



JAEA at a Glance

- **Comprehensive nuclear R&D institution** in Japan based on the Atomic Energy Basic Act
- Established through the consolidation of former JAERI (Japan Atomic Energy Research Institute) and JNC (Japan Nuclear Cycle Development Institute)
- Number of employees: **approx. 3,900*** (April 2018)

*Number of personnel employed on a full-time basis

- Total Income: **approx. 170 billion yen**** (JFY 2016)

**The amount includes the budget from the Government and the external funds

- Engaged in the R&D activities of following areas
 - Restoration from the Accident of TEPCO's Fukushima Daiichi NPS
 - Advanced reactors (FBR and HTGR)
 - Basic research on cutting-edge nuclear science and technology
 - Nuclear safety research
 - Nuclear non-proliferation and nuclear security
 - Decommissioning and radioactive waste management

Restoration from the Accident of TEPCO's Fukushima Daiichi NPS

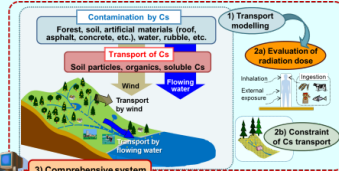
- R&D to contribute to 1F decommissioning
- Contribution to environmental recovery



TMI-2 debris sample



Molten core-concrete interaction (MCCI)



Assessment of radionuclides behavior in the environment

Nuclear Safety Research

- Reduction of risks associated with nuclear facilities
- Prevention and mitigation of severe accidents
- Radiation protection for humans and the environment



Nuclear Safety Research Reactor (NSRR)



Static Experiment Critical Facility (STACY)

Advanced Reactors

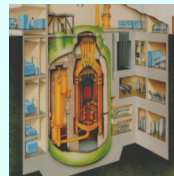
- Fast Breeder Reactor (FBR) and fuel cycle
- High Temperature Gas-cooled Reactor (HTGR) and heat application



Fast Reactor Monju (to be decommissioned)



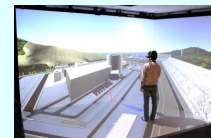
Experimental Fast Reactor Joyo



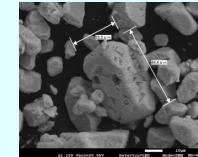
High Temperature engineering Test Reactor (HTTR)

Nuclear Non-proliferation and Nuclear Security

- Capacity building activities mainly in Asia
- Technology development



Nuclear Security Exercise Virtual Reality System



Nuclear Forensics Research Development



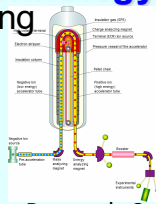
Annual international Forum

Basic Research on Cutting-edge Nuclear Science and Technology

- Nuclear science and engineering
- Advanced science research
- Materials science research



Japan Proton Accelerator Research Complex (J-PARC)



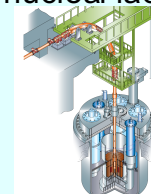
Tandem Accelerator Facility

Decommissioning and Radioactive Waste Management

- High-level radioactive waste disposal technology
- Reduction of volume and toxicity of HLW
- Decommissioning our nuclear facilities/ managing waste



350m depth



ADS : Accelerator-Driven System for nuclear transmutation

Adopted in 2017 to promote the interaction with the global nuclear community in terms of the following consideration

- Efficient promotion of R&D and maximization of the results using resources of other countries Increased JAEA's presence in the international nuclear community through contribution to addressing the common challenges
- Contribution to the international nuclear community and Japanese industry through the international outreach of R&D

Basic policy for promoting international cooperation

- Contribution to ensuring **nuclear safety**
- Contribution to ensuring **nuclear non-proliferation/nuclear security**
- **Maximization of R&D results**
- Support for **developing human resources** in the nuclear field
- **Overseas dissemination and international outreach** of R&D results

Measures for promoting international cooperation

- High priority placed on international cooperation in terms of the allocation of resources
- Enhancement of the global orientation of the JAEA
 - Exchange of experts with other countries
 - Cultivation of JAEA experts who can play a role in the global nuclear community
 - Enhancement of outreach activities in English, etc.
- Enhancement of the function of the Office of Strategy and International Affairs as an internal think tank
 - **Organization of networking events by overseas office**
- Cooperation optimized in each R&D field and with each state



Symposium in Washington D.C.
(June 2018)



HTGR Seminar in Vienna
(Oct. 2018)



