TECHNOLOGY NEEDS FOR DECOMMISSIONING AND DECONTAMINATION (U)

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EXECUTIVE SUMMARY

This report summarizes the current view of the most important decontamination and decommissioning (D&D) technology needs for the five U.S. Department of Energy facilities for which the D&D programs are managed and operated by Martin Marietta Energy Systems, Inc.* The source of information used in this assessment was a survey of the D&D program managers at each facility. This document reflects a brief initial assessment of ongoing needs; these needs will change as plans for D&D are finalized, some of the technical problems are solved, and new ideas for D&D technologies appear. Thus, this assessment should be updated and upgraded periodically, perhaps, annually.

ORNL probably has the widest range of D&D problems of the five sites. The need for robotics for use in decontaminating walls, ceilings, and high radiation areas were at the top of the list of technology needs reported for ORNL. Dismantlement and material disposition needs were also included.

The majority of the D&D problems at the K-25 Site are associated with the process buildings. Not surprisingly, the highest ranking technology needs were associated with the process equipment. Characterization of other areas and facilities and reduction in secondary wastes were also listed. There was a strong interest in the use of smelting to complete the decontamination of metals and recover them for reuse.

Thus far, D&D planning at the Y-12 plant has concentrated on Building 9201-4 (Alpha-4), which housed the Colex process for separating lithium isotopes using mercury. The main need that was listed was for D&D performance criteria. Decontamination of the mercury-contaminated process equipment was next. An in-situ method was preferred. In-situ rough cleaning was desired if complete decontamination could not be obtained. Engineering data on thermal desorption; surface cleaning processes; field measurement techniques; in-situ characterization of equipment; dismantling techniques which do not vaporize mercury; aqueous recycling and final disposal alternatives for elemental mercury contaminated with uranium are also needed.

Decontamination of the inside and outside and dismantlement of process equipment were given the highest priority by the staff of the Portsmouth Gaseous Diffusion Plant. In-situ decontamination is preferred. The need for decontamination extends to the auxiliary equipment and other metal items. The need for concrete decontamination applies primarily to floors, but also applies to walls and other concrete structures. Recovery of purified nickel from barrier, improved characterization techniques, and minimization of secondary wastes from D&D were also considered important.

The need for smelting as a means for decontamination was given the highest priority by the Paducah Gaseous Diffusion Plant. Technology for characterization, decontamination, and disposal of transite siding is a major need. Decontamination and minimization of the waste from painted metal surfaces was listed. Paducah also listed the need for personal protective equipment with improved worker protection and comfort.

A composite prioritized list of the D&D technology needs for Energy Systems was compiled. The priority was based upon both the number of sites that indicated a need and the priority assigned to it by each of these sites. The main items from the composite list are:

*Energy Systems is responsible for environmental restoration (including D&D) and waste management at the Portsmouth Gaseous Diffusion Plant (PORTS) and the Paducah Gaseous Diffusion Plant (PGDP) even though these facilities are managed and operated by Martin Marietta Utility Services, Inc. under contract with the United States Enrichment Corporation.

- Decontamination of metal equipment and structures,
- Decontamination of concrete floors, walls, etc.,
- Characterization of equipment and facilities,
- Remote and automated systems for decontamination, characterization, and dismantlement,
- Reduction and treatment of secondary wastes,
- Development of D&D performance criteria,
- Removal of contaminated equipment,
- Characterization, decontamination, and disposal of transite siding,
- Disposition of scrap metal,
- Personal protective equipment with added worker protection and comfort, and
- Disposition of waste.

1. INTRODUCTION

This report summarizes the current view of the most important decontamination and decommissioning (D&D) technology needs for the U.S. Department of Energy (DOE) facilities for which the D&D programs are the responsibility of Martin Marietta Energy Systems, Inc.* The source of information used in this assessment was a survey of the D&D program managers at each facility. A summary of needs presented in earlier surveys of site needs¹⁻⁴ in approximate priority order was supplied to each site as a starting point to stimulate thinking. Some sites returned marked-up versions of this list, while some sites gave entirely new lists of needs. This document reflects a brief initial assessment of ongoing needs; these needs will change as plans for D&D are finalized, some of the technical problems are solved through successful development programs, and new ideas for D&D technologies appear. Thus, this assessment should be updated and upgraded periodically, perhaps, annually.

