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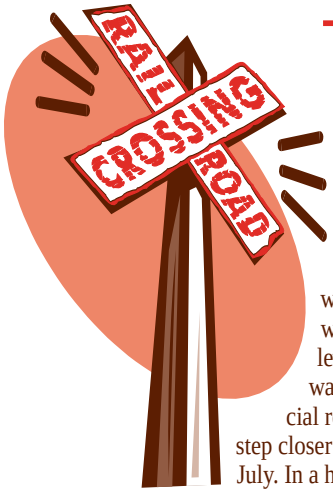
Volume 18 • September 2002

REACTIONS

FROM THE AMERICAN NUCLEAR SOCIETY TO TEACHERS INTERESTED IN THE NUCLEAR SCIENCES

Transporting Radioactive Waste



After years of scientific studies and much discussion, the question of where America will store its high-level radioactive waste from commercial reactors moved a step closer to an answer this July. In a highly anticipated vote, the United States Senate joined the House of Representatives in overruling the objections of Nevada and cleared the way for the Department of Energy (DOE) to begin preparing the licensing application for the Yucca Mountain repository.

No exact application date has been determined, but the process is expected to take a considerable time. Once the application is prepared and submitted, it must receive approval from the Nuclear Regulatory Commission (NRC). In addition, the DOE must complete work on plans for transporting radioactive waste to the Nevada facility.

Currently, high-level nuclear waste from power reactors is stored at power plants across the country. It has been estimated that none of these materials could begin their trip to Yucca Mountain until 2010.

During the debate about Yucca Mountain, opponents raised questions about the safety of transporting radioactive materials. It is likely that this issue will receive additional attention in the days ahead. Some of that attention may be more emotional that factual. Your students should have access to the information, not just emotion and opinion.

What are the facts about transportation of radioactive materials?

- Each year, 100 million shipments of hazardous supplies navigate America's roadways, railways, airspace and shipping routes. Of these hazardous shipments, only 2 to 5 million involve radioactive material, and most of these shipments are radioisotopes for medical and industrial use.
- Radioactive materials are transported to medical, industrial, research and manufacturing facilities; nuclear power plants; and storage and disposal sites. They are used in a variety of applications, such as the diagnosis and treatment of disease, agricultural research, manufacture of commercial goods and nuclear electricity production.
- It is less hazardous to ship solid spent nuclear fuel than to ship many other materials, including gasoline, that are routinely transported all over the country. Fresh nuclear fuel is even less hazardous to ship; it is not highly radioactive.

What are the facts about transportation of radioactive waste (used nuclear fuel)?

- Over the past 40 years, about 3,000 shipments of spent nuclear fuel have navigated more than 1.7 million miles of U.S. roads and railways. Of all this travel, no radioactive materials have been released to contaminate the environment as a result from an accident.
- Over the past four decades, 90 spent fuel casks have been involved in accidents*; none of these has resulted in release of radioactive material.
- Casks used for shipping spent nuclear fuel are designed to minimize potential radiation exposure for the public. They are rigorously designed according to requirements established by the NRC and the Department of Transportation (DOT).
- The used fuel transportation casks are about 15 times thicker than a gasoline tank truck they include three inches of stainless steel and thick radiation shields. Typically, for every ton of spent fuel, there are more than three tons of protective packaging and shielding.
- Casks are designed and tested to withstand crashes, crushing, fire, puncture, and water immersion. To be certified, a cask design must withstand a sequence of tests that measure its performance in specified crash and accident conditions.
- Public routes used for the transport of nuclear materials must meet strict safety requirements before nuclear fuel is permitted access. Risk assessments of radioactive materials transportation evaluate factors such as accident rate, transit time, population density, other vehicles sharing the route and time of day.

Regulations require that anything other than normal, routine transportation with no variations from the expected must be reported as an accident. Any adjustment needed as a result of a periodic crew inspection of the vehicle is included in this category.

www.aboutnuclear.org
a new resource for teachers

The American Nuclear Society has developed a new public information web site called aboutnuclear.org. The site provides information about nuclear science and technology and its impact on everyday life. The content is peer-reviewed by scientists, engineers, professors, and others who have nuclear-related jobs.

