

Questions and Answers about Mail Irradiation

The recent threat to the public from anthrax has resulted in unprecedented measures being taken by the U.S. Postal Service (USPS) to sterilize the mail. The USPS' decision-making process has been marred by a lack of openness. Consequently, many basic questions about the decision to use large doses of electron beam radiation to treat mail remain unanswered.

So far, eight irradiation systems using this technology have been purchased from SureBeam, a subsidiary of the San-Diego based defense contractor Titan Corporation. Even though the eight machines were delivered to the USPS in February 2002, none of them has been installed yet.¹ The cost for the eight systems is reported to be \$40 million and the USPS has an option to purchase 12 more systems. Postmaster General John E. Potter, who testified on October 30, 2001 before the U.S. House of Representatives Government Reform Committee, said that the USPS would seek as much as \$2.5 billion to sanitize the mail.

There are serious cost, safety, and logistical challenges presented by the extensive use of irradiation to kill anthrax in the mail. To date, the USPS has been unwilling or unable to answer questions posed to them about the selection of the electron beam technology, the initiation of worker safety programs, how they will address logistical issues including the separation of items likely to be damaged by irradiation, the bidding process for future purchases of equipment or how they selected the Titan subsidiary, SureBeam. In a response to a Freedom of Information Act request filed by Public Citizen on November 1, 2001, the USPS would not divulge the results of tests performed on different pieces of irradiated mail and their contents because the agency contends that it is sensitive information and relates solely to the internal procedures of the Postal Service. The USPS admitted in the response that the contract it signed with Titan/SureBeam was awarded on a non-competitive basis. The USPS also stated that there was no correspondence between it and other federal government agencies regarding the decision-making process to irradiate the mail.²

Question: What is known about the effectiveness of irradiation in killing anthrax spores?

Answer: The USPS refers inquiries about the effectiveness and the amount of irradiation necessary to kill anthrax spores to Titan, the company that is providing the electron beam (e-beam) irradiation equipment. After repeated inquiries to Titan and their subsidiary SureBeam, on October 31, 2001 we were told to call their Nebraska office for assistance.

A staff person in the Nebraska office said that their primary information on irradiation and anthrax came from a study done with a different irradiation technology, gamma rays. The study, "Inactivation of *Bacillus Anthracis* Vegetative Cells and Spores by Gamma Irradiation," was published in 1996 in the *Salisbury Medical Bulletin*.³ The study's authors concluded that a dose

¹ "USPS Sees New Way to Spot Biohazards", Ellen Nakashima, Washington Post, March 9, 2002.

² Correspondence from Robert J. Faruq, Sr., Manager of Records Office for the USPS, December 17, 2001.

³ Bowen, Jane E., Manchee, R.J., Watson, Sharon, and Turnbull, P.C.B "Inactivation of *Bacillus anthracis* vegetative cells and spores by gamma irradiation" *Salisbury Medical Bulletin* Special Supplement 87, 1996.

on the order of 41.5 kiloGray was necessary to kill two different strains of anthrax spores, including the Ames strain which has been identified in anthrax-contaminated mail. This study was also cited by the World Health Organization in its “Guidelines for the Surveillance and Control of Anthrax in Humans and Animals.”⁴

For some perspective on the dose that appears necessary to kill anthrax spores, consider the doses the Food and Drug Administration (FDA) allows for the irradiation of food: 1 kiloGray for fruit and vegetables, 3 kiloGray for eggs, 3-7 kiloGray for meat, and 30 kiloGray for spices.

During testimony before the House of Representatives Government Reform Committee hearing on October 30, 2001, the USPS’ Vice President of Technology Tom Day cited a July 2001 study by the Armed Forces Radiobiology Research Institute (AFRRI) as proof that the Titan Corporation’s e-beam technology would be effective to irradiate the mail. Public Citizen has obtained a copy of the study, which has not been published or widely released to the public. The study shows that strains similar to, but different from, the Ames strain can be neutralized with e-beams at approximately 20 kiloGray.

In addition, Public Citizen has found an article in a Bulgarian veterinary medicine journal (at present only available in abstract form) which suggests that a 20 kiloGray dose of gamma rays is needed to kill anthrax spores in pelts and wool.⁵

The USPS has revealed that it began using a dose of 70 kiloGray to treat the mail at the Ohio Titan facility and the New Jersey IBA facility it is now leasing . Since complaints began to emerge about the condition of the irradiated mail and the possible health effects suffered by those who handled irradiated mail, the dosage was cut by approximately 40% -- to about 56 kiloGray.⁶ To put this in perspective, frozen hamburger patties are irradiated at 7 kiloGray, which is the equivalent of 233 million chest X-rays. Spices are irradiated at 30 kiloGray, which is the equivalent of approximately 1 billion chest X-rays.

