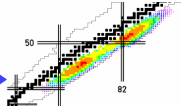


# Safety at SPIRAL2





- Administrative procedure
- SPIRAL2 Presentation
- Safety approach
- Releases authorization



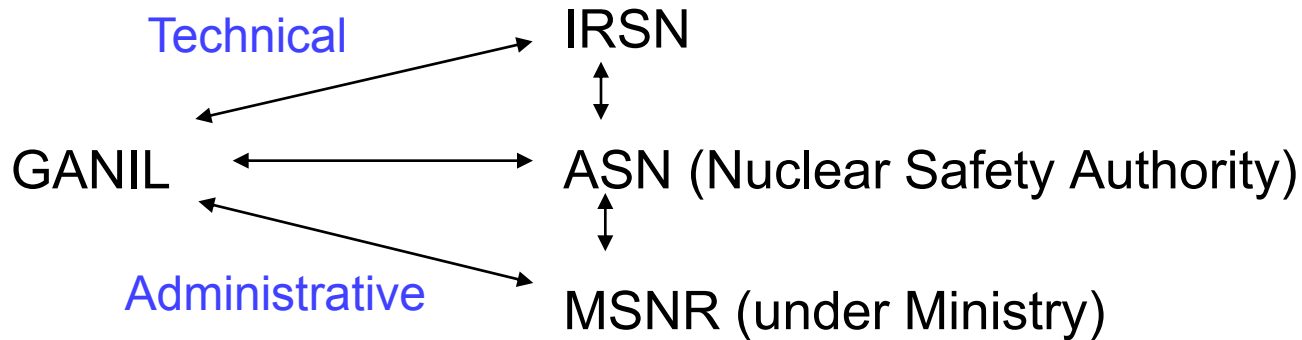
# Administrative procedure



**Main text : Law dedicated to transparency and safety in nuclear field (« loi TSN » in French), 13/06/2006**



Change in national organization :



And the New Environmental Authority (linked with MSNR)



■ Application decree of TSN law : decree 2007-1557, 02/11/2007



describes all the steps to produce a creation/modification authorization demand (DAM) for a nuclear facility, and the content of the different documents

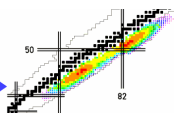
SPIRAL2 : modification of the perimeter of the nuclear facility

+

Releases authorization demand for SPIRAL2 and for the existing facility

*SPIRAL2 is one of the first facilities following this new procedure.*

# Spiral2



CLASSEUR 1/3

## DEMANDE D'AUTORISATION

de modification du périmètre de l'installation nucléaire de base n°113 pour implanter le projet **SPIRAL2**

