

NARREC

Naraha Center for Remote Control Technology Development

Open up the Future by Remote Control Technology



Naraha Center for Remote Control Technology Development

Sector of Fukushima Research and Development
Fukushima Research Institute



Japan Atomic Energy Agency

Development center on advanced remote control technology with researchers and engineers in a wide range of specialized areas

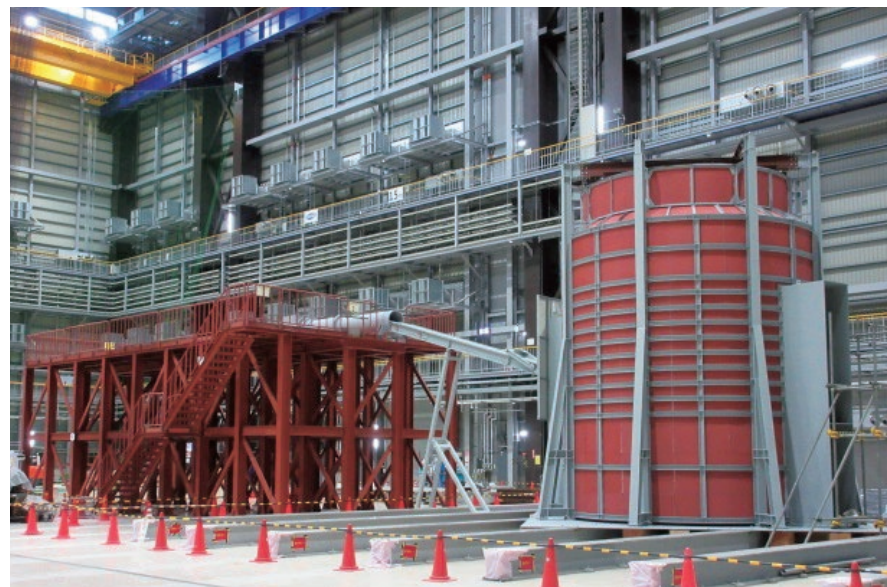
NARREC Naraha Center for Remote Control Technology Development

The Naraha Center for Remote Control Technology Development (NARREC) of the Japan Atomic Energy Agency (JAEA) was established to develop and verify remote control equipment (robots, etc.) for promoting the decommissioning of the Fukushima Daiichi Nuclear Power Plant (1F) of Tokyo Electric Power Company Holdings, Inc...