This assessment differs from others that have been made in that it directly and solely reflects the perceived need for new technology by key personnel in the D&D programs at the various facilities and does not attempt to consider the likelihood that these technologies can be successfully developed. Thus, this list of technology needs also does not consider the cost, time, and effort required to develop the desired technologies. An R&D program must include studies that have a reasonable chance for success as well as those for which there is a high need. Other studies that considered the cost and probability of successful development as well as the need for new technology are documented in References 1-3 and 5. However, the need for new technology may be diluted in such studies; this document focuses only on the need for new technology as currently perceived by those actually charged with accomplishing D&D.

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2. TECHNOLOGY NEEDS FROM INDIVIDUAL SITES

This section describes the needs identified by each site. The information on needs supplied from each site was a simple list, often accompanied by a brief explanation. No guidance was given as to the number of items listed or the specificity of the items. Thus, the information received varied in these respects.

2.1 OAK RIDGE NATIONAL LABORATORY

Past R&D, isotope production, and waste management programs at Oak Ridge National Laboratory (ORNL) have resulted in a significant surplus of contaminated facilities. Currently, there are 39 individual facilities awaiting decommissioning.⁶ The programs that formerly used these facilities had both defense and non-defense sponsors. ORNL probably has the widest range of D&D problems of the Energy Systems sites. The surplus facilities range in size and complexity from shielded shipping casks to large experimental reactors and include a variety of laboratory- and pilot-scale facilities for chemical and physical processes. Figure 1 is a photograph of the Molten Salt Reactor Experiment. Radioactive contaminants at ORNL include fission products, corrosion products, and induced radiation that involve a large fraction of the periodic chart. Although radiation levels are quite low in some areas, the ORNL site also includes some areas where the radiation levels are too high to permit hands-on D&D operations.

The list of technology needs reported for ORNL are given in Table 1. The list is in approximate priority order and is dominated by decontamination needs. The need for robotics for use in decontaminating walls, ceilings, and high radiation areas received the highest rankings. Dismantlement and material disposition needs are also included.

Table 1. Technology needs reported from ORNL

1.	Robotics for use with shot blaster, etc. on walls, ceilings, etc.
2.	Robotics to use with scabblers, etc. in high radiation areas
3.	Decontamination of floors and walls
4.	Concrete decontamination
5.	Decontamination of metals
6.	Demonstration of commercial ice blasting systems on ORNL problems
7.	Demonstration of supercritical CO ₂ blasting system on ORNL problems
8.	Demonstration of entombment by encasement
9.	Engineered storage for very radioactive items
10.	Removal of highly contaminated process equipment and piping
11.	Treatment systems to recycle water from decontamination equipment using water or ice

2.2 OAK RIDGE K-25 SITE

D&D of the process facilities at the K-25 Site will be an enormous task. The Oak Ridge K-25 Site contains about 5000 stages in five process buildings having a total floor area of about 300 acres. Each stage consists of a converter, a heat exchanger, one axial or two centrifugal compressors, a control valve, and associated piping. Figure 2 shows a typical U.S. gaseous diffusion stage

Fig. 1. Molten Salt Reactor Experiment Cell.

Fig. 2. Typical U.S. Gaseous Diffusion Stage Arrangement.

arrangement. Auxiliary equipment includes ventilation, electrical, lube oil and cooling systems. More than 50 auxiliary facilities, including gas centrifuge development and demonstration facilities, require D&D in addition to the five process buildings. The EBASCO estimate⁷ places the cost of D&D of the gaseous diffusion facilities at the K-25 Site at approximately \$7.5 billion. Of this sum, nearly \$4 billion is associated with the construction and operation of decontamination facilities and the dismantlement and transport of contaminated process equipment to these facilities.

