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STUDIECENTRUM VOOR KERNENERGIE
CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE

ALARA for Decommissioning and Site Remediation

Scenarios and strategy for dismantling hot cell M2 at LHMA installation, Mol

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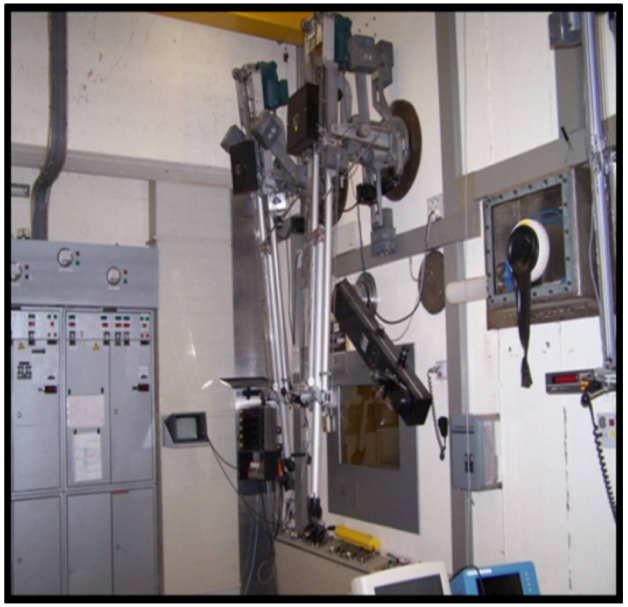
Agenda

- Introduction
- Initial state of hot cell M2
- Strategy and sequences of the dismantling
- Dosimetric results
- Conclusions

The cell M2 was intended to study irradiated fuels

- Forms with Cell M1 (always operational) a group of hot cell
- Put into service in 1977
- Internal volume : 3 m x 3 m x 5 m
- Barium concrete shielding and Pb balls (0,6 à 1 m)
- Liner in stainless steel



- 2 telemanipulators, 3 vertical storage channels
- Travelling crane 3 T. Possible access through the roof (1,6 x 2,1 m)
- In the past: cuts irradiated fuel elements:
  - Turning lathe
  - Milling machine, cutting devices

The initial state of cell M2 was very bad

- From a mechanical point of view:
  - Two existing tables blocked
  - Malfunctions different present devices
  - Waste accumulation
  - La Calhène lock blocked (lock and Pb-shielding)
  - 2 normal ventilations out of duty, emergency ventilation operational
  - Access difficulties
- From a radiological point of view
  - Dose rates from 140 to 180 mGy/h, hot spots up to 4 Gy/h
  - Old experiment in storage 8 Gy/h at 30 cm from shielding
  - Estimated $\beta\gamma$ contamination 27,5 GB/dm²
    - ^{137}Cs, le ^{134}Cs, l'^{154}Eu, l'^{241}Am, le ^{106}Ru le ^{57}Co, l'^{155}Eu, le ^{60}Co,…
  - Estimated α contamination 1,88 GBq/dm²
    - ^{242}Cm, ^{238}Pu, ^{241}Am, $^{239/240}$Pu, …

