A CASE STUDY: RADIOACTIVE WASTE STORAGE IN THE REPUBLIC OF CHINA (ROC)

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ABSTRACT

The Republic of China (ROC) is currently producing nuclear generated electric power and the associated radioactive wastes. At present, disposal of the waste is not being performed until research and development determine the most feasible method. Until such time that disposal operations commence, the ROC Atomic Energy Agency is storing the solid radioactive waste at the Lan-yu facility. Consideration of the facility's design and operation should be included with any storage facilities contemplated for use in the United States.

INTRODUCTION

The Republic of China (ROC) is an island nation of large population density embarked on an aggressive nuclear power generating program. During the 1970's the Taiwan Power Company started a nuclear power plant building program to diversify from fossil fuel sources for the country's increasing household and industry demand. This diversification has helped decrease the dependency on fossil fuels but created an increasing volume of radioactive waste and the associated disposition problems. The disposition of radioactive waste in a heavily populated small country with large coastal areas presents difficult management objectives which must be considered for the safe and permanent disposal of the waste.

RADIOACTIVE WASTE STORAGE ROC

As part of the overall radioactive waste management program a storage site was built and placed into operation in early 1982. The reasons for establishing such a facility differ greatly from our own unique waste dilemma, however, the successful construction and operation of this facility should provide insight to alternatives in managing our own waste.

In May, 1984, NUS Corporation evaluated the ROC's transportation and storage programs established by the Atomic Energy Commission (AEC). The Taiwan AEC contracted with NUS for a critical review of their programs from the standpoint of improving the transportation, handling and storage by taking advantage of NUS Corporation's experience in these areas. The storage facility is the key component in the ROC's nationalized waste management program and was in operation only two years at the time of the evaluation.

The Lan-yu (Orchid Island) storage facility is located on a sparsely populated island 75 kilometers southeast of Taiwan. The facility is designed for the storage of solidified radioactive waste in 200 liter (55 gallon) drums and the subsequent removal for permanent disposition. The Lan-yu storage facility is used to store solidified waste with on-contact radiation levels of less than 2 REM per hour for up to 100 years. Taiwan does not currently bury radioactive material, however, releases gases and liquid in small concentrates as allowed by AEC regulations. The AEC and National Taiwan University have determined that ocean dumping may be a viable disposal option and are embarked on a research project to develop satisfactory methods of doing so for solid radioactive wastes. At that time, wastes will be removed from the Lan-yu facility and disposed of.

The storage facility consists of concrete trenches for drum storage, administrative offices and a waste inspection facility. Wastes produced by Taiwan Power Company are transferred to the AEC for transport to Lan-yu. Each container is inspected to assure for the proper condition for interment. Those drums not found to be satisfactorily packaged are encapsulated with bitumen and overpacked in the inspection facility. The inspection facility includes laboratory facilities for sample counting and a remotely operated bitumen solidification system.

Trench construction is anticipated to continue until approximately 350,000 drum capacity is reached. Although trenches may vary in length and volume capacity, all of the trenches are designed in a similar fashion. Typically, 35cm of concrete is used for the walls and bottom of each trench that measures 5.4m wide, 4.5m deep, and less than 90m long. The reduction of general area radiation levels outside the trenches is accomplished by having 3.0 meters of the trench below grade, therefore, the 35cm concrete wall, earthen material and asphalt work areas, around the trench, provide for adequate shielding. Drums are stacked two layers high to assure the material is below grade. The trench is then sealed with concrete slabs of various thicknesses, up to 35cm, to form an A-frame cover. The cover's slope and asphalt sealent provide for waterproofing of the exposed trench. Trench radiation monitoring programs assess the adequacy of the shielding and individual liquid collection systems, for each trench, are used to retain and monitor liquids. When drums are to be retrieved the covers are simply removed and the drums are vacuum lifted out of the trench.

Taiwan's limited experience with waste "disposal" has not effected the establishment of a technically sound and an easily operated facility. Lan-yu can be operated with minimum personnel staffing and equipment. The small containers (200 liter) have the potential of increasing the exposure received during processing and handling but the use of vacuum lifter and cranes have reduced the exposures at Lan-yu. Smaller containers are more easily repaired by encapsulation and reduce the capital expenditure for large remotely operated encapsulation systems.

However, Taiwan's does not have the experience of waste "disposal" that we have had from almost 25 years of swallow land burial and does not have the volumes of waste we must contend with. Therefore, use of steel 200 liter drums may not be acceptable for use in the United States.

The establishment of storage sites in the United States similar to Lan-yu is feasible, however, we must consider the following:

- Can long-term storage, greater than ten years, be accomplished in thin gauge steel drums?
- Is the storage efficiency of small cylindrical drums desirable?
- Is there an advantage to storing waste that will be disposed of as radioactive by land burial after storage?
- Should storage be designed for the decay and subsequent non-radioactive disposition of the material?

The ROC is not faced with these decisions; they have decided to store waste until disposal methods are developed. In the United States, we have developed methods suitable for disposal but must turn to storage as an alternative to burial or as a substitute for burial when necessary.