Status of J-PARC Transmutation Experimental Facility

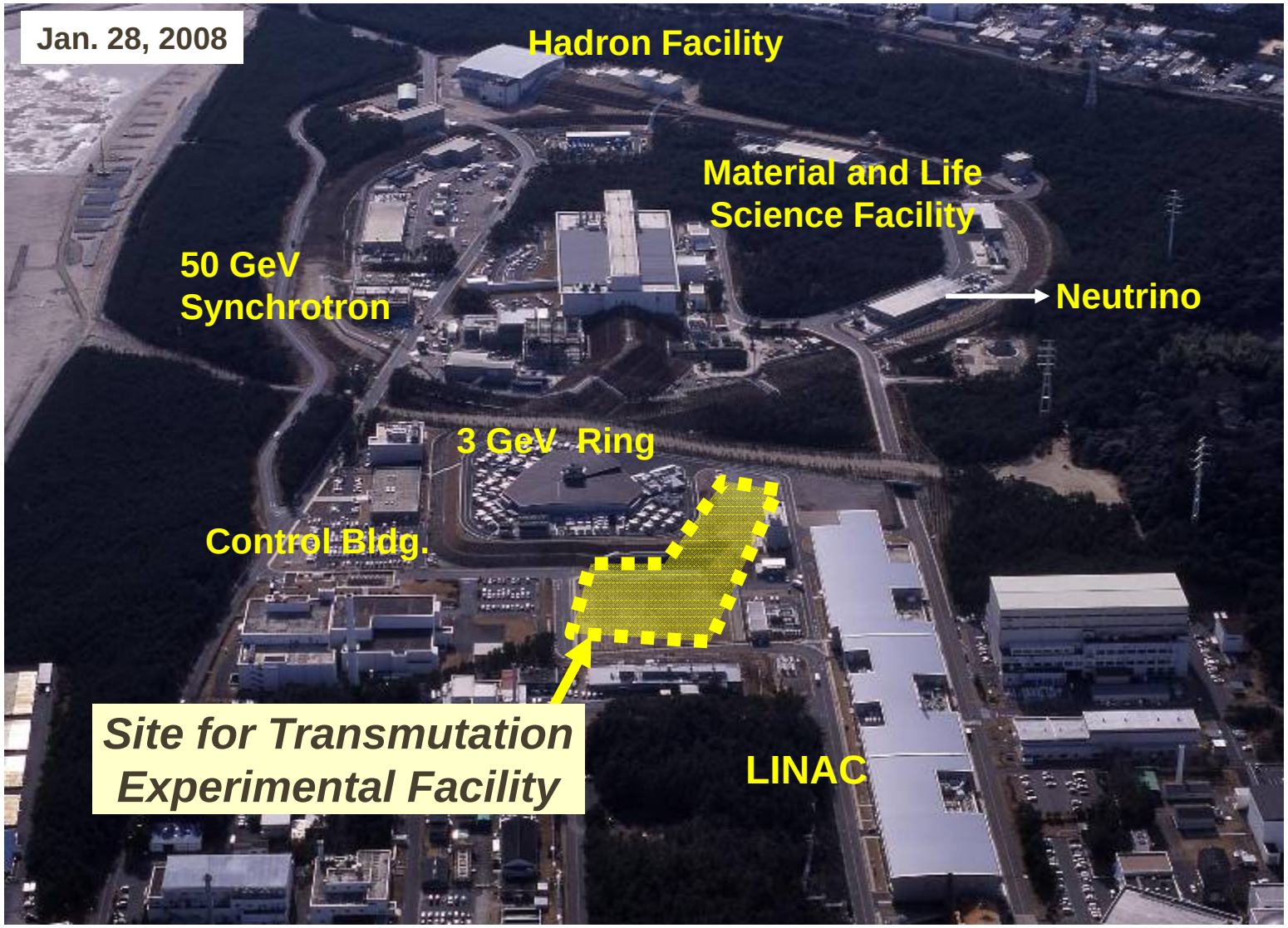
10th OECD/NEA Information Exchange Meeting for Actinide and Fission Product Partitioning and Transmutation

