A Flowchart for the Development of a National Radon Action Plan (RAP)

Time

	Regulation / Legislation	Radon measurement and other relevant data	Communication / Awareness	Building protection	Comments / Notes
Scientific interest in radon	Apply requirements of IAEA GSR Part 3	Radon measurement for scientific or research purposes *1			Only dwellings and other buildings with high occupancy factors for the members of the public are considered in the scope of the RAP presented here. Workplaces may be included in the RAP as well but some of the provisions may differ reflecting the specific situation on workplaces.
RAP 1st phase – First assessment of the radon risk in the country	Yes The government shall provide for data collection to identify existing exposure situations – specifically activity concentration of ^{222}Rn. Is exposure due to radon of concern from the point of view of radiation protection? Yes No Yes Government shall provide information on levels of radon indoors and the associated health risks incl. increased risks relating to smoking to: **stakeholders** and **public**. Repeat radon survey in future? Yes No Set the time span for measurements *4 Radon is currently not a problem in the country 1. Government shall provide information on levels of radon indoors and the associated health risks incl. increased risks relating to smoking to: **stakeholders** and **public**. 2. Government shall assign responsibility for the establishment and implementation of Radon Action Plan (RAP) to the national regulatory body or other relevant authority. 3. Government shall provide for involvement of other ministries (national agencies) and other interested parties in decision regarding RAP and their responsibilities in the RAP (para 3.17 SSG-32).	Collect all available information about ^{222}Rn measurements in dwellings and other relevant buildings carried out in the country in the past, information about geology etc. to support the decision if public exposures due to radon are of concern from the point of view of radiation protection or not. Collected data are sufficient for decision? Yes No Develop or adapt the measurement protocol for long-term measurements for the purpose of radon survey *2. Design and carry out initial population weighted radon survey *3.	Develop first basic information leaflet on radon to accompany the measurement explaining the purpose of the measurement Prepare information on levels of radon indoors and the associated health risks incl. increased risks related to smoking. Consider linking to other relevant national programmes and projects such as indoor air quality, thermal energy retrofit.		Research plays an important role in supporting the development of national radon strategy and RAP. *1 Interest in radon problem is associated mainly with universities and research institutes *2 Long term measurements provide more reliable indication of radon levels in the dwelling. *3 The first survey should be done in dwellings. If this is not possible, then kindergartens and schools (in some cases also hospitals) may be used as alternative. To design the national representative radon survey properly, the statisticians, physicists and civil engineers should be involved. The information from last census should be used (Annex 1, SSG-32). *4 Radon levels indoors may change in future due to various reasons, e.g. new building technologies.
RAP – 2nd phase – Preparatory phase for Radon Action plan	Regulatory body - consider: Establishment of a "radon working group" or "national radon center" Representative radon survey carried out? Establish National Radon Laboratory?*4 Yes Find reliable contractors for measurement No Yes No Regulatory body: Prepare RAP taking into account the results of representative survey Regulatory body: Establish evaluation criteria for RAP Establish an appropriate reference level for ^{222}Rn for dwellings and other buildings with high occupancy factors for members of the public, with account taken of the prevailing social and economic circumstances, that in general will not exceed an annual average activity concentration due to ^{222}Rn of 300 Bq/m^3 *6 Approach relevant organizations to develop applicable and effective corrective actions (**CA**) and preventive measures (**PM**) in respect to prevailing building characteristics in the region/ country Collect information about available equipment for radon measurement; Consider: - requirements on QA/QC system; - capacity building National protocol for long-term measurement exists? No Yes Regulatory body: Approve and publish the protocol for long-term measurements Develop or adapt the measurement protocol for long-term measurements for the purpose of radon survey. Design and carry out initial population weighted radon survey in dwellings. Evaluate data from representative radon survey. Regulatory body: Ensure dissemination of results of national radon survey		Support of establishment of national radon center/radon working group Star design of long-term communication strategy 1st radon awareness study Communicate the radon issue with building sector and building professionals Develop/update basic information leaflet on radon to accompany the measurement explaining the purpose of the measurement Support regulatory body in dissemination of information about results of national survey	Corrective actions (**CA**) and Protective measures (**PM**) – 1st attempts Further development of CA and PM Test CA and PM realizations with detailed tests of their effectiveness	*5 Based on the expected extent of radon problem in the country decide whether it would be useful to establish a national laboratory for radon measurement or the commercial contractor for radon detectors would be preferred. In any case, the to ensure the reliability of radon measurements, the system of quality assurance should be considered (incl. protocols, metrology, inter-comparisons, agreement or licensing etc.) *6 See para 3.35-3.41 of SSG-32. If the concept of 2 reference levels is used then clearly define the meaning of "old" and "new" buildings (e.g. "old" are those built before the new legislation with provision on radon comes into force). *7 To be effective, the new legal framework should be applicable, practical and controllable. Decision of the Government and Regulatory body: What should be recommended, what should be mandatory and under what conditions – CA, PM, measurement, information sharing in selling/ renting process, etc.?