Question: What are the different kinds of irradiation technology?

Answer: Radiation is energy in the form of either high speed particles (such as electrons) or electromagnetic waves. Low-energy electromagnetic waves are encountered everyday in the form of light or radio waves.

⁴ Turnbull, P.C.B. "Guidelines for the Surveillance and Control of Anthrax in Humans and Animals." Department of Communicable Diseases Surveillance and Response, World Health Organization, Geneva.

⁵ Jordanov, I. “Gamma-ray decontamination of pelts and wool infected with the spores of *Bacillus anthracis*” *Vet. Med. Nauki* (Sofia) 14(8): 14-19, 1977.

⁶ Tracy Swartz, “Mail-Related Illnesses on Steep Decline After Radiation Dosage Decreased,” *Roll Call Daily*, April 12, 2002.

Ionizing radiation, on the other hand, has a tremendous amount of energy. It has sufficient energy that in an interaction with atoms (the tiny particles that compose matter), it can remove tightly bound electrons from their orbits.⁷ This causes the atoms to become charged or ionized.

Ionizing radiation is very damaging to living cells and is the energy utilized by irradiation technologies. Irradiation technologies create ionizing radiation in three different ways: gamma rays (generated by a radioactive material like cobalt 60), X-rays (similar to gamma rays, but produced differently), or electron beams (in a linear accelerator, electrons reach nearly the speed of light and are carried on radio waves).

One of the key differences between the technologies is how far they can penetrate the exposed material. Gamma rays and X-rays can penetrate further than e-beam, which is estimated to be limited to about 1.5 inches. So the effectiveness of e-beam irradiation on denser items or large packages is uncertain.

The electron beam can be converted into X-ray beams that have very deep penetration ability, but this is very expensive. The University of Colorado Health Sciences Center (UCHSC) web site provides this information:⁸

Electron beams are limited by a short depth of penetration (hence are not very good for carcasses), but can be converted into X-ray beams that overcome this problem. The downside of this source of radiation is the large amount of power consumption used to generate the beams, the expense and complicated nature of the machines, and potential need for frequent maintenance.

X-ray equipment becomes more cost-effective if higher energy levels are used. However at high doses and high voltage levels, X-rays can induce radioactivity in materials. Because we know so little about the amount of radiation that will be used, the potential for this to occur in the treatment of mail cannot be fully evaluated.

Question: Is e-beam equipment the most effective way to irradiate mail?

Answer: During the House of Representatives Government Reform Committee hearing on October 30, 2001, Congressman Henry Waxman (D-CA) stated that his office contacted a number of private experts on irradiation who raised questions about the effectiveness of e-beam in treating the mail. Their primary concern was that e-beam does not penetrate as far as gamma rays or X-rays. Thus while it may be suitable for flat mail, e-beam would not penetrate large boxes or adjust easily to different density material.

At this hearing, the Vice President of Technology for the USPS Tom Day acknowledged the shortcomings of using e-beam and conceded that X-rays would be better able to penetrate boxes,

⁷ The center of each atom has a nucleus that contains protons and neutrons. Protons are positively charged particles. Neutrons, which have no electrical charge, hold the protons together. Electrons are negatively charged particles that surround the nucleus and travel in orbits.

⁸ This information can be found at www.uchsc.edu/sm/pmb/envh/food.htm.

but would be more expensive. This would also require separating out mail above certain dimensions for separate radiation.

At the present time, the USPS is only irradiating letters and large envelopes addressed to the White House, the Congress and federal government agencies in the Washington, DC area.⁹ The condition of the mail after it has been irradiated has been criticized by some of the recipients, including by congressional staff whose members have been irradiation proponents.¹⁰ Furthermore, health effects have begun to emerge in congressional staff who handle the mail.

Question: Is gamma radiation a better choice for irradiating mail because it can penetrate deeper?

Answer: Irradiation equipment using a radioactive source can irradiate large quantities of items at one time because the gamma rays created have the ability to penetrate large items. However, the use of radioactive isotopes has many problems, including the potential for worker exposures to radiation and the need for radioactive source materials. The transport and disposal of the waste associated with this technology is also of grave concern. Certainly, with the existing concerns about security at Postal Service facilities, having deadly radioactive isotopes on-site raises serious safety concerns.

Question: Are there worker safety concerns?

Answer: Working with irradiation equipment is potentially hazardous to workers. There are two primary concerns: the creation of ozone and the need for proper shielding to prevent radiation exposure.

Some forms of irradiation — including electron beams — result in the formation of ozone, a highly reactive form of oxygen that Occupational Safety and Health Administration regulations mandate must be vented when it reaches a certain level inside buildings. Ozone has been associated with numerous health problems, such as aggravating asthma, reducing lung capacity and causing various respiratory problems.