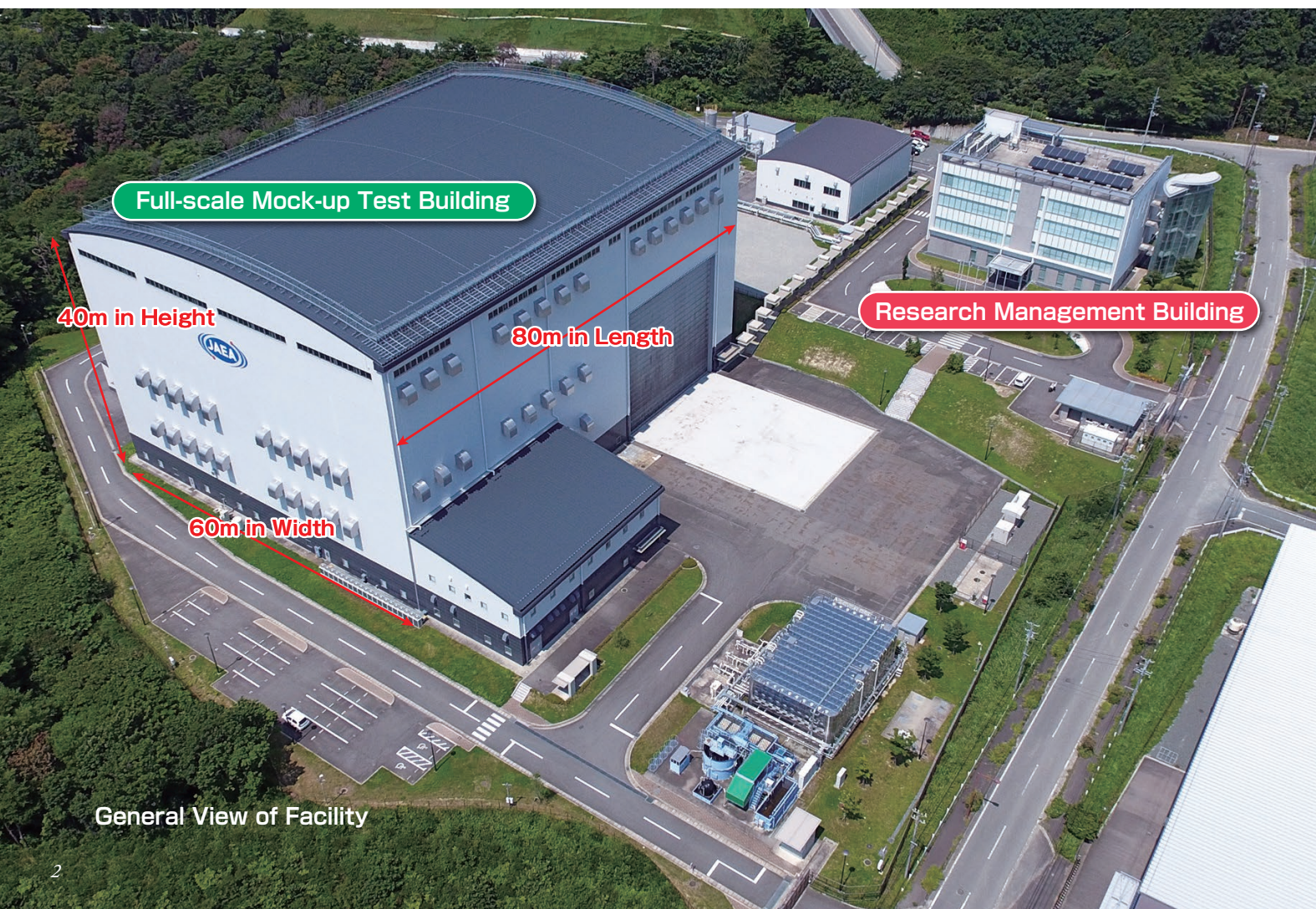
In the facility, which consists of the Research Management Building and the Full-scale Mock-up Test Building, users can use a robot simulator along with mock-up testing devices to conduct efficient and effective research and development.

External use of these facilities started in April 2016, and NARREC supports R&D for researchers and engineers in a wide range of specialized areas related to remote control technology. In addition, by disseminating the information on the obtained results, the NARREC is aiming to become a global center for remote control technology development.

In addition to the decommissioning of 1F, the facility can also be used for a wide range of purposes.



▲Primary Containment Vessel (PCV) Mock-up in the Full-scale Test Area (Full-scale model).
Example of use: See 1 Ref. Agency for Natural Resources and Energy website



General View of Facility

To ensure safe and efficient decommissioning of 1F,

To ensure safe and efficient decommissioning of 1F, verification testing is performed on various types of remote control technology used in the decommissioning process, including tests in preparation for fuel debris retrieval, which will be the most difficult task in the decommissioning.

Example of use: 1

International Research Institute for Nuclear Decommissioning (IRID)

Development of Technology for Detailed Investigation of Inside of PCV (On-site verification of technology for detailed investigation of inside PCV using X-6 penetration)

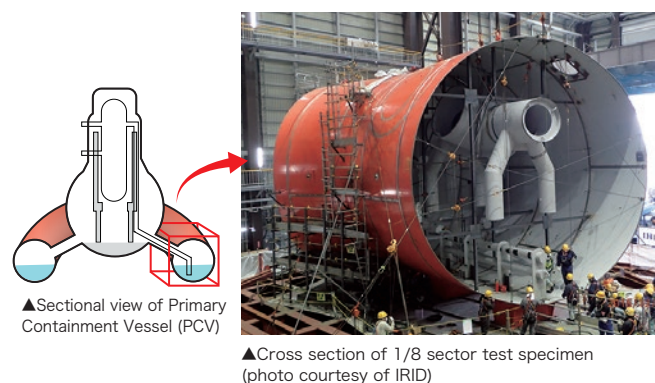
- Facility: Full-scale Mock-up Test Building (full-scale mock-up test area)
- Details: To verify the detailed operation procedure of the robot arm used in the detailed investigation on inside of the PCV (Unit 2 of 1F) and to train operators.

