Critical remarks on the new EU BSS as an introduction to the panel discussion

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Critical remarks on the new EU BSS as an introduction to the panel discussion

Although the new EU BSS looks quite different, it contains few changes of substance

EU BSS still refers to the old dose coefficients for internal contamination

- ICRP 100 and ICRP 103 not yet implemented
- The ICRP statement of 2009 on radon not yet implemented

Work activities replaced by planned or existing exposure situations

- However few changes in practice

Exemption and clearance levels are treated in the same way…

- But less strict than the current approach in Belgium?
- Dilution is now permitted in specific circumstances

➡ *Question for the panel discussion*

Is the new EU BSS just a storm in a teacup?

Although the new EU BSS looks quite different, it contains few changes of substance

The EU BSS is a long and complicated directive

- 73 pages (109 articles and 19 annexes)
- The many cross references make the directive difficult to read and understand
- The unfamiliar structure with separate chapters on occupational, medical and public exposures
  This structure is completely different from the ICRP 103 and the IAEA BSS, with separate chapters on planned, emergency and existing exposure situations
- Old and new terminology are used interchangeable
  For example: a practice = a planned exposure situation

The directive leaves considerable room to the member states as regards action to be taken

- "**where appropriate**": 34 matches
- "**as appropriate**": 24 matches
- "**if appropriate**": 8 matches
- "**may**": 95 matches

A minimum directive so that member states may adopt stricter regulations

- The "minimum" is almost always below the current Belgian regulation

EU BSS still refers to the old dose coefficients for internal contamination

ICRP is not delivering on the dose coefficients

- ICRP 100 is not yet implemented
  - ICRP published in **2006** the "Human Alimentary Tract Model (HATM)
  - 8 years later, ICRP has still to calculate the ingestion dose coefficients with the model developed in publication of 1979
- ICRP 103 is not yet implemented
  - ICRP published in **2007** new general recommendations adapting the definition of effective dose to the progress of scientific knowledge
  - 7 years later, ICRP is still using the superseded radiation and tissue weighting factors of publication 60 (1991)
- ICRP 119 (**2012**) is no more than a compilation of existing dose coefficients from publications 68, 72 and 74 based on the
  - ICRP 30 (1979) model of the gastrointestinal tract
  - ICRP 66 (1994) model of the human respiratory tract
  - ICRP 60 (1991) general recommendations

The ICRP statement of 2009 on radon is not yet implemented

In the 2009 statement, ICRP announces its intention

- To increase the dose coefficients for radon by about a factor of 2
- To replace the current epidemiological based dose coefficients with a dosimetric approach

Epidemiological approach

Publication 115 (2010) increased the lung cancer risk of Publication 65 (1993)

- From 2.83 10^{-4} to **5 10^{-4} per WLM**

Publication 103 (2007) decreased the total detriment from cancer and hereditary effects from publication 60 (1991)

- Workers: from 5.6 10^{-2} to **4.2 10^{-2} per Sv**
- Public: from 7.3 10^{-2} to **5.7 10^{-2} per Sv**

So the new dose coefficients using the epidemiological approach are

- Workers: 5 10^{-4} per WLM / 4.2 10^{-2} per Sv = **12 mSv per WLM**
- Public: 5 10^{-4} per WLM / 5.7 10^{-2} per Sv = **9 mSv per WLM**

More than 2 times higher than the publication 65 values

- Workers: from 5 to **12 mSv per WLM**
- Public: from 4 to **9 mSv per WLM**

Dosimetric approach using the ICRP 66 lung model

The dose coefficients calculated with the human respiratory tract model of publication 66 (1994) are (*):

- Home: 14 mSv per WLM
- Indoor workplace: 21 mSv per WLM (higher breathing rate)
- Mine: 12 mSv per WLM (higher aerosol concentrations ➡ lower unattached fraction)

