Management of radioactive waste from the production of radioisotopes

Dr. Grégory Delécaut, Head of IRE Lab

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IRE-IRE ELiT, worldwide leaders

- **~ 25% of the world demand of ^{99}Mo**
  - Parent of ^{99m}Tc generator used in 80% of procedures in nuclear medicine diagnosis
- **Major supplier of fission ^{131}I covering about 35% of the world demand**
  - Essential and irreplaceable radionuclide for some thyroid treatments
- **Only EU supplier of ^{133}Xe**
  - Study of pulmonary ventilation and cerebral perfusion by inhalation
- **One of only two** global suppliers of Ge-68/Ga-68 generator approved as a drug in Europe and as a pharmaceutical grade active ingredient in the United States

Also other former companies on the site

Nordion / Best Medical Belgium

- ^{99m}Tc, ^{131}I, ^{133}Xe, ^{90}Y
- cyclotron isotopes such as ^{201}Tl, ^{125}I
- Industrial sources such as ^{192}Ir, ^{60}Co, ^{137}Cs

IBA Radiolsotope

- ^{103}Pd

All classes of waste are managed at IRE

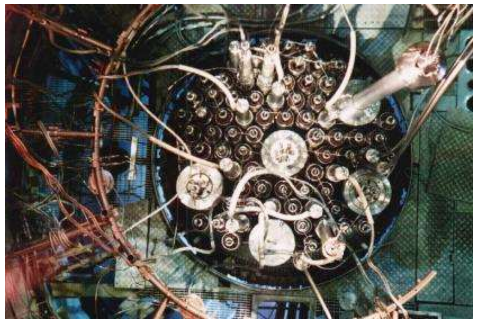
- **High Level Waste (HLW)**
  - > 2 Sv/h
  - > 37 TBq/m³
- **Intermediate Level Waste (ILW)**
- **Low Level Waste (LLW)**
  - < 2 mSv
  - < 40 GBq/m³ gamma/beta
  - < 40 MBq/m³ alpha

Production process

Target manufacture

Irradiation

Transport



Target dissolution → ^{133}Xe trapping

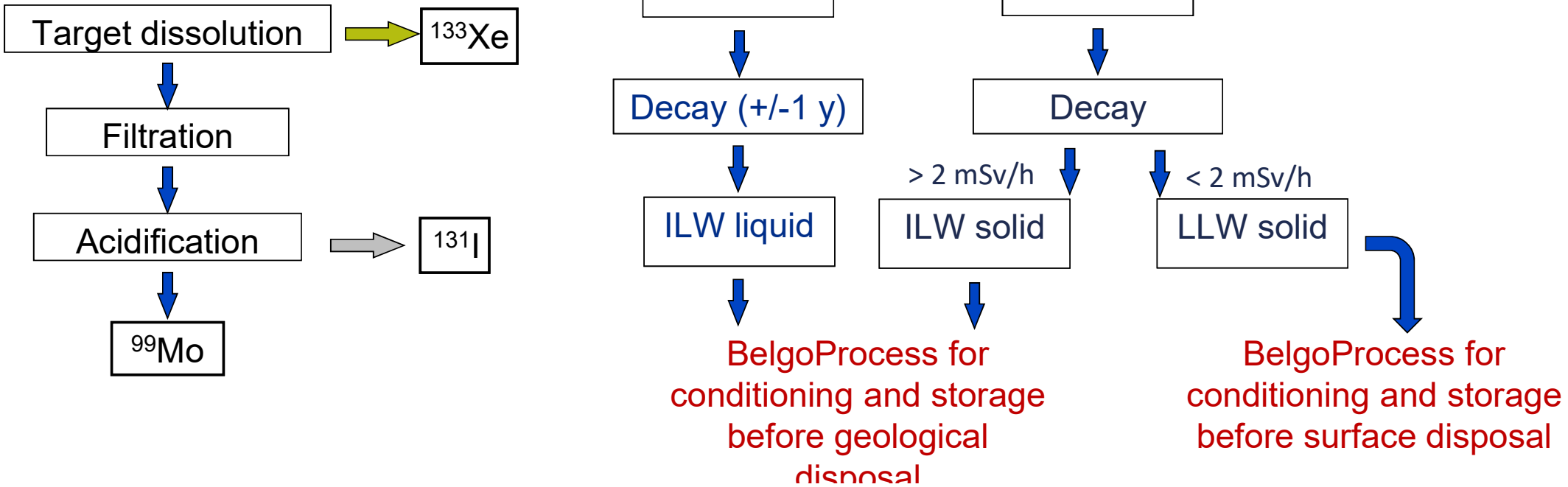
Filtration → U cake → **RECUMO** project

