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Belgian class II nuclear facilities such as
irradiators and accelerators:

Regulatory Body attention points and operating
experience feedback.

Preamble

This paper is a continuation of the former paper presented during 2012 Brussels Eurosafe Forum, dealing with :

- Creation of Bel V, subsidiary of Federal Agency for Nuclear Control (FANC)
- Creation of a new facility "subclass IIA"

E U R O S A F E

Towards Convergence of
Technical Nuclear Safety Practices in Europe

Recent evolution in the regulatory framework of the Belgian class II nuclear installations such as irradiators and accelerators

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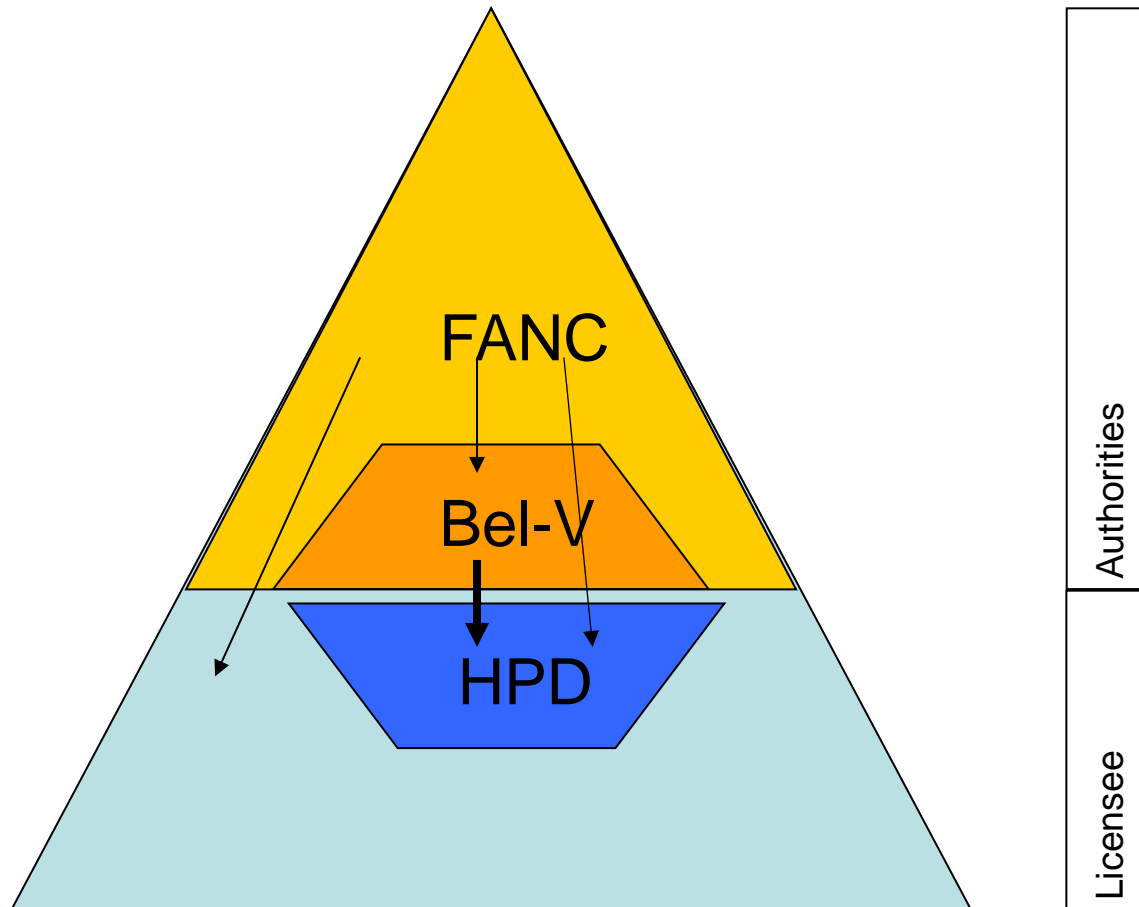
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E U R O S A F E

Towards Convergence of
Technical Nuclear Safety Practices in Europe

Belgian regulatory framework since 2008



A reminder : class II and "class IIA" facilities (1)

- Belgian 20/07/2001 RD prescribes the nuclear facilities classification :
 - Class I (NPP, waste treatment facilities, ...), Class III, IV
(out of scope)
 - Class II :
 - «Class IIA»
 - facilities producing or conditioning radionuclides from irradiated fissile substances ;
 - particle accelerators ;
 - facilities containing high activity sources (irradiators, ...) ;
 - nuclear medicine ;
 - X-rays generators with nominal peak voltage > 200 kV ;
 - ...

