ENVIRONMENTAL IMPACT OF RADIOACTIVE WASTE MANAGEMENT IN THE NUCLEAR INDUSTRY

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Abstract. Radioactive wastes from the nuclear industry are classified into low, intermediate and high activity levels, and problems of their storage and release examined in detail. Current means of storage are considered with reference to processing of low and intermediate level liquid waste, processing of high level waste, processing of airborne waste, and ground disposal and processing of solid waste. Release is discussed in terms of effluent release limits, monitoring and the use of permanent records, impact of release to the human environment, impact of release to the material environment, and guides for preventing accidental release. Contamination of the shore of Lake Huron from radioactive fallout is discussed as a particular example.

Problems to be solved are identified in three main areas: gaseous wastes, actinide-contaminated wastes, and permanent disposal, and some specific suggestions for study are made.

1. Introduction

1.1. THE PROBLEM

The nuclear industry in its present phase deals with the production of power through the nuclear fission process. The main processes in the full fuel cycle are uranium mining, fuel fabrication, reactor operation and fuel reprocessing. Operation of these processes produces both radioactive (radwaste) and nonradioactive waste. Fission fragments, actinide products and neutron-induced material are the three main classes of radwastes. The first two of these are the special products of fission processes, whereas the last one is not unique to fission processes. By carefully choosing the reactor material, it may be possible to reduce the amount of neutron-induced radwaste, but it is impossible to reduce the production of fission fragments and actinide products in a fission reactor. As long as there is burning of the fissile fuel, fission fragments and actinide products will always be produced. For the operation of the full fuel cycle, including fuel reprocessing, these two radwastes constitute the main impact to the environment. The importance of this impact can be seen with the aid of a brief description of the quantity and type of radwaste produced, and the limits of environmental assimilation.

Pigford [1] calculated a detailed waste inventory for the full cycle flow sheet of a typical uranium-fueled 1000 MW light water reactor nuclear power plant. His results after simplification are shown here in Figure 1. It can be seen that one main hazard is the fission fragments with radioactivity totalling of the order of $10^8$ Ci. For this type of reactor an average of 240 kg yr$^{-1}$ of plutonium is produced. This is also hazardous although it is usually not considered a waste because it may immediately be reused after separation as a fissile element. The problem in handling Pu-contaminated material is that only small amounts of plutonium are needed to cause a hazard to public health.
Fig. 1  Typical full fuel cycle flow sheet for uranium-fueled 100 MW light water reactor (Pigford).