Acidification → ^{131}I trap

^{99}Mo purification

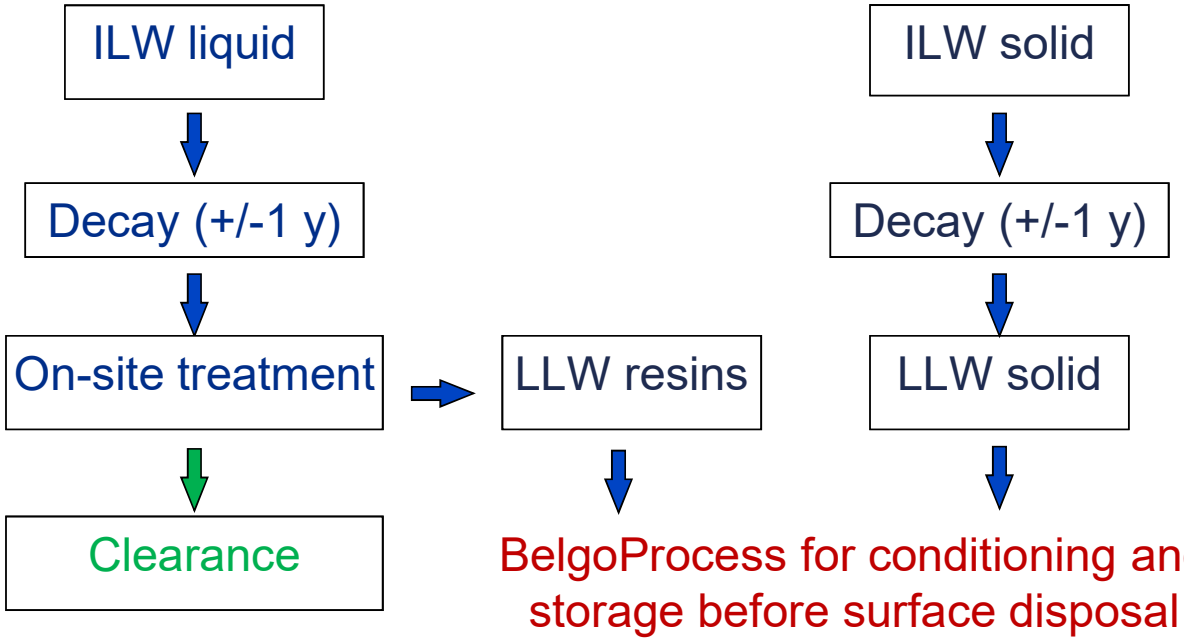
HLW are stored for decay till ILW or LLW

- High Level Waste are produced during the first steps of the production process
  - Ex: molecular sieve, charcoal, zeolite



ILW are stored for decay till LLW or clearance

- Intermediate Level Waste are produced during the first steps of the production process and the purification steps



Management of HL and IL solid waste

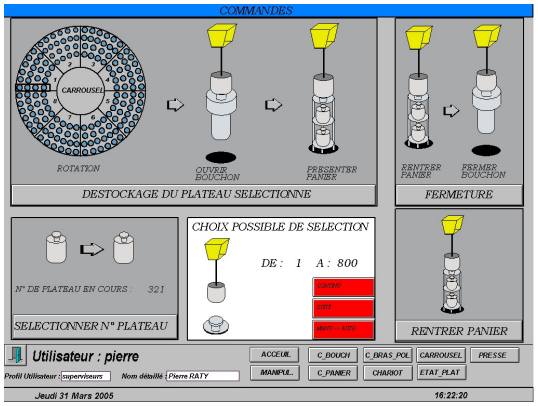
- Contact dose rate: up to 400 Sv/h
- Collected from the production shielded hot cells in 10 L iron boxes
- Labelled for traceability
- Shielded transfer to waste management hot cell shielded by 120 cm high density concrete

