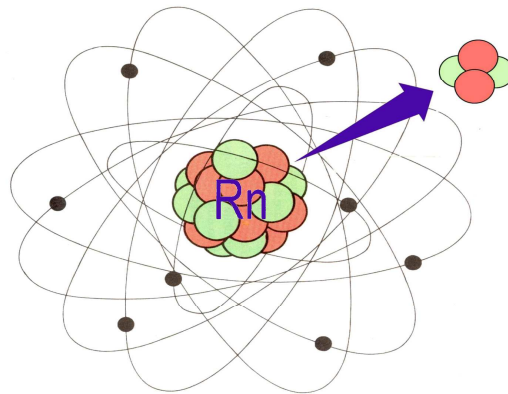


Il radon

Documenti utili



argomenti

rischio radon
mappatura
metodi di misura
azioni di rimedio
normativa

da

ARPA Piemonte

www.arpa.piemonte.it

3

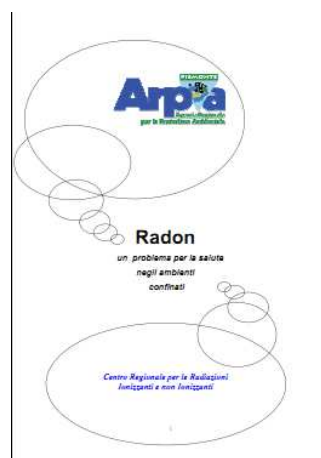
ARPA Piemonte

Radon

un problema per la salute negli ambienti confinati

Opuscolo divulgativo di
introduzione al problema
del radon

[http://www.arpa.piemonte.it/
upload/dl/Radiazioni_Ioniz
zanti/Reti_regionali_di_m
onitoraggio/Radon/ABC_r
adon.pdf](http://www.arpa.piemonte.it/upload/dl/Radiazioni_Ionizanti/Reti_regionali_di_monitoraggio/Radon/ABC_radon.pdf)



ARPA Piemonte
La mappatura del radon in Piemonte
(sintesi)

- Caratterizzazione del territorio Piemontese
**MEDIE COMUNALI e
CARTINE**
- http://www.arpa.piemonte.it/upload/dl/Pubblicazioni/2009_-_La_mappatura_del_radon_in_Piemonte/LibroRadonWeb.pdf



ARPA Piemonte
La mappatura del radon in Piemonte

Testo a carattere tecnico:
oltre ai risultati sono
descritti metodi e modelli
utilizzati

http://www.arpa.piemonte.it/upload/dl/Pubblicazioni/2009_-_La_mappatura_del_radon_in_Piemonte/La_mappatura_del_radon_in_Piemonte.pdf



documenti

www.ispesl.it

ISPESL (ora INAIL)

7

ISPESL

Il radon in Italia: guida al cittadino



<http://www.ispesl.it/ossvita/pdf/radon.pdf>

8

- Documento a carattere divulgativo

Tratta diversi argomenti partendo dagli aspetti fisici e dal rischio sanitario fino ai consigli per le azioni di bonifiche e preventive

9

Documenti dal sito

<http://www.ispesi.it/pubblicazioni/dossier.asp?q=rpcb>

Il Radon nei luoghi di lavoro

Questo cd multimediale è rivolto agli operatori sanitari. Lo scopo è di affrontare la problematica del gas radon negli ambienti di lavoro.



La presenza di Gas Radon nei luoghi di lavoro. Guida agli adempimenti

Con questa guida si intendono fornire informazioni in merito alla normativa vigente e su come ottemperare agli obblighi di legge.



Aspetti teorici ed operativi per la Protezione dal Radon nei luoghi di Lavoro

Questo volume intende fornire una panoramica delle problematiche connesse all'esposizione dei lavoratori al radon in settori lavorativi di interesse sia dal punto di vista radio protezionistico che sanitario.



Una scuola senza radon

Questa guida è rivolta a quanti operano nel mondo della scuola intesa sia come "laboratorio formativo della persona" sia come sede lavorativa del personale docente e non docente. Lo scopo è di affrontare la problematica del gas radon in modo semplice, chiaro ed efficace.