A reminder : class II and "class IIA" facilities (2)

- The new "subclass IIA" covers the following "heavy" class II:

"Class IIA" licensees :	13
containing :	
Industrial irradiators	2
Research irradiators	3
Cyclotrons	12
Cyclotrons awaiting dismantling	5
Bulk radionuclides conditioner	1
Cyclotron suppliers	1

Content

- Preamble about Bel V and "class IIA" facilities
- Regulatory Body attention points concerning "class IIA" facilities
- Operating Experience Feedback 2009 – 2015 (OEF)
- Lessons learnt from this OEF
- Conclusions

RB attention points for "class IIA" facilities (1)

- **Limiting, Recording and Reporting the radioactive gaseous effluents releases from facilities producing positron emitters radiotracers (^{18}F , ^{11}C , ...)** :
 - ↪ 20/07/2001 RD prescribes radioactive releases limits
 - ↪ Impractical to be respected by PET tracers producers (for ex., ^{18}F instantaneous limit: 2100 Bq/m³)
 - ↪ After FANC assessment programme, determination of standard authorisation conditions for the radioactive gaseous releases from accelerators and PET tracers producers.

RB attention points for "class IIA" facilities (2)

- **Radioactive solid waste management :**

Competence shared by :

- **Belgian Agency for Management of Radioactive Waste and Enriched Fissile materials (ONDRAF / NIRAS), among others :**
 - Radioactive waste and sites containing radioactive substances inventories ;
 - Writing-up of waste acceptance criteria ;
 - Long term management of radioactive waste.
- **Federal Agency for Nuclear Control (FANC) :**
 - Verification that waste management process does not lead to excess of dose to the workers, the public and the environment.

RB attention points for "class IIA" facilities (3)

- **Radioactive solid waste management (cnt.) :**

FANC organised in collaboration with ONDRAF / NIRAS and Bel V cross inspections in class I and "class IIA" facilities (2014 – 2015).

The main result was a common better understanding on the radioactive waste management process in order to **avoid potential waste accumulation** in the nuclear facilities.

RB attention points for "class IIA" facilities (4)

- **Promoting safety culture :**

Analysis of Human and Organisational Factors (HOF) is necessary to improve nuclear safety.

Bel V and FANC developed a [Safety Culture Observations Tool](#) in order to collect and analyse positive and negative indicators of safety culture.

Representative analysis for "class IIA" facilities is not yet available due to the insufficient number of observations.

However, the Operating Experience Feedback presented here shows that the operator's / manager's behaviour is frequently involved in events related to nuclear safety and radiation protection ⇒ Opportunity for improvement for Bel V.

Operating Experience Feedback for "class IIA" facilities

- **Declaration of events related to nuclear safety and RP :**

Between 2009 and 2015 : 39 events were declared to the Authority by "class IIA" licensees.

Except one particular event, no exceedance of dose limit, neither for the workers nor for the population, was observed.

- **Analysis of events in order to highlight their causes:**

Analysis per facility type ... ⇒

OEF Industrial and research irradiators (1)

