TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

APPROVED BY

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

Course Name: Development of Basic Solutions for Nuclear Power Facilities Construction Team Project

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 3, year 2

ECTS: 3

Total Hours: 108

Contact Hours: 48

- **Lectures:** 8
- **Practical experience:** 16
- **Laboratory experience:** 24

Self-study: 60

Assessment: Credit-test, graded credit-test

Division: Nuclear Fuel Cycle

Director of Programme _____ / Vera V. Verkhoturova

Instructor _____ / Boris P. Stepanov

TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

Course name: Development of Basic Solutions for Nuclear Power Facilities Construction Team Project

Course Overview

Course Objectives	The objective of the training course «Team Project "Development of Basic Solutions for Nuclear Power Facilities Construction"» is to develop students' knowledge of and skills to ensure security measures in the design of nuclear power facilities, design of nuclear and radiation safety systems at the operation of ionizing radiation sources, development of administrative and engineering procedures for the operation of nuclear materials physical protection, control and accounting system at nuclear power facilities based upon the features of applied nuclear technologies.
Learning Outcomes	**Upon completion of the course, a graduate will obtain the knowledge of:** – stages of the project life-cycle; – stages of the project development and implementation; – methods of the project development and management; – methods of team building; – fundamentals of report structuring and presentation preparation in a foreign language (English) accepted in the international community; – features of planning independent activities aimed at the solution of professional tasks; – fundamentals of execution of scientific and research activities results in the form of articles, reports, scientific reports and presentations with the use of desktop publishing systems and office software packages; – existing nuclear power facility designs and their structural elements; – purpose and functioning of the security systems main elements, features of their operation; – fundamental principles of security systems and equipment, organizational structure of nuclear industry enterprises. **Upon completion of the course, graduates are expected to develop the following skills:** – to develop a project based upon the analysis of its implementation alternative options, determine the milestones and priorities in the activities; – to explain the objectives and formulate the tasks related to the project preparation and implementation; – to manage the project at all stages of its life-cycle; – to develop the plan of group and organizational communications at the project preparation and implementation, set the tasks for the team members for the achievement of assigned objective; – to compile and present technical and scientific documentation used in the professional field in the form of presentation; – to solve the problems aimed at one's own professional and personal development, determine the priorities of the professional activity improvement; – to execute the results of scientific and research activities in the form of articles, reports, scientific reports and presentations with the use of desktop publishing

	systems and office software packages; – to apply the analytical methods with regard to causes of equipment failures and enhancement of operational reliability of the nuclear power facilities; – to use regulatory legal documents in the field of professional activity, design security systems, analyze technical solutions for improvement of nuclear materials physical protection, control and accounting system structure. **Upon completion of the course, graduates should acquire the practical experience in:** – applying the methods of the project development and management; – evaluating the project efficiency and resource requirements; – analyzing, designing, and organizing interpersonal, group, and organizational communications within the team in order to achieve the objective; – communication in a foreign (English) language in the professional field of training in a well-argued manner with the use of supplementary tools (table, graphs, diagrams, etc.); – planning and managing one's own professional activity and its improvement; – executing the results of scientific and research activities results in the form of articles, reports, scientific reports and presentations with the use of desktop publishing systems and office software packages; – applying the obtained knowledge for design engineering within the framework of current rules and regulations in the field of nuclear power use and for specification of requirements and procedures for the safe operation of ionizing radiation sources; – preparing statements of order on the creation of security systems, furnishing the project with devices and tools; – application of technological procedures and requirements for safety assurance during the systems and equipment operation at the nuclear power facilities.
Course Outline	The training course is delivered through the following teaching modes: – 4 lectures; – 3 laboratory experiences; – 8 practical experiences. The course consists of 3 sections, which are given below. **Section 1. Safety assurance at nuclear power facilities.** **Section 2. Security system design at nuclear power facilities.** **Section 3. Application of procedures for assurance of nuclear materials, nuclear facilities and radiation sources physical protection.** Each section includes several lectures, laboratory and practical experiences. The training course finishes with a credit-test/ graded credit-test. In the course of study, students are to defend three reports on laboratory experiences which are scored with the maximum of 10 points each, perform a review which is scored with the maximum of 15 points and a group assignment which is scored with the maximum of 25 points. Besides, the course implies conducting two tests which are scored with the maximum of 15 points each.
Course Structure	The content of the course covers 3 topics. Each topic is studied through lectures, laboratory and practical experiences, as well as self-study. **Section 1. Safety assurance at nuclear power facilities.** *Conditions of the nuclear power safe use. The IAEA main approaches to safety*

