

Main engineering and technology approaches in design of Polyfunctional Radiochemical Complex (PRC)

Sergey Poglyad, Mikhail Kormilitsyn

Research Institute of Atomic Reactors,

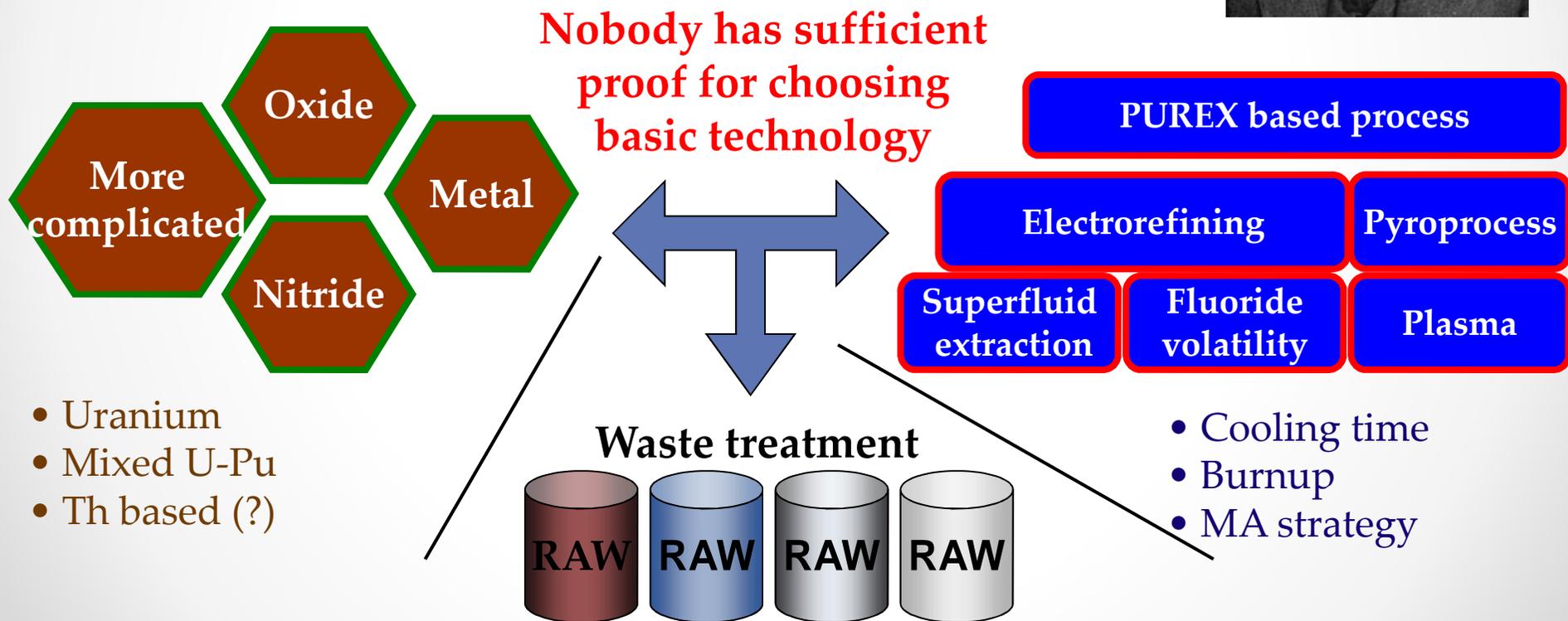
Dimitrovgrad, Russia

“Once upon a time” story

The country which first develop a breeder reactor will have a great competitive advantage in atomic energy

Enrico Fermi

«Discussion on Breeding», 26 April 1944



Demands on reprocessing in Russia

- Fast reactors “dense” spent fuel reprocessing;
- Fuel cycle closing for all actinides;
- Process losses less than 0,1%
- No more than 1 year cooling time;
- Avoid the production of pure plutonium
- Eliminate long-term storage of high-and intermediate-level waste in liquid and gaseous form;

“Ultima ratio”

Rosatom starts project for creation new experimental facility for feasibility demonstration, full-scale reprocessing experiments, industrial equipment prototype lifecycle test, safety and economic assessment of different technologies (exist or under development).

Polyfunctional Radiochemical Complex (PRC)

