

Instructor Training Course JFY2025

Course Prospectus

Environmental Radioactivity Monitoring

Nuclear Human Resource Development Center
JAPAN ATOMIC ENERGY AGENCY

1 COURSE INTRODUCTION

1.1 OBJECTIVES

The objective of this course is to educate future instructors in the field of environmental radiation and radioactivity monitoring. Through a three-week program, participants are expected to acquire basic knowledge to be able to contribute as instructors in their countries. The course involves lectures on basic topics such as environmental radiation monitoring and radioactivity measurement. After going back to their home countries, **all participants are required to give a lecture in a future Follow-up Training Course (FTC).**

1.2 PARTICIPANTS

The course is open to those who work for nuclear-related organizations or academic institutions and are willing to contribute to human resource development in the field of environmental radiation and radioactivity monitoring in their own countries. Please refer to the Application Guidance for further information.

1.3 NOTE

- Pre-course learning will be implemented in ITC 2025. Participants are required to use the Learning Management System provided by JAEA to watch lecture videos and submit a report in advance before the course begins. The pre-course learning topics are described in **2 COURSE SYLLABUS**.
- ITC on Environmental Radioactivity Monitoring will be held in parallel with ITC on Nuclear/Radiological Emergency Preparedness (NREP). Therefore, some of the lectures and other activities will be jointly conducted. The joint activities are described in **2 COURSE SYLLABUS** as Joint Class.
- This course will be conducted in person.

2 COURSE SYLLABUS (Tentative)

2.1 Lecture

- (1) Basics of Radiation and Radiation Protection (Pre-course learning)
 - Type of radiation (natural radiation and artificial radiation)
 - Unit of radiation
 - Feature of each radiation
 - Interaction of radiation with matter
 - Radiation exposure
 - Basic radiation protection
- (2) Biological Effects of Radiation on Human (Pre-course learning)
 - Historical background
 - DNA damage by radiation and repairing function of DNA
 - Deterministic and stochastic effects
 - Acute and late effects
 - Somatic and genetic effects
- (3) Introduction to Nuclear Reactor (Joint Class)
 - History of various reactors
 - Outline and utilization of research reactor
 - Mechanisms and features of light water reactor (LWR): boiling water reactor (BWR) and pressurized water reactor (PWR)
- (4) Overview of Environmental Radiation Monitoring
 - Objectives of environmental monitoring
 - Exposure pathways
 - Environmental monitoring program
 - Role of Environmental Monitoring Engineer
- (5) Radioactivity Monitoring in Environmental Samples
 - Concept of environmental radioactivity monitoring
 - Procedure of environmental sample analysis
 - Radioactivity in environmental samples in Ibaraki area: before and after Fukushima Daiichi Nuclear Power Station (NPS) accident
- (6) Pretreatment of Environmental Samples
 - Purpose of pretreatment
 - Pre-treatment procedure of environmental samples such as leafy vegetables, sea water, marine products and soil
 - Summary of radioactivity measurement
- (7) Outline of Fukushima Daiichi Nuclear Power Station Accident and Exposure

Situation (Joint Class)

- Outline of Fukushima Daiichi NPS accident
- The reason why Fukushima Daiichi and Onagawa NPS survived even attacked by mega tsunami
- Strengthening of safety measures after Fukushima Daiichi NPS accident based on new safety regulation standard
- Present ambient dose rate at Fukushima Daiichi NPS and Fukushima area
- Radiation exposure situation of radiation workers and residents in the accident
- Decommissioning of Fukushima Daiichi NPS

(8) Radioactivity Measurement by HP germanium Detector (Joint Class)

- Principle of HP germanium semiconductor detector
- Calibrations (energy calibration, efficiency calibration)
- Radioactivity analysis: how to assign a radionuclide and decide its radioactivity in samples

(9) Evaluation of Uncertainty in Measurement (Joint Class)

- Concept of uncertainty
- Extraction of uncertainty factor
- Evaluation and expression of uncertainty

(10) Lecture Materials and Presentation Skills (Joint Class)

- Tips for material preparation
- Effective presentation

(11) Radioactivity Measurement by Liquid Scintillation Counter

- Structure of LSC
- Detection Mechanism
- Solvent and solute
- Various methods for measurement (external standard method, spill over method, and efficiency tracing method)

(12) ALPS Treated water (Joint Class)

- ALPS treated water
- Properties of Tritium
- Regulatory concentration limit

(13) Lectures by Guest lecturers (Joint Class)

- Guest lecturers from participating countries are sharing their experiences on FTC

2.2 Exercise

- (1) Handling of Radiation Survey Meters (Joint Class)
 - Usage of hand-held radiation survey meters (Ionizing chamber, Geiger-Müller counter, Scintillation counter)
 - Radiation related to shielding materials
 - Surface contamination survey
- (2) Collection of Environmental Samples
 - Collecting environmental soil samples
- (3) Pretreatment of Environmental Samples
 - Pretreatment of environmental soil samples, such as drying, sieving
 - Pretreatment of environmental water samples, such as distillation
- (4) Ambient Dose Rate Measurement (Joint Class)
 - Ambient gamma dose rate measurement in outdoor environment
- (5) Presentation Exercise (Joint Class)
 - Delivering presentation related to environmental radiation monitoring by each participant
 - Discussing presentation by participants with other participants
- (6) Measurement of Radioactivity by germanium semi-conductor detector
 - Structure and operation of germanium semi-conductor detector
 - Calibration and self-absorption
 - Analyzing radioactivity in environmental sample
- (7) Measurement of Radioactivity with Liquid Scintillation Counter
 - Sample preparation
 - Determination of tritium and carbene-14 concentration in wastewater
- (8) Comprehensive Exercise
 - Evaluating results of environmental sample radioactivity measurement related to exercises related to the course
 - Summarizing topics learnt in the course
 - Preparing final presentation
- (9) Final Presentation (Joint Class)
 - Presentation on specified topic related to the course curriculum

2.3 Facility Visit

- (1) Environmental Radiation Monitoring Equipment in JAEA
- (2) The Great East Japan Earthquake and Nuclear Disaster Memorial Museum

(Joint Class)

- (3) Fukushima Daiichi Nuclear Power Station, Tokyo Electric Power Co. Holdings, Inc. (Joint Class)
- (4) Nuclear Emergency Assistance and Training Center (NEAT), JAEA (Joint Class)
- (5) Ibaraki Off-Site Center (Joint Class)

3 Assignment

- (1) Reports on pre-course learning materials
- (2) Pre-test and Post-test
- (3) Experimental Reports
- (4) Final Presentation on a Specified Topic related to the Course Curriculum