Workshop in Paris
(Oct. 2018)



International cooperation on R&D for the decommissioning of Fukushima Daiichi NPS

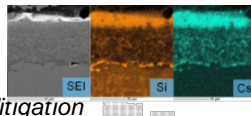
Collaborative Laboratories for Advanced Decommissioning Science "CLADS" will promote R&D and human resource development towards decommissioning **as an international center of excellence.**

- NNL
- Univ. Bristol
- Analysis of radioactive fine particles
- Dose evaluation and detector systems development



- VTT
- Univ. Helsinki
- FP-behavior modeling
- H₂ behavior analysis and Mitigation

International Cooperation



- SCK·CEN
- Information exchange on damaged spent fuel

- NRI/CVR
- Fuel debris characterization

- ISP-NPP
- Information exchange on Chernobyl LAVA



- IAEA
- Management of damaged spent fuel & corium
- Waste management on Fukushima (EGFWMD)

- SAFEST
- (KIT, KTH, CEA, UJV, AREVA, JRC, MTA-EK, SCK-CEN)
- Information exchange on severe accident validation (EU) and 1F accident evaluation (CLADS) test facilities

- CEA
- MCCI demonstration and product characterization
- FP-behavior evaluation



- OECD/NEA
- PreADES: Preparatory work on fuel debris analysis and handling
- TCOFF: Thermodynamic characterization of fuel debris and FP



Fukushima Research Conference (FRC)



- Gathering worldwide wisdom and expertise on Severe Accident, decommissioning and related technologies.
- Provide opportunities to researchers and decommissioning operators for communication beyond their expertise

- SRNL
- LBNL
- ANL

- Waste management on Fukushima
- Laser monitoring technology
- MCCI product characterization
- TMI-2 Workshop and Fukushima Forensics, etc.



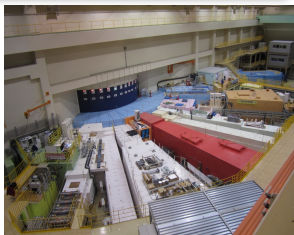
The CLADS is conducting R&D for encountered 1F decommissioning with concentrating worldwide wisdom and expertise from national and international cooperation.

- Collaborative R&D on fuel debris, FP (CEA, VTT, NRI/CVR, and ISP-NPP) and waste management (SRNL, NNL)
- Coordination of two OECD/NEA projects (PreADES and TCOFF) and information exchange in IAEA.
- Collaborative workshop/seminar with European institutes (ex. SAFEST, improvement of nuclear safety and identification of major non-soluble subjects of 1F-accident progression), etc.

Global center of neutron science research

The Japan Proton Accelerator Research Complex (J-PARC)
(JAEA, Tokai)

(joint project between JAEA and KEK)



Materials and life science experimental facility

Center of excellence for advanced atomic energy research

The Reimei Research Program

Promotion program of international collaboration for research themes to explore novel principles and phenomena and creating new materials

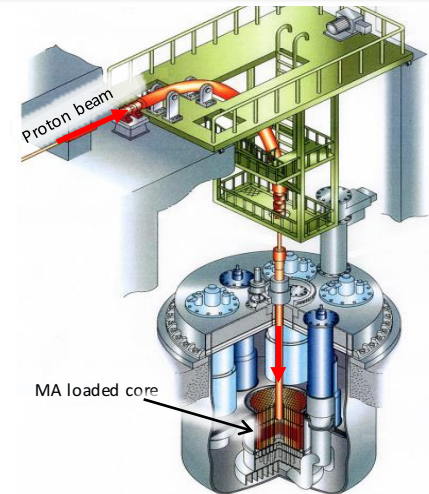
2017 Collaboration List

- Columbia University
- Université de Bordeaux
- University of Bristol
- Ohio University
- Institut Laue Langevin
- University of Tokyo
- University Mainz

- Ex. Einsteinium Experiment TANDEM Accelerator (JAEA, Tokai)



Development of Accelerator-driven System (ADS)



Management of Radioactive waste
Proton beam irradiation experiment
ADS Design, Material, Lead-Bismuth
MA separation, Neutronics