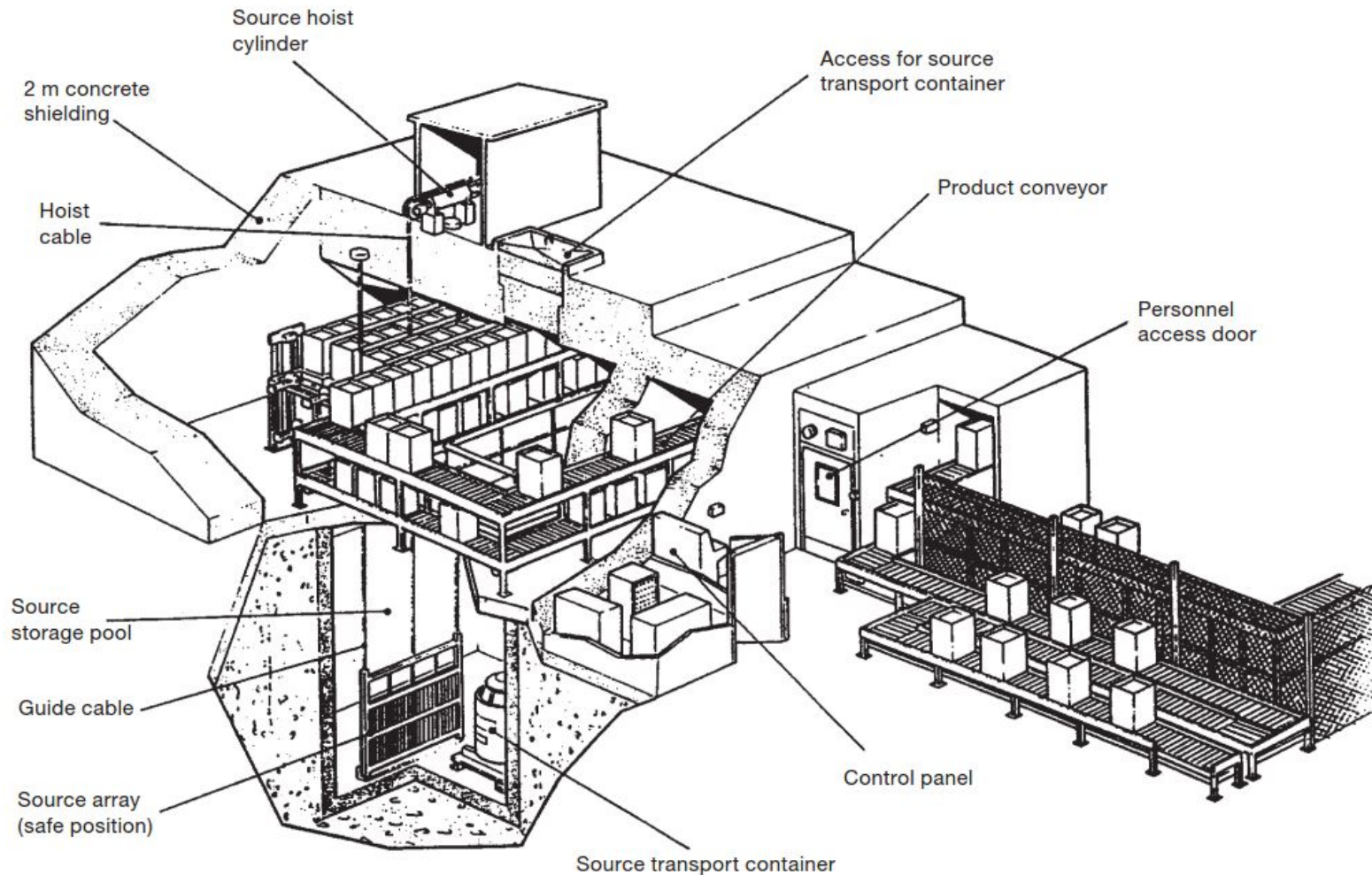


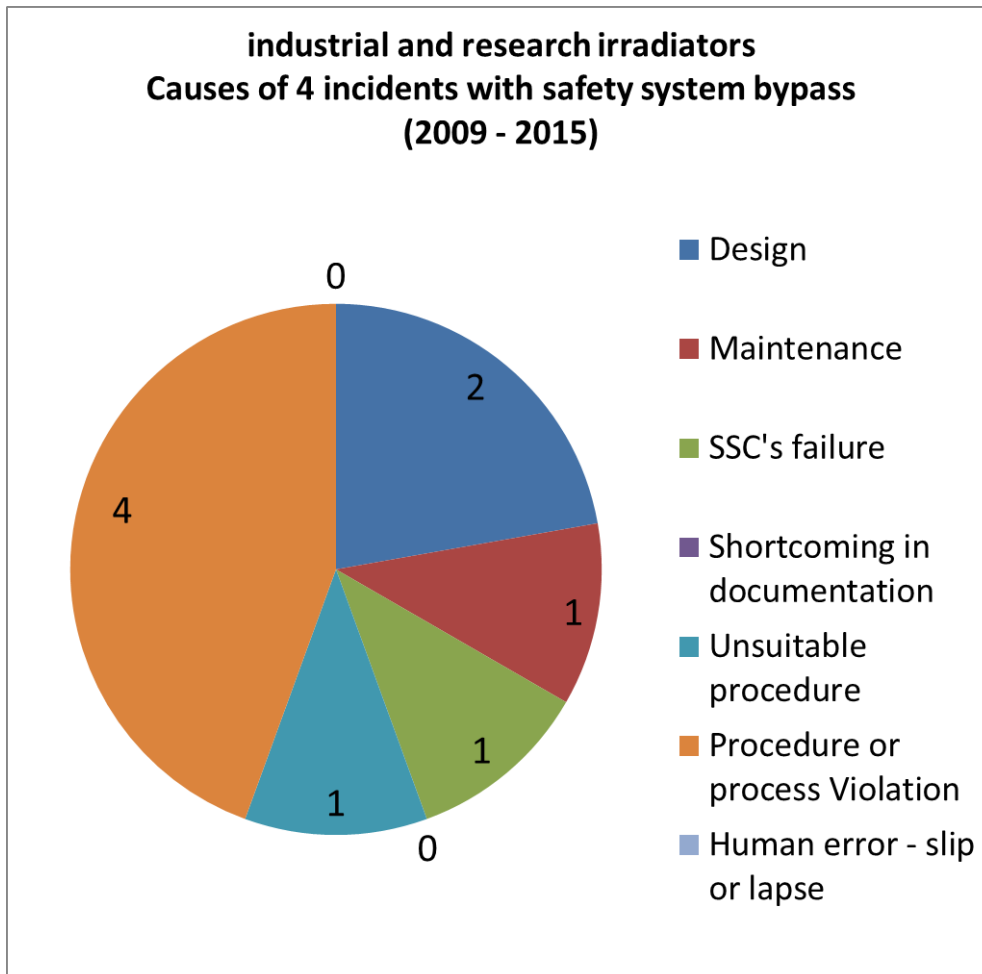
FIG. 3. Category IV gamma irradiation facility: Panoramic wet source storage irradiator. IAEA SSG-8

OEF Industrial and research irradiators (2)

- **8 events declared to the RB between 2009 and 2015 :**
 - **4 unauthorised by-pass of safety systems or layers :**
 - Physical by-pass of interlocks to work in degraded mode
 - Non-compliance with the irradiation starting procedure
 - 1 sources blocking in unsafe position (also cause 2^d ev.)
 - 1 incorrect transition from a degraded mode to a normal mode during sources reloading ;
 - 1 start of fire in ventilation system ;
 - 1 unintentional release of potentially contaminated liquid effluent, before γ spectrometry measurement realisation.

OEF Industrial and research irradiators (3)

