

# Safety Analysis Report for Packaging Shielding and Nuclear Criticality Safety Courses Developed and Conducted by Oak Ridge National Laboratory

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Oak Ridge National Laboratory

September 13, 2017

NCSD Topical Meeting

Carlsbad, New Mexico



# Agenda

- Introduce the US Department of Energy (DOE) Packaging Certification Program, Office of Packaging and Transportation, Safety Analysis Report for Packaging (SARP) Shielding and Nuclear Criticality Safety (NCS) courses for SARP generalists and analysts
- Course background
- Courses offered
  - Generalist Course
  - Analyst Course
- Course registration options

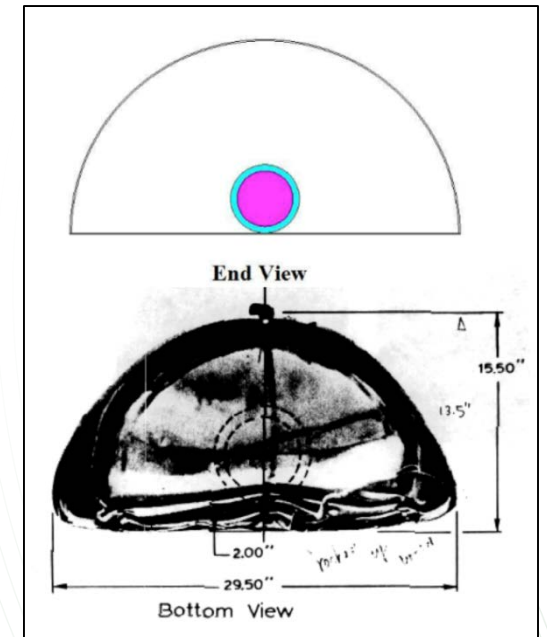
# SARP course background

- **The SARP Generalist Course**

- Designed for project managers, supervisors, NCS/shielding subject matter experts (SMEs), and SMEs in non-NCS/shielding technical areas (e.g., structural, thermal, package design)
- Developed to improve the understanding of how NCS/shielding analyses fit into the broader body of SARP documentation

- **The SARP Analyst Course**

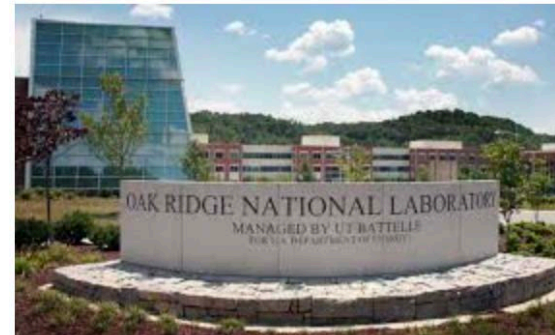
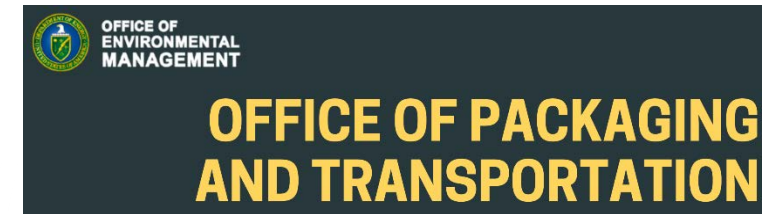
- Provides detailed instruction on the radioactive material package shielding analyses and NCS evaluation fundamentals needed by analysts/practitioners
- Designed to help prepare and/or review technical analyses for the SARP documentation





# SARP course background

- The courses were originally developed for the National Nuclear Security Administration (NNSA) in 2013
- A pilot SARP Generalist Course was offered for NNSA staff members for the first time in September 2013 in Albuquerque, New Mexico
- The updated courses are now conducted for the DOE Packaging Certification Program's Office of Packaging and Transportation
- The goal is to offer each course once per year at the National Transportation Research Center (NTRC) at Oak Ridge National Laboratory (ORNL)