2008.10.9

Japan Atomic Energy Agency

Toshinobu Sasa

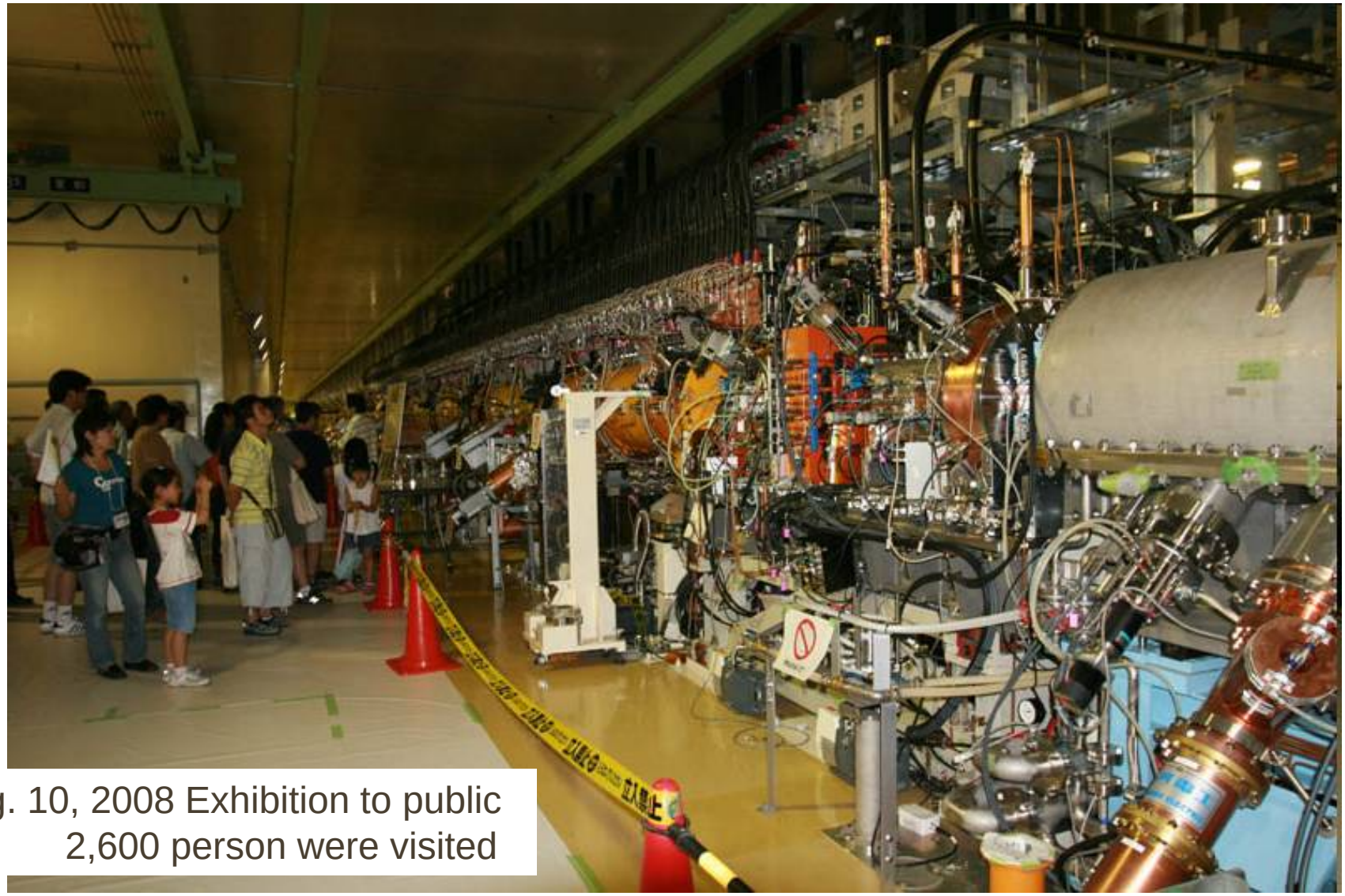
Current Status of J-PARC



Operation history of J-PARC

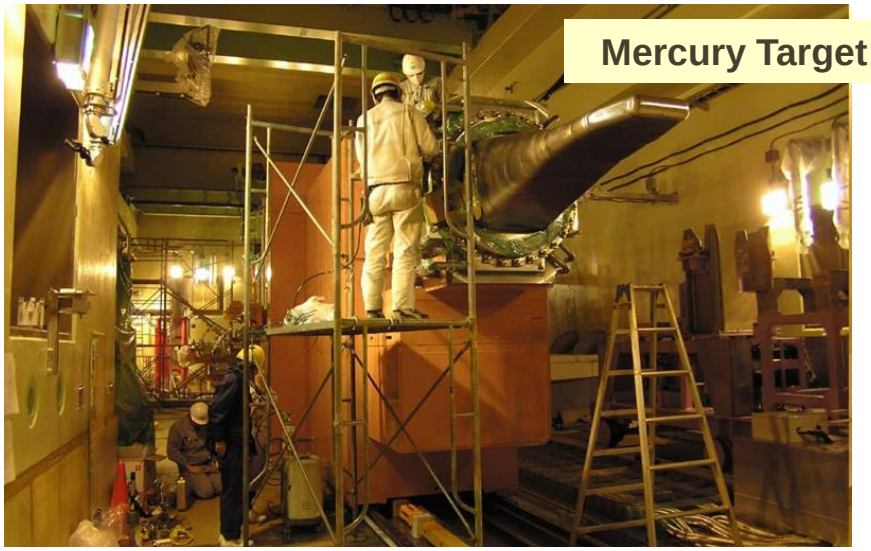
- **2002.3 Start Construction**
- **2006.11.22 Accelerate first beam**
- **2007.1.24 Success to accelerate proton to 181MeV**