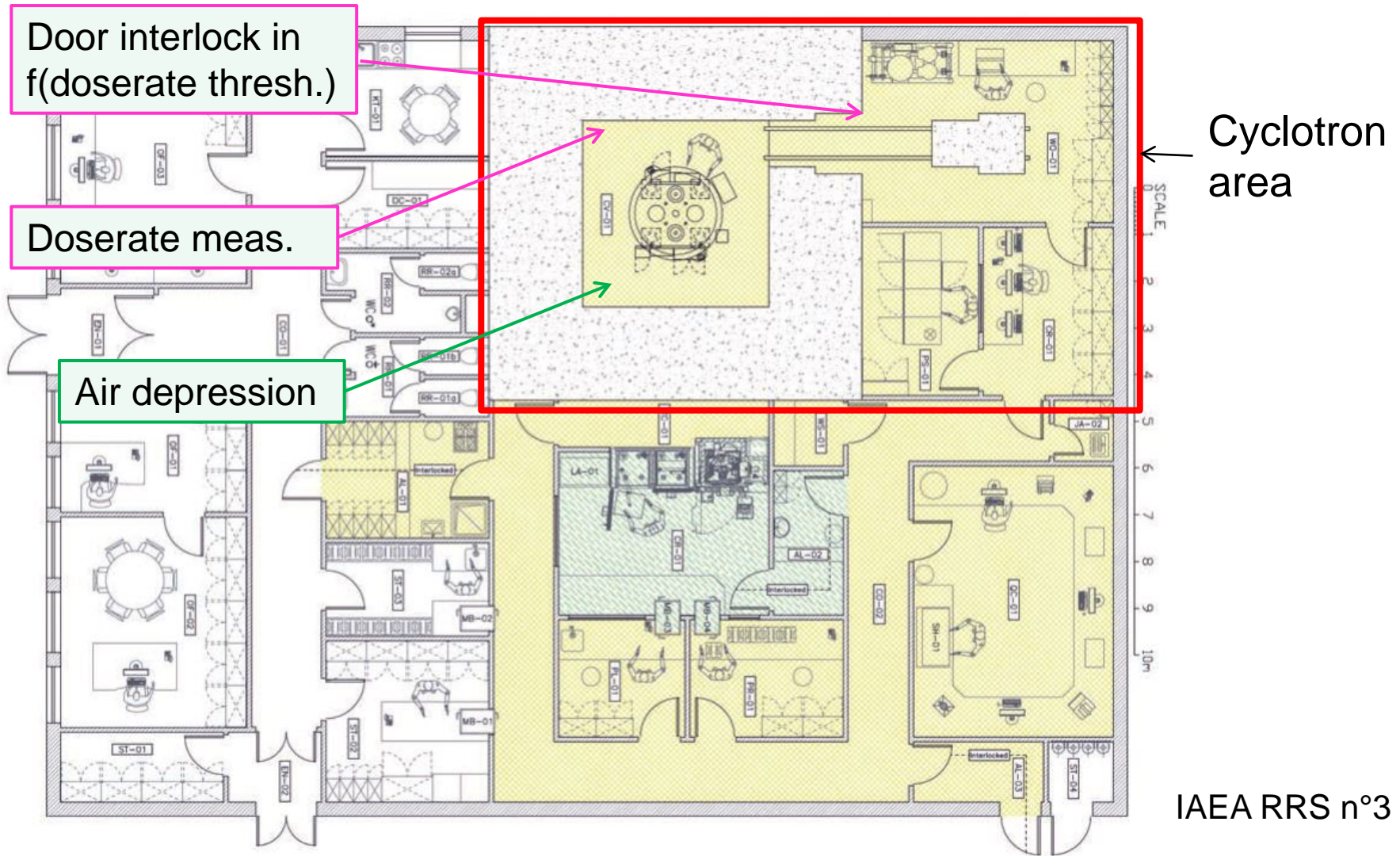
- Detected causes of 4 unauthorised by-pass of safety layer :



⇐ Easy to by-pass if safety system is too reachable

⇐ Obvious.
Due to voluntary action

OEF Particles accelerators (1)