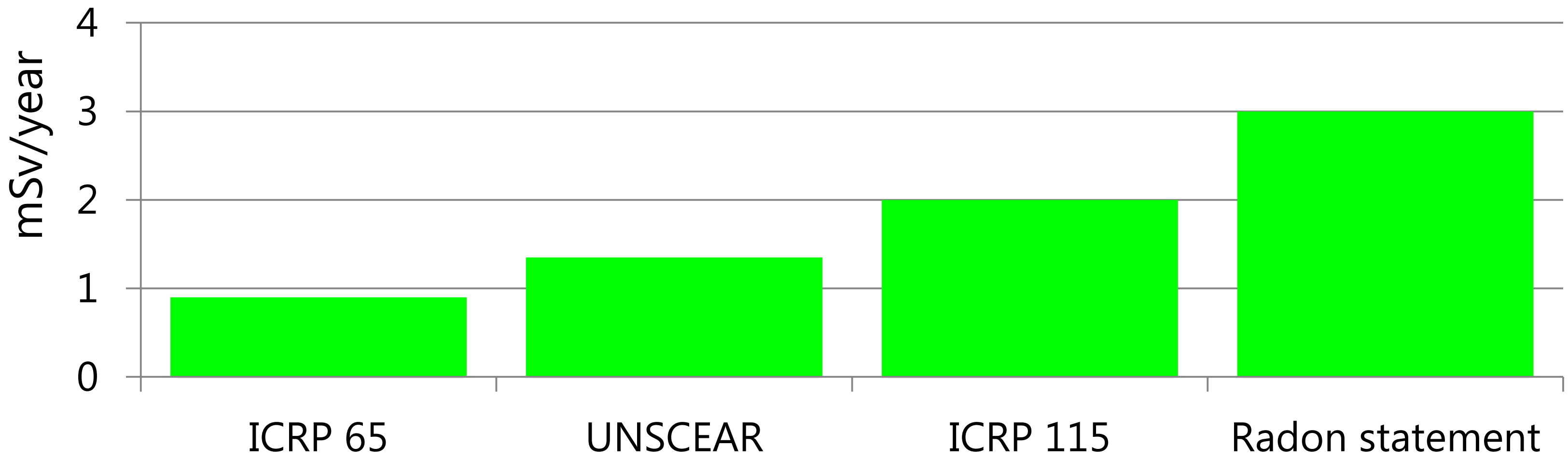
The dosimetric approach is even higher than the epidemiological approach and much higher than the publication 65 values

(in mSv per WLM)	ICRP 65 **Epidemiological**	ICRP 115 **Epidemiological**	Radon statement **Dosimetric**
Home	**4**	**9**	**14**
Indoor workplace	**5**	**12**	**21**

(*) From the presentation of John Harrison (IRPA Geneva, 2014)

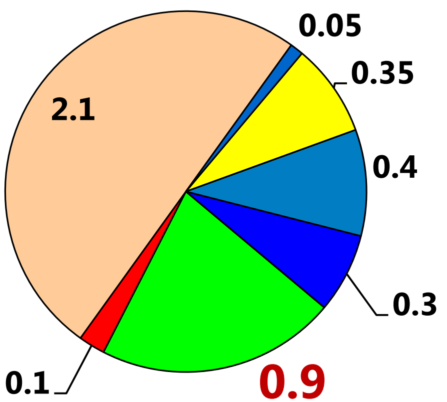
The average radon exposure in Belgian dwellings of 50 Bq/m^3, calculated according to:

- ICRP 65 (epidemiological approach): **0.9 mSv/year**
- UNSCEAR: **1.35 mSv/year**
- ICRP 115 (epidemiological approach): **2 mSv/year**
- Radon statement (dosimetric approach): **3 mSv/year**



