Radon Exposure Management in the Workplace Guide for Employers

Radon Action Plan

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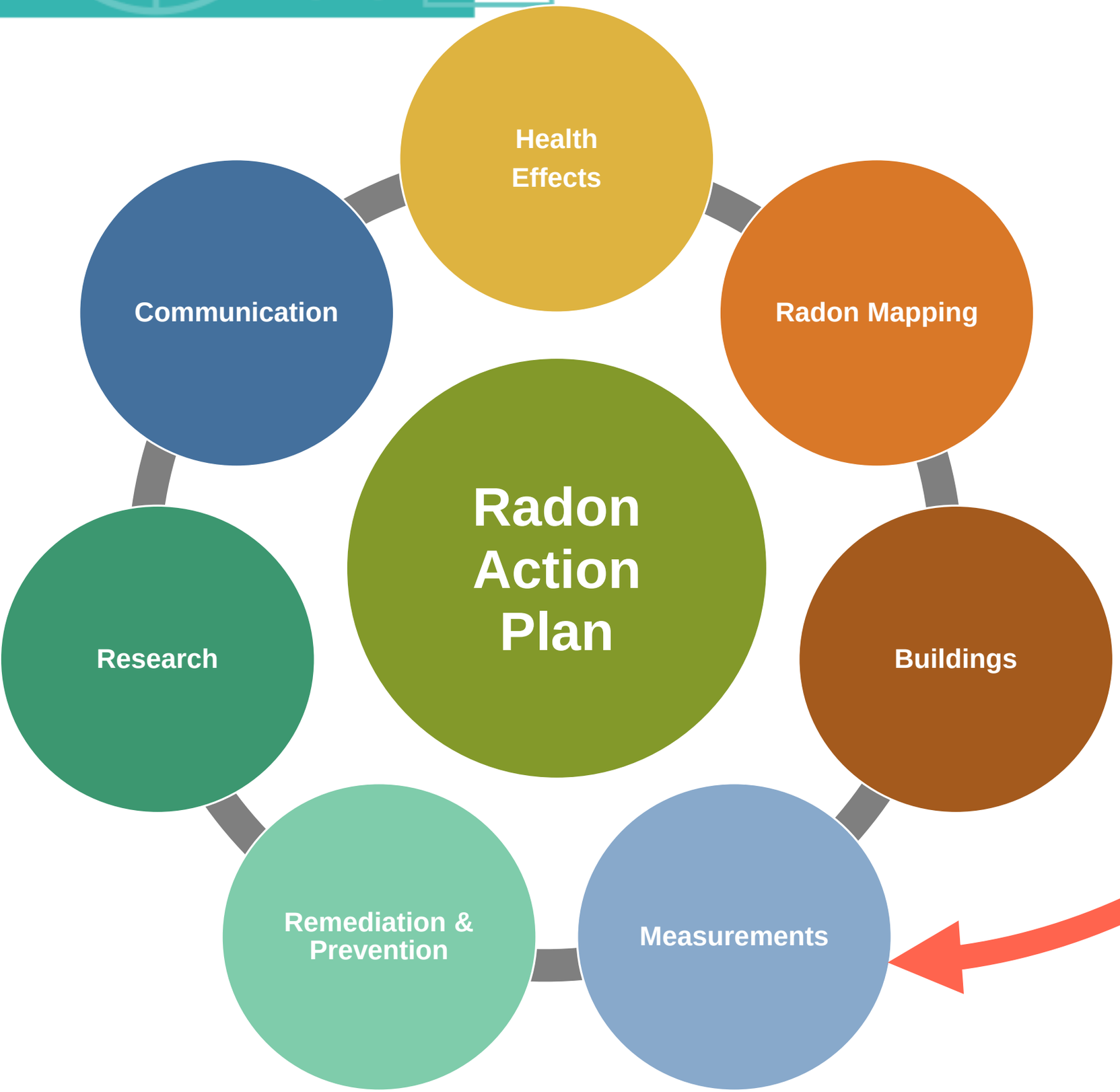

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Scope

- Identify the obligations of employers in managing the risk associated with exposure to radon.
- Practical tool for assessing and managing the risk of exposure to radon in the workplace.
- Determine if the average annual radon concentration to which workers or the public are exposed exceeds the national reference level
- Applicable to most workplaces.

