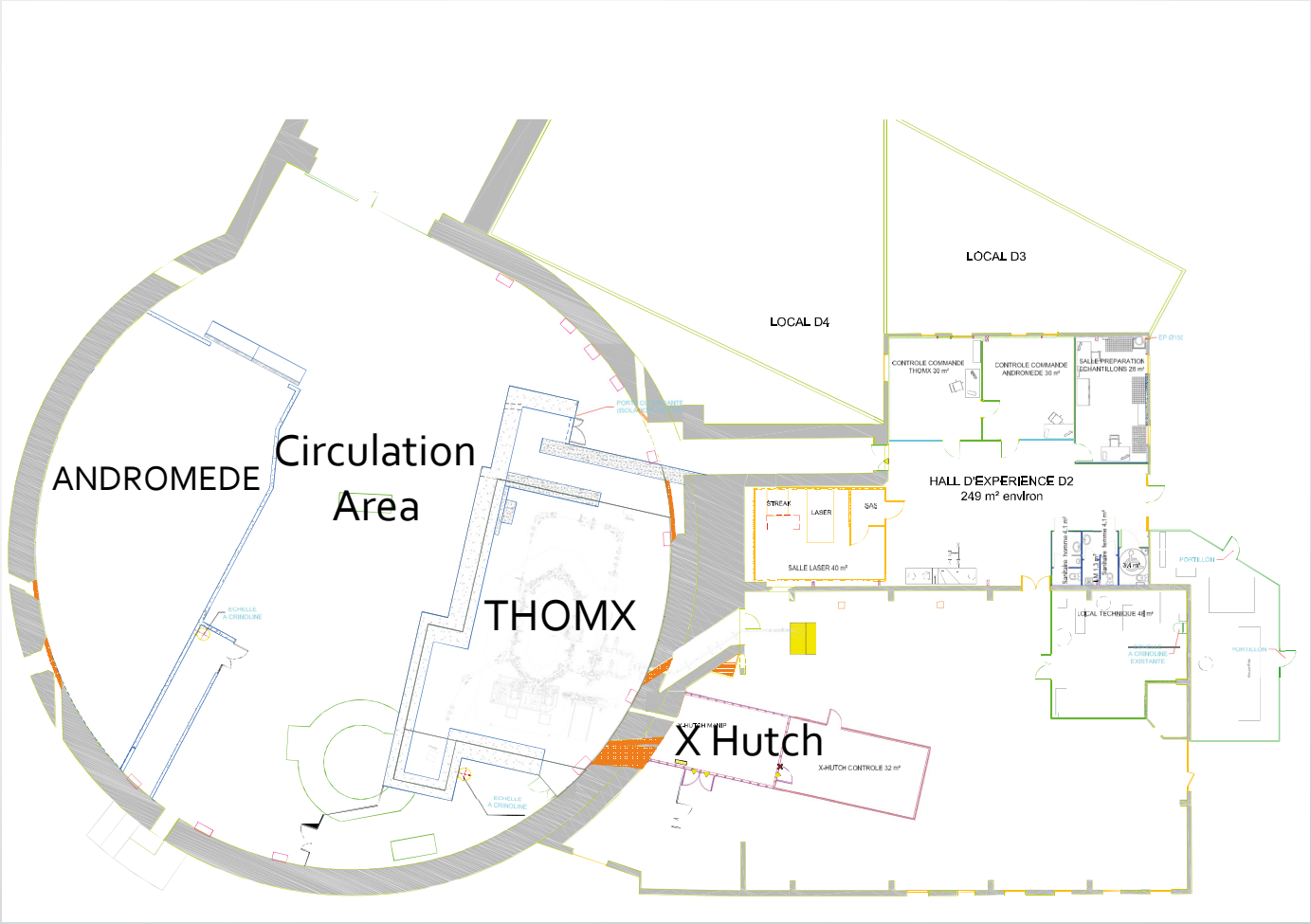
# Safety and Radiation Protection for ThomX