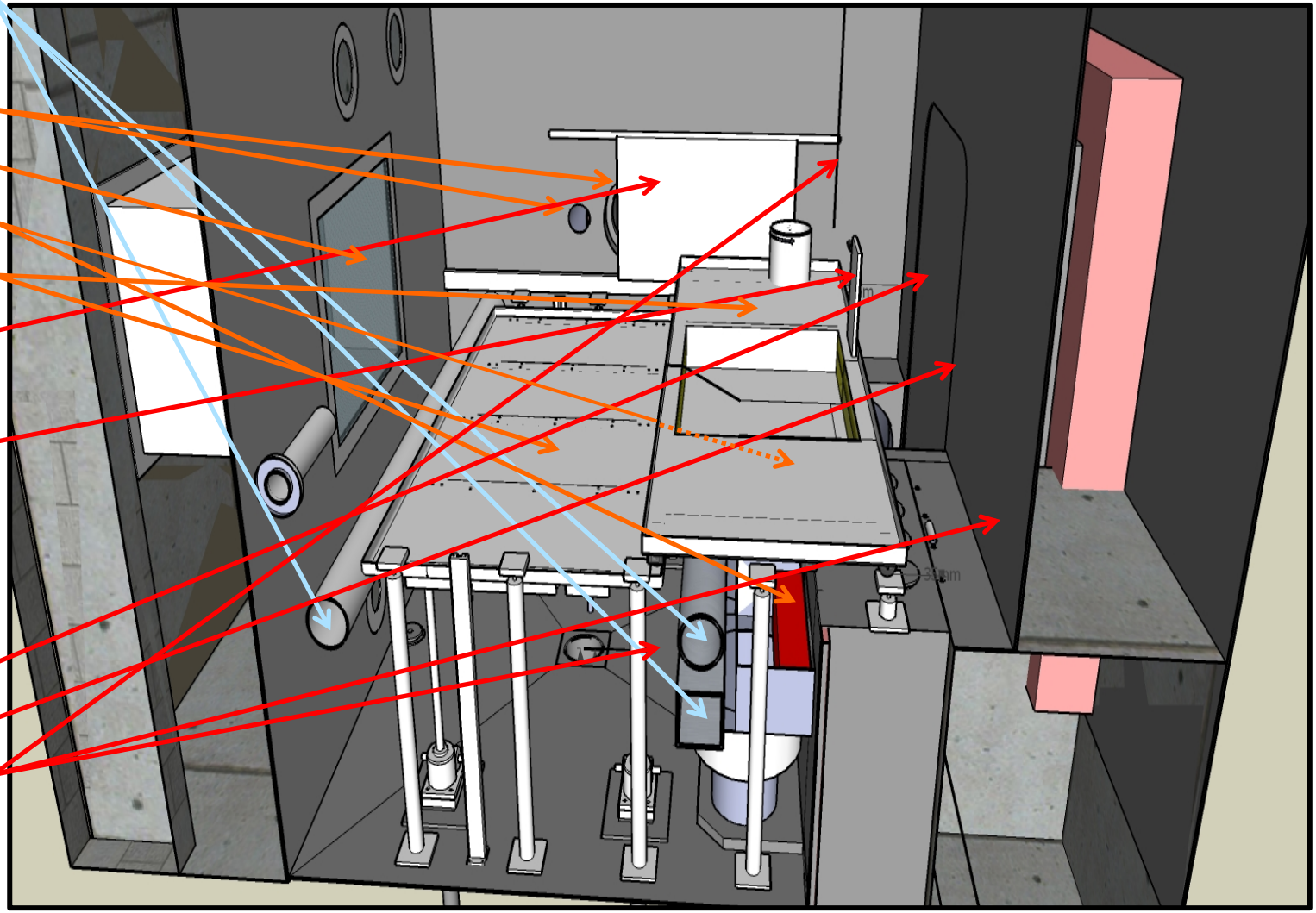
Fixed structures

tools

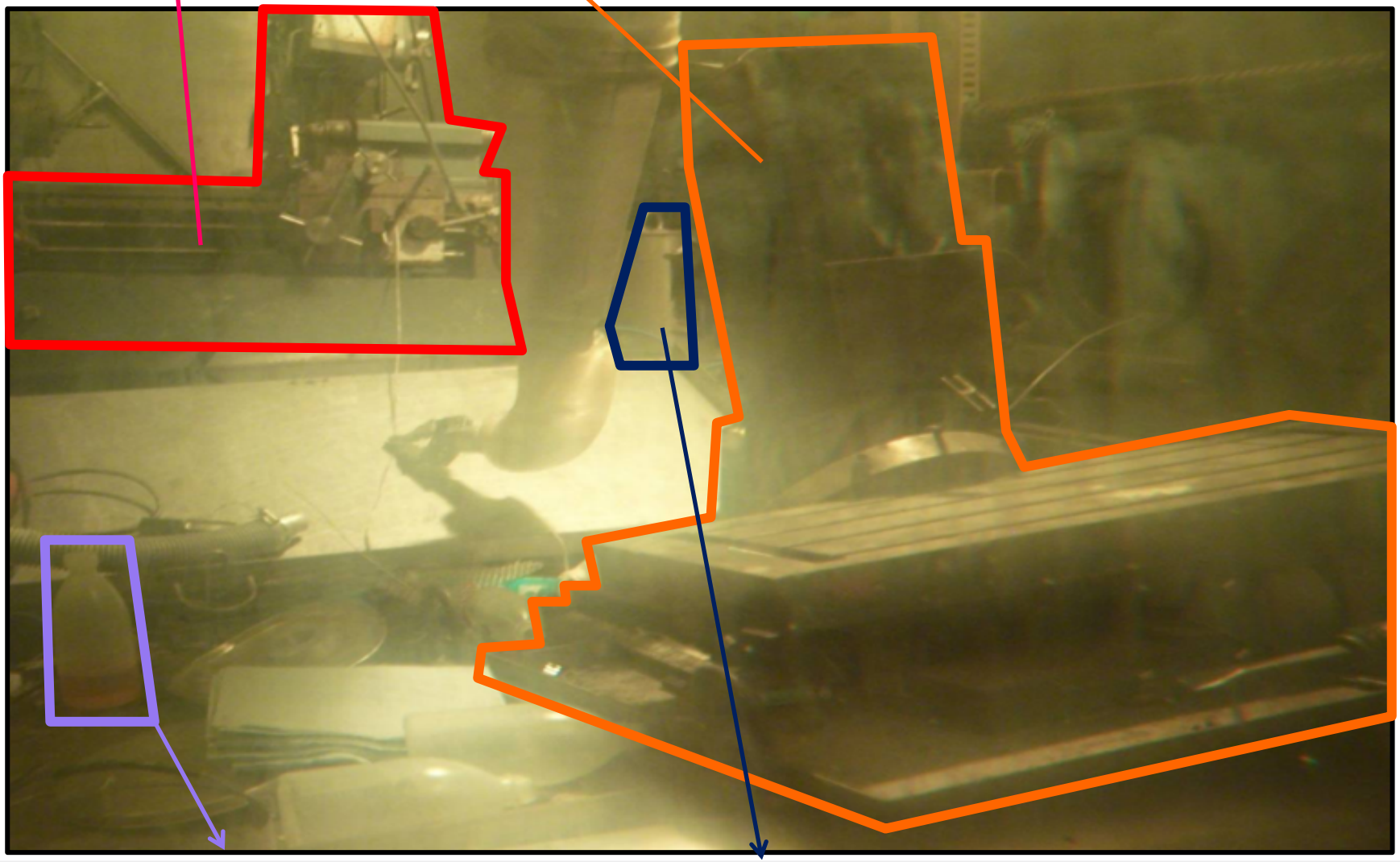
known failures in 2010→ reason for decommissioning M2

failures noticed during decommissioning

- Manipulators < 15 kg
- Jammed portal crane
- Broken entry Φ=180mm
- Hindering piping of M1
- No drain for liquids
- Broken small LC locks
- Poor lead glass visibility
- Clogged HEPA filters
- Jammed disconnected tables
- Blocked Pb screen
- Broken lighting 7/8
- Obstructing power supply
- Dose rate ceiling 60mGy/h
- Historical waste
- No access to cell floor
- Distortion of back door
- Degenerated alpha seals
- ≠ holes through the walls
- Hidden cavities for decon
- Oversized mill & lathe