Regulations

Reference levels:

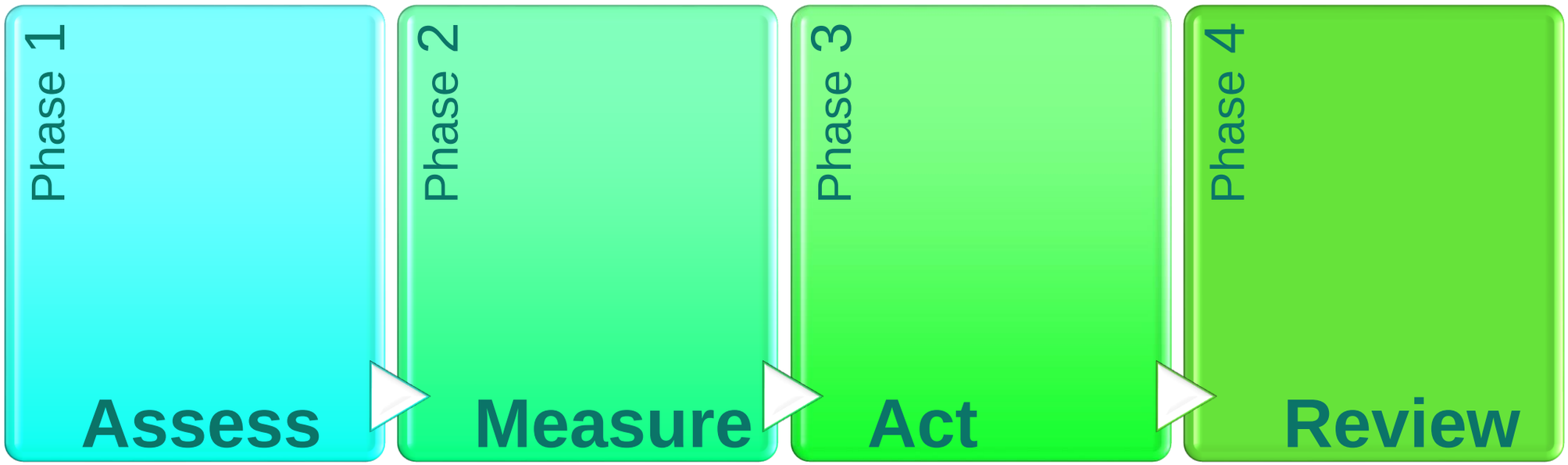
- 300 Bq/m^3 for all workplaces and buildings with high occupancy factors by members of the public.

Obligations of employers:

- 1 - Employers must ensure that the radon concentration in the workplace is as low as reasonably achievable, below the reference level and ensure that this protection is optimized.
- 2 - If, despite all reasonable efforts of the employer to reduce radon levels, the radon concentration in the workplace remains above the reference level, this situation shall be managed as a planned exposure situation.

Methodology

Four Main Phases:



Phase 1 - Assess

Regulations on Radon Monitoring in the Workplace:

1 - Employers carry out radon measurements with a periodicity not exceeding 12 months:

a) When the site is located in areas identified in the radon action plan, on the ground floor or at underground levels, taking into account the parameters included in the plan;

b) In specific types of workplaces identified in the national strategic plan for radon.

2 - In areas of workplaces where the radon concentration, on an annual average, continues to exceed the national reference level, despite measures taken in accordance with the principle of optimization, the provisions for planned exposure situations apply.

Phase 1 - Assess

Type	Definition	Examples
Risk areas	Workplaces located in areas affected by radon.	Risk map
Flagged locations	Workplaces located below ground level.	Subway, mines, tunnels, caves and tourist mines,…
	Workplaces that use groundwater extraction.	Groundwater extraction and / or treatment stations, thermal establishments, Spas,…
	Workplaces that use internal radon sources as geological samples.	Universities, laboratories, museums
	Industrial practices involving natural radioactive material	Industrial sectors identified in Article 60 of Decree-Law No. 108/2018 of 3 December.

Phase 2 - Measure

Two measurement stages:

- Diagnostic monitoring - initial test;
- Effectiveness monitoring - corrective measures effectiveness test.

Consult radon measurement services provider.

Organize the measurement campaign.

Inform employees about the measurement campaign and radon testing.