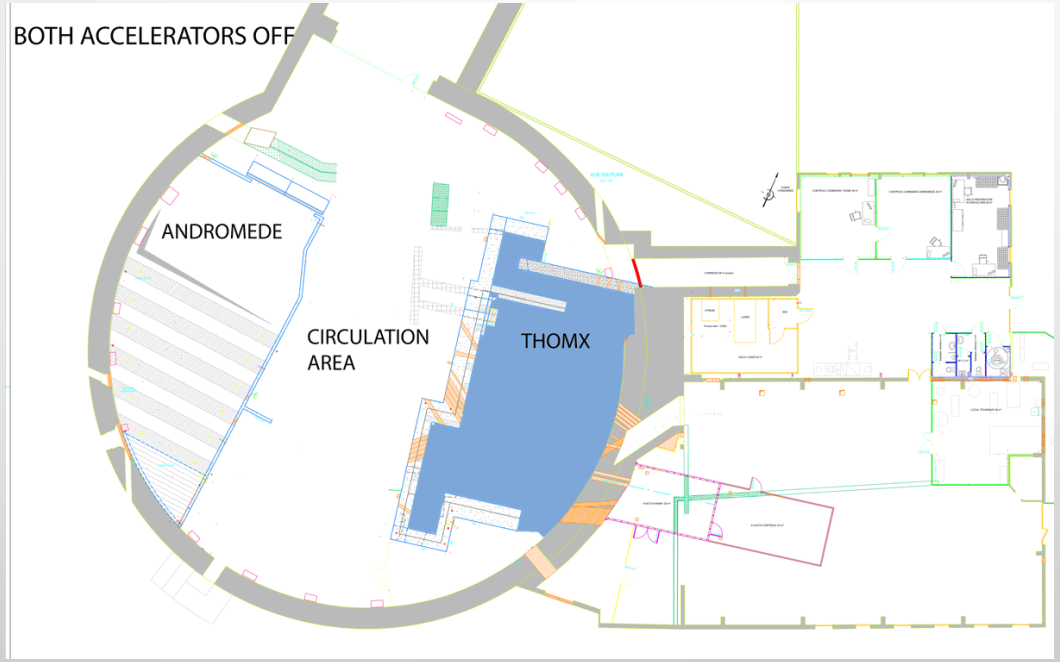
M.A.C. – 03/20/2017- LAL

# IGLEX
# Multidisciplinary Center for Technologies and Applied Sciences

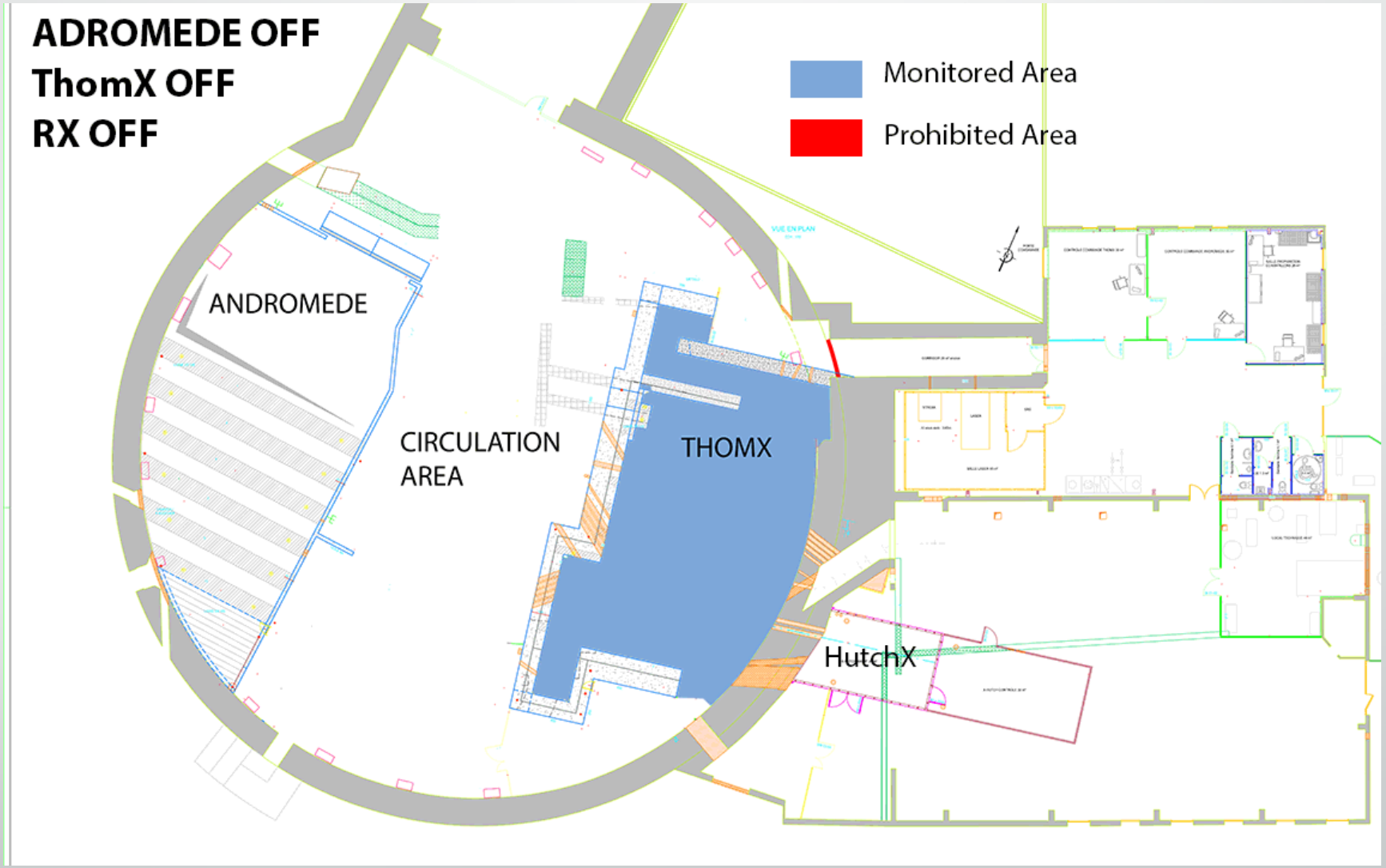
- Two accelerators in the same building: need to be operated independantly
- A common area between both devices called « circulation area », where presence of workers is possible.
- Two bunkers need to be designed, one for each machine.