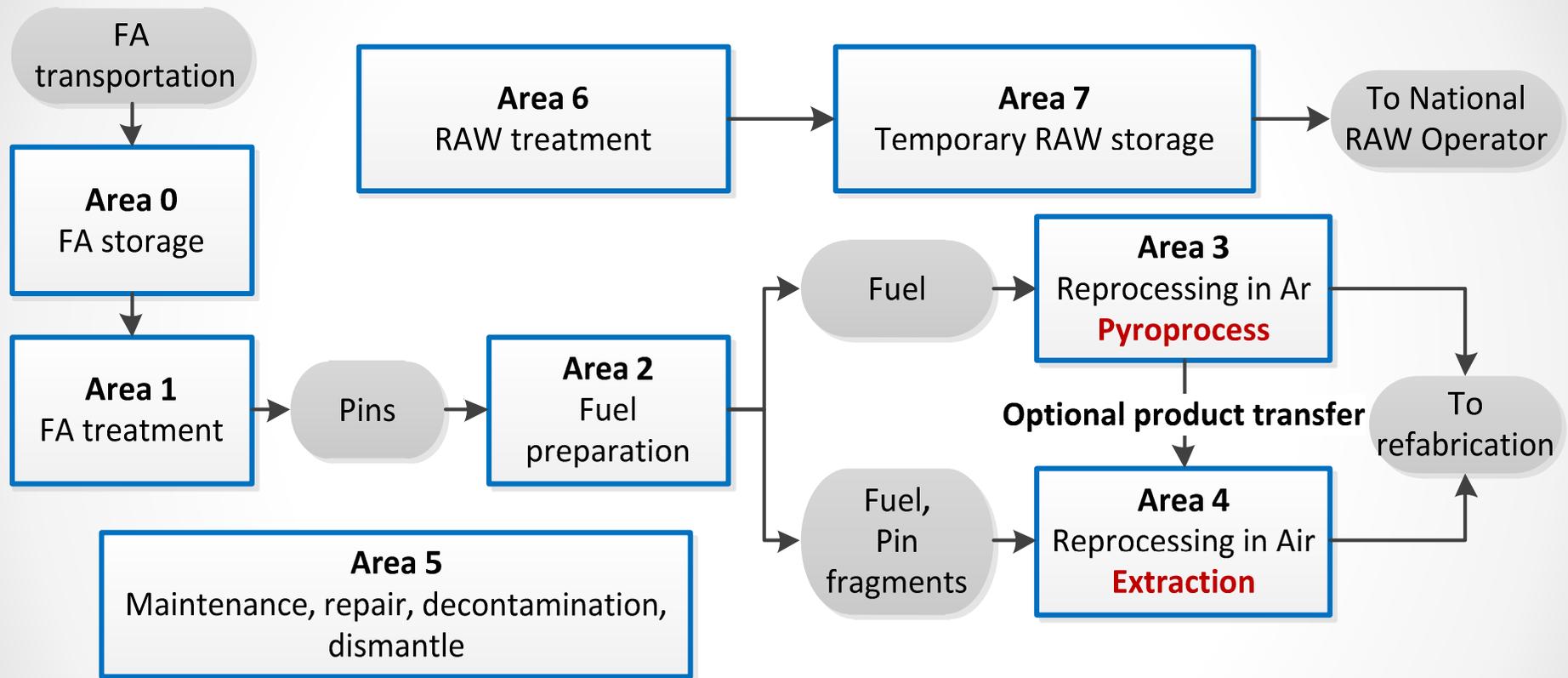
have to be designed as next generation plant prototype

PRC will be placed on RIAR site

PRC's main principles

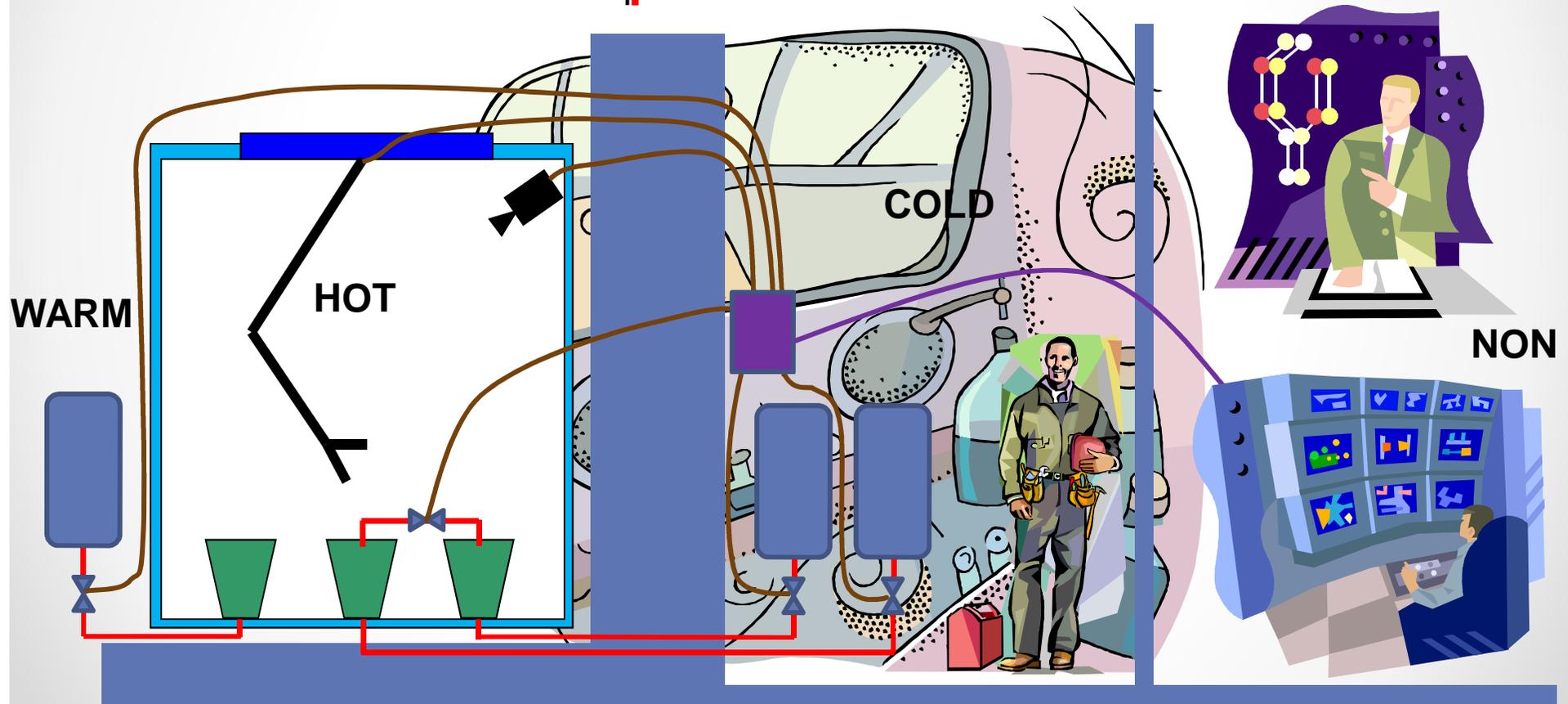
- “Hot” spent nuclear fuel
- All type of FA FR – existed or at designed will be able to get to PRC;
- Modularity of hot cells and technological equipment
- Equipment prototype will provide high throughput equal to plant line;
- Full SNF reprocessing lifecycle test:
 - *Technology;*
 - *Equipment maintainability and repair;*
 - *Final disposal of technological apparatus and safety equipment;*
 - *Treatment for all kind of RAW;*
- Lack of liquid HLW
- Decrease of secondary RAW amount
- Full-scale automation;
- Wide implementation of the robotics technologies.