Management of HL and IL solid waste

- Preparation for storage
  - Stainless steel overpack
  - Dose rate measurement, no spectrometry
- Storage for decay
  - Rotating store in the shielded cellar for 800 packages
  - Diameter of the carousel is 7 meters, on 2 concentric rails
  - Basket with 5 independent positions
  - Accuracy of the positioning is less than 1mm

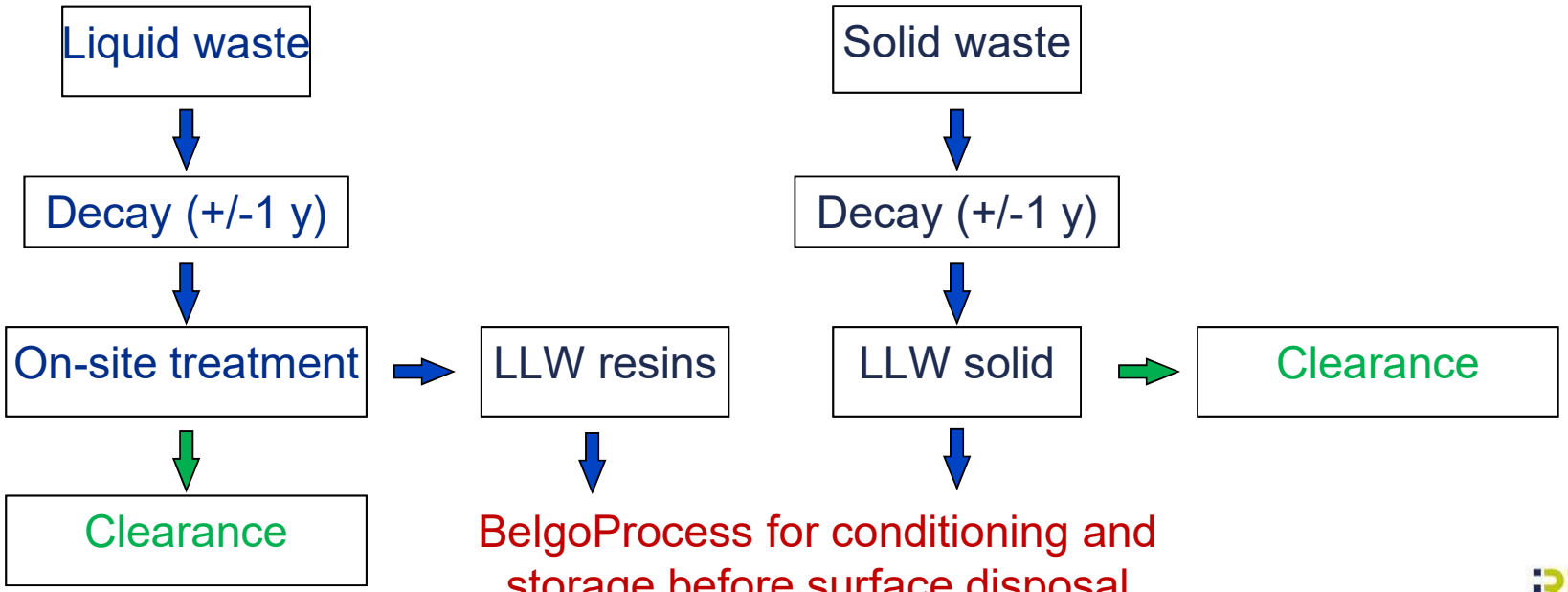
Management of HL and IL solid waste

- Transfers are supervised by automatons
- Data are recorded
  - Origin of the waste, position, dose rate, etc.
- Packages dose rate are regularly measured
- Below 2 mSv/h, waste can be reconditioned as LLW
  - If possible, with volume reduction
  - More than 25 boxes in one drum



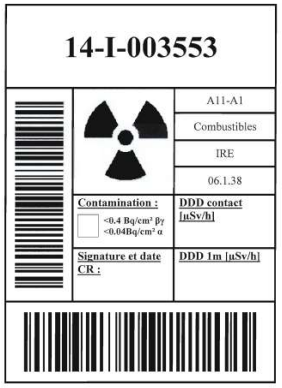
Management of LLW

- Low Level Waste are produced during maintenance, decontamination and from laboratories