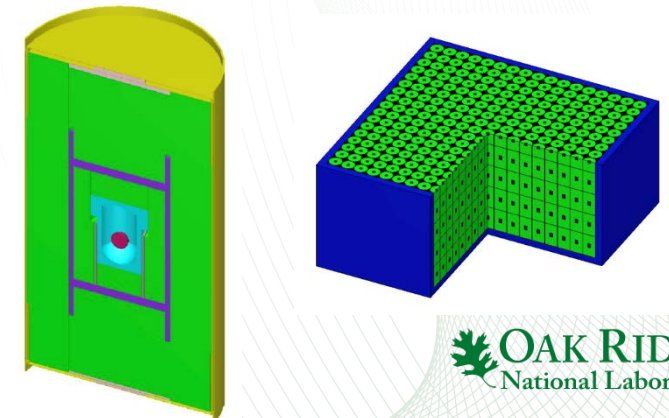
# SARP Generalist Course

- The SARP Generalist Course provides an overview of the regulations and guidelines for criticality and shielding analyses for a SARP
  - Specifically, this course provides an overview of 49 CFR 171-178 and 10 CFR Part 71 regulations for designing and certifying type B packages for transporting fissionable materials safely
- Students are introduced to the content of a SARP document so they can understand how Chapter 5, “Shielding Evaluation,” and Chapter 6, “Criticality Safety,” relate to the other SARP chapters
- Students review an actual SARP document to examine key elements of the shielding and criticality analyses

| Not Radioactive   | Exemption Value | Excepted Quantity<br><i>Excepted pkg</i>             | Lib. Qty & 18A Value | Type A Quantity<br><i>Type A pkg</i>                  | A <sub>1</sub> /A <sub>2</sub> Value | Type B Quantity<br><i>Type B pkg</i> |
|---|-----------------|--|----------------------|---|--------------------------------------|--------------------------------------|
| Exemption values (nuclide specific)                                       |                 | $\leq 10^{-2} A_1$ or $A_2$ (Instruments & Articles) |                      | $\leq A_1$ (special form) or $\leq A_2$ (normal form) |                                      | $> A_1$ or $A_2$                     |
| For contaminated items, surface contamination levels (fixed + removable): |                 | $\leq 10^{-3} A_1$ or $A_2$ (LQ solids/gases)        |                      |   |                                      |                                      |
| $\leq 22$ dpm/cm <sup>2</sup> (β, γ, low tox α); and                      |                 | $\leq 10^{-4} A_1$ or $A_2$ (LQ liquids)             |                      |   |                                      |                                      |
| $\leq 2.2$ dpm/cm <sup>2</sup> (high tox α)                               |                 |  |                      |   |                                      |                                      |

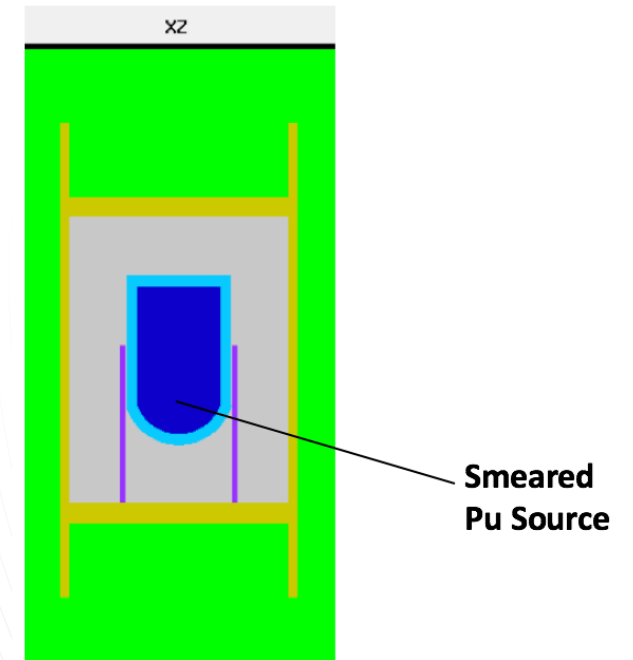
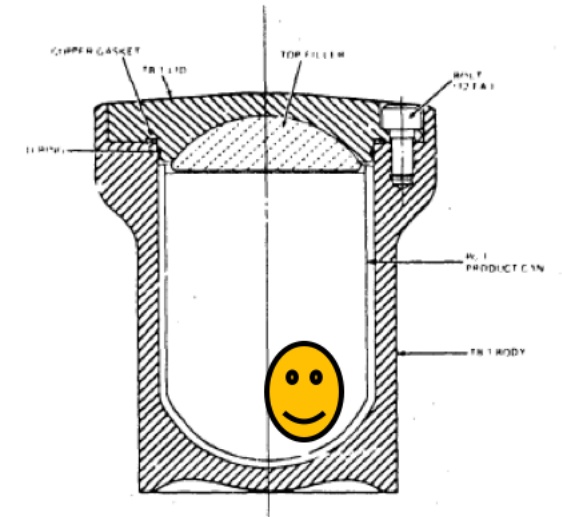
Referenced from the *Radioactive Materials Packaging and Transportation Primer*.

