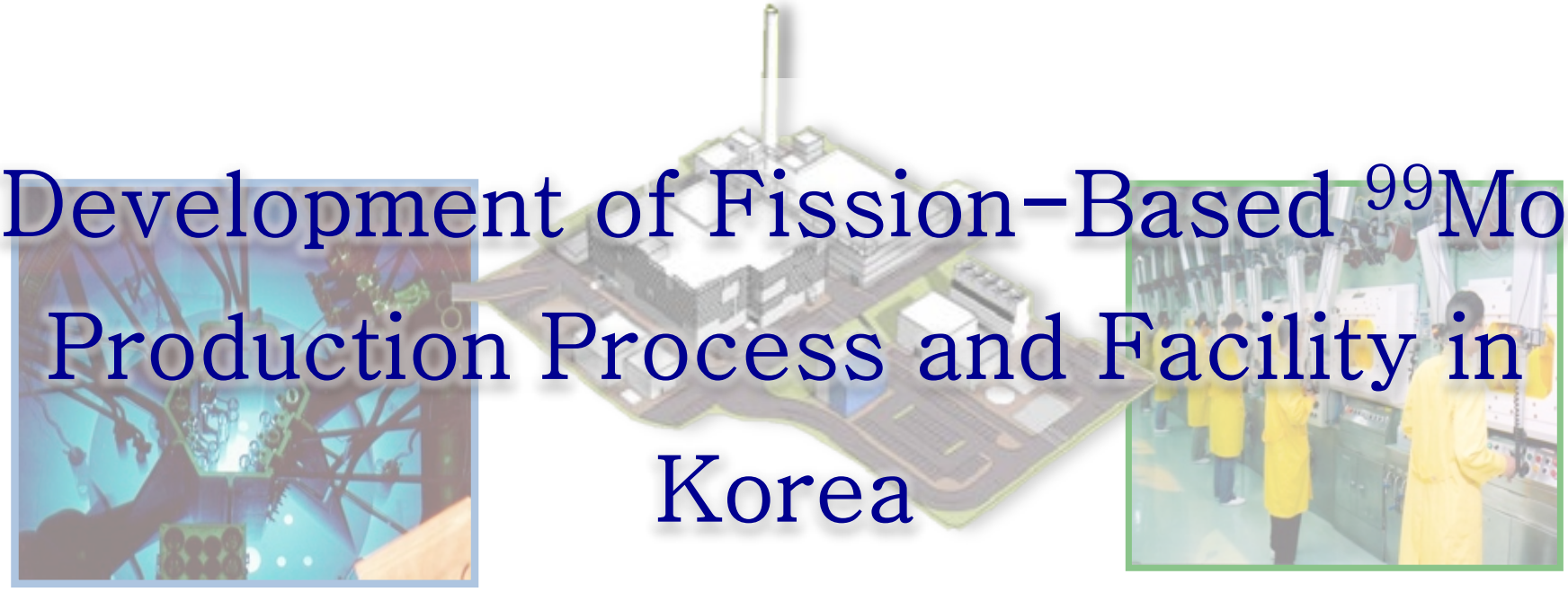


Development of Fission-Based ^{99}Mo Production Process and Facility in Korea

Seung-Kon Lee
Division of Radioisotope Research
Deptatment of HANARO Utilization Research
KAERI

Contents

1. KJRR Project: Update
2. Fission ^{99}Mo Production Facility Development
3. Fission ^{99}Mo Production Process Development
4. Summary

Kijang New Research Reactor Project

- **Insecurity of Medical Radioisotopes (Mo-99) Supply in Korea** ➔ Major issue (Now 100% imported)
  - Self-sufficiency of RI demand became an issue for health care
  - Require to secure the medical welfare.

New Research Reactor Project in Korea

- Launched in 2012.
- Location: Kijang, Busan.
- Phase: PSAR review for C.L.
- Aiming for 1st Criticality: March of **2019**.
- Fission Mo Production Capacity: 2,000Ci/w
- NTD, Ir-192, I-125, Lu-177 etc.

KJRR Location

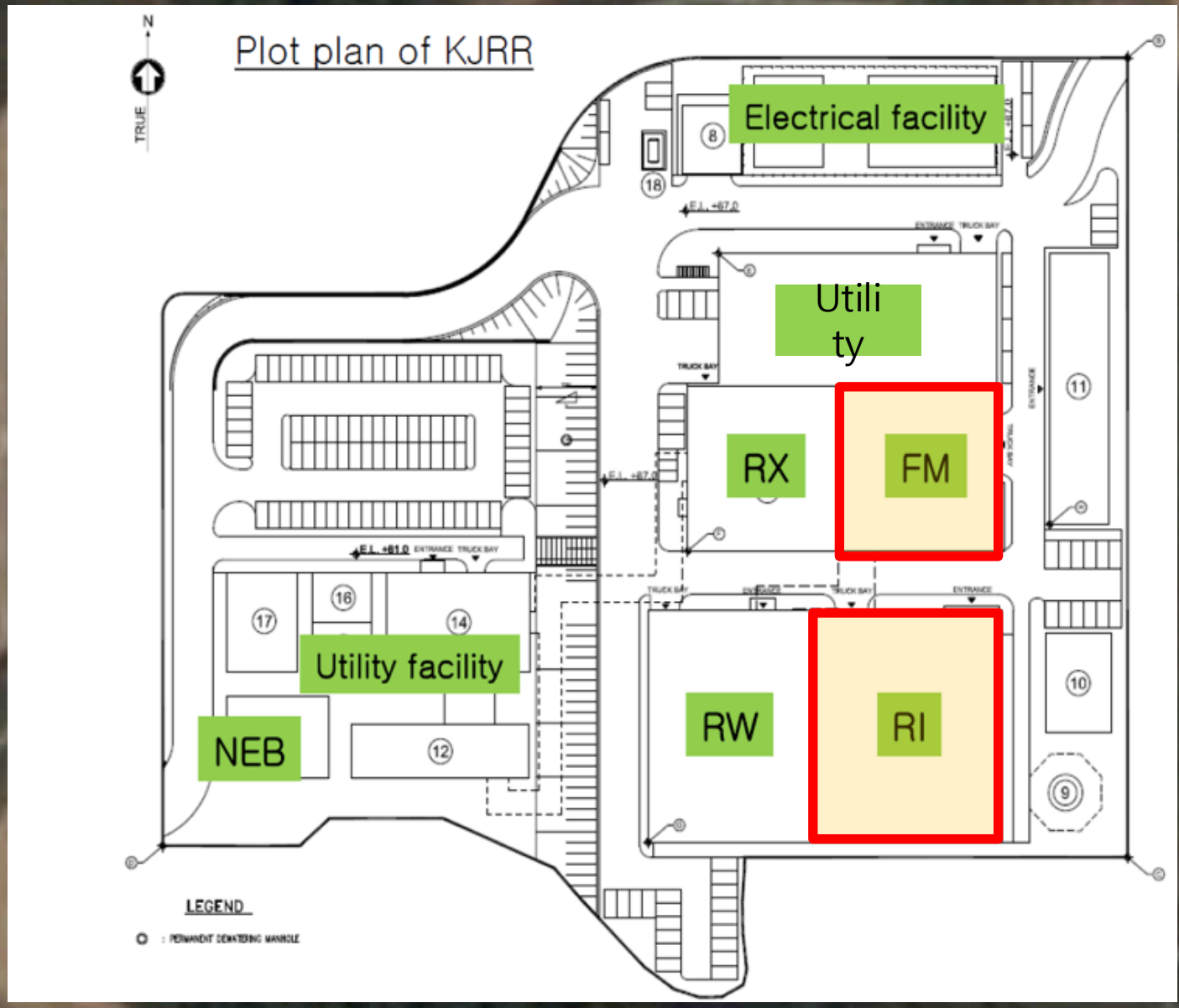
City of Busan
(2nd, 3.5 M)

City of Ulsan
(7th, 1.2 M)

Furthest from North Korea

KJRR Location

Plot Plan: KJRR



BIRD'S EYE VIEW

RIPF (Radioisotope Production Facility)