Il radon nei nostri spazi di vita

Che cos'è, perchè ci minaccia e come possiamo difenderci



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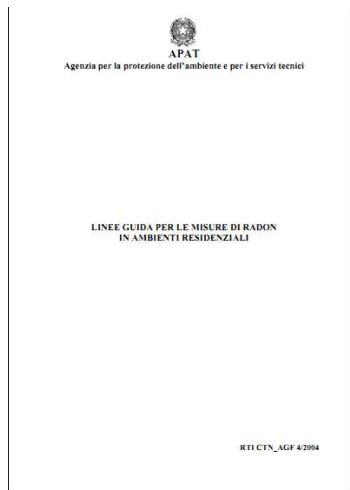
Documenti

APAT (ora ISPRA)

www.apat.gov

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Linee guida per la misura del radon in ambienti residenziali



Documento di
ISPRA (ex APAT)

http://www.apat.gov.it/site/_files/Rapporto_tecnico_radon.pdf

13

Linee guida relative ad alcune tipologie di azioni di risanamento per la riduzione dell'inquinamento da radon

Organizzato a schede:
descrive le principale
tecniche per ridurre il
radon negli edifici

http://www.arpa.umbria.it/ausinanet/Radiazioni%20Ionizzanti/IR_04/RTI-CTN_AGF_04_2005.pdf



da altre ARPA

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Arpa Veneto

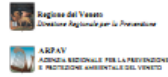
<http://www.arpa.veneto.it/temi-ambientali/agenti-fisici/riferimenti/publicazioni>



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Arpa Veneto

Mappatura radon in Veneto



<http://www.arpa.veneto.it/temi-ambientali/agenti-fisici/riferimenti/publicazioni>

INDAGINE REGIONALE
PER L'INDIVIDUAZIONE DELLE AREE
AD ALTO POTENZIALE DI RADON
NEL TERRITORIO VENETO

Arpa FVG



<http://www.arpa.fvg.it/index.php?id=229> 18

Arpa FVG

Opuscolo divulgativo

<http://www.arpa.fvg.it/index.php?id=229>



Inghilterra

HPA - Health Protection Agency Radon Atlas of England

NRPB-W26

Radon Atlas of England and Wales

B M R Green, J C H Miles, E J Bradley and D M Rees

ABSTRACT

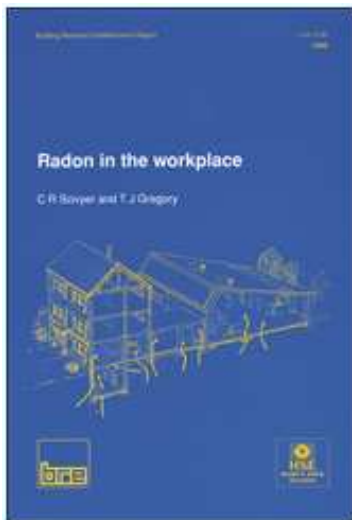
This new report brings together and updates the information in three earlier reports of radon levels in English and Welsh homes. In particular, data from measurements in over 400,000 homes in England and Wales are presented in tabular form. The tables give the data by various administrative divisions, down to electoral wards for Cornwall, Devon and Somerset and council areas elsewhere and to sector level of the postcode system. The radon probability maps are based on the national grid system and show significantly more locational detail than the previous publications, an extra division in the probability banding to coincide with current Government initiatives on radon in England and, in southwest England, more detailed probability mapping than before - by 1 km grid squares in place of the 5 km grid squares used in Wales and the rest of England.

© National Radiological Protection Board Approval: August 2002
Denton Edition: November 2002
Denton ISBN 0 85653 497 6

This ISBN is available on ordering and evaluation of the current scientific evidence as presented and referenced in this document.

http://www.hpa.org.uk/wbc/HPAwebFile/HPAweb_C/1194947416844

BRE -Building Research Establishment Radon in the workplace



Prima edizione del 1995

<http://www.brebookshop.com/details.jsp?id=586&query=BR293&publisher=&type=&from=0&s=true>

Radon in the workplace: A guide for building owners and managers (Second edition) 2011

This guide to reducing the risk of exposure to radon in the workplace has been thoroughly updated to include lessons learned and changes in legislation since the first edition was published in 1995. It is aimed at managers, maintenance staff and building contractors who need to determine whether a building has a radon problem or to reduce known elevated radon levels.