Example of use: 2

International Research Institute for Nuclear Decommissioning (IRID)

Full-scale Test of Repair Technology for Leakage Sections in PCV

- Facility: Full-scale Mock-up Test Building (full-scale mock-up test area)
- Details: Installing a test specimen with the suppression chamber at the bottom of the Primary Containment Vessel (PCV) which is cut out to 1/8 in the actual size. The full-scale testing is conducted to develop the technology for repair and water stoppage at the bottom of the PCV.



▲Sectional view of Primary Containment Vessel (PCV)

▲Cross section of 1/8 sector test specimen (photo courtesy of IRID)

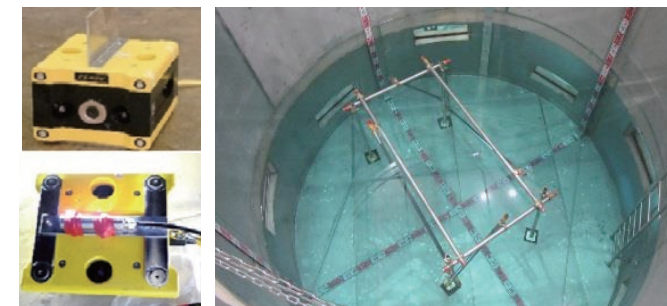
Example of use: 3 ABLE Co., Ltd.

- Facility: Full-scale Mock-up Test Building (Robot Test Pool)
- Details: Simulation test of pumping up stagnant water and collecting oil from water in the basement floor in the 1F building.



Example of use: 4 ATOX Co., Ltd.

- Facility: Full-scale Mock-up Test Building (Robot Test Pool)
- Details: Testing was performed to investigate the radiation dose on the basement floor of the high temperature incinerator building, as part of the investigation in preparation for completing the treatment of water retained in the building. A test was performed to check how high the sludge rises using an underwater vehicle (ROV), and training was conducted in operations for avoiding structures (obstacles).



Example of use: 5 The Creative Robot Contest for Decommissioning

This is conducted as part of the program to strengthen decommissioning research and personnel training by the Ministry of Education, Culture, Sports, Science and Technology. Students at technical colleges from all over the country think of problems in the decommissioning process and solutions to those problems, and compete with one another in robot operation.

- Facility: Full-scale Mock-up Test Building (common area)
- Details of this event: The competition task is to retrieve fuel debris at the bottom of the pedestal of 1F, and the students retrieve debris-like objects from the platform of the pedestal mock-up.



▲The 4th Creative Robot Contest for Decommissioning (with 17 schools and 18 teams participating)

Changing from the disaster area to the “challenge area”

Based on the Fukushima Innovation Coast Framework, a national project that aims to realize the agglomeration of new industries in the area of Hamadori, we have begun various efforts in research and development as well as the personnel training.

Our facilities are open to the public along with events held by local governments.

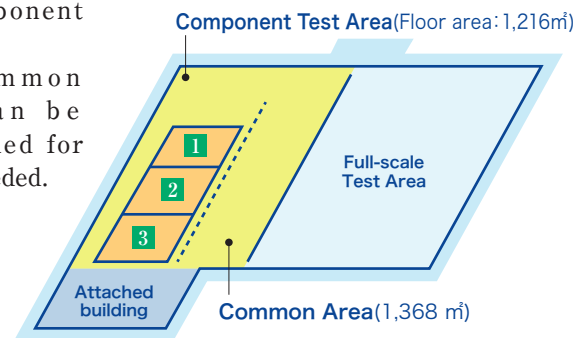
- Holding a facility observation event along with the partial reopening of Roadside Station Naraha (April 25, 2019).
- Our facilities are open to the public along with the “Futaba World 2019” event at J-Village (October 5, 2019).

