Start Up of Naraha Remote Technology Development Center (NRTDC)

October 2, 2015

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1. Introduction
2. Role of NRTDC
3. Location and construction schedule and status of NRTDC
4. Mockup and instrumentation tools to be equipped
5. Planned development by JAEA at NRTDC
6. International Cooperation
7. Conclusion
1. Introduction

**Background**

For research and development (R&D) on the decommissioning of TEPCO’s Fukushima Daiichi Nuclear Power plants (called 1F), 85 billion yen was financed to Japan Atomic Energy Agency (JAEA) to construct the research facilities in 2012 by Japanese Ministry of Economy, Trade and Industry (METI).

**Challenge of the establishment**

As an essential research center for Remote controlled equipment and device development facility for 1F, Naraha Remote Technology Development Center (NRTDC) is under construction, is in partially operation and will be fully operation in April 2016.
2. Role of NRDTC

Acceleration of research for 1F decommissioning

- NRTDC will be utilized by IRID and Tepco for remote controlled equipment and device for 1F decommissioning and will be utilized for disaster response research and development robotics by university researcher and JAEA.

Contribution of decommissioning of 1F

- Challenge to create a testing environment which can be performed only here to solve new problems concerning the decommissioning by using R&D results which have been accumulated in JAEA.
- Integration of wisdom of researchers and engineers who have engaged in national and international related facilities, and nuclear human resource development through the R&D above mentioned.
3. Location and construction schedule and status of NRTDC

<table>
<thead>
<tr>
<th>Year</th>
<th>Design</th>
<th>Construction</th>
<th>Operation</th>
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<tbody>
<tr>
<td>2013</td>
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<td>2014</td>
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<td>2017</td>
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Remote Controlled Equipment and Device Development Facility

- Acceleration of the decommissioning of 1F
- Advancement of the technology (JAEA R&Ds)
- Reinforcement of safe base
- R&Ds with the local business (Industrial innovation)

Map:
- Fukushima Pref.
- Iwaki city
- Futaba
- Okuma
- Naraha
- Fukushima Daiichi

Naraha Remote Controlled Technology Development Center
3. Location and construction schedule and status of NRTDC

Layout of the site

Research management building ($w35m \times d25m \times h20m$)

Test building ($w60m \times d80m \times h40m$)
4. Mockup and instrumentation tools to be equipped (1)

Purpose and target of this facility

In the inside of the 1F building, a person cannot approach the operation floor because of a high radiation dose.

Remote controlled devices are necessary for the decommissioning works.

- Contribution to decommissioning of 1F through the establishment of the technical base about remote controlled devices
- Creation of the R&D base for the researchers of the remote technology

- Demonstration test for the technique to repair a water leakage at the primary containment vessel (PCV)
- Development test of the remote controlled devices to be used an investigation, the decontamination in the 1F building
- Confirmation of the work procedure and training of the workers in 1F by the virtual reality system
- Development of robot and training of operators by robot simulator
- R&Ds of remote controlled technology with the local companies
4. Mockup and instrumentation tools to be equipped (2)

Demonstration test area for the technique to repair a water leakage at the PCV and development and demonstration test area for the remote controlled devices are prepared in Test building.

Test building (W60m×D80m×H40m)

Research management building

Virtual Reality System

Test assembly (1/8 scale)

Water pool

Motion capture camera

Mock-up Ladders

Robot Simulator
① Planning of the work procedure
   It will be used to validate the working method and procedure, by testing the plan in the virtual space.

② Training and drill
   The workers can better understand the work environment, the work methods and procedures by going through the virtual scenarios as experience for real world scenarios.
5. Planned development by JAEA at NRTDC (1)

Research theme for 7 years from FY 2015.

<table>
<thead>
<tr>
<th>No.</th>
<th>Research theme</th>
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<tbody>
<tr>
<td>1</td>
<td>Development of Robotic Technology</td>
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<tr>
<td></td>
<td>Standard performance test method</td>
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<tr>
<td>2</td>
<td>Robot simulator</td>
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<tr>
<td>3</td>
<td>Powered exoskeleton with radiation shielding</td>
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<td>4</td>
<td>Nuclear emergency assistance robot</td>
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<td>5</td>
<td>Development of Hot testing Technology</td>
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<td>Laser machining technology</td>
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<td>6</td>
<td>Laser diagnostics technology</td>
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<td>7</td>
<td>Gamma-ray CT technology</td>
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<tr>
<td>8</td>
<td>Advanced instrumentation system</td>
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<tr>
<td>9</td>
<td>Water stoppage technology using photo-curing resin</td>
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Example of robotic technology development (1)

Developing test method for quantitatively evaluating common capacities of task performance for nuclear emergency response robot. Clarifying demanded level for robots and technical achievement level for operators

Inputting data into PC which include changeable work site environment for decommissioning and Developing simulator with the aim to plan and training of decommissioning work for robot, and its streamlined development

Standard performance test methods for nuclear emergency response robots

Robot development

Robot operation training

* Robotic simulation system is based on AIST’s Choreonoid

Simulator for robots used for 1F decommissioning

Design

Test operation

Manufacturing

Test operation

Basic training

Operation training

1F environmental data
5. Planned development by JAEA at NRTDC (3)

Example of robotic technology development (2)

- Light task Robot for door opening
- Small unmanned Helicopter for investigation
- Investigation Robot for Radioactivity Distribution
  - Gamma Ray imaging and measurement device
5. Planned development by JAEA at NRTDC (4)

Example of hot testing technology development

<Goals>
○ Develop a compact and multifunction head for fusing/crushing which can measure geometry.
○ Improve the database and simulation for fusing/crushing.
○ Develop analysis technology that can evaluate the mechanical properties change caused by thermal effect.

Development of machining technology for radioactive material

Database Simulation

Laser output

Fusing/crushing velocity

Fuel debris

Laser beam machining head

Fusing

Crushing

Control of illumination conditions

Fusing/crushing efficiency

Development of analysis technology for radioactive material

Target

Core boring

Laser for excitation

Laser for measurement

ultrasonic

thermal effect
6. International Cooperation

Establishment of strategic partnership

Successive development and operation

- Establishment of the standard test method for nuclear emergency response robot
- Planning a robot competition

Promotion of utilization

- Survey of overseas facilities utilized for remote technology development and emergency response and establish a partnership.
- Open for foreign researchers and engineers to use
7. Conclusion

✓ JAEA follows the medium-and-long term road map and pushes forward the construction or design works of facilities.

✓ The Remote controlled Equipment and Device Development Facility has been constructed from September 2014, is in partially operation in 2015, and will be in full operation in April 2016.

✓ JAEA aims at the establishment of the attractive international R&D base facilities based on user’s needs to facilities.