



University of Nevada, Reno Graduate Certificate in Nuclear Packaging

Miles Greiner, Ph.D., University of Nevada, Reno

Yung Y. Liu, Sc.D., Argonne National Laboratory

James Shuler, Ph.D., Department of Energy

Southern States Energy Board

Radioactive Materials Transportation Committee and Transuranic Waste Transportation Working Group

December 12-13, 2018, Austin, Texas



Funded by DOE Packaging Certification Program



Nuclear and Other Radioactive Materials



- Are used for large-scale electricity generation, medical treatments, food sterilization, and advanced measurement technologies.
- **Packaging** that protects the public and environment during their transport, must
 - Meet all relevant Federal regulations and safety standards, and
 - Be designed, analyzed, approved by a regulatory authority, fabricated, and used safely.

Radioactive Material Packaging



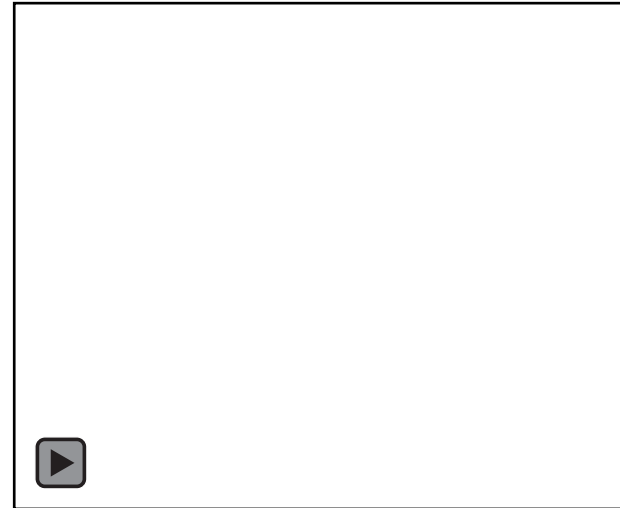
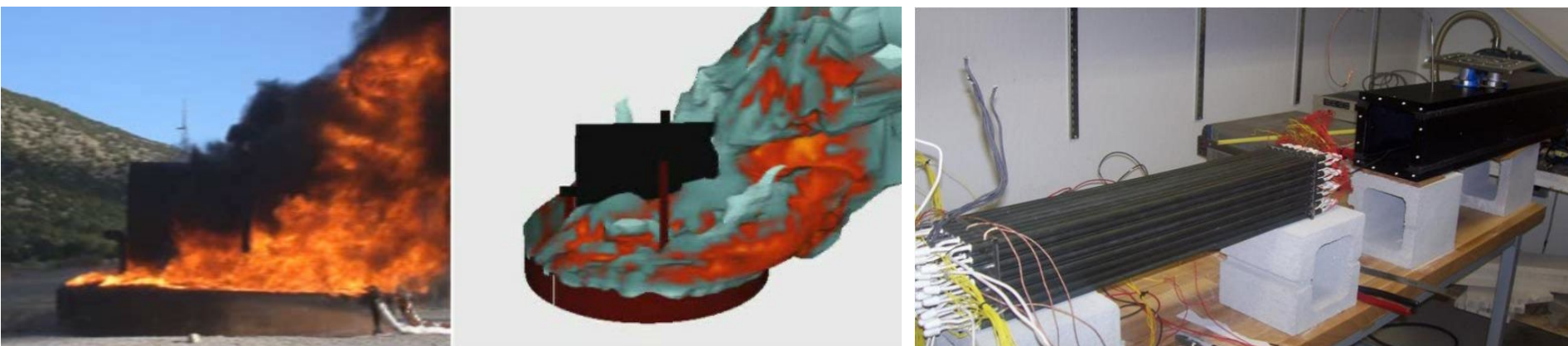
- Federal regulations in 10 CFR 71 require them to provide containment, shielding and critically-safety under normal and hypothetical-accident conditions
 - For large packages, the accidents consist of a sequential 9-m drop onto an unyielding surface, 1-m drop onto a puncture bar, 30-minute engulfment in 800°C-fire, and water submersion
- Packaging System Engineers, Analysts and Reviewers must produce and assess a 9-chapter **Safety Analysis Report for Packaging (SARP)** that demonstrates that the package will meet all regulations and requirements for issuance of a Certificate of Compliance (CoC)
- Package Users must follow the Operating Procedures, Acceptance Tests, Maintenance, and Quality Assurance practices specified in the SARP and the Conditions of Approval in the CoC
- These Engineers and Users require domain-specific knowledge and skills

DOE Packaging Certification Program (PCP)