# Radiation Protection Zoning



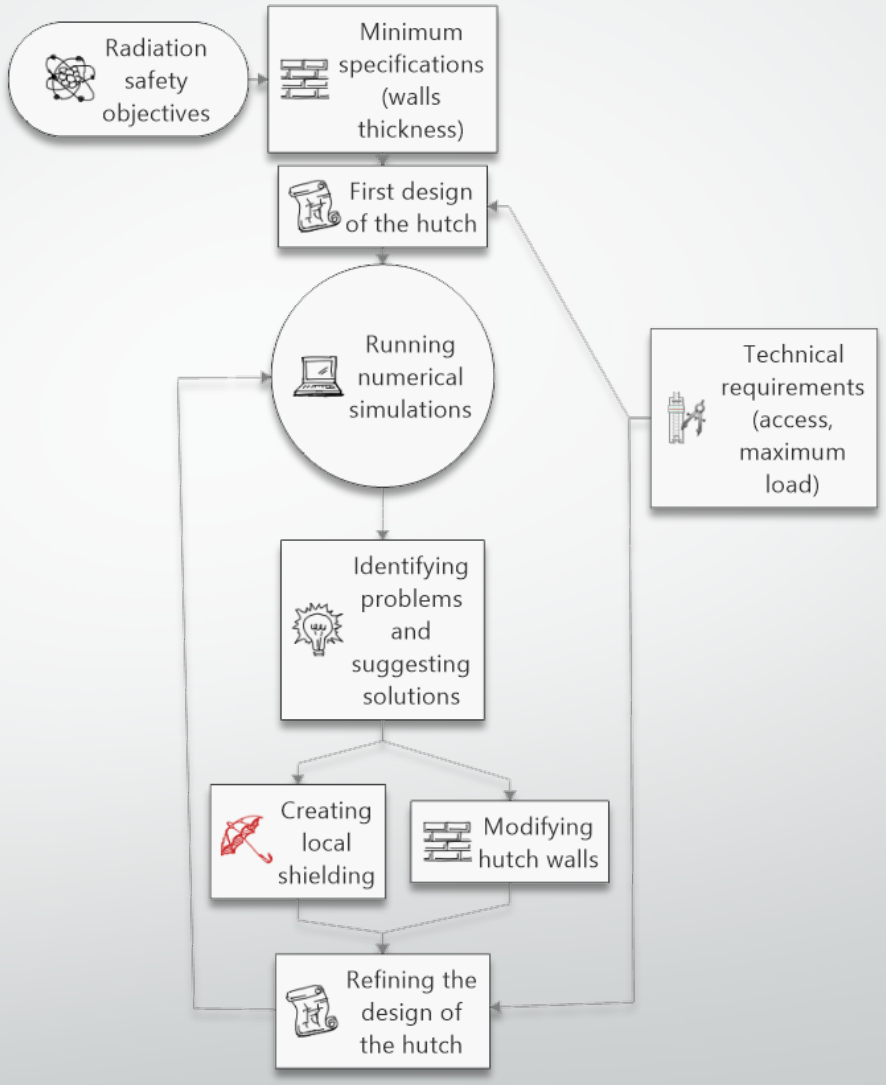
# Radiation Protection Zoning



# ThomX
# Shielding Design – Methods and Tools

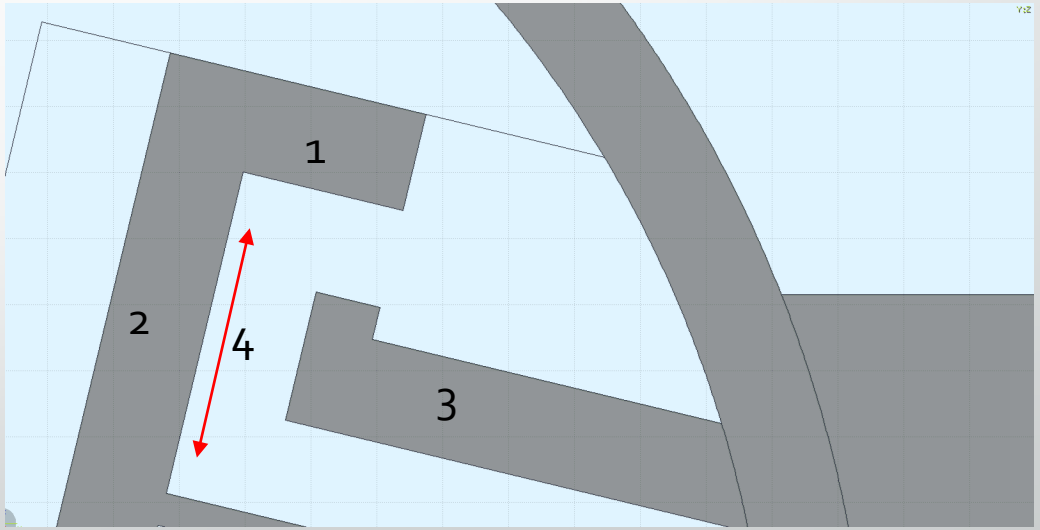
Step-by-step methods have been followed using FLUKA code:

- Empirical assessment of minimum specifications
- First design of the hutch
- Running numerical simulations until compliance with radiation safety objectives and technical/financial requirements



