TOMSK POLYTECHNIC UNIVERSITY | ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

APPROVED BY

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

Course Name: Methodology for Analysis and Vulnerability Assessment of Nuclear Materials and Facilities Physical Protection

Field of Study: Nuclear Science and Technology

Programme name: Nuclear Science and Technology

Specialization: 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:** 16
- **Practical experience:** 32

Self-study: 60

Assessment: Credit-test

Division: Nuclear Fuel Cycle

Director of Programme _____ / Vera V. Verkhoturova

Instructor _____ / Boris P. Stepanov

TOMSK POLYTECHNIC UNIVERSITY ТОМСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

Course name:
Methodology for Analysis and Vulnerability Assessment of Nuclear Materials and Facilities Physical Protection

Course Overview

Course Objectives	The objective of the training course "Methodology for Analysis and Vulnerability Assessment of Nuclear Materials and Facilities Physical Protection" is to develop students' knowledge of and skills in establishment, design, creation of efficient physical protection systems at nuclear and radiation facilities, organization of activities on nuclear power facilities vulnerability analysis, as well as evaluation of designed or existing physical protection system effectiveness at nuclear and radiation facilities.
Learning Outcomes	**Upon completion of the course, a graduate will obtain the knowledge of:** – techniques for developing the plan of actions for the detection and solution of a problem situation; – stages of the project development and implementation; – fundamentals of report structuring and presentation preparation in a foreign language (English) accepted in the international community; – methods and ways of implementing the analysis of the process activities as a management object in the field of nuclear energy use; – regulatory framework in the field of nuclear energy use, features of application of rules and regulations on the nuclear materials and nuclear facilities physical protection assurance at the nuclear facilities; – implementation techniques and methods of analysis of the process activities related to the improvement of operation of the physical protection system elements and devices; – operation requirements and conditions of technical subsystems and devices within the physical protection system. **Upon completion of the course, graduates are expected to develop the following skills:** – to develop the plan of actions and make specific decisions for its implementation; – to explain the objectives and formulate the tasks related to the project preparation and implementation; – to compile and present technical and scientific documentation used in the professional field in the form of presentation; – to use regulatory legal documents and technical documentation in the field of professional activity, design security systems, analyze technical solutions for improvement of nuclear materials physical protection, control and accounting system structure; – to use regulatory documents related to the implementation of the vulnerability analysis of a nuclear facility, fulfill the requirements of departmental guidelines related to the physical protection system design and its effectiveness evaluation.

	Upon completion of the course, graduates should acquire the practical experience in: – setting the objective, determining the ways of its achievement, developing the plan of actions; – evaluating the project efficiency and resource requirements; – monologue speaking in a foreign (English) language on the profile in a well-argued manner with the use of supplementary tools (table, graphs, diagrams, etc.); – applying the main methods of project development and security systems design at nuclear power facilities; – evaluating the effectiveness of the physical protection system under design, developing the proposals on the improvement and upgrade of the system of nuclear materials physical protection, control and accounting procedures; – analyzing and solving the set task related to the design of the efficient physical protection system with the consideration of the nuclear facility features; – preparing statements of order on the physical protection system design, selecting its elements and devices.
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. Physical protection system design at a nuclear facility.** **Section 2. Methods of conducting the evaluation of physical protection system effectiveness.** Each section includes several lectures and practical experiences. The training course finishes with a credit-test. In the course of study, students are to perform a review, which is scored with the maximum of 25 points and a group assignment which is scored with the maximum of 35 points. Besides, the course implies conducting a test which is scored with the maximum of 16 points.
Course Structure	The content of the course covers 2 topics. Each topic is studied through lectures and practical experiences, as well as self-study. **Section 1. Physical protection system design at a nuclear facility.** Structure of main federal, departmental rules and regulations related to the security issues of nuclear materials and facilities. Stages of physical protection system design. Methods of conducting the vulnerability analysis of a nuclear facility. Selection of the composition of technical subsystems and engineering tools. Organization and functioning of the physical protection system. Administrative procedures. Adversary model, characteristics and technical outfit. **Topics of lectures:** 1. Main requirements, rules, and regulations in the field of assurance of nuclear materials and nuclear facilities physical protection. 2. Objectives, performed functions, composition of the physical protection system at a nuclear facility. 3. Organization of the process of nuclear facilities vulnerability analysis. 4. Formalization of an adversary model. **Topics of practical experience tutorials:** 1. Selection of the nuclear facility PPS structure. 2. Vulnerability analysis of a hypothetical nuclear facility.