The main nuclear science and technology section includes information about the structure of the atom, a brief history of the development of nuclear science and technology, basics of radiation, and information about waste and transportation issues.

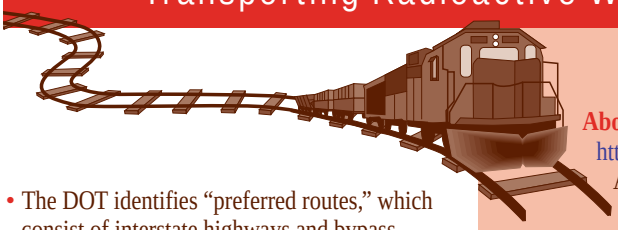
There is a special section dealing with applications of nuclear science. It contains information about applications in the following areas: food, industry, medicine, space and electricity.

Teachers can use the site as a background source or send their students to it for information.

Visit the new web site at http://www.aboutnuclear.org ■

Continued page 2

Transporting Radioactive Waste... Continued from page 1



- The DOT identifies "preferred routes," which consist of interstate highways and bypass routes around cities, where possible, or an alternative route selected by a state routing authority. If the routing authority selects an alternate route, it must demonstrate by a routing analysis that using the alternate route does not increase overall risk.
- Specialized trucking companies handle used nuclear fuel shipments in the United States. Vehicles are state of the art, equipped with computers that provide an instantaneous update on the truck's location and convey messages between driver and dispatcher through a satellite communications network. Drivers receive extensive training and must be certified. ■

Interesting Online Resources

Center for History of Physics

The American Institute of Physics provides this resource, but teachers in other specialty areas are also likely to appreciate it. The site includes interesting online exhibits (Marie Curie, Albert Einstein, Discovery of the Electron, Heisenberg and Uncertainty, Transistor, and more), access to selected papers of great American physicists, visual archives, and more. Don't miss the links to other science history resources. Visit the site at http://www.aip.org/history/

ENC Online

The Eisenhower National Clearinghouse for Mathematics and Science Education offers teachers an attractive and useful online resource. You can browse or search for curriculum resources, check for new web links, investigate resources for professional development and more. ENC is based at The Ohio State University and is funded through a contract with the U.S. Department of Educations Office Educational Research and Improvement. Visit ENC at http://www.enc.org

The Greening of the Nuclear Age

This new brochure focuses on the contributions of nuclear science & technology to sustainable development efforts. It discusses ways in which nuclear technology has been fulfilling the Rio Principles for many years. The brochure was prepared for distribution at the World Summit on Sustainable Development in August 2002. Read the brochure at http://www.ans.org/pi/brochures/ ■

To Read More

About Yucca Mountain
http://www.ans.org/pi/np/yucca/
Additional links are available on this page.

About Radioactive Waste
http://www.ans.org/pi/glossary/#H
Look for a definition of "high-level waste"

http://www.aboutnuclear.org/view.cgi?fC=Waste
Explore the links here and learn about differences in waste classifications.

http://www.nei.org/doc.asp?catnum=2&catid=62
This page from the NEI web site explains Spent Fuel.

About Transportation of Radioactive Waste
http://www.ans.org/pi/np/transport
Contains information about nuclear transportation safety; provides links to additional information.

http://www.ans.org/pi/faq/transport.html
Some "Frequently Asked Questions" about Nuclear Transportation; provides answers and offers links to additional information.

http://www.em.doe.gov/ftplink/ntp/factsheets/spentfuel.pdf
U.S. Department of Energy information about High-Level Radioactive Waste Transportation.

http://www.ans.org/pi/ps/pdfs/ps18.pdf
The ANS Position Statement on The Safety of Transporting Radioactive Materials

http://www.nei.org/doc.asp?catnum=2&catid=243
Discusses how much radiation exposure a person would receive from a loaded transportation cask.

http://www.nei.org/doc.asp?catnum=2&catid=64
Time line for a national waste program.

http://www.nrc.gov/waste/spent-fuel-transp.html
What NRC regulates in regard to transportation; link to diagram of dry cask.

http://www.ymp.gov/documents/feis_a/vol_2/eis_j_bm.pdf
This download (207 pages) is the Transportation appendix from the Environmental Impact Statement for Yucca Mountain. It gives information about risk analyses of potential transportation routes.