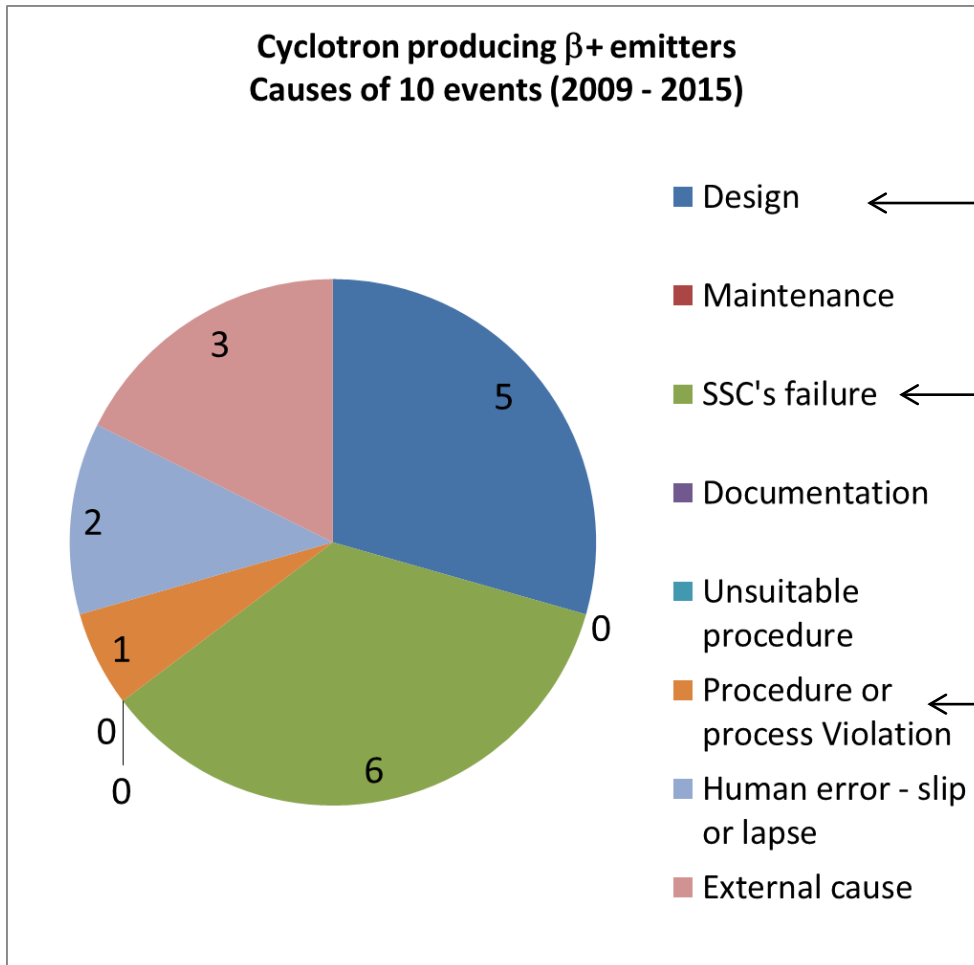


OEF Particles accelerators (2)

- **10 events reported to the RB between 2009 and 2015:**
 - 1 by-pass of interlock vault door not clearly declared to all staff
 - 1 irradiation started when communication between safety PLC and cyclotron PC was probably interrupted
 - 1 unexplained effective dose (32 mSv / 2 months) for a maintenance operator, exceeding dose limit (20 mSv / 12 consecutive months)
 - 3 flooding due to abundant rain infiltration (site specific)
 - 2 internal flooding due to failure on the secondary cooling water circuit
 - 1 irradiation on an empty target leading to water dispersion in the vacuum chamber
 - 1 dispersion of ^{18}F activity in the cyclotron and in the ventilation system due to window target piercing

OEF Particles accelerators (3)

● Detected causes of 10 events :