The majority of the D&D problems at the K-25 Site are associated with the process buildings. A primary interest is the ability of the characterization equipment to show that an item of steel, concrete, equipment, etc., meets the applicable release criteria (radiological, PCB, RCRA, etc.) The process needs to be fast, field portable, and (most importantly) accepted by the regulatory community. The process equipment was fabricated primarily of nickel-lined steel with significant amounts of aluminum, copper, monel, and porous nickel barrier. Many of the buildings were constructed with external surfaces covered by Transite (asbestos fibers embedded in concrete). The primary contaminants inside the process equipment are fluorides and oxyfluorides of uranium and technetium. The outside of the process equipment and other items in the process buildings are contaminated with small amounts of these same contaminants and also with PCBs, oil, and chromates. Some facilities are also contaminated with sulfur, barium, and arsenic compounds and dioxins. Table 2 lists the technical needs reported for D&D of the K-25 Site. The general technology needs were prioritized (by the D&D staff), and specific examples, if known, are listed under each general technology need.

Not surprisingly, the highest ranking technology needs were associated with the process equipment. Characterization of other areas and facilities and reduction in secondary wastes were also listed. There was a strong interest in the use of smelting to complete the decontamination of metals and recover them for reuse.

Table 2. D&D technology needs reported for the K-25 Site

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1.	Decontamination of the interior of the gaseous diffusion process equipment
	ClF ₃ gas phase decontamination process
	Aqueous decontamination processes
	Removal of technetium from gaseous diffusion equipment surfaces
2.	Characterization of contaminated equipment and facilities
	Improved radionuclide field screening
	Radioactive characterization under coatings (such as paint)
	Remote/inaccessible sampling and analysis (inside equipment)
	Fast characterization of large surface areas
3.	Reduction of secondary wastes
	Decontamination of metal through smelting
	Oxidation of contaminated organics
4.	Decontamination of facility and equipment exterior surfaces
	High-velocity CO ₂ blasting
5.	Recycling of contaminated resources
	Metal smelting decontamination/recovery process
	Electrochemical refining of contaminated metals
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2.3 OAK RIDGE Y-12 PLANT

Thus far, D&D planning at the Y-12 plant has concentrated on Building 9201-4 (Alpha-4). This building housed the Colex process for separating lithium isotopes, which used large amounts of mercury. Earlier, the building had housed the electro-magnetic process for enriching uranium. Later, a portion of the building also housed an uranium electro-machining operation. Substantial amounts of mercury contaminate the inside of the process equipment, the outside of the process and other equipment, and building floors and walls. Much of the mercury exists in the form of small balls that are coated with mercury oxide. Much of the mercury has escaped to the surrounding soil and creek. Mercury vapor in the air is a frequent problem. Most of the process insulation is asbestos. The portion of the building that housed the uranium electro-machining operation and, possibly, other parts of the building also have some uranium contamination.

According to the current plan, D&D of the Alpha-4 building is to be accomplished in three phases. During Phase I mercury will be drained from equipment so that it can be disassembled; Y-12 plant utilities in the building will be relocated; asbestos will be removed; the waste to be expected from the building structure will be characterized; and the process equipment will be removed from the building, further decontaminated if necessary, and disposed of. Phase II includes removal and D&D of building internals, removal and D&D of outside process equipment, demolition of the above-grade building structure, and waste treatment and final disposal. During Phase III the concrete foundation below grade will be removed; remedial action will be performed on the surrounding contaminated soil; waste from Phase III will be treated and finally disposed of; and the site will be returned to a "green field."

The D&D technology needs that were listed for the Y-12 Plant are given in Table 3. The main need that was listed was for development of D&D performance criteria. Decontamination of the mercury-contaminated process equipment was the next most important item. Development of an in-situ method was preferred. In-situ rough cleaning was desired if complete decontamination could not be obtained. Engineering data on thermal desorption of mercury is needed so that thermal desorption could be used to remove the mercury left by the in-situ methods. Supercritical fluid extraction, in-situ thermal removal, and biological treatment of mercury were of interest if better techniques could not be developed. Demonstration and application of surface cleaning processes for other equipment, floors, walls, concrete, etc. are also needed. Other technology that was perceived as being needed included field measurement techniques; in-situ characterization, with contaminant mapping, of equipment; dismantling techniques which do not vaporize mercury; a recycle process for aqueous solutions; and demonstration of final disposal alternatives for elemental mercury contaminated with uranium.