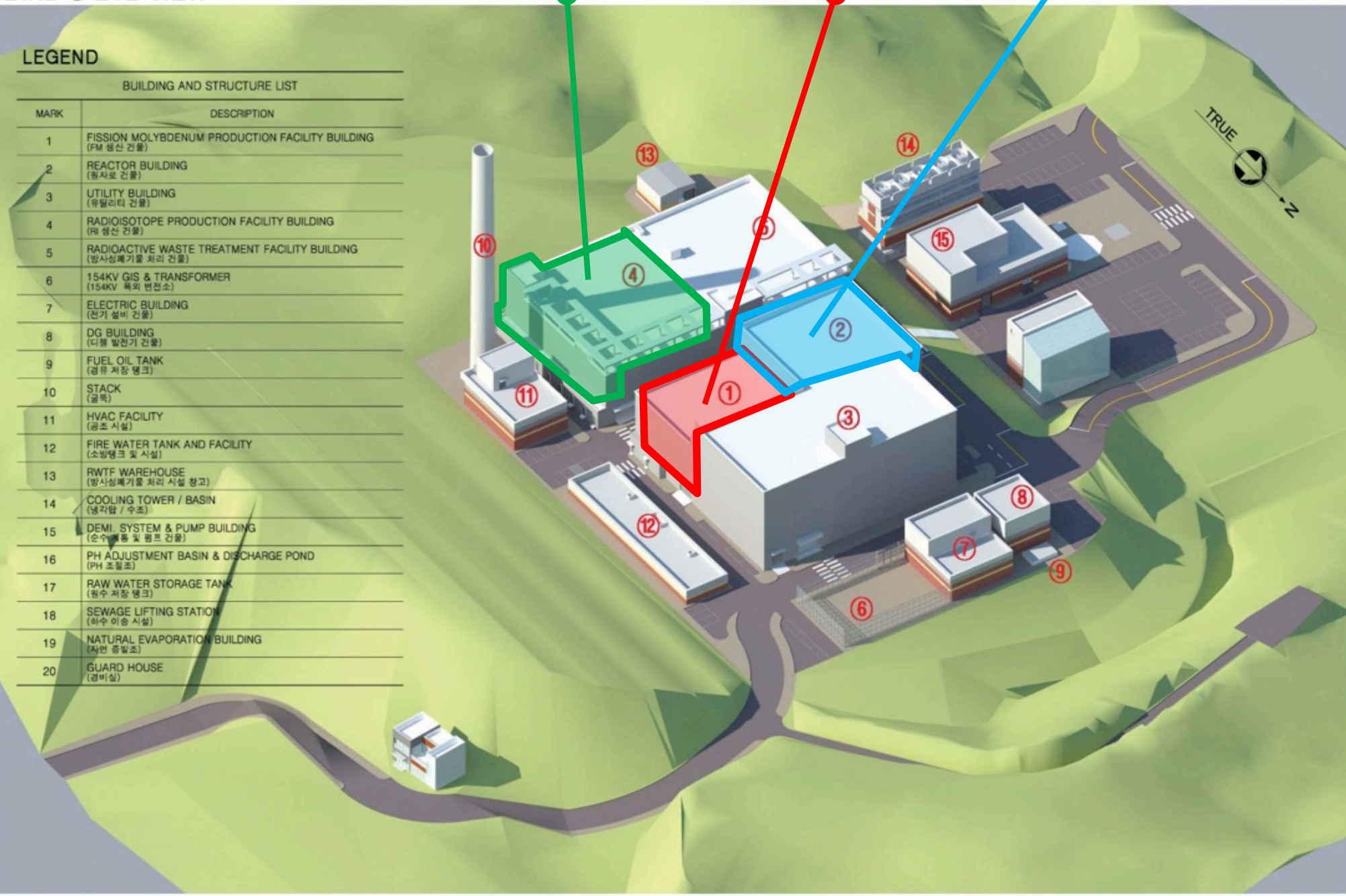
FMPF (Fission Molybdenum Production Facility)

Reactor

LEGEND

BUILDING AND STRUCTURE LIST

MARK	DESCRIPTION
1	FISSION MOLYBDENUM PRODUCTION FACILITY BUILDING (FM 생산 건물)
2	REACTOR BUILDING (원자로 건물)
3	UTILITY BUILDING (유틸리티 건물)
4	RADIOISOTOPE PRODUCTION FACILITY BUILDING (RI 생산 건물)
5	RADIOACTIVE WASTE TREATMENT FACILITY BUILDING (방사성폐기물 처리 건물)
6	154KV GIS & TRANSFORMER (154KV 옥외 변전소)
7	ELECTRIC BUILDING (전기 설비 건물)
8	DG BUILDING (디젤 발전기 건물)
9	FUEL OIL TANK (경유 저장 탱크)
10	STACK (굴뚝)
11	HVAC FACILITY (공조 시설)
12	FIRE WATER TANK AND FACILITY (소방탱크 및 시설)
13	RWTF WAREHOUSE (방사성폐기물 처리 시설 창고)
14	COOLING TOWER / BASIN (냉각탑 / 수조)
15	DEMI. SYSTEM & PUMP BUILDING (순수설비동 및 펌프 건물)
16	PH ADJUSTMENT BASIN & DISCHARGE POND (PH 조절조)
17	RAW WATER STORAGE TANK (원수 저장 탱크)
18	SEWAGE LIFTING STATION (하수 이송 시설)
19	NATURAL EVAPORATION BUILDING (자연 증발조)
20	GUARD HOUSE (경비실)



DAEWOO E&C KEPCO E&C

KAERI Korea Atomic Energy Research Institute

Schedule

HANARO will be back in Nov.

Research Fission Mo-99 Process

Development Proto-type Processing Units

Test Production System

Construction Full-scale, Production Equipment

Test Production at HANARO

Reactor Criticality

Establishment Mo-99 Production line

Establishment QA/QC Protocols

Launching (2012.03.01)

Development U-Powder & Target Fabrication

Fabrication Mini & Real Size Targets

Establishment Target Production Protocols

Target Irradiation Test at HANARO

Establishment Target Production line

FM Production

March

2012 2013 2014 2015 2016 2017 2018 2019

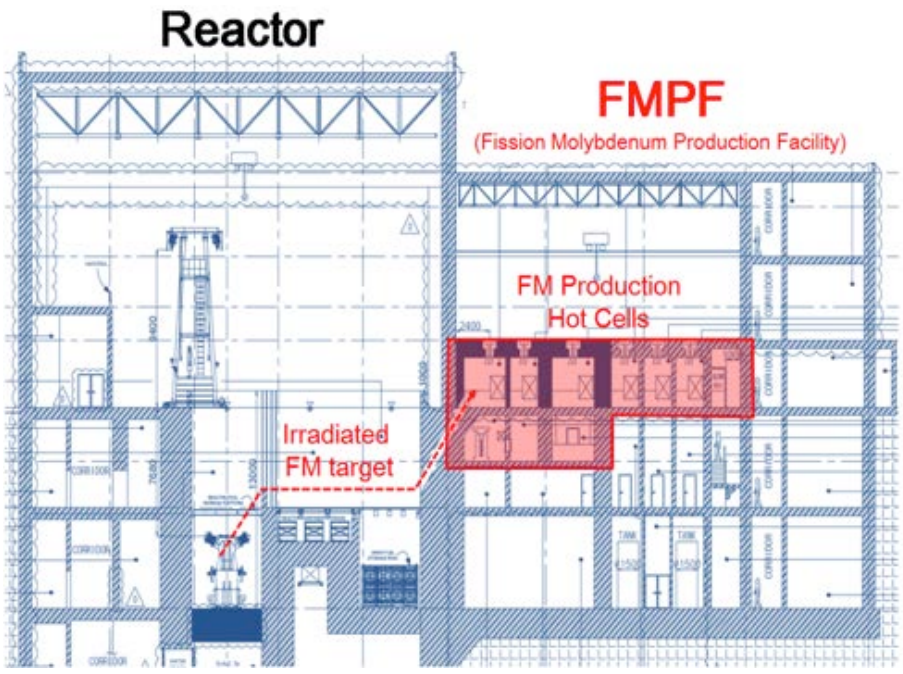
PSAR (Dec. 2016)

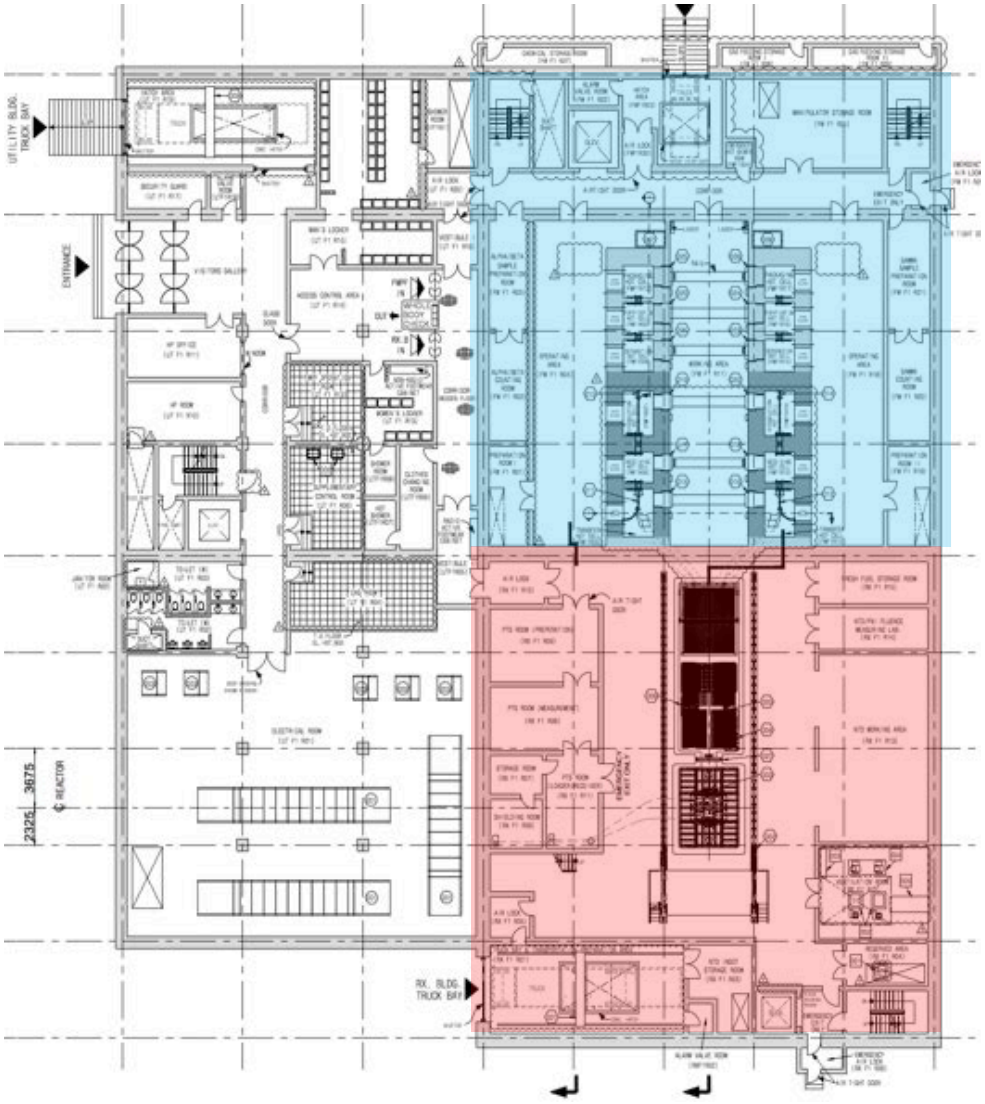
Construction Start (Jan. 2017)