About Cask Testing
http://www.sandia.gov/tp/SAFE_RAM/TESTING.HTM
This site offers photos and dramatic videos of cask testing.

http://www.nrc.gov/reading-rm/doc-collections/cfr/part071/part071-0073.html
Read details about conditions for cask testing (accident conditions).

About Radiation Dose
http://www.ans.org/pi/brochures/pdfs/radiationdose.pdf
This brochure provides information that helps you estimate your annual radiation exposure.

About Mother Nature's Reactor
http://www.ans.org/pi/np/oklo/
Read about a natural fission reactor and the waste products from it.

About Nuclear Science and Technology
http://www.ans.org/pi/brochures/pdfs/sustainabledev.pdf
Describes how nuclear science and technology contribute to sustainable development.

http://www.ans.org/pi/brochures/pdfs/power.pdf
Discusses nuclear power in relation to sustainable energy.

About Power Plant Locations
http://www.nei.org/doc.asp?catnum=2&catid
Interactive map from NEI tells locations of nuclear power plants.

http://www.eia.doe.gov/cneaf/nuclear/page/at_a_glance/reactors/states.html
This provides a state by state list of nuclear power plants.

What else should my students know?

They should know some basic facts about radiation.

Some useful types of background information:

- we live in a radioactive world, as did our ancestors
- there are different types of radiation; each has different characteristics
- time, distance and shielding are factors in radiation dose
- we can detect and quantify radiation
- nuclear science and technology make many significant contributions to modern life (medical diagnosis and treatment, food safety and preservation, basic research in many fields, improve and help monitor industrial processes, provide techniques that aid in environmental protection, etc.)
- in the U.S., nuclear power is the energy source for about 20% of our electricity
- nuclear power plants produce electricity without releasing greenhouse gases (mining of uranium ore, construction of nuclear power plants, and transportation of nuclear fuel and waste products require a minimal amount of fossil fuel combustion)

Where can I get additional background information on radiation?

If you've participated in a Teacher Workshop sponsored by ANS, consult your Teacher Handbook for "Detecting Radiation in Our Radioactive World." It contains useful background information.

You can also visit www.aboutnuclear.org and the Public Information Page of the ANS web site at www.ans.org/pi for additional information. The PI page has a list of web links. ■

Project #67 – Modeling Activity

Transportation of Radioactive Wastes

The transportation of radioactive wastes to a disposal or storage facility is carefully planned and implemented. By having your students plan the movement of an object within your school and then having them compare their plan to some of the considerations involved in transport of radioactive waste, you can help them gain a better understanding of the steps taken to ensure safe transportation of these materials.

A. Bring a collection of solid objects to the classroom (e.g., light bulb, piece of pipe, glass plate, piece of metal, Fiesta Ware plate, etc.).

B. Explain to the class that you want to move each object to some other location in the school or elsewhere on the school grounds where it will be (1) away from people and (2 undisturbed until/unless you want to retrieve it.

C. Divide the students into several groups. Give each group an object (these can be similar or different types of objects). Ask each group to come up with a plan for transporting the object as noted above. Give each group a large piece of butcher or construction paper to outline their plan.

Each plan should include the following points:

- What site in the school will be the final location for object? Why? (List reasons why this site was selected over other options.)
- How should the material be packaged to insure that (1) it does not become damaged during transportation and (2) no one outside your group will come in contact with it during its

Continued next page

New Trace Analysis Technique Can Detect One Atom

Researchers at Argonne National Laboratory (ANL) have developed a new trace analysis technique capable of detecting a single atom in a large sample.

The technique, called Atom Trap Trace Analysis (ATTA), has been used to count individual atoms of krypton-85 and krypton-81 isotopes in a sample of natural krypton gas. These two isotopes are very rare. In a natural sample of krypton, every krypton-81 atom is mixed in with a trillion krypton-84 atoms.

In the ATTA device, a small amount of krypton gas is directed into a 1-meter long tube. There the krypton atoms encounter a laser beam shining at them, tuned to the resonant frequency of a specific isotope, such as krypton-81. The laser beams enable researchers to slow the atoms of a specific isotope from high speed to a crawl in a short distance.