2.4 PORTSMOUTH AND PADUCAH GASEOUS DIFFUSION PLANTS

The first gaseous diffusion facilities were constructed in the 1940s at Oak Ridge to produce highly enriched uranium for defense purposes. Additional facilities were added later to satisfy defense needs by constructing additional facilities at the Oak Ridge K-25 Site between 1950-1954, at Paducah, Kentucky between 1951-1954, and at Portsmouth, Ohio between 1953-1956. The equipment, materials of construction, and contaminants at the Paducah and Portsmouth facilities are generally similar to those at the Oak Ridge K-25 Site. However, there are some differences. Since technetium tends to move up the cascade and the three gaseous diffusion plants were operated as a single complex for many years by shipping UF_6 in cylinders between plants, the technetium contamination at the Portsmouth plant is worse than at the other plants. One important difference is that the Paducah and Portsmouth plants are still operating, while uranium enrichment at Oak Ridge was halted in 1985.

Table 3. D&D technology needs for the Y-12 Plant

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1. Development of D&D performance criteria
 2. In-situ mercury decontamination of equipment
 3. Demonstration/applications of field measurement techniques
 4. In-situ characterization, including contaminant mapping, of equipment
 5. Demonstration/applications of surface cleaning processes
 - Equipment
 - Floors
 - Walls
 - Concrete
 - Other
 6. Development of thermal desorption engineering data
 7. Demonstration/application of dismantling techniques which do not vaporize mercury
 8. Development/demonstration of recycle process for aqueous solutions
 9. Demonstration/application of final disposal alternatives for elemental mercury contaminated with uranium
 10. In-situ flushing/rough cleaning of equipment
 11. Internal/external method to determine the mercury concentration, remove mercury from the air during operation, and condense out and collect the mercury
 12. Improved characterization/analysis system
 13. Mobile work area chilling system
 14. Supercritical fluid extraction of mercury from equipment
 15. In-situ thermal removal of mercury
 16. Treatment methods for materials with low mercury levels
 17. Methods for rendering asbestos innocuous
 18. Equipment removal methods which do not require equipment to touch the floor
 19. Vacuum distillation of mercury
 20. Secondary waste reduction
 21. Declassification methods
 22. Smelting process for the DOE metals recycle program
 23. Mercury condensation/recovery system
 24. Robotics characterization methods to determine specific mercury concentration and grid map inside pipes, tanks, etc.
 25. Method for determining the amount of mercury in off gases.
 26. Automated asbestos removal system
 27. Biological treatment of mercury
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Thus, the current need for D&D at Portsmouth and Paducah is limited to a few auxiliary facilities and some equipment that is no longer needed. An exception to this statement is the high-enrichment cascade at Portsmouth, which was shut down during FY 1993.

The D&D technology needs reported by the staff of the Portsmouth Gaseous Diffusion Plant (PORTS) are listed in Table 4. These needs primarily look forward to the eventual decommissioning of the plant. The needs for D&D of process equipment dominate the list. Decontamination of the inside and outside of process equipment and dismantlement of process equipment are given the highest priority. In-situ decontamination is preferred, if possible. The need for decontamination extends to the auxiliary equipment and other metal items including metal building structures. The

