Observing National Nuclear Science Week

Why is nuclear science important to you?

- Commercial nuclear power plants produce 20 percent of electricity in the US
- 18 million nuclear medicine procedures are performed each year in the US, positively impacting the lives and health of people both young and old.
- Nuclear science and technology plans an important role in basic research in many fields including agriculture
- 53 new nuclear plants are under construction in 14 countries
- Radiation can be used to sterilize medical materials

These are just a few reasons why nuclear science and technology are important to you. There are many other ways you may experience the benefits of nuclear science in your everyday life. For some other examples of everyday applications of nuclear science, look for A Day With the Atom at http://www.ans.org/pi/resources/brochures/docs/a-day-w-atom081030.pdf

Radiation Risk in Perspective

Position Statement of the Health Physics Society

In accordance with current knowledge of radiation health risks, the Health Physics Society recommends against quantitative estimation of health risks below an individual dose of 5 rem in one year or a lifetime dose of 10 rem above that received from natural sources. Doses from natural background radiation in the United States average about 0.3 rem per year. A dose of 5 rem will be accumulated in the first 17 years of life and about 25 rem in a lifetime of 80 years. Estimation of health risk associated with radiation doses that are of similar magnitude as those received from natural sources should be strictly qualitative and encompass a range of hypothetical health outcomes, including the possibility of no adverse health effects at such low levels.

There is substantial and convincing scientific evidence for health risks following high-dose exposures. However, below 5–10 rem (which includes occupational and environmental exposures), risks of health effects are either too small to be observed or are nonexistent.

In part because of the insurmountable intrinsic and methodological difficulties in determining if the health effects...
Europe Banks Airport X-Ray Scanners. Should the U.S. Follow Suit?

As millions of American travelers take to the airways, they will increasingly face the new generation of full-body scanners at airport security— including the kind that Europe just banned for reasons of “health and safety.”

In its new airport security policy, the European Commission announced on November 14, 2011 that it would ban the controversial “backscatter” X-ray machines, which emit ionized radiation, from all airports in the European Union’s 27 member nations “in order not to risk jeopardizing citizens’ health and safety.”

The U.S. Transportation Security Administration (TSA), meanwhile, has rolled out about 250 backscatter X-ray machines across the country. It has also installed some 260 millimeter-wave scanners, which do the same job but use low-energy radio waves instead of X-rays. Millimeter-wave scanners are allowed at European airports.

Both devices display reasonably accurate images of your body, beneath your clothes, helping airport security workers to spot hidden weapons or explosives that wouldn’t be caught by metal detectors. The difference is that millimeter waves don’t cause cancer, while cumulative, high doses of X-ray exposure are a known carcinogen.

“What makes X-rays different is the fact that they’re more energetic,” says Dr. David J. Brenner, director of the Center for Radiological Research at Columbia University Medical Center. “They have enough energy to knock an electron out of an atom. Basically, if that atom happened to be in DNA, (X-rays) could break strands of DNA in a way that millimeter waves simply can’t because they don’t have enough energy.”

In other words, X-rays have enough energy to cause a DNA mutation that can trigger cancer, while millimeter waves don’t.

The TSA and Department of Homeland Security (DHS) maintain that backscatter X-ray scanners emit such low levels of radiation—equivalent to the radiation you’d get in about two minutes of flying, according to the TSA—that any resulting increase in cancer risk would be negligible. Some scientists say, however, that even if any one individual’s risk of developing cancer from scanner radiation exposure remains low, when you consider the risks accrued over time by an entire population—say the 100 million Americans who fly each year—the machines pose a potential public-health danger.

Brenner further points to the lack of independent and clinical data on backscatter X-ray safety as a reason not to use the devices. “By all accounts both machines are equally effective and the TSA is buying both kinds of machines, which cost about the same and have the same efficiency,” says Brenner. “So it seems to me a strange decision to use the backscatter machine, where you don’t really know what the risks are; the biggest issue is the uncertainty. And it’s going to be 30 years before the cancers start to appear. I’m not sure why you’d want to take that risk.”

