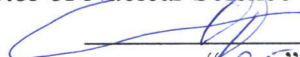


APPROVED BY

Director of Nuclear Science & Engineering School

 / Oleg Yu. Dolmatov
"25" 06 2020

Course Name: Nuclear Safety and Radiation Protection

Field of Study: Nuclear Science and Technology

Programme name: Nuclear Science and Technology

Academic profile: Nuclear Safety, Security and Non-Proliferation of Nuclear Materials

Level of Study: Master Degree Programme

Year of admission: 2020

Semester, year: semester 1, year 1

ECTS: 6

Total Hours: 216

Contact Hours: 48

- **Lectures:** 16
- **Practical experience:** 32

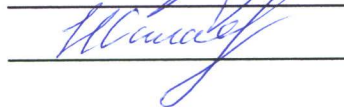
Self-study: 168

Assessment: Exam

Division: Nuclear Fuel Cycle

Director of Programme

Instructor

 / Vera V. Verkhoturova
 / Maxim E. Silaev

Course name: Nuclear Safety and Radiation Protection

Course Overview

Course Objectives	The objective of the training course is to develop students' theoretical knowledge and practical skills, which are necessary to conduct professional activity involving the usage of principles and techniques of nuclear and radiation safety and control protection of people and environment from radiation.
Learning Outcomes	Upon completion of the course, a graduate will obtain the knowledge of: – main principles of system analysis – professional English language and rules of reports preparation and presentation; – generic safety problems, methods and principals of it solution; – main sources of scientific information and requirements to the information presentation; – methods of accident prevention and response; – safety operation parameters of nuclear and radiation facilities; – dose assessment methods from external and internal exposure; – methods of radiation situation forecast; – procedures of the use of control and protection means; – radiation protections requirements and regulations; – conditions of normal and emergency operations of nuclear facilities; – methods of assessment of nuclear and radiation characteristics; – norms and regulation in fields of nuclear safety; – methods of nuclear and radiation characteristics evaluation. Upon completion of the course, graduates are expected to develop the following skills: – to generalize the acquired knowledge of natural sciences by the categories of system analysis; – to compile and present technical and scientific information used in professional activities in the form of a presentation; – to draw up a general plan of research work under a given topic, to select research methods and methods for processing results; – to work with regulatory and technical documents; – to use safety principles at nuclear and radiation facilities; – to compare technical parameters with safety ones; – to use methods of safety technical control under condition of nuclear and radiation facilities; – to make assessment of safety characteristics; – to select protection means and means of individual dose control; – to use measures of radiation protection of the environment; – to apply calculation methods to calculate radiation parameters; – to use modern methods of calculation and experimental results evaluation; – to use mechanical devices for calculation.

	Upon completion of the course, graduates should acquire the practical experience in: – application of methods for getting knowledge and problem solution; – using speaking skills in a foreign language in accordance with the field of training. The performance of a speaker shall be justified and supported with auxiliary means (such as tables, graphs, charts, etc.); – application of a foreign language at a sufficient level for professional activities in future; – implementing professional knowledge at a sufficient level for professional activities in future; – development of technical and administrative measures for safety improvement; – predicting radiation situation and individual doses during normal operation and deviation from a normal operation conditions; – predicting radiation situation, individual doses and impact on an environment during emergency situations; – using an approach to select a calculation methods for evaluation of radiation characteristics; – collecting and using of data; – making radiation calculations; – preparation and performance of research works and calculation of radiation characteristics.
Course Outline	The training course is delivered through the following teaching modes: – 8 lectures; – 16 practical experiences. The course consists of 2 sections, which are given below. Section 1. Radiation protection from ionizing radiation Section 2. Safety handling with nuclear materials Each section includes several lectures and practical experiences. The training course finishes with an exam. The course implies conducting 2 intermediate tests and 2 intermediate colloquiums. Each test is scored with the maximum of 20 points. Each colloquium is scored with the maximum of 20 points.
Course Structure	The content of the course covers 2 topics. Each topic is studied through lectures and practical experiences. Section 1. Radiation protection from ionizing radiation Radiation protection is ensured by means of a set of administrative and technical measures. These measures protect workers, public, and the environment from harmful effects of ionizing radiation. All possible exposure conditions (occupational, natural and emergency) as well as groups of exposed persons (workers, population and medical patients) are considered. The risk management system, developed on the basis of fundamental safety principles, allows providing an acceptable level of probability of occurrence of undesirable consequences of exposure in all possible conditions, including the situation of handling radiation sources in living conditions, at facilities, and during handling radioactive wastes. Section 2. Safety handling with nuclear materials Nuclear safety is ensured by means of a set of administrative and technical measures. Technical measures include the provision of defense in depth, the

	necessary safety margins for nuclear and radiation factors and the multiplicity of safety barriers operating independently of each other. One of the most significant dangerous factors is a possibility for appearance of an uncontrolled fission chain reaction. A threat of a nuclear accident has the highest risk of detrimental consequences because of existence of huge quantities of fission and activation products inside a nuclear reactor core. Constraints of a nuclear and radiation accident at a nuclear facility are achieved by regulating the neutron multiplication factor, reactivity, maintaining the thermohydraulic parameters at a safe level.
Facilities and Equipment	1. Lecture Hall with multimedia equipment: Tomsk, Lenin ave., 2, building 10, room 340.
Grading Policy	In accordance with TPU rating system we use: – Current assessment which is performed on a regular basis during the semester by scoring the quality of mastering of theoretical material and the results of practical activities (performance tests, perform tasks, problem solving). Max score for current assessment is 80 points, min – 44 points. – Course final assessment (exam/ credit test) is performed at the end of the semester. Max score for course final assessment is 20 points, min – 11 points. The final rating is determined by summing the points of the current assessment during the semester and protection of the course project at the end of the semester. Maximum overall rating corresponds to 100 points, min pass score is 55.
Course Policy	Attendance is strictly controlled. All classes are obligatory for attendance.
Teaching Aids and Resources	Compulsory reading: 1. Pham H. Safety and Risk Modeling and Its Applications / H. Pham. – London : Springer-Verlag Ltd., 2011. – 429 p. – Текст: электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/978-0-85729-470-8 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. 2. Domenech H. Radiation Safety Management and Programs / H. Domenech. – Cham : Springer International Publishing, 2017. – 334 p. – Текст: электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/978-3-319-42671-6 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. 3. Prince R. Radiation Protection at Light Water Reactors / R. Prince. – Berlin : Springer-Verlag, 2012. – 372 p. – Текст: электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/978-3-642-28388-8 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. 4. Marguet, S. The Physics of Nuclear Reactors / S. Marguet. — Cham : Springer International Publishing AG, 2017. — 1445 p. – Текст: электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/978-3-319-59560-3 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. Additional reading: 1. Safety Cultures, Safety Models Taking Stock and Moving Forward / by editors C. Gilbert, B. Journé, H. Laroche; C. Bieder. - Cham : Springer Open, 2018. - Текст: электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/978-3-319-95129-4 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ.

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