International cooperation

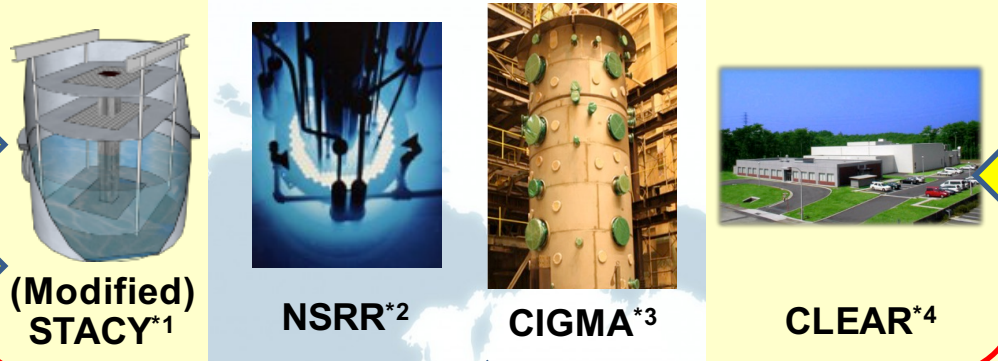
- CERN (EU)
- SFTC (UK)
- GSI (DEU)
- PSI (CHE)
- ESS (EU)
- ORNL (USA)
- IHEP (CHN)
- INSTN(CHN)
- KAERI (KOR)
- BATAN (IDN)
- ANSTO (AUS)

International cooperation

- IAEA
- OECD/NEA
- KIT (DEU)
- PSI (CHE)
- SCK-CEN (BEL)
- DOE (USA)
- CEA (FRA)

International Cooperation in the fields of Nuclear Safety Research

JAEA facilities in Tokai



Ex.) Criticality safety

IRSN (France)

- technical exchange, JAEA staff hosting at IRSN

NCCP (Russia)

- STACY Fuel fabrication

OECD/NEA

- ICSBEP (Int. Criticality Safety Benchmark Evaluation Project)

Ex.) Environmental sampling

IAEA

- NWAL (Network of Analytical Labs.)

OECD/NEA
CSNI SESAR/SFEAR2 (Senior Expert Group on Safety Research / Support Facilities for Existing and Advanced Reactors 2)

- *1: STACY (Static Critical Experiment Facility)
- *2: NSRR (Nuclear Safety Research Reactor)
- *3: CIGMA (Containment InteGral Measurement Apparatus)
- *4: CLEAR (Clean Laboratory for Environmental Analysis and Research)

Multilateral collaboration

OECD / NEA

- WGs of CSNI (WGFS, WGFCs, WGAMA, WGIAGE, WGRISK)
- CSNI SESAR/SFEAR2
- Joint Projects (BSAF, CIP, Halden, SCIP, ARC-F, ICSBEP, etc)

IAEA

- NWAL, RANET, ANSN

NUGENIA

- IPRESCA

EU

- MITHYGENE (ETSON)
- Coop. Arrangement (JRC)

Bilateral collaboration

Canada (McMaster Univ.)

- Coop. Agreement (IRSN)
- Framework Agreement (CEA)
- VERDON5 (CEA)

Germany

- Framework Arrangement (KIT)

Korea

- Arrangement for coop. (KAERI)

Norway (IFE)

U.S.A.

- Memorandum of Coop. (NRC)

Russia

- STACY fuel fabrication (NCCP)
- Zr cladding for PWR (VNIINM)

Sweden (KTH)

GIF(Generation IV International Forum)

- Standardization of Safety Design Criteria
- Sharing of R&D items
- Discussion on the international utilization of JAEA's R&D facilities

OECD/NEA

- NI (Nuclear Innovation) 2050

IAEA (INPRO, etc.)

- Information sharing on R&D activities
- Discussion on the international utilization of JAEA's R&D facilities
- Standardization of Safety Design Criteria

Japan-USA (CNWG)

- Sharing tasks and data

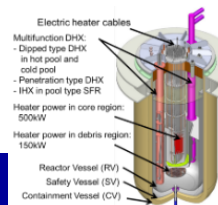
JOYO

- **Fast neutron irradiation facility**
 - ✓ 100MWth output
 - ✓ First Criticality 1977
 - ✓ 100 Irradiation Experiences
 - ✓ Material & Fuel irradiations
 - ✓ 21 in-core + Outer core/reactor vessel



AtheNa (Advanced Technology Experiment Na Facility)

- **Mega-scale sodium loops**
 - ✓ Dimension: 130m(W) x 62m x 55m(H)
 - ✓ Sodium inventory : 240 ton
 - ✓ Cranes : 120 & 100 ton
 - ✓ For Thermal-hydraulic experiments, Safety demonstration, System & Component developments