Then, at the end of the tube, six lasers are used to trap the slow moving atom and hold it in place. While in the trap, the atom scatters photons from the laser beams and appears as a bright dot, visible to the naked eye. A photon detector

Continued page 4

New Clues About Obesity and Food Addiction

Researchers at Brookhaven National Laboratory (BNL) have been gathering new clues about obesity and food addiction, using Positron Emission Tomography (PET).

Power of Aroma and Taste

The researchers have found that when food-deprived subjects are allowed merely to see, smell and taste their favorite foods without actually eating them, there is a significant elevation in brain dopamine (a neurotransmitter associated with feelings of pleasure and reward).

Gathering the Data

The BNL researchers gathered their data using Positron Emission Tomography. This medical imaging method measures the concentration and movement of a positron emitting isotope in living tissue. Volunteers in the study were given a radiotracer, a radioactive chemical tag designed to bind to dopamine receptors in the brain. Then, PET scanning was used to detect how much of the tracer gathered in various parts of the brain during the experiment.

Other Findings

Some other research at BNL has shown that obese people have fewer dopamine receptors in the brain than people of normal weight. In fact, the more obese the individual the lower the number of receptors. However, scientists are careful to note that it isn't clear whether these differences are the consequence or cause of obesity.

The researchers also found that those parts of the brain responsible for sensation in the mouth, lips, and tongue are more active in obese people than in normal-weight control subjects. ■

To read more about research on this topic by BNL scientists, visit
http://www.bnl.gov/bnlweb/pubaf/pr/2002/bnlpr052002.htm
http://www.bnl.gov/bnlweb/pubaf/pr/2002/bnlpr062002.htm
http://www.bnl.gov/bnlweb/pubaf/pr/2001/bnlpr020101.htm
To read more about Positron Emission Tomography, visit http://www.bnl.gov/pet

Nuclear Sciences

Continued from page 3.

transport or storage?

- How will the material be transported from your classroom to the storage site, including:
  - method of movement (carry, cart, wheel barrow, skateboard, bicycle, etc.)
  - route to take through school building (including why some routes might not be appropriate)
  - time during school day for actual transport (Reasons for specific time choice)
  - protection of the object in transit and in storage (monitoring, tracking, guarding)

D. Depending on what computer resources are available, have the students study the actual transportation of radioactive wastes by either using web links listed in this issue of *ReActions* or by making a copy of the listings in this issue.

E. Tell your students to think of (imagine) your school grounds as the entire United States and your classroom as a nuclear power plant. They should think of the object you gave them as High Level Waste (HLW) in a nuclear power plant. Then, using their group's plan for transportation of the object to a site on school grounds, they should answer the following questions:

1) In what way(s) is the site you selected for safekeeping of the object similar to the Yucca Mountain site for placement of HLW? In what ways is it different?
2) What aspects of your transportation plan are similar to the Department of Energy (DOE) plan for transportation of HLW in regard to minimizing the risk of a transportation accident?
3) What aspects of your transportation plan are similar to those of the DOE in regard to minimizing risk of release of radiation from a shipping cask if an accident should occur?
4) After comparing your plan to the plan for transportation of HLW, what part(s) of your plan would you change to make the transportation of your object safer?

Register for Email Notification of *ReActions* Web-Only Editions

Some issues of *ReActions* are web-only editions. We will send registered readers an email notification when a new issue is available online.

Getting registered for email notification is easy. Visit http://www.ans.org/pi/teachers/reactions/. Click on "Register for *ReActions* Email Notification" and follow the directions. ■

One Atom... Continued from page 3

records when individual atoms arrive and depart.

ATTA may be used to help determine the age of ancient Greenland ice cores. Krypton-81, which lasts 40 times longer than carbon-14, can be used to date samples up to 1 million years old.

Researchers are hoping that the technique can be used with the isotopes of other elements. One possibility being considered is calcium-41, which could be useful for medical testing of bone loss from osteoporosis. ■

To read more about ATTA and its potential applications, visit
http://www.anl.gov/OPA/frontiers/b6excell.html
To read more about the ATTA technique and see diagrams of its construction, visit
http://www-mep.phy.anl.gov/atta/main.htm

Teacher Workshop Schedule

ANS Teacher Workshops provide an opportunity to expand your knowledge and skills in teaching about nuclear science and technology. Workshops will be held in many locations in the months ahead.