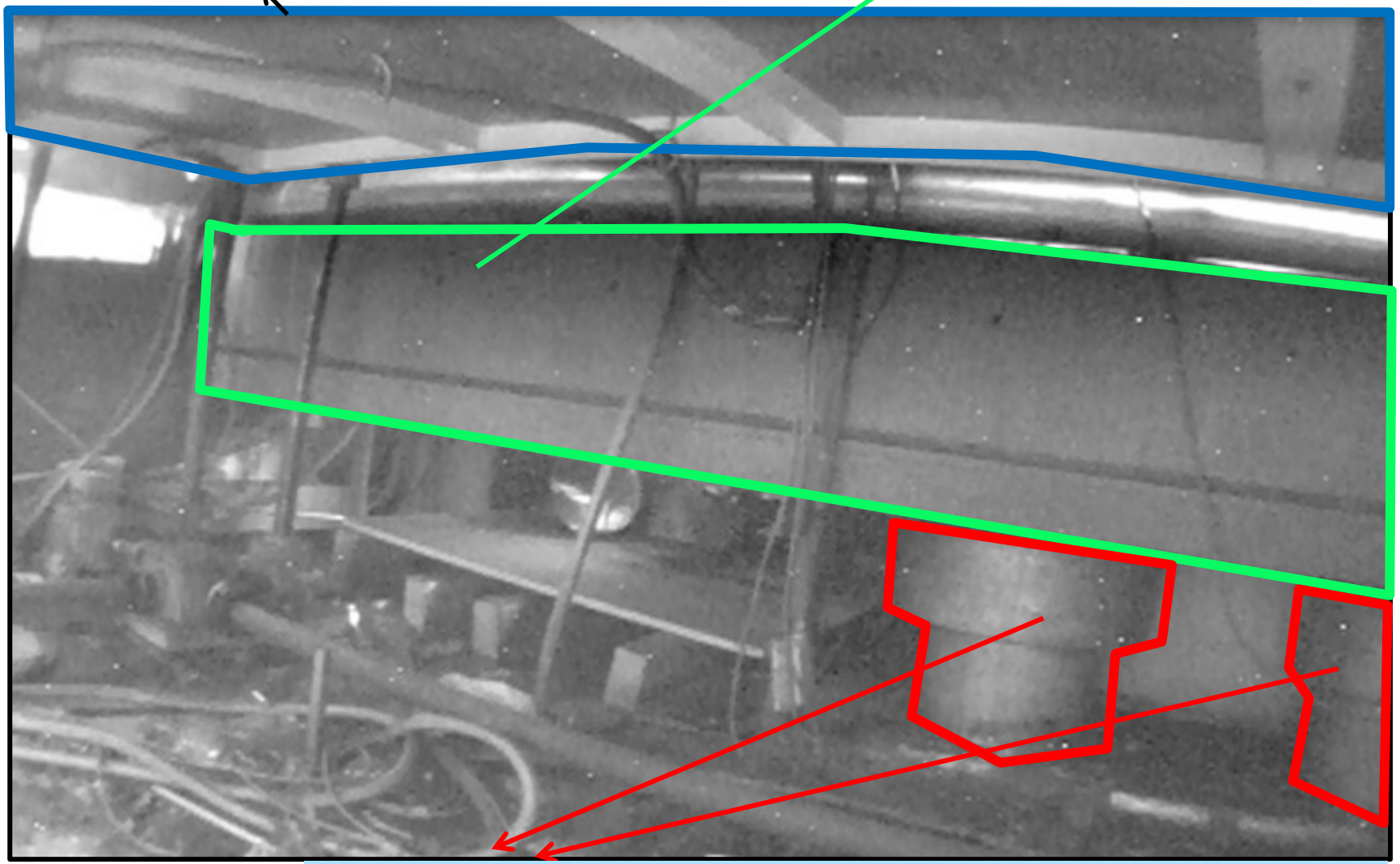
… & a lot of material on top



Underneath the tables …

Front working table:
jammed and disconnected

Piping adjacent M1 hot cell: hindering passage & quality has to remain



Clogged HEPA filters – 100% on emergency ventilation - not designed for hands-off removal

Several dismantling strategies were studied

- Goal of the project
  - Dismantling and decontamination of the inside of the cell
  - Shielding around the cell always operational
  - At the end, reuse HC M2 for new applications
- First studied strategy (before 2010)
  - Decontamination at distance of present pieces (dry ice blasting, no effluents).
  - Transfer decontaminated pieces through opening in roof
  - Cuts by operators of evacuated pieces in an intervention zone to be build above the cell.
  - Strategy applied in the past for the reconditioning of HC 41
    - But : HC 41 smaller and dose levels lower.
  - Difficulties to have a sufficient decontamination.
  - Important dose risks for operators
  - Strategy abandoned

A new strategy was then applied

- Restoration functioning support infrastructure
  - La Calhène lock
  - Normal ventilation of the cell
- Cuts at distance of present equipment's
  - Via telemanipulators
  - Development of specific tools