Reactor assembly

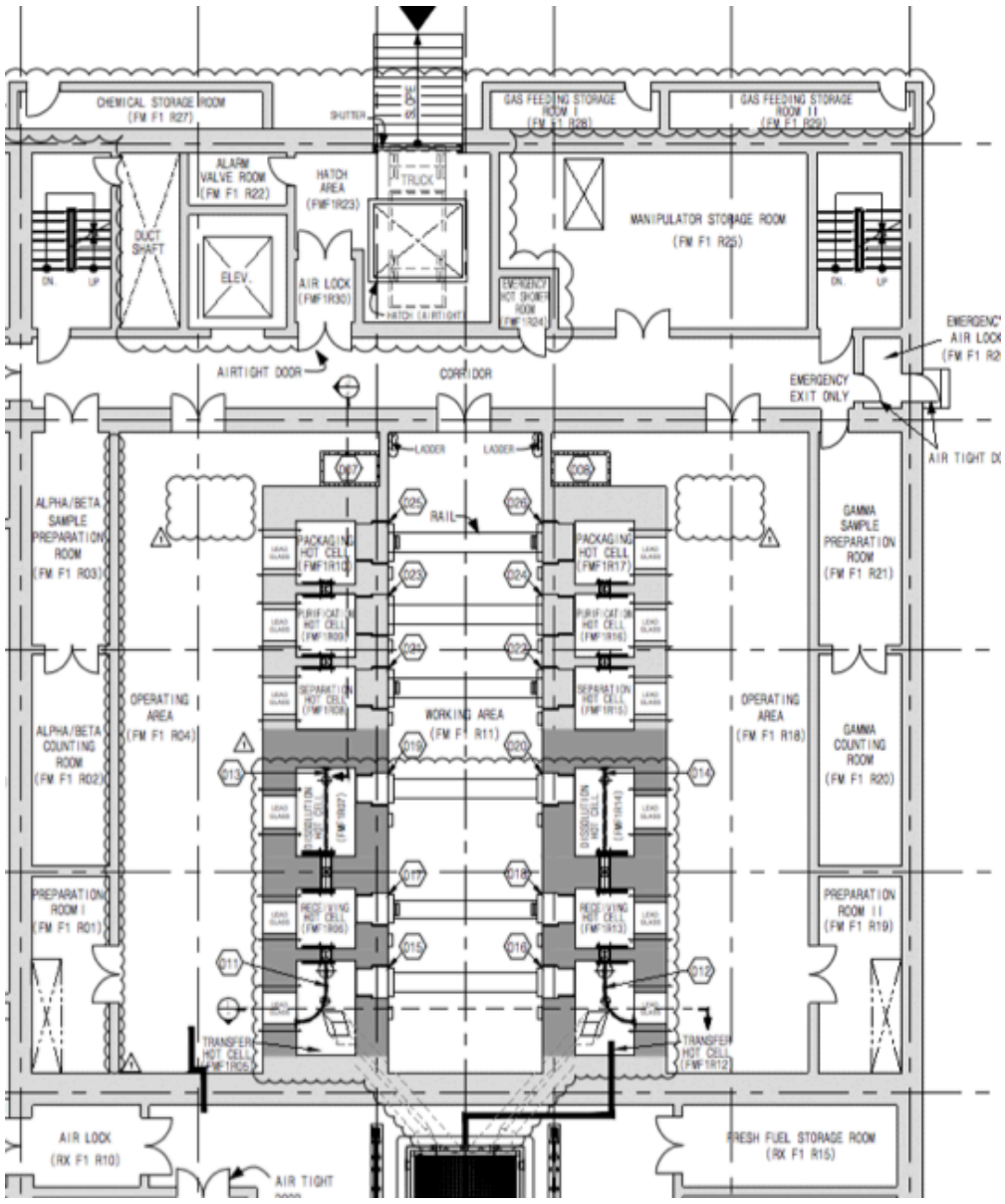
Contents

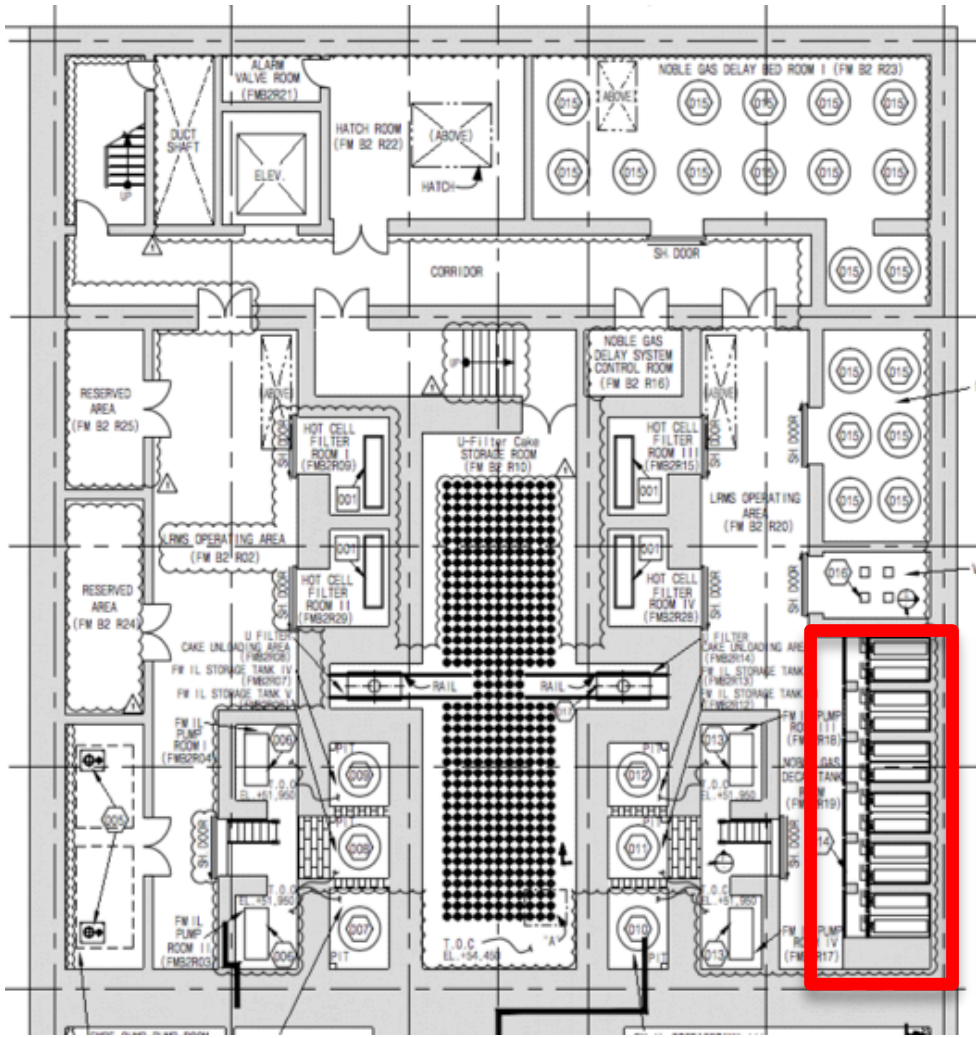
Arrangement of Reactor and FMPF



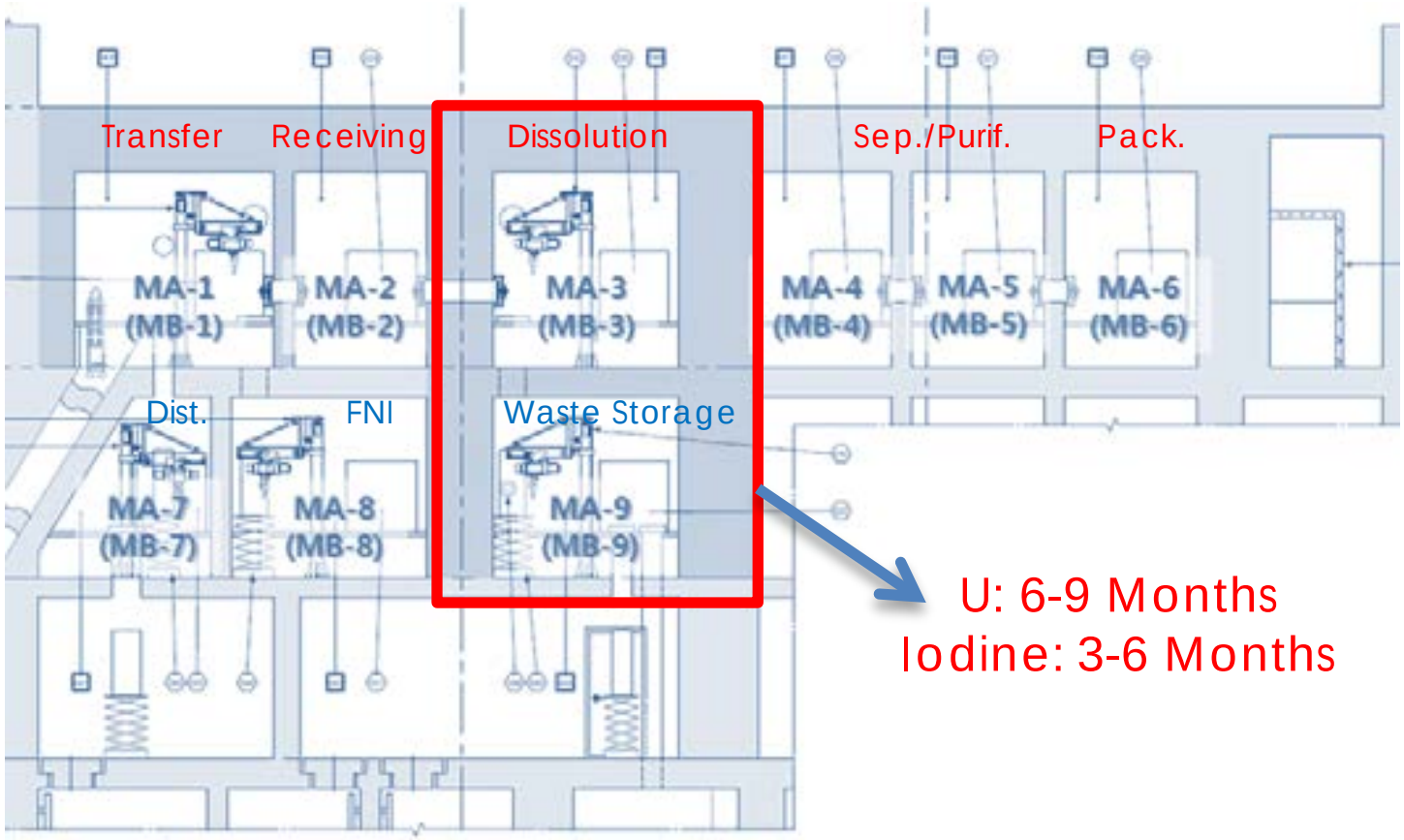


FMPF General Arrangement



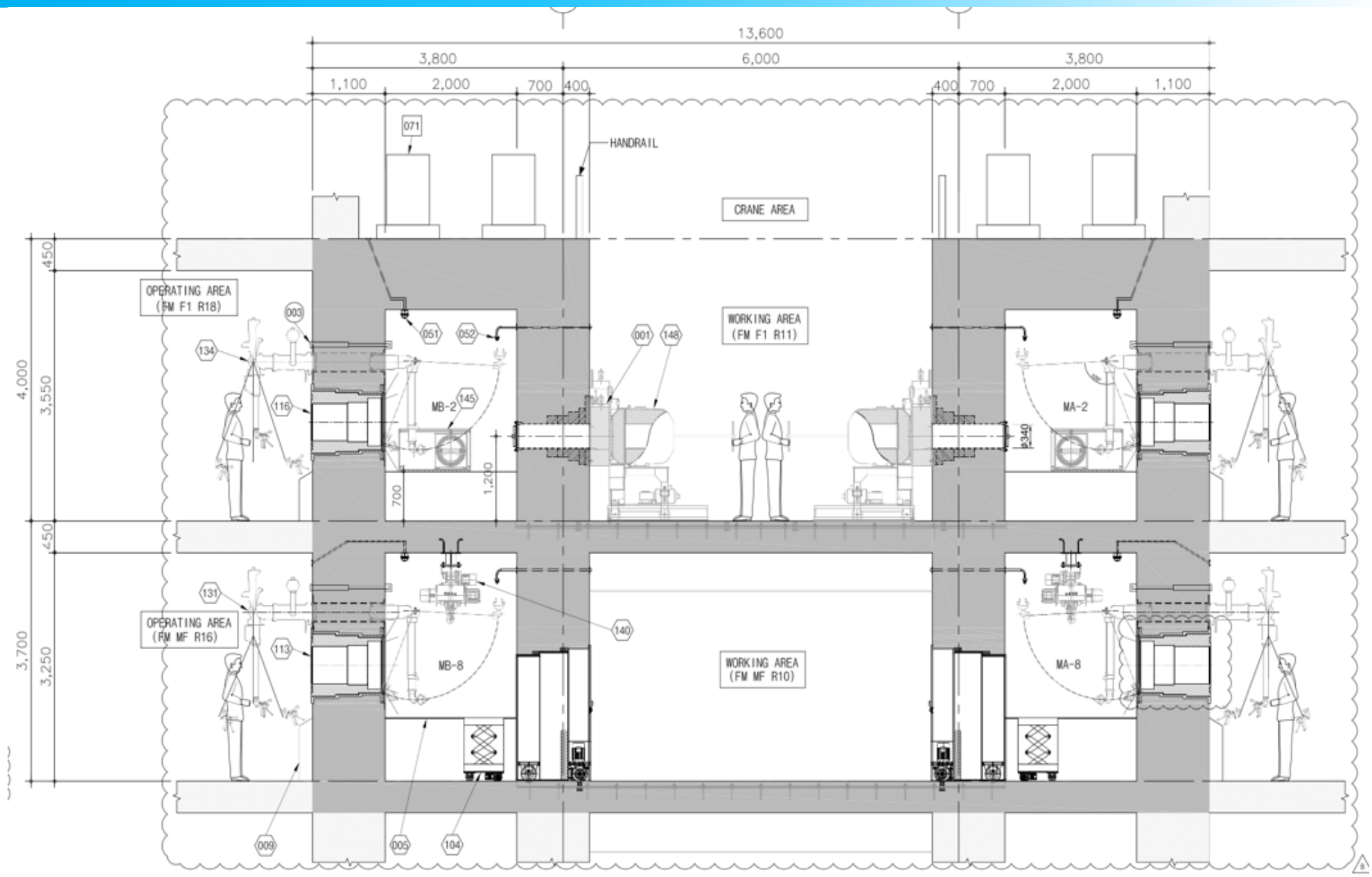


Hot Cell for Fission Mo-99 Production (Two hot cell banks for back-up)

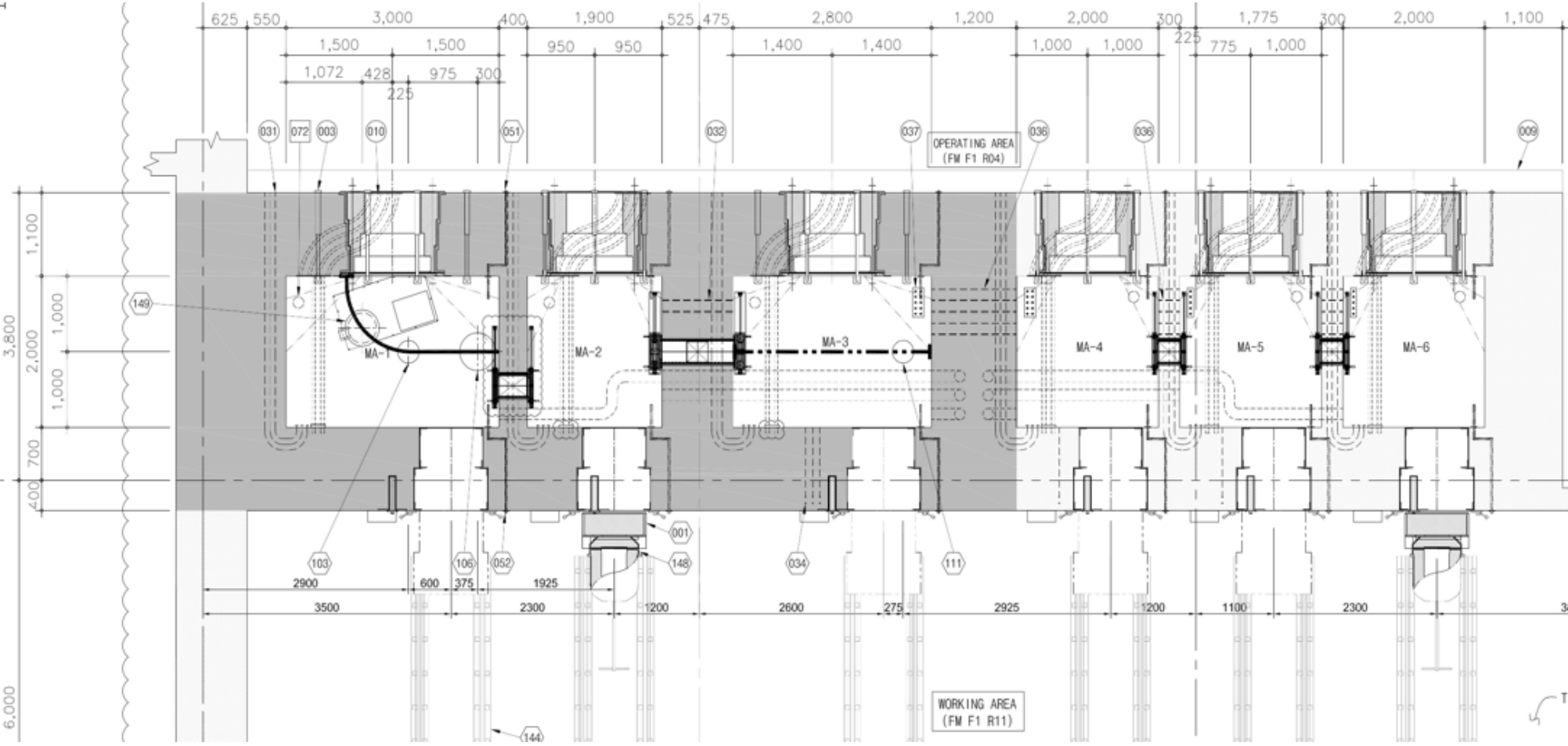


Hot Cell No.	Name	Function	Hot Cell No.	Name	Function
MA-2	Receiving	Isolation of FMPF from Rx	MA-6	Packaging	Packaging Mo-99 Solution
MA-3	Dissolution	Target Dissolution	MA-7	Distribution	RI Target Transfer
MA-4/MA-5	Separation/ Purification	Mo-99 Separation/ Purification	MA-9	Waste Storage	Temporary Storage for Solid Radwastes