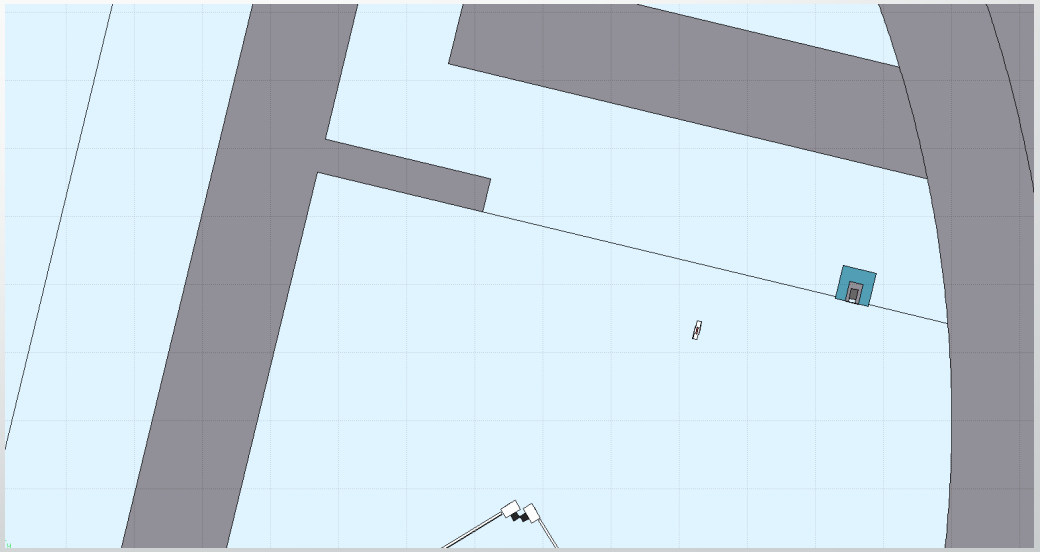
# ThomX
# Optimization of the Hutch walls

| Wall | Changes |
|---|---|
| 1 | Length: + 45 cm |
| 2 | Width: -50 cm |
| 3 | Width: -70 cm + baryte concrete |
| 4 | Length: -120 cm |



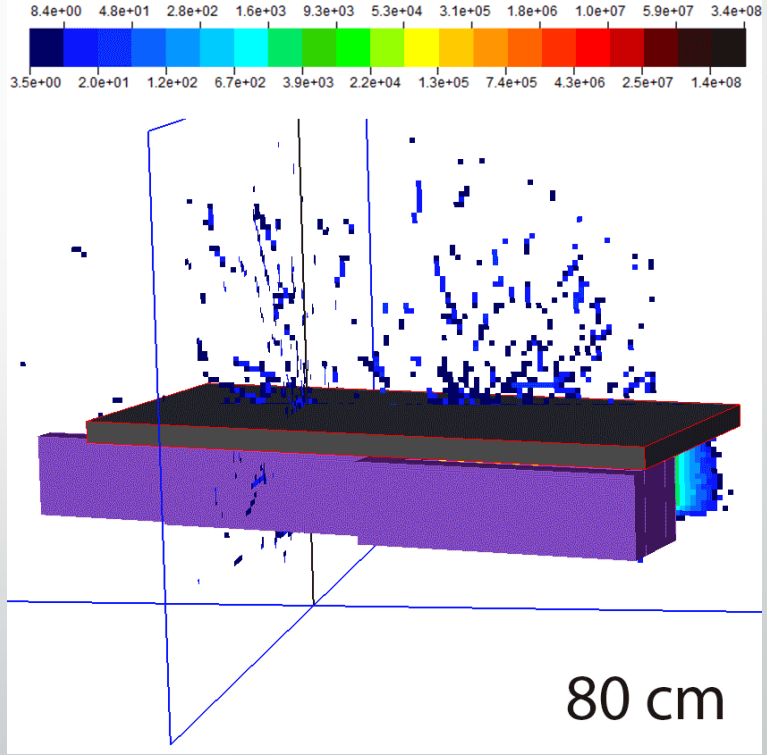
# ThomX
# Optimization of the Hutch walls– Scraper shielding

- Wall of 1,5 m of regular concrete: Rate dose above the objective
  - Modelling a new wall of baryte concrete
  - Optimization in order to reduce total volume
- Modelling a local shielding
  - Lead with Tantalum
  - Three purposes:
    - Reduction of the volume of concrete added
    - Photons produced are collimated by the lead pipe
    - Dose rate reduced when accelerator is off (shielding against delayed radiation)



