Overview of the DOE Packaging Certification Process*

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INTRODUCTION

The U.S. Department of Transportation (DOT) regulations in Title 49 of the Code of Federal Regulations, Part 173 (49 CFR 173.7d) authorize the U.S. Department of Energy (DOE) to certify its own packages for transportation of radioactive materials. The DOT regulations also require DOE to certify that the packages meet standards equivalent to those prescribed by the Nuclear Regulatory Commission (NRC) in Title 10 of the Code of Federal Regulations, Part 71 (10 CFR 71) for commercial shipment of radioactive materials. DOE Order 460.1 establishes the safety requirements for packaging and transportation of radioactive materials that are equivalent to the standards described in 10 CFR 71; the Implementation Guide for DOE Order 460.1 contains information on the administrative procedures for certifying and using radioactive material packaging by DOE. DOE Order 460.1 and its Implementation Guide thus provide the basis for DOE packaging certification. Exclusions from DOE Order 460.1 are DOE's Office of Defense Program for packagings of nuclear weapons and weapons components, Office of Naval Reactors Program for packagings used in nuclear propulsion related activities, and Office of Civilian Radioactive Waste Management, which is required by law to have its packagings reviewed and certified by NRC.

This paper gives an overview of the DOE packaging certification process, which is implemented by the Office of Facility Safety Analysis, under the Assistant Secretary for Environment, Safety and Health, for packagings that are not used for weapons and weapons components, nor for naval nuclear propulsion. The overview will emphasize Type B packagings and the Safety Analysis Report for Packaging (SARP) review that parallels the NRC packaging review. Other important elements in the DOE packaging certification program, such as training, methods development, data bases, and technical assistance, are also emphasized, because they have contributed significantly to the improvement of the certification process since DOE consolidated its packaging certification function in 1985. The paper finishes with a discussion of the roles and functions of the DOE Packaging Safety Review Steering Committee, which is chartered to address issues and concerns of interest to the DOE packaging and transportation safety community. Two articles related to DOE packaging certification were published earlier on the SARP review

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procedures (Popper et al. 1988) and the DOE Packaging Review Guide (Fischer and Chou 1989). These articles may be consulted for additional information.

SAFETY ANALYSIS REPORT FOR PACKAGING (SARP) REVIEW

The Safety Analysis Report for Packaging, SARP, is a document that should provide a comprehensive technical description of the packaging and demonstration of compliance with the NRC safety regulations and standards when the packaging is offered for shipment of radioactive materials. Subcriticality, radiation shielding, and containment are the three basic packaging safety requirements that must be demonstrated in a SARP prepared in the format described in NRC Regulatory Guide 7.9, which calls for inclusion of eight chapters: Introduction and General Information, Structural Evaluation, Thermal Evaluation, Containment, Shielding Evaluation, Criticality Evaluation, Operating Procedures, and Acceptance Tests and Maintenance Program. In addition, the DOE Packaging Review Guide (Fischer 1988) recommends that the SARP should (1) include a description (Chapter 9) of the quality assurance program for the design, fabrication, assembly, testing, maintenance, repair, modification, and use of the proposed packaging; (2) identify established codes and standards proposed for use in package design, fabrication, assembly, testing, maintenance, and use; and (3) identify any specific provisions of the quality assurance program that are applicable to the particular packaging design under consideration, including a description of the leak testing procedure.

After a SARP is prepared by a packaging user, it is usually submitted through one of the DOE Program Offices to the Office of Facility Safety Analysis, under the Assistant Secretary for Environment, Safety, and Health, which has review and certification authority within DOE for nonweapons packagings. The Office is supported by technical staff specialists at Argonne National Laboratory (ANL), Lawrence Livermore National Laboratory (LLNL), and the Eagle Research Group, Inc. These technical groups assist DOE in providing an independent review and evaluation function to ensure that the specific packaging meets all DOE orders and Federal regulations for safe transport of radioactive materials. The SARP review performed by these groups typically involves meetings with packaging user (or applicant), written communication of questions and responses between reviewers and applicant, confirmatory analyses by reviewers, and revision of SARP by applicant, when necessary. The end product of the SARP review is a Technical Review Report (TRR), prepared by the SARP review group, that describes what is done in the technical review and confirmatory analysis, and also documents the results. Based on the information in the TRR, the DOE Certifying Official then issues a Certificate of Compliance (CoC) for the packaging, along with a Safety Evaluation Report, which documents that the packaging described in the SARP complies with 10 CFR 71 and other applicable Federal regulations and which provides justification for issuance of the CoC.

