1 Research and Development Related to the Accident at TEPCO's Fukushima Daiichi NPS

Assistance in Environmental Restoration and Decommissioning

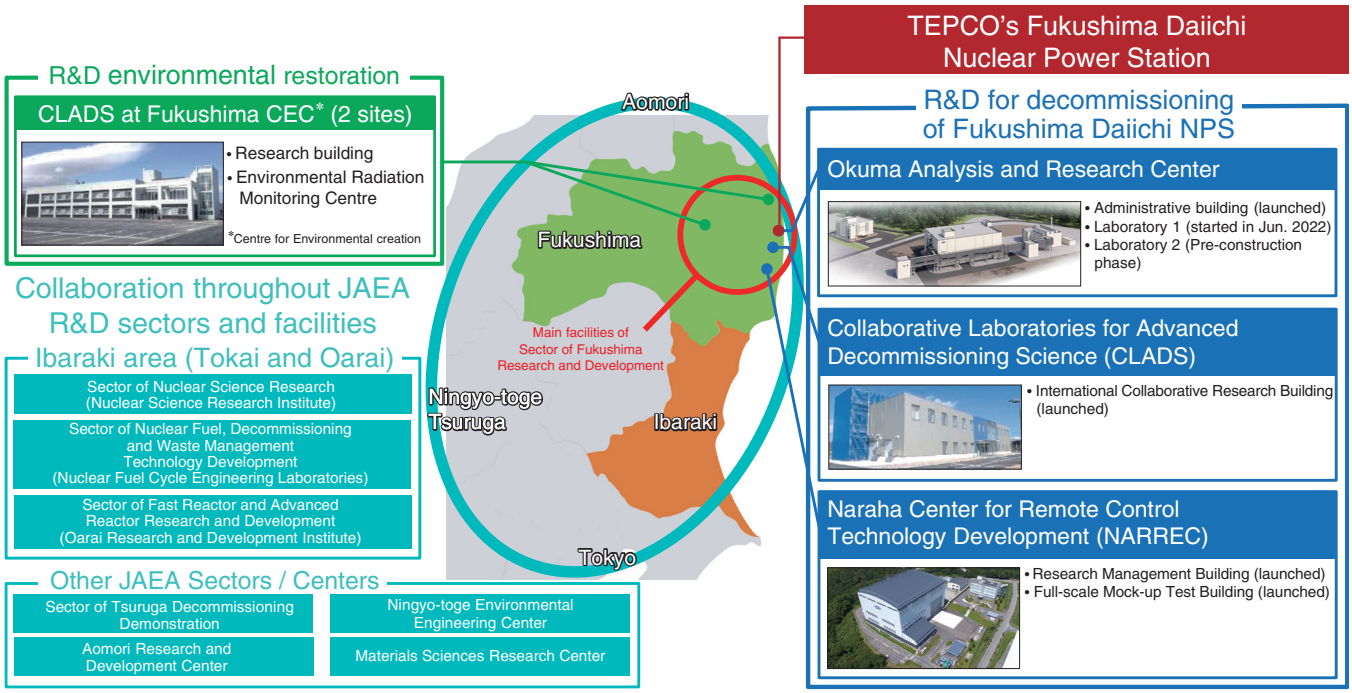

Fig.1-1 Research and development (R&D) facilities of Sector of Fukushima Research and Development and the status of collaboration throughout the JAEA R&D sectors and facilities
The Sector of Fukushima Research and Development has been proceeding with the development work of the facilities that will serve as research bases in Fukushima to conduct R&D related to TEPCO's Fukushima Daiichi NPS (1F) decommissioning and environmental restoration of Fukushima. In addition, the entire JAEA has been working cross sectionally on urgent issues related to 1F decommissioning.

Soon after the accident at the TEPCO's Fukushima Daiichi NPS (1F), the JAEA, as the only organization conducting comprehensive research and development (R&D) on nuclear energy in Japan, commenced activities in Fukushima. The Fukushima Research and Development (R&D) Sector has been establishing R&D facilities in Fukushima and is working on R&D for the decommissioning of the 1F and for environmental recovery in the surrounding area by collaborating with other JAEA R&D sectors (Fig.1-1).