|   |  |  |
|---|--|--|
| <b>Chapter 1</b><br>General Information | <b>Chapter 2</b><br>Structural Evaluation                  | <b>Chapter 3</b><br>Thermal Evaluation     |
| <b>Chapter 4</b><br>Containment         | <b>Chapter 5</b><br>Shielding Evaluation                   | <b>Chapter 6</b><br>Criticality Evaluation |
| <b>Chapter 7</b><br>Package Operations  | <b>Chapter 8</b><br>Acceptance Tests & Maintenance Program | <b>Chapter 9</b><br>Quality Assurance      |



# SARP Generalist Course

- Shielding course modules
  - Students will better understand the analysis methods that are a part of the package shielding analysis in Chapter 5 of a SARP
  - Students will learn
    - Which radiation transport codes and nuclear data are used for this type of analysis
    - How the packaging characteristics and radiation source terms are defined and used, ensuring that a package's external radiation levels are acceptable for a given packaging configuration and fissionable payload
  - Exercises are provided throughout the course to solidify key points

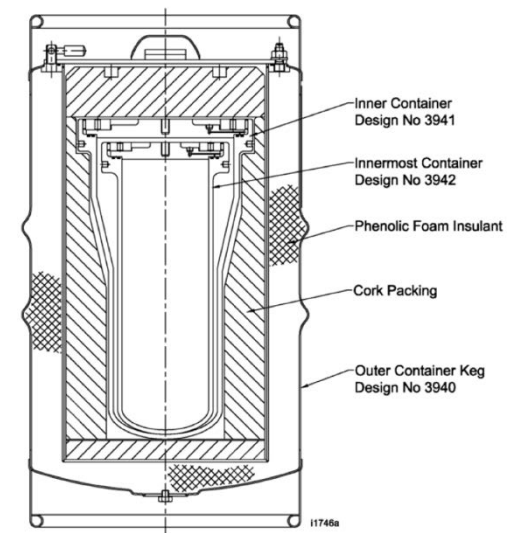




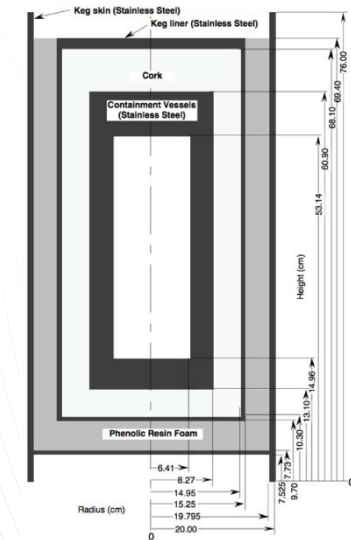
# SARP Generalist Course

- Criticality course modules

- Students will be provided with an overview of the regulations to perform single package and array of package criticality analysis; this analysis is used to derive a criticality safety index (CSI) for a certain package configurations and fissionable payload
- Other topics covered at a high level include
  - The use of radiation transport codes
  - Neutron cross sections
  - Analysis methods
  - Validation
- Exercises are also provided for students to gain an understanding of how to derive the CSI from analysis results
- Students perform a mock review of SARP criticality analysis to become familiar with the content of Chapter 6 and to suggest opportunities for improvement based on the guidance and requirements