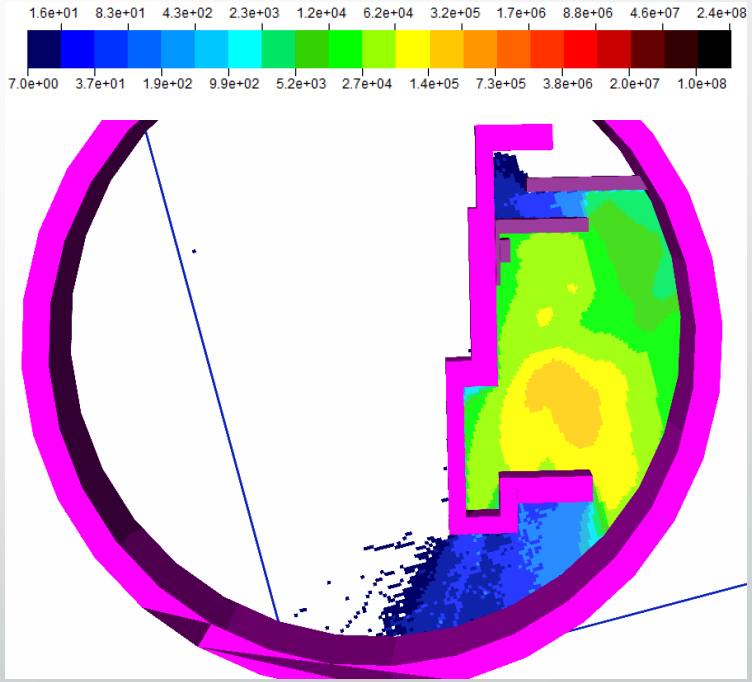
# ThomX
# Optimization of the Hutch walls - Roof

- Initial width of the roof was defined to entirely stop prompt radiations: 1 meter of regular concrete
- The area over the roof will be prohibited during accelerator running => width and weight or the roof can be reduced to 55 cm.
- Classical step-by-step method to find the best compromise between radiation protection and technical limitation



# ThomX
# Final design and results

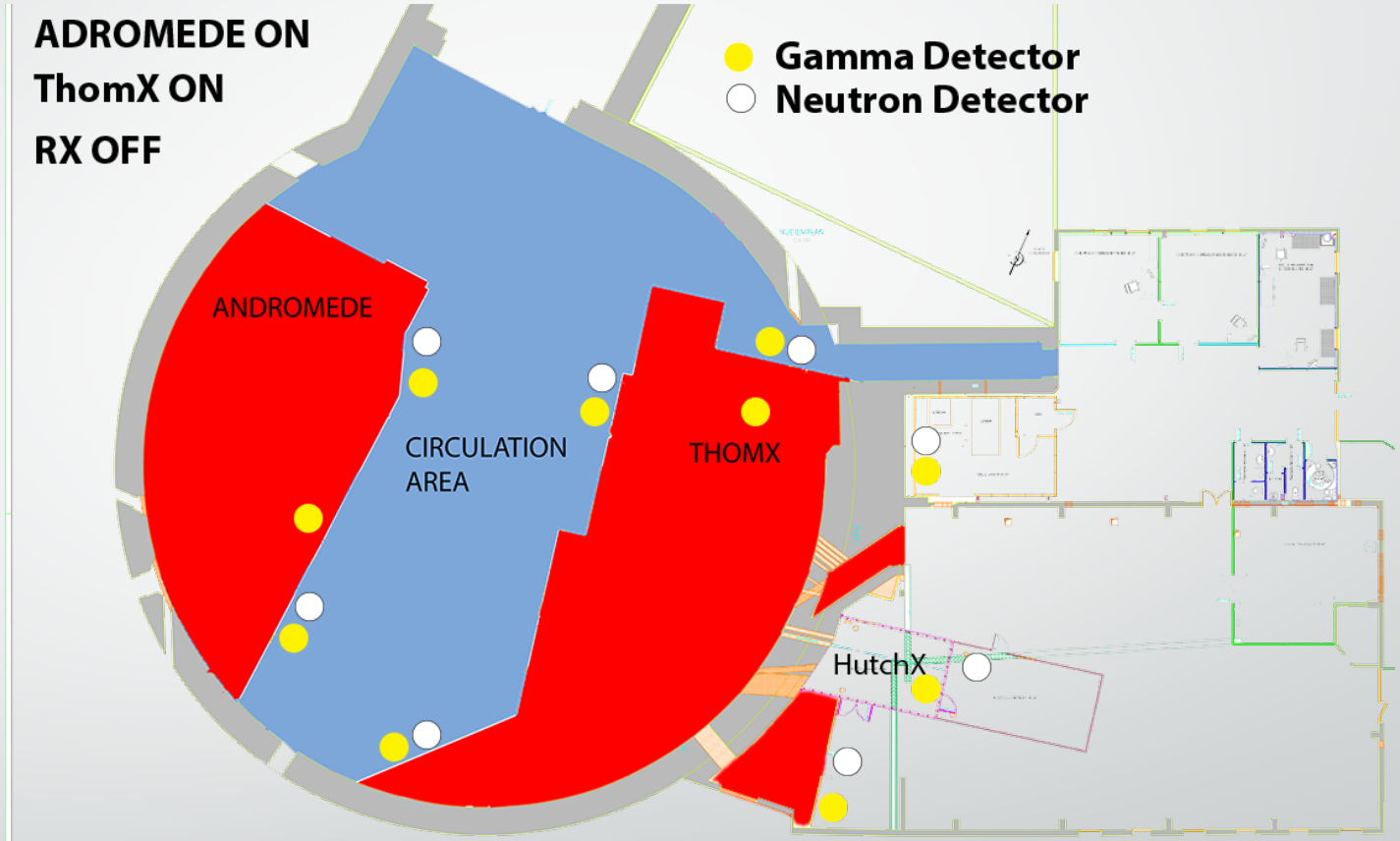
| | Weight removed (t) | Money saved (k€) | Costs (k€) |
|---|---|---|---|
| Optimization of the Hutch walls | 350 | 152 | |
| Local shielding added | | | 20-30 |
| Baryte walls for scraper | | | 66 |

