

Russian University Education in Nuclear Safeguards and Security

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Background

- ▶ Goal: Educate the next generation Russian safeguards and security (S&S) specialists in nonproliferation and S&S methodology
- ▶ U.S. DOE Office of International Material Protection and Cooperation has worked with the Russian Federation since mid-1990s to secure its nuclear materials through the Material Protection, Control and Accounting (MPC&A) Program
- ▶ MPC&A Program supports infrastructure activities at national and regional levels, including university level education



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Safeguards and Security Education Program Curriculum Development

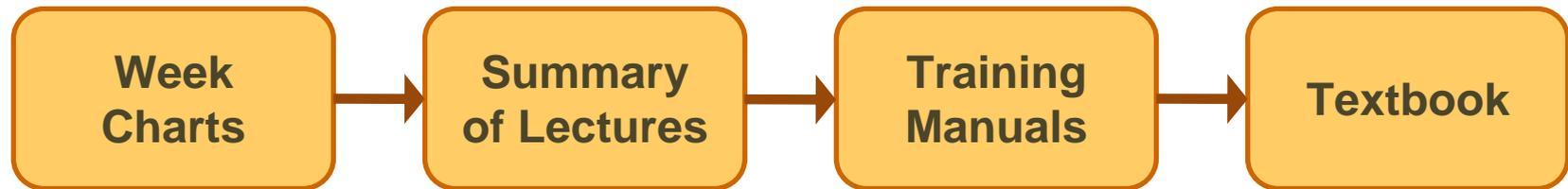
- ▶ Prepares graduates for entry-level professional positions at nuclear facilities, agencies or research institutes
- ▶ Graduates are qualified to:
 - Assess effectiveness of facility's S&S system
 - Design improvements to S&S systems
 - Prioritize proposed improvement based on cost/benefit analysis and regulatory requirements
 - Address technical issues
 - Undertake oversight activities
 - Contribute to development and implementation of S&S and nonproliferation policy



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Safeguards and Security Education Program Curriculum Development

Developed through a 4-stage process:



This process of curriculum development is used for the master's program and the engineering degree programs.



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MEPhI Safeguards and Security Education Program Curriculum Development

► Textbooks

- *Fundamentals of Nuclear Material Physical Protection, Control and Accounting* – published 2007
- *Methods of Passive Nuclear Material Measurements (Vol. 1) and Physical Methods and Measurement Instruments for Active Control of Fissile Materials (Vol. 2)* – published 2007
- *Physical Protection of Nuclear Facilities* – published 2009



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Safeguards and Security Education Training and Conferences

- ▶ Selected students participate in training courses
 - Russian Methodological Training Center (for material control and accounting)
 - Interdepartmental Special Training Center (for physical protection)
- ▶ Student tours of nuclear facilities
- ▶ S&S professors attend conferences in U.S. and Europe
- ▶ Professors and students participate in the International Nuclear Student Conference *Polar Lights*
- ▶ In 2009, conference for college and high school students in Snezhinsk



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Safeguards and Security Education Internships

- ▶ Internships at Russian facility or organization for all students
- ▶ Select top students have opportunity for international internships
 - Monterey Institute of International Studies
 - Aquila Technologies
 - EU Joint Research Centre – Ispra, Italy
 - University of Missouri
 - International Atomic Energy Agency (IAEA)



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MEPhi MC&A Laboratory Equipment

NDA



Barcoding



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MEPhI Physical Protection Laboratory Equipment

- Interior sensors laboratory
- Exterior sensors laboratory
- Access control laboratory
- Video surveillance laboratory
- Data collection station laboratory



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TPU MC&A Laboratory Equipment



Tamper-Indicating
Devices Laboratory



Nondestructive Assay
Laboratory



Spectrophotometer



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TPU Physical Protection Laboratory Equipment

EDP students get hands-on experience with different camera systems



Information on access control systems



Information on video surveillance systems



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MEPhI Master's Program

- ▶ World's first S&S degree program established in 1997
- ▶ 2 years; 4 semesters
 - 1st and 2nd semesters: lecture and lab courses
 - 3rd semester: internships
 - 4th semester: thesis development and defense
- ▶ 10 classes have graduated; 79 students
 - Graduates working for Rosatom, Rostekhnadzor, Institute of Physics and Power Engineering, Kursk NPP, Kurchatov Institute, Situation and Crisis Center, Bochvar, Eleron, ATOMINFORM, Ministry of Trade, etc.
 - Graduates pursuing PhD studies