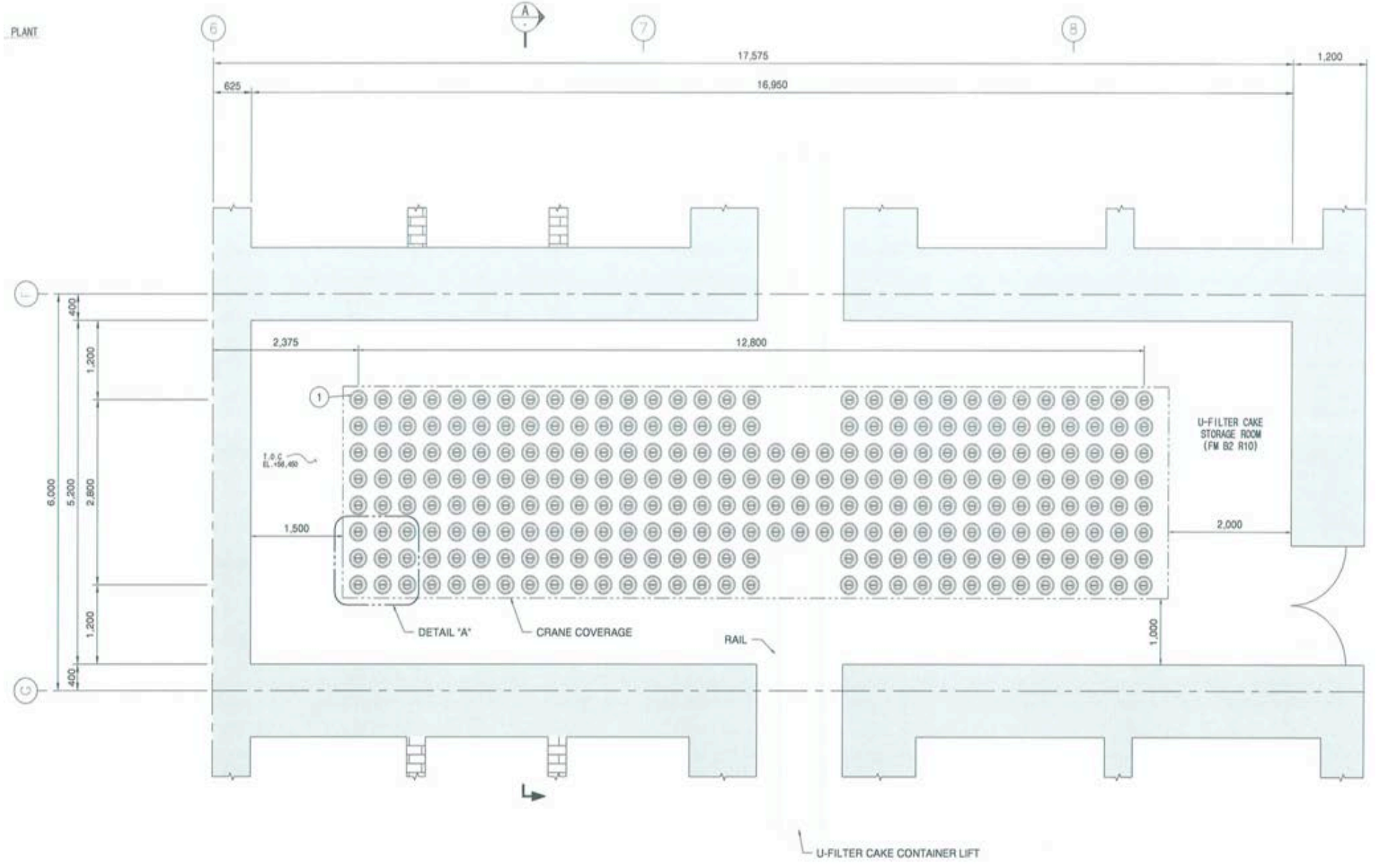
Hot Cell Cross Section



Hot Cell Arrangement (Fl. 1)

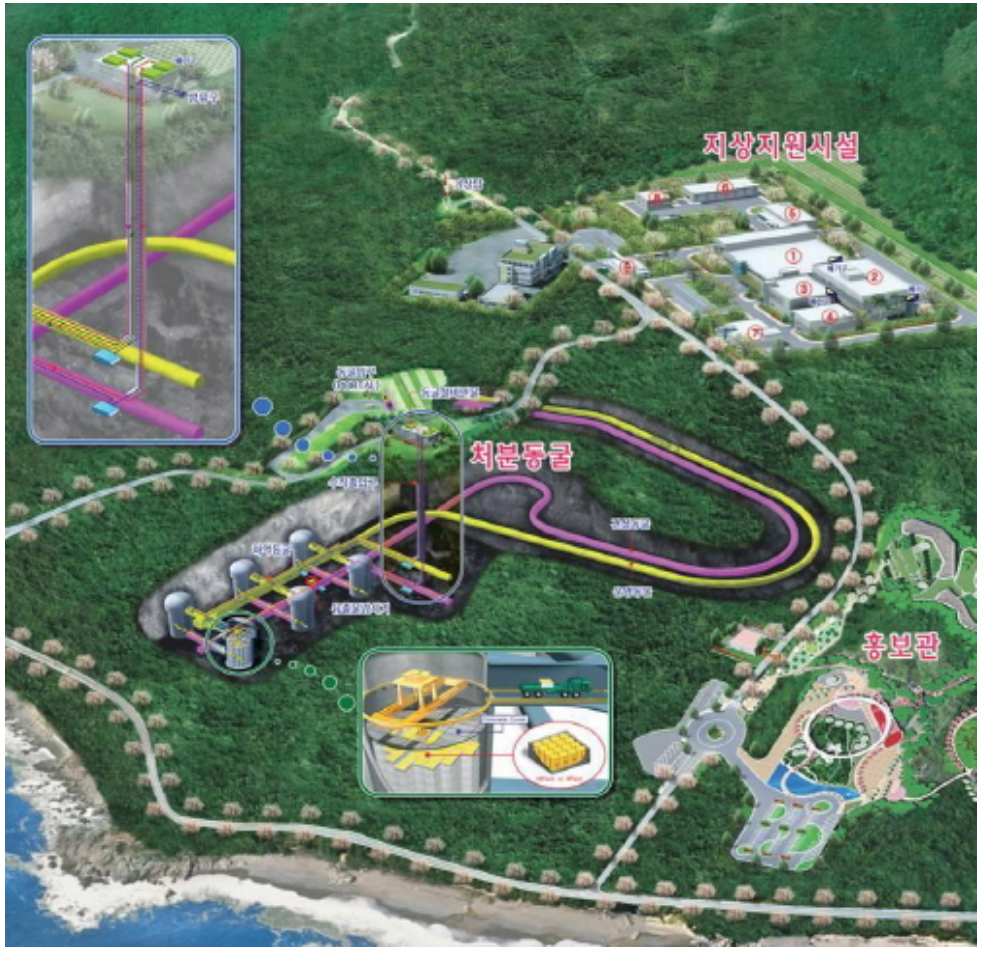


Long-term (50 yr.) Storage of U-Residue



Disposal of ISW and LSW (other than U residues)

KORAD LILW disposal facility in Gyeongju (2014



Current plan: Cementation of ILW from FM production (Disposal experience)