Since 1985, the SARP review groups at ANL and LLNL have reviewed many SARPs covering a wide range of radioactive material contents, including nuclear reactor fuel elements, transuranic wastes, uranium hexafluoride, uranium tritide, highly enriched uranium oxide, plutonium metals and oxides, cesium chloride and cobalt irradiation capsules, californium and americium special forms, and radioisotope thermal generators. The technical staff specialists at each of these institutions have worked together as a team for a long time, and many have become "subject-matter" experts who not only cover disciplinary areas in the SARP review, but also participate actively in the preparation of the DOE Packaging Review and Design Guides, as well as in the development of packaging-related technical standards for national and international organizations such as the American National Standards Institute (ANSI), the American Society for Mechanical Engineers (ASME), and the International Standards Organization (ISO). Two of the ongoing technical standards activities presented at the PATRAM'95 Conference with ANL and

LLNL staff participation are the ANSI N14.5 Leakage Tests on Packages for Shipment (Fischer 1996), and NuPack, the ASME Code for Type B containment (Turula 1996). Members of the ANL and LLNL SARP review groups have also recently completed comments on the draft 1996 Revision of the IAEA Safety Series 6 for Safe Transport of Radioactive Material, the Criteria for Safe Storage of Plutonium Metals and Oxides (DOE-STD-3013-94), and the Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Orders 5480.23, Nuclear Safety Analysis Reports (DOE-STD-1027-92).

TRAINING, METHODS DEVELOPMENT, DATA BASES, AND TECHNICAL ASSISTANCE

Training, development of methods for confirmatory analyses in the SARP review, data bases of certified packages and transportation and packaging occurrences, and technical assistance to the field are elements important to the DOE packaging certification program that have contributed significantly, either directly or indirectly, to the improvement of the packaging certification process. Currently, the DOE packaging certification program sponsors 10 training courses on various aspects of packaging and transportation safety:

- Methods for Reviewing Safety Analysis Reports for Packagings and its adjunct Refresher Course
- Materials Selection for Shipping Containers
- Welding Criteria for Shipping Containers
- Containment Criteria for Shipping Containers
- Qualification Testing for Shipping Containers
- Hydrogen Gas Generation in Radioactive Material Packaging
- Quality Assurance for Radioactive Material Packaging
- Application of the ASME Code to Radioactive Material Packaging
- The SCALE Code System
- The SCANS Code

All of these training courses are taught by either the technical staff specialists in the SARP review groups at ANL and LLNL, or experts at other institutions such as Oak Ridge National Laboratory (ORNL) for the SCALE code system. Enrollment is usually limited in order to emphasize hands-on training, and attendees are required to pass tests at the end of each course in order to obtain a certificate of satisfactory completion. Some of the training courses are more heavily subscribed than others. For example, the courses on the Methods for Reviewing SARPs and Quality Assurance for Radioactive Material Packaging have generally been offered more than once a year, and the latter (QA) course had been offered 25 times in the last 8 years, with more than 600 participants successfully completing the course. In addition to DOE and DOE contractor personnel, NRC, DOT, and several foreign countries have used these DOE training courses since 1987. (In the past year, NRC has utilized the expertise of the DOE training program to help train Ukrainian engineers to initiate a Safety Analysis Review Program for the transportation of radioactive materials in Ukraine.) As a result of these DOE training courses, the quality of the SARPs has improved over the years. The SARPs submitted in recent years generally followed the recommended format and presented more convincing evidence for compliance with regulatory requirements than the SARPs of earlier vintage. Unfortunately, budget limitations have seriously curtailed the presentation of many of these courses in fiscal year 1995, and the resource available for training in fiscal year 1996 is presently unknown. Table 1 contains information on the course titles and class duration for the 10 training courses; Ashok Kapoor, Manager of the DOE packaging certification program, should be consulted for the latest course schedule information.