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MEPhI Master's Program Curriculum Development

► Example courses

- Introduction to systems of safeguards and security
- Methods and devices for nuclear material measurements
- Computerized systems for material control and accounting (MC&A)
- Organization of communications, alarm, access delay and response actions in physical protection (PP)
- Methods of vulnerability analysis and optimization of PP systems
- Nuclear nonproliferation: political, legal and economic aspects



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MEPhI Engineering Degree Program

- ▶ Oriented toward facility needs
- ▶ 5½ years; 11 semesters
 - 6th – 9th semesters: lecture and laboratory courses
 - 10th semester: internship
 - 11th semester: thesis development and defense
- ▶ 3rd class graduated in February 2009
 - Total of 38 students graduated since 2007
 - Graduates working at Mayak, Eleron, ATOMINFORM, Rosatom, Rostekhnadzor, Kurchatov Institute, Kursk NPP, Energoatom Concern, etc.
 - Graduates pursuing PhD studies



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MEPhI Engineering Degree Program Curriculum

▶ Example courses

- Methods and devices of physical measurements
- Active methods of nuclear material control
- Computerized technologies in MC&A systems
- Engineering technical tools of physical protection
- Design of physical protection systems
- Fundamentals of design and vulnerability assessment
- Legal and international aspects of nonproliferation

▶ Many of these courses have associated laboratory courses; DOE and MEPhI have purchased laboratory equipment



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TPU Engineering Degree Program

- ▶ Serves students east of the Ural Mountains
- ▶ 5½ years; 11 semesters
 - 6th – 10th semesters: lecture and laboratory courses
 - Summer between 10th and 11th semesters: internships
 - 11th semester: thesis development and defense
- ▶ Offers courses and laboratory exercises in chemical technology
- ▶ 1st class of 17 students graduated February 2009
 - All-Russian Scientific Research Institute of Experimental Physics (Sarov) , All-Russian Scientific Research Institute of Technical Physics (Snezhinsk), Research Institute of Atomic Reactors (Dmitrovgrad), Mining and Chemical Combine (Zheleznogorsk), Petersburg Nuclear Physics Institute, Novosibirsk Chemical Concentrates Plant, etc.



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TPU Engineering Degree Program Thesis Defense



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TPU Engineering Degree Program Curriculum

▶ Example courses

- Accounting and control of fissile materials in the nuclear fuel cycle
- Methods and devices of physical measurements
- Analytical chemistry of uranium, plutonium and thorium
- Automatic systems of physical protection
- Physical protection hardware
- Basics of protection and physical protection vulnerability
- Legal basis for nonproliferation of nuclear weapons

▶ Many of these courses have associated laboratory courses; DOE and TPU have purchased laboratory equipment



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Nonproliferation Education and Training

- ▶ Monterey Institute of International Studies has been assisting the project in addressing nonproliferation education and training in Russia
 - Assisting Russian universities to develop nonproliferation courses
 - Training professors
 - Lecturing at universities
 - Establishing high school nonproliferation curriculum
 - Introducing nonproliferation sessions at student conferences in St. Petersburg and this summer in Snezhinsk
- ▶ Center for Policy Studies in Russia (PIR Center) conducts Summer School on Global Security, with one week devoted to nonproliferation



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Recent Initiatives

- ▶ MEPhI is developing new lecture course *Fundamentals of Nuclear Materials Safe and Secure Management*
 - Pilot course to be delivered at MEPhI and other selected Russian “nuclear universities”
- ▶ National Nuclear Research University to be led by MEPhI
- ▶ Nonproliferation Educators Seminar was held in 2007 to exchange curriculum and teaching techniques among participants from Russia and the Former Soviet Union



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Conclusion

- ▶ Russian universities have successfully established the first S&S degree programs in the world
 - Continue to enhance S&S and nonproliferation policy education in the Former Soviet Union
 - Are assisting the IAEA in S&S and nonproliferation policy curriculum for global use
- ▶ Strengthening of global nonproliferation regime
- ▶ DOE continues to work to ensure these programs are self-sustaining by 2012 when it completes its involvement



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