

Graduate Certificate in Transportation Security and Safeguards at the University of Nevada, Reno

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ABSTRACT

For society to benefit from using of radioactive materials, safe and secure packaging and procedures that protect people and the environment during the transport of these potentially hazardous materials must be developed, approved by a regulatory authority, and employed. In 2020, the University of Nevada, Reno (UNR) Mechanical Engineering Department began offering a 9-unit Graduate Certificate in Transportation Security and Safeguards (GCTSS). It developed this certificate with support from the U.S. Department of Energy's Packaging Certification Program, in coordination with Argonne National Laboratory. The purpose of the GCTSS is to provide a curriculum in transportation security and safeguards for nuclear and other radioactive materials that complements graduate engineering programs and is more applied knowledge based than research based. The goals of the certificate program are to (a) to encourage students to complete a comprehensive curriculum in this discipline that has both depth and breadth, (b) give students an advantage when seeking employment or advancement in this and related fields, and (c) help the industries train and advance current and potential employees. The purpose, goals, and format of the GCTSS are like those of the UNR Graduate Certificate in Nuclear Packaging (GCNP), which UNR started offering in 2016. The four required courses, and nine of the electives are offered by experienced subject matter experts at Argonne, Lawrence Livermore, Oak Ridge, Sandia, and Savannah River National Laboratories. Predecessors to the GCTSS classes have been taken by technical staff from nuclear industries, national labs, and government agencies from within and outside the United States.

INTRODUCTION

Industries and governments employ nuclear and other radioactive materials for large-scale production of electricity without greenhouse gas generation, defense, advanced medical diagnostics and treatments, food sterilization, state-of-the-art measurement methods, and other sophisticated technologies. For society to benefit from these uses, packagings for nuclear and other radioactive materials, which protect public health and the environment during storage, transport, and disposal of these hazardous materials, must be developed, manufactured, regulated, and used safely. Packagings must provide safety functions for containment, shielding, and sub-criticality of their contents under normal and hypothetical accident conditions [1]. The security and safeguards of these materials must always be maintained, especially during transport [2].

Since 1986, the Department of Energy (DOE) Packaging Certification Program (PCP) has supported Argonne, Lawrence Livermore, Oak Ridge, Sandia, and Savannah River National

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Laboratories to offer 3-to-10-day courses that provided training and education on the knowledge required to develop skills involved in the various aspects of transportation packaging to ensure safety, security, and safeguards of nuclear and other radioactive material. Domestic and international professionals from government agencies, industries, and national labs have attended these courses. Experienced subject matter experts developed and taught these courses, in accordance with DOE standards [3]. However, they were not originally offered for university credit.

Since 1993, faculty and students at the University of Nevada, Reno (UNR) Mechanical Engineering (ME) Department have conducted nuclear packaging research with funding from DOE, the Nuclear Regulatory Commission (NRC), the National Nuclear Security Administration (NNSA), and the State of Nevada. UNR is an appropriate institution to host nuclear packaging as well as transportation security and safeguards educational programs because (a) practitioners in these fields are familiar with its research, (b) UNR students conducting research in these areas will benefit from it, and (c) providing such educational programs supports UNR's strategic goals.

GRADUATE CERTIFICATE IN NUCLEAR PACKAGING

In 2013, with support from the DOE PCP, the UNR ME Department began working with the national laboratories to help them develop courses that were eligible for UNR graduate level credit. The labs organized their existing course materials into topical courses that would be delivered over one- or two-week sessions, presented by subject matter experts at the lab, and required 45 or 90 hour of student involvement. The University helped the labs rigorously define course student learning outcomes, student assessment/grading methods, and continuous improvement processes. This made the 1-or-2-week courses eligible to award, respectively, 1 or 2 units of university graduate credit.

The ME Department used UNR's normal new course/program proposal process to gain UNR approval for these new classes. A three-unit internship course, which requires students to plan, perform and report on a nuclear packaging-related project in a professional setting, under the supervision of a site supervisor and a university faculty member, was also approved [4]. The ME Department established volunteer contracts with the subject matter experts who teach the classes as part of their normal professional duties, to allow them to instruct courses as adjunct faculty. UNR worked with the US states where each lab resides to gain authorization to teach in-person courses in those states. The Department used projected enrollments to establish a self-funded student fee system to cover all anticipated university expenses.