- **2007.10.31 Success to accelerate proton to 3GeV**
- **2008.5.27 Success to inject 3GeV beam to 50GeV ring**
- **2008.5.30 Success to produce spallation neutron**

Status of J-PARC: LINAC



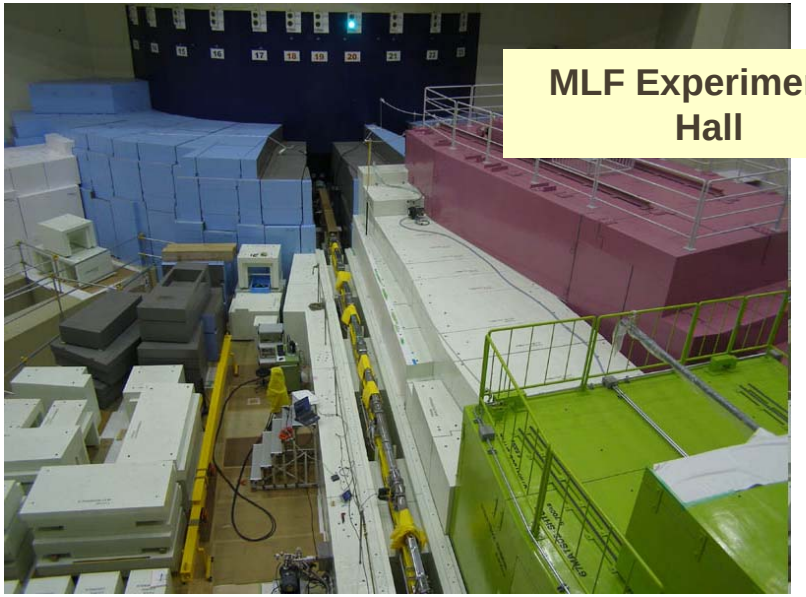
Aug. 10, 2008 Exhibition to public
2,600 person were visited