Table 1. Training Courses Sponsored by the DOE Packaging Certification Program (Contact Ashok Kapoor at 301-903-6838 for latest schedule information)

Title	Duration
Methods for Reviewing Safety Analysis Reports for Packagings[1]	2 weeks
and Adjunct Refresher[1]	1 week
Materials Selection for Shipping Containers[1]	2 days
Qualification Testing for Shipping Containers[1]	2 days
Containment Criteria for Shipping Containers[1]	2 days
Welding Criteria for Shipping Containers[1]	2 days
Shipping Cask Analysis System (SCANS) Code[1]	3 days
Hydrogen Gas Generation in Radioactive Material Packaging[2]	1 day
Quality Assurance for Radioactive Material Packaging[2]	3 days
Application of the ASME Code to Radioactive Material Packaging[2]	2 days
Standardized Computer Analysis for Licensing Evaluation (SCALE) Code System[3]	1 week

[1]Offered by Lawrence Livermore National Laboratory.
[2]Offered by Argonne National Laboratory; course description available online via INTERNET at http://www.et.anl.gov/thm.html.
[3]Offered by Oak Ridge National Laboratory.

The DOE packaging certification program and NRC have been supporting methods development for the Standardized Computer Analysis for Licensing Evaluation (SCALE 1995) at ORNL, and the Shipping Cask Analysis System (SCANS; Gerhard et al. 1991) at LLNL. The SCALE code system and its modules provide a suite of codes that can be used for criticality, shielding, and thermal confirmatory analyses in the SARP review, whereas the SCANS code can be used in a similar capacity, but primarily for structural and thermal analyses of spent-fuel shipping casks. Development of these two codes, particularly SCALE, has covered many years, dating to the early days of the DOE nuclear reactor program. However, it has been the support of the NRC and DOE packaging certification programs in recent years that has maintained and enhanced the codes for use by the NRC and DOE certification staff, as well as by other members of the DOE community who are interested in applying the codes for packaging and transportation safety.

The DOE Office of Facility Safety Analysis sponsors two data base activities of certified Radioactive Materials Packages (RAMPAC) and the Occurrence Reporting and Processing System (ORPS). The RAMPAC data base, maintained by Analysas Corporation in Oak Ridge, TN, is designed for electronic storage and retrieval of information on all non-classified packages certified by DOE and NRC, as well as U.S. and foreign packages certified by DOT, which is the U.S. Competent Authority, for import and export use. The RAMPAC data base is accessible via INTERNET to qualified individuals involved in the shipment of radioactive materials, and is the only data base containing information on certified packages from all three Federal agencies. Any authorized user who has a need to

ship radioactive materials can search the RAMPAC data base for possible use of an existing certified package, which can result in a substantial saving of the packaging certification cost. The ORPS data base, maintained by ORNL, is an activity that issues electronic weekly reports of transportation and packaging incidents across the DOE complex. The weekly occurrence reports are compiled over time for trending and root-cause analyses, based on which corrective actions are recommended, and lessons learned bulletins are issued for wide dissemination to members of the DOE packaging and transportation safety community. Recent analysis of the 1994 occurrences (Welch and Dickerson 1995) showed that almost one-half of the offsite occurrences (21 of 53) not caused by others were related to shipping preparation, such as regulatory noncompliance of shipping papers, marking, labeling, placarding, loading, and tie-downs, i.e., violations of requirements in the operating procedures described in Chapter 7 of the SARPs for the packagings.

In the past year, the Office of Facility Safety Analysis has developed a program to provide technical assistance to DOE Operations Offices to determine the conditions and usage of packagings, and compliance with Federal regulations, DOE Orders, certifications, facility QA plans, and/or other program requirements. The assistance program provides DOE Operations Management with effective feedback to aid in the continuous improvement of the overall safe use of packagings for radioactive materials. Pursuant to this program, the Office recently assembled a packaging safety team (with members from DOE headquarters, LLNL, and ORNL) and provided assistance to ANL-W at Idaho in a packaging quality assurance evaluation of the T-2 spent-fuel shipping cask. The assisted evaluation resulted in recommendations to both DOE Headquarters Certifying Official and the DOE Area Office Management to resolve concerns identified in the regulatory package design review process, and the user's procedures of operation, maintenance, and inspection.