**GANIL CAEN**  
Boulevard Henri Becquerel  
BP 55027 / 14076 CAEN cedex 5  
www.ganil-spiral2.eu

AVRIL 2009

**GANIL**  
Microscopie ionique CAEN/SP2

### PARTIE 1

Identification du pétitionnaire

### PARTIE 2

Document descriptif

### PARTIE 3

Etude d'impact

### PARTIE 4

Etude de maîtrise des risques

### PARTIE 5

Plan de démantèlement

### PARTIE 6

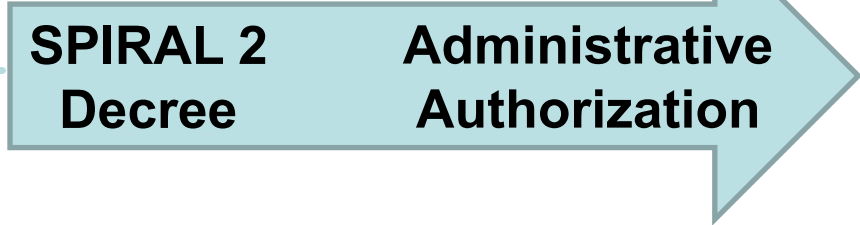
Plans réglementaires



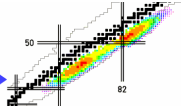


Technical Instruction of Impact Study      Technical prescriptions for releases

Preliminary safety report Phase 2

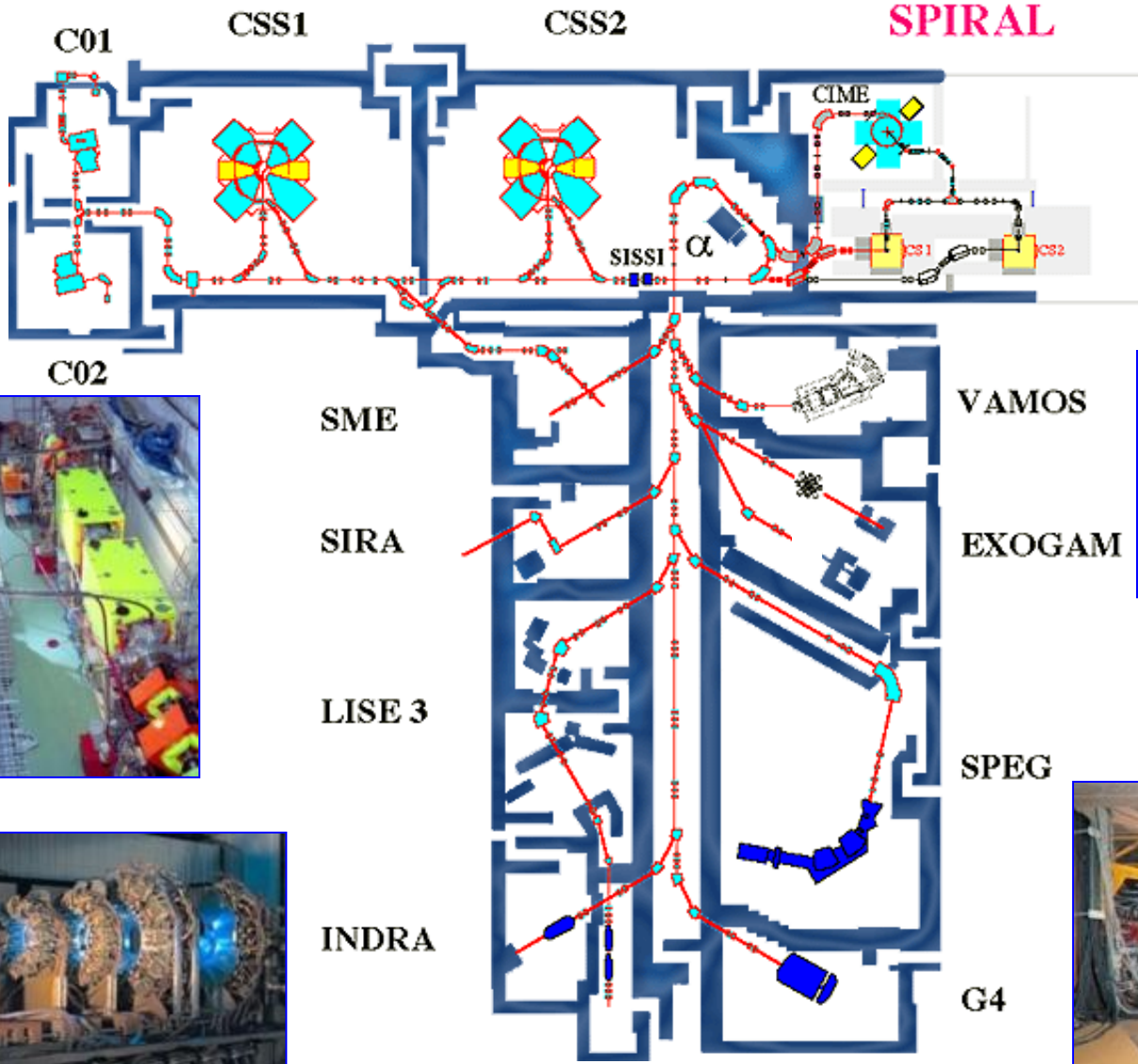


Compliance Test for all Safety equipments



# SPIRAL2 Presentation







## Phase 2

HEB : Deuteron (40 MeV, 5 mA)

Deuteron : 40 MeV, 5 mA

ACCELERATEUR

Dedicated for Deuteron

## Phase 1

C Converter and UCx Target  $\leq 10^{14}$  fissions/s

PRODUCTION

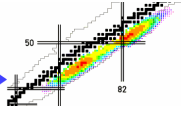
Ions ( $^{12}\text{C}$ ) : 15 MeV/A, 1 mA

