IRRADIATION SERVICE FACILITIES for RADIATION EXPOSURE and PRODUCTS' QUALIFICATION

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IONISOS' EXPERTISE in **Radiation Chemistry**

- Ionisos is one of the leaders in **irradiation sub-contracting and services** (n°2 in Europe), providing 2 technologies:
  - **Accelerated electrons** (E-Beam)
  - **Gamma radiations** (Cobalt-60 services)
- 5 facilities dedicated to **medium and large batches** (see map hereinafter)
- 2 trial services for **products' qualifications and for the treatment of small batches.**
- An EB facility, recently bought, in Spain, called IONMED.
- **COFRAR**, subsidiary of Ionisos, is specialized in **engineering for the build-up of EB facilities**.

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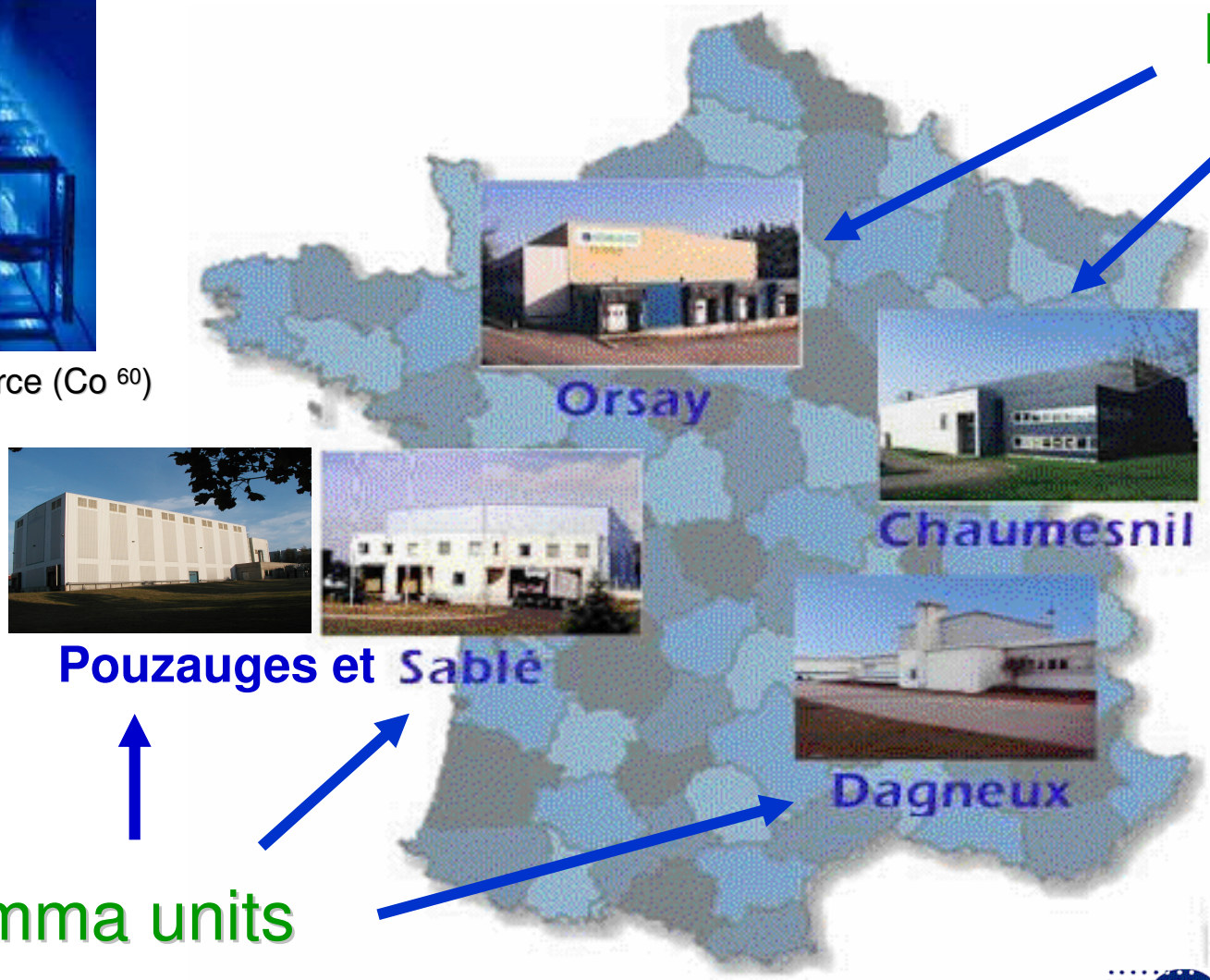
http://www.ionisos.com

Gamma source (Co ^{60})

