



***Nuclear, Plasma, and Radiological Engineering 442***  
**Radioactive Waste Management**  
**Spring 2026**  
**University of Illinois at Urbana-Champaign**

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3:30 to 4:50 pm. Tuesdays and Thursdays in 3018 Campus Instructional Facility

*Instructor*

**Prof. W. R. Roy**

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*Teaching Assistant*

**Jake Mitstifer**

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**Course description: 3 hours credit. Technical Elective.**

Welcome! Climate change has resulted in a renaissance of the Nuclear Industry. One of the major barriers to nuclear energy, however, is the management of radioactive wastes. In this course, we will discuss:

*How radioactivity impacts waste management:*

Social and ethical aspects

Background sources of radiation.

Health impacts of radiation.

Attenuation of radioactivity by solid matter.

*Concepts borrowed from geology and chemistry:*

Geochemistry of radionuclides and hydrogeology.

Uranium and thorium resources.

*The various radioactive, hazardous and mixed wastes and how they are managed:*  
Low-level radioactive wastes, used nuclear fuel, U.S. DOE legacy wastes, decommissioning wastes, geological repositories, waste package stability, transportation of radioactive materials, and radiological risk management.

*International radioactive waste management*

France, Japan, Russia, and in 12 other countries.

*And more!*

#### **Course Canvas Website**

[Spring 2026-NPRE 442-Radioactive Waste Management-Section A](#)

#### **Course Textbook**

Roy, W. R. 2021. Radioactive Waste Management in the 21<sup>st</sup> Century. World Scientific Publishing Company, Singapore, 298 p., ISBN 978-981-122-829-2.

#### **Overall-Learning Objective**

Connect a group of engineering- and science-oriented students with the current and future issues resulting from the management of radioactive, hazardous, and mixed wastes created by nuclear energy, research, medicine, industry, and by defense activities.

#### **Approach**

The emphasis of this course is on concepts and experiences gained from case studies. This approach is accomplished by exploring the history and current status of radioactive-waste disposal using information from various fields of science and engineering, such as chemistry, geology, waste-site design and operation, and risk assessment. Technical knowledge about how radioactive wastes are managed in both the United States and in other countries is also emphasized. The course will provide insights into what to expect during the next 30+ years for managing radioactive wastes.

#### **Grading**

Midterm Exam	100 points
Final Exam	100
9 Class Assignments	<u>170</u>
Total	370



## Grading Scale

A+ (> 96.0%), A (93.0 - 95.9), A- (90.0 - 92.9), B+ (86.0 - 89.9), B (83.0 - 85.9), B- (80.0 - 82.9), C+ (76.0 - 79.9), C (73.0 - 75.9), C- (70.0 - 72.9), D+ (66.0 - 69.9), D (63.0 - 65.9), D- (60.0 - 62.9), F+ (56.0 - 59.9), F (53.0 - 55.9) and F- (< 52.9) of the total number of points.

## About the instructor

Prof. Roy's principal area of expertise is the application of geology and chemistry to the study of waste management. He is a Commissioner for the Central Midwest Interstate Low-Level Radioactive Waste Commission. His current research includes the Illinois Microreactor Demonstration Project, Consent-Based Siting, public engagement and education, decommissioning, and environmental restoration of nuclear-energy facilities.

He has made the "List of Teachers Ranked as Excellent by their Students" 41 times. He has taught NPRE 442 for 18 years. In 2011 and 2018, he was presented with the American Nuclear Society "Students' Award for Excellence in Undergraduate Teaching." In 2017, 2020, 2021, 2022, 2023, and 2024 he was nominated for the College of Engineering Rose Award for Teaching Excellence. In 2018, NPRE named him "Teacher of the Year." He was appointed to the Academy of Excellence in Engineering Education in 2020. In 2022, he was also nominated for the Campus Award for Excellence in Graduate Teaching. In 2022, he gave the lecture "Teaching Radioactive Waste Management in Illinois, Denver, and Sweden: Lessons Learned" at a Nuclear Waste Educators' Workshop.

Prof. Roy also teaches NPRE/GLBL 481, *Writing on Technology and Security*, and NPRE 498 D, *Decommissioning Nuclear Facilities*. He is a former Lecturer and Co-organizer for the Royal Institute of Technology in Sweden for SH262V, *Geological Storage of Nuclear Spent Fuel*. He also taught two graduate-level, on-line courses for the University of Denver: EPM 4465, *Environmental Restoration and Waste Management*. He is a faculty member of the Program in Arms Control & Domestic and International Security (ACDIS). He is the Faculty Advisor for the *Illini Journal of International Security*.