Status of J-PARC: Others

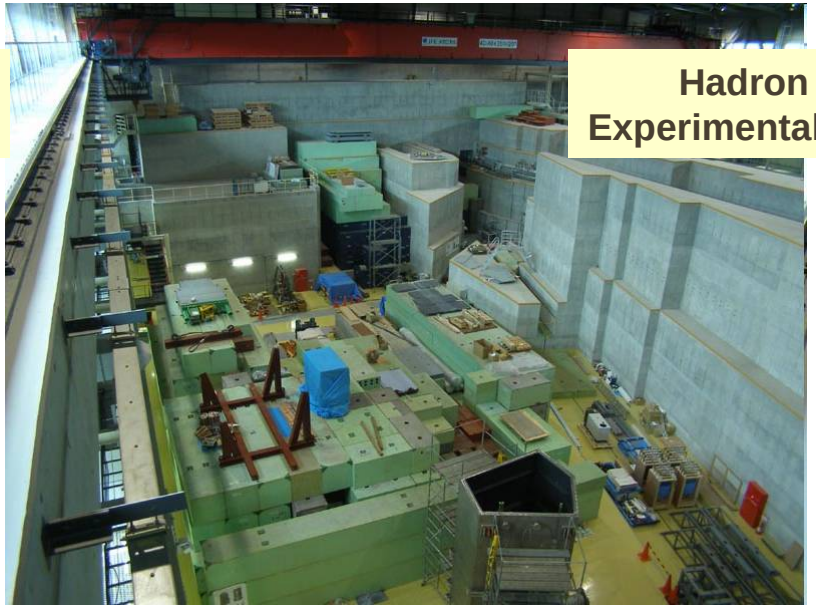


Mercury Target

Injection to 3 GeV Synchrotron



MLF Experimental Hall



Hadron Experimental Hall

Current Condition of TEF Location

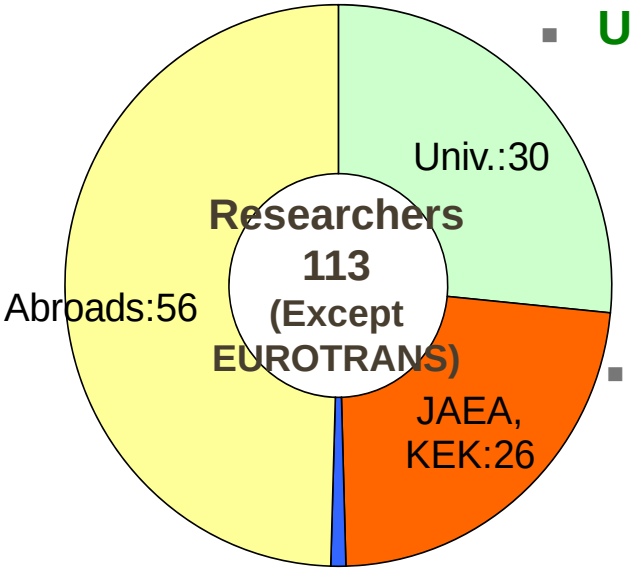
Activities for TEF user community

- **Working party for ADS**
  - Organized by Japan Atomic Energy Research Institute from 1999 to 2006
  - Study of critical assembly for innovative nuclear systems including ADS
- **Call for Letter Of Intent for Transmutation Experimental Facility**
- **Symposium for Actinide Management**
  - Held in Dec., 2007 at Tokyo (Organized by JAEA)
  - Discuss about the requirements for neutronic experiments for actinide management
- **Special Session for utilization of TEF in Annual Meeting of Atomic Energy Society of Japan (AESJ)**
  - Held in Mar. 2008 at Osaka (Organized by Reactor Physics Division of AESJ)
  - Agree to launch research committee for next-generation critical assembly
- **Meeting on future perspective for reactor physics research**
  - Held in Jun. 2008 at Tokyo (Organized by Reactor Physics Division of AESJ)
  - Confirm future needs for neutronics experiments for minor actinides, etc.
- **Research Committee for Neutronic Experimental Facility for Actinide Management**
  - Started from Jul. 2008 (Duration : 2 years)

Current Summary of Pre-LOI

- Total Number of Proposals: 38
- Research Field and Items
  1. ADS (Accelerator coupling,Multi-region core,Subcriticality measurements, etc.) 11
  2. Innovative Reactors (MA Neutronics,Heavy Metal Reactor,FP Transmutation) 10
  3. Nuclear Data Measurements (TOF、Threshold Reaction) 6
  4. Shielding, Safety 5
  5. Particle Physics (Ultra Cold Neutron, Neutrino) 3
  6. Pb-Bi Target Development (Irradiation) 2
  7. Medical Application (Boron Neutron Capture Therapy) 1

- **Abroads**
  - EUROTRANS
  - PSI (Swiss)
  - CIAE (China)
  - Seoul Univ. (Korea)
  - MINT (Malaysia)
  - NTI (Serbia)
- **Company**
  - Engineering Development inc.