An excerpt from the draft Safety Manual for U.S. Department of Agriculture (USDA) meat inspectors who work around irradiation equipment underscores the potential problem:¹¹

A major by-product of irradiation is ozone, a highly oxidative molecule. Gamma rays or electrons ionize the oxygen molecules in the air that combine to form ozone. This ozone must be removed from the irradiation chamber to prevent its migration out of the maze to the product handling area where people can be exposed. The ozone must be removed by an air evacuation system that draws outside air into the irradiation chamber and exhausts

⁹ Telephone conversation with Gerry Kreienkamp, January 14, 2002.

¹⁰ “Anti-anthrax Sanitation Fries Mail to Crispy Mess, Lawmakers Discover,” Dana Wilkie, Copley News Service, January 8, 2002.

¹¹ Draft computer based training outline for USDA meat inspectors from 3/3/00, pg. 30.

that air to the outside. In order to comply with environmental regulations, large volumes of air are needed to dilute the ozone to permissible levels. To prevent any ozone from moving back through the maze to the product handling area and exposing workers, air handling systems must be designed such that some of the exhausted air comes from the product handling area through the transport maze. Additionally, the concern about ozone extends into operating procedures in that after the irradiation source has returned to a safe condition when operations have stopped, worker access to the irradiation chamber is delayed for several minutes to ensure that all of the ozone is evacuated before the workers enter the area.

Unfortunately, the USPS has provided insufficient information about the dose of radiation or how the devices will be installed to assure us that this critical issue is being given the attention it deserves.

Additionally, elaborate shielding equipment must be installed inside irradiation facilities to protect workers from radiation exposure. This is an expensive proposition and could involve new construction, but it is critical to protect workers, especially in light of numerous injuries throughout the U.S. and fatalities abroad at irradiation facilities.

Workers will have to be trained to operate this equipment. They will also have to wear a device, known as a dosimeter, that measures the amount of radiation these workers are exposed to while on duty, just like workers in nuclear power plants and X-ray technicians.

Since the USPS mail irradiation program began, there have been several incidents in which employees opening up mail that has been treated were overcome by fumes caused by irradiating plastic that has either been wrapped around the mail or has been part of the mail. These hazards were unforeseen when the USPS decided to embark on this program.¹² Since irradiated mail began to arrive in Washington, DC in December 2001, there have been numerous media reports of USPS employees, congressional staff, and other government mail room employees suffering ill effects of handling irradiated mail. Among the symptoms include respiratory problems, skin rashes, headaches, nausea, and bloody noses. The Capitol Hill newspaper *Roll Call* reported on March 4, 2002 that 255 congressional staff had complained of mail-related illnesses since January 22, 2002.¹³ In addition, Senator Dianne Feinstein (D-CA) and Representative Billy Tauzin (R-LA) – a long-standing food irradiation proponent – have complained of getting ill from handling irradiated mail.¹⁴ The Attending Physician for the Capitol (a medical doctor stationed at the U.S. Capitol to deal with medical emergencies) has admitted that there may be an unknown irritant produced when mail is irradiated.¹⁵

Addressing worker safety issues will take time. But any attempt to irradiate the mail that does not include these protections is unacceptable.

¹² "Irradiated Mail Causes Illness," Christopher Newton, Associated Press, January 11, 2002.

¹³ *Roll Call Daily*, March 4, 2002.

¹⁴ "Hill Workers Feel Irritated by Irradiated Envelopes; Congressional Aides Say Mail Sickens Them", Ellen Gamerman, *Baltimore Sun*, February 20, 2002.

¹⁵ *The Hill*, February 20, 2002.

Question: What are the logistical concerns about irradiating the mail?

Answer: Again, because of the lack of information from the USPS about what type of mail they will irradiate, this is extremely difficult to answer. But, given the high radiation dose estimated to be necessary to kill anthrax, a variety of obvious questions about exposing sensitive materials to radiation need to be answered. In addition to the problems related to mail size and e-beam's limited penetration, mail will need to be carefully sorted to address problems that will occur if some items—including food, pharmaceutical drugs, film, compact discs, medical samples, museum specimens, eye glasses, contact lenses, gemstones, and electronics—are irradiated. Seed companies are already scrambling to make arrangements for their products, which would no longer be fertile if irradiated at a high dose. The need to protect sensitive materials from the effects of irradiation could create a logistical nightmare and lead to serious loopholes in the system. What kind of security does this plan offer if it is known that boxes labeled as containing certain materials won't get irradiated? Surely a terrorist could exploit this loophole.

Question: What would happen to food items irradiated at the high doses that appear to be necessary to destroy the anthrax spore?