The three facilities located in Hamadori area on the Pacific coast of Fukushima are the Collaborative Laboratories for Advanced Decommissioning Science (CLADS) at Tomioka, Naraha Center for Remote Control Technology Development (NARREC), and Okuma Analysis and Research Center. They are a part of the Fukushima Innovation Coast Initiative (field of decommissioning), a national project that aims to build a new industrial base in Hamadori area to restore the industries that were lost because of the Great East Japan Earthquake and the nuclear disaster. These facilities conduct R&D for decommissioning, etc. according to their respective roles. As R&D for decommissioning, we mainly work on R&D related to fuel debris retrieval, accident progression scenario analysis, treatment and disposal of radioactive waste, remote control technology, etc. and contribute to 1F decommissioning (Fig.1-2).

During fuel debris retrieval, it is necessary to conduct an accurate safety and risk assessment to safely and reliably implement a series of processes, including retrieval from the reactor, transfer, storage, and management. We are conducting R&D related to understanding fuel debris properties and the situation inside a reactor. For example, an estimate of the state of degradation of fuel debris that has been most likely exposed to water for a long period is an index to understand the properties of the fuel debris to be retrieved (Topic 1-1). It is also important to evaluate the possibility of criticality due to changes in the ratio of nuclear fuel material and water, shape, etc. when retrieving fuel debris (Topic 1-2). In addition, to understand the current fuel debris properties and the situation inside the reactor, it is important to estimate the accident progress scenario and the situation inside the reactor immediately after the accident. Therefore, it is essential to study the failure mechanism that takes into account the unique structure of the 1F reactor to estimate the situation inside the reactor at the time of the accident (Topic 1-3).

To safely and stably store the radioactive waste generated in the 1F accident and during the decommissioning and to dispose it in the future, it is necessary to consider appropriate treatment and disposal methods for radioactive waste. As one approach toward this purpose, in the treatment of contaminated water containing a wide variety of radioactive substances and compounds, it is important to develop new element removal technologies that are different from the existing ones to prepare for unexpected treatment conditions (Topic 1-4). In addition, when storing radioactive waste, it is necessary to consider a management method different from that applied for general waste, considering the effects of radiation (Topic 1-5).

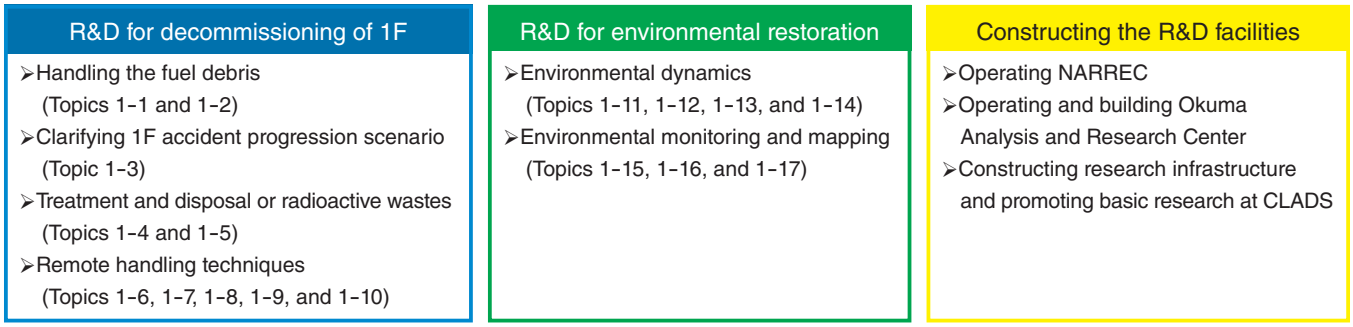

Fig.1-2 R&D efforts related to the response to the accident at the 1F based on medium-/long-term plans
R&D is carried out by extracting the items to be implemented for each field based on the three pillars: "R&D for decommissioning", "R&D related to environmental restoration", and "construction of R&D infrastructure".