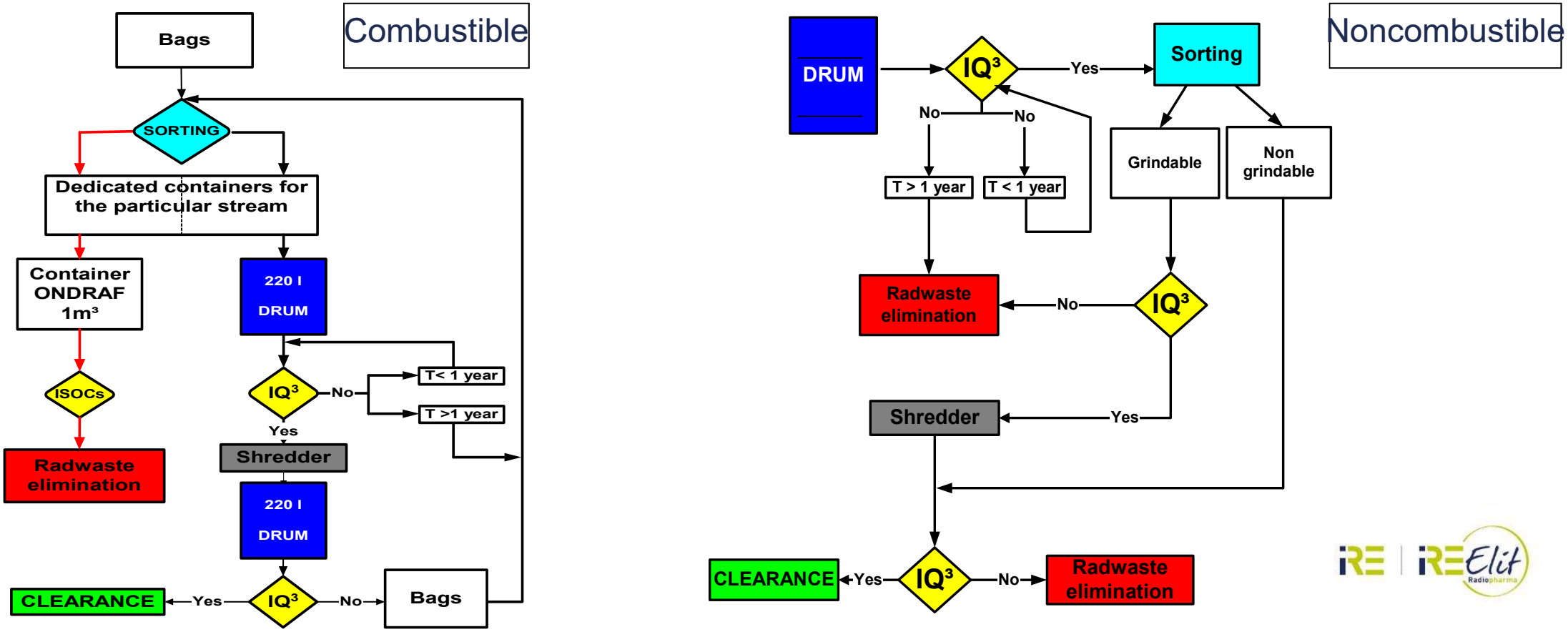


Management of LLW

- More than 100 different fluxes of LLW on the site
  - Difficult to measure isotopes, half-life, contamination, etc.
  - Physico-chemical features
- Permanent traceability to differentiate the waste fluxes
- Characterization by gamma spectrometry (IQ3)
- Determination of difficult to measure isotopes
  - Inventory (^{90}Sr production)
  - Tracers
    - Knowledge and/or modelling of the process (^{144}Ce for U, Pu)
    - Chemical equivalent (^{131}I for ^{129}I with decay correction)
  - Sample analysis
    - Issue of representativity and costly but sometime best option



Management of LLW



Conclusion

- IRE ensures a proper management of its radioactive waste through
  - A very good knowledge of its production processes and the resulting waste fluxes
  - A continuous traceability of the waste packages
  - An on-site waste storage facility
  - Dedicated radiological characterization systems approved by the relevant authorities
  - Maximizing waste clearance
  - Limiting the production of radwaste by increasing workers awareness

IRE | IRE Elit Radiopharma

Avenue de l'Espérance, 1
6220 Fleurus, Belgium

T. +32 (0)71 82 95 96
F. +32 (0)71 81 38 12

www.ire.eu
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