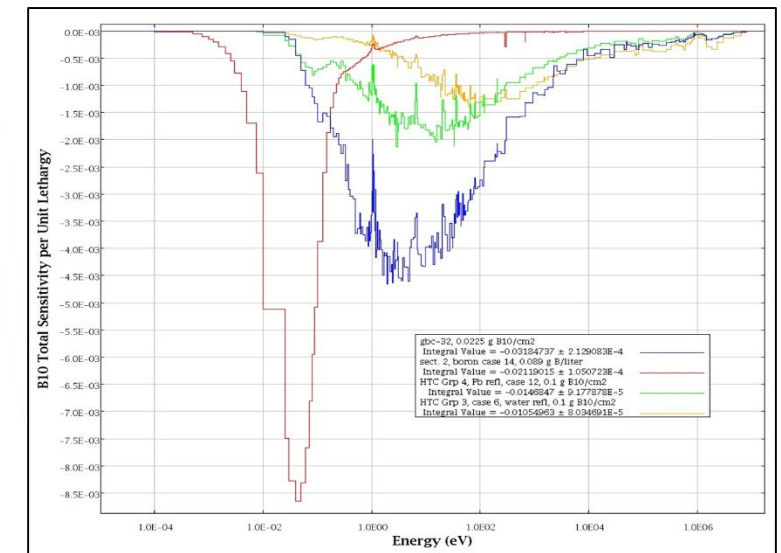
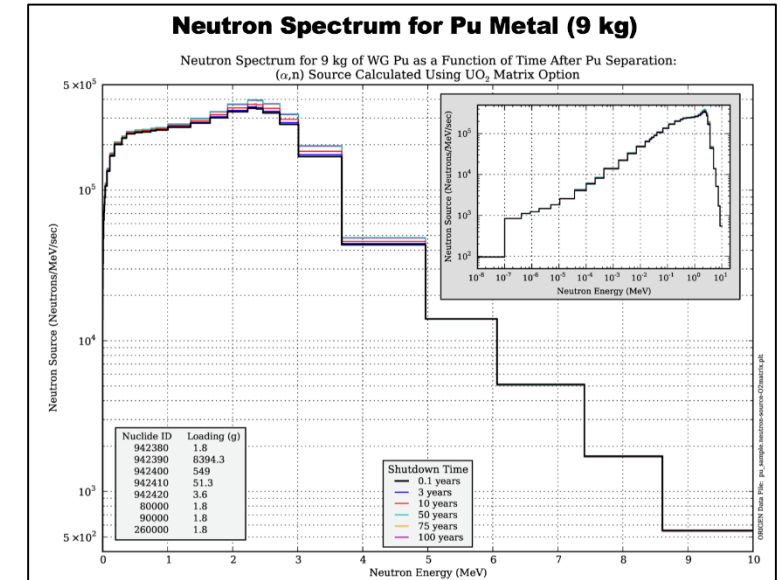
Actual Package Configuration



NCS Analysis Sketch

# SARP Analyst Course

- The SARP analyst course provides
  - Detailed instructions on the radioactive material package shielding analyses and NCS evaluation fundamentals needed by analysts/practitioners to prepare and/or review technical analyses for the SARP documentation for a type B package for shipping fissionable materials
  - An overview of regulations and guidelines, in addition to detailed in-class exercises associated with package shielding and NCS analyses
  - An exercise setting up Monte Carlo N-Particle (MCNP) input files and interpreting results of shielding and criticality analyses
- Analysis teams will be presented with staged SARP examples in which several important decision processes required in the generation of a SARP will be demonstrated and discussed
  - For example, teams will learn how criticality analysis for a given payload mass may require either a mass reduction or package redesign