1. KJRR Project: Update
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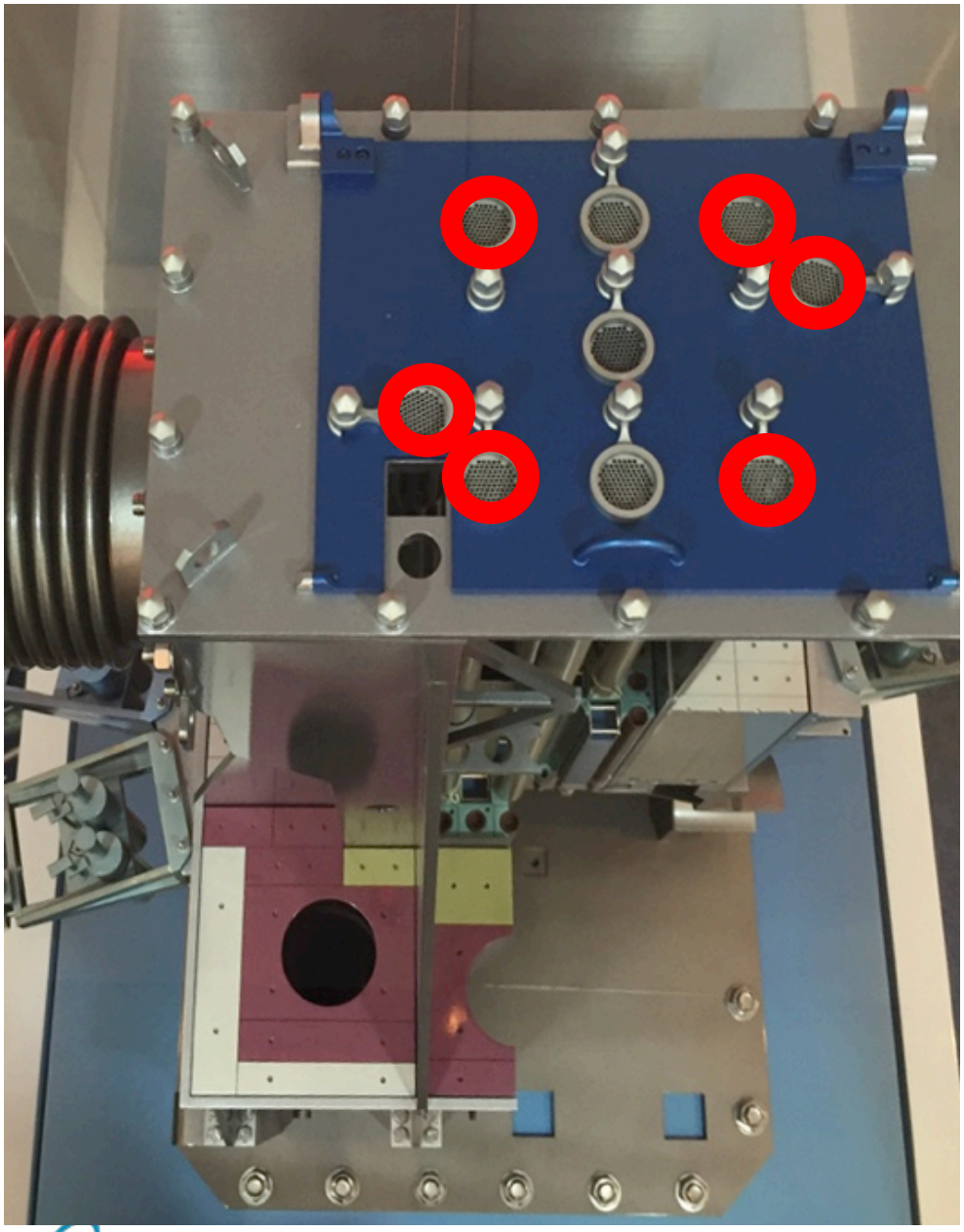
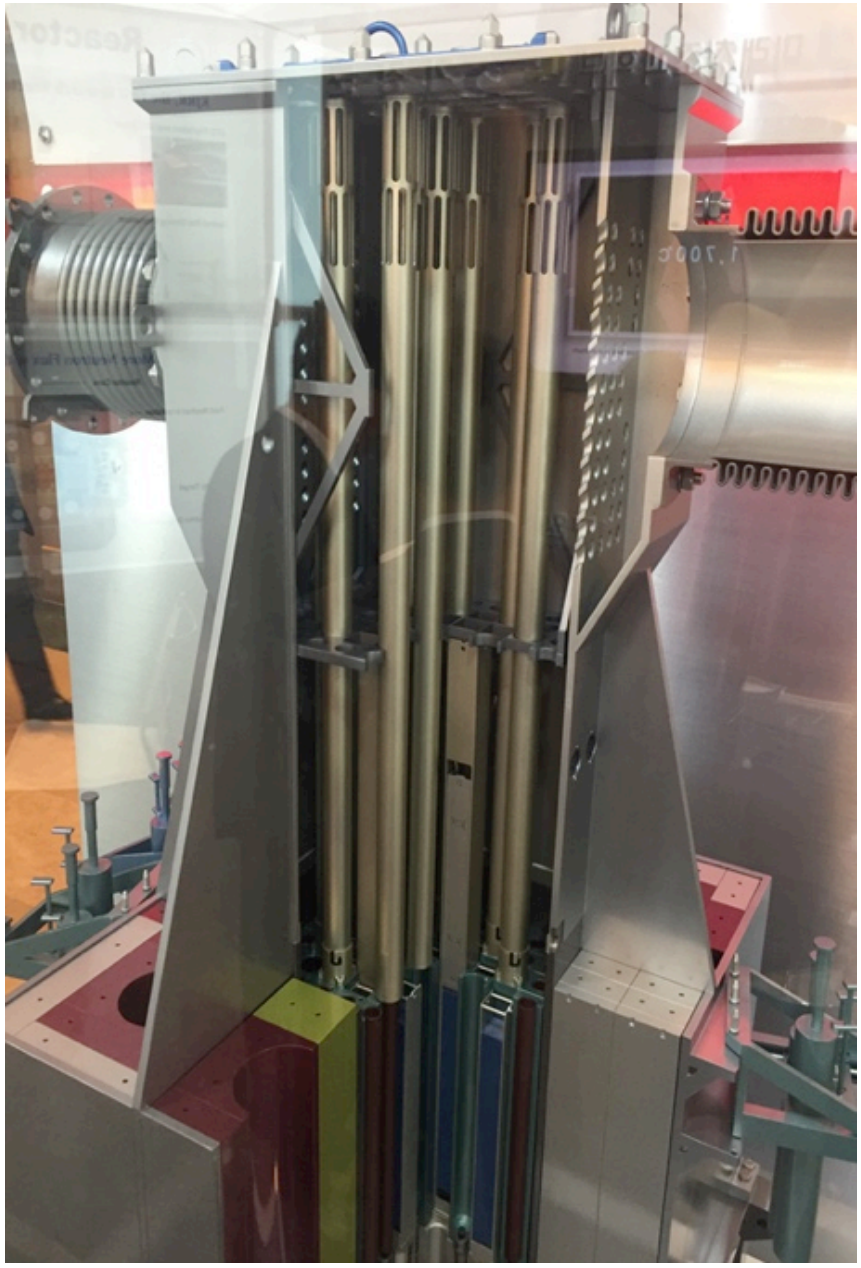
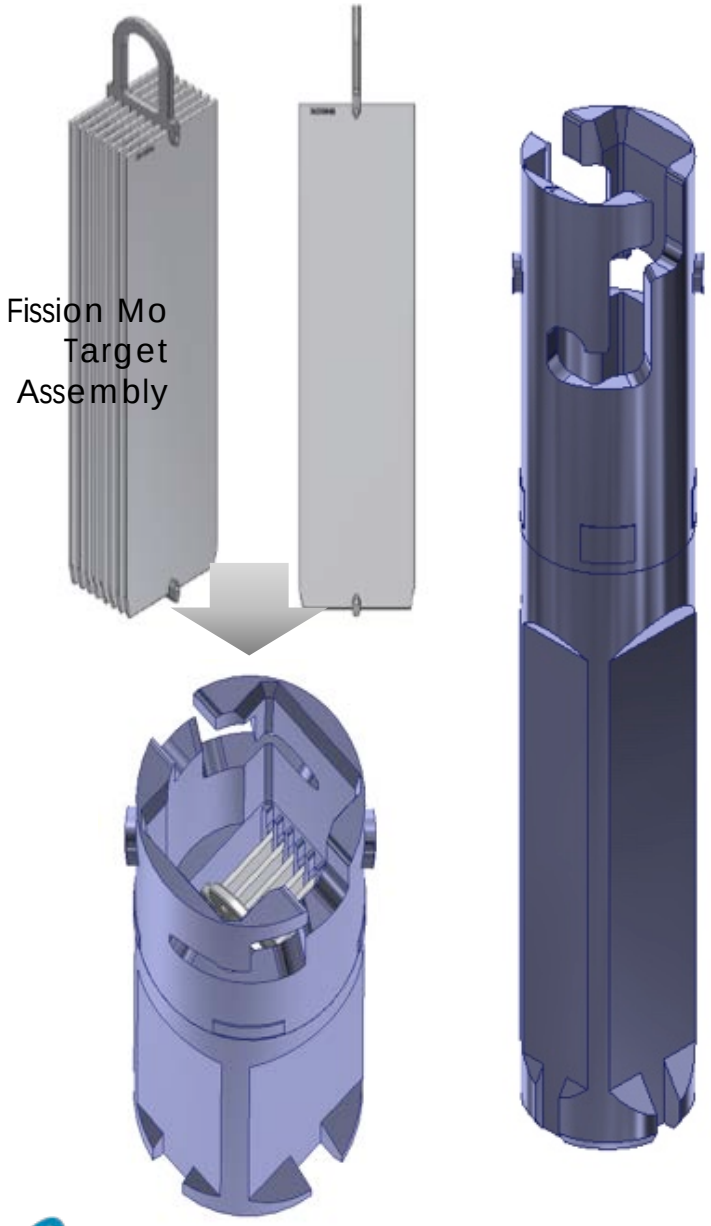
FM Target and KJRR Reactor Model