EB units

E Beam



Gamma units

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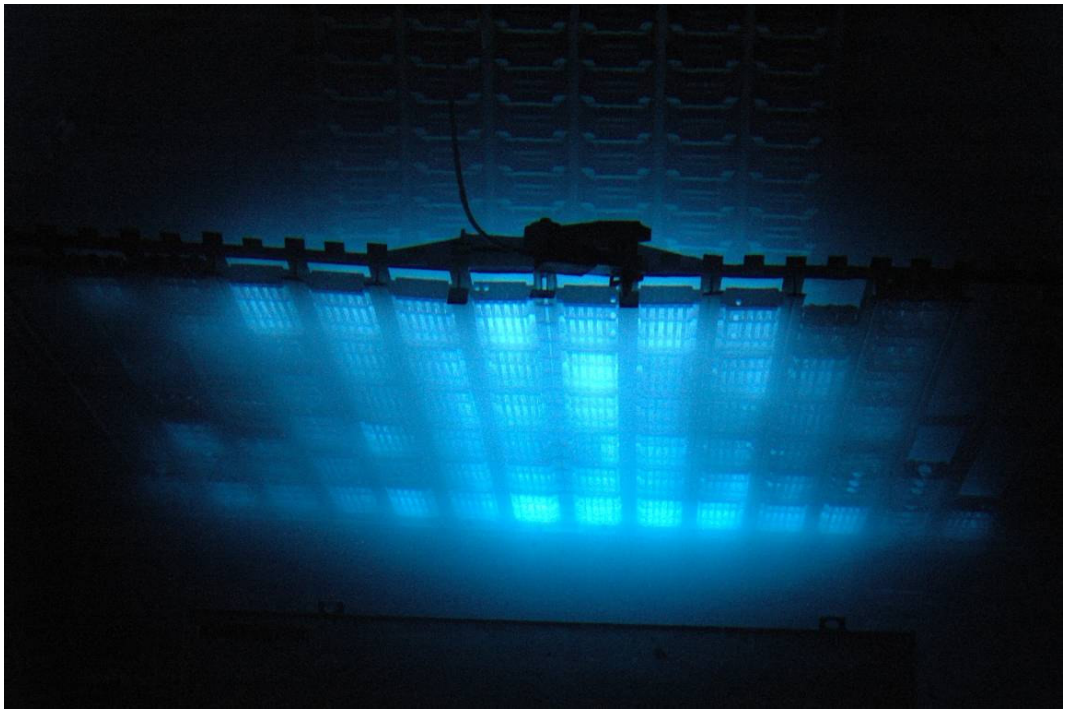
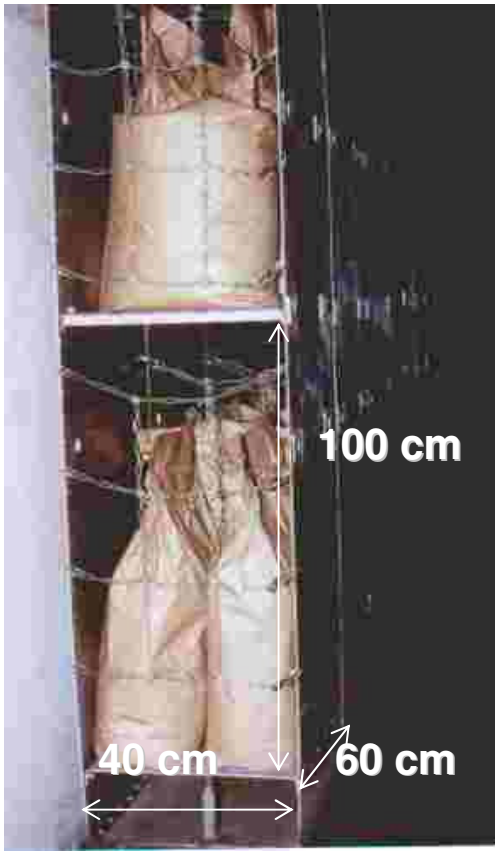
GAMMA irradiators

- Ionisos uses Cobalt 60 source
- Photons are emitted all around the source
- Their penetration is very high (> 1m)
- Continuous production
- Gamma sources are characterized by their power
- Half life of Co 60 : about 5.3 years

IONISOS Dagneux Gamma irradiator





- 2 millions Curies powered Co^{60} source
- for production : container carriers process (up to150 kg / container)
- ISO 9001, ISO 14001, ISO 13488, EN 552 certifications

