

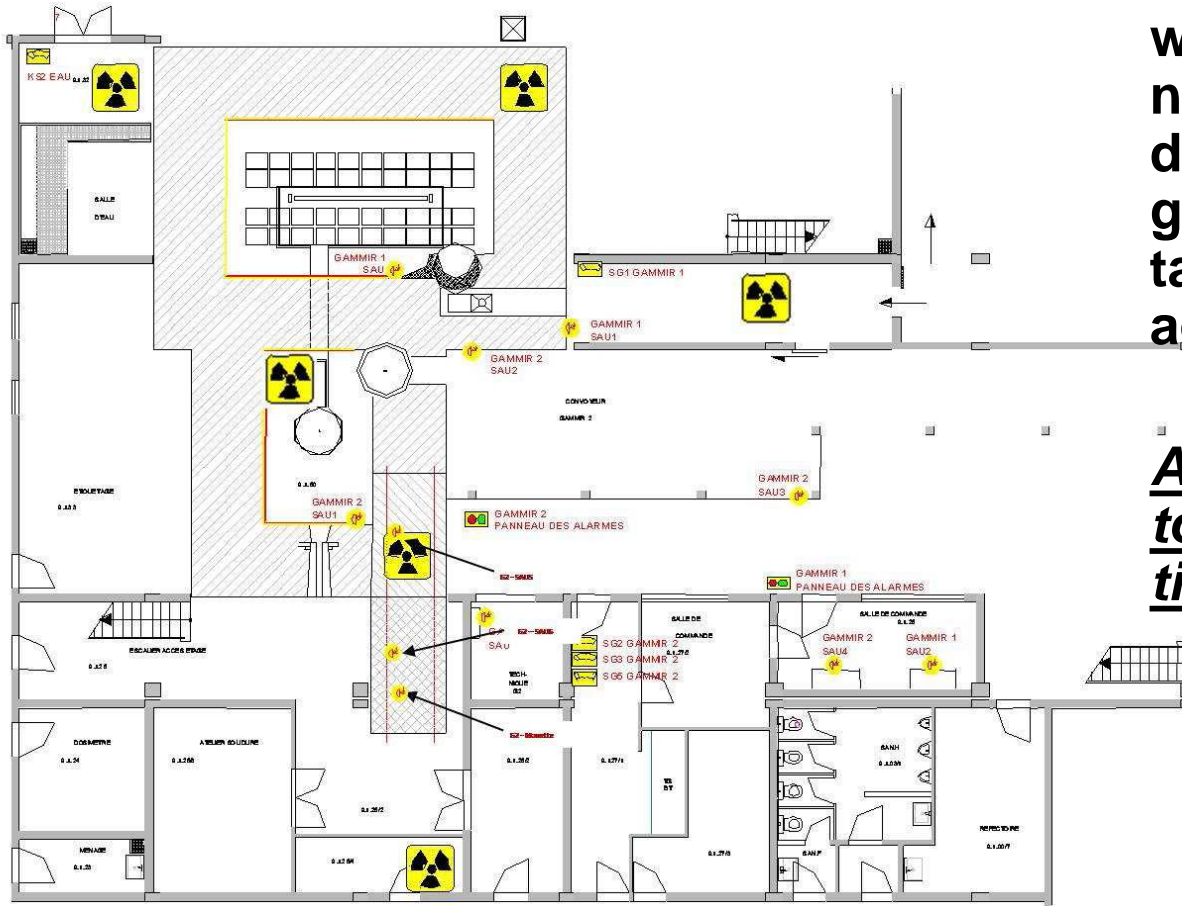
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Safety Improvements of an Industrial Irradiation Facility

Contents

- **Description of the facility**
- **Incident/Accident**
- **Modifications of the facility**
- **Historical problems solved**
- **Conclusions**

Accident of March 2006



Severe irradiation of a worker (4.2 Gy), worker did not wear his dosimeter, did not use a portable gammameter and did not take any alarm into account

As a result, it was decided to remove the safety delay timer for patrol

Situation end 2006

- **Incident of 1999 not completely solved :**
6 broken sources were sitting « protected » on the bottom of the pool
- **Accident of 2006**
- **+ historical problem obsolete sources**
48 obsolete sources COP4 were sitting on the bottom of the pool of Gammir I