CANIL EXISTANT

NFS

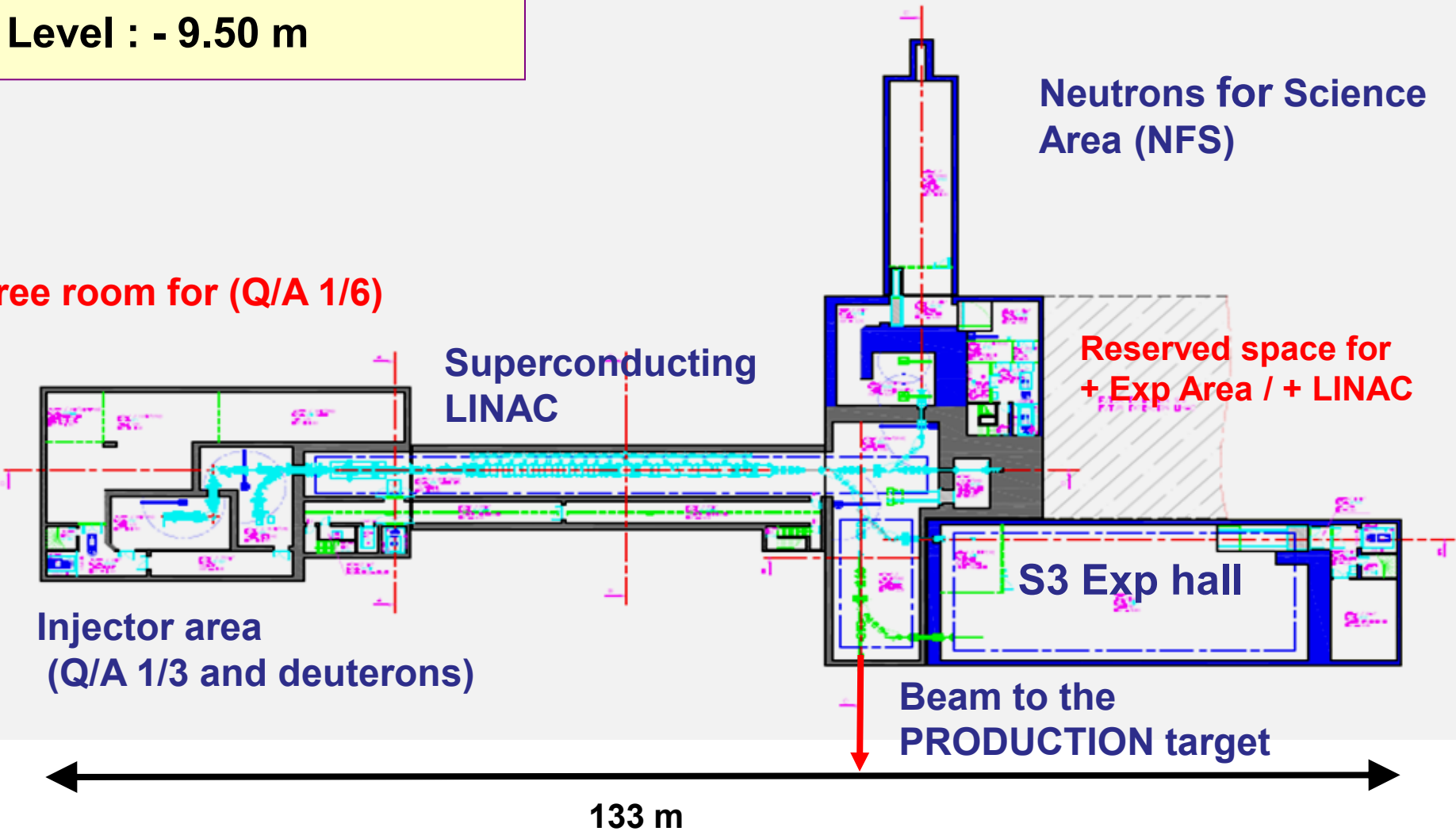
S3

DESIR

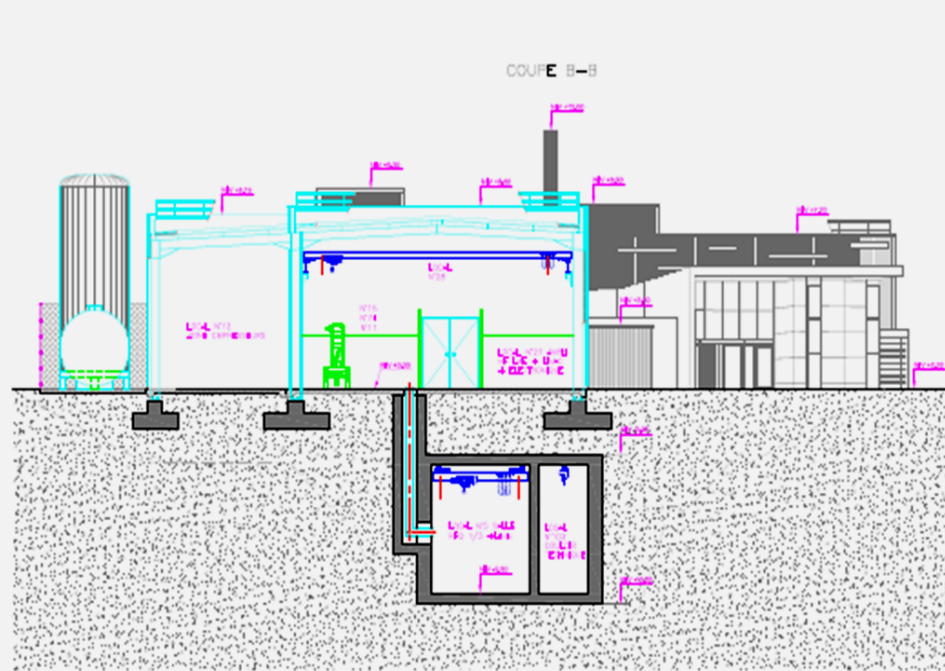


Level : - 9.50 m

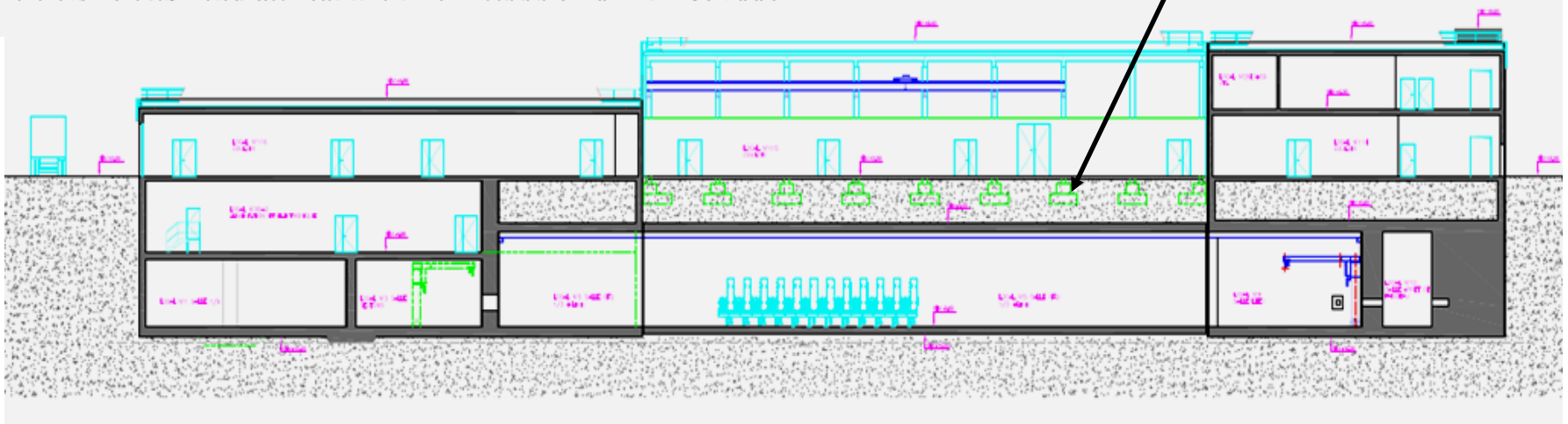
Free room for (Q/A 1/6)



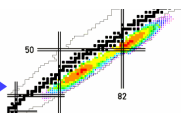
# Phase 1 : Cross section View



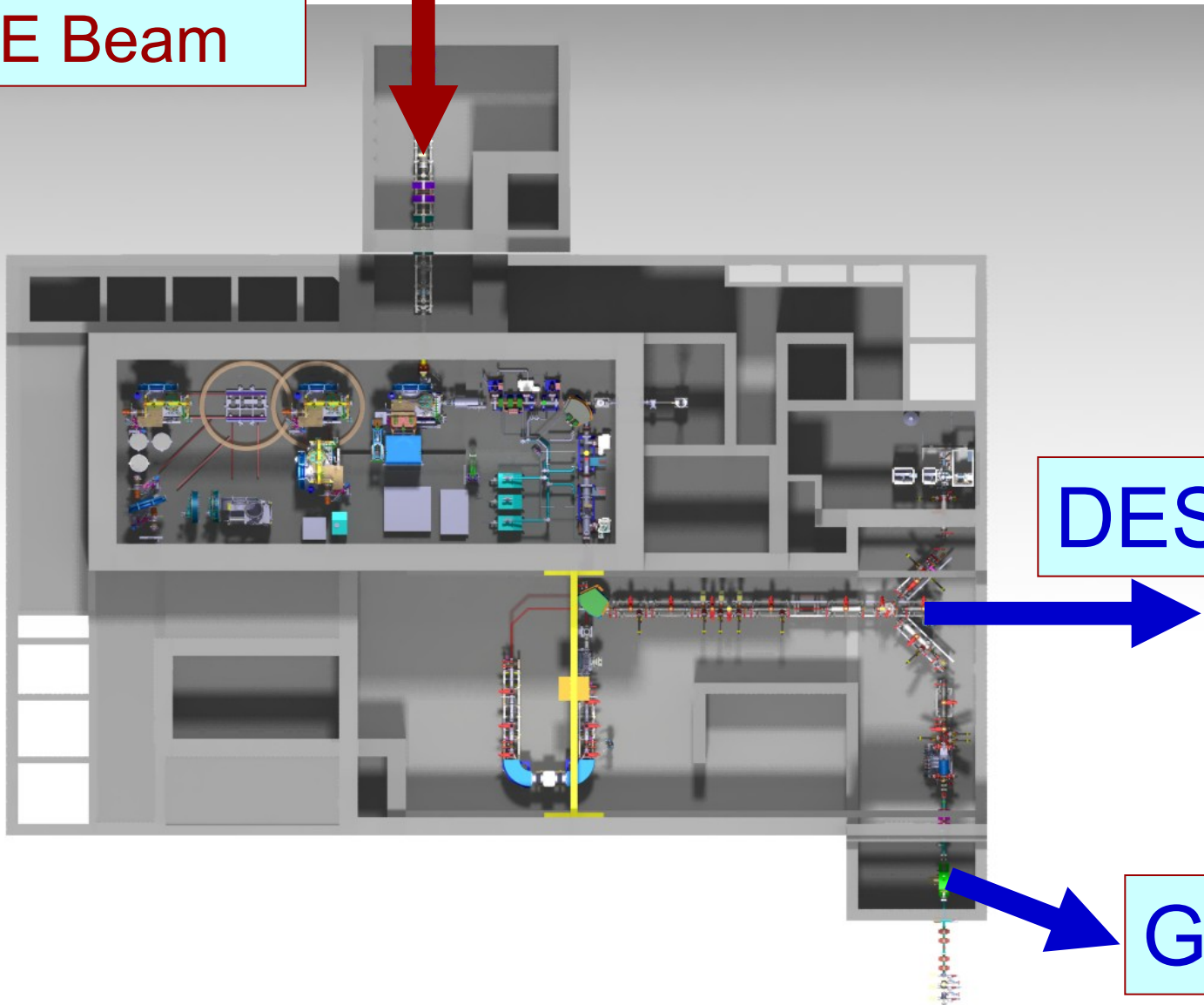
**Filling up layer (using the limestone extracted during the excavation)**



