CHELATION FACTS

The purpose of this document is to provide information on chelation therapy to Department of Energy (DOE) facilities that use plutonium. The information in this document will be incorporated in a DOE Standard (STD), DOE-STD-1128-2008, *Guide of Good Practices for Occupational Radiological Protection in Plutonium Facilities*. It will also be used to update the chelation information provided to plutonium radiological workers in a DOE Handbook (HDBK), DOE HDBK-1145-2008, *Radiological Safety Training for Plutonium Facilities*.

Chelation therapy, or chelation, is the process of removing unwanted metals from the body by administering an agent that binds to the metal and promotes its excretion. It is important to remove plutonium from the body because it is retained in the bones and liver for many years. Plutonium remaining in the body continues to irradiate nearby tissues, which may result in increased risk of cancer. Chelation therapy has been practiced successfully and safely in treating lead and other heavy metal poisoning for over 60 years.

Chelating agents can be administered orally, intravenously, or as a mist, depending on the agent and the type of poisoning. Several chelating agents are available; each has different affinities for different metals. DTPA (diethylenetriaminepentaaceticacid) has been proven effective for the treatment of people accidentally contaminated internally with the transuranic nuclides plutonium, americium, and curium. Recently, based on additional clinical data and peer-reviewed articles, the Food and Drug Administration (FDA) has approved DTPA as a safe and effective compound to enhance elimination/excretion of radioactive materials from the body. There are two primary DTPA compounds: Ca-DTPA and Zn-DTPA. Ca-DTPA is more effective than Zn-DTPA in the first 24 hours after contamination. To avoid long-term depletion of essential metals, Ca-DTPA is administered initially, followed by Zn-DTPA if multiple doses are required.

The number of treatments is based on the results of the bioassay analyses. Most situations involve single treatments; however, a 2010 wound incident at a DOE facility involved 71 treatments. Possible side effects of such an extended chelation therapy regiment could include depletion of essential elements, which can be treated by administering supplemental minerals.

In addition, according to the Centers for Disease Control and Prevention (CDC) Web site, people who are given repeat doses of Ca-DTPA within a short period of time may have nausea, vomiting, diarrhea, chills, fever, itching, and muscle cramps. Other side effects may include headache, lightheadedness, chest pain, and a metallic taste in the mouth. Chelation therapy administered by nebulized inhalation may cause breathing difficulties in some individuals.

According to the FDA Web site at
http://www.fda.gov/Drugs/EmergencyPreparedness/BioterrorismandDrugPreparedness/ucm130314.htm:

- If Ca-DTPA is not available, or treatment cannot be started within the first 24 hours after contamination, treatment should begin with Zn-DTPA.

- If Zn-DTPA is not available, Ca-DTPA can be given for continued treatment, along with vitamin or mineral supplements that contain zinc.
- Ca-DTPA and Zn-DTPA can be administered by nebulizer or directly into the blood stream (i.e., intravenously). If the route of internal contamination is through inhalation alone, then nebulized chelation therapy will suffice. If the routes of contamination are multiple (e.g., inhalation and through wounds), then intravenous chelation therapy is preferred.
- The duration of treatment is dictated by the level of internal contamination and the individual's response to therapy. Levels of internal contamination should be ascertained weekly during chelation therapy to determine when to terminate treatment.
- Zn-DTPA is the preferred treatment for the pregnant woman with internal contamination.
- FDA recommends nebulized DTPA for patients whose internal contamination is only by inhalation.
- The safety and effectiveness of the intramuscular route has not been established for Ca-DTPA or Zn-DTPA.
- The duration of Ca-DTPA and Zn-DTPA therapy depends on the amount of internal radioactive contamination and the individual's response to therapy.
- Ca-DTPA should be used with caution in patients suffering from a severe form of a disease called hemochromatosis.

Additional information can be found on the CDC Web site at **http://www.bt.cdc.gov/radiation/dtpa.asp.**

Some of this information includes:

- Radioactive materials chelated to DTPA are excreted from the body in the urine; therefore, DTPA must be used carefully in people whose kidneys do not function properly.
- Breathing treatments using DTPA may not be safe for some people with asthma. If a person with asthma requires treatment with DTPA, the drug should be injected.
- DTPA should not be used to treat people who are internally contaminated with the radioactive materials uranium or neptunium.

The big advantage of chelation for radioactive metals, such as plutonium, is the radiation dose reduction for the patient. Substantial dose reductions can be achieved if DTPA is administered within a few hours (recommended within 1 hour) of the intake of plutonium. Dose reductions from 10 percent to 90 percent have been achieved for contaminated wound or burn cases and up to 30 percent for inhalation cases.

The decision to administer chelation therapy is made by the worker in consultation with a board-certified occupational medicine physician. Communication of the risks and benefits associated with chelation is necessary. In communicating information to the individual concerning the risks from the radiation exposure, refer to the Health Physics Society policy paper **http://hps.org/documents/risk_ps010-2.pdf** that states: 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.

Chelation is generally recommended when the estimated dose exceeds 2 rem committed effective dose. If a quick dose estimate cannot be made, indicators such as airborne radioactivity exposure, nasal/mouth smears, facial contamination, skin breaks, or bioassay measurements may be used. In addition, chest or whole-body counts and wound counts may be used for dose estimates.

References and Web sites for this subject, in addition to the ones listed previously, include National Council on Radiation Protection and Measurements Report Number 161, *Management of Persons Contaminated with Radionuclides*, and the Radiation Emergency Assistance Center/Training Site Web site at **http://orise.orau.gov/reacts/guide/internal.htm.**