In parallel, the ME Department used the normal new course/program proposal process to gain UNR approval for a 9-unit Graduate Certificate in Nuclear Packaging (GCNP). It consists of four units of required materials, that the program stakeholders consider essential for all packaging engineers, analysts, managers, and users. It also includes five units of electives that are chosen by students, from a list of courses, to satisfy their own interests and needs. All UNR courses and programs are accredited by the Northwest Commission of Colleges and Universities, a regional accreditation body.

Since the GCNP was launched in late 2016, 96 students have completed its courses. Six students completed nuclear packaging internships (at Argonne and Savannah River National Laboratories, and at Orano Group), and four students have earned the certificate [5]. Student

progress toward program completion has slowed due to COVID-19 safety protocols, but several students plan to complete the certificate soon.

GRADUATE CERTIFICATE IN TRANSPORTATION SECURITY AND SAFEGUARDS

In August 2020, the ME Department began offering a 9-credit Graduate Certificate in Transportation Security and Safeguards (GCTSS). Like the GCNP, it was developed with support from the DOE PCP based on existing PCP course content. It consists of 4 units of required course work and 5 units chosen by students from a set of electives. The process to approve this program was very similar to the one used for the GCNP.

The admission requirements for the GCTSS are an earned baccalaureate degree in mechanical, materials, or nuclear engineering or a closely related field, or a baccalaureate degree and background in project management related to nuclear and radioactive materials packaging. The GCTSS program provides a curriculum in transportation security and safeguards that complements graduate programs in mechanical, nuclear, materials and related engineering fields, and is more applied knowledge based than research based. The goals of the certificate program are to

- a) Encourage students to complete a comprehensive curriculum in transportation security and safeguards that has both depth and breadth,
- b) Provide a graduate-level curriculum designed to give students advantages when seeking employment or advancement in transportation security and safeguards, or related fields, and
- c) Help the transportation security and safeguards industry recruit, train and advance current and potential employees.

The GCTSS program educational objectives are to provide the necessary applied knowledge and skills that mechanical, material, or nuclear engineers require to be successful as nuclear packaging engineers, analysts, and users. To do this, students who earn a Graduate Certificate in Transportation Security and Safeguards will be able to describe and understand methods for implementing and satisfying nuclear security and safeguards requirements, and either US domestic or international nuclear transport security requirements. They will be able to understand and describe the American Society of Mechanical Engineers (ASME) Code requirements for design, procurement, fabrication, examination, and testing of radioactive material packaging and storage casks to satisfy regulatory requirements, as well as a depth and breadth of transport security and safeguard practices.

The following thirteen national laboratory courses are currently part of the GCTSS curriculum. Each course number uses the Nuclear Packaging (NP) prefix, and the number of units and the lab that offers each course are also included [6]:

1. NP 600 - American Society of Mechanical Engineers (ASME) Pressure Vessel Code for Nuclear Transport and Storage, 1 unit, Argonne National Laboratory
2. NP 601 - Quality Assurance (QA) for Radioactive Material Packaging and Storage Casks, 1 unit, Argonne National Laboratory
3. NP602- Safety Analysis Report for Packaging (SARP) Review and Confirmatory Analysis, 2 units, Lawrence Livermore National Laboratory

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4. NP 603 - Management of Safety Analysis Report for Packaging (SARP) Preparation, 1 unit, Savannah River National Laboratory
5. NP 604 - Radioactive Material Packaging Quality Control (QC)/Quality Assurance (QA): Part 1 Welding/NDE Quality Control, & Part 2 Software Quality Assurance, 1 unit, Lawrence Livermore National Laboratory
6. NP 605 - Thermal Modeling and Testing of RAM Packages, 1 unit, Sandia National Laboratory
7. NP 606 - Containment Analysis of Radioactive Material Transportation Packages, 1 unit, Lawrence Livermore National Laboratory
8. NP 607 - Radiation and Nuclear Criticality Analysis of RAM, 1 unit, Oak Ridge National Laboratory
9. NP 608 - Radioactive Material Package Operations and Leak Testing, 1 unit, Savannah River National Laboratory
10. NP 610 - Nuclear and Other Radioactive Materials Transport Security - Domestic, 1 unit, Argonne National Laboratory
11. NP 611 - Nuclear and Other Radioactive Materials Transport Security - International, 1 credit, Argonne National Laboratory
12. NP 620 - Fundamentals of Nuclear Security, 1 unit, Sandia National Laboratory
13. NP 630 - Fundamentals of Nuclear Safeguards, 1 unit, Oak Ridge National Laboratory

In addition, the following six 3-credit courses, offered by the ME and the Materials Science and Engineering (MSE) programs at UNR, are part of the curriculum.