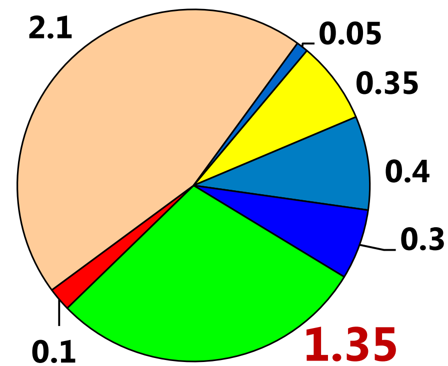
The average radiation exposure in Belgium according to:

ICRP 65: 4.2 mSv/year

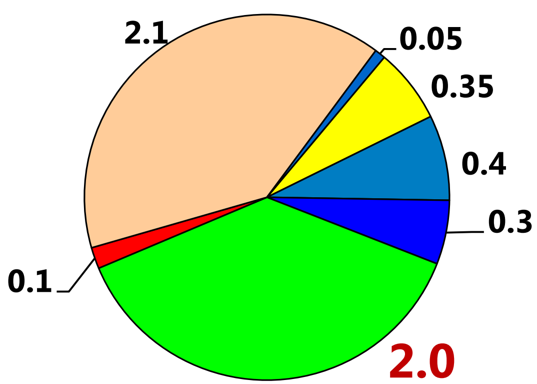


- Cosmic radiation
- Soil and buildings
- Body
- Radon
- Thoron
- Medical imaging
- Other man-made

UNSCEAR: 4.6 mSv/year

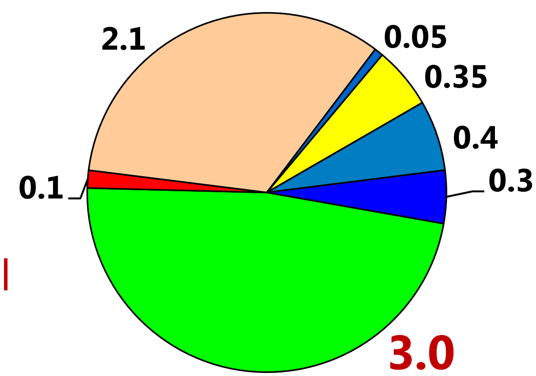


ICRP 115: 5.3 mSv/year



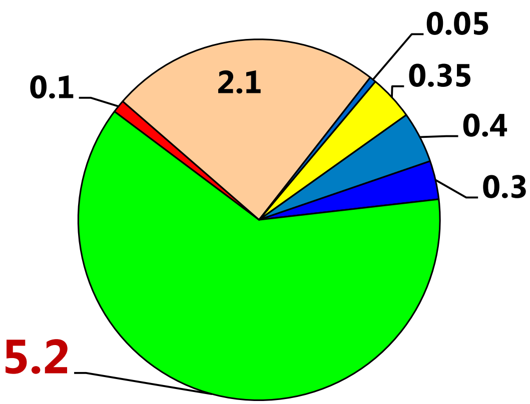
Radon statement: 6.3 mSv/year

All other contributions, including medical imaging, look small



The radiation exposure in a Belgian dwelling of 300 Bq/m^3, calculated according to:

ICRP 65: 8.5 mSv/year



- Cosmic radiation
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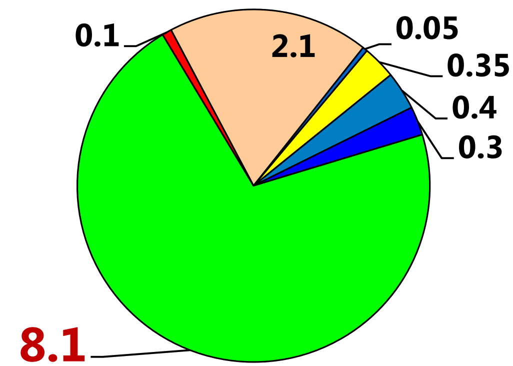
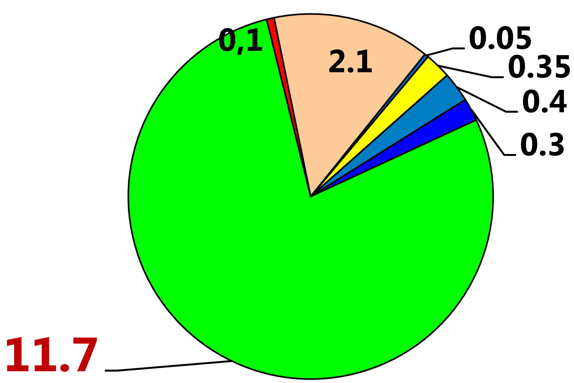
UNSCEAR: 11.4 mSv/year