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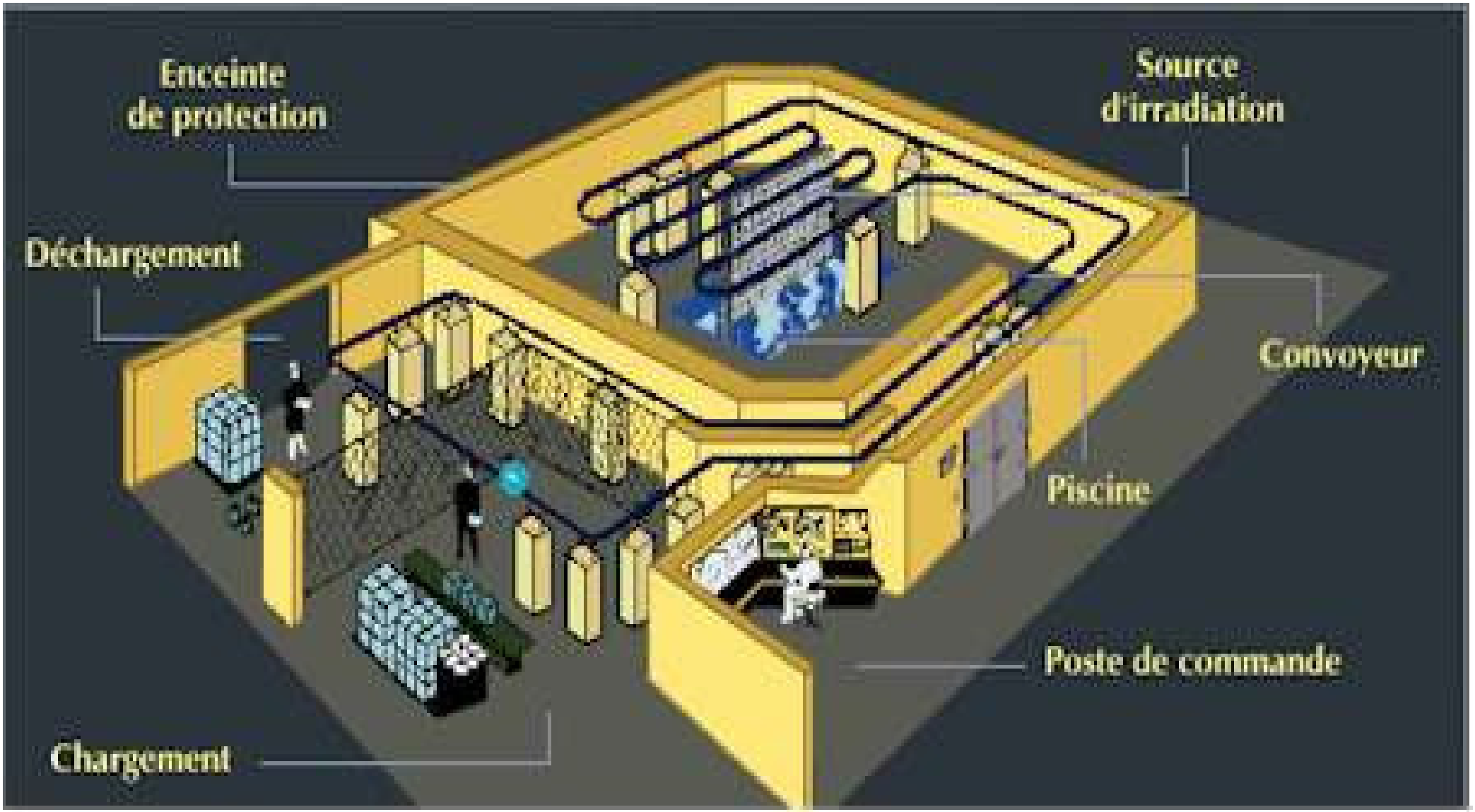
Principle for mass production



TRIALS AT DAGNEUX GAMMA IRRADIATOR

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- Near A42 motorway between Geneva and Lyon (25 km from Lyon)
- **The high activity Cobalt-60 source enables to perform 2 types of gamma exposure for trials :**
  - A medium dose rate from 0,1 to 2 kGy / h in conditions of dynamic exposure:
    - Products, of maximum gabarit 60*40*230 cm (150 kg maxi), move around the source by the mean of an aerial conveyor.
    - Mainly used for doses < 150 kGy and if a constant dose rate is not expected.
  - A constant dose rate (about 0,7 kGy / h) in 2 defined areas dedicated to static exposure.