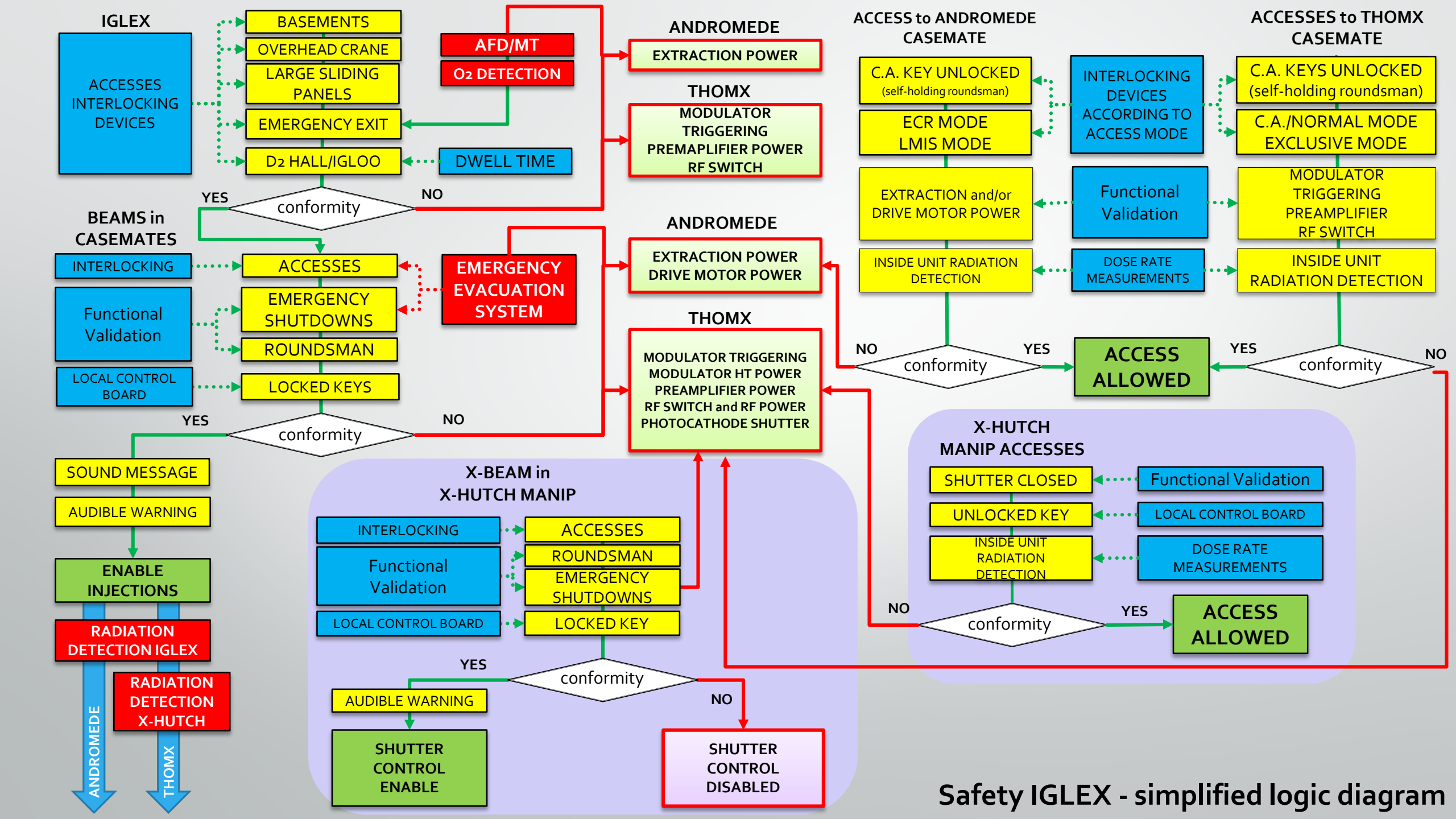


# Radiation Monitoring System

Gamma and neutron detectors provide a continuous radiation monitoring of

- Areas outside the Hutches
- Inside the hutches when beams are stopped




IGLEX
ACCESSES INTERLOCKING DEVICES
BASEMENTS
OVERHEAD CRANE
LARGE SLIDING PANELS
EMERGENCY EXIT
D2 HALL/IGLOO
AFD/MT
O2 DETECTION
DWELL TIME
YES
conformity
NO
ANDROMEDE
EXTRACTION POWER
THOMX
MODULATOR TRIGGERING PREMAPLIFIER POWER RF SWITCH
BEAMS in CASEMATES
INTERLOCKING
Functional Validation
LOCAL CONTROL BOARD
ACCESSES
EMERGENCY SHUTDOWNS
ROUNDSMAN
LOCKED KEYS
EMERGENCY EVACUATION SYSTEM
YES
conformity
NO
ANDROMEDE
EXTRACTION POWER DRIVE MOTOR POWER
THOMX
MODULATOR TRIGGERING MODULATOR HT POWER PREAMPLIFIER POWER RF SWITCH and RF POWER PHOTOCATHODE SHUTTER
SOUND MESSAGE
AUDIBLE WARNING
ENABLE INJECTIONS
RADIATION DETECTION IGLEX
RADIATION DETECTION X-HUTCH
ANDROMEDE
THOMX