- **Universities**
  - Hokkaido Univ.
  - Tohoku UNiv.
  - Tokyo Tech.
  - Niigata Univ.
  - Nagoya Univ.
  - Osaka Univ.
  - Kyoto Univ.
  - Kinki Univ.
  - Kyushu Univ.
- **JAEA**
  - Quantum Beam Sci. Dir.
  - Nucl. Sci. and Eng. Dir.
  - Advanced Nucl. System R&D Dir.
  - J-PARC Center

R&D and experimental needs for FR

- **Expectation for fast reactor neutronic experiments**
  - Data preparation for licensing beyond 2015
  - Prepare higher-Pu&MA-bearing fuel data by integral experiments
  - Heterogeneous MA loading
  - Reactivity worth measurements
    - Preparation of experimental methods and data for capture reaction
    - Systematic experiments by spectrum adjustment
  - Mockup experiments for FaCT backup concepts (Metal-FR etc.)
  - Experiments for LLFP Transmutation

R&D and experimental needs for LWR

- **High burnup**
  - Experiments with more than 5wt% EU fuel
  - Experiments for new materials (cladding, poison, etc.)

- **MOX fuel**
  - Burnup experiments
  - Study for higher-ordered Pu
  - Parametric survey for Pu isotopic composition
  - Survey for fuel lattice structure
  - Experiments with MA-doped fuel

- **Burnup credit**
  - Experiments with actual spent fuel
  - Experiments for nuclides with large reactivity influences

Needs for innovative systems

- **Water-cooled Thorium Breeder**
  - Studied at Tokyo Inst. Tech.（2004～）
  - Experiments for Heavy water coolant、MFR=1.0、7-8% Enriched U-233
- **Reduced-moderated LWR**
  - Simuration of midium-energy neutron spectrum
  - Sensitivity at entire energy range (Fast-resonance-thermal)
  - Experiments with MOX Blankets
  - Experiments with original-lattice structure
- **Accelerator-driven system (ADS)**

Research Committee in AESJ

- **Research Committee on "experimental facility for reactor physics concerning actinide management"**
  - Around 30 reactor physics experts from Universities, Research Institutes, Companies

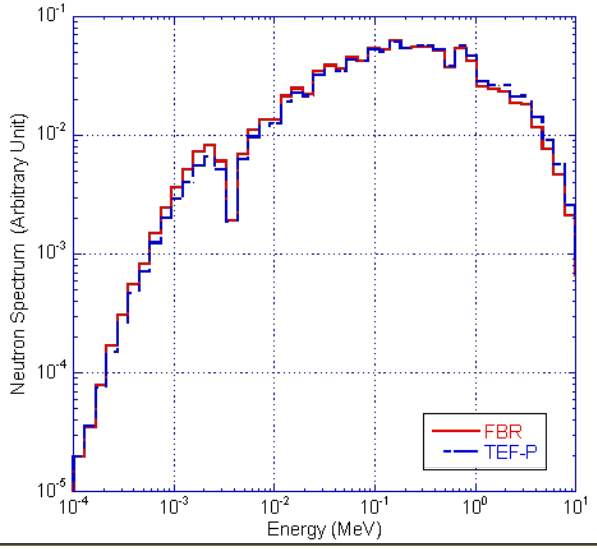
- **Objectives**
  - survey needs for neutronic experiments necessary for actinide management
  - specify the requirements for experimental methods, devices, equipments and experimental facility design
  - clarification of issues for effective use of experimental facility in the field of scientific research, education and publicity

