VOLUME REDUCTION THROUGH DRY ACTIVE WASTE SEGREGATION

Alfred N. Johnson
Hydro Nuclear Services, Inc.
440 N. Elmwood Road
Marlton, NJ 08053

ABSTRACT

Dry active waste (DAW) segregation programs offer the benefits of radioactive waste volume reduction and recovery of reusable materials, but at the same time they pose the risk of release of radioactive material to uncontrolled areas. The principal concerns of utilities in implementing segregation programs are lack of regulatory guidance and lack of confidence in clean waste monitoring techniques. These concerns are examined, and it is concluded that regulatory guidance is adequate to permit segregation programs to function; however, conventional contamination monitoring techniques may not provide adequate detection sensitivities. The basic considerations for establishing an effective segregation program are discussed: sorting and segregation, contamination monitoring, and unrestricted release criteria.

INTRODUCTION

The increasing volume of low level radioactive waste, combined with increasing costs and decreasing disposal site capacity, has created a serious problem for all users of radioactive materials, including the nuclear power industry. In an attempt to reduce the volume of this waste, a few nuclear power utilities have initiated programs to segregate non-radioactive waste from the radioactive waste generated in radiologically controlled areas. These programs, which process solid waste material for unrestricted release, offer the promise of reductions of 50 percent or more in the volume of dry active waste (DAW) that normally would be disposed of as radioactive waste (1). Furthermore, the recovery of reusable items inadvertently disposed of as waste (items such as tools, respirators, and protective clothing that are normally decontaminated and reused) can by itself, make these programs cost effective.

Despite their obvious appeal, waste segregation programs have been the subject of considerable controversy. Many nuclear power utilities feel that it is not in their best interest to implement such programs, and justification for their belief is almost always based on two major concerns:

1. the lack of regulatory standards for unrestricted disposal of minute quantities of radioactive contamination in solid waste, and

2. the lack of confidence in, and reliability of, segregation programs that incorporate conventional survey techniques and waste processing equipment.

A waste segregation program offers the promise of reduced costs through volume reduction and the recovery of reusable materials, some potentially quite valuable. But at the same time, it presents the very real risk of releasing significant quantities of radioactive material to uncontrolled areas - areas to which the public has access. The solution to this dilemma lies in the level of commitment (technical and financial) to the program, as the following discussion will show.

REGULATORY GUIDANCE

At present, there is no specific minimum quantity of radioactivity in solid waste material generated at a nuclear power facility that may be disposed of in any manner other than as low level radioactive waste. However, suggestions for establishing specific exemptions from regulation of radioactive surface contamination (2-6) have been published. For example,

1. NUREG 0613 and 0707 (2,3) conclude that surfaces uniformly contaminated at levels of 5000 dpm/100 cm^2 (beta-gamma emitting nuclides from nuclear power reactors) would result in potential doses to the general public of less than 5 mrem/yr,

2. USNRC Regulatory Guide 1.86(4) recommends limits for beta-gamma emitting nuclides of 5000 dpm/100cm^2 for fixed contaminants and 1000 dpm/100cm^2 for removable contaminants for the unrestricted release of materials from nuclear power reactors undergoing decommissioning, and

3. ANSI N13.12(5) recommends surface contamination limits for selected beta-gamma emitting nuclides of 5000 dpm/100cm² total and 1000 dpm/100cm² removable on materials, equipment, and facilities to be released for uncontrolled use.

These surface contamination limits are not regulations, and as such, they may not be used to establish specific quantities of radioactivity in solid materials that may be released to an uncontrolled area. However, these guidelines may be used by the licensee to establish contamination control procedures that specify the minimum detection sensitivity required for determining whether or not materials brought into a radiologically controlled area may be released unconditionally as "clean" material or controlled as "radioactive" material.

PROBLEMS WITH CONVENTIONAL CONTAMINATION MONITORING TECHNIQUES

The present lack of confidence that many nuclear power facilities have for waste segregation programs that incorporate conventional sorting and surface contamination monitoring techniques has in some ways been substantiated by previous operational experience. The USNRC has reported several events that have resulted in the inadvertent release of radioactive contamination from nuclear power facilities to uncontrolled areas (7).

One such event involved the disposal of supposedly clean trash in a nearby sanitary landfill. High background radiation levels in the facility due to buildup of radioactive wastes, coupled with improperly trained personnel, precluded adequate radiation surveys of trash prior to unrestricted release. An inspector, upon observing these conditions, suspected that radioactive material might have been released from the facility, and then confirmed his suspicions when he detected levels of radiation 20 to 30 times greater than normal background at the landfill. Subsequent surveys by the licensee, the state, and the USNRC revealed several other areas in the landfill with higher than normal dose rates. Excavation of the landfill by the licensee revealed items with contamination levels that produced dose rates up to 100mrem/hr on contact. The excavation, packaging, shipping, and burial of this contaminated material was costly but insignificant when compared to the public outrage and political ramifications caused by the incident.

The lack of confidence in surface contamination monitoring techniques has also been substantiated by testing and experience. The conventionally accepted survey techniques for monitoring materials for surface contamination (8,9) involve the use of GM and gas-proportional detectors, and in the United States, the most common detector used is the thin-window pancake GM probe. Studies performed by Sommers (10) have concluded that for low-level surface contamination, about 5000 dpm of beta-gamma activity is the minimum level that can be routinely detected with a pancake GM probe using conventional direct survey techniques. A later study by Andrews showed that pancake GM probes could only detect levels of about 17,000 dpm/100cm² at normal frisking speeds and that small spots of activity as high as 20,000 dpm could be missed when frisking (11). It should be noted that these sensitivity studies were based on Cs-137, and the GM detectors are not as sensitive to many of the lower energy (Emax 100 keV) beta emitters that make up a significant percentage of total radioactivity typically present in the dry active waste generated at a nuclear power plant.