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HPA - Health Protection Agency An analysis of Radon Remediation Methods

HPA-CRCE-019

An Analysis of Radon Remediation Methods

S A Hodgson, W Zhang, E J Bradley, B M R Green and P McCall

ABSTRACT

Radon gas in the home is a major source of public radiation exposure and an established cause of lung cancer. A range of approaches are available to reduce high indoor radon concentrations in homes. Information on some 2,700 radon remediation projects has been analysed with the aim of identifying the factors that influence the performance of various remediation methods, including the specific remediation techniques applied, the physical characteristics of the home, the radon level before remediation and who carried out the work.

The analysis shows that each method used to reduce radon levels has a range of performance which is influenced by some factors but is independent of others. Each remediation method showed a trend in performance with respect to the initial radon concentration. Higher initial radon concentrations offer greater relative reductions when remediated. However, homes with higher initial concentrations measure were less likely to achieve reductions below the Action Level (200 Bq m⁻³). Overall, an active sump system is most likely to offer a substantial reduction, on average a 100. Other methods are less effective, reducing levels by a typical factor of about 2. Passive ventilation and sealing are least effective. This analysis does not support firm conclusions about the relative performance of different types of remediation and householders who do 'DIY'. Typical costs have been estimated with active sumps being the most expensive at around £800.

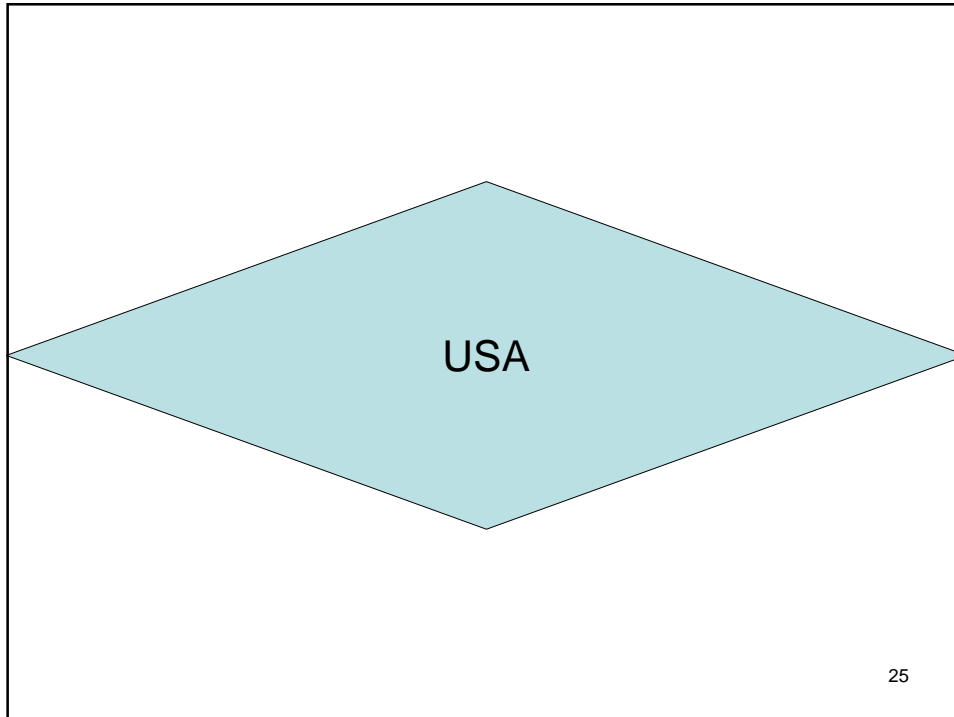
This information will be used to update guidance for householders and others such as contractors, using fact sheets, presentations at radon householder events and the UK radon website.

http://www.hpa.org.uk/welb/HPAwebFile/HPAwelb_C/1296687112283

Health Protection Agency
Centre for Radiation, Chemical and Environmental Hazards
Crickle, Essex
Colchester, Essex, UK

Radon in the Workplace
Publication 11/2011
CRCE-019
ISBN 978-0-89851-494-8

This report from HPA, which understanding and evaluation of the current scientific evidence as presented and referenced in the document.