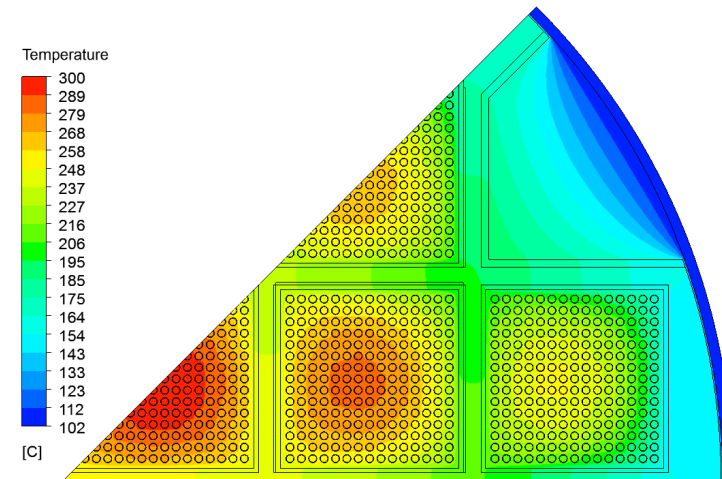


- Has for many years supported Nuclear Material Packaging & Transportation Safety courses
 - Three to ten day classes taught by technical experts at several national laboratories
 - Attended by domestic and international professionals from government agencies, industries, and national labs.
 - Presented in small classroom settings, with group activities and hands-on demonstrations
- Due to attrition and projected retirements, there is a need to proactively *increase training opportunities*

The University of Nevada, Reno (UNR)



- Is a natural home for an *academic* program since it has
 - Conducted experimental and computational research on nuclear packaging safety under normal and fire accident conditions with DOE, NRC and State of Nevada support since 1993, and
 - Has received NRC funding to support
 - US Citizens pursuing MS and Ph.D. degrees in nuclear safety topics
 - Development of nuclear-safety related courses



In 2013, DOE PCP funded UNR to

- Work with three National Labs to organize existing PCP course content into six 1- and 2-credit courses
 - The student learning outcomes were formalized to allow the courses to be a part of the UNR Mechanical Engineering Graduate Program
 - These courses are taught at, and by, the labs over 1 and 2 week periods
- Create a 9-credit **Graduate Certificate in Nuclear Packaging (GCNP)** curriculum, consisting of
 - 4 credits of required courses (Provide foundational material)
 - 5 credits of electives (For depth and breadth, chosen from Lab and UNR courses)
- The Program was accredited by the Northwest Commission of Colleges and Universities in December 2015

Program Educational Objectives



- Based on needed knowledge and skills
- Packaging system engineers/managers
 - Relevant Federal Regulations for transport and storage packages, using a graded approach on structures, systems and components (SSCs), in accordance with importance to safety (Defines design goals)
 - The ASME Boiler and Pressure Vessel Code related to nuclear packaging (Foundation for design, analysis, fabrication, examination)
 - Quality Assurance requirements (Guarantee designs & procedures are enacted)
 - Knowledge of all SARP technical areas, because they interact.
- Package Function-Designers, Reviewers or Analysts
 - *In-depth* knowledge of that function
 - General knowledge of other technical areas, because they all interact.
- Packaging Users
 - Insure that all Operating Procedures, Acceptance Tests, Maintenance, and Quality Assurance practices prescribed in the SARP are precisely enacted.

Relationship of SARP Chapters to the 10 Lab Courses

SARP Chapter	SARP Chapter Topic	Course Topic	Required (4 credits)			Elective (choose 5 credits)						
			QA for Nuclear Packaging	ASME Code for Nuclear Transport & Storage	SARP Review & Confirmatory Analysis	Operation & Leak Testing	Thermal Testing & Analysis	Shielding and Criticality	Management of SARP Preparation	Transport Security Domestic	Transport Security International	Nuclear Packaging Internship
			Credits	1	1	2	1	1	1	1	1	3
		Lab	ANL	ANL	LLNL	SRNL	SNL	ORNL	SRNL	ANL	ANL	All
1	General Information		X		X	X			X			.
2	Structural Evaluation		X	X	X				X			.
3	Thermal Evaluation		X	X	X		X		X			.
4	Containment Evaluation		X	X	X				X			.
5	Shielding Evaluation		X		X			X	X			.
6	Criticality Evaluation		X		X			X	X			.
7	Operating Procedures		X		X	X			X			.
8	Acceptance Tests & Maintenance		X	X	X	X			X			.
9	Quality Assurance		X	X	X				X			.
	Transport Security									X	X	.
	Professionalism											X

Benefits

- Help engineers and managers obtain needed knowledge and skills to be successful in nuclear packaging or related fields, so they can qualify for
 - Employment and
 - Advancement
- Help nuclear regulatory and industry organizations
 - Train new employees, and
 - Gain credibility with clients
- University students and professional take classes together
- For continuous improvement, an Advisory Board
 - Consisting of Industry and Government Packaging Experts and Employer
 - Will review the curriculum annually to assure relevance and quality