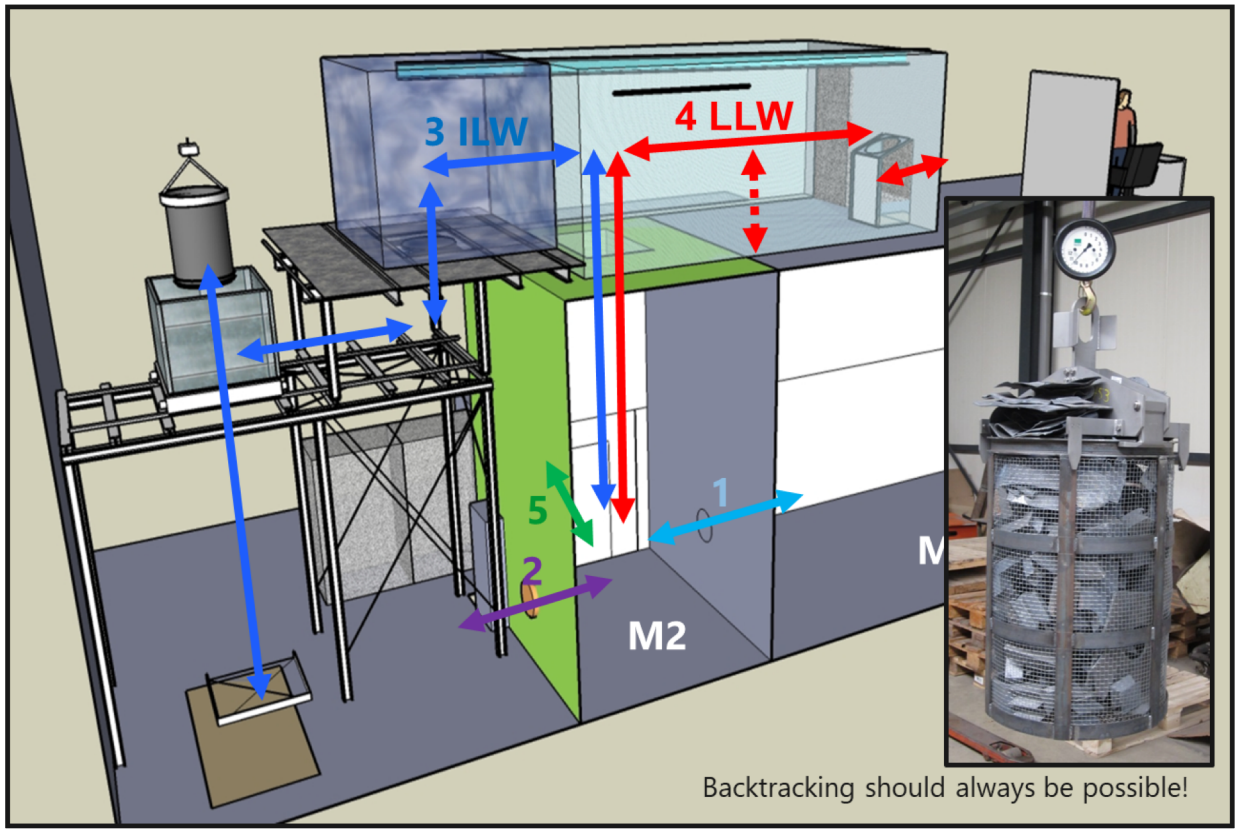






A new strategy was then applied

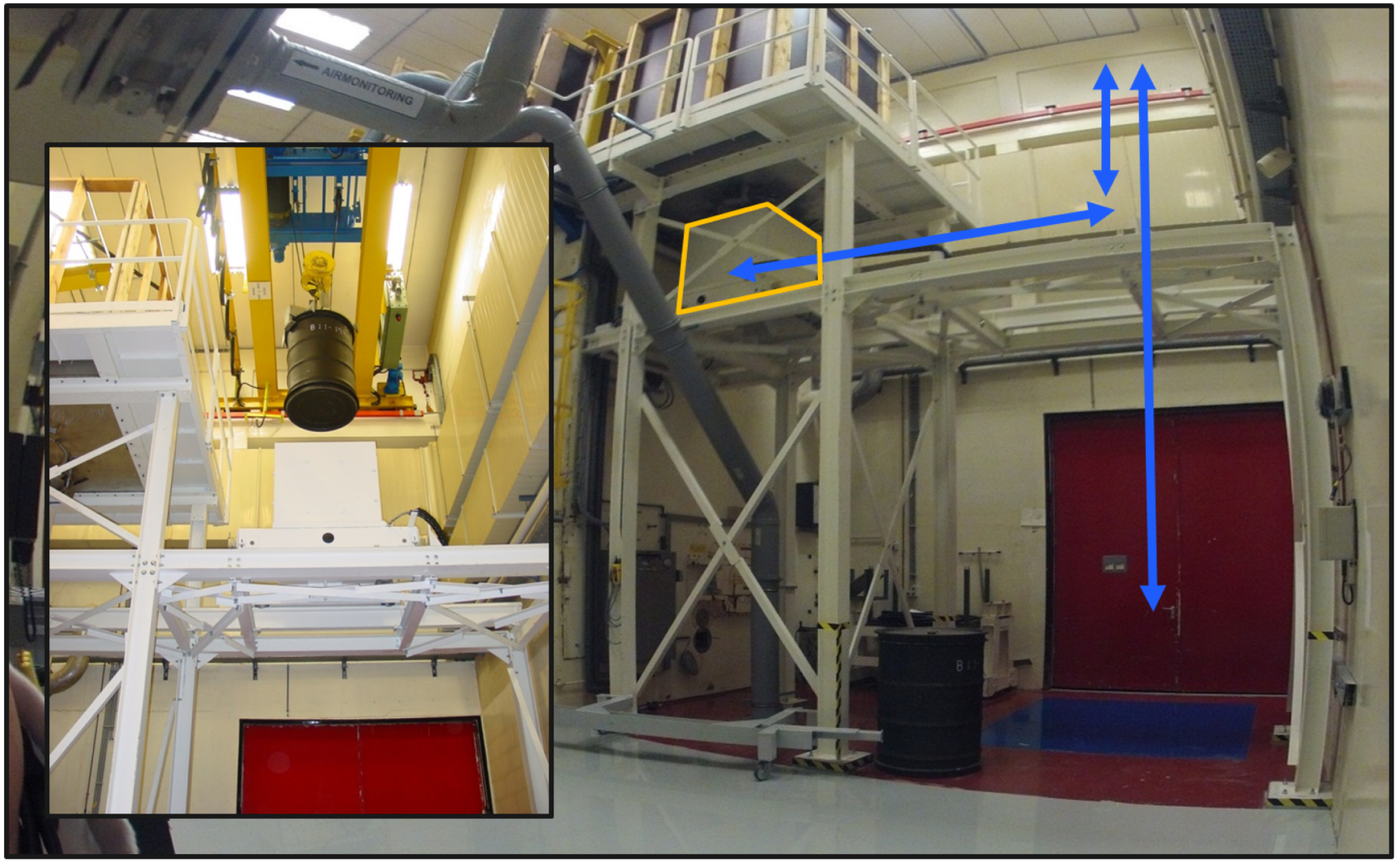
- Creation of new evacuation ways for big volume wastes (via intervention zone on roof cell)



⇨ 143 TBq evacuated in total

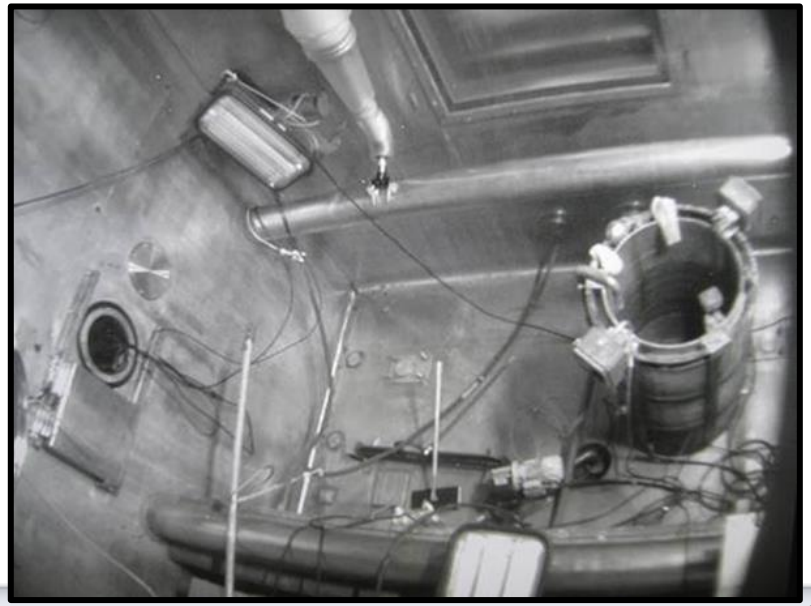
⇨ Strong later limitation of received doses during the interventions