OSHA Occupational Safety and Health
Administration

**Radon in the workplace
the OSHA Ionizing Radiation
Regulations**

Documento di riferimento per ambienti di lavoro in
USA redatto dall'agenzia federale OSHA

<http://ebookbrowse.com/2004-07-radon-in-the-workplace-the-osha-ionizing-radiation-pdf-d15206354>

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Environmental Protection Agency
EPA

Sul sito web
numerose
pubblicazioni
da divulgative a
tecniche

<http://www.epa.gov/radon/pubs/index.html#index4>

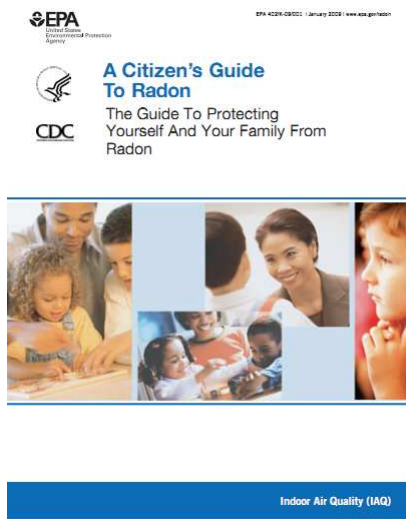
Tra cui:.....

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Environmental Protection Agency (EPA)
**A Citizen's Guide to Radon: The Guide to Protecting
Yourself and Your Family from Radon**

This guidance offers strategies for testing your home for radon and discussions of what steps to take after you have tested, discussions of the risk of radon and radon myths.

<http://www.epa.gov/radon/pdfs/citizensguide.pdf>



Environmental Protection Agency (EPA)
Home Buyer's and Seller's Guide to Radon

This booklet is intended for anyone who is buying or selling a home, real estate and relocation professionals, home inspectors and others.

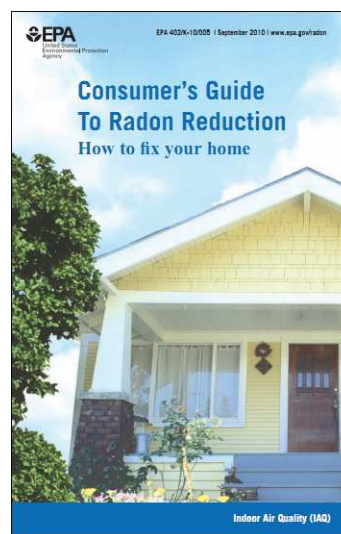
<http://www.epa.gov/radon/pdfs/hmbuygud.pdf>



Environmental Protection Agency (EPA)
**Consumer's Guide to Radon Reduction:
How to Fix Your Home**

You have tested your home for radon, but now what? This guidance has been specifically designed for people who have tested their home for radon and confirmed that they have elevated radon levels

<http://www.epa.gov/radon/pdfs/consguid.pdf>

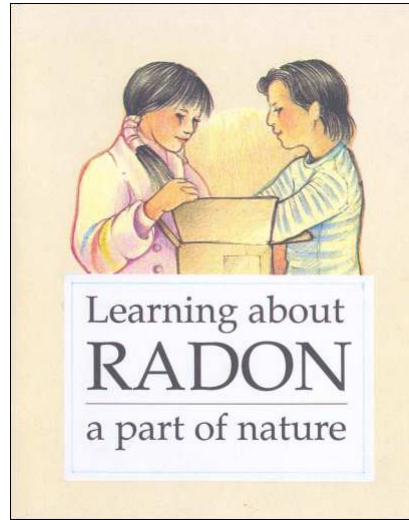


Environmental Protection Agency (EPA)

Learning About Radon A Part Of Nature

Written for Native Americans, this 18-page booklet discusses radon's place in the world, the basics on testing, and how homes can be fixed to reduce radon levels.