The conventional method of monitoring segregated waste material for surface contamination calls for frisking each individual item with pancake GM probe. A skilled technician frisking at a speed of less than 5 cm/sec (i.e., very slowly) and using the audible output of the ratemeter can detect uniform contamination levels somewhere between 10,000 and 20,000 dpm/100cm². Lower amounts of activity (down to 5,000 dpm) can be detected if concentrated in areas smaller than the surface area of the probe (about 15cm²). In any case, direct contamination monitoring with pancake GM probes is an extremely slow and tedious process that involves a great deal of individual judgement and, therefore, requires the skills of technicians that are well trained, dedicated, and closely supervised. Even then, the results are not acceptable when compared to the guidance on contamination limits discussed earlier.

CONSIDERATIONS FOR AN EFFECTIVE DAW SEGREGATION PROGRAM

It is clear that some of the aspects of the "conventional" approach to waste segregation programs pose too great a risk to the utility. However, the potential benefits of such programs just as clearly dictate that these problems should be overcome. Inadvertent releases of radioactive contamination of the type previously described can be avoided in a truly effective waste segregation program. Such a program should include the following considerations:

Sorting and Segregation

To be both efficient and effective, the sorting and segregation of waste material should be a centralized operation with the following features:

1. Trash that is removed from contaminated areas through control points should be pre-monitored to separate highly contaminated items from those with little or no contamination.

2. A dedicated low-background area should be established from which high-activity trash is excluded and from which materials that have been segregated for disposal as radioactive waste are periodically removed.

3. An adequate ventilation and exhaust air handling system should be set up to preclude the possible spread or respiration of loose surface contamination during waste handling.

4. Well-defined procedures should be established for the sorting of waste materials into various clean and contaminated subcategories (i.e., wet, dry, compactible, noncompactible, reusable, etc.).

5. A well trained and dedicated work force should be established for increased lproficiency in handling waste.

Contamination Monitoring

Conventional frisking techniques are generally suitable for preliminary screening and sorting of trash into contaminated and "potentially clean" categories. Final sorting and monitoring of this waste material prior to disposal as "clean", call for contamination monitoring equipment and techniques that have all of the following features:

1. The contamination monitoring equipment used should be sensitive to both beta and gamma radiation and capable of meeting plant-specific criteria for surface contamination monitoring,

2. The contamination monitoring equipment should be well-suited for surface contamination monitoring (e.g., large surface area probes for rapid frisking),

3. Microprocessor controls such as automatic background subtraction counting times, and alarm levels should be incorporated into the contamination monitoring equipment to eliminate variations in personnel judgment during surveys,

4. Redundant contamination monitoring systems should be established to prevent the unrestricted release of contaminated waste material due to system malfunction or technician error,

5. Detectors should be calibrated based upon radionuclide distributions that are periodically determined from waste streams associated with DAW generation or, alternatively, estimated from smear samples obtained from locations in which DAW is generated, and

6. Contamination monitoring equipment should be operated by technicians that are qualified, well-trained, and dedicated.

Unrestricted Release Criteria

Solid waste material should not be released to an unrestricted waste disposal site unless all of the following criteria have been met:

1. The waste material has been adequately surveyed for the presence of radioactive contamination by monitoring equipment that meet the licensee's minimum detection sensitivity requirements for classifying "clean" material for unrestricted release

2. The waste material composition is suitable for unrestricted release. Specifically this should exclude all liquids, sludges, chemicals, and/or toxic materials.

3. The waste material is in a non-identifiable/non-traceable form. No intact items normally associated with the identification of radioactive material or the waste generating site should be released. Specifically, this should exclude radiation symbols, radioactive material identification, and/or facility identification.

4. The appropriate information has been documented for release and written authorization of the designated licensee representative has been obtained in accordance with the licensee's procedures.

SUMMARY

The primary problems in implementing an effective waste segregation program are generally not regulatory in nature. Existing regulatory guidance specifically addresses minimum detection sensitivity requirements for establishing a contamination control program. Instead, problems result when unrestricted release criteria are established by the licensee at levels less than conventional contamination survey techniques are capable of reliably detecting. For example, conformance with the ANSI and USNRC Regulatory Guide recommended limits for removable surface contamination (1000 dpm/100cm^2) is well beyond the capabilities of conventional GM detectors using direct survey techniques. The utility that operates a waste segregation program using such techniques is therefore running the very real risk of releasing radioactive contamination to unrestricted areas at levels that may be detected by more sophisticated counting equipment.

One conservative approach to the contamination limit problem is to consider all potential surface contamination as being removable, and then establish minimum detection sensitivity requirements for total surface contamination at 1000 dpm/100cm^2. Complying with such a release limit then requires the acquisition and use of waste monitoring systems with detection sensitivities comparable to sophisticated laboratory counting equipment. Such high sensitivity monitoring systems must be microprocessor controlled with automatic background subtraction and alarm functions to reduce operator subjectivity and achieve consistent monitoring sensitivities.

In conclusion, an effective and safe waste segregation program requires a significant commitment of resources in terms of equipment, people, and management attention. The potential returns from the program are just as significant: dramatic reductions in the volume of waste requiring disposal as radioactive, and the recovery of reusable tools, equipment, and materials.

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