Improvement of the facility after incidents

- New plug cover on the roof of Gammir I
- New safety barriers around Gammir I (to avoid a fall in the pool)
- Two separated hydraulic systems for Gammir I and Gammir II
- Mechanical lock on the sources cylinders when the sources are down
- New safety labelling
- Improvement of the QA system

Lock out/tag out of irradiator procedures

Week, month and year testing system procedures

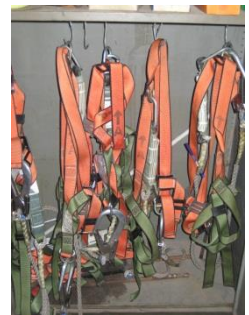
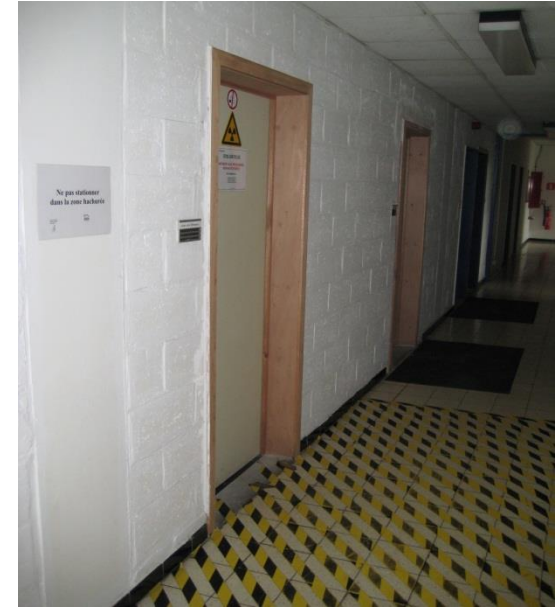
Education program

New safety report, ...



Improvement of the facility after incidents

- Improvement of the shielding around the Gammacell Excell 220
- Setting-up of an exclusion zone around the Gammacell Excell 220
- New radiation probes set up to replace the obsolete ones
- Separation of the no-break system previously linked with the no-break of IRE
- Operational dosimetry (electronic system)
- Use of safety harness during loading and unloading of irradiators

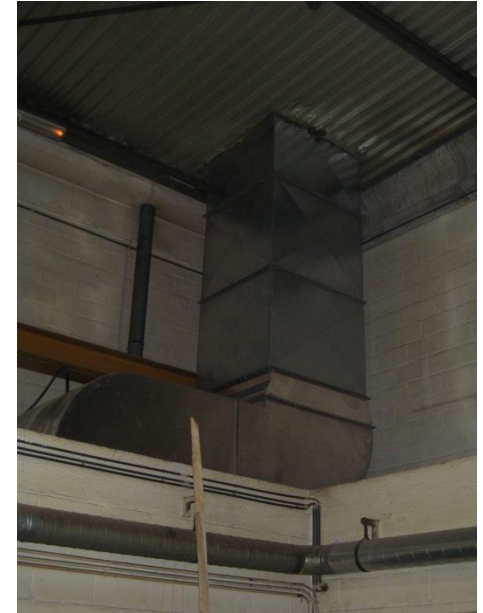


Improvement of the facility after incidents

- New retention tanks for acid used for cation exchange resins
- Automatic closing valve against water overflow
- Water proof painting on the wall of the water storage tank
- Setting up of a new valve between waste tank and the final exhaust water pipe
- New sand filter, new NaI probe (sensitivity), ...