Phase 2 - Measure

Define the areas to monitor

- Areas located on the ground and underground floors.
- Areas that are occupied routinely.
- Areas that represent the different working environments in the building.
- Places / rooms with low or no occupancy such as corridors, bathrooms, archives, etc. measurement is not necessary.
- Exposures from 3 months to 1 year, avoiding the periods when the facilities are closed.
- During the monitoring campaign, the professional activity performed in the facilities must remain representative of normal working situations.

Phase 2 - Measure

Recommended measurement densities for different workplace types

Workplace type	Number of monitors	Examples
Office, individual or small	One per 100 m^2, generally corresponds to between a half and third of all ground floor rooms	Banks, small shops, professional practice (solicitors, etc), residential homes
Open plan office, and retail or workshop up to about 1000 m^2, also public access areas	One per 250 m^2	Administrative and call centres, light industry, hotels
As above, up to 5000 m^2	One per 500 m^2	Large retail etc
Very large areas of several thousand m^2	One for each distinct area with obviously different environmental conditions, not less than 1 per 1000 m^2.	Manufacturing or process plant, warehouses
Basements	One in each separate room, section or area irrespective of size, if occupied more than 50 hours per year	Retail, bank and professional storage areas
Totally underground	As a guide at least one in each main working area, and other normally occupied areas, but seek specialist advice	Water industry, mines and caves

* On higher floors: At least two detectors per floor and at least one detector per 250 m²

Phase 2 - Measure

<u>Placing the detectors:</u>

The place:

- It must provide a reasonable degree of representativeness and safety in order to prevent falls and loss of the detector;
- Must be chosen taking into account that the detector will remain in the same position for the duration of the monitoring (between 3 months to 1 year)
- When testing the effectiveness of corrective measures the detectors should be placed in the same locations where the radon concentrations where above the reference level.

Phase 2 - Measure

<u>Placing the detectors:</u>

The detector:

• must be placed about 1 m to 2 m from the floor;

• must be away from the wall;

• must be away from a source of fresh air, such as an air intake fan, permanent ventilation or a window that is frequently open;

• must be away from a heat source such as heaters or radiators;

• must not be placed in a closed space, such as cabinets, drawers or boxes;

• must not be placed in close contact with water.

Phase 3 - Act

- ≤ 300 Bq/m3
- > 300 Bq/m3
- Consult an Expert or Technician qualified in Radiological Protection or a Technician in Health and Safety at Work to advise on the management of radon exposure.
- Actions:
    - Remediation
    - Notification
    - Exposure assessment

Phase 3 - Act

Remediation:

- Where a corrective engineering solution is identified as the most appropriate reduction method, it must be implemented as soon as possible.
- After the engineering solution has been installed, monitoring of radon concentration levels will be carried out again to assess the effectiveness of the measures to ensure the effectiveness of the corrective measures.

Notification:

- The employer shall report to the competent authority whenever the levels of radon concentration in indoor air continue to exceed the national reference level, despite measures taken in accordance with the principle of optimization.

Phase 3 - Act

Exposure assessment:

- This assessment will determine whether the effective dose received by workers is likely to exceed 6 mSv / year.
- To calculate the effective dose, the appropriate dose coefficient is multiplied by the radon concentration and exposure time

Effective dose = radon level × time × dose coeficiente

Workplaces	Dose coeficiente ($mSv/Bq.h.m^{-3}$)
• Most workplaces • Mines	6.7
• Workplaces that require high physical activity • Tourist caves	13

(ICRP 137)

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Phase 4 – Review

In this phase there are 3 different situations depending on the previous phases.

- Situation 1 - Radon concentration < 300 Bq / m^3
- Situation 2 - Effective dose < or = 6 mSv / year
- Situation 3 - Effective dose > 6 mSv / year.

Situation 1 - Radon concentration < 300 Bq / m^3

Review:

- Annually if in a radon risk area or a flagged location
- Annually if a corrective measure is in place;
- After any building works or change of use to the building
- If corrective measures are in place, systems need to be maintained and checked regularly

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Phase 4 - Review

Situation 2 - Effective dose < or = 6 mSv / year

- Competent authority requires that the employer keeps the exposures under review
- Situation 1 reviews also apply

Situation 3 - Effective dose > 6 mSv / year

- This situation shall be managed as a planned exposure situation
- Decree-Law nº108 / 2018, of 3rd December
- Establish a protection strategy in coordination with the competent authority
- Situation 1 reviews also apply