Prof. Roy served as an Editor and Associate Editor of the *Journal of Environmental Quality*, a lecturer for a NATO Advanced Study Institute in Italy, and a Peer Review Panelist for the U.S. Environmental Protection Agency. He has also served on the Editorial Boards of the *Journal of Hazardous Wastes* and the *Soil Science Society of America Journal*. He is currently an Editor for the *Journal of Nuclear Energy Science and Power Generation Technology*. He has also been a consultant for various private, state, and federal agencies such as Life Systems, Inc. and the U.S. Department of Justice. He is currently a Geochemist for the Electric Power Research Institute (EPRI). For EPRI, he conducted research on

radionuclides in coal combustion by-products, and on dissolved radionuclides in groundwater. He was also a member of the NPRE Reactor Safety Committee. He has represented NPRE on the Radiation and Laser Safety Committee (UIUC). He is a member of the American Nuclear Society (Fuel Cycle and Waste Management and the Decommissioning and Environmental Sciences Divisions). He has been re-nominated to the Executive Committee of the Decommissioning and Environmental Sciences Division.

Office hours (219 Talbot Laboratory) 2:00 to 3:15 pm Tuesdays or e-mail for an appointment.

#### **About the Teaching Assistant**

Jake Mitstifer is a 2nd-year MS student in NPRE. His BS was in NPRE with a concentration in Power, Safety and Environment, and a minor in Political and Civil Leadership. He took NPRE 442 in 2023 and is the former President of the local Student Chapter of the American Nuclear Society (ANS).

He interned at the Nuclear Regulatory Commission (NRC) in their Probabilistic Risk Analysis division for operating reactors. He examined fault trees for the fleet's FLEX equipment. Last summer, he spent time at Blue Energy, a nuclear start up, as a licensing engineering intern. He assisted in writing Blue Energy's Construction Permit Application. Both experiences gave him knowledge in how nuclear facilities are cited and emphasized the importance of communication with the general public.

His thesis topic is about public perception and policy for nuclear energy and the management of spent nuclear fuel in Illinois. Ultimately, he hopes to identify and help resolve barriers for public acceptance by working with ANS in support of DOE's Collaboration-Based Siting Program.



## NPRE 442. Radioactive Waste Management

**Syllabus for Spring 2026. Lecture: 3:30 to 4:50 pm, Tuesday and Thursday  
in 3018 Campus Instructional Facility by Prof. W. R. Roy**

Date	Subject(s)	Class Assignments <sup>1</sup>
Jan. 20	Introduction	Student questionnaire
Jan. 22	Social and Ethical Aspects: Part 1 Decay, Background Radiation, and Risk	Read Preface <sup>2</sup>
Jan. 27, 29	An Overview of Radioactive and Hazardous Waste	
Feb. 3	Who Regulates Radioactive Materials? Potential Health Impacts of U, Ra, Pu, Cs, and <sup>3</sup> H Physical Chemistry Applied to Radioactive Wastes	CA-1. Read Chapter 1 Answer Review Questions 5, 6, 7, 8, and 13
Feb. 5	Radioactive Decay, Attenuation and Shielding Dosimetry and Radiation Safety	
Feb. 10	Geochemical Fate and Transport of Radionuclides	CA-2. Read Chapter 2 Answer Review Questions 2, 3, 4, and 6
Feb. 12	Uranium and Thorium Resources and Wastes Depleted Uranium	Class Demonstration: Uranium Ores Read Chapter 3
Feb. 17	Low-Level Radioactive Waste Management	CA-3. Read Chapter 4 Answer Review Questions 5, 8 and 9
Feb. 19	Radioactive Wastes from Fusion Reactors Managing Radioactive Graphite	
Feb. 24	Low-Level Waste Acceptance Criteria	CA-4. Neutron-Activation Products in a Fusion-Reactor Component
Feb. 26	Martinsville That Never Was	
March 3	Used-Fuel Management Social and Ethical Aspects: Part 2	Read Chapter 5
March 5	Natural Geological Analogues Waste Isolation Pilot Plant	
March 10	Review for the Midterm	
March 12	<b>Midterm</b>	
March 24	Deep-Bore Disposal, Deep Isolation Deep-Well Injection of Radioactive Wastes	CA-5. Speciation and Solubility of Uranium, Cesium, and Strontium
March 26	Used-Nuclear Fuel Reprocessing	
March 31	Hanford and the Savannah River Site	
April 2	Legacy Waste Management by U.S. DOE Navy Spent Nuclear Fuel Management	CA-6. Read Chapter 6. Answer Review Questions 1, 3, 5, 6, and 7. Read Chapter 9. Answer Review Questions 2, 3, and 5.
April 7	Treatment and Conditioning of Nuclear Wastes Partitioning and Transmutation	
April 9	Long-Term Stability of Wasteforms	CA-7. The Uranium Diffusion Question
April 14	Radiological Risk Assessment	
April 16	Transporting Radioactive Materials	CA-8. Read Chapter 8 Answer Review Questions 1, 2, 3, 4, 5, and 11
April 21, 23	International Radioactive Waste Management	
April 28	International Radioactive Waste Management	CA-9. Read Chapter 10 Answer Review Questions 2, 3, 4, 5, and 8
April 30	The Global Nuclear Energy Partnership Social and Ethical Aspects: Part 3	
May 5	Honors presentations, Review for the Final	
May 13	<b>Final Exam</b>	

<sup>1</sup>Dates are when assignments begin (due in one week).

<sup>2</sup>Reading assignments in the course textbook. Other Reading assignments will also include publications and on-line news articles.