PRC principal scheme

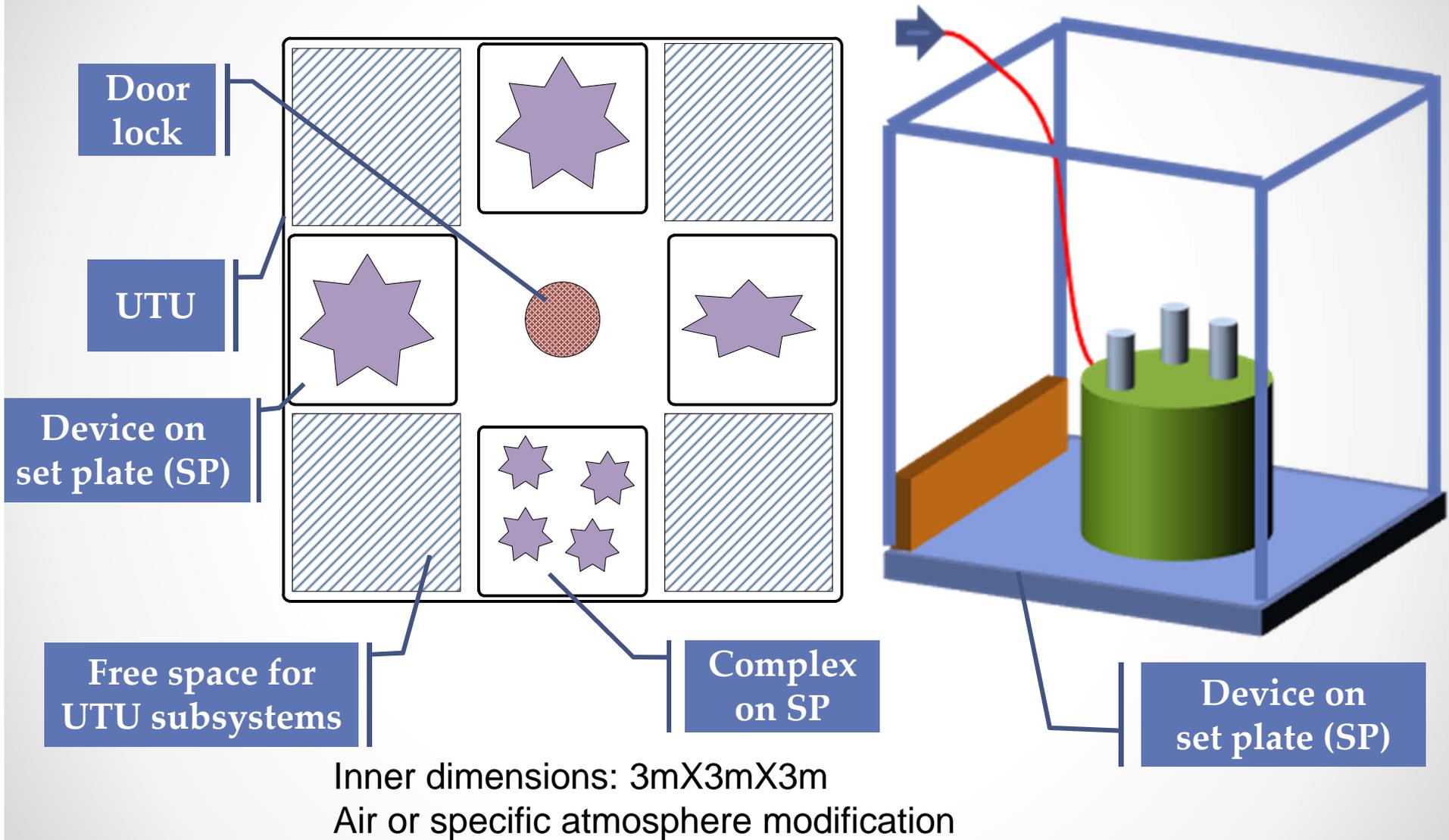


Decision gates

- **Passive shielded glass** or **Video systems**
- **Master-slave manipulators** or **Telerobotics**

