Safety Improvements of an Industrial Irradiation Facility
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Description of the facility

Gammarir I
Gammarir II
Gammacell
Incident: October 1999

- Blocked sources rack on upper position after test
- During deblocking of the sources rack, six sources were damaged
- Contamination of the pool > 26 kBq/l
- Capture of the cobalt-60 on resin and sand filters (limit 2 mSv/h)
- Double packing of the damaged sources
Accident of March 2006

Severe irradiation of a worker (4.2 Gy), worker did not wear his dosemeter, 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?