RAP – 3rd phase – Implementation	- Legal framework for protection against radon indoor, considering building materials and water with high content of natural radionuclides - Amended building code with provisions regarding protection against radon - RAP Development of national legal framework with provisions to protect public against radon (Regulations on radiation protection, public health, building code).*7 Measurement protocols for: - Long-term measurement (if not developed in 1st / 2nd phase) - Short-term indicative measurement - Content of radionuclides in building materials and in water - Radon in soil Methodology for: - Radon maps (from geological data and indoor measurements) Technical standards for CA and PM and criteria for evaluation their effectiveness Regulatory body: Approve and publish measurement protocols, technical standards for CA and PM and evaluation criteria to assess their effectiveness Establish national radon database Who will have access; What data will be stored etc. Design the database National radon database Establish training system for building professionals Consider: Accreditation of training Accreditation/ licensing of building professionals? Yes Design the system Foster and support measurement companies? Establish training system for professionals providing measurement Consider: Accreditation of training Accreditation/ licensing of measurement companies? Yes Design the system Subsidies / Grants for CA? Yes Conditions Who will provide money Design the system Radon grants Develop radon maps Delineate radon prone areas? Radon prone areas Control of licensees Control of licensees	Develop or adapt the measurement protocols requested or considered as important for legal framework e.g. radon measurement indoors, measurement of radon in soil gas, assessment of activity concentration of radionuclides in building materials and water. Develop or adapt methodology for radon maps (methodology is related to the purpose of the map) (Annex 1 of SSG-32) Put in place measurement programmes to identify existing dwellings and other buildings with high occupancy factors for the public in which the reference levels for radon are exceeded. Establish a programme to identify building materials that may lead to exposure of members of the public that is higher than the reference level for building materials. Develop training system for professionals providing measurement Collect all available data for development of radon maps Identify Rn prone area(s) based on agreed methodology (para 3.42-3.45 of SSG-32)	Finalize long-term communication strategy Develop and disseminate of information on radon containing the following: - health risk (general, radon map, reference level) - need for measurements - need for corrective action (reconstruction, high levels of radon, thermal retrofitting) - need for preventive measures in future buildings - Campaigns for various target audiences (e.g. architects, building surveyors, physicians, insurance companies, engineers, housing transactions parties) - Leaflets for various target audiences - Web pages, Hotline, Roadshow etc. Continue with public risk awareness raising Co-operate with journalists to get radon issue into media Advertise subsidies/grants 2nd radon awareness study Effectiveness evaluation	Draft of technical standards and radon related provisions for building code and building regulations reflecting the knowledge gained Develop technical standards for CA and PM and evaluation criteria to assess their effectiveness Introduce radon in curriculum of building professionals education Develop training system for building professionals Carry out trainings of building professionals (capacity building) Realization of CA and PM accompanied with the verification of their effectiveness	**IAEA Safety Standards Series No. GSR Part 3 "Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards" (2014)** **Requirement 47: Responsibilities of the government** The government shall ensure that existing exposure situations that have been identified are evaluated to determine which occupational exposures and public exposures are of concern from the point of view of radiation protection. **Requirement 48: Justification of protection actions and optimization of protection and safety** The government and the regulatory body or other relevant authority shall ensure that remedial actions are justified and that protection and safety is optimized. **Requirement 50: Public exposure due to radon indoors** **The government shall provide information on levels of radon indoors and the associated health risks and, if appropriate, shall establish and implement an action plan for controlling public exposure due to radon indoors.** 5.19. As part of its responsibilities as required in para. 5.3, the government shall ensure that: (a) Information is gathered on activity concentrations of radon in dwellings and other buildings with high occupancy factors for members of the public through appropriate means such as representative radon surveys; (b) Relevant information on exposure due to radon and the associated health risks, including the increased risks relating to smoking, is provided to the public and other interested parties. 5.20. Where activity concentrations of radon that are of concern for public health are identified on the basis of the information gathered as required in para. 5.19(a), the government shall ensure that an action plan is established comprising coordinated actions to reduce activity concentrations of radon in existing buildings and in future buildings, which includes: (a) Establishing an appropriate reference level for ^{222}Rn for dwellings and other buildings with high occupancy factors for members of the public, with account taken of the prevailing social and economic circumstances, that in general will not exceed an annual average activity concentration due to ^{222}Rn of 300 Bq/m^3; (b) Reducing activity concentrations of ^{222}Rn and consequent exposures to levels at which protection is optimized; (c) Giving priority to actions to reduce activity concentrations of ^{222}Rn in those situations for which such action is likely to be most effective; (d) Including in building codes appropriate preventive measures and corrective actions to prevent the ingress of ^{222}Rn and to facilitate further actions wherever necessary. 5.21. The government shall assign responsibility for: (a) Establishing and implementing the action plan for controlling public exposure due to ^{222}Rn indoors; (b) Determining the circumstances under which actions are to be mandatory or are to be voluntary, with account of legal requirements and of the prevailing social and economic circumstances. IAEA Safety Standards Series No. SSG-32: Protection of the Public against Exposure Indoors due to Radon and Other Natural Sources of Radiation (2015)
RAP – 4a phase – Realization phase	Targeted surveys in RPA? Targeted communication in RPA?	Carry out training for professionals providing measurement (capacity building) Carry out measurements of indoor radon, radionuclides in building material and water: - upon request - when required by legal framework	Improve communication strategy (long term process) - Social (health marketing) - Targeted communication with public, influential social groups, e.g. physicians, local stakeholders, parents, teachers, journalists, ... - Promotion of measurement - Promotion of CA and PM	Prioritization of reduction of ^{222}Rn activity concentrations where likely to be most effective (implementation of CA) Application of PM Verification of effectiveness of applied CA and PM	
RAP – 4b phase – Realization phase – Evaluation	Evaluation of the tools to reduce the health burden based on the evaluation criteria defined in previous phase (para 3.57-3.59 of SSG-32): - legislation - effectiveness of CA and PM - awareness, willingness to make measurement, to take action (CA or PM) REPORTING TO the government, building authorities, etc. DISCUSSION of the update of legislation, technical standards, measurement protocols, training schedules, awareness programmes, etc. if appropriate				Beginning/End of the process Decision Process Document

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