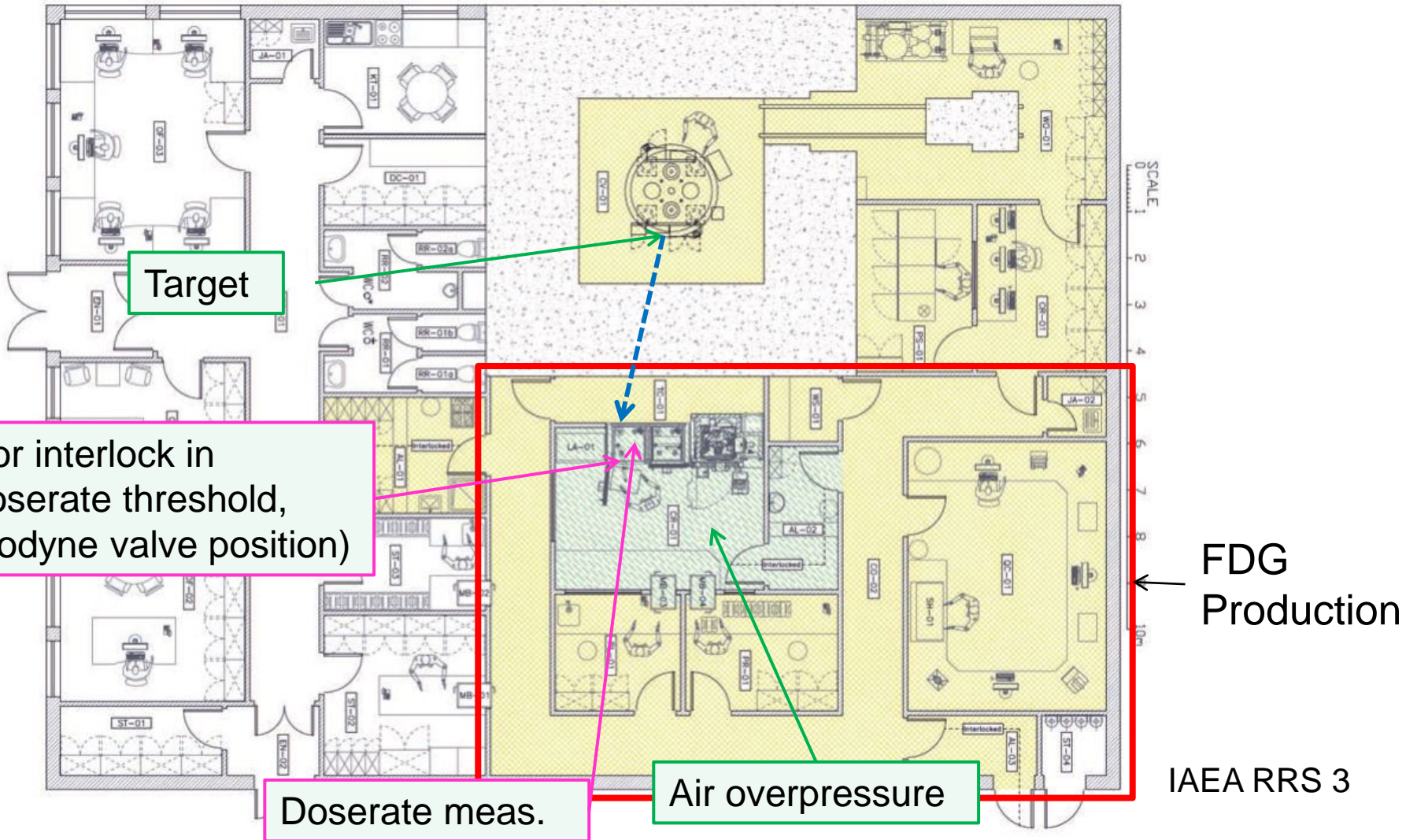


← External / internal flooding of vault ...

← Rheodyne vault failure, safety PLC failure, ...

← Only 1 by-pass of safety syst.

OEF Radionuclides producers – conditioners (1)