Evacuation of Moderately Active Wastes (< 200 mGy/h)



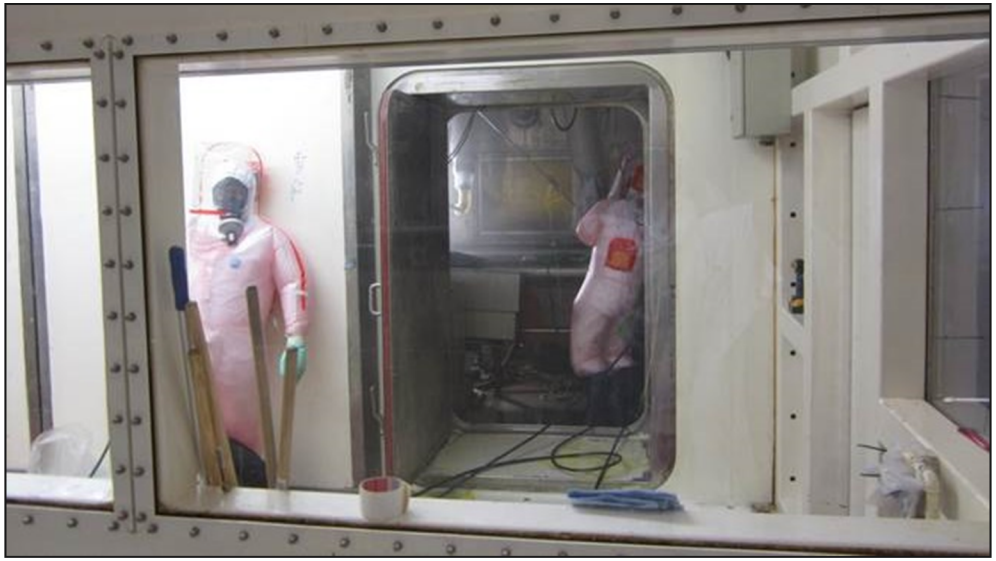
A new strategy was then applied

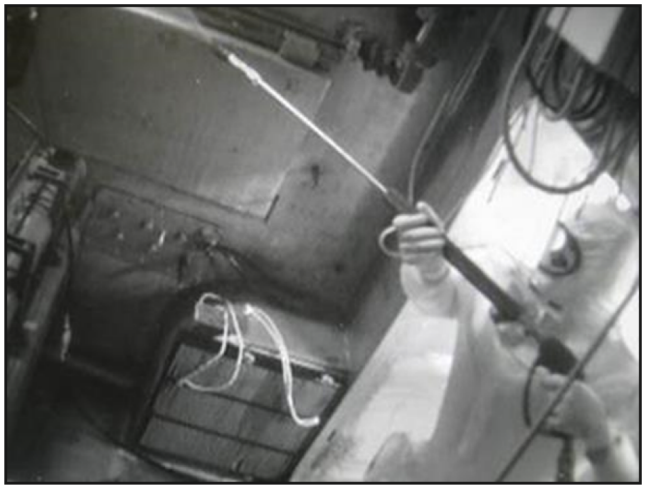
- Decontamination at distance
  - Via telemanipulators
  - Surface-active and foaming agent sent at low pressure
  - After ½ h up to 1 h, rinsing with water at low pressure
  - Limited water volume
  - Water gathered in barrel with heating resistors
    - Evaporation water and concentration activity



A new strategy was then applied

- Interventions in the cell
  - From background 2 mSv/h
  - Decontamination under high pressure
  - Construction scaffolding to reach the top of the cell
  - Dismantling travelling crane
  - Manual decontamination





