance.

A Radon Management strategy would be appropriate for situations where radon concentrations are high only in areas with low occupancy.

A Radon Remediation strategy would be required for areas where the Radon Management criterion cannot be achieved. It would involve corrective actions, such as increasing ventilation, installing a radon mitigation system, or placing limits on working hours, as needed.

Proposed Radon Management in NORM Workplaces



For example, consider a water treatment room where the radon concentration is 1000 Bq/m^3. If workers spend no more than one hour per day in that room (about 230 hours per year), the annual exposure level is 1000x230/2000=115Bq/m^3, which is under the threshold of 200Bq/m^3. In this case, Radon Mitigation actions are not required; however, a periodic review is recommended. The review is to determine if there have been changes to the workplace and to determine if modifications are needed.

This approach is not intended to discourage employers from voluntarily taking steps to reduce ambient radon concentrations even when they are below the Radon Management threshold. Radon exposure carries some risk at any level and efforts should always be made to keep doses as low as reasonably achievable, with social and economic factors taken into consideration.

Conclusions

For practical use and reduction of management burden, we suggest that radon management be simply based on annual average radon activity concentration with consideration of actual annual working hours in a given workplace.

If average annual concentration in a given area, when adjusted for occupancy, is not significantly higher than 200 Bq/m^3, no intervention is required unless occupancy rates or radon concentrations change.

This approach is consistent with ICRP's recommendations for protection of workers which relies on a derived concentration that at which doses will not exceed 10 mSv/a.

For reasons of practicality and consistency, the value of the Radon Management threshold is the same as the derived concentration used as an action level for dwellings and for adventitious radon exposures in workplaces and public spaces.

References

[1] World Health Organization (WHO), WHO handbook on indoor radon. Geneva (2009).
[2] Health Canada, Canadian Guidelines for the management of Naturally Occurring Radioactive materials (NORM), Prepared by the Canadian NORM working group of the Federal Provincial Territorial Radiation Protection Committee, Ottawa (2011).