Recommendation to TEF will be summarized in this fiscal year

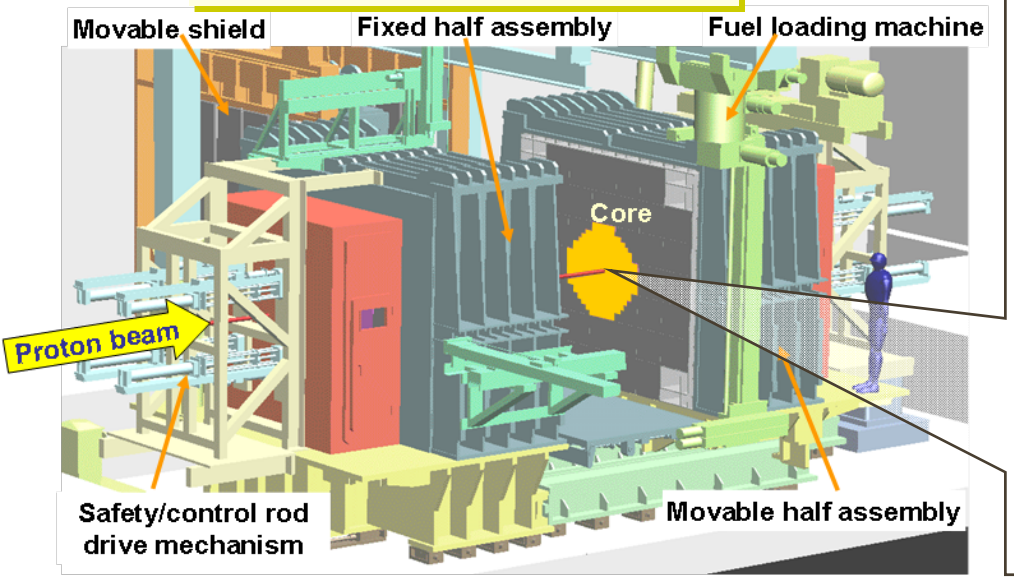
Facility Image of TEF 1st Phase

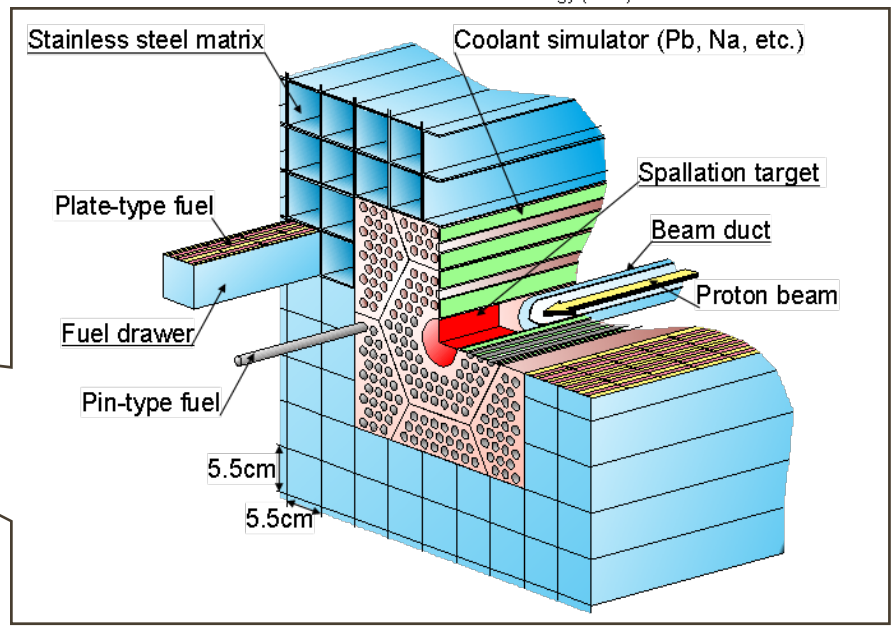
Transmutation Physics Experimental Facility

- Low power critical facility for reactor physics and nuclear data of transmutation systems including ADS and FBR.
- Neutron source: 10^{12}n/s, 25Hz. 1ns pulsed beam can be supplied by laser charge exchange technique.
- By replacing central 5 x 5 matrix tubes with pin-type assembly, MA fuel can be used with cooling and remote handling.