PACKAGING SAFETY REVIEW STEERING COMMITTEE

The Packaging Safety Review Steering Committee, chartered by the Director of DOE's Office of Facility Safety Analysis, is an internal committee created to provide a forum for identification, discussion, and resolution of issues and concerns arising from activities of the DOE packaging certification program. The major functions of the Committee are to (1) identify common issues and concerns in packaging certification, (2) develop strategies for improving the packaging certification process, and (3) ensure uniformity in the technical review and evaluation process. Although the regular membership in the Committee is limited, the Committee may establish working groups to address specific packaging safety issues or other areas of concern. These working groups may have members from DOE contractor organizations, NRC, DOT, or other external public or private agencies. Examples of the packaging issues recently addressed by the Committee working groups are the use of the leak-test adapter plates in packaging containment verification, sealed penetration covers, and decay heat in spent fuel. Frequently Asked Questions (FAQs) in SARP review is another Committee working group activity that aims to improve the DOE packaging certification process. The idea behind the FAQs in SARP review is that in the past SARP reviews conducted at ANL and LLNL, many of the same issues came up repeatedly for such items as contents definition, materials specification, drawing legibility, etc. A compilation of "Frequently Asked Questions" disseminated to the field should prove useful to applicants in avoiding common problems in SARP preparation; the result should be a faster, less expensive packaging certification process. One of the interesting results obtained from the FAQs activity is the distribution of the number of questions by chapters generated in the SARP reviews. Figure 1 shows that Chapter 1 (General Information) and Chapter 2 (Structural Evaluation) are the two chapters in the SARPs for which the reviewers had asked the most questions. The percentages of the review questions that fall into Chapters 1 and 2 (16.4 and 27.7%, respectively) are also similar to those (22.7 and

30.8%) found in an earlier study (Primeau and Mauck 1989), thus indicating the major problem areas in SARP preparation where future training may be directed.

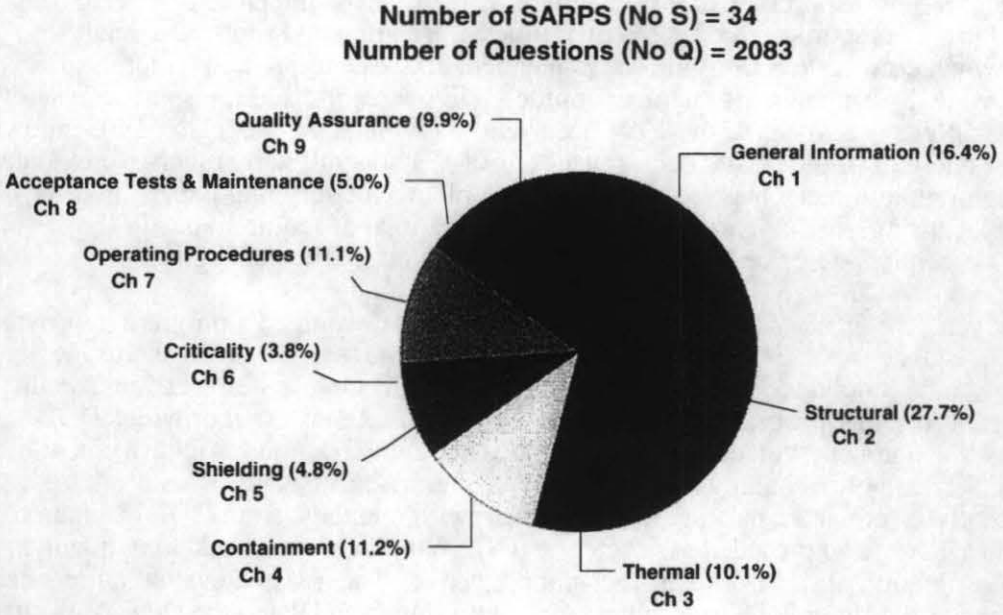

Figure 1. Safety Analysis Report for Packaging (SARP) Review Questions by Chapter

