bp Naperville Complex
Health Safety Environment
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May 18, 2001

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SUBJECT: 8EHQ-1198-14311

This letter is in response to questions raised about the use of radioactive sources at the BP Naperville Complex during our meeting of May 8, 2001. By far, the most common sources used at the BP Naperville Complex during its 30-year history have been Cesium 137 (Cs-137) level detection gauges (1 and 10 mCi). Currently, we have a total of 13 gauges on 5 pilot plant units. All of these sources are Cs-137, either 1 or 10 mCi.

The sources are used as a non-intrusive way to measure liquid levels inside a closed steel reactor. This is a very common way of measuring liquid levels in tightly sealed vessels in the petrochemical industry. Typically, a lead sealed Cs-137 source is locked onto the outside of a steel vessel with the shuttered side of the source pointing diagonally throughout the vessel. A detector is placed opposite the source on the other side of the vessel and the photon beam (gamma rays) emitted from the unshuttered source is collimated to line up directly with the detector.

During operation, the shutter for the Cs-137 gauge is opened and fluid levels determined inside the reactor vessel. The signal at the detector is inversely proportional to the amount of fluid in the beam path. For example, when the fluid level is high, the photon beam from the source is partially blocked so the detector receives an attenuated signal. As the fluid levels are lowered, larger and larger amounts of energy are able to pass through to the detector.

At our site, anyone who may come into contact with radioactive materials or devices is required to go through an approval process with the site Radiation Safety Committee, they must receive appropriate radiation safety training, and they enter our dosimetry program. Film dosimeters are the oldest and most widely used personal dosimetry systems. Film dosimeters worn as badges on the outside of laboratory coats were used at the BP Naperville Complex until the year 2000. The badges contain film with a sensitive photographic emulsion and were supplied by Landauer Inc. The dose to the film is measured as light transmission: the darker the film, the higher the dose. Every month, a person in the dosimetry program would turn in the film from their badge to the site Radiation Safety Officer (RSO) and receive new film for the next month. Since 2000, employees in the site dosimetry program have been using Landauer's Luxel OSL (Optically Stimulated Luminescence)

Dosimeter in place of the traditional film badges. This new, state of the art technology, offers improvements over traditional film techniques.

Employees who operate level detector gauges also wear Landauer's thermoluminescent dosimeter (TLD) ring. Thermoluminescence dosimetry is well suited for personal monitoring of exposure to gamma rays. Employees wore these devices as rings on their fingers because of the concern that the highest personal exposure may occur in the unlikely event that the person's hand passed through the beam when the shutter of the radiation source was opened. TLD rings were also turned into the RSO each month. The RSO would then send the potentially exposed film and rings to Landauer Inc. for evaluation. I refer you to *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol. 75; Ionizing Radiation, Part 1: X – and Gamma –Radiation, and Neutrons, 2000, page 42*, for an in-depth explanation of dosimetric methods and models and further explanation for why the above methods of personal dosimetry are the methods of choice for gamma-radiation.

As required by law, semi-annual wipe tests are performed on all radioactive sources to make sure there is no leakage of radioactive material. These tests have always demonstrated the sources to be intact. The external lead casings of the gauges have also been checked with a Geiger-Mueller counter and are at background radiation levels just several centimeters from the source. Also, the Illinois Department of Nuclear Safety externally audits our Radiation Safety Program each year.

In over 30 years of monitoring employees for exposure to ionizing radiation at the BP Naperville Complex, total lifetime exposures received at the site are all less than the allowable annual limit for each individual in the program. That is, no one has received a lifetime exposure approaching the annual limit of 5 Rem. The annual exposure limit for exposure to ionizing radiation is based on risk assessments conducted by the National Council for Radiation Protection (NCRP). NCRP's exposure standards are intended to prevent "non-stochastic" effects and to limit the predicted risks to radiation workers of "stochastic effects" including incidence of fatal cancers and of severe genetic effects among the first two generations of their offspring, to be no greater than the average risk of accidental death among workers in non-radiation industries. See NCRP Report No. 91 (1987) for a discussion of this limit. Similar estimates of risk have also been produced by the international agencies ICRP and UNSCEAR. According to NCRP, the most radiosensitive organs (in decreasing order) are gonads, breast, red bone marrow, lung, thyroid, and bone surfaces, followed by all other "remainder" organs.

Based on the above information, investigators from the University of Alabama at Birmingham and Johns Hopkins School of Hygiene and Public Health determined that it was highly unlikely that exposure to ionizing radiation at the BP Naperville Complex contributed to the unusual occurrence of brain cancer that we have seen at our facility. I hope this information answers the questions raised during the seminar I gave on May 8. If you need further clarification or have further questions, please do not hesitate to get in touch with me.

Sincerely,

Michael S. Wells

Michael S. Wells, PhD
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