REMARKS ON TRITIUM APPLICATIONS AND HANDLING AT OAK RIDGE NATIONAL LABORATORY

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With the advent of fusion energy, tritium control would seem to be an imperative issue. On a world basis it is estimated that the inventory of tritium will increase by as much as 100 MCi from 70-140 MCi currently in the environment. Concerns over handling of wastes from fission reactors should transfer to fusion devices albeit the waste products from the latter power sources will be of much shorter half-life.

Therefore, research and development efforts must continue to attain effective and safe methods of treating tritium-containing effluents. Being a hydrogen isotope, tritium is a chemically reactive species and easily converted to water on almost any surface in the presence of oxygen. The biological hazard to humans is 10,000 times greater when tritium is in the form of water rather than in elemental form because of the rapid absorption into body tissue through skin contact or inhalation.

At Oak Ridge National Laboratory tritium handling procedures have evolved through pragmatic experience and dedicated effort to minimize personnel exposure on the "as low as reasonably achievable" (ALARA) principle. Generally two procedures (or combinations of these) have been used to limit exposure to tritium. Where only small releases of elemental tritium are anticipated (less than 50 Ci), a high velocity air sweep over processing equipment is used with subsequent exhaust of the effluent gases to the atmosphere. This technique has been found practical and effective. No deleterious environmental consequences of this procedure have been observed over a twenty-year history. Where direct handling of tritium-contaminated equipment is required, protective clothing and fresh air masks are provided for the personnel.

A second approach is the "total containment" concept wherein all tritium handling is confined to enclosures using materials known to have very low permeability to hydrogen. In this case, effluent gases are vented to catalytic converters in which elemental tritium is oxidized to water and subsequently removed by sorption on solids to be later disposed of as solid waste.

Depending upon the application, both of these procedures (or a combination) have proved effective in limiting personnel and environmental exposures. Development efforts in West Germany, Japan, the United States and other countries have resulted in finding new containment materials, low porosity surface coatings and improved elastomers which limit tritium releases from containment facilities -- and the efforts continue.

In the Isotopes Program at Oak Ridge National Laboratory, the principal uses of tritium in significant quantities are the preparation of metal hydride targets for 14.5 Mev neutron production, packaging of tritium for shipment to other laboratories and commercial firms, preparation of radioluminescent light sources, and the helium-doping of metallurgical test specimens for embrittlement studies (most samples being used for fusion reactor first-wall materials evaluation). In these programs, several megacuries of tritium are handled annually with no significant health hazard to operating personnel or environmental insult.

From our experience it appears that future consumption of tritium in these and other programs (including medical applications) will increase significantly. An excellent example of such projected increase is the relatively new development of radioluminescent light sources (RL) for use in remote geographic regions where electric power is limited or is nonexistent. Our development of these tritium-containing phosphor lights will be commercially exploited through technology transfer. Because of the half-life limitation of tritium in these sealed RL light sources, Oak Ridge National Laboratory is now developing a safe tritium recovery process for "spent" sources. Such development should impact the much greater needs for separation, purification and storage of tritium associated with fusion reactors.