14. ME 675 Introduction to Combustion,
15. MSE 601 Corrosion of Metals
16. MSE 665 Nuclear Power Fundamentals
17. MSE 666 Nuclear Fuel Cycle
18. MSE 667 Radiation Detection and Measurement
19. MSE 668 Nuclear Materials

Finally, student may take the following internship course at national laboratory, nuclear industry, or government sites [4]

20. NP 640 Nuclear Packaging Internships, 3 credits

The current 9-credit GCTSS curriculum requires student to complete four courses, NP 600, NP 620, NP 630, and either NP 610 or NP 611. The contents of these courses are foundational to all nuclear transportation security and safeguards practitioners. They comprise four credits and are all offered by the national laboratories. Student must take five additional elective credits from the remaining national laboratory, UNR or internship courses. These electives add depth, breadth and/or professionalism to the required content.

To earn UNR mechanical engineering graduate credit in any of the lab classes, a student must enroll with and pay any necessary fees to the national lab that offers the course. The student must then gain admission to UNR and enroll in the course, pay UNR fees (in addition to any fees collected by the national laboratory), and earn a passing grade based on class assignments and a

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final exam. The student may then use the course credit toward selected graduate degrees at UNR, or at other universities that accept it.

To use a course toward the GCTSS, the student must (a) enroll in the GCTSS program, (b) earn a C grade or better, and (c) complete the certificate curriculum in 6 years or less, with an average grade point average (weighted based on course credits) of B or better. Students may use no more than four units of courses for both the Nuclear Packaging and the Transportation Security and Safeguards graduate certificates.

ONGOING WORK

The UNR ME Department is currently working with support from the DOE PCP (through Argonne National Laboratory), to perform the following tasks:

- Administer the GCTSS and GCNP Programs. This includes answering student questions, granting student admissions, tracking student grades and progress toward completion, and awarding certificates upon completion.
- Publicize the GCTSS and GCNP programs to potential students and employers. This includes presenting papers on these programs at national and international conferences.
- Develop an assessment and continuous improvement process for the GCTSS and GCNP program. This includes soliciting, analyzing, and drawing conclusions from students and their employers, and acting on those conclusions.
- Work with site supervisors to conduct and evaluate nuclear packaging internships (NP 640).
- Establish an Industrial/Governmental Advisory Council. The objectives of the Council are to (a) Evaluate curriculum information, as well as student and employer survey data, (b) Assess the relevance and effectiveness the GCTSS and GCNP courses in achieving the educational objectives, and (c) suggest programmatic improvements. The Council members will consist of high-level packaging managers and employers from industry and government, some of whom may have experience or interests in hiring packaging engineers, certificate holders, and/or using the certificate program to train new employees.
- Work with subject matter experts from the following national laboratories to develop and gain UNR approval for eight new 1-unit national laboratory courses.
 - Argonne National Lab:
 - Transport Emergency Response
 - Facility Decommissioning
 - Los Alamos National Lab
 - Use of Type B and Fissile Certified Packages
 - Oak Ridge National Lab
 - Nondestructive Assay Measurement Fundamentals
 - Pacific Northwest National Lab
 - Fundamentals of Cyber-Physical Security
 - Sandia National Laboratory
 - Explosive Analysis of Nuclear Packages
 - Structural Analysis of Radioactive Material Packages
 - Transportation Physical Security

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- Determine the feasibility of establishing a new 30-unit Master of Science degree in Nuclear Packaging (MSNP). This degree will include a 9-unit research-based thesis, 8 units of required course work, and 13 units of electives (which may include up to 6 internship units). The degree will take advantage of courses that the national labs and UNR have established for the GCTSS and GCNP programs.

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