	3. Allocation of physical protection objects. 4. Distinguishing adversary model's characteristics. 5. Preparation of initial data for the nuclear facility vulnerability analysis. 6. Description of scenarios of unauthorized actions committed by adversaries with regard to physical protection objects. 7. Organization of a nuclear facility protection. **Section 2. Methods of conducting the evaluation of physical protection system effectiveness.** Improvement of the nuclear facility PPS structure. Formalization of the adversary movement scenarios. Physical protection system improvement and upgrade. Compensatory procedures at the PPS operation. **Topics of lectures:** 5. Methodological basics of evaluation of physical protection system effectiveness. 6. Choosing and improving the structure of physical protection system. 7. Stages of the PPS effectiveness evaluation at a nuclear facility. 8. Development of administrative and compensatory procedures. **Topics of practical experience tutorials:** 9. Selection of engineering tools. 10. Determination of time required to overcome reinforcing obstacles and the facility territory. 11. Allocation and application of security alarm technical means and CCTV devices. 12. Actions of response forces. 13. Evaluation of PPS effectiveness at a hypothetical nuclear facility. 14. Administrative procedures at the PPS operation. 15. Organization of management in the PPS at nuclear facilities. 16. PPS improvement. 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; – Performance of assignments and tests; – Preparation for practical experiences and seminars; – Analysis of scientific publications on the topic predetermined by the instructor; – Preparation for assessment activities.
Facilities and Equipment	1. Classrooms with multimedia equipment for practical experiences: Tomsk, Lenin ave. 2, build. 10, room 312; 2. Lecture hall with multimedia equipment: Tomsk, Lenin ave. 2, build. 10, rooms 313 3. Equipment for practical experiences: – Complex of security and CCTV systems; – Training system of radio-ray security alarm system "Astra"; – Canon PowerShot S5 IS camera; – Radiation monitoring systems for nuclear materials bringing control;

	– Automated workplace; – Analytical complex of security systems, identification tools, detection tools and CCTV equipment; – Laminating machine for ID cards production Fellowes SPLA4; – Network IP-camera Cisco CIVS-IPC-2520V; – Printing device STYLUS Photo R800; – Colour camera SAMSUNG SVD-4400P; – Special cutting machine Warrior 21173C; – Training system of the physical protection system security assurance; – 15 computers; – 3 printers.
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. Nuclear Power Plants: Innovative Technologies for Instrumentation and Control Systems. International Symposium on Software Reliability, Industrial Safety, Cyber Security and Physical Protection of Nuclear Power Plant / by editor Y Xu. — Singapore : Springer, 2017. — IX, 224 с. —Текст : электронный // SpringerLink. — URL: https://link.springer.com/book/10.1007/978-981-10-3361-2 (дата обращения: 10.04.2020). — Режим доступа : по подписке. 2. Safety and Risk Modeling and Its Applications / by editor H. Pham. – London : Springer-Verlag Ltd., 2011. – XIV, 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 : по подписке. 3. Nuclear Non-Proliferation in International Law : in 5 volumes. Vol. 3. Legal Aspects of the Use of Nuclear Energy for Peaceful Purposes / by editors J. L. Black-Branch, D. Fleck. — Berlin : Springer Verlag, 2016. — XIII, 556 p. — Текст : электронный // SpringerLink. — URL: https://link.springer.com/book/10.1007/978-94-6265-138-8 (дата обращения: 10.04.2020). — Режим доступа : по подписке. **Additional reading:** 1. Verma, A. K. Risk Management of Non-Renewable Energy Systems / A. K. Verma, S. Ajit, H. P. Muruva. — Cham: Springer, 2015. — XVII, 422 p. — Текст : электронный // SpringerLink. — URL: https://link.springer.com/book/10.1007/978-3-319-16062-7 (дата обращения: 10.04.2020). — Режим доступа : по подписке.

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