The large space and state-of-the-art facilities in the Full-scale Mock-up Test Building used for R&D and verification testing for remote control technology

Can be used for verification testing of various types of remote control equipment

Full-scale Mock-up Test Building (60m in Width,80m in Length,40m in Height)

A verification testing field focusing on test equipment to simulate an environment of robot activity is prepared in the component test area.
The common area can be partitioned for use as needed.

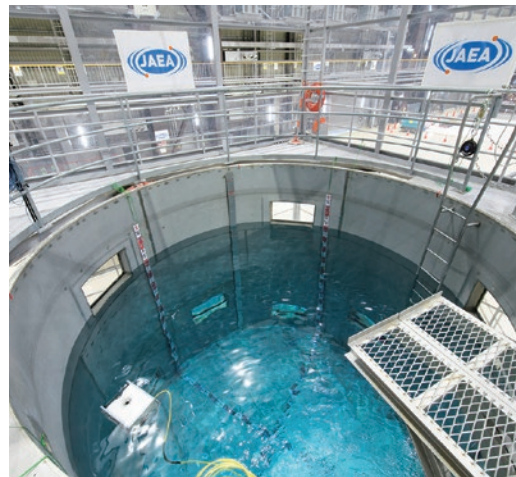
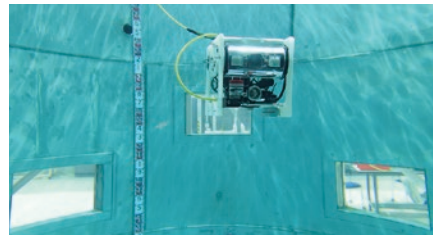


▲Test equipment in the component testing area in the full-scale mock-up test building

1 Robot Test Pool

Cylinder-type water tank for use in verification testing of underwater vehicles. Simulating the required water quality, tests can be conducted up to a depth of 5m.

[Specifications]
Diameter: 4.5m,
Depth: 5.0m (height: 5.5m)
Observation windows: 12 places
Water temperature: Room temp to 60℃
Water quality: potable water, water for industrial use, turbid water, salt water
Attached facilities: underwater camera, lights, jib crane

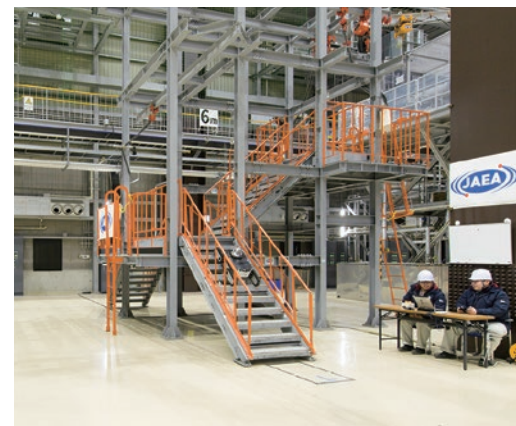


▲There are a total of 12 windows at the top, mid and lower levels for observing the interior, making it possible to verify the robot operation during tests.

2 Mock-up Stairs

The slope angle, guardrail width, step height and floorboard materials can be varied, enabling various types of tests.

[Specifications]
Angle: 40, 41, 42, 43, 51 and 55 degrees
Guardrail width: 700, 800, 900, 1000 mm
Floorboard: checkered plate, grating
Step height: 180, 190, 200, 210, 220, 230 mm
The stairs can be changed to rotate at 90 degrees (right and left) or 180 degrees (right and left).



▲Mock-up stairs can simulate the stairs in the reactor building of 1F

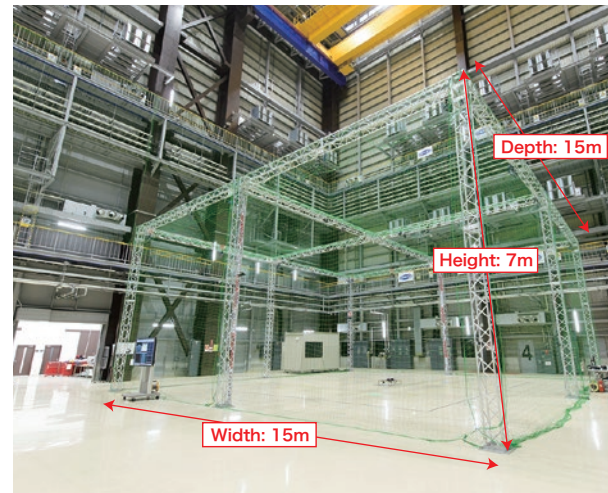
3 Motion Capture System

Quantitative measurement of the movement of drones and robots in a wide spatial domain. The measurement range is subject to change depending on the camera position.