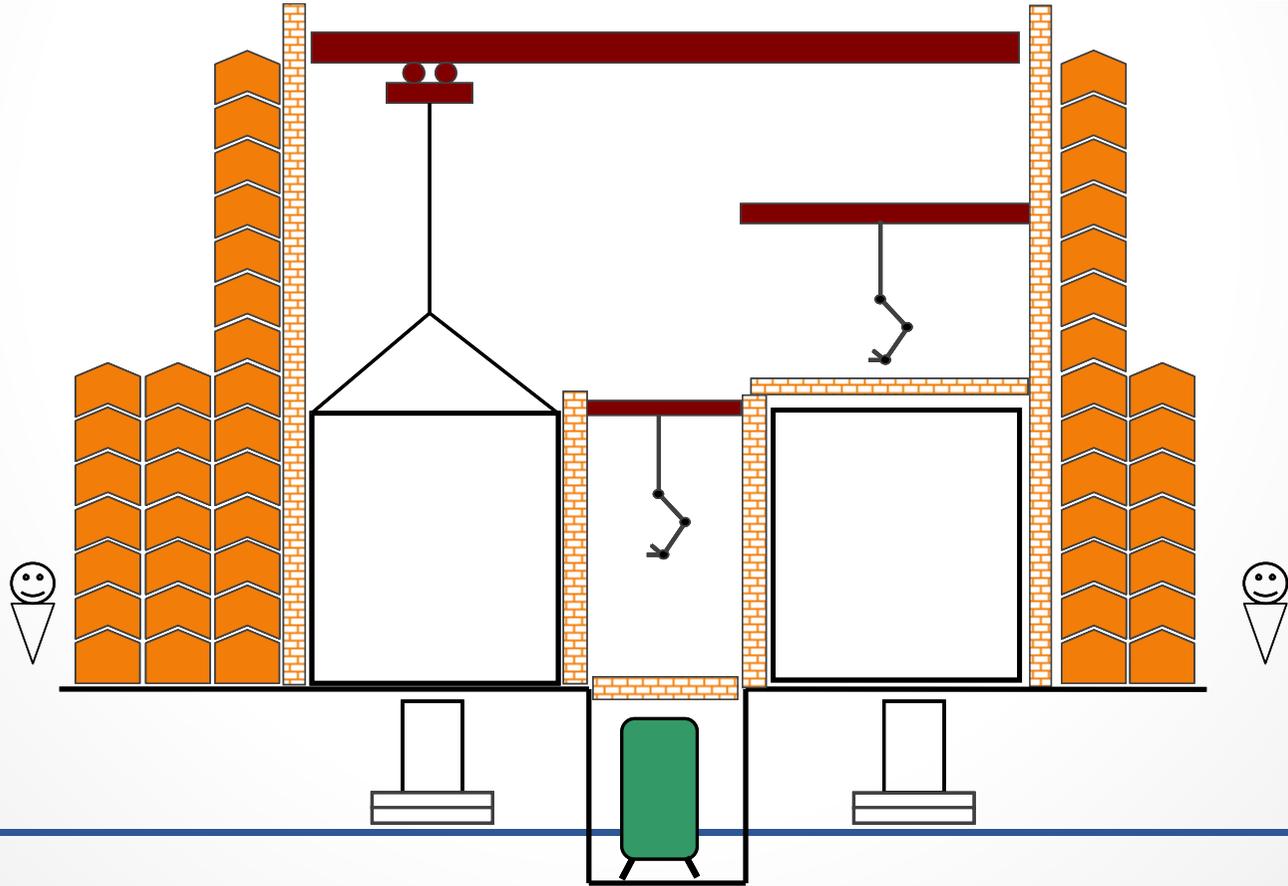
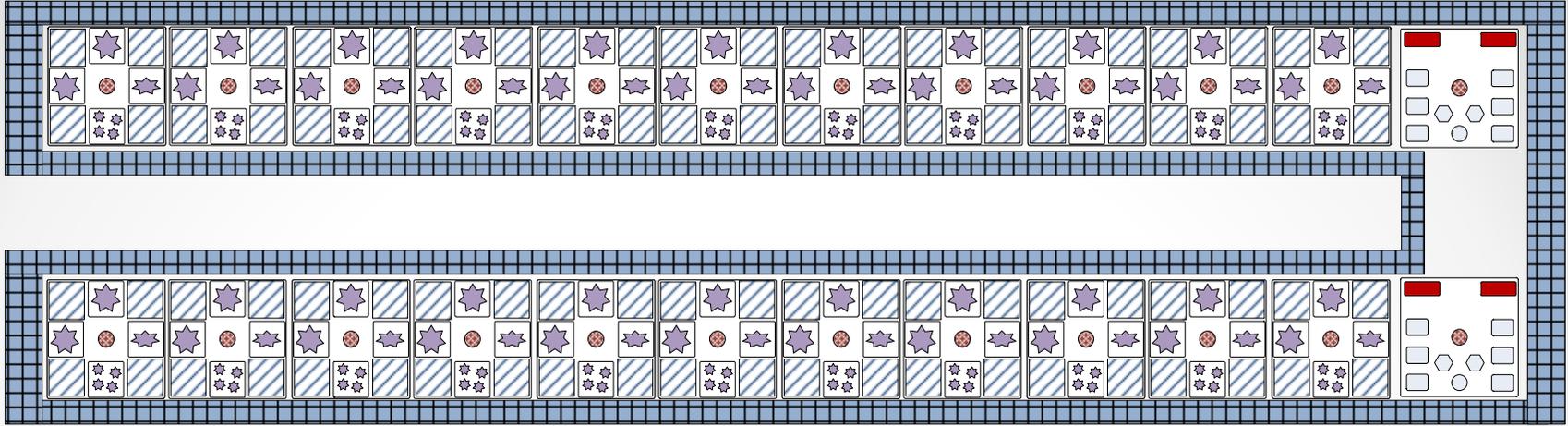