Japan-France (ASTRID, Cooperation with EDF and IRSN)

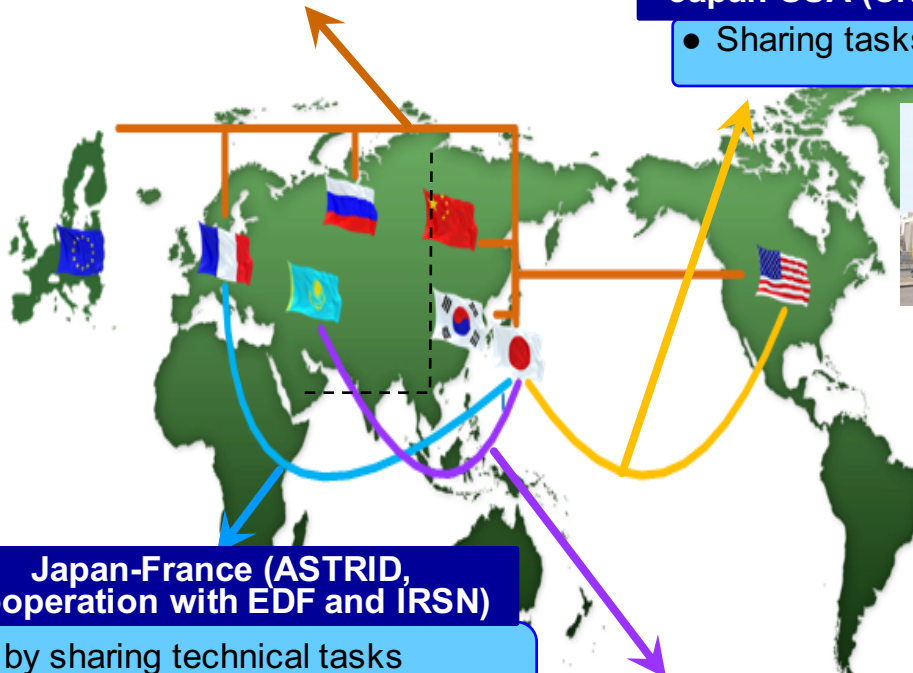
- R&D by sharing technical tasks
- Harmonization of safety designs
- Discussion on the international utilization of JAEA's R&D facilities

Japan-Kazakhstan (EAGLE Project)

- Experiments on severe accident studies

Japan-USA-France

- Information exchange and study on safety, reduction of radioactive waste, etc.



Multilateral collaboration

OECD/NEA



Joint Test by HTTR, LOFC Project (Contracted Research)

- Loss of forced cooling test (Completed)
- Loss of core cooling test (planned)

NI2050 • Cooperation related to HTGR cogeneration

IAEA



Coordinated Research Project (CRP) under Technical Working Group on Gas Cooled Reactors (TWG-GCR)

- Modular HTGR safety design

Generation IV International Forum (GIF)



Very High Temperature Reactor (VHTR)

EU



GEMINI+ Project

- Design and R&D of HTGR with heat application

Bilateral collaboration



USA

Civil Nuclear R&D Working Group (CNWG)

- Simulation algorithm, analytical model, study of connecting test between HTTR and heat utilization system (DOE, INL)



Poland

- Information exchange under “Action Plan for the Implementation of the Strategic Partnership between Japan and the Republic of Poland (2017-2020)” (NCBJ)



United Kingdom

- U-Battery project (URENCO, etc.)

High Temperature engineering Test Reactor (HTTR)

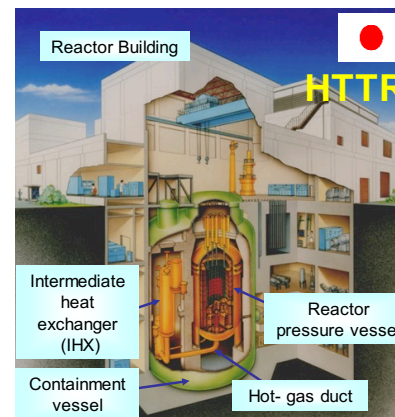
- Thermal power: 30 MW
- Fuel: Coated fuel particle/ Prismatic block type
- Core material: Graphite
- Coolant: Helium gas (Reactor outlet temperature 950°C(Max.))