X-BEAM in X-HUTCH MANIP
INTERLOCKING
Functional Validation
LOCAL CONTROL BOARD
ACCESSES
ROUNDSMAN
EMERGENCY SHUTDOWNS
LOCKED KEY
YES
conformity
NO
AUDIBLE WARNING
SHUTTER CONTROL ENABLE
SHUTTER CONTROL DISABLED
ACCESS to ANDROMEDE CASEMATE
C.A. KEY UNLOCKED (self-holding roundsman)
ECR MODE LMIS MODE
EXTRACTION and/or DRIVE MOTOR POWER
INSIDE UNIT RADIATION DETECTION
INTERLOCKING DEVICES ACCORDING TO ACCESS MODE
Functional Validation
DOSE RATE MEASUREMENTS
ACCESSES to THOMX CASEMATE
C.A. KEYS UNLOCKED (self-holding roundsman)
C.A./NORMAL MODE EXCLUSIVE MODE
MODULATOR TRIGGERING PREAMPLIFIER RF SWITCH
INSIDE UNIT RADIATION DETECTION
NO
conformity
YES
ACCESS ALLOWED
YES
conformity
NO
X-HUTCH MANIP ACCESSES
SHUTTER CLOSED
UNLOCKED KEY
INSIDE UNIT RADIATION DETECTION
Functional Validation
LOCAL CONTROL BOARD
DOSE RATE MEASUREMENTS
NO
conformity
YES
ACCESS ALLOWED
Safety IGLEX - simplified logic diagram