[Specifications]
Measuring range:
① 10m width x 10m depth x 2m height
② 6m width x 6m depth x 5m height
Measuring precision: ±1.5mm (for the above-mentioned measuring range)
Cameras: 16 (T20S from Vicon)
Software: (Nexus2.0Network from Vicon)



▲High-speed cameras provide an overall picture of movement from all directions.



▲Large motion capture system of a wide measuring range, where a truss (15 m width, 15 m depth, and 7 m height) is equipped with 16 cameras.

※ There is also portable equipment in the form of 10 cameras. Please feel free to talk to us if you would like to use them.

In addition to a VR system, users can also utilize the user room

Research Management Building (60m in Width,80m in Length,40m in Height)

The virtual reality (VR) system enables efficient and effective verification and development of robot design in cooperation with a robot simulator. In addition, we have user room and laboratories for long-term facility users and also lecture rooms and a meeting room are available.

4 VR system

Since the data for the 1F building are installed in the system, it is possible to project CAD and CG data as well as point cloud data that are measured using a laser scanner.

Using these data, it is possible to discuss the plans for decommissioning with this system and to practice the decommissioning. You can also use these data in your own laboratories (outside of NARREC).

The simulation can also be projected on a screen in cooperation with a robot simulator. This enables to verify the robot movement from 3D view and multilateral viewpoints as well as to study and practice of the operation plans.

[Main Functions]

Watching function of simulated space, Display function of radiation dose distribution, Light setting function, Distance measurement function between objects, Arbitrary objects input function in the simulated space



▲VR system that enables to project various types of 3D data on the front, right, left and bottom sides of a cubic screen.

In addition to robot verification testing, facilities for exhibitions, meetings and lectures can be used.



▲ There is no charge to use the tools



▲ User room



▲ Lecture room



▲ Multipurpose room

Efficient technology development through verification testing and robot simulator

Remote control technology for robots is absolutely necessary in the high-dose radiation environment of 1F decommissioning. For this purpose, NARREC builds systems that combine verification tests and simulations, and makes technology development for robot simulator with communication disturbance simulation. NARREC also provides environment model data. In addition, taking advantage of our potential for technological development as experts in remote control technology, NARREC not only offers the facilities for users but also supports their technological development.

Efficient robot development is possible through interaction

Development and verification testing of standard test methods for robots used in dealing with nuclear hazards

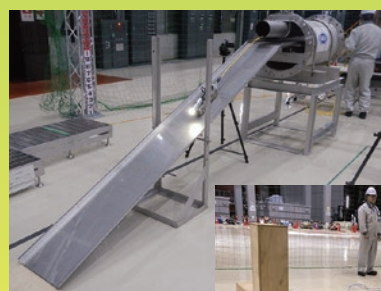
Development of test methods for quantitatively evaluating basic robot performance needed in nuclear hazards and decommissioning



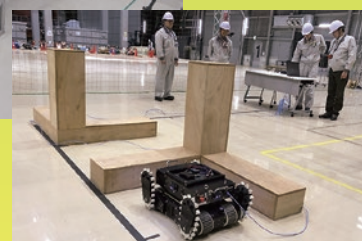
Testing performance on the stairs



▲Testing performance in a narrow passage



▲Testing access into the primary containment vessel (PCV) through open holes



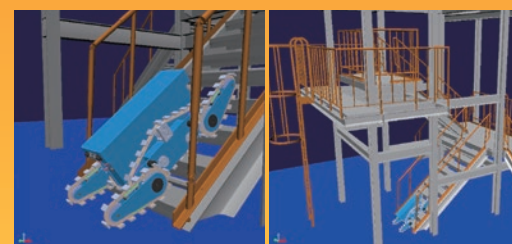
▲Testing cable traction performance

Development of robot simulator

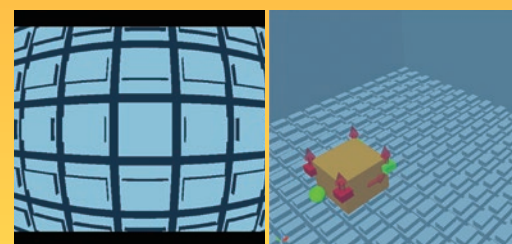
Development of simulator for the efficient robot development and support of the robot operation training, using environmental data at the decommissioning site.