*Spiral2*



HE Beam



DESIR

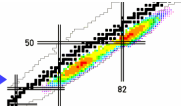
Ganil



© GANIL - Enguerrand J-M



© GANIL



# Safety Approach



- Different sources of ionizing radiation :
  - Neutrons produced by nuclear reaction between beam and :
    - Vacuum chamber in case of diffuse loose (1 W/m)
    - Target and/or beam dump
  - Prompt Gamma produced by nuclear reactions due to :
    - Beam (in target and beam dump)
    - Neutrons (in concrete)
  - Gamma from decay of radionuclides produced by :
    - Beam activation
    - Neutron activation
    - Radioactive targets
  - Decay of radioactive beam





## ■ Safety Approach

### ● Shielding (concrete + limestone)

- Radioprotection (french regulation rules)
- limestone activation (lower than 1/10 of specific activities from french regulation (same values as those of the 96/29 european directive))

### ● Safety access system

- UGA : Prevent Beam and Workers in the same room at the same time
- UGB : Radiation measurement

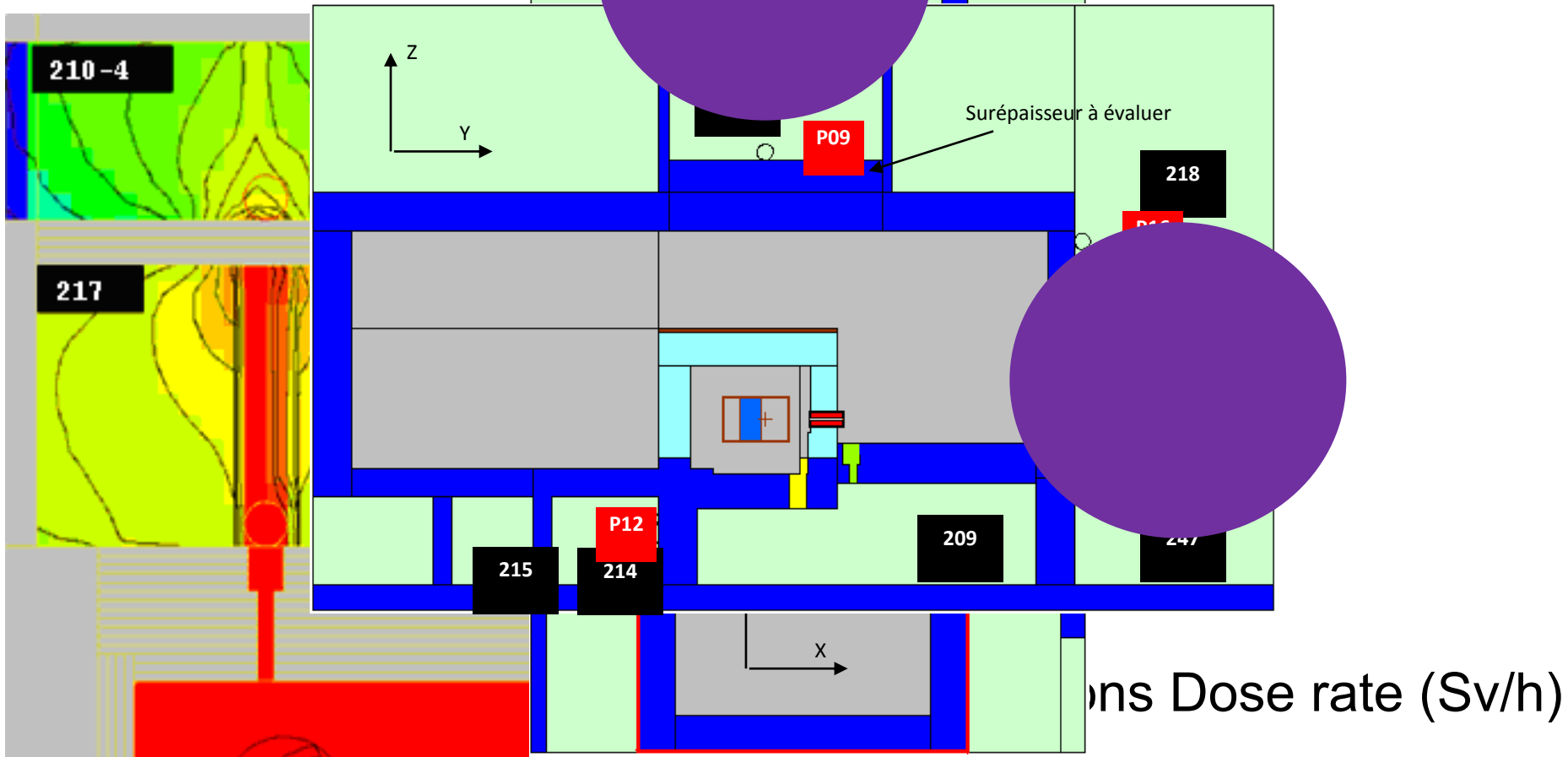
### ● ALARA approach

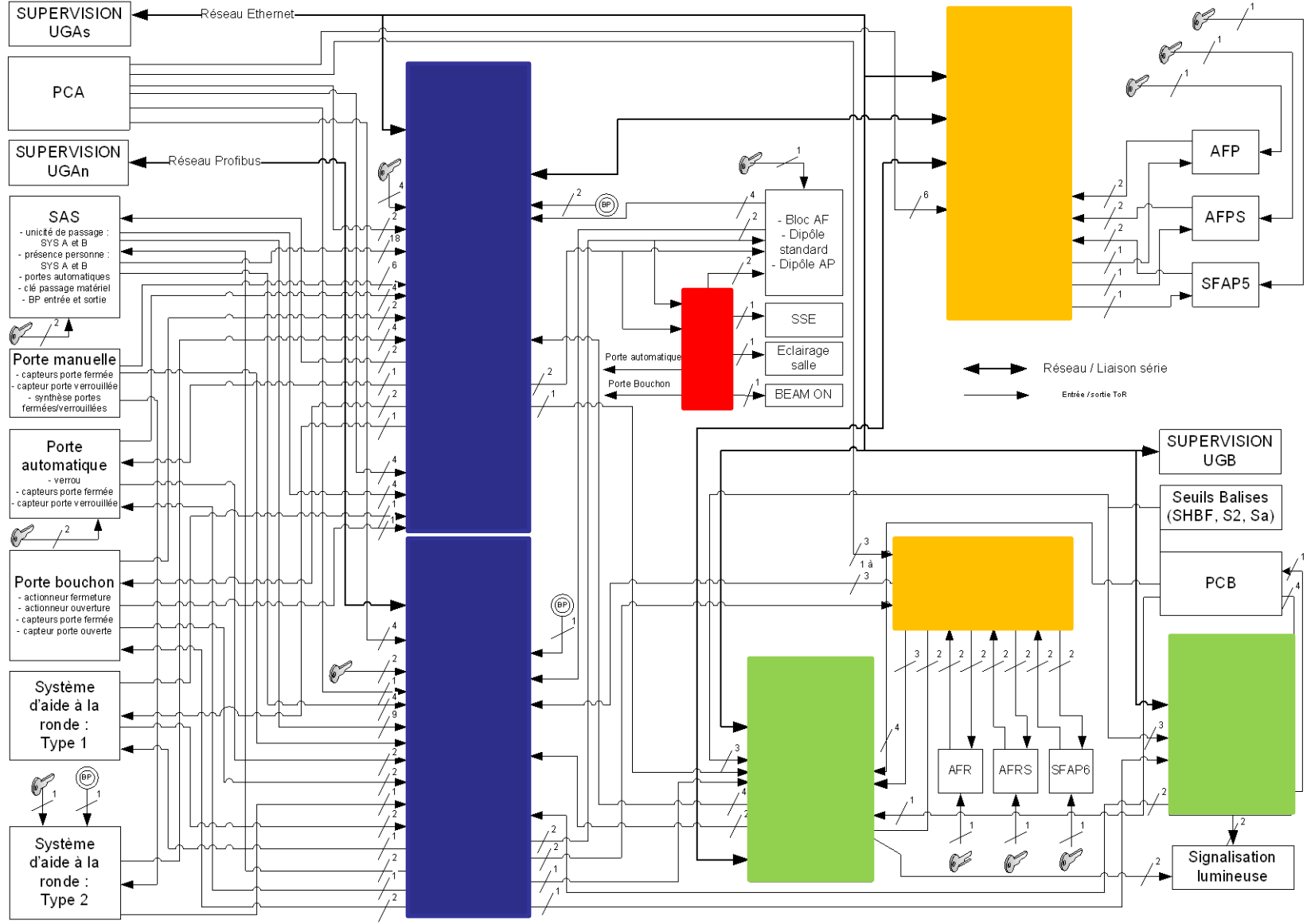
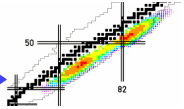
- Monitoring of diffuse beam losses (BLM, ...)
- Estimation of worker dose due to maintenance (hypothesis of process availability)

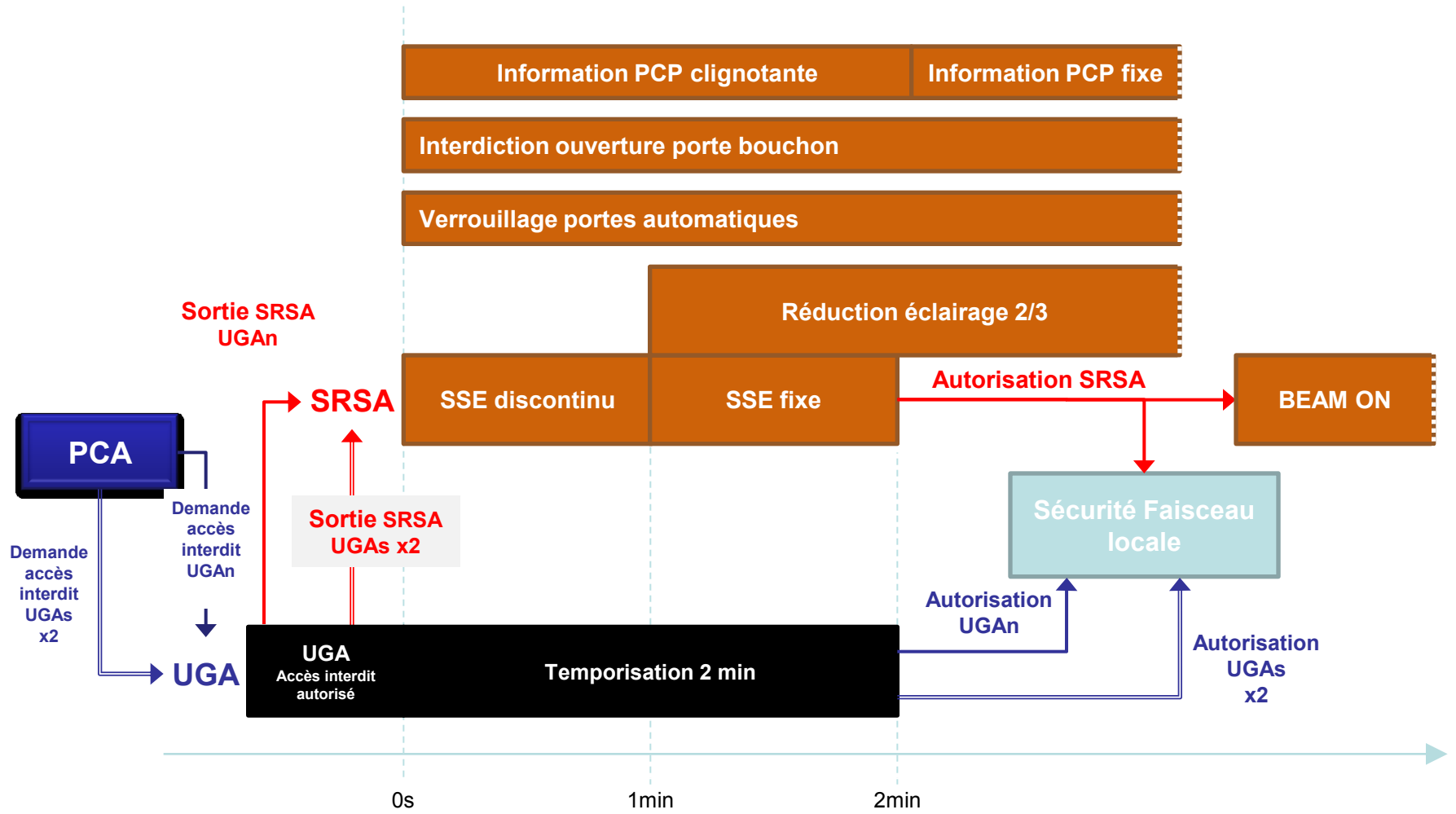
➡ Concrete, limestone and safety access system are safety classified



