TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

APPROVED BY

Director of ~~Nuclear~~ Science & Engineering School
_____ / Oleg Yu. Dolmatov
"25" 06 2020

Course Name:
Design and Management of Nuclear Facilities Decommissioning Team Project

Field of Study: Nuclear Physics and Technology

Programme name: Nuclear Science and Technology

Specialization: Nuclear Power Engineering

Level of Study: Master Degree Programme

Year of admission: 2019

Semester, year: semester 3, year 2

ECTS: 3

Total Hours: 108

Contact Hours: 48

- **Lectures:** 16
- **Practical experience:** 16
- **Lab:** 16

Self-study: 60

Assessment: Exam, graded credit-test

Division: Nuclear Fuel Cycle

Director of Programme _____ / Vera V. Verkhoturova

Instructor _____ / Maxim E. Silaev

TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

Course name:
Design and Management of Nuclear Facilities Decommissioning Team Project

Course Overview

Course Objectives	The objectives of the training course "Design and management of decommissioning of Nuclear Facilities Team Project" is the formation of a set of competencies which are required for a specialist to be prepared for decommissioning in the field of nuclear energy. The discipline is devoted to familiarizing students with the theoretical and practical issues underlying decommissioning of nuclear facilities, as well as with the principles and algorithms for radioactive waste management, safety analysis and decommissioning approaches and technologies.
Learning Outcomes	**Upon completion of the course, a graduate will obtain the knowledge of:** – Modern decommissioning approaches and technologies; – Radioactive waste management; – Recommendations of the IAEA on the safety assessment in area of decommissioning; – Safety requirements for decommissioning; – Safety analysis of options and technical solutions for nuclear power plants; – Basic procedures to ensure nuclear and radiation safety of the decommissioning process. **Upon completion of the course, graduates are also expected to develop the following skills:** – To develop programs for inspection of nuclear facilities; – To develop a plan for the production of works on the nuclear power plant; – To carry out design and develop a working project; – To perform analysis of design solutions; – To perform analysis of existing projects of nuclear power plants; – To conduct risk analysis in case of nuclear power plant decommissioning; – To perform analysis of approaches to the preparation of infrastructure to support the nuclear power plant, approaches to handling radioactive waste at the decommissioning of nuclear facilities. **Upon completion of the study of all sections of the discipline, students will gain practical experience in:** – simulation of the radiation environment during the decommissioning of nuclear facilities. – modeling the accumulation and decay of activity for decommissioning of nuclear facilities. – measurement of activity. Spectrometric methods and equipment.
Course Outline	The target course is taught using a variety of teaching forms such as: – 8 lectures; – 8 practical experiences; – 3 laboratory activities; – 2 tests;

	– group project; – term project. The course consists of 3 sections, which are given below. Section 1. Decommissioning of nuclear facilities. Section 2. Safety assessment during preparation and decommissioning of nuclear facilities Section 3. Designing the decommissioning of nuclear facilities Each section includes several lectures, practical experiences and a laboratory activity. The course ends with an exam, the defense of the course project ends with a pass-fail grading test. As part of the study of the discipline, students must prepare and defend an abstract, complete a group project and a course project. The training course provides for the implementation of 2 tests to check the development of trainees' knowledge and skills. The term project for the training course includes the following tasks to be done by students: 1. Analysis of nuclear power plants projects in Russia and abroad. Current state and prospects. 2. Comprehensive engineering and radiation survey. Approaches and equipment. 3. Competence centers in the field of renewable energy in the Russian Federation and abroad. 4. Problems of nuclear legacy. Review of the experience of using robotic devices. 5. The regulatory framework of the Russian Federation in the field of renewable energy. 6. Basic safety requirements for the decommissioning of nuclear facilities. IAEA recommendations. 7. Basic procedures to ensure nuclear and radiation safety of the decommissioning process. Approaches and experience in radioactive waste (RW) management. 8. Stages of design. Justification of the working draft. Organization and functioning.
Course Structure	The content of the course covers 3 topics. Each topic is studied through lectures, practical experiences and laboratory activities. **Section 1. Decommissioning of nuclear facilities** Current situation. Analysis of decommissioning projects (decommissioning) of nuclear facilities (NF) in the Russian Federation and abroad. The main recommendations of the IAEA on the safety assessment at different stages of the nuclear power plant nuclear power plant. Comprehensive engineering and radiation survey. Areas of research and development work to ensure safety. Spent nuclear fuel (SNF) and radioactive waste (RW) management. Preparation of the nuclear facility infrastructure. Safety requirements for decommissioning (decommissioning) of nuclear facilities (NF). Existing regulatory framework and its features. **Section 2. Safety assessment during preparation and decommissioning of nuclear facilities** Regulatory support for the decommissioning of nuclear facilities. Basic safety

	requirements for the decommissioning of nuclear facilities. IAEA recommendations. Implementation of the procedure for accounting and control of radioactive substances (RS), radioactive waste and nuclear materials. **Section 3. Section 3. Designing the decommissioning of nuclear facilities** Design stages of the nuclear power plant for nuclear power plants, the sequence of their implementation. Safety assessment criteria. Pre-design stage: collection of initial data, formalization of the problem, analysis of technical conditions of operation. Development of a conceptual project. The choice of structures of security systems, the formulation of requirements for the constituent elements.
Facilities and Equipment	1. Lecture hall: Tomsk, Lenin Ave. 2, building 10, room 312. 2. Lecture hall: Tomsk, Lenin Ave. 2, building 10, room 313 (laboratory with spectrometric equipment and special software). 3. Lecture hall: Tomsk, Lenin Ave. 2, building 10, room 248.
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 40 points, min – 22 points. – Course final assessment (exam/ credit test) is performed at the end of the semester. Max score for course final assessment is 60 points, min – 33 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. Souza G. Thermal Power Plant Performance Analysis / G. Souza. – London : Springer-Verlag Ltd., 2012. – 287 p. – Текст: электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/978-1-4471-2309-5 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. 2. 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. 3. 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. 4. 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. 5. Stabin M. G. Radiation Protection and Dosimetry: An Introduction to Health Physics / M. G. Stabin. - New York : Springer Publishing, 2007. – 390 p. – Текст: электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/978-0-387-49983-3 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ.

	Additional reading: 1. Cerrito L. Radiation and Detectors: Introduction to the Physics of Radiation / L. Cerrito. – Cham : Springer International Publishing AG, 2017. – 217 p. – Текст: электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/978-3-319-53181-6 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. 2. Marguet S. The Physics of Nuclear Reactor / 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. 3. Equidosimetry – Ecological Standardization and Equidosimetry for Radioecology and Environmental Ecology : Proceedings of the NATO Advanced Research Workshop on Ecological Standardization and Equidosimetry for Radioecology and Environmental Ecology Kiev, Ukraine 14–20 April 2002 / by ed. F. Bréchignac, G. Desmet. – Dordrecht : Springer Nature BV, 2005. – 436 p. – Текст: электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/1-4020-3650-7?page=1 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. 4. Oka Y. Nuclear Reactor Design / Y. Oka. – Tokyo: Springer, 2014. – 327 p. – Текст: электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/978-4-431-54898-0 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ.
Instructor	Dr. Maxim Evgenevich Silaev, Associate professor, Nuclear Fuel Cycle Division, School of Nuclear Science & Engineering, Tomsk Polytechnic University, e-mail: silaev@tpu.ru , phone: +7 (3822) 701-777 (ext. 5410).