Table 4. D&D technology needs for PORTS

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1. Decontamination of the interior of process equipment and piping
 2. Dismantlement of process equipment and piping
 3. Decontamination of metals
 4. Concrete decontamination
 5. Recovery of purified nickel from barrier
 6. Decontamination of the exterior of process equipment and piping
 7. Characterization and certification for release as below regulatory concern (BRC)
 8. Characterization of secondary wastes
 9. Decontamination of floors and walls
 10. Decontamination of auxiliary equipment
 11. Improved characterization/analysis systems
 12. Decontamination of metal building structures
 13. Reduction of secondary wastes
 14. In-situ decontamination
 15. Remote automated systems
 16. Disposition of scrap metal
 17. Decontamination of concrete building structures
 18. Treatment systems to recycle water from decontamination systems that use water (or ice)
 19. Technology in support of BRC
 20. Treatment of secondary wastes
 21. Improved containment systems/emission control
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need for concrete decontamination applies primarily to the large expanse of concrete floor area in the process buildings, but also applies to floors of other facilities and to walls and other concrete structures. Recovery of purified nickel from barrier received a high priority. A need was seen for improved characterization techniques, particularly in support of characterization and certification for release of wastes as having contamination only to a level that is below regulatory concern (BRC). (No such limit has yet been established.) The need to characterize and minimize secondary wastes from D&D was also considered important.

The technology needs supplied by the Paducah Gaseous Diffusion Plant (PGDP) are given in Table 5. The need for smelting as a means for decontamination was given the highest priority. The large amount of transite siding used in the construction of the facilities at Paducah (and other gaseous diffusion plants) was considered to be a major problem. Technology for characterization, decontamination, and disposal of this material is needed. Decontamination and minimization of the waste from painted metal surfaces is a problem. Paducah also listed the need for personal protective equipment with improved worker protection and comfort. This includes both clothing and respirators. Light, cool, comfortable clothing and lighter respirators with easier breathing are needed.

Table 5. D&D technology needs for PGDP

1. Smelting as a means of decontamination
 2. Transite siding
 - a. Characterization
 - b. Decontamination
 - c. Disposal
 3. Decontamination and waste minimization of painted metal surfaces
 4. Personal protective equipment with added worker protection and comfort
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3. COMPOSITE TECHNOLOGY NEEDS

Although the lists of technology needs that were obtained from the various sites were surprisingly different, many similarities do exist. Thus, an attempt was made to compile a composite prioritized list of the D&D technology needs for Energy Systems as a whole. To do this, needs that were worded differently but seemed to convey the same idea were combined. The priority was based upon both the number of sites that indicated a need for a technology and the priority assigned to it by each of these sites. It is recognized that the authors' technical judgement enters into this process to some degree. The composite list of the highest ranking D&D technology needs that was generated is given in Table 6 and is discussed below. The main items in the table are listed in priority order, and each of the subitems are also listed in priority order under each of the more general items.

Table 6. Composite list of D&D technology needs for Energy Systems

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1. Decontamination of metals
 - a. Decontamination of the interior of gaseous diffusion process equipment
 - (1) ClF_3 gas phase decontamination process
 - (2) Aqueous decontamination processes
 - (3) Removal of technetium
 - b. Decontamination of mercury contaminated equipment
 - (1) In-situ decontamination (non thermal)
 - (2) Development of mercury engineering data for thermal desorption of mercury
 - (3) In situ flushing/rough cleaning
 - (4) Supercritical fluid extraction of Hg from equipment
 - (5) In-situ thermal removal
 - c. In-situ decontamination of gaseous diffusion facilities
 - d. Surface cleaning processes for equipment exterior and building structures
 - (1) High-velocity CO_2 blasting
 - (2) Demonstration of commercial ice blasting on ORNL problems
 - (3) Demonstration of supercritical CO_2 blasting for ORNL problems
 - (4) Other
 - e. Decontamination of painted metal surfaces
 - f. Decontamination of auxiliary gaseous diffusion equipment
 2. Decontamination of concrete floors, walls, etc.
 3. Characterization of equipment and facilities
 - a. In-situ characterization, including mapping, inside gaseous diffusion and mercury contaminated equipment
 - b. Remote automated systems
 - c. Fast field characterization of large surface areas of contaminated equipment and facilities
 - d. Radioactive characterization of alpha and beta radiation under paint and other coatings

Table 6. (continued)