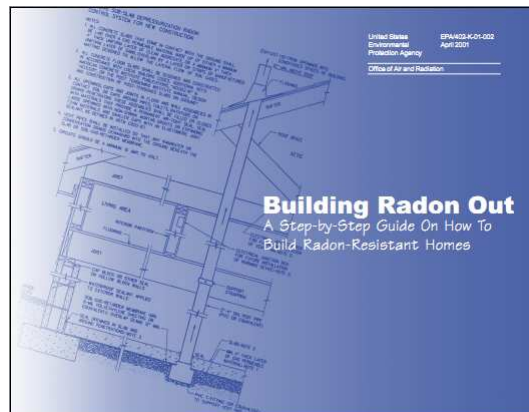
http://www.epa.gov/radon/pdfs/learning_about_radon.pdf



Environmental Protection Agency (EPA)

Building Radon Out: A Step-by-Step Guide on How to Build Radon- Resistant Homes

- This 81-page, fully illustrated guide contains all the info you need in one place to educate home builders about [radon-resistant new construction](#)
- <http://www.epa.gov/radon/pdfs/buildradonout.pdf>





ICRP
International Commission on Radiological
Protection

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**ICRP Publication 65:
Protection Against Radon-222 at Home and at
Work**

Importante per la valutazione della
dose da esposizione a radon:ha
fornito i fattori convenzionali di dose
utilizzati negli allegati del D.L.vo
241/2000

34

ICRP Publication 103: The 2007 Recommendations of the International Commission on Radiological Protection

<http://www.icrp.org/publication.asp?id=ICRP%20Publication%20103>

http://www.icrp.org/docs/P103_Italian.pdf



IARC : classificazione del radon nel gruppo 1 delle sostanze cancerogene



WORLD HEALTH ORGANIZATION
INTERNATIONAL AGENCY FOR RESEARCH ON CANCER

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans

Volume 43 Man-made Mineral Fibres and Radon

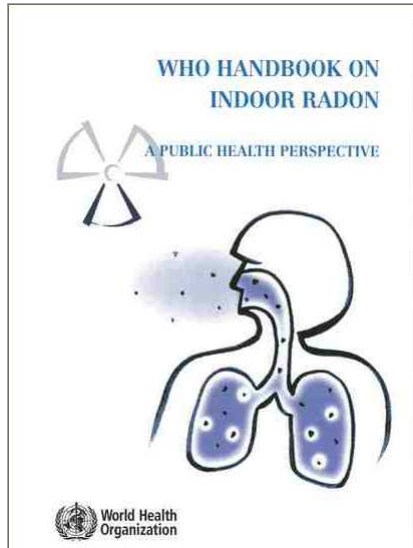
Summary of Data Reported and Evaluation

[Man-made mineral fibres](#)

[Radon](#)

- <http://monographs.iarc.fr/ENG/Monographs/vol43/volume43.pdf>

WHO radon handbook



Documento dell'organizzazione mondiale della sanità:

- http://www.who.int/ionizing_radiation/env/radon/en/index1.html

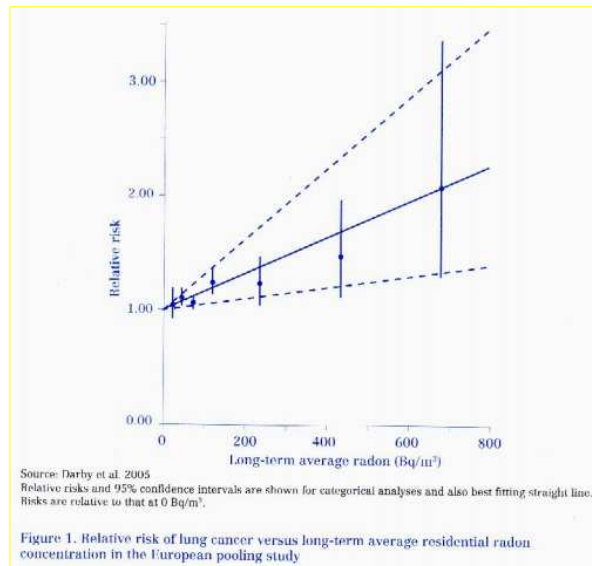
37

Effetti sulla salute

- Il manuale riassume gli studi e le considerazioni che permettono di stabilire una relazione tra rischio relativo e concentrazione radon media a cui si è esposti. Nel testo si evince la pericolosità del radon anche a concentrazioni di radon dell'ordine di 100 Bq/m^3

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European pooling study



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il manuale WHO

non tratta solo di effetti sanitari e studi epidemiologici ma tratta in generale di molti aspetti: la misura, la prevenzione, i costi, la comunicazione del rischio, e l'attivazione di piani nazionali che permettano strategie integrate

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Ministero della salute Piano Nazionale radon

Il Piano Nazionale Radon (PNR) consiste in un insieme coordinato di azioni volte a ridurre il rischio di tumore polmonare associato all'esposizione al radon in Italia.

Il PNR è stato preparato nel 2002 da una commissione del Ministero della Salute...

L'intero documento programmatico è reperibile sul link:
<http://www.iss.it/binary/tesa/cont/PNR-Testo%20completo.1195145887.pdf>

41

In particolare, il progetto PNR-CCM prevede la valutazione dei rischi associati all'esposizione al radon, l'istituzione dell'Archivio Nazionale Radon presso l'ISS, lo sviluppo delle indagini sulla distribuzione territoriale delle concentrazioni di radon negli edifici, la messa a punto e l'avvio di un piano di informazione della popolazione e di gruppi specifici, la produzione di linee guida e la predisposizione di adeguamenti normativi.

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Valutazione del rischio radon
Come individuare gli edifici ad elevata
concentrazione radon
Sorgenti di radon ed altri fattori che
influiscono sui livelli di concentrazione di
radon negli edifici
Come misurare la concentrazione di radon
in aria
Come ridurre e prevenire le concentrazioni
elevate di radon negli edifici
Informazione, formazione qualificazione
Normative

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Allegati tecnici

Caratteristiche fisiche, sorgenti e meccanismi di
ingresso del radon negli ambienti chiusi
Rassegna degli interventi per ridurre o prevenire
livelli elevati di concentrazione radon
Dati sull'edilizia italiana rilevanti per il problema
radon
Elementi di base sulla radioattività.
...

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Nell'ambito del PNR è stata redatta la

“Raccomandazione sull'introduzione di sistemi di prevenzione dell'ingresso del radon in tutti gli edifici di nuova costruzione”

- Utile riferimento per gli strumenti urbanistici (piani regolatori, regolamenti edilizi) al fine di prevenire il rischio radon...
- http://www.iss.it/binary/tesa/cont/PNR_Raccomandazione.pdf

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Normativa

Testo non ufficiale (quello ufficiale è reperibile sulla GU) però utile perché raccoglie in un “testo unico” diversi atti normativi:
http://www.aimn.it/lex/DLgs_230_modificato.pdf
(AIMN-Associazione Italiana Medicina Nucleare)

Decreto Legislativo del Governo 17 marzo 1995 n° 230
modificato

dal D.Lgs. 26 maggio 2000, n. 187,

dal D.Lgs. 26 maggio 2000, n. 241

dal D.Lgs. 9 maggio 2001, n. 257

dal D.Lgs. 26 marzo 2001, n.151

e dalla Legge 1 marzo 2002, n. 39

"Attuazione delle direttive 89/618/Euratom, 90/641/Euratom, 92/3/Euratom e 96/29/Euratom in materia di radiazioni ionizzanti."