Calculation chain : MCNPX - MCNPX  
Transport - Transport



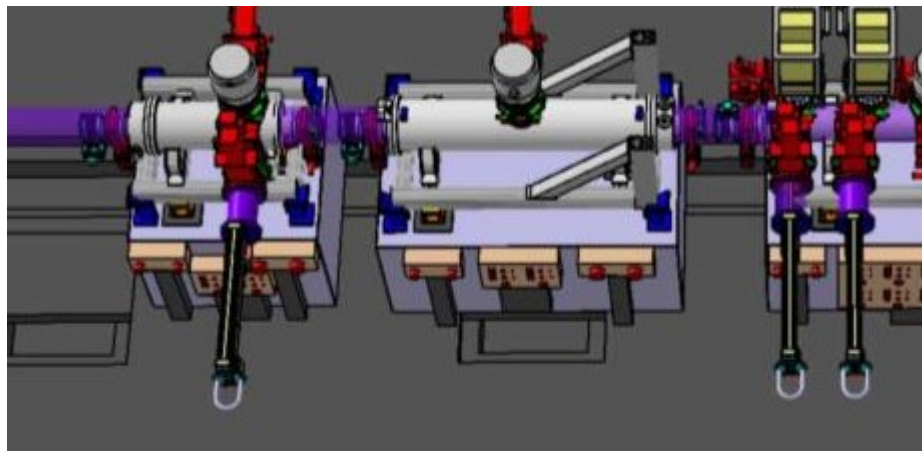






- Collect of input for all the process equipments :
  - duration of maintenance (based on GANIL experience or on first test operations)
  - dose rate in situ or in isolated place for each equipment
  - identification of different kinds of workers (mechanic, vacuum specialist ...)

➔ Verification of the individual worker's dose objective of 2 mSv per year





- Very large difference between the two phases of SPIRAL2 :
    - Phase 1 :
      - Actinides targets with a maximum activity of 1 GBq for the thin targets and 10 GBq for sealed targets
      - Human handling
      - Accidental impact for the public lower than 1  $\mu$ Sv
    - Phase 2 :
      - UCx target up to  $10^{14}$  fissions/s with radioactive inventory up to  $6 \cdot 10^{14}$  Bq
      - Maintenance in hot cell
      - Accidental impact for the public in the order of 1 mSv
- ➔ Under vacuum, the first static barrier is continuous from production (red zone) to experiment area (green zone)



## ■ First barrier :

### ● Sealed Target capsule :

- Designed to resist in case of fall

### ● Wall of the chamber and Vacuum valves :

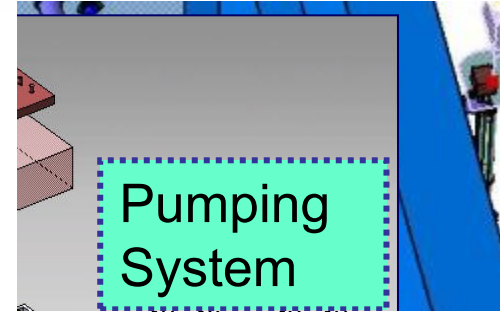
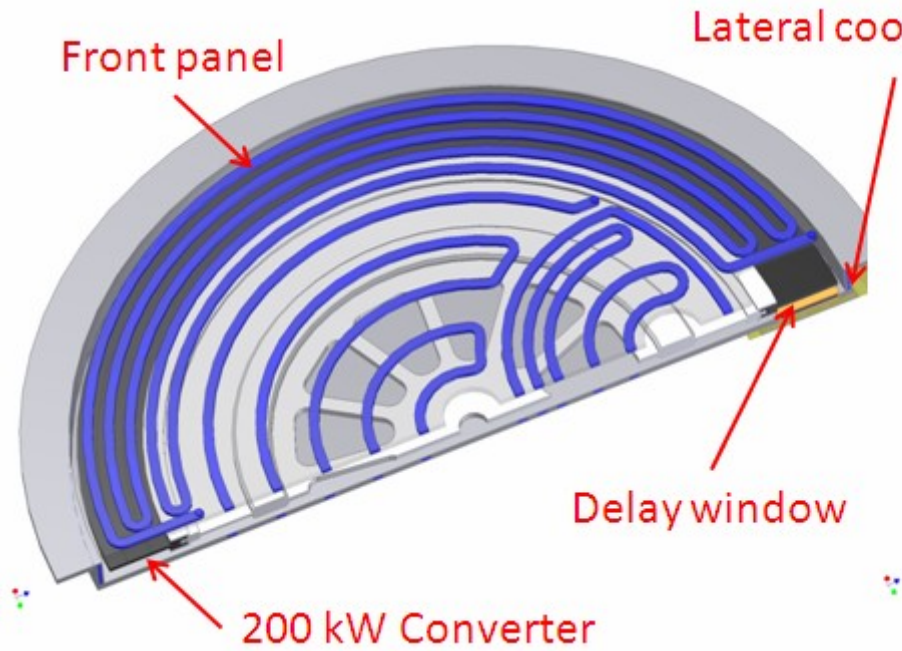
- Diaphragma (before and after the thin target)
- Survey of pressure and quick valves automatism

