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Geotechnical Application and Education Initiatives to Recovery of Nuclear Power Plant Accident

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1. INTRODUCTION
   By off the Pacific coast of Tohoku earthquake in Japan on March, 2011, the subsequent accident of nuclear power plants in Fukushima has been problematic. Nuclear reactors have been damaged, and surrounding environment has been contaminated by radioactivity. The severe accident must be solved along with four tasks: demolition of damaged facilities, remediation of the site, waste management and preventing the spreading of contamination. So far, geotechnical engineering has technically contributed to radioactive waste disposal and general/industrial waste disposal. Sufficient results related to controlling groundwater and ground stabilization have been achieved in general construction projects. Both techniques and experiences of geotechnical engineering would be applicable to the tasks. The Japanese Geotechnical Society (JGS) has started a project that is being supported by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). The project promotes both the technical development and the education of geotechnical engineering for decommissioning of nuclear power plants. This paper introduces contents of the JGS project. Geotechnical application and education initiatives to support the long term solution of nuclear power plant accident are discussed.
2. (a) RECENT SITUATION IN FUKUSHIMA AND GEOTECHNICAL VIEWPOINTS Factual details regarding the situation at the Fukushima I Nuclear Power Plant are still not clear, because the high levels of radiation around the site are preventing ground-based investigation. Currently, plans are being made to send in robotic samplers that can communicate electronically, and many nuclear, mechanical, and electronic engineers are now working on the development of such remote technologies. Outside the Fukushima I Nuclear Power Plant, remediation of contaminated ground is proceeding. Use, storage and disposal of the soil removed from the contaminated site are important practical issue at this moment. Geotechnical engineering has contributed to recycling by-products and waste, the environmental impact assessment in construction projects, construction and operation of waste disposal site, remediation of groundwater and soils contaminated by heavy metals, and planning geological disposal of radioactive waste. The situation caused by the accident at the Fukushima I Nuclear Power Plant would be improved to adopt the geo-environmental techniques.

3.RESEARCH AND EDUCATION PROJECT IN JAPAN

As shown in Fig. 1, JGS focused on three subjects: (i) prediction for land and groundwater contamination by radionuclide from now until decommissioning, (ii) development of boring technology and excavation methods such as tunneling that can be used for excavation of the fuel debris remaining in the nuclear reactors, and (iii) planning and development for the disposal of large amounts of radioactive waste from the accident and decommissioning of the damaged nuclear power plant. Geotechnical engineering is able to make a variation of countermeasure against troubles in that site, which is a mind of fault tolerance in civil engineering.

Research groups were systematically established in order to promote fundamental studies related to the subjects. As a preliminary investigation, Waseda University experimentally investigated a shielding technique against radiation using soils and the heavy slurry synthesized by metals and clays as shown in Fig. 2.

Huge amounts of radioactive contaminated soils produced during the nuclear power plant accident are also big issue. According to the directive of the Ministry of the Environment in Japan, the excavated contaminated soils are temporally stocked, and it is gradually transported to the intermediate facility for the storage. A liner system of the facility, compaction of soils and designing cover soil are specialty of geotechnical engineering. Brand-new technologies are now developing to apply geotechnical engineering to the problem as soon as possible.

Based on progress of the research, JGS has been working on an education program regarding fuel debris treatment and decommissioning of a nuclear power plant in Fukushima, supported by MEXT. Because it takes a long time to complete the remediation at Fukushima, it is necessary to educate younger persons who will become engineer and policymaker. "Radioactivity"is an advanced key word for geotechnical engineering and civil engineering, so the curriculum must be arranged by new viewpoints such as shielding and protection against radiation to be considered in conventional construction, operation and monitoring process.

4.CONCLUDING REMARKS

Soil is composed by solid (soil particle), liquid (water) and gas (air) phases. The ratio of the three phases and

density of soil can be artificially controlled. Therefore, soil is a useful natural material which has a shielding potential against radiation. To solve the issue caused by the accident at Fukushima I Nuclear Power Plant, geotechnical engineering must be developed still. The advanced geotechnical engineering will be established with both fundamental researches and in-situ education. JGS aims at cooperation with various academic fields, and networking to next generations, which are key toward the total solution of the severe accident such as a nuclear power plant in Fukushima.

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