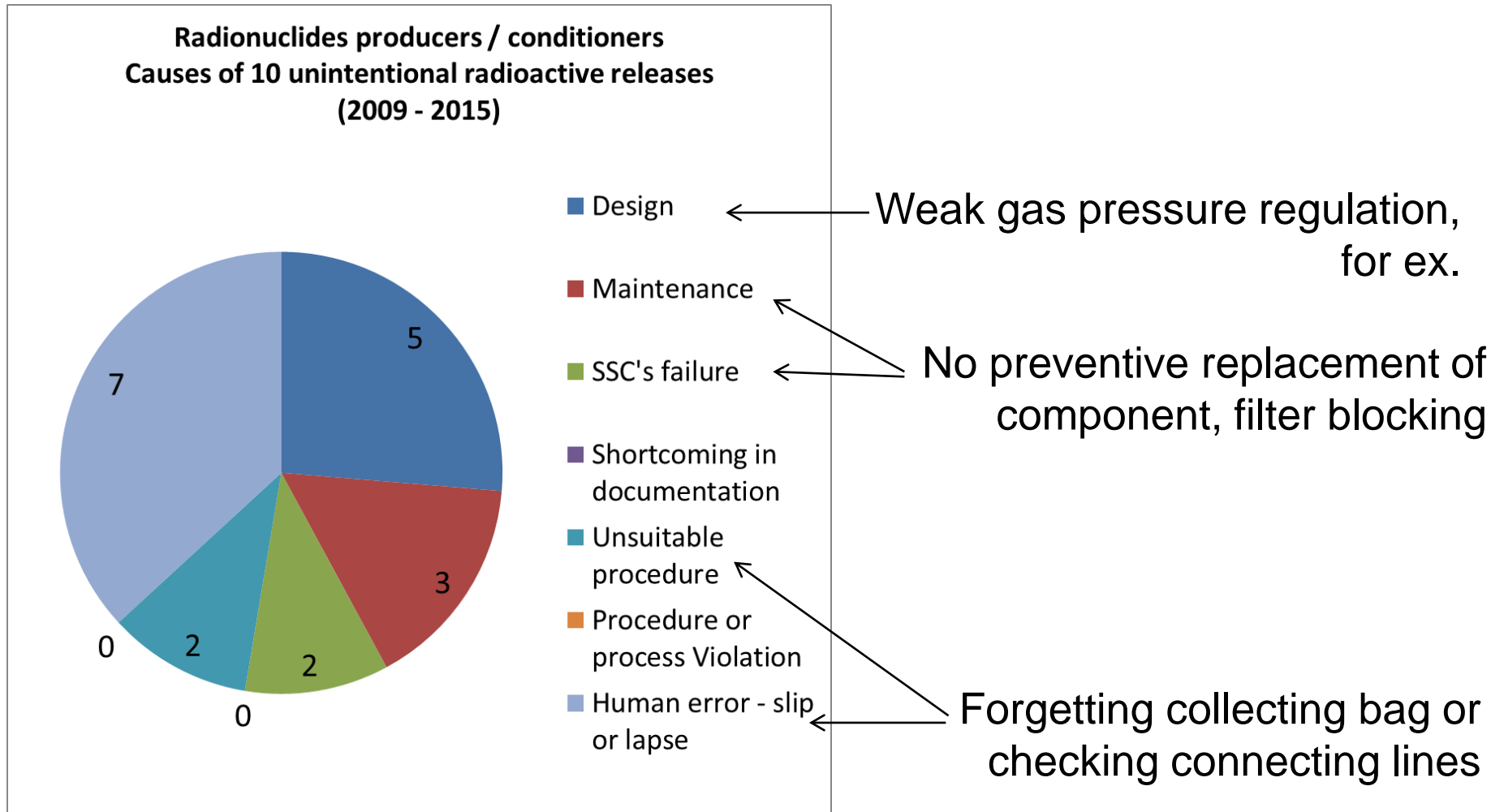


OEF Radionuclides producers – conditioners (2)

- **21 events reported to the RB between 2009 and 2015:**
 - 3 by-pass of shielded cell door interlock (1 involuntary)
 - 10 unintentional radioactive gaseous effluent releases
 - 2 losses of dynamic confinement
 - 1 internal flooding due to work in controlled area
 - 5 contaminations of operators, installations or rooms

OEF Particles accelerators (3)

● Detected causes of 10 unintentional rad gaseous releases:



Lessons learnt

- Probably nothing brand new compared to the practice in class I.
- Facility and installation :
 - ↪ SSC's sometimes based on weak design (absence of interlock, by-passing safety layer too easy, ...)
 - ↪ Incomplete documentation on structures, systems and components (modification performed without clear view of its impact on the installations, ...)
 - ↪ Modification not systematically well documented and analysed (incomplete understanding of installation behaviour, ...)

Lessons learnt (2)

- Safety culture observations:
 - Routine operations tend to lessen operator's vigilance
 - Actual or supposed pressure on the operator to gain time or to ensure production
 - Incomplete information of the staff or lack of clear indication of degraded situation
 - ↳ **Importance of the message from the managers and the Health Physics Department !**
 - ↳ **Importance of the operators supervision !**

Encouraging the worker's questioning attitude is necessary to improve the nuclear safety and radiation protection

Lessons learnt (3)

- Lack of maintenance can lead to situations at risk:
 - ↪ Several sources blocked in unsafe position after cable breaking or cable blocking, in two Belgian irradiators facilities .
 - ↪ Unintentional radioactive gaseous effluents releases due to lack of preventive replacement of collecting bag, ...
- Use of Electronic Personal Dosimeter (EPD):
 - ↪ When correctly set and used, EPD can be sometimes the last safety layer able to warn the operator against high dose rate.

Conclusions

- Belgian RB intends to improve nuclear safety and radiation protection in Belgian class II facilities presenting higher irradiation and/or contamination risk.
- Therefore, reinforcement of the safety requirements for new "class IIA" (industrial and research irradiators, bulk radionuclides producers and particles accelerators).
- 2009 – 2015 : FANC and Bel V paid attention, among others, to:
 - ↳ Inspection and control programmes
 - ↳ Limiting, recording and reporting radioactive gaseous effluents releases from β^+ emitters producing facilities
 - ↳ Radioactive waste management
 - ↳ Experience sharing with the licensees

Conclusions (2)

- As mentioned in 2012, the RB notices a real willingness of the licensees to meet the new safety requirements.
- Keep in mind that "class IIA" means are not equivalent to those of class I facilities (staff relatively small : 5 to 30 workers).
- Promoting the safety culture, the nuclear safety and radiation protection remains an endless challenge for the Regulatory Body

References

- 20/07/2001 *Royal Decree prescribing the general regulation for the protection of the workers, the public and the environment against the ionising radiations danger.* Moniteur belge 30/08/2001.
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Thank you for your attention.

Do you have any question ?