Remote control training with a robot model in a virtual decommissioning environment built inside a computer



▲Example of traveling robot simulation



▲Example of underwater swimming type robot simulation

※Development based on a choreonoid developed at the National Institute of Advanced Industrial Science and Technology

Procedures and fees for using the facilities

Procedures for using the facilities Please apply to use the facilities after consulting with us in advance.

●The procedures for using NARREC are as indicated below.

Before use	Consultation	Please consult with us regarding the details of how you would like to use the facilities (date, area, testing details, etc.) by email or telephone. Contact: Utilization Promotion Section ✉ naraha_mockup@jaea.go.jp ☎ +81-240-26-1040 (main number)
	Application	Please input the details in the use application system based on what has been determined as a result of your consultation with us. After confirming the safety issues, we will inform you thereof.
When using the facilities	Using the facilities	We will provide safety training and explanation of how to handle the facilities when you visit NARREC. Please consult with us as needed regarding how you would like to use the equipment.
After Use	Pay the fees	We will send you an invoice based on your use of the facilities. Please pay by bank transfer within 30 days.

※Applications for using the facilities are contract-based. Therefore, please be sure to confirm the contract. (You can view the contract on our website. <https://naraha.jaea.go.jp/use/flow.html>)

Use fees The fees for using the facilities are as indicated in the table below.

●Support when operating the facilities is included in the facility use fees. You can also use various attached facilities such as the robot simulator, crane, forklift, measuring instruments and machine tools.

Fees for using the facilities ※1		+ <ul style="list-style-type: none"> Handling fees (900 yen for each usage) Actual cost of use (actual cost of electricity, water supply, etc. used in tests) 	= Use fees
※All costs include tax			
Division of areas	Use fees		Note
	Regular fees	Discounted fees ※2	
Component Test Area (Floor area: 1,216㎡)	Height from 0 to 40 m 133 yen	Height from 0 to 40 m 67 yen	Per ㎡ and per day
Common area (Floor area: 1,368 ㎡)	Height from 0 to 10 m 82 yen	Height from 0 to 10 m 41 yen	Per ㎡ and per day
Multi-purpose testing area (outside)	65 yen	33 yen	Per ㎡ and per day
Robot Test Pool (48㎡)	3,936 yen	1,968 yen	Per day
Mock-up Stairs (43㎡)	3,526 yen	1,763 yen	Per day
Motion Capture System (225㎡)	18,450 yen	9,225 yen	Per day
VR system	3,890 yen	1,960 yen	Per hour
Multipurpose room	5,387 yen	2,714 yen	Per hour
※1 The laboratory and meeting room can be used for purposes other than those mentioned above. Please see our website for details. ※2 Discounted fees are applied for special measures for institutions of higher education, small and medium-sized enterprises and people using the facilities for purposes of decommissioning 1F or the Fukushima Innovation Cost Framework.			

Visiting the facilities and inquiries

You can visit our facilities at any time

What can be observed

- Overview of Naraha Center for Remote Control Technology Development
- Visit to the Virtual Reality (VR) system
- Visit to the Full-scale Mock-up Test Building (Test pool, Mock-up stairs, and Motion capture system)

Time needed

45 min. – 60 min. (depending on what you want to observe)

How to apply

- After calling in advance, please read the precautions in the observation application form and apply by filling in the necessary items. An application form can be downloaded as indicated below.

<https://naraha.jaea.go.jp/en/>

Naraha Center for Remote Control Technology Development



Inquiries and Applying

☎ 0240-26-1040



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Sector of Fukushima Research and Development
Fukushima Research Institute



Japan Atomic Energy Agency

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