2 areas for static exposure according to the gabarit of the samples:

- *Area for samples :* tailored for exposing cables, flasks …
- *Area for industrial products:* tailored for exposing industrial components and complete systems (maximum height of 66 cm) i.e. chemical reactors, electric transformers, electronic components, cards and supports…

Rotating system for seals immersed in water

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FOLLOW-UP OF THE TRIALS

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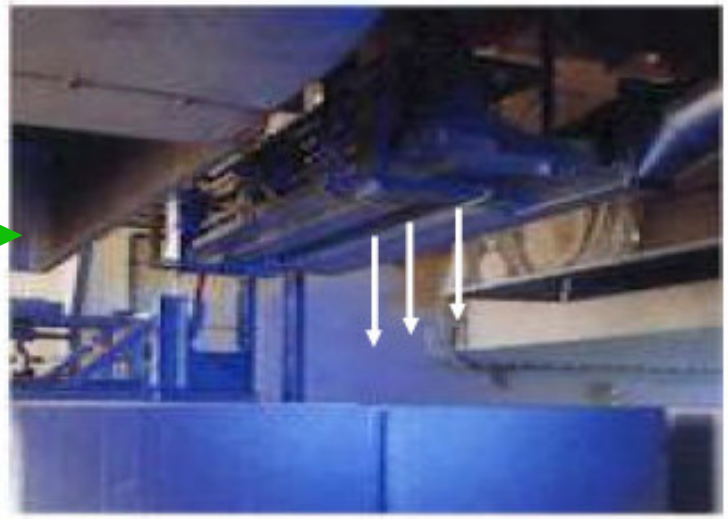
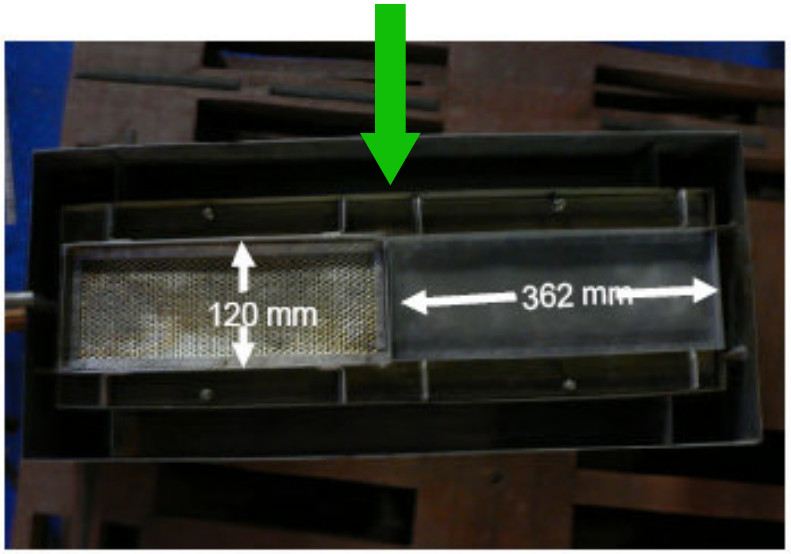
- **DOSIMETRY:**
  - Low doses (< 100 kGy) and dose rate are controlled by radiochromic FWT dosimeters. Alanine dosimeters can also be used for a better accuracy.
  - Dose range : 1 – 50 kGy.
  - Time of exposure is recorded in case of high doses.
- **SPECIFIC CONDITIONS:**
  - Electric supply of electric systems is possible.
  - Particular dose control and dose mapping in case of complex or large products.
  - Heating (for 2008) and low temperature (with carbo ice) can be performed.

BETA EXPOSURE at HIGH DOSES

- **In IONISOS ORSAY facility (20 km from the south of Paris)**
- **Electron Beam of 10 MeV energy, 10 kW :**
  - Scanning width of 60 cm
  - Possibility of different dose rates
  - Continuous cooling of the product with a water flow





IONISOS MATERIAL-RADIATION INTERACTIONS EXPERTISE

- **ENGINEERING of EQUIPMENTS**
  - **COFRAR** team : design of casemates and engineering for conveying systems.
  - **Dagneux irradiator technical team** : large expertise and long experience in material resistance towards radiation (metal, plastics and rubbers, electric and electronic systems i.e. sensors).
  - We can propose tailor-made consulting by the technical team.
  - At any time, we can give you trends about the resistance of polymers and advise you tailor-made grades of plastics.

- **RADIATION CHEMISTRY ACTIVITY**

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Use of radiations to improve the performances of materials:

- Curing of composites
- Cross-linking of plastics to confers on them thermosets' properties (example in next slide)
- Over-crosslinking of elastomers and rubbers to improve their resistance in compression (compression set)
- Radiation grafting (for fonctionalization with anti-sceptic properties for example)
- Colouring of glass and semi-precious stones
- Doping of electronic components (wafers)

Example of the advantage of plastic cross-linking:
Thermal aging test: 30 min at 280°C

Polyamide 6 FRIANYL VN from FRISETTA

FRISETTA study

← Cross-linked

← Untreated

0 3 5 10 15 30 minutes

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TECHNICAL TEAM and CONTACT

Trials are performed by a team of technicians:

- A technician (chemist) is dedicated to radiation trials
- The technical team can design and realise tailor-made systems for exposing your produts:
  - 2 mechanic designers
  - 1 mechanic
- Chemist engineer with a speciality in Polymer and Composites

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