Unify Technological Unit (UTU)

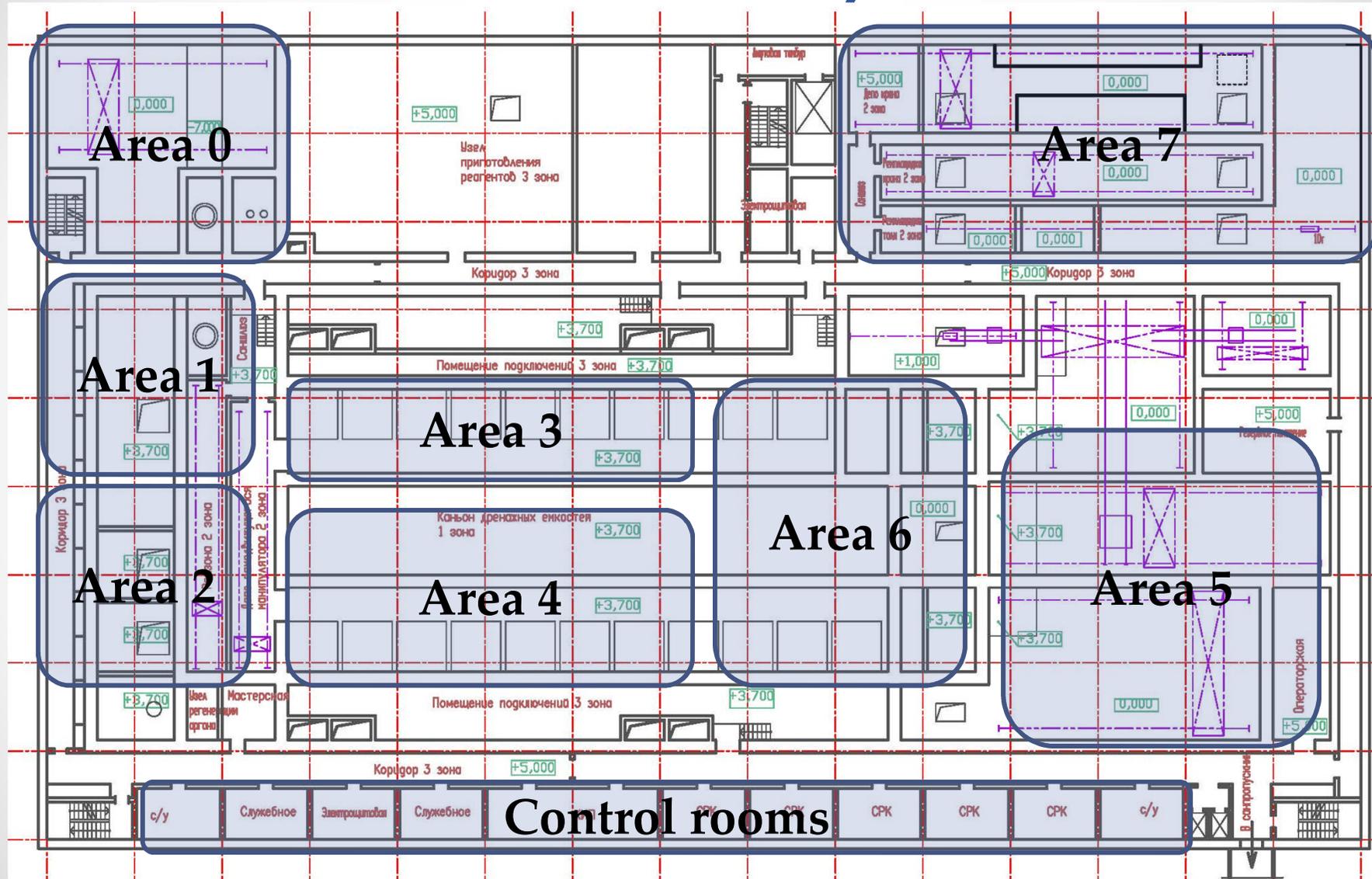


Decision gates

- **Video system**
- **Telerobotics**
- Worker in UTU or **remote maintenance & repair**
- On-site repair or **dedicated hot cell**
- On-site or **centralized decontamination**