Improvement of the facility after incidents



- **Fire safety improvement**

- New extinguishers, new hose reels**

- Smoke exhausts**

- New PLC/PC to manage the fire alarming system**

- Zone separation, compartmentation**

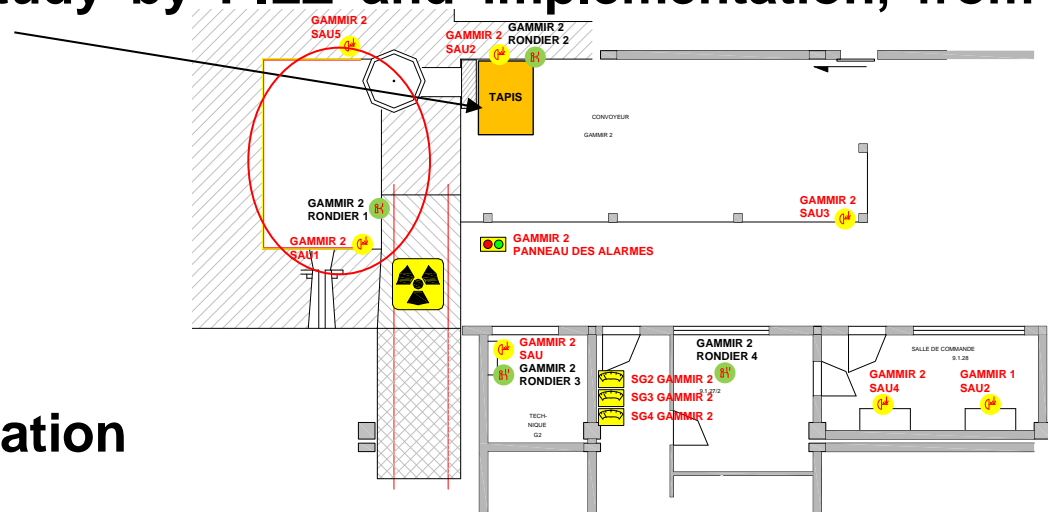
- New safety exits, new safety lights, ...**

New incident : May 2009

- A maintenance technician was trapped in the Gammir II irradiator. He actuated an emergency stop before the irradiation sequence began.

Improvement

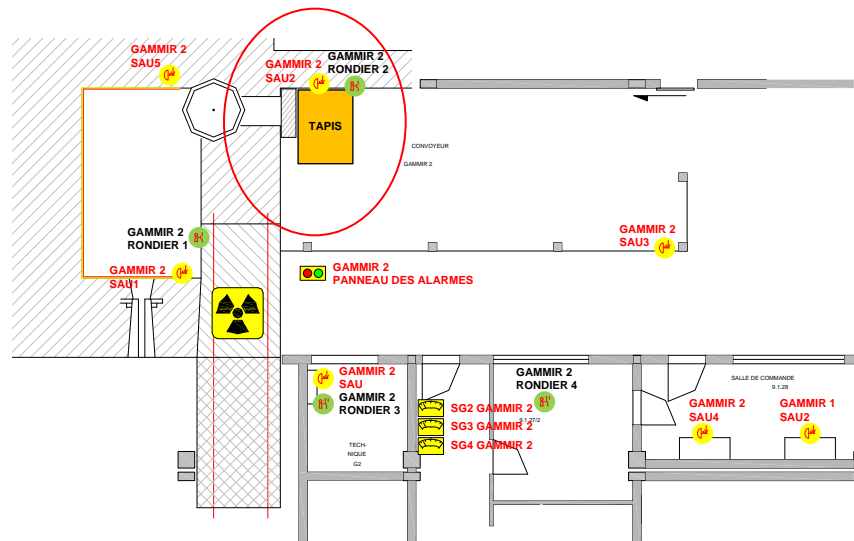
- First phase, multiple consignations (one lock per person entering an irradiator), from May 2009
- Second phase, immaterial barrier and sensitive carpet, patrol is back (safety delay timer): study by PILZ and implementation, from Dec 2009



- New operating authorization

Incident of May 2009 follow-up

- Jump of one employee over the sensitive carpet



- Improvement : Modification of the layout around the carpet

Last incident

- Empty rack sources blocked in upper position due to damaged cable (12.11.2014). Reloading of the irradiator while still in degraded mode (16.11.2014) : Procedure describing degraded mode requested the locking of the irradiator at the end of the tests ; wrong communication between two teams; human and organisational factors.



Improvements

- Replacement of the guide and traction cables and review of their preventive replacement frequency
- Test of the empty rack movements and of the damaged cables
- Test of the Revision of the degraded mode procedure to include a double check (project leader and control).
- Revision of the risk analysis taking into account the organizational and the human factor impact

Historical problems solved

- **Sources**

48 obsolete sources COP4 have been evacuated from the bottom of the pool of Gammir I (DONE in 2008)

Evacuation of 6 broken sources from the bottom of the pool of Gammir I placed in a special container (DONE in 2014)

Conclusions for Sterigenics Fleurus

- Accident of 2006 has helped to improve the situation at the level of :

The licensee

And the regulator

- Long-term improvements are now underway in Fleurus irradiation facility :

Water room treatment,

Independent power supply,

Irradiator control system,

Pool cleaning and pool covering, ...

- After incidents, improvements have been put in place in order to avoid repetition

Thank you for your attention.

Do you have any question ?