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Nuova Direttiva europea

Draft Euratom Basic Safety Standards Directive

- Version 24 February 2010 (final)

http://ec.europa.eu/energy/nuclear/radiation_protection/doc/art31/2010_02_24_draft_euratom_basic_safety_standards_directive.pdf

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Piani Nazionali

Article 38

Radon action plan

1. Member States shall establish an action plan to manage long term risks from radon exposures in dwellings, buildings with public access and workplaces for any source of radon ingress, whether from soil, building materials or water. The action plan shall take into account the issues specified in Annex 13.
2. Member States shall forward the action plan and information on any identified radon prone areas to the Commission. The action plan and information on radon prone areas shall be updated on a regular basis.

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Luoghi di lavoro

Article 79 Radon in workplaces

1. Within the framework of the action plan, referred to in Article 38, Member States shall establish national reference levels for indoor radon concentrations, which **shall not exceed an annual average of 1 000 Bq m⁻³ for workplaces.**
2. Within the framework of the national action plan Member States shall ensure that radon measurements are carried out in workplaces located at ground floor or at basement level within radon prone areas and in specific types of workplaces as identified in the action plan.
3. Member States shall require undertakings in which the national reference level for existing workplaces is exceeded to take appropriate action in order to reduce radon concentrations or exposures, in accordance with the principle of optimisation laid down in Title III.
4. Where workplaces or specific rooms within a building continue to exceed the reference level despite the actions carried out as required in paragraph 3, the Member States shall apply the dose limits laid down in Article 10 and, where appropriate, the requirements set up for occupational exposure in planned exposure situations as laid down in Title VII.

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Livelli anche per le abitazioni...

Article 100 Radon in dwellings and buildings with public access

1. Within the framework of the action, referred to in Article 38, plan Member States shall establish national reference levels for indoor radon concentrations, which shall not exceed (as an annual average):
200 Bq m⁻³ for new dwellings and new buildings with public access
300 Bq m⁻³ for existing dwellings
300 Bq m⁻³ for existing buildings with public access, allowing for the occupancy time with a maximum of 1 000 Bq m⁻³.
2. Within the framework of the national action plan Member States shall
 - (a) Take action to identify existing dwellings exceeding the reference level and to encourage radon reducing measures in existing dwellings where the reference levels are exceeded
 - (b) Ensure that radon measurements are carried out in buildings with public access within radon prone areas.
3. Member States shall establish specific **building codes** to prevent radon ingress from the soil and, as specified in the national action plan, from building materials, and require compliance with such building codes, in particular in radon prone areas, so as to avoid radon concentrations exceeding the reference level for new buildings.
4. Member States shall provide local and national information on prevailing radon concentrations, on the associated health risks and on the available technical means for reducing existing radon concentrations.

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Annex 13

Indicative list of items to be covered in the national action plan for radon in dwellings, buildings with public access and workplaces

1. Strategy for conducting surveys of indoor radon concentrations, for management of measurement data (**national radon database**) and for the establishment of other parameters (soil and **rock types, soil gas concentration, permeability and radium -226 content of rock or soil**)
2. Available data and criteria used for the delineation of **radon prone areas** or for the identification of radon prone buildings.
3. **Identification of types of buildings** with public access and workplaces, e.g. schools, underground workplaces or spas, **where measurements are needed**, based on a risk assessment including occupancy hours.
4. The basis for the establishment of reference levels for existing dwellings, workplaces, buildings with public access and for new buildings
5. Assignment of responsibilities, governmental and non-governmental, coordination mechanisms and available resources for the implementation of the **action plan**
6. **Strategy for reducing radon exposure** in dwellings particularly in radon-prone areas
7. Strategy, including methods and tools, for preventing radon ingress in new buildings, including identification of **building materials** for which radon exhalation is important.
8. Schedules for audits and reviews of the action plan
9. Strategy for **communication** to increase public awareness and inform local decision makers of the risks of radon in relation to smoking.
10. Member States shall also, where appropriate, make arrangements to provide **guidance on methods and tools for measurements and remedial actions**. Criteria for the accreditation of measurement and remediation services should also be considered.
11. Where appropriate the national action plan may foresee the **provision of financial support for radon surveys and for remedial action**, in particular for private dwellings with very high radon concentrations.
12. **Long-term goals in terms of reducing lung cancer risk attributable to radon exposure (for smokers and non-smokers)**

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