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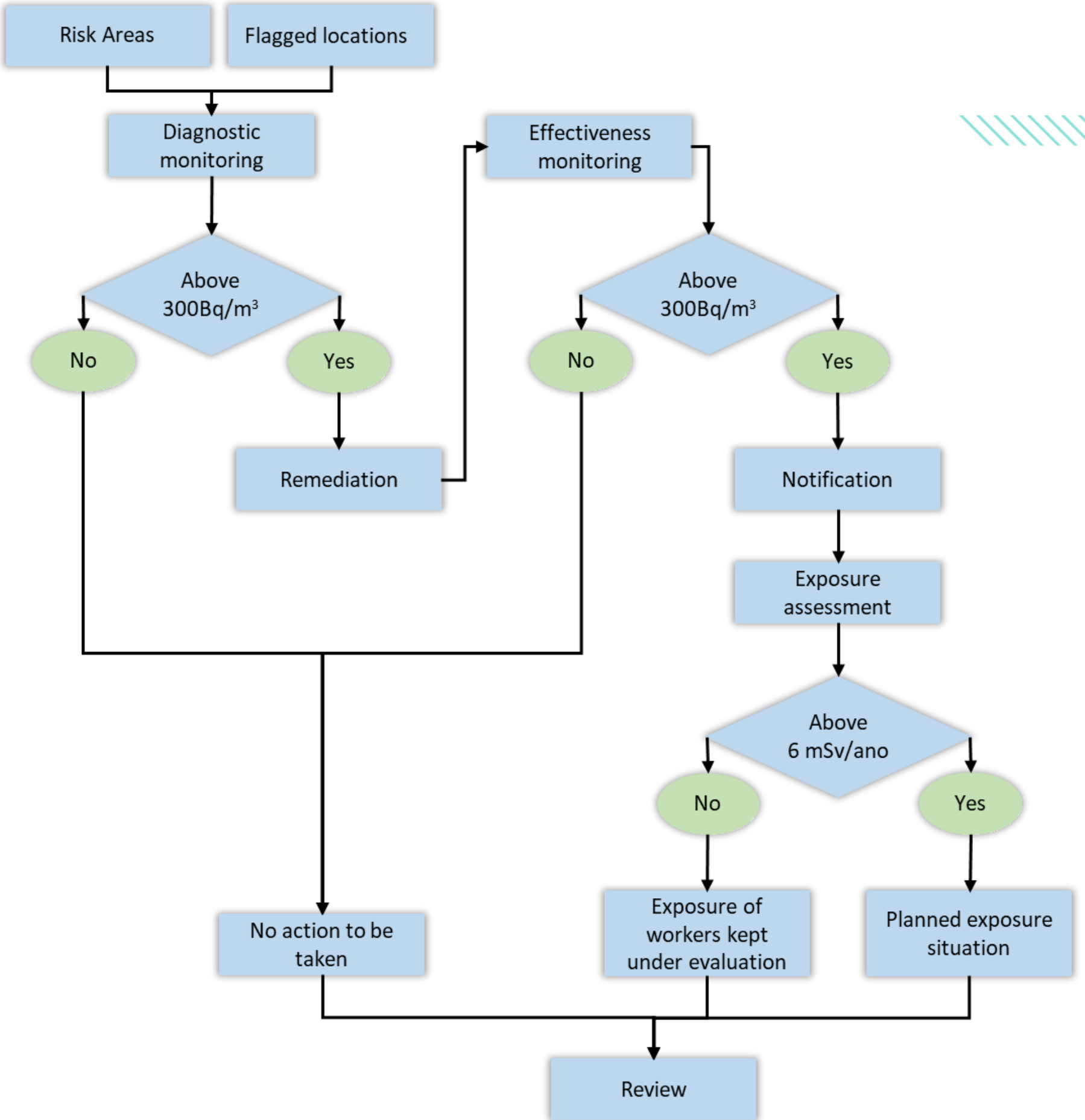
Flowchart


Risk Areas
Flagged locations
Diagnostic monitoring
Above 300Bq/m³
No
Yes
Remediation
Effectiveness monitoring
Above 300Bq/m³
No
Yes
Notification
Exposure assessment
Above 6 mSv/ano
No
Yes
No action to be taken
Exposure of workers kept under evaluation
Planned exposure situation
Review

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Thank you!

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