Thermal power : 500W



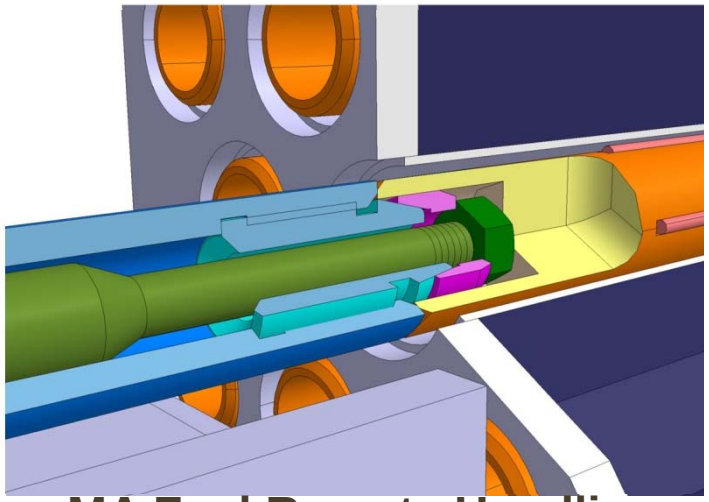


Effectiveness of MA-bearing fuel

Specify importance of MA fuel experiments

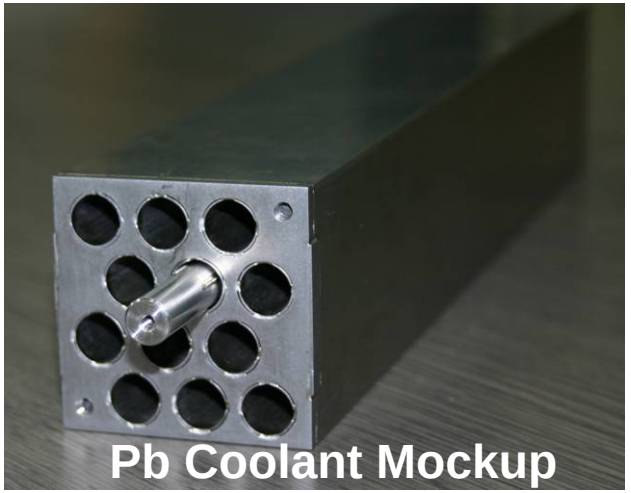
Simulate neutron spectrum of actual FBR and ADS

- MOX+5%MA fuel，ADS fuel are installed in TEF-P driver zone (25cm×25cm×60cmL)
- Add 7 simulative experiments to existing data
  Characterize effect of MA fuel experiments
  It is also found that cross section and covariance data must be checked



MA Fuel Remote Handling

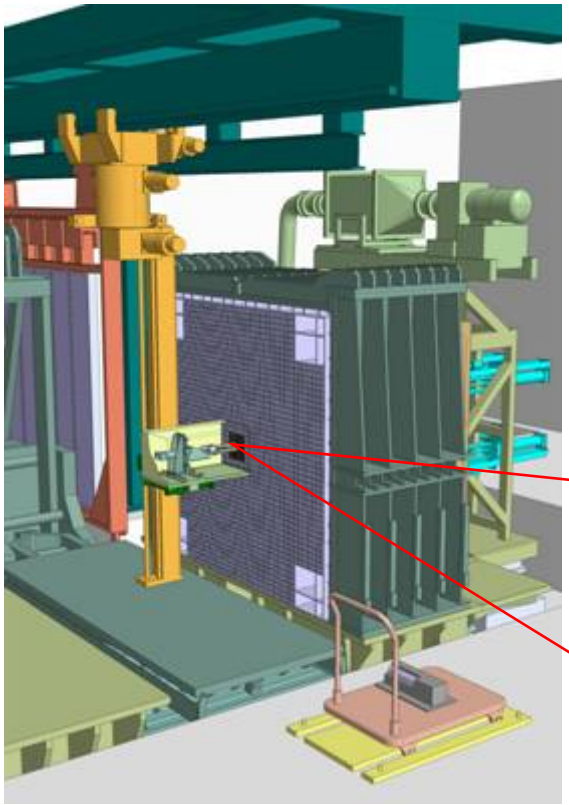
Experiment Item	MA5% mixed MOX Fuel FR			(MA, Pu)N + ZrN Fuel ADS		
	Initial	After Adjustment		Initial	After Adjustment	
		233 data	233 data+ 7 simulations		233 data	233 data+ 7 simulations
k-eff	1.1	0.30	0.27	1.1	0.74	0.68
Coolant Void Reactivity	2.4	1.6	1.4	5.8	3.8	3.0
Doppler Reactivity	3.8	2.2	1.7	4.9	4.0	2.8