Nuclear Packaging Internship



- Supervised independent use of engineering skills for professional project planning, performance, and communications at a DOE or Industry Site.
 - 3 credits, requires 140 to 270 hours of student involvement
 - 4 to 12 weeks in residence at a Site
 - Attending regular meeting, following organizational protocols, ...
- Intended to develop *professionalism* in undergraduate or graduate university students, and introduce them to the packaging profession
- DOE, national labs and many companies offer *competitive* internship-for-pay and summer employment opportunities, which can support this internship-for-credit

GCNP Status

- 47 students have taken GCNP courses since 2015
 - The first Certificate was awarded in 2017
- Internship
 - 6 university students completed internships last summer
 - At Argonne, Savannah River, and Orano (formerly AREVA)
 - The students were from UNR, Texas A&M, Virginia Tech, Missouri Univ. of Science & Tech, Univ. of South Carolina, Aiken
- Current Electives choices
 - Six 1-credit National Laboratory classroom courses
 - New ones are currently being developed
 - Six 3-credit UNR courses
 - A 3-credit internship

Nuclear Packaging Summer School



- Two required courses will be offered at a UNR campus in Reno, Nevada (35 minutes from Lake Tahoe) during consecutive weeks in June 2019



- June 3-7, 2019, ASME Pressure Vessel Code for Nuclear Transport and Storage
- June 10-15, 2019, Quality Assurance for Nuclear Packaging

- The remaining required 2-credit (two week) course will be offered in Pleasanton, CA (60 minutes from San Francisco)



- August 13-16 & 19-22, 2019, SARP Review and Confirmatory Analysis

New: Graduate Certificate in Transport Security & Safeguards

- The DoE PCP recently funded UNR to begin work with national laboratories to develop a new 9-credit graduate certificate
- 4 required 1-credit courses
 - ASME Code for Nuclear Transport and Storage
 - Domestic (or International) Transport Security
 - Nuclear Security Fundamentals (Oak Ridge NL)
 - Nuclear Safeguards Fundamentals (Sandia NL)
- 5 elective credits, chosen from
 - International (or Domestic) Transport Security
 - 3-credit Internship
 - Other existing and new courses



Summary



- The University of Nevada, Reno offers a 9-credit Graduate Certificate in Nuclear Packaging, that provides engineers and managers needed knowledge and skill to be successful in the nuclear packaging industry
- The GCNP consists of four required credits, and five elective credits, chosen by students to support their interests and needs, including an optional for 3-credit internship
- 47 students have taken GCNP courses since 2015, and the first Certificate was awarded in 2017
- In 2019, the required courses will be offered in Summer Schools near Lake Tahoe in June, and near San Francisco in August
- UNR is currently developing a new Graduate Certificate in Transportation Security and Safeguards
- [Questions?](#) greiner@unr.edu

Extra Slides

Instructional Settings



- Classroom courses
 - 1 or 2 credits, 45-90 hours of student involvement, one or two week sessions
 - Presented in small classroom settings, with group activities and demonstrations
 - Ideal for delivering and reinforcing large amounts of structured information and skills
 - Generally requires travel and short-term lodging
 - Generally funded by employer, requires time away from work
 - Typical of high-quality professional/graduate education

Internship Format



- Before enrollment, Intern works with a committed Site Supervisor to
 - Design Internship Project that will be conducted at an Internship Site
 - Identify a UNR Faculty Member who assesses achievement of student learning outcomes
- Internship Proposal (10% of grade)
 - Establishes goals, schedule milestones, resources, contingency plans
- Midterm Report (35%)
 - Progress and any needed Revisions
- Final Report (55%)
 - Written or Presented, demonstrating competencies

Competencies

- Nuclear Packaging Competencies
 - Depth of knowledge of “essential” technical or management areas, and/or breadth of knowledge of an overall packaging system and its operation
 - Assessed primarily by Site Supervisor
- Professionalism Competencies: Validates the student’s ability to:
 - Communicate effectively
 - Understand the impact of engineering solutions in a global context
 - Gain information and skills independently
 - Identify issues that have yet to be resolved
 - Determine problems that need to be solved, and then find ways to solve them
 - Assessed by UNR Faculty Member with support from Site Supervisor

UNR Electives

- Six, 3-credit nuclear and packaging-safety-related classes that are primarily available to UNR graduate students
 - Introduction to Combustion (ME 675)
 - Corrosion of Metals (MSE 601)
 - Nuclear Power Fundamentals (MSE 665)
 - Nuclear Fuel Cycle (MSE 666)
 - Radiation Detection and Measurement (MSE 667)
 - Nuclear Materials (MSE 668)

Miles Greiner Bio

- Received his Ph.D. from MIT in 1986 and joined the University of Nevada, Reno Mechanical Engineering Department that same year.
- He is currently a Foundation Professor and Department Chair of Mechanical Engineering
- He has conducted nuclear packaging safety heat transfer research since 1993
- He is the Principal Educator for the UNR Graduate Certificate in Nuclear Packaging.