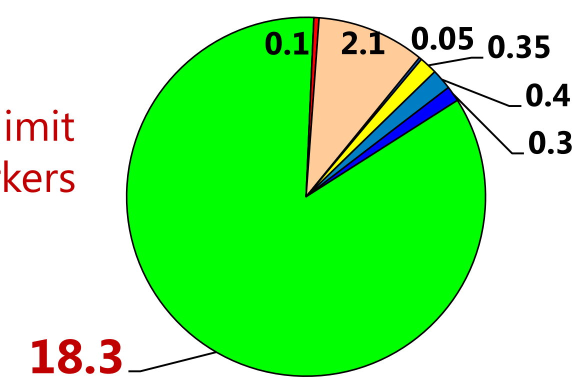


ICRP 115: 15.0 mSv/year



Radon statement: 21.6 mSv/year

Higher than the limit for radiation workers



Lung cancer risk derived from the European pooled case-control studies (Darby et al., 2005)

Absolute risks of lung cancer by age 75 years at radon concentrations of 0, 100 and 400 Bq/m^3

- 0.4 %, 0.5 % and 0.7 % for lifelong non-smokers
- 10 %, 12 % and 16 % for cigarette smokers **(25 times greater)**

An almost synergistic effect between radon and smoking so that smokers have for the same radon concentration an order of magnitude higher risk than non-smokers

➡ Different dose coefficients for groups with a low smoking prevalence? (for non-smoking children?)

The dose coefficients for radon **are for more than 90% determined by smoking**

- A decrease in the ratio of smokers to non-smokers will result in a comparable decrease in the dose coefficient

- There are radon prone areas with a low smoking prevalence where **more lung cancers are calculated than there actually are in the area**, although radon is not the only and even not the most important cause of lung cancer

➡ The proposed ICRP coefficients are at the high end and not applicable for areas with a low smoking rate

I suggest to use the long established UNSCEAR dose coefficient

The UNSCEAR dose coefficient is

- 50% higher than the ICRP 65 value
- About half the new ICRP values

➡ Applying the new ICRP coefficients would blow up the radon contribution to the average annual exposure and make all the other contributions including medical imaging look small

➡ The new ICRP coefficients are not applicable for groups with a low smoking prevalence

Work activities replaced by planned or existing exposure situations (1)

Norm industries: a planned exposure situation

- < 1 mSv/year: exempted from regulatory control
- > 1 mSv/year: notification including
  - Supervised areas: radiological surveillance where appropriate, warning signs for ionizing radiation if appropriate, working instructions if appropriate
  - Category B workers: individual monitoring if appropriate

➡ Very much the same as the current approach in Belgium

Exposure of air crew to cosmic radiation: a planned exposure situation

- < 1 mSv/year: exempted from regulatory control
- > 1 and < 6 mSv/year: the current approach
- > 6mSv/year: the relevant requirements apply, allowing for the specific features of this exposure

➡ Very much the same as the current approach

Exposure of spacecraft crew above the dose limits is managed as a specially authorized exposure (current ARBIS: maximum 40mSv/year and 100 mSv over the whole career !)