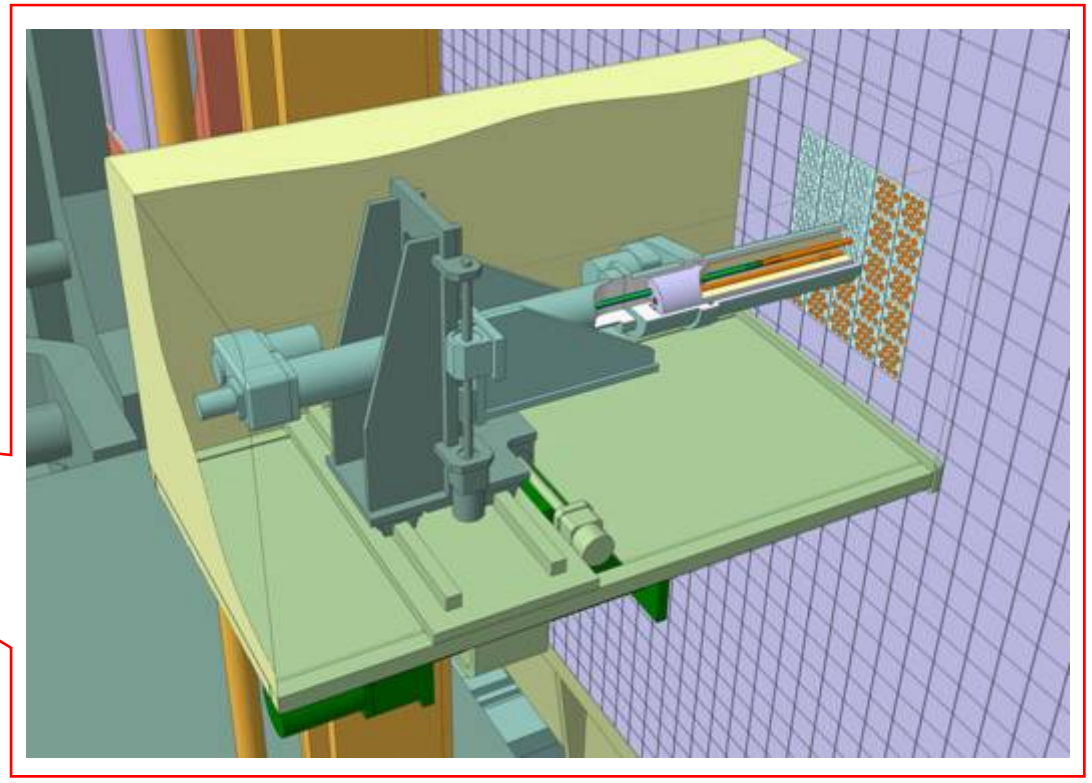


Pb Coolant Mockup

Handling for MA-bearing Fuel

- **Performing preliminary study for remote handling**
- **6 fuel pins are stored in stainless cartridge for shielding and protecting critical accident**
- **Handling at storage and reactor room is done by remote devices**
- **MA fuel storage equip the local cooling circuit connected to emergency power supply**





Summary

- **Explore experimental needs and requirements for next-generation Critical Assembly, TEF**
  - Data required to improve existing reactor systems
  - Experimental devices to study innovative nuclear systems
  - Researches for innovative nuclear fuel concepts
  - Neutronics with various neutron/proton beam
  - AESJ Research Committee presents recommendation to TEF

- **R&D for TEF-P**
  - Analyses for TEF-P and its effectiveness for MA physics
  - Study for MA-bearing fuel (Fuel form and handling)
  - Updating facility plan by reflecting user needs

Draft Schedule for TEF Construction