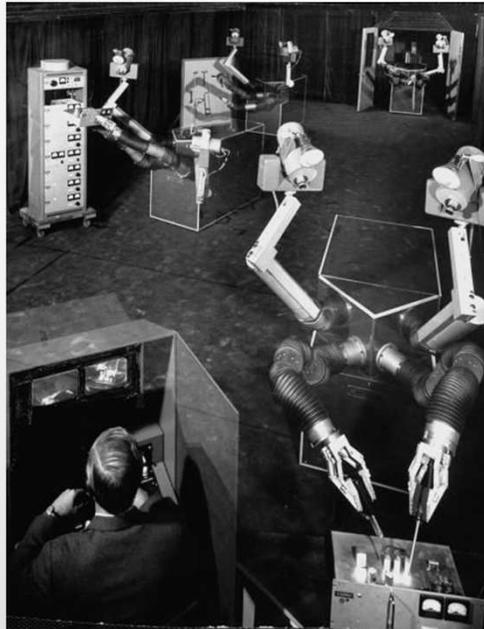
PRC floor plan



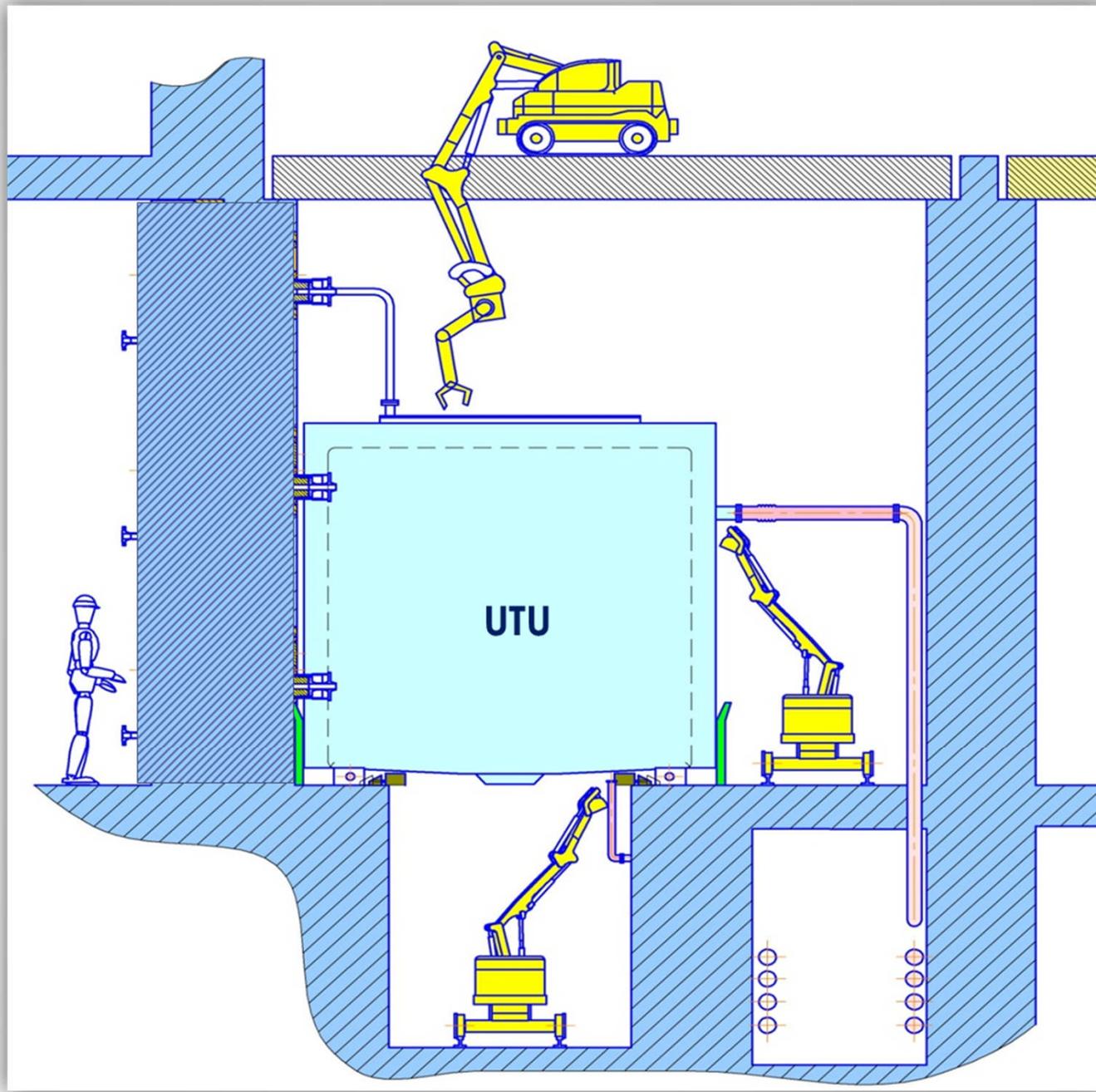
Decision gates

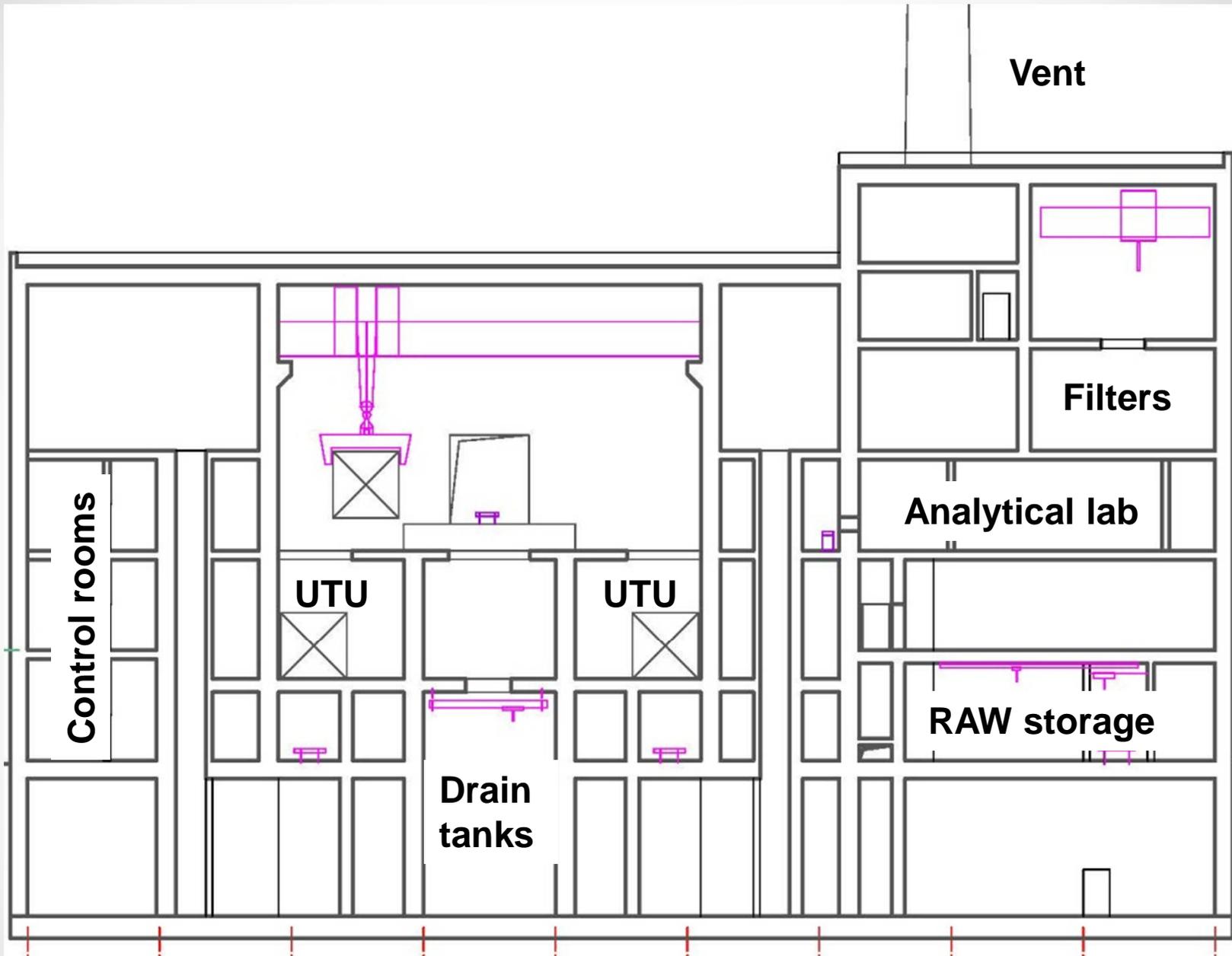
- Video system
- Telerobotics
- Remote maintenance & repair
- Dedicated hot cell for repair
- Centralized decontamination
- Will there workers in hot cell or **robots**
- **Will it be repair area at all?**

Hughes Mobot Gets Frisky With the Ladies in 1964



<http://cyberneticzoo.com/?tag=mobot>





Decisions list

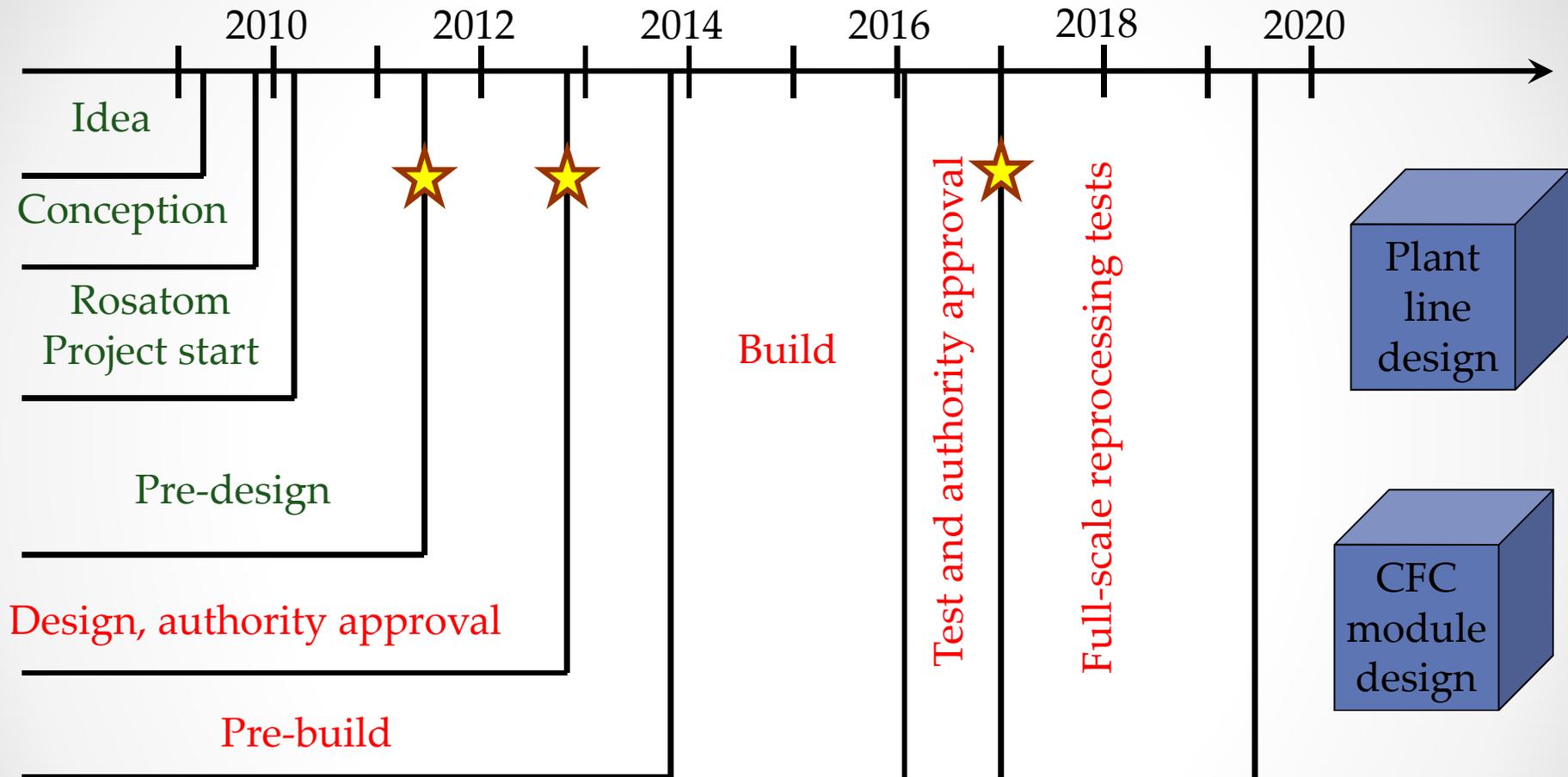
- **Video system**
- **Telerobotics**
- **Remote maintenance & repair**
- **Dedicated hot cell for repair**
- **Centralized decontamination**
- **Just robots in hot cells**
- **Small repair area only for robots**

- **Positive pressure in Ar UTU and hot cell**
- **Dry decontamination if needed**
- **Close loop ventilation with chillers**
- **On-site target gas cleaning**

Not only chemistry

- Equipment design
- Remote maintenance and repair
- Analytical support
- Online control
- “Space” technologies
- Automation
- Algorithms
- Safety control system
- Waste management, including secondary
-

Step by step



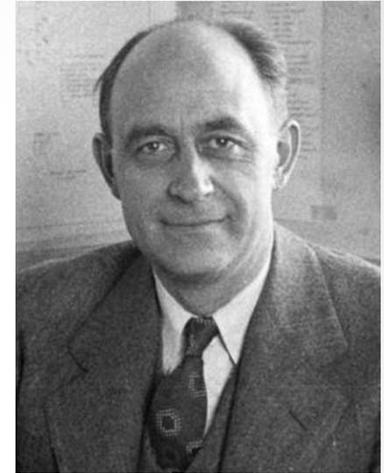
CFC research center

- **Real FR SNF**
 - Up to 600 kg SNF per year
 - Any FA existing and planned
- **Full-scale demonstration**
 - Up to 12 ton per year throughput
 - One FA at once
- **It is possible to reproduce any technology or combination**
 - Unify, modular hot cell - UTU
 - Shielding if needed
 - Unify set plate
- **Proven assessment for decisions**
 - SNF reprocessing lifecycle
 - Industrial prototype scale
 - Automation and informatization
 - Decreasing "human factor"
- **BONUS – FR and refabrication facility interface**
 - Innovative and experimental fuel lab in 20 m
 - Multipurpose fast research reactors founded in 100 m

The country which first develop a breeder reactor will have a great competitive advantage in atomic energy

Enrico Fermi

«Discussion on Breeding», 26 April 1944



Thank for your attention