The current data on radiation exposure from backscatter machines comes largely from the government and from the scanner’s manufacturer. As Alice Park noted last year at the time of the devices’ public debut, some scientists think the exposure hasn’t been measured correctly:

After studying the degree of detail obtained in the seconds-long scans, the scientists wondered how the (stated) radiation exposure could be so low. The answer, they concluded, lay in how the manufacturer and government officials measured the dose: by averaging the exposure from the beam over the volume of the entire body. This is how scientists measure exposure from medical X-rays, which are designed to sap straight through bone and tissue. But backscatter beans skim the body’s surface, Sedat and his colleagues maintain that if the dose were based only on skin exposure, the result would be 10 to 20 times and manufacturer’s calculations.

That’s a huge difference, but the higher amount, TSA and FDA officials maintain, still falls within the limits of safe radiation exposure. Based on measurements conducted by the FDA as well as by technicians at Johns Hopkins University and elsewhere, says the FDA’s Daniel Kassiday, “We are confident that full-body-X-ray security products and practices do not pose a significant risk to the public health.

If you also want to avoid X-ray exposure at the airport, it’s easy to tell one scanning machine from the other, courtesy of ProPublica:

In the backscatter machine, a passenger stands between two large blue boxes and is scanned with a narrow X-ray beam that rapidly moves left to right and up and down the body. In the millimeter-wave machine, a passenger enters a changer that looks like a round phone booth and is scanned with radio-frequency waves.

A robotic suit originally designed to help elderly people walk has been upgraded to assist emergency teams working in the difficult conditions at Japan’s crippled Fukushima Daiichi nuclear plant.

The Hybrid Assistive Limb—or HAL—was first unveiled by scientists at The Tokyo University of Tsukuba in 2009. Fitted with motors at the key joints—the lower back, knees, elbows and shoulders—the suit works as an external skeleton and works in tandem with the wearer to provide him with additional strength.

The robotic suit gives the wearer double his natural strength. The outfits have since been developed by Cyberdyne, who demonstrated a unit designed to be worn by emergency teams operating close to the damaged reactors who have to wear anti-radiation tungsten vests that can weigh up to 60 kg (132 lb).

Workers at the plant have found it difficult to operate for long periods of time while wearing full protective equipment, particularly in the heat of the summer months.

“This new type of HAL robot suit supports the weight of protective clothing made of tungsten and enables the wearer to work on the site without feeling the burden,” the company said in a statement. “It is hoped this will reduce the risks of working in harsh environments and contribute to the early restoration of operations by humans in the wake of disasters.”

Efforts to regain control of the damaged reactors are continuing, although high levels of radiation throughout the site remain a danger to the workers. More than 2,000 employees of Tokyo Electric Power Co. and other companies are at the plant.


Although many people might find them counter-intuitive, all of the above statements are correct. Beginning with the nuclear explosion at Hiroshima in August, 1945, and due largely to necessary secrecy continuing through the end of the Cold War in 1989, numerous misunderstandings and misconceptions have become paradigms of public understanding with respect to nuclear power plants. These misunderstandings and misconceptions have resulted in a widespread psychological bias which may be termed the Hiroshima Syndrome. The above statements are but the tip of the iceberg. With the ominous threat of global warming now looming over us, we need to utilize the only large-scale form of electricity production which leaves no carbon footprint: nuclear. Before the nuclear power option can become one of the primary solutions to global warming, the numerous misconceptions which perpetuate the Hiroshima Syndrome must be exposed and corrected in the public mind.

In the aftermath of Three Mile Island’s meltdown accident in 1979, the terms “nuclear” and “environmentalist” became mutually exclusive in the mind of the American public. For the most part,

Continued on Page 5
that are demonstrated at high radiation doses are also present at low doses, current radiation protection standards and practices are based on the premise that any radiation dose, no matter how small, may result in detrimental health effects, such as cancer and hereditary genetic damage. Further, it is assumed that these effects are produced in direct proportion to the dose received, that is, doubling the radiation dose results in a doubling of the effect. These two assumptions lead to a dose-response relationship, often referred to as the linear, no-threshold model, for estimating health effects at radiation dose levels of interest. There is, however, substantial scientific evidence that this model is an oversimplification. It can be rejected for a number of specific cancers, such as bone cancer and chronic lymphocytic leukemia, and heritable genetic damage has not been observed in human studies. However, the effect of biological mechanisms such as DNA repair, bystander effect, and adaptive response on the induction of cancers and genetic mutations are not well understood and are not accounted for by the linear, no-threshold model.