## ■ Second barrier :

### ● Nuclear ventilation

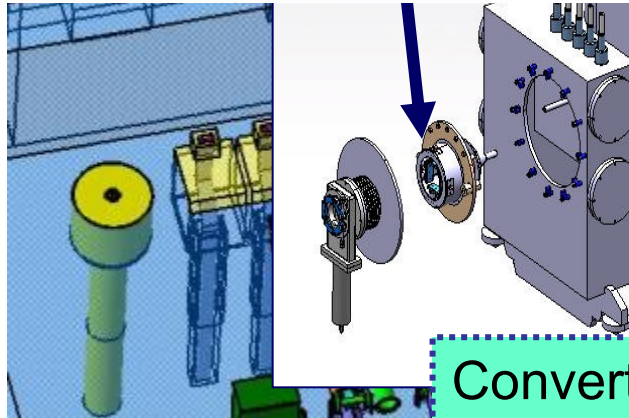
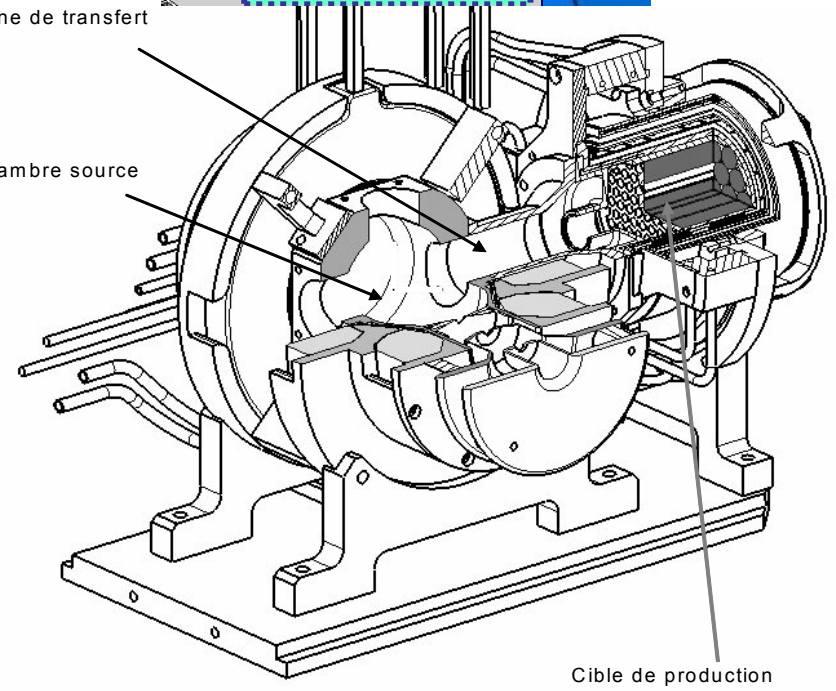
### ● Calculated to Earthquake (walls and filters)

### ● Automatic fire extinction (foam)



Zone de transfert

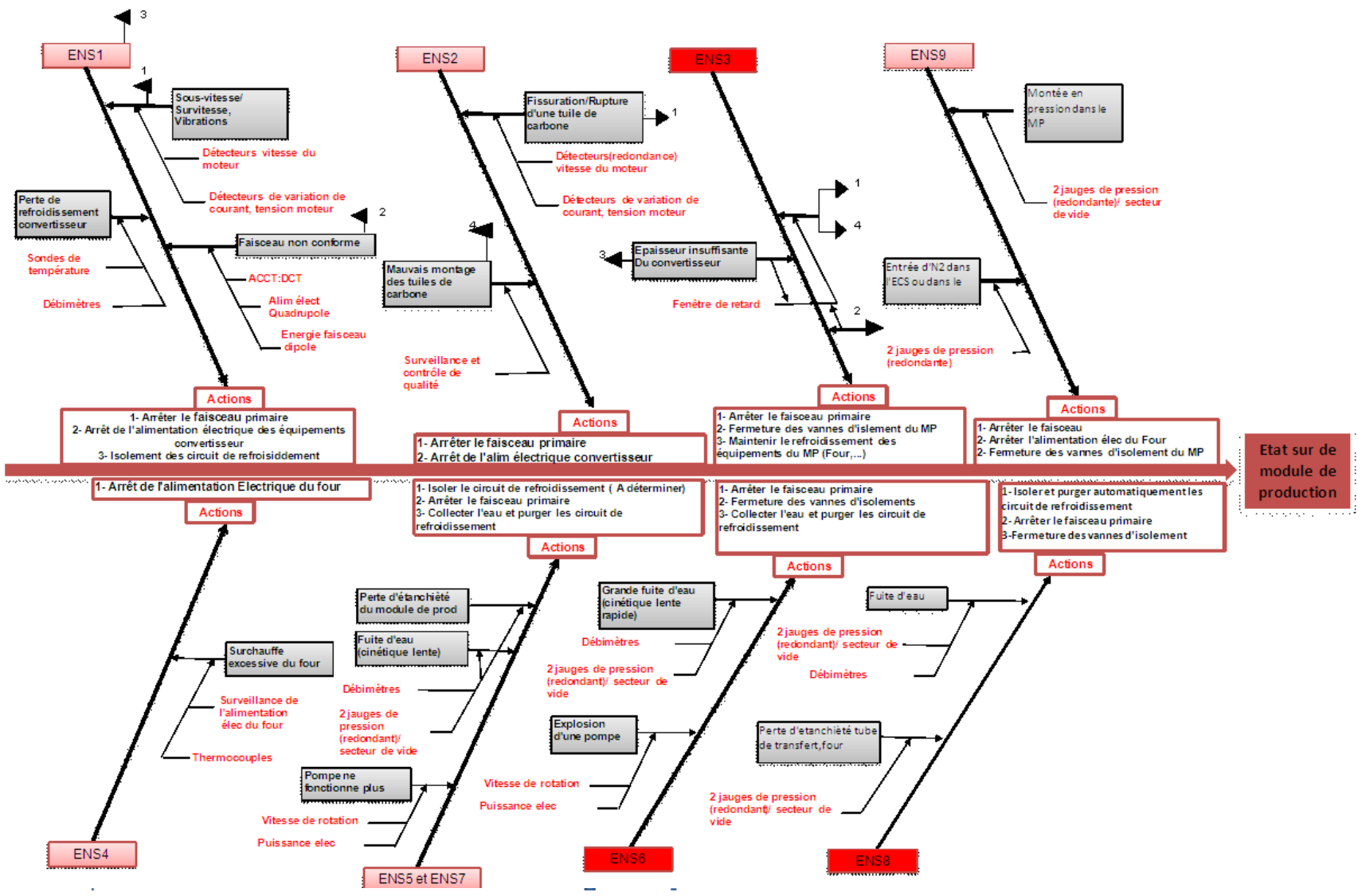
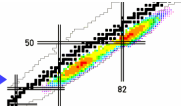
Chambre source







- The concentration of oxygen in the production cave is controlled below 1 % :
  - Walls and filters of the production cave are calculated to earthquake
  - Survey of pressure and quick valves automatism
  - Vacuum valves can be closed if an earthquake occurs
  
- Water cooling system (oven, source, converter) :
  - Double Layer between water and UCx
  - If not achievable to realize, single layer could be acceptable :
    - with specific calculation
    - the equipment need to be changed each time





## ■ External risks :

### ● Air plane crash :

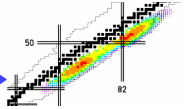
- The production building is calculated to a plane crash (LEARJET 23)

### ● Propane and Butane transport Truck :

- Production cave and gaseous storage are located under the ground level
- The parts of the building which contain significant radioactive inventories are built to resist to an overpressure of 50 mbar

### ● Earthquake :

- The production building is calculated to Safety earthquake
- Risks analysis are under progress to define requirements on the equipments



# Releases authorization



## ■ Decree of 26/11/1999 :

- As low as possible
- Uncontrolled radioactive releases : not allowed
- Collected at the origin, filtered, treated if necessary, released only by smockestack with minimal flow and suitable height

## ■ Limits for radioactive releases (on activity flow, on volumetric activity) :

- tritium
- iodine
- rare gasses ;
- others bêta et gamma emitters ;
- alpha emitters.