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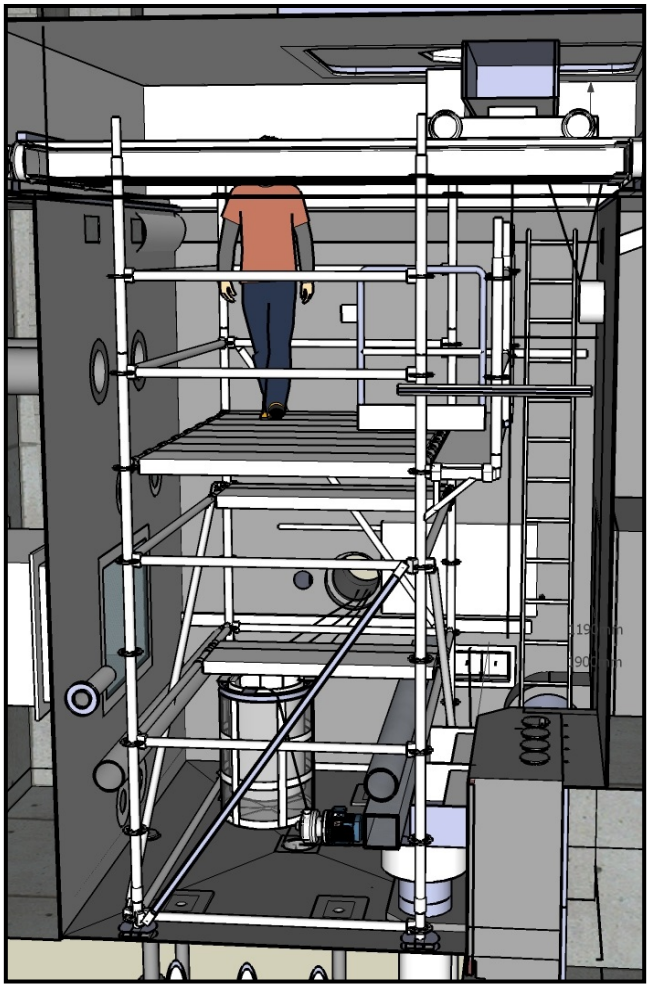


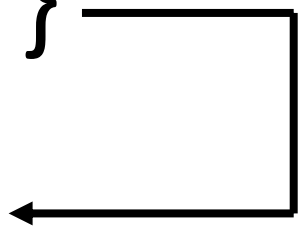
The dosimetric impact of the dismantling could be limited

- Global collective Dose 2010–2018
  - **47,169 man.mSv**
- Construction intervention zone 2010–2012
  - 1,544 man.mSv
- Cuts and decontamination at distance 2010-2015
  - 0,959 man.mSv
- Use intervention zone of which evacuation wastes 2012-2018
  - 1,963 man.mSv
- Interventions in the cell 2015-2018: 42,703 man.mSv of which
  - Decontamination: 21,526 man.mSv
  - Construction scaffolding: 4,786 man.mSv
  - Dismantling travelling crane: 9,378 man.mSv
  - Several interventions: 7,013 man.mSv
- Maximum Individual Dose on 1 year: 1,861 mSv

The dosimetric impact of the dismantling could be limited

- Collective dose **47,169** man.mSv between 2010 and 2018

- Operations at distance
  - Evacuation majority present activity (143 TBq)
  - Decontamination at distance

  } 

  - Strong diminution of doses during interventions

- Interventions in cell
  - Deeper decontamination and future reduction of doses
  - Necessity to reach all corners of the cell
  - Collective dose **42,703** man.mSv
  - Ratio **Hs(0,07)/Hp(10) from 3** to **5** ⇨ Strong β component of the contamination

Conclusions

- The content of cell M2 has been dismantled
- Initial state of the cell very bad
  - From mechanical as radiological point of view
  - Background from **140 to 180 mGy/h**, hot spots **4 Gy/h**
- ALARA approach
  - Different operations carried out at distance
    - Cuts and evacuation of the content of the cell
    - Decontamination under low pressure via telemanipulators
  - Interventions inside the cell
    - From mean level of 2 mSv/h
    - Decontamination under high pressure
    - Construction scaffolding
    - Dismantling travelling crane
- Collective dose 2010 – 2018: **47,169** man.mSv

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