For conducting decommissioning work in an environment with a high radiation dose, it is necessary to develop a radiation-measuring device and a remote identification method for ensuring work efficiency and reducing worker exposure to radiation. Therefore, we are developing detectors that can perform measurements even in harsh environments and equipment that can visualize contaminated areas. As an example of detector development, we have developed detectors that can operate under high dose-rate radiation fields and high humidity environment (Topics 1-6 and 1-7) and a detector that can quickly measure alpha/beta/gamma rays (Topic 1-8). In addition, we developed a new method to measure the distribution of radioactive material using optical fibers (Topic 1-9) and a device that can visualize contamination locations three-dimensionally by combining a detector that measures distribution of radioactive contamination and three-dimensional environment modeling device that uses a laser (Topic 1-10).

For R&D related to environmental restoration, CLADS has established a research base in Research Building (Miharu town) and Environmental Radiation Monitoring Centre (Minamisoma City) of the Fukushima Prefectural Centre for Environmental Creation, and has been working on environmental dynamics research and the development of environmental monitoring and mapping technologies through collaboration among Fukushima Prefecture, National Institute for Environmental Studies, and JAEA (Fig.1-2).

With regard to environmental dynamics research, it is important to focus on the transfer and accumulation of ^{137}Cs, a major radionuclide among the radioactive materials discharged into the environment as a result of the 1F accident, to provide basic information to resolve the concerns based on scientific findings, and to determine the zones for which the evacuation order is to be repealed and specific restoration and rehabilitation sites. Therefore, we are conducting R&D to elucidate the dynamics of radioactive Cs in the natural environment, such as the trend of changes in the amount of radioactive Cs discharged into river systems during typhoons (Topic 1-11), and to elucidate the transfer behavior of radioactive Cs ecosystems via computational studies on the retention mechanism of radioactive Cs in living organisms (Topic 1-12).

Radionuclides present in the environment may include ^{90}Sr and ^{99}Tc in addition to ^{137}Cs. Hence, a method for analyzing these nuclides is required (Topics 1-13 and 1-14).

For environmental monitoring and mapping (Topic 1-15), it is important to measure radiation dose rates, predict and evaluate exposure doses to contribute to decision-making by local governments on policy scheduling and considering the zones for which the evacuation order is to be lifted (Topics 1-16 and 1-17).

We have been generating R&D results that are the key to achieving the milestones of the medium-/long-term roadmap for decommissioning. We are evaluating the data that contribute to the planning of the lifting of evacuation orders by local governments for environmental restoration and providing these data to the relevant organizations. We are also working to promote the understanding of local residents and others by disseminating and sharing information on the status of decommissioning and other initiatives through collaborative projects with local communities and educational institutions, events, and press releases. Furthermore, we contribute to the improvement of technology, regional revitalization, and job creation in Hamadori area of Fukushima through the participation of local companies and the promotion of technology transfers in the implementation of R&D results in the field.

In the fourth medium- to long-term plan starting in FY2022, priority is given to "contribution to the experimental removal of fuel debris", "treatment and disposal of radioactive waste, and measures for disposal of Advanced Liquid Processing System (ALPS) treated water", and "provision and dissemination of information contributing to the release of the Specific Reconstruction and Revitalization Sites" as the main tasks at present. In addition to promoting safe, reliable, and prompt decommissioning processes that are technically challenging, such as fuel debris removal, we will continue to conduct surveys and R&D for environmental restoration to create an environment in which residents can live safely and securely. In the area of research facility development, we have commenced the operation of the Okuma Analysis and Research Center Analysis and Research Facility laboratory 1, which will conduct analysis of the radioactive solid waste generated during decommissioning and third-party analysis of ALPS-treated water. In addition, we will utilize the technologies, knowledge, and experience we have accumulated through decommissioning for back-end measures of nuclear facilities and share them widely with the rest of the world to contribute to improving the safety of nuclear facilities in worldwide.