# SARP Course Registration Options

- The DOE Packaging Certification Program's Office of Packaging and Transportation has collaborated with the University of Nevada, Reno (UNR) to establish a Nuclear Packaging Graduate Certificate Program
  - The UNR Department of Mechanical Engineering conducts this program for DOE and is currently the only university program for this purpose in the United States
  - The nine-credit-hour program consists of a combination of courses offered at UNR, as well as at three national laboratories, including ORNL
  - The SARP generalist and analyst courses will likely be part of this program starting in fiscal year 2018
  - Details about the certificate program can be found at the UNR Nuclear Packaging Certificate Program website:



<https://www.unr.edu/degrees/nuclear-packaging/certificate>



# SARP Course Registration Options

- Students interested in attending the SARP generalist and analyst courses but not the Nuclear Packaging Graduate Certificate program can register for the courses directly through the ORNL conference center
  - Registration links are provided at the Radioactive Material Packaging (RAMPAC) website (<https://rampac.energy.gov>) and announced throughout the year on the ORNL Radiation Safety Information Computational Center (RSICC) website (<https://rsicc.ornl.gov>) and in RSICC monthly newsletters
  - The SARP generalist course is offered each June, and the SARP analyst course is offered each September

[Home](#) [Register](#) [Agenda](#) [Lodging](#) [Course Description](#) [Contacts](#)

## Safety Analysis Report for Packaging (SARP) Shielding/Criticality Safety Generalist and Analyst Courses Developed and Conducted by Oak Ridge National Laboratory

### Course Information

#### Important Dates

SARP Generalist Course: June 5-9, 2017  
Registration Closes: May 12, 2017

SARP Analyst Course: Sept 18-22, 2017  
Registration Closes: August 18, 2017

#### Radioactive Material Package Shielding Evaluation and Nuclear Criticality Safety Evaluation Training:


The U.S. Department of Energy (DOE) Packaging Certification Program (PCP), Office of Packaging and Transportation, is offering Safety Analysis Report for Packaging (SARP) shielding and nuclear criticality safety (NCS) courses for SARP generalists and analysts.


A SARP Generalist Course is available that is designed for project managers, supervisors, NCS/shielding subject matter experts (SME), or SMEs in non-NCS/shielding technical areas (e.g., structural, thermal, package design, etc.) who need to better understand how the NCS/shielding analyses fit in the broader SARP documentation. Specifically, the Generalist Course provides an overview of the regulations and guidelines for the criticality and shielding analysis for a SARP, and the course shows how the NCS/shielding chapters integrate with the other parts of the SARP. Students in the Generalist Course will review an actual SARP document after the course material is presented to emphasize the key elements of the shielding and criticality analyses. The next SARP Generalist Course is scheduled for June 5-9, 2017 at Oak Ridge National Laboratory in Oak Ridge, TN.

A SARP Analysts Course is also available that provides detailed instruction on the radioactive material package shielding analyses and NCS evaluation fundamentals needed by analysts/practitioners (i.e., safety analysts and/or technical reviewers) to prepare and/or review technical analyses for the SARP documentation. The Analyst Course also provides an overview of regulations and guidelines in addition to detailed in-class exercises associated with the package shielding and NCS analyses. With regard to the in-class exercises, analysis teams will be faced with "staged" SARP examples in which a number of important decision processes in the generation of a SARP will be demonstrated and discussed. A SARP Analyst Course is scheduled for September 18-22, 2017 at Oak Ridge National Laboratory in Oak Ridge, TN.

A SARP course information booklet complete with an outline of both courses can be [downloaded here](#).

Please contact the course coordinator, [Douglas G. Bowen](#), at (865) 576-0315.

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# Acknowledgments

Jim Shuler of the DOE Packaging Certification Program Office of Packaging and Transportation supported development of these courses



**Are there any  
questions?**