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- e. Improved radionuclide field screening
 - f. Characterization of transite siding
 - g. Improved characterization/analysis system for Hg and other non-radionuclide contaminants
 - 4. Remote and automated systems
 - a. Robotics for use with a shot blaster, etc. for use on walls, ceilings, etc.
 - b. Robotics to use with scabblers, etc. in high radiation areas
 - c. Other
 - 5. Reduction of secondary wastes
 - a. From decontamination of painted metal surfaces
 - b. Other
 - 6. Treatment of secondary wastes
 - a. Treatment system to recycle water from decontamination equipment using water or ice
 - b. Oxidation of contaminated organics
 - 7. Development of D&D performance criteria
 - 8. Removal of contaminated equipment
 - a. Removal of gaseous diffusion process equipment and piping
 - b. Removal of highly contaminated process equipment and piping
 - c. Demonstration of dismantling techniques that do not vaporize Hg
 - 9. D&D of transite siding
 - a. Decontamination
 - b. Disposal
 - 10. Disposition of scrap metal
 - a. Decontamination /recovery of metal through smelting
 - b. Recovery of purified Ni from barrier
 - c. Electrochemical refining/recovery of contaminated metals
 - 11. Personal protective equipment with added worker protection and comfort
 - 12. Disposition of waste
 - a. Characterization and certification for release as below regulatory concern
 - b. Demonstration of entombment by encasement
 - c. Characterization of secondary waste
 - d. Engineered storage for very radioactive items
 - e. Demonstration of final disposal alternatives for elemental Hg contaminated with U.
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3.1 DECONTAMINATION OF METALS

The highest ranking D&D technology need was for decontamination of metal equipment and structures both in terms of the ranking of the general technology and in terms of high rankings given to the specific technology needs listed under it. The highest priority would be for a technology that could decontaminate one, or more, of the following: the inside and the outside of gaseous diffusion process equipment in situ, mercury contaminated equipment, building structures, painted metal

surfaces, and auxiliary gaseous diffusion equipment. The more of these problems that could be effectively handled by the technology, the greater would be the interest in that technology.

The chlorine trifluoride gas phase process, which is being developed at K-25, and aqueous decontamination processes similar to those used by British Nuclear Fuels, Ltd. to decontaminate the gaseous diffusion plant at Capenhurst are of particular interest for decontaminating the inside of gaseous diffusion process equipment. The gas phase process is an in-situ process, but is applicable only to the inside of the equipment. Aqueous processes would decontaminate both the inside and the outside of the equipment, but would not be in-situ processes. A technology that would remove technetium-99 (principally from the inside of the equipment) would be of great interest, since this highly radioactive material is difficult to remove.

In-situ non-thermal decontamination would be preferred for cleaning mercury-contaminated equipment. In-situ rough cleaning by flushing is of interest as a pretreatment to minimize spread of contamination and exposure to workers during equipment dismantlement even if it does not produce complete decontamination. Supercritical fluid extraction of mercury from equipment is of interest. In-situ thermal removal would be satisfactory. Engineering data is needed for thermal desorption of mercury, which is the technology of greatest current interest, although it is a thermal process and is not an in-situ process. High-velocity CO₂ blasting is a highly desirable process for decontaminating the outside of process equipment and piping and other exterior surfaces. High CO₂ pellet velocities can probably best be achieved using centrifugal pellet accelerators. This process is under development by the ORNL Fusion Energy Division and, reportedly, also by one of the CO₂ equipment manufacturers. ORNL indicated interest in having commercial ice blasting and supercritical CO₂ blasting technologies demonstrated on their decontamination problems.

3.2 DECONTAMINATION OF CONCRETE

The next highest ranking technology need was for decontamination of concrete. Decontamination of concrete floors would be the biggest need in this category, but decontamination of concrete walls, columns, and other structures would also be included.

3.3 CHARACTERIZATION OF EQUIPMENT AND FACILITIES

Better technology to characterize equipment and facilities was the third highest ranked technology need. Remote automated contaminant characterization systems are needed for many applications. Two applications are in-situ characterization of the inside of both gaseous diffusion and mercury-contaminated equipment. The capability to map automatically the contamination levels into a data base should be included in these technologies. Radioactive characterization of alpha and beta radiation under paint and other coatings is an important widespread technology need that may be quite difficult to satisfy. There are general needs to improve radionuclide field screening and also for improved characterization and analysis systems for mercury and other non-radionuclide contaminants. Characterization of transit siding is an important need at the gaseous diffusion plants and, perhaps, other Energy Systems facilities as well.