Work activities replaced by planned or existing exposure situations (2)

Radon exposure at work

- < 6 mSv/year or less than the national reference level (max. 300 Bq/m^3): an existing exposure situation: exempted from regulatory control
- > 6 mSv/year or exceeding the national reference level (max. 300 Bq/m^3): a planned exposure situation: notification including
  - Supervised areas: radiological surveillance where appropriate, warning signs for ionizing radiation if appropriate, working instructions if appropriate
  - Category B workers: individual monitoring if appropriate

➡ Decrease of the current reference level of 400 Bq/m^3 to 300 Bq/m^3 or less

Indoor radon exposure: an existing exposure situation

- National reference level of maximum 300 Bq/m^3
- Radon action plan addressing the long-term risks from radon exposures

➡ Decrease of the current reference level of 400 Bq/m^3 to 300 Bq/m^3 or less

Exemption and clearance (1)

Unconditional exemption and clearance for artificial radionuclides

- Activity concentrations in table A part 1 (any amount) **or** total activity in table B (moderate amounts)

Comparison of EU BSS to activity concentrations in annex IB (clearance) and total activity in annex IA (exemption) of our current ARBIS/RGPRI

Radionuclide	EU BSS		ARBIS/RGPRI	
	Concentration Bq/g	Quantity Bq	**Concentration** Bq/g	Quantity Bq
H-3	100	10^9	100	10^9
C-14	**1**	10^7	**10**	10^7
Co-60	0.1	10^5	0.1	10^5
I-131	**10**	10^6	**1**	10^6
Cs-137	**0.1**	10^4	**1**	10^4
Pu-241	**10**	10^5	**1**	10^5
Am-241	0.1	10^4	0.1	10^4

➡ Some values are lower, others are higher: not much change

Exemption and clearance (2)

Exemption for moderate amounts of material (artificial radionuclides)

- Activity concentrations in table B (moderate amounts) may be used

Comparison of EU BSS to annex IA (exemption) of our current ARBIS/RGPRI

Radionuclide	EU BSS Concentration Bq/g	ARBIS/RGPRI Concentration Bq/g
H-3	10^6	10^6
C-14	10 000	10 000
Co-60	10	10
I-131	100	100
Cs-137	10	10
Pu-241	100	100
Am-241	1	1

➡ For exemption: no change

Exemption and clearance (3)

Unconditional exemption and clearance for naturally-occurring radionuclides

- Activity concentrations in table A part 2 (any amount). For mixtures: no weighted sum

Comparison of EU BSS to the current FANC approach (including weighted sum for mixtures)

Naturally-occurring radionuclides	EU BSS Concentration Bq/g	Current FANC approach Concentration Bq/g
From the U-238 series	1	**0.5**
From the Th-232 series	1	**0.5**
K-40	10	10

➡ Less strict than the current approach in Belgium

➡ Unconditional clearance of all the gypsum deposits (over 200 ha in Belgium)

Exemption and clearance of "other" amounts of material or "other" activity concentrations

Is possible, if an assessment shows compliance with the following criteria

- The radiological risks are sufficiently low to be of no regulatory concern
- For artificial radionuclides
  - No radiation workers (less than 1 mSv/year)
  - Dose for members of the public of the order of **10 µSv/year** or less
- For naturally-occurring radionuclides
  - Dose for workers and members of the public of the order of **1 mSv/year** or less
- The practice is inherently safe

➡ For artificial radionuclides: extension of article 18 ARBIS/RGPRI above the current exemption levels

➡ For naturally-occurring radionuclides: a bit more flexible than the current FANC approach

Dilution is now permitted in specific circumstances

Deliberate dilution is not permitted for unconditional clearance

However

- Mixing is permitted if part of normal operation

  As the cost of radioactive waste is a very important cost element, the choice of the “normal” operation process could favor mixing below the clearance levels

- Mixing of radioactive and non-radioactive materials may be authorized for the purposes of re-use or recycling

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