	justification at the stages of nuclear fuel cycle (NFC). Conditions of the nuclear power facility (NPF) normal operation. Security culture. **Topics of lectures:** 1. Features of nuclear technologies application at NPF. **Topics of practical experience tutorials:** 1. Security culture. Ways of assessment. 2. Analysis of human factor. 3. Justification and analysis of managerial decisions. **Topics of laboratory experiences:** 1. Application of access controls for securing nuclear materials. **Section 2. Security system design at nuclear power facilities.** *Stages of nuclear power facility design, sequence of implementation. Criteria for security system assessment. Pre-design stage: initial data collection, problem formalization, analysis of operation technical conditions. Development of conceptual design. Selection of the security systems structure, specification of requirements to component elements.* **Topics of lectures:** 2. Selection of the security systems structure, specification of requirements to component elements. 3. Stages of nuclear power facility design. Justification of detail design. **Topics of practical experience tutorials:** 4. Concept of risk. Safety justification issues at the nuclear energy use. 5. Implementation of design engineering. Project evaluation. 6. Analysis of design solutions. **Topics of laboratory experiences:** 2. Methods and tools of person identification in access control systems at a nuclear facility. **Section 3. Application of procedures for assurance of nuclear materials, nuclear facilities and radiation sources physical protection.** *Regulatory support of physical protection in the course of nuclear materials management and nuclear reactor operation. Implementation of methods, procedures for nuclear materials and radioactive substances control and accounting. Organization of nuclear materials, nuclear facilities physical protection at the nuclear facility. Establishment and operation of physical protection system (PPS) at the nuclear and radiation facilities.* **Topics of lectures:** 4. PPS organization and functioning at the nuclear and radiation facilities. **Topics of practical experience tutorials:** 7. Physical protection system organization at the nuclear and radiation facilities. 8. Selection of the PPS structure. **Topics of laboratory experiences:** 3. Application of CCTV tools in the security systems. **Topics of the term projects:** 1. Development of basic solutions for the healthcare center construction project. 2. Development of basic solutions for the research reactor construction project. 3. Development of basic solutions for the irradiated fuel repository construction project. 4. Development of basic solutions for the diagnostic radiation center construction

	project. 5. Development of basic solutions for the nuclear power plant construction project. The training course provides for the graduates' self-study of the following types and forms: – Study of lecture materials, search and review of literature and electronic information resources on the individually specified course topic; – Study of topics submitted for independent examination; – Information research, analysis, structuring, and presentation of information and data obtained; – Preparation of texts in a foreign language; – Performance of group assignments; – Preparation for laboratory and practical experiences; – Performance of the course project; – Analysis of scientific publications on the topic predetermined by the instructor; – Preparation for assessment activities.
Facilities and Equipment	1. Lecture hall with multimedia equipment: 634050, Tomsk, Lenin ave. 2, building 10, room 248. 2. Classrooms with multimedia equipment for laboratory experiences: 634050, Tomsk, Lenin ave. 2, building 10, rooms 312, 313: the complex of security and CCTV systems for security assurance and nuclear terrorism countering; training system for ensuring security and physical protection of nuclear facilities; engineering bench of CCTV means; laminator for ID cards production.
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. 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. 2. Zohuri B. Thermal-Hydraulic Analysis of Nuclear Reactors / B. Zohuri, N. Fathi. – Cham : Springer International Publishing, 2015. – 651 p. – Текст : электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/978-3-319-17434-1 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. 3. Kessler G. Sustainable and Safe Nuclear Fission Energy. Technology and Safety of Fast and Thermal Nuclear Reactors / G. Kessler. – Berlin : Springer-

	Verlag, 2012. – 464 p. – Текст : электронный // SpringerLink. – URL: https://link.springer.com/book/10.1007/978-3-642-11990-3 (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. **Additional reading:** 1. Крайнов А В. Тепловые процессы в энергосистемах = Heat Processes in Energy Systems : учебное пособие / А. В. Крайнов, Г. В. Швалова. – Томск : Изд-во ТПУ, 2013. – URL : http://www.lib.tpu.ru/fulltext2/m/2013/m167.pdf (дата обращения: 20.09.2020). – Режим доступа: из корпоративной сети ТПУ. – Текст : электронный.
Instructor	Boris P. Stepanov, Associate Professor, Nuclear-Fuel Cycle Division, School of Nuclear Science and Engineering, Tomsk Polytechnic University, e-mail: sbp@tpu.ru, phone: +7 (3822) 701-770 (ext. 2259), personal site: https://portal.tpu.ru/SHARED/s/SBP/eng