Answer: The current FDA dose limits for food are as follows: 1 kiloGray for fruit and vegetables, 3 kiloGray for eggs, 3-7 kiloGray for meat, and 30 kiloGray for spices. Since the allowable dose of irradiation for most food is much lower than we expect to see used for irradiating mail, mailed food items will suffer significant damage and experience changes in chemical composition if irradiated.

The extremely high doses of radiation required to kill anthrax spores could chemically alter food sent through the mail. Irradiation at doses higher than 10 kiloGray can affect meat's odor and cause it to taste rancid. Furthermore, among the main reasons the FDA has established maximum dose levels for the irradiation of food is to limit the formation of potentially hazardous chemicals, called "unique radiolytic products," and to limit the corruption of the food's flavor, texture and odor. Without measures to prevent food from being irradiated, foods that the FDA has not legalized for irradiation, including dairy products, seafood, and processed ("ready-to-eat") foods, could be irradiated.

Food irradiation, even at legal doses, is very controversial because it destroys vitamins and creates new and untested chemicals in food. It also can create carcinogenic chemicals like benzene and formaldehyde, depending on the food and the dose of radiation. The difficulty in gaining public acceptance for the technology has prompted the irradiation industry and their allies in the food industry to seek the removal of labeling from irradiated food.

Question: What process did the U.S. Postal Service use to select Titan's electron beam irradiation equipment to sanitize mail?

Answer: In response to a Public Citizen Freedom of Information Act request, the USPS stated: “There was no bidding process to award Titan Corporation and the SureBeam Corporation a contract. Both contracts were non-competitive.”¹⁶

Question: Who is Titan?

Answer: Titan, formed in 1981, is a San Diego-based defense contractor with profitable ties to the Pentagon. The company has 7,800 employees and annualized sales of approximately \$1.1 billion. Even before the defense build-up associated with September 11, 2001, Titan expected to continue receiving government contracts. On February 13, 2001, Titan’s Executive Vice President and Chief Financial Officer, Eric DiMarco said in *The Sector: Everything Tech San Diego*, a web magazine, “[w]e continue to win large contracts and we have more bids pending.” And in an October press release about third quarter earnings, he said that “approximately 80 - 85% [of next year’s expected revenue] will come from government customers, with approximately \$750 million to \$800 million of that revenue derived from intelligence, surveillance and reconnaissance related activities.” Since September, Titan has won contracts with the military that total more than \$700 million.

On October 17, 2001, Titan announced that the company had created the Homeland Security Office to focus on chemical and biological terrorism. The same day, Larry Oberkfell, President and CEO of SureBeam, indicated during Titan’s third quarter earnings conference call with their investors that they would use Titan’s contacts at the Department of Defense to obtain the U.S. Postal Service contact. Subsequently, when Postmaster General John Potter testified at the House of Representatives Government Reform Committee hearing on October 30, 2001, he said that the Department of Defense was advising them on which equipment to purchase.

Although the process suffered from a lack of transparency, which limits what is known about the deal, it appears that Titan Corporation received the USPS contract because of their relationship with the Department of Defense. Additionally, there is no information on how the \$40 million dollar price tag for the equipment was determined or if competitive bids were considered. These circumstances raise serious doubts about how the USPS evaluated the suitability of e-beam technology for treating the mail.

Even in times of crisis, good management practices should be followed. With the large amount of money and the potential for creating worker safety and logistical problems at stake, there should be more transparency in the process of selecting contractors.

Question: Do irradiation facilities have accidents or quality control problems?

Answer: Irradiation facilities do have accidents. Facilities using radioactive isotopes have a particularly bad record, which includes facilities catching fire, equipment malfunctions, radioactive water being flushed into public sewer systems and radioactive waste being thrown into the garbage. Workers at electronic beam facilities have also been injured.

¹⁶ Correspondence from Robert J. Faruq, Sr., Manager, Records Office, USPS, December 17, 2001.

Of interest is the fact that Titan has had a problem with quality assurance in one of its e-beam facilities. We do not know if the USPS knew about the problem at a Titan irradiation facility in Denver, Colorado when it awarded the contract to the company. On July 19, 2001, the FDA's Denver District Office wrote a warning letter to Louis T. Ruggiero, President and CEO of Titan Scan Technologies. The letter stated that they had conducted an inspection of the firm, which uses the electron beam technology to sterilize medical equipment. The letter went on to state that the medical devices being processed were adulterated because of numerous failures to create and implement adequate quality control procedures. The letter asked that the company take prompt action to correct the problems or regulatory action would be taken.

Prepared by Public Citizen's Critical Mass Energy and Environment Program
www.citizen.org/cmep

updated April 23, 2002