Radiogenic Health Effects Have Not Been Consistently Demonstrated Below 10 Rem
Radiogenic health effects (primarily cancer) have been demonstrated in humans through epidemiological studies only at doses exceeding 5–10 rem delivered at high dose rates. Below this dose, estimation of adverse health effect remains speculative. Risk estimates that are used to predict health effects in exposed individuals or populations are based on epidemiological studies of well-defined populations (for example, the Japanese survivors of the atomic bombings in 1945 and medical patients) exposed to relatively high doses delivered at high dose rates. Epidemiological studies have not demonstrated adverse health effects in individuals exposed to small doses (less than 10 rem) delivered in a period of many years.

Limit Quantitative Risk Assessment to Doses at or Above 5 Rem per Year or 10 Rem Lifetime
In view of the above, the Society has concluded that estimates of risk should be limited to individuals receiving a dose of 5 rem in one year or a lifetime dose of 10 rem in addition to natural background. In making risk estimates, specific organ doses and age-adjusted and gender-adjusted organ risk factors should be used. Below these doses, risk estimates should not be used. Expressions of risk should only be qualitative, that is, a range based on the uncertainties in estimating risk (NCRP 1997) emphasizing the inability to detect any increased health detriment (that is, zero health effects is a probable outcome).

Impact on Radiation Protection
Limiting the use of quantitative risk assessment, as described above, has the following implications for radiation protection:

(a) The possibility that health effects might occur at small doses should not be entirely discounted. The Health Physics Society also recognizes the practical advantages of the linear, no-threshold hypothesis to the practice of radiation protection. Nonetheless, risk assessment at low doses should focus on establishing a range of health outcomes in the dose range of interest and acknowledge the possibility of zero health effects. These assessments can be used to inform decision making with respect to cleanup of sites contaminated with radioactive material, disposition of slightly radioactive material, transport of radioactive material, etc.

(b) Collective dose (the sum of individual doses in a defined exposed population expressed as person-rem) has been a useful index for quantifying dose in large populations and in comparing the magnitude of exposures from different radiation sources. However, collective dose may aggregate information excessively, for example, a large dose to a small number of
Continued from page 4

people is not equivalent to a small dose to many people, even if the collective doses are the same. Thus, for populations in which almost all individuals are estimated to receive a lifetime dose of less than 10 rem above background, collective dose is a highly speculative and uncertain measure of risk and should not be used for the purpose of estimating population health risks.

Footnotes
1 Dose is a general term used to express (quantify) how much radiation exposure something (a person or other material) has received. The exposure can subsequently be expressed in terms of the absorbed, equivalent, committed, and/or effective dose based on the amount of energy absorbed and in what tissues.
2 The rem is the unit of effective dose. In international units, 1 rem=0.01 sievert (Sv)=10 mSv.

References


Continued from page 3

they still are. As we will see in the course of this website, what’s appropriate for the environment must include the large scale production of electricity from the splitting of atoms. If what’s most natural to the world around us is the most appropriate environmental option for electricity production, then nuclear becomes an environmentalist’s central focus. "Nuclear" and "environmentalist" should be correctly understood to be mutually agreeable terms. Radical? Absolutely! A flight of fancy resulting from a warped use of facts? Absolutely not! The truth about nuclear energy is mostly not what has been believed by the public, news media, and most of the non-nuclear scientific community over the past six-plus decades. It’s time to set the record straight, and attempt to halt America's contribution to global warming, before it's too late.

http://www.hiroshimasyndrome.com/

<table>
<thead>
<tr>
<th>Name</th>
<th>Office</th>
<th>Home</th>
<th>Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohio University Police</td>
<td>593-1911</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alan Watts*</td>
<td>593-4176</td>
<td></td>
<td>740-517-5075</td>
</tr>
<tr>
<td>Crystal Brooks*</td>
<td>597-2950</td>
<td></td>
<td>330-903-0506</td>
</tr>
<tr>
<td>David Schleter*</td>
<td>593-1662</td>
<td></td>
<td>740-591-0557</td>
</tr>
<tr>
<td>David Ingram**</td>
<td>593-1705</td>
<td>594-7511</td>
<td></td>
</tr>
<tr>
<td>Joe Adams***</td>
<td>593-1667</td>
<td>753-3494</td>
<td>740-591-9600</td>
</tr>
</tbody>
</table>

* RMS Staff
** Chair Radiation Safety Committee
*** Associate Vice President, Risk Management & Safety