To ensure uniformity in the SARP review and evaluation process, the Packaging Safety Review Steering Committee has institutionalized the functions and procedures of the DOE packaging certification program in a Conduct of Operations document, while the SARP technical review groups embrace their practice based on the DOE Packaging Review Guide. Additionally, annual meetings are held for the ANL and LLNL SARP reviewers, the DOE program managers, and the Eagle Research docket managers to discuss technical issues and exchange viewpoints, almost always with participation of colleagues from NRC and DOT. Other forums for information exchange also include meetings of the Special Interest Group (SIG) on Packaging and Transportation Safety (PATS), which is part of the larger DOE-sponsored network on Training Resources and Data Exchange (TRADE). The primary vehicle used by the Steering Committee for external communication of the DOE packaging certification program is the Packaging Certification News, the latest electronic version of which (August 1995) can be found in either of the following INTERNET addresses: http://www.et.anl.gov/thm.html, or http://www.ornl.gov/pats/pats.htm.

SUMMARY

Consolidation of the packaging certification function by DOE and its investment in training, methods development, data bases, and technical assistance in the last 10 years has resulted in a consistent review and evaluation process for packaging certification, improved SARPs, and, above all, packaging that can be used safely to transport radioactive materials without undue risk to public health and safety, property, and environment. The DOE packaging certification program will continue its improvement of the packaging certification process in a climate that seems to call increasingly for external regulation of DOE nuclear safety. While the Advisory Committee on External Regulation of DOE Nuclear Safety has yet to deliver its final recommendation, a preliminary conclusion of the Advisory Committee is that an efficient, internal system for ensuring safety is essential, independent of the ultimate choice of how regulation and oversight of safety is handled (Ahearne and Scannell 1995).

The DOE packaging certification program should be part of that efficient, internal system for ensuring the packaging and transportation safety of radioactive materials.

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REFERENCES

Ahearne, J.F. and Scannell, G.F. *Advisory Committee on External Regulation of U.S. Department of Energy Nuclear Safety,* Status Report by the Co-Chairs (August 14, 1995).

Fischer, L. E. et al. *Packaging Review Guide for Reviewing Safety Analysis Reports for Packagings,* Revision 1, Lawrence Livermore National Laboratory report, UCID-21218 (1988)

Fischer, L.E. and Chou, C.K. *Overview of the DOE Packaging Review Guide and the Review Process,* Proc. 9th Int. Symp. on Packaging and Transportation of Radioactive Materials, Washington DC, p. 1634 (1989).

Fischer, L.E. *Revision of ANSI N14.5 Leakage Test Standards,* Proc. PATRAM'95, to be published (1996).

Gerhard, M.A., Trummer, D.J., Johnson, G.L., and Mok, G.C. *SCANS (Shipping Cask Analysis System) A Microcomputer Based Analysis System for Shipping Cask Design Review,* NUREG/CR 4554, UCID-20674, Rev.1 (1991).

Popper, G.F., Raske, D.T., and Turula, P. *The Procedures Used to Review Safety Analysis Reports for Packaging Submitted to the U.S. Department of Energy for Certification,* Proc. 29th Annual Meeting of the Institute of Nuclear Materials Management, Las Vegas, NV, p. 166 (1988).

Primeau, S.J. and Mauck, C.J. *Technical Problems Encountered in Applications for Packaging Certification,* Eagle Research Group, Inc. report, ERG 89-218T6 (1989).

SCALE: A Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation, NUREG/CR-0200, Vols. 1-4, Rev. 4, ORNL/NUREG/CSD-2/R4 (1995).

Turula, P. *Progress Toward NuPack, the ASME Code for Type B Containments,* Proc. PATRAM'95, to be published (1996).

Welch, M. J. and Dickerson, L. S. *Packaging- and Transportation-Related Occurrence Reports, FY 1994 Annual Report,* Oak Ridge National Laboratory report, ORNL--/PATS-95-002 (1995).