➤ History

- First criticality: 1998
- Full power operation: 2001
- 50 days continuous 950°C operation: 2010
 - Fundamental technologies: fuel, core physics, operational data, etc.
 - Demonstration of stable heat supply to a future heat application system
- Loss of forced cooling test at 9MW: 2010
 - Demonstration of safety features of HTGR

Development of hydrogen production technology using heat from HTGR

- Completion of Bench-scale test for IS-process (Hydrogen production from water through chemical processes)
- Industrial material component test by test facility
 - 31 hours hydrogen production with 0.02m³/h (2016)



Hydrogen production test facility

Workshop on "technological development for nuclear non-proliferation and security"



IAEA

DOE



On-site practical facilities training using computers by invited specialists from relevant domestic and international agencies.

Policy Research

Implementation of policy research for present-day issues concerning peaceful use of nuclear energy, nuclear non-proliferation and nuclear security

EURATOM

Domestic organizations

Contribution to the CTBT International Verification Regime

- Development of advanced CTBT nuclear test verification technologies and establishment of international monitoring system
- Analysis and evaluation of the DPRK's nuclear tests



JAEA/ISCN

*Integrated Support Center for Nuclear Nonproliferation and Nuclear Security

Capacity Building Assistance

- Human resource development (HRD) support by training, seminars and workshops, mainly for Asian countries
- Nuclear security course
- Safeguards and SSAC course
- International Nuclear Nonproliferation Framework course
- Multi-/bilateral cooperation

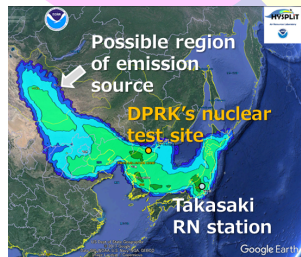
CTBTO

Technology Development

- Nuclear proliferation resistance technology and evaluation techniques
- Advanced safeguard technology
- Molten fuel measuring control technology for Fukushima Daiichi NPS
- Non-destructive detection/measurement technology
- Nuclear forensics technology



Providing training courses to Asian Countries



Analysis result of estimation of the possible source region by Atmospheric Transport Modelling simulation (the DPRK's 6th test)

WINS

ASNO

Relevant ministries

Nuclear relevant Network in Asia

Recent topics

- ❑ Cooperation with National Centre for Nuclear Research in Poland (NCBJ) and URENCO on HTGR (MOC was signed with respective organizations on May 18, 2017)
- ❑ Cooperation with ROSATOM on the information exchange for the R&D on the transmutation of minor actinoid (MA) (MOC was signed on September 7, 2017)
- ❑ Cooperation with U.S. Nuclear Regulatory Commission (NRC) for nuclear safety research (MOC was signed on December 26, 2017)
- ❑ Cooperation with the French Alternative Energies and Atomic Energy Commission on the information exchange for the decommissioning of Monju (Arrangement was signed on January 18, 2018)



MOC was signed on the occasion of East Economic Forum held at Vladivostok



Arrangement was signed at the bilateral meeting held in Avignon



Significance of International Cooperation on R&D in the nuclear field

- ❑ Global dimension of nuclear energy
 - Global dimension in terms of both benefits (ex. mitigation of climate change) and challenges (ex. damage inflicted beyond the national border in case of nuclear incidents, proliferation and security risk).
 - We have to work together to tackle common challenges
 - International cooperation has become further important as the number of states operating nuclear power plants increases.
- ❑ Significance of International Cooperation on nuclear R&D
 - While competition among supplier states intensifies in the global nuclear market, in the field of nuclear science and technology the means and outcomes of international cooperation should be widely shared and be used for solving global issues and for enhancing human knowledge.
- ❑ Example of collaborative efforts on nuclear R&D
 - Joint use of large-scale experimental facilities
 - Implementation of R&D projects to fill the technology gaps
 - Efforts of HRD activities in terms of expanding global nuclear use avoiding the risks on safety, proliferation and security



Conclusion

- Given the global dimension of nuclear energy, international engagement is essential.
- We will work together with the international partners for the advancement of the knowledge base for nuclear science and technology.
- Specifically, such type of cooperation as the sharing of expertise and research infrastructures is important and the mechanism for such cooperation should be further developed.
- JAEA will continue to play a role as a sole comprehensive nuclear R&D institute of Japan in cooperation with the global nuclear community.