## ■ Limits for chemical releases (on concentration, on flow - kg/year, kg/day, kg/hour...)



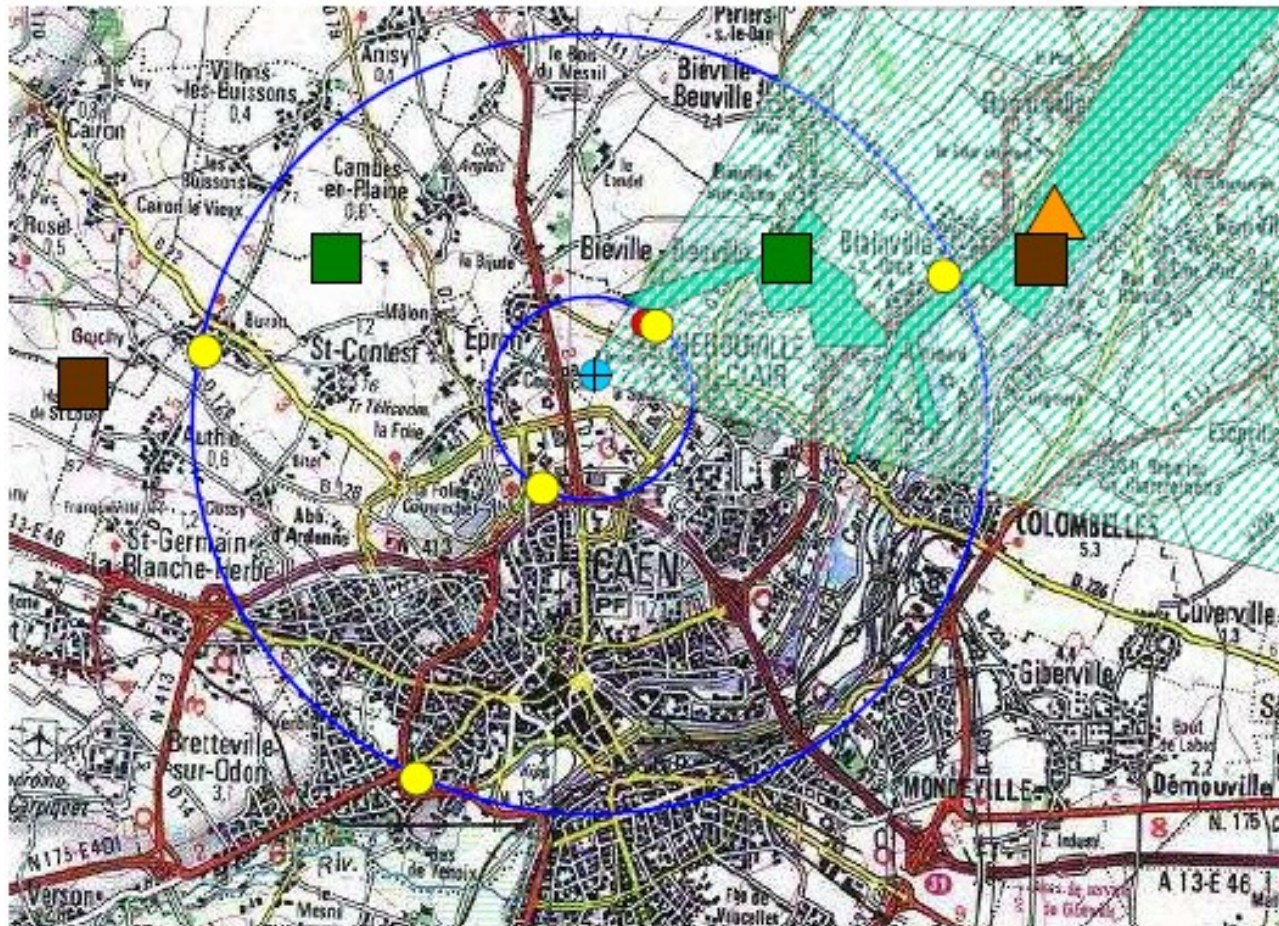
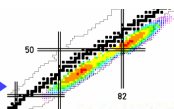
- Hypothesis on the running of the facilities, in nominal conditions :
  - 36 weeks per year for existing facility
  - 3\*3 months for SPIRAL2 phase 1 and 3\*3 months for SPIRAL2 phase 2
  - Intensity and energy of the beams in the limits of the safety report

Category	Activity for 1 year Existing GANIL (Bq)	Activity for 1 year SPIRAL2 Phase 1 (Bq)	Activity for 1 year SPIRAL2 Phase 2 (Bq)
Tritium	$2.1 \cdot 10^9$	$6,5 \cdot 10^9$	$8,6 \cdot 10^{11}$
Rare gasses	$3.35 \cdot 10^{10}$	$2,2 \cdot 10^{12}$	$1,6 \cdot 10^{12}$
Iodin	$1.94 \cdot 10^8$	$0,5 \cdot 10^6$	$6,2 \cdot 10^6$
Carbone 14	$5.6 \cdot 10^4$	$4,3 \cdot 10^7$	$1.4 \cdot 10^9$
Other $\beta$ $\gamma$ emitters	$1.2 \cdot 10^{13}$	$1.4 \cdot 10^{12}$	$3,3 \cdot 10^{12}$



- Gamma emitters : permanent registration on 4 points near the site limit, one situated under prevailing wind, Systematic measure at site limits once a month, Permanent and systematic measure outside of the site and on several points,
- On 4 points : air sampling system for the measure of the radioactive elements having a release limit,
- On the same points : dust sampling system and filter, analysed once a day for radioactivity,
- Rain sampling during a month around the site,
- Ground sampling once a year,
- Grass and milk sampling once a month,
- Main agricultural products sampling once a year.





-  GANIL
-  Population de référence
-  Périmètre 1 et 5 km
-  Zone écologique
-  Zone sous vents dominants
-  dosimètre passif
-  Productions agricoles
-  Terre
-  Herbe et lait