3.4 REMOTE AUTOMATED SYSTEMS

Remote and automated systems was another high ranking technology need. Robotics for use with a shot blaster, etc. for use on walls, ceilings, etc. and robotics for use with scabblers, etc. in high

radiation areas were the only technology needs that were specifically listed in this category. However, other applications of this general type of technology are obviously needed. For example, some of the characterization technologies discussed above would require robotics or automation for implementation. Also, in the authors opinion, automation should find many applications in the repetitive task of dismantling gaseous diffusion process equipment.

3.5 REDUCTION AND TREATMENT OF SECONDARY WASTES

Reduction of secondary wastes is evidently a principal D&D technology need, although reduction of secondary wastes from decontamination of painted metal surfaces was the only specific need listed in this category. Reduction of secondary wastes is an important consideration in all improved D&D technologies.

After technology to reduce secondary waste has been developed to the greatest extent possible, treatment of the remaining secondary wastes remains as a major technology need. The specific needs listed in this category were a treatment system to recycle water from decontamination equipment that uses water or ice and oxidation of contaminated organics, but the need for secondary waste treatment is obviously more general than these two specific examples. Again, secondary waste treatment and the need to recycle decontamination reagents is certainly a technology need that encompasses the entire spectrum of D&D technologies, particularly decontamination.

3.6 DEVELOPMENT OF D&D PERFORMANCE CRITERIA

The development of D&D performance criteria is an important D&D need. However, this factor is more of a regulatory need than a technology need. Technology development can contribute to the solution of this problem by indicating the levels to which contaminants can be removed.

3.7 REMOVAL OF CONTAMINATED EQUIPMENT

The removal of contaminated equipment is another major D&D technology need. Removal of the gaseous diffusion process equipment is the biggest and the most costly D&D dismantlement effort that faces Energy Systems. Because of the repetitive nature of the equipment, it is also the dismantlement effort in which significant improvements in technology that can effect major reductions in cost are most likely. The removal of highly contaminated process equipment and piping is another major dismantlement problem, particularly at ORNL. At Y-12 the greatest dismantlement need is for demonstration of dismantling techniques that do not vaporize mercury.

3.8 D&D OF TRANSITE SIDING

D&D of transite siding is a major problem, particularly at the gaseous diffusion sites. In addition to the need for improved technology to characterize potentially contaminated transite, which has already been mentioned, the decontamination and disposal of transite also present technology needs.

3.9 DISPOSITION OF SCRAP METAL

The disposition of scrap metal from D&D was also properly regarded as an area needing new technology. The decontamination and recovery of metal through smelting is receiving some attention. Recovery and purification of the nickel from barrier could return hundreds of millions of dollars to the government, even if this material had to be recycled within the Department of Energy. Electrochemical refining of contaminated metals to recover them was listed as a fruitful area for new technology.

3.10 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment with added worker protection and comfort is a need at all the sites at which the D&D programs are managed and operated by Energy Systems even though it was only listed as a D&D technology need by PGDP. The desired characteristics of the improved clothing and respirators that are needed are given in the section on the needs listed by that site.

3.11 DISPOSITION OF WASTE

Since D&D of the facilities managed by Energy Systems could easily produce unprecedented volumes of waste, the disposal of these wastes presents an important need for better technology. This category will include the requirement for technology to adequately characterize secondary waste. New technology for characterization and certification for release as BRC could have a major impact on the cost of D&D if such a limit can be established or negotiated with regulators on a local basis. Any technology that would facilitate the establishment of such a limit should be pursued. Demonstration of entombment by encasement and engineered storage for very radioactive items are needed, as is the demonstration of final disposal alternatives for elemental mercury that is contaminated with uranium.

4. REFERENCES

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