Look for introductory "Detecting Radiation" workshops at the NSTA regionals in Louisville, Portland, and Albuquerque this fall. In addition, we're planning a full-day workshop in the Washington, DC area in November.

You can see the latest workshop schedule at http://www.ans.org/pi/teachers/workshops/schedule.cgi

Information is added to our schedule as new workshop locations are confirmed, so check the site periodically. ■

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September 2002

The Future is in the Atom

Win Glenn Seaborg's Necktie

Details Inside!

REACTIONS
555 N. Kensington Avenue
La Grange Park, IL 60526-5592

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Win Glenn Seaborg's Necktie

Glenn T. Seaborg's name was etched into the world of science permanently when seaborgium (atomic number 106) was named for him.

Seaborg and his co-workers discovered many radioisotopes used in nuclear medicine and ten transuranium elements. He played a crucial role in the development of nuclear science, inspired many young students, and served the country in various roles under ten presidents.

ANS Outreach Department staffers examine the two Seaborg neckties, a photo, and letter of authenticity from Mrs. Seaborg. The Nobel winner's ties will be framed for presentation to two lucky entrants.

Tie up a Piece of History

Now, you have a once-in-a-lifetime opportunity to win one of Glenn Seaborg's neckties framed for display.

The family of the late Dr. Seaborg has donated two of his favorite neckties – one showing a portion of the periodic table and the other with a hiker motif (he was a devoted hiker) – and two copies of his book, *National Service with Ten Presidents of the United States*. The donations were designated to raise funds for the Public Education Program (PEP) of the American Nuclear Society (ANS).

Each tie will be attractively mounted in a frame along with a photo of Dr. Seaborg and a letter of authenticity. Such a unique collector's item would be a wonderful addition to your office or den and a delightful piece to bring to your school classroom.

The two framed ties and the two books are being offered to PEP supporters in a special drawing.

How do you enter the drawing?

Getting a chance to be one of the four lucky winners is easy. Every $20 donation to the PEP fund received by September 30, 2002, will qualify the contributor for an entry in the drawing. Complete details are on the entry form.

What is PEP?

PEP funds help support the many educational efforts of ANS, including educator workshops, exhibits, classroom presentations, and distribution of printed materials, such as *ReActions*. PEP funds come from the voluntary contributions of ANS members and friends.

Enter Now!

Since Dr. Seaborg was a strong supporter of educational efforts, we would be pleased to have a teacher as one of the winners. But, you must enter to win. ***Remember, all entries must be received by September 30, 2002.***

Mail your check and entry form today!

To read about the life and contributions of Glenn Seaborg, you can visit http://www.lbl.gov/seaborg/ or http://www-ia1.lbl.gov/Seaborg/bio.htm

"Tie up a Piece of History" Memorabilia Drawing

Official Entry Form

Suggested Minimum Donation of $20.00 to
ANS Public Education Program (PEP)

Please type or print clearly!

Name _____

Address _____

City _____ State_____ ZIP _____ Phone _____

Memorabilia (two neckties and two books) have been donated to ANS by the family of Dr. Glenn Seaborg.

NO PURCHASE OR DONATION IS REQUIRED TO ENTER OR WIN. DRAWING IS OPEN TO ALL LEGAL RESIDENTS OF THE CONTINENTAL U.S. A DONATION DOES NOT IMPROVE CHANCES OF WINNING. THIS OFFER AND DRAWING IS VOID WHERE PROHIBITED BY LAW. For alternate entry, on a 3" x 5" card, print full name, address, city, state, ZIP, and telephone number and mail to ANS Public Education Program, American Nuclear Society, P.O. Box 97781, Chicago, IL, 60678-7781. Deadline for receipt of all entries is September 30, 2002. Drawing to determine four winners will be held at American Nuclear Society, 555 N. Kensington, La Grange Park, IL, on October 10, 2002, at 1:00 PM Central. Winners will be notified by mail or telephone.

Mail your PEP donations and official entry form to:
ANS Public Education Program, American Nuclear Society,
P.O. Box 97781, Chicago, IL 60678-7781