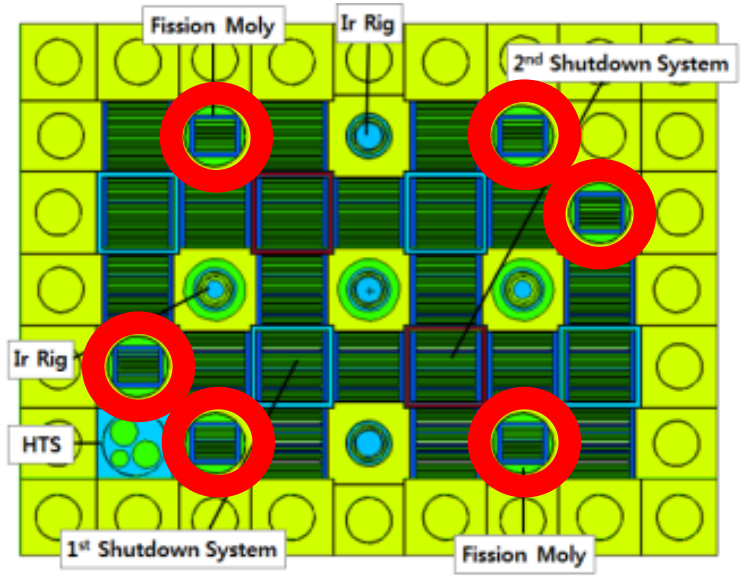




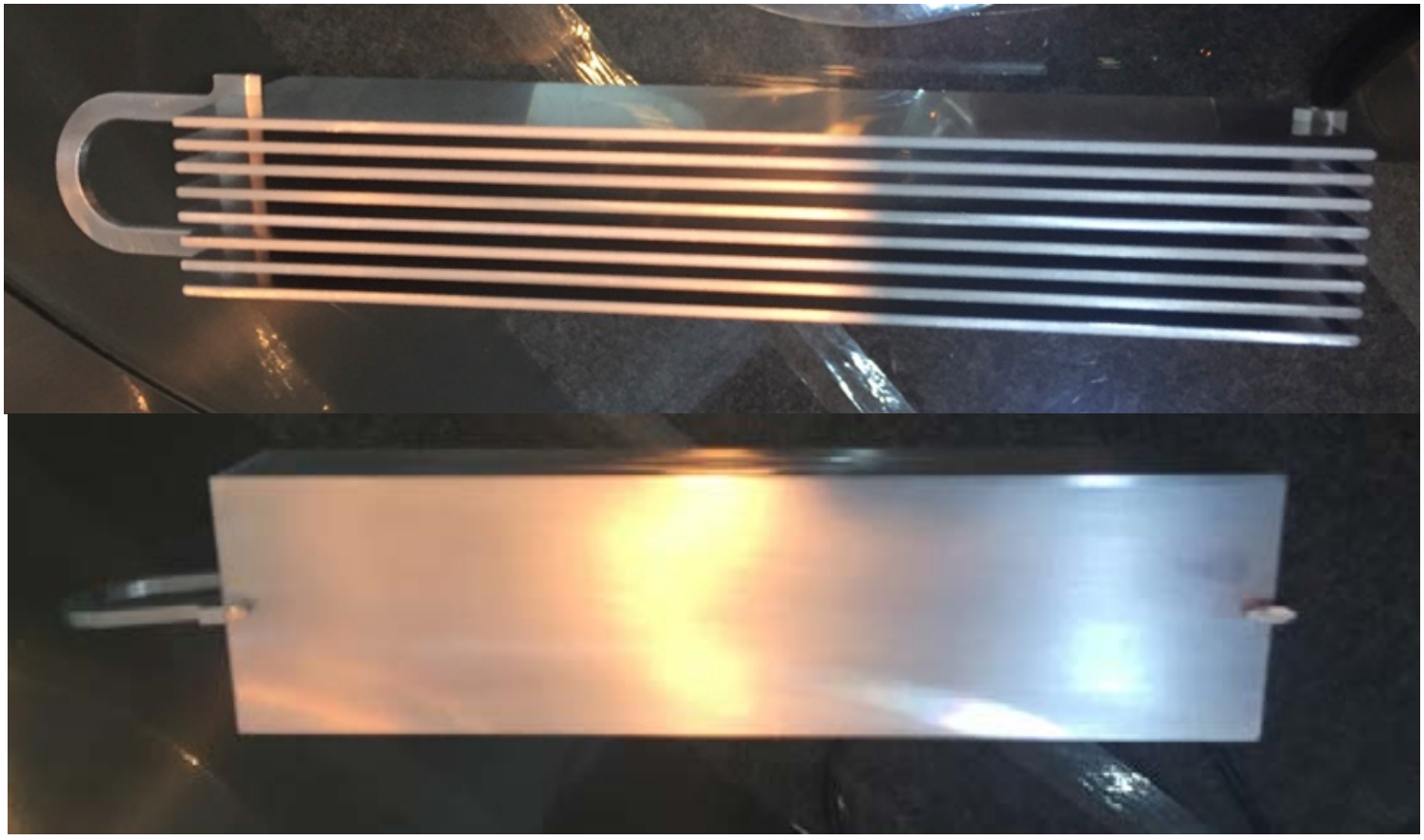
FM Target Irradiation



KJRR Reactor Core

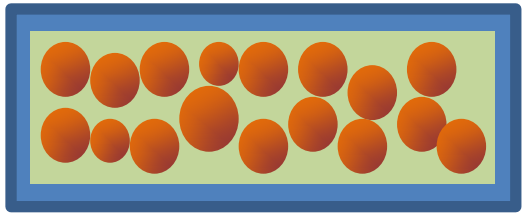


FM Target Assembly (8 Plates with Combs)

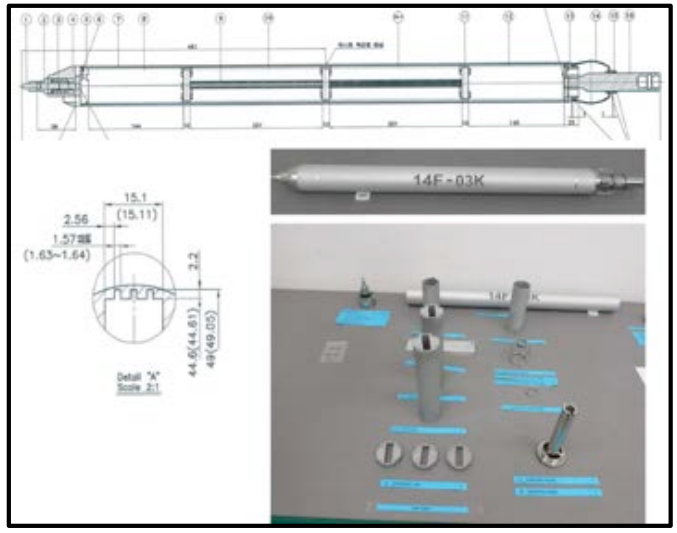


II. FMPF: FM Target Specification

- Weight: 53 g
- Total U: 15 g
- Total U-235: 3 g
- U density: 2.6 g-U/cc



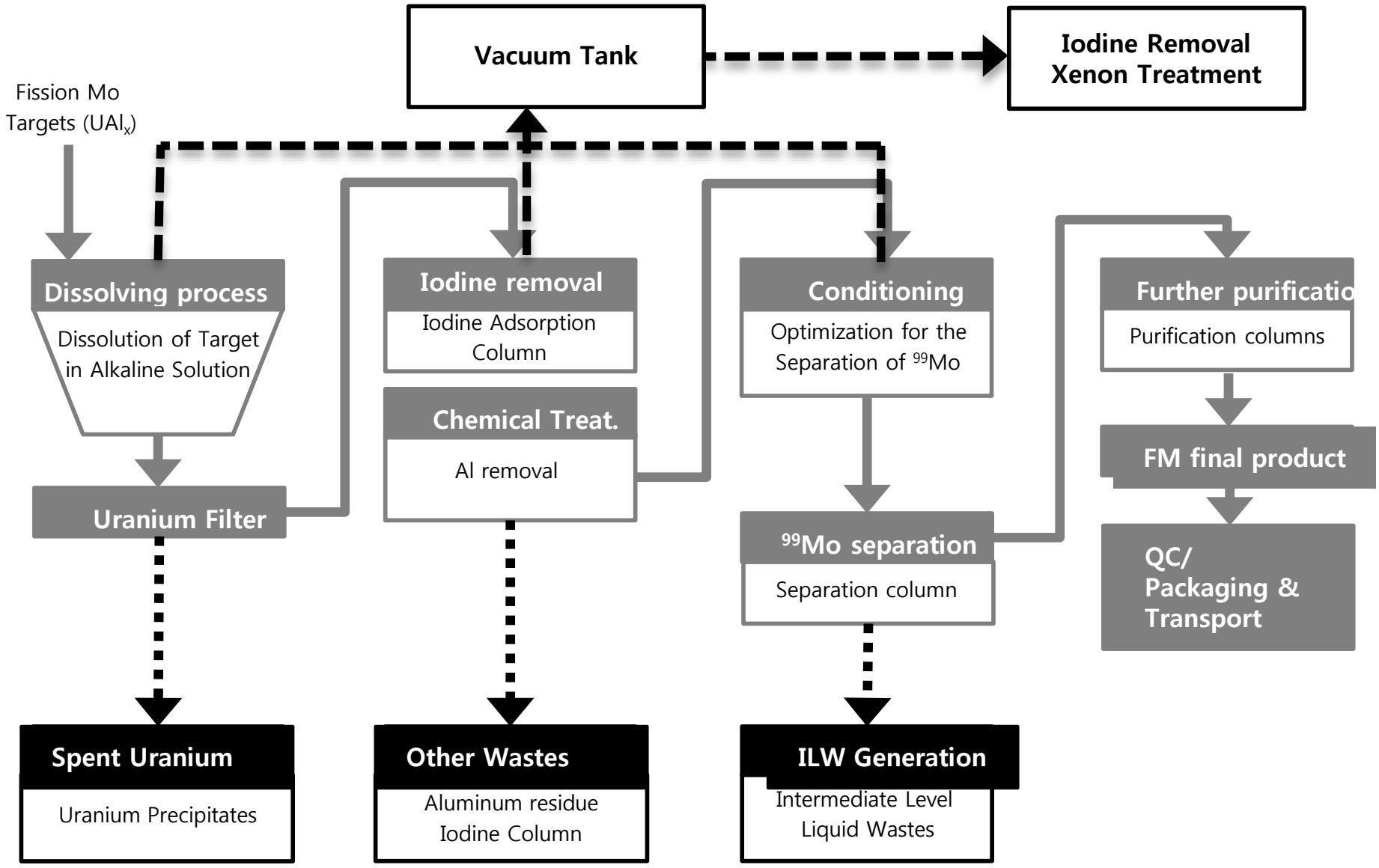
Al 6061 T6 @cladding
Al 1050 @ meat (matrix)
UAlx powder @ meat



➢ **Green light for the HANARO irradiation test**
- Flow rate & pressure drop: satisfied
- Vibration test: satisfied

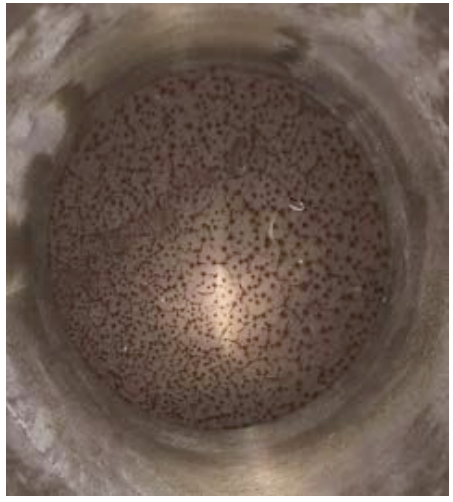
60-days ex-core test

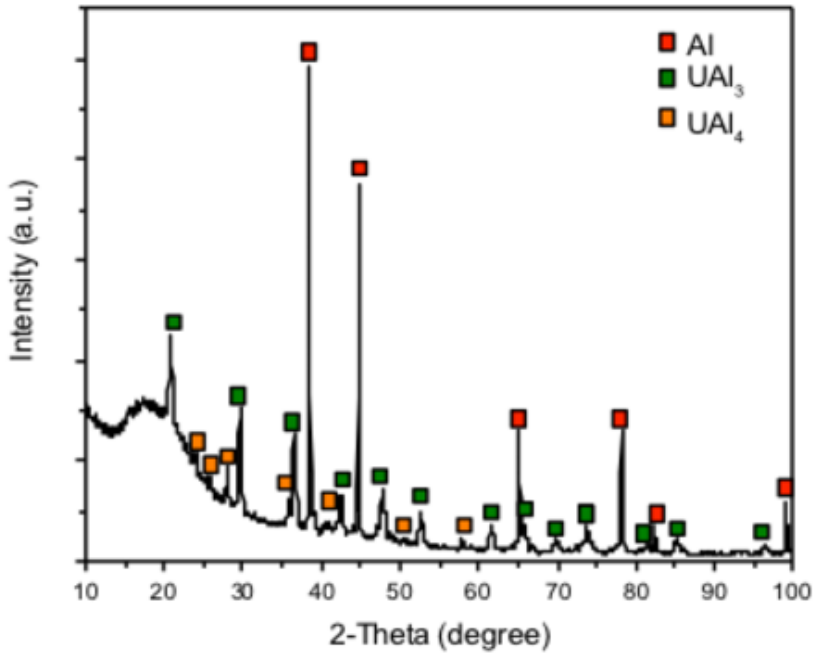
Process Scheme

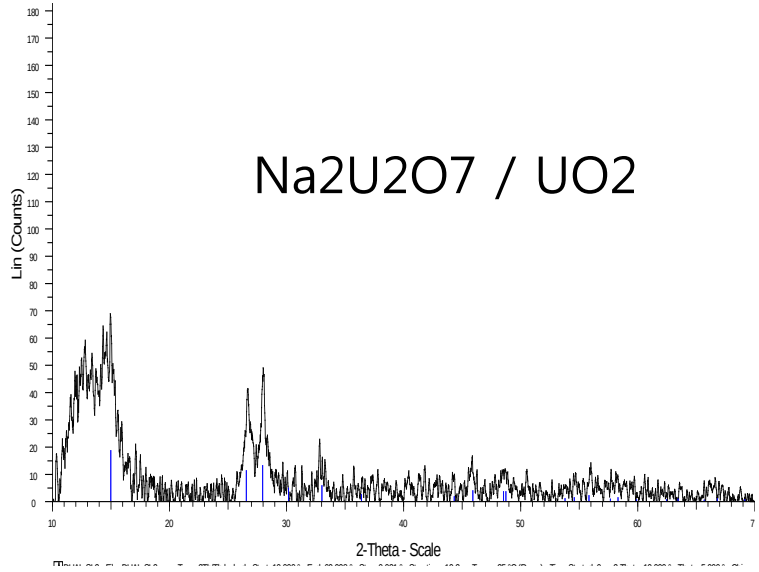


Full-scale Prototype (cold test)

Dissolution





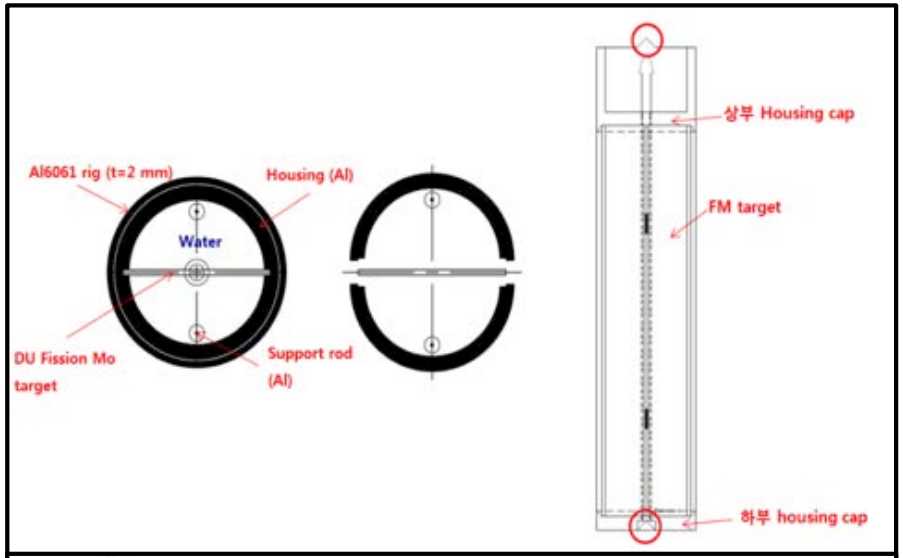


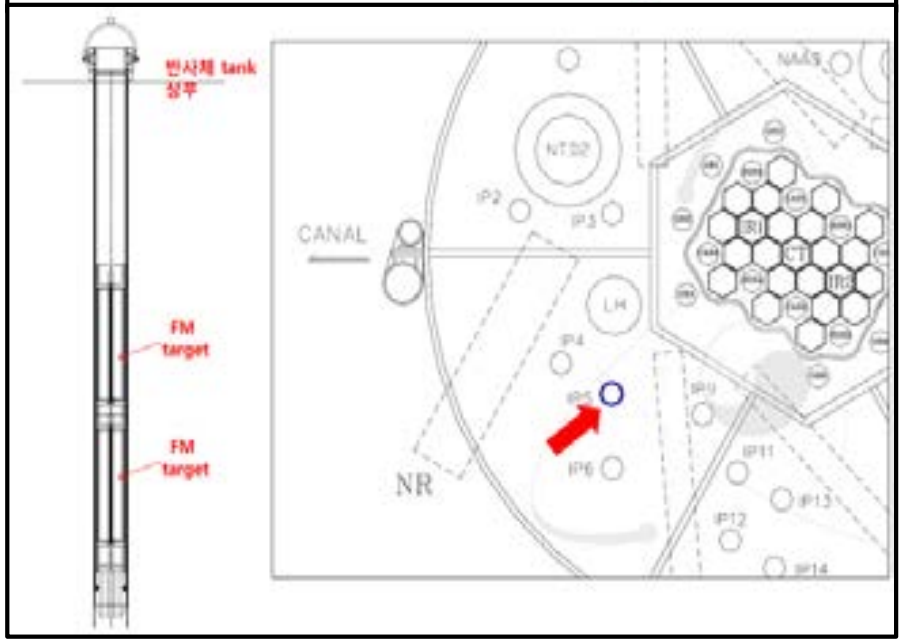
Na2U2O7 / UO2

Fission Mo Production: Hot Test Module (1/8 scale)

Fission Mo Production: Hot Test

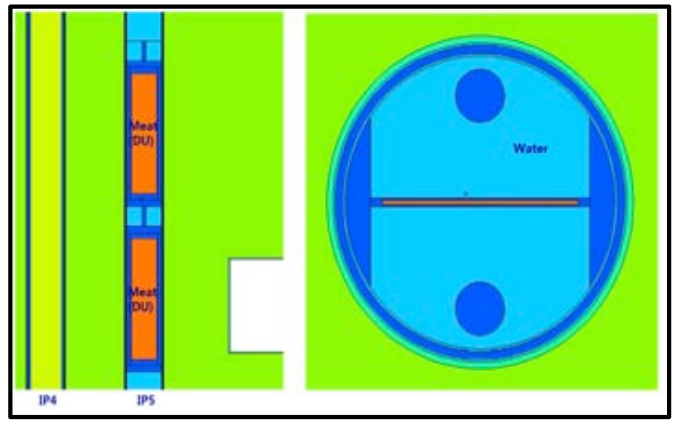
Fission Mo Target Capsule / Rig and Irradiation Hole





Irradiation in HANARO

Fission Mo Target (DU) Combustion Analysis



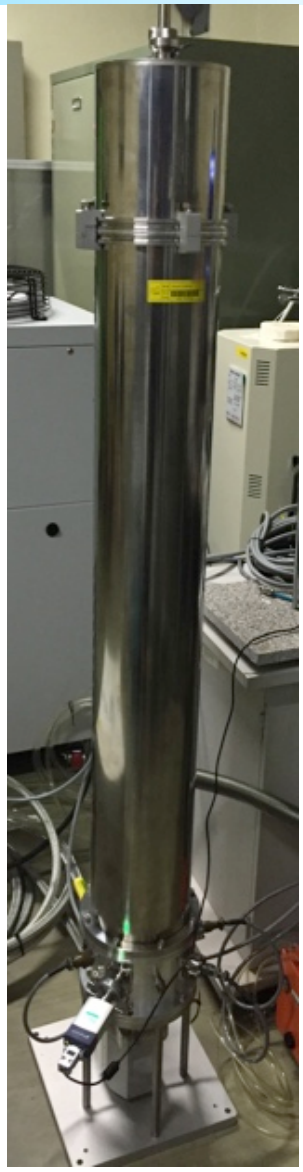
Tool	MCNP6
Result (from 2 target plates)	1 hr Irradiation – 0.1390 Ci 6 hr Irradiation – 0.8317 Ci 1 day Irradiation – 3.025 Ci 7 day Irradiation –10.84 Ci

Compact Xenon Treatment System (Cryogenic)

Experimental Setup Mark1

Experimental Setup Mark2

- Single column retains 7 batches
- Integrated column now testing (TSA operation)
- Continuous operation



Prototype

1. KJRR Project: Update
2. Fission ^{99}Mo Production Facility Development
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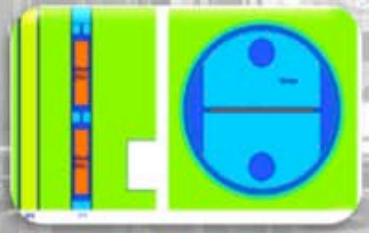
Summary

Fission ^{99}Mo Production Process

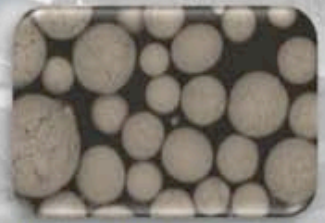
Active Production Test



Irradiation Analysis

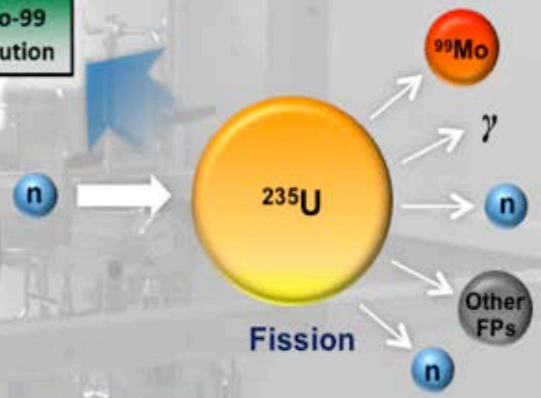
Commercial-scale Process

Target Fabrication



Uranium Powder Preparation

Off-gas Treatment



Summary

1. Mo-99 facility and process development is in progress
2. KJRR project is moving forward in spite of some obstacles: budget / licensing